

# **Development Document For the Final Effluent Limitations Guidelines and Standards for the Metal Products and Machinery Point Source Category**



**U.S. Environmental Protection Agency  
Office of Water (4303T)  
1200 Pennsylvania Avenue, NW  
Washington, DC 20460**

**EPA-821-B-03-001**

**Development Document For The  
Final Effluent Limitations  
Guidelines and Standards  
For The  
Metal Products & Machinery  
Point Source Category**

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February 2003

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## **ACKNOWLEDGMENTS AND DISCLAIMER**

The Agency would like to acknowledge the contributions of Shari Barash, Yu-Ting Guilaran, Carey Johnston, Jan Matuszko, Marvin Rubin, Marla Smith, and Richard Witt to development of this technical document. In addition, EPA acknowledges the contribution of Eastern Research Group, Westat, Abt Associates, and Science Applications International Corporation.

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## **1.0 SUMMARY AND SCOPE OF THE REGULATION**

This section presents a brief overview of the Metal Products and Machinery (MP&M) Point Source Category, discusses the applicability of the MP&M effluent limitations guidelines and standards for the category, and presents the applicability interface between the final rule and other regulations for the metals industry. This section also briefly summarizes the final rule and describes the Agency's efforts to protect confidential business information. This section is organized as follows:

- Section 1.1 - Overview of the MP&M Point Source Category;
- Section 1.2 - Overlap with other effluent guidelines;
- Section 1.3 - Summary of applicability;
- Section 1.4 - Promulgated effluent limitations guidelines and standards;  
and
- Section 1.5 - Protection of confidential business information.

### **1.1 Overview of the MP&M Point Source Category**

The MP&M Point Source Category includes facilities that discharge wastewater from processing metal parts, metal products, and machinery. This processing can be described by two types of activities: manufacturing and rebuilding/maintenance. Manufacturing is the series of unit operations necessary to produce metal products and is generally performed in a production environment. Rebuilding/maintenance is the series of unit operations necessary to disassemble used metal products into components, replace the components or subassemblies or restore them to original function, and reassemble the metal product. Rebuilding and maintenance operations are intended to keep metal products in operating condition and can be performed in either a production or a nonproduction environment. The MP&M Point Source Category encompasses manufacturing, rebuilding, or maintenance of metal parts, products, or machines for use in the following industrial sectors:

- Aerospace;
- Aircraft;
- Bus and Truck;
- Electronic Equipment;
- Hardware;
- Household Equipment;
- Instruments;
- Mobile Industrial Equipment;
- Motor Vehicle;
- Office Machine;

- Ordnance;
- Precious Metals and Jewelry;
- Railroad;
- Ships and Boats;
- Stationary Industrial Equipment; and
- Miscellaneous Metal Products.

EPA also evaluated manufacturing, rebuilding, or maintenance of metal parts, products, or machines used in two other industrial sectors (Job Shops and Printed Wiring Board) but has decided not to regulate them as part of the final rule.

These sectors considered by EPA for regulation manufacture, maintain, and rebuild metal products under more than 200 different Standard Industrial Classification (SIC) codes. Appendix A includes a list of example SIC codes and North American Industrial Classification System (NAICS) codes that apply to the above industrial sectors. EPA is not revising limitations and standards for three proposed industrial sectors (i.e., job shops, printed wiring board, and steel forming and finishing).

The final rule does not apply to maintenance or repair of metal parts, products, or machines that takes place only as ancillary activities at facilities not included in the 16 MP&M industrial sectors. EPA estimates that these ancillary repair and maintenance activities would typically discharge *de minimis* quantities of process wastewater. For example, wastewater discharges from repair of metal parts at oil and gas extraction facilities (40 CFR 435) are not subject to the final rule. The Agency has determined that permit writers are establishing limits using best professional judgment (BPJ) to regulate wastewater discharges from ancillary waste streams for direct dischargers (see 66 FR 433).

Facilities in any one of the 16 industrial sectors in the MP&M Point Source Category are subject to the final rule only if they directly discharge process wastewater resulting from one or more of the following “oily operations:”

- Abrasive Blasting;
- Adhesive Bonding;
- Alkaline Cleaning for Oil Removal;
- Alkaline Treatment Without Cyanide;
- Aqueous Degreasing;
- Assembly/Disassembly;
- Burnishing;
- Calibration;
- Corrosion Preventative Coating (as specified at 40 CFR 438.2(c) and Appendix C of Part 438);
- Electrical Discharge Machining;
- Floor Cleaning (in Process Area);
- Grinding;

- Heat Treating;
- Impact Deformation;
- Iron Phosphate Conversion Coating;
- Machining;
- Painting-Spray or Brush (Including Water Curtains);
- Polishing;
- Pressure Deformation;
- Solvent Degreasing;
- Steam Cleaning;
- Testing (e.g., hydrostatic, dye penetrant, ultrasonic, magnetic flux);
- Thermal Cutting;
- Tumbling/Barrel Finishing/Mass Finishing/Vibratory Finishing;
- Washing (Finished Products);
- Welding;
- Wet Air Pollution Control for Organic Constituents; and
- Suboperations within the operations listed above (see Section 5.0).

These operations are defined in Appendix B to 40 CFR 438 and also in Section 4.0.

In addition, the final rule covers process wastewater resulting from associated rinses that remove materials that the processes listed above deposit on the surface of the work piece. The final rule does not apply to direct discharges of wastewaters that are otherwise covered by other effluent limitations guidelines.

The final rule also covers direct discharges of process wastewater generated from oily operations related to maintenance and repair of metal products, parts, and machinery at military installations (i.e., federal facilities) as well as facilities owned or operated by state or local governments. For example, the final rule covers direct discharges of process wastewater generated from oily operations related to maintenance and repair of aircraft, cars, trucks, buses, tanks (or other armor personnel carriers), and industrial equipment. These operations are commonly performed at military installations and state or local government maintenance facilities. However, the final rule does not apply to wastewater discharges introduced into a federally owned and operated Treatment Works Treating Domestic Sewage (TWTDS), as defined at 40 CFR 122.2.

The MP&M Point Source Category evaluated for the final rule encompasses more than 41,000 facilities that manufacture, rebuild, or maintain metal parts, products, or machines for use in the 16 MP&M industrial sectors. Approximately 29,000 of these facilities annually discharge 5.02 billion gallons of process wastewater. Of the facilities discharging process wastewater, EPA estimates that 91.6 percent are indirect dischargers, 8.4 percent are direct dischargers, and 0.1 percent discharge both directly and indirectly. The Agency estimates that the remaining facilities (an estimated 12,000) fall into one of three categories:

- *Zero discharge.* A zero-discharging facility does not discharge pollutants to waters of the United States or to a POTW. Included in this definition are discharge or disposal of pollutants by way of evaporation, deep-well injection, off-site transfer to a treatment facility, and land application.
- *Non-water-using.* A non-water-using facility does not use process wastewater (i.e., water that comes into direct contact with or results from the production or use of any raw material, intermediate product, finished product, by-product, or waste product) at its oily operation.
- *Contract haulers.* Contract hauling is the removal of any waste stream from a facility by a company authorized to transport and dispose of the waste, excluding discharges to sewers or surface waters.

The MP&M final rule does not regulate indirect dischargers and discharges to federally owned and operated TWTDS. There are approximately 2,400 direct dischargers regulated by the MP&M final rule.

MP&M sites evaluated for the final rule perform a wide variety of process unit operations on metal parts, products, or machines. In general, MP&M unit operations can be characterized as belonging to one of the following types of unit operations:

- Assembly/disassembly operations;
- Metal shaping operations;
- Organic chemical deposition operations;
- Surface finishing operations; and
- Surface preparation operations.

EPA also evaluated the following types of unit operations but has decided not to regulate them as part of the final rule:

- Dry dock operations; and
- Metal deposition operations.

Specifically, EPA decided not to regulate “metal-bearing operations” as defined in 40 CFR 438.2(d) and Appendix C to Part 438. The list of unit operations not regulated by the final rule is also given in Section 4.0.

At a given MP&M facility, the specific unit operations performed and the sequence of those operations depend on many factors, including the activity (i.e., manufacturing, rebuilding, or maintenance), industrial sector, and type of product processed. The extent to which a facility uses process water for these unit operations also varies from site to site.

The approximately 2,400 sites regulated by the MP&M final rule discharge approximately 267 million gallons of process wastewater per year. This wastewater typically contains total suspended solids, oil and grease, and organic pollutants. MP&M wastewater may also contain some metals (e.g., zinc, tin, aluminum), often in suspended or particulate phase.

## **1.2 Overlap with Other Effluent Guidelines**

EPA has previously established effluent limitations guidelines and standards for 13 industries that may perform unit operations or process parts that are sometimes found at MP&M sites. These effluent guidelines are:

- Electroplating (40 CFR 413);
- Iron and Steel Manufacturing (40 CFR 420);
- Nonferrous Metals Manufacturing (40 CFR 421);
- Ferroalloy Manufacturing (40 CFR 424);
- Metal Finishing (40 CFR 433);
- Battery Manufacturing (40 CFR 461);
- Metal Molding and Casting (40 CFR 464);
- Coil Coating (40 CFR 465);
- Porcelain Enameling (40 CFR 466);
- Aluminum Forming (40 CFR 467);
- Copper Forming (40 CFR 468);
- Electrical and Electronic Components (40 CFR 469); and
- Nonferrous Metals Forming & Metal Powders (40 CFR 471).

In 1986, the Agency reviewed coverage of these regulations and identified a significant number of metals-processing facilities discharging wastewater that these 13 regulations did not cover. Based on this review, EPA performed a more detailed analysis of these unregulated sites and identified the discharge of significant amounts of pollutants (see Section 1.1 of the rulemaking record, DCN M432). This analysis resulted in the decision to develop national limitations guidelines and standards for the “Metal Products and Machinery” (MP&M) Point Source Category (see Section 2.2.5).

Table 1-1 summarizes the coverage of industrial operations by each MP&M subcategory for which EPA proposed regulations. Additionally, the MP&M final rule does not apply to process wastewaters from metal-bearing operations (as defined at §438.2(d) and Appendix C of Part 438) or process wastewaters that are subject to the limitations and standards of other effluent limitations guidelines (e.g., Metal Finishing (40 CFR 433) or Iron and Steel Manufacturing (40 CFR 420)).

**Table 1-1****Clarification of Coverage by Proposed MP&M Subcategory**

<b>Proposed Subcategory</b>	<b>Continue to Cover Under 40 CFR 413 (Electroplating)</b>	<b>Continue to Cover Under 40 CFR 433 (Metal Finishing)</b>	<b>Cover Under 40 CFR 438 (Metal Products &amp; Machinery)</b>
General Metals (Including Continuous Electroplaters)	Existing indirect dischargers covered by Part 413.	New and existing direct and indirect dischargers covered by Part 433.	None
Metal Finishing Job Shops	Existing indirect dischargers covered by Part 413.	New and existing direct and indirect dischargers covered by Part 433.	None
Non-Chromium Anodizing	Existing indirect dischargers covered by Part 413.	New and existing direct and indirect dischargers covered by Part 433.	None
Printed Wiring Board (Printed Circuit Board)	Existing indirect dischargers covered by Part 413.	New and existing direct and indirect dischargers covered by Part 433.	None
Steel Forming and Finishing <sup>a</sup>	NA	NA	None
Oily Wastes	NA	NA	All new and existing direct dischargers (see 438.10).
Railroad Line Maintenance	NA	NA	None
Shipbuilding Dry Dock	NA	NA	None

NA - Not applicable.

<sup>a</sup>These facilities will remain subject to 40 CFR 420.

### **1.3 Summary of Applicability**

The MP&M effluent limitations guidelines and standards regulate process wastewater from oily operations at existing or new direct dischargers engaged in manufacturing, rebuilding, or maintenance of metal parts, products, or machines used in any of the 16 industrial sectors listed in Section 1.1. The guidelines and standards do not apply to wastewater from oily operations in certain circumstances (e.g., if they are subject to other national effluent limitations or standards). The MP&M regulation does not regulate any of the other subcategories for which it proposed regulations. These subcategories are the General Metals, Metal Finishing Job Shops, Non-Chromium Anodizing, Printed Wiring Board, Steel Forming and Finishing, Railroad Line Maintenance, and Shipbuilding Dry Dock. Process wastewater is defined in §438.2.

EPA defines process wastewater for the final rule to include wastewater discharges from oily operations for the manufacturing, rebuilding, or maintenance of metal parts, products, or machinery for use in any of the 16 MP&M industrial sectors and wastewater from air pollution control devices.

EPA notes that direct discharges resulting from the washing of cars, aircraft, or other vehicles, when performed as a preparatory step prior to one or more successive manufacturing, rebuilding, or maintenance operations, are subject to the MP&M rule.

Nonprocess wastewater discharges are not subject to the final rule. Nonprocess wastewater means sanitary wastewater, noncontact cooling water, water from laundering, and noncontact stormwater. Nonprocess wastewater for this part also includes wastewater discharges from nonindustrial sources such as residential housing, schools, churches, recreational parks, shopping centers as well as wastewater discharges from gas stations, utility plants, and hospitals.

In addition to nonprocess wastewater, the final rule does not apply to wastewater generated from: (1) gravure cylinder and metallic platemaking conducted within or for printing and publishing facilities; (2) the washing of cars, aircraft or other vehicles when it is performed only for aesthetic/cosmetic purposes; (3) MP&M operations at gasoline stations (SIC Code 5541) or vehicle rental facilities (SIC Codes 7514 or 7519); or (4) unit operations performed by drum reconditioners/refurbishers to prepare metal drums for reuse.

As noted, EPA is also not promulgating limitations and standards for facilities in the proposed Shipbuilding Dry Dock Subcategory. The final rule does not cover wastewater generated on-board ships and boats when they are afloat (that is, not in dry docks or similar structures), flooding water, and dry dock ballast water (see 66 FR 445). For U.S. military ships, EPA is in the process of establishing standards to regulate discharges of wastewater generated on-board these ships when they are in U.S. waters and are afloat under the Uniform National Discharge Standards (UNDS) pursuant to section 312(n) of the Clean Water Act (CWA) (see 64 FR 25125, May 10, 1999).



Finally, as previously stated, the final rule does not apply to maintenance or repair of metal parts, products, or machines that takes place only as ancillary activities at facilities not included in the 16 MP&M industrial sectors.

See Section 15.0 for a more detailed discussion regarding applicability.

#### **1.4 Promulgated Effluent Limitations Guidelines and Standards**

EPA proposed effluent limitations and standards for eight subcategories. However, for reasons discussed in Section 9.0 and Section VI of the preamble to the final rule, the final rule establishes effluent limitations guidelines and standards for new and existing direct dischargers in one subcategory: Oily Wastes.

EPA may divide a point source category (e.g., MP&M) into groupings called “subcategories” to provide a method for addressing variations between products, raw materials, processes, and other factors that result in distinctly different effluent characteristics. Regulation of a category using subcategories allows each subcategory to have a uniform set of effluent limitations that take into account technological achievability and economic impacts unique to that subcategory. Grouping similar facilities into subcategories increases the likelihood that the regulations are practicable, and diminishes the need to address variations between facilities through a variance process. The CWA requires EPA, in developing effluent limitations guidelines and pretreatment standards, to consider a number of different subcategorization factors. (See Section 6.0 for a list of the factors considered for the final MP&M rule and a detailed discussion of subcategorization.)

EPA is promulgating concentration-based limits and standards for direct dischargers for the Oily Wastes Subcategory. However, the CWA authorizes permit writers to decide when it is most appropriate to implement mass-based limits. Guidance for setting limits is included in Section 15.0.

Table 1-2 summarizes the regulatory levels of control and selected technology bases EPA used in promulgating the limitations and standards presented in Table 1-3, Section 14.0, and 40 CFR 438, Subpart A (Oily Wastes Subcategory). Section 15.0 provides guidance to permit writers.

**Table 1-2****Technology Bases for Promulgated MP&M Limitations and Standards**

Subcategory	Regulatory Level	Selected Technology Option
Oily Wastes	BPT/BCT/NSPS	Pollution prevention; chemical emulsion breaking and oil/water separation (Option 6). See Section 9.7.
	BAT	No limitations established under Part 438.
	PSES/PSNS	No standards established under Part 438.

**Table 1-3****Effluent Limitations Guidelines for the MP&M Point Source Category  
(40 CFR 438)**

BPT/BCT/NSPS - Oily Wastes Subcategory	
Regulated Parameter	Maximum Daily mg/L (ppm)
Total Suspended Solids (TSS)	62
Oil and Grease (as HEM)	46
pH	a

<sup>a</sup>Discharges must remain within the pH range 6 to 9.

**1.5 Protection of Confidential Business Information**

Whenever EPA is required to develop effluent limitations, pretreatment standards, or other standards, Section 308(a) of the CWA authorizes the Agency to require owners or operators of point sources to provide certain information. Various statutes under which EPA operates contain special provisions concerning the entitlement to confidential treatment of certain business information (CBI). In compliance with these statutes and EPA's implementing regulations, the Agency has withheld CBI from the public record in the Water Docket, but retains CBI in the nonpublic version of the rulemaking record. In addition, the Agency has withheld from disclosure some data not claimed as CBI because the release of these data could indirectly reveal CBI. Furthermore, EPA has aggregated certain data in the public record, masked facility identities, or used other strategies to prevent the disclosure of CBI. The Agency's approach to CBI protection ensures that the data in the public record both explain the basis for the final rule and provide the opportunity for public comment, without compromising data confidentiality.

## **2.0 BACKGROUND**

This section presents background information supporting the development of effluent limitations guidelines and standards for the Metal Products and Machinery (MP&M) Point Source Category. Section 2.1 presents the legal authority to regulate the MP&M industry. Section 2.2 discusses the Clean Water Act, Pollution Prevention Act, Regulatory Flexibility Act (as amended by the Small Business Regulatory Enforcement Fairness Act of 1996), and prior regulation of the metals industry.

### **2.1 Legal Authority**

EPA is promulgating these regulations under the authority of Sections 301, 304, 306, 307, 308, 402, and 501 of the Clean Water Act, 33 U.S.C.1311, 1314, 1316, 1317, 1318, 1342, and 1361 and under authority of the Pollution Prevention Act of 1990 (PPA), 42 U.S.C. 13101 et seq., Public Law 101-508, November 5, 1990.

### **2.2 Regulatory Background**

#### **2.2.1 Clean Water Act**

Congress adopted the Clean Water Act (CWA) to “restore and maintain the chemical, physical, and biological integrity of the Nation’s waters” (Section 101(a), 33 U.S.C. 1251(a)). To achieve this goal, the CWA prohibits the discharge of pollutants into navigable waters except in compliance with the statute. The CWA confronts the problem of water pollution on a number of different fronts. Its primary reliance, however, is on establishing restrictions on the types and amounts of pollutants discharged from various industrial, commercial, and public sources of wastewater.

Congress recognized that regulating only those sources that discharge effluent directly into the nation’s waters would not be sufficient to achieve the CWA’s goals. Consequently, the CWA requires EPA to promulgate nationally applicable pretreatment standards that restrict pollutant discharges for those who discharge wastewater indirectly through sewers flowing to publicly owned treatment works (POTWs) (Sections 307(b) and (c), 33 U.S.C. 1317(b) and (c)). National pretreatment standards are established for those pollutants in wastewater from indirect dischargers that may pass through or interfere with POTW operations. Generally, pretreatment standards are designed to ensure that wastewater from direct and indirect industrial dischargers are subject to similar levels of treatment. In addition, EPA requires POTWs to implement local pretreatment limits applicable to their industrial indirect dischargers to satisfy any local requirements (40 CFR 403.5).

Direct dischargers must comply with effluent limitations in National Pollutant Discharge Elimination System (“NPDES”) permits; indirect dischargers must comply with pretreatment standards. EPA establishes these limitations and standards by regulation for

categories of industrial dischargers and bases them on the degree of control that can be achieved using various levels of pollution control technology.

1. Best Practicable Control Technology Currently Available (BPT)  
(Section 304(b)(1) of the CWA)

BPT effluent limitations guidelines are applicable to direct dischargers (i.e., sites that discharge wastewater to surface water). BPT effluent limitations guidelines are generally based on the average of the best existing performance by facilities of various sizes, ages, unit processes or other common characteristics within the category or subcategory for control of conventional, priority, and nonconventional pollutants. Section 304(a)(4) designates the following as conventional pollutants: biochemical oxygen demand (BOD<sub>5</sub>), total suspended solids (TSS), fecal coliform, pH, and any additional pollutants defined by the Administrator as conventional. The Administrator designated oil and grease as an additional conventional pollutant on July 30, 1979 (44 FR 44501). EPA has identified 65 pollutants and classes of pollutants as toxic pollutants, of which 126 specific substances have been designated priority toxic pollutants. See Appendix A to Part 403 (reprinted after 40 CFR 423.17). All other pollutants are considered to be nonconventional.

In establishing BPT effluent limitations guidelines, EPA first considers the total cost of applying the control technology in relation to the effluent reduction benefits. The Agency also considers the age of the equipment and facilities involved, the processes employed and any required process changes, engineering aspects of the control technologies, non-water quality environmental impacts (including energy requirements), and such other factors as the EPA Administrator deems appropriate (CWA 304(b)(1)(B)). Traditionally, EPA establishes BPT effluent limitations based on the average of the best performances of facilities within the industry of various ages, sizes, processes or other common characteristics. Where existing performance is uniformly inadequate, EPA may require higher levels of control than are currently in place in an industrial category if the Agency determines that the technology can be practically applied.

2. Best Conventional Pollutant Control Technology (BCT)  
(Section 304(b)(4) of the CWA)

The 1977 amendments to the CWA established BCT for discharges of conventional pollutants from existing industrial point sources. BCT effluent limitations guidelines are applicable to direct discharging sites. In addition to other factors specified in Section 304(b)(4)(B), the CWA requires that EPA establish BCT limitations after consideration of a two-

part "cost-reasonableness" test. EPA explained its methodology for the development of BCT limitations in 1986 (51 FR 24974; July 9, 1986).

3. Best Available Technology Economically Achievable (BAT)  
(Sections 304(b)(2) of the CWA)

BAT effluent limitations guidelines are applicable to direct discharging sites. In general, BAT effluent limitations guidelines represent the best available economically achievable performance of plants in the industrial subcategory or category. The CWA establishes BAT as the principal national means of controlling the direct discharge of priority pollutants and nonconventional pollutants to waters of the United States. The factors considered in assessing BAT include the cost of achieving BAT effluent reductions, the age of equipment and facilities involved, the processes employed, potential process changes, non-water quality environmental impacts (including energy requirements), and such factors as the Administrator deems appropriate. The Agency retains considerable discretion in assigning the weight to be accorded to these factors. As with BPT, where existing performance is uniformly inadequate, EPA may base BAT upon technology transferred from a different subcategory within an industry or from another industrial category. In addition, BAT may include process changes or internal controls, even when these technologies are not common industry practice.

4. New Source Performance Standards (NSPS)  
(Section 306 of the CWA)

NSPS are applicable to new direct discharging sites and are based on the best available demonstrated treatment technology. New facilities have the opportunity to install the best and most efficient production processes and wastewater treatment technologies. As a result, NSPS should represent the greatest degree of effluent reduction attainable through the application of the best available demonstrated control technology for all pollutants (i.e., conventional, nonconventional, and priority pollutants). In establishing NSPS, the CWA directs EPA to take into consideration the cost of achieving the effluent pollutant reduction and any non-water quality environmental impacts (including energy requirements).

5. Pretreatment Standards for Existing Sources (PSES)  
(Section 307(b) of the CWA)

PSES are applicable to indirect discharging sites (i.e., sites that discharge to a POTW). The CWA requires PSES for pollutants that pass through, interfere with, or are otherwise incompatible with POTW treatment

processes or sludge disposal methods. The CWA specifies that pretreatment standards are to be technology-based and analogous to the BAT effluent limitations guidelines.

The General Pretreatment Standards, which set forth the framework for implementing categorical pretreatment standards, are found at 40 CFR 403.

6. Pretreatment Standards for New Sources (PSNS)  
(Section 307(c) of the CWA)

PSNS are applicable to new indirect discharging sites. Like PSES, PSNS are designed to prevent the discharges of pollutants that pass through, interfere with, or are otherwise incompatible with the operation of POTWs. PSNS are to be issued at the same time as NSPS. New indirect dischargers have the opportunity to incorporate into their plants the best available demonstrated technologies. The Agency considers the same factors in promulgating PSNS that it considers in promulgating NSPS.

The following table summarizes these regulatory levels of control and the pollutants controlled.

**Table 2-1**  
**Summary of Regulatory Levels of Control**

Type of Sites Regulated	BPT	BCT	BAT	NSPS	PSES	PSNS
Existing Direct Dischargers	X	X	X			
New Direct Dischargers				X		
Existing Indirect Dischargers					X	
New Indirect Dischargers						X
Pollutants Regulated	BPT	BCT	BAT	NSPS	PSES	PSNS
Priority Pollutants	X		X	X	X	X
Nonconventional Pollutants	X		X	X	X	X
Conventional Pollutants	X	X		X		

Source: Clean Water Act.

EPA typically does not establish pretreatment standards for conventional pollutants (e.g., BOD<sub>5</sub>, TSS, oil and grease) since POTWs are designed to treat these pollutants, but EPA has exercised its authority to establish categorical pretreatment standards for conventional pollutants as surrogates for toxic or nonconventional pollutants or to prevent interference. For example, EPA established categorical pretreatment standards for new and existing sources with a one-day maximum concentration of 100 mg/L oil and grease in the

Petroleum Refining Point Source Category (40 CFR 419) to "minimize the possibility of slug loadings of oil and grease being discharged to POTWs" (see Section 24.4 of the rulemaking record, DCN 17949).

### **2.2.2 Section 304(m) Requirements**

Section 304(m) of the CWA, added by the Water Quality Act of 1987, requires EPA to establish schedules for: (1) reviewing and revising existing effluent limitations guidelines and standards; and (2) promulgating new effluent guidelines. On January 2, 1990, EPA published an Effluent Guidelines Plan (see 55 FR 80), in which schedules were established for developing new and revised effluent guidelines for several industry categories, including the metal products and machinery industry.

Natural Resources Defense Council, Inc. (NRDC) and Public Citizen, Inc. challenged the Effluent Guidelines Plan in a suit filed in the U.S. District Court for the District of Columbia, (NRDC et al v. Browner, Civ. No. 89-2980). On January 31, 1992, the Court entered a consent decree (the "304(m) Decree"), which establishes schedules for, among other things, EPA's proposal and promulgation of effluent guidelines for a number of point source categories. The consent decree, as amended, requires EPA to take final action on the Metal Products and Machinery effluent guidelines by February 14, 2003.

### **2.2.3 Pollution Prevention Act**

The Pollution Prevention Act of 1990 (PPA) (42 U.S.C. 13101 et seq., Public Law 101-508, November 5, 1990) "declares it to be the national policy of the United States that pollution should be prevented or reduced whenever feasible; pollution that cannot be prevented should be recycled in an environmentally safe manner, whenever feasible; pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; and disposal or release into the environment should be employed only as a last resort..." (Sec. 6602; 42 U.S.C. 13101 (b)). In short, preventing pollution before it is created is preferable to trying to manage, treat or dispose of it after it is created. The PPA directs the Agency to, among other things, "review regulations of the Agency prior and subsequent to their proposal to determine their effect on source reduction" (Sec. 6604; 42 U.S.C. 13103(b)(2)). EPA reviewed this effluent guideline for its incorporation of pollution prevention.

According to the PPA, source reduction reduces the generation and release of hazardous substances, pollutants, wastes, contaminants, or residuals at the source, usually within a process. The term source reduction "include[s] equipment or technology modifications, process or procedure modifications, reformulation or redesign of products, substitution of raw materials, and improvements in housekeeping, maintenance, training or inventory control. The term 'source reduction' does not include any practice which alters the physical, chemical, or biological characteristics or the volume of a hazardous substance, pollutant, or contaminant through a process or activity which itself is not integral to or necessary for the production of a product or the providing of a service." 42 U.S.C. 13102(5). In effect, source reduction means reducing the

amount of a pollutant that enters a waste stream or that is otherwise released into the environment prior to out-of-process recycling, treatment, or disposal.

EPA gathered information on pollution prevention practices used by the MP&M industry from site visits, survey responses, and other references. Typical pollution prevention practices include reducing water use, extending the life of process bath constituents, or adding recycle or reuse technologies. See Section 8.0 for a detailed discussion of these practices. EPA supports pollution prevention technology by including pollution prevention in its technology bases for the final MP&M effluent limitations and new source performance standards. This includes water conservation and reuse of lubricants and solvents. Technology options considered, as well as selected, as the basis for the MP&M effluent limitations guidelines and standards include pollution prevention practices and are discussed in Section 9.0.

#### **2.2.4 Regulatory Flexibility Act (RFA) as Amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA)**

The RFA generally requires an agency to prepare a regulatory flexibility analysis of any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act or any other statute unless the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. Small entities include small businesses, small organizations, and small governmental jurisdictions.

For assessing the impacts of the final rule on small entities, a small entity is defined as: (1) a small business according to the Regulations of the Small Business Administration (SBA) at 13 CFR 121.201, which define small businesses for Standard Industrial Classification (SIC) codes; (2) a small governmental jurisdiction that is a government of a city, county, town, school district or special district with a population of less than 50,000; and (3) a small organization that is any not-for-profit enterprise that is independently owned and operated and is not dominant in its field.

In accordance with Section 603 of the RFA, EPA prepared an initial regulatory flexibility analysis (IRFA) for the proposed rule and convened a Small Business Advocacy Review Panel to obtain advice and recommendations of representatives of the regulated small entities in accordance with Section 609(b) of the RFA (see 66 FR 519). The results of IRFA are provided in Chapter 10 of the Economic, Environmental, and Benefits Analysis (EEBA) (EPA-821-B-03-002). The January 2001 proposed rule (see 66 FR 523) presents a summary of the Panel's recommendations and the full Panel Report (see Section 11.2, DCN 16127) presents a detailed discussion of the Panel's advice and recommendations.

A regulatory flexibility analysis addresses:

- The need for, objectives of, and legal basis for a rule.



- A description of, and where feasible, an estimate of the number of small entities to which a rule would apply.
- The projected reporting, recordkeeping, and other compliance requirements of a rule, including an estimate of the classes of small entities that would be subject to a rule and the types of professional skills necessary for preparation of the report or record.
- An identification, where practicable, of all relevant federal rules that may duplicate, overlap, or conflict with a rule.
- A description of any significant regulatory alternatives to a rule that accomplish the stated objectives of applicable statutes and that minimize any significant economic impact of a rule on small entities. Consistent with the stated objectives of the CWA, the analysis discusses significant alternatives such as:
  - Establishing differing compliance or reporting requirements or timetables that take into account the resources available to small entities.
  - Clarifying, consolidating, or simplifying compliance and reporting requirements under the rule for such small entities.
  - Using performance rather than design standards.
  - Excluding from coverage of a rule, or any part thereof, such small entities. Based on the regulatory flexibility analysis and other factors, EPA considered an exclusion to eliminate disproportionate impacts on small businesses, which reduced the number of small businesses that would be affected by a rule.

The Small Business Advocacy Review Panel comprised representatives from three federal agencies: EPA, the Small Business Administration, and the Office of Management and Budget. The Panel reviewed materials EPA prepared in connection with the proposed rule IRFA, and collected the advice and recommendations of small entity representatives. For the Small Business Advocacy Review Panel, the small entity representatives included nine small MP&M facility owner/operators, one small municipality, and these six trade associations representing different sectors of the industry:

- National Association of Metal Finishers (NAMF)/Association of Electroplaters and Surface Finishers (AESF)/MP&M Coalition;
- Association Connecting Electronics Industries (also known as IPC);

- Porcelain Enamel Institute;
- American Short Line Railroad Association (ASLRA);
- Electronics Industry Association (EIA); and
- American Wire Producers Association (AWPA).

The Panel provided background information and analysis to the small entity representatives and conducted meetings with the representatives. The Panel asked the small entity representatives to submit written comment on the MP&M proposed rule in relation to the elements of the proposal IRFA. The Panel carefully considered these comments when developing their recommendations. The Panel's report summarizes their outreach to small entities and the comments submitted by the small entity representatives. The Panel's report also presented their findings on issues related to the elements of the proposal IRFA and recommendations regarding the rulemaking. Based on this input, EPA made several changes to the January 2001 proposal that reduced the number of small entities regulated and the level of impact to small entities that remain within the scope of the regulation.

In the final rule, EPA excluded direct dischargers in seven of eight proposed subcategories and indirect dischargers in all eight proposed subcategories. Consequently, EPA excluded most small entities from additional regulation (see Section VI of the MP&M preamble to the final rule and Chapter 10 of the EEBA). To assess the potential economic impact of the final rule on small entities regulated by the final rule, EPA drew on: (1) a comparison of compliance costs to revenue; and (2) the firm and facility impact analyses discussed in Chapters 9 and 10 of the EEBA.

First, EPA performed an analysis comparing annualized compliance costs to revenue for small entities at the firm level. EPA found that none of the small firms are estimated to incur compliance costs equaling or exceeding one percent of annual revenue. Second, EPA drew on the facility impact analysis, which estimated facility closures and other adverse changes to financial condition (referred to as "moderate impacts"). See Chapter 5 of the EEBA for details of EPA's analysis of closures and moderate impacts for privately owned businesses. This analysis indicated that the final rule would cause no regulated facilities owned by small entities to close or to incur moderate impacts. From these analyses, EPA determined that the final rule will not have a significant economic impact on a substantial number of small entities. See Chapter 10 of the EEBA for the final rule for a more detailed discussion of the economic impacts on small entities.

### **2.2.5 Regulatory History of the Metals Industry**

EPA has promulgated effluent limitations guidelines and standards for 13 metals industries. These regulations cover metal manufacturing, metal forming, and component finishing, as summarized below.

**Table 2-2****Summary of Metals Industry Effluent Guidelines**

Coverage Area	Title	CFR Reference
Metal and Metal Alloy Manufacturing	Iron and Steel Manufacturing <sup>a</sup>	40 CFR 420
	Nonferrous Metals Manufacturing	40 CFR 421
	Ferroalloy Manufacturing	40 CFR 424
Metal Forming	Iron and Steel Manufacturing <sup>a</sup>	40 CFR 420
	Metal Molding and Casting	40 CFR 464
	Aluminum Forming	40 CFR 467
	Copper Forming	40 CFR 468
	Nonferrous Metals Forming and Metal Powders	40 CFR 471
Component Finishing	Electroplating	40 CFR 413
	Iron and Steel Manufacturing <sup>a</sup>	40 CFR 420
	Metal Finishing	40 CFR 433
	Battery Manufacturing	40 CFR 461
	Coil Coating	40 CFR 465
	Porcelain Enameling	40 CFR 466
	Electrical and Electronic Component Manufacturing	40 CFR 469

Source: Code of Federal Regulations, Part 40.

<sup>a</sup>The Iron and Steel Manufacturing category includes metal manufacturing, metal forming, and component finishing.

In 1986, the Agency reviewed these 13 regulations and identified a significant number of metals-processing facilities discharging wastewater that these regulations did not cover. Based on this review, EPA performed a detailed analysis of these unregulated sites and identified the discharge of significant amounts of pollutants. This analysis resulted in a preliminary decision to consider new regulations for a Machinery Manufacturing and Rebuilding (MM&R) Point Source Category. In 1989, the Agency published a Preliminary Data Summary (PDS) for the MM&R industry, which is located in the MP&M Public Record (Section 1.1, DCN M432). The preliminary study of the unregulated MP&M facilities indicated the following:

- The number of facilities, wastewater flow, and toxic and nonconventional pollutant loads were significant;
- The large quantities of toxic pollutants discharged threatened the treatment capability of many POTWs as found by the Domestic Sewage Study;
- There were gaps in federal regulatory coverage in the electroplating, metal finishing, and electrical and electronic components categories;
- Pollutant concentrations were at treatable levels and at levels as high and sometimes higher than concentrations in wastewater from other regulated categories; and

- Some MP&M operations generate hazardous solid waste and sludge that could impact hazardous waste disposal.

Based on information contained in the PDS, EPA divided the MM&R category into two phases by major industrial groups or sectors. The Agency announced its schedule for the development of effluent guidelines for two separate MM&R phases in EPA's January 2, 1990 Effluent Guidelines Plan (55 FR 80). One of the primary reasons for dividing the category into two phases was the large number of facilities (over 900,000) identified in the PDS as potentially included in the MM&R Point Source Category. On May 7, 1992, EPA changed the category name to Metal Products and Machinery (MP&M) to clarify the coverage of the category (57 FR 19748). Many questionnaire respondents found the MM&R label confusing and interpreted the category to apply only to machinery sites. The Agency believes that the MP&M title more accurately describes the coverage of the category.

As mentioned in Section 2.2.2, NRDC and Public Citizen, Inc. challenged the Effluent Guidelines Plan in a suit filed in U.S. District Court for the District of Columbia (NRDC et al. v. Browner, Civ. No. 89-2980). Under a consent decree in this litigation, EPA developed a plan to promulgate effluent guidelines for, among others, the MP&M Point Source Category. The 1992 Effluent Guidelines Plan provided for EPA to propose effluent guidelines for the MP&M Phase I Category by November 1994 and take final action by May 1996. Based on a motion filed by EPA on September 28, 1994, the court granted an extension for proposal and promulgation of the final regulation. To make the regulation more manageable, EPA initially divided the industry into two phases based on industrial sectors. The Phase I proposal included the following industry sectors: Aerospace; Aircraft; Electronic Equipment; Hardware; Mobile Industrial Equipment; Ordnance; and Stationary Industrial Equipment. At that time, EPA planned to propose a rule for the Phase II sectors approximately three years after the MP&M Phase I proposal. Phase II sectors included: Bus & Truck, Household Equipment, Instruments, Job Shops, Motor Vehicles, Office Machines, Precious Metals and Jewelry, Printed Wiring Boards, Railroad, Ships and Boats, and Miscellaneous Metal Products.

On May 30, 1995, EPA published the MP&M Phase I proposal (60 FR 28210). EPA proposed effluent limitations guidelines, pretreatment standards, and new source performance standards for the seven MP&M Phase I industrial sectors. EPA received over 350 public comments on the Phase I proposal requesting that the Agency combine all MP&M industrial sectors into one effluent guideline. Commentors raised concerns regarding the regulation of similar facilities with different compliance schedules and potentially different limitations solely based on whether they were in a Phase I or Phase II MP&M industrial sector. Furthermore, many facilities performed work in multiple sectors. In such cases, permit writers and control authorities (e.g., POTWs) would need to decide which MP&M rule (Phase I or II) applied to a facility.

Based on these comments and after negotiations with NRDC, EPA proposed merging the two phases into one rule (61 FR 35042; July 3, 1996). In 1997, EPA obtained approval from the U.S. District Court for the District of Columbia to combine MP&M Phases I

and II into a single regulation for the 18 MP&M industrial sectors and to extend the effluent guidelines schedule (62 FR 8726; February 26, 1997). Extension of the schedule allowed EPA to use POTW survey data to develop more precise estimates of administrative burden and allowed more extensive stakeholder involvement for data collection. Under the Consent Decree as amended, EPA is required to take final action on the MP&M rule by February 14, 2003.

EPA published a new proposal on January 3, 2001 (66 FR 424), which completely replaced the 1995 proposal. EPA proposed to establish new effluent limitations and guidelines and standards for 18 MP&M industrial sectors (without any designation of “Phase I or II”) and divided the industry into eight regulatory subcategories: General Metals, Metal Finishing Job Shops, Printed Wiring Board, Non-Chromium Anodizing, Steel Forming and Finishing, Oily Wastes, Railroad Line Maintenance, and Shipbuilding Dry Dock (see 66 FR 439 for a discussion of the proposal subcategorization scheme).

EPA found two basic types of waste streams in the industry: (1) wastewater with high metals content (metal-bearing), and (2) wastewater with low concentration of metals and high oil and grease content (oil-bearing). When looking at facilities generating metal-bearing wastewater (with or without oil-bearing wastewater), EPA identified five groups of facilities that could potentially be subcategorized by dominant product, raw materials used, and/or nature of the waste generated (i.e., General Metals, Metal Finishing Job Shops, Printed Wiring Board, Non-Chromium Anodizing, and Steel Forming and Finishing). When evaluating facilities with only oil-bearing wastewater for potential further subcategorization, EPA identified two types of facilities (i.e., Railroad Line Maintenance and Shipbuilding Dry Dock) that were different from the other facilities in the Oily Wastes Subcategory based on size, location, and dominant product or activity. This subcategorization scheme allowed EPA to more accurately assess various technology options in terms of compliance costs, pollutant reductions, benefits, and economic impacts.

EPA proposed new limits and standards for direct dischargers in all eight MP&M subcategories and proposed pretreatment standards for all indirect dischargers in three subcategories (i.e., Metal Finishing Job Shops, Printed Wiring Board, and Steel Forming and Finishing); pretreatment standards for facilities above a certain wastewater flow volume in two subcategories (i.e., General Metals and Oily Wastes); and no national pretreatment standards for facilities in three subcategories (i.e., Non-Chromium Anodizing, Railroad Line Maintenance, and Shipbuilding Dry Dock). EPA received over 1,500 comment letters on the 2001 proposal.

On June 5, 2002, EPA published a Notice of Data Availability (NODA) at 67 FR 38752. In the NODA, EPA discussed major issues raised in comments on the 2001 proposal; suggested revisions to the technical and economic methodologies used to estimate compliance costs, pollutant loadings, and economic and environmental impacts; presented the results of these suggested methodology changes and incorporation of new (or revised) data; and summarized the Agency’s thinking on how these results could affect the Agency’s final decisions.

The NODA also included a discussion of possible alternative options for certain subcategories based on comments, including an Environmental Management System (EMS) alternative in lieu of Part 438 limitations and standards, and a discussion of “upgrading” sites currently regulated under the Electroplating regulations (40 CFR 413) to meet the Metal Finishing regulations (40 CFR 433) (see 67 FR 38797). Finally, the NODA included preliminary revised effluent limitations and pretreatment standards for all eight proposed subcategories. EPA received over 300 comment letters on the NODA. EPA’s responses to comments on the May 1995 proposal, January 2001 proposal, and June 2002 NODA can be found in Section 20.3 of the rulemaking record.

### 3.0 DATA COLLECTION ACTIVITIES

This section summarizes the Agency's data collection activities for the MP&M rulemaking effort. Section 3.1 summarizes the 1989 and 1996 MP&M industry questionnaires including their purpose, recipient selection process, types of information collected, and uses of data. Sections 3.2 and 3.3 summarize the site visit and field sampling programs, respectively, conducted at facilities performing proposed MP&M operations.<sup>1</sup> Sections 3.4, 3.5, and 3.6 discuss other data sources.

#### 3.1 Industry Questionnaires

EPA distributed two screener and six detailed questionnaires (surveys) as part of the data collection effort for the MP&M rulemaking. As discussed in Section 2.0, EPA initially divided the MP&M Point Source Category into two phases by major industrial sectors. The surveys distributed for the seven Phase I industrial sectors requested data reflecting 1989 operations, and the surveys distributed for the 11 Phase II industrial sectors requested data reflecting 1996 operations. The table below lists the industry surveys and the distribution dates. Sections 3.1.1 and 3.1.2 discuss these questionnaire efforts.

**Distribution of the MP&M Industry Surveys**

Type of Survey	Survey Name	Distribution Date
Screener	1989 Screener Survey	8/90
	1996 Screener Survey	12/96
	1996 Benefits Screener	10/98
Detailed	1989 Detailed Survey	1/91
	1996 Long Detailed Survey	6/97
	1996 Short Detailed Survey	9/97
	1996 Municipality Detailed Survey	6/97
	1996 POTW Detailed Survey	11/97
	1996 Federal Detailed Survey	4/98

During the same time that EPA was developing the MP&M Point Source Category rulemaking, EPA was also updating the effluent limitations guidelines and standards for the Iron and Steel Point Source Category. As part of the revised Iron and Steel rulemaking, EPA distributed detailed and short surveys to iron and steel facilities. Following receipt of the 1997 Iron and Steel Surveys, EPA evaluated whether some facilities may be more appropriately covered under the MP&M Point Source Category.

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<sup>1</sup>Note: EPA evaluated a number of unit operations for the May 1995 proposal, January 2001 proposal, and June 2002 NODA (see Tables 4-3 and 4-4). However, EPA selected a subset of these unit operations for regulation in the final rule (see Section 1.0). For this Section, the term "proposed MP&M operations" means those operations evaluated for the two proposals, NODA, and final rule. The term "final MP&M operations" means those operations defined as "oily operations" (see Section 1.0, 40 CFR 438.2(f), and Appendix B to Part 438) and regulated by the final rule.

EPA included data from 154 iron and steel surveys in the MP&M survey database and proposed to create a new subcategory, the Steel Forming and Finishing Subcategory in the MP&M Point Source Category (see 66 FR 424). Based on comments on the January 2001 proposal and June 2002 NODA EPA concluded that those operations included in the proposed Steel Forming and Finishing Subcategory should remain subject to effluent guidelines at the Iron and Steel Point Source Category (40 CFR 420). See Section 6.0 for further discussion of subcategorization.

For this final rule, EPA also evaluated portions of the iron and steel surveys to determine if continuous electroplaters would be more appropriately covered under the MP&M Point Source Category, as described in the Notice of Data Availability (NODA) (67 FR 38752; June 5, 2002). EPA included these facilities in the General Metals Subcategory for evaluating options for the final rule. See Section 6.0 for further discussion of this determination. EPA has data for 47 continuous electroplating lines at 24 sites. The data for these lines were evaluated in developing the final MP&M effluent limitation guidelines and standards (see Section 3.1.3 for further discussion). A blank copy of the Iron and Steel Surveys and the relevant data from the 24 surveys are available in Section 5.3.6, DCN 16147 and Section 15.4.3 of the rulemaking record.

### **3.1.1 The 1989 Industry Surveys**

EPA distributed a screener and a detailed survey for the Phase I MP&M proposed regulation to manufacturing, rebuilding, and/or maintenance facilities engaged in the following seven industrial sectors:

- Aerospace;
- Aircraft;
- Electronic Equipment;
- Hardware;
- Mobile Industrial Equipment;
- Ordnance; and
- Stationary Industrial Equipment.

The 1989 screener and detailed surveys are discussed below. EPA describes in detail the recipient selection, stratification schemes, and the type and potential use of the requested information in the Information Collection Request (ICR) for the 1989 screener and detailed MP&M industry surveys. The ICR can be found in Section 3.6.2 of the rulemaking record, DCN M15738.

#### **3.1.1.1 1989 Screener Survey**

In August and September 1990, EPA mailed 8,342 screener surveys (also referred to as the Mini Data Collection Portfolio (MDCP)) to sites believed to be engaged in manufacturing, rebuilding, or maintenance activities in one of the seven industrial sectors listed above. Mailout of the screener was the preliminary step in an extensive data-gathering effort for



these seven industrial sectors. The purpose of the screener was to identify sites to receive the more detailed survey and to make a preliminary assessment of these seven industrial sectors.

### 1989 Screener Recipient Selection and Distribution

EPA identified potential recipients from a Dun & Bradstreet database using Standard Industrial Classification (SIC) codes. The Agency identified more than 190 SIC codes applicable to the seven industrial sectors listed in Section 3.1.1. Within each sector, EPA identified between 1 and 40 SIC codes. EPA calculated the number of sites to receive the screener within each SIC code by a coefficient of variation (CV) minimization procedure, described in the Statistical Summary for the Metal Products & Machinery Industry Surveys (Section 10.0, DCN 16118). Based on the number of sites selected within each SIC code, the Agency purchased a list of randomly selected names and addresses from the Dun & Bradstreet database for each SIC code. This list included twice the number of sites specified by the CV minimization procedure for each SIC code.

EPA deleted sites from the purchased Dun & Bradstreet list for the following reasons: sites had SIC codes that were inconsistent with company names; sites were corporate headquarters without manufacturing, rebuilding, or maintenance operations; or sites had insufficient mailing addresses. EPA then randomly selected 30 to 60 sites within each SIC code and assigned each site a randomly selected identification number. EPA assigned each site identification number a corresponding barcode to track the distribution and processing of the screeners.

To examine trends and similarities in manufacturing across the industry sectors, EPA also sent screener surveys to some facilities performing manufacturing in the following eight industrial sectors:

- Bus and Truck;
- Household Equipment;
- Instruments;
- Motor Vehicles;
- Office Machines;
- Precious and Nonprecious Metals;
- Railroad; and
- Ships and Boats.

The Agency did not send the screener to sites whose SIC codes indicated that they were engaged in only rebuilding or maintenance (i.e., not manufacturing) operations in the eight industrial sectors listed above.

EPA maintained a toll-free helpline from August through October of 1990 to assist screener recipients in completing the survey. This helpline received approximately 900 calls from screener recipients. Additional information about the screener mailing (e.g., a copy of

the screener, specific mailing and processing procedures, non-CBI screener responses, follow-up letters, and notes from helpline telephone conversations) is contained in Sections 3.7, 3.8 and 5.3 of the rulemaking record.

### 1989 Screener Mailout Results

EPA mailed 8,000 screener surveys in August 1990. Based on the number of surveys returned undelivered, EPA mailed an additional 342 in September 1990. In addition, EPA received 22 unsolicited responses to the survey. Of the 8,364 potential respondents to the screener, including those who provided unsolicited responses, 7,846 received the screener. Screeners for the remaining 518 were returned to EPA as undeliverable. EPA assumed these sites to be out of business. Of the total potential respondents, 84 percent (6,981) returned the screener to EPA. A blank copy of the screener form and nonconfidential portions of the completed screeners are contained in the rulemaking record (see Section 3.7.2, DCN 17223, and Sections 3.7.1 and 5.3.7). Table 3-1 and Figure 3-1 summarize the mailout results for the 1989 and 1996 survey efforts.

### Information Collected

The Agency requested the following site-specific information in the 1989 screener:

- Name and address of facility;
- Contact person;
- Parent company;
- Sectors in which the site manufactures, rebuilds, or maintains machines or metal components;
- SIC codes corresponding to products at the site;
- Number of employees;
- Annual revenues;

**Table 3-1****1989 and 1996 MP&M Survey Mailout Results**

<b>Survey Type</b>	<b>Mailed</b>	<b>Returned Undelivered</b>	<b>Returned (%)</b>	<b>Not Returned (%)</b>	<b>Respondents Performing Proposed MP&amp;M Operations (%)</b>	<b>Respondents Not Performing Proposed MP&amp;M Operations and Respondents Performing only Dry Proposed MP&amp;M Operations (%)</b>
1989 Screener Survey	8,342	518	6,981 <sup>a</sup> (84)	865 (11)	3,598 (52)	3,373 (48)
1989 Detailed Survey	1,020	0	998 <sup>b</sup> (98)	22 (2)	792 (79)	199 (20) <sup>c</sup>
1996 Screener Survey	5,325	579	4,248 <sup>d</sup> (80)	497 (10)	2,424 (57)	1,824 (43)
1996 Benefits Screener	1,750	155	1,392 (80)	161 (10)	1,354 (97)	38(3)
1996 Long Detailed Survey	353	1	311 <sup>b</sup> (88)	41 (12)	303 <sup>c</sup> (97)	8 (3) <sup>c</sup>
1996 Short Detailed Survey	101	1	83 (82)	17 (17)	59 (71)	24 (29)
1996 Municipality Detailed Survey	150	2	147 (98)	1 (1)	144 (53) <sup>f</sup>	3 (47) <sup>f</sup>
1996 Federal Detailed Survey	--	--	51 (--)	--	44 (86)	7 (14)

Source: 1989 and 1996 Survey Tracking Systems (see Section 8.8.1, DCN 16331, and Section 5.3, DCN 16330 of the rulemaking record).

<sup>a</sup>Includes 22 unsolicited responses.

<sup>b</sup>Seven of the 1989 detailed surveys and two of the 1996 long detailed surveys were returned too late to be incorporated into the detailed survey database.

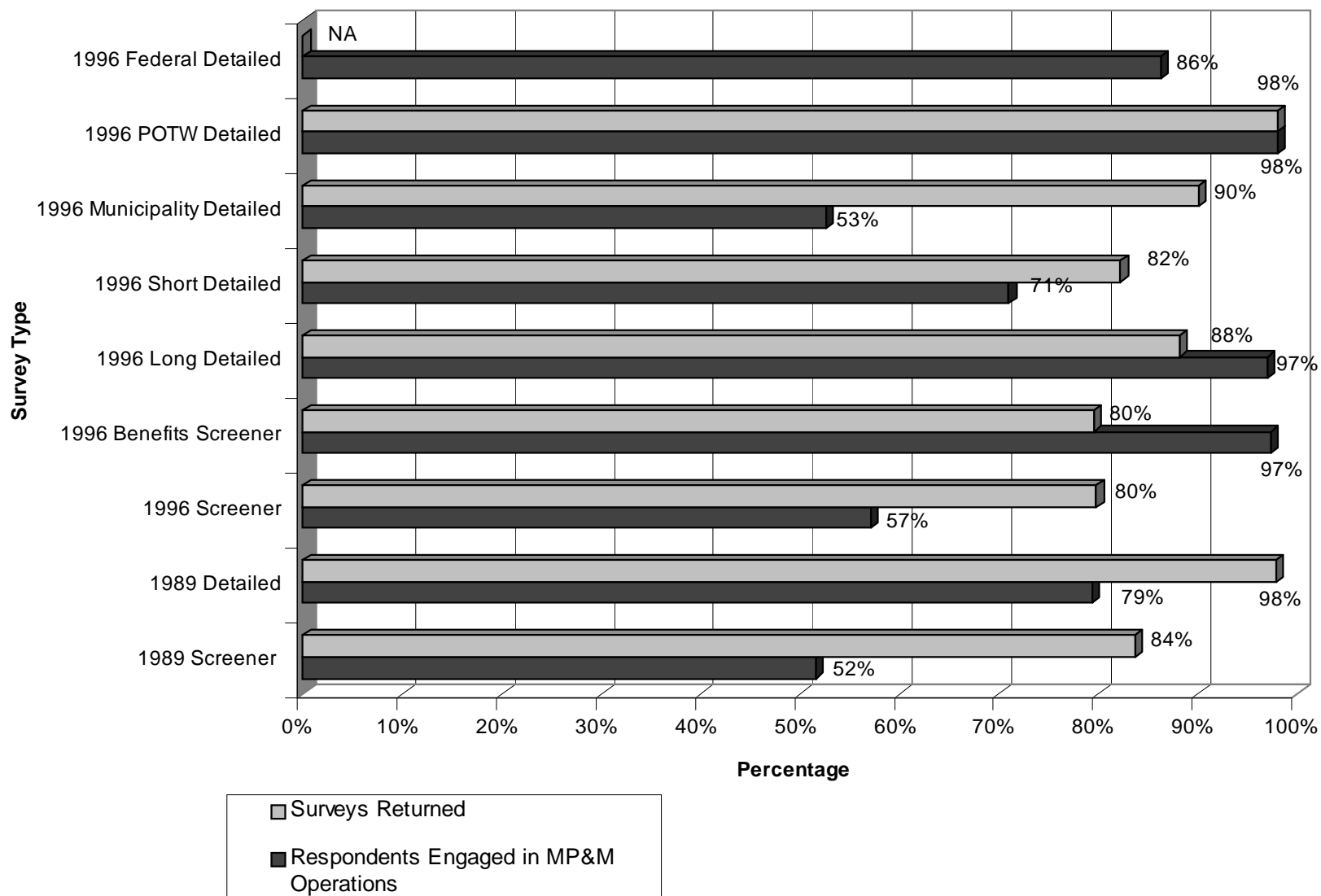
<sup>c</sup>Includes long survey respondents that discharge <1 mgd.

<sup>d</sup>Does not include one duplicate survey received.

<sup>e</sup>Number of respondents also includes sites with classified process information (1989 detailed survey), sites with insufficient data (1996 long survey), and surveys returned too late to incorporate into the database (1996 long survey). The data from these surveys were not incorporated into the survey databases.

<sup>f</sup>For the municipality survey, these numbers represent the number and percentage of POTWs receiving wastewater from facilities evaluated in the final rule, and the number and percentage of POTWs not receiving wastewater from facilities evaluated in the final rule.

-- Not applicable to the survey.



NA - The number of federal surveys distributed is not certain, and the percentage of returned surveys cannot be calculated.

**Figure 3-1. Percentage of 1989 and 1996 MP&M Surveys Returned and Percentage of Survey Respondents Performing Proposed MP&M Operations**

- Unit operations performed at the site;
- Whether there is process water use and/or wastewater discharge for each unit operation performed at the site; and
- Base metal(s) on which each unit operation is performed.

The Agency used a computerized database system (MS Access 97) to store and analyze data received from the screeners. The database dictionary and all nonconfidential screener surveys are located in Section 5.3.7 of the rulemaking record.

EPA determined the number of sites engaged in proposed MP&M operations by responses to the screener. As shown in Table 3-1, approximately 52 percent of the 1989 screener survey respondents reported that their sites were engaged in proposed MP&M operations and approximately 48 percent reported no or only dry proposed MP&M operations at their sites. EPA could not determine the status of 10 of the sites because they returned incomplete screeners and did not respond to follow-up efforts.

The Agency contacted a statistically representative sample of the nonrespondent sites (i.e., sites that did not return the screener) and sites reporting “not engaged” in proposed MP&M operations to determine whether their responses were due to confusion over the scope of the industry. Based on the results of this follow-up, EPA adjusted the survey weights for misclassification and incorrect responses. The methodology for calculating the adjustment factors is provided in the Statistical Summary for the Metal Products & Machinery Industry Surveys (Section 10.0, DCN 16118).

#### 1989 Screener Data Entry, Engineering Coding, and Analysis

EPA reviewed all of the screener surveys prior to data entry. As part of this effort, the Agency reviewed all documentation provided by the site, corrected errors and deficiencies, and coded the information for data entry. In some cases, these revisions required telephone contact with site personnel. The Agency contacted more than 1,100 screener recipients to resolve survey deficiencies and code information for data entry. Following preliminary review, EPA entered the scannable data (i.e., responses to multiple-choice, Mark Sense™ questions) into the database using a Scantron™ reader. EPA scanned each form twice and compared the information using a computer program as a quality control check. The Agency performed double key-entry of nonscannable data, resolved any inconsistencies, and converted the data to database files.

Based on the screener mailout results, EPA developed an industry profile for the seven sectors. The screener database report provides estimates of the national population for sites in these industrial sectors with regard to water use characteristics, size, location, sector, unit operations, and metal types. The Statistical Summary for the Metal Products & Machinery

Industry Surveys (Section 10.0, DCN 16118) discusses the sample size determination and statistical procedures for developing national estimates for the industry.

### **3.1.1.2 1989 Detailed Survey**

Based on responses to the 1989 screener, EPA sent a more detailed survey to a select group of water-using facilities performing proposed MP&M operations. This survey, also referred to as the data collection portfolio (DCP), was designed to collect detailed technical and financial information reflecting a site's 1989 operations. EPA used this information to characterize these facilities from the seven industrial sectors, develop pollutant loadings and reductions, and develop compliance cost estimates, as discussed later in this document.

EPA mailed 896 detailed surveys in January 1991. Based on the number of detailed surveys returned undelivered, EPA mailed an additional 124 detailed surveys in January and February 1991, for a total of 1,020 detailed surveys mailed. A blank copy of the 1989 detailed survey (Section 3.7.2, DCN 17224) and copies of the nonconfidential portions of the completed detailed surveys are located in Section 5.3.8 of the rulemaking record.

#### 1989 Detailed Survey Recipient Selection and Distribution

EPA selected 1,020 sites to receive detailed surveys from the following three groups of sites:

- Water-discharging 1989 screener respondents (860 sites);
- Water-using 1989 screener respondents that did not discharge process water (74 sites); and
- Water-discharging sites from key companies performing proposed MP&M operations that did not receive the 1989 screener (86 sites).

The methods used to select sites within each group are described below.

The Agency mailed the 1989 detailed survey to all 860 water-discharging screener respondents. EPA's intent in collecting detailed data from all 860 sites was to characterize the potential variations in unit operations performed and water-use practices among water-discharging sites in these seven industrial sectors.

The Agency mailed the 1989 detailed survey to a probability sample of 50 screener respondents that reported using but not discharging process water. EPA selected these sites to provide information on water-use practices at sites that use but do not discharge process water, and to determine if "zero-discharge" practices used at those sites could be used at other facilities performing proposed MP&M operations. In addition to the 50 probability sample sites, EPA mailed the 1989 detailed survey to 24 screener respondents that reported using but not

discharging process water. The Agency selected these sites because they performed unit operations that were not expected to be sufficiently characterized by detailed surveys mailed to other sites. The unit operations that EPA expected at each of the 24 sites are listed in Section 3.8.2 of the rulemaking record.

EPA mailed the 1989 detailed survey to 86 sites that did not receive the 1989 screener. The Agency identified these sites as representing key companies in the industry that EPA did not select as 1989 detailed survey recipients based on the screener mailout. EPA identified key companies from Dun & Bradstreet company lists, the Thomas Register, Fortune Magazine's list of the top 500 U.S. companies, and MP&M site visits at companies with annual revenues of \$50 million or more that EPA believed to be leading companies in their particular industrial sector. The Agency contacted each of the key companies to identify sites within the company that were performing proposed MP&M operations and used process water to perform these operations. Records of these follow-up telephone calls are located in the MP&M rulemaking record (see Section 3.8.2). EPA did not use these 86 surveys for developing the national estimates because the Agency did not randomly select these facilities.

EPA operated a toll-free telephone helpline from January until July 1991 to assist recipients in completing the 1989 detailed survey. The helpline received approximately 1,400 calls from detailed survey recipients. Callers to the 1989 detailed survey helpline typically requested the following:

- Assistance with the technical sections of the detailed survey (e.g., technical clarification of unit operation definitions);
- Additional time to complete the survey;
- Assistance with the financial sections of the detailed survey (these calls were referred to a separate economics helpline); or
- Clarification of the applicability of the survey (i.e., did the survey apply to the site?).

Records for nonconfidential telephone calls to the helpline and to EPA personnel are located in Section 5.3.8 of the rulemaking record.

#### 1989 Detailed Survey Mailout Results

Table 3-1 summarizes the results of the detailed survey mailout. Of the 1,020 sites that received the detailed survey, 998 responded to the survey and 22 did not. EPA did not include 199 of the 1,020 sites that responded in the detailed survey database for one of the following reasons:

- The site was out of business;

- The site did not use process water;
- The site was not performing proposed MP&M operations; or
- Process information at the site was Department of Defense or Department of Energy classified information.

Specific reasons for not using data from these sites are documented in Section 5.3.8.2 of the rulemaking record.

Upon review of the detailed surveys submitted by these sites, EPA determined 87 sites to be in the other 11 industrial sectors rather than the seven sectors identified in Section 3.1.1. Because the scope of the detailed survey mailout effort included only sites from the seven industrial sectors listed in Section 3.1.1, EPA did not include these 87 sites in the detailed survey database.

#### Information Collected

The Agency designed the 1989 detailed survey to collect information necessary to develop effluent limitations guidelines and standards for the MP&M rulemaking. EPA divided the detailed survey into the following parts:

- Part I - General Information;
- Part II - Process Information;
- Part III - Water Supply;
- Part IV - Wastewater Treatment and Discharge;
- Part V - Process and Hazardous Wastes; and
- Part VI - Financial and Economic Information.

The detailed survey instructions and the ICR for this project contain further details on the types of and potential uses for information collected. These documents are located in Section 3.7.2 of the rulemaking record, DCN 17224.

Part I (questions 1 through 13) requested information necessary to identify the site, to characterize the site by certain variables, and to confirm that the site was performing proposed MP&M operations. This information included: site name, address, contact person, number of employees, facility age, average energy usage, discharge permit status, and MP&M activity (manufacturing, rebuilding, or maintenance).

Part II (questions 14 through 21) requested detailed information on products, production levels, unit operations, activity, water use for unit operations, wastewater discharge from unit operations, miscellaneous wastewater sources, waste minimization practices (e.g., pollution prevention), and air pollution control for unit operations. EPA requested the site to provide detailed technical information (e.g., water balance, chemical additives, metal type



processed, disposition of wastewater) for each proposed MP&M operation and air pollution control device using process water. This section also requested information on unique and/or auxiliary operations. EPA used this information to evaluate raw waste characteristics, water use and discharge practices, and sources of pollutants for each proposed MP&M operation.

Part III (question 22) requested information on the water supply for the site. EPA requested the site to specify the source water origin, average intake flow, average intake operating hours, and the percentage of water used for proposed MP&M operations. EPA used this information to evaluate overall water use for the site.

Part IV (questions 23 through 33) requested detailed information on influent and effluent wastewater treatment streams and wastewater treatment operations. The information requested included: the origin of each stream contributing to the site's overall wastewater discharge; a block diagram of the wastewater treatment system; detailed technical information (e.g., wastewater stream flow rates, treatment chemical additives, system capacity, disposition of treatment sludge) for each wastewater treatment operation; self-monitoring data; and capital and operating cost data. EPA collected this information on facilities performing proposed MP&M operations to: (1) evaluate treatment in place at these facilities; (2) develop and design a cost model to estimate various control options; and (3) assess the long-term variability of effluent streams.

Part V (question 34) requested detailed information on the types, amounts, and composition of wastewater and solid/hazardous wastes generated during production or waste treatment, and the costs of solid waste disposal. EPA collected this information to evaluate the types and amounts of wastes currently discharged, the amount of waste that is contract hauled off site, and the cost of contract hauling wastes.

Part VI requested detailed financial and economic information from the site and the company owning the site. EPA collected this information to calculate the economic impacts of the regulatory options considered for the MP&M rulemaking.

#### 1989 Detailed Survey Review, Coding, and Data Entry

The Agency completed an engineering review of the detailed surveys, including coding responses to questions from Parts I through V to facilitate entry of technical data into a database. The MP&M DCP Database Dictionary identifying all database codes developed for this effort and the database dictionary for Section VI of the detailed survey are located in Section 5.3.8.2 of the rulemaking record, DCN 17387.

The Agency followed up with telephone calls to all respondents who did not provide: (1) information on operations (manufacturing, rebuilding, or maintenance) or sectors; (2) metal type or unit operation descriptions for each water-using unit operation; or (3) descriptions for each wastewater treatment operation. EPA also made follow-up calls to

clarify incomplete or contradictory technical or economic information. EPA confirmed all information obtained from follow-up calls by sending a letter to the site.

EPA developed a database to store all technical data provided in the detailed surveys. After engineering review and coding, the Agency entered data from the detailed surveys into the database using a double key-entry and verification procedure. EPA coded and entered data from 792 detailed survey respondents determined to be performing proposed MP&M operations into the detailed survey database. The MP&M DCP Database Dictionary presents the database structure and defines each field in the detailed survey database and the codes that describe data in these fields.

The Economic, Environmental, and Benefits Analysis of the Proposed Metal Products and Machinery Rule, which is located in Section 8.1 of the rulemaking record, DCN 2000, discusses EPA's review of Section VI of the detailed survey.

### 1989 Detailed Survey Data Analysis

EPA used the information collected in the detailed survey to develop an industry profile and to identify the baseline of treatment in place and estimate the amount of pollutant discharges from facilities performing proposed MP&M operations. Section 4.0 of this document provides estimates of the national population of these facilities that discharge water with regard to size, location, sector, unit operations, metal types, and discharge flows, and discusses the statistical procedures for developing national estimates for the industry. Section 11.0 and 12.0 present the methodologies used to estimate pollutant discharges and compliance costs, respectively.

### **3.1.2 The 1996 Industry Surveys**

Between 1996 and 1998, EPA distributed one screener and five detailed surveys, requesting data representing the survey recipients' 1996 operations. The five detailed surveys included the long, short, municipality, federal, and publicly owned treatment works (POTW) surveys. The Agency distributed the 1996 surveys to commercial and government (federal, state, and local) facilities that manufacture, rebuild, or maintain metal products or parts to be used in one of the following 11 industrial sectors:

- Bus and Truck;
- Household Equipment;
- Instruments;
- Job Shops;
- Motor Vehicles;
- Office Machines;
- Precious Metals and Jewelry;
- Printed Wire Boards;
- Railroad;

- Ships and Boats; and
- Miscellaneous Metal Products.

The 1996 screener and detailed surveys are discussed below. Recipient selection, stratification schemes, and the type and potential use of the information requested are described in more detail in the ICR for the 1996 screener (see Section 3.5.1, DCN 15766).

### **3.1.2.1 1996 Screener Survey**

In December 1996 and February 1997, EPA distributed 5,325 screener surveys to sites believed to be engaged in manufacturing, rebuilding, or maintenance activities in one of the 11 industrial sectors listed in Section 3.1.2. The purpose of the screener surveys was to identify sites to receive the more detailed survey and to make a preliminary assessment of the industry for the 11 industrial sectors. EPA sent an additional 1,750 screeners to facilities located in Ohio (a state with a high concentration of facilities performing proposed MP&M operations) as part of a benefits study. The Agency used these screeners to collect data to analyze environmental benefits.

#### 1996 Screener Recipient Selection and Distribution

As discussed above, EPA sent the 1996 screener survey to 5,325 randomly selected facilities performing proposed MP&M operations (includes replacement sites). The Agency selected potential recipients from the Dun & Bradstreet database based on the industrial sector (using the SIC code), activity (i.e., manufacturing, maintenance, or rebuilding), size as measured by number of employees, and wastewater discharge flow rate.

The Agency identified more than 126 SIC codes applicable to the 11 industrial sectors. Within each sector, EPA identified between 1 and 26 SIC codes. EPA calculated the number of sites to receive the 1996 screener within each SIC code by a coefficient of variation (CV) minimization procedure described in the Statistical Support Document located in Section 10.0 of the rulemaking record, DCN 16119. Based on the number of sites selected within each SIC code, the Agency obtained a list of randomly selected names and addresses from Dun & Bradstreet. This list included twice the number of sites specified by the CV minimization procedure for each SIC code. EPA randomly selected the initial list of sites from the Dun & Bradstreet database for each SIC code.

After reviewing the potential sites, EPA deleted sites for the following reasons:

- The site was a corporate headquarters without manufacturing, rebuilding, or maintenance operations;
- The site received a 1989 screener or detailed survey;

- The site was a duplicate of another facility in the list of potential facilities performing proposed MP&M operations;
- The site had an SIC code that was inconsistent with company name; or
- The site had an insufficient mailing address.

EPA established a toll-free telephone helpline and an electronic mail address to assist screener recipients in completing the survey. EPA received helpline calls and electronic mail inquiries from more than 600 screener recipients. Nonconfidential notes from helpline and review follow-up calls are located in Section 5.3.1 of the rulemaking record.

#### 1996 Screener Mailout Results

EPA initially mailed 4,900 surveys in December 1996. The Agency distributed surveys to an additional 425 sites to replace surveys that were returned undelivered. EPA assumed the undeliverable survey sites to be out of business. Of the 5,325 surveys mailed, 80 percent (4,248) of the recipients returned completed surveys to EPA. A blank copy of the 1996 screener (see Section 3.7.1, DCN 16367) and nonconfidential portions of the completed screeners are located in the public record for this rulemaking (see Section 5.3.1.1). Table 3-1 and Figure 3-1 summarize the MP&M survey mailout results.

The Agency contacted a statistically representative sample of nonrespondent sites to determine whether these sites were performing proposed MP&M operations and discharged process wastewater. Only 24 percent of the nonrespondents contacted were performing proposed MP&M operations, and approximately half of these facilities did not discharge process wastewater.

#### Information Collected

The Agency requested the following site-specific information in the screener:

- Name and address of facility;
- Contact person;
- Whether process water is used at the site;
- Destination of process wastewater discharged;
- Volume of process wastewater discharged;
- Number of employees;

- Annual revenue;
- Sectors in which the site manufactures, rebuilds, or maintains machines or metal components; and
- Unit operations performed at the site and whether there is water use and/or wastewater discharge for each unit operation performed at the site.

The Agency used a computerized database system (MS Access 97) to store and analyze data received from the 1996 screeners. Nonconfidential portions of the screener surveys (see Section 5.3.1.1) and the database dictionary are located in the public record for this rulemaking (see Section 5.3.1.2, DCN 15393).

#### 1996 Screener Data Review and Data Entry

EPA reviewed the 1996 screener survey responses for accuracy and consistency and formatted the information for data entry. The Agency contacted approximately 1,800 screener respondents to resolve deficient and inconsistent information prior to data entry. Following review, EPA double key entered and compared the data from the formatted screeners, using a computer program, as a quality control check. The Agency then reviewed the database files for deficiencies and inconsistencies, and resolved all issues for the final survey database.

#### 1996 Benefits Screener Survey

For an environmental benefits study, EPA sent the 1996 screener survey to 1,750 (including replacement sites) randomly selected sites in Ohio, a state with a large number of facilities performing proposed MP&M operations. The selection criteria and sampling frame for the benefits screener recipients are described in more detail in memoranda located in Section 3.8.1.7 of the rulemaking record, DCN 16333.

The Agency initially mailed the benefits screener to 1,600 facilities in October 1998. EPA mailed screeners to an additional 150 facilities in February 1999 to replace surveys that were returned undelivered. The Agency assumed the undeliverable survey sites to be out of business. Of the 1,750 surveys mailed, 80 percent (1,392) of the recipients returned completed screeners to EPA. A blank copy of the 1996 benefits screener (see Section 3.7.1, DCN 16367) and nonconfidential portions of the completed benefits screeners (see Section 8.8.1) are located in the public record for this rulemaking. Table 3-1 and Figure 3-1 summarize the MP&M mailout results.

EPA established a toll-free telephone helpline and an electronic mail address to assist screener recipients in completing the survey. EPA received helpline calls and electronic mail inquiries from more than 900 benefits screener recipients. Nonconfidential notes from helpline and review follow-up calls are located in Section 8.8.1 of the public record for this rulemaking.

The Agency followed the same review, data entry, and database development procedures used for the original 1996 screener survey. EPA contacted more than 400 screener respondents to resolve deficient and inconsistent information prior to data entry. The benefits screener database is discussed in the Economic, Environmental, and Benefits Analysis of the Proposed Metal Products and Machinery Rule.

### **3.1.2.2 1996 Long Detailed Survey**

EPA distributed the long detailed surveys (long survey) in June 1997 to 353 wastewater-discharging facilities performing proposed MP&M operations. EPA designed this survey to gather detailed technical and economic information required to develop the MP&M effluent limitations guidelines and standards. The long survey is discussed below.

#### 1996 Long Survey Recipient Selection and Distribution

In June 1997, EPA sent the long survey to all 353 1996 screener respondents who indicated they performed operations in one of the 11 industry sectors listed in Section 3.1.2 and discharged one million or more gallons of MP&M process wastewater annually. EPA established a toll-free telephone helpline and an electronic mail address to assist long survey recipients in completing the survey. EPA received helpline calls and electronic mail inquiries from approximately 200 long survey recipients. Nonconfidential notes from helpline and review follow-up calls are located in Section 5.3.2.1 of the public record for this rulemaking.

#### 1996 Long Survey Mailout Results

Of the 353 surveys mailed, 88 percent (311) of the recipients returned completed surveys to EPA. One survey was returned as undelivered and EPA assumed the facility to be out of business. A blank copy of the 1996 long survey (Section 3.7.1, DCN 713) and nonconfidential portions of the completed long surveys are located in Section 5.3.2.1 of the public record for this rulemaking. Table 3-1 and Figure 3-1 summarize the MP&M survey mailout results.

#### Information Collected

EPA divided the long detailed survey into the following sections:

- Section I: General Site Information;
- Section II: General Process Information;
- Section III: Specific Process Information;

- Section IV: Economic Information; and
- Section V: Voluntary Supplemental Information.

Table 3-2 summarizes the information requested in the 1996 long, short, federal, and municipality detailed surveys by question number. EPA designed these surveys to collect similar detailed process information from different audiences, as discussed below for each survey. Further details on the types of information collected and the potential uses of the information are contained in the ICR for this data collection (see Section 3.5.1, DCN 15766) and in the survey instructions that are located in Section 3.7.1 of the rulemaking record, DCN 713.

Section I requested information to determine if the facility was performing proposed MP&M operations. Question 1 requested the site to identify the industry sector and type of activity (manufacturing, rebuilding, or maintenance) performed.

Section II requested information to identify the site location and contact person, number of employees, facility age, process wastewater discharge status and destination, and wastewater discharge permits and permitting authority. This section also requested general information about metal types processed, products and production levels, water use for unit operations, and wastewater discharge from unit operations. EPA used the process information to evaluate water use and discharge practices and sources of pollutants for each proposed MP&M operation.

Section III requested detailed information on wet proposed MP&M operations, pollution prevention practices, wastewater treatment technologies, costs for water use and wastewater treatment systems, and wastewater/sludge disposal costs. EPA also requested the site to provide block diagrams of the production process and the wastewater treatment system. The unit operation information requested included: metal types processed, production rate, operating schedule, chemical additives, volume and destination of process wastewater and rinse waters, in-process pollution prevention technologies, and in-process flow control technologies. The information requested for each wastewater treatment unit included: operating flow rate, design capacity, operating time, chemical additives, and unit operations discharging to each treatment unit. In addition, EPA requested the site to provide the type of any wastewater sampling data collected. EPA used these data to characterize the industry, to perform subcategorization analyses, to identify best management practices, to evaluate performance of the treatment technology for inclusion in the regulatory options, and to develop regulatory compliance cost estimates.

Section IV requested detailed financial and economic information about the site or the company owning the site. EPA collected this information to calculate the economic impacts of the regulatory options considered for the MP&M rulemaking.

Section V requested supplemental information on other facilities performing proposed MP&M operations owned by the company. EPA included this voluntary section to

measure the combined impact of proposed MP&M effluent guidelines on companies with multiple facilities

**Table 3-2**

**Summary of 1996 Detailed Survey Information by Question Number**

Survey Question Number			Type of Information Requested
Long and Federal	Short	Municipality	
<b>Section I</b> 1	<b>Section I</b> 1	<b>Part II</b> 1	Industrial sector activities
<b>Section II</b> 2-5	<b>Section II</b> 2-5	2-5	Site location and facility contact
6, 7	6, 7	5, 6	Number of employees and age of site
8, 9	8, 9	7, 8	Discharge status and destination
10	10	9	Permits under miscellaneous categorical effluent guidelines
---	11-12	10-11	Types of end-of-pipe wastewater treatment units
11	13	12	Metal types processed
12	15	13	5 major products (quantity and sector)
13	16	14	Unit operations: water use and associated rinses
<b>Section III</b> 14-15	---	---	General water use and costs
16	---	---	Production process diagram
17-23	---	---	Detailed description of <b>wet</b> unit operations performed
24-29	<b>Section II</b> 17	16	In-process pollution prevention technologies or practices
30	---	---	Wastewater treatment (WWT) diagram
31-41	---	---	Detailed design and operating parameters of WWT units
42	---	---	WWT costs by treatment unit
43-44	<b>Section II</b> 14	15	Wastewater sampling and analysis conducted
45	---	---	Contract haul and disposal costs
---	---	---	Facility comments page
<b>Section IV</b> 1-9	<b>Section IV</b> 1-8	<b>Part I</b> 1-3	Financial and economic data
<b>Section V</b> 1	<b>Section V</b> 1	---	Parent firm name and contact, number of other facilities performing proposed MP&M operations
2	2	---	Number of employees for other facility(ies)
3	3	---	Industrial and activity
2, 4	2, 4	---	Discharge status and destination
5	5	---	Unit operations: water use and discharge status

--- Question is not applicable to this survey.



performing proposed MP&M operations that discharge process wastewater. This section requested the same information collected in the 1996 MP&M screener survey. Responses to questions in this section provided the size, industrial sector, revenue, unit operations, and water usage of the company's other facilities performing proposed MP&M operations.

#### 1996 Long Survey Data Review and Data Entry

EPA completed a detailed engineering review of Sections I through III of the detailed long survey to evaluate the accuracy of technical information provided by the respondents. During the engineering review, EPA coded responses to facilitate entry of technical data into the long survey database. The MP&M 1996 Long Survey Database Dictionary identifies the database codes developed for this project, and is located in Section 5.3.2.2 of the rulemaking record, DCN 15773. EPA contacted approximately 240 long survey respondents, by telephone and letter, to clarify incomplete or inconsistent technical information prior to data entry.

The Agency developed a database for the technical information provided by survey respondents. After engineering review and coding, EPA entered data from 303 long surveys into the database using a double key-entry and verification procedure. The MP&M 1996 Long Survey Database Dictionary presents the database structure and defines each field in the database files. EPA did not include data from 8 long survey respondents in the database for the following reasons:

- The site was out of business;
- The site did not use process water;
- The site was not performing proposed MP&M operations; or
- The site provided insufficient data and the survey was returned too late to enter into the database.

The Economic, Environmental, and Benefits Analysis of the Proposed Metal Products and Machinery Rule, which is located in Section 8.1 of the rulemaking record, DCN 2000, discusses EPA's review of Section IV of the detailed survey.

#### **3.1.2.3 1996 Short Detailed Survey**

EPA distributed the short detailed survey (short survey) in September 1997 to 101 wastewater-discharging facilities performing proposed MP&M operations. EPA designed this survey to gather additional technical and economic information required to develop the MP&M effluent limitations guidelines and standards. The short survey is discussed below.

### 1996 Short Survey Recipient Selection and Distribution

EPA initially sent 100 short surveys in September 1997 and mailed one additional survey to a site to replace a short survey that was returned undelivered. EPA assumed the undeliverable site to be out of business. The Agency sent the short surveys to randomly selected 1996 screener respondents who performed operations in one of the 11 industry sectors identified in Section 3.1.2 and indicated they discharged less than one million gallons of MP&M process wastewater annually. The selection criteria and sampling frame for short survey recipients are described in more detail in the Statistical Summary for the Metal Products & Machinery Industry Surveys (Section 10.0, DCN 16118).

EPA established a toll-free telephone helpline and an electronic mail address to assist short survey recipients in completing the survey. EPA received helpline calls and electronic mail inquiries from approximately 20 short survey recipients. Nonconfidential notes from helpline and review follow-up calls are located in Section 5.3.3.1 of the public record for this rulemaking.

### 1996 Short Survey Mailout Results

Of the 101 surveys mailed, 82 percent (83 surveys) of the recipients returned completed surveys to EPA. A blank copy of the 1996 short survey (Section 3.7.1, DCN 16368) and nonconfidential portions of the completed short surveys (Section 5.3.3.1) are located in the public record for this rulemaking. Table 3-1 and Figure 3-1 summarize the MP&M survey mailout results.

### Information Collected

The information collected in the 1996 short survey included the identical general site and process information and economic information collected in Sections I, II, IV, and V of the long detailed survey (see Section 3.1.2.2). To minimize the burden on facilities discharging less than one million gallons of process wastewater, EPA did not require these facilities to provide the detailed information on proposed MP&M operations or treatment technologies that EPA requested in Section III of the long survey. The ICR for this data collection and the survey instructions contain further details on the types of information collected and the potential uses of the information.

EPA divided the short survey into the following sections:

- Section I: General Site Information;
- Section II: General Process Information;
- Section IV: Economic Information; and
- Section V: Voluntary Supplemental Information.

Section III, Specific Process Information, consisted of a statement that EPA was not requesting this information to reduce burden on sites discharging less than one million gallons of process wastewater per year. Table 3-2 summarizes the 1996 short survey information by question number.

#### 1996 Short Survey Data Review and Data Entry

EPA completed a detailed engineering review of Sections I and II of the short survey to evaluate the accuracy of technical information provided by the respondents. During the engineering review, EPA coded responses to facilitate entry of technical data into the short survey database. The MP&M 1996 Short Survey Database Dictionary identifies the database codes developed for this project and is located in Section 5.3.3.2 of the rulemaking record, DCN 15772. EPA contacted more than 60 short survey respondents, by telephone and letter, to clarify incomplete or inconsistent technical information prior to data entry.

The Agency developed a database for the technical information provided by survey respondents. After engineering review and coding, EPA entered data for 75 short surveys into the database using a double key-entry and verification procedure. The MP&M 1996 Short Survey Database Dictionary presents the database structure and defines each field in the database files. EPA did not include data from eight short survey respondents in the database for the following reasons:

- The site was out of business;
- The site did not use process water; or
- The site was not performing proposed MP&M operations.

The Economic, Environmental, and Benefits Analysis of the Proposed Metal Products and Machinery Rule, which is located in Section 8.1 of the rulemaking record, DCN 2000, discusses EPA's review of Section IV of the short survey.

#### **3.1.2.4 1996 Municipality Detailed Survey**

EPA distributed the municipality surveys in June 1997 to 150 city and county facilities that might operate facilities performing proposed MP&M operations. EPA designed this survey to measure the impact of this rule on municipalities and other government entities that perform certain maintenance and rebuilding operations (e.g., bus and truck, automobiles).

#### Recipient Selection and Distribution

The Agency sent the municipality survey to 150 city and county facilities randomly selected from the Municipality Year Book-1995 based on population and geographic location. EPA allocated 60 percent of the sample to municipalities and 40 percent to counties. The 60/40 distribution was approximately proportional to their aggregate populations in the frame. The Agency divided the municipality sample and the county sample into three size

groupings as measured by population. For municipalities, the population groupings were: less than 10,000 residents, 10,000 - 50,000 residents, and 50,000 or more residents. For counties, the population groupings were: less than 50,000 residents, 50,000 - 150,000 residents, and 150,000 or more residents. The geographic stratification conformed to the Census definitions of Northeast, North Central, South, Pacific, and Mountain states.

EPA established a toll-free telephone helpline and an electronic mail address to assist municipality survey recipients in completing the survey. EPA received helpline calls and electronic mail inquiries from more than 50 municipality survey recipients. Notes from helpline and review follow-up calls are located in Section 5.3.4.1 of the rulemaking record.

### 1996 Municipality Survey Mailout Results

Of the 150 municipality surveys mailed, three surveys were returned undelivered and 135 surveys (90 percent) of the recipients returned completed surveys to EPA. A blank copy of the 1996 municipality survey (Section 3.7.1, DCN 16366) and nonconfidential portions of the completed municipality surveys (Section 5.3.4.1) are located in the public record for this rulemaking. Table 3-1 and Figure 3-1 summarize the MP&M survey mailout results.

### Information Collected

The 1996 municipality survey collected economic information for the entire municipality and site-specific process information for each facility performing proposed MP&M operations operated by the municipality.

EPA divided the municipality detailed survey into the following parts:

- Part I: Economic and Financial Information; and
- Part II: General Site-Specific Process Information.

Table 3-2 summarizes the 1996 municipality survey information by question number. The ICR for this data collection (Section 3.5.1, DCN 15766) and the survey instructions (Section 3.7.1, DCN 15366) contain further details on the types of information collected and the potential uses of the information and are located in the rulemaking record.

Part I requested information on the site location and contact person, number of employees, detailed financial and economic information about the entire municipality, and information necessary to determine if the municipality owned and operated facilities performing proposed MP&M operations in any of the proposed industrial sectors.

Part II requested site-specific process information for each facility performing proposed MP&M operations owned and operated by the municipality. Question 1 requested the site to identify the industry sector and type of activity (manufacturing, rebuilding, or maintenance) performed. The remaining questions were identical to Section II of the short

detailed survey and requested facility age, process wastewater discharge status and destination, wastewater discharge permits and permitting authority, general information about metal types processed, products and production levels, water use for unit operations, and wastewater discharge from unit operations. The Agency used the process information to evaluate water use and discharge practices and sources of pollutants for each proposed MP&M operation.

#### 1996 Municipality Survey Data Review and Data Entry

EPA completed a detailed engineering review of Part II of the municipality survey to evaluate the accuracy of technical information provided by the respondents. During the engineering review, the Agency coded responses to facilitate entry of technical data into the municipality survey database. The MP&M 1996 Municipality Survey Database Dictionary identifies the database codes developed for this project, and is located in Section 5.3.4.2 of the rulemaking record, DCN 15771. EPA contacted more than 50 municipality survey respondents by telephone to clarify incomplete or inconsistent technical information prior to data entry.

The Agency developed a database for the technical information provided by survey respondents. After engineering review and coding, EPA entered data from 209 municipality facilities into the database using a double key-entry and verification procedure. This number is greater than the number of respondents because some municipalities had more than one facility performing proposed MP&M operations. The MP&M 1996 Municipality Survey Database Dictionary presents the database structure and defines each field in the database files.

The Economic, Environmental, and Benefits Analysis of the Proposed Metal Products and Machinery Rule, which is located in Section 8.1 of the rulemaking record, DCN 2000, discusses EPA's review of Part I of the municipality survey.

#### **3.1.2.5 1996 Federal Facilities Detailed Survey**

In April 1998, EPA distributed the federal facilities detailed survey (federal survey) to the following seven federal agencies:

- Department of Energy;
- Department of Defense;
- National Aeronautics and Space Administration (NASA);
- Department of Transportation (including the United States Coast Guard);
- Department of Interior;
- Department of Agriculture; and
- United States Postal Service.

EPA used this survey to assess the impact of the MP&M effluent limitations guidelines and standards on federal agencies that operate facilities performing proposed MP&M operations.

### Recipient Selection and Distribution

There was no specific sampling frame for the federal survey. EPA distributed the survey to federal agencies likely to perform industrial operations on metal products or machinery. EPA requested representatives of seven federal agencies to voluntarily distribute copies of the survey to sites they believed performed proposed MP&M operations. The selection criteria for federal survey recipients are described in more detail in the ICR for the 1996 MP&M industry surveys. Because the sample was not randomly selected, EPA did not use data from these surveys to develop national estimates.

EPA established a toll-free telephone helpline and an electronic mail address to assist federal survey recipients in completing the survey. EPA received helpline calls and electronic mail inquiries from approximately 20 federal survey recipients. Nonconfidential notes from helpline and review follow-up calls are located in Section 5.3.5.1 of the public record for this rulemaking.

### 1996 Federal Survey Distribution Results

The Agency received 51 completed federal surveys, 39 from Department of Defense facilities and 12 from NASA facilities. A blank copy of the 1996 federal survey (Section 3.7.1, DCN 721) and nonconfidential portions of the completed federal surveys are located in Section 5.3.5.1 of the public record for this rulemaking.

### Information Collected

The information requested in Sections I and III of the 1996 federal survey was identical to the long survey (see Section 3.1.2.2). The financial and economic questions in Section IV were revised to obtain this information for only the MP&M activities on a federal site. The ICR for this data collection and the survey instructions contain further details on the types of information collected and the potential uses of the information. Table 3-2 summarizes the 1996 federal detailed survey information by question number.

### Data Review and Data Entry

EPA completed a detailed engineering review of Sections I through III of the federal survey to evaluate the accuracy of technical information provided by the respondents. During the engineering review, the Agency coded responses to facilitate entry of technical data into the federal survey database. The MP&M 1996 Federal Survey Database Dictionary identifies the database codes developed for this project and is located in Section 5.3.5.2 of the rulemaking record, DCN 15991.

The Agency developed a database for the technical information provided by survey respondents. After engineering review and coding, EPA entered data from 44 federal surveys into the database using a double key-entry and verification procedure. The Agency did

not include data from seven federal survey responses in the database because the sites did not use MP&M process water. The MP&M 1996 Federal Survey Database Dictionary presents the database structure and defines each field in the database files.

The Economic, Environmental, and Benefits Analysis of the Proposed Metal Products and Machinery Rule, which is located in Section 8.1 of the rulemaking record, DCN 2000, discusses EPA's review of Section IV of the federal survey.

### **3.1.2.6 1996 POTW Detailed Survey**

EPA distributed the POTW survey to 150 sites in November 1997. The Agency designed this survey to evaluate benefits associated with the MP&M regulations and to estimate possible costs and burden that POTWs might incur in writing and maintaining MP&M permits or other control mechanisms.

#### Recipient Selection and Distribution

The Agency sent the POTW survey to 150 POTWs with flow rates greater than 0.50 million gallons per day. EPA randomly selected the recipients from the 1992 Needs Survey Review, Update, and Query System Database. EPA divided the POTW sample into two strata by daily flow rates: 0.50 to 2.50 million gallons, and 2.50 million gallons or more. The selection criteria and sampling frame for POTW survey recipients are described in more detail in the ICR for the 1996 surveys.

EPA established a toll-free telephone helpline and an electronic mail address to assist POTW survey recipients in completing the survey. EPA received helpline calls and electronic mail inquiries from approximately 50 POTW survey respondents. Nonconfidential notes from helpline and review follow-up calls are located in Section 8.7 of the public record for this rulemaking.

#### 1996 POTW Survey Mailout Results

Of the 150 POTW surveys mailed, two surveys were returned undelivered and 98 percent (147) of the recipients returned completed surveys to EPA. A blank copy of the 1996 POTW survey (Section 3.7.1, DCN 16369) and nonconfidential portions of the completed POTW survey (Section 8.7) are located in the public record for this rulemaking. Table 3-1 and Figure 3-1 summarize the MP&M survey mailout results.

#### Information Collected

The POTW survey requested data required to estimate benefits and costs associated with implementation of the MP&M regulations. The ICR for this data collection and the survey instructions contain further details on the types of information collected and the potential uses of the information. EPA divided the POTW survey into the following parts:

- Part I: Introduction and Basic Information;
- Part II: Administrative Permitting Costs; and
- Part III: Sewage Sludge Use or Disposal Costs.

Part I requested site location and contact information and the total volume of wastewater treated at the site. EPA used the wastewater flow information to characterize the size of the POTW.

Part II requested the number of industrial permits written, the cost to write the permits, the permitting fee structure, the percentage of industrial dischargers covered by National Categorical Standards (i.e., effluent guidelines), and the percentage of permits requiring expensive administrative activities. EPA used this information to estimate administrative burden and costs.

Part III requested information on the use or disposal of sewage sludge generated by the POTW. EPA required only POTWs that received discharges from facilities performing proposed MP&M operations to complete Part III. The sewage sludge information requested included the amount generated, use or disposal method, metal levels, use or disposal costs, and the percentage of total metal loadings at the POTW from facilities performing proposed MP&M operations. The Agency used this information to assess the potential changes in sludge handling resulting from the MP&M rule and to estimate economic benefits to the POTW related to sludge disposal and reduction in upsets/interference.

#### Data Review and Data Entry

EPA performed a detailed review of the POTW survey to evaluate the accuracy of information provided by the respondents. During the review, the Agency coded responses to facilitate entry of data into the POTW survey database. The database dictionary for the POTW survey identifies the database codes developed for this project, and is located in Section 8.7 of the rulemaking record. EPA contacted more than 95 POTW survey respondents by telephone to clarify incomplete or inconsistent information prior to data entry.

The Agency developed a database for the information provided by survey respondents. After review and coding, EPA entered data from 147 POTW surveys into the database using a double key-entry and verification procedure. The database dictionary presents the database structure and defines each field in the database files.

### **3.1.3 1997 Iron and Steel Industry Survey Data**

As part of its effort to review and revise effluent limitations guidelines and standards for the Iron and Steel Point Source Category (40 CFR 420), EPA distributed, reviewed, and coded the iron and steel industry detailed and short surveys of 402 iron and steel facilities in November 1998.



EPA included data from 154 iron and steel surveys in the MP&M survey database. EPA used these 154 Iron & Steel surveys to create a new subcategory, Steel Forming and Finishing, in the January 2001 proposal. Based on comments to the January 2001 proposal and June 2002 NODA, EPA concluded that those operations included in the proposed Steel Forming and Finishing Subcategory of the MP&M Point Source Category should remain subject to the effluent guidelines and standards at the Iron and Steel Point Source Category (40 CFR 420). See Section 6.0 for further discussion of subcategorization.

As discussed in the June 2002 NODA (67 FR 38752), EPA considered establishing a segment of the Steel Forming and Finishing Subcategory for discharges resulting from continuous electroplating of flat steel products (e.g., strip, sheet, and plate). EPA examined its database for facilities that perform continuous steel electroplating and found that continuous electroplaters do not perform operations similar to facilities in the proposed Steel Forming and Finishing Subcategory. Rather, continuous electroplaters perform operations included in the proposed General Metals Subcategory. Therefore, in evaluating options for the final rule, EPA included continuous electroplaters in the proposed General Metals Subcategory. See Section 6.0 for a detailed discussion of subcategorization. For this reason, EPA incorporated the information on these operations reported in 24 iron and steel surveys into the MP&M database. Operations on the continuous electroplating lines may include:

- Acid cleaning;
- Alkaline cleaning;
- Conversion coating (e.g., passivation, surface activation/fluxing);
- Electroplating;
- Rinsing; and
- Sealing.

All 24 sites with electroplating lines processing steel flat-rolled products discharge process wastewater. The Agency coded and entered process and wastewater treatment information from the 47 lines in the 24 iron and steel surveys into the MP&M cost model. A blank copy of the 1997 iron and steel detailed and short surveys and nonconfidential portions of the 24 completed iron and steel surveys are located in Sections 5.3.6 and 15.1 of the public record for this rulemaking. As discussed in Section 9.0, EPA rejected establishing limitations and standards for the proposed General Metals Subcategory. Continuous electroplaters remain subject to the Metal Finishing Point Source Category (40 CFR 433), as applicable.

#### 1997 Iron and Steel Survey Recipient Selection and Distribution

The Agency consulted with industry trade associations and visited a number of sites to develop the survey instruments and to ensure an accurate mailing list.

EPA distributed four industry surveys:

- U.S. EPA Collection of 1997 Iron and Steel Industry Data (detailed survey);
- U.S. EPA Collection of 1997 Iron and Steel Industry Data (Short Form) (short survey);
- U.S. EPA Collection of Iron and Steel Industry Wastewater Treatment Capital Cost Data (cost survey); and
- U.S. EPA Analytical and Production Data Follow-Up to the Collection of 1997 Iron and Steel Industry Data (analytical and production survey).

In October 1998, EPA mailed the detailed survey to 176 iron and steel sites and the short survey to 223 iron and steel sites. EPA designed the detailed survey for those iron and steel sites that perform any iron and steel manufacturing process. Those sites include integrated and non-integrated steel mills, as well as sites that were initially identified as stand-alone cokemaking plants, stand-alone sinter plants, stand-alone direct-reduced ironmaking plants, stand-alone hot forming mills, and stand-alone finishing mills. The short survey is an abbreviated version of the detailed survey. It was designed for stand-alone iron and steel sites with the exceptions of those that received the detailed survey. EPA mailed the cost survey and the analytical and production survey to subsets of the facilities that received the detailed or short survey to obtain more detailed information on wastewater treatment system costs, analytical data, and facility production. EPA mailed the cost survey to 90 iron and steel sites and the analytical and production survey to 38 iron and steel sites.

EPA mailed the iron and steel industry surveys by mail to facilities that were identified from the following sources:

- Association of Iron and Steel Engineers' 1997 and 1998 Directories: Iron and Steel Plants Volume 1, Plants and Facilities;
- Iron and Steel Works of the World (11th and 12th editions) directories;
- Iron and Steel Society's The Steel Industry of Canada, Mexico, and the United States: Plant Locations;
- Member lists from the following trade associations:
  - American Coke and Coal Chemicals Institute,
  - American Galvanizers Association,
  - American Iron and Steel Institute,
  - American Wire Producers Association,
  - Cold Finished Steel Bar Institute,

- Specialty Steel Industry of North America,
  - Steel Manufacturers Association,
  - Steel Tube Institute of North America, and
  - Wire Association International;
- Dun & Bradstreet Facility Index Database;
  - EPA's Permit Compliance System (PCS) Database;
  - EPA's Toxic Release Inventory (TRI) Database;
  - Iron and Steel Society's Iron and Steelmaker "Roundup" editions;
  - 33 Metalproducing "Roundup" editions (Reference 3-22);
  - 33 Metalproducing "Census of the North American Steel Industry"; and
  - Thomas Register.

The Agency cross-referenced these sources with one another to develop a list of individual sites. Based on these sources, EPA identified 822 candidate facilities to receive surveys. To minimize the burden on the respondents, EPA grouped facilities into 12 strata. In general, EPA determined the strata based on its understanding of the manufacturing processes at each facility.

Depending on the amount or type of information EPA required for the rulemaking, EPA either solicited information from all facilities within a stratum (i.e., a census or "certainty" stratum) or selected a random sample of facilities within a stratum (i.e., statistically sampled stratum). EPA sent a survey to all facilities in the certainty strata (strata 5 and 8) because the Agency determined it was necessary to capture the size, complexity, or uniqueness of the steel operations at these sites. EPA also sent surveys to all facilities in strata 1 through 4 (all cokemaking sites, integrated steelmaking sites, and sintering and direct-reduced ironmaking sites) because of the relatively low number of sites in each stratum and because of the size, complexity, and uniqueness of raw material preparation and steel manufacturing operations at these sites. The Agency statistically sampled the remaining sites in strata 6, 7, and 9 through 12. EPA calculated survey weights for each selected facility based on the facility's probability of selection. If the Agency sent a survey to every facility in a stratum, each selected facility represents only itself and has a survey weight of one. For statistically sampled strata, each selected facility represents itself and other facilities within that stratum that were not selected to receive an industry survey. These facilities have survey weights greater than one. See the Development Document for Final Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category (EPA-821-R-02-004) for more details.

Of the 822 candidate facilities, EPA mailed either a detailed survey or a short survey to 399 facilities.<sup>2</sup> Detailed survey recipients included integrated mills, non-integrated mills, stand-alone cokemaking sites, stand-alone sintering sites, stand-alone direct-reduced ironmaking sites, stand-alone hot forming sites, and stand-alone finishing sites. Short survey recipients included stand-alone cold forming sites, stand-alone pipe and tube sites, stand-alone hot dip coating sites, and stand-alone wire sites.

Once the Agency completed a review of the detailed and short surveys and defined the technology options, EPA identified survey respondents who had installed wastewater treatment systems in the last 10 years (since 1990) that were similar to the technology options and mailed them the cost survey. EPA selected 38 facilities to receive the analytical and production survey who had indicated in the detailed or short survey that: (1) they had treatment trains similar to the treatment technology options, (2) they had collected analytical data for that treatment train, (3) they had a treatment train with a dedicated outfall from which EPA could evaluate performance, and (4) they did not add excessive dilution water to the outfall before sampling.

#### 1997 Iron and Steel Survey Information Collected

The detailed and short surveys were divided into two parts: Part A: Technical Information and Part B: Financial and Economic Information. The “Part A” technical questions in the detailed survey comprised four sections, with Sections 3 and 4 being combined in the short survey, as follows:

- Section 1: General Site Information;
- Section 2: Manufacturing Process Information;
- Section 3: In-Process and End-of-Pipe Wastewater Treatment and Pollution Prevention Information; and
- Section 4: Wastewater Outfall Information.

The financial and economic information in Part B of the detailed survey also comprised four sections, as shown below:

- Section 1: Site Identification;
- Section 2: Site Financial Information;
- Section 3: Business Entity Financial Information; and

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<sup>2</sup>Before the surveys were actually mailed, the Agency notified potential survey recipients. One site, randomly selected from stratum 12 and notified that it would be receiving a survey, notified the Agency that it was not engaged in iron and steel activities. The Agency decided not to mail a survey to that site. Therefore, this site was not included in the 399 facilities receiving surveys.

- Section 4: Corporate Parent Financial Information.

Part B of the short survey contained a single section for site identification and financial information. More detailed descriptions of financial data collection and analysis are included in the Economic Analysis of Final Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category (EPA 821-R-02-006).

The detailed survey requested detailed descriptions of all manufacturing processes and treatment systems on site. The short survey contained manufacturing process questions for only forming and finishing operations. EPA eliminated the cokemaking, ironmaking, and steelmaking questions from the short survey because those processes were not applicable to the facilities that received the short survey. The Agency also reduced the amount of detail requested in the short survey. EPA used the detailed descriptions of hot forming mills from the integrated, non-integrated, and stand-alone hot forming mills to make assumptions about industry trends.

Part A Section 1 requested site contacts and addresses and general information regarding manufacturing operations, age, and location. The Agency used this information to develop the proposed subcategorization and applicability statements.

Part A Section 2 requested information on products, types of steel produced, production levels, unit operations, chemicals and coatings used, quantity of wastewater discharged from unit operations, miscellaneous wastewater sources, flow rates, pollution prevention activities, and air pollution control. The Agency used these data to evaluate manufacturing processes and wastewater generation, to develop the model production-normalized flow rates, and to develop regulatory options. EPA also used these data to develop the proposed subcategorization and applicability and to estimate compliance costs and pollutant removals associated with the regulatory options EPA considered for the final rule.

Part A Section 3 requested detailed information (including diagrams) on the wastewater treatment systems and discharge flow rates, monitoring analytical data, and operating and maintenance cost data (including treatment chemical usage). The Agency used these data to identify treatment technologies in place, to determine regulatory options, and to estimate compliance costs and pollutant removals associated with the regulatory options considered for the final rule.

Part A Section 4 requested permit information, discharge locations, wastewater sources to each outfall, flow rates, regulated pollutants and limits, and permit monitoring data. EPA used this information to calculate baseline or current loadings for each facility. The Agency also used this information to calculate the pollutant loadings associated with the regulatory options considered for the final rule.

The cost survey requested detailed capital cost data on selected wastewater treatment systems installed since 1993, including equipment, engineering design, and installation costs. (EPA chose 1993 because 1997 was the base year for the detailed and short surveys, and

this provided the Agency with a five-year range for collecting cost data on recently installed treatment systems.) EPA incorporated these data into a costing methodology and used them to determine incremental investment costs and incremental operating and maintenance costs associated with the regulatory options considered for the final rule.

The analytical and production survey requested detailed daily analytical and flow rate data for selected sampling points, and monthly production data and operating hours for selected manufacturing operations. The Agency used the analytical data collected to estimate baseline pollutant loadings and pollutant removals from facilities with treatment in place similar to the technology options considered for the final rule, to evaluate the variability associated with iron and steel industry discharges, and to establish effluent limitations guidelines and standards. The Agency used the production data collected to evaluate the production basis for applying the proposal in National Pollutant Discharge Elimination System (NPDES) permits and pretreatment control mechanisms.

#### 1997 Iron and Steel Surveys Data Review and Data Entry

EPA completed a detailed engineering review of the detailed surveys to evaluate the accuracy of technical information provided by the respondents. During the engineering review, EPA coded responses to facilitate entry of technical data into the survey database. EPA contacted survey respondents, by telephone and letter, to clarify incomplete or inconsistent technical information prior to data entry.

The Agency developed a database for the technical information provided by survey respondents. After engineering review and coding, EPA entered data from the surveys into the database using a double key-entry and verification procedure. During the engineering review, EPA coded responses to facilitate entry of technical data into the survey database.

#### **3.1.4 Data Submitted by the American Association of Railroads (AAR)**

As noted in the June 2002 NODA (67 FR 38752), EPA conducted another review of all railroad line maintenance (RRLM) facilities in the MP&M questionnaire database to determine the destination of discharged wastewater (i.e., either directly to surface waters or indirectly to POTWs or both) and the applicability of the final rule to discharged wastewaters. As a result of this review, EPA determined its questionnaire database did not accurately represent direct dischargers in this subcategory. Consequently, EPA used information supplied during the comment period by the American Association of Railroads (AAR) as a basis for its analyses and conclusions on direct dischargers in this subcategory.

AAR is a trade association which currently represents all facilities in the RRLM Subcategory. As discussed in the NODA (see 67 FR 38755), for each RRLM direct discharging facility known to them, AAR provided current permit limits, treatment-in-place, and summarized information on each facility's measured monthly average and daily maximum values. AAR also

provided a year's worth of long-term monitoring data for each facility (see Section 15.1 of the rulemaking record for the AAR surveys).

AAR provided information on 27 facilities. EPA reviewed the information on each of these facilities to ensure they were direct dischargers, discharged wastewaters resulting from operations subject to this final rule, and discharged "process" wastewaters as defined by the final rule. As a result of this review, EPA concluded 18 of the facilities for which AAR provided information do not directly discharge wastewaters exclusively from oily operations. Therefore, EPA's final database consists of nine direct discharging RRLM facilities.

### **3.1.5 National Estimates**

EPA used the data collected in the MP&M and iron and steel industry surveys to: (1) calculate national estimates of the number and types of facilities performing proposed MP&M operations; (2) develop the industry profile presented in Section 4.0; (3) estimate the current pollutant discharges from facilities performing proposed MP&M operations; and (4) identify the baseline of treatment in place. The Agency assigned each survey a specific survey weight to use as a multiplier for national estimates.

#### Sampling Frame

To produce a mailing list of facilities for the MP&M and the iron and steel surveys, EPA developed a sampling frame of the industry. A sampling frame is a list of all members (sampling units) of a population, from which a random sample of members will be drawn for the survey. Therefore, a sample frame is the basis for the development of a sampling plan to select a random sample. A sample frame size (N) is the total number of members in the frame.

EPA mailed MP&M industry surveys to all of the facilities in the sample. Based on the survey responses, EPA determined that some facilities were "out of scope" or "ineligible" because the regulation would not apply to them. EPA also made a nonrespondent adjustment to the weights (see below).

#### Calculation of Sample Weights

The next step in developing national estimates is to calculate the base weights, nonresponse adjustments, and the final weights. The base weights and nonresponse adjustments reflect the probability of selection for each facility and adjustments for facility-level nonresponses, respectively. Weighting the data allows inferences to be made about all eligible facilities, not just those included in the sample, but also those not included in the sample or those that did not respond to the survey. Also, the weighted estimates have a smaller variance than unweighted estimates. In its analysis, EPA applied sample weights to survey data.

### Calculation of National Estimates

For each characteristic of interest (e.g., number of sites using a particular unit operation or annual discharge flow from a particular unit operation), EPA estimated totals for the entire U.S. industry performing proposed MP&M operations (i.e., national estimates). Each national estimate,  $Y_{st}$ , was calculated as:

$$Y_{st} = \sum_{h=1}^T [FINALWT_h \cdot \sum_{i=1}^{n_h} y_{hi}] \quad (3-1)$$

where:

$h$	=	Survey where $h = 1, 2, \dots, T$ ;
$T$	=	Total number of surveys;
$FINALWT_h$	=	Final weight for survey $h$ ; and
$y_{hi}$	=	$i$ th value from the sample.

The development of survey weights and national estimates for the MP&M surveys are discussed in greater detail in the Statistical Summary for the Metal Products & Machinery Industry Surveys (Section 10.0, DCN 16118) and DCNs 36086 and 36087, Section 19.5.

Each national estimate for the entire U.S. iron and steel industry,  $\hat{Y}_{st}$ , was calculated as:

$$\hat{Y}_{st} = \sum_{h=1}^{12} [FINALWT_h \cdot \sum_{i=1}^{n_h} y_{hi}] \quad (3-2)$$

where:

$h$	=	Stratum and $h=1, 2, \dots, 12$ since there are 12 strata;
$FINALWT_h$	=	Final weight for the stratum $h$ ; and
$y_{ih}$	=	$i$ th value from the sample in stratum $h$ .

The development of the iron and steel survey weights and national estimates are discussed in greater detail in the Development Document for Final Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category (EPA-821-R-02-004).

## **3.2 Site Visits**

The Agency visited 234 facilities performing proposed MP&M operations and iron and steel sites between 1986 and 2001 to collect information about proposed MP&M operations, water use practices, pollution prevention and treatment technologies, and waste disposal methods, and to evaluate sites for potential inclusion in the MP&M sampling program (described in Section 3.3). In general, the Agency visited sites to encompass the range of sectors, unit operations, and wastewater treatment technologies within the industry (discussed in Section



3.2.1). Table 3-3 lists the number of sites visited within each industrial sector. The total number of site visits presented in this table exceeds 234 because some sites had operations in more than one sector. Figure 3-2 presents the number of facilities visited and sampled by industrial sector. Table 3-3 and Figure 3-2 also include site visits initially conducted as part of the iron and steel rulemaking, the results of which were incorporated into the MP&M rulemaking.

**Table 3-3**

**Number of Sites Visited Within Each Proposed Industrial Sector**

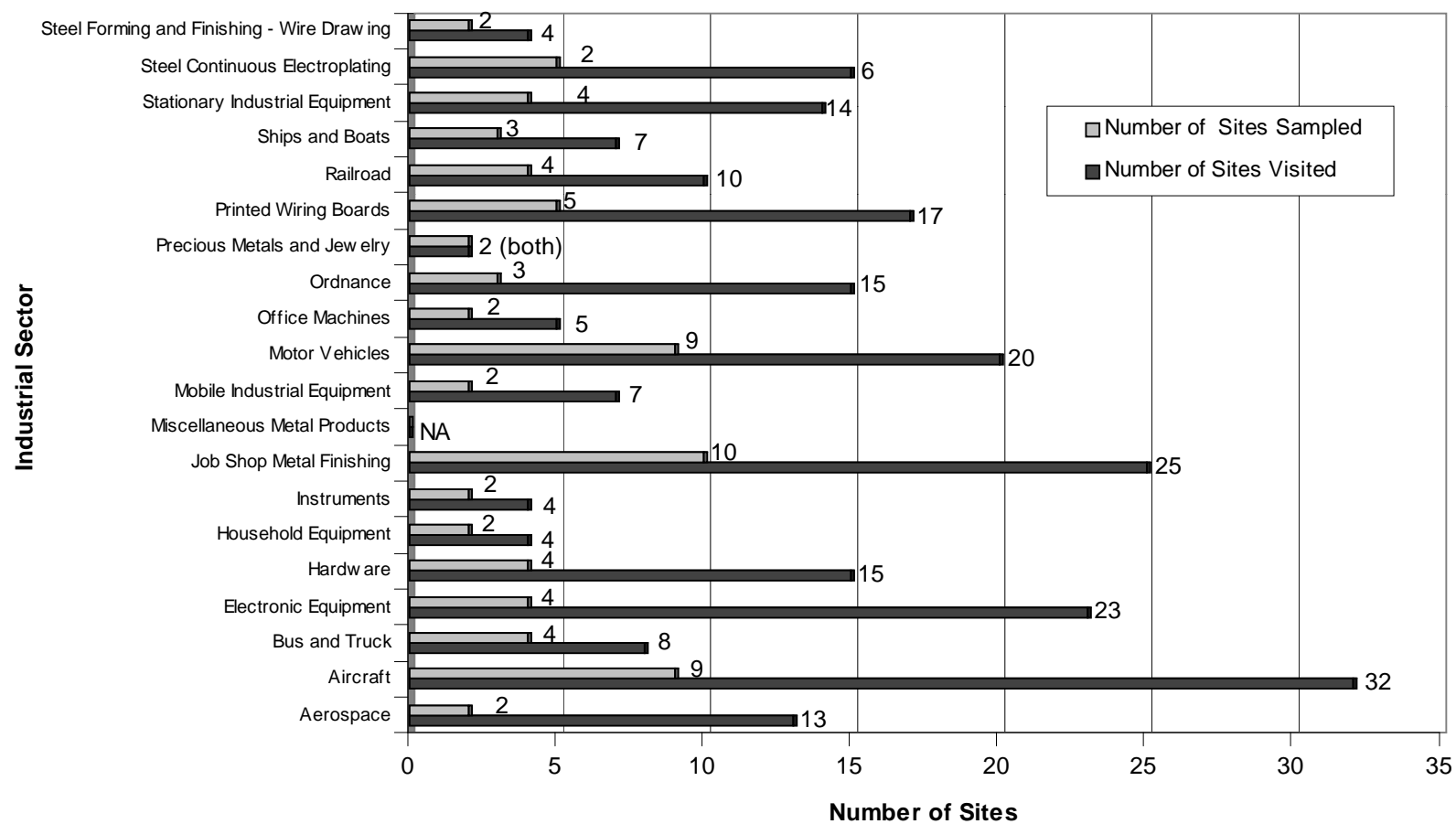
<b>Industrial Sectors</b>	<b>Total Number of Sites Visited</b>	<b>Industrial Sectors</b>	<b>Total Number of Sites Visited</b>
Aerospace	13	Office Machines	5
Aircraft	32	Ordnance	15
Bus and Truck	8	Precious Metals and Jewelry	2
Electronic Equipment	23	Printed Wiring Boards	17
Hardware	15	Railroad	10
Household Equipment	4	Ships and Boats	7
Instrument	4	Stationary Industrial Equipment	14
Job Shops	25	Steel Continuous Electroplating <sup>a</sup>	15
Miscellaneous Metal Products	0	Steel Forming and Finishing: Wire	4
Mobile Industrial Equipment	7	Drawing <sup>a</sup>	
Motor Vehicle	20		

Source: MP&M and Iron and Steel Site Visits.

<sup>a</sup>The number of sites visited is listed separately for steel forming and finishing and steel continuous electroplating sites instead of by industrial sector.

### 3.2.1 Criteria for Site Selection

The Agency selected sites for visits based on information contained in the MP&M and iron and steel surveys. The Agency also contacted regional EPA personnel, state environmental agency



**Figure 3-2. Number of Facilities Performing Proposed MP&M Operations Visited and Sampled by Industrial Sector**

personnel, and local pretreatment coordinators to identify facilities performing proposed MP&M operations believed to be operating in-process source reduction and recycling technologies and/or well-operated end-of-pipe wastewater treatment technologies. For visits to iron and steel sites prior to receipt of any completed survey, EPA used information collected from the sources used to develop the iron and steel survey receipt list (discussed in Section 3.1.3).

The Agency used the following four general criteria to select sites that encompassed the range of sectors and unit operations within the industry:

1. The site performed proposed MP&M operations in one of the industrial sectors. To assess the variation of unit operations and water-use practices across sectors, the Agency visited sites in 18 industrial sectors.
2. The site performed proposed MP&M operations that needed to be characterized for development of the regulation.
3. The site had water-use practices that were believed to be representative of the best sites within an industrial sector.
4. The site operated in-process source reduction, recycling, or end-of-pipe treatment technologies EPA was evaluating in developing the MP&M technology options.

The Agency also visited sites of various sizes. EPA visited sites with wastewater flows ranging from less than 200 gallons per day (gpd) to more than 1,000,000 gpd.

EPA selected iron and steel sites to visit based on the type of site (steel forming and finishing, integrated, non-integrated), the manufacturing operations at each facility, the type of steel produced (carbon, alloy, stainless), and the wastewater treatment operations. The Agency wanted to visit all types of iron and steel manufacturing operations as well as all types of wastewater treatment operations, including recently installed treatment systems. After EPA evaluated the completed surveys and in response to comments received on the proposed rule, the Agency used information provided by the sites to select additional iron and steel sites to visit.

Site-specific selection criteria are discussed in site visit reports (SVRs) prepared for each site visited by EPA. The SVRs are located in Sections 5.1 and 15.2 of the rulemaking record.

### 3.2.2 Information Collected

During the site visits, EPA collected the following types of information:

- Types of unit operations performed at the site and the types of metals processed through these operations;
- Purpose of unit operations performed and purpose of any process water and chemical additions used by the unit operations;
- Types and disposition of wastewater generated at the site;
- Types of in-process source reduction and recycling technologies performed at the site;
- Cross-media impacts of in-process source reduction and recycling technologies;
- Types of end-of-pipe treatment technologies performed at the site; and
- Logistical information required for sampling.

This information is documented in the SVRs for each site. Nonconfidential SVRs can be found in the MP&M rulemaking record (see Sections 5.1 and 15.2).

### 3.3 EPA MP&M Sampling Program

The Agency conducted sampling episodes at 84 sites between 1986 and 2001 to obtain data on the characteristics of wastewater and solid wastes. In addition, EPA performed sampling episodes to assess the following: (1) the loading of pollutants to surface waters and POTWs from facilities performing proposed MP&M operations; (2) the effectiveness of technologies designed to reduce and remove pollutants from wastewater; and (3) the variation of wastewater characteristics across unit operations, metal types processed in each unit operation, and sectors. Table 3-4 indicates the number of sites sampled within each industrial sector. The number of sampled sites presented in the table does not equal 84 because EPA conducted multiple sampling episodes at some sites, and some sites had operations in multiple sectors. Figure 3-2 presents the number of sites visited and sampled by industrial sector. Table 3-4 and Figure 3-2 also include sites initially sampled as part of the iron and steel rulemaking, the results of which were incorporated into the MP&M rulemaking.

**Table 3-4****Number of Sites Sampled Within Each Proposed Industrial**

<b>Industrial Sectors</b>	<b>Total Number of Sites Sampled</b>	<b>Industrial Sectors</b>	<b>Total Number of Sites Sampled</b>
Aerospace	2	Office Machines	2
Aircraft	9	Ordnance	3
Bus and Truck	4	Precious Metals and Jewelry	2
Electronic Equipment	4	Printed Wiring Boards	5
Hardware	4	Railroad	4
Household Equipment	2	Ships and Boats	3
Instruments	2	Stationary Industrial Equipment	4
Job Shops	10	Steel Continuous Electroplating <sup>a</sup>	5
Miscellaneous Metal Products	0	Steel Forming and Finishing: Wire Drawing <sup>a</sup>	2
Mobile Industrial Equipment	2		
Motor Vehicle	9		

Source: MP&M and Iron and Steel Sampling Episodes.

<sup>a</sup>The number of sites sampled is listed separately for steel forming and finishing and steel continuous electroplater sites instead of by industrial sector.

### 3.3.1 Criteria for Site Selection

The Agency used information collected during MP&M site visits to identify candidate sites for sampling. The Agency used the following general criteria to select sites for sampling:

- The site performed proposed MP&M operations EPA was evaluating for the MP&M regulation;
- The site processed metals through proposed MP&M operations for which the metal type/unit operation combination needed to be characterized for the sampling database;
- The site performed in-process source reduction, recycling, or end-of-pipe treatment technologies that EPA was evaluating for technology option development; and
- The site performed unit operations in a sector that EPA was evaluating for the MP&M regulation.

The Agency also sampled at sites of various sizes, with wastewater flows ranging from less than 200 gpd to more than 1,000,000 gpd.

EPA selected iron and steel sampling sites using the following criteria:

- The site performed operations either currently regulated under 40 CFR 420 or identified in the Preliminary Study or otherwise identified as iron and steel operations;
- The site performed high-rate recycling, in-process treatment, or end-of-pipe treatment operations that EPA believed may represent potential model pollutant control technology; and
- The site's compliance monitoring data indicated that it was among the better performing pollutant control systems in the industry, based on comparisons of monitoring data from other facilities with limits from the 1982 regulation in their permits.

In response to comments received on the proposed rule, EPA conducted wastewater sampling at four additional sites between November 2000 and April 2001. EPA selected these additional sites for the following reasons:

- As a collaborative effort between the American Iron and Steel Institute and EPA, to supplement the 1997/1998 sampling results by further characterizing raw sinter plant wastewater, specifically the amount of dioxins and furans generated by this industry, and to evaluate wastewater treatment system performance; and
- To further characterize untreated wastewater generated by continuous casting and hot forming operations at non-integrated steel mills.

After it selected a site for sampling, the Agency prepared a detailed sampling and analysis plan (SAP), based on the information contained in the SVR and follow-up correspondence with the site. EPA prepared the SAPs to ensure samples collected would be representative of the sampled waste streams. The SAPs contained the following types of information: site-specific selection criteria for sampling; information about site operations; sampling point locations and sample collection, preservation, and transportation procedures; site contacts; and sampling schedules.

### **3.3.2 Information Collected**

In addition to wastewater and solid waste samples, the Agency collected the following types of information during each sampling episode:

- Dates and times of sample collection;
- Flow data corresponding to each sample;

- Production data corresponding to each sample of wastewater from proposed MP&M operations;
- Design and operating parameters for source reduction, recycling, and treatment technologies characterized during sampling;
- Information about site operations that had changed since the site visit or that were not included in the SVR; and
- Temperature and pH of the sampled waste streams.

EPA documented all data collected during sampling episodes in the sampling episode report (SER) for each sampled site. SERs are located in Sections 5.2 and 15.3 of the rulemaking record.

### **3.3.3 Sample Collection and Analysis**

The Agency collected, preserved, and transported all samples according to EPA protocols as specified in EPA's Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants (1) (Section 4.2, DCN 17334) and the MP&M Quality Assurance Project Plan (QAPP) (Section 4.4, DCN 17366). These documents are located in the rulemaking record. Appendix B presents the analytical methods and baseline values.

In general, EPA collected composite samples from wastewater streams with compositions that the Agency expected to vary over the course of a production period (e.g., overflowing rinse waters, wastewater from continuous recycling and treatment systems). The Agency collected grab samples from unit operation baths or rinses that the facility did not continuously discharge and that the Agency did not expect to vary over the course of a production period. EPA also collected composite samples of wastewater treatment sludge at 11 facilities. EPA collected the required types of quality control samples as described in the MP&M QAPP, such as blanks and duplicate samples, to verify the precision and accuracy of sample analyses.

The Agency shipped samples via overnight air transportation to EPA-approved laboratories, where the samples were analyzed for metal and organic pollutants and additional parameters (including several water quality parameters). EPA analyzed metal pollutants using EPA Method 1620 (2), volatile organic pollutants using EPA Method 1624 (3), and semivolatile organic pollutants using EPA Method 1625 (4). Tables 3-5 and 3-6 list the metal and organic pollutants, respectively, analyzed using these methods. Table 3-5 also lists additional metal pollutants that EPA analyzed in the MP&M sampling program, but, as specified by EPA Method 1620, were not subject to the rigorous quality assurance/quality control procedures established by the QAPP.

**Table 3-5**

**Metal Constituents Measured Under the MP&M Sampling Program  
(EPA Method 1620)**

Metal Constituents		
ALUMINUM ANTIMONY ARSENIC BARIUM BERYLLIUM BORON CADMIUM CALCIUM CHROMIUM	COBALT COPPER IRON LEAD MAGNESIUM MANGANESE MERCURY MOLYBDENUM NICKEL	SELENIUM SILVER SODIUM THALLIUM TIN TITANIUM VANADIUM YTTRIUM ZINC
Additional Metal Constituents <sup>a</sup> Not Subject to Rigorous QA/QC Procedures Per Method 1620		
BISMUTH CERIUM DYSPROSIUM ERBIUM EUROPIUM GADOLINIUM GALLIUM GERMANIUM GOLD HAFNIUM HOLMIUM INDIUM IODINE IRIDIUM	LANTHANUM LITHIUM LUTETIUM NEODYMIUM NIOBIUM OSMIUM PALLADIUM PHOSPHORUS PLATINUM POTASSIUM PRASEODYMIUM RHENIUM RHODIUM RUTHENIUM	SAMARIUM SCANDIUM SILICON STRONTIUM SULFUR TANTALUM TELLURIUM TERBIUM THORIUM THULIUM TUNGSTEN URANIUM YTTERBIUM ZIRCONIUM

Source: EPA Method 1620.

<sup>a</sup>Analyses for these metals were used primarily for screening purposes



**Table 3-6**

**Organic Constituents Measured Under the MP&M Sampling Program  
(EPA Methods 1624 and 1625)**

<b>Volatile Organic Constituents (EPA Method 1624)</b>	
ACRYLONITRILE	TRANS-1,4-DICHLORO-2-BUTENE
BENZENE	TRIBROMOMETHANE
BROMODICHLOROMETHANE	TRICHLOROETHENE
BROMOMETHANE	TRICHLOROFLUOROMETHANE
CARBON DISULFIDE	VINYL ACETATE
CHLOROACETONITRILE	VINYL CHLORIDE
CHLOROBENZENE	1,1-DICHLOROETHANE
CHLOROETHANE	1,1-DICHLOROETHENE
CHLOROFORM	1,1,1-TRICHLOROETHANE
CHLOROMETHANE	1,1,1,2-TETRACHLOROETHANE
CIS-1,3-DICHLOROPROPENE	1,1,2-TRICHLOROETHANE
CROTONALDEHYDE	1,1,2,2-TETRACHLOROETHANE
DIBROMOCHLOROMETHANE	1,2-DIBROMOETHANE
DIBROMOMETHANE	1,2-DICHLOROETHANE
DIETHYL ETHER	1,2-DICHLOROPROPANE
ETHYL CYANIDE	1,2,3-TRICHLOROPROPANE
ETHYL METHACRYLATE	1,3-BUTADIENE, 2-CHLORO
ETHYLBENZENE	1,3-DICHLOROPROPANE
IODOMETHANE	1,4-DIOXANE
ISOBUTYL ALCOHOL	2-BUTANONE
M-XYLENE	2-CHLOROETHYL VINYL ETHER
METHYL METHACRYLATE	2-HEXANONE
METHYLENE CHLORIDE	2-PROPANONE
O+P-XYLENE	2-PROPEN-1-OL
TETRACHLOROETHENE	2-PROPENAL
TETRACHLOROMETHANE	2-PROPENENITRILE, 2-METHYL-
TOLUENE	3-CHLOROPROPENE
TRANS-1,2-DICHLOROETHENE	4-METHYL-2-PENTANONE
TRANS-1,3-DICHLOROPROPENE	ACROLEIN

**Table 3-6 (Continued)**

Semivolatile Organic Constituents (EPA Method 1625)	
ACENAPHTHENE	BENZO(A)ANTHRACENE
ACENAPHTHYLENE	BENZO(A)PYRENE
ACETOPHENONE	BENZO(B)FLUORANTHENE
ALPHA-TERPINEOL	BENZO(GHI)PERYLENE
ANILINE	BENZO(K)FLUORANTHENE
ANILINE, 2,4,5-TRIMETHYL-	BENZOIC ACID
ANTHRACENE	BENZONITRILE, 3,5-DIBROMO-4-HYDROXY-
ARAMITE	BENZYL ALCOHOL
BENZANTHRONE	BETA-NAPHTHYLAMINE
BENZENETHIOL	BIPHENYL
BENZIDINE	BIPHENYL, 4-NITRO
BIS(2-CHLOROETHOXY)METHANE	N-EICOSANE
BIS(2-CHLOROETHYL) ETHER	N-HEXACOSANE
BIS(2-CHLOROISOPROPYL) ETHER	N-HEXADECANE
BIS(2-ETHYLHEXYL) PHTHALATE	N-NITROSODI-N-BUTYLAMINE
BUTYL BENZYL PHTHALATE	N-NITROSODIETHYLAMINE
CARBAZOLE	N-NITROSODIMETHYLAMINE
CHRYSENE	N-NITROSODIPHENYLAMINE
CIODRIN	N-NITROSOMETHYLETHYLAMINE
CROTOXYPHOS	N-NITROSOMETHYLPHENYLAMINE
DI-N-BUTYL PHTHALATE	N-NITROSOMORPHOLINE
DI-N-OCTYL PHTHALATE	N-NITROSOPIPERIDINE
DI-N-PROPYLNITROSAMINE	N-OCTACOSANE
DIBENZO(A,H)ANTHRACENE	N-OCTADECANE
DIBENZOFURAN	N-TETRACOSANE
DIBENZOTHIOPHENE	N-TETRADECANE
DIETHYL PHTHALATE	N-TRIACONTANE
DIMETHYL PHTHALATE	N,N-DIMETHYLFORMAMIDE
DIMETHYL SULFONE	NAPHTHALENE
DIPHENYL ETHER	NITROBENZENE
DIPHENYLAMINE	O-ANISIDINE
DIPHENYLDISULFIDE	O-CRESOL
ETHANE, PENTACHLORO-	O-TOLUIDINE
ETHYL METHANESULFONATE	O-TOLUIDINE, 5-CHLORO-
ETHYLENETHIOUREA	P-CHLOROANILINE
FLUORANTHENE	P-CRESOL
FLUORENE	P-CYMENE
HEXACHLOROBENZENE	P-DIMETHYLAMINOAZOBENZENE
HEXACHLOROBUTADIENE	P-NITROANILINE
HEXACHLOROCYCLOPENTADIENE	PENTACHLOROBENZENE
HEXACHLOROETHANE	PENTACHLOROPHENOL
HEXACHLOROPROPENE	PENTAMETHYLBENZENE
HEXANOIC ACID	PERYLENE
INDENO(1,2,3-CD)PYRENE	PHENACETIN

**Table 3-6 (Continued)**

Semivolatile Organic Constituents (EPA Method 1625)	
ISOPHORONE	PHENANTHRENE
ISOSAFROLE	PHENOL
LONGIFOLENE	PHENOL, 2-METHYL-4,6-DINITRO-
MALACHITE GREEN	PHENOTHIAZINE
MESTRANOL	PRONAMIDE
METHAPYRILENE	PYRENE
METHYL METHANESULFONATE	PYRIDINE
N-DECANE	RESORCINOL
N-DOCOSANE	SAFROLE
N-DODECANE	SQUALENE
STYRENE	2-NITROANILINE
THIANAPHTHENE	2-NITROPHENOL
THIOACETAMIDE	2-PHENYLNAPHTHALENE
THIOXANTHE-9-ONE	2-PICOLINE
TOLUENE, 2,4-DIAMINO-	2,3-BENZOFLUORENE
TRIPHENYLENE	2,3-DICHLOROANILINE
TRIPROPYLENEGLYCOL METHYL ETHER	2,3-DICHLORONITROBENZENE
1-BROMO-2-CHLOROBENZENE	2,3,4,6-TETRACHLOROPHENOL
1-BROMO-3-CHLOROBENZENE	2,3,6-TRICHLOROPHENOL
1-CHLORO-3-NITROBENZENE	2,4 -DICHLOROPHENOL
1-METHYLFLUORENE	2,4-DIMETHYLPHENOL
1-METHYLPHENANTHRENE	2,4-DINITROPHENOL
1-NAPHTHYLAMINE	2,4-DINITROTOLUENE
1-PHENYLNAPHTHALENE	2,4,5-TRICHLOROPHENOL
1,2-DIBROMO-3-CHLOROPROPANE	2,4,6-TRICHLOROPHENOL
1,2-DICHLOROBENZENE	2,6-DI-TERT-BUTYL-P-BENZOQUINONE
1,2-DIPHENYLHYDRAZINE	2,6-DICHLORO-4-NITROANILINE
1,2,3-TRICHLOROBENZENE	2,6-DICHLOROPHENOL
1,2,3-TRIMETHOXYBENZENE	2,6-DINITROTOLUENE
1,2,4-TRICHLOROBENZENE	3-METHYLCHOLANTHRENE
1,2,4,5-TETRACHLOROBENZENE	3-NITROANILINE
1,2:3,4-DIEPOXYBUTANE	3,3'-DICHLOROBENZIDINE
1,3-DICHLORO-2-PROPANOL	3,3'-DIMETHOXYBENZIDINE
1,3-DICHLOROBENZENE	3,6-DIMETHYLPHENANTHRENE
1,3,5-TRITHIANE	4-AMINOBIHENYL
1,4-DICHLOROBENZENE	4-BROMOPHENYL PHENYL ETHER
1,4-DINITROBENZENE	4-CHLORO-2-NITROANILINE
1,4-NAPHTHOQUINONE	4-CHLORO-3-METHYLPHENOL
1,5-NAPHTHALENEDIAMINE	4-CHLOROPHENYL PHENYL ETHER
2-(METHYLTHIO)BENZOTHAZOLE	4-NITROPHENOL
2-CHLORONAPHTHALENE	4,4'-METHYLENEBIS(2-CHLOROANILINE)
2-CHLOROPHENOL	4,5-METHYLENE PHENANTHRENE
2-ISOPROPYLNAPHTHALENE	5-NITRO-O-TOLUIDINE
2-METHYLBENZOTHIOAZOLE	7,12-DIMETHYLBENZ(A)ANTHRACENE
2-METHYLNAPHTHALENE	N-NITRODOSI-N-PROPYLAMINE

Source: EPA Methods 1624 and 1625.

The Agency used these metals analyses for screening purposes and did not select the metals for regulation in this rulemaking (see Section 7.0). EPA analyzed additional parameters, including several water quality parameters, using analytical methods contained in EPA's Methods for Chemical Analysis of Water and Wastes (5). Table 3-7 lists these parameters, along with the method and technique used to analyze for each parameter. Method descriptions are included in the MP&M QAPP. The specific parameters measured in each sample are listed in the SER for each sampling episode.

Quality control measures used in performing all analyses complied with the guidelines specified in the analytical methods and in the MP&M QAPP. EPA reviewed all analytical data to ensure that these measures were followed and that the resulting data were within the QAPP-specified acceptance criteria for accuracy and precision.

As discussed previously, upon receipt and review of the analytical data for each site, EPA prepared an SER to document the data collected during sampling, the analytical results, and the technical analyses of the results. The SAPs and correspondence with site personnel are included as appendices to the SERs.

### **3.4            Other Sampling Data**

The Association of American Railroads (AAR), the Hampton Roads Sanitation District (HRSD), the Los Angeles County Sanitation Districts (LACSD), and the Association Connecting Electronic Industries (IPC) proposed potential sampling sites to the Agency, and EPA visited these sites to identify candidates for sampling. After conducting site visits, EPA selected six sites for sampling episodes.

EPA selected the six sites to characterize end-of-pipe treatment technologies in metal finishing and aircraft parts job shops and the railroad and shipbuilding industrial sectors. AAR sampled a railroad line maintenance that used dissolved air flotation (DAF) to treat MP&M process wastewater. HRSD sampled a ship manufacturer that uses DAF, chemical precipitation, and cyanide destruction to treat process wastewater. LACSD sampled two metal finishing job shops and one aircraft parts manufacturing job shop. EPA selected the LACSD sites to provide data for cyanide treatment and also conducted effluent variability sampling at one of the metal finishing job shops. The IPC site is a printed wiring board facility that uses chemical precipitation with chelation breaking, cyanide destruction and batch treatment to treat process wastewater.

EPA prepared detailed SAPs based on the information collected during the six site visits, and AAR, HRSD and LACSD collected the wastewater samples. EPA also prepared the sampling episode reports. In addition to the wastewater samples, sampling personnel documented the collection date and time, sample flow data, treatment unit design and operating parameters, and temperature and pH of the sampled waste streams. All data collected during sampling episodes are documented in the SER for each sampled site, which are located in the

**Table 3-7****Additional Parameters Measured Under the MP&M Sampling Program**

<b>Parameter</b>	<b>EPA Method</b>
Acidity	305.1
Alkalinity	310.1
Ammonia as Nitrogen	350.1
BOD 5-Day (Carbonaceous)	405.1
Chemical Oxygen Demand (COD)	410.1 410.2
Chloride	325.3
Chromium, Hexavalent	218.4
Cyanide, Amenable	335.1
Cyanide, Total	335.2
Cyanide, Weak Acid Dissociable (WAD)	1677
Fluoride	340.2
Nitrogen, Total Kjeldahl	351.2
Oil and Grease	413.2
Oil and Grease (as HEM)	1664
pH	150.1
Phenolics, Total Recoverable	420.2
Phosphorus, Total	365.4
Sulfate	375.4
Sulfide, Total	376.1, 376.2
Total Dissolved Solids (TDS)	160.1
Total Organic Carbon (TOC)	415.1
Total Petroleum Hydrocarbons (as SGT-HEM)	1664
Total Suspended Solids (TSS)	160.2
Ziram (zinc dimethyldithiocarbamate)	630.1

Source: EPA Methods for Chemical Analysis of Water and Wastes (5).

MP&M rulemaking record (see Sections 5.2 and 15.3). EPA combined these data with data collected from the MP&M sampling program. For a discussion of sample collection and the sampling protocols for the IPC site, see the SER (DCN 16684) in Section 15.3.7 of the MP&M rulemaking record.

AAR, HRSD, and LACSD collected, preserved, and transported all samples according to EPA protocols as specified in EPA's Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants (Section 4.2, DCN 17334) and the MP&M QAPP. Procedures for shipping and analysis of the samples were similar to those discussed in Section 3.3 with the exception that some samples were shipped directly to internal sanitation district laboratories for analysis. Pollutant parameters and analytical methods were agreed upon by EPA, AAR, HRSD, and LACSD and were treated as equivalent to those in the EPA MP&M sampling program.

### **3.5            Other Industry-Supplied Data**

EPA evaluated other industry data in developing the MP&M effluent guidelines. The data sources reviewed included:

- Public comments to the May 1995 Proposal, January 2001 proposal, and June 2002 NODA;
- The Metal Finishing F006 Benchmark Study (6);
- Data supporting the Final Rule for the F006 Accumulation Time Extension (65 FR 12377, March 8, 2000);
- Data provided by the Aluminum Anodizing Council (AAC), the American Wire Producers Association (AWPA), and the Aerospace Association; and
- Surveys provided by the North Carolina Pretreatment Consortium.

EPA also reviewed data from stormwater pollution prevention plans provided by several shipbuilding sites, dry dock data from a shipbuilding site, and data from periodic compliance monitoring reports/discharge monitoring reports for 19 sites that were part of the Agency's wastewater sampling program.

The Agency included data submitted with comments on the 1995 MP&M Proposed Rule, the 2001 MP&M Proposed Rule, or the 2002 MP&M NODA in the establishment of effluent limitations and standards if they met the following criteria:

- Measurements of daily effluent concentration were provided;

- Data represented effluent from a treatment system equivalent to EPA's BAT options;
- Samples represented fully treated effluent (as defined by Options 2, 6, or 10 as appropriate); and
- Treated pollutants were identified and/or unit operations contributing pollutants were described.

In addition, the North Carolina Pretreatment Consortium conducted a survey of POTWs in that state. EPA evaluated the results of these surveys and used the results as appropriate to verify and supplement information from the previous MP&M POTW survey on loadings, number of facilities performing proposed MP&M operations served, and administrative costs. The results of EPA's analysis of this data is in the Comment Response Document, Issue Codes 4 and 20G. The AMSA and North Carolina Pretreatment Consortium surveys can be found in Section 17.6 of the rulemaking record.

### **3.6            Other Data Sources**

In developing the MP&M effluent guidelines, EPA evaluated the following existing data sources:

1. EPA Engineering and Analysis Division (EAD) databases from development of effluent guidelines for miscellaneous metals industries;
2. The Fate of Priority Pollutants in Publicly Owned Treatment Works (50 POTW Study) database;
3. The Office of Research and Development (ORD) National Risk Management and Research Laboratory (NRMRL) treatability database;
4. The Domestic Sewage Study;
5. The Toxics Release Inventory (TRI) database; and
6. Discharge Monitoring Reports (DMR) from EPA's Permit Compliance System (PCS).

These data sources and their uses for the development of the MP&M effluent guidelines are discussed below.

### 3.6.1 EPA/EAD Databases

As discussed in Section 2.0, EPA had earlier promulgated effluent guidelines for 13 metals industries. In developing these past effluent guidelines, EPA collected wastewater samples to characterize the unit operations and treatment systems at sites in these industries. Facilities performing proposed MP&M operations operate many of the same or similar sampled unit operations and treatment systems; therefore, EPA evaluated these data for transfer to the MP&M effluent guidelines development effort.

For the pollutant loading and wastewater characterization efforts, EPA reviewed the data collected for unit operations performed at both facilities performing proposed MP&M operations and at sites in the other metals industries. EPA reviewed the Technical Development Documents (TDDs), sampling episode reports, and supporting rulemaking record materials for the other metals industries to identify available data. EPA used these data for the preliminary assessment of the industry, but did not use these data to estimate pollutant loadings because EPA obtained sufficient data from the MP&M sampling program to characterize the proposed MP&M operations.

For the MP&M technology effectiveness assessment effort, EPA reviewed sampling data collected to characterize treatment systems for the development of effluent guidelines for miscellaneous metals industries. For several previous effluent guidelines, EPA used treatment data from metals industries to develop the Combined Metals Database (CMDB), which served as the basis for developing limits for these industries. EPA also developed a separate database used as the basis for limits for the Metal Finishing category. EPA used the CMDB and Metal Finishing data as a guide in identifying well-designed and well-operated treatment systems. EPA did not use these data in developing the MP&M technology effectiveness concentrations, since the Agency collected sufficient data from facilities performing proposed MP&M operations to develop technology effectiveness concentrations.

### 3.6.2 Fate of Priority Pollutants in Publicly Owned Treatment Works Database

In September 1982, EPA published the Fate of Priority Pollutants in Publicly Owned Treatment Works (7), referred to as the 50-POTW Study. The purpose of this study was to generate, compile, and report data on the occurrence and fate of the 129 priority pollutants in 50 POTWs. The report presents all of the data collected, the results of preliminary evaluations of these data, and the results of calculations to determine the following:

- The quantity of priority pollutants in the influent to POTWs;
- The quantity of priority pollutants discharged from the POTWs;
- The quantity of priority pollutants in the effluent from intermediate process streams; and



- The quantity of priority pollutants in the POTW sludge streams.

EPA used the data from this study to assess removal by POTWs of pollutants of concern (see Section 7). To provide consistency for data analysis and establishment of removal efficiencies, EPA reviewed the 50-POTW Study and standardized the reported minimum levels of quantitation (MLs) for use in the MP&M final rule. EPA's review of the 50-POTW Study is described in more detail in the development document for the MP&M proposed regulation located in Section 7.2 of the rulemaking record, DCN 16377, and in memoranda located in Section 6.4 of the rulemaking record.

### **3.6.3 National Risk Management Research Laboratory (NRMRL) Treatability Database**

EPA's ORD developed the NRMRL (formerly RREL) treatability database to provide data on the removal and destruction of chemicals in various types of media, including water, soil, debris, sludge, and sediment. This database contains treatability data from POTWs as well as industrial facilities for various pollutants. The database includes physical and chemical data for each pollutant, the types of treatment used for specific pollutants, the types of wastewater treated, the size of the POTW or industrial plant, and the treatment concentrations achieved. EPA used the NRMRL database to estimate pollutant reductions achieved by POTWs for MP&M pollutants of concern that were not found in the 50-POTW database. The Agency used these percent removal estimates in calculating the pollutant loads removed by indirect discharging facilities performing proposed MP&M operations. Because the 50-POTW database contained sufficient data, EPA did not use these percent removal estimates in the pass-through analysis. EPA used only treatment technologies representative of typical POTW secondary treatment operations (i.e., activated sludge, activated sludge with filtration, aerated lagoons). The Agency further edited these files to include information pertaining only to domestic or industrial wastewater. EPA used pilot-scale and full-scale data, and eliminated bench-scale data and data from less reliable references.

### **3.6.4 The Domestic Sewage Study**

In February 1986, EPA issued the Report to Congress on the Discharge of Hazardous Wastes to Publicly Owned Treatment Works (8), referred to as the Domestic Sewage Study (DSS). This report, which was based in part on the 50-POTW Study, revealed a significant number of sites discharging pollutants to POTWs. These pollutants are a threat to the treatment capability of the POTW. These pollutants were not regulated by national effluent regulations. Some of the major sites identified were in the metals industries, particularly one called equipment manufacturing and assembly. This industry included sites that manufacture such products as office machines, household appliances, scientific equipment, and industrial machine tools and equipment. The DSS estimated that this category discharges 7,715 metric tons per year of priority hazardous organic pollutants, which are presently unregulated. Data on priority hazardous metals discharges were unavailable for this category. Further review of the DSS revealed miscellaneous categories that were related to metals industries, namely the motor

vehicle category, which includes servicing of new and used cars and engine and parts rebuilding, and the transportation services category, which includes railroad operations, truck service and repair, and aircraft servicing and repair. EPA used the information in the DSS in developing the 1989 Preliminary Data Summary (PDS) for the MP&M rulemaking.

### **3.6.5 Toxics Release Inventory (TRI) Database**

The TRI database contains specific toxic chemical release and transfer information from manufacturing facilities throughout the United States. This database was established under the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA), which Congress passed to promote planning for chemical emergencies and to provide information to the public about the presence and release of toxic and hazardous chemicals. Each year, manufacturing facilities meeting certain activity thresholds must report the estimated releases and transfers of listed toxic chemicals to EPA and to the state or tribal entity in whose jurisdiction the facility is located. The TRI list includes more than 600 chemicals and 30 chemical categories.

EPA considered using the TRI database in developing the MP&M effluent guidelines. However, EPA did not use TRI data on wastewater discharges from facilities performing proposed MP&M operations because sufficient data were not available for effluent guidelines development. Also, many of the reported discharges are estimates, not based on measurement. For example, in developing the MP&M effluent guidelines, EPA uses wastewater influent concentrations to characterize a facility's wastewater and to calculate treatment efficiency (i.e., percent removal across the treatment system). The TRI database does not provide concentrations for the influent to a facility's treatment system. EPA also did not use the data on wastewater discharge because many facilities performing proposed MP&M operations do not meet the reporting thresholds for the TRI database.

### **3.6.6 Discharge Monitoring Reports from EPA's Permit Compliance System**

The PCS provides information on companies which have been issued permits to discharge wastewater into surface water. Users can review information on when a permit was issued and expires, how much the company is permitted to discharge, and the actual monitoring data showing what the company has discharged. Respondents to MP&M surveys and commentors on the May 1995 proposal, January 2001 proposal, and June 2002 NODA supplied facility specific DMR data. In addition, EPA retrieved facility limits and process wastewater monitoring data from facilities performing proposed MP&M operations for selected pollutant parameters (e.g., metals, oil and grease). EPA used DMR data to estimate industry baseline pollutant loadings. Section 12.3 discusses the estimation of baseline pollutant loadings using PCS data.

### 3.7 References

1. U.S. Environmental Protection Agency. Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants, April 1977.
2. U.S. Environmental Protection Agency. Method 1620 Draft - Metals by Inductively Coupled Plasma Atomic Emission Spectroscopy and Atomic Absorption Spectroscopy, September 1989.
3. U.S. Environmental Protection Agency. Method 1624 Revision C - Volatile Organic Compounds by Isotope Dilution GCMS, June 1989.
4. U.S. Environmental Protection Agency. Method 1625 Revision C - Semivolatile Organic Compounds by Isotope Dilution GCMS, June 1989.
5. U.S. Environmental Protection Agency. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020, Washington, DC, March 1979.
6. U.S. Environmental Protection Agency. Metal Finishing F006 Benchmark Study. Washington, DC, September 1998.
7. U.S. Environmental Protection Agency. Fate of Priority Pollutants in Publicly Owned Treatment Works. EPA 440/1-82/303, Washington, DC, September 1982.
8. U.S. Environmental Protection Agency. Report to Congress on the Discharge of Hazardous Wastes to Publicly Owned Treatment Works. EPA 530-SW-86-004, Washington, DC, February 1986.
9. U.S. Environmental Protection Agency. Development Document for Final Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category (EPA-821-R-02-004).

## 4.0 INDUSTRY DESCRIPTION

As discussed in Section 1.0, EPA has promulgated effluent limitations for the MP&M Point Source Category that regulate directly discharged process wastewaters from oily operations at facilities engaged in manufacturing, rebuilding, or maintenance of metal parts, products, or machines for use in one or more of the following 16 industrial sectors:

- Aerospace;
- Aircraft;
- Bus and Truck;
- Electronic Equipment;
- Hardware;
- Household Equipment;
- Instruments;
- Mobile Industrial Equipment;
- Motor Vehicle;
- Office Machine;
- Ordnance;
- Precious Metals and Jewelry;
- Railroad;
- Ships and Boats;
- Stationary Industrial Equipment; and
- Miscellaneous Metal Products.

This section describes these facilities. For the final rule, EPA evaluated facilities in the 16 MP&M industrial sectors above and Job Shop, Printed Wiring Board, and Steel Forming and Finishing industrial sectors (i.e., Iron & Steel Wire Drawers and Steel Electroplaters). For the purposes of this section, EPA is identifying all facilities evaluated for the final rule as “MP&M facilities.” Section 4.1 presents an overview of MP&M facilities; Section 4.2 provides a general discussion of unit operations performed, types of metal processed, and volumes of wastewater discharged at MP&M facilities; Section 4.3 discusses trends at MP&M facilities; and Section 4.4 lists the references used in this section.

### 4.1 Overview of MP&M facilities

This subsection discusses the number and size of MP&M facilities evaluated for regulation, the geographic distribution of these facilities, the number of wastewater-discharging MP&M facilities, and the number of MP&M facilities that do not discharge wastewater.

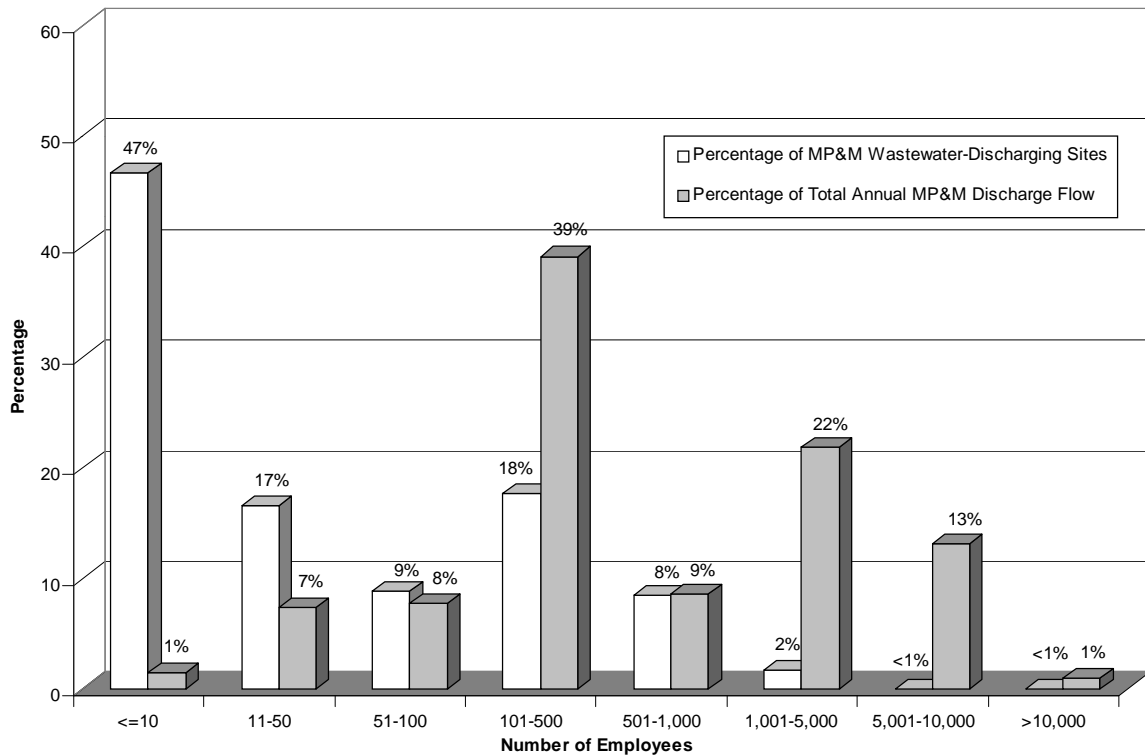
#### **4.1.1 Number and Size of MP&M Facilities**

Based on information in the MP&M survey database, there are an estimated 57,000 MP&M facilities in the United States.<sup>1</sup> Results of the detailed surveys indicate there are an estimated 44,000 MP&M facilities that discharge process wastewater (i.e., wastewater-discharging MP&M facilities). The remaining 13,000 facilities fall into one of three categories: zero dischargers, non-water-users, or contract haulers. A zero discharger is a facility that does not discharge process wastewater to a treatment system, a non-water-user is a facility that does not use process water in their unit operations, and a contract hauler is a facility that has all of their process wastewater contract hauled. For the purposes of the evaluating options for the final rule, EPA considers MP&M facilities that discharge wastewater exclusively to privately owned treatment works to be zero dischargers that contract haul their wastewater to centralized wastewater treatment facilities.

Wastewater-discharging MP&M facilities range in size from facilities with less than 10 employees to facilities with thousands of employees. As shown in Figure 4-1, 91 percent of the wastewater-discharging MP&M facilities have 500 or fewer employees. These facilities discharge 55 percent (i.e., 43 billion gallons per year) of the total annual wastewater discharge for the MP&M industry. The 9 percent of the wastewater-discharging MP&M facilities that have more than 500 employees discharge 35 billion gallons of wastewater annually, or 45 percent of the total annual wastewater discharge for the MP&M category.

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<sup>1</sup>More information on how the MP&M survey database was used to generate national estimates is in the MP&M rulemaking record (see Section 10.0, DCN 16118 and Section 19.5, DCNs 36086 and 36087).



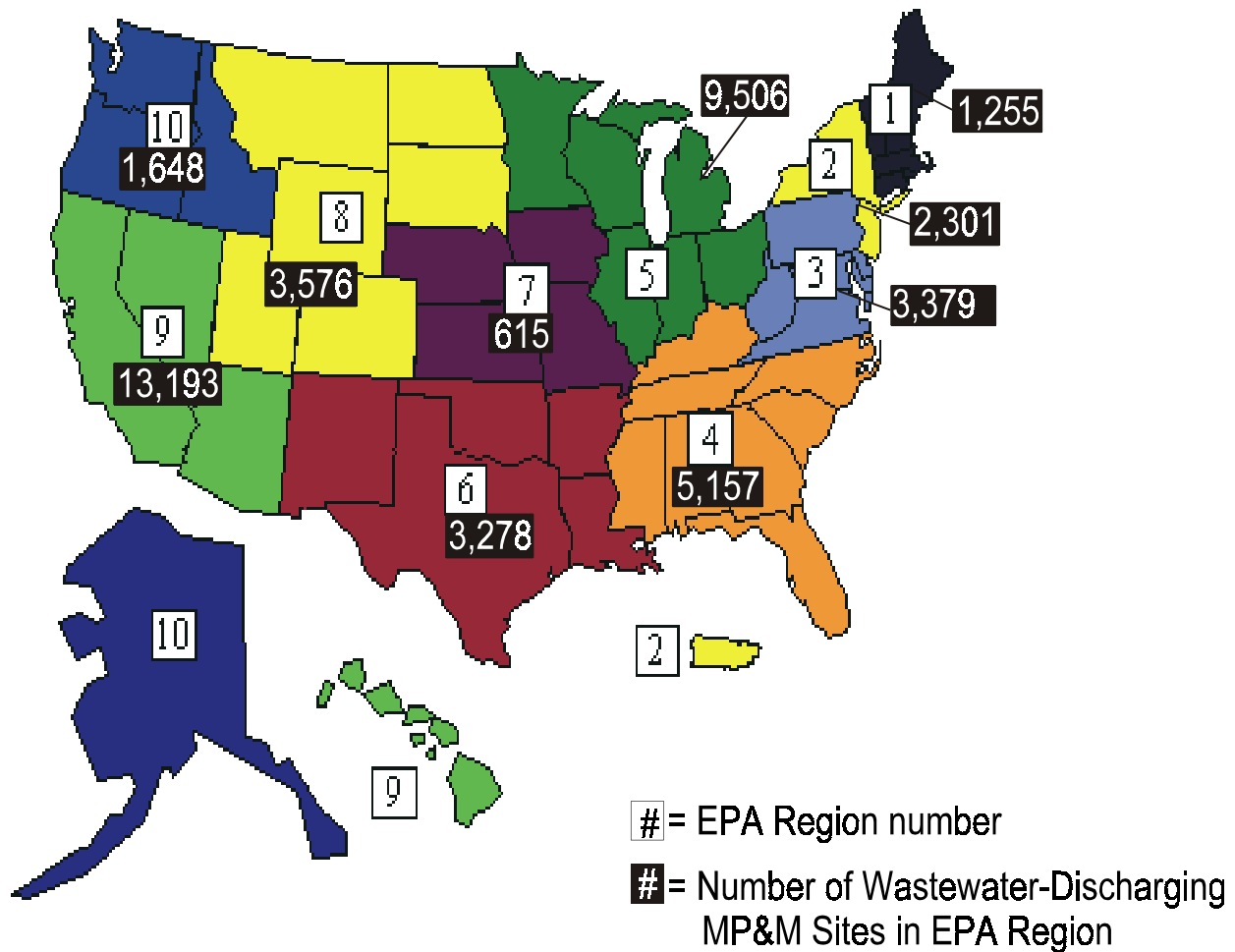
Source: MP&M Survey Database.

Note: There are 44,000 wastewater-discharging MP&M facilities. Total MP&M wastewater flow is 78.2 billion gallons per year.

**Figure 4-1. Percentage of Wastewater-Discharging MP&M facilities and Percentage of Annual Wastewater Discharge by Number of Employees**

#### 4.1.2 Geographic Distribution

Wastewater-discharging MP&M facilities are located throughout the United States. They are mostly concentrated in industrialized areas, with the highest concentration of facilities in California, Pennsylvania, and Illinois. The following map shows the estimated number of wastewater-discharging MP&M facilities located in each EPA region.



**Figure 4-2. Estimated Number of Wastewater-Discharging MP&M facilities by EPA Region**

#### 4.1.3 Wastewater-Discharging Facilities

EPA evaluated MP&M facilities in 20 industrial sectors for the final rule. Table 4-1 summarizes the number of wastewater-discharging MP&M facilities by industrial sector. Because some MP&M facilities perform operations or make products used in more than one sector, the sum of wastewater-discharging MP&M facilities by sector exceeds the total number of wastewater-discharging MP&M facilities identified in the surveys. As shown in Table 4-1, the ordnance sector has the smallest number of wastewater-discharging facilities (405) and the job shop sector has the largest number of wastewater-discharging facilities (14,589).

**Table 4-1****Wastewater-Discharging MP&M facilities by Sector**

<b>Sector</b>	<b>Estimated Number of MP&amp;M Facilities That Discharge Process Wastewater<sup>a</sup></b>
Aerospace	712
Aircraft	1,598
Bus and Truck	3,522
Electronic Equipment	2,644
Hardware	6,223
Household Equipment	3,137
Instruments	3,902
Iron and Steel Wire Drawers <sup>b, c</sup>	153
Job Shop <sup>c</sup>	14,589
Miscellaneous Metal Products	5,316
Mobile Industrial Equipment	1,079
Motor Vehicle	13,070
Office Machine	1,092
Ordnance	405
Precious Metals and Jewelry	1,860
Printed Circuit Boards <sup>c</sup>	1,456
Railroad	5,181
Ships and Boats	1,367
Stationary Industrial Equipment	1,724
Steel Electroplaters <sup>b, c</sup>	28

Source: MP&M Survey Database.

<sup>a</sup> Because some facilities perform unit operations in more than one sector, the sum of facilities by sector exceeds the total number of facilities that discharge wastewater (44,000).

<sup>b</sup> Technical surveys for these facilities did not include sector information; therefore, they were listed separately for this table.

<sup>c</sup> These industrial sectors are not included in the final rule.



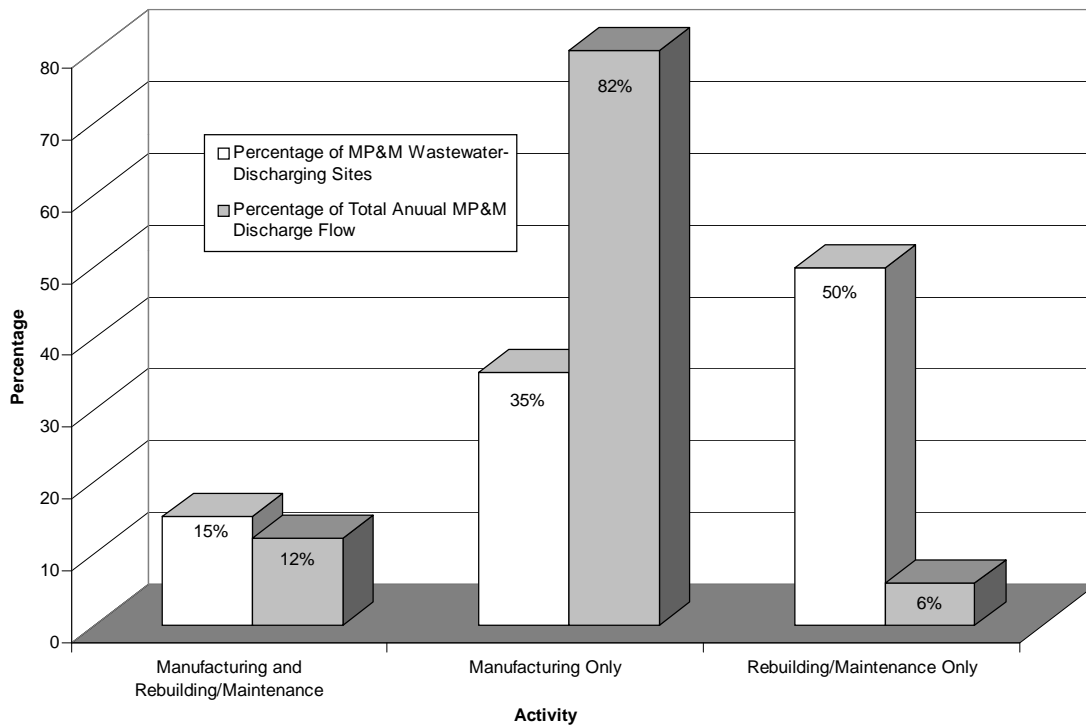
In addition to description by industrial sector, MP&M operations<sup>2</sup> that were proposed for regulation can be described by two types of activities: manufacturing and rebuilding/maintenance.

- Manufacturing is the series of unit operations necessary to produce metal products, and is generally performed in a production environment.
- Rebuilding/maintenance is the series of unit operations necessary to disassemble used metal products into components, replace the components or subassemblies or restore them to original function, and reassemble the metal products. These operations are intended to keep metal products in operating condition and can be performed in either a production or a nonproduction environment.

Figure 4-3 presents the percentage of wastewater-discharging MP&M facilities and percentage of the total annual wastewater discharge by activity. Eighty-two percent of the annual wastewater discharge is discharged by facilities with only manufacturing operations. These facilities represent 35 percent of the total wastewater-discharging MP&M facilities. The highest percentage of the MP&M facilities (i.e., 50 percent) have only rebuilding and maintenance operations.

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<sup>2</sup>EPA evaluated a number of unit operations for the May 1995 proposal, January 2001 proposal, and June 2002 Notice of Data Availability (NODA) (see Tables 4-3 and 4-4). However, EPA selected a subset of these unit operations for regulation in the final rule (see section 1.0). For this section, the term “proposed MP&M operations” means those operations evaluated for the two proposals, NODA, and final rule. The term “Final MP&M operations” means those operations defined as “oily operations” (see Section 1.0, 40 CFR 438.2(f), and Appendix B to Part 438) and regulated by the final rule.

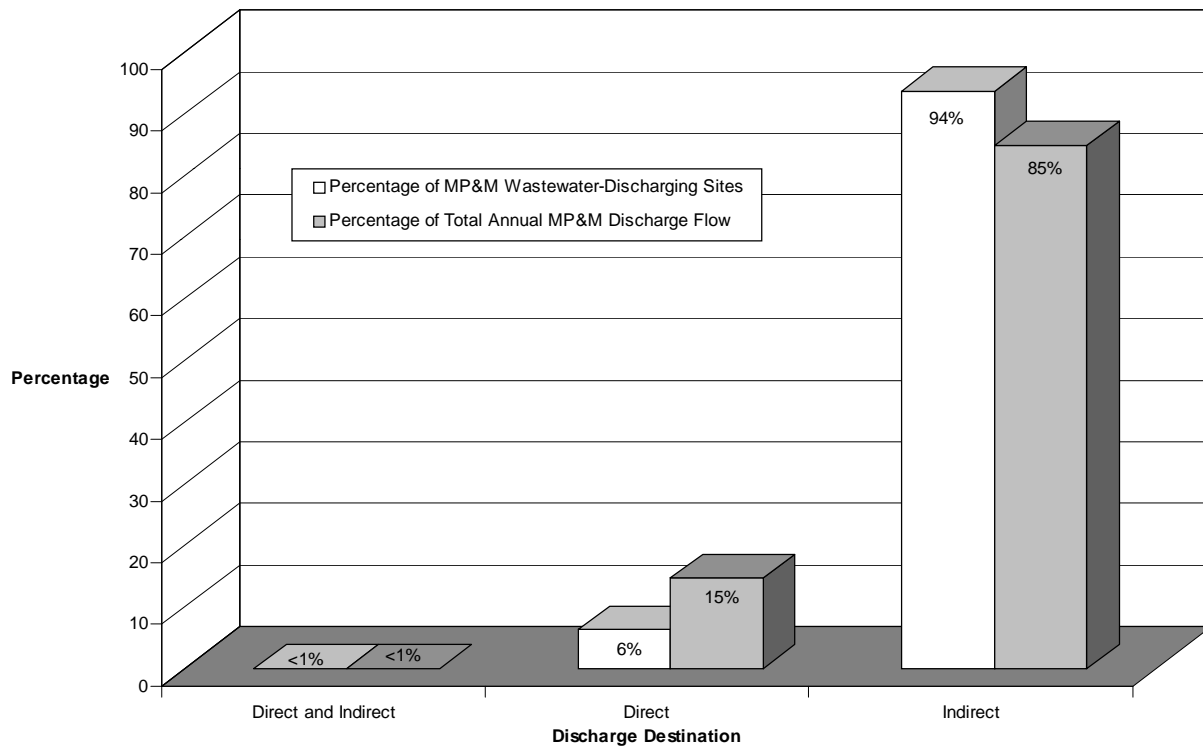


Source: MP&M Survey Database.

Note: There are 44,000 wastewater-discharging MP&M facilities. Total MP&M wastewater flow is 78.2 billion gallons per year.

**Figure 4-3. Percentage of Wastewater-Discharging MP&M facilities and Percentage of Total Annual Discharge by Activity**

Wastewater-discharging MP&M facilities include direct dischargers, indirect dischargers, and those that are both direct and indirect dischargers. A direct discharger is a facility that discharges wastewater to a surface water (e.g., river, lake, ocean). An indirect discharger is a facility that discharges wastewater to a publicly owned treatment works (POTW). Figure 4-4 presents the percentage of wastewater-discharging MP&M facilities and the percentage of the total annual wastewater discharge by discharge status. This figure shows that the highest percentage of wastewater-discharging MP&M facilities are indirect dischargers, and those facilities account for 85 percent of the total annual discharge from all MP&M facilities.

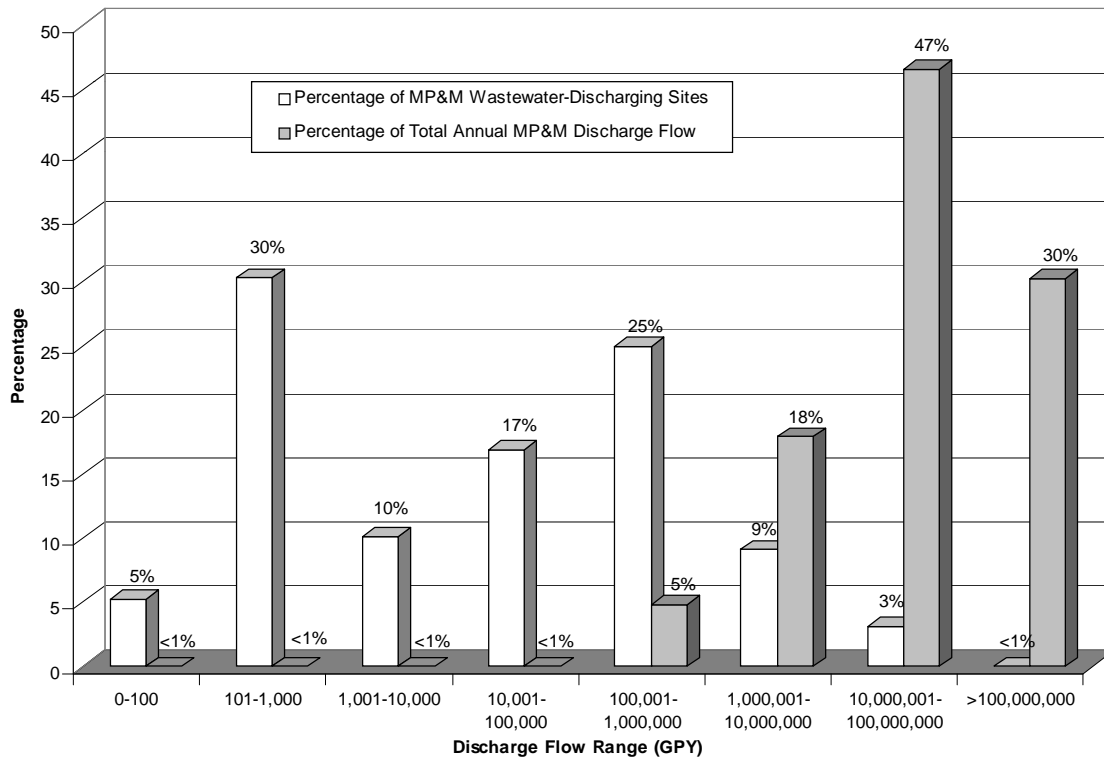


Source: MP&M Survey Database.

Note: There are 44,000 wastewater-discharging MP&M facilities. Total MP&M wastewater flow is 78.2 billion gallons per year.

**Figure 4-4. Percentage of Wastewater-Discharging MP&M facilities and Percentage of Total Annual Discharge by Discharge Status**

Wastewater discharge flow rates for MP&M facilities range from less than 100 gallons per year to greater than 100 million gallons per year. Figure 4-5 presents the percentage of wastewater-discharging MP&M facilities and the percentage of the annual MP&M wastewater discharge by range of wastewater flow rates. As this figure shows, MP&M facilities discharging more than one million gallons per year (approximately 12 percent of the total facilities) account for approximately 95 percent of the total annual wastewater discharge for all MP&M facilities. In contrast, facilities discharging less than 100,000 gallons per year (approximately 62 percent of the total facilities) account for less than one percent of the total annual wastewater discharge for all MP&M facilities.



Source: MP&M Survey Database.

Note: There are 44,000 wastewater-discharging MP&M facilities. Total MP&M wastewater flow is 78.2 billion gallons per year.

**Figure 4-5. Percentage of Wastewater-Discharging MP&M facilities and Percentage of Total Annual MP&M Discharge by Flow Rate Range**

#### 4.1.4 Non-Wastewater-Discharging Facilities

Based on the results of the detailed MP&M surveys, an estimated 13,000 MP&M facilities either generate process water and do not discharge wastewater (i.e., zero discharge or contract haulers) or do not use process water (dry facilities). Information from the MP&M detailed surveys, site visits, and technical literature indicates these facilities achieve zero discharge of process wastewater in one of the following ways:

- Contract haul all process wastewater generated on site;
- Discharge process wastewater to either on-site septic systems or deep-well injection systems;

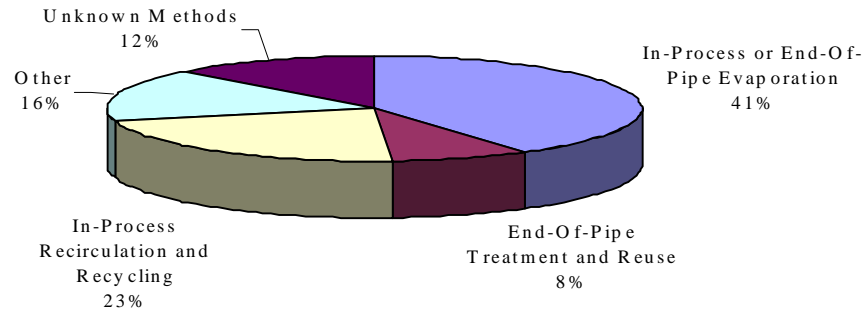
- Perform end-of-pipe treatment and reuse all process wastewater generated on site;
- Perform either in-process or end-of-pipe evaporation to eliminate wastewater discharges; or
- Perform in-process recirculation and recycling to eliminate wastewater discharges.

As discussed in Section 3.0, EPA mailed the 1989 detailed survey to a probability sample of 50 screener respondents that reported using but not discharging process water. Based on the survey responses, 5 of these facilities contract hauled all wastewater generated on site, 8 actually discharged process wastewater, 18 had no process wastewater discharges, and 19 were not engaged in proposed MP&M operations. The Agency also mailed the 1989 detailed survey to an additional 24 screener respondents that reported using but not discharging process water. As discussed in Section 3.0, EPA selected these facilities because they performed unit operations that were not expected to be characterized sufficiently by detailed surveys mailed to other facilities. Of the additional 24, 14 actually discharged process wastewater, 2 had no process wastewater discharges, and 8 were not engaged in proposed MP&M operations. Of the 74 screener respondents that received the 1989 detailed survey, only 20 reported no discharge of process water.

In addition to the 20 facilities discussed above that do not discharge process wastewater, 205 of the 1996 screener survey respondents reported eliminating wastewater discharges by in-process or end-of-pipe evaporation, end-of-pipe treatment and reuse, in-process recirculation and recycling, or other unspecified means. Figure 4-6 shows the percentage of the facilities using each type of zero discharge method. Note that Figure 4-6 provides the percentage of survey respondents, not industry percentages, because this information was available for only a subset of the industry. The methods used by the 225 survey facilities to eliminate wastewater discharges are discussed below.

**In-Process or End-Of-Pipe Evaporation.** Forty-one percent of the screener survey respondents (i.e., 92 respondents) reported discharging wastewater to either evaporators, on-site ponds, or lagoons to evaporate process wastewater. None of these facilities reported recovering the process wastewater. Facilities reported contracting for off-site disposal of sludge from the evaporation units.

**End-Of-Pipe Treatment and Reuse.** Eight percent of the screener survey respondents (i.e., 18 respondents) reported eliminating wastewater discharges through end-of-pipe treatment and reuse of all wastewater generated on site.



Note: There are 225 survey facilities that have eliminated wastewater discharge.

**Figure 4-6. Percentage of Screener Survey Respondents Using Each Zero Discharge Method**

**In-Process Recirculation and Recycling.** Twenty-three percent of the screener survey respondents (i.e., 52 respondents) reported eliminating wastewater discharges through in-process recirculation and recycling. Several facilities used a stagnant bath in their heat treating operations. Some facilities used stagnant baths in their surface finishing operations (e.g., alkaline cleaning and chemical conversion coating). Make-up water is added to the stagnant baths to account for losses of bath water through evaporation.

**Other.** Sixteen percent of the screener survey respondents (i.e., 36 respondents) reported eliminating wastewater discharge through a variety of other methods including land application and septic tank systems or contract hauling through a centralized waste treater (CWT) or privately owned treatment works (PrOTW).

## **4.2 Proposed MP&M Operations**

This subsection discusses the proposed MP&M operations and presents a brief description of each unit operation. It also discusses the metals processed in proposed MP&M operations, and presents an estimate of the annual wastewater discharge for each proposed MP&M operations.

### 4.2.1 Types of Unit Operations

MP&M facilities perform several different types of unit operations and associated rinses on metal parts, products, and machines. Section 4.2.2 describes these unit operations.

The types of proposed MP&M operations include:

- Metal shaping;
- Surface preparation;
- Metal deposition;
- Organic material deposition;
- Surface finishing;
- Assembly;
- Dry dock; and
- Specialized printed wiring board operations.

Metal shaping is a mechanical operation that alters the form of raw materials into intermediate and final products. Surface preparation includes chemical and mechanical operations that remove unwanted materials from or alter the chemical or physical properties of the part surface prior to subsequent proposed MP&M operations. Metal deposition applies a metal coating to the part surface by chemical or physical means. Organic material deposition applies an organic material to the part by chemical or physical means. Facilities may perform metal and organic material deposition to protect the surface from wear or corrosion, modify the electrical properties of the surface, or alter the appearance of the surface. Surface finishing protects and seals the surface of the treated part from wear or corrosion by chemical means. Facilities also may use surface finishing to alter the appearance of the part surface. Assembly is performed throughout the manufacturing, rebuilding, or maintenance process. Dry dock operations are proposed MP&M operations performed at ship and boat facilities within dry docks or similar structures and incorporate many types of proposed MP&M operations. Printed wiring board unit operations are those specific to the manufacture or rebuilding/maintenance of wiring boards (e.g., carbon black deposition, solder flux cleaning, and photo image developing). Specialized printed wiring board operations do not include those performed at assembly-only facilities. Table 4-2 lists examples of the different types of proposed MP&M operations.

**Table 4-2****Types of Proposed MP&M operations**

Type of Unit Operations	Example
Metal Shaping	Machining, Grinding, Deformation
Surface Preparation	Alkaline Cleaning, Acid Treatment
Metal Deposition	Electroplating, Vapor Deposition
Organic Material Deposition	Painting
Surface Finishing	Chemical Conversion Coating
Assembly	Testing (e.g., leak testing), Assembly
Dry Dock	Welding
Specialized Printed Wiring Board	Solder Leveling, Photoresist Applications

At a given MP&M facility, the specific unit operations and the sequence of operations depend on many factors, including the activity at the facility (i.e., manufacturing, rebuilding/maintenance), industrial sector, and type of product processed. As a result, MP&M facilities perform many different combinations and sequences of unit operations. For example, MP&M facilities that repair, rebuild or maintain products often conduct preliminary operations that may not be performed at manufacturing facilities (e.g., disassembly, cleaning, or degreasing to remove dirt and oil accumulated during use of the product). In general, however, MP&M products are processed in the following order:

- The raw material (e.g., bar stock, wire, rod, sheet stock, plates) undergoes some type of metal-shaping process, such as impact or pressure deformation, machining, or grinding. In these operations, the raw material is shaped into intermediate forms for further processing or into final forms for assembly and shipment to the customer. Facilities typically clean and degrease the parts between some of the shaping operations to remove lubricants, coolants, and metal fines. Facilities also may heat a part between shaping operations to alter its physical characteristics.
- After shaping, the part typically undergoes some type of surface preparation, such as alkaline cleaning, acid treatment (pickling), or barrel finishing. The specific operation depends on the subsequent unit operations and the final use of the products. For example, prior to electroplating, parts typically go through acid pickling (i.e., acid cleaning) to prepare the part surface for electroplating. Before assembly, parts typically go through alkaline cleaning or barrel finishing. Parts go through surface preparation at various stages of the production process. Additional cleaning and degreasing steps precede metal deposition, organic material deposition, surface finishing, and assembly.



- Metal and organic material deposition typically follow shaping and surface preparation, and precede surface finishing and final assembly. For example, electroplating usually follows alkaline and acid treatment, while painting usually follows phosphate conversion coating and alkaline treatment.
- Surface finishing operations typically are performed after shaping and surface preparation. Some surface finishing is performed after metal deposition. For example, chromate conversion coating typically follows acid cleaning, although this operation is sometimes performed as a sealant operation after electroplating (e.g., chemical conversion coating of cadmium plated parts). Surface finishing also is done prior to applying organic coatings. For example, phosphate conversion coating frequently precedes painting to enhance the paint adhesion.
- Disassembly may be the first step in the rebuilding process. Assembly, on the other hand, is done during many steps of the manufacturing and rebuilding process to prepare the final product. Assembly also may involve some final shaping (e.g., drilling and grinding) and surface preparation (e.g., alkaline cleaning). Final assembly usually is the last operation prior to shipment to the customer.

Some MP&M facilities conduct all of these types of unit operations in manufacturing or rebuilding products, while others may perform only some types. For example, a facility that manufactures products used in the hardware sector may start with bar stock and manufacture a final hardware product, performing machining, cleaning, electroplating, conversion coating, painting, degreasing, and assembly. Another hardware product manufacturing facility may only clean and paint the parts. A third hardware product manufacturing facility may only shape the parts, and perform only machining, cleaning, and degreasing operations.

#### **4.2.2 Description of Proposed MP&M Operations**

EPA described the operations above as either metal-bearing operations or oily operations. This section describes each of the MP&M operations for which EPA considered new regulations. Oily operations (as defined in 40 CFR 438.2(f)) are listed in Table 4-3. Metal-bearing operations (as defined in 40 CFR 438.2(d)) are listed in Table 4-4.

**Table 4-3****List of MP&M Oily Operations**

- |                                      |   |
|--------------------------------------|---|
| • Abrasive Blasting                  | • Iron Phosphate Conversion Coating                                     |
| • Adhesive Bonding                   | • Machining   |
| • Alkaline Cleaning for Oil Removal  | • Painting-spray or Brush (Including Water Curtains)                    |
| • Alkaline Treatment Without Cyanide | • Polishing   |
| • Aqueous Degreasing                 | • Pressure Deformation  |
| • Assembly/Disassembly               | • Solvent Degreasing  |
| • Burnishing                         | • Steam Cleaning  |
| • Calibration                        | • Testing (e.g., Hydrostatic, Dye Penetrant, Ultrasonic, Magnetic Flux) |
| • Corrosion Preventive Coating       | • Thermal Cutting   |
| • Electrical Discharge Machining     | • Tumbling/Barrel Finishing/Mass Finishing/Vibratory Finishing          |
| • Floor Cleaning (In Process Area)   | • Washing (Finished Products)   |
| • Grinding                           | • Welding   |
| • Heat Treating                      | • Wet Air Pollution Control for Organic Constituents                    |
| • Impact Deformation                 |   |

Note: This list is replicated at 40 CFR 438.2(f) with definitions at Appendix B to Part 438.

**Table 4-4****List of MP&M Metal-Bearing Operations**

• Abrasive Jet Machining	• Mechanical and Vapor Plating
• Acid Pickling Neutralization	• Metallic Fiber Cloth Manufacturing
• Acid Treatment With Chromium	• Metal Spraying (including Water Curtain)
• Acid Treatment Without Chromium	• Painting-immersion (including Electrophoretic, "E-coat")
• Alcohol Cleaning	• Photo Imaging
• Alkaline Cleaning Neutralization	• Photo Image Developing
• Alkaline Treatment With Cyanide	• Photoresist Application
• Anodizing With Chromium	• Photoresist Strip
• Anodizing Without Chromium	• Phosphor Deposition
• Carbon Black Deposition	• Physical Vapor Deposition
• Catalyst Acid Pre-dip	• Plasma Arc Machining
• Chemical Conversion Coating Without Chromium	• Plastic Wire Extrusion
• Chemical Milling (or Chemical Machining)	• Salt Bath Descaling
• Chromate Conversion Coating (or Chromating)	• Shot Tower - Lead Shot Manufacturing
• Chromium Drag-out Destruction	• Soldering
• Cyanide Drag-out Destruction	• Solder Flux Cleaning
• Cyaniding Rinse	• Solder Fusing
• Electrochemical Machining	• Solder Masking
• Electroless Catalyst Solution	• Sputtering
• Electroless Plating	• Stripping (paint)
• Electrolytic Cleaning	• Stripping (metallic coating)
• Electroplating With Chromium	• Thermal Infusion
• Electroplating With Cyanide	• Ultrasonic Machining
• Electroplating Without Chromium or Cyanide	• Vacuum Impregnation
• Electropolishing	• Vacuum Plating
• Galvanizing/Hot Dip Coating	• Water Shedder
• Hot Dip Coating	• Wet Air Pollution Control
• Kerfing	• Wire Galvanizing Flux
• Laminating	

Note: This list is replicated at 40 CFR 438.2(d) with definitions at Appendix C to Part 438.

EPA also evaluated process wastewater from “Bilge Water” and “Dry Dock/Stormwater” for the final rule. These two processes generate mainly oily or organic wastewater but are not included in the final definition of “oily operations” (as defined in 40 CFR 438.2(f)) as these unit operations only occur at facilities EPA decided should not be subject to the final rule (see 40 CFR 438.1(e)(5)). EPA used the following definitions for “Bilge Water” and “Dry Dock/Stormwater” for the final rule:

- **Bilge Water** is water that collects in the inner hull of a ship. When a ship is in a dry dock or similar structure, the bilge water is collected and then treated and disposed of.
- **Dry Dock/Stormwater**. Maintenance operations performed on a ship/boat in a dry dock that either use process water or are exposed to stormwater.

The following descriptions are provided to aid the reader in understanding the described processes and do not supersede regulatory definitions of unit operations in the final MP&M rule. Moreover, the definitions in this section should not be used to differentiate between the six “core” metal finishing operations (i.e., Electroplating, Electroless Plating, Anodizing, Coating (chromating, phosphating, and coloring), Chemical Etching and Milling, and Printed Circuit Board Manufacture) and 40 “ancillary” process operations listed at 40 CFR 433.10(a).

#### 4.2.2.1 Description of MP&M Oily Operations

**Abrasive Blasting** involves removing surface film from a part by using abrasive directed at high velocity against the part. Abrasive blasting includes bead, grit, shot, and sand blasting, and may be performed either dry or with water. The primary applications of wet abrasive blasting include: removing burrs on precision parts; producing satin or matte finishes; removing fine tool marks; and removing light mill scale, surface oxide, or welding scale. Wet blasting can be used to finish fragile items such as electronic components. Also, some aluminum parts are wet blasted to achieve a fine-grained matte finish for decorative purposes. In abrasive blasting, the water and abrasive typically are reused until the particle size diminishes due to impacting and fracture.

**Adhesive Bonding** involves joining parts using an adhesive material. Typically, an organic bonding compound is used as the adhesive. This operation usually is dry; however, aqueous solutions may be used as bonding agents or to contain residual organic bonding materials.

**Alkaline Cleaning for Oil Removal** is a general term for the application of an alkaline cleaning agent to a metal part to remove oil and grease during the manufacture, maintenance, or rebuilding of a metal product.

This unit operation does not include washing of the finished products after routine use (as defined in “Washing (Finished Products)” in this subsection), or applying an alkaline cleaning

agent to remove nonoily contaminants such as dirt and scale (as defined in “Alkaline Treatment Without Cyanide” in this subsection and “Alkaline Treatment With Cyanide” in Section 4.2.2.2). Wastewater generated includes spent cleaning solutions and rinse waters.

- **Alkaline cleaning** is performed to remove foreign contaminants from parts. This operation usually is done prior to finishing (e.g., electroplating).
- **Emulsion cleaning** is an alkaline cleaning operation that uses either complex chemical enzymes or common organic solvents (e.g., kerosene, mineral oil, glycols, and benzene) dispersed in water with the aid of an emulsifying agent. The pH of the solvent usually is between 7 and 9, and, depending on the solvent used, cleaning is performed at temperatures from room temperature to 82°C (180°F). This operation often is used as a replacement for vapor degreasing.

**Alkaline Treatment Without Cyanide** is a general term used to describe the application of an alkaline solution not containing cyanide to a metal surface to clean the metal surface or prepare the metal surface for further surface finishing.

**Aqueous Degreasing** involves cleaning metal parts using aqueous-based cleaning chemicals primarily to remove residual oils and greases from the part. Residual oils can be from previous operations (e.g., machine coolants), oil from product use in a dirty environment, or oil coatings used to inhibit corrosion. Wastewater generated by this operation includes spent cleaning solutions and rinse waters.

**Assembly/Disassembly** involves fitting together previously manufactured or rebuilt parts or components into a complete metal product or machine or taking a complete metal product or machine apart. Assembly/disassembly operations are typically dry; however, special circumstances can require water for cooling or buoyancy. Also, rinsing may be necessary under some conditions.

**Burnishing** involves finish sizing or smooth finishing a part (previously machined or ground) by displacing, rather than removing, minute surface irregularities with smooth point or line-contact, fixed or rotating tools. Lubricants or soap solutions can be used to cool the tools used in burnishing operations. Wastewater generated during burnishing include process solutions and rinse water.

**Calibration** is performed to provide reference points for the use of a product. This unit operation typically is dry, although water may be used in some cases (e.g., pumping water for calibration of a pump). Water used in this unit operation usually does not contain additives.

**Corrosion Preventive Coating** involves applying removable oily or organic solutions to protect metal surfaces against corrosive environments. Corrosion preventive coatings include, but are not

limited to: petrolatum compounds, oils, hard dry-film compounds, solvent-cutback petroleum-based compounds, emulsions, water-displacing polar compounds, and fingerprint removers and neutralizers. Corrosion preventive coating does not include electroplating or chemical conversion coating operations.

Many corrosion preventive materials also are formulated to function as lubricants or as a base for paint. Typical applications include: assembled machinery or equipment in standby storage; finished parts in stock or spare parts for replacement; tools such as drills, taps, dies, and gauges; and mill products such as sheet, strip, rod and bar.

Wastewater generated during corrosion preventive coating includes spent process solutions and rinses. Process solutions are discharged when they become contaminated with impurities or are depleted of constituents. Corrosion preventive coatings typically do not require an associated rinse, but parts are sometimes rinsed to remove the coating before further processing.

**Electrical Discharge Machining** involves removing metals by a rapid spark discharge between different polarity electrodes, one the part and the other the tool, separated by a small gap. The gap may be filled with air or a dielectric fluid. This operation is used primarily to cut tool alloys, hard nonferrous alloys, and other hard-to-machine materials. Most electrical discharge machining processes are operated dry; however, in some cases, the process uses water and generates wastewater containing dielectric fluid.

**Floor Cleaning (in Process Area)** removes dirt, debris, and process solution spills from process area floors. Floors can be cleaned using wet or dry methods, such as vacuuming, mopping, dry sweeping, and hose rinsing. Nonprocess area floor cleaning in offices and other similar nonprocess areas is not included in this unit operation.

**Grinding** involves removing stock from a part by using abrasive grains held by a rigid or semirigid binder. Grinding shapes or deburrs the part. The grinding tool usually is a disk (the basic shape of grinding wheels), but can also be a cylinder, ring, cup, stick, strip, or belt. The most commonly used abrasives are aluminum oxide, silicon carbide, and diamond. The process may use a grinding fluid to cool the part and remove debris or metal fines.

Wastewater generated during grinding includes spent coolants and rinses. Metal-working fluids become spent for a number of reasons, including increased biological activity (i.e., the fluids become rancid) or decomposition of the coolant additives. Rinse waters typically are assimilated into the working fluid or treated on site.

**Heat Treating** involves modifying the physical properties of a part by applying controlled heating and cooling cycles. This operation includes tempering, carburizing, cyaniding, nitriding, annealing, aging, normalizing, austenitizing, austempering, siliconizing, martempering, and malleablizing. Parts are heated in furnaces or molten salt baths, and then may be cooled by quenching in aqueous solutions (e.g., brine solutions), neat oils (pure oils with little or no impurities), or oil/water emulsions. Heat treating typically is a dry operation, but is considered a

wet operation if aqueous quenching solutions are used. Wastewater includes spent quench water and rinse water.

**Impact Deformation** involves applying impact force to a part to permanently deform or shape it. Impact deformation may include mechanical processes such as hammer forging, shot peening, peening, coining, high-energy-rate forming, heading, or stamping.

Natural and synthetic oils, light greases, and pigmented lubricants are used in impact deformation operations. Pigmented lubricants include whiting, lithapone, mica, zinc oxide, molybdenum disulfide, bentonite, flour, graphite, white lead, and soap-like materials.

These operations typically are dry, but wastewater can be generated from lubricant discharge and from rinsing operations associated with the operation.

**Iron Phosphate Conversion Coating** is the process of applying a protective coating on the surface of a metal using a bath consisting of a phosphoric acid solution containing no metals (e.g., manganese, nickel, or zinc) or a phosphate salt solution (i.e., sodium or potassium salts of phosphoric acid solutions) containing no metals (e.g., manganese, nickel, or zinc) other than sodium or potassium. Any metal concentrations in the bath are from the substrate.

**Machining** involves removing stock from a part (as chips) by forcing a cutting tool against the part. This includes machining processes such as turning, milling, drilling, boring, tapping, planing, broaching, sawing, shaving, shearing, threading, reaming, shaping, slotting, hobbing, and chamfering. Machining processes use various types of metal-working fluids, the choice of which depends on the type of machining being performed and the preference of the machine shop. The fluids can be categorized into four groups: straight oil (neat oils), synthetic, semisynthetic, and water-soluble oil.

Machining operations generate wastewater from working fluid or rinse water discharge. Metal-working fluids periodically are discarded because of reduced performance or development of a rancid odor. After machining, parts are sometimes rinsed to remove coolant and metal chips. The coolant reservoir is sometimes rinsed, and the rinse water is added to the working fluid.

**Painting - Spray or Brush (Including Water Curtains)** involves applying an organic coating to a part. Coatings such as paint, varnish, lacquer, shellac, and plastics are applied by spraying, brushing, roll coating, lithographing, powder coating, and wiping.

Water is used in painting operations as a solvent (water-borne formulations) for rinsing, for cleanup, and for water-wash (or curtain) type spray booths. Paint spray booths typically use most of the water in this unit operation. Spray booths capture overspray (i.e., paint that misses the product during application), and control the introduction of pollutants into the workplace and environment.

**Polishing** involves removing stock from a part using loose or loosely held abrasive grains carried to the part by a flexible support. Usually, the objective is to achieve a desired surface finish or appearance rather than to remove a specified amount of stock. Buffing is included in this unit operation, and usually is performed using a revolving cloth or sisal buffing wheel, which is coated with a suitable compound. Liquid buffing compounds are used extensively for large-volume production on semiautomated or automated buffing equipment. Polishing operations typically are dry, although liquid compounds and associated rinses are used in some polishing processes.

**Pressure Deformation** involves applying force (other than impact force) to permanently deform or shape a part. Pressure deformation may include rolling, drawing, bending, embossing, sizing, extruding, squeezing, spinning, necking, forming, crimping or flaring.

These operations use natural and synthetic oils, light greases, and pigmented lubricants. Pigmented lubricants include whiting, lithapone, mica, zinc oxide, molybdenum disulfide, bentonite, flour, graphite, white lead, and soap-like materials.

Pressure deformation typically is dry, but wastewater is sometimes generated from the discharge of lubricants or from rinsing associated with the process.

**Solvent Degreasing** removes oils and grease from the surface of a part using organic solvents, including aliphatic petroleum (e.g., kerosene, naphtha), aromatics (e.g., benzene, toluene), oxygenated hydrocarbons (e.g., ketones, alcohol, ether), and halogenated hydrocarbons (e.g., 1,1,1-trichloroethane, trichloroethylene, methylene chloride).

Solvent cleaning takes place in either the liquid or vapor phase. Solvent vapor degreasing normally is quicker than solvent liquid degreasing. However, ultrasonic vibration is sometimes used with liquid solvents to decrease the required immersion time of complex shapes. Solvent cleaning often is used as a precleaning operation prior to alkaline cleaning, as a final cleaning of precision parts, or as surface preparation for some painting operations. Solvent degreasing operations typically are not followed by rinsing, although rinsing is performed in some cases.

**Steam Cleaning** removes residual dirt, oil, and grease from parts after processing through other unit operations. Typically, additives are not used in this operation; the hot steam removes the pollutants. Wastewater is generated when the cleaned parts are rinsed.

**Testing (e.g., hydrostatic, dye penetrant, ultrasonic, magnetic flux)** involves applying thermal, electrical, mechanical, hydraulic, or other energy to determine the suitability or functionality of a part, assembly, or complete unit. Testing also may include applying surface penetrant dyes to detect surface imperfections. Other examples of tests frequently performed include electrical testing, performance testing, and ultrasonic testing; these tests typically are dry but may generate wastewater under certain circumstances. Testing usually is performed to replicate some aspect of the working environment. Wastewater generated during testing includes spent process solutions and rinses.



**Thermal Cutting** involves cutting, slotting, or piercing a part using an oxy-acetylene oxygen lance, electric arc cutting tool, or laser. Thermal cutting typically is a dry process, except for the use of contact cooling waters and rinses.

**Tumbling/Barrel Finishing/Mass Finishing/Vibratory Finishing** involves polishing or deburring a part using a rotating or vibrating container and abrasive media or other polishing materials to achieve a desired surface appearance. Parts to be finished are placed in a rotating barrel or vibrating unit with an abrasive media (e.g., ceramic chips, pebbles), water, and chemical additives (e.g., alkaline detergents). As the barrel rotates, the upper layer of the part slides toward the lower side of the barrel, causing the abrading or polishing. Similar results can be achieved in a vibrating unit, where the entire contents of the container are in constant motion, or in a centrifugal unit, which compacts the load of media and parts as the unit spins and generates up to 50 times the force of gravity. Spindle finishing is a similar process, where parts to be finished are mounted on fixtures and exposed to a rapidly moving abrasive slurry.

Wastewater generated during barrel finishing includes spent process solutions and rinses. Following the finishing process, the contents of the barrel are unloaded. Process wastewater is either discharged continuously during the process, discharged after finishing, or collected and reused. The parts are sometimes given a final rinse to remove particles of abrasive media.

**Washing (Finished Products)** involves cleaning finished metal products after use or storage using fresh water or water containing a mild cleaning solution. This unit operation applies only to the finished products that do not require maintenance or rebuilding.

**Welding** involves joining two or more pieces of material by applying heat, pressure, or both, with or without filler material, to produce a metallurgical bond through fusion or recrystallization across the interface. This includes gas welding, resistance welding, arc welding, cold welding, electron beam welding, and laser beam welding. Welding typically is a dry process, except for the occasional use of contact cooling waters or rinses.

**Wet Air Pollution Control for Organic Constituents** involves using water to remove organic constituents that are entrained in air streams exhausted from process tanks or production areas. Most frequently, wet air pollution control devices are used with cleaning and coating processes. A common type of wet air pollution control is the wet packed scrubber consisting of a spray chamber that is filled with packing material. Water is continuously sprayed onto the packing and the air stream is pulled through the packing by a fan. Pollutants in the air stream are absorbed by the water droplets and the air is released to the atmosphere. A single scrubber often serves numerous process tanks.

#### **4.2.2.2 Description of MP&M Metal-bearing Operations**

**Abrasive Jet Machining** includes removing stock material from a part by a high-speed stream of abrasive particles carried by a liquid or gas from a nozzle. Abrasive jet machining is used for deburring, drilling, and cutting thin sections of metal or composite material. Unlike abrasive

blasting, this process operates at pressures of thousands of pounds per square inch. The liquid streams typically are alkaline or emulsified oil solutions, although water also can be used.

**Acid Pickling Neutralization** involves using a dilute alkaline solution to raise the pH of acid pickling rinse water that remains on the part after pickling. The wastewater from this operation is the acid pickling neutralization rinse water.

**Acid Treatment With Chromium** is a general term used to describe any application of an acid solution containing chromium to a metal surface. Acid cleaning, chemical etching, and pickling are types of acid treatment.

Chromic acid is used occasionally to clean cast iron, stainless steel, cadmium and aluminum, and bright dipping of copper and copper alloys. Also, chromic acid solutions can be used for the final step in acid cleaning phosphate conversion coating systems. Chemical conversion coatings formulated with chromic acid are defined as “Chromate Conversion Coating (or Chromating)” in this subsection.

Wastewater generated during acid treatment includes spent solutions and rinse waters. Spent solutions typically are batch discharged and treated or disposed of off site. Most acid treatment operations are followed by a water rinse to remove residual acid.

**Acid Treatment Without Chromium** is a general term used to describe any application of an acid solution not containing chromium to a metal surface. Acid cleaning, chemical etching, and pickling are types of acid treatment.

Wastewater generated during acid treatment includes spent solutions and rinse waters. Spent solutions typically are batch discharged and treated or disposed of off site. Most acid treatment operations are followed by a water rinse to remove residual acid.

**Alcohol Cleaning** involves removing dirt and residue material from a part using alcohol.

**Alkaline Cleaning Neutralization** involves using a dilute acid solution to lower the pH of alkaline cleaning rinse water that remains on the part after alkaline cleaning. Wastewater from this operation is the alkaline cleaning neutralization rinse water.

**Alkaline Treatment With Cyanide** is the cleaning of a metal surface with an alkaline solution containing cyanide.

Wastewater generated during alkaline treatment includes spent solutions and rinse waters. Alkaline treatment solutions become contaminated from the introduction of soils and dissolution of the base metal. They usually are treated and disposed of on a batch basis. Alkaline treatment typically is followed by a water rinse that is discharged to a treatment system.

**Anodizing With Chromium** involves producing a protective oxide film on aluminum, magnesium, or other light metal, usually by passing an electric current through an electrolyte bath in which the metal is immersed. Anodizing may be followed by a sealant operation.

Chromic acid anodic coatings have a relatively thick boundary layer and are more protective than are sulfuric acid coatings. For these reasons, chromic acid is sometimes used when the part cannot be rinsed completely. These oxide coatings provide corrosion protection, decorative surfaces, a base for painting and other coating processes, and special electrical and mechanical properties.

Wastewaters generated during anodizing include spent anodizing solutions, sealants, and rinse waters. Because of the anodic nature of the process, anodizing solutions become contaminated with the base metal being processed. These solutions eventually reach an intolerable concentration of dissolved metal and require treatment or disposal. Rinse water following anodizing, coloring, and sealing typically is discharged to a treatment system.

**Anodizing Without Chromium** involves applying a protective oxide film to aluminum, magnesium, or other light metal, usually by passing an electric current through an electrolyte bath in which the metal is immersed. Phosphoric acid, sulfuric acid, and boric acid are used in anodizing. Anodizing also may include sealant baths. These oxide coatings provide corrosion protection, decorative surfaces, a base for painting and other coating processes, and special electrical and mechanical properties.

Wastewater generated during anodizing includes spent anodizing solutions, sealants, and rinse waters. Because of the anodic nature of the process, anodizing solutions become contaminated with the base metal being processed. These solutions eventually reach an intolerable concentration of dissolved metal and require treatment or disposal. Rinse water following anodizing, coloring, and sealing steps typically is discharged to a treatment systems.

**Carbon Black Deposition** involves coating the inside of printed circuit board holes by dipping the circuit board into a tank that contains carbon black and potassium hydroxide. After excess solution dips from the circuit boards, they are heated to allow the carbon black to adhere to the board.

**Catalyst Acid Pre-Dip** uses rinse water to remove residual solution from a part after the part is processed in an acid bath. The wastewater generated in this unit operation is the rinse water.

**Chemical Conversion Coating without Chromium** is the process of applying a protective coating on the surface of a metal without using chromium. Such coatings are applied through phosphate conversion (except for “Iron Phosphate Conversion Coating,” see section 4.2.2.1), metal coloring, or passivation. Coatings are applied to a base metal or previously deposited metal to increase corrosion protection and lubricity, prepare the surface for additional coatings, or formulate a special surface appearance. This unit process includes sealant operations that use additives other than chromium.

- **In phosphate conversion**, coatings are applied for one or more of the following reasons: to provide a base for paints and other organic coatings; to condition surfaces for cold forming operations by providing a base for drawing compounds and lubricants; to impart corrosion resistance to the metal surface; or to provide a suitable base for corrosion-resistant oils or waxes. Phosphate conversion coatings are formed by immersing a metal part in a dilute solution of phosphoric acid, phosphate salts, and other reagents.
- **Metal coloring** by chemical conversion coating produces a large group of decorative finishes. Metal coloring includes the formation of oxide conversion coatings. In this operation, the metal surface is converted into an oxide or similar metallic compound, giving the part the desired color. The most common colored finishes are used on copper, steel, zinc, and cadmium.
- **Passivation** forms a protective coating on metals, particularly stainless steel, by immersing the part in an acid solution. Stainless steel is passivated to dissolve embedded iron particles and to form a thin oxide film on the surface of the metal.

Wastewater generated during chemical conversion coating includes spent solutions and rinses (i.e., both the chemical conversion coating solutions and post-treatment sealant solutions). These solutions commonly are discharged to a treatment system when contaminated with the base metal or other impurities. Rinsing normally follows each process step, except when a sealant dries on the part surface.

**Chemical Milling (or Chemical Machining)** involves removing metal from a part by controlled chemical attack, or etching, to produce desired shapes and dimensions. In chemical machining, a masking agent typically is applied to cover a portion of the part's surface; the exposed (unmasked) surface is then treated with the chemical machining solution.

Wastewater generated during chemical machining includes spent solutions and rinses. Process solutions typically are discharged after becoming contaminated with the base metal. Rinsing normally follows chemical machining.

**Chromate Conversion Coating (or Chromating)** involves forming a conversion coating (protective coating) on a metal by immersing or spraying the metal with a hexavalent chromium compound solution to produce a hexavalent or trivalent chromium compound coating. This also is known as chromate treatment, and is most often applied to aluminum, zinc, cadmium or magnesium surfaces. Sealant operations using chromium also are included in this unit operation.

Chromate solutions include two types: (1) those that deposit substantial chromate films on the substrate metal and are complete treatments themselves, and (2) those that seal or supplement oxide, phosphate, or other types of protective coatings.

Wastewater generated during chromate conversion coating includes spent process solutions (i.e., both the chromate conversion coating solutions and post-treatment sealant solutions) and rinses. These solutions typically are discharged to a treatment system when contaminated with the base metal or other impurities. Also, chromium-based solutions, which are typically formulated with hexavalent chromium, lose operating strength when the hexavalent chromium reduces to trivalent chromium during use. Rinsing normally follows each process step, except for sealants that dry on the surface of the part.

**Chromium Drag-out Destruction** is a unit operation performed following chromium-bearing operations to reduce hexavalent chromium that is “dragged out” of the process bath. Parts are dipped in a solution of a chromium-reducing chemical (e.g., sodium metabisulfite) to prevent the hexavalent chromium from contaminating subsequent process baths. This operation typically is performed in a stagnant drag-out rinse tank that contains concentrated chromium-bearing wastewater.

**Cyanide Drag-out Destruction** involves dipping the part in a cyanide oxidation solution (e.g., sodium hypochlorite) to prevent cyanide that is “dragged out” of a process bath from contaminating subsequent process baths. This operation typically is performed in a stagnant drag-out rinse tank.

**Cyaniding Rinse** is generated during cyaniding hardening of a part. The part is heated in a molten salt solution containing cyanide. Wastewater is generated when excess cyanide salt solution is removed from the part in rinse water.

**Electrochemical Machining** is a process in which the part becomes the anode and a shaped cathode is the cutting tool. By pumping electrolyte between the electrodes and applying a current, metal is rapidly but selectively dissolved from the part. Wastewater generated during electrochemical machining includes spent electrolytes and rinses.

**Electroless Catalyst Solution** involves adding a catalyst just prior to an electroless plating operation to accelerate the plating operation.

**Electroless Plating** involves applying a metallic coating to a part using a chemical reduction process in the presence of a catalyst. An electric current is not used in this operations. The metal to be plated onto a part typically is held in solution at high concentrations using a chelating agent. This plates all areas of the part to a uniform thickness regardless of the configuration of the part. Also, an electroless-plated surface is dense and virtually nonporous. Copper and nickel electroless plating operations are the most common.

Sealant operations (i.e., other than hot water dips) following electroless plating are considered separate unit operations if they include any additives.

Wastewater generated during electroless plating includes spent process solutions and rinses. The wastewater contains chelated metals, which require separate preliminary treatment to break the metal chelates prior to conventional chemical precipitation. Rinsing follows most electroless plating processes to remove residual plating solution and prevent contamination of subsequent process baths.

**Electrolytic Cleaning** involves removing soil, scale, or surface oxides from a part by electrolysis. The part is one of the electrodes and the electrolyte is usually alkaline. Electrolytic alkaline cleaning and electrolytic acid cleaning are the two types of electrolytic cleaning.

- **Electrolytic alkaline cleaning** produces a cleaner surface than do nonelectrolytic methods of alkaline cleaning. This operation uses strong agitation, gas evolution in the solution, and oxidation-reduction reactions that occur during electrolysis. In addition, dirt particles become electrically charged and are repelled from the part surface.
- **Electrolytic acid cleaning** sometimes is used as a final cleaning before electroplating. Sulfuric acid is most frequently used as the electrolyte. As with electrolytic alkaline cleaning, the mechanical scrubbing effect from the evolution of gas enhances the effectiveness of the process.

Wastewater generated during electrolytic cleaning includes spent process solutions and rinses. Electrolytic cleaning solutions become contaminated during use due to the dissolution of the base metal and the introduction of pollutants. The solutions typically are batch discharged for treatment or disposal after they weaken. Rinsing following electrolytic cleaning removes residual cleaner to prevent contamination of subsequent process baths.

**Electroplating with Chromium** involves producing a chromium metal coating on a surface by electrodeposition. Electroplating provides corrosion protection, wear or erosion resistance, lubricity, electrical conductivity, or decoration.

In electroplating, metal ions in acid, alkaline, or neutral solutions are reduced on the cathodic surfaces of the parts being plated. Metal salts or oxides typically are added to replenish the solutions. Chromium trioxide often is added as a source of chromium.

In addition to water and the metal being deposited, electroplating solutions often contain agents that form complexes with the metal being deposited, stabilizers to prevent hydrolysis, buffers for pH control, catalysts to assist in deposition, chemical aids to dissolve anodes, and miscellaneous ingredients that modify the process to attain specific properties. Sealant operations performed after this operation are considered separate unit operations if they include any additives (i.e., other than hot water dips).

Wastewater generated during electroplating includes spent process solutions and rinses. Electroplating solutions occasionally become contaminated during use due to the base metal dissolving and the introduction of other pollutants, diminishing the effectiveness of the electroplating solutions. Spent concentrated solutions typically are treated to remove pollutants and reused, processed in a wastewater treatment system, or disposed of off site. Rinse waters, including some drag-out rinse tank solutions, typically are treated on site.

**Electroplating with Cyanide** involves producing metal coatings on a surface by electrodeposition using cyanide. Electroplating provides corrosion protection, wear or erosion resistance, electrical conductivity, or decoration.

In electroplating, metal ions in acid, alkaline, or neutral solutions are reduced on the cathodic surfaces of the parts being plated. The metal ions in solution typically are replenished by dissolving metal from anodes contained in inert wire or metal baskets. Sealant operations performed after this operation are considered separate unit operations if they include any additives (i.e., any sealant operations other than hot water dips).

In addition to water and the metal being deposited, electroplating solutions often contain agents that form complexes with the metal being deposited, stabilizers to prevent hydrolysis, buffers to control pH, catalysts to assist in deposition, chemical aids to dissolve anodes, and miscellaneous ingredients that modify the process to attain specific properties. Cyanide, usually in the form of sodium or potassium cyanide, frequently is used as a complexing agent for zinc, cadmium, copper, and precious metal baths.

Wastewater generated during electroplating includes spent process solutions and rinses. Electroplating solutions occasionally become contaminated during use due to dissolution of the base metal and the introduction of other pollutants, diminishing the performance of the electroplating solutions. Spent concentrated solutions typically are treated to remove pollutants and reused, processed in a wastewater treatment system, or disposed of off site. Rinse waters, including some drag-out rinse tank solutions, typically are treated on site.

**Electroplating without Chromium or Cyanide** involves the production of metal coatings on a surface by electrodeposition, without using chromium or cyanide. Commonly electroplated metals include nickel, copper, tin/lead, gold, and zinc. Electroplating provides corrosion protection, wear or erosion resistance, lubricity, electrical conductivity, or decoration.

In electroplating, metal ions in acid, alkaline, or neutral solutions are reduced on the cathodic surfaces of the parts being plated. The metal ions in solution typically are replenished by dissolving metal from anodes contained in inert wire or metal baskets. Sealant operations performed after this operation are considered separate unit operations if they include any additives (i.e., any sealant operations other than hot water dips).

In addition to water and the metal being deposited, electroplating solutions often contain agents that form complexes with the metal being deposited, stabilizers to prevent hydrolysis, buffers to

control pH, catalysts to assist in deposition, chemical aids to dissolve anodes, and miscellaneous ingredients that modify the process to attain specific properties.

Wastewater generated during electroplating without chromium or cyanide includes spent process solutions and rinses. Electroplating solutions occasionally become contaminated during use due to dissolution of the base metal and the introduction of other pollutants, diminishing the effectiveness of the electroplating solutions. Spent concentrated solutions typically are treated for pollutant removal and reused, processed in a wastewater treatment system, or disposed of off site. Rinse waters, including some drag-out rinse tank solutions, typically are treated on site.

**Electropolishing** involves producing a highly polished surface on a part using reversed electrodeposition in which the anode (part) releases some metal ions into the electrolyte to reduce surface roughness. When current is applied, a polarized film forms on the metal surface, through which metal ions diffuse. In this operation, areas of surface roughness on parts serve as high-current density areas and are dissolved at rates greater than the rates for smoother portions of the metal surface.

Metals are electropolished to improve appearance, reflectivity, and corrosion resistance. Base metals processed by electropolishing include aluminum, copper, zinc, low-alloy steel, and stainless steel. Common electrolytes include sodium hydroxide and combinations of sulfuric acid, phosphoric acid, and chromic acid.

Wastewater generated during electropolishing includes spent process solutions and rinses. Eventually, the concentration of dissolved metals increases to the point where the process becomes ineffective. Typically, a portion of the bath is decanted and either fresh chemicals are added or the entire solution is discharged to treatment and replaced with fresh chemicals. Rinsing can involve several steps and can include hot immersion or spray rinses.

**Galvanizing/Hot Dip Coating** involves using various processes to coat an iron or steel surface with zinc. In hot dipping, a base metal is coated by dipping it into a tank that contains a molten metal.

**Hot Dip Coating** involves applying a metal coating (usually zinc) to the surface of a part by dipping the part in a molten metal bath. Wastewater is generated in this operation when residual metal coating solution is removed from the part in rinse water.

**Kerfing** uses a tool to remove small amounts of metal from a product surface. Water and synthetic coolants may be used to lubricate the area between the tool and the metal, to maintain the temperature of the cutting tool, and to remove metal fines from the surface of the part. This operation generates oily wastewater that contains metal fines and dust.

**Laminating** involves applying a material to a substrate using heat and pressure.



**Mechanical and Vapor Plating** involves applying a metallic coating to a part. For mechanical plating, the part is rotated in a drum containing a water-based solution, glass beads, and metal powder. In vapor plating, a metallic coating is applied by atomizing the metal and applying an electric charge to the part, which causes the atomized (vapor phase) metal to adhere to the part.

Wastewater generated in this operation includes spent solutions from the process bath and rinse water. Typically, the wastewater contains high concentrations of the applied metal.

**Metallic Fiber Cloth Manufacturing** involves weaving thin metallic fibers to create a mesh cloth.

**Metal Spraying (Including Water Curtain)** involves applying a metallic coating to a part by projecting molten or semimolten metal particles onto a substrate. Coatings can be sprayed from rod or wire stock or from powdered material. The process involves feeding the material (e.g., wire) into a flame where it is melted. The molten stock then is stripped from the end of the wire and atomized by a high-velocity stream of compressed air or other gas that propels the material onto a prepared substrate or part.

Metal spraying coatings are used in a wide range of special applications, including: insulating layers in applications such as induction heating coils; electromagnetic interference shielding; thermal barriers for rocket engines; nuclear moderators; films for hot isostatic pressing; and dimensional restoration of worn parts.

Metal spraying is sometimes performed in front of a “water curtain” (a circulated water stream used to trap overspray) or a dry filter exhaust hood that captures the overspray and fumes. With water curtain systems, water is recirculated from a sump or tank. Wastewater is generated when the sump or tank is discharged periodically. Metal spraying typically is not followed by rinsing.

**Painting-Immersion (Including Electrophoretic, “E-coat”)** involves applying an organic coating to a part using processes such as autophoretic and electrophoretic painting.

- **Autophoretic Painting** involves applying an organic paint film by electrophoresis when a part is immersed in a suitable aqueous bath.
- **Electrophoretic Painting** is coating a part by making it either anodic or cathodic in a bath that is generally an aqueous emulsion of the organic coating material.
- **Other Immersion Painting** includes all other types of immersion painting such as dip painting.

Water is used in immersion paint operations as a carrier for paint particles and to rinse the part. Aqueous painting solutions and rinses typically are treated through an ultrafiltration system. The concentrate is returned to the painting solution, and the permeate is reused as rinse water. Sites

typically discharge a bleed stream to treatment. The painting solution and rinses are batch discharged periodically to treatment.

**Photo Imaging** is the process of exposing a photoresist-laden printed wiring board to light to impact the circuitry design to the board. Water is not used in this operation.

**Photo Image Developing** is an operation in which a water-based solution is used to develop the exposed circuitry in a photoresist-laden printed wiring board. Wastewater generated in this operation includes spent process solution and rinse water.

**Photoresist Application** is an operation that uses heat and pressure to apply a photoresist coating to a printed wiring board. Water is not used in this operation.

**Photoresist Strip** involves removing organic photoresist material from a printed wiring board using an acid solution.

**Phosphor Deposition** is the application of a phosphorescent coating to a part. Wastewater generated in this unit operation includes water used to keep the parts clean and wet while the coating is applied, and rinse water used to remove excess phosphorescent coating from the part.

**Physical Vapor Deposition** involves physically removing a material from a source through evaporation or sputtering, using the energy of the vapor particles in a vacuum or partial vacuum to transport the removed material, and condensing the removed material as a film onto the surface of a part or other substrate.

**Plasma Arc Machining** involves removing material or shaping a part by a high-velocity jet of high-temperature, ionized gas. A gas (nitrogen, argon, or hydrogen) is passed through an electric arc, causing the gas to become ionized, and heated to temperatures exceeding 16,650°C (30,000°F). The relatively narrow plasma jet melts and displaces the material in its path. Because plasma arc machining does not depend on a chemical reaction between the gas and the part, and because plasma temperatures are extremely high, the process can be used on almost any metal, including those that are resistant to oxygen-fuel gas cutting. The method is used mainly for profile cutting of stainless steel and aluminum alloys.

Although plasma arc machining typically is a dry process, water is used for water injection plasma arc torches. In these cases, a constricted swirling flow of water surrounds the cutting arc. This operation also may be performed immersed in a water bath. In both cases, water is used to stabilize the arc, to cool the part, and to contain smoke and fumes.

**Plastic Wire Extrusion** involves applying a plastic material to a metal wire through an extrusion process.

**Salt Bath Descaling** involves removing surface oxides or scale from a part by immersing the part in a molten salt bath or hot salt solution. Salt bath descaling solutions can contain molten salts,

caustic soda, sodium hydride, and chemical additives. Molten salt baths are used in a salt bath-water quench-acid dip sequence to remove oxides from stainless steel and other corrosion-resistant alloys. In this process, the part typically is immersed in the molten salt, quenched with water, and then dipped in acid. Oxidizing, reducing, or electrolytic salt baths can be used depending on the oxide to be removed. Wastewater generated during salt bath descaling includes spent process solutions, quenches, and rinses.

**Shot Tower - Lead Shot Manufacturing** involves dropping molten lead from a platform on the top of a tower through a sieve-like device and into a vat of cold water.

**Soldering** involves joining metals by inserting a thin (capillary thickness) layer of nonferrous filler metal into the space between them. Bonding results from the intimate contact produced by the metallic bond formed between the substrate metal and the solder alloy. The term soldering is used where the melting temperature of the filler is below 425°C (800°F). Some soldering operations use a solder flux, which is an aqueous or nonaqueous material used to dissolve, remove, or prevent the formation of surface oxides on the part.

Except for the use of aqueous fluxes, soldering typically is a dry operation; however, a quench or rinse sometimes follows soldering to cool the part or remove excess flux or other foreign material from its surface. Recent developments in soldering technology have focused on fluxless solders and fluxes that can be cleaned off with water.

**Solder Flux Cleaning** involves removing residual solder flux from a printed circuit board using either an alkaline or alcohol cleaning solution.

**Solder Fusing** involves coating a tin-lead plated circuit board with a solder flux and then passing the board through a hot oil. The hot oil fuses the tin-lead to the board and creates a solder-like finish on the board.

**Solder Masking** involves applying a resistive coating to certain areas of a circuit board to protect the areas during subsequent processing.

**Sputtering** is a vacuum evaporation process in which portions of a coating material are physically removed from a substrate and deposited a thin film onto a different substrate.

**Stripping (Paint)** involves removing a paint (or other organic) coating from a metal basis material. Stripping commonly is performed as part of the manufacturing process to recover parts that have been improperly coated or as part of maintenance and rebuilding to restore parts to a usable condition.

Organic coatings (including paint) are stripped using thermal, mechanical, and chemical means. Thermal methods include burn-off ovens, fluidized beds of sand, and molten salt baths. Mechanical methods include scraping and abrasive blasting (as defined in “Abrasive Blasting” in

Section 4.2.2.1). Chemical paint strippers include alkali solutions, acid solutions, and solvents (e.g., methylene chloride).

Wastewater generated during organic coating stripping includes process solutions (limited mostly to chemical paint strippers and rinses).

**Stripping (Metallic Coating)** involves removing a metallic coating from a metal basis material. Stripping is commonly part of the manufacturing process to recover parts that have been improperly coated or as part of maintenance and rebuilding to restore parts to a usable condition.

Metallic coating stripping most often uses chemical baths, although mechanical means (e.g., grinding, abrasive blasting) also are used. Chemical stripping frequently is performed as an aqueous electrolytic process.

Wastewater generated during metallic coating stripping includes process solutions and rinses. Stripping solutions become contaminated from dissolution of the base metal. Typically, the entire solution is discharged to treatment. Rinsing is used to remove the corrosive film remaining on the parts.

**Thermal Infusion** uses heat to infuse metal powder or dust onto the surface of a part. Typically, thermal infusion is a dry operation. In some cases, however, water may be used to remove excess metal powder, metal dust, or molten metal.

**Ultrasonic Machining** involves forcing an abrasive liquid between a vibrating tool and a part. Particles in the abrasive liquid strike the part, removing any microscopic flakes on the part.

**Vacuum Impregnation** is used to reduce the porosity of the part. A filler material (usually organic) is applied to the surface of the part and polymerized under pressure and heat. Wastewater is generated in this unit operation when rinse water is used to remove residual organic coating from the part.

**Vacuum Plating** involves applying a thin layer of metal oxide onto a part using molten metal in a vacuum chamber.

**Water Shedder** involves applying a dilute water-based chemical compound to a part to accelerate drying. This operation typically is used to prevent a part from streaking when excess water remains on the part.

**Wet Air Pollution Control** involves using water to remove chemicals, fumes, or dusts that are entrained in air streams exhausted from process tanks or production areas. Most frequently, wet air pollution control devices are used with electroplating, cleaning, and coating processes. A common type of wet air pollution control is the wet packed scrubber consisting of a spray chamber that is filled with packing material. Water is continuously sprayed onto the packing and the air stream is pulled through the packing by a fan. Pollutants in the air stream are absorbed by

the water droplets and the air is released to the atmosphere. A single scrubber often serves numerous process tanks; however, the air streams typically are segregated by source into chromium, cyanide, and acid/alkaline sources. Wet air pollution control can be divided into several suboperations, including:

- Wet Air Pollution Control for Acid Alkaline Baths;
- Wet Air Pollution Control for Cyanide Baths;
- Wet Air Pollution Control for Chromium-Bearing Baths; and
- Wet Air Pollution Control for Fumes and Dusts.

**Wire Galvanizing Flux** involves using flux to remove rust and oxide from the surface of steel wire prior to galvanizing. This provides long-term corrosion protection for the steel wire.

#### **4.2.3 Metals Processed**

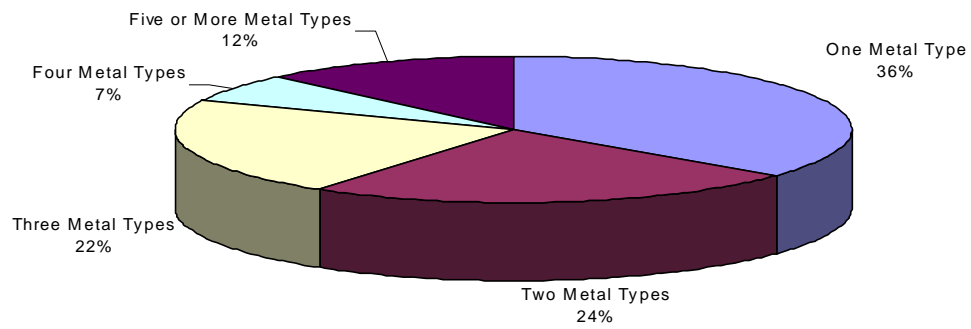
MP&M facilities perform proposed MP&M operations on a variety of metals. EPA identified 29 different metals processed at MP&M facilities from survey results. Of these, iron, aluminum, and copper are the metals most frequently processed. Nickel, tin, lead, gold, and zinc frequently are used in electroplating operations.

Many MP&M facilities process more than one metal. Figure 4-7 shows the percentage of wastewater-discharging MP&M facilities by number of metals processed. As shown in Figure 4-7, 65 percent of the wastewater-discharging MP&M facilities that provided metal use information process more than one metal.

#### **4.2.4 Estimated Annual Wastewater Discharge**

Process wastewater is generated in many of the proposed MP&M operations listed in Section 4.2.2. Some operations may be performed with or without water (wet or dry) depending on the purpose of the operation, raw materials used, and final product use. For example, some machining operations (e.g., drilling) are performed without a coolant, while other machining operations (e.g., milling) require a coolant. Process wastewater may be recirculated, recycled or reused as described in Section 4.1.4; however, process wastewater generally is discharged to a treatment system or disposed of through other means (e.g., transfer to CWT).

Based on survey results, the most commonly performed wet proposed MP&M operations are floor cleaning and acid treatment. Survey results also show the most commonly performed proposed MP&M operations do not generate the largest volumes of wastewater. Of the volume of wastewater discharged, 79 percent is generated from rinses, with chemical conversion coating rinsing, acid treatment rinsing, and alkaline treatment rinsing generating the highest volume of wastewater. Table 4-5 lists the proposed MP&M operations and presents the estimated number of MP&M facilities that discharge wastewater generated in each proposed MP&M operation and the estimated annual discharge for the proposed MP&M operation. Note that MP&M facilities typically conduct more than one proposed MP&M operation.



Source: MP&M Survey Database.

Note: Although there are 44,000 wastewater-discharging MP&M facilities only 15,470 are represented in the above pie chart. The 1996 short and municipality surveys did not request metal use information. Additionally, several 1989 and 1996 long survey recipients did not provide this information.

**Figure 4-7. Percentage of Wastewater-Discharging MP&M facilities by Number of Metal Processed**

**Table 4-5**

**Estimated Number of MP&M Facilities Discharging Process Wastewater  
by Proposed MP&M Operation and Estimated Annual Discharge<sup>a</sup>  
for Each Proposed MP&M Operation**

<b>Survey Unit Operation Number</b>	<b>Unit Operation</b>	<b>Estimated Number of MP&amp;M Facilities Discharging Wastewater from Unit Operation</b>	<b>Estimated Annual Discharge<sup>b</sup> (gpy)</b>
1	Abrasive Blasting	1,140	38,136,192
1R.	Abrasive Blasting Rinse	2,714	294,364,698
2	Abrasive Jet Machining	1,802	32,882,557
3	Acid Treatment With Chromium	789	4,119,176
3R.	Acid Treatment With Chromium Rinse	1,139	514,116,041
4	Acid Treatment Without Chromium	21,518	307,274,559
4R.	Acid Treatment Without Chromium Rinse	25,886	9,877,473,513
5	Alkaline Cleaning for Oil Removal	15,194	1,017,415,369
5R.	Alkaline Cleaning for Oil Removal Rinse	10,918	7,007,305,341
6	Alkaline Treatment With Cyanide	447	4,260,538
6R.	Alkaline Treatment With Cyanide Rinse	529	43,781,206
7	Alkaline Treatment Without Cyanide	16,200	276,426,070
7R.	Alkaline Treatment Without Cyanide Rinse	12,937	4,782,461,104
8	Anodizing With Chromium	275	271,552
8R.	Anodizing With Chromium Rinse	358	145,962,877
9	Anodizing Without Chromium	1,090	5,430,253
9R.	Anodizing Without Chromium Rinse	1,587	1,303,183,805
10	Aqueous Degreasing	41,220	669,348,451
10R.	Aqueous Degreasing Rinse	28,923	517,175,686
11	Assembly/Disassembly	2,031	18,107,602
11R.	Assembly/Disassembly Rinse	2,189	796,489
12	Barrel Finishing	14,632	640,037,840
12R.	Barrel Finishing Rinse	6,694	539,294,744
13	Burnishing	4,920	132,891,318
13R.	Burnishing Rinse	2,881	326,955,097
14	Chemical Conversion Coating Without Chromium	9,357	564,137,211

**Table 4-5 (Continued)**

<b>Survey Unit Operation Number</b>	<b>Unit Operation</b>	<b>Estimated Number of MP&amp;M Facilities Discharging Wastewater from Unit Operation</b>	<b>Estimated Annual Discharge<sup>b</sup> (gpy)</b>
14R.	Chemical Conversion Coating Without Chromium Rinse	11,582	6,042,069,830
15	Chemical Milling	1,466	41,355,172
15R.	Chemical Milling Rinse	2,323	645,522,600
16	Chromate Conversion Coating	5,071	54,795,746
16R.	Chromate Conversion Coating Rinse	5,980	1,707,025,516
17	Corrosion Preventive Coating	2,262	41,326,563
17R.	Corrosion Preventive Coating Rinse	1,015	287,465,378
18	Electrical Discharge Machining	1,323	934,885
18R.	Electrical Discharge Machining Rinse	559	3,368,479
19	Electrochemical Machining	294	329,427,414
19R.	Electrochemical Machining Rinse	258	34,587,020
20	Electroless Plating	2,583	18,034,222
20R.	Electroless Plating Rinse	3,664	565,437,766
21	Electrolytic Cleaning	5,280	33,756,614
21R.	Electrolytic Cleaning Rinse	6,886	1,501,249,740
22	Electroplating With Chromium	1,019	37,242,632
22R.	Electroplating With Chromium Rinse	1,937	678,282,897
23	Electroplating With Cyanide	1,958	38,162,499
23R.	Electroplating With Cyanide Rinse	8,885	686,691,868
24	Electroplating Without Chromium or Cyanide	4,558	92,968,816
24R.	Electroplating Without Chromium or Cyanide Rinse	13,644	3,778,033,165
25	Electropolishing	442	633,484
25R.	Electropolishing Rinse	458	70,178,477
26	Floor Cleaning	49,002	797,062,121
26R.	Floor Cleaning Rinse	3,580	45,391,545
27	Grinding	8,738	169,740,183
27R.	Grinding Rinse	263	72,465,147
28	Heat Treating	1,609	156,660,147
28R.	Heat Treating Rinse	1,315	2,186,067,713
29	Impact Deformation	404	40,582,591
29R.	Impact Deformation Rinse	148	8,237,308
30	Machining	16,935	585,628,906



**Table 4-5 (Continued)**

<b>Survey Unit Operation Number</b>	<b>Unit Operation</b>	<b>Estimated Number of MP&amp;M Facilities Discharging Wastewater from Unit Operation</b>	<b>Estimated Annual Discharge<sup>b</sup> (gpy)</b>
30R.	Machining Rinse	683	149,922,705
31	Metal Spraying	91	866,823,774
32	Painting - Spray or Brush	2,303	3,009,847,635
32R.	Painting - Spray or Brush Rinse	688	726,589,166
33	Painting - Immersion	450	164,139,746
33R.	Painting - Immersion Rinse	404	190,487,578
34	Plasma Arc Machining	547	10,728,876
35	Polishing	1,111	113,097,868
35R.	Polishing Rinse	2,745	567,887,844
36	Pressure Deformation	520	241,040,874
36R.	Pressure Deformation Rinse	249	783,831,607
37	Salt Bath Descaling	99	62,703
37R.	Salt Bath Descaling Rinse	111	53,938,360
38	Soldering/Brazing	1,258	425,688,291
38R.	Soldering/Brazing Rinse	4,905	231,488,012
39	Solvent Degreasing <sup>c</sup>	2,288	8,128,901
39R.	Solvent Degreasing Rinse	824	108,089,561
40	Stripping (paint)	1,730	68,326,631
40R.	Stripping (paint) Rinse	2,720	295,059,493
41	Stripping (metallic coating)	2,929	5,855,277
41R.	Stripping (metallic coating) Rinse	3,867	943,853,805
42	Testing	5,947	3,713,880,058
42R.	Testing Rinse	1,093	46,615,860
43	Thermal Cutting	228	35,395,401
43R.	Thermal Cutting Rinse	64	2,940,934
44	Washing Finished Products	17,276	1,975,525,613
44R.	Washing Finished Products Rinse	5,378	651,385,578
45	Welding	1,003	1,177,301,469
45R.	Welding Rinse	360	44,297,886
46AA	Wet Air Pollution Control for Acid Alkaline Baths	2,726	1,335,631,480
46CN	Wet Air Pollution Control for Cyanide Baths	189	43,321,771
46CR	Wet Air Pollution Control for Chromium-Bearing Baths	942	234,814,961

**Table 4-5 (Continued)**

<b>Survey Unit Operation Number</b>	<b>Unit Operation</b>	<b>Estimated Number of MP&amp;M Facilities Discharging Wastewater from Unit Operation</b>	<b>Estimated Annual Discharge<sup>b</sup> (gpy)</b>
46FD	Wet Air Pollution Control for Fumes and Dusts	657	30,596,886
46OR	Wet Air Pollution Control for Organic Constituents	347	19,613,181
50	Carbon Black Deposition	20	31,848
50R.	Carbon Black Deposition Rinse	43	2,377,389
51	Bilge Water	11	69,949,548
51R.	Bilge Water Rinse	8	304,839
54R.	Galvanizing/Hot Dip Coating Rinse	69	225,928,671
56	Mechanical Plating	246	27,717,634
56R.	Mechanical Plating Rinse	240	202,002,940
57	Photo Image Developing	1,456	430,595,569
57R.	Photo Image Developing Rinse	1,531	603,943,807
58	Photo Imaging	9	27,900
58R.	Photo Imaging Rinse	9	497,022
59	Photoresist Applications	15	7,157
59R.	Photoresist Applications Rinse	17	180,161
62	Solder Flux Cleaning	99	1,694,799
62R.	Solder Flux Cleaning Rinse	461	214,927,721
63	Solder Fusing	27	5,739,846
63R.	Solder Fusing Rinse	280	55,114,403
65	Steam Cleaning	26	18,130,100
65R.	Steam Cleaning Rinse	16	15,851,628
66	Vacuum Impregnation	8	649,893
66R.	Vacuum Impregnation Rinse	98	10,144,137
70	Kerfing	30	7,429,800
71	Adhesive Bonding	186	525,950
72	Calibration	55	2,467
73R.	Cyanide Rinsing Rinse	22	33,490
74	Hot Dip Coating	9	692
74R.	Hot Dip Coating Rinse	75	28,135,640
76	Thermal Infusion	62	138,939
78	Phosphor Deposition	11	4,283
78R.	Phosphor Deposition Rinse	11	42,826
80	Chromium Drag-out Reduction	8	857,994

**Table 4-5 (Continued)**

<b>Survey Unit Operation Number</b>	<b>Unit Operation</b>	<b>Estimated Number of MP&amp;M Facilities Discharging Wastewater from Unit Operation</b>	<b>Estimated Annual Discharge<sup>b</sup> (gpy)</b>
83	Acid Pickling Neutralization	8	22,761
83R.	Acid Pickling Neutralization Rinse	16	22,497,118
87	Tin Catalyst	385	295,415
87R.	Tin Catalyst Rinse	468	102,883,125
88	Catalyst Acid Pre-Dip	961	680,949
88R.	Catalyst Acid Pre-Dip Rinse	1,108	64,173,379
90	Photoresist Strip	439	8,039,179
90R.	Photoresist Strip Rinse	732	312,703,073

Source: MP&M Survey Database.

<sup>a</sup>EPA used MP&M survey information to generate the estimated facility counts and estimated annual discharge.

<sup>b</sup>These totals do not include facilities generating process wastewater that is contract hauled off site or not discharged.

<sup>c</sup>Solvent degreasing operations that use process water are included under alkaline treatment (see unit operation 5).

### 4.3 Trends in the Industry

To develop the MP&M rule, EPA collected data from the MP&M industry for over 10 years, including detailed information from surveys in 1990, 1996, and 1997. Survey data and results of industry site visits and sampling episodes showed numerous changes in the industry between 1990 and 1996. Survey data indicate a greater than 30-percent industry increase in the use of wastewater treatment systems between 1990 and 1996. Many facilities also have begun to implement advanced treatment systems that include ultrafiltration for increased organic pollutant removal and microfiltration units to improve clarification. The MP&M survey database indicates that in 1990, 260 of the MP&M facilities with wastewater treatment in place were using membrane filtration. By 1996, that number increased to 700. In addition, facilities are moving toward greater implementation of pollution prevention and water reduction, including progression to zero discharge when possible. Fifty-three percent currently have in-process pollution prevention or water use reduction practices in place, and over 27 percent of discharging facilities report having wet unit operations with zero discharge. Improvements in treatment controls are allowing for more automated process controls, which leads to more consistent wastewater treatment. Advances in wastewater treatment chemicals also result in higher treatment efficiencies.

### 4.4 References

1. Cubberly, William H. (ed.). Tool and Manufacturing Engineers Handbook, Desk Edition. Society of Manufacturing Engineers, Dearborne, MI, 1989.
2. Detrisac, M. Arthur. "Treatable Cleaners," Metal Finishing. September 1991.
3. U.S. Environmental Protection Agency. Development Document for Effluent Limitations Guidelines and Standards for the Metal Finishing Point Source Category. EPA 440/1-83/091, June 1983.
4. Mohler, J.B. "Alkaline Cleaning for Electroplating," Metal Finishing. September 1984.
5. Wood, William G. (Coordinator). The New Metals Handbook, Vol. 5. Surface Cleaning, Finishing, and Coating. American Society for Metals, May 1990.
6. Lowenheim, Frederick A. Electroplating Fundamentals of Surface Finishing. McGraw-Hill Book Company, New York, NY, 1978.
7. Murphy, Michael (ed.). Metal Finishing Guidebook and Directory Issue '93, Metal Finishing. January 1993.

## **5.0 WASTEWATER CHARACTERISTICS**

This section summarizes the characteristics of wastewater generated by oily operations (as defined in Section 1.0) and discharged to wastewater treatment systems at MP&M facilities. In general, the MP&M industry generates oil- and organic pollutant-bearing wastewater. This wastewater exhibits high concentrations of oil and concentrations of organic pollutants. Oil-bearing wastewater is classified as containing either free (floating) oils or oil/water emulsions. These wastewaters may also contain incidental levels of metals most often in the suspended or particulate phase.

Analytical data from the MP&M sampling program, including data obtained from sanitation districts, MP&M facilities, and MP&M industry trade associations, are in the sampling episode reports located in Sections 5.2 and 15.3 of the rulemaking record. As part of the MP&M rulemaking, EPA also evaluated the following wastewaters: (1) hexavalent chromium-bearing wastewater; (2) cyanide-bearing wastewater; (3) chelated metal-bearing wastewater; and (4) metal-bearing wastewater. These additional analyses are presented in Appendix C.

This section summarizes analytical data obtained during the MP&M regulatory development process for oily operations and influents to the wastewater treatment systems. These subsections present the number of samples analyzed, the number of times each pollutant was detected, and the minimum, maximum, mean, and median pollutant concentrations. Section 5.1 discusses the oily operations that generate oil-bearing and organic pollutant-bearing wastewater and presents pollutant concentration data for the process waters and rinse waters for those oily operations. Section 5.2 characterizes the influent to oily wastewater treatment systems.

### **5.1 Process Water and Rinse Water**

Table 5-1 lists the oily operations that generate oil-bearing and organic pollutant-bearing wastewater and presents the number of process water and rinse water samples collected for each operation during EPA's sampling program. Section 4.0 describes these operations in detail.

MP&M facilities usually use oil/water emulsions as coolants and lubricants in machining, grinding, and deformation operations. These facilities also perform alkaline cleaning operations to remove oil and grease from parts. Table 5-2 summarizes the pollutant concentration data collected during the MP&M sampling program for process water from oily operations that generate oil-bearing wastewater. Table 5-3 summarizes similar data for the associated rinse waters. The maximum concentration of oil and grease (measured as hexane extractable material (HEM)) in the process water samples was 390,000 mg/L (from an alkaline cleaning bath), while the maximum concentration of oil and grease in the rinse water samples was 9,195 mg/L.

**Table 5-1****Number of Process Water and Rinse Water Samples For Oily Operations**

<b>Unit Operation</b>	<b>No. of Process Water Samples<sup>a</sup></b>	<b>No. of Rinse Water Samples<sup>a</sup></b>
Abrasive Blasting	3	3
Adhesive Bonding	0	0
Alkaline Cleaning for Oil Removal	34	42
Alkaline Treatment without Cyanide	18	32
Aqueous Degreasing	11	6
Corrosion Preventive Coating	8	4
Electrical Discharge Machining	1	0
Floor Cleaning (In Process Area)	6	0
Grinding	19	0
Heat Treating	3	7
Impact Deformation	1	0
Machining	14	0
Painting-spray or Brush (Including Water Curtains)	6	0
Steam Cleaning	8	0
Testing (e.g., Hydrostatic, Dye Penetrant, Ultrasonic, Magnetic Flux)	8	3
Thermal Cutting	2	0
Tumbling/Barrel Finishing/Mass Finishing/Vibratory Finishing	9	4
Washing (Finished Products)	4	3
Welding	0	1
Wet Air Pollution Control for Organic Constituents	0 <sup>b</sup>	0 <sup>b</sup>

Source: MP&M Sampling Program.

<sup>a</sup>Oily operations for which no samples were collected are rarely performed or were not observed at MP&M facilities.

<sup>b</sup>Data were transferred for this operation.

NA - Not applicable; unit operation has no associated rinse.

**Table 5-2****Process Water Pollutant Concentration Data for Oily Operations**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Organic Priority Pollutants						
1,1,1-Trichloroethane	76	1	0.011	0.011	0.011	0.011
1,1-Dichloroethane	76	0	NA	NA	NA	NA
1,1-Dichloroethene	76	0	NA	NA	NA	NA
2,4-Dimethylphenol	71	5	0.016	0.064	0.052	0.062
2,4-Dinitrophenol	75	0	NA	NA	NA	NA
2,6-Dinitrotoluene	75	0	NA	NA	NA	NA
2-Nitrophenol	76	0	NA	NA	NA	NA
4-Chloro-3-Methylphenol	75	11	0.011	91.1	18.2	0.587
4-Nitrophenol	74	1	0.424	0.424	0.424	0.424
Acenaphthene	76	0	NA	NA	NA	NA
Acrolein	73	1	0.161	0.161	0.161	0.161
Anthracene	76	1	0.193	0.193	0.193	0.193
Bis(2-ethylhexyl) Phthalate	76	18	0.015	143	8.65	0.164
Butyl Benzyl Phthalate	76	1	0.066	0.066	0.066	0.066
Chlorobenzene	76	1	0.028	0.028	0.028	0.028
Chloroethane	76	1	8.34	8.34	8.34	8.34
Chloroform	76	5	0.010	0.019	0.014	0.013
Di-n-butyl Phthalate	75	3	0.012	0.070	0.033	0.018
Di-n-octyl Phthalate	75	1	0.020	0.020	0.020	0.020
Dimethyl Phthalate	75	0	NA	NA	NA	NA
Ethylbenzene	76	4	0.028	0.594	0.239	0.167
Fluoranthene	76	4	0.029	0.243	0.132	0.129
Fluorene	75	2	0.010	0.021	0.015	0.015
Isophorone	75	0	NA	NA	NA	NA
Methylene Chloride	76	3	0.028	6.76	2.27	0.030
n-Nitrosodimethylamine	75	0	NA	NA	NA	NA

**Table 5-2 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Organic Priority Pollutants (continued)						
Naphthalene	76	4	0.025	1.84	0.511	0.091
Phenanthrene	76	4	0.101	5.50	1.47	0.143
Phenol	76	21	0.012	8.84	1.28	0.103
Pyrene	76	0	NA	NA	NA	NA
Tetrachloroethene	76	2	0.015	0.021	0.018	0.018
Toluene	76	6	0.029	0.653	0.183	0.103
Trichloroethene	75	10	0.019	2.29	0.251	0.023
Metal Priority Pollutants						
Antimony	149	49	0.003	1.93	0.217	0.042
Arsenic	150	66	0.001	1.65	0.183	0.023
Beryllium	150	24	0.0005	0.025	0.004	0.002
Cadmium	154	78	0.002	12.6	1.23	0.088
Chromium	154	121	0.007	995	11.7	0.128
Copper	154	142	0.006	190	6.40	0.695
Lead	154	87	0.006	7,150	91.9	0.414
Mercury	150	33	0.0001	0.017	0.001	0.0005
Nickel	154	113	0.008	80.9	2.24	0.141
Selenium	149	41	0.001	1.57	0.087	0.024
Silver	154	48	0.001	2.12	0.138	0.014
Thallium	149	22	0.001	0.113	0.023	0.021
Zinc	154	145	0.008	1,160	27.2	1.31
Conventional Pollutants						
BOD 5-day (Carbonaceous)	65	54	3.00	64,900	3,953	837
Oil and Grease (as HEM)	102	83	1.08	390,000	13,884	390
Total Suspended Solids	153	140	4.00	110,000	2,764	172
Nonconventional Organic Pollutants						
1,4-Dioxane	76	2	0.077	1.00	0.539	0.589
1-Bromo-2-Chlorobenzene	76	0	NA	NA	NA	NA
1-Bromo-3-Chlorobenzene	76	0	NA	NA	NA	NA
1-Methylfluorene	76	3	0.014	2.60	0.912	0.123



**Table 5-2 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Nonconventional Organic Pollutants (continued)						
2-Butanone	76	13	0.057	38.3	3.72	0.121
2-Hexanone	76	3	0.124	0.505	0.263	0.161
2-Isopropyl-naphthalene	76	1	7.34	7.34	7.34	7.34
2-Methylnaphthalene	76	9	0.011	3.14	0.511	0.236
2-Propanone	76	41	0.050	11.9	0.943	0.215
3,6-Dimethylphenanthrene	76	1	8.50	8.50	8.50	8.50
4-Methyl-2-Pentanone	76	10	0.052	63.7	6.73	0.358
Acetophenone	76	1	0.566	0.566	0.566	0.566
Alpha-terpineol	72	12	0.012	14.1	2.69	178
Aniline	76	0	NA	NA	NA	NA
Benzoic Acid	76	11	0.071	13.2	1.48	0.189
Benzyl Alcohol	76	2	0.094	0.208	0.151	0.151
Biphenyl	76	2	0.014	0.038	0.026	0.026
Carbon Disulfide	76	0	NA	NA	NA	NA
Dibenzofuran	76	0	NA	NA	NA	NA
Dibenzothiophene	76	0	NA	NA	NA	NA
Diphenyl Ether	76	0	NA	NA	NA	NA
Diphenylamine	76	2	0.024	0.026	0.025	0.025
Hexanoic Acid	76	24	0.019	1,490	66.6	1.17
Isobutyl Alcohol	76	3	0.012	1.31	0.446	0.018
m+p Xylene	52	2	0.013	0.352	0.183	0.183
m-Xylene	24	2	0.153	2.13	1.14	1.14
Methyl Methacrylate	76	0	NA	NA	NA	NA
n,n-Dimethylformamide	76	4	0.028	0.665	0.322	0.297
n-Decane	75	9	0.017	1.33	0.462	0.132
n-Docosane	76	23	0.013	141	7.97	0.164
n-Dodecane	76	24	0.011	36.8	3.60	0.419
n-Eicosane	76	29	0.012	14.1	1.40	0.190
n-Hexacosane	76	19	0.011	109	7.82	0.093
n-Hexadecane	76	28	0.015	95.3	6.64	0.444

**Table 5-2 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Nonconventional Organic Pollutants (continued)						
n-Octacosane	76	7	0.035	61.1	11.9	0.542
n-Octadecane	76	28	0.013	264	13.1	0.198
n-Tetracosane	76	16	0.011	116	9.92	0.283
n-Tetradecane	76	30	0.011	48.5	6.31	0.753
n-Triacontane	76	12	0.012	31.9	3.89	0.666
o+p Xylene	24	2	0.063	1.48	0.774	0.774
o-Cresol	76	1	0.039	0.039	0.039	0.039
o-Xylene	52	6	0.010	0.201	0.044	0.013
p-Cresol	76	7	0.010	4.31	1.02	0.041
p-Cymene	76	2	0.021	0.051	0.036	0.036
Pyridine	76	0	NA	NA	NA	NA
Styrene	75	1	1.18	1.18	1.18	1.18
Trichlorofluoromethane	76	1	0.106	0.106	0.106	0.106
Tripropyleneglycol Methyl Ether	76	6	1.93	5,254	1,222	245
Nonconventional Metal Pollutants						
Aluminum	154	132	0.039	29,600	242	2.31
Barium	150	137	0.001	31.4	1.62	0.106
Boron	150	127	0.022	4,150	136	1.11
Calcium	150	145	0.274	11,600	200	39.0
Cobalt	150	59	0.005	35.3	0.723	0.034
Gold	3	1	1.66	1.66	1.66	1.66
Iron	154	147	0.016	2,790	49.1	4.83
Magnesium	150	139	0.088	213	26.1	11.6
Manganese	154	142	0.002	20,600	146	0.190
Molybdenum	150	100	0.003	112	2.74	0.122
Sodium	150	147	1.61	152,000	4,908	297
Tin	154	64	0.004	1,830	30.5	0.080
Titanium	150	105	0.002	59.7	0.886	0.040
Vanadium	150	64	0.002	1.07	0.095	0.023

**Table 5-2 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Other Nonconventional Pollutants						
Ammonia as Nitrogen	47	41	0.160	2,340	82.2	1.76
Chemical Oxygen Demand (COD)	109	103	6.90	330,000	25,354	4,800
Chloride	62	59	2	14,400	482	137
Cyanide	9	7	0.004	0.232	0.078	0.059
Fluoride	69	66	0.130	190	6.00	1.10
Hexavalent Chromium	61	16	0.016	1.70	0.185	0.065
Sulfate	86	72	1.50	46,000	1,793	121
Total Dissolved Solids	146	146	33.5	411,420	25,197	4,200
Total Kjeldahl Nitrogen	45	42	0.200	2,830	167	34.9
Total Organic Carbon (TOC)	72	68	4.26	85,300	8,280	666
Total Petroleum Hydrocarbons (as SGT-HEM)	69	47	6.55	6,230	489	46.0
Total Phosphorus	39	37	0.051	7,170	276	11.0
Total Recoverable Phenolics	109	92	0.006	33.8	1.53	0.160
Total Sulfide	16	5	1.00	11.0	4.40	2.00

Source: MP&M Sampling Program.

<sup>a</sup>Due to budgetary constraints, EPA did not analyze all samples for all pollutants.

NA - Not applicable.

**Table 5-3****Rinse Water Pollutant Concentration Data for Oily Operations**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Organic Priority Pollutants						
1,1-Dichloroethane	62	1	0.039	0.039	0.039	0.039
1,1-Dichloroethene	62	0	NA	NA	NA	NA
1,1,1-Trichloroethane	62	1	0.023	0.023	0.023	0.023
2-Nitrophenol	62	0	NA	NA	NA	NA
2,4-Dimethylphenol	48	0	NA	NA	NA	NA
2,4-Dinitrophenol	59	0	NA	NA	NA	NA
2,6-Dinitrotoluene	62	1	0.616	0.616	0.616	0.616
4-Chloro-3-Methylphenol	60	2	0.023	0.050	0.037	0.037
4-Nitrophenol	60	0	NA	NA	NA	NA
Acenaphthene	62	0	NA	NA	NA	NA
Acrolein	53	0	NA	NA	NA	NA
Anthracene	62	0	NA	NA	NA	NA
Bis(2-ethylhexyl) Phthalate	62	8	0.011	1.15	0.417	0.327
Butyl Benzyl Phthalate	62	0	NA	NA	NA	NA
Chlorobenzene	62	0	NA	NA	NA	NA
Chloroethane	62	0	NA	NA	NA	NA
Chloroform	62	17	0.010	0.081	0.021	0.016
Di-n-octyl Phthalate	62	0	NA	NA	NA	NA
Di-n-butyl Phthalate	62	1	0.017	0.017	0.017	0.017
Dimethyl Phthalate	62	0	NA	NA	NA	NA
Ethylbenzene	62	1	0.039	0.039	0.039	0.039
Fluoranthene	62	0	NA	NA	NA	NA
Fluorene	62	0	NA	NA	NA	NA
Isophorone	62	0	NA	NA	NA	NA
Methylene Chloride	62	1	0.016	0.016	0.016	0.016
n-Nitrosodiphenylamine	62	0	NA	NA	NA	NA
n-Nitrosodimethylamine	62	0	NA	NA	NA	NA

**Table 5-3 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Organic Priority Pollutants (continued)						
Phenanthrene	62	1	0.527	0.527	0.527	0.527
Phenol	62	4	0.010	8.28	2.14	0.132
Pyrene	62	0	NA	NA	NA	NA
Tetrachloroethene	62	0	NA	NA	NA	NA
Toluene	62	2	0.011	0.045	0.028	0.028
Trichloroethene	62	9	0.011	0.022	0.017	0.018
Metal Priority Pollutants						
Antimony	99	20	0.003	0.256	0.051	0.037
Arsenic	100	30	0.001	0.303	0.044	0.009
Beryllium	100	5	0.001	0.005	0.002	0.002
Cadmium	104	30	0.002	11.9	0.432	0.012
Chromium	104	60	0.001	104	1.97	0.082
Copper	104	88	0.008	14.7	0.942	0.247
Lead	104	24	0.002	6.89	0.759	0.050
Mercury	100	14	0.0001	0.002	0.001	0.0003
Nickel	104	50	0.001	10.3	0.434	0.099
Selenium	99	9	0.001	0.232	0.056	0.022
Silver	104	29	0.001	0.118	0.022	0.011
Thallium	99	12	0.001	0.036	0.008	0.002
Zinc	104	85	0.009	46.7	1.89	0.110
Conventional Pollutants						
BOD 5-day (Carbonaceous)	51	42	3.04	12,900	730	47.0
Oil and Grease (as HEM)	75	47	1.12	9,195	348	25.5
Total Suspended Solids	102	77	5.00	2,560	201	65.0
Nonconventional Organic Pollutants						
1-Bromo-2-Chlorobenzene	62	0	NA	NA	NA	NA
1-Bromo-3-Chlorobenzene	62	0	NA	NA	NA	NA
1-Methylfluorene	62	1	0.129	0.129	0.129	0.129
1-Methylphenanthrene	62	1	1.02	1.02	1.02	1.02
1,4-Dioxane	62	1	2.02	2.02	2.02	2.02

**Table 5-3 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Nonconventional Organic Pollutants (continued)						
2-Hexanone	62	0	NA	NA	NA	NA
2-Isopropyl-naphthalene	62	1	1.57	1.57	1.57	1.57
2-Methylnaphthalene	62	1	1.10	1.10	1.10	1.10
2-Propanone	62	8	0.065	3.10	0.655	0.390
3,6-Dimethylphenanthrene	62	1	0.811	0.811	0.811	0.811
4-Methyl-2-Pentanone	62	0	NA	NA	NA	NA
Acetophenone	62	0	NA	NA	NA	NA
Alpha-Terpineol	52	2	65.3	67.3	66.3	66.3
Aniline	62	0	NA	NA	NA	NA
Benzoic Acid	62	7	0.122	6.61	2.03	1.45
Benzyl Alcohol	62	2	2.73	24.8	13.8	13.8
Biphenyl	62	0	NA	NA	NA	NA
Carbon Disulfide	62	2	0.062	0.354	0.208	0.208
Dibenzofuran	62	1	0.010	0.010	0.010	0.010
Dibenzothiophene	62	0	NA	NA	NA	NA
Diphenyl Ether	62	0	NA	NA	NA	NA
Diphenylamine	62	0	NA	NA	NA	NA
Hexanoic Acid	62	20	0.013	28.4	1.84	0.189
Isobutyl Alcohol	62	0	NA	NA	NA	NA
m-xylene	13	0	NA	NA	NA	NA
m+p Xylene	49	1	0.104	0.104	0.104	0.104
Methyl Methacrylate	62	0	NA	NA	NA	NA
n-Eicosane	62	13	0.011	2.41	0.490	0.172
n-Decane	62	1	5.01	5.01	5.01	5.01
n-Docosane	62	8	0.018	6.47	0.964	0.039
n-Dodecane	62	6	1.77	53.3	15.3	7.24
n-Hexacosane	62	6	0.011	1.46	0.512	0.268
n-Hexadecane	62	9	0.011	52.7	12.2	1.27
n-Octacosane	62	3	0.396	1.37	0.818	0.684
n-Octadecane	62	10	0.018	4.03	0.952	0.159

**Table 5-3 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Nonconventional Organic Pollutants (continued)						
n-Tetradecane	62	8	0.011	160	40.0	1.07
n-Tirosopiperidine	62	0	NA	NA	NA	NA
n-Triacontane	62	2	0.039	0.322	0.180	0.180
n,n-Dimethylformamide	62	1	0.011	0.011	0.011	0.011
o-Cresol	62	1	0.012	0.012	0.012	0.012
o-Xylene	49	1	0.056	0.056	0.056	0.056
o+p Xylene	13	0	NA	NA	NA	NA
p-Cresol	62	3	0.014	0.063	0.030	0.014
p-Cymene	62	1	0.190	0.190	0.190	0.190
Pyridine	62	0	NA	NA	NA	NA
Styrene	62	0	NA	NA	NA	NA
Trichlorofluoromethane	62	1	0.036	0.036	0.036	0.036
Tripropyleneglycol Methyl Ether	62	3	0.413	4.18	2.43	2.71
Nonconventional Metal Pollutants						
Aluminum	104	66	0.060	321	12.9	0.389
Barium	100	86	0.001	1.61	0.134	0.032
Boron	100	66	0.012	838	36.6	0.223
Calcium	100	91	0.050	175	36.1	20.8
Cobalt	100	19	0.005	0.627	0.115	0.024
Gold	7	3	0.056	0.086	0.074	0.081
Iron	104	77	0.011	453	14.2	0.418
Magnesium	100	87	0.066	37.3	9.12	6.36
Manganese	104	79	0.001	135	4.07	0.043
Molybdenum	100	41	0.008	187	4.71	0.045
Sodium	100	99	1.63	19,100	524	113
Tin	104	31	0.006	16.3	1.22	0.042
Titanium	100	43	0.001	1.85	0.206	0.014
Vanadium	100	23	0.001	0.182	0.026	0.014

**Table 5-3 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Other Nonconventional Pollutants						
Ammonia as Nitrogen	30	14	0.020	10.1	2.01	0.125
Chemical Oxygen Demand (COD)	65	58	5.20	32,700	1,690	175
Chloride	21	21	3.00	64,500	3,128	30.0
Cyanide	2	2	0.010	1.45	0.730	0.730
Fluoride	22	20	0.300	135	7.50	0.705
Hexavalent Chromium	54	15	0.011	0.590	0.067	0.022
Sulfate	48	39	2.33	780	96.0	34.8
Total Dissolved Solids	100	99	26.0	120,000	2,955	756
Total Kjeldahl Nitrogen	23	12	0.310	149	16.2	3.25
Total Organic Carbon (TOC)	64	60	1.72	10,100	490	83.5
Total Petroleum Hydrocarbons (as SGT-HEM)	62	29	5.00	7,367	317	27.0
Total Phosphorus	10	9	0.060	720	85.5	7.30
Total Recoverable Phenolics	63	43	0.005	0.800	0.110	0.050
Total Sulfide	11	1	12.0	12.0	12.0	12.0

Source: MP&M Sampling Program.

<sup>a</sup>Due to budgetary constraints, EPA did not analyze all samples for all pollutants.

NA - Not applicable.



As shown in Tables 5-2 and Table 5-3, oil-bearing process water and rinses also contain numerous organic pollutants. These pollutants are either components of the oil/water emulsions or pollutants in the aqueous cleaning solutions. The maximum organic pollutant concentration found in process water samples was 5,245 mg/L for tripropyleneglycol methyl ether from a testing unit operation. The maximum organic pollutant concentration in the rinse water samples was 160 mg/L for n-tetradecane in the rinse water for a testing unit operation. EPA also measured the concentration of chemical oxygen demand (COD) in oil-bearing wastewater. The maximum COD concentration found in process water and rinse water samples was 330,000 mg/L and 32,700 mg/L, respectively. Data in Tables 5-2 and 5-3 show that the process water samples also contained conventional, nonconventional, and metal pollutants.

In general, the organic pollutants that EPA detected most frequently were those associated with petroleum products used in the MP&M industry (e.g., long, straight-chain organic pollutants associated with oil-based machining and grinding coolants and lubricants). EPA also detected additional organic cleaners and solvents (e.g., phenol, 2-propanone, bis(2-ethylhexyl) phthalate, and hexanoic acid). EPA also detected numerous metals in the oil-bearing waste streams. However, when compared to the metals concentrations detected in metal-bearing waste streams (see Appendix C), the oil-bearing waste streams contained lower median metals concentrations. While some specific oil-bearing wastewater streams may contain elevated concentrations of specific metals (e.g., machining of a copper part will generate copper-bearing wastewater), these streams are typically lower-flow streams as compared to other oil-bearing streams, resulting in lower treatment influent metals concentrations. These wastewaters may also contain incidental levels of metals most often in the suspended or particulate phase.

## **5.2            Influent to Oily Wastewater Treatment Systems**

Wastewater containing oil and organic pollutants generated in the oily operations listed in Table 5-1 generally require treatment to separate oil from the wastewater. Benzene, toluene, ethylbenzene, and xylenes (BTEX) and other light hydrocarbons, for example, are moderately soluble in process waters and rinse waters. If the oils are free or floating, a technology such as oil skimming or ultrafiltration can separate the oil and water. If the oil is emulsified, techniques such as chemical emulsion breaking may be required before physical separation (see Section 8.4.5). Oil/water separation technologies remove organic pollutants that are more soluble in oil than in water from the wastewater. Table 5-4 summarizes the MP&M pollutant concentration data for the influent to oil/water separation, ultrafiltration, and dissolved air flotation treatment systems. The influent-to-treatment concentrations are typically lower than the concentrations of process and rinse water due to the number of high-flow, low-concentration rinses that are commingled prior to treatment.

**Table 5-4**

**MP&M Pollutant Concentration Data for the Influent to  
Oily Wastewater Treatment Systems**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Organic Priority Pollutants						
1,1-Dichloroethane	93	1	0.011	0.011	0.011	0.011
1,1-Dichloroethylene	93	0	NA	NA	NA	NA
1,1,1-Trichloroethane	93	4	0.006	0.022	0.013	0.012
2,4-Dimethylphenol	92	2	0.017	0.270	0.144	0.144
2,4-Dinitrophenol	79	0	NA	NA	NA	NA
2,6-Dinitrotoluene	93	0	NA	NA	NA	NA
2-Nitrophenol	93	1	0.025	0.025	0.025	0.025
4-Chloro-m-Cresol	93	20	0.247	3,834	637	73.9
4-Nitrophenol	85	0	NA	NA	NA	NA
Acenaphthene	93	5	0.006	1.82	0.396	0.025
Acrolein	88	1	0.168	0.168	0.168	0.168
Anthracene	93	1	0.007	0.007	0.007	0.007
Benzyl Butyl Phthalate	92	7	0.024	2.73	0.440	0.065
Bis(2-ethylhexyl) Phthalate	92	73	0.007	216	5.82	0.173
Chlorobenzene	93	0	NA	NA	NA	NA
Chloroethane	93	0	NA	NA	NA	NA
Chloroform	93	6	0.010	0.038	0.019	0.016
Di-n-butyl Phthalate	92	9	0.011	0.193	0.079	0.059
Di-n-octyl Phthalate	93	10	0.013	19.7	2.37	0.332
Dimethyl Phthalate	89	0	NA	NA	NA	NA
Ethylbenzene	94	19	0.010	14.0	0.798	0.040
Fluoranthene	92	0	NA	NA	NA	NA
Fluorene	93	7	0.010	9.93	1.47	0.034
Isophorone	89	0	NA	NA	NA	NA
Methylene Chloride	93	0	NA	NA	NA	NA
n-Nitrosodimethylamine	89	0	NA	NA	NA	NA

**Table 5-4 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Organic Priority Pollutants (continued)						
Naphthalene	93	15	0.010	8.91	1.04	0.075
Phenanthrene	93	18	0.012	5.30	0.459	0.030
Phenol	92	41	0.020	27.1	1.09	0.136
Pyrene	92	2	0.031	1.01	0.521	0.521
Tetrachloroethene	93	1	0.006	0.006	0.006	0.006
Toluene	94	23	0.006	14.0	0.795	0.040
Trichloroethylene	93	0	NA	NA	NA	NA
Metal Priority Pollutants						
Antimony	97	38	0.002	0.234	0.030	0.022
Arsenic	97	46	0.002	0.534	0.048	0.006
Beryllium	97	20	0.0002	0.187	0.036	0.002
Cadmium	101	67	0.002	12.1	0.744	0.023
Chromium	101	85	0.003	15.9	0.630	0.063
Copper	101	101	0.027	232	19.7	0.407
Lead	101	74	0.006	210	16.2	0.247
Mercury	97	23	0.0001	0.003	0.001	0.0007
Nickel	101	77	0.012	18.4	0.870	0.172
Selenium	97	14	0.001	0.124	0.027	0.008
Silver	101	18	0.004	2.80	0.273	0.022
Thallium	97	6	0.001	0.068	0.012	0.001
Zinc	101	98	0.123	664	22.7	1.66
Conventional Pollutants						
BOD 5-Day (Carbonaceous)	82	74	4.00	34,800	3,137	641
Oil and Grease (as HEM)	97	95	8.33	261,500	10,686	848
Total Suspended Solids	101	99	6.00	100,000	3,251	275
Nonconventional Organic Pollutants						
1-Bromo-2-Chlorobenzene	88	0	NA	NA	NA	NA
1-Bromo-3-Chlorobenzene	88	0	NA	NA	NA	NA
1-Methylfluorene	88	12	0.010	1.72	0.188	0.019

**Table 5-4 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Nonconventional Organic Pollutants (continued)						
1,4-Dioxane	88	2	0.069	0.465	0.267	0.267
2-Butanone	88	13	0.073	6.18	1.22	0.308
2-Hexanone	88	2	0.505	0.512	0.509	0.509
2-Isopropyl-naphthalene	88	2	0.421	3.49	1.96	1.96
2-Methylnaphthalene	89	21	0.011	440	21.9	0.099
2-Propanone	88	74	0.060	28.8	3.84	0.670
3,6-Dimethylphenanthrene	88	5	0.013	1.28	0.583	0.371
4-Methyl-2-Pentanone	88	13	0.072	6.72	0.660	0.113
Acetophenone	88	3	0.014	0.092	0.051	0.047
Alpha-terpineol	88	33	0.011	189	19.4	1.43
Aniline	88	1	0.014	0.014	0.014	0.014
Benzoic Acid	88	4	0.098	0.522	0.315	0.320
Benzyl Alcohol	88	7	0.011	10.8	1.63	0.141
Biphenyl	88	10	0.014	1.54	0.226	0.060
Carbon Disulfide	88	5	0.045	0.466	0.312	0.369
Dibenzofuran	88	2	0.014	0.018	0.016	0.016
Dibenzothiophene	87	3	0.015	1.29	0.452	0.048
Diphenyl Ether	88	0	NA	NA	NA	NA
Diphenylamine	88	4	0.738	1.99	1.54	1.71
Hexanoic Acid	88	34	0.011	31.9	4.27	0.561
Isobutyl Alcohol	88	0	NA	NA	NA	NA
m+p Xylene	40	10	0.038	0.241	0.125	0.139
m-Xylene	48	6	0.018	0.312	0.071	0.024
Methyl Methacrylate	88	0	NA	NA	NA	NA
n,n-Dimethylformamide	88	2	0.014	0.023	0.019	0.019
n-Decane	88	36	0.011	27.7	2.65	0.130
n-Docosane	88	44	0.012	79.7	2.78	0.125
n-Dodecane	88	52	0.017	207	21.0	0.594
n-Eicosane	87	59	0.010	109	5.95	0.217
n-Hexacosane	88	34	0.011	217	8.54	0.134

**Table 5-4 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Nonconventional Organic Pollutants (continued)						
n-Nitrosopiperidine	88	0	NA	NA	NA	NA
n-Octacosane	88	10	0.031	70.7	12.9	0.266
n-Octadecane	88	67	0.011	162	5.66	0.214
n-Tetracosane	87	32	0.011	56.8	3.29	0.248
n-Tetradecane	88	64	0.011	243	15.0	0.203
n-Triacontane	87	11	0.016	25.6	5.15	1.21
o+p Xylene	48	6	0.011	0.030	0.021	0.021
o-Cresol	88	0	NA	NA	NA	NA
o-Xylene	40	12	0.012	0.130	0.059	0.046
p-Cresol	88	7	0.018	1.09	0.413	0.287
p-Cymene	88	12	0.015	14.6	1.29	0.052
Pyridine	88	15	0.014	3.42	1.02	0.063
Styrene	88	0	NA	NA	NA	NA
Trichlorofluoromethane	93	0	NA	NA	NA	NA
Tripropyleneglycol Methyl Ether	88	14	0.447	1,680	328	4.96
Nonconventional Metal Pollutants						
Aluminum	97	82	0.076	134	13.0	2.48
Barium	97	96	0.006	32.0	1.89	0.217
Boron	97	95	0.057	686	34.0	5.50
Calcium	97	96	0.154	2,200	156	41.0
Cobalt	97	41	0.008	1.22	0.203	0.102
Gold	2	1	2.81	2.81	2.81	2.81
Iron	97	95	0.604	940	47.7	10.6
Magnesium	97	94	0.180	255	36.1	12.9
Manganese	101	99	0.031	29.0	1.68	0.349
Molybdenum	101	80	0.003	40.3	1.25	0.088
Sodium	97	96	1.19	2,030	397	181
Tin	101	58	0.003	85.2	3.05	0.053
Titanium	97	72	0.003	1.80	0.228	0.081
Vanadium	97	48	0.004	0.482	0.054	0.019

**Table 5-4 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Other Nonconventional Pollutants						
Amenable Cyanide	4	0	NA	NA	NA	NA
Ammonia as Nitrogen	15	15	0.021	160	32.7	0.500
Chemical Oxygen Demand (COD)	96	96	30.0	213,000	23,722	5,660
Chloride	11	11	22.0	450	83.1	27.0
Cyanide	4	2	0.006	0.007	0.007	0.007
Fluoride	16	16	0.500	17.0	2.54	1.00
Hexavalent Chromium	78	12	0.011	1.74	0.212	0.020
Sulfate	39	38	16.0	176,000	13,957	405
Total Dissolved Solids	93	93	70.0	88,800	9,341	2,450
Total Kjeldahl Nitrogen	15	15	0.840	1,500	222	3.10
Total Organic Carbon (TOC)	81	79	7.66	106,000	6,181	1,340
Total Petroleum Hydrocarbons (as SGT-HEM)	81	75	5.07	25,431	1,941	507
Total Phosphorus	24	24	0.160	240	38.9	25.6
Total Recoverable Phenolics	95	91	0.005	1,360	58.6	0.240
Total Sulfide	27	24	2.00	18.0	7.13	5.50

Source: MP&M Sampling Program.

<sup>a</sup>Due to budgetary constraints, EPA did not analyze all samples for all pollutants.

NA - Not applicable.

## 6.0 INDUSTRY SUBCATEGORIZATION

This section discusses the subcategorization evaluated for the final rule (MP&M Point Source Category). Section 6.1 discusses the methodology and factors considered when determining the subcategories evaluated for the final rule. Section 6.2 describes the types of facilities included in each subcategory evaluated for the final rule.

As discussed below, EPA proposed effluent limitations and standards for eight subcategories. However, for reasons discussed in Section 9.0 and Section VI of the preamble to the final rule, the final rule only establishes effluent limitations guidelines and standards for new and existing direct dischargers in one subcategory: Oily Wastes (40 CFR 438, Subpart A).

### 6.1 Methodology and Factors Considered for Basis of Subcategorization

In order to address variations between products, raw materials processed, and other factors that result in distinctly different effluent characteristics, EPA proposed eight groupings called “subcategories” for the January 2001 proposal and June 2002 Notice of Data Availability (NODA). EPA retained this subcategory structure for evaluating options for the final rule. Regulation of a category using subcategories allows each subcategory to have a uniform set of effluent limitations that take into account technological achievability and economic impacts unique to that subcategory. The Clean Water Act (CWA) requires EPA, in developing effluent limitations guidelines and pretreatment standards, to consider a number of different subcategorization factors. The statute also authorizes EPA to take into account other factors the Agency deems appropriate. EPA considered the following factors in evaluating the eight subcategories for the final rule:

- Unit operation;
- Activity;
- Raw materials;
- Products;
- Size of site;
- Geographic location;
- Facility age;
- Nature of the waste generated;
- Economic impacts;
- Treatment costs;
- Total energy requirements;
- Air pollution control methods; and
- Solid waste generation and disposal.

As a result of this evaluation, EPA retained the eight subcategories for evaluating options for the final rule as shown in Table 6-1.

**Table 6-1****Final Subcategories Evaluated in the Final Rule**

<b>Facilities that Generate Metal-Bearing Wastewater (With or Without Oil-Bearing Wastewater)</b>	<b>Facilities that Generate Only Oil-Bearing Wastewater</b>
General Metals <sup>a</sup>	Oily Wastes
Metal Finishing Job Shops <sup>a</sup>	Railroad Line Maintenance <sup>a</sup>
Non-Chromium Anodizing <sup>a</sup>	Shipbuilding Dry Dock <sup>a</sup>
Printed Wiring Board <sup>a</sup>	
Steel Forming and Finishing <sup>a</sup>	

<sup>a</sup>For reasons discussed in Section 9.0 and Section VI of the preamble to the final rule, EPA did not establish effluent guidelines for these subcategories.

### **6.1.1 Factors Contributing to the Subcategorization Structure Evaluated for the Final Rule**

As discussed in Section 5.0 and Appendix C, facilities performing proposed MP&M operations<sup>1</sup> generate two basic types of waste streams: (1) wastewater with relatively high metals content (metal-bearing, including hexavalent chromium-bearing and cyanide-bearing), and (2) wastewater with relatively low metals content and/or relatively high oil and grease content (oil-bearing). The type of wastewater a facility generates is directly related to the unit operations it performs. For example, unit operations such as machining, grinding, aqueous degreasing, and impact or pressure deformation tend to generate a wastewater with relatively high oil and grease (and associated organic pollutants) loadings but relatively low concentrations of metal pollutants. Other unit operations such as electroplating, conversion coating, chemical etching and milling, and anodizing generate higher metals loadings with moderate or low oil and grease concentrations or generate wastewater containing both metals and oil and grease. EPA defined “oily operations” in the final rule (see 40 CFR 438.2(f) and Appendix B to Part 438) and these final MP&M operations are listed in Table 6-2. EPA defined “metal-bearing operations” in the final rule (see 40 CFR 438.2(d) and Appendix C to Part 438) and these proposed MP&M operations are listed in Table 6-3.

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<sup>1</sup>EPA evaluated a number of unit operations for the May 1995 proposal, January 2001 proposal, and June 2002 NODA (see Tables 6-2 and 6-3). However, EPA selected a subset of these unit operations for regulation in the final rule (see Section 1.0). For this section, the term “proposed MP&M operations” means those operations evaluated for the two proposals, NODA, and final rule. The term “final MP&M operations” means those operations defined as “oily operations” (see Section 1.0, 40 CFR 438.2(f), and Appendix B to Part 438) and regulated by the final rule.



**Table 6-2****Oily Operations as Defined by the Final Rule**

• Abrasive Blasting	• Iron Phosphate Conversion Coating
• Adhesive Bonding	• Machining
• Alkaline Cleaning for Oil Removal	• Painting-spray or Brush (Including Water Curtains)
• Alkaline Treatment Without Cyanide	• Polishing
• Aqueous Degreasing	• Pressure Deformation
• Assembly/Disassembly	• Solvent Degreasing
• Burnishing	• Steam Cleaning
• Calibration	• Testing (e.g., Hydrostatic, Dye Penetrant, Ultrasonic, Magnetic Flux)
• Corrosion Preventive Coating	• Thermal Cutting
• Electrical Discharge Machining	• Tumbling/Barrel Finishing/Mass Finishing/Vibratory Finishing
• Floor Cleaning (In Process Area)	• Washing (Finished Products)
• Grinding	• Welding
• Heat Treating	• Wet Air Pollution Control for Organic Constituents
• Impact Deformation	

Note: This list is replicated at 40 CFR 438.2(f) with definitions at Appendix B to Part 438.

**Table 6-3****Metal-Bearing Operations as Defined by the Final Rule**

• Abrasive Jet Machining	• Mechanical and Vapor Plating
• Acid Pickling Neutralization	• Metallic Fiber Cloth Manufacturing
• Acid Treatment With Chromium	• Metal Spraying (including Water Curtain)
• Acid Treatment Without Chromium	• Painting-immersion (including Electrophoretic, "E-coat")
• Alcohol Cleaning	• Photo Imaging
• Alkaline Cleaning Neutralization	• Photo Image Developing
• Alkaline Treatment With Cyanide	• Photoresist Application
• Anodizing With Chromium	• Photoresist Strip
• Anodizing Without Chromium	• Phosphor Deposition
• Carbon Black Deposition	• Physical Vapor Deposition
• Catalyst Acid Pre-dip	• Plasma Arc Machining
• Chemical Conversion Coating Without Chromium	• Plastic Wire Extrusion
• Chemical Milling (or Chemical Machining)	• Salt Bath Descaling
• Chromate Conversion Coating (or Chromating)	• Shot Tower - Lead Shot Manufacturing
• Chromium Drag-out Destruction	• Soldering
• Cyanide Drag-out Destruction	• Solder Flux Cleaning
• Cyaniding Rinse	• Solder Fusing
• Electrochemical Machining	• Solder Masking
• Electroless Catalyst Solution	• Sputtering
• Electroless Plating	• Stripping (Paint)
• Electrolytic Cleaning	• Stripping (Metallic Coating)
• Electroplating With Chromium	• Thermal Infusion
• Electroplating With Cyanide	• Ultrasonic Machining
• Electroplating Without Chromium or Cyanide	• Vacuum Impregnation
• Electropolishing	• Vacuum Plating
• Galvanizing/Hot Dip Coating	• Water Shedder
• Hot Dip Coating	• Wet Air Pollution Control
• Kerfing	• Wire Galvanizing Flux
• Laminating	

Note: This list is replicated at 40 CFR 438.2(d) with definitions at Appendix C to Part 438.

Although many facilities performing proposed MP&M operations generate both metal- and oil-bearing wastewater, a large number of facilities, typically machine shops and maintenance and repair facilities, only generate process wastewater from oily operations (see Table 6-2). Because the wastewater at these facilities primarily contains oil and grease and other organic constituents, these facilities use treatment technologies that focus on oil removal only and do not include the chemical precipitation step needed to treat metal-bearing wastewater. These treatment technologies generally include oil skimming, chemical emulsion breaking followed by either gravity flotation, coalescing plate oil/water separators, dissolved air flotation (DAF), or ultrafiltration. Therefore, EPA first divided facilities on the basis of unit operations performed and the nature of the wastewater generated, resulting in the following two wastewater groups: (1) metal-bearing (with or without oily and organic constituents) group; and (2) oil-bearing only group. EPA then identified any significant differences in the subcategorization factors within the two basic groups.

### **Metal-Bearing Wastewater (With or Without Oil-Bearing Wastewater)**

When evaluating facilities generating metal-bearing wastewater (with or without oil-bearing wastewater) for the final rule, EPA identified five groups of facilities that could potentially be subcategorized by dominant product, raw materials used, and/or nature of the waste generated: steel forming and finishing facilities, non-chromium anodizing facilities, metal finishing job shops, printed wiring board facilities, and general metals facilities. In two of these groups (non-chromium anodizing and metal finishing job shops), EPA also considered economic impacts as a subcategorization factor because of the reduced ability of these facilities to afford treatment costs. EPA describes its rationale for subcategorizing each of these groups below (see Section 6.2 for additional detailed discussion and applicability). In general, EPA identified four distinct groups within the metal-bearing group that warranted splitting out from the rest of this group.

### **Steel Forming and Finishing Facilities**

EPA proposed moving certain finishing operations subject to the Iron and Steel Manufacturing effluent guidelines (40 CFR 420) into the scope of the MP&M regulations because EPA's analyses, at that time, showed these operations to be more similar to MP&M operations than to iron and steel operations (see W-00-25, Section 14.1, DCN IS10883). In the MP&M proposed rule, these operations (at stand-alone facilities and at steel manufacturing facilities) would have been subject to the limits and standards in the proposed Steel Forming and Finishing Subcategory. This subcategory would have applied to wastewater discharges from finishing or cold forming operations on steel wire, rod, bar, pipe, or tube. In order to better assess potential economic impacts associated with the final rule, EPA concluded that facilities performing these operations should be evaluated as a separate subcategory when EPA selected options for the final rule.

Commentors on the proposed rule stated that these operations and resulting wastewaters are comparable to those at facilities subject to the Iron and Steel Manufacturing

effluent guidelines and that these discharges should remain subject to Part 420 rather than the final MP&M rule. In addition, commentors stated that Part 420 adequately protects the environment from discharges associated with these activities.

For reasons discussed in Section 9.0, EPA is not revising limitations or standards for any facilities that would have been subject to this subcategory. Such facilities will continue to be regulated by the General Pretreatment Standards (Part 403), local limits, permit limits, and Iron and Steel effluent limitations guidelines (Part 420) as applicable.

### **Non-Chromium Anodizing Facilities**

The non-chromium anodizers differ from other metal-bearing facilities performing proposed MP&M operations in that all of their products are primarily of one metal type, anodized aluminum, and, most importantly, they do not use chromic acid, dichromate sealants, or other process solutions containing significant concentrations of chromium in their anodizing process. Table 6-4 shows the percentage of facilities using multiple metal types by subcategory. EPA's data show that these facilities have very low levels of metals (with the exception of aluminum) and toxic organic pollutants in their wastewater discharges, while other facilities performing proposed MP&M operations have much greater concentrations of a wider variety of metals.

**Table 6-4**

### **Percentage of Facilities Performing Proposed MP&M Operations Using Multiple Metal Types by Subcategory**

Subcategory	Percentage of Facilities by Number of Metal Types Processed					
	1	2	3	4	5-10	>10
General Metals	31	32	13	8	15	1
Metal Finishing Job Shops	6	18	17	13	38	7
Non-Chromium Anodizing	100	0	0	0	0	0
Oily Wastes	46	17	32	3	2	0
Printed Wiring Board	4	1	20	17	56	2
Railroad Line Maintenance	76	8	16	0	0	0
Shipbuilding Dry Dock	57	0	29	14	0	0
Steel Forming and Finishing	56	25	14	3	3	0

Source: MP&M Survey Database.

In addition, non-chromium anodizing facilities require more extensive wastewater treatment systems than other metal-bearing facilities performing proposed MP&M operations to remove both very high concentrations of aluminum (and resulting large volumes of wastewater treatment sludge) and relatively low levels of alloy metals generated in their wastewater. As a

result, these facilities have relatively higher treatment costs compared to other metal-bearing facilities. EPA also found that, due to their current economic state, non-chromium anodizing facilities are less able to afford pollutant control technologies as compared to other types of facilities (see the Economic, Environmental, and Benefits Analysis for the Final Metal Products & Machinery Rule (EEBA) (EPA-821-B-03-002)). Therefore, based on the differences in raw materials used, nature of the waste generated, treatment costs, and economic conditions, EPA concluded that non-chromium anodizing facilities should be evaluated as a separate subcategory when EPA selected options for the final rule.

For reasons discussed in Section 9.0, EPA is not revising limitations or standards for any facilities that would have been subject to this subcategory. Such facilities will continue to be regulated by the General Pretreatment Standards (Part 403), local limits, permit limits, and Parts 413 and/or 433, as applicable.

### **Metal Finishing Job Shops**

EPA investigated whether to subcategorize the metal finishing and electroplating job shops covered currently by the Metal Finishing (40 CFR 433) and Electroplating (40 CFR 413) effluent guidelines (with the exception of printed circuit board manufacturers, which were analyzed as a separate subcategory as discussed below). Although these facilities have metal types that require the same treatment technologies as many other metal-bearing facilities, EPA determined that they can be different due to the variability of their raw materials and products as well as their current economic state compared to other metal-bearing facilities performing proposed MP&M operations. Metal finishing and electroplating job shops perform electroplating, electroless plating, anodizing, coating, and chemical etching and milling, and are “job shops” as defined in the Metal Finishing effluent guidelines (i.e., as owning less than 50 percent of the products processed on site).

Because metal finishing job shops work on a contract basis, they cannot always predict the type of plating or other finishing operations required. In addition, because these facilities work on a large variety of metal types from various customers, their wastewater characteristics can vary from week to week (or even day to day). Table 6-5 demonstrates the variety of metal types processed at metal finishing job shops as compared to the rest of the industry. EPA performed sampling to specifically identify the variability in the wastewater generated at metal finishing job shops, and found that the variability factors calculated solely on the analytical wastewater sampling data from metal finishing and electroplating job shops are higher for most pollutant parameters than those calculated for other metal-bearing subcategories (see Section 10.1 for a discussion of EPA’s variability factor calculations). In addition, EPA found that, due to the current economic state, metal finishing job shops are less able to afford pollutant control technologies compared to other metal-bearing subcategories (see the EEBA). For these reasons, EPA concluded that metal finishing and electroplating job shops should be evaluated as a separate subcategory when EPA selected options for the final rule.

**Table 6-5**

**Percentage of Facilities Performing Proposed MP&M Operations by  
Subcategory Using Each Metal Type**

Metal	Percentage of Facilities by Subcategory							
	General Metals	Metal Finishing Job Shops	Non-Chromium Anodizing	Oily Wastes	Printed Wiring Board	Railroad Line Maintenance	Shipbuilding Dry Dock	Steel Forming and Finishing
Aluminum	69	154	88	67	17	32	14	3
Beryllium	< 1	0	0	0	0	0	0	0
Cadmium	2	12	0	0	0	0	0	3
Chromium	9	21	0	< 1	4	0	0	10
Cobalt	4	0	0	1	2	0	0	3
Copper	29	50	0	20	99	8	43	10
Gold	4	13	0	< 1	73	0	0	0
Indium	< 1	0	0	< 1	0	0	0	0
Iron	82	94	12	96	5	100	100	100
Lead	6	4	0	1	72	0	0	1
Magnesium	3	6	0	1	0	0	0	0
Manganese	< 1	0	0	< 1	1	0	0	0
Molybdenum	1	0	0	0	5	0	0	0
Nickel	17	54	0	5	79	0	43	5
Palladium	1	0	0	1	5	0	0	0
Platinum	1	1	0	0	0	0	0	0
Rhodium	1	7	0	0	3	0	0	0
Selenium	< 1	0	0	0	0	0	0	0
Silver	3	17	0	< 1	10	0	0	0
Tantalum	1	0	0	< 1	0	0	0	0
Tin	15	29	0	2	89	0	0	5
Titanium	3	3	0	2	0	0	0	3
Tungsten	1	0	0	< 1	0	0	0	0
Vanadium	0	0	0	< 1	0	0	0	0
Zinc	18	59	0	3	4	0	0	29
Zirconium	< 1	0	0	< 1	0	0	0	0

Source: MP&amp;M Survey Database.

For reasons discussed in Section 9.0, EPA is not revising any limitations or standards for facilities that would have been subject to this subcategory. Such facilities will continue to be regulated by the General Pretreatment Standards (Part 403), local limits, permit limits, and Parts 413 and/or 433, as applicable.

### **Printed Wiring Board Facilities**

EPA subcategorized printed wiring board facilities based on raw materials, unit operations performed, primary product, and nature of the waste generated. First, as shown in Table 6-5, printed wiring board facilities process a more consistent set of metal types (copper, tin, lead, nickel, and gold) than other metal-bearing facilities. EPA concluded that this consistent mix of metal types enables printed wiring board facilities to tailor their treatment technology. Printed wiring board facilities generally work with copper-clad laminate material, allowing them to target copper for removal in their wastewater treatment systems or recover the copper using in-process ion exchange.

Second, printed wiring board facilities apply, develop, and strip photoresist - a set of unit operations that is unique to this subcategory. This process produces a higher concentration of a more consistent group of organic constituents than other facilities in the metal-bearing group. Printed wiring board facilities also require chelation breaking more often than other facilities performing proposed MP&M operations. Finally, the nature of the wastewater generated at these facilities may also be different because these facilities perform more lead-bearing operations (e.g., lead/tin electroplating, wave soldering) than other facilities performing proposed MP&M operations. For these reasons, EPA concluded that printed wiring board facilities should be evaluated as a separate subcategory when EPA selected options for the final rule.

At proposal, EPA included printed wiring board job shops in the Metal Finishing Job Shops Subcategory based on the similar economic considerations for job shops. However, information submitted by commentors in response to the proposed rule indicates that printed wiring board job shops are much more similar to Printed Wiring Board Subcategory facilities than to metal finishing job shops when considering their wastewater characteristics and operations. Therefore, for the final rule, EPA included printed wiring board job shops in the Printed Wiring Board Subcategory evaluated for the final rule.

For reasons discussed in Section 9.0, EPA is not revising any limitations or standards for facilities that would have been subject to this subcategory. Such facilities will continue to be regulated by the General Pretreatment Standards (Part 403), local limits, permit limits, and Parts 413 and/or 433, as applicable.

### **General Metals Facilities**

After developing separate subcategories for non-chromium anodizing facilities, metal finishing job shops, printed wiring board facilities, and steel forming and finishing

facilities, EPA grouped the remaining metal-bearing wastewater generating facilities performing proposed MP&M operations into a subcategory entitled “General Metals” for evaluating options for the final rule. This subcategory would be a “catch-all” for metal-bearing wastewater-generating facilities that do not fall into any of the previous subcategories. For example, wastewater generated from most manufacturing operations and heavy rebuilding operations (e.g., aircraft, aerospace, auto, bus/truck, railroad) would be grouped under the General Metals Subcategory.

Based on comments received on the proposed rule, EPA reviewed the unit operations of printed wiring assembly facilities and determined that they are most similar to the facilities in the General Metals Subcategory (discussed below). Printed wiring assembly facilities do not manufacture printed circuit boards, but instead attach circuit boards to other structures. Therefore, they do not perform the operations typical of a printed wiring board facility (e.g., applying photoresist, etching the board, or stripping). At proposal, EPA included most printed wiring assembly facilities in the General Metals Subcategory; however, some were included in the Printed Wiring Board Subcategory. For the final rule, EPA included all printed wiring assembly facilities in the General Metals Subcategory.

As discussed in the NODA (67 FR 38767), EPA considered establishing a segment of the Steel Forming and Finishing Subcategory for discharges resulting from continuous electroplating of flat steel products (e.g., strip, sheet, and plate). EPA reexamined its database for facilities that perform continuous steel electroplating, and found that, contrary to its initial finding, continuous electroplaters do not perform operations similar to other facilities in this subcategory (i.e., steel forming and finishing facilities performing cold forming on steel wire, rod, bar, pipe, and tube) (see Section 24.6.1 of the rulemaking record, DCN 17919). Thus, EPA included continuous electroplaters performing electroplating and coating operations in the General Metals Subcategory for evaluating options for the final rule.

As also discussed in the NODA, EPA also considered an additional subcategory for facilities that primarily perform zinc electroplating (“zinc platers”). EPA uses the term “zinc platers” to describe facilities where over 95 percent of their wastewater is generated from zinc electroplating lines. Most of these facilities follow electroplating with chromium conversion coating. Depending on whether or not these facilities operate as a captive or a job shop, EPA had proposed to include them as part of the General Metals or Metal Finishing Job Shops Subcategories, respectively. The wastewater characteristics of zinc platers differ from other facilities in these two subcategories, particularly with respect to their concentrations of zinc. Where nonzinc platers may have concentrations of 10 to 90 mg/l zinc in their wastewater prior to treatment, zinc platers have concentrations of 100 to 800 mg/l zinc in their wastewater prior to treatment. However, zinc platers have very low concentrations of other pollutants as compared to nonzinc platers.

The NODA explained that EPA was also considering: (1) creating a separate subcategory for zinc platers; (2) segmenting zinc platers within the General Metals and Metal Finishing Job Shops Subcategories; or (3) retaining the proposed subcategory structure and



establishing numerical limitations and standards for zinc that would be achievable by zinc platers. NODA commentors supported retaining the proposed subcategories as long as zinc platers could achieve the zinc numerical limitations and standards. Commentors raised concerns that creating a separate subcategory or segment to address the limitations for one pollutant would be confusing and difficult to implement. EPA did not create a separate subcategory or segment for zinc platers in evaluating the data for the final rule. EPA included zinc platers in the General Metals or Metal Finishing Job Shops Subcategories, as applicable, for evaluating options for the final rule.

For reasons discussed in Section 9.0, EPA is not revising or establishing any limitations or standards for facilities that would have been subject to this subcategory. Such facilities will continue to be regulated by the General Pretreatment Standards (Part 403), local limits, permit limits, and Parts 413 and/or 433, as applicable.

In summary, EPA divided facilities that generate metal-bearing wastewater, with or without oil-bearing wastewater, into the following five subcategories: (1) non-chromium anodizing facilities; (2) metal finishing job shops; (3) printed wiring board facilities; (4) steel forming and finishing; and (5) general metals facilities.

### **Oil-Bearing Wastewater Only Group**

When evaluating facilities generating oil-bearing wastewater for the final rule, EPA identified three groups of facilities that could potentially be subcategorized by size, location, and dominant product or activity: railroad line maintenance facilities, shipbuilding dry docks or similar structures, and oily wastes facilities (see Section 6.2 for detailed descriptions of these subcategories).

Railroad line maintenance facilities perform routine cleaning and light maintenance on railroad engines, cars, car-wheel trucks, or similar parts or machines, and discharge wastewater exclusively from oily operations (see Section 1.0). EPA subcategorized railroad line maintenance facilities due to their outdoor location, unit operations performed, and low level of pollutant loadings they discharge to the environment. EPA also determined that the railroad line maintenance facilities discharge a much more limited range of organic pollutants than general oily-wastewater-bearing facilities. These facilities perform only one or more of the following operations: assembly/disassembly, floor cleaning, maintenance machining (wheel truing), touch-up painting, and washing. In addition, because some of these operations are typically performed outdoors, stormwater collection and treatment is of concern for this subcategory. Therefore, EPA included railroad line maintenance facilities in the Railroad Line Maintenance Subcategory evaluated for the final rule. EPA notes that this subcategory does not include railroad manufacturing facilities or railroad overhaul or heavy maintenance facilities.

The second type of facility is dry docks (and similar structures such as graving docks, building ways, lift barges, and marine railways). These are large, outdoor areas, exposed to precipitation, where shipyards perform final assembly, maintenance, rebuilding, and repair

work on large ships and boats. In evaluating options for the final rule, EPA grouped shipbuilding dry docks and similar structures in the Shipbuilding Dry Dock Subcategory due to their size, outdoor location, low level of pollutant loadings they discharge to the environment, and the fact this wastewater is unique to the shipbuilding industry. This subcategory does not include other proposed MP&M operations that occur at shipyards (e.g., shore-side operations such as electroplating).

The facilities that generate only oil-bearing wastewater but are not dry docks or railroad line maintenance facilities fall into the Oily Wastes Subcategory (40 CFR 438, Subpart A). These facilities meet the applicability criteria in Section 438.1 and discharge only oil-bearing wastewater and perform one or more oily operations listed in Table 6-2.

EPA received comments at proposal concerning the definition of “oily operations” used in the applicability statement of the Oily Wastes Subcategory (see Section 6.2.5). Commentors provided data on several proposed MP&M operations that were not considered “oily operations” in the proposed rule. These operations include:

- Abrasive blasting;
- Adhesive bonding;
- Alkaline treatment without cyanide;
- Assembly/disassembly;
- Burnishing;
- Calibration;
- Electrical discharge machining;
- Iron phosphate conversion coating;
- Painting-spray or brush (including water curtains);
- Polishing;
- Thermal cutting;
- Tumbling/barrel finishing/mass finishing/vibratory finishing;
- Washing (finished products);
- Welding; and
- Wet air pollution control for organic constituents.

The data show low levels of metals in these unit operations. Based on the data received and a review of other unit operations containing only low metals content, EPA revised the definition of “oily operations” in the Oily Wastes Subcategory (see 40 CFR 438.2(f)) to incorporate these additional unit operations considered in the NODA, with the exception of bilge water. Bilge water from ships that are afloat is not considered an in-scope wastewater for any subcategories of the MP&M rule and was inadvertently included in the oily operations definition in the NODA. Bilge water from ships in a dry dock or similar structure is considered for the Shipbuilding Dry Dock Subcategory only.

In addition, EPA is no longer including wastewater from laundering as part of the oily operations definition because EPA does not consider it to be a process wastewater under this rule (67 FR 38766).

For reasons discussed in Section 9.0, EPA is only promulgating limitations and standards for existing and new direct dischargers in the Oily Wastes Subcategory. EPA is not promulgating pretreatment standards for existing or new indirect dischargers in this subcategory.

In summary, EPA divided facilities that generate only oil-bearing wastewater into the following three subcategories: (1) railroad line maintenance facilities; (2) shipbuilding dry docks (and similar structures); and (3) oily wastes facilities.

For reasons discussed in Section 9.0, EPA is not establishing limitations or standards for any facilities in two subcategories evaluated for the final rule that only discharge oil-bearing wastewater: Railroad Line Maintenance Subcategory and Shipbuilding Dry Dock Subcategory. Permit writers and control authorities will establish controls using best professional judgment (BPJ) to regulate wastewater discharges from these facilities.

### **6.1.2 Factors That are Not a Basis For MP&M Subcategorization**

During its consideration of the final rule, EPA examined the other factors listed earlier in this section for possible basis of subcategorization. The Agency determined that there was no basis for subcategorizing facilities performing proposed MP&M operations based on the following factors: geographic location, age of facilities, total energy requirements, air pollution control methods, and solid waste generation and disposal. These factors are discussed below. In addition, EPA also considered subcategorizing the facilities performing proposed MP&M operations according to the 18 industrial sectors proposed in the January 2001 proposal (66 FR 424). As described in Section 1.0, EPA did not regulate the following industrial sectors (Job Shops, Printed Wiring Board Manufacturing, and Steel Forming & Finishing) as part of the final rule. As discussed in Section 6.1.1, and further discussed below, EPA determined for evaluating options for the final rule that subcategorization based on sectors was appropriate for only one sector (printed wiring boards), and for portions of three other sectors (railroad, ships and boats, and job shops).

For the Steel Forming and Finishing Subcategory, EPA did not have sector information from the Iron and Steel Surveys; therefore, EPA evaluated the steel forming and finishing sites as their own subcategory for the proposed and final rule. EPA concluded that the basis for subcategorization is the difference in the raw material and primary product at these facilities. Facilities in this proposed subcategory primarily process steel and, for the most part, produce uniformly shaped products such as wire, rod, bar, pipe, and tube. In addition, this is the only subcategory for which EPA proposed to cover forming operations under the MP&M regulations.

## **Geographic Location**

Facilities performing proposed MP&M operations are located throughout the United States. Sites are not limited to any one geographical location, but approximately half are located east of the Mississippi River, with additional concentrations of facilities in Texas, Colorado, and California. EPA did not subcategorize based on geographic location because location does not affect the ability of facilities to comply with the MP&M final rule. EPA's data show that well-performing facilities are located throughout the United States.

Geographic location may impact costs if additional land is required to install treatment systems, because the cost of the land will vary depending on whether the site is located in an urban or rural location. However, the treatment systems used to treat wastewater typically do not have large land requirements, as demonstrated by the fact that many facilities performing proposed MP&M operations are located in urban settings. The Agency, however, recognizes that spatial constraints may present a problem for certain facilities and believes this issue should be evaluated on a case-by-case basis.

Water availability is another function of geographical location. Limited water supply encourages efficient use of water. The Agency encourages installing water recycle and reuse practices. Some technology options evaluated for the final rule include pollution prevention and water conservation because these practices tend to reduce treatment costs and improve pollutant removals.

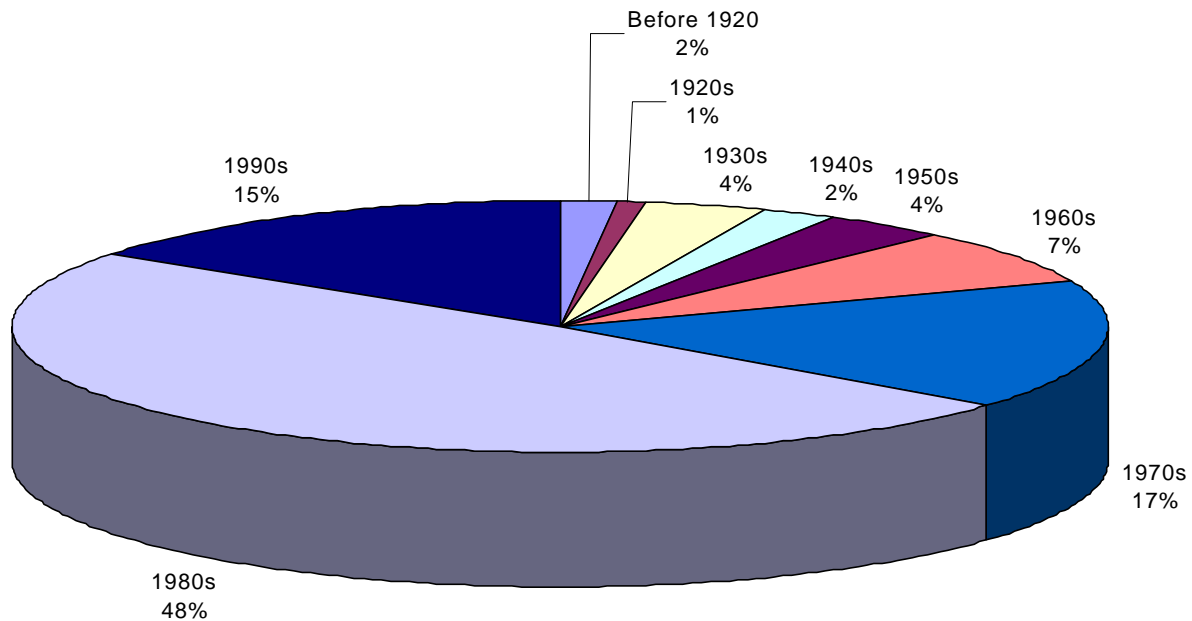
## **Facility Age**

Figure 6-1 presents the percentage of water-discharging facilities by the decade in which they were built. This information is based upon responses to MP&M surveys that reported the date the facility was built.

Most facilities have been built since 1970. Although the survey respondents reported a wide range of ages, these facilities must be continually modernized to remain competitive. Most of the facilities EPA visited during the MP&M site visit program had recently modernized some area of their site. Modernizing production processes and air pollution control equipment results in generation of similar process waste types regardless of the site's age. Therefore, EPA did not select facility age as a basis for subcategorization. EPA's data show that well-performing facilities include both older and newer facilities.

## **Total Energy Requirements**

EPA did not select total energy requirements as a basis for subcategorization because the estimated increase in energy consumption for the final rule is trivial (< 0.001 percent) as compared to national energy usage (see Section 13.0). EPA estimated the energy requirements associated with each MP&M technology option and considered these in estimating compliance costs (see Section 11.0).



Source: MP&M Survey Database.

Note: Although there are 44,000 wastewater-discharging facilities performing proposed MP&M operations, only 42,282 are represented in the above pie chart. Several 1989 and 1996 Long Survey and several Municipality Survey recipients did not provide this information.

**Figure 6-1. Percentage of Wastewater-Discharging Facilities Evaluated for the Final Rule by Decade Built**

### **Air Pollution Control Methods**

Many facilities control air emissions using wet air pollution control units that affect the wastewater flow rate from the site. However, based on data collected during the MP&M sampling program, wastewater generated by these devices does not affect the effectiveness of technologies used to control wastewater pollutant loadings from proposed

MP&M operations (see Sections 5.2 and 15.3 of the rulemaking record). EPA considers some wet air pollution control units as proposed MP&M operations, but not as a basis of subcategorizing the category.

### **Industrial Sectors**

EPA considered subcategorizing facilities performing proposed MP&M operations by industrial sector (e.g., aerospace, aircraft, bus and truck, electronic equipment, hardware, household equipment, instruments, job shops, mobile industrial equipment, motor vehicles, office machines, ordnance, precious metals and jewelry, printed wiring boards, railroad, ships and boats, stationary industrial equipment, steel forming and finishing, and miscellaneous metal products). The Agency determined that subcategorization based solely on industrial sector would be complex and confusing because many facilities are in multiple sectors. Adopting such a subcategorization scheme would complicate the implementation of the limitations and standards because permit writers might be required to develop facility-specific limitations across multiple subcategories.

The Agency determined that wastewater characteristics, unit operations, and raw materials used to produce products within a given sector are not always the same from site to site, and they are not always different from sector to sector. Within each sector, facilities can perform a variety of unit operations on a variety of raw materials. For example, a site in the aerospace sector may primarily machine aluminum missile components and not perform any surface treatment other than alkaline cleaning. Another site in that sector may electroplate iron parts for missiles and perform little or no machining. Wastewater characteristics from these facilities may differ because of the different unit operations performed and different raw materials used. As another example, an automobile manufacturer and an automobile repair facility are both part of the motor vehicle sector. However, the automobile manufacturer may perform unit operations that generate metal-bearing and oil-bearing wastewater (aqueous degreasing, electroplating, chemical conversion coating, etc.) while the automobile repair facility may perform unit operations that generate only oil-bearing wastewater (machining, aqueous degreasing, impact deformation, painting, etc.).

Based on the analytical data collected for this rule, EPA has not found a statistically significant difference in industrial wastewater discharge among industrial sectors when performing similar unit operations for cadmium, chromium, copper, cyanide, lead, manganese, molybdenum, nickel, oil and grease, silver, tin, total suspended solids (TSS), and zinc. (The analytical data are available in Sections 5 and 15 of the rulemaking record.) In other words, after dividing facilities performing proposed MP&M operations according to the unit operations performed (metal-bearing or oil-bearing operations), EPA concluded that raw wastewater has similar treatability across all of the industrial sectors. For example, a facility that performs chromium electroplating in the process of manufacturing office machines produces metal-bearing wastewater with similar chemical characteristics as a facility that performs chromium electroplating in the process of manufacturing a part for a bus. Similarly, a facility that performs machining to repair and maintain an airplane engine produces oil-bearing

wastewater that has similar chemical characteristics to a facility that performs machining to repair and maintain construction machinery.

Most proposed MP&M operations are not unique to a particular sector and are performed across all sectors. For example, all sectors perform several of the major wastewater-generating unit operations (e.g., alkaline treatment, acid treatment, machining, electroplating). And, for the most part, the unit operations that are rarely performed (e.g., abrasive jet machining) are not performed in all sectors, but are also not limited to a single sector. Therefore, a facility in any one of the proposed industrial sectors can generate metal-bearing or oil-bearing wastewater (or a combination of both) depending on what unit operations the facility performs.

Due to the reasons stated above, EPA determined that a regulation based on industrial sector would create a variety of implementation issues for state and local regulators as well as for those multiple-sector facilities. As a result, EPA did not use industrial sector as a basis for subcategorizing the industry.

### **Solid Waste Generation and Disposal**

Physical and chemical characteristics of solid waste generated by facilities performing proposed MP&M operations are determined by the raw materials, unit operations, and types of air pollution control in use. Therefore, this factor does not provide a primary basis for subcategorization. The subcategorization scheme that EPA is promulgating should account for any variations in solid waste generation and disposal. EPA considered the amount of sludge generated as a result of the MP&M technology options, and included disposal of these sludges in the compliance cost estimates (see Section 11.0) and non-water quality impact assessments (see Section 13.0).

## **6.2 General Description of Facilities in Each Subcategory Evaluated for the Final Rule**

Below is a general description of the types of facilities that fall within each of the subcategories evaluated for the final rule. Sections 11.0 and 12.0 present information on compliance costs and pollutant reductions, respectively, evaluated for the final rule for each proposed subcategory. However, for reasons discussed in Section 9.0 and Section VI of the preamble to the final rule, the final rule establishes effluent limitations guidelines and standards for new and existing direct dischargers in one subcategory: Oily Wastes (40 CFR 438, Subpart A).

### **6.2.1 General Metals Subcategory Evaluated for the Final Rule**

As discussed in Section 6.1, the General Metals Subcategory evaluated for the final rule is a “catch-all” for facilities performing proposed MP&M operations that discharge metal-bearing wastewater (with or without oil-bearing wastewater) that do not fit the applicability of the Metal Finishing Job Shops, Non-Chromium Anodizing, and Printed Wiring

Board Subcategories evaluated for the final rule. This proposed subcategory also includes general metals facilities that are owned and operated by the federal government, states and municipalities. General metals facilities typically perform manufacturing or heavy rebuilding of metal products, parts, or machines. Facilities that perform metal finishing or electroplating operations on site, but do not meet the definition of a job shop (i.e., captive shops), would fit in the proposed General Metals Subcategory. EPA also includes continuous electroplaters of flat steel products (e.g., strip, sheet, and plate) in the General Metals Subcategory evaluated for the final rule.

Wastewater discharges from railroad overhaul or heavy maintenance facilities may be covered by the MP&M effluent guidelines (Subpart A), the Metal Finishing Point Source Category (40 CFR 433), or by other effluent limitations guidelines, as applicable. This provision is codified at 40 CFR 438.1(d). Facilities engaged in the manufacture, overhaul or heavy maintenance of railroad engines, cars, car-wheel trucks, or similar parts or machines (“railroad overhaul or heavy maintenance facilities”) typically perform different unit operations than railroad line maintenance facilities. Railroad line maintenance facilities perform routine cleaning and light maintenance on railroad engines, cars, car-wheel trucks, or similar parts or machines, and discharge wastewater exclusively from oily operations. These facilities only perform one or more of the following operations: assembly/disassembly, floor cleaning, maintenance machining (wheel truing), touch-up painting, and washing.

Railroad overhaul or heavy maintenance facilities are engaged in the manufacture, overhaul, or heavy maintenance of railroad engines, cars, car-wheel trucks, or similar parts or machines. These facilities typically perform one or more of the same operations as railroad line maintenance facilities and one or more of the following operations: abrasive blasting, alkaline cleaning, aqueous degreasing, corrosion preventive coating, electrical discharge machining, grinding, heat treating, impact deformation, painting, plasma arc machining, polishing, pressure deformation, soldering/brazing, stripping (paint), testing, thermal cutting, and welding. Depending on the operations performed, railroad overhaul or heavy maintenance facilities may be included in the proposed General Metals Subcategory or the Oily Wastes Subcategory.

EPA estimates that there are approximately 10,914 indirect dischargers and 250 direct dischargers in the General Metals Subcategory evaluated for the final rule. EPA currently regulates 99 percent of the facilities in this proposed subcategory by existing effluent guidelines. Some general metals facilities are currently covered by multiple regulations. The Agency estimates that, based on responses to its questionnaires, the Metal Finishing (40 CFR 433) and Electroplating (40 CFR 413) effluent guidelines cover approximately 89 percent and 16 percent, respectively, of general metals facilities. Approximately 50 percent of the general metals facilities are covered by other metal-related effluent guidelines (see Section 1.2.7). Facilities in the proposed General Metals Subcategory are specifically not regulated by the final rule (see 40 CFR 438.1(b)).



### **6.2.2 Metal Finishing Job Shops Subcategory Evaluated for the Final Rule**

Facilities in the Metal Finishing Job Shops Subcategory evaluated for the final rule met the following criteria: (1) perform one or more of the following five operations: electroplating, electroless plating, anodizing, chemical conversion coating (chromating, phosphating, passivation, and coloring), and chemical etching and milling, and (2) own not more than 50 percent (on an annual area basis) of the materials undergoing metal finishing. (Note that printed wiring board job shops are in the Printed Wiring Board Subcategory evaluated for the final rule based on the operations performed and wastewater characteristics.)

The Agency estimates that there are approximately 1,530 indirect dischargers and 12 direct dischargers in the Metal Finishing Job Shops Subcategory evaluated for the final rule. EPA currently regulates all facilities in this proposed subcategory under the existing Metal Finishing or Electroplating effluent guidelines and standards.

EPA has identified approximately 32,139 facilities that meet the definition of job shop but do not perform one or more of the five metal finishing operations listed above. EPA does not consider such job shops to be part of the Metal Finishing Job Shops Subcategory. These other job shops typically perform assembly, painting, and machining on a contract basis and are included in the General Metals, Oily Wastes, or Printed Wiring Board Subcategories evaluated for the final rule. Facilities in the Metal Finishing Job Shops proposed subcategory are specifically not regulated by the final rule (see 40 CFR 438.1(b)).

### **6.2.3 Non-Chromium Anodizing Subcategory Evaluated for the Final Rule**

Facilities in the Non-Chromium Anodizing Subcategory evaluated for the final rule performed aluminum anodizing without using chromic acid or dichromate sealants. Anodizing is a surface conversion operation used to alter the properties of aluminum for better corrosion resistance and heat transfer. Generally, non-chromium anodizing facilities perform sulfuric acid anodizing; however, facilities can use other acids (except chromic acid), such as oxalic acid, for aluminum anodizing. In evaluating options for the final rule, EPA included anodizers that use chromic acid or dichromate in the proposed General Metals Subcategory or, if they operate as a job shop, in the proposed Metal Finishing Job Shops Subcategory.

Some facilities that could potentially fall into the proposed Non-Chromium Anodizing Subcategory also may perform other metal surface finishing operations. If these facilities commingle wastewater from their non-chromium anodizing operations with wastewater from other surface finishing operations (e.g., chromic acid anodizing, electroplating, chemical conversion coating) for treatment, or perform chromium-bearing operations on site, they would not be included in the proposed Non-Chromium Anodizing Subcategory. Instead, the proposed General Metals or Metal Finishing Job Shops Subcategories would apply.

EPA estimates that there are approximately 122 indirect dischargers in the proposed Non-Chromium Anodizing Subcategory. EPA did not identify any direct discharging

non-chromium anodizers in its survey efforts. The wastewater generated at non-chromium anodizing facilities contains relatively low levels of metals, with the exception of aluminum, and low levels of toxic organic pollutants. Facilities in the proposed Non-Chromium Anodizing Subcategory are specifically not regulated by the final rule (see 40 CFR 438.1(b)).

#### **6.2.4 Printed Wiring Board Subcategory Evaluated for the Final Rule**

The Printed Wiring Board Subcategory evaluated for the final rule includes wastewater discharges from the manufacture and repair of printed wiring boards (i.e., circuit boards), including job shops. However, printed wiring assembly facilities are included in the General Metals Subcategory evaluated for the final rule. EPA currently regulates all facilities in this proposed subcategory by the existing Metal Finishing or Electroplating effluent limitation guidelines and standards. EPA estimates that there are approximately 840 indirect dischargers and 8 direct dischargers in the Printed Wiring Board Subcategory evaluated for the final rule. Facilities in the Printed Wiring Board Subcategory evaluated for the final rule are specifically not regulated by the final rule (see 40 CFR 438.1(b)).

#### **6.2.5 Steel Forming and Finishing Subcategory Evaluated for the Final Rule**

Facilities in the Steel Forming and Finishing Subcategory evaluated for the final rule performed MP&M finishing operations and/or cold forming operations on steel wire, rod, bar, pipe, or tube. This subcategory does not include facilities that perform those operations on other base materials. Generally, steel forming and finishing facilities perform acid pickling, annealing, conversion coating (e.g., zinc phosphate, copper sulfate), hot dip coating and/or electroplating of steel wire or rod, heat treatment, welding, drawing, patenting, and oil tempering.

EPA estimates that there are approximately 110 indirect and 43 direct dischargers in the proposed Steel Forming and Finishing Subcategory. EPA currently regulates all facilities in this proposed subcategory under the Iron and Steel Point Source Category (40 CFR 420). Facilities in the proposed Steel Forming and Finishing Subcategory are specifically not regulated by the final rule (see 40 CFR 438.1(b)).

#### **6.2.6 Oily Wastes Subcategory**

The Oily Wastes Subcategory established in the final rule is a “catch-all” for facilities in one or more of the 16 industrial sectors (see Section 1.0) performing proposed “oily operations” (see Table 6-2) and are not specifically excluded by the applicability to the final rule (see Section 1.0 and 40 CFR 438.1). EPA defined the applicability of this subcategory by the presence of specific unit operations (see Table 6-2). Facilities in the proposed Railroad Line Maintenance or Shipbuilding Dry Dock Subcategories (see below) are not subject to the Oily Wastes Subcategory in the final rule (see Section 1.0 and 40 CFR 438.1(d) and 438.1(e)(5)). Facilities in the Oily Wastes Subcategory are predominantly machine shops or maintenance and repair shops. This subcategory also includes federal, municipal, and state-owned facilities performing only the listed operations.

In the final rule, EPA also clarified the applicability of certain unit operations. EPA defined “corrosion preventive coating” in the final rule (40 CFR 438.2(c)) as “the application of removable oily or organic solutions to protect metal surfaces against corrosive environments. Corrosion preventive coatings include, but are not limited to: petrolatum compounds, oils, hard dry-film compounds, solvent-cutback petroleum-based compounds, emulsions, water-displacing polar compounds, and fingerprint removers and neutralizers. Corrosion preventive coating does not include electroplating, or chemical conversion coating operations.” EPA’s analytical database shows that wastewater generated from phosphate conversion coating operations may contain high levels of zinc, nickel, and manganese (see Section 16.5.1 of the rulemaking record, DCN 16715).

However, based on comments on the January 2001 proposal and June 2002 NODA, EPA added iron phosphate conversion coating to the final list of oily operations (see 40 CFR 438.2(f) and Appendix B to Part 438). EPA defined iron phosphate conversion coating as “the process of applying a protective coating on the surface of a metal using a bath consisting of a phosphoric acid solution containing no metals (e.g., manganese, nickel, or zinc) or a phosphate salt solution (i.e., sodium or potassium salts of phosphoric acid solutions) containing no metals (e.g., manganese, nickel, or zinc) other than sodium or potassium. Any metal concentrations in the bath are from the substrate.” EPA notes that iron phosphate conversion coating should be distinguished from zinc, manganese, or nickel phosphate conversion coating based on the constituents of the bath. Manganese, nickel, or zinc phosphate conversion coating baths contain metals in addition to what may be added from the substrate.

If a facility discharges wastewater from any of the operations listed in Table 6-2, but also discharges wastewater from any of the operations listed in Table 6-3, it does not meet the criteria of the Oily Wastes Subcategory but instead would have been included under either the proposed General Metals Subcategory or another metal-bearing wastewater proposed subcategory. EPA determined that both of the following wastewaters require some form of wastewater treatment (e.g., chemical precipitation) to properly remove metals: (1) wastewaters from metal-bearing operations; and (2) wastewaters commingled from metal-bearing operations and oily operations. Thus, the final regulations do not apply to the discharge of wastewater from oily operations commingled with wastewater from metal-bearing operations. Additionally, the regulations in the final rule do not apply to process wastewater discharges subject to the limitations and standards of other effluent limitations guidelines (e.g., Metal Finishing (40 CFR 433) or Iron and Steel Manufacturing (40 CFR 420)). These provisions are codified in the final rule at 40 CFR 438.1(b):

“The regulations in this part do not apply to process wastewaters from metal-bearing operations (as defined at §438.2(d) and Appendix C of this part) or process wastewaters which are subject to the limitations and standards of other effluent limitations guidelines (e.g., Metal Finishing (40 CFR 433) or Iron and Steel Manufacturing (40 CFR 420)). The regulations in this part also do not apply to process wastewaters from oily operations (as defined at §438.2(f) and Appendix B of this part) commingled with process wastewaters already covered

by other effluent limitations guidelines or with process wastewaters from metal-bearing operations. This provision must be examined for each point source discharge at a given facility.”

Wastewater discharges from railroad overhaul or heavy maintenance facilities may be covered by the MP&M effluent guidelines (Subpart A), the Metal Finishing Point Source Category (40 CFR 433), or by other effluent limitations guidelines, as applicable. This provision is codified at 40 CFR 438.1(d). Facilities engaged in the manufacture, overhaul or heavy maintenance of railroad engines, cars, car-wheel trucks, or similar parts or machines (“railroad overhaul or heavy maintenance facilities”) typically perform different unit operations than railroad line maintenance facilities. Railroad line maintenance facilities perform routine cleaning and light maintenance on railroad engines, cars, car-wheel trucks, or similar parts or machines, and discharge wastewater exclusively from oily operations. These facilities only perform one or more of the following operations: assembly/disassembly, floor cleaning, maintenance machining (wheel truing), touch-up painting, and washing.

Railroad overhaul or heavy maintenance facilities are engaged in the manufacture, overhaul, or heavy maintenance of railroad engines, cars, car-wheel trucks, or similar parts or machines. These facilities typically perform one or more of the same operations as railroad line maintenance facilities and one or more of the following operations: abrasive blasting, alkaline cleaning, aqueous degreasing, corrosion preventive coating, electrical discharge machining, grinding, heat treating, impact deformation, painting, plasma arc machining, polishing, pressure deformation, soldering/brazing, stripping (paint), testing, thermal cutting, and welding. Depending on the operations performed, railroad overhaul or heavy maintenance facilities may be included in the proposed General Metals Subcategory or the Oily Wastes Subcategory.

EPA estimates that there are approximately 26,824 indirect dischargers and 2,382 direct dischargers in the Oily Wastes Subcategory. EPA has concluded that less than two percent of the MP&M process wastewater discharged from the facilities in this subcategory is covered by existing effluent guidelines. Limitations and standards for this subcategory are given in Section 1.0 and at 40 CFR 438, Subpart A (Oily Wastes).

### **6.2.7 Railroad Line Maintenance Subcategory Evaluated for the Final Rule**

The Railroad Line Maintenance Subcategory evaluated for the final rule included facilities that perform routine cleaning and light maintenance (mostly consisting of parts replacement) on railroad engines, cars, car-wheel trucks, and similar parts or machines. These facilities discharge wastewater from only those proposed MP&M operations that EPA defines as oily operations (see Table 6-2). The wastewater generated at railroad line maintenance facilities contains relatively low levels of metals and toxic organic pollutants. Because these operations are conducted outdoors, these facilities may also discharge large volumes of stormwater that may or may not be commingled with process wastewater.

Railroad line maintenance facilities are similar to facilities in the Oily Wastes Subcategory in that they produce oil-bearing wastewater and do not perform MP&M operations that generate wastewater that requires metals removal treatment technology. This proposed subcategory does not include railroad manufacturing facilities or railroad overhaul or heavy maintenance facilities. Railroad manufacturing facilities and railroad overhaul or heavy maintenance facilities perform operations more similar to operations in the proposed General Metals Subcategory (e.g., acid treatment without chromium) and Oily Wastes Subcategory (e.g., heat treating and impact deformation).

EPA estimates that there are approximately 820 indirect dischargers and 9 direct dischargers in the proposed Railroad Line Maintenance Subcategory evaluated for the final rule. Facilities in the proposed Railroad Line Maintenance Subcategory are specifically not regulated by the final rule (see Section 1.0 and 40 CFR 438.1(d)). Additionally, EPA did not establish and limitations and standards for the proposed General Metals Subcategory (see Section 9.0). Consequently, railroad manufacturing facilities and railroad overhaul or heavy maintenance facilities in the proposed General Metals Subcategory will continue to be regulated by the General Pretreatment Standards (Part 403), local limits, permit limits, and Parts 413 and/or 433, as applicable.

### **6.2.8 Shipbuilding Dry Dock Subcategory**

The Shipbuilding Dry Dock Subcategory evaluated for the final rule included wastewater generated in or on dry docks and similar structures such as graving docks, building ways, marine railways, and lift barges at shipbuilding facilities (or shipyards). Shipbuilding facilities use these structures to maintain, repair, or rebuild existing ships, or perform the final assembly and launching of new ships (including barges). Shipbuilders use these structures to reach surfaces and parts that would otherwise be under water. Because dry docks and similar structures include sumps or containment systems, shipyards can control the discharge of pollutants to surface water. Typical proposed MP&M operations that occur in dry docks and similar structures include: abrasive blasting; hydro-blasting; painting; welding; corrosion preventive coating; floor cleaning; aqueous degreasing; and testing. Not all of these proposed MP&M operations generate wastewater. The proposed subcategory also included wastewater generated when a shipyard cleans a ship's hull in a dry dock (or similar structure) to remove marine life (e.g., barnacles) in preparation for performing proposed MP&M operations.

This subcategory included only process wastewater generated and discharged from proposed MP&M operations inside and outside ships (including bilge water) that occur in or on dry docks or similar structures. The Agency is not including process wastewater from proposed MP&M operations that is generated at other locations at the shipyard ("on-shore" operations) in this proposed subcategory. EPA included these wastewaters from these "on-shore" shipbuilding operations (e.g., electroplating, plasma arc cutting) in the proposed General Metals Subcategory or Oily Wastes Subcategory. Also, EPA is not including wastewater generated onboard ships when they are afloat (i.e., not in dry docks or similar structures). For U.S. military ships, EPA is in the process of establishing standards under the Uniform National

Discharge Standards (UNDS) pursuant to Section 312(n) of the CWA (see 64 FR 25125; May 10, 1999) to regulate discharges of wastewater generated onboard these ships when they are in U.S. waters and are afloat (e.g., at a shipyard's dock).

In addition to wastewater from proposed MP&M operations, three other types of water streams are in or on dry docks and similar structures: flooding water, dry dock ballast water, and stormwater. Flooding water enters and exits the dry dock or similar structure prior to performing any MP&M operations. For example, in a graving dock, the gates are opened, allowing flooding water in and ships to float inside the chamber. Then the flooding water is drained, leaving the ship's exterior exposed so shipyard employees can repair and maintain the ship's hull. Dry dock ballast water serves a similar purpose. It is used to lower (or sink) a floating dry dock so that a ship can float over it. Then the dry dock ballast water is pumped out, raising the dry dock with the ship on top. Flooding water and dry dock ballast water are not directly associated with proposed MP&M operations. Finally, because these structures are located outdoors and are exposed to the elements, stormwater may fall in or on the dry dock or similar structures.

In its evaluation, EPA excluded all three of these water streams (i.e., flooding water, dry dock ballast water, and stormwater) from the proposed definition of process wastewater specific to the Shipbuilding Dry Dock Subcategory. Stormwater at these facilities is covered by EPA's Storm Water Multi-Sector General Permit, similar general permits issued by authorized states, and individual stormwater permits. In general, stormwater permits at shipyards include best management practices (BMPs) that are designed to prevent the contamination of stormwater. For example, these practices include sweeping areas after paint stripping or painting are completed.

Many shipyards perform only dry proposed MP&M operations in their dry docks (and similar structures) or do not discharge wastewater generated in dry docks (and similar structures) from proposed MP&M operations. Many shipyards prefer to handle this wastewater as hazardous, and contract haul it off site due to the possible presence of copper or tin (used as an antifoulant) in paint chips from paint stripping operations. The wastewater discharged from dry docks and similar structures contains relatively low levels of metals and toxic organic pollutants.

EPA estimates that there are nine indirect dischargers and six direct dischargers in the Shipbuilding Dry Dock Subcategory evaluated for the final rule. Many shipbuilders operate multiple dry docks (or similar structures); this is the number of estimated facilities (not dry docks) that discharge process wastewater from proposed MP&M operations at dry docks or similar structures. Facilities in the proposed Shipbuilding Dry Dock Subcategory are specifically not regulated by the final rule (see Section 1.0 and 40 CFR 438.1(e)(5)).

## 7.0 SELECTION OF POLLUTANT PARAMETERS

This section discusses the criteria EPA used to identify pollutants of concern (POCs) and regulated pollutants. For the final rule, EPA evaluated process wastewater from proposed MP&M operations<sup>1</sup> to determine the presence of priority, conventional, and nonconventional pollutant parameters. EPA reviewed data on 308 metal and organic pollutant parameters listed in The 1990 Industrial Technology Division List of Analytes (1) under the MP&M final rule. These pollutants are listed in Section 3.0, Tables 3-5 and 3-6. The Agency also evaluated regulating 24 conventional and other nonconventional pollutant bulk parameters under the MP&M rule. These pollutants are listed in Section 3.0, Table 3-7.

Section 7.1 discusses the criteria EPA used to identify POCs for the MP&M final rule. POCs are pollutants EPA has identified at significant concentrations in process wastewater from proposed MP&M operations. While EPA generally considers the full list of POCs in its analysis, it regulates only a subset of these pollutants. Section 7.2 presents the criteria EPA used to select the regulated pollutants. Section 7.3 presents the references used in this section.

### 7.1 Identification of Pollutants of Concern

EPA performed the POC analysis using the analytical data from the Phase I and Phase II sampling programs. The POC analysis identifies those pollutants present in industry wastewater at significant concentrations. These pollutants are evaluated in the pollutant reduction analysis (Section 11.0) and further considered for regulation. To identify POCs for the MP&M rulemaking, EPA analyzed for 329 pollutants in over 1,994 samples of unit operation processes and rinse water, wastewater treatment influent, and wastewater treatment effluent during the Phase I and Phase II sampling programs. EPA did not use data collected during the post-proposal sampling program and industry-supplied data in the POC analysis. The Agency excluded acidity, total alkalinity, and pH from the POC analysis since these pollutant parameters do not have a detection limit.

EPA performed the POC analysis using all data across proposed subcategories evaluated for the final rule. When determining regulated pollutants (Section 7.2), EPA considered proposed subcategory-specific factors. EPA identified POCs primarily using data from proposed MP&M operations (both process baths and rinses) and wastewater treatment influent data. The pollutants generated depend more on the nature of the unit operations than the subcategory in which the operation is performed (e.g., pollutants present in a machinery operation conducted on steel parts will be similar across subcategories). While the oil-bearing subcategories exclude operations generating high concentrations of metal pollutants, EPA still

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<sup>1</sup>Note: EPA evaluated a number of unit operations for the May 1995 proposal, January 2001 proposal, and June 2002 NODA (see Tables 4-3 and 4-4). However, EPA selected a subset of these unit operations for regulation in the final rule (see Section 1.0). For this section, the term “proposed MP&M operations” means those operations evaluated for the two proposals, NODA, and final rule. The term “final MP&M operations” means those operations defined as “oily operations” (see Section 1.0, 40 CFR 438.2(f), and Appendix B to Part 438) and regulated by the final rule.

detected many metal pollutants in oil-bearing wastewaters (see Section 5.0) and therefore considered these to be POCs.

EPA reduced the list of 329 analyzed pollutants to 132 POCs by retaining only those pollutants that met the following criteria:

- EPA detected the pollutant in at least three samples collected during the MP&M sampling programs. For this evaluation, EPA considered all samples collected from Phase I and Phase II process water, rinse water, wastewater treatment influent, or wastewater treatment effluent.
- The average of all the detected concentrations of the pollutant in samples of wastewater from proposed MP&M operations and treatment system influents was at least five times the minimum level (ML). EPA describes the ML as “the lowest level at which the entire analytical system must give a recognizable signal and an acceptable calibration point for the analyte” (2). EPA evaluated the unit operation, rinse, and treatment influent data to identify those pollutants present in raw wastewater. EPA did not evaluate the effluent data for this step because the treatment systems are designed to remove pollutants, so including effluent data in this step may have artificially lowered the average concentration.
- EPA analyzed the pollutant in a quantitative manner following the appropriate quality assurance/quality control (QA/QC) procedures. Thus, wastewater analyses performed solely for certain semiquantitative “screening” purposes did not meet this criterion, and EPA excluded these results from the POCs analysis. EPA performed these semiquantitative analyses only in unusual cases (e.g., to qualitatively screen for the presence of a rare metal such as osmium).

For the first criterion, EPA combined data from the unit operation, treatment system influent, and treatment system effluent wastewater samples to determine the total number of samples in which each pollutant was detected.

EPA calculated the average detected pollutant concentrations of the unit operation wastewater and treatment system influent samples to determine if the data met the second criterion. In this analysis, EPA focused only on detected pollutants so nondetected pollutants were not included. For pollutants not meeting the second criterion based on this calculation (i.e., the average detected pollutant concentration in samples of unit operation wastewater and treatment system influent samples was less than five times the ML), EPA also calculated the average detected pollutant concentration in the treatment system effluent and determined whether those averages exceeded five times the ML. EPA took this step for two reasons. First, the Agency wanted to identify any pollutants that were generated during treatment. For example, EPA determined that chloroform can be produced in alkaline chlorination systems and adjusted



the pollutant removal model accordingly. Second, matrix interferences associated with unit operation and wastewater treatment influent samples may have masked the presence of a pollutant in a unit operation or influent sample. For six pollutants (1,1-dichloroethene, chloroform, diphenyl ether, isophorone, n-nitrosopiperidine, and trichlorofluoromethane), the average treatment system effluent concentrations exceeded five times the ML. Consequently, EPA considered these compounds POCs.

As explained above, EPA started with a possible list of 329 pollutants. The Agency excluded acidity, total alkalinity, and pH from the POC analysis since these pollutant parameters do not have a detection limit. EPA also excluded oil and grease (EPA Method 413.2) from the POC analysis since oil and grease (as HEM) was included. Therefore, these pollutant parameters were not considered for regulation under the final MP&M rule.

Of the 324 remaining pollutants EPA initially considered regulating under MP&M, EPA excluded 192 as POCs because they failed to meet the following criteria:

- EPA did not detect 113 pollutant parameters in samples collected during the Phase I and Phase II MP&M sampling programs. Table 7-1 lists these pollutants.
- EPA detected 50 pollutants in less than three samples collected during the Phase I and Phase II MP&M sampling programs. Table 7-2 lists these pollutants.
- EPA detected 23 pollutants at average detected concentrations that were less than five times the ML in unit operation wastewater and treatment system influent. Table 7-3 lists these pollutants.
- EPA performed analyses for 42 pollutants, listed in Section 3.0, Table 3-5, using semiquantitative methods for “screening” purposes to determine if these analytes were present. For this screening, the Agency did not use the QA/QC procedures required by analytical method 1620. EPA excluded the six pollutants (strontium, potassium, platinum, sulfur, silicon, and phosphorus) that passed the first three criteria but were part of the screening analysis. Based on the screening results, EPA did not measure for these pollutants in a quantitative manner.

After excluding these pollutants, EPA defined the 132 remaining pollutants as POCs for further evaluation with respect to technology options and the performance of the technologies. These include 47 priority pollutants (34 priority organic pollutants, 13 priority metal pollutants), 3 conventional pollutants, and 82 nonconventional pollutants (50 organic pollutants, 15 metal pollutants, and 17 other nonconventional pollutants). Table 7-4 lists these pollutants, along with the number of times EPA analyzed for and detected each pollutant

**Table 7-1**

**Pollutants Not Detected in Any Samples Collected During the Phase I and  
Phase II MP&M Sampling Programs**

<b>Priority Pollutants</b>	
1,2-Dichloropropane	Benzo(K)Fluoranthene
1,3-Dichlorobenzene	Bis(2-Chloroisopropyl) Ether
2-Chloroethylvinyl Ether	Chrysene
3,3'-Dichlorobenzidine	Dibenzo(A,H)Anthracene
4-Bromophenyl Phenyl Ether	Hexachlorobenzene
4-Chlorophenylphenyl Ether	Hexachlorobutadiene
Acenaphthylene	Hexachlorocyclopentadiene
Benzidine	Hexachloroethane
Benzo(A)Anthracene	Indeno(1,2,3-Cd)Pyrene
Benzo(A)Pyrene	Pentachlorophenol
Benzo(B)Fluoranthene	Trans-1,2-Dichloroethene
Benzo(Ghi)Perylene	Trans-1,3-Dichloropropene
<b>Nonconventional Organic Pollutants</b>	
1,2,3-Trichlorobenzene	2-Nitroaniline
1,2,3-Trichloropropane	2-Phenylnaphthalene
1,2,3-Trimethoxybenzene	2-Propen-1-ol
1,2,4,5-Tetrachlorobenzene	2-Propenenitrile, 2-Methyl-
1,2-Dibromo-3-Chloropropane	3,3'-Dimethoxybenzidine
1,2-Dibromoethane	3,5-Dibromo 4-Hydroxybenzonitrile
1,3-Butadiene, 2-Chloro	3-Chloropropene
1,3-Dichloro-2-Propanol	3-Methylcholanthrene
1,3-Dichloropropane	3-Nitroaniline
1,5-Naphthalenediamine	4,4'-Methylenebis(2-Chloroaniline)
1-Chloro-3-Nitrobenzene	4,5-Methylene Phenanthrene
1-Phenylnaphthalene	4-Chloro-2-Nitroaniline
2,3,4,6-Tetrachlorophenol	5-Nitro-O-Toluidine
2,3,6-Trichlorophenol	7,12-Dimethylbenz(A)Anthracene
2,3-Benzofluorene	Aniline, 2,4,5-Trimethyl-
2,3-Dichloroaniline	Aramite
2,3-Dichloronitrobenzene	Benanthrone
2,4,5-Trichlorophenol	Benzenethiol
2,6-Dichloro-4-Nitroaniline	Biphenyl, 4-Nitro
2,6-Dichlorophenol	Chloroacetonitrile
2-Methylbenzothiazole	Crotonaldehyde
Crotoxypfos	Methyl Methanesulfonate

**Table 7-1 (Continued)**

<b>Nonconventional Organic Pollutants (continued)</b>	
Diethyl Ether	n-Nitrosodiethylamine
Dimethyl Sulfone	o-Toluidine, 5-Chloro-
Diphenyldisulfide	p-Dimethylaminoazobenzene
Ethyl Cyanide	Pentachlorobenzene
Ethyl Methacrylate	Pentachloroethane
Ethyl Methanesulfonate	Perylene
Hexachloropropene	Phenacetin
Iodomethane	Pronamide
Isosafrole	Squalene
Longifolene	Thioacetamide
Malachite Green	Trans-1,4-Dichloro-2-Butene
Mestranol	Triphenylene
Methapyrilene	Vinyl Acetate
<b>Nonconventional Metal Pollutants</b>	
Cerium	Praseodymium
Erbium	Rhenium
Europium	Samarium
Gadolinium	Scandium
Gallium	Tellurium
Germanium	Terbium
Holmium	Thorium
Indium	Thulium
Iodine	Uranium
Lanthanum	

Source: MP&amp;M Sampling Data.

**Table 7-2**

**Pollutants Detected in Less Than Three Samples Collected  
During the Phase I and Phase II MP&M Sampling Programs**

<b>Priority Pollutants</b>	
1,1,2,2-Tetrachloroethane	2-Chloronaphthalene
1,1,2-Trichloroethane	2-Chlorophenol
1,2,4-Trichlorobenzene	Acrylonitrile
1,2-Dichlorobenzene	Bis(2-Chloroethoxy) Methane
1,2-Dichloroethane	Bis(2-Chloroethyl) Ether
1,2-Diphenylhydrazine	Bromomethane
1,4-Dichlorobenzene	Nitrobenzene
2,4-Dichlorophenol	n-Nitrosodi-n-Propylamine
2,4-Dinitrotoluene	Vinyl Chloride
<b>Nonconventional Organic Pollutants</b>	
1,1,1,2-Tetrachloroethane	Ethylenethiourea
1,2:3,4-Diepoxybutane	n-Nitrosodi-n-Butylamine
1,3,5-Trithiane	n-Nitrosomethylphenylamine
1,4-Dinitrobenzene	o-Anisidine
1,4-Naphthoquinone	p-Chloroaniline
1-Naphthylamine	Pentamethylbenzene
2,6-Di-Tert-Butyl-P-Benzoquinone	Phenothiazine
2-Picoline	p-Nitroaniline
4-Aminobiphenyl	Resorcinol
Beta-Naphthylamine	Safrole
Carbazole	Thianaphthene
Cis-1,3-Dichloropropene	Thioxanthe-9-One
Dibromomethane	Toluene, 2,4-Diamino-
<b>Nonconventional Metal Pollutants</b>	
Dysprosium	Rhodium
Hafnium	Ruthenium
Neodymium	Zirconium

Source: MP&amp;M Sampling Data.

**Table 7-3**

**Pollutants Detected at Average Concentrations of Less Than Five  
Times the Minimum Level During the Phase I and Phase II  
MP&M Sampling Programs<sup>a</sup>**

Priority Pollutants	
2,4,6-Trichlorophenol	Chloromethane
4,6-Dinitro-o-Cresol	Dibromochloromethane
Benzene	Diethyl Phthalate
Bromodichloromethane	Tribromomethane
Carbon Tetrachloride (Tetrachloromethane)	
Nonconventional Organic Pollutants	
2-(Methylthio)Benzothiazole	n-Nitrosomorpholine
n-Nitrosomethylethylamine	o-Toluidine
Nonconventional Metal Pollutants	
Bismuth	Osmium
Iridium	Palladium
Lithium	Tantalum
Lutetium	Tungsten
Niobium	Ytterbium

Source: MP&M Sampling Data.

<sup>a</sup>The average of all detected concentrations of the pollutants in samples of wastewater from proposed MP&M operations and treatment system influent was less than five times the detection limit.

**Table 7-4****Summary of Pollutants of Concern Information**

Pollutant Parameter	Phase I and Phase II Sampling Information			
	No. of Times Analyzed for All Samples <sup>a</sup>	No. of Times Detected for All Samples <sup>a</sup>	Average Concentration in Samples of Unit Operation Wastewater and Treatment System Influent (mg/L) <sup>a</sup>	Minimum Level (mg/L)
<b>Priority Organic Pollutants</b>				
1,1,1-Trichloroethane	1,043	28	0.327	0.01
1,1-Dichloroethane	1,043	7	0.091	0.01
1,1-Dichloroethylene	1,043	3	0.418	0.01
2,4-Dimethylphenol	994	31	0.078	0.01
2,4-Dinitrophenol	946	4	83.7	0.05
2,6-Dinitrotoluene	1,029	3	2.73	0.01
2-Nitrophenol	1,021	9	0.394	0.02
4-Chloro-m-cresol	1,003	95	260	0.01
4-Nitrophenol	969	5	2.99	0.05
Acenaphthene	1,029	6	0.332	0.01
Acrolein	1,003	5	0.307	0.05
Anthracene	1,029	4	0.117	0.01
Bis(2-Ethylhexyl) Phthalate	1,028	211	4.15	0.01
Benzyl Butyl Phthalate	1,026	16	1.08	0.01
Chlorobenzene	1,043	7	0.282	0.01
Chloroethane	1,043	4	4.22	0.05
Chloroform	1,043	331	0.049	0.01
Di-N-Butyl Phthalate	1,026	41	0.352	0.01
Di-N-Octyl Phthalate	1,028	18	1.58	0.01
Dimethyl Phthalate	994	3	0.739	0.01
Ethylbenzene	1,043	61	0.165	0.01
Fluoranthene	1,028	4	0.132	0.01
Fluorene	1,029	18	0.956	0.01
Isophorone	996	3	.056	0.01
Methylene Chloride	1,043	52	0.403	0.01
n-Nitrosodimethylamine	996	3	3.68	0.05
N-Nitrosodiphenylamine	1,029	15	1.14	0.02
Naphthalene	1,029	71	0.638	0.01

**Table 7-4 (Continued)**

Pollutant Parameter	Phase I and Phase II Sampling Information			
	No. of Times Analyzed for All Samples <sup>a</sup>	No. of Times Detected for All Samples <sup>a</sup>	Average Concentration in Samples of Unit Operation Wastewater and Treatment System Influent (mg/L) <sup>a</sup>	Minimum Level (mg/L)
<b>Priority Organic Pollutants (continued)</b>				
Phenanthrene	1,029	45	0.500	0.01
Phenol	1,021	244	10.1	0.01
Pyrene	1,028	5	0.219	0.01
Tetrachloroethene	1,043	23	0.210	0.01
Toluene	1,043	83	0.230	0.01
Trichloroethylene	1,042	40	0.092	0.01
<b>Priority Metal Pollutants</b>				
Antimony	1,956	606	6.12	0.02
Arsenic	1,972	627	0.178	0.01
Beryllium	1,972	301	0.147	0.005
Cadmium	1,972	873	244	0.005
Chromium	1,972	1,480	1,029	0.01
Copper	1,972	1,752	495	0.025
Lead	1,972	911	30.0	0.05
Mercury	1,970	321	0.0014	0.0002
Nickel	1,972	1,518	356	0.04
Selenium	1,956	317	0.137	0.005
Silver	1,972	698	0.531	0.01
Thallium	1,956	206	0.065	0.01
Zinc	1,971	1,691	188	0.02
<b>Conventional Pollutants</b>				
BOD 5-Day (Carbonaceous)	1,005	757	2,015	2
Oil and Grease (as HEM)	1,028	554	2,308	5
Total Suspended Solids	1,959	1,563	1,007	4
<b>Nonconventional Organic Pollutants</b>				
1,4-Dioxane	1,003	33	0.854	0.01
1-Bromo-2-Chlorobenzene	989	8	0.233	0.01
1-Bromo-3-Chlorobenzene	989	6	0.135	0.01
1-Methylfluorene	989	24	0.347	0.01
1-Methylphenanthrene	989	29	0.581	0.01
2-Butanone	1,003	160	1.59	0.05

**Table 7-4 (Continued)**

Pollutant Parameter	Phase I and Phase II Sampling Information			
	No. of Times Analyzed for All Samples <sup>a</sup>	No. of Times Detected for All Samples <sup>a</sup>	Average Concentration in Samples of Unit Operation Wastewater and Treatment System Influent (mg/L) <sup>a</sup>	Minimum Level (mg/L)
<b>Nonconventional Organic Pollutants (continued)</b>				
2-Hexanone	1,003	7	1.26	0.05
2-Isopropyl-naphthalene	989	6	3.21	0.01
2-Methylnaphthalene	989	61	0.775	0.01
2-Propanone	1,003	593	3.14	0.05
3,6-Dimethylphenanthrene	989	13	1.24	0.01
4-Methyl-2-Pentanone	1,003	91	5.19	0.01
Acetophenone	989	10	0.159	0.01
Alpha-Terpineol	978	133	13.6	0.01
Aniline	989	19	0.684	0.01
Benzoic Acid	989	202	277	0.05
Benzyl Alcohol	989	61	1.23	0.01
Biphenyl	989	23	0.174	0.01
Carbon Disulfide	1,003	63	0.408	0.01
Dibenzofuran	989	4	0.055	0.01
Dibenzothiophene	988	6	0.240	0.01
Diphenyl Ether	989	5	0.047	0.01
Diphenylamine	989	14	0.704	0.02
Hexanoic Acid	989	237	15.2	0.01
Isobutyl Alcohol	1,003	19	0.167	0.01
m+p Xylene	595	31	0.159	0.01
m-Xylene	408	21	0.498	0.01
Methyl Methacrylate	1,003	6	0.396	0.01
n,n-Dimethylformamide	989	63	0.193	0.01
n-Decane	989	67	2.10	0.01
n-Docosane	989	108	3.47	0.01
n-Dodecane	989	125	13.8	0.01
n-Eicosane	988	156	3.30	0.01
n-Hexacosane	989	95	5.84	0.01
n-Hexadecane	989	168	6.27	0.01
n-Nitrosopiperidine	989	4	0.020	0.01
n-Octacosane	989	40	7.45	0.01



**Table 7-4 (Continued)**

Pollutant Parameter	Phase I and Phase II Sampling Information			
	No. of Times Analyzed for All Samples <sup>a</sup>	No. of Times Detected for All Samples <sup>a</sup>	Average Concentration in Samples of Unit Operation Wastewater and Treatment System Influent (mg/L) <sup>a</sup>	Minimum Level (mg/L)
<b>Nonconventional Organic Pollutants (continued)</b>				
n-Octadecane	989	174	5.74	0.01
n-Tetracosane	988	90	4.13	0.01
n-Tetradecane	989	158	12.7	0.01
n-Triacontane	988	55	2.69	0.01
o+p Xylene	408	30	0.256	0.01
o-Cresol	989	16	0.067	0.01
o-Xylene	595	40	0.058	0.01
p-Cresol	989	82	0.293	0.01
p-Cymene	989	21	0.988	0.01
Pyridine	989	37	0.920	0.01
Styrene	989	9	0.261	0.01
Trichlorofluoromethane	1,043	12	0.049	0.01
Tripropyleneglycol Methyl Ether	989	141	190	0.01
<b>Nonconventional Metal Pollutants</b>				
Aluminum	1,972	1,520	166	0.2
Barium	1,972	1,651	1.75	0.2
Boron	1,913	1,645	85.0	0.1
Calcium	1,972	1,929	68.4	5
Cobalt	1,972	640	12.8	0.05
Gold	161	104	16.2	1
Iron	1,972	1,743	777	0.1
Magnesium	1,972	1,803	53.8	5
Manganese	1,972	1,620	43.4	0.015
Molybdenum	1,972	1,091	2.97	0.01
Sodium	1,972	1,953	3,384	5
Tin	1,912	850	153	0.03
Titanium	1,913	949	32.6	0.005
Vanadium	1,972	504	5.31	0.05
Yttrium	1,913	306	0.061	0.005

**Table 7-4 (Continued)**

Pollutant Parameter	Phase I and Phase II Sampling Information			
	No. of Times Analyzed for All Samples <sup>a</sup>	No. of Times Detected for All Samples <sup>a</sup>	Average Concentration in Samples of Unit Operation Wastewater and Treatment System Influent (mg/L) <sup>a</sup>	Minimum Level (mg/L)
<b>Other Nonconventional Pollutants</b>				
Amenable Cyanide	160	128	44.3	0.02
Ammonia As Nitrogen	689	569	385	0.05
Chemical Oxygen Demand (COD)	1,461	1,343	11,289	5
Chloride	677	631	5,526	1
Fluoride	688	618	301	0.1
Hexavalent Chromium	1,074	268	1.78	0.01
Sulfate	1,171	1,086	7,046	1
Total Cyanide	406	327	2,072	0.02
Total Dissolved Solids	1,953	1,948	21,883	10
Total Kjeldahl Nitrogen	661	572	606	1
Total Organic Carbon (TOC)	997	838	3,385	1
Total Petroleum Hydrocarbons (as SGT-HEM)	1,016	350	841	5
Total Phosphorus	500	452	170	0.01
Total Recoverable Phenolics	1,357	871	11.7	0.05
Total Sulfide	215	80	6.50	1
Weak-Acid Dissociable Cyanide	72	62	19.4	0.002
Ziram	31	22	1.41	0.01

Source: MP&M Sampling Data.

<sup>a</sup>Counts and average based on Phase I and Phase II sampling results. Sample concentrations less than the ML were not included in the average.

parameter in samples of the unit operation wastewater or treatment system influent. Table 7-4 also presents the average concentration at which each pollutant was detected. The Agency did not use sample concentrations reported as less than the ML in calculating the average.

## 7.2 Regulated Pollutants

EPA determined the pollutants for potential regulation on a subcategory basis. As a first step in selecting the pollutants, the Agency grouped the proposed MP&M subcategories (discussed in Section 6.0) according to whether the facilities in the proposed subcategory generated wastewater with high metals content (metal-bearing) or wastewater with low metals content and high oil and grease content (oil-bearing). The proposed General Metals, Metal Finishing Job Shops, Printed Wiring Board, Non-Chromium Anodizing, and Steel Forming and Finishing Subcategories generate metal-bearing wastewaters, while the Oily Wastes Subcategory

and the proposed Railroad Line Maintenance and Shipbuilding Dry Dock Subcategories generate only oil-bearing wastewaters.

Then, EPA evaluated the concentrations and prevalence of the POCs in the unit operations (baths and rinses) and treatment system influents for each subcategory. EPA also evaluated the effectiveness of the selected treatment technologies for each option (see Section 9.0) to determine which pollutants were effectively removed by these technologies. Using this information, EPA considered the following factors in determining which pollutants should not be further considered for regulation:

- The pollutant is controlled through the regulation of other pollutants. EPA evaluated wastewater treatment data to determine if control of one parameter would also control other pollutants. For example, most metal POCs are effectively removed by chemical precipitation. Control of the metals predominantly detected in process wastewater from proposed MP&M operations also controls those other metals not as common in process wastewater from proposed MP&M operations. Therefore, EPA considered only a subset of metals for regulation. In addition, many organic pollutants detected in process wastewater from proposed MP&M operations are removed in oil/water separation systems in the oil phase of the wastewater. Therefore, controlling the oil and grease bulk parameter effectively controls these organic pollutants.
- The pollutant is present in only trace amounts in the subcategory's wastewater type (metal-bearing or oil-bearing) and/or is not likely to cause toxic effects. EPA performed this evaluation on a pollutant-by-pollutant basis using the data presented in Section 5.0.
- The pollutant may be used as a treatment chemical.
- The pollutant is not controlled by the selected BPT/BAT technologies. EPA reviewed the treatment data for technologies considered in the MP&M technology options (see Section 9.0), and identified any pollutants that were not effectively removed by these technologies.

Based on these criteria, a number of these pollutants were not further considered for regulation. Based on other factors, EPA established limitations and standards for direct dischargers in the Oily Wastes Subcategory only. For that subcategory, the list of remaining POCs was reduced for the purpose of setting limitations and standards to oil and grease (as HEM) and TSS. Table 7-5 lists all of the remaining POCs and the reason each pollutant was eliminated.

EPA determined that regulating only oil and grease will control the removal of organic constituents for the Oily Wastes Subcategory. EPA did not promulgate a limit for total

petroleum hydrocarbons (TPH) (as SGT-HEM) because it believes that regulating oil and grease (as HEM) will control the discharge of TPH (as SGT-HEM).

EPA determined that it was not necessary to promulgate limits for 28 POCs that are present in only trace amounts in the Oily Wastes Subcategory and/or are not likely to cause toxic effects. As shown in Table 5-4, the median concentration at the influent to treatment for most of these metals is less than 0.5 mg/L.

EPA did not select aluminum, calcium, iron, magnesium, manganese, sodium, chloride, sulfate, or total sulfide for regulation in the Oily Wastes Subcategory because they may be used as treatment chemicals by facilities in the Oily Wastes Subcategory.

EPA did not select lead, zinc, barium, boron or total phosphorus for regulation in the Oily Wastes Subcategory because they are not controlled by the selected BPT/BAT technology.

### **7.3            References**

1.            U.S. Environmental Protection Agency. The 1990 Industrial Technology Division List of Analytes. Washington, DC, May 1990.
2.            U.S. Environmental Protection Agency. Development Document for Final Effluent Limitations Guidelines and Standards for the Centralized Waste Treatment Industry. (EPA-821-R-00-020), 2000.

**Table 7-5**

**Pollutants Considered for Regulation for Direct Dischargers in the Oily Wastes Subcategory**

Pollutant Parameter	Controlled Through Regulation of Other Pollutants	Present in Trace Amounts or Not Likely to Cause Toxic Effects	Treatment Chemical	Not Controlled by BPT/BAT Technology	Regulated Under 40 CFR 438
<b>Priority Organic Pollutants</b>					
1,1,1-Trichloroethane	✓				
1,1-Dichloroethane	✓				
1,1-Dichloroethylene	✓				
2,4-Dimethylphenol	✓				
2,4-Dinitrophenol	✓				
2,6-Dinitrotoluene	✓				
2-Nitrophenol	✓				
4-Chloro-m-cresol	✓				
4-Nitrophenol	✓				
Acenaphthene	✓				
Acrolein	✓				
Anthracene	✓				
Bis(2-Ethylhexyl) Phthalate	✓				
Benzyl Butyl Phthalate	✓				
Chlorobenzene	✓				
Chloroethane	✓				
Chloroform	✓				
Di-N-Butyl Phthalate	✓				
Di-N-Octyl Phthalate	✓				
Dimethyl Phthalate	✓				
Ethylbenzene	✓				
Fluoranthene	✓				
Fluorene	✓				
Isophorone	✓				
Methylene Chloride	✓				
n-Nitrosodimethylamine	✓				
N-Nitrosodiphenylamine	✓				
Naphthalene	✓				
Phenanthrene	✓				

**Table 7-5 (Continued)**

Pollutant Parameter	Controlled Through Regulation of Other Pollutants	Present in Trace Amounts or Not Likely to Cause Toxic Effects	Treatment Chemical	Not Controlled by BPT/BAT Technology	Regulated Under 40 CFR 438
<b>Priority Organic Pollutants (continued)</b>					
Phenol	✓				
Pyrene	✓				
Tetrachloroethene	✓				
Toluene	✓				
Trichloroethylene	✓				
<b>Priority Metal Pollutants</b>					
Antimony		✓			
Arsenic		✓			
Beryllium		✓			
Cadmium		✓			
Chromium		✓			
Copper		✓			
Lead				✓	
Mercury		✓			
Nickel		✓			
Selenium		✓			
Silver		✓			
Thallium		✓			
Zinc				✓	
<b>Conventional Pollutants</b>					
BOD 5-Day (Carbonaceous)	✓				
Oil and Grease (as HEM)					✓
Total Suspended Solids					✓
<b>Nonconventional Organic Pollutants</b>					
1,4-Dioxane	✓				
1-Bromo-2-Chlorobenzene	✓				
1-Bromo-3-Chlorobenzene	✓				
1-Methylfluorene	✓				
1-Methylphenanthrene	✓				
2-Butanone	✓				
2-Hexanone	✓				
2-Isopropylnaphthalene	✓				
2-Methylnaphthalene	✓				
2-Propanone	✓				

**Table 7-5 (Continued)**

Pollutant Parameter	Controlled Through Regulation of Other Pollutants	Present in Trace Amounts or Not Likely to Cause Toxic Effects	Treatment Chemical	Not Controlled by BPT/BAT Technology	Regulated Under 40 CFR 438
<b>Nonconventional Organic Pollutants (continued)</b>					
3,6-Dimethylphenanthrene	✓				
4-Methyl-2-Pentanone	✓				
Acetophenone	✓				
Alpha-Terpineol	✓				
Aniline	✓				
Benzoic Acid	✓				
Benzyl Alcohol	✓				
Biphenyl	✓				
Carbon Disulfide		✓			
Dibenzofuran	✓				
Dibenzothiophene	✓				
Diphenyl Ether	✓				
Diphenylamine	✓				
Hexanoic Acid	✓				
Isobutyl Alcohol	✓				
m+p Xylene	✓				
m-Xylene	✓				
Methyl Methacrylate	✓				
n,n-Dimethylformamide	✓				
n-Decane	✓				
n-Docosane	✓				
n-Dodecane	✓				
n-Eicosane	✓				
n-Hexacosane	✓				
n-Hexadecane	✓				
n-Nitrosopiperidine	✓				
n-Octacosane	✓				
n-Octadecane	✓				
n-Tetracosane	✓				
n-Tetradecane	✓				
n-Triacontane	✓				
o+p Xylene	✓				
o-Cresol	✓				
o-Xylene	✓				

**Table 7-5 (Continued)**

Pollutant Parameter	Controlled Through Regulation of Other Pollutants	Present in Trace Amounts or Not Likely to Cause Toxic Effects	Treatment Chemical	Not Controlled by BPT/BAT Technology	Regulated Under 40 CFR 438
<b>Nonconventional Organic Pollutants (continued)</b>					
p-Cresol	✓				
p-Cymene	✓				
Pyridine	✓				
Styrene	✓				
Trichlorofluoromethane	✓				
Tripropyleneglycol Methyl Ether	✓				
<b>Nonconventional Metal Pollutants</b>					
Aluminum			✓		
Barium				✓	
Boron				✓	
Calcium			✓		
Cobalt		✓			
Gold		✓			
Iron			✓		
Magnesium			✓		
Manganese			✓		
Molybdenum		✓			
Sodium			✓		
Tin		✓			
Titanium		✓			
Vanadium		✓			
Yttrium		✓			
<b>Other Nonconventional Pollutants</b>					
Amenable Cyanide		✓			
Ammonia As Nitrogen		✓			
Chemical Oxygen Demand (COD)	✓				
Chloride			✓		
Fluoride		✓			
Hexavalent Chromium		✓			
Sulfate			✓		
Total Cyanide		✓			
Total Dissolved Solids		✓			
Total Kjeldahl Nitrogen		✓			



**Table 7-5 (Continued)**

Pollutant Parameter	Controlled Through Regulation of Other Pollutants	Present in Trace Amounts or Not Likely to Cause Toxic Effects	Treatment Chemical	Not Controlled by BPT/BAT Technology	Regulated Under 40 CFR 438
<b>Other Nonconventional Pollutants (continued)</b>					
Total Organic Carbon (TOC)	✓				
Total Petroleum Hydrocarbons (as SGT-HEM)	✓				
Total Phosphorus				✓	
Total Recoverable Phenolics	✓				
Total Sulfide			✓		
Weak-Acid Dissociable Cyanide		✓			
Ziram		✓			

## **8.0 POLLUTION PREVENTION PRACTICES AND WASTEWATER TREATMENT TECHNOLOGIES**

In general, MP&M facilities generate process wastewater containing metals, cyanide, oil and grease, and suspended solids. Pollution prevention practices and wastewater treatment technologies currently used by facilities evaluated for the final rule (“MP&M facilities”) are designed to remove these pollutants before they are discharged to either a receiving stream (direct discharge) or public owned treatment works (indirect discharge). The type of pollution prevention practice and wastewater treatment technology a MP&M facility selects depends on the manufacturing operations generating the wastewater. Many facilities have implemented process modifications for waste reduction. Some of those modifications include prolonging process bath life by removing contaminants, redesigning part racks to reduce dragout, installing spray or fog nozzle rinse systems, and installing dragout recovery tanks (1).

Most MP&M facilities rely on chemical precipitation and gravity or membrane clarification to remove metals; however, certain pretreatment techniques may be necessary when chelated metals or hexavalent chromium are present. Facilities that generate oily wastewater from operations such as machining and grinding typically use chemical emulsion breaking followed by gravity or membrane clarification. If cyanide is present, facilities typically use oxidation techniques such as alkaline chlorination.

This section describes the pollution prevention practices and wastewater treatment technologies that are used by MP&M facilities, in the first instance, to prevent the generation of wastewater pollutants or, secondarily, to reduce the discharge of wastewater pollutants. Section 8.1 describes flow reduction practices, Section 8.2 describes in-process pollution prevention technologies, Section 8.3 describes management practices for pollution prevention, Section 8.4 describes technologies used for the preliminary treatment of waste streams, and Section 8.5 describes end-of-pipe wastewater treatment and sludge dewatering technologies. This section discusses the most prevalent treatment technologies, as determined by survey responses and site visits, in place at facilities evaluated for the final rule. This section includes descriptions of all the technologies evaluated for the final rule and used as a basis for the MP&M effluent guidelines (see Section 9.0). Additional technologies may be applicable for some MP&M facilities, depending on the waste streams generated. Additionally, not all technologies discussed in this section are applicable to all MP&M facilities; the applicability of a technology is driven by the unit operations performed and waste streams generated on-site. EPA presents pollution prevention practices and wastewater treatment information potentially applicable to all facilities evaluated for the final rule (“MP&M facilities”).

### **8.1 Flow Reduction Practices**

MP&M facilities applies flow reduction practices to process baths or rinses to reduce the volume of wastewater discharged. Flow reduction practices consist of optimizing rinse tank design and configuration, and installing flow reduction technologies such as flow restrictors or timers. Table 8-1 lists various flow reduction practices and the number

observations at EPA MP&M site visits and surveys (see Section 3.0). This table also provides EPA's estimate of the number of MP&M facilities employing the various flow reduction practices based on occurrence at surveyed facilities and their respective survey weights. The following subsections discuss these flow reduction practices in greater detail.

### **8.1.1 Rinse Tank Design and Innovative Configurations**

Rinsing follows many proposed MP&M operations<sup>1</sup> to remove dirt, oil, or chemicals remaining on parts or racks from a previous unit operation (i.e., drag-out). Rinsing improves the quality of the surface finishing process and prevents the contamination of subsequent process baths. Rinse tank design and rinsing configuration greatly influence water usage. The key objectives of optimal rinse tank design are to quickly remove drag-out solution from the part and to disperse the drag-out throughout the rinse tank.

MP&M facilities use various rinsing configurations. The most common are countercurrent cascade rinsing, drag-out rinsing, and spray rinsing. EPA estimates that over 5,000 MP&M facilities use at least one of these rinse schemes to reduce wastewater flow. The use of single overflow rinse tanks following each process tank is the most inefficient use of rinse water. Multiple rinse tanks connected in series (i.e., cascade rinsing) reduce the water needs of a given rinsing operation by one or more orders of magnitude (i.e., less water is needed to achieve the same rinsing quality). Spray rinsing, where the part is suspended over a tank and rinsed with water applied by spray nozzles, also may be used to reduce water use requirements, although less than countercurrent cascade rinses. Below are descriptions of some of the common rinse types.

#### **Cascade Rinsing**

Cascade rinsing is a method of reusing water from one rinsing operation to another, less critical rinsing operation before being discharged to treatment. Some rinse waters acquire chemical properties, such as low pH, that make them desirable for reuse in other rinse systems. For example, water from an acid treatment rinse may be reused in an alkaline treatment rinse. In this case, the rinse water both removes drag-out from the work piece and neutralizes the drag-out.

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<sup>1</sup>Note: EPA evaluated a number of unit operations for the May 1995 proposal, January 2001 proposal, and June 2002 NODA (see Tables 4-3 and 4-4). However, EPA selected a subset of these unit operations for regulation in the final rule (see Section 1.0). For this Section, the term "proposed MP&M operations" means those operations evaluated for the two proposals, NODA, and final rule. The term "final MP&M operations" means those operations defined as "oily operations" (see Section 1.0, 40 CFR 438.2(f), and Appendix B to Part 438) and regulated by the final rule.

**Table 8-1****MP&M Flow Reduction Technologies**

Technology	Technology Description	Demonstration Status		
		Number of Facilities Visited Using the Technology <sup>a</sup>	Number of Survey Facilities Using the Technology <sup>b</sup>	Estimated Number of MP&M Facilities Using the Technology <sup>c</sup>
Countercurrent Cascade Rinsing	Series of consecutive rinse tanks that are plumbed to cause water to flow from one tank to another in the direction opposite of the work flow. Water is introduced into the last tank of the series, making it the cleanest, and is discharged from the first tank, which has the highest concentration of pollutants.	110	130	1,569
Drag-Out Rinsing	Stagnant rinse, initially of fresh water, positioned immediately after process tanks. The drag-out rinse collects most of the drag-out from the process tank, preventing it from entering the subsequent flowing rinses. Drag-out rinse is commonly reused as make-up for heated process bath to replace evaporative loss.	62	139	1,737
Spray Rinsing	Water sprayed on parts above a process tank or drip/drag-out tank; uses considerably less water than immersion for certain part configurations. This technology can also be performed as countercurrent cascade rinsing with spray rinses instead of overflow immersion rinses.	75	187	1,767
Flow Restrictors	Equipment that prevents the flow in a pipe from exceeding a predetermined flow rate. Flow restrictors can be used to limit the flow into a rinse system. For continuously flowing rinses, a flow restrictor controls the flow into the system, ensuring a consistent, optimum flow rate.	50	127	1,581

Table 8-1 (Continued)

Technology	Technology Description	Demonstration Status		
		Number of Facilities Visited Using the Technology <sup>a</sup>	Number of Survey Facilities Using the Technology <sup>b</sup>	Estimated Number of MP&M Facilities Using the Technology <sup>c</sup>
Conductivity Probes	Equipment that measures the conductivity of water in a rinse tank to regulate the flow of fresh rinse water into the rinse system. A solenoid valve on the rinse system fresh water supply is connected to the controller, which opens the valve when a preset conductivity level is exceeded and closes the valve when conductivity is below that level.	40	29	320

Source: MP&M site visits, MP&M sampling episodes, MP&M surveys and technical literature. Statistics specific to wastewater-discharging facilities.

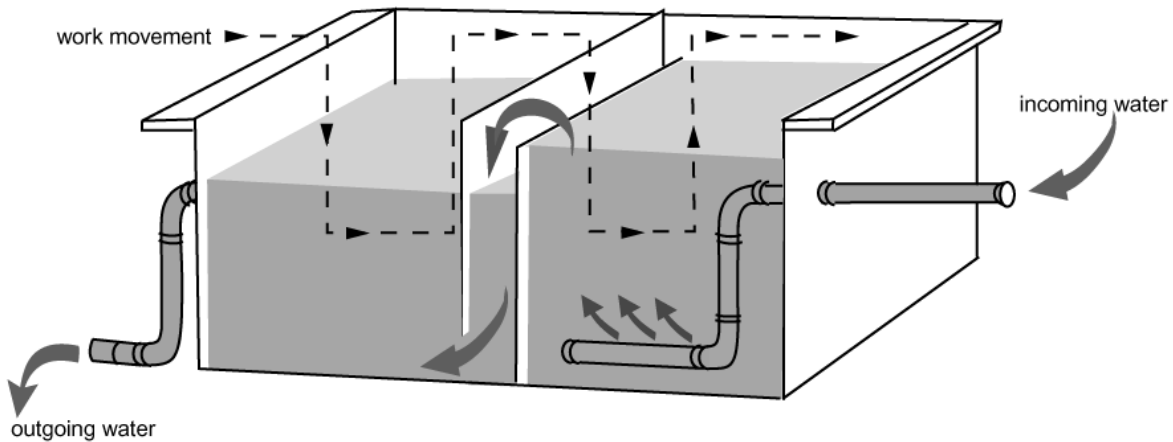
<sup>a</sup>Indicates the number of MP&M facilities visited by EPA that use the listed technology. EPA visited a total of 221 facilities.

<sup>b</sup>Number of survey facilities based on data collected in 1996 detailed survey only. The 1989 survey did not request this information. EPA sent the 1996 detailed survey to 311 facilities.

<sup>c</sup>Indicates the estimated number of MP&M facilities currently performing this technology based on the 1996 detailed survey. EPA’s national estimate of the 1996 detailed survey includes approximately 4,900 facilities. EPA estimated numbers in this column using statistical weighting factors for the 1996 detailed survey respondents. See Section 3.0 for a discussion of the development of national estimates and statistical survey weights.

### Countercurrent Cascade Rinsing

Countercurrent cascade rinsing refers to a series of consecutive rinse tanks that are plumbed to cause water to flow from one tank to another in the direction opposite of the work flow. Fresh water flows into the rinse tank located farthest from the process tank and overflows (i.e., cascades) into the rinse tank that is closest to the process tank. This is called countercurrent rinsing because the work piece and the rinse water move in opposite directions. Over time, the first rinse becomes contaminated with drag-out solutions and reaches a stable concentration of process bath constituents that is lower than the concentration in the process bath. The second rinse stabilizes at a lower concentration, which enables less rinse water to be used than if only one rinse tank were in place. The more countercurrent cascade rinse tanks (three-stage, four-stage, etc.), the less rinse water is needed to adequately remove the process solution. This differs from a single, overflow rinse tank where the rinse water is composed of fresh water that is discharged after use without any recycle or reuse. Figure 8-1 illustrates countercurrent cascade rinsing.



**Figure 8-1. Countercurrent Cascade Rinsing**

The rinse rate needed to adequately dilute drag-out depends on the concentration of process chemicals in the initial process bath, the concentration of chemicals that can be tolerated in the final rinse tank to meet product specifications, the amount of drag-out solution carried into each rinse stage, and the number of countercurrent cascade rinse tanks. These factors are expressed in Equation 8-1 (2):

$$V_r = \left( \frac{C_o}{C_f} \right)^{1/n} \times V_D \quad (8-1)$$

where:

$V_r$	=	the flow rate through each rinse stage, gal/min;
$C_o$	=	the concentration of the contaminant(s) in the initial process bath, mg/L;
$C_f$	=	the tolerable concentration of the contaminant(s) in the final rinse to give acceptable product cleanliness, mg/L;
$n$	=	the number of rinse stages used; and
$V_D$	=	the drag-out carried into each rinse stage, expressed as a flow rate, gal/min.

This mathematical rinsing model is based on complete rinsing (i.e., removal of all contaminants from the work piece) and complete mixing (i.e., homogeneous rinse water in each rinse stage). Under these conditions, each additional rinse stage can reduce rinse water use by 90 percent. However, each rinse stage needs to have sufficient residence time and agitation for complete mixing to occur in each rinse tank to achieve these conditions. For less efficient rinse systems, each added rinse stage reduces rinse water use by 50 to 75 percent.

Countercurrent cascade rinsing systems have higher capital costs than do overflow rinses and require more space to accommodate the additional rinse tanks. Also, when countercurrent cascade rinsing is used, the low flow rate through the rinse tanks may not provide the needed agitation for drag-out removal. In such cases, air or mechanical agitation may be added to increase rinsing efficiency.

### **Drag-out Rinsing**

Drag-out rinse is a stagnant rinse, initially filled with fresh water, positioned immediately after the process tank. Work pieces are rinsed in drag-out tanks directly after exiting the process bath. The drag-out rinse collects most of the drag-out from the process tank, thus preventing it from entering the subsequent flowing rinses and reducing pollutant loadings in those rinses. Gradually, the concentration of process chemicals in the drag-out tank rises. In the most efficient configuration, a drag-out tank follows a heated process tank that has a moderate to high evaporation rate. A portion of the fluid in the drag-out tank returns to the process tank to replace the evaporative loss. The level of fluid in the drag-out tank is maintained by adding fresh water. Electrolytic recovery, discussed in Section 8.2.6, is commonly used to remove dissolved metals from drag-out tanks.

### **Spray Rinsing**

For certain work piece configurations, spray rinsing uses considerably less water than does immersion rinsing. During spray rinsing, the parts are held over a catch tank and are sprayed with water. Water then drips from the part into the catch tank, and is then either recycled to the next stage or discharged to treatment. Spray rinsing can occur in a countercurrent cascade configuration, further reducing water use. Spray rinsing can enhance draining over a process

bath by diluting and lowering the viscosity of the process fluid film clinging to the work piece. Using spray rinsing can control rinse water flow.

### **8.1.2 Additional Design Elements**

In addition to rinse configuration, unit operations can be modified in other ways to reduce drag-out of process bath chemicals. For example, air knives and drip tanks reduce the pollutant loading and volume of rinse water requiring treatment. Other aspects of good rinse tank design include positioning the water inlet and discharge points of the tank at opposite locations in the tank to avoid short-circuiting, using air agitation for better mixing, using a flow distributor, and using the minimum tank size possible (3). Four rinse design elements are described in more detail below.

#### **Air Knives**

Air knives are high-pressure air blowers installed over a process tank or drip shield and are designed to remove drag-out by blowing the liquid off the surface of work pieces and racks and into a catch tank. Liquid from the catch tank is pumped back to the process tank. Air knives are most effective with flat parts and cannot be used to dry surfaces that passivate or stain due to oxidation.

#### **Drip Shields**

Drip shields are inclined sheets installed between process tanks and rinse tanks to recover, and drain to the process tank, process fluid that drips from racks and barrels and would otherwise fall into rinse tanks or onto the floor. Often, drip shields are composed of polypropylene or another inert material.

#### **Drip Tanks**

Drip tanks are installed immediately after the process tank. Work pieces exiting a process bath are held over the drip tank and the process fluid that drips from the work pieces collects in the drip tank. When enough fluid is collected in the drip tank, the fluid flows back to the process tank.

#### **Long Dwell Time**

Automatic finishing lines can be programmed to include optimum drip times. Long dwell times over the process tank reduce the volume of drag-out reaching the rinsing system. On manual lines, racks can be hung on bars over process baths to allow the fluid drip. Barrels can be rotated over the process bath to enhance drainage. Increases in drip time may be unsuitable for surfaces that can be oxidized or stained by exposure to air.



### **8.1.3 Rinse Water Use Control**

Facilities can reduce water use by coordinating and closely monitoring rinse water requirements (e.g., rinse water use is optimized based on drag-out rates so that the rinse quality is consistent). Matching water use to rinse water requirements optimizes the quantity of rinse water used for a given work load and tank arrangement (3). Inadequate controlling water use negates the benefits of using multiple rinse tanks or other water conservation practices and results in a high water usage.

Many facilities use some form of rinse water control. The four most common methods are flow restrictors (these can be used with other methods to regulate the rate at which water is dispensed), manual control (i.e., turning water valves on and off as needed), conductivity controls, and timer rinse controls. Using data from the 1996 MP&M industry survey, EPA estimates there are over 1,900 MP&M facilities using this equipment to control rinse water flow. These are discussed below.

#### **Flow Restrictors**

A flow restrictor prevents the flow in a pipe from exceeding a predetermined flow rate. Flow restrictors are commonly installed on a rinse tank's water inlet. These devices contain an elastomer washer that flexes under pressure to maintain a constant water flow regardless of pressure. Flow restrictors can maintain a wide range of flow rates, from less than 0.1 gal/min to more than 10 gal/min. As a stand-alone device, a flow restrictor provides a constant water flow and is therefore best suited for continuous rinsing. For intermittent rinsing operations, a flow restrictor does not coordinate the rinse flow with drag-out introduction. Precise control with intermittent operations typically requires a combination of flow restrictors and rinse timers. However, for continuous rinsing (e.g., continuous electroplating machines), flow restrictors may be adequate for good water use control.

#### **Conductivity Controllers**

Conductivity controllers use conductivity probes to measure the conductivity (total dissolved solids (TDS)) of water in a rinse tank to regulate the flow of fresh rinse water into the rinse system. Conductivity controllers consist of a controller, a meter with adjustable set points, a probe that is placed in the rinse tank, and a solenoid valve. As parts are rinsed, dissolved solids enter the water in the rinse tank, raising the conductivity of the water. When conductivity reaches a set point where the water can no longer provide effective rinsing, the solenoid valve opens to allow fresh water to enter the tank. When the conductivity falls below the set point, the valve closes to discontinue the fresh water flow.

In theory, conductivity control of rinse flow is a precise method of maintaining optimum rinsing conditions in intermittent rinsing operations. In practice, conductivity controllers work best with deionized rinse water. Incoming fresh water conductivity may vary day to day and season to season, which forces frequent set point adjustments. In addition,

suspended solids and nonionic contaminants (e.g., oil) can cause inadequate rinsing and are not measured by the conductivity probe.

### **Rinse Timers**

Rinse timers are electronic devices that control a solenoid valve. The timer usually consists of a button that, when pressed, opens the valve for a predetermined time period, usually from 1 to 99 minutes. After the time period has expired, the valve automatically closes. The timer may be activated either manually by the operator or automatically by the action of racks or hoists. Automatic rinse timers are generally preferred for intermittent rinses because they eliminate operator error. Rinse timers installed in conjunction with flow restrictors can provide precise control when the incoming water pressure may rise and fall. Rinse timers are less effective in continuous or nearly continuous rinse operations (e.g., continuous electroplating machines) because the rinse operates nearly continuously.

#### **8.1.4 Pollution Prevention for Process Baths**

Facilities also can implement measures that will reduce or prevent pollution in process baths to reduce the drag-out pollutant loadings and therefore the amount of drag-out solution produced. Examples of these technologies are increasing bath temperature, operating at lower batch concentration, and using wetting agents, discussed below:

- Temperature and viscosity are inversely related; therefore, operating a bath at the highest possible temperature will lower process bath viscosity and reduce drag-out.
- Operating at the lowest possible concentration reduces the mass of chemicals in a given volume of drag-out. Also, viscosity and concentration are directly related; therefore, lower process bath concentration will result in lower process bath viscosity and less drag-out volume. Contaminants and other process bath impurities should be minimized, if possible, to extend the usefulness of the bath, reducing the frequency of treatment or disposal.
- Adding wetting agents or surfactants to some process baths reduces viscosity and surface tension, thereby significantly reducing drag-out.

## **8.2 In-Process Pollution Prevention Technologies**

This section describes in-process pollution prevention technologies used at MP&M facilities to reduce pollutant loadings to the wastewater treatment system. Table 8-2 lists a number of in-process pollutant prevention technologies. This table also provides EPA's estimate of the number of MP&M facilities employing the various in-process pollutant

**Table 8-2****MP&M In-Process Pollution Prevention Technologies**

<b>Technology</b>	<b>Technology Description</b>	<b>Demonstration Status</b>		
		<b>Number of Facilities Visited Using the Technology<sup>a</sup></b>	<b>Number of Survey Facilities Using the Technology<sup>b</sup></b>	<b>Estimated Number of MP&amp;M Facilities Using the Technology<sup>c</sup></b>
Evaporation with Condensate Recovery	Removes water by evaporation, leaving a concentrated residue for disposal and water vapor for condensation and reuse.	7	15	147
Ion Exchange (in-process)	Removes metal salts from electroplating rinse water using combined cation and anion exchange. Effluent (permeate) from the ion exchange flows back to the electroplating rinse system. Ion exchange regenerants are either discharged to the end-of-pipe chemical precipitation unit for metals removal or to electrolytic recovery for metals recovery.	35	33	437
Reverse Osmosis	Forces wastewater through a membrane at high pressure, leaving a concentrated stream of pollutants for disposal. Reverse osmosis may provide an effluent clean enough for reuse.	3	1	3
Centrifugation of Painting Water Curtains	Removes the heavier solids from the water curtain by centrifugation, allowing the water to be reused. The solids are collected as a cake in the basket of the centrifuge. This technology can achieve closed-loop reuse of water curtains.	3	1	12
Filtration of Painting Water Curtains	Removes solids by filtration (cloth, sand, diatomaceous earth, etc.) followed by reuse. This technology can achieve closed-loop reuse of water curtains.	2	3	20
Settling of Painting Water Curtains	Removes the heavier solids from the water curtains by gravity separation. This technology can be used in conjunction with other removal technologies to lessen the solids loading.	5	5	23
Biocide Addition to Lengthen Coolant Life	Can impede the growth of microorganisms that cause rancidity. Machining coolant is often discarded as it becomes rancid.	9	27	216
Centrifugation of Machinery Coolant	Removes the solids from the coolant by centrifugation to extend its usable life. Some high-speed centrifuges can also perform liquid-liquid separation to remove tramp oils and further extend coolant life.	18	10	78

**Table 8-2 (Continued)**

Technology	Technology Description	Demonstration Status		
		Number of Facilities Visited Using the Technology <sup>a</sup>	Number of Survey Facilities Using the Technology <sup>b</sup>	Estimated Number of MP&M Facilities Using the Technology <sup>c</sup>
Filtration of Machinery Coolant	Removes the solids from the coolant using filters such as cloth, sand, or carbon to extend its usable life.	18	18	142
Skimming of Tramp Oils in Machinery Coolants	Removes tramp oils using mechanical skimming to extend coolant life. Tramp oil buildup often makes machining coolant unusable.	8	9	82
Pasteurization of Machinery Coolants	Kills the microorganisms that cause rancidity using heat. Machining coolant is often discarded as it becomes rancid.	2	2	18
General Filtration of Baths and Solutions	Removes metals and other impurities from process tanks, including electrolytic plating solutions and acid/alkaline cleaning tanks. Increases bath longevity. Technologies include paper filters, carbon adsorption, and magnetic separators.	6		
Electrolytic Recovery (Electrowinning)	Recovers dissolved metals from concentrated sources using an electrochemical process. For rinses, electrolytic recovery is typically restricted to drag-out rinses. Flowing rinses are generally too dilute for efficient electrolytic recovery. This technology effectively recovers metals from ion exchange regenerants.	22	23	142

Source: MP&M site visits, MP&M sampling episodes, MP&M surveys and technical literature. Statistics specific to wastewater-discharging facilities.

<sup>a</sup>Indicates the number of MP&M facilities visited by EPA that use the listed technology. EPA visited a total of 221 facilities.

<sup>b</sup>Number of survey facilities based on data collected in 1996 detailed survey only. The 1989 survey did not request this information. EPA sent the 1996 detailed survey to 311 facilities.

<sup>c</sup>Indicates the estimated number of MP&M facilities currently performing this technology based on the 1996 detailed survey. EPA's national estimate of the 1996 detailed survey includes approximately 4,900 facilities. EPA estimated numbers in this column using statistical weighting factors for the 1996 detailed survey respondents. See Section 3.0 for a discussion of the development of national estimates and statistical survey weights.

prevention technologies based on occurrence at surveyed facilities and their respective survey weights. In-process pollution prevention technologies can be applied to process baths or rinses. Not all technologies discussed in this subsection are applicable to all MP&M facilities.

Process baths become contaminated with impurities that affect their performance. The sources of process bath contamination include: (1) breakdown of process chemicals; (2) buildup of by-products (e.g., carbonates); (3) contamination from impurities in make-up water, chemicals, or anodes; (4) corrosion of parts, racks, tanks, heating coils, etc.; (5) drag-in of chemicals; (6) errors in bath additions; and (7) airborne particles entering the tank. If not properly maintained, process baths become prematurely unusable and require disposal. Regeneration and maintenance techniques help keep baths in good operating condition, thereby extending the useful lives of process solutions. Using these technologies reduces the frequency of process bath discharges, and therefore reduces pollutant loadings to the wastewater treatment system. This, in turn, reduces wastewater treatment requirements and sludge disposal costs.

Rinsing removes residual process chemicals from the surface of a work piece. As more and more work pieces are rinsed, the concentration of process chemicals (contaminants) in the rinse water increases. At some point, the concentration of process chemicals in the rinse water becomes so high that an unacceptable amount of process chemicals remain on the surface of the work piece. When this occurs, clean water is added to the rinse solution to lower the concentration of process chemicals to a level that will not impact the quality of the work piece. Overflow from the rinsing operation goes to treatment for removal of the residual process chemicals. For continuous processing operations, clean water may continuously flow into the rinse process to ensure that the concentration of contaminants will not exceed the quality limit for the work piece.

This section describes the following technologies used to treat and reuse process solutions:

- Activated carbon adsorption;
- Carbonate freezing;
- Centrifugation and pasteurization of machining coolants;
- Centrifugation and recycling of painting water curtains;
- Electrodialysis;
- Electrolytic recovery;
- Evaporation;
- Filtration;
- Ion exchange; and
- Reverse osmosis.

### **8.2.1 Activated Carbon Adsorption**

Activated carbon adsorption is a common method of removing organic contaminants from electroplating baths. Process solution flows through a filter where the carbon

adsorbs organic impurities that result from the breakdown of bath constituents. Carbon adsorption can be either a continuous or batch operation, depending on the site's preference. Carbon treatment is most commonly applied to nickel, copper, zinc, and cadmium electroplating baths but also can be used to remove organic contaminants from paint curtains.

### **8.2.2 Carbonate “Freezing”**

Carbonate “freezing” removes excessive carbonate buildup by forming carbonate salt crystals at a low temperature that are then removed. MP&M facilities most often apply this process to electroplating baths formulated with sodium cyanide. Carbonates build up in the process bath by the breakdown of cyanide (especially at high temperatures) and the adsorption of carbon dioxide from the air. An excessive carbonate concentration reduces the product quality of many metal finishing operations. Carbonate “freezing” takes advantage of the low solubility of carbonate salts in the sodium cyanide bath. The method lowers the bath temperature to approximately 26°F (-3°C), at which point hydrated salt ( $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ ) crystallizes out of solution. The crystallized carbonate can be removed by decanting the fluid into another tank or by filtration.

### **8.2.3 Centrifugation and Pasteurization of Machining Coolants**

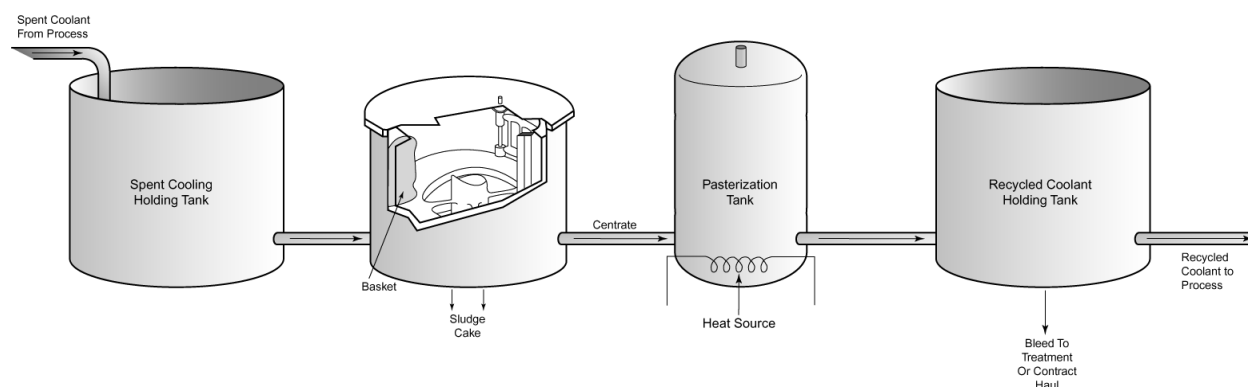
Most machining coolants contain water-soluble oil in water. The water-soluble coolant typically is pumped from a sump, over the machining tool and work piece during machining, and back to the sump. Over a period of time, recycled coolant becomes ineffective, or spent, for one or more of the following reasons:

- The concentration of suspended solids in the coolant begins to inhibit performance;
- Nonemulsified, or “tramp,” oil collects on the surface of the coolant, inhibiting performance;
- The coolant becomes rancid due to microbial growth; or
- Coolant additives are consumed by drag-out and organic breakdown, thus reducing corrosion prevention and lubrication properties.

As shown in Table 8-2, EPA estimates that nearly 300 MP&M facilities use centrifugation and biocide/pasteurization processes to extend the life of their water-soluble coolants.

Coolant recycling is most effective when facilities minimize the number of different coolants used on-site and use a centralized coolant recycling system. However, some facilities may not be able to use a single recycling system because of multiple coolant types required by product or customer specifications. In this case, facilities may need to purchase dedicated coolant recycling systems for each type of coolant used.

Using a centrifugal separator and pasteurization unit can extend the useful life of machining coolants. The separator is a rotating chamber that uses centrifugal force to push the coolant through a mesh chamber, leaving behind solid contaminants of sludge. Sludge is scraped from the centrifuge and collected in a sludge hopper. Some high-speed centrifuges also can perform liquid-liquid separation to remove tramp oils. The coolant undergoes pasteurization after separation to kill the microorganisms that cause bacterial growth. Adding a biocide can also control bacterial growth. Figure 8-2 shows a diagram of a typical machine coolant recycling system.



**Figure 8-2. Machine Coolant Recycling System**

Centrifugal separators are very reliable and require only routine maintenance, such as periodic cleaning and removal of accumulated solids. Flow rate is the primary operating factor to control. The sludge generated from this technology is commonly classified as a hazardous waste, based on the metal type processed and the amount of metal that dissolves into the coolant. Facilities typically haul the sludge off-site for treatment and disposal.

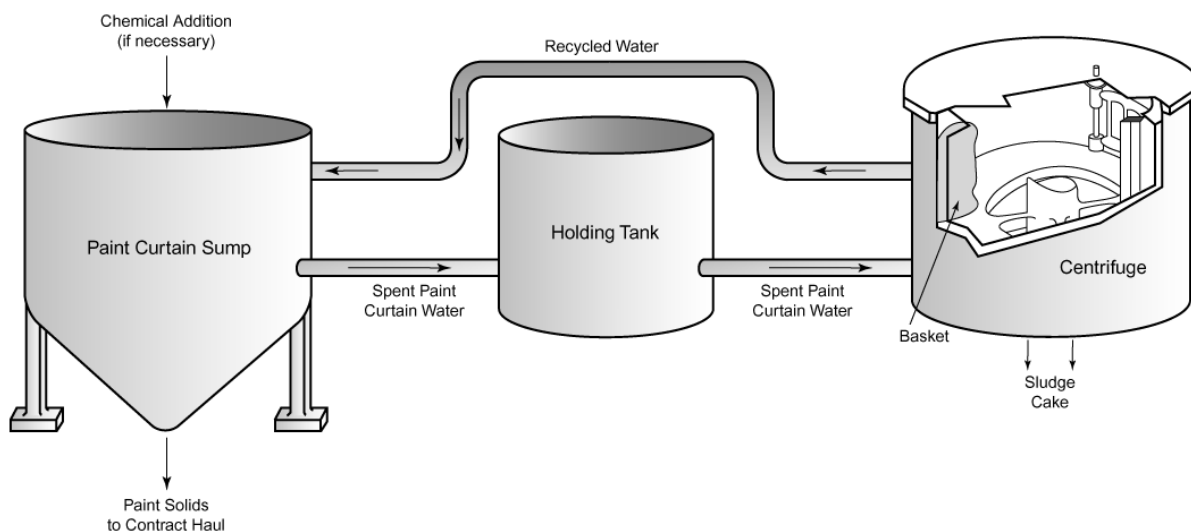
Centrifugation and pasteurization can be used in conjunction with oil skimming and biocide addition to reduce coolant discharge and pollutant generation at the source. Oil skimming using a vertical belt system (described in Section 8.4.5.2) removes large amounts of tramp hydraulic oils floating on the surface of the machine coolant. Oil skimming and biocide addition can further extend the life of water-soluble coolant, thereby reducing the amount of coolant and wastewater requiring treatment and disposal, and minimizing fresh coolant requirements.

#### **8.2.4 Centrifugation and Recycling of Painting Water Curtains**

Water curtains are a continuous flow of water behind the work piece being spray painted in a paint booth. The water traps paint overspray and is continuously recirculated in the paint curtain until the solids content in the wastewater necessitates either in-process treatment and recycling or discharge. Based on data from the 1996 MP&M detailed survey, approximately 12 MP&M facilities centrifuge and recycle water from their paint curtains.

Wastewater from painting water curtains commonly contains organic pollutants as well as certain metals. Eliminating the discharge of wastewater from painting water curtains may eliminate the need for an end-of-pipe treatment step for organic pollutants at certain facilities. Moreover, if a facility uses only painting water curtains and continuously recycles the water, the facility would not need end-of-pipe wastewater treatment.

Figure 8-3 shows a diagram of a typical in-process centrifugation and recycling treatment system for a paint curtain. Centrifugal separators remove the solids and recycle the water curtain, eliminating the need for discharge. This system can recycle the paint curtain water continuously. The system pumps the water curtain from the paint curtain sump to a holding tank, then through the centrifugal separator, which separates the solids from the wastewater (see section 8.2.3). Solids from the centrifuge are hauled for off-site disposal, while the treated wastewater is returned to the paint booth. Centrifugation of the paint curtain proceeds until all wastewater is treated and only sludge remains in the paint curtain sump. Operators must remove the sludge in the paint curtain sump either manually, with a sludge pump, or by vacuum truck. The facility may add detactifiers before centrifugation to increase the solid separation efficiency. Detactifiers make the paint solids less sticky, allowing them to be more easily removed from the centrifuge. Make-up water is added to the system to compensate for evaporation.



**Figure 8-3. Centrifugation and Recycling of Painting Water Curtains**

As discussed in Section 8.2.3, centrifugal separators are very reliable and require only routine maintenance. Flow rate is the primary operating factor to control. One disadvantage of this technology is that it may not be economically feasible for facilities generating only a small amount of paint curtain wastewater. Facilities that have multiple sumps can use portable centrifuges.



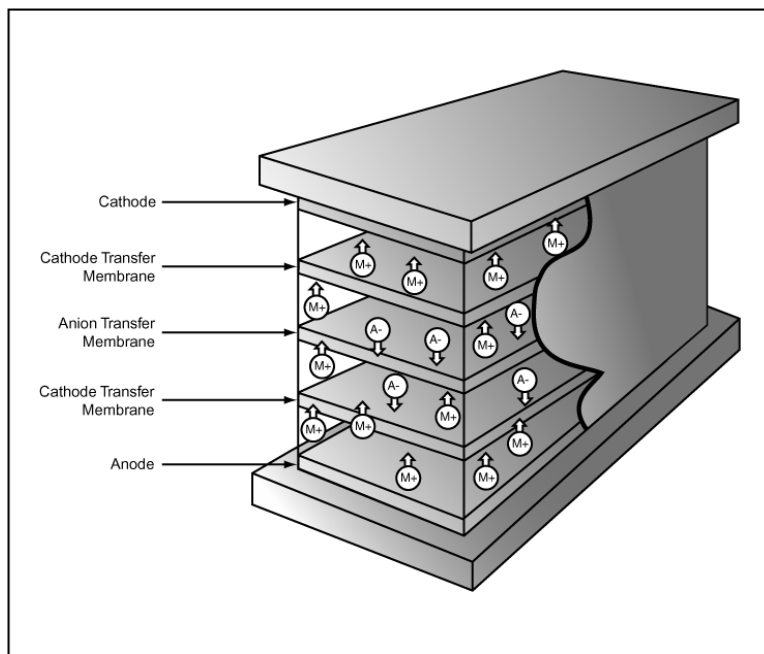
The sludge generated from painting water curtains is commonly classified as a hazardous waste, based on the type of paint used, and typically is hauled off-site for treatment and disposal. See Appendix D for more information on pollution prevention practices with painting operations.

### **8.2.5        Electrodialysis**

Electrodialysis is a process in which dissolved colloidal species are exchanged between two liquids through selective semipermeable membranes (11). The technology applies a direct current across a series of alternating anion and cation exchange membranes to remove dissolved metal salts and other ionic constituents from solutions.

An electrodialysis unit consists of a rectifier and a membrane stack. The rectifier converts alternating current to direct current. The stack consists of alternating anion- and cation-specific membranes that form compartments. As the feed stream enters the unit, ions move across the electrodialysis membranes, forming a concentrated stream and a deionized stream. When the compartments are filled, a direct current is applied across each membrane in the stack. Cations traverse one cation-specific membrane in the direction of the cathode and are trapped in that concentrate compartment by the next membrane, which is anion-specific. Anions from the neighboring compartment traverse the anion-specific membrane in the direction of the anode, joining the cations, and are likewise trapped in the concentrate compartment by the next cation-specific membrane. In this way, the technology depletes the feed stream of ions, and traps anions and cations in each concentrate compartment. Facilities typically use electrodialysis to remove metal ions from electroplating wastewater. Figure 8-4 shows a diagram of an electrodialysis cell.

## EDR Module

**Figure 8-4. Electrodialysis Cell**

By using the electrodialysis cell, facilities remove impurities from the process bath, extending its life. Facilities can treat the removed concentrate stream on-site, or haul it off-site for disposal, treatment, or metals reclamation.

### 8.2.6 Electrolytic Recovery

Electrolytic recovery is an electrochemical process used to recover metal contaminants from many types of process solutions and rinses, such as electroplating rinse waters and baths. Electrolytic recovery removes metal ions from a waste stream by processing the stream in an electrolytic cell, which consists of a closely spaced anode and cathode. Equipment consists of one or more cells, a transfer pump, and a rectifier. Current is applied across the cell and metal cations are deposited on the cathodes. The waste stream is usually recirculated through the cell from a separate tank, such as a drag-out recovery rinse.

Facilities typically apply electrolytic recovery to solutions containing either nickel, copper, precious metals, or cadmium. Chromium cannot be electrolytically recovered because it exists primarily in anionic forms such as dichromate. Drag-out rinses and ion-exchange regenerant are solutions that commonly are processed using electrolytic recovery. Some solutions require pH adjustment prior to electrolytic recovery. Acidic, metal-rich, cation regenerant is an excellent candidate stream for electrolytic recovery and is often electrolytically

recovered without pH adjustment. In some cases, when the target metal concentration is reached, the waste stream can act as cation regenerant.

The capacity of electrolytic recovery equipment depends on the total cathode area and the maximum rated output of the rectifier. Units are available with a cathode area ranging from 1 ft<sup>2</sup> to 100 ft<sup>2</sup> or larger, and an output of 10 to 1,000 amperes or more. Faraday's law, which states the amount of chemical change produced by an electric current is proportional to the quantity of electricity used, determines theoretical electrolytic recovery rates. Theoretical recovery rates range from 1.09 grams/amp-hour for nickel to 7.35 grams/amp-hour for monovalent gold. Actual rates are usually much lower and depend on the metal concentration in the waste stream. At concentrations under 100 mg/L, electrolytic recovery rates may be below 10 percent of the theoretical maximum.

Electrolytic recovery units use various types of cathodes, depending mainly on the concentration of metal in the waste stream. Cathodes are often classified by their surface area. Flat-plate cathodes have the lowest surface area and are used only for recovering metal from metal-rich waste streams (usually 1,000 to 20,000 mg/L of metal). Reticulate cathodes, which have a metallized woven fiber design, have a surface area 10 times greater than their apparent area. These cathodes are effective over a wide range of metal concentrations but typically are used where the dissolved metal concentration is below 100 mg/L. Carbon and graphite cathodes have the highest surface area per unit of apparent area. Their use is usually restricted to metal concentrations below 1,000 mg/L.

Reticulate or carbon cathodes can recover metals in electrolytes to concentrations as low as 5 mg/L. Electrolytes are substances that dissociate into ions in solution (i.e., water), thereby becoming electrically conducting (4). In practice, however, the target effluent concentration for most applications is 50 to 250 mg/L or higher because of the time and energy required to achieve concentrations less than 100 mg/L. With flat-plate cathodes, the target effluent concentration is usually above 500 mg/L, because plating efficiency drops as concentration falls. Plating time required to lower the concentration of a pollutant from 100 to 10 mg/L can be several times longer than that required to lower the concentration from 10,000 mg/L to 100 mg/L. Also, unit energy costs (measured in dollars per pound of metal recovered) increase substantially at lower metal concentrations.

Electrolytic recovery units have relatively low labor requirements. Units recovering dissolved metal from drag-out rinse tanks only may require occasional cleaning and maintenance. Units treating batch discharges from ion-exchange units (see Section 8.2.8.1) require more labor due to the higher metal content of the solution and the resultant increase in cathode loading frequency. Energy costs for this technology can be high, and, in some cases, exceed the recovery value of the metal. Energy requirements depend on several factors, including required voltage, rectifier efficiency, and current efficiency. In addition, from an energy standpoint, electrolytic recovery removes metals from concentrated solutions more efficiently than from dilute solutions. Electrode replacement costs may be significant for units

using disposable cathodes, especially for high metal recovery rates. However, if electrodes are constructed properly, cathodes and anodes may last more than five years for most applications.

Numerous vendors offer electrolytic recovery technology. The technology is applicable to a wide range of processes, drag-out rinses, and ion-exchange regenerants due to the diversity of materials and configurations available for anodes and cathodes. Electrolytic recovery is not applicable to flowing rinses due to the lower metal concentrations and the extended time required for metal recovery. In most cases, this technology cannot cost-effectively remove dissolved metals to concentrations required for discharge to POTWs or surface waters.

### **8.2.7 Evaporation**

Evaporation is a volume reduction and water recovery technology applicable when raw water costs are high or discharge to either a receiving stream or the local sewerage district is not permitted. EPA estimates there are 147 MP&M facilities using evaporation to reduce the volume of their waste and to recover and reuse their water. Evaporators have the potential to recover 95 percent of the water in a waste stream for reuse in the process. MP&M facilities use two basic types of evaporators: atmospheric and vacuum. Atmospheric evaporators are more prevalent and are relatively inexpensive to purchase and easy to operate. Vacuum evaporators are mechanically more sophisticated and are more energy-efficient. Facilities typically use vacuum evaporators when evaporation rates greater than 50 to 70 gallons per hour are required. MP&M facilities use evaporators to recover metals from ion exchange regenerates, to reduce the volume of oily wastes that require off-site transfer, and to recover and reuse rinse water from plating operations.

Equipment required for evaporation systems include (12):

- Basket strainers in lift stations and sumps to prevent items like shop rags from reaching the evaporator;
- Equalization tanks to handle batch dumps of process water;
- An oil skimmer in the equalization tank to remove floatable oil;
- Evaporators (either vacuum or atmospheric);
- Residue holding tanks;
- Air pollution control equipment;
- A condenser to capture water vapor for return to the manufacturing process; and
- Natural gas or propane tanks for evaporator fuel storage.

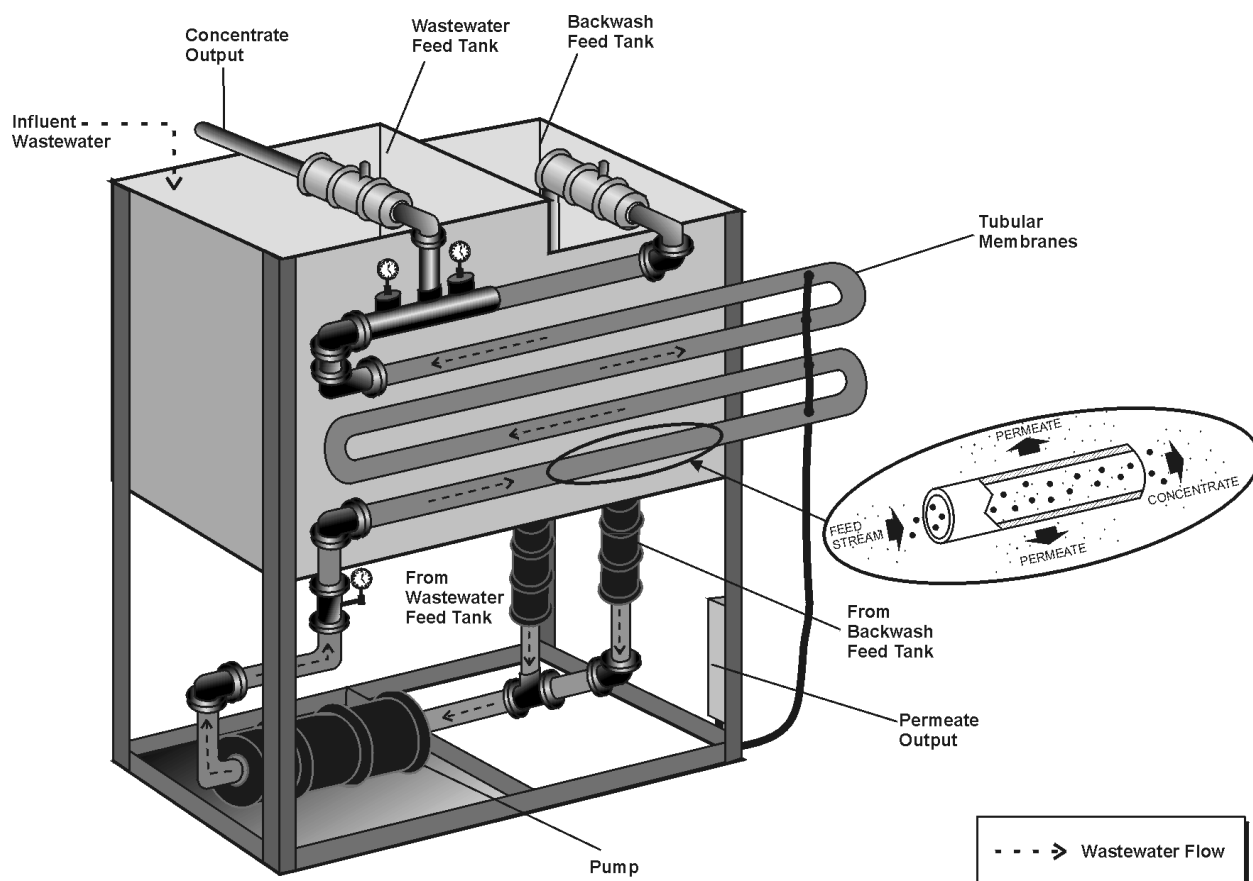
Residue from evaporators can be recycled if sufficiently pure, disposed of off-site, or used for energy recovery if the material has a sufficient BTU content.

### **8.2.8 Filtration**

Filtration removes suspended solids from surface finishing operations. EPA estimates there are nearly 150 MP&M facilities that use filters on their machining and grinding operations to remove solids, debris, or swarf from machining coolants. If solids are not removed from machining coolants, they may cause a rough or burred surface on the work piece. Filtered coolants return to the manufacturing process. In-process filtration extends the life of the coolant and reduces the amount of oil and grease sent to treatment. Filtration equipment includes cartridge filters, precoat diatomaceous earth filters, sand, and multimedia filters.

Cartridge filters are available with either in-tank or external configurations. The in-tank units are used mostly for small tanks and the external units for larger tanks. Most cartridges are disposable; however, washable and reusable filters are available, which further reduce waste generation. Precoat, sand, and multimedia filters are used mostly for large tanks. The filter media used depends on the chemical and physical characteristics of the bath, which determine the filter material type, density, nominal micron retention, wet strength, mullen burst, and air permeability. Material type is important to ensure the media is compatible with the liquid being filtered. Media density is how close or dense the media fibers are laid, laminated, or woven. Nominal micron retention indicates the smallest particle size the media will retain to develop a filter cake. Flux rate through the filter is determined by the air permeability characteristics. All filtration systems are sized based on solids loading and the required flow rate.

Membrane filtration also can remove oils and metals from process baths or rinses, and remove solids from paint curtains or tramp oils from machine coolants to extend usable life. They are also commonly used to recover and recycle electrophoretic painting (“e-coat”) solutions. Membrane filtration is a pressure-driven process that separates solution components based on molecular size and shape. Solvent and small solutes can pass through the membrane while the membrane retains and collects larger compounds as a concentrated waste stream. The cleaner permeate can be reused in the process while the concentrated waste stream is discharged to treatment. Figure 8-5 shows a typical membrane filtration unit.

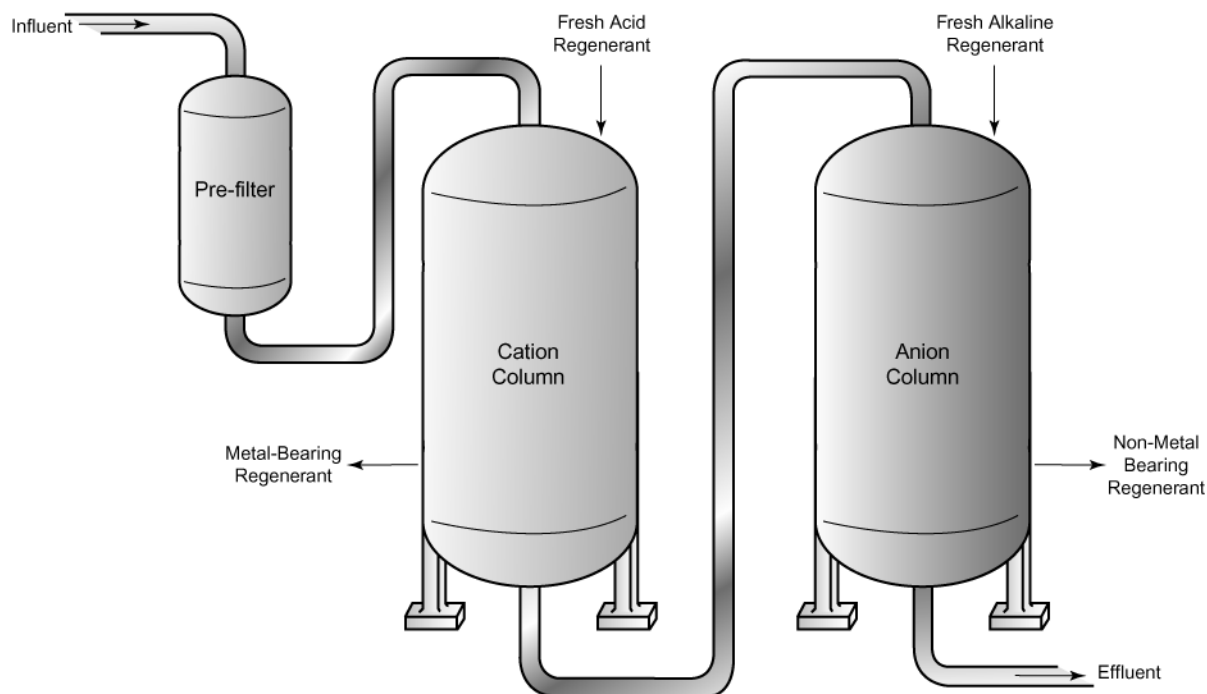


**Figure 8-5. Membrane Filtration Unit**

### 8.2.8.1 Ion Exchange (in-process)

Ion exchange is a commonly used technology within MP&M facilities. In addition to water recycling and chemical recovery applications, ion exchange is used to soften or deionize raw water for process solutions. Figure 8-6 shows a typical ion-exchange system.

Ion exchange is a reversible chemical reaction that exchanges ions in a feed stream for ions of like charge on the surface of an ion-exchange resin. Resins are broadly divided into cationic or anionic types. Typical cation resins exchange  $H^+$  for other cations, while anion resins exchange  $OH^-$  for other anions (10).



**Figure 8-6. Ion Exchange**

A feed stream passes through a column, which holds the resin. The feed stream is usually either dilute rinse water (in-process ion exchange) or treated wastewater (end-of-pipe ion exchange). Often, prior to ion-exchange treatment, the feed stream passes through a cartridge filter and a carbon filter to remove suspended solids and organic pollutants that foul the resin bed. The exchange process continues until the capacity of the resin is reached (i.e., an exchange has occurred at all the resin sites). A regenerant solution then passes through the column. For cation resins, the regenerant is an acid, and the  $H^+$  ions replace the cations captured from the feed stream. For anion resins, the regenerant is a base, and  $OH^-$  ions replace the anions captured from the feed stream. The metals concentration is much higher in the regenerant than in the feed stream; therefore, the ion-exchange process not only separates the metals from the waste stream but also results in a more concentrated waste stream.

MP&M facilities use ion exchange for water recycling and metal recovery. For water recycling, cation and anion columns are placed in series. The feed stream is deionized and the product water is reused for rinsing. Often, the system can achieve closed-loop rinsing. The regenerant from the cation column contains metal ions, which are recoverable in elemental form via electrolytic recovery (see Section 8.2.6). The anion regenerant typically flows to wastewater treatment. Facilities use this type of ion exchange to recycle relatively dilute rinse streams. Generally, the TDS concentration of such streams must be below 500 mg/L to maintain an

efficient regeneration frequency. Reducing drag-out can enhance the efficiency of the recovery process. Effluent TDS concentrations of 2 mg/L or less are typical.

When facilities are seeking only metal recovery, they use a single or double cation column unit containing selective resin. These resins attract divalent cations while allowing monovalent cations to pass, a process usually called metal scavenging. This technology is efficient if the metal ions being scavenged are the primary source of ions in the stream. Ion exchange provides effective metals recovery even when the metal content of the stream is only a small fraction of the TDS present in the stream, making scavenging suitable over a wider range of TDS than water recycling. Scavenging also provides a highly concentrated regenerant, particularly suitable for electrolytic recovery (see Section 8.2.6). Water recycling using this ion exchange configuration is not possible because only some of the cations and none of the anions are removed. Standard units typically achieve effluent metal concentrations of under 0.5 mg/L.

Many process wastewaters are excellent candidates for ion exchange, including the rinse water from plating processes of chromium, copper, cadmium, gold, lead, nickel, tin, tin-lead, and zinc. Ion exchange resins usually are regenerated using inexpensive chemicals such as sulfuric acid and sodium hydroxide. Gold-bearing resins are difficult to regenerate and frequently require incineration to recover the gold content. Lead also is difficult to recover from ion exchange resins. Methane sulfonic acid and fluoboric acid (usually not suitable for electrolytic recovery) are effective regenerants for lead ion exchange but are very expensive. Cyanide rinse waters are amenable to ion exchange; cation resins can break the metal-cyanide complex and the cyanide is removed in the anion column. The metals in the cation regenerant can be recovered electrolytically and the cyanide present in the anion regenerant can be returned to the process or discharged to treatment.

Ion-exchange equipment ranges from small, manual, single-column units to multi-column, highly automated units. Two sets of columns are necessary for continuous treatment; one set receives the wastewater flow while the other set is being regenerated. Thus, two-column metal scavenging and four-column deionizing systems are common. Automatic systems direct the wastewater flow and initiate regeneration with little or no operator involvement.

The labor requirements for ion exchange depend on the automation level of the equipment. Manual systems can have significant labor costs associated with preparing, transporting, and disposing of regenerants. Automatic systems require far less labor. Resins need to be replaced periodically due to organic contamination, resin oxidation, and fouling from suspended solids. This process can be hastened by misuse, accidents, or poor engineering.

Equipment size is based on flow rate and concentration. Resin capacity varies but often ranges from 1 to 2 lbs/ft<sup>3</sup>. Flow rates may range from 1 to 20 or more gpm. Columns typically are sized to handle wastewater flow for at least a period of time equal to that required for regeneration. Automatic systems are sized to provide continuous treatment. Regeneration volume typically ranges from 2 to 4 resin bed volumes of dilute acid or caustic. Concentrations of feed stream contaminants generally range from 10 to 20 g/L.



### 8.2.8.2 Reverse Osmosis

Reverse osmosis is a membrane separation technology used by MP&M facilities for chemical recovery and water recycling. The system pumps dilute rinse water to the surface of the reverse osmosis membrane at pressures of 400 to 1,000 pounds per square inch gauge (psig). The membrane separates the feed stream into a reject stream and a permeate. The reject stream, containing most of the dissolved solids in the feed stream, is retained by the membrane while the permeate passes through. Reverse osmosis membranes reject more than 99 percent of multivalent ions and 90 to 96 percent of monovalent ions, in addition to organic pollutants and nonionic dissolved solids. The permeate stream usually is of sufficient quality to be recycled as rinse water, despite the small percentage of monovalent ions (commonly potassium, sodium and chloride) that pass through the membrane. Reverse osmosis equipment is similar to the equipment shown in Figure 8-5.

A sufficiently concentrated reject stream can be returned directly to the process bath. Recycling the stream through the unit more than once or by increasing the feed pressure can increase the reject stream concentration. In multiple-stage units containing more than one membrane chamber, the reject stream from the first chamber is routed to the second, and so on. The combined reject streams from multistage units may, in some cases, have high enough concentrations to go directly back to the bath.

The capacity of reverse osmosis equipment generally is measured in flow volume, and is determined by the membrane surface area and operating pressure. Increasing the surface area of the membrane usually increases the membrane capacity. Operating at higher pressures increases the permeate flow volume per unit membrane area (also called the flux). Reject stream concentration increases with pressure and decreases as flow volume increases.

Facilities may need to prefilter and pretreat the feed stream to lengthen membrane life or reduce the frequency of fouling; filtration to remove suspended solids is usually necessary. Adjusting pH may prevent precipitation as the feed stream is concentrated, but it may make the concentrate unfit to return to the process bath.

Reverse osmosis is most applicable to electroplating rinse waters, including electroplating of Watts nickel, bright nickel, brass cyanide, copper cyanide, and zinc cyanide. This technology can treat TDS concentrations of up to 1,000 mg/L. Permeate TDS concentrations of 250 mg/L or less are typical, and the dissolved solids are mostly commonly monovalent ions, allowing the permeate stream to be reused in many rinsing operations.

The maximum achievable reject stream concentration for basic reverse osmosis equipment is approximately 20,000 mg/L TDS. Multipass and multistage units achieve concentrations of 30,000 mg/L TDS or higher. If the reject stream is acceptable to return directly to the process bath and the permeate is recycled as rinse water, a closed loop is created. However, returning the reject stream directly to the bath is uncommon because the concentration is often too low. When the reject stream concentration is not high enough to return it to the bath,

it can be concentrated with an evaporator, electrolytically recovered, or discharged to wastewater treatment. When evaporators are used, however, reverse osmosis loses its low-energy advantage over other in-process reuse and recovery technologies.

Reverse osmosis often has a higher capital cost than does ion exchange when both technologies include an electrolytic recovery unit. When used for water recycling, reverse osmosis and ion exchange both remove similar quantities of metals; however, reverse osmosis may allow for more water recycling.. During reverse osmosis, only the pumps use energy. In most cases, water is recycled; in some cases, a closed loop is possible. Compared to ion exchange, reverse osmosis can treat somewhat higher feed stream concentrations. The concentration of reverse osmosis reject streams are near or higher than that of ion-exchange regenerants. Both are less effective in handling oxidizing chemistries or feed streams high in organic compounds and total suspended solids. Ion-exchange effluent generally has a lower TDS concentration than does reverse osmosis permeate and can be recycled in most rinses.

For most applications, reverse osmosis membranes last for one to five years, although they are susceptible to fouling from organic pollutants, suspended solids, or misuse. Reverse osmosis units may be able to track the condition of the membrane by measuring the flux. If the membrane fouls or clogs, the flux rate drops, indicating that the membrane should be cleaned. Labor associated with operating reverse osmosis equipment is for periodic membrane cleaning. Membrane and pump replacement are the primary maintenance items.

### **8.3 Best Management Practices and Environmental Management Systems for Pollution Prevention**

EPA encourages the wide spread use of Best Management Practices (BMPs), and Environmental Management Systems (EMS), to achieve improved environmental performance and compliance, pollution prevention through source reduction, and continual improvement (see EPA Position Statement on Environmental Management Systems, May 15, 2002, DCN 17848, Section 24.4). However, as described in the Section IV of the preamble to the final rule, EPA is not requiring the use of BMPs or EMSs for compliance with the MP&M effluent guidelines.

Best Management Practices (BMPs) are inherently pollution prevention practices. BMPs may include the universe of pollution prevention encompassing production modifications, operational changes, material substitution, materials and water conservation, and other such measures (17). BMPs include methods to prevent the discharge of toxic and hazardous pollutants. BMPs are most effective when organized into a comprehensive facility EMS.

MP&M facilities employ many types of pollution prevention measures including the following: training and supervision; production planning; process or equipment modification; raw material and product substitution or elimination; loss prevention and housekeeping; waste segregation and separation; and closed-loop recycling. These practices are discussed in further detail below (1).

- **Training and Supervision**  
Training and supervision ensure that employees are aware of, understand, and support the company's pollution prevention goals. Effective training programs translate these goals into practical information that enables employees to minimize waste generation by properly and efficiently using tools, supplies, equipment, and materials.
- **Production Planning**  
Production planning can minimize the number of process operation steps and eliminate unnecessary procedures (e.g., production planning can eliminate additional cleaning steps between process operations).
- **Process or Equipment Modification**  
Facilities can modify processes and equipment to minimize the amount of waste generated (e.g., changing rack configuration to reduce drag-out).
- **Raw Material and Product Substitution or Elimination**  
Where possible, facilities should replace toxic or hazardous raw materials or products with other materials that produce less waste and less toxic waste (e.g., replacing chromium-bearing solutions with non-chromium-bearing and less toxic solutions, or consolidating types of cleaning solutions and machining coolants).
- **Loss Prevention and Housekeeping**  
Loss prevention and housekeeping includes performing preventive maintenance and managing equipment and materials to minimize leaks, spills, evaporative losses, and other releases (e.g., inspecting the integrity of tanks on a regular basis; using chemical analyses instead of elapsed time or number of parts processed as the basis for disposal of a solution).
- **Waste Segregation and Separation**  
Facilities should avoid mixing different types of wastes or mixing hazardous wastes with nonhazardous wastes. Similarly, facilities should not mix recyclable materials with noncompatible materials or wastes. For example, facilities can segregate scrap metal by metal type, separate cyanide-bearing wastewater for preliminary treatment, and segregate coolants for recycling or treatment.
- **Closed-Loop Recycling**  
Facilities can recover and reuse some process streams. For example, some facilities can use ion exchange to recover metal from electroplating rinse water, reuse the rinse water, and reuse the regenerant solution as process solution make-up.

The following sections describe pollution prevention opportunities for a few MP&M facilities.

### **8.3.1 Pollution Prevention for Cleaning and Degreasing Operations**

The majority of facilities in the Oily Wastes Subcategory perform cleaning and degreasing operations to remove residual oil and coolants from metal parts following machining and grinding operations. These facilities also perform cleaning and degreasing on equipment undergoing maintenance. Opportunities to reduce waste from these operations include process elimination, material substitution, in-process recycling, waste segregation, maintenance/housekeeping, procedures/scheduling, and equipment layout/piping/automation. Examples of these opportunities are presented below (15).

#### **Process Elimination**

- Determine whether parts need to be cleaned;
- Use easy-to-clean or no-clean rust inhibitors and lubricants;
- Review the parts-handling process to determine why parts are getting dirty, and take action to prevent it from happening in the future; and
- Purchase clean input stock.

#### **Material Substitution**

- Clean by brushing and wiping where possible;
- Use aqueous-based cleaners;
- Use solvents with low vapor pressure and high flash point; and
- Use citrus or terpene cleaners.

#### **In-Process Recycling**

- Use countercurrent rinsing;
- Skim/filter and reuse aqueous cleaners;
- Reuse solvents by installing filtration or distillation units; and
- Install a bioremediation parts washer that uses enzymes to remove oil and grease.

### Waste Segregation

- Segregate solvents to allow recycling;
- Keep solvents out of waste oil;
- Keep fuel, brake fluid and other fluids out of solvents to prevent the mixture from becoming hazardous; and
- Keep solvents out of aqueous cleaners.

### Maintenance/Housekeeping

- Use secondary containment for solvent storage; and
- Implement a maintenance program to fix and prevent leaks.

### Procedures/Scheduling

- Reduce dragout by increasing drain time; and
- When dripping parts, lift them such that it reduces dragout.

### Equipment Layout/Piping/Automation

- Install sliding lids on solvent tanks;
- Increase the freeboard height to significantly reduce solvent evaporation;
- Install automatic parts lift on vapor degreasers;
- Use drain racks to reduce dragout; and
- Drain parts using a rotating rack.

## **8.3.2 Pollution Prevention for Machining Operations**

Many machining operations use metal-working fluids to cool and lubricate parts and machining tools during cutting, drilling, milling, and other machining operations. These fluids become contaminated and begin to lose their working characteristics. If neglected, the fluids become unusable and require treatment and disposal. Through proper care, the life span of the fluids can be extended indefinitely. For most machining operations, prolonging metal-working fluid life reduces the cost of treatment and disposal, as well as the cost of fresh coolant.

Many MP&M facilities use some type of pollution prevention and water conservation practices for machining wastewaters. Some facilities have implemented numerous pollution prevention and water conservation methods and technologies that result in very low machining wastewater discharge rates and in some cases eliminate the discharge of machining fluids. Pollution prevention and water conservation practices are applicable to all machining

operations; however, process-related factors and site-specific conditions may restrict the utility of certain methods.

The Agency has identified two categories of pollution prevention and water conservation practices and technologies that can be used to reduce metal-working fluid discharge: those used to prevent metal-working fluid contamination and those used to extend the life of machining fluids, including recovering and recycling metal-working fluids. Within each of these categories are several specific practices and technologies. See Appendix D for more information on these pollution prevention practices.

### **8.3.3 Painting Operations**

Paint is applied to a base material for protective and decorative reasons in various forms, including dry powder, solvent-diluted formulations, and water-borne formulations. There are various methods of application, the most common being immersion and spraying. Water is used in painting operations in paint booth water-wash systems (water curtains), in water-borne formulations, in electrophoretic painting solutions and rinses, and in clean-up operations. This discussion is directed at water use in spray painting booths; however, Appendix D also provides some information on rinsing following electrophoretic painting and water clean-up.

EPA has identified three categories of pollution prevention and water conservation practices that, if implemented, can reduce or eliminate wastewater discharges from painting operations: practices to reduce the quantity of paint entering the water system; recycling technologies for paint booth water; and conversion of water-wash booths to dry-filter booths. These are discussed in this subsection and summarized in Appendix D. It is possible, however, that facilities can reduce or eliminate wastewater discharges using different practices than those described here.

### **8.3.4 Pollution Prevention for Printed Wiring Board Manufacturing**

Printed wiring board manufacturers use a large amount of water each day, mostly for rinsing and electroplating processes. The following BMP's developed specifically for printed wiring board manufacturing outline water-saving process changes and controls that can be inexpensively incorporated in the production process. A number of these pollution prevention processes are described in more detail in Section 8.1.

- Use dry film photoresist instead of wet applications.
- Examine the pre-plating rinse processes:
  - Based on monitoring data, eliminate unnecessary cycles and rinse only until desired cleanliness is reached.
  - Switch from continuous to on-demand rinsing, and from once-through to closed-loop use.

- Use counter-current rinsing.
- Use air or workpiece agitation to increase rinsing efficiency.
- Spray rinse with high-pressure, low flow nozzles. This can reduce rinse water use up to 60 percent.
- Link flow controls to conductivity meters that measure the total dissolved solids in the rinses.
- Examine the electroplating process. Extending bath life will reduce both water consumption and toxics in the effluent.
  - Reduce drag-in through efficient rinsing.
  - Use deionized or distilled water for makeup.
  - Reduce drag-out through the following methods:
    - a) Minimize bath chemical concentrations.
    - b) Use nonionic wetting agents to reduce surface tension in the process baths.
    - c) Prior to rinsing, maximize water returned to the process bath through several measures – withdraw pieces from the baths slowly, install drainage boards between process baths and rinses to return drag-out back to the process bath, install rails above process baths to hang workpiece/racks for drainage and/or use air knives or spray rinses above process baths to rinse excess solution into the process bath.
  - Restore barrel holes.
  - Maintain bath solution quality through monitoring, replacement of reagents and stabilizers, and impurity removal.
- Install multiple baths after the process bath for using counter-current rinsing wherever possible.

#### **8.4 Preliminary Treatment of Segregated Wastewater Streams**

Preliminary treatment systems reduce pollutant loadings in segregated waste streams prior to combined end-of-pipe treatment. Wastewater containing pollutants such as

cyanide, hexavalent chromium, oil and grease, or chelated metals may not be treated effectively by chemical precipitation and gravity settling without preliminary treatment. Proper segregation and treatment of these streams is critical for the successful treatment of process wastewater. Highly concentrated metal-bearing wastewater also may require pretreatment to reduce metal concentrations before end-of-pipe treatment. This subsection describes the following wastewater streams that typically undergo preliminary treatment at MP&M facilities:

- Chromium-bearing wastewater;
- Concentrated metal-bearing wastewater;
- Cyanide-bearing wastewater;
- Chelated metal-bearing wastewater; and
- Oil-bearing wastewater.

Table 8-3 summarizes these preliminary treatment operations.

#### **8.4.1 Chromium-Bearing Wastewater**

MP&M facilities generate hexavalent-chromium-bearing wastewater from acid treatment, anodizing, conversion coating, and electroplating operations and rinses. Hexavalent chromium exists in an ionic form and does not form a metal hydroxide; therefore, hexavalent chromium cannot be treated by chemical precipitation and sedimentation (discussed in Section 8.5.1). The wastewater requires preliminary chemical treatment to reduce the hexavalent chromium to trivalent chromium, which can be removed by chemical precipitation and sedimentation. As shown in Table 8-3, EPA estimates there are over 1,800 MP&M facilities that perform hexavalent chromium reduction. The chemical reduction process is discussed below. Figure 8-7 presents a diagram of a continuous chromium reduction system.



**Table 8-3****MP&M Preliminary and End-of-Pipe Treatment Technologies**

Technology	Technology Description	Demonstration Status		
		Number of Facilities Visited Using the Technology <sup>a</sup>	Number of Survey Facilities Using the Technology <sup>b</sup>	Estimated Number of MP&M Facilities Using the Technology <sup>c</sup>
Chemical Emulsion Breaking Followed by Gravity Oil/Water Separation	Adds acids (typically sulfuric), polymer, and sometimes alum to oil-bearing wastewater to break oil/water emulsions for subsequent gravity separation. Separated oil is skimmed and hauled by a contractor. A facility may purchase the recycled oil for reuse.	13	56	958
Chemical Emulsion Breaking Followed by Dissolved Air Flotation	Adds acids (typically sulfuric), polymer, and sometimes alum to oil-bearing wastewater to break oil/water emulsions for subsequent gravity separation. Introduces gas bubbles into the wastewater, bringing oils and solids to the surface for subsequent removal.	85	25	244
Chemical Reduction of Hexavalent Chromium	Reduces hexavalent chromium to trivalent chromium using a reducing agent such as sulfur dioxide, sodium bisulfite, or sodium metabisulfite.	56	103	1,839
Cyanide Destruction by Alkaline Chlorination	Destroys cyanide by adding chlorine (usually sodium hypochlorite or chlorine gas) to high pH wastewater to first oxidize cyanide to cyanate, then cyanate to carbon dioxide and nitrogen gas.	14	53	1,136
Oil Skimming of Oily Wastewater Streams	Removes free floating oil by gravity separation and mechanical skimming. This technology does not remove emulsified oils.	45	89	2,087
Cyanide Oxidation by Ozone	Ozone oxidizes cyanide to ammonia, carbon dioxide and oxygen.	0	1	4
Chelation Breaking/ Precipitation to Remove Complexed Metals	Wastewater from electroless plating and some cleaning operations contains chelated metals that cannot be removed by chemical precipitation. Strong reducing agents such as dithiocarbamate are added to break the metal-organic chelate bond and precipitate the metal.	15	49	555
Ultrafiltration	Removes emulsified or free-floating oils. This technology also removes other solids. Uses a membrane of very small pore size.	19	23	351
Activated Carbon Adsorption	Removes dissolved organic pollutants by filtration through and adsorption on activated carbon. This technology requires preliminary treatment to remove suspended solids and oil and grease.	9	21	165
Aerobic Biological Treatment	Biochemically decomposes organic materials in the presence of oxygen using microorganisms.	1 (used to treat nonprocess wastewater)	4	130
Air Stripping	Removes dissolved volatile organic pollutants by contacting the organics in the wastewater with a continuous stream of air bubbles. Volatile organic pollutants are transferred from the wastewater to the air.	0	2	14

**Table 8-3 (Continued)**

Technology	Technology Description	Demonstration Status		
		Number of Facilities Visited Using the Technology <sup>a</sup>	Number of Survey Facilities Using the Technology <sup>b</sup>	Estimated Number of MP&M Facilities Using the Technology <sup>c</sup>
Neutralization	Neutralizes high or low pH wastewater to within an acceptable range using acidic or alkaline chemicals. Common acids include sulfuric and hydrochloric. Common alkaline chemicals include lime and sodium hydroxide.	63	233	3,713
Chemical Precipitation and Gravity Sedimentation	Removes metals by precipitating insoluble compounds such as hydroxides, sulfides, or carbonates. Precipitation as metal hydroxides using lime or sodium hydroxide is the most common. Precipitated and flocculated solids are removed by gravity sedimentation in a clarifier.	149	203	2,981
Chemical Precipitation and Microfiltration	Removes metals by precipitating insoluble compounds such as hydroxides, sulfides, or carbonates. Precipitation as metal hydroxides using lime or sodium hydroxide is the most common. Precipitated and flocculated solids are removed by microfiltration through a porous membrane.	6	5	36
Atmospheric Evaporation	Includes both natural solar evaporation and forced atmospheric evaporation by which the evaporation rate is accelerated by increased temperature, air flow, and surface area.	4	12	142
Ion Exchange (end-of-pipe)	Polishing technique after metals precipitation to scavenge low concentrations of residual metals (cations) using combined cation and anion exchange. Anions remain in solution and are discharged. Concentrated metal-containing regenerants are typically returned to the metals precipitation system.	17	39	251
Multimedia Filtration	Removes solids from wastewater using filter media of different grain size. Coarser media remove larger particles and finer media remove smaller particles. Media include garnet, sand, and anthracite coal. The filter is periodically backwashed to remove solids.	12	16	354
Sand Filtration	Removes solids from wastewater using a sand filter. The filter is periodically backwashed to remove solids.	46	41	830
Gravity Settling	Physically removes suspended particles by gravity. This technology does not include the addition of any chemicals.	7	46	1,679
Centrifugation of Sludge	Separates water from solids using centrifugal force. Centrifugation dewateres sludges, reducing the volume and creating a semisolid cake. Centrifugation of sludge can typically achieve a sludge of 20-35 percent solids.	7	9	127
Gravity Thickening of Sludge	Physically separates solids and water by gravity. Gravity thickening can typically thicken sludge to 5 percent solids.	83	85	1,161

**Table 8-3 (Continued)**

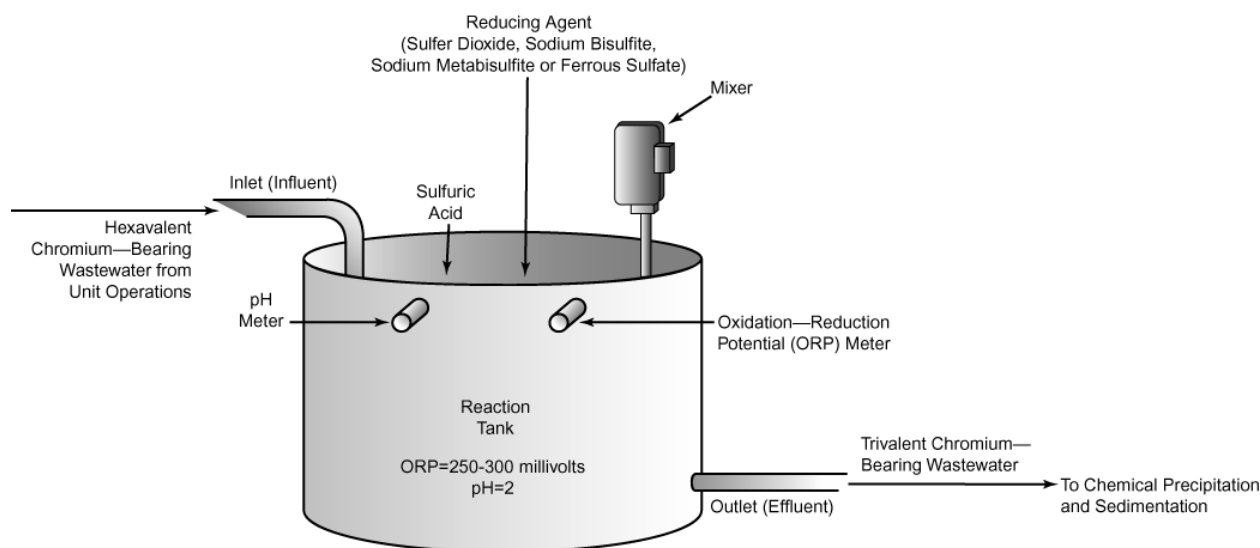
Technology	Technology Description	Demonstration Status		
		Number of Facilities Visited Using the Technology <sup>a</sup>	Number of Survey Facilities Using the Technology <sup>b</sup>	Estimated Number of MP&M Facilities Using the Technology <sup>c</sup>
Pressure Filtration of Sludge	Physically separates solids and water by pressure filtration. Most commonly performed in a plate-and-frame filter press where the sludge builds up between the filter plates and water is filtered through a cloth. Pressure filtration can produce a sludge cake with greater than 40 percent solids.	140	189	3,106
Sludge Drying	Dries sludge by heating, which causes the water in the sludge to evaporate.	28	48	835
Vacuum Filtration of Sludge	Physically separates solids and water by vacuum filtration. Most commonly performed in a cylindrical drum vacuum filter, where water is pulled by vacuum through the filter and dewatered sludge is retained and subsequently scraped from the filter surface. Vacuum filtration can produce a sludge cake with 20 - 30 percent solids.	11	9	193

Source: MP&M site visits, MP&M sampling episodes, MP&M surveys and technical literature. Statistics specific to wastewater-discharging facilities.

<sup>a</sup>Indicates the number of MP&M facilities visited by EPA using the listed technology. EPA visited a total of 221 facilities.

<sup>b</sup>Indicates the number of water-discharging survey facilities that reported using this technology. Based on 874 MP&M survey respondents for the 1996 detailed survey and the 1989 survey.

<sup>c</sup>Indicates the estimated number of MP&M facilities currently performing this technology based on the 1989 and 1996 detailed surveys. EPA's national estimate of the 1996 detailed survey and the 1989 survey includes approximately 44,000 water-discharging facilities. EPA estimated numbers in this column using statistical weighting factors for the MP&M survey respondents. See Section 3.0 for a discussion of the development of national estimates and statistical survey weights.



**Figure 8-7. Chemical Reduction of Hexavalent Chrome**

Reduction is a chemical reaction in which electrons are transferred from one chemical (the reducing agent) to the chemical being reduced. Sulfur dioxide, sodium bisulfite, sodium metabisulfite, peroxide, and ferrous sulfate form strong reducing agents in water. MP&M facilities use these agents to reduce hexavalent chromium to the trivalent form, which allows the metal to be removed from solution by subsequent chemical precipitation.

Sodium metabisulfite, sodium bisulfite, and sulfur dioxide are the most widely used reducing agents at MP&M facilities (14). Below is an equation showing the sulfur dioxide reaction (reduction using other reagents is similar chemically):



An operating pH of between 2 and 3 is normal for chromium reduction. At pH levels above 5, the reduction rate is slow, and oxidizing agents such as dissolved oxygen and ferric iron interfere with the reduction process by consuming the reducing agent.

Typically, the chemicals are retained in a reaction tank for 45 minutes. The tank is equipped with pH and oxidation-reduction potential (ORP) controls. Sulfuric acid is added to maintain a pH of approximately 2, and a reducing agent is metered to the reaction tank to maintain the target ORP.

Chemical reduction of hexavalent chromium is a proven technology that is widely used at MP&M facilities. Operation at ambient conditions requires little energy, and the process

is well suited to automatic control. For high concentrations of chromium, treatment chemical costs may be significant.

Maintenance of chemical reduction systems consists of sludge removal, the frequency of which depends on the concentration of contaminants. There also may be small amounts of sludge generated due to minor shifts in the solubility of the contaminants (e.g., iron hydroxides). This sludge can be removed by the sludge-handling equipment associated with subsequent end-of-pipe chemical precipitation and sedimentation.

#### **8.4.2 Concentrated Metal-Bearing Wastewater**

Facilities use several methods to manage concentrated metal-bearing wastewater from spent process solutions. Facilities may:

- Meter the concentrated metal-bearing wastewater slowly to the end-of-pipe chemical precipitation system and commingle it with other facility wastewater;
- Treat the concentrated metal-bearing wastewater in a batch pretreatment system; or
- Send concentrated metal-bearing wastewater for off-site treatment.

Batch pretreatment allows better control of the treatment system (e.g., the treatment chemicals can be better tailored to the specific solution being treated), better treatment of difficult-to-treat materials (e.g., photo-resist-bearing wastewater), and potential recovery of metals from the sludge. With batch treatment, facilities typically discharge effluent from the batch treatment tank to the end-of-pipe treatment system for additional polishing.

Batch chemical precipitation of concentrated metal-bearing wastewater typically occurs in a single stirred tank, where a precipitating agent (e.g., sodium hydroxide, lime, sodium sulfide) is added to create an insoluble metal hydroxide or sulfide complex. Following precipitate formation, a polyelectrolyte is added to flocculate the metal hydroxide or metal sulfide particles into larger clumps that will settle to the bottom of the reaction tank following mixing. Clarified effluent from the batch tank is discharged to the end-of-pipe treatment system and the settled sludge, typically containing only one type of metal, is transferred off-site for metals recovery.

#### **8.4.3 Cyanide-Bearing Wastewater**

Plating and cleaning wastewater may contain significant amounts of cyanide, which should be removed through preliminary treatment. In addition to its toxicity, cyanide forms complexes with metals that prohibit subsequent removal in chemical precipitation systems.

Cyanide typically is treated using alkaline chlorination with sodium hypochlorite or chlorine gas or by ozone oxidation. These two processes are described below.

### 8.4.3.1 Alkaline Chlorination

Alkaline chlorination is in wide use in industrial wastewater treatment to destroy cyanide. Table 8-3 shows there are over 1,100 MP&M facilities using alkaline chlorination to remove cyanide. Chlorine is typically used as either chlorine gas or sodium hypochlorite (i.e., bleach). The alkaline chlorination process oxidizes cyanides to carbon dioxide and nitrogen by the following two-step chemical reaction (10):

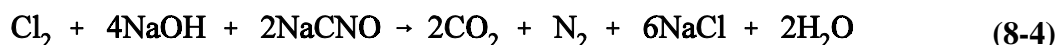
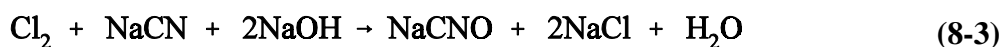
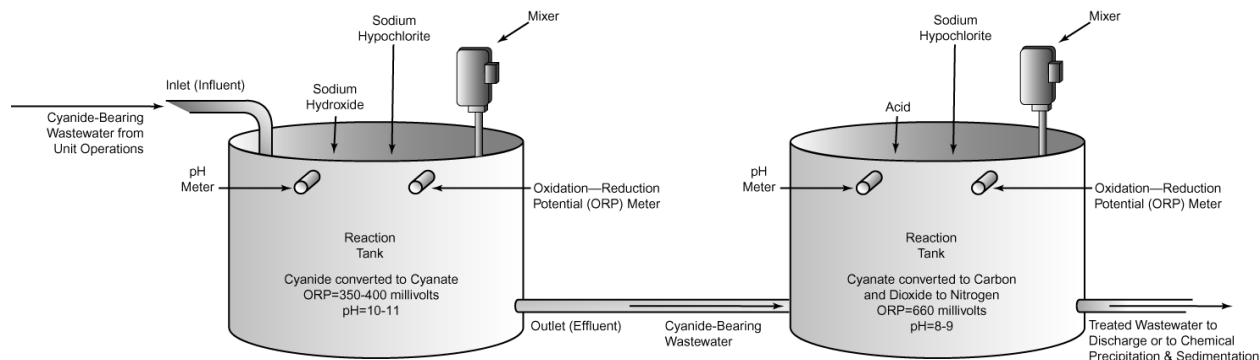


Figure 8-8 presents a diagram of an alkaline chlorination system.



**Figure 8-8. Cyanide Destruction Through Alkaline Chlorination**

Treatment equipment often consists of an equalization tank followed by two continuous reaction tanks, although the batch reaction can occur in a single tank. Each tank has an electronic controller to monitor and maintain the required pH and ORP. To oxidize cyanides to cyanates, chlorine or sodium hypochlorite is metered to the first reaction tank as necessary to maintain the ORP at 350 to 400 millivolts, and aqueous sodium hydroxide is added to maintain a pH of approximately 11. This pH dictates that most of the cyanide exists in the  $\text{CN}^-$  form, rather than as the highly toxic hydrogen cyanide ( $\text{HCN}$ ) form. In the second reaction tank, the ORP and the pH level typically are maintained at 600 millivolts and 8 to 9, respectively, to oxidize cyanate to carbon dioxide and nitrogen. Each reaction tank has a chemical mixer designed to provide approximately one turnover per minute.

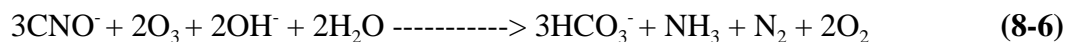
The batch process typically occurs in two tanks, one to collect water over a specified time period and one to treat an accumulated batch. If concentrated wastes are

frequently dumped, another tank may be required to equalize the flow to the treatment tank. When the holding tank is full, the liquid is transferred to the reaction tank for treatment.

Alkaline chlorination can take place at ambient temperature, can be automatically controlled at relatively low cost, and can achieve effluent concentrations of free cyanide that are below the detection limit. Disadvantages include the need for careful pH control, possible chemical interference in treating mixed wastes, and the potential hazard of storing and handling chlorine gas (if sodium hypochlorite is not used). If organic compounds are present, chlorinated organic compounds may be generated. Additionally, there are several safety concerns associated with handling chlorine gas and with the gas feed system. This technology is not effective in treating metalocyanide complexes, such as ferrocyanide.

#### 8.4.3.2 Ozone Oxidation

A less common cyanide treatment method is ozone oxidation. Ozone, generated as a gas, is bubbled through a wastewater solution containing free cyanide. The ozone reacts with cyanide, converting it to cyanate. Additional ozone reacts with the cyanate to convert it to nitrogen gas, ammonia, and bicarbonate, as shown by the reactions below.



The reaction rate is limited by mass transfer of ozone to the solution, the cyanide concentration, and temperature. Literature data show that oxidation can reduce amenable cyanide in electroplating wastewaters to below detection (5). Ozone is not effective in treating metalocyanide complexes, such as ferrocyanide, unless ultraviolet light is added to the reaction tank (6).

One advantage ozone has over chlorine is the type of residuals formed. Chlorine oxidation of organic compounds has the potential to form trihalomethanes. Ozone oxidizes organic compounds to form relatively less toxic, short-chain organic acids, ketones, and aldehydes. Equipment required for ozone oxidation of cyanides includes an ozone generator, gas diffusion system, a mixed reaction tank, and off-gas controls to prevent the release of unreacted ozone.

The major disadvantage of the ozone oxidation process is the capital and operating cost (12). Ozone must be manufactured on-site and delivered directly to the reaction tank. Ozone generation equipment is expensive, and facilities also must purchase closed reaction tanks and ozone off-gas treatment equipment.

#### **8.4.4 Chelated-Metal-Bearing Wastewater**

Certain process wastewaters evaluated for the final rule contain chelating agents that form metal complexes and interfere with conventional chemical precipitation treatment. This wastewater is often associated with electroless plating and requires specific treatment for the chelated metals. In general, there are three methods of treating these wastewaters:

- Reduction to elemental metal;
- Precipitation as an insoluble compound; and
- Physical separation.

##### **8.4.4.1 Reduction to Elemental Metal**

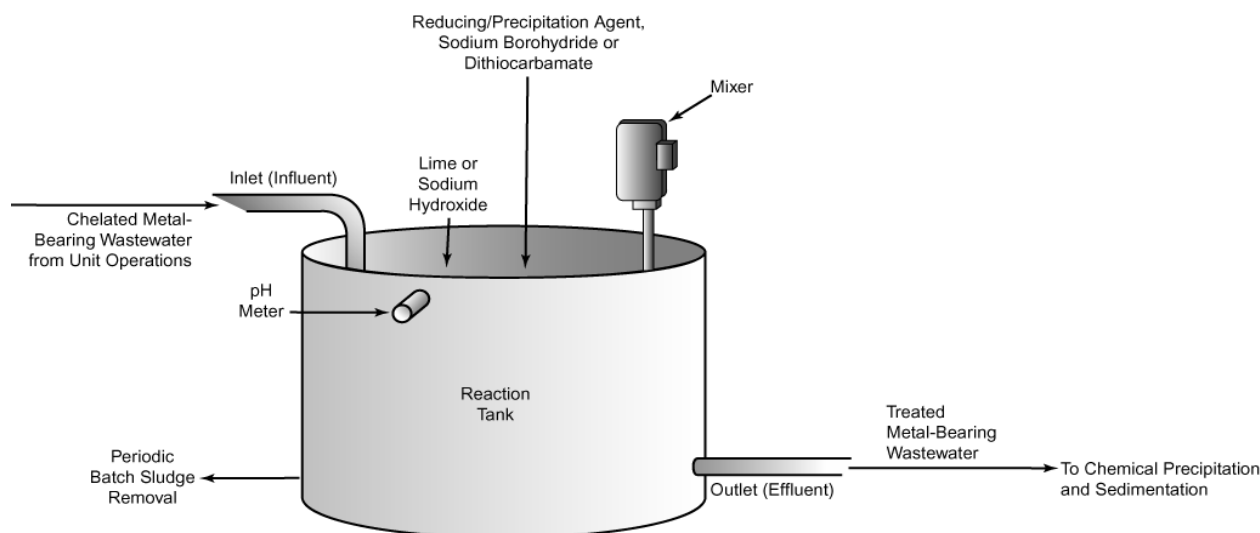
Reduction to elemental metal can be done using one of two methods. One method is electrolytic recovery (see Section 8.2.6), in which the dissolved metal is deposited on a cathode for reclamation or disposal. The electric current provides the electrons to reduce the metal ion to its elemental form. The reaction rate and achievable concentration for this technology depend on the volume of wastewater per unit surface area of cathode. This method typically does not lower metal concentrations to levels sufficient for wastewater discharge.

The second method uses a reducing agent to provide the electrons to reduce the metal. Possible reducing agents for treating chelated wastewater streams include:

- Dithiocarbamate (DTC);
- Sodium borohydride;
- Hydrazine; and
- Sodium hydrosulfite.

Upon reduction, the metal forms a particulate in solution, which a solids removal technique, such as gravity clarification, can remove. For effective use, these reducing agents sometimes require the use of other chemicals (e.g., lime or sodium hydroxide) for pH adjustment. Figure 8-9 presents a diagram showing this method of chemical reduction of chelated metals.





**Figure 8-9. Chemical Reduction / Precipitation of Chelated Metals**

#### 8.4.4.2 Precipitation as an Insoluble Compound

Chelating agents hinder the formation of hydroxides, making hydroxide precipitation ineffective for treating chelated-metal-bearing wastewaters. Other precipitation methods that are less affected by chelating agents include sulfide precipitation, DTC precipitation, and carbonate precipitation. Section 8.5.1 discusses sulfide precipitation and carbonate precipitation.

DTC is added to solution in stoichiometric ratio to the metals present. Equation 8-7 shows the reduction of nickel using DTC:



DTC is effective in treating wastewater containing chelated metals. Based on information provided in the MP&M Detailed Surveys, approximately 53 percent of MP&M facilities with chelated metals use DTC for treatment. DTC compounds are a class of pesticides and, if used incorrectly, may cause process upsets in the biological treatment system used at the POTW and can potentially be harmful to the environment (e.g., lead to fish kills if it passes through the POTW and reaches surface waters). Another disadvantage is that DTC precipitation generates large amounts of sludge.

Other treatment chemicals used by MP&M industries for treatment of chelated metals include:

- Borohydride;
- Sodium hydrosulfite;

- Sodium metabisulfite;
- Polysulfide polymer;
- Sodium hydroxide;
- Ferrous sulfate;
- Ferris chloride; and
- Formaldehyde.

EPA evaluated the treatment performance of polysulfide polymer (Sampling Episode 6462) and determined this compound effectively treated chelated copper and nickel to metal finishing effluent limits (40 CFR 433). Further concentration reductions may have been achievable if additional jar testing was conducted. Iron or calcium salts and pH adjustment may also provide acceptable methods for chelated metals treatment; however, no data are available for evaluation.

The Orange County Sanitation District (OCS D) compile a study of a NDMA and found that the highest concentrations of a probable human carcinogen, n-nitrosodimethylamine (NDMA), at a printed circuit board manufacturer were observed at effluent from batch treatment (18). “Overdosing” of DTC in batch treatment systems may be common and may lead to the formation of NDMA. During its evaluation OCS D encouraged facilities and treatment chemical vendors to develop non-NDMA forming treatments. EPA compiled information on DTC alternative treatments for the record (see “DTC Alternatives for Treatment of Chelated Metals,” Section 24.6.1 of the rulemaking record, DCN 17962).

#### **8.4.4.3 Physical Separation**

Ion exchange and reverse osmosis can separate metals from solution. These technologies are not affected by chelating agents in the wastewater, making them effective in treating wastewater from electroless plating. Sections 8.2.8.1 and 8.2.8.2, respectively, discuss these technologies.

#### **8.4.5 Oil-Bearing Wastewater**

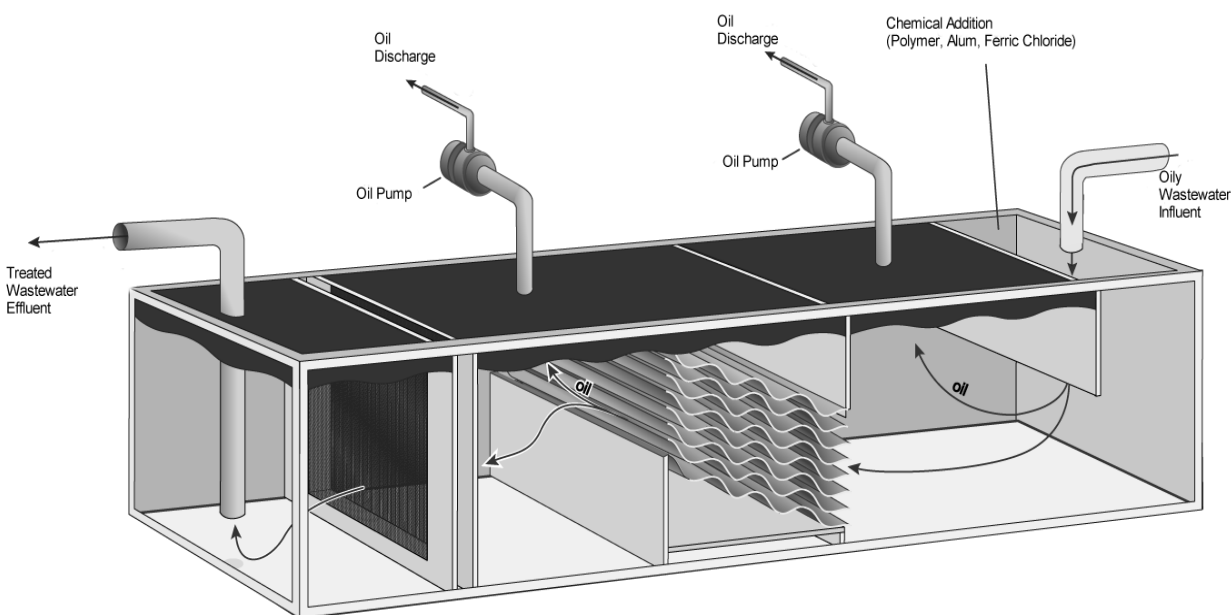
Some MP&M wastewater (e.g., alkaline cleaning wastewater and water-based metal-working fluids) contains significant amounts of oil and grease. This wastewater sometimes requires preliminary treatment to remove oil and grease and organic pollutants. Oil/water separation includes breaking oil/water emulsions (oil dispersed in water, stabilized by electrical charges and emulsifying agents) as well as gravity separation of oil. When only free oil (i.e., nonemulsified oil) is present, oil skimming is enough for effective treatment. Techniques available to remove oil include chemical emulsion breaking followed by oil/water separation or dissolved air flotation (DAF), oil skimming, and ultrafiltration. These technologies are described in more detail below.

Oil/water separation not only removes oil but also removes organic compounds that are more soluble in oil than in water. Subsequent clarification removes organic solids

directly and may also remove dissolved organic compounds by adsorption on inorganic solids. In MP&M operations, sources of these organic compounds mainly are process coolants and lubricants, additives to formulations of cleaners, paint formulations, or leaching from plastic lines and other materials.

#### 8.4.5.1 Chemical Emulsion Breaking

Chemical emulsion breaking is used to break stable oil/water emulsions. A stable emulsion will not separate or break down without chemical and or physical treatment. Chemical emulsion breaking is applicable to wastewater containing emulsified coolants and lubricants such as machining and grinding coolants and impact and pressure deformation lubricants. This technology also is applicable to cleaning solutions that contain emulsified oils. Figure 8-10 shows a diagram of a type of continuous chemical emulsion breaking system.



**Figure 8-10. Continuous Chemical Emulsion Breaking Unit with Coalescing Plates**

Treatment of spent oil/water emulsions involves adding chemicals to break the emulsion followed by oil/water separation. The major equipment required for chemical emulsion breaking includes reaction chambers with agitators, chemical storage tanks, chemical feed systems, pumps, and piping. Factors to be considered for breaking emulsions are type of chemicals, dosage and sequence of addition, pH, mixing, heating requirements, and retention time.

Chemicals (e.g., polymers, alum, ferric chloride, and organic emulsion breakers) break emulsions and allow coagulation (13) by neutralizing repulsive charges between particles, precipitating or salting out emulsifying agents, or weakening the interfacial film between the oil

and water so it is readily broken. Reactive cations (e.g.,  $H^+$ ,  $Al^{+3}$ ,  $Fe^{+3}$ ) and cationic polymers are particularly effective in breaking dilute oil/water emulsions. Once the charges are neutralized or the interfacial film broken, the small oil droplets and suspended solids either adsorb on the surface of the floc that is formed, or break out and float to the top. Different types of emulsion-breaking chemicals are used for different types of oils. If more than one chemical is required, the sequence of adding the chemicals can affect both breaking efficiency and chemical dosages.

Another important consideration in emulsion breaking is pH, especially if cationic inorganic chemicals, such as alum, serve as coagulants. For example, a pH of between 2 and 4 keeps the aluminum ion in its most positive state where it most effectively neutralizes charges. After some of the oil is broken free and skimmed, raising the pH into the 6-to-8 range with lime or caustic causes the aluminum to hydrolyze and precipitate as aluminum hydroxide. This floc entraps or adsorbs destabilized oil droplets, which can then be separated from the water. Cationic polymers can break emulsions over a wider pH range and thus avoid acid corrosion and the additional sludge generated from neutralization; however, this process usually requires adding an inorganic flocculent to supplement the adsorptive properties of the polymer emulsion breaker.

Mixing is important in effectively breaking oil/water emulsions because it provides proper chemical feed and dispersion. Mixing also causes droplets to collide and break the emulsion and promotes subsequent agglomeration into larger droplets. Heating also improves chemical emulsion breaking by lowering the viscosity and increasing the apparent specific gravity differential between oil and water. In addition, heating increases the frequency of droplet collisions, which helps to rupture the interfacial film.

Once an emulsion is broken, the oil floats to the surface of the water because of the difference in specific gravity between oil and water. Solids usually form a layer between the oil and water because some solids become suspended in the oil. The longer the retention time, the more complete the separation between the oil, solids, and water. Oils and solids typically are skimmed from the surface of the water after chemical emulsion breaking. Often, other techniques such as air flotation or rotational separation (e.g., centrifugation) enhance separation after chemical emulsion breaking.

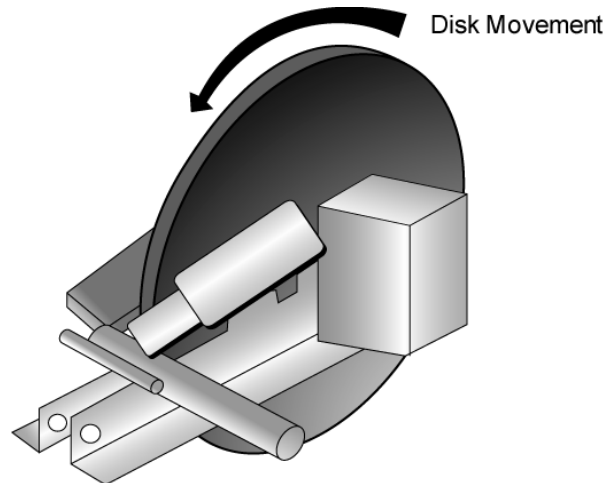
The advantages of chemical emulsion breaking are the high removal efficiency potential and the possibility of reclaiming the oily waste. Disadvantages include corrosion problems associated with acid-alum systems, operator training requirements for batch treatment, chemical sludges produced, and poor efficiency for low oil concentrations.

Chemical emulsion breaking is a very reliable process. The main control parameters are pH and temperature. Some MP&M facilities may achieve effective emulsion breaking by lowering the pH with acid, by heating the wastewater, or both. Maintenance is required on pumps, mixers, instrumentation and valves, as is periodic cleaning of the treatment tank to remove any accumulated solids. Energy use typically is limited to mixers and pumps, but

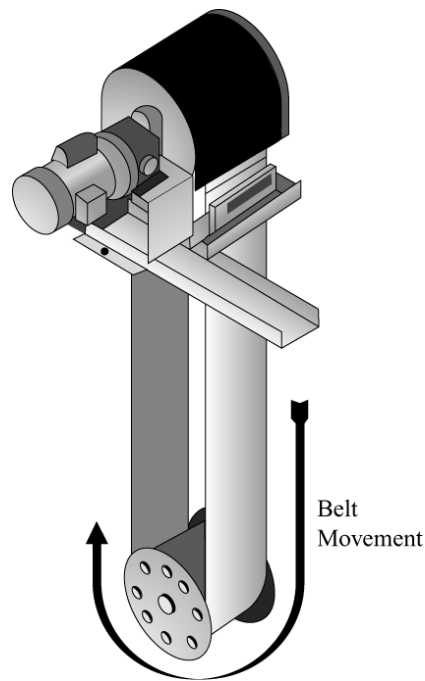
also can include heating. Solid wastes generated by chemical emulsion breaking include surface oil and oily sludge, which are usually contract hauled for disposal by a licensed contractor. If the recovered oil contains a low enough percentage of water, it may be burned for its fuel value or processed and reused.

#### **8.4.5.2 Oil Skimming**

Oil skimming is a physical separation technology that removes free or floating oil from wastewater using the difference in specific gravity between oil and water. Common separation devices include belts, rotating drums, disks, and weir oil skimmers and coalescers. These devices are not suited to remove emulsified oil, which requires chemical treatment, ultrafiltration, or other treatment. Figures 8-11a and 8-11b show diagrams of disk and belt oil skimming units, respectively, that are applicable for small systems or on process tanks. The oil removal system shown in Figure 8-10 is a coalescing separator used for large systems.



**Figure 8-11a. Disk Oil Skimming Unit**



**Figure 8-11b.**  
**Belt Oil Skimming Unit**

To separate oil from process solutions, oil skimming devices typically mount onto the side of a tank and operate on a continuous basis. The disk skimmer is a vertically rotating disk that is partially submerged in the solution (see Figure 8-11a). The disk continuously revolves between spring-loaded wiper blades that are located above the liquid surface. The disk's adhesive characteristics cause the floating oil to remain on the disk. As the disk's surface passes under the wiper blades, the blades scrape off the oil, which is diverted to a run-off spout for collection. Belt and drum skimmers operate in a similar manner, with either a continuous belt or drum rotating partially submerged in a tank. As the surface of the belt or drum emerges from the liquid, the oil that adheres to the surface is scraped off (drum) or squeezed off (belt) and diverted to a collection vessel. The oil typically is hauled off-site for disposal.

Gravity separators use overflow and underflow weirs to skim a floating oil layer from the surface of the wastewater. The oil layer flows over the weir into a trough for disposal or reuse while most of the water flows underneath the weir. A diffusion device, such as a vertical slot weir, helps create a uniform flow through the system and increase oil removal efficiency.

An oil skimmer's removal efficiency depends on the composition of the waste stream and the retention time of the water in the tank. Larger, more buoyant particles require less retention time than do smaller particles. The retention time necessary for phase separation and subsequent skimming varies from 1 to 15 minutes, depending on the wastewater characteristics. Gravity-type separators tend to be more effective for wastewater streams with consistently large

amounts of surface oil. Drum and belt type skimmers are more applicable to waste streams containing smaller amounts of floating oil. A gravity separator in conjunction with a drum-type skimmer effectively removes floating contaminants from nonemulsified oily waste streams.

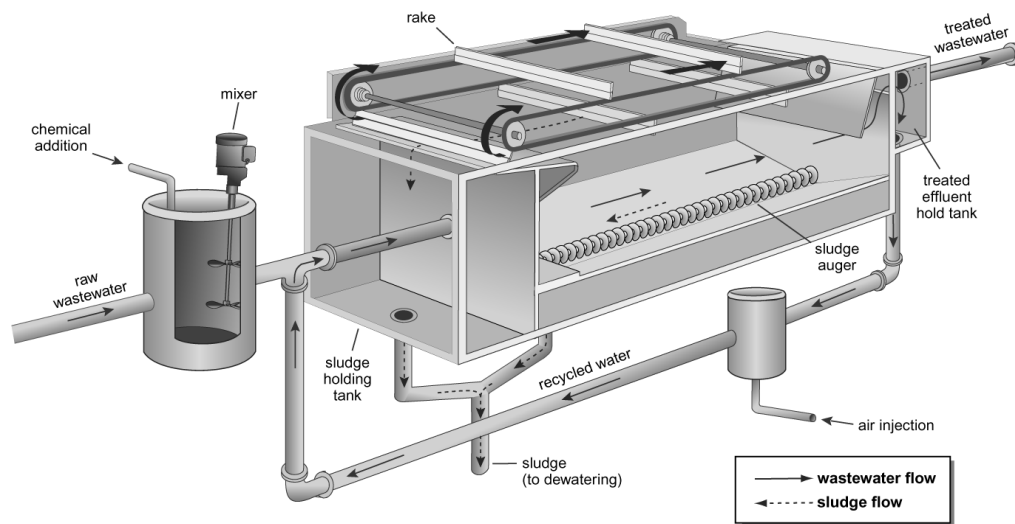
Coalescers remove oil droplets too finely dispersed for conventional gravity separation-skimming technology. Coalescing also reduces the residence times (and therefore separator sizes) required to separate oil from some wastes. The basic principle of coalescence involves the attraction of oil droplets to the coalescing medium (typically plates). The oil droplets accumulate on the medium and then rise to the surface of the solution as they combine to form larger particles. The most important requirements for coalescing media are attraction for oil and large surface area. Coalescing media include polypropylene, ceramic, and glass.

Coalescing stages may be integrated with a wide variety of gravity oil separators, and some systems may incorporate several coalescing stages. A preliminary oil skimming step avoids overloading the coalescer.

#### **8.4.5.3 Flotation of Oils or Solids**

Air flotation combined with chemical emulsion breaking is an effective way to treat oily wastewater containing low concentrations of metals. Flotation separates oil and grease from the wastewater, and entrainment or adsorption will remove small amounts of metal. In DAF, air is injected into a fluid under pressure. The amount of air that can dissolve in a fluid increases with increasing pressure. When the pressure is released, the air comes out of solution as bubbles, which attach to oil and grease molecules and “float” the oil and grease to the surface. Induced-air flotation uses the same separation principles as DAF systems but the gas is self-induced by a rotor-disperser mechanism.

Figure 8-12 shows a diagram of a DAF unit. A DAF system consists of a pressurizing pump, air injection equipment, pressurizing tank, a pressure release valve, and a flotation tank. DAF systems operate in two modes: full-flow pressurization and recycle pressurization. In full-flow pressurization, all influent wastewater is pressurized and injected with air. The wastewater then enters the flotation unit where the pressure is relieved and bubbles form, causing the oil and grease to rise to the surface with the air bubbles. In recycle pressurization, part of the clarified effluent is recycled back to the influent of the DAF unit, then pressurized and supersaturated with air. The recycled effluent then flows through a pressure release valve into the flotation unit. Pressurizing only the recycle reduces the amount of energy required to pressurize the entire influent. DAF is the most common method of air flotation.



**Figure 8-12. Dissolved Air Flotation Unit**

#### 8.4.5.4 Ultrafiltration

Ultrafiltration is a membrane-based process used to separate solution components based on molecular size and shape. Under pressure, solvent and small solute species pass through the membrane and are collected as permeate while the membrane retains larger compounds, which are recovered as concentrate. Figure 8-5 shows a typical membrane filtration unit.

Ultrafiltration typically removes materials ranging from 0.002 to 0.2 microns or molecular-weights from 500 to 300,000. It can be used to treat oily wastewater. Filtering the ultrafiltration influent removes large particles and free oil to prevent membrane damage and fouling. Most ultrafiltration membranes consist of homogeneous polymer or copolymer material. The transmembrane pressure required for ultrafiltration depends on membrane pore size, and typically ranges between 15 to 200 psi.

Ultrafiltration typically produces a concentrated oil phase that is two to five percent of the influent volume. Oily concentrates typically are hauled off-site or incinerated, and the permeate (water phase) can be either treated further to remove water-soluble metals and organic compounds or discharged, depending on local and state requirements.

An ultrafiltration system includes: pumps and feed vessels, piping or tubing, monitoring and control units for temperature, pressure, and flow rate; process and cleaning tanks; and membranes. Membranes are designed specifically to handle various waste stream



parameters, including temperature, pH, and chemical compatibility. There are different types of membranes, including hollow fiber, tubular, flat plate, and spiral wound. The type selected depends on the application. For example, tubular membranes commonly separate suspended solids, whereas spiral wound membranes separate oil from water. Ultrafiltration systems designed to remove oil typically are more expensive than are DAF systems. Membranes must be cleaned periodically to ensure effective treatment.

## **8.5 End-of-Pipe Wastewater Treatment and Sludge-Handling Technologies**

This subsection describes end-of-pipe technologies that MP&M facilities use for wastewater treatment and sludge handling. Table 8-3 describes each technology and lists the number of MP&M facilities that use the technology. Section 8.5.1 discusses metal removal by chemical precipitation, Section 8.5.2 discusses oil removal technologies, Section 8.5.3 discusses wastewater polishing technologies, and Section 8.5.4 discusses sludge-handling technologies.

### **8.5.1 Chemical Precipitation for Metals Removal**

The most common end-of-pipe treatment technology used at MP&M facilities to remove dissolved metals is chemical precipitation and flocculation followed by gravity clarification. The data in Table 8-3 show there are nearly 3,000 MP&M facilities that use chemical precipitation and gravity settling to treat their metals-bearing wastewater. Some MP&M facilities use microfiltration, filter press operations, centrifuge operations, DAF, and American Petroleum Institute (API) separation in place of clarification, but this subsection discusses only clarification and microfiltration. The types of equipment used for chemical precipitation vary widely. Small batch operations can take place in a single tank that typically has a conical bottom to permit removal of settled solids. Continuous processes usually occur in a series of tanks, including an equalization tank, a rapid-mix tank for dispersing the precipitating chemicals, and a slow-mix tank for adding coagulants and flocculants and for floc formation.

For continuous-flow systems, the first tank in the treatment train typically is the equalization tank. The flow equalization tank prevents upsets in processing operations from exceeding the hydraulic design capacity of the treatment system, improves chemical feed control, and allows wastewater neutralization.

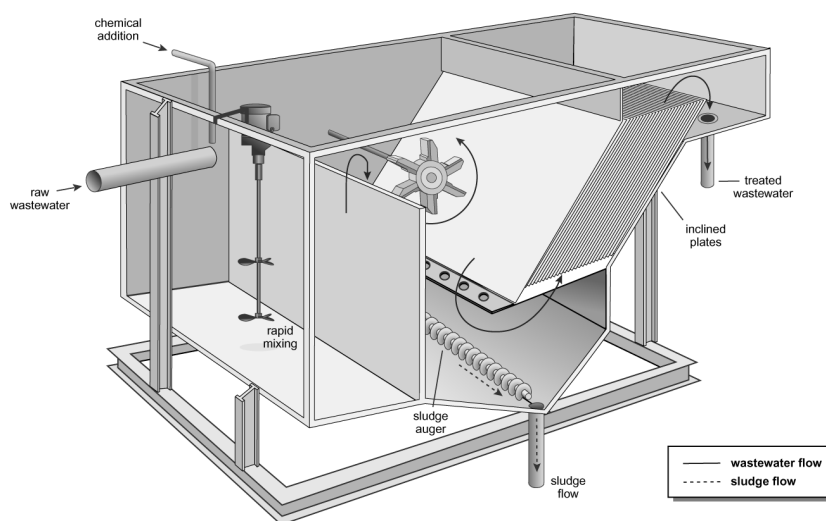
Commingled wastewater from the equalization tank enters the rapid mix tank, along with various types of precipitation chemicals added to convert the soluble metals into insoluble compounds. Following precipitation, the wastewater flows into a flocculation tank where polyelectrolytes (polymers) are added, causing the precipitated solids to coagulate into larger particles that gravity settling or other separation techniques can remove.

Chemical precipitation is a highly reliable technology when properly monitored and controlled. The effectiveness of this technology depends on the types of equipment used and numerous operating factors, such as the characteristics of the raw wastewater, types of treatment reagents used, and operating pH. In some cases, subtle changes in operating factors (e.g., varying

the pH, altering chemical dosage, or extending the process reaction time) may sufficiently improve the system's efficiency. In other cases, modifications to the treatment system are necessary. For example, some raw wastewater contains chemicals that may interfere with metals precipitation, and may require additional, specialized treatment reagents such as ferrous sulfate, sodium hydrosulfate, aluminum sulfate, or calcium chloride. These chemicals may be added prior to or during the precipitation process.

Chemical precipitation systems require routine maintenance for proper operation. This includes: calibrating instrumentation and cleaning probes; maintaining chemical pumps and mixers (inspection, cleaning, lubrication, replacing seals and packing, replacing check valves, cleaning strainers); and monitoring tanks and sumps (inspection, cleaning, corrosion prevention).

There are several basic methods of performing chemical precipitation and flocculation and many variations of each method. The four most common methods are described below. Figure 8-13 shows a typical continuous chemical precipitation system.

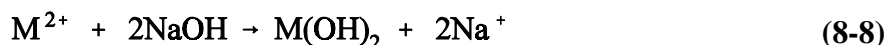


**Figure 8-13. Continuous Chemical Precipitation System with Lamella Clarifier**

Removing precipitated metals typically involves adding flocculating agents or polymers to destabilize the hydrodynamic forces that hold the particles in suspension. For a continuous treatment system, polymer is either added in-line between the reaction tank and the flocculation tank, or in a small rapid mix tank between the reaction tank and flocculation tank. In the flocculation tank, the mixer is slowed to promote agglomeration of the particles until their density is greater than water and they settle from solution in the clarifier.

## Hydroxide Precipitation

Hydroxide precipitation is the most common method of removing metals from MP&M wastewater. This process typically consists of several stages. In an initial tank, which is mechanically agitated, alkaline treatment reagents such as lime (calcium hydroxide or hydrated lime), sodium hydroxide, or magnesium hydroxide are added to the wastewater to precipitate metal ions as metal hydroxides. The reaction for precipitation of a divalent metal using sodium hydroxide is shown in the following equation:



The precipitation process usually operates at a pH of between 8.5 and 11, depending on the types of metals in the wastewater. The pH set point for each hydroxide precipitation system is determined by jar testing. Jar testing results determine the optimum pH, flocculent type and dosage to maximize the removal of target metals. Figure 8-14 shows the effect of pH on hydroxide precipitation. Figure 8-14 was developed based on empirical studies using single metal solutions in reagent-free water. However, metal solubilities in complex wastewater may differ from those shown in the figure, and therefore facilities must test their actual wastewater to define the minimum solubility for all metals.

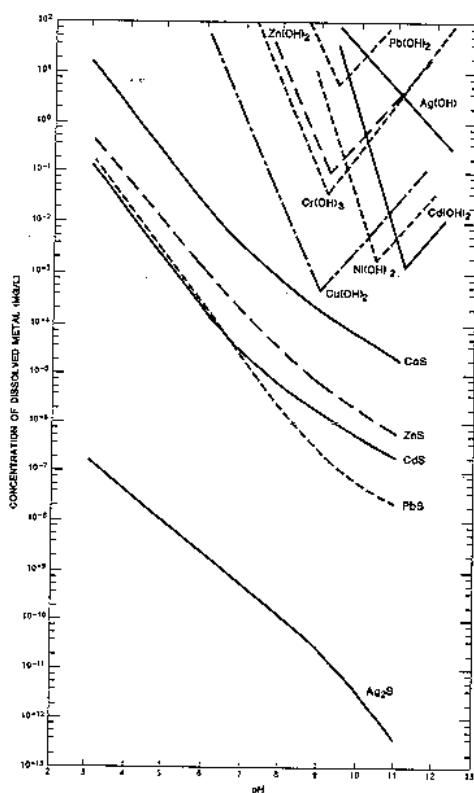
## Iron Coprecipitation

Iron coprecipitation is one method that has proven effective at reducing the concentration of metals such as arsenic, beryllium, cadmium, copper, lead, nickel and zinc to less than could be achieved with hydroxide precipitation alone (7). Iron coprecipitation involves adding an iron source such as ferric sulfate or ferric chloride to the pH adjustment tank in the chemical precipitation treatment system. Iron is then precipitated as iron oxyhydroxide (7). During this process, other metal hydroxides (e.g., nickel hydroxide, copper hydroxide) may be incorporated as an impurity within the iron oxyhydroxide matrix or physically entrapped within its pore spaces. Metal hydroxides may also be adsorbed to the surface of the iron oxyhydroxide precipitate. Factors affecting the iron coprecipitation process include iron dose and iron oxidation state, pH, the target metals oxidation state, the initial concentration of the target metal, and competition for adsorbent sites from other species. Facilities should conduct jar testing using their actual wastewater to optimize the operating conditions for this process.

## Sulfide Precipitation

The sulfide precipitation process uses equipment similar to that used for hydroxide precipitation. The major difference between the two processes is the treatment reagents used. Sulfide precipitation uses either soluble sulfides (e.g., hydrogen sulfide or sodium sulfide) or insoluble sulfides (e.g., ferrous sulfide) in place of alkali reagents used in hydroxide precipitation. The sulfide reagents precipitate dissolved metals as metal sulfides, which often have lower solubility limits than metal hydroxides. Therefore, the sulfide precipitation process

can (for many metals) achieve lower levels of residual dissolved metal in the effluent than hydroxide precipitation treatment (see Figure 8-14). The sulfide precipitation reaction is shown in the following equation:



**Figure 8-14. Effect of pH on Hydroxide and Sulfide Precipitation (10)**

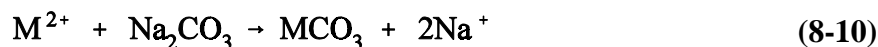
Unlike hydroxides, sulfide can precipitate most chelated metals and can remove hexavalent chromium without first reducing the chromium to its trivalent state.

The major disadvantages of sulfide precipitation as compared to hydroxide precipitation are higher capital and operating costs. Additional disadvantages of sulfide

precipitation are the potential for toxic hydrogen sulfide gas generation and excessive sulfide releases in the effluent, and the generation of sulfide odors.

### Carbonate Precipitation

Carbonate precipitation typically uses sodium carbonate (soda ash), sodium bicarbonate, or calcium carbonate to form insoluble metal carbonates. The reaction is shown in the following equation:



Carbonate precipitation is similar in operation to hydroxide precipitation, and its purpose is to remove metals such as cadmium or lead. For these metals, carbonate precipitation operates at a lower pH to achieve effluent concentrations similar to those achieved by hydroxide precipitation. Facilities sometimes operate carbonate precipitation in conjunction with hydroxide precipitation, which may improve the overall performance of certain systems.

Carbonate precipitation is less common than hydroxide precipitation due to the higher cost of treatment reagents and certain operational problems, such as the release of carbon dioxide, which can result in foaming and floating sludge. Also, because many metal carbonates are more soluble than are sulfides or hydroxides, this process does not effectively precipitate all target metals.

### Chemical Precipitation Performance Factors

Ionic strength of the wastewater is another factor that can negatively affect the performance of the chemical precipitation system (8). As MP&M facilities lower water usage by implementing technologies such as flow restrictors, countercurrent cascade rinsing, and timed rinses, the ionic strength of the wastewater reaching the treatment system will increase. In process chemistry, a precipitate always forms or dissolves in the presence of indifferent electrolytes. Although ions from such species do not participate directly in the solubility equilibrium reaction, they do affect the solubility behavior of the precipitate. The following chemical equilibrium equations show the impact of ionic strength on the precipitation process:



The equilibrium constant expression for this reaction is given by

$$(K_a)_{eq} = (C)(A) \quad (8-12)$$

or

$$(K_a)_{eq} = g_m[C] g_m[A] \quad (8-13)$$

This equation can be rewritten as

$$(K_e)_{eq} = (K_a)_{eq} / (g_m)^2 \quad (8-14)$$

The greater the concentration of indifferent electrolytes, the greater the ionic strength of the solution and the smaller the value of the activity coefficient. In process chemistry, the value of  $g$  is normally less than 1.0. Therefore, the smaller the value of  $g$ , the larger the value of  $(K_e)_{eq}$ , indicating the solubility of the solid phase (metal hydroxide precipitate) will increase. This means that the solubility of a precipitate will increase if the concentration of indifferent electrolytes in solution increases (8). MP&M facilities that reduce process water usage should be aware of these equilibria changes that will occur within their treatment system. Facilities should conduct additional jar testing to determine if they can mitigate the negative impacts with new treatment chemistry or add process water to improve treatment efficiency.

One issue raised during the MP&M public comment period was that treatment system performance is fixed (i.e., percent removal) and therefore the effluent concentration is a direct function of influent concentration. The MP&M sampling episode data, however, indicate the effluent concentration is a function of the minimum solubility of the metal, regardless of the influent concentration. As explained in the June 2002 NODA (67 FR 38779), EPA reviewed graphical displays of the paired influent and effluent values and other data analyses. Because the results were inconclusive and sometimes inconsistent, EPA was unable to reach a conclusion about the effect of influent concentrations on the effluent concentrations. If a facility finds that influent concentrations appear to affect its effluent concentrations, it may be useful to perform jar testing on a representative sample of wastewater to optimize the treatment conditions for both high and low influent concentrations.

After precipitation, the metal hydroxide particles are very fine and resistant to settling. To increase their particle size and improve their settling characteristics, coagulating and flocculating agents are added, usually in a second tank, and slowly mixed. Coagulating and flocculating agents include inorganic chemicals such as alum and ferric sulfate, and a highly diverse range of organic polyelectrolytes with varying characteristics suitable for different wastewaters. The type and dosage of flocculent and coagulant are based on the results of jar testing done using the actual facility wastewater.

Flocculated particles with densities greater than water settle in a separate clarification tank (e.g., a lamella clarifier), under quiescent conditions. Operators remove the solids from the bottom of the settling tank or clarifier, then transfer them to a thickener or other dewatering process (see Section 8.5.4). Clarifier effluent either undergoes further processing in a polishing unit such as a multimedia filter or discharges.

### 8.5.1.1 Gravity Clarification for Solids Removal

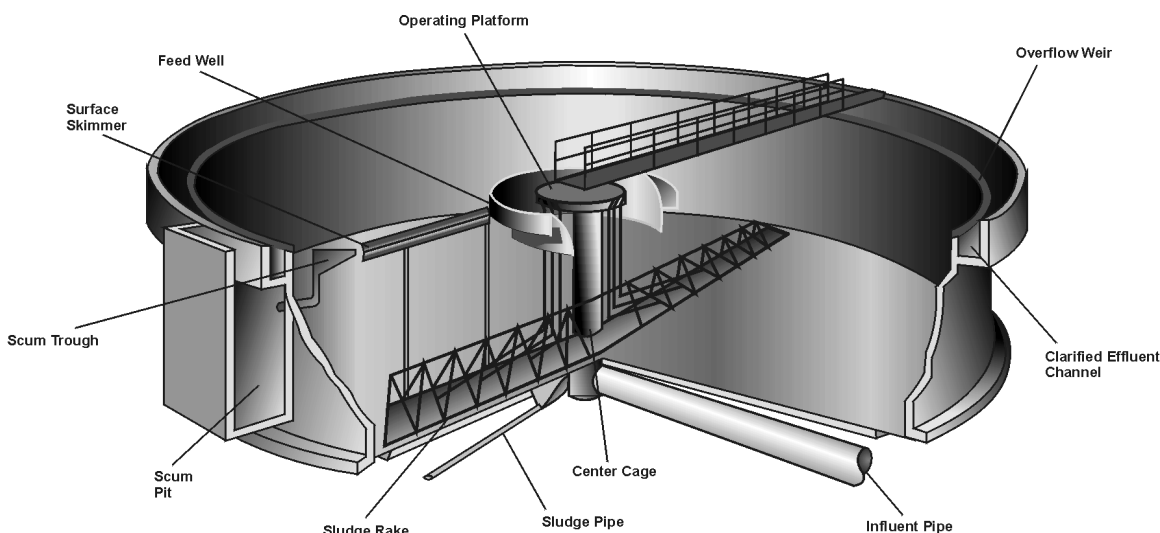
Gravity sedimentation to remove precipitated metal hydroxides is the most common method of clarification (solids removal) used by MP&M facilities. Typically, two types of sedimentation devices are used: inclined-plate clarifiers (e.g., lamella clarifiers) and circular center-feed rim flow clarifiers.

Lamella clarifiers contain inclined plates oriented at angles varying between 45 and 60 degrees from horizontal. As the water rises through the clarifier, the solids settle on the plates. Clarified effluent continues to the top of the clarifier, passes over a weir, and collects in a holding tank. The solids collect on the inclined plates and slide downward and into the bottom of the clarifier. When sufficient solids collect in the bottom of the clarifier, they are scraped into a sludge hopper and then discharged, usually to a thickener. Figure 8-13 presents a lamella clarifier.

Overflow rates for lamella clarifiers (i.e., between 1,000 and 1,500 gpd/ft<sup>2</sup> for metal hydroxide sludges) are two to four times higher than the overflow rates for clarifiers not equipped with inclined plates. Clarifier inlets must be designed to distribute flow uniformly through the tank and plate settlers. In addition, because solids can build up on plate surfaces and adversely affect flow distribution, the clarifier should be cleaned periodically.

Lamella clarifiers are more common at MP&M facilities than other types of clarifiers because of the smaller area required. They typically require only 65 to 80 percent of the area required for clarifiers without inclined plates. Their design promotes laminar flow through the clarifier, even when the water throughput is relatively high.

In a center-feed rim flow clarifier, wastewater flows into the bottom of a center feed well and then up into a circular tank. Heavy particles settle to the bottom of the tank where they are raked to a discharge pipe and removed. Materials with a density less than the density of water float to the top of the water and are skimmed from the water surface and discharged to a scum pit through a scum trough. Scum is removed from the scum pit periodically and then disposed of. Clarified effluent flows over the top of the clarifier and is collected in an effluent channel and discharged. Figure 8-15 shows a center-feed rim flow clarifier.



**Figure 8-15. Center-Feed Rim Flow Clarifier**

#### 8.5.1.2 Microfiltration for Solids Removal

Microfiltration is an alternative to conventional gravity clarification after chemical precipitation. Microfiltration is a membrane-based process used to separate small suspended particles based on size and shape. Water and small solute species pass under pressure through a membrane and are collected as permeate while larger particles such as precipitated and flocculated metal hydroxides are retained by the membrane and are recovered as concentrate. Microfiltration is similar to ultrafiltration (Section 8.4.5.4) but has a larger pore size.

Microfiltration removes materials ranging from 0.1 to 1.0 microns (e.g., colloidal particles, heavy metal particulates and their hydroxides). Most microfiltration membranes consist of homogeneous polymer material. The transmembrane pressure required for microfiltration typically ranges between 3 to 50 psi, depending on membrane pore size.

Microfiltration produces a concentrated suspended solid slurry that typically goes to dewatering equipment such as a sludge thickener or a filter press. The permeate can either be treated further to adjust the pH or be discharged, depending on local and state requirements. Figure 8-5 shows a typical membrane filtration system.

The microfiltration system includes: pumps and feed vessels; piping or tubing; monitoring and control units for temperature, pressure, and flow rate; process and cleaning tanks; and membranes. Membranes are designed specifically to handle various waste stream parameters, including temperature, pH, and chemical compatibility. Different types of membranes are available, including hollow fiber, tubular, flat plate, and spiral wound. The configuration selected for a particular facility depends on the type of application. For example, tubular membranes commonly separate suspended solids, whereas spiral wound membranes



separate oils from water. Microfiltration is more expensive than conventional gravity clarification. Membranes must be cleaned periodically to prevent fouling and ensure effective treatment.

### **8.5.1.3 Optimization of Existing Chemical Precipitation Treatment System**

Facilities can optimize the performance of an existing chemical precipitation and clarification system using a variety of techniques such as adding equalization prior to treatment, conducting jar testing to optimize treatment chemistry, upgrading control systems, and providing operator training.

#### **Equalization**

Equalization is simply the damping of flow and concentration variations to achieve a constant or nearly constant wastewater treatment system loading (8). Equalization improves treatment performance by providing a uniform hydraulic loading to clarification equipment, and by damping mass loadings, which improves chemical feed control and process reliability. MP&M facilities implement equalization by placing a large collection tank ahead of the treatment system. All process water and rinse water entering this tank are mixed mechanically and then pumped or allowed to gravity flow to the treatment system at a constant rate. The size (volume) of the tank depends on the facility flow variations throughout the day. Operating data collected during MP&M sampling episodes indicate hydraulic residence times for equalization tanks average 4 to 6 hours.

#### **Jar Testing**

The purpose of jar testing is to optimize treatment pH, flocculant type and dosage, the need for coprecipitants such as iron, and solids removal characteristics. Facilities should conduct jar testing on a sample of their actual wastewater to provide reliable information.

#### **Control System Upgrades**

Typical treatment system controls at MP&M facilities includes pH and ORP controllers on alkaline chlorination systems for cyanide destruction, pH controllers on chemical precipitation systems, flow and level monitoring equipment on equalization tanks, and solenoid valves and metering pumps on chemical feed systems to provide accurate treatment chemical dosing. A number of MP&M facilities have computer hardware and software to monitor and change treatment system operating parameters. For a number of MP&M facilities, upgrading control equipment may reduce both pH and ORP swings caused by excess chemical dosing, resulting in consistent effluent metals concentrations.

## **Operator Training**

Having operators trained in both the theory and practical application of wastewater treatment is key to ensuring the systems are operating at their best. Many MP&M facilities send their operators to off-site training centers while others bring consultants familiar with their facility's operations and wastewater treatment system to the facility to train operators. Some of the basic elements of an operator training course should include (1):

- An explanation of the need for wastewater treatment, which emphasizes the benefits to employees and the community;
- An emphasis on management's commitment to environmental stewardship;
- An explanation of wastewater treatment terminology in simple terms;
- An overview of the environmental regulations that govern the facility's wastewater discharges;
- A simple overview of wastewater treatment chemistry;
- Methods that can optimize treatment performance (e.g., how to conduct jar testing);
- The test methods or parameters used to verify the system is operating properly (e.g., control systems); and
- The importance of equipment maintenance to ensure the system is operating at its maximum potential.

First-time training for new operators may require 4 to 5 days of classroom and hands-on study. Experienced MP&M wastewater treatment operators should consider attending at least 1 day of refresher training per year to update themselves on the chemistry and to learn about new equipment on the market that may help their system's performance.

### **8.5.2 Oil Removal**

Operations such as machining and grinding, disassembly of oily equipment, and cleaning can generate wastewater containing organic machining coolants, hydraulic oils, and lubricating oils. In addition, shipbuilding facilities may commingle oily bilge water with wastewater from other shore-side operations, resulting in a mixed oily wastewater. Information collected during MP&M site visits, sampling episodes, and from the MP&M detailed surveys showed a variety of methods to treat oily wastewater. The primary treatment technologies are

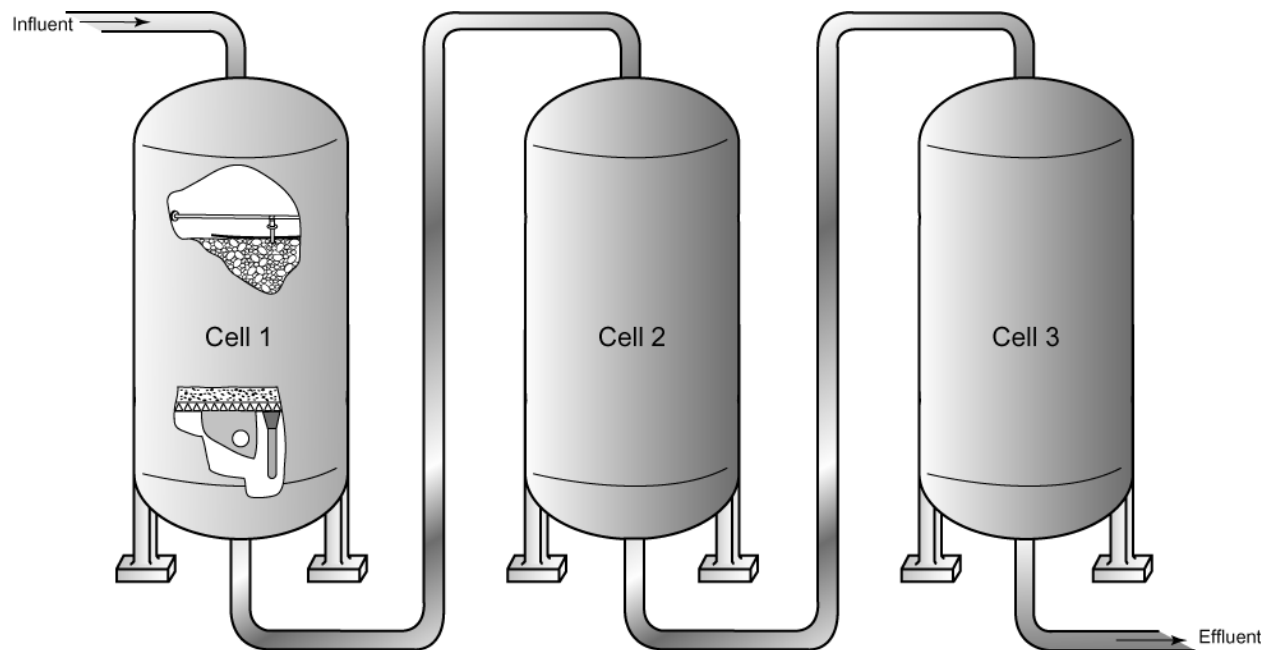
emulsion breaking and gravity flotation, emulsion breaking and DAF, and ultrafiltration. Section 8.4 discusses these technologies.

### 8.5.3 Polishing Technologies

Polishing systems remove small amounts of pollutants that may remain in the effluent after treatment using technologies such as chemical precipitation and gravity clarification. These systems also can act as a temporary measure to prevent pollutant discharge should the primary solids removal system fail due to a process upset or catastrophic event. The following are descriptions of end-of-pipe polishing technologies that are applicable to MP&M facilities.

#### 8.5.3.1 Multimedia Filtration

Sand filtration and multimedia filtration systems typically remove small amounts of suspended solids (metal precipitates) entrained in effluent from gravity clarifiers. Sand and multimedia polishing filters usually are designed to remove 90 percent or greater of all filterable suspended solids 20 microns or larger at a maximum influent concentration of 40 mg/L. Wastewater is pumped from a holding tank through the filter. The principal design factor for the filter is the hydraulic loading. Typical hydraulic loadings range between 4 and 5 gpm/ft<sup>2</sup> (9). Sand and multimedia filters are cleaned by backwashing with clean water. Backwashing is timed to prevent breakthrough of the suspended solids into the effluent. Figure 8-16 shows a diagram of a multimedia filtration system.



**Figure 8-16. Multimedia Filtration System**

### **8.5.3.2 Activated Carbon Adsorption**

Activated carbon adsorption removes dissolved organic compounds from wastewater. Some MP&M facilities use carbon adsorption to polish effluent from ultrafiltration systems treating oily wastewater. During adsorption, molecules of a dissolved compound adhere to the surface of an adsorbent solid. Activated carbon is an excellent adsorption medium due to its large internal surface area, generally high attraction to organic pollutants, and hydrophobic nature (i.e., water will not occupy bonding sites and interfere with the adsorption of pollutants). Pollutants in the wastewater bond on the activated carbon grains until all the surface bonding sites are occupied. At that point, the carbon is considered to be “spent.” Spent carbon requires regeneration; regenerated carbon has a reduced adsorption capacity compared to fresh carbon. After several regenerations, the carbon is disposed of.

The carbon fits in granular carbon system vessels, forming a “filter” bed. Vessels are usually circular for pressure systems and rectangular for gravity flow systems. For wastewater treatment, activated carbon typically is packed into one or more filter beds or columns; a typical treatment system consists of multiple filter beds in series. Wastewater flows through the filter beds and comes in contact with all portions of the activated carbon. The activated carbon in the upper portion of the column is spent first (assuming flow is downward), and progressively lower regions of the column are spent as the adsorption zone moves down the unit. When pollutant concentrations at the bottom of the column begin to increase above acceptable levels, the entire column is considered spent and must be regenerated or removed.

### **8.5.3.3 Reverse Osmosis**

Reverse osmosis is a membrane separation technology used by MP&M facilities as an in-process step or as an end-of-pipe treatment. Section 8.2.8.2 discusses in-process reverse osmosis. In an end-of-pipe application, reverse osmosis typically recycles water and reduces discharge volume rather than recovers chemicals. The effluent from a conventional treatment system generally has a TDS concentration unacceptable for most rinsing operations, and cannot be recycled. Reverse osmosis with or without some pretreatment can replace TDS concentrations, and the resulting effluent stream can be used for most rinsing operations.

### **8.5.3.4 Ion Exchange**

Ion exchange is both an in-process metals recovery and recycle and end-of-pipe polishing technology. Section 8.2.8.1 discusses in-process ion exchange. This technology generally uses cation resins to remove metals but sometimes uses both cation and anion columns. The regenerant from end-of-pipe ion exchange is not usually amenable to metals recovery as it typically contains multiple metals at low concentrations.

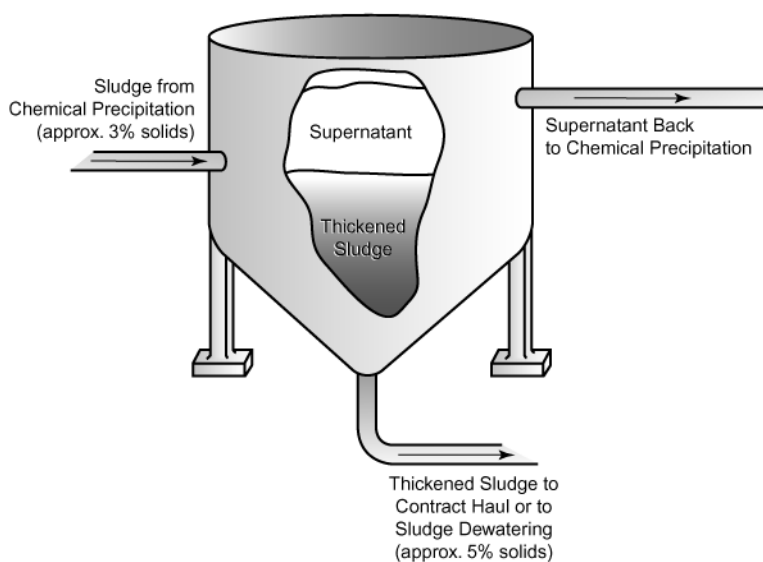
## 8.5.4 Sludge Handling

This subsection discusses the following sludge-handling technologies:

- Gravity thickening;
- Pressure filtration;
- Sludge drying; and
- Vacuum filtration.

### 8.5.4.1 Gravity Thickening

Gravity thickening is a physical liquid-solid separation technology used to dewater wastewater treatment sludge. Sludge feeds from a primary settling tank or clarifier to a thickening tank, where gravity separates the supernatant (liquid) from the sludge, increasing the sludge density. The supernatant returns to the primary settling tank or the head of the treatment system for further treatment. The thickened sludge that collects on the bottom of the tank is pumped to additional dewatering equipment or contract hauled for disposal. Figure 8-17 shows a diagram of a gravity thickener.

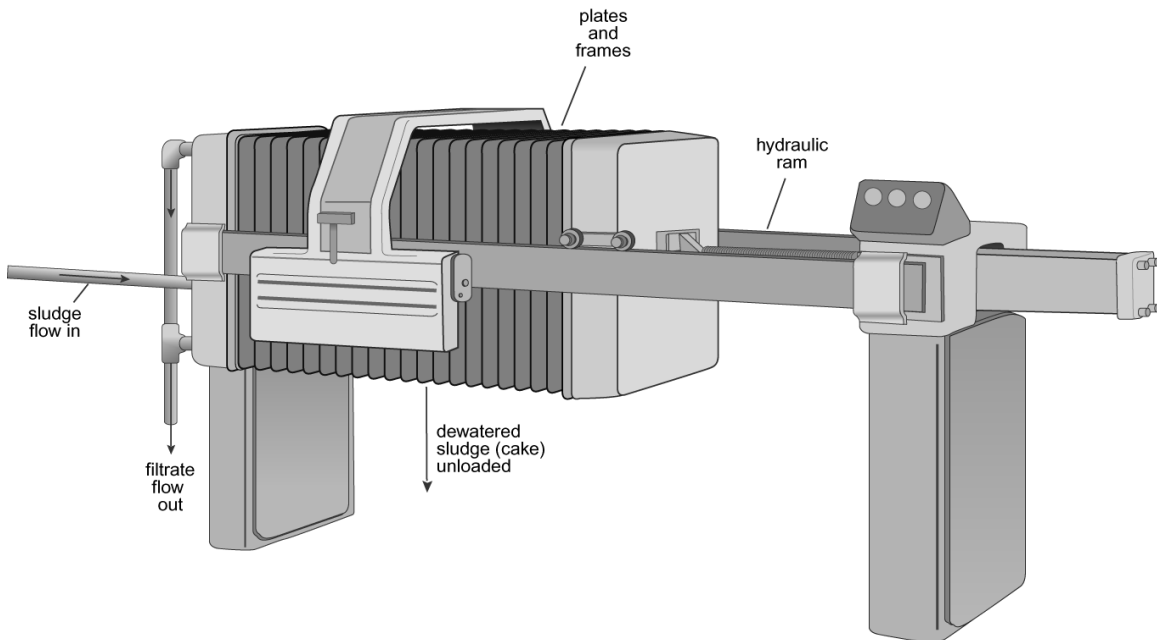


**Figure 8-17. Gravity Thickening**

Facilities where the sludge is to be further dewatered by a mechanical device, such as a filter press, generally use gravity thickeners. Increasing the solids content in the thickener substantially reduces capital and operating costs of the subsequent dewatering device and also reduces the hauling cost. This process is potentially applicable to any MP&M facility that generates sludge.

### 8.5.4.2 Pressure Filtration

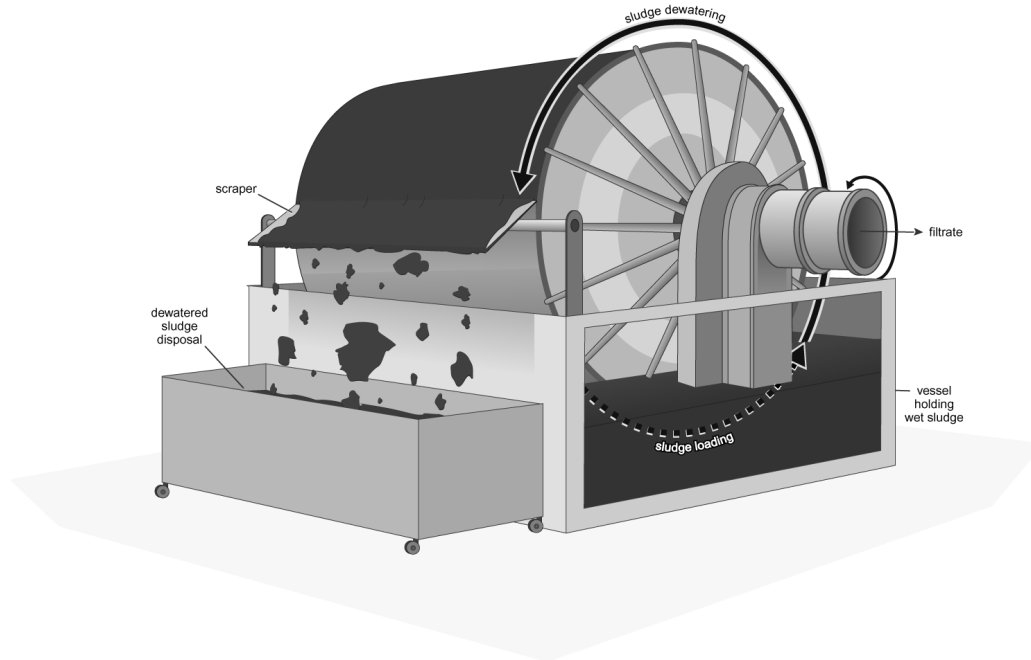
The filter press is the most common type of pressure filtration used at MP&M facilities for dewatering wastewater treatment sludges. A filter press consists of a series of parallel plates pressed together by a hydraulic ram (older models may have a hand crank), with cavities between the plates. Figure 8-18 shows a diagram of a plate-and-frame filter press. The filter press plates are concave on each side to form cavities and are covered with a filter cloth. At the start of a cycle, a hydraulic pump clamps the plates tightly together and a feed pump forces a sludge slurry into the cavities of the plates. The liquid (filtrate) escapes through the filter cloth and grooves molded into the plates and is forced by the pressure of the feed pump (typically around 100 psi) to a discharge port. The filter cloth retains the solids, which remain in the cavities. This process continues until the cavities are packed with sludge solids. Some units use an air blow-down manifold at the end of the filtration cycle to drain remaining liquid from the system, further drying the sludge. The pressure releases and the plates separate. The sludge solids or cake is loosened from the cavities and falls into a hopper or drum. A plate filter press can produce a sludge cake with a dryness of approximately 20 to 30 percent solids for metal hydroxides precipitated with sodium hydroxide, and 30 to 40 percent solids for metal hydroxides precipitated with calcium hydroxide. Filter presses are available in a very wide range of capacities ( $0.6 \text{ ft}^3$  to  $20 \text{ ft}^3$ ). A typical operating cycle is from 4 to 8 hours, depending on the dewatering characteristics of the sludge. Units are usually sized based on one or two cycles per day.



**Figure 8-18. Plate-and-Frame Filter Press**

### 8.5.4.3 Vacuum Filtration

Some MP&M facilities conduct vacuum filtration to reduce the water content of metal hydroxide sludge. These MP&M facilities generally use cylindrical drum vacuum filters. The filters on these drums typically are either made of natural or synthetic fibers, or a wire-mesh fabric. The drum dips into a vat of sludge and rotates slowly. A vacuum inside the drum draws sludge to the filter. Water is drawn through the filter to a discharge port, and the dewatered sludge is scraped from the filter. Because dewatering sludge with a vacuum filter is relatively expensive per kilogram of water removed, the liquid sludge is frequently gravity-thickened prior to vacuum filtration. Figure 8-19 shows a typical rotary vacuum filter. Municipal treatment plants and a wide variety of industries frequently use vacuum filters. Larger facilities more commonly use this technology, as they may have a gravity thickener to double the solids content of clarifier sludge before vacuum filtering. Often facilities apply a precoat to inhibit filter blinding.



**Figure 8-19. Rotary Vacuum Filter**

Maintenance of vacuum filters involves cleaning or replacing the filter media, drainage grids, drainage piping, filter parts, and other parts. Since maintenance time may be as high as 20 percent of total operating time, facilities may maintain one or more spare units. If this technology is used intermittently, the facility may drain and wash the filter equipment each time it is taken out of service.

#### 8.5.4.4 Sludge Drying

Wastewater treatment sludges are often hauled long distances to disposal facilities. The transportation and disposal costs depend mostly on the volume and weight of sludge, which is directly related to its water content. Therefore, many MP&M facilities use sludge drying equipment following dewatering to further reduce the volume and weight of the sludge. The solids content of the sludge dewatered on a filter press usually ranges from 20 to 40 percent. Drying equipment can produce a waste material with a solids content of approximately 90 percent.

There are several design variations for sludge drying equipment. A commonly used system consists of an auger or conveyor system to move a thin layer of sludge through a drying region and discharge it into a hopper. Various heat sources including electric, electric infrared, steam, and gas are used for sludge drying. Some continuous units are designed such that the sludge cake discharged from a filter press drops into the feed hopper of the unit, making the overall dewatering process more automated. System capacities range from less than 1 ft<sup>3</sup>/hr to more than 20 ft<sup>3</sup>/hr of feed. Sludge drying equipment requires an air exhaust system due to the fumes generated during drying.

#### 8.6 References

1. Freeman, H.M. Hazardous Waste Minimization. McGraw-Hill Publishing Co., 1990, p. 39.
2. U.S. Environmental Protection Agency. Development Document for Effluent Limitations Guidelines and Standards for the Nonferrous Metals Forming and Metal Powders Point Source Category. EPA 440-1-86-019, September 1996.
3. Cushnie, George C. Pollution Prevention and Control Technology for Plating Operations. National Center for Manufacturing Sciences, 1994.
4. Brown, T. and LeMay, H. Chemistry - The Central Science, 2<sup>nd</sup> Edition. Prentice-Hall, Inc., 1981, p. 360.
5. AFCEC-TR-76-13, Final Report: Ozone Oxidation of Metal Plating Cyanide Wastewater. September 1976.
6. Garrison, R.L. and Monk, C.E. "Advanced Ozone-Oxidation for Complexed Cyanides." Proceedings of the First International Symposium on Ozone for Water and Wastewater Treatment, 1973, p. 551.
7. Electric Power Research Institute. Trace Element Removal by Iron Adsorption/Coprecipitator: Process Design Manual. EPRI GS-7005, October 1990.



8. Benefield, L. and Judkins, J. Process Chemistry for Water and Wastewater Treatment. Prentice-Hall, Inc., 1982, p. 110.
9. Metcalf & Eddy, Inc. Wastewater Engineering: Treatment Disposal and Reuse. McGraw-Hill Book Company, 1979, p. 187.
10. Freeman, H.M. Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill Publishing Co., 1989.
11. Cherry, K.F. Plating Waste Treatment. Ann Arbor Science, 1982.
12. Evans, F.L. Ozone in Water and Wastewater Treatment. Ann Arbor Science, 1975.
13. Harms, L.L. Chemicals in the Water Treatment Process. Water/Engineering and Management, March 1987, pg 32.
14. Eckenfelder, W.W. Principles of Water Quality Management. CBI Publishing Co., 1980.
15. Texas Natural Resource Conservation Commission. Pollution Prevention for Cleaning and Degreasing Operations. [www.eponline.com](http://www.eponline.com).
16. Ogunbameru, G. Reducing Water Used for Printed Circuit Board Manufacturing. Water and Wastewater Products, January 2003. [www.wwp-online.com](http://www.wwp-online.com).
17. U.S. EPA, Guidance Document for Developing Best Management Practices (BMP),” EPA 833-B-93-004, 1993.
18. NDMA Source Control. Source Control Division, Orange County Sanitation District, California. March 27, 2002. [www.ocsd.com](http://www.ocsd.com).

## 9.0 TECHNOLOGY OPTIONS

This section presents the technology options evaluated by EPA as the basis for the final MP&M effluent limitations guidelines and standards. It also describes EPA's rationale for selecting the technology options for the final rule. EPA used the options presented in this section as the basis for evaluating Best Practicable Control Technology Currently Available (BPT), Best Conventional Pollutant Control Technology (BCT), Best Available Technology Economically Achievable (BAT), New Source Performance Standards (NSPS), Pretreatment Standards for Existing Sources (PSES), and Pretreatment Standards for New Sources (PSNS).

EPA is promulgating performance-based limitations and standards for the Oily Wastes Subcategory to control direct discharges. These limitation and standards do not require the use of any particular pollution prevention or wastewater treatment technology. Rather, a facility may use any combination of pollution prevention and wastewater treatment technology to comply with the limitations. Direct dischargers must also comply with NPDES regulations (40 CFR 122).

Section 9.1 summarizes the methodology EPA used to select the technologies included in the options. Sections 9.2 through 9.9 describe the technology options evaluated for the final effluent limitations guidelines and standards for each subcategory for each of the regulatory levels of control. Section 9.10 summarizes the options for each subcategory considered and selected in developing the effluent limitations and standards, and Figures 9-1 through 9-6 (at the end of this section) present schematic diagrams of the options.

### 9.1 Technology Evaluation Methods

Facilities performing proposed MP&M operations generate wastewater containing oils, organic pollutants, cyanide, hexavalent chromium, complexed metals, and dissolved metals.<sup>1</sup> The technology options considered for the final rule consist of pollution prevention and wastewater treatment technologies designed to reduce or eliminate the generation or discharge of pollutants from facilities performing proposed MP&M operations. EPA identified these technologies from responses to the MP&M detailed and screener surveys, MP&M site visits and sampling episodes, and technical literature. EPA then grouped the most common technologies according to the type of wastewater treated (e.g., oily wastewater, metal-bearing wastewater, cyanide-bearing wastewater), and also by source reduction and pollution prevention technologies, recycling technologies, and end-of-pipe treatment technologies. Tables 8-1 through 8-3 in Section 8.0 show the in-process and end-of-pipe treatment used by industry as reported in industry surveys.

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<sup>1</sup>Note: EPA evaluated a number of unit operations for the May 1995 proposal, January 2001 proposal, and June 2002 NODA (see Tables 4-3 and 4-4). However, EPA selected a subset of these unit operations for regulation in the final rule (see Section 1.0). For this section, the term "proposed MP&M operations" means those operations evaluated for the two proposals, NODA, and final rule. The term "final MP&M operations" means those operations defined as "oily operations" (see Section 1.0, 40 CFR 438.2(f), and Appendix B to Part 438) and regulated by the final rule.

EPA considered a technology to be demonstrated in the industry if the technology effectively treated wastewater from proposed MP&M operations and if EPA observed the technology during at least one MP&M site visit or at least one survey respondent reported using the technology. EPA evaluated the performance of each technology in terms of percent removal and final effluent concentration using analytical data available from MP&M sampling episodes, discharge monitoring reports and periodic compliance reports, previous effluent guidelines data collection efforts, and quantitative and qualitative assessments from engineering site visits, comment submittals, and literature.

EPA evaluated several technology options for direct dischargers in the subcategories listed in the January 2001 proposal (i.e., General Metals, Metal Finishing Job Shops, Printed Wiring Board, Non-Chromium Anodizing, Steel Forming and Finishing, Oily Wastes, Railroad Line Maintenance, and Shipbuilding Dry Dock).

## **9.2 General Metals Subcategory**

EPA is not revising or establishing any limitations or standards for facilities that would have been subject to this subcategory. Such facilities will continue to be regulated by the General Pretreatment Standards (Part 403), local limits, permit limits, and Parts 413 and/or 433, as applicable.

### **9.2.1 Best Practicable Control Technology Currently Available (BPT)**

The following discussion describes the technology options considered for the proposed General Metals Subcategory. Facilities in this proposed subcategory generate metal-bearing wastewater but may also generate some oily wastewater (see Section 6.0).

#### **Option 1**

Option 1 includes segregation and preliminary treatment of oily wastewater, cyanide-bearing wastewater, hexavalent chromium-bearing wastewater, and complexed metal-bearing wastewater, followed by chemical precipitation using either sodium hydroxide or lime, sedimentation using a clarifier, and sludge removal using gravity thickening and a filter press. Segregation of wastewater and subsequent preliminary treatment allows for the most efficient, effective, and economical means of removing pollutants in certain wastewater streams. These streams contain pollutants (e.g., oil and grease, cyanide, hexavalent chromium, chelated metals, and organic solvents) that can inhibit the performance of chemical precipitation and sedimentation treatment, while increasing the overall treatment costs. For example, if a facility segregates its oil-bearing wastewater from its metal-bearing wastewater, then the facility can design an oil removal treatment technology based on only the oily waste flow volume and not on the combined metal-bearing and oil-bearing wastewater flow, decreasing the size of the overall treatment system. Treatment chemical costs are also reduced because of the reduced volume. Preliminary treatment technologies for these types of wastewater streams are described below.

(see Section 5.0 and Appendix C for a more detailed description of each of these wastewater streams).

- **Oil-Bearing Wastewater.** Alkaline cleaning wastewater and water-based metal-working fluids (e.g., machining and grinding coolants) typically contain significant amounts of oil and grease. These wastewater streams require preliminary treatment to remove oil and grease and organic pollutants. Option 1 includes a preliminary treatment step for these wastewaters consisting of chemical emulsion breaking followed by gravity separation of oil and water (oil/water separator or gravity flotation).
- **Cyanide-Bearing Wastewater.** The industry generates several types of wastewater that may contain significant amounts of cyanide, such as electroplating and cleaning wastewater. Option 1 includes a preliminary treatment step for these wastewaters consisting of alkaline chlorination with sodium hypochlorite.
- **Hexavalent Chromium-Bearing Wastewater.** The industry generates several types of wastewater that contain hexavalent chromium, usually from acid treatment, anodizing, conversion coating, and electroplating. Because hexavalent chromium does not form an insoluble hydroxide, this wastewater requires chemical reduction of the hexavalent chromium to trivalent chromium prior to chemical precipitation and sedimentation. Trivalent chromium forms an insoluble hydroxide and is treated by chemical precipitation and sedimentation. Option 1 includes a preliminary treatment step for these wastewaters consisting of chromium reduction using sodium metabisulfite.
- **Chelated Metal-Bearing Wastewater.** Electroless plating and some cleaning operations generate wastewater that contains significant amounts of chelated metals. This wastewater requires chemical reduction to break the metal-chelate bond or reduce the metal-chelate complex to an insoluble state so that it can be removed during chemical precipitation. Option 1 includes a preliminary treatment step for these wastewaters consisting of chemical reduction using sodium borohydride, dithiocarbamate, hydrazine, or sodium hydrosulfite.
- **Organic Solvent-Bearing Wastewater.** Option 1 also includes contract hauling of solvent degreasing wastewater, where applicable. Based on the MP&M surveys and site visits, most solvent degreasing operations that use organic solvents (e.g., 1,1,1-trichloroethane, trichloroethene) are contract hauled for off-site recycling. Some facilities performing proposed MP&M operations reported using organic solvent/water mixtures or rinses

following organic solvent degreasing. EPA found contract hauling of this wastewater to be the most common disposal method for these sites.

After pretreatment of the applicable segregated streams, the Option 1 technology basis is chemical precipitation and gravity clarification. Chemical precipitation adjusts the pH of the wastewater with alkaline chemicals such as lime (calcium hydroxide) or caustic (sodium hydroxide) or acidic chemicals (such as sulfuric acid) to produce insoluble metal hydroxides. This step is followed by a gravity settling process in a clarifier to remove the precipitated and flocculated metal hydroxides. Sludge is then thickened in a gravity-thickening unit. The sludge is then sent to a filter press used to remove excess wastewater, which is generally recycled back to the clarifier.

The technology components that many facilities performing proposed MP&M operations currently use are equivalent to those described for Option 1. Differences in the level of performance (i.e., effluent limitations) between current discharges and Option 1 derive from improvements in operation and control of process operations and pollutant control technology. EPA's technical database developed for this rule, including industry survey, site visit, and sampling information collected during the period from 1989 through 2001, demonstrate significant progress by the industry in reducing pollutants in wastewater discharges beyond the existing regulatory standards. For example, sites are moving toward greater implementation of pollution prevention and water reduction, including progression to zero discharge when possible. In addition, improvements in treatment controls allow for more automated controls, which leads to more consistent process operation and wastewater treatment. Finally, advances in wastewater treatment chemicals also result in higher treatment efficiencies.

### **Option 2**

Option 2 builds on Option 1 by adding the following in-process pollution prevention, recycling, and water conservation methods that allow for recovery and reuse of materials:

- Two-stage countercurrent cascade rinsing for all flowing rinses;
- Centrifugation and recycling of painting water curtains; and
- Centrifugation, pasteurization, and recycling of water-soluble machining coolants.

### **Option 2S**

Option 2S includes the technologies that compose Option 2 plus a sand filter after the clarifier to further remove residual suspended solids from chemical precipitation and clarification effluent.

### **Option 3**

In Option 3, an ultrafilter replaces the Option 1 chemical emulsion breaking and oil/water separator to remove oil and grease, and a microfilter replaces the Option 1 clarifier.

### **Option 4**

Option 4 includes the technologies in Option 3 plus the in-process flow control and pollution prevention technologies described in Option 2, allowing recovery and reuse of materials along with water conservation.

### **Best Professional Judgment (BPJ) to Part 433 Option**

EPA also considered transferring limitations from existing Metal Finishing effluent guidelines (40 CFR 433) to the General Metals Subcategory. The technology basis for Part 433 includes the following: (1) segregation of wastewater streams; (2) preliminary treatment steps as necessary (including oils removal using chemical emulsion breaking and oil/water separation, alkaline chlorination for cyanide destruction, reduction of hexavalent chromium, and chelation breaking); (3) chemical precipitation using sodium hydroxide; (4) sedimentation using a clarifier; and (5) sludge removal (i.e., gravity thickening and filter press).

### **Option Selection Discussion**

As discussed in the 2001 proposal (see 66 FR 451), EPA dropped Options 1 and 3 from further consideration because Options 2 and 4, respectively, cost less and provided greater pollutant removals. After proposal, EPA also dropped Option 4 from further consideration for the final rule because of its increased cost and lack of significant additional pollutant removals beyond Option 2. In addition, comments submitted on the proposed rule questioned the completeness of EPA's database on microfiltration (Option 4), noting that EPA transferred limitations for several pollutants from the Option 2 technology based on lack of data.

EPA dropped Option 2S from further consideration for the final rule for the reasons outlined in the 2002 Notice of Data Availability (NODA) (67 FR 38767). First, Option 2S results in greatly increased cost and minimal increased pollutant removals beyond Option 2. Second, EPA believes, after incorporating additional treatment performance data and revising the statistical methodology used for calculating numerical limitations (see Section 10.0), the Option 2 limitations are consistently achievable without adding a sand filter. Therefore, for the final rule, EPA considered Option 2 and "BPJ to Part 433 Option" as the basis for limitations for BPT for the General Metals Subcategory. See Sections 11.0 and 12.0 for the final estimated compliance costs and pollutant removals for Option 2.

EPA proposed to establish BPT limitations for existing direct dischargers in the General Metals Subcategory based on the Option 2 technology. EPA evaluated the cost of achieving effluent reductions, pollutant reductions, and the economic achievability of compliance

with BPT limitations based on the Option 2 technology and the level of the pollutant reductions resulting from compliance with such limitations. EPA has decided not to establish BPT limitations for existing direct dischargers in the proposed General Metals Subcategory. The 2001 proposal also contains detailed discussions on why EPA rejected BPT limitations based on other BPT technology options (see 66 FR 452). The information in the rulemaking record for the final rule provides no basis for EPA to change this conclusion.

Those facilities potentially regulated in the General Metals Subcategory include facilities that are currently subject to effluent limitations guideline regulation under 40 CFR 433 as well as facilities not currently subject to national regulation. Approximately 263 of the 266 existing General Metals direct dischargers (estimated from survey weights for 31 surveyed facilities) are currently covered by the Metal Finishing effluent guidelines at Part 433. The remaining three facilities (estimated from a survey weight for one surveyed facility) are currently directly discharging metal-bearing wastewaters (e.g., salt bath descaling) but are not covered by existing Metal Finishing effluent guidelines. EPA's review of discharge monitoring data and unit operations for this surveyed non-433 General Metals facility (with a survey weight of approximately three) indicates that this facility is already achieving Part 433 limitations because this facility has discharges that closely mirror those required by Part 433.

The facilities that are currently subject to Part 433 regulations and those facilities achieving Part 433 discharge levels, in most cases, have already installed effective pollution control technology that includes many of the components of the Option 2 technology. Approximately 30 percent of the direct discharging facilities in the General Metals Subcategory currently use chemical precipitation followed by a clarifier. Further, EPA estimates that compliance with BPT limitations based on the Option 2 technology would result in no closures of the existing direct dischargers in the General Metals Subcategory. EPA also notes that the adoption of this level of control would also reduce the pollutants discharged into the environment by facilities in this subcategory. For facilities in the General Metals Subcategory at Option 2, EPA estimates an annual compliance cost of \$23.7 million (2001\$). Using the method described in Section 12.0 to estimate baseline pollutant loadings, EPA estimates Option 2 pollutant removals of 417,477 pounds of conventional pollutants and 33,716 pounds of priority metal and organic pollutants from current discharges into the Nation's waters.

Evaluated under its traditional yardstick, EPA calculated that the effluent reductions are achieved at a cost of \$18.1/pound-pollutant removed (2001\$) for the General Metals Subcategory at Option 2. To estimate all pounds of pollutant removed by Option 2 technology for direct dischargers in the General Metals Subcategory, EPA used the revised method described in Section 12.0 to estimate baseline pollutant loadings as the sum of chemical oxygen demand (COD) pounds removed plus the sum of all metals pounds removed. EPA used the combination of COD pounds removed plus the sum of all metals pounds removed to avoid any significant double counting of pollutants.

As previously stated, EPA received many comments on its estimation of baseline pollutant loadings and reductions for the various options presented in the January 2001 proposal.

In response to these comments, EPA solicited comment in the June 2002 NODA on alternative methods to estimate baseline pollutant loadings. Commentors on the NODA were generally supportive of EPA's alternative methods to estimate baseline pollutant loadings. In particular, commentors noted that more accurate estimates of baseline pollutant loadings could be achieved by using DMR data. In response to these NODA comments, EPA combined the alternative methods in the NODA into the EPA Costs & Loadings Model for the final rule (see Sections 11.0 and 12.0).

EPA also received comment on the parameter or parameters it should use for estimating total pounds removed by the selected technology option. EPA selected the sum of COD and all metals pounds removed for the final rule to compare effluent reductions and compliance costs. This approach avoided any significant double counting of pollutants and also provided a reasonable estimate of total pounds removed by Option 2 for the General Metals Subcategory. Option 2 technology segregates wastewaters into at least five different waste streams, each of which have one or two treatment steps. For example, segregated oily wastewaters have two treatment steps under Option 2 technology as they are first treated by chemical emulsion breaking-oil/water separation and then by chemical precipitation and sedimentation. These segregated wastestreams can be loosely grouped together as either oily wastewaters or metal-bearing wastewaters. EPA's use of COD pounds removed for Option 2 technology generally represents the removal of pollutants from the segregated oily wastewaters. EPA's use of total metals pounds removed for Option 2 technology generally represents the removal of pollutants from the segregated metal-bearing wastewaters.

EPA also considered alternative parameters for calculating total pounds removed by Option 2 for the comparison of effluent reductions and compliance costs for the General Metals Subcategory. In particular, EPA calculated a ratio of less than \$14/pound-pollutant removed (2001\$) for the General Metals Subcategory at Option 2 when EPA used the highest set of pollutants removed per facility with no significant double counting of pollutants (i.e., highest per facility pollutant removals of: (1) COD plus total metals; (2) oil and grease (as HEM) plus total metals; or (3) oil and grease (as HEM) plus total suspended solids (TSS)). EPA used the highest per facility pollutant removals as a confirmation of its primary method for calculating baseline pollutant loadings (see Section 12.0) and Option 2 for General Metals Subcategory.

Based on the revisions and corrections to the EPA Costs & Loadings Model discussed in the June 2002 NODA and in Sections 11.0 and 12.0, EPA has decided not to adopt BPT limitations based on Option 2 technology. A number of factors supports EPA's conclusion that BPT limitations based on Option 2 technology do not represent effluent reduction levels attainable by the best practicable technology currently available. As previously noted, a substantial number of facilities that would be subject to limitations as General Metals facilities are already regulated by BPT/BAT Part 433 limitations and other facilities are *de facto* Part 433 facilities if characterized by their discharges. Thus, establishing BPT limitations for a new General Metals Subcategory would effectively revise existing BPT/BAT limitations with respect to those facilities. In this case, EPA felt that since the Agency is revising BPT/BAT limitations for a significant portion of an industry, it should further review the effluent reductions achieved,



and corresponding costs, for Option 2 technology. Such an examination shows that, while the Option 2 technology would remove additional pollutants at costs in the middle of the range EPA has traditionally determined are reasonable, the costs of the additional removals of toxic pollutants are substantially greater. In developing the final rule, EPA determined that, where a substantial portion of a subcategory is already subject to effluent limitations guidelines that achieve significant removal, the Agency should not promulgate the proposed BPT limitations because the limitations would achieve additional toxic removals at a cost (\$1,000/pound equivalent (PE) in 1981\$) substantially greater than that EPA has typically imposed for BAT technology in other industries (generally less than \$200/PE in 1981\$).

EPA also considered transferring limitations from existing Metal Finishing effluent guidelines (40 CFR 433) to the General Metals Subcategory. The technology basis for Part 433 includes the following: (1) segregation of wastewater streams; (2) preliminary treatment steps as necessary (including oils removal using chemical emulsion breaking and oil/water separation, alkaline chlorination for cyanide destruction, reduction of hexavalent chromium, and chelation breaking); (3) chemical precipitation using sodium hydroxide; (4) sedimentation using a clarifier; and (5) sludge removal (i.e., gravity thickening and filter press).

Approximately 99 percent of the existing direct dischargers in the General Metals Subcategory are currently covered by the existing Metal Finishing effluent guidelines. The remaining 1 percent (an estimated three facilities nationwide based on the survey weight associated with one surveyed facility) are currently permitted to discharge metal-bearing wastewaters but are not covered by the existing Metal Finishing effluent guidelines. EPA's review of discharge monitoring data and unit operations for this surveyed non-433 General Metals facility (with a survey weight of approximately three) indicates that this facility is subject to permit limitations established on a BPJ basis that are equivalent or more stringent than Part 433 limitations. Transferring limitations from existing Metal Finishing effluent guidelines would likely result in no additional pollutant load reductions. Therefore, based on the lack of additional pollutant removals that are estimated, EPA is not promulgating BPT limitations transferred from existing Metal Finishing effluent limitations guidelines for the General Metals Subcategory.

EPA is not revising or establishing BPT limitations for any facilities in this subcategory. Direct dischargers in the General Metals Subcategory will remain regulated by permit limits and Part 433, as applicable.

## **9.2.2 Best Conventional Pollutant Control Technology (BCT)**

In deciding whether to adopt more stringent limitations for BCT than BPT, EPA considers whether there are technologies that achieve greater removals of conventional pollutants than those adopted for BPT, and whether those technologies are cost-reasonable under the standards established by the CWA. EPA generally refers to the decision criteria as the "BCT cost test." For a more detailed description of the BCT cost test and details of EPA's analysis, see Chapter 4 of the Economic, Environmental, and Benefits Analysis of the Final Metal Products & Machinery Rule (EEBA) (EPA-821-B-03-002).

As EPA is not establishing any BPT limitations for the General Metals Subcategory, EPA did not evaluate any technologies for the final rule that can achieve greater removals of conventional pollutants. Consequently, EPA is not establishing BCT limitations for the General Metals Subcategory.

### **9.2.3 Best Available Technology Economically Achievable (BAT)**

EPA proposed to establish BAT limitations for existing direct dischargers in the General Metals Subcategory based on the Option 2 technology. As discussed in Section 9.2.1, EPA has decided not to establish BPT limitations based on Option 2 technology. For the same reasons, EPA is not establishing BAT limitations based on the same technology. EPA evaluated the cost of effluent reductions, pollutant reductions, and the economic achievability of compliance with BAT limitations based on the Option 2 technology.

Based on the revisions and corrections to the EPA Costs & Loadings Model discussed in the NODA, preamble to the final rule, and in Sections 11.0 and 12.0, EPA determined that the costs of Option 2 are disproportionate to the toxic pollutant reductions (measured in PE). The cost of achieving the effluent reduction (in 1981\$) for Option 2 for direct dischargers in the General Metals Subcategory is over \$1,000/PE removed (see the EEBA and Section 26.0 of the rulemaking record, DCN 37900, for a discussion of the cost-effectiveness analysis). The costs associated with this technology are, as previously noted, substantially greater than the level EPA has traditionally determined are associated with available toxic pollutant control technology. EPA has determined that Option 2 technology is not the best available technology economically achievable for existing direct dischargers in the General Metals Subcategory. Therefore, EPA is not revising or establishing BAT limitations for this subcategory based Option 2 technology.

EPA also considered transferring BAT limitations from existing Metal Finishing effluent guidelines (40 CFR 433.14) to the General Metals Subcategory (see “BPJ to Part 433 Option” in Section 9.2.1). EPA reviewed existing General Metals facilities and found that all are currently achieving Part 433 BAT limitations. Transferring BAT limitations from existing Metal Finishing effluent guidelines would likely result in no additional pollutant load reductions and minimal incremental compliance costs (see Section 9.2.1). Therefore, based on the lack of additional pollutant removals that are estimated, EPA is not promulgating BAT limitations transferred from existing Metal Finishing effluent limitations guidelines for the General Metals Subcategory.

EPA is not revising or establishing BAT limitations for any facilities in this subcategory. Direct dischargers in the General Metals Subcategory will remain regulated by permit limits and Part 433, as applicable.

#### **9.2.4 New Source Performance Standards (NSPS)**

EPA proposed NSPS for the General Metals Subcategory based on Option 4 technology (see Section 9.2.1). Option 4 technology is similar to Option 2 (including Option 2 flow control and pollution prevention) but includes oils removal using ultrafiltration and solids separation by a microfilter (instead of a clarifier). Commentors stated that EPA had under-costed the Option 4 technology and that the compliance costs would be a barrier to entry for new facilities. In addition, commentors questioned the completeness of EPA's database on microfiltration, noting that EPA transferred standards for several pollutants from the Option 2 technology, based on lack of data. EPA reviewed its database for the Option 4 technology and agrees that its microfiltration database is insufficient to support a determination that the Option 4 limitations are technically achievable.

EPA also evaluated setting General Metals NSPS based on the Option 2 technology and assessed the financial burden to new General Metals direct dischargers. Specifically, EPA's 'barrier-to-entry' analysis identified whether General Metals NSPS based on the Option 2 technology would pose sufficient financial burden as to constitute a material barrier to entry of new General Metals establishments into the MP&M Point Source Category. Additionally, EPA reviewed its database for establishing General Metals NSPS based on the Option 2 technology as commentors indicated the proposed standards were not technically achievable.

In response to these comments, EPA reviewed all the information currently available on General Metals facilities employing Option 2 technology. This review demonstrated that process wastewaters at General Metals facilities contain a wide variety of metals in significant concentrations. Commentors stated that single-stage precipitation and solids separation steps may not achieve sufficient removals for wastewaters that contain significant concentrations of a wide variety of metals - especially if the metals preferentially precipitate at disparate pH ranges. Consequently, to address concerns raised by commentors, EPA also costed new sources to operate two separate chemical precipitation and solids separation steps in series. Two-stage chemical precipitation and solids separation allows General Metals facilities with multiple metals to control metal discharges to concentrations lower than single-stage chemical precipitation and solids separation over a wider pH range.

Applying this revised costing approach, EPA projects a barrier to entry for General Metals NSPS based on the Option 2 technology because 14 percent of General Metals direct dischargers have after-tax compliance costs between 1 to 3 percent of revenue, 22 percent have after-tax compliance costs between 3 to 5 percent of revenue, and 2 percent have after-tax compliance costs greater than 5 percent of revenue. Consequently, based on the compliance costs of the modified Option 2 technology, EPA rejected Option 2 technology as the basis for NSPS in the General Metals Subcategory. See Section 11.0 for a description of how these new source compliance costs were developed and Chapter 9 of the EEBA for a description of the framework EPA used for the barrier-to-entry analysis and general discussion of the results.

EPA also considered transferring NSPS from existing Metal Finishing effluent guidelines (40 CFR 433.16) to the General Metals Subcategory. EPA reviewed existing General Metals direct dischargers and found that all are currently either covered by or have permits based on the Metal Finishing limitations at 40 CFR 433. EPA has no basis to conclude that new General Metals facilities would have less stringent requirements than existing facilities, particularly since, in the absence of promulgated NSPS, it is likely that permit writers would consult the Part 433 requirements to establish BPJ limits. In addition, those new facilities which meet the applicability criteria for Part 433 will be subject to the NSPS for that category. Therefore, transferring standards from these existing Metal Finishing effluent limitations guidelines would likely result in no additional pollutant load reductions.

Therefore, based on the lack of additional pollutant removals that are estimated, EPA is not promulgating NSPS for the General Metals Subcategory. EPA is not revising or establishing NSPS for any facilities in this subcategory. Direct dischargers in the General Metals Subcategory will remain regulated by permit limits and Part 433, as applicable.

### **9.2.5 Pretreatment Standards for Existing Sources (PSES)**

As discussed in the June 2002 NODA (67 FR 38798), EPA also considered a number of alternative options whose economic impacts would be less costly than Option 2 technology. These options potentially have compliance costs more closely aligned with toxic pollutant reductions. EPA considered the following alternative options for the final rule:

- Option A: No change in current regulation.
- Option B: Option 2 with a higher low-flow exclusion.
- Option C: Upgrading facilities currently covered by Part 413 to meet the PSES of Part 433 (“413 to 433 Upgrade Option” described below).
- Option D: Upgrading all facilities covered by Part 413 and those facilities covered by “local limits only” that discharge greater than a specified wastewater flow (e.g., 1, 3, or 6.25 million gallons per year (MGY)) of process wastewater to meet the PSES of Part 433 (“Local Limits to 433 Upgrade Option” described below). Note that facilities regulated by “local limits only” are also regulated by the General Pretreatment Standards (40 CFR 403).

#### **413 to 433 Upgrade Option**

The 413 to 433 Upgrade Option would require those facilities currently required to meet the standards of the Electroplating effluent limitations guidelines (40 CFR 413) to meet the limitations and standards of the Metal Finishing effluent guidelines (40 CFR 433). Currently, the only facilities that are still completely covered by the Electroplating effluent guidelines are

indirect dischargers that were in existence prior to 1982 and have not significantly upgraded their operations. Therefore, this alternative option applies to only a subset of indirect dischargers within the proposed General Metals, Metal Finishing Job Shops, Printed Wiring Board, and Non-Chromium Anodizing Subcategories.

The technology components that compose the basis for the 413 to 433 Upgrade Option are equivalent to those described for Option 1. Differences in the level of performance (i.e., effluent limitations) between the 413 to 433 Upgrade Option and Option 1 derive from improvements in operation and control of process operations and pollutant control technology since the early 1980s when the Electroplating effluent guidelines were developed.

### **Local Limits to 433 Upgrade Option**

This option would upgrade all facilities covered by Part 413 and those facilities covered by “local limits only” that discharge greater than a specified wastewater flow (e.g., 1, 3, or 6.25 million gallons per year) of process wastewater to meet the PSES of Part 433. Accordingly, this technology option applies to only a subset of indirect dischargers within the proposed General Metals Subcategory. A separate but similar alternative option (see Section 9.2.1) applies to direct dischargers.

The technology components that compose the basis for the Local Limits to 433 Upgrade Option are equivalent to those described for Option 1. Differences in treatment performance (i.e., effluent limitations) between the Local Limits to 433 Upgrade Option and Option 1 derive from improvements in operation and control of pollutant control technology implemented since the early 1980s when the Electroplating effluent guidelines were developed.

### **Option Selection Discussion**

EPA proposed to establish PSES for existing indirect dischargers in the General Metals Subcategory based on the Option 2 technology (i.e., the same technology basis that EPA considered for BPT/BCT/BAT for this subcategory) with a “low-flow” exclusion of 1 MGY to reduce economic impacts on small businesses and administrative burden for control authorities. Based on the revisions and corrections to the EPA Costs & Loadings Model discussed in the NODA, preamble to the final rule, and in Sections 11.0 and 12.0, EPA rejected promulgating PSES for existing indirect dischargers in the General Metals Subcategory based on the Option 2 technology for the following reasons: (1) many General Metals indirect dischargers are currently regulated by existing effluent guidelines (Parts 413 or 433 or both, as applicable); (2) EPA estimates that compliance with PSES based on the Option 2 technology will result in the closure of approximately 4 percent of the existing indirect dischargers in this subcategory; and (3) EPA determined that the incremental toxic pollutant reductions are very expensive per pound removed (the cost-effectiveness value (in 1981\$) for Option 2 for indirect dischargers in the General Metals Subcategory is \$432/PE).

This suggests to EPA that the identified technology is not truly “available” to this industry because it would remove a relatively small number of additional toxic pounds at a cost significantly greater than that EPA has typically determined is appropriate for other industries. Therefore, EPA has determined that Option 2 technology is not the best available technology economically achievable for existing indirect dischargers in the General Metals Subcategory, and is not establishing PSES for this subcategory based on the Option 2 technology.

Based on the revisions and corrections to the EPA Costs & Loadings Model discussed in the NODA, preamble to the final rule, and in Sections 11.0 and 12.0, EPA has revised its methodology for estimating compliance costs and pollutant loadings for Option 2, higher low-flow exclusions (Option B), and the “upgrade” options (Options C and D) previously described. Using information from this revised analysis, EPA concludes that all of these alternative options (Options B, C, and D) are either not available or not economically achievable. EPA rejected Options B, C, and D because: (1) more than 10 percent of existing indirect dischargers not covered by Part 433 close at the upgrade option; or (2) toxic removals of the upgrade options are quite expensive (cost-effectiveness values (in 1981\$) in excess of \$420/PE), suggesting that these options are not truly available technologies for this industry segment.

EPA consequently determined that none of the treatment options represented best available technology economically achievable. Therefore, EPA is not revising or establishing PSES for existing indirect dischargers in the General Metals Subcategory (Option A). Wastewater discharges to POTWs from facilities in this subcategory will remain regulated by local limits, General Pretreatment Standards (Part 403), and Parts 413 and/or 433, as applicable. EPA also notes that facilities regulated by Parts 413 and/or 433 PSES must comply with Part 433 PSNS if the changes to their facilities are determined to make them new sources.

## **9.2.6 Pretreatment Standards for New Sources (PSNS)**

In 2001, EPA proposed pretreatment standards for new sources based on the Option 4 technology basis. Option 4 technology is similar to Option 2 (including Option 2 flow control and pollution prevention) but includes oils removal using ultrafiltration and solids separation by a microfilter (instead of a clarifier). As explained in Section 9.2.4, EPA concluded that its database is insufficient to support a determination that the Option 4 standards are technically achievable. As a result, for the final rule, EPA considered establishing PSNS in the General Metals Subcategory based on the Option 2 technology (i.e., the same technology basis that was considered for BPT/BCT/BAT for this subcategory) along with the same “low-flow” exemption of 1 MGY considered for existing sources.

For the final rule, EPA evaluated setting General Metals PSNS based on the Option 2 technology and assessed the financial burden to new General Metals indirect dischargers. Specifically, EPA's ‘barrier-to-entry’ analysis identified whether General Metals PSNS based on the Option 2 technology would pose sufficient financial burden on new General Metals facilities to constitute a material barrier to entry into the MP&M Point Source Category.

EPA projects a barrier to entry for General Metals PSNS based on the Option 2 technology because 14 percent of General Metals indirect dischargers have after-tax compliance costs between 1 to 3 percent of revenue and 20 percent have after-tax compliance costs between 3 to 5 percent of revenue. Consequently, EPA rejected Option 2 technology as the basis for PSNS in the General Metals Subcategory. EPA has selected “no further regulation,” and is not revising PSNS for new General Metals indirect dischargers. Wastewater discharges to POTWs from facilities in this subcategory will remain regulated by local limits, General Pretreatment Standards (Part 403), and Part 433, as applicable. See Section 11.0 for a description of how these new source compliance costs were developed and Chapter 9 of the EEBA for a description of the framework EPA used for the barrier-to-entry analysis and general discussion of the results.

### **9.3 Metal Finishing Job Shops Subcategory**

EPA is not revising any limitations or standards for facilities that would have been subject to this subcategory. Such facilities will continue to be regulated by the General Pretreatment Standards (Part 403), local limits, permit limits, and Parts 413 and/or 433, as applicable.

#### **9.3.1 BPT, BCT, and BAT**

EPA evaluated several technology options for direct dischargers for the Metal Finishing Job Shops (MFJS) Subcategory. Facilities in this subcategory perform unit operations that primarily generate metal-bearing wastewater, but may also generate some oily wastewater. EPA evaluated Options 1, 2, 2S, 3, and 4, which are described in detail in Section 9.2.1. As discussed in Section 9.2.1, EPA dropped Options 1, 2S, 3, and 4 from further consideration. Therefore, for the final rule, EPA considered only Option 2 as the basis for limitations for the MFJS Subcategory. See Sections 11.0 and 12.0 for the final estimated compliance costs and pollutant loadings for Option 2.

EPA proposed to establish BPT/BCT/BAT for existing direct dischargers in the MFJS Subcategory based on the Option 2 technology (see Section 9.2.1 for a description of Option 2). EPA evaluated the cost of effluent reductions, pollutant reductions, and the economic achievability of compliance with BPT/BCT/BAT limitations based on the Option 2 technology. Based on the revisions and corrections to the EPA Costs & Loadings Model discussed in the NODA, preamble to the final rule, and in Sections 11.0 and 12.0, EPA determined that the compliance costs of the Option 2 technology are not economically achievable.

EPA estimates that compliance with BPT/BCT/BAT limitations based on the Option 2 technology will result in the closure of 50 percent of the existing direct dischargers in this subcategory (12 of 24 existing MFJS direct dischargers). Consequently, EPA concludes that, for existing direct dischargers in the MFJS Subcategory, Option 2 is not the best practicable control technology, best conventional pollutant control technology, or best available technology economically achievable. EPA has decided not to establish new BPT, BCT, or BAT limitations

for existing MFJS direct dischargers based on the Option 2 technology; these discharges will remain subject to Part 433.

### **9.3.2 NSPS**

EPA proposed to establish NSPS for new direct dischargers in the MFJS Subcategory based on the Option 4 technology. Option 4 technology is similar to Option 2 (including Option 2 flow control and pollution prevention) but includes oils removal using ultrafiltration and solids separation by a microfilter (instead of a clarifier). As explained in Section 9.2.4, EPA concluded that its database is insufficient to support a determination that the Option 4 standards are technically achievable. Consequently, EPA rejected Option 4 technology as the basis for NSPS in the MFJS Subcategory.

For the final rule, EPA evaluated setting MFJS NSPS based on the Option 2 technology and assessed the financial burden to new MFJS direct dischargers. Specifically, EPA's 'barrier-to-entry' analysis identified whether MFJS NSPS based on the Option 2 technology would pose sufficient financial burden so as to constitute a material barrier to entry into the MP&M point source category. Additionally, EPA reviewed its database for establishing MFJS NSPS based on the Option 2 technology as commentors indicated the proposed standards were not technically achievable.

In response to these comments, EPA reviewed all the information currently available on MFJS facilities using the Option 2 technology basis. This review demonstrated that process wastewaters at MFJS facilities contain a wide variety of metals in significant concentrations. Commentors stated that single-stage precipitation and solids separation may not achieve sufficient removals for wastewaters that contain significant concentrations of a wide variety of metals, especially if the metals preferentially precipitate at disparate pH ranges. Consequently, to address concerns raised by commentors, EPA also costed new sources to operate two separate chemical precipitation and solids separation steps in series. Two-stage chemical precipitation and solids separation allows MFJS facilities with multiple metals to control metal discharges to concentrations lower than single-stage chemical precipitation and solids separation over a wider pH range.

Applying this revised costing approach, EPA projects a barrier to entry for MFJS NSPS based on the Option 2 technology because all MFJS direct dischargers have new source compliance costs that are greater than 5 percent of revenue. Consequently, EPA rejected Option 2 technology as the basis for NSPS in the MFJS Subcategory, and is not revising NSPS for new MFJS direct dischargers. Wastewater discharges from these facilities in this subcategory will remain regulated by local limits and Part 433 NSPS as applicable. See Section 11.0 for a description of how these new source compliance costs were developed and Chapter 9 of the EEBA for a description of the framework EPA used for the barrier-to-entry analysis and general discussion of the results.



### 9.3.3 PSES

EPA evaluated several technology options for indirect dischargers for the MFJS Subcategory, whose unit operations primarily generate metal-bearing wastewater, but may also generate some oily wastewater. These include the same option as evaluated for BAT (i.e., Option 2), as well as several alternative options discussed below. EPA did not further evaluate Options 1, 2S, 3, and 4 for the final rule for the same reasons as explained for BPT above. See Sections 11.0 and 12.0 for the final estimated compliance costs and pollutant loadings for Option 2 and the alternative options considered for the final rule.

EPA proposed to establish PSES for existing indirect dischargers in the MFJS Subcategory based on the Option 2 technology. Based on the revisions and corrections to the EPA Costs & Loadings Model discussed in the NODA, preamble to the final rule, and Sections 11.0 and 12.0, EPA determined that the costs of Option 2 are not economically achievable for existing indirect dischargers in the MFJS Subcategory. EPA estimates that compliance with PSES based on the Option 2 technology will result in the closure of 46 percent of the existing indirect dischargers in this subcategory (589 of 1,270 existing MFJS indirect dischargers), which EPA considers to be too high. EPA has determined that Option 2 technology is not the best available technology economically achievable for existing indirect dischargers in the MFJS Subcategory. Therefore, EPA is not establishing PSES for this subcategory based on the Option 2 technology.

As discussed in the January 2001 proposal (66 FR 551) and June 2002 NODA (67 FR 38801), EPA also considered a number of alternative options whose economic impacts would be less costly than Option 2 technology. These options potentially have compliance costs more closely aligned with toxic pollutant reductions. EPA considered the following alternative options for the final rule:

- Option A: No change in current regulation;
- Option B: Option 2 with a higher low-flow exclusion;
- Option C: Upgrading facilities currently covered by Part 413 to meet the PSES of Part 433 (“413 to 433 Upgrade Option” described in Section 9.2.5); and
- Option D: Pollution prevention option (see 66 FR 551).

All facilities in the MFJS Subcategory are currently subject to Part 413, Part 433 or both.

As discussed in the NODA, preamble to the final rule, and Sections 11.0 and 12.0, based on comments, EPA has revised its methodology for estimating compliance costs and pollutant loadings for Option 2, low-flow exclusions (Option B), and the “upgrade” option (Option C) previously described. Using information from this revised analysis, EPA concludes

that neither of these alternative options (Options B or C) are economically achievable. EPA rejected Options B and C because more than 10 percent of existing indirect dischargers not covered by Part 433 close at the upgrade option.

EPA also solicited comment in the January 2001 proposal on a pollution prevention alternative for indirect dischargers in this subcategory (Option D). Commentors supported Option D and stated that the pollution prevention practices identified by EPA in the January 2001 proposal represent environmentally sound practices for the metal finishing industry. The commentors also stated that Option D should, however, be implemented on a voluntary basis similar to the National Metal Finishing Strategic Goals Program (see 66 FR 511). Control authorities also commented that Option D may increase their administrative burden because of additional review of facility operations and compliance with the approved pollution prevention plan, and enforcement of Option D may be more difficult than other options considered. EPA is not promulgating Option D for facilities in the MFJS Subcategory for the final rule due to the increased administrative burden on pretreatment control authorities and potential problems enforcing Option D. Section 8.0 describes many of the pollution prevention practices that were considered for Option D. These pollution prevention practices may be useful in helping facilities lower operating costs, improve environmental performance, and foster other important benefits.

EPA is not establishing PSES for existing indirect dischargers in the MFJS Subcategory. Wastewater discharges to POTWs from facilities in this subcategory will remain regulated by General Pretreatment Standards (Part 403), and Parts 413 and/or 433, as applicable. EPA also notes that facilities regulated by Parts 413 and/or 433 PSES must comply with Part 433 PSNS if the changes to their facilities are determined to make them new sources.

#### **9.3.4 PSNS**

EPA proposed to establish PSNS for indirect dischargers in the MFJS Subcategory based on the Option 4 technology. Option 4 technology is similar to Option 2 (including Option 2 flow control and pollution prevention) but includes oils removal using ultrafiltration and solids separation by a microfilter (instead of a clarifier). As explained in Section 9.2.4, EPA concluded its database is insufficient to support a determination that the Option 4 standards are technically achievable. Consequently, EPA rejected Option 4 technology as the basis for PSNS in the MFJS Subcategory.

For the final rule, EPA evaluated setting MFJS PSNS based on the Option 2 technology and assessed the financial burden to new MFJS indirect dischargers. Specifically, EPA's 'barrier-to-entry' analysis identified whether MFJS PSNS based on the Option 2 technology would pose sufficient financial burden on new MFJS facilities to constitute a material barrier to entry into the MP&M Point Source Category.

EPA projects a barrier to entry for MFJS PSNS based on the Option 2 technology because 8 percent of MFJS indirect dischargers have after-tax compliance costs between 1 to 3

percent of revenue, 5 percent have after-tax compliance costs between 3 to 5 percent of revenue, and 6 percent have after-tax compliance costs greater than 5 percent of revenue. Consequently, EPA rejected Option 2 technology as the basis for PSNS in the MFJS Subcategory, and is not revising PSNS for new MFJS indirect dischargers. Wastewater discharges to POTWs from facilities in this subcategory will remain regulated by local limits, General Pretreatment Standards (Part 403), and Part 433, as applicable. See Section 11.0 for a description of how these new source compliance costs were developed and Chapter 9 of the EEBA for a description of the framework EPA used for the barrier-to-entry analysis and general discussion of the results.

## **9.4 Non-Chromium Anodizing Subcategory**

EPA is not revising limitations or standards for any facilities that would have been subject to this subcategory. Such facilities will continue to be regulated by the General Pretreatment Standards (Part 403), local limits, permit limits, and Parts 413 and/or 433, as applicable.

### **9.4.1 BPT, BCT, and BAT**

As previously discussed, after publication of the June 2002 NODA, EPA conducted another review of all Non-Chromium Anodizing (NCA) facilities in the MP&M survey database to determine the destination of discharged wastewater (i.e., either directly to surface waters or indirectly to POTWs or both) and the applicability of the final rule to discharged wastewaters. As a result of this review, EPA did not identify any NCA direct discharging facilities or NCA facilities that do not discharge wastewater (i.e., zero discharge or contract haulers) or do not use process water (dry facilities) in its rulemaking record. All of the NCA facilities in EPA's database are indirect dischargers. Therefore, EPA cannot evaluate treatment systems at direct dischargers. As a result, EPA transferred cost and pollutant loading data from the best performing indirect facilities in order to evaluate direct discharging limitations in this subcategory.

EPA evaluated several technology options for direct dischargers for the NCA Subcategory, whose unit operations primarily generate metal-bearing wastewater, but may also generate some oily wastewater. These include Options 1, 2, 2S, 3, and 4, which are described in detail in Section 9.2.1. As discussed in Section 9.2.1, EPA dropped Options 1, 2S, 3, and 4 from further consideration. Therefore, for the final rule, EPA considered only Option 2 as the basis for limitations for the NCA Subcategory. See Sections 11.0 and 12.0 for the final estimated compliance costs and pollutant loadings for Option 2.

In 2001, EPA proposed to establish BPT/BCT/BAT limitations for direct dischargers in the NCA Subcategory based on the Option 2 technology. EPA evaluated the cost of effluent reductions, quantity of pollutant reductions, and the economic achievability of compliance with BPT/BCT/BAT limitations based on the Option 2 technology. Based on the revisions and corrections to the EPA Costs & Loadings Model discussed in the NODA, preamble to the final rule, and Sections 11.0 and 12.0, the costs of the Option 2 technology were

disproportionate to the projected toxic pollutants reductions (cost-effectiveness values (in 1981\$) in excess of \$1,925/PE).

EPA decided not to establish BPT/BAT limitations based on the Option 2 technology for the NCA Subcategory for following reasons: (1) EPA identified no NCA direct dischargers, and (2) the costs of Option 2 are disproportionate to the estimated toxic pollutant reductions (i.e., \$1,925/PE). EPA concludes that for existing direct dischargers in the NCA Subcategory, Option 2 is not the best practicable control technology, best conventional pollutant control technology, or best available technology economically achievable. EPA has decided not to establish new BPT, BCT, or BAT limitations for existing NCA direct dischargers based on the Option 2 technology. Although, EPA identified no NCA direct dischargers through its survey efforts, if such facilities do exist, they would be subject to Part 433.

#### **9.4.2 NSPS**

EPA proposed to establish NSPS for direct dischargers in the NCA Subcategory based on the Option 2 technology. For the final rule, EPA evaluated setting NCA NSPS based on the Option 2 technology and assessed the financial burden to new NCA direct dischargers. Specifically, EPA's 'barrier-to-entry' analysis identified whether NCA NSPS based on the Option 2 technology would pose sufficient financial burden on new NCA facilities to constitute a material barrier to entry into the MP&M Point Source Category.

EPA projects a barrier to entry for NCA NSPS based on the Option 2 technology because approximately 26 percent of NCA direct dischargers have new source compliance costs that are between 3 percent and 5 percent of revenue. Consequently, EPA rejected Option 2 technology as the basis for NSPS in the NCA Subcategory. EPA has selected "no further regulation" for new NCA direct dischargers and is not revising NSPS for new NCA direct dischargers, which will remain subject to Part 433. See Section 11.0 for a description of how these new source compliance costs were developed and Chapter 9 of the EEBA for a description of the framework EPA used for the barrier-to-entry analysis and general discussion of the results.

#### **9.4.3 PSES and PSNS**

EPA proposed "no further regulation" for existing and new indirect dischargers in the NCA Subcategory. EPA based this decision on the economic impacts to indirect dischargers associated with Option 2 and the small quantity of toxic pollutants discharged by facilities in this subcategory, even after a economically achievable flow cutoff is applied (see 66 FR 467). For the reasons set out in the 2001 proposal, EPA has decided not to establish new regulations and is not establishing PSES or PSNS in the NCA Subcategory. These facilities remain subject to Parts 413 or 433, or both, as applicable. EPA also notes that facilities regulated by Parts 413 and/or 433 PSES must comply with Part 433 PSNS if the changes to their facilities are determined to make them new sources.

## **9.5 Printed Wiring Board Subcategory**

EPA is not revising any limitations or standards for facilities that would have been subject to this subcategory. Such facilities will continue to be regulated by the General Pretreatment Standards (Part 403), local limits, permit limits, and Parts 413 and/or 433, as applicable.

### **9.5.1 BPT, BCT, and BAT**

EPA evaluated several technology options for direct dischargers for the Printed Wiring Board (PWB) Subcategory, whose unit operations primarily generate metal-bearing wastewater, but may also generate some oily wastewater. These include Options 1, 2, 2S, 3, and 4, which are described in detail in Section 9.2.1. As discussed in Section 9.2.1, EPA dropped Options 1, 2S, 3, and 4 from further consideration. Therefore, for the final rule, EPA considered only Option 2 as the basis for limitations for the PWB Subcategory. See Sections 11.0 and 12.0 for the final estimated compliance costs and pollutant loadings for Option 2.

EPA proposed to establish BPT/BCT/BAT for direct dischargers in the PWB Subcategory based on the Option 2 technology (see Section 9.2.1 for a description of Option 2). EPA evaluated the cost of effluent reductions, pollutant reductions, and the economic achievability of compliance with BPT/BCT/BAT limitations based on the Option 2 technology.

Based on MP&M survey information, EPA estimates that compliance with BPT/BCT/BAT limitations based on the Option 2 technology results in no closures of the existing eight direct dischargers in the PWB Subcategory. However, EPA decided not to establish BPT/BAT limitations based on the Option 2 technology for the PWB Subcategory for the following reasons: (1) EPA identified only eight existing PWB direct dischargers and all of these PWB direct dischargers are currently regulated by existing effluent guidelines (Part 433), and (2) the costs of Option 2 are disproportionate to the estimated toxic pollutant reductions. EPA estimates compliance costs of \$0.3 million (2001\$ dollars) with only 186 toxic pound-equivalents (PE) being removed. This equates to a cost-effectiveness value (in 1981\$) of approximately \$900/PE. EPA concludes that, for existing direct dischargers in the PWB Subcategory, Option 2 is not the best practicable control technology, best conventional pollutant control technology, or best available technology economically achievable. EPA has decided not to establish new BPT, BCT, or BAT limitations for existing PWB direct dischargers based on the Option 2 technology; these discharges will remain subject to Part 433.

### **9.5.2 NSPS**

EPA proposed to establish NSPS for new direct dischargers in the PWB Subcategory based on the Option 4 technology. Option 4 technology is similar to Option 2 (including Option 2 flow control and pollution prevention) but includes oils removal using ultrafiltration and solids separation by a microfilter (instead of a clarifier). As explained in Section 9.2.4, EPA concluded that its database is insufficient to support a determination that the

Option 4 standards are technically achievable. Consequently, EPA rejected Option 4 technology as the basis for NSPS in the PWB Subcategory.

For the final rule, EPA evaluated setting PWB NSPS based on the Option 2 technology. EPA reviewed its database for establishing PWB NSPS based on the Option 2 technology as commentors indicated the proposed standards were not technically achievable. In response to these comments, EPA reviewed all the information currently available on PWB facilities using the Option 2 technology basis. EPA now concludes that the PWB's Option 2 database can only be used to establish limitations for copper, nickel, and tin. In order to assess the difference between current NSPS requirements (from Part 433) for PWB facilities and those under consideration in the final rule, EPA estimated the incremental quantities of copper, nickel, and tin that would be reduced if a new PWB facility were required to meet NSPS based on the Option 2 technology rather than NSPS based on Part 433. EPA analysis shows minimal amounts of pollutant reductions based on more stringent requirements on copper, nickel, and tin.

Consequently, EPA rejected Option 2 technology as the basis for NSPS in the PWB Subcategory based on the small incremental quantity of toxic pollutants that would be reduced in relation to existing requirements. EPA is not establishing NSPS or revising existing NSPS for new PWB direct dischargers. Wastewater discharges from these facilities in this subcategory will remain regulated by permit limits and Part 433 as applicable. See Section 11.0 for a description of how these new source compliance costs were developed and Chapter 9 of the EEBA for a description of the framework EPA used for the barrier-to-entry analysis and general discussion of the results.

### **9.5.3 PSES**

EPA evaluated several technology options for indirect dischargers for the PWB Subcategory, whose unit operations primarily generate metal-bearing wastewater, but may also generate some oily wastewater. These include the same option as evaluated for BAT (i.e., Option 2 as described in Section 9.2.1), as well as several alternative options described below. EPA did not further evaluate Options 1, 2S, 3, and 4 for the final rule for the same reasons as explained for BPT above. See Sections 11.0 and 12.0 for the final estimated compliance costs and pollutant loadings for Option 2 and the alternative options considered for the final rule.

EPA proposed to establish PSES for existing indirect dischargers in the PWB Subcategory based on the Option 2 technology. Based on the revisions and corrections to the EPA Costs & Loadings Model discussed in the NODA, preamble to the final rule, and Sections 11.0 and 12.0, EPA rejected promulgating PSES for existing indirect dischargers in the PWB Subcategory based on the Option 2 technology for the following reasons: (1) all PWB indirect dischargers are currently regulated by existing effluent guidelines (Parts 413 or 433 or both, as applicable); (2) EPA estimates that compliance with PSES based on the Option 2 technology will result in the closure of 6.5 percent of the existing indirect dischargers in this subcategory (55 of 840 existing PWB indirect dischargers); and (3) EPA determined that the toxic pollutant reductions are very expensive per pound removed (the cost-effectiveness value (in 1981\$) is

\$455/PE). EPA has determined that Option 2 technology is not the best available technology economically achievable for existing indirect dischargers in the PWB Subcategory, and therefore is not establishing PWB PSES based on the Option 2 technology.

As discussed in the June 2002 NODA (see 67 FR 38802), EPA also considered a number of alternative options whose economic impacts would be less costly than Option 2 technology. These options potentially have compliance costs more closely aligned with toxic pollutant reductions. EPA considered the following alternative options for the final rule:

- Option A: No change in current regulation;
- Option B: Option 2 with a higher low-flow exclusion; and
- Option C: Upgrading facilities currently covered by Part 413 to the PSES of Part 433 (“413 to 433 Upgrade Option”).

EPA notes that all facilities in the PWB Subcategory are currently subject to Part 413, Part 433, or both.

As discussed in the NODA, preamble to the final rule, and Sections 11.0 and 12.0, based on comments, EPA has revised its methodology for estimating compliance costs and pollutant loadings for Option 2, higher low-flow exclusions (Option B), and the “upgrade” option (Options C) previously described. Using information from this revised analysis, EPA rejected Options B and C because: (1) more than 10 percent of existing indirect dischargers not covered by Part 433 close at the upgrade option; or (2) the incremental compliance costs of the upgrade options were too great in terms of toxic removals (cost-effectiveness values (in 1981\$) in excess of \$833/PE). Therefore, EPA is not revising PSES for existing indirect dischargers in the PWB Subcategory. Wastewater discharges to POTWs from facilities in this subcategory will remain regulated by General Pretreatment Standards (Part 403) and Parts 413 and/or 433, as applicable. EPA also notes that facilities regulated by Parts 413 and/or 433 PSES must comply with Part 433 PSNS if the changes to their facilities are determined to make them new sources.

#### **9.5.4 PSNS**

EPA proposed to establish PSNS for indirect dischargers in the PWB Subcategory based on the Option 4 technology. Option 4 technology is similar to Option 2 (including Option 2 flow control and pollution prevention) but includes oils removal using ultrafiltration and solids separation by a microfilter (instead of a clarifier). As explained in Section 9.2.4, EPA concluded that its database is insufficient to support a determination that the Option 4 standards are technically achievable. Consequently, EPA rejected Option 4 technology as the basis for PSNS in the PWB Subcategory.

For the final rule, EPA evaluated setting PWB PSNS based on the Option 2 technology and assessed the financial burden to new PWB indirect dischargers. Specifically,

EPA's 'barrier-to-entry' analysis identified whether PWB PSNS based on the Option 2 technology would pose sufficient financial burden on new PWB facilities to constitute a material barrier to entry into the MP&M Point Source Category.

EPA projects a barrier to entry for PWB PSNS based on the Option 2 technology because 3 percent of PWB indirect dischargers have after-tax compliance costs between 1 to 3 percent of revenue and 4 percent have after-tax compliance costs greater than 5 percent of revenue. Consequently, EPA rejected Option 2 technology as the basis for PSNS in the PWB Subcategory. EPA has selected "no further regulation" for new PWB indirect dischargers and is not revising PSNS for new PWB indirect dischargers. Wastewater discharges to POTWs from facilities in this subcategory will remain regulated by local limits, General Pretreatment Standards (Part 403), and Part 433, as applicable. See Section 11.0 for a description of how these new source compliance costs were developed and Chapter 9 of the EEBA for a description of the framework EPA used for the barrier-to-entry analysis and general discussion of the results.

## **9.6 Steel Forming and Finishing Subcategory**

EPA is not revising limitations or standards for any facilities that would have been subject to this subcategory. Such facilities will continue to be regulated by the General Pretreatment Standards (Part 403), local limits, permit limits, and Iron and Steel effluent limitations guidelines (Part 420), as applicable.

### **9.6.1 BPT, BCT, and BAT**

EPA evaluated several technology options for direct dischargers for the Steel Forming and Finishing (SFF) Subcategory, whose unit operations primarily generate metal-bearing wastewater, but may also generate some oily wastewater. These include Options 1, 2, 2S, 3, and 4, which are described in detail in Section 9.2.1. As discussed Section 9.2.1, EPA dropped Options 1, 2S, 3, and 4 from further consideration. Therefore, for the final rule, EPA considered only Option 2 as the basis for limitations for the SFF Subcategory. See Sections 11.0 and 12.0 for the final estimated compliance costs and pollutant loadings for Option 2.

EPA proposed to establish BPT/BCT/BAT for existing direct dischargers in the SFF Subcategory based on the Option 2 technology (see Section 9.2.1 for a description of Option 2). For the final rule, EPA evaluated the cost of effluent reductions, pollutant reductions, and the economic achievability of compliance with BPT/BCT/BAT limitations based on the Option 2 technology. Based on the revisions and corrections to the EPA Costs & Loadings Model discussed in the NODA, preamble to the final rule, and Sections 11.0 and 12.0, EPA determined that the compliance costs of Option 2 are not economically achievable. EPA estimates that compliance with BPT/BCT/BAT limitations based on the Option 2 technology will result in the closure of 17 percent of the existing direct dischargers in this subcategory (7 of 41 existing SFF direct dischargers). EPA concludes that, for existing direct dischargers in the SFF Subcategory, Option 2 is not the best practicable control technology, best conventional pollutant control technology, or best available technology economically achievable, and therefore, EPA is not



establishing new BPT, BCT, or BAT limitations for existing SFF direct dischargers based on the Option 2 technology. These facilities will remain subject to Part 420.

### **9.6.2 NSPS**

EPA proposed to establish NSPS for new direct dischargers in the SFF Subcategory based on the Option 4 technology. Option 4 technology is similar to Option 2 (including Option 2 flow control and pollution prevention) but includes oils removal using ultrafiltration and solids separation by a microfilter (instead of a clarifier). As explained in Section 9.2.4, EPA concluded that its database is insufficient to support a determination that the Option 4 standards are technically achievable. Consequently, EPA rejected Option 4 technology as the basis for NSPS in the SFF Subcategory. EPA has selected “no further regulation” for new SFF direct dischargers and is not revising NSPS for new SFF direct dischargers, which will remain subject to Part 420.

### **9.6.3 PSES**

EPA evaluated several technology options for indirect dischargers for the Steel Forming and Finishing Subcategory, whose unit operations primarily generate metal-bearing wastewater, but may also generate some oily wastewater. For the final rule, EPA considered the same option as evaluated for BAT (i.e., Option 2). EPA did not further evaluate Options 1, 2S, 3, and 4 for the final rule for the same reasons as explained for BPT above. See the Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Metal Products & Machinery Point Source Category (EPA 821-B-00-005) for the final estimated compliance costs and pollutant loadings for Option 2.

EPA proposed to establish PSES for existing indirect dischargers in the SFF Subcategory based on the Option 2 technology. Based on the revisions and corrections to the EPA Costs & Loadings Model discussed in the NODA, preamble to the final rule, and Sections 11.0 and 12.0, EPA estimates that compliance with PSES based on the Option 2 technology will result in the closure of 9 percent of the existing indirect dischargers in this subcategory (10 of 112 existing SFF indirect dischargers).

EPA has determined that Option 2 technology is not the best available technology economically achievable for existing indirect dischargers in the SFF Subcategory, and therefore EPA is not revising PSES for this subcategory based on the Option 2 technology. Wastewater discharges to POTWs from these facilities will remain regulated by General Pretreatment Standards (Part 403) and Part 420.

### **9.6.4 PSNS**

EPA proposed to establish PSNS for indirect dischargers in the SFF Subcategory based on the Option 4 technology. Option 4 technology is similar to Option 2 (including Option 2 flow control and pollution prevention) but includes oils removal using ultrafiltration and solids

separation by a microfilter (instead of a clarifier). As explained in Section 9.2.4, EPA concluded its database is insufficient to support a determination that the Option 4 standards are technically achievable. Consequently, EPA rejected Option 4 technology as the basis for PSNS in the SFF Subcategory. EPA has selected “no further regulation” for new SFF indirect dischargers and is not revising PSNS for new SFF indirect dischargers; these facilities will remain subject to Part 420.

## **9.7            Oily Wastes Subcategory**

EPA is promulgating limitations and standards for existing and new direct dischargers in the Oily Wastes Subcategory based on the proposed Option 6 technology (see Section 9.7.1). EPA is not promulgating pretreatment standards for existing or new indirect dischargers in this subcategory.

### **9.7.1        BPT**

EPA evaluated several technology options for the direct dischargers in the Oily Wastes Subcategory. Each of these options is discussed below. As discussed in Section 6.0, EPA defines the Oily Wastes Subcategory as those facilities that only discharge wastewater from one or more oily operations (see Table 6-2 and 40 CFR 438.2(f)).

#### **Option 5**

Option 5 consists of end-of-pipe chemical emulsion breaking followed by gravity separation using an oil/water separator. EPA performed sampling episodes at several facilities in the Oily Wastes Subcategory that used chemical emulsion breaking followed by gravity flotation and oil skimming. These systems typically achieved a 96-percent removal of oil and grease. Breaking the oil/water emulsion requires adding treatment chemicals such as acid, alum, and/or polymers to change the emulsified oils or cutting fluids from hydrophilic colloids to aggregate hydrophobic particles. The aggregated oil particles, with a density less than water, can be removed by gravity flotation in a coalescing plate oil/water separator. Option 5 also includes contract hauling of organic solvent-bearing wastewaters instead of discharge.

#### **Option 6**

Option 6 consists of the technologies in Option 5 plus the following in-process flow control and pollution prevention technologies, which allow for recovery and reuse of materials along with water conservation:

- Two-stage countercurrent cascade rinsing for all flowing rinses;
- Centrifugation and recycling of painting water curtains; and

- Centrifugation, pasteurization, and recycling of water-soluble machining coolants.

### **Option 7**

Option 7 consists of end-of-pipe ultrafiltration, as well as contract hauling of organic solvent-bearing wastewater instead of discharge. Sampling episode data determined that, on average, ultrafilters will remove greater than 99 percent of all oil and grease in the influent stream.

### **Option 8**

Option 8 consists of the Option 7 technology (ultrafiltration) plus the pollution prevention and water conservation alternatives described in Option 6.

### **Option Selection**

As discussed in the 2001 proposal (66 FR 451), EPA dropped Options 5 and 7 from further consideration because Options 6 and 8, respectively, cost less and provided greater pollutant removals. Subsequent to proposal, EPA also dropped Option 8 from further consideration for the final rule because of its increased cost and lack of significant additional pollutant removals beyond Option 6. Therefore, for the final rule, EPA considered only Option 6 as the basis for limitations for the Oily Wastes Subcategory. See Sections 11.0 and 12.0 for the final estimated compliance costs and pollutant loadings for Option 6.

EPA is establishing BPT pH limitations and daily maximum limitations for two pollutants, oil and grease as hexane extractable material (oil and grease (as HEM)) and total suspended solids (TSS), for direct dischargers in the Oily Wastes Subcategory based on the proposed technology option (Option 6). Option 6 technology includes the following treatment measures: (1) in-process flow control and pollution prevention; and (2) oil/water separation by chemical emulsion breaking and skimming (see above for additional details on the Option 6 technology).

The Agency concluded that the Option 6 treatment technology represents the best practicable control technology currently available and should be the basis for the BPT Oily Wastes limitations for the following reasons. First, this technology is available and readily applicable to all facilities in the Oily Wastes Subcategory. Approximately 42 percent of the direct dischargers in the Oily Wastes Subcategory currently use the Option 6 technology. Second, the cost of compliance with these limitations in relation to the effluent reduction benefits is not wholly disproportionate. None of these wastewater discharges are currently subject to national effluent limitations guidelines and the final rule will control wastewater discharges from a significant number (2,382) of facilities.

EPA estimates that compliance with BPT limitations based on Option 6 technology will result in no closures of the existing direct dischargers in the Oily Wastes Subcategory. Moreover, the adoption of this level of control will significantly reduce the amount of pollutants discharged into the environment by facilities in this subcategory. For facilities in the Oily Wastes Subcategory at Option 6, EPA estimates an annual compliance cost of \$13.8 million (pre-tax, 2001\$) and 480,325 pounds of conventional pollutants removed from current discharges into the Nation's waters at a cost of \$28.73/pound-pollutant removed (2001\$). EPA has, therefore, determined that the total cost of effluent reductions as a result of using the Option 6 technology are reasonable in relation to the effluent reduction benefits. (In estimating the pounds of pollutant removed by implementing Option 6 technology for direct dischargers in the Oily Wastes Subcategory, EPA used the sum of oil and grease (as HEM) and TSS pounds removed to avoid any significant double counting of pollutants).

The 2001 proposal also contains detailed discussions explaining why EPA rejected BPT limitations based on other BPT technology options (see 66 FR 457). The information in the record for the final rule provides no basis for EPA to change this conclusion.

In the 2001 proposal, EPA proposed to regulate sulfide in addition to pH, oil and grease (as HEM), and TSS. In the final rule, EPA has not established a sulfide limitation because it may serve as a treatment chemical (see Section 7.0). EPA also proposed three alternatives to control discharges of toxic organics in MP&M process wastewaters: (1) meet a numerical limit for the total sum of a list of specified organic pollutants (similar to the Total Toxic Organic (TTO) parameter used in the Metal Finishing effluent limitations guidelines); (2) meet a numerical limit for total organic carbon (TOC) as an indicator parameter; or (3) develop and certify the implementation of an organic chemicals management plan. EPA evaluated the analytical wastewater and treatment technology data from Oily Wastes facilities and concluded it should not establish a separate indicator parameter or control mechanism for toxic organics. Optimizing the separation of oil and grease from wastewater using the Option 6 technology will similarly optimize the removal of toxic organic pollutants amenable to this treatment technology. Consequently, EPA is effectively controlling toxic organics and other priority and nonconventional pollutant discharges in Oily Wastes Subcategory process wastewaters by regulating oil and grease (as HEM).

In its analyses, EPA estimated that facilities will monitor once per month for oil and grease (as HEM) and TSS. EPA expects that 12 data points for each pollutant per year will yield a meaningful basis for establishing compliance with the promulgated limitations through long-term trends and short-term variability in oil and grease (as HEM) and TSS pollutant discharge loading patterns.

Although EPA is not changing the technology basis from that proposed, EPA is revising all of the proposed Oily Wastes Subcategory BPT limitations. This is a result of a recalculation of the limitations after EPA revised the data sets used to calculate the promulgated limitations to reflect changes including corrections and additional data (see 67 FR 38754).

### **9.7.2 BCT**

In deciding whether to adopt more stringent limitations for BCT than BPT, EPA considered whether there are technologies that achieve greater removals of conventional pollutants than adopted for BPT, and whether those technologies are cost-reasonable under the standards established by the CWA. EPA generally refers to the decision criteria as the “BCT cost test.” EPA is promulgating effluent limitations for conventional parameters (e.g., pH, TSS, oil and grease) equivalent to BPT for this subcategory because it identified no technologies that can achieve greater removals of conventional pollutants than the selected BPT technology basis that also pass the BCT cost test. EPA evaluated the addition of ultrafiltration technology to the BPT technology basis as a means to obtain further oil and grease reductions. However, this technology option failed the BCT cost test. For a more detailed description of the BCT cost test and details on EPA’s analysis, see Chapter 4 of the EEBA.

### **9.7.3 BAT**

EPA proposed to control toxic and nonconventional pollutants by establishing BAT limitations based on Option 6 technology. As described in Section 9.7.1, EPA has decided not to establish BAT toxic and nonconventional limitations based on the Option 6 technology. While the BPT limitations are cost reasonable, the additional costs associated with compliance with Option 6-generated BAT limitations are not warranted. EPA has determined that these costs, primarily monitoring costs, are not warranted in view of the small quantity of additional effluent reduction (if any) the BAT limitations would produce. As explained above, EPA has determined that the BPT limitation on oil and grease (as HEM) will effectively control toxic and nonconventional discharges in Oily Wastes Subcategory process wastewaters. EPA has not identified any more stringent economically achievable treatment technology option beyond BPT technology (Option 6) that it considered to represent BAT level of control applicable to Oily Wastes Subcategory facilities.

For the reasons explained above, EPA has concluded that it should not establish BAT limitations for specific pollutant parameters for Oily Waste operations. EPA notes that permit writers retain the authority to establish, on a case-by-case basis under Section 301(b)(1)(C) of the CWA, toxic effluent limitations that are necessary to meet state water quality standards.

### **9.7.4 NSPS**

EPA is promulgating NSPS that would control pH and the same conventional pollutants controlled at the BPT and BCT levels. The selected technology basis for NSPS for this subcategory for the final rule is Option 6. This is unchanged from the proposal. EPA projects no barrier to entry for new source direct dischargers associated with Option 6 because: (1) Option 6 technology is currently used at existing direct dischargers (i.e., Option 6 technology is technically available), and (2) there is no barrier to entry for new sources.

EPA evaluated the economic impacts for existing direct dischargers associated with compliance with limitations based on Option 6 and found Option 6 to be economically achievable (no closures projected). EPA expects compliance costs to be lower for new sources as new sources can use Option 6 technology without incurring retrofitting costs (as is required for some existing sources). Additionally, EPA projects no barrier to entry for Oily Wastes NSPS based on the Option 6 technology because approximately 97 percent of Oily Wastes direct dischargers have after-tax compliance costs less than 1 percent of revenue and 3 percent have after-tax compliance costs between 1 to 3 percent of revenue.

In addition, EPA also evaluated and rejected more stringent technology options for Oily Wastes NSPS (i.e., Options 8 and 10). EPA reviewed its database for the Option 8 and 10 technologies and found that the database for Option 8 and 10 technologies is insufficient (i.e., no available data) or the costs are not commensurate with the pollutant removals (see 66 FR 457).

Consequently, EPA selected Option 6 technology as the basis for NSPS in the Oily Wastes Subcategory. See Section 11.0 for a description of how these new source compliance costs were developed and Chapter 9 of the EEBA for a description of the framework EPA used for the barrier-to-entry analysis and general discussion of the results.

In addition, EPA also evaluated and rejected more stringent technology options for Oily Wastes NSPS (i.e., Options 8 and 10). EPA reviewed its database for the Option 8 and 10 technologies and found no available data for Option 8 and 10 technologies. Since EPA's database did not contain Option 10 treatability data from Oily Wastes facilities, EPA considered transferring limitations for Option 10 from the Shipbuilding Dry Dock or Railroad Line Maintenance Subcategories. EPA ultimately rejected this approach, however, because influent wastewaters in the Shipbuilding Dry Dock and Railroad Line Maintenance Subcategories are generally less concentrated and contain less pollutants than wastewaters discharged by Oily Wastes facilities.

### **9.7.5 PSES**

EPA evaluated the same technology options for indirect dischargers in the Oily Wastes Subcategory as for direct dischargers in the subcategory. For the final rule, EPA considered the same option as evaluated for BAT (i.e., Option 6). EPA did not further evaluate Options 5, 7, and 8 for the final rule for the same reasons as explained for BPT above. See Sections 11.0 and 12.0 for the final estimated compliance costs and pollutant loadings for Option 6.

EPA proposed to establish PSES for existing indirect dischargers in the Oily Wastes Subcategory based on the Option 6 technology (i.e., the same technology basis that is being promulgated for BPT/BCT/NSPS for this subcategory) with a “low-flow” exclusion of 2 MGY to reduce economic impacts on small businesses and administrative burden for control authorities. Based on the revisions and corrections to the EPA Costs & Loadings Model

discussed in the NODA, preamble to the final rule, and Sections 11.0 and 12.0, and previously discussed, EPA determined that the toxic pollutant reductions are very expensive in dollars per toxic pounds removed. The cost-effectiveness value (in 1981\$) for Option 6 for indirect dischargers in the Oily Wastes Subcategory is in excess of \$3,500/PE removed. This suggests that the technology is not truly “available.” EPA has determined that Option 6 technology with a 2-MGY low-flow cutoff is not the best available technology economically achievable for existing indirect dischargers in the Oily Wastes Subcategory. Therefore, EPA is not establishing PSES for this subcategory based on Option 6 technology with a 2-MGY low-flow cutoff.

As discussed in the June 2002 NODA (67 FR 38804), EPA also considered alternative options for which economic impacts could be less costly than Option 6 technology with a 2-MGY low-flow cutoff. These options potentially have compliance costs more closely aligned with toxic pollutant reductions. EPA considered the following alternative options for the final rule:

- Option A: No regulation; and
- Option B: Option 6 with a higher low-flow exclusion.

As discussed in the NODA, preamble to the final rule, and Sections 11.0 and 12.0, based on comments, EPA has revised its methodology for estimating compliance costs and pollutant loadings for Option 6 with a higher low-flow exclusion (Option B). Using information from this revised analysis, EPA concludes that none of the alternative low-flow exclusions (even as high as 6.25 MGY) represented “available technology” because the costs associated with these alternatives were not commensurate with the projected toxic pollutants reductions. Therefore, EPA is not establishing PSES for existing indirect dischargers in the Oily Wastes Subcategory (Option A). Since EPA did not identify another technology basis that was more cost-effective, EPA is not promulgating PSES for existing indirect dischargers in the Oily Wastes Subcategory. These facilities remain subject to the General Pretreatment Standards (40 CFR 403) and local limits, as applicable.

#### **9.7.6 PSNS**

EPA proposed to establish PSNS for indirect dischargers in the Oily Wastes Subcategory based on the Option 6 technology (i.e., the same technology basis that is being promulgated for NSPS for this subcategory) with a “low-flow” exclusion of 2 MGY to reduce economic impacts on small businesses and reduce administrative burden to POTWs.

For the final rule, EPA evaluated setting Oily Wastes PSNS based on Option 6 technology and assessed the financial burden of Oily Wastes PSNS based on Option 6 technology on new Oily Wastes indirect dischargers. Specifically, EPA's ‘barrier-to-entry’ analysis identified whether Oily Wastes PSNS based on Option 6 technology would pose sufficient financial burden on new Oily Wastes facilities to constitute a material barrier to entry into the MP&M Point Source Category.

EPA projects a barrier to entry for Oily Waste PSNS based on Option 6 technology as approximately because 1 percent of Oily Waste indirect dischargers have after-tax compliance costs between 1 to 3 percent of revenue and 5 percent have after-tax compliance costs between 3 to 5 percent of revenue. Consequently, EPA rejected Option 6 technology as the basis for PSNS in the Oily Wastes Subcategory. EPA has selected “no further regulation” for new Oily Wastes indirect dischargers and is not revising PSNS for new Oily Wastes indirect dischargers. Wastewater discharges to POTWs from facilities in this subcategory will remain regulated by local limits and General Pretreatment Standards (Part 403), as applicable. See Section 11.0 for a description of how these new source compliance costs were developed and Chapter 9 of the EEBA for a description of the framework EPA used for the barrier-to-entry analysis and general discussion of the results.

## **9.8 Railroad Line Maintenance Subcategory**

EPA is not establishing limitations or standards for any facilities that would have been subject to this subcategory. Permit writers and control authorities will establish controls using BPJ to regulate wastewater discharges from these facilities.

### **9.8.1 BPT**

At proposal, EPA evaluated four technology options for the Railroad Line Maintenance (RRLM) Subcategory. These included Options 7 and 8, which are described in detail in Section 9.7.1, and Options 9 and 10, described below. In addition, for the final rule, EPA evaluated Option 6 for this subcategory (see Section 9.7.1).

#### **Option 9**

Option 9 consists of end-of-pipe chemical emulsion breaking followed by dissolved air flotation (DAF) to remove flocculated oils. This treatment train is demonstrated in both the Shipbuilding Dry Dock and RRLM Subcategories and effectively removes emulsified oils and suspended solids. Option 9 also includes contract hauling of organic solvent-bearing wastewater instead of discharge.

#### **Option 10**

Option 10 consists of the end-of-pipe treatment technologies included in Option 9 plus in-process flow control and pollution prevention technologies, which allow for recovery and reuse of materials along with water conservation. The specific Option 10 in-process technologies include:

- Two-stage countercurrent cascade rinsing for all flowing rinses;
- Centrifugation and recycling of painting water curtains; and



- Centrifugation, pasteurization, and recycling of water soluble machining coolants.

### **Option Selection**

For the final rule, EPA evaluated setting BPT limitations for two pollutants, TSS and oil and grease (as HEM), for direct dischargers in the RRLM Subcategory based on a different technology basis from that proposed in 2001. EPA proposed Option 10 technology as the technology basis for BPT. However, as discussed in the NODA, EPA considered promulgating limitations for the final rule based on the Option 6 technology for the RRLM Subcategory (see 67 FR 38804). Option 6 technology includes the following: (1) in-process flow control and pollution prevention; and (2) oil/water separation by chemical emulsion breaking and skimming (see Section 9.7.1 for additional details on the Option 6 technology).

For the RRLM Subcategory, EPA changed the technology basis considered for the final rule based on comments and data submitted by the American Association of Railroads (AAR). This organization is a trade association that currently represents all facilities in this subcategory. As discussed in the NODA (67 FR 38755), for each RRLM direct discharging facility known to them, AAR provided current permit limits, treatment-in-place, and summarized information on each facility's measured monthly average and daily maximum values. AAR also provided a year's worth of long-term monitoring data for each facility (see Section 15.1 of the rulemaking record for the AAR surveys). This data shows that, contrary to EPA's initial findings in the 2001 proposal, most RRLM direct dischargers treat their wastewater by chemical emulsion breaking/oil skimming (Option 6). Based on this updated information, EPA rejected Option 10 as the technology basis for BPT. The 2001 proposal also contains detailed discussions on why EPA rejected BPT limitations based on other BPT technology options (see 66 FR 451). The information in the rulemaking record provides no basis for EPA to change this conclusion.

As previously discussed, after publication of the June 2002 NODA, EPA also conducted another review of all RRLM facilities in the MP&M survey database to determine the destination of discharged wastewater (i.e., either directly to surface waters or indirectly to POTWs or both) and the applicability of the final rule to discharged wastewaters. As a result of this review, EPA determined that its survey database did not accurately represent direct dischargers in this subcategory. Consequently, for the final rule, EPA used the information supplied by AAR as a basis for its analyses and conclusions on direct dischargers in this subcategory.

AAR provided information on 27 facilities. EPA reviewed the information on each of these facilities to ensure they were direct dischargers, discharged wastewaters resulting from operations subject to this final rule, and discharged "process" wastewaters as defined by the final rule. As a result of this review, EPA concluded that 18 of the facilities for which AAR provided information do not directly discharge wastewaters exclusively from oily operations (see Section V.A of the preamble to the final rule). Therefore, EPA's final database consists of data for nine direct discharging RRLM facilities. EPA considered promulgating BPT limitations for

these nine direct discharging RRLM facilities based on the Option 6 technology. The Agency made the following conclusions during its evaluation of Option 6 for this subcategory.

First, this technology is readily applicable to all facilities in the RRLM Subcategory. All direct dischargers in the RRLM Subcategory currently use wastewater treatment equivalent or better than chemical emulsion breaking/oil skimming (Option 6). Second, EPA estimates that compliance with BPT limitations based on Option 6 technology will result in no closures of the existing direct dischargers in the RRLM Subcategory. Moreover, none of the facilities identified by AAR are small businesses as defined by the Small Business Administration (SBA). Third, most of the RRLM facilities identified by AAR have NPDES daily maximum permit limitations for oil and grease (as HEM) and TSS as 15 and 45 mg/L, respectively. Based on AAR survey information, EPA concludes that these oil and grease (as HEM) and TSS daily maximum limits represent the average of the best performances of facilities utilizing Option 6 technology.

EPA evaluated the compliance costs and load reductions associated with establishing BPT daily maximum limitations equivalent to 15 and 45 mg/L for oil and grease (as HEM) and TSS, respectively. EPA concluded that all of the facilities identified by AAR currently meet a daily maximum oil and grease limit of 15 mg/L and most currently monitor once per month. Therefore, EPA estimates no pollutant load reductions and minimal incremental annualized compliance costs for the monitoring associated with a BPT daily maximum limitation equivalent to 15 mg/L for oil and grease (as HEM). For TSS, with the exception of one facility, all RRLM facilities identified by AAR currently meet a daily maximum limit of 45 mg/L. For this one facility, EPA estimates the TSS pollutant loadings reductions associated with a BPT daily maximum limitation equivalent to 45 mg/L to be less than 1 pound of TSS per day. Given the fact that the few facilities in this subcategory are already essentially achieving the limitations under consideration, EPA has determined that additional national regulation is not warranted. As a result of this analysis, EPA concludes that it is more appropriate to address permits limitations for this industry on a case-by-case basis and that additional national regulation of direct discharges in the RRLM Subcategory at this time is unwarranted.

### **9.8.2 BCT**

In deciding whether to adopt more stringent limitations for BCT than BPT, EPA considers whether there are technologies that achieve greater removals of conventional pollutants than adopted for BPT, and whether those technologies are cost-reasonable under the standards established by the CWA. EPA generally refers to the decision criteria as the “BCT cost test.” For a more detailed description of the BCT cost test and details of EPA’s analysis, see Chapter 4 of the EEBA.

For the reasons discussed above, EPA is not establishing BCT limitations for the RRLM Subcategory.

### **9.8.3 BAT**

As proposed, EPA is not establishing BAT regulations for the RRLM Subcategory. EPA did not propose BAT regulations because the Agency concluded that facilities in this subcategory discharge very few pounds of toxic pollutants. EPA estimates that six facilities discharge 34 PE per year to surface waters, or about 6 PE per year per facility. The Agency based the loadings calculations on EPA sampling data, which found very few priority toxic pollutants at treatable levels in raw wastewater. EPA has received no data or information during the rulemaking that contradicts these conclusions. Therefore, nationally applicable regulations for toxic and nonconventional pollutants are unnecessary at this time and direct dischargers will remain subject to permit limitations for toxic and nonconventional pollutants established on a case-by-case basis using BPJ.

### **9.8.4 NSPS**

EPA proposed setting NSPS based on Option 10 technology for this subcategory. For the final rule, EPA considered setting RRLM NSPS based on Option 10 technology and assessed the financial burden of RRLM NSPS based on Option 10 technology on new RRLM direct dischargers. Specifically, EPA's 'barrier-to-entry' analysis identified whether RRLM NSPS based on Option 10 technology would pose sufficient financial burden as to constitute a material barrier to entry into the MP&M Point Source Category.

EPA projects no barrier to entry for RRLM NSPS based on Option 10 technology because: (1) Option 10 technology is currently used at existing RRLM direct dischargers (i.e., Option 10 technology is technically available), and (2) all RRLM direct dischargers have new source compliance costs that are less than 1 percent of revenue. However, EPA is not promulgating RRLM NSPS based on the Option 10 technology because EPA concludes that it is more appropriate to address limitations for this industry on a case-by-case basis and that national regulation of direct discharges in the RRLM Subcategory at this time is unwarranted. See Section 11.0 for a description of how these new source compliance costs were developed and Chapter 9 of the EEBA for a description of the framework EPA used for the barrier-to-entry analysis and general discussion of the results.

### **9.8.5 PSES and PSNS**

EPA proposed not to establish pretreatment standards for existing and new indirect dischargers in the RRLM Subcategory based on the small quantity of toxic pollutants discharged to the environment (after POTW treatment) by facilities in this subcategory (i.e., approximately 2 PE removed annually per facility (see 66 FR 470-471)). For the same reasons set out in the 2001 proposal, EPA is not promulgating pretreatment standards for existing or new indirect dischargers in this subcategory. These facilities remain subject to the General Pretreatment Standards (40 CFR 403) and local limits.

## **9.9 Shipbuilding Dry Dock Subcategory**

EPA is not establishing limitations or standards for any facilities that would have been subject to this subcategory. Permit writers and control authorities will establish controls using BPJ to regulate wastewater discharges from these facilities.

### **9.9.1 BPT/BCT/BAT/NSPS**

EPA evaluated four technology options for the Shipbuilding Dry Dock (SDD) Subcategory. These include Options 7 and 8, which are described in detail in Section 9.7.1, and Options 9 and 10, which are described in detail in Section 9.8.1.

As discussed in the 2001 proposal (66 FR 451), EPA dropped Options 7 and 9 from further consideration because Options 8 and 10, respectively, cost less and provided greater pollutant removals. EPA also evaluated and rejected a more stringent technology option for SDD NSPS (i.e., Option 8). EPA reviewed its database for the Option 8 technology and found that no available data or possibility of data transfer from the other oily subcategories are available because ultrafiltration does not consistently show a better removal than Option 10 to support a determination that NSPS based on Option 8 standards are technically achievable. EPA concluded that Option 8 does not represent the best practicable control technology. Therefore, for the final rule, EPA considered only Option 10 as the basis for limitations for the SDD Subcategory. See Sections 11.0 and 12.0 for the final estimated compliance costs and pollutant loadings for Option 10.

At the time of the 2001 proposal, EPA identified six direct discharging SDD facilities with multiple discharges. Based on the information in the database at that time, discharges from these facilities contained minimal concentrations of toxic organic and metals pollutants (<9 PE/facility), but substantial quantities of conventional pollutants, particularly oil and grease. Consequently, EPA proposed to establish BPT limitations and NSPS for only two pollutants, TSS and oil and grease (as HEM), for direct dischargers in the SDD Subcategory based on Option 10 technology. This technology includes the following: (1) in-process flow control and pollution prevention, and (2) oil/water separation by chemical emulsion breaking and oil/water separation by dissolved air flotation (see Section 9.8.1). EPA proposed this technology basis because some existing SDD facilities use this technology and it projected significant reductions in conventional pollutants and determined that these reductions were cost reasonable.

Following proposal, EPA received comments and supporting data indicating that its estimates of current pollutant discharges from this subcategory were overestimated. In particular, commentors claimed that current discharges of oil and grease were minimal and that national regulation was not warranted for this subcategory.

For the final rule, EPA incorporated the additional information provided by commentors into its analysis. EPA continues to conclude that there are six direct discharging SDD facilities. However, EPA now concludes that direct discharges from these facilities

generally contain minimal levels of all pollutants. In particular, EPA's database indicates that regulation of oil and grease in direct discharges from SDD facilities is unwarranted because current oil and grease discharges from these facilities are not detectable (< 5 mg/L) or nearly not detectable. EPA has similarly determined that it should not establish nationally applicable limitations and standards for TSS because TSS discharges are, on average, minimal. The data show that TSS discharges may increase episodically, particularly when the dry dock is performing abrasive blasting operations cleaning. However, EPA has concluded that these episodic discharges from six facilities do not warrant national regulation.

Therefore, nationally applicable regulations for new and existing SDD direct dischargers are unnecessary at this time and these facilities will remain subject to permit limitations established on a case-by-case basis using BPJ.

### **9.9.2 PSES and PSNS**

EPA proposed not to establish pretreatment standards for existing and new indirect dischargers in the SDD Subcategory based on the small number of facilities in this subcategory and on the small quantity of toxic pollutants removed by the technology options evaluated by EPA at proposal (i.e., less than 26 PE removed annually per facility (see 66 FR 471)). For the same reasons set out in the 2001 proposal, EPA is not promulgating pretreatment standards for existing or new indirect dischargers in this subcategory. These facilities remain subject to the General Pretreatment Standards (40 CFR 403) and local limits.

## **9.10 Summary of Technology Options Considered and Selected for the Final MP&M Rule**

Table 9-1 summarizes all of the technology options considered for the MP&M subcategories for either the proposed or final rules. Table 9-2 summarizes EPA's selected technology bases for the final rule.

**Table 9-1****Technology Options by Subcategory**

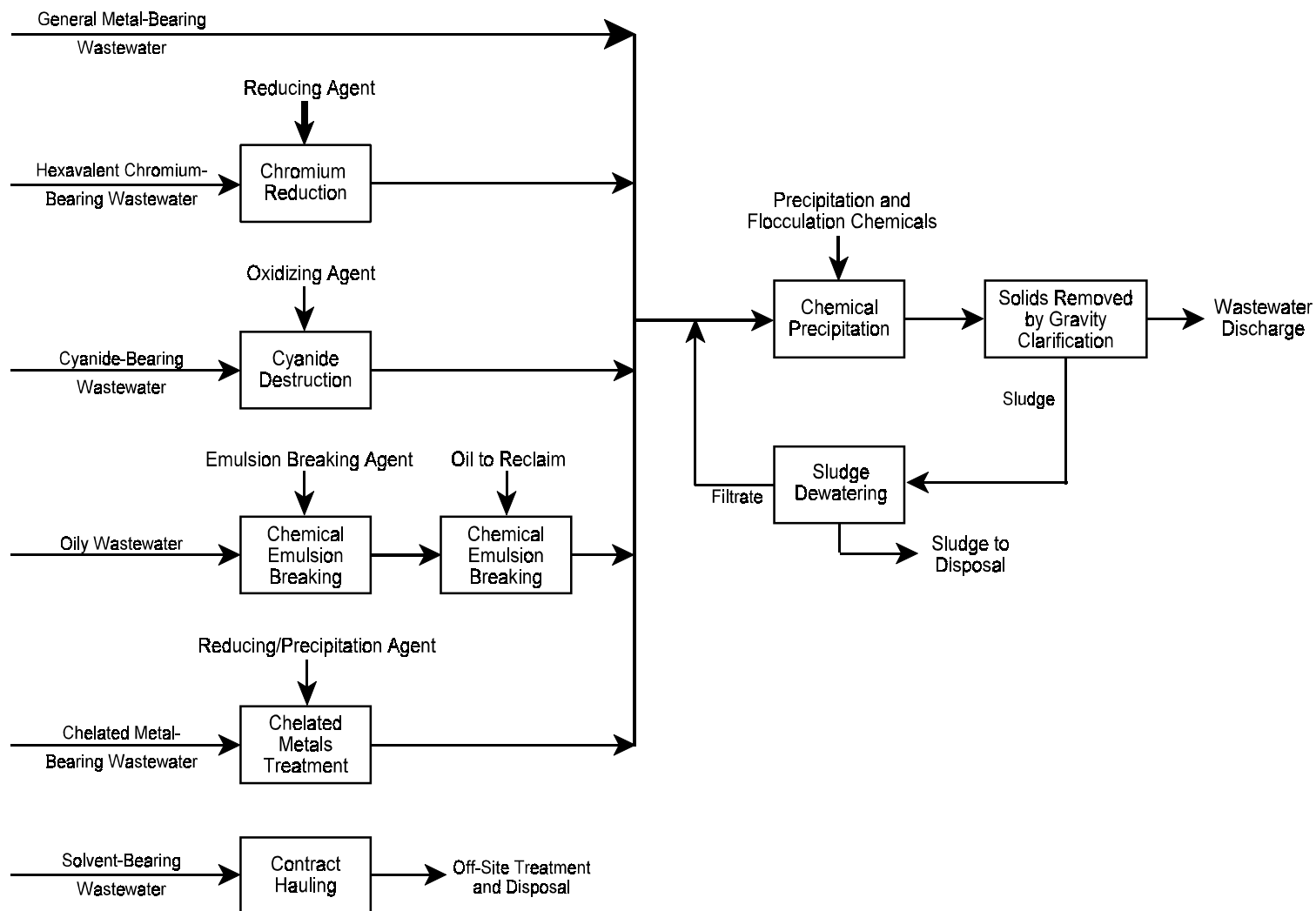
Treatment or Source Reduction Technology	Technology Options Considered for the General Metals, Metal Finishing Job Shops, Printed Wiring Board, Steel Forming and Finishing, and Non-Chromium Anodizing Subcategories <sup>a</sup>							Technology Options Considered for the Oily Wastes, Shipbuilding Dry Dock, and Railroad Line Maintenance Subcategories <sup>b</sup>					
	1	2	2S	3	4	413 to 433 Upgrade	Local Limits to 433 Upgrade	5	6	7	8	9	10
Chemical Precipitation	✓	✓	✓	✓	✓	✓	✓						
Gravity Clarification for Metal Hydroxide Removal	✓	✓	✓			✓	✓						
Microfiltration for Metal Hydroxide Removal				✓	✓								
Chemical Emulsion Breaking Followed by Gravity Separation for Oil Removal	✓	✓	✓			✓	✓	✓	✓				
Ultrafiltration for Oil Removal				✓	✓					✓	✓		
Chemical Emulsion Breaking Followed by Dissolved Air Flotation for Oil Removal												✓	✓
Alkaline Chlorination for Cyanide Removal	✓	✓	✓	✓	✓	✓	✓						
Chemical Reduction of Hexavalent Chromium	✓	✓	✓	✓	✓	✓	✓						
Chelation Breaking/Precipitation to Remove Complexed Metals	✓	✓	✓	✓	✓	✓	✓						
Contract Hauling of Organic Solvent-Bearing Wastewater Instead of Discharge	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Countercurrent Cascade Rinsing to Conserve Water		✓	✓		✓				✓		✓		✓
Centrifugation of Painting Water Curtains to Extend Life		✓	✓		✓				✓		✓		✓
Centrifugation and Pasteurization of Machining Coolants to Extend Life		✓	✓		✓				✓		✓		✓
Sand Filter to Remove Additional Suspended Solids			✓										
Sludge Dewatering and Disposal	✓	✓	✓	✓	✓	✓	✓					✓	✓

<sup>a</sup>See Section 9.2.2 for a discussion of BCT options considered for the General Metals Subcategory.

<sup>b</sup>EPA evaluated Option 5 for the Oily Wastes Subcategory only, Option 6 for the Oily Wastes and Railroad Line Maintenance Subcategories only, and Options 9 and 10 for the Shipbuilding Dry Dock and Railroad Line Maintenance Subcategories only. See Sections 9.7.2, 9.8.2, and 9.9.1 for discussions of BCT options considered for these subcategories.

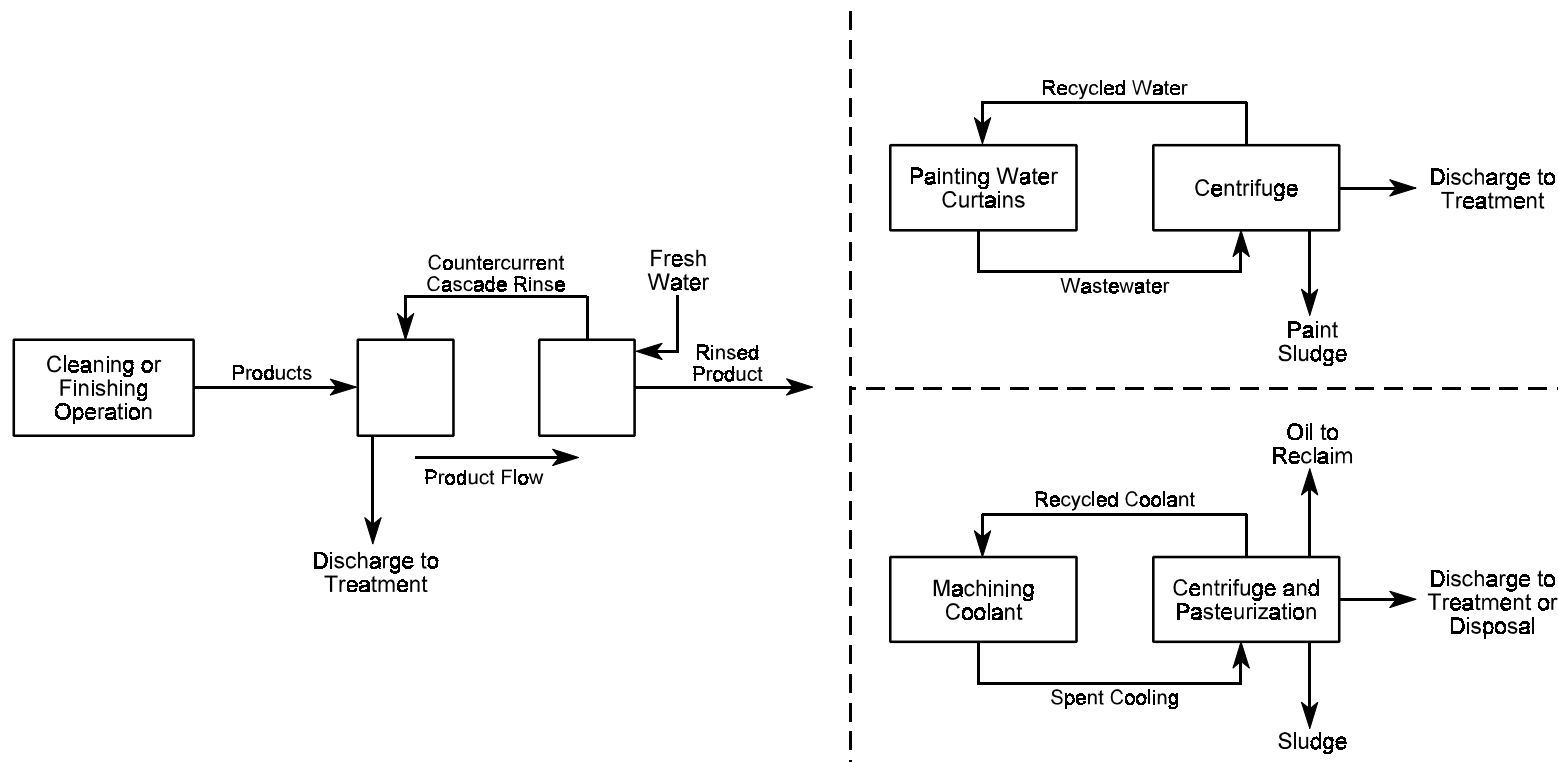
**Table 9-2****Summary of Technology Bases for the Final Rule**

<b>Subcategory</b>	<b>Regulatory Level</b>	<b>Technology Basis</b>
General Metals	BPT/BCT/BAT/NSPS	No new or revised limitations or standards established
	PSES/PSNS	No new or revised standards established
Metal Finishing Job Shops	BPT/BCT/BAT/NSPS	No new or revised limitations or standards established
	PSES/PSNS	No new or revised standards established
Printed Wiring Board	BPT/BCT/BAT/NSPS	No new or revised limitations or standards established
	PSES/PSNS	No new or revised standards established
Non-Chromium Anodizing	BPT/BCT/BAT/NSPS	No new or revised limitations or standards established
	PSES/PSNS	No new or revised standards established
Steel Forming and Finishing	BPT/BCT/BAT/NSPS	No new or revised limitations or standards established
	PSES/PSNS	No new or revised standards established
Oily Wastes	BPT/BCT/NSPS	Option 6: In-process pollution prevention, recycling, and water conservation methods; and chemical emulsion breaking followed by oil/water separation
	BAT	No new or revised limitations established
	PSES/PSNS	No new or revised standards established
Railroad Line Maintenance	BPT/BCT/BAT/NSPS	No new or revised limitations or standards established
	PSES/PSNS	No new or revised standards established
Shipbuilding Dry Dock	BPT/BCT/BAT/NSPS	No new or revised limitations or standards established
	PSES/PSNS	No new or revised standards established

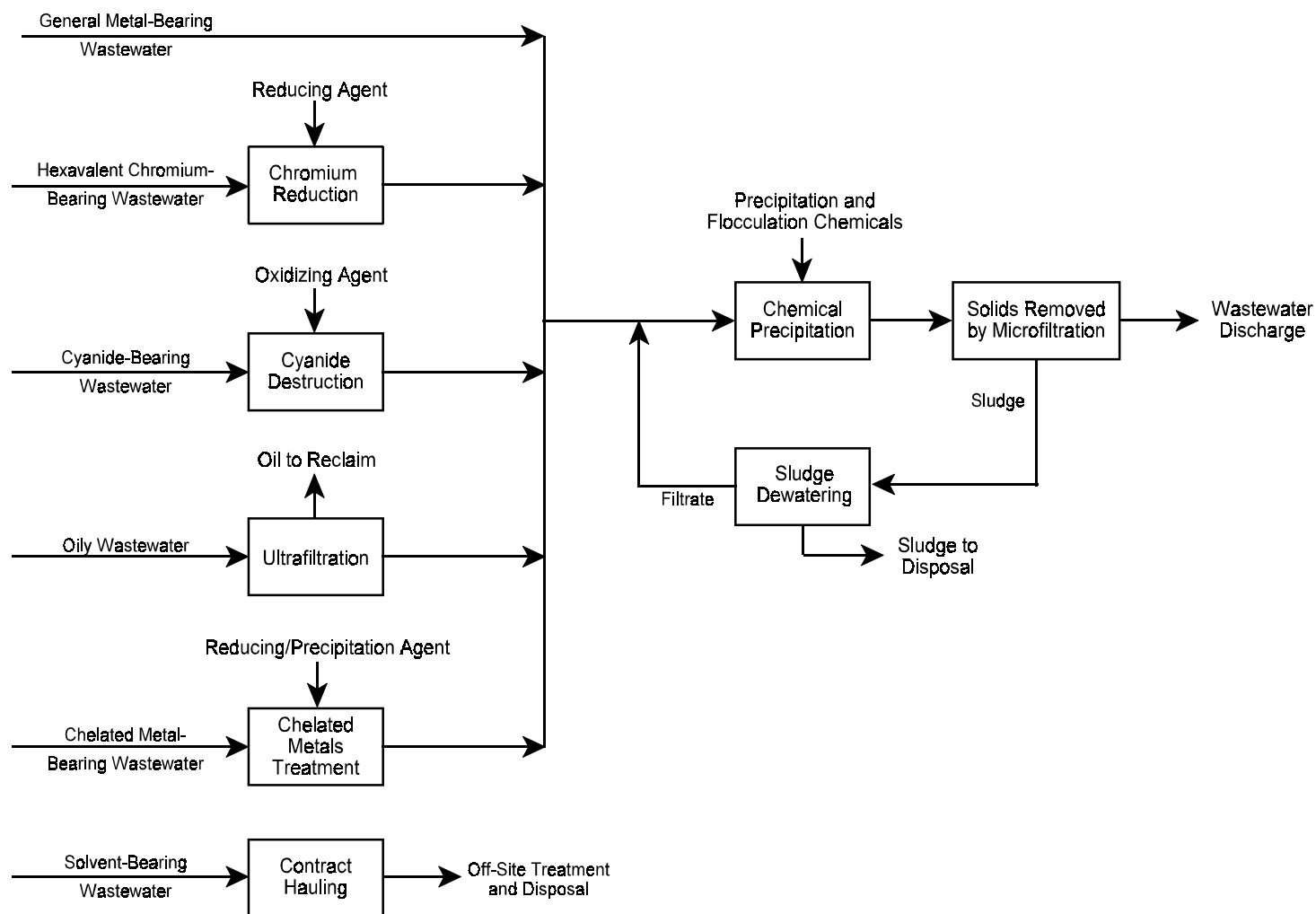


**Figure 9-1. End-of-Pipe Treatment Train for Options 1 and 2 Considered for the Following Subcategories: General Metals, Metal Finishing Job Shops, Non-Chromium Anodizing, Printed Wiring Board, and Steel Forming and Finishing**

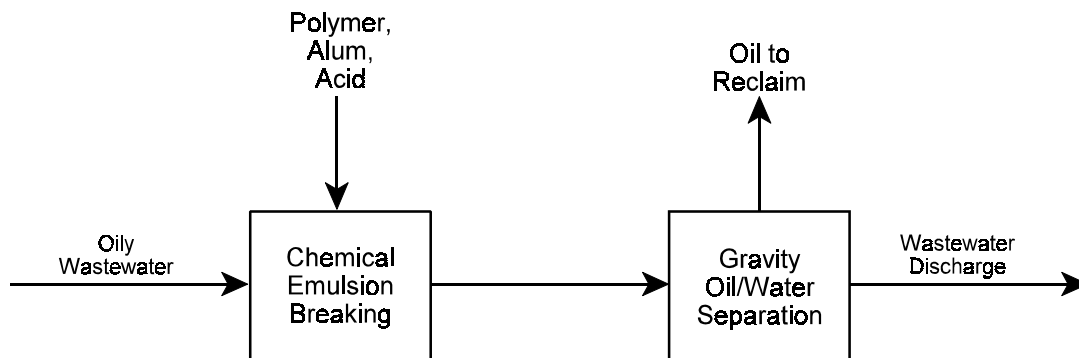




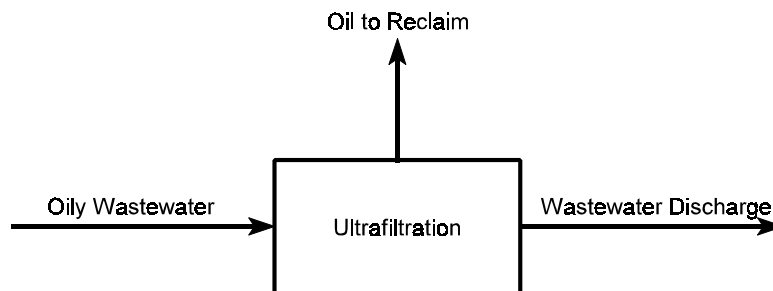
**Figure 9-2. In-Process Water Use Reduction Technologies for Options 2 and 4 Considered for the Following Subcategories: General Metals, Metal Finishing Job Shops, Non-Chromium Anodizing, Printed Wiring Board, and Steel Forming and Finishing**



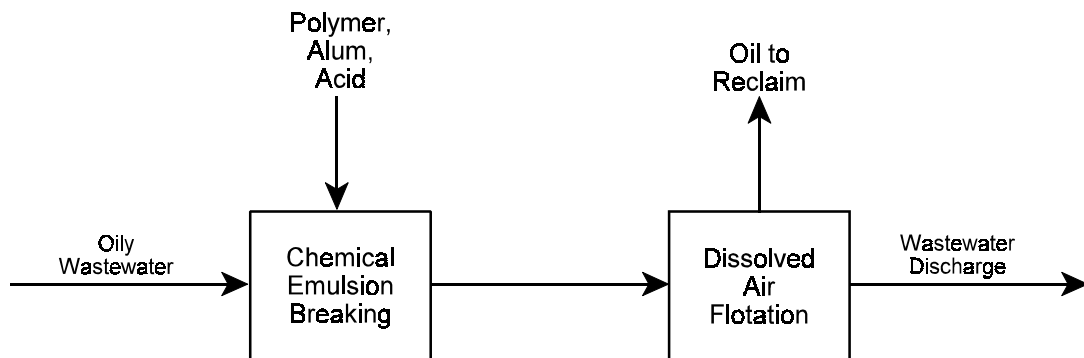
**Figure 9-3. End-of-Pipe Treatment Train for Options 3 and 4 Considered for the Following Subcategories: General Metals, Metal Finishing Job Shops, Non-Chromium Anodizing, Printed Wiring Board, and Steel Forming and Finishing**



**Figure 9-4. End-of-Pipe Treatment Train for Options 5 and 6 Considered for the Following Subcategories: Oily Wastes and Railroad Line Maintenance**



**Figure 9-5. End-of-Pipe Treatment Train for Option 7 and 8 Considered for the Following Subcategories: Oily Wastes, Railroad Line Maintenance, Shipbuilding Dry Dock**



**Figure 9-6. End-of-Pipe Treatment Train for Options 9 and 10 Considered for the Following Subcategories: Railroad Line Maintenance and Shipbuilding Dry Dock**

## **10.0 LIMITATIONS AND STANDARDS: DATA SELECTION AND CALCULATION**

This section describes the data sources, data selection, data conventions, and statistical methodology used by EPA in calculating the long-term averages, variability factors, and daily maximum limitations. The effluent limitations and standards<sup>1</sup> are based on long-term average effluent values and variability factors that account for variation in treatment performance within a particular treatment technology over time. As explained in the preamble to the rule, EPA is promulgating daily maximum limitations only for the Oily Wastes Subcategory. This section describes the data selection and calculations for the daily maximum limitations for total suspended solids (TSS) and oil and grease measured as *n*-hexane extractable material (O&G).

Section 10.1 gives a brief overview of data sources (a more detailed discussion is provided in Chapter 3) and describes EPA's evaluation and selection of episode data sets that are the basis of the limitations. Section 10.2 provides a more detailed discussion of the selection of the episodes and data for each pollutant. Section 10.3 presents the procedures for data aggregation. Section 10.4 provides an overview of the daily maximum limitations. Section 10.5 describes the procedures for and summary of the estimation of long-term averages, variability factors, and limitations. Section 10.6 presents an evaluation of the limitations.

### **10.1 Overview of Data Selection**

To develop the long-term averages, variability factors, and limitations, EPA used concentration data from facilities with the Option 6 technology in the Oily Wastes Subcategory. These data were collected from two sources, EPA's sampling episodes and self-monitoring data.

All sampling episodes were conducted using the EPA sampling and chemical analysis protocols as described in Section 3.3. Sampling episode reports maintained in the rulemaking record present the data collected during each sampling episode.

In comments on the proposal and from other sources, EPA received compliance monitoring data from industry. These data are sometimes referred to as 'Discharge Monitoring Report' (DMR) or self-monitoring data. EPA denoted these data with a 'D' appended to the 4-digit episode identifier, the same 4-digit number used for EPA sampling data at that facility. In the statistical analyses, the self-monitoring data are treated separately from the EPA sampling data. This practice is consistent with other guidelines and is used because the data tend to be associated with different time periods and/or analytical methods than EPA sampling data.

Following the 2001 proposal and 2002 NODA, EPA received many comments on its selection of facilities and datasets used as the basis of its limitations. In response to these comments, EPA revisited its selection of facilities operating the Option 6 technology in the Oily Wastes Subcategory. As discussed in Section 10.2, for the episode datasets that were used to

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<sup>1</sup>In the remainder of this chapter, references to 'limitations' includes 'standards.'

develop the final MP&M limitations, EPA performed a detailed review of the data and all supporting documentation accompanying the data. This was done to ensure that the selected data represent a facility's normal operating conditions and that the data accurately reflect the performance expected by the production method and treatment systems. Thus, EPA evaluated whether the data were collected while a facility was experiencing exceptional incidents (upsets).

EPA also examined the range of unit operations covered by the facilities. As part of its detailed review, EPA verified that it had selected facilities that generated wastewater that encompassed the unit operations that generated the most concentrated types of wastewater in the Oily Wastes Subcategory. (Section IV.A.3.6 of the preamble to the final rule identifies the unit operations in the Oily Wastes Subcategory.)

In evaluating the data for the rule, EPA relied on two major sources of data: sampling episode reports and data review narratives.

The sampling episode report (SER) describes the collection, analysis, and results of EPA's comprehensive sampling at a facility in support of effluent guidelines rulemakings. Each SER presents a general overview of facility operations, includes process diagrams of treatment operations, summarizes the sample fractions collected for each sample point, describes any deviations from the sampling and analysis plan, provides flow and production information, and lists the analytical data results. SERs are located in Sections 5.2 and 15.3 of the record.

The data review narratives (DRNs) present an assessment of the quality of the analytical (chemical) data, based upon a five-stage review process. The DRNs are included as an attachment to each SER. Because the data are the basis of the limitations, EPA determined that an additional evaluation of the laboratory submissions was appropriate. As a result of that evaluation, EPA confirmed that its previous determinations were appropriate for the TSS data and most oil and grease data. As explained in Section 10.2, EPA excluded some oil and grease data as a result of the evaluation. (See DCN 36500 in Section 28.5 of the record for a summary of the evaluation.)

## **10.2      Episode and Data Selection**

This section describes the episodes selected for EPA's evaluations of the technology option for the Oily Wastes Subcategory. Table 10-1 summarizes the episode and sample point selections, and Table 10-2 identifies the unit operations for each facility.

**Table 10-1****Oily Wastes Subcategory Oil/Water Separation**

<b>Episode No.</b>	<b>Treatment Type (specific information on treatment from LTA folders, batch vs. continuous)<sup>1,2</sup></b>	<b>Discharger Type (indirect/direct)</b>	<b>Type of Data (EPA sampling, industry sampling episode, comment data)</b>	<b>Influent Sampling Point</b>	<b>Effluent Sampling Point</b>	<b>Number of Effluent Data Points</b>
4471	Process: <b>Eq, skim, CE, O/W</b> , CPT, sed Batch vs. Cont: continuous Additives: <b>H<sub>2</sub>SO<sub>4</sub></b> , ferric chloride, lime, polymer Targets: unspecified Flow: unspecified	Indirect	EPA sampling	SP-1	SP-5	4
4851	Process: <b>API, eq, CE, skim</b> Batch vs. Cont: continuous Additives: <b>CO<sub>2</sub>, aluminum chloride</b> Targets: Oil and grease, metals, organics Flow: 9,900-12,000 gph during sampling	Indirect	EPA sampling	SP-11	SP-13	5
4872	Process: <b>CE, O/W</b> , oil cooking Batch vs. Cont: batch Additives: <b>H<sub>2</sub>SO<sub>4</sub>, NaOH, alum, polymer</b> Targets: Oil and grease Flow: design max 433,000 gal/batch × 2 batches/day; during sampling 433,133 gal/batch × 1 batch/day	Indirect	EPA sampling	SP-4	SP-5	3
4872D	Same as above	Indirect	Industry-supplied DMR data	N/A	SP-5	4
4876	Process: <b>CE, O/W, gravity flot</b> , DAF, oil cooking Batch vs. Cont: batch Additives: <b>polymer, alum, NaOH, H<sub>2</sub>SO<sub>4</sub></b> Targets: Oil and grease, TSS Flow: 152,000 gpd	Indirect	EPA sampling	SP-4	SP-5	5

**Table 10-1 (Continued)**

<b>Episode No.</b>	<b>Treatment Type (specific information on treatment from LTA folders, batch vs. continuous)<sup>1,2</sup></b>	<b>Discharger Type (indirect/direct)</b>	<b>Type of Data (EPA sampling, industry sampling episode, comment data)</b>	<b>Influent Sampling Point</b>	<b>Effluent Sampling Point</b>	<b>Number of Effluent Data Points</b>
4877	Process: <b>Eq, CE, O/W</b> , oil cooking Batch vs. Cont: batch Additives: <b>polymer, alum, NaOH, H<sub>2</sub>SO<sub>4</sub>, floc</b> Targets: unspecified Flow: 100,000-200,000 gpd	Indirect	EPA sampling	SP-4	SP-5	5

<sup>1</sup>Process abbreviations:

API = API separator  
 CE = chemical emulsion breaking  
 CPT = chemical precipitation  
 DAF = dissolved air flotation  
 Eq = flow equalization  
 Gravity flot = gravity flotation  
 O/W = oil/water separation  
 Sed = sedimentation  
 Skim = oil skimmer

<sup>2</sup>Treatment units or additives represented by the sampling points are in bold.



**Table 10-2****Unit Operations at Each Episode**

<b>Unit Operation</b>	<b>Description</b>	<b>4471</b>	<b>4851<sup>a</sup></b>	<b>4872/ 4872D<sup>b</sup></b>	<b>4876</b>	<b>4877</b>
01	Abrasive Blasting	dry	dry			X
05	Alkaline Cleaning for Oil Removal	X	X	X	X	
07	Alkaline Treatment Without Cyanide					
10	Aqueous Degreasing		X	dry		X
11	Assembly/Disassembly	dry	X	dry	X	dry
12	Barrel Finishing					
13	Burnishing					
17	Corrosion Preventative Coating	X				
18	Electrical Discharge Machining					
26	Floor Cleaning		X	X	X	X
27	Grinding	X		X	X	X
28	Heat Treating	X		zero		
29	Impact Deformation		dry	X		X
30	Machining	X	X	X	X	X
32	Painting (Spray or Brush)	X	dry	zero		zero
35	Polishing			X		
36	Pressure Deformation					
39	Solvent Degreasing		X			
42	Testing (Such as Hydrostatic, Dye Penetrant, Ultrasonic, Magnetic Flux)	X	X		X	X
43	Thermal Cutting					
44	Washing of Final Products		X	X		
45	Welding	dry	dry	dry		
46OR	Wet Air Pollution Control of Organic Constituents		zero			X
65	Steam Cleaning					
71	Adhesive Bonding					
72	Calibration					
	Iron Phosphate Conversion Coating	X				

<sup>a</sup>4851 also performs chromium and nickel electroplating (nonoily operations) where the wastes are contract hauled and plasma arc machining (a nonoily operation) but never discharged to the water table.

<sup>b</sup>4872 also has manganese phosphate coating and leaking hydraulic oil from machines.

As a first step, EPA reviewed all of its data from facilities with the Option 6 treatment in the Oily Wastes Subcategory. Table 10-1 identifies all of the episodes with Oily Wastes Subcategory oil/water separation treatability data in EPA's database. EPA has data from six different sampling episodes: five are EPA sampling episodes (4471, 4851, 4872, 4876, 4877) and one is industry-supplied DMR data (4872D). For the final rule, EPA based the oil and grease limitations on the data from Episodes 4872, 4872D, and 4877 and the TSS limitation on the data from Episode 4851. The following describes EPA's evaluation of each of the six episodes and its decisions to include or exclude the data. As shown in Table 10-2, these episodes encompass a variety of unit operations included in the Oily Wastes Subcategory.

Episode 4471 was conducted at a facility that manufactured magnum tractors for the farming industry. The facility's primary water-using unit operations included alkaline cleaning, grinding, heat treating, painting, and testing of the finished product. Episode 4471 operated chemical precipitation and sedimentation following the Option 6 technology. Consequently, the facility did not need to rely on the Option 6 technology alone to meet any discharge requirements, and most likely optimized oil and grease and TSS removals following during the chemical precipitation and solids separation step. Consequently, its Option 6 technology performance had removal rates of only 31 percent for TSS and 42 percent for oil and grease during the sampling episode. In contrast, the other facilities had removal rates of over 90 percent for TSS and oil and grease using the Option 6 technology. In addition, EPA measured oil and grease using a freon method, rather than a hexane extractable method used for the other episodes. As explained in the NODA, the sampling data in Phase 1 (this includes Episode 4471) had been analyzed by EPA Method 413.2, a method utilizing freon that was unlikely to produce comparable results to methods approved under 40 CFR 136 (such as EPA Method 413.1). Thus, EPA did not use these data in determining the final daily maximum oil and grease limitation, because the facility had not optimized its Option 6 technology (because it did not need to do so) and the oil and grease data were not measured by a method comparable to those approved at 40 CFR 136.

Episode 4851 was conducted at a facility that repaired and manufactured locomotives. The facility's primary water-using unit operations included alkaline cleaning, machining, and testing of the finished product. Episode 4851 operated the Option 6 technology and was used as the basis of the final TSS daily maximum limitation because this facility had the highest concentrations of TSS in the influent (except for Episode 4876, which EPA excluded as explained below). Episode 4851's average influent TSS concentration was 833 mg/L compared to the next highest TSS influent average of 219 mg/L at Episode 4872. Although this facility, on average, had concentrated TSS influent, it also had the lowest daily value for TSS in the influent that EPA observed in its sampling of facilities in this subcategory. Because EPA was concerned that this value might not represent normal operations for a facility that normally has concentrated TSS in its influent, it excluded this one value from its calculations of the limitation. In addition, EPA excluded all of the oil and grease effluent data based upon a review of the laboratory reports. Over the five-day period for the sampling episode, EPA collected 36 oil and grease samples at the effluent sample point. One sample (36240) broke and thus was not analyzed. For 31 other samples (36232-36239, 36241-36263), when EPA performed a final review of the

laboratory reports, it realized that the ongoing precision recoveries (OPR) were below the acceptable range of 79-144 percent that is specified in Method 1664. For the four remaining samples (36264-36267), EPA considered these values to be ‘minimum values’ because the matrix spike and its matrix sample duplicate (MS/MSD) recoveries were outside of the criteria in the method. For these reasons, EPA excluded the oil and grease data from Episode 4851.

Episodes 4872 and 4872D are from a facility that manufactured automotive parts, including axles, shafts, tubes, housings, and transmission gear sets. The facility’s unit operations included machining, polishing, impact deformation (punch pressing), heat treatment (carburizing and tempering), and washing of the components. The facility also performed manganese phosphate coating and painting operations. In general, based on information obtained from episode 4872, the facility generated approximately 70 percent of the daily process wastewater from 21 aqueous parts washers, and approximately 30 percent from 14 machining operations containing a 5-percent solution of machining coolant. Less than 1 percent of the wastewater flow was generated from minor water-producing operations, including the paint booth water curtain, the manganese phosphate coating operation, heat treatment, and leaking hydraulic oil from machines (tramp oil). Because this facility also commingles wastewater generated by CFR 433 operations (i.e., manganese phosphate coating) with wastewater generated by oily waste operations, it would be subject to 433 rather than 438<sup>2</sup>. However, EPA determined it was appropriate to retain this facility in its Part 438 limitations calculations because the commingled wastewater from this facility largely comprises wastewater generated from oily waste operations (>99 percent). Furthermore, EPA compared the influent concentrations of the regulated parameters at this facility with those at other oily waste facilities and found them to be comparable.

During the time periods of these episodes, this facility operated the Option 6 technology to treat its wastewater. As noted in Section 10.1, EPA has treated its self-monitoring data separately from the EPA sampling data. The data for the two episodes were collected about two years apart (1997 for the sampling episode and 1999 for the self-monitoring episode). EPA expects that some changes in process, production mix, volume of production, and wastewater treatment systems were likely to have occurred during the two-year period and has used the data as if they were from two different facilities. EPA also notes that the ranges of the daily oil and grease effluent concentrations were different for the two episodes, with Episode 4872 ranging from 44.8 to 57.1 mg/L and Episode 4872D ranging from 8.6 to 23.6 mg/L.

For Episode 4872, the treatment system consisted of a large batch tank in which the facility added emulsion breaking chemicals and then allowed the oil to separate from the water. The facility then discharged the water layer (i.e., the lower layer). Upon review of the operating procedures for this facility, EPA determined that the approach used to determine when to stop the draw-down was based solely on tank level, as opposed to being based on any type of measurement. While EPA has concerns about this approach and has incorporated costs in this rule for an upgrade to remove the subjectivity, EPA determined that the Episode 4872D data

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<sup>2</sup>See 438.2(b)

demonstrated that the system can achieve low concentrations of oil and grease when the treatment system is operated properly. For this reason, EPA has included all but one oil and grease value in calculating the limitation. EPA excluded the concentration value of 25.8 mg/L from the third grab sample (38970) on Day 1 of Episode 4872, because the MS/MSD percent recoveries were below the method criteria and the value is considered to be a minimum value. Because its field duplicate value was reported with a higher value of 65.9 mg/L and met the criteria in the data review guidelines, the field duplicate value was used in calculating the oil and grease limitation instead (i.e., sample 38970 was excluded). EPA also considered excluding the data value for the fourth grab sample (38971) on Day 1, because the MS percent recovery was below the method criteria and the relative percent difference (RPD) between the MS and its MSD also exceeded the method criteria. Despite these qualifiers, EPA decided to retain this sample because it was consistent with the value for its field duplicate (105 mg/L) which had met the method criteria.

Episode 4876 was conducted at a facility that manufactured engines for automobiles and light trucks. The primary wastewater generating operations at this facility included machining and grinding operations, which require a water-based cutting fluid. The facility also performed alkaline cleaning operations. Episode 4876 treated its wastewater using a DAF system following the Option 6 technology. When EPA reviewed these data in detail, it found that the facility appeared to be optimizing its Option 6 portion of the treatment technology for TSS removals, but not oil and grease. Because the system was not optimized for oil and grease removals (because the facility additionally used the DAF system for this purpose), EPA excluded those data in calculating the oil and grease limitation. Although the facility had a removal rate of 99 percent for TSS, EPA excluded the TSS effluent data values because EPA had collected daily grab samples at this sample point, rather than daily composite samples that EPA expects that facilities would use in complying with the final TSS daily maximum limitation<sup>3</sup>. As explained in Section 10.5, while it had excluded the data from its limitation calculations, EPA ultimately used these TSS data to evaluate the limitation.

Episode 4877 was conducted at a facility that manufactured and assembled automatic transmissions and chassis components. Manufacturing processes included machining, grinding, impact deformation, abrasive blasting, and aqueous degreasing of the metal components. The facility also performed painting operations; however, no wastewater was generated from painting. In general, the facility generated approximately 75 percent of its process wastewater from 60 aqueous parts washers and 20 percent from 18 machine coolant recirculation filtration systems (hydromation pits), containing a 4- to 12-percent solution of coolant used for machining and grinding operations. Miscellaneous wastewater sources such as floor washing, leaking hydraulic oil, and transmission oil from hydrostatic testing were included in the remaining 5 percent of the flow. This facility treated its wastewater using the Option 6 technology. In calculating the limitation, EPA excluded the oil and grease data from the second day because operation on that day was not representative of the normal operating conditions for

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<sup>3</sup> This system was a batch system that discharged over the course of 24 hours. EPA expects that facilities with this type of system would conduct continuous compliance monitoring.

Option 6 technology. As documented in the sampling episode report, on that day only, the operator failed to add the proper treatment chemicals. EPA also reviewed the laboratory reports and identified qualifiers on two of the effluent samples used to calculate the oil and grease limitation, but has included both results in calculating the oil and grease limitation. These samples were the third and fourth grab samples (39564 and 39565) collected on Day 1 of the sampling episode. For both samples, the RPD between the MS and its MSD exceeded the method criteria. In addition, the MSD recovery was below the method criteria for the fourth grab sample. In conjunction with those samples, EPA had collected field duplicates. The oil and grease limitation was calculated using daily values calculated from the average of each duplicate pair. When EPA calculated the daily value with the averages of each duplicate pair (see Section 10.3), it found virtually no difference if the qualified data were included or excluded. Because their inclusion results in a minutely higher daily value for Day 1, the values for samples 39564 and 39565 were included in calculating the limitations.

### **10.3      Data Aggregation**

In developing the limitations, EPA modeled daily data values rather than individual sample measurements. EPA's approach of aggregating multiple analytical results to obtain a single daily value is consistent with standard, conventional practice in environmental analytical work. This approach also gives one day's sampling information appropriate weight in determining effluent limitations and is consistent with requirements of NPDES regulations at 40 CFR 122 which define the daily discharge.

In some cases, EPA mathematically aggregated two or more samples to obtain a single value that could be used in other calculations. This occurred with field duplicates and grab samples collected over time to represent a single waste stream. Table 10-3 lists these values. Table 10-4 lists the influent and effluent data after these aggregations were completed and a single daily value was obtained for each day for each pollutant.

In all aggregation procedures, EPA considered the censoring type associated with the data. EPA considered measured values to be detected. In statistical terms, the censoring type for such data was 'noncensored' (NC). The Agency censored measurements reported as being less than some sample-specific detection limit (e.g., <10 mg/L) and considered them to be nondetected (ND). In the tables and data listings in this document and the rulemaking record, EPA uses the abbreviations NC and ND to indicate the censoring types. The data used as a basis for the final limitations are all NC and thus all aggregated results also are considered to be NC.

This subsection describes each of the different aggregation procedures. They are presented in the order that the aggregation was performed (i.e., field duplicates were aggregated first and grab samples second). Table 10-3 lists the effluent data before aggregation and Table 10-4 lists the daily influent and effluent values after any aggregation.

**Table 10-3****Effluent Data Before Aggregation<sup>a</sup>**

Pollutant	Episode	Sample Day	Original Sample	Corresponding Field Duplicate (if any)
			Concentration (mg/L)	Concentration (mg/L)
Oil and Grease	4872	1	23.1	50.8
			14.4	23.3
				65.9
			108.0	105.0
		2	89.6	
			54.5	
			21.1	
			14.1	
		3	33.2	
			63.1	
			68.2	
			57.9	
	4877	1	25.0	26.0
			21.0	15.0
			33.0	20.0
			20.0	32.0
		3	12.0	
			16.0	
			10.0	
			21.0	
		4	21.0	
			11.0	
			24.0	
			29.0	
		5	13.0	
			31.0	
			8.0	
			8.0	
TSS	4851	1	54.0	26.0
		2	40.0	30.0
		3	36.0	62.0

<sup>a</sup>This table includes only values that were later aggregated with other values. See Table 10-4 for all daily values.

**Table 10-4****Data After Aggregation (i.e., Daily Values)**

<b>Pollutant</b>	<b>Episode</b>	<b>Sample Day</b>	<b>Influent Daily Value (mg/L)</b>	<b>Effluent Daily Value (mg/L)</b>
Oil and Grease	4872	1	696	57.050
		2	2182	44.825
		3	502	55.600
	4872D	1		12.100
		2		23.600
		3		15.200
		4		8.640
	4877	1	557	24.000
		3	997	14.750
		4	544	21.250
		5	469	15.000
TSS	4851	1	1720	40.000
		2	508	35.000
		3	373	49.000
		4	615	48.000

**10.3.1 Aggregation of Field Duplicates**

During its sampling episodes, EPA collected field duplicates for quality control purposes. Generally, 10 percent of the number of samples collected were duplicated. Field duplicates are two samples collected for the same sampling point at the same time, assigned different sample numbers, and flagged as duplicates for a single sample point at a facility. Because the analytical data from each duplicate pair characterize the same conditions at that time at a single sampling point, EPA averaged the data to obtain one value for each duplicate pair. This aggregation step for the duplicate pairs was the first step in the aggregation procedures.

**10.3.2 Aggregation of Grab Samples**

During its sampling episodes, EPA collected two types of samples: grab and composite. For oil and grease, EPA collected four grab samples over the course of each day of sampling during each sampling episode. To obtain one value characterizing the oil and grease levels at the sample point on a single day, EPA arithmetically averaged the measurements to obtain a single value for the day. In developing the TSS limitation, EPA used the concentration values of daily composite samples from episode 4851, and thus, this aggregation step was not necessary.

## **10.4      Overview of Limitations**

The preceding subsections discuss the data selected as the basis for the limitations and the data aggregation procedures EPA used to obtain daily values in its calculations. This subsection provides a general overview of limitations.

The oil and grease and TSS limitations are provided as maximum daily discharge limitations. The definition provided in 40 CFR 122.2 states that the “maximum daily discharge limitation” is the “highest allowable daily discharge.” Daily discharge is defined as the “discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling.”

EPA did not establish monthly average limitations for oil and grease and TSS because a monthly average limitation would be based on the assumption that a facility would be required to monitor more frequently than once a month. For the rule, EPA has determined that one monthly monitoring event is sufficient; however, if permitting authorities choose to require more frequent monitoring for oil and grease and TSS, they may set monthly average limitations and standards based on their best professional judgement. (See, e.g., 40 CFR 430.24(a)(1), footnote b.)

The following three subsections describe EPA’s objective for daily maximum limitations, the selection of the percentile for those limitations, and compliance with final limitations. EPA has included this discussion in Section 10.0 because these fundamental concepts are often the subject of comments on EPA’s effluent guidelines regulations and in EPA’s contacts and correspondence with industry.

### **10.4.1      Objective**

In establishing daily maximum limitations, EPA’s objective is to restrict the discharges on a daily basis to a level that is achievable for a facility that targets its treatment at the long-term average. EPA acknowledges that variability around the long-term average results from normal operations. This variability means that occasionally facilities may discharge at a level that is lower than or greater than the long-term average. To allow for possibly higher daily discharges, EPA has established the daily maximum limitation. A facility that discharges consistently at a level near the daily maximum limitation would not be operating its treatment system to achieve the long-term average, which is part of EPA’s objective in establishing the daily maximum limitations. That is, targeting treatment to achieve the limitations may result in frequent values exceeding the limitations due to routine variability in treated effluent.

In estimating the limitations, EPA first determines an average performance level (the “option long-term average” discussed in Section 10.5) that a facility with well-designed and operated model technologies (that reflect the appropriate level of control) is capable of achieving. This long-term average is calculated from the data from the facilities using the model technologies for the option. EPA expects that all facilities subject to the final limitations will



design and operate their treatment systems to achieve the long-term average performance level on a consistent basis because facilities with well-designed and operated model technologies have demonstrated that this can be done.

Next, EPA determines an allowance for the variation in pollutant concentrations when wastewater is processed through extensive and well-designed treatment systems. This allowance incorporates all components of variability, including shipping, sampling, storage, and analytical variability. This allowance is incorporated into the limitations through the use of the variability factors that EPA calculated from the data from the facilities using the model technologies. If a facility operates its treatment system to achieve the relevant option long-term average, EPA expects the facility will be able to comply with the limitations. Variability factors assure that normal fluctuations in a facility's treatment are accounted for in the limitations. By accounting for these reasonable excursions above the long-term average, EPA's use of variability factors results in limitations that are generally well above the actual long-term averages.

EPA calculates the percentile used as a basis for the daily maximum limitation using the product of the long-term average and the daily variability factor. The following subsection describes EPA's rationale for selecting the 99th percentile as the basis for the daily maximum limitations.

#### **10.4.2 Selection of Percentiles**

EPA calculates limitations based upon percentiles chosen, on one hand, to be high enough to accommodate reasonably anticipated variability within control of the facility and, on the other hand, to be low enough to reflect a level of performance consistent with the Clean Water Act requirement that these effluent limitations be based on the "best" technologies. The daily maximum limitation is an estimate of the 99th percentile of the distribution of the daily measurements.

The 99th percentile does not relate to, or specify, the percentage of time a discharger operating the "best available" or "best available demonstrated" level of technology will meet (or not meet) the limitations. Rather, EPA used this percentile in developing the daily maximum limitation. If a facility is designed and operated to achieve the long-term averages on a consistent basis and the facility maintains adequate control of its processes and treatment systems, the allowance for variability provided in the daily maximum limitations is sufficient for the facility to meet the requirements of the rule. EPA used 99 percent to draw a line at a definite point in the statistical distributions (100 percent is not feasible because it represents an infinitely large value), while setting the percentile at a level that would ensure that operators work hard to establish and maintain the appropriate level of control. By targeting its treatment at the long-term average, a well-operated facility should be able to comply with the limitations at all times because EPA has incorporated an appropriate allowance for variability into the limitations.

In conjunction with the statistical methods, EPA performs an engineering review to verify that the limitations are reasonable based upon the design and expected operation of the

control technologies and the facility process conditions. As part of that review, EPA examines the range of performance by the facility datasets used to calculate the limitations. Some facility datasets demonstrate the best available technology. Other facility datasets may demonstrate the same technology, but not the best demonstrated design and operating conditions for that technology. For these facilities, EPA will evaluate the degree to which the facility can upgrade its design, operating, and maintenance conditions to meet the limitations. If such upgrades are not possible, then EPA will modify the limitations to reflect the lowest levels that the technologies can reasonably be expected to achieve.

### 10.4.3 Compliance with Limitations

EPA promulgates limitations with which facilities can comply at all times by properly operating and maintaining their processes and treatment technologies. EPA uses a percentile of a statistical distribution in developing the daily maximum limitation because statistical methods provide a logical and consistent framework for analyzing a set of effluent data and determining values from the data that form a reasonable basis for effluent limitations. EPA establishes the limitations on the basis of percentiles estimated using data from facilities with well-operated and controlled processes and treatment systems. However, because EPA uses a percentile basis, the issue of exceedances (i.e., values that exceed the limitations) or excursions is often raised in public comments on limitations. For example, comments often suggest that EPA include a provision that allows a facility to be considered in compliance with permit limitations if its discharge exceeds the daily maximum limitations one day out of 100. This issue was, in fact, raised in other rules, including EPA's final Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) rulemaking. EPA's general approach there for developing limitations based on percentiles is the same in this rule, and was upheld in Chemical Manufacturers Association v. U.S. Environmental Protection Agency, 870 F.2d 177, 230 (5th Cir. 1989). The Court determined that:

EPA reasonably concluded that the data points exceeding the 99th and 95th percentiles represent either quality-control problems or upsets because there can be no other explanation for these isolated and extremely high discharges. If these data points result from quality-control problems, the exceedances they represent are within the control of the plant. If, however, the data points represent exceedances beyond the control of the industry, the upset defense is available.

Id. at 230.

As that Court recognized, EPA's allowance for reasonably anticipated variability in its effluent limitations, coupled with the availability of the upset defense, reasonably accommodates acceptable excursions. Any further excursion allowances would go beyond the reasonable accommodation of variability and would jeopardize the effective control of pollutant discharges on a consistent basis and/or bog down administrative and enforcement proceedings in detailed fact-finding exercises, contrary to Congressional intent. See, as an example, Rep. No.

92-414, 92d Congress, 2d Sess. 64, reprinted in A Legislative History of the Water Pollution Control Act Amendments of 1972 at 1482; Legislative History of the Clean Water Act of 1977 at 464-65.

EPA expects that facilities will comply with promulgated limitations *at all times*. If an exceedance is caused by an upset condition, the facility would have an affirmative defense to an enforcement action if the requirements of 40 CFR 122.41(n) are met. If the exceedance is caused by a design or operational deficiency, then EPA has determined that the facility's performance does not represent the appropriate level of control. For promulgated limitations and standards, EPA has determined that such exceedances can be controlled by diligent process and wastewater treatment system operational practices such as frequent inspection and repair of equipment, use of back-up systems, and operator training and performance evaluations.

EPA recognizes that, as a result of the rule, some dischargers may need to improve treatment systems, process controls, and/or treatment system operations in order to consistently meet the effluent limitations. EPA believes that this consequence is consistent with the Clean Water Act statutory framework, which requires that discharge limitations reflect the best technology.

## 10.5 Calculation of the Limitations

This section discusses the calculation of the daily maximum limitations for TSS and oil and grease.

First, EPA calculated the episode long-term average and daily variability factor by using the modified delta-lognormal distribution (see Appendix E). Table 10-5 lists these episode-specific values.

**Table 10-5**

### **Episode Long-Term Averages and Daily Variability Factors**

Pollutant	Episode	Episode Long-Term Average (mg/L)	Episode Daily Variability Factor
Oil and grease	4872	52.6533	1.3489
	4872D	15.2101	2.4403
	4877	18.8921	1.7203
TSS	4851	43.1442	1.4312

Second, EPA calculated the option long-term average for a pollutant as the *median* of the episode-specific long-term averages for that pollutant. The median is the midpoint of the values ordered (i.e., ranked) from smallest to largest. For oil and grease, when the three

episode long-term averages are ordered, this midpoint value is 18.89 mg/L from Episode 4877. For TSS, this midpoint value is the same as the episode long-term average from Episode 4851.

Third, EPA selected the option daily variability factor. For oil and grease, EPA used the self-monitoring data, Episode 4872D, as the basis of the option daily variability factor. In the proposal and NODA, when EPA used multiple episodes as the basis of a limitation, it used the *mean* of the episode daily variability factors. That practice was consistent with EPA's development of limitations for other industries. However, for this pollutant in this subcategory, EPA has determined that it is appropriate to deviate from its normal practice, because each of the self-monitoring measurements were obtained several months apart (i.e., 2/23/99, 4/29/99, 8/11/99, and 10/28/99). As explained in the NODA, EPA intended to investigate whether autocorrelation was likely to be present in the data. When data are positively autocorrelated, it means that measurements taken at specific time intervals (such as 1 day or 2 days apart) are related. To determine autocorrelation in the data, many measurements for each pollutant would be required with values for every single day over an extended period of time. Despite its requests to industry, the data were not made available to EPA for Option 6 oily wastes effluent. However, by selecting the self-monitoring data, each measured several months apart, as the basis of the option daily variability factor, EPA has avoided the possibility of autocorrelation existing in the data used as a basis of the option daily variability factor for oil and grease. For TSS, the option daily variability factor is the same as the episode daily variability factor from Episode 4851, because EPA used the data from that facility as the basis for the limitation as explained in Section 10.2. While autocorrelation might exist in the Episode 4851 data, EPA selected a facility with high concentrations of TSS in the influent as the basis of the option daily variability factor. EPA notes that no facilities with the Option 6 technology with similar high concentrations of TSS influents provided any daily measurements of TSS effluent concentrations. From the information that EPA had available to it, EPA determined that the allowance for variability provided by the Episode 4851 data was sufficient and the limitation was demonstrated to be achievable, as described later in this subsection.

Fourth, EPA calculated each *daily maximum limitation* for a pollutant using the product of the option long-term average and the option daily variability factor. EPA rounded the limitation to two significant digits. The rounding procedure rounds up values of five and above, and rounds down values of four and below. Table 10-6 provides the option long-term average, option daily variability factor, and the daily maximum limitation.

## **10.6 Evaluation of the Limitations**

To evaluate the limitations, EPA compared the daily maximum limitations to all of the effluent data that it had received from facilities in the Oily Wastes Subcategory. In addition, EPA compared the values of the final daily maximum limitation to the values presented in the 2001 proposal and the 2002 NODA. The following subsections describe these evaluations.

**Table 10-6****Option Long-Term Averages, Daily Variability Factors, and Limitations**

<b>Pollutant</b>	<b>Option Long-Term Average (mg/L)</b>	<b>Option Daily Variability Factor</b>	<b>Daily Maximum Limitation (mg/L)</b>
Oil and grease	19	2.4	46
TSS	43	1.4	62

**10.6.1 Comparison to Data**

This section compares the daily maximum limitations to all of the data that EPA had available to it from the Oily Wastes Subcategory. In the following subsections, EPA first evaluated the TSS limitation and then the oil and grease limitation. In addition, EPA compared the data from each facility to both limitations, because it had received many comments stating that facilities would have difficulty complying with multiple limitations simultaneously. From its conclusions about the data comparisons, EPA has determined that the data do not support such assertions. As a result of the data comparisons and reviews described below, EPA has concluded that facilities that properly design and operate to achieve the option long-term average will be able to comply with the limitations.

**Total Suspended Solids Limitation**

For TSS, none of the daily values from Episode 4851 (i.e., the basis of the limitation) were greater than the daily maximum limitation of 62 mg/L. EPA performed this comparison to determine whether it used appropriate distributional assumptions for the data used to develop the limitations (i.e., whether the curves EPA used provide a reasonable “fit” to the actual effluent data<sup>4</sup> or if there was an engineering or process reason for an unusual discharge). As a result of this comparison, EPA determined that the distributional assumptions appear to be appropriate for these data. As a further evaluation of these limitations, EPA compared the individual measurements from field duplicate pairs and also found that none of the individual values were greater than the limitation.

EPA performed additional comparisons of the limitation to other EPA sampling data obtained from the Option 6 technology in the Oily Wastes Subcategory, although they were not used as a basis of the limitation. EPA compared the limitation to the TSS data values from Episode 4876 (see Section 10.2 for EPA’s reasons for excluding these data from its limitation

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<sup>4</sup>EPA believes that the fact that the Agency performs such an analysis before promulgating limitations might give the impression that EPA expects occasional exceedances of the limitations. This conclusion is *incorrect*. EPA promulgates limitations that facilities are capable of complying with at all times by properly operating and maintaining their treatment technologies.

calculations). Although this episode had more concentrated TSS influent than Episode 4851 (which was the basis for the limitation), all of its TSS effluent data values were considerably less than the daily maximum limitation. In addition, none of the individual measurements exceeded the option long-term average of 43 mg/L. For the episodes that EPA excluded from the limitations calculations because they had less concentrated influents (Episodes 4872, 4872D, and 4877), all of the daily values and individual values in each field duplicate pair were below the option long-term average, except for the data from the second sampling day during Episode 4877 when the facility did not add the proper treatment chemicals. During Episode 4471, the facility achieved levels lower than the limitation on three sampling days even though the facility had not optimized its treatment system. EPA notes that the single effluent value greater than the limitation was also greater than its corresponding influent value, and thus, the system did not demonstrate any removals of TSS on that day. (See DCNs 36000S and 36034 in Section 19.1 of the record and DCN 00573 in Section 5.2.32.1.)

EPA also compared the TSS limitation to the sampling episode and self-monitoring data obtained from three facilities (4819, 4820, and 4824) that treated oily wastes using ultrafiltration systems. The average influent concentrations at these facilities ranged from 128 mg/L to 10,100 mg/L. During the sampling episodes and their own self-monitoring, none of the facilities had average concentration values that were greater than 12 mg/L, which is substantially less than the option long-term average of 43 mg/L used in calculating the limitation. Furthermore, during EPA's sampling episodes, none of the effluent data values were greater than 17 mg/L.

EPA compared the TSS limitation to the data from Episode 7052P that operated DAF technology in addition to the Option 6 technology. The influent values ranged from 212 to 4440 mg/L. This facility demonstrated treatment performance levels below the option long-term average for each of the four days that the facility sampled.

As a further evaluation of its TSS daily maximum limitation, EPA examined TSS monitoring data provided by the questionnaire respondents that operated facilities in the Oily Wastes Subcategory, including two facilities that operated the Option 6 technology. Each facility provided the average of its TSS concentrations for one year, but not the individual measurements or the influent concentrations (because the questionnaire did not request this information). For both Option 6 facilities, the average TSS concentrations were below the daily maximum limitation as well as the long-term average. Other than these two facilities, the questionnaire respondents in the Oily Wastes Subcategory either reported that they used a different technology than Option 6 or did not provide TSS average concentrations. Except for two facilities, the reported TSS long-term averages were all less than the option long-term average. One of the two exceptions used a treatment technology that was less sophisticated than Option 6, and thus, it is to be expected that it would have a higher TSS average concentration than demonstrated by Option 6. The other exception operated a carbon adsorption and oil/water separation treatment system. Operated properly, this treatment technology is equivalent or better than the Option 6 technology. EPA did not receive sufficient information in the survey from this facility to conduct a detailed engineering analysis of their unit operations and treatment system. Using the limited information that it had, EPA compared this facility's unit operations and wastewater generating

operations to similar facilities in this subcategory, and found no factors that would prevent this facility from achieving the demonstrated TSS removal of Option 6. Furthermore, this facility did not provide comments to EPA stating that it would be unable to meet the TSS limitations in the proposed rule or the NODA. EPA considers that it may be possible that the carbon adsorption system was overloaded on one or more occasions resulting in large TSS discharges that affected the overall average TSS value reported by the facility. To ensure that the facility would be capable of complying with the limitation, EPA assigned a one-time unit upgrade cost to this facility which includes contractor fees, operator training, and additional treatment controls. With this cost for additional system optimization, the site should be able to comply with the daily maximum limitation.

### Oil and Grease Limitation

For oil and grease, EPA compared the daily maximum limitations to the data from Episodes 4872, 4872D, and 4877 which were used as the basis of the limitation. None of the daily values or even the individual values for grab samples from Episodes 4872D and 4877 were greater than the daily maximum limitation of 46 mg/L. For Episode 4872, EPA found some daily values (and values for individual grab samples) that were greater than the daily maximum limitation. While EPA recognizes that the data from this episode forms the technology basis of the oil and grease limitation, based upon its review of the data, EPA concluded that improvements to its system would optimize its treatment performance. Based upon this review, EPA also discussed the possibility of excluding these data from developing the daily maximum limitation because the data probably reflect less than optimal performance.<sup>5</sup> EPA decided to maintain a conservative approach by retaining these data in developing the limitation.<sup>6</sup> As a result of this comparison, EPA determined that the distributional assumptions appear to be appropriate for effluent data from the Option 6 technology.

EPA performed additional comparisons of the limitation to other EPA sampling data obtained from the Option 6 technology in the Oily Wastes Subcategory, although the data were not used as a basis of the limitation. During Episode 4876, the system still achieved levels lower than the daily maximum limitation on two of the sampling days although it was not optimized for oil and grease removals. Although EPA used most of the data from Episode 4877 in calculating the limitation, it had excluded the data for the second sampling day as explained in Section 10.2. This daily value was greater than the limitation, which is what EPA expects from a system operating without the proper treatment chemicals. EPA did not compare the Episode 4177 and 4851 data values to the limitation because any conclusions would have been hard to

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<sup>5</sup>A review of the treatment technology as this facility demonstrates that this facility lacks some parts of the Option 6 technology basis (i.e., skimmer).

<sup>6</sup>Because EPA did not include this facility in its sample for the questionnaire, it did not include costs for it in the rule. Also, as explained in Sections 11.0 and 12.0, EPA only estimated compliance costs and loadings reductions for facilities in its cost and loads model database. Had this been a costed facility, EPA would have included cost estimates for additional energy, labor and equipment for this facility to improve the operation of its current systems in order to comply with the daily maximum limitation.

interpret. As explained in Section 10.2, the data for Episode 4177 and 4851 were excluded due to concerns about the analytical method and the quality of the data. (See DCNs 36000S and 36034 in Section 19.1 of the record and DCN 00573 in Section 5.2.32.1.)

EPA also compared the oil and grease limitation to the sampling episode and self-monitoring data obtained from the three ultrafiltration facilities. Two facilities (4819 and 4820) had average effluent values that were less than the option long-term average of 19 mg/L used in calculating the limitation, and their daily effluent values during EPA's sampling episodes were all below the daily maximum limitation. These episodes had influent values ranging from 90 to 144 for Episode 4820 and 689 to 857 for Episode 4819. For the third facility (4824), EPA's sampling data had an average effluent value below the daily maximum limitation, although one daily value at 78 mg/L was greater than the limitation. During the sampling episode, the facility's oil and grease influent values ranged from 660 to 3670 mg/L. The self-monitoring data (4824D) for that facility had an average value of 47 mg/L, which is greater than the limitation. However, this facility demonstrated poor performance of the ultrafiltration system during EPA's sampling episode. It was only able to remove about half of the 5-day biochemical oxygen demand (BOD<sub>5</sub>) and chemical oxygen demand (COD) concentrations, resulting in effluent averages of 1390 mg/L and 5450 mg/L, respectively. Thus, because this facility did not achieve typical removal rates for pollutants generally well treated by ultrafiltration, EPA has determined that its concentrations of oil and grease are abnormally high and can be corrected by improved operations.

EPA compared the oil and grease limitation to the data from the DAF facility (Episode 7052P). The effluent average concentration was below the option long-term average, with each daily concentration having a value less than the daily maximum limitation. The influent levels ranged from 212 to 1020 mg/L.

As it had for TSS, EPA examined oil and grease monitoring data provided by the questionnaire respondents that operated facilities in the Oily Wastes Subcategory, including three facilities that operated the Option 6 technology. For two of the three Option 6 facilities, the average oil and grease concentrations were below the daily maximum limitation as well as the long-term average. For the third, the average oil and grease concentration was slightly above the long-term average (21 as compared to 19 mg/L), but well below the daily maximum limitation. In the questionnaire, the facility reported that it used Method 413.1 to measure oil and grease. Because EPA used only data measured by Method 1664 in developing the TSS limitation, the slight difference between the averages might be a result of the different solvents used in the two analytical methods or just normal variability that has been incorporated into the option daily variability factor. For the nonoption 6 facilities, the reported oil and grease long-term averages were all less than the option long-term average, except for the one facility that operated a less sophisticated treatment technology, resulting in a higher oil and grease average concentration value. In developing the rule, EPA also included costs for this facility to upgrade its treatment system to comply with the daily maximum limitation.



### Both Limitations

To respond to comments that stated that facilities would have difficulties complying with multiple limitations simultaneously, EPA compared the data from each facility to both limitations.

For facilities with the Option 6 technology for which EPA had daily data values for both TSS and oil and grease concentrations, only Episode 4872 had any daily values that were greater than the oil and grease daily limitation and none were greater than the TSS limitation. Thus, Episode 4872 was still able to treat its TSS and sometimes its oil and grease influent concentrations to low levels in the effluent, although, as explained above, it has not optimized its treatment system.

For facilities with the ultrafiltration technology, two had average effluent values that were below both limitations. Although the third facility had poor removals of key parameters including oil and grease, it still had adequate TSS removals and the average effluent values were less than the TSS limitation.

The facility with the DAF technology had daily concentration values below both limitations for each sampling day.

For the seven facilities that provided averages of their monitoring data in the questionnaire, only two reported effluent averages above either limitation. One facility operates a technology that is less sophisticated than Option 6, and thus, it is not surprising that its effluent is more concentrated than Option 6 levels. The other facility reports that it operates the Option 6 technology, but, while it was able to treat oil and grease to levels below detection, it had an average value greater than the TSS limitation. As explained above, EPA has incorporated costs into the rule for this facility to improve its operations.

#### **10.6.2 Comparison to Proposed and NODA Values**

EPA compared the TSS and oil and grease daily maximum limitations to the values in the 2001 proposed rule and the 2002 NODA. Table 10-7 shows the three sets of values. In the NODA, EPA requested comment on an approach that would select the higher value of the proposed and revised limitation. In general, the comments that EPA received did not address this approach, but rather focused on the data selection and achievability of the limitations. Thus, EPA has chosen to base the final limitations on its in-depth review of the episodes, as explained in Sections 10.1 and 10.2. As a result of these changes, the final oil and grease daily maximum limitation has a value that is greater than the proposed and NODA values; and the TSS daily maximum limitation has a value that is slightly less than the proposed and NODA values. EPA has determined that these are reasonable outcomes of its in-depth review of the data.

**Table 10-7****Daily Maximum Limitations: Proposal, NODA, and Final Rule**

<b>Pollutant</b>	<b>2001 Proposal</b>	<b>2002 NODA</b>	<b>Final Rule</b>
Oil and grease (mg/L)	27	45.9	46
TSS (mg/L)	63	63.0	62

## 11.0 COSTS OF TECHNOLOGY BASES FOR REGULATIONS

This section presents EPA's estimates of costs for the MP&M industry to comply with the technology options considered and described in Section 9.0. EPA estimated the compliance costs for each technology option in order to determine potential economic impacts on the industry. EPA also weighed these costs against the effluent reduction benefits resulting from each technology option. This section includes cost estimates for options and subcategorization schemes that EPA selected for promulgation and for those that EPA ultimately rejected. Section 12.0 presents Agency estimates of corresponding annual pollutant loadings and removals. The Agency is reporting estimates of potential economic impacts associated with the total estimated annualized costs of the regulation separately, in the Economic, Environmental, and Benefit Analysis of the Final Metal Products & Machinery Rule (EEBA).

Section 11.1 summarizes the costs associated with each stage of the regulation development process. The remainder of this section discusses the following information:

- Section 11.2: Selection and development of cost model inputs;
- Section 11.3: The methodology for estimating costs, including an overview of the cost model;
- Section 11.4: The specific methodology and assumptions used to estimate costs for the Notice of Data Availability (NODA) and for analyses after the NODA;
- Section 11.5: Design and cost elements for pollution prevention and end-of-pipe technologies;
- Section 11.6: Examples of how sites were allocated costs, from start to finish; and
- Section 11.7: References used in this section.

Tables are presented in the text and figures are located at the end of this section.

### 11.1 Summary of Costs

This subsection summarizes EPA's final capital, operating and maintenance (O&M), and annualized cost estimates for each final regulatory option. Table 11-1 summarizes the capital and O&M costs and Table 11-2 summarizes the annualized costs. These tables also present costs for each

**Table 11-1****Incremental Capital and O&M Costs**

Subcategory	Discharge Status	Options Evaluated Since Proposal	NODA Costs (\$2001)			Final Rule Costs (\$2001)			Technology Basis for Final Rule?
			Number of Sites	Capital Costs	O&M Costs	Number of Sites	Capital Costs	O&M Costs	
<b>General Metals</b>	Direct	Option 2	1,521	215,372,532	406,618,406	228	16,302,446	10,582,427	No
	Indirect	Option 2, 1 MGY cutoff	2,354	545,616,505	718,480,881	NA			No
		Upgrade Option	NA			429	65,548,547	36,159,912	No
		50% Local Limits	NA			628	95,760,054	40,732,283	No
<b>Metal Finishing Job Shops</b>	Direct	Option 2	24	6,136,725	3,952,333	NA			No
	Indirect	Option 2	1,270	252,665,620	167,585,291	NA			No
		Upgrade Option	NA			314	51,694,660	11,409,399	No
<b>Non-Chromium Anodizing</b>	Direct	Option 2 (model site)	35	21,726,209	35,625,488	19	2,473,423	6,584,137	No
	Indirect	Not Proposed	NA						No
<b>Printed Wiring Board</b>	Direct	Option 2	4	1,117,553	222,423	NA			No
	Indirect	Option 2	840	178,724,756	176,775,257	NA			No
		Upgrade Option	NA			354	51,588,250	17,942,002	
<b>Steel Forming and Finishing</b>	Direct	Option 2	41	12,089,100	28,744,590	Not Covered by MP&M			No
	Indirect	Option 2	112	19,399,831	22,760,945	Not Covered by MP&M			No
<b>Oily Wastes</b>	Direct	Option 6	2,749	14,578,563	34,841,549	2,382	6,505,602	13,110,283	Yes
	Indirect	Option 6, 2 MGY cutoff	288	16,338,598	94,408,489	NA			No

**Table 11-1 (Continued)**

Subcategory	Discharge Status	Options Evaluated Since Proposal	NODA Costs (\$2001)			Final Rule Costs (\$2001)			Technology Basis for Final Rule?
			Number of Sites	Capital Costs	O&M Costs	Number of Sites	Capital Costs	O&M Costs	
Railroad Line Maintenance	Direct	Option 10	31	5,941,283	3	NA			No
		Option 6	NA			9	See Footnote A		No
	Indirect	Not Proposed	NA						No
Shipbuilding Dry Dock	Direct	Option 10	6	601,172	3,152,880	6	See Footnote A		No
	Indirect	Not Proposed	NA						No

Source: EPA Costs & Loadings Model.

Note: Cost estimates presented in this table will not equal those presented in the EEBA. These estimates do not include costs for facilities that are projected to close in the baseline.

NA - Not applicable.

Footnote A - Based on DMR data received both from the model facilities and in comments, EPA considered the final removals to be negligible. Therefore, the Agency did not calculate exact final costs.

**Table 11-2****Incremental Annualized Costs**

Subcategory	Discharge Status	Options Evaluated Since Proposal	NODA Costs (\$2001)		Final Rule Costs (\$2001)		Option Promulgated?
			Number of Sites	Annualized Costs	Number of Sites	Annualized Costs	
<b>General Metals</b>	Direct	Option 2	1,521	431,321,635	228	12,452,318	No
	Indirect	Option 2, 1 MGY cutoff	2,354	781,063,094	NA		No
		Upgrade Option	NA		429	43,678,331	No
		50% Local Limits	NA		628	51,715,961	No
<b>Metal Finishing Job Shops</b>	Direct	Option 2	24	4,656,215	NA		No
	Indirect	Option 2	1,270	196,566,038	NA		No
		Upgrade Option	NA		314	17,338,777	No
<b>Non-Chromium Anodizing</b>	Direct	Option 2 (model site)	35	38,117,484	19	6,867,838	No
	Indirect	Not Proposed	NA				No
<b>Printed Wiring Board</b>	Direct	Option 2	4	350,606	NA		No
	Indirect	Option 2	840	197,274,986	NA		No
		Upgrade Option	NA		354	23,859,174	No
<b>Steel Forming and Finishing</b>	Direct	Option 2	41	30,131,210	Not Covered by MP&M		No
	Indirect	Option 2	112	24,986,106	Not Covered by MP&M		No
<b>Oily Wastes</b>	Direct	Option 6	2,749	36,513,710	2,382	13,856,475	Yes
	Indirect	Option 6, 2 MGY cutoff	288	96,282,526	NA		No
<b>Railroad Line Maintenance</b>	Direct	Option 10	31	681,469	NA		No
		Option 6	NA		9	See Footnote A	No
	Indirect	Not Proposed	NA				No

**Table 11-2 (Continued)**

Subcategory	Discharge Status	Options Evaluated Since Proposal	NODA Costs (\$2001)		Final Rule Costs (\$2001)		Option Promulgated?
			Number of Sites	Annualized Costs	Number of Sites	Annualized Costs	
Shipbuilding Dry Dock	Direct	Option 10	6	3,221,834	6	See Footnote A	No
	Indirect	Not Proposed	NA				No

Source: EPA Costs & Loadings Model.

Note: Cost estimates presented in this table will not equal those presented in the EEBA. These estimates do not include costs for facilities that are projected to close in the baseline.

NA - Not applicable.

Footnote A - Based on DMR data received both from the model facilities and in comments, EPA considered the final removals to be negligible. Therefore, the Agency did not calculate exact final costs.

option considered following proposal of the rule and compares EPA's final cost estimates to those presented in the NODA. Cost estimates presented in this section differ from those presented in the EEBA because of additional EEBA annual costs (e.g., taxes and amortization). In addition, the EEBA cost estimates exclude facilities that EPA projected will close in the baseline (i.e., facilities already financially stressed without the additional compliance costs associated with this rule). The remainder of this section discusses the methodology EPA used to calculate its final cost estimates. For a discussion of the costing methodology EPA used at NODA, see Section 16 of the rulemaking record.

## **11.2            Development of Cost Model Inputs**

This subsection describes the key inputs to the cost model: model sites, wastewater discharge parameters, pollutant concentrations, and technology in place. This section also discusses the data sources used to determine these parameters. Section 11.3 describes how the cost model uses the input data.

### **11.2.1        Model Site Development**

The Agency used a model-site approach to estimate costs for the water-discharging sites in the MP&M Point Source Category. A model site is an operating MP&M survey site whose regulatory status, and unit operation and treatment information were used as input to the cost model. EPA selected a site-by-site model approach to estimate compliance costs, as opposed to a more generalized approach, to better characterize the variability of both process water and wastewater discharges in the MP&M industry. EPA selected 915 model sites from the 1,563 sites returning surveys. EPA excluded sites if:

- The site's operations did not fall within the scope of this rulemaking;
- The site did not discharge wastewater (treated or untreated) to either a surface water or publicly owned treatment works (POTW); or
- The site did not supply sufficient technical data to estimate compliance costs and pollutant loading reductions associated with the technology options.

Each of the 915 facilities is considered a "model" facility for two reasons. First, because only a portion of the MP&M universe was surveyed, each facility represents a larger number of similar facilities in the overall industry population, as determined by its statistical survey weight. Section 3.0 discusses the development of survey weights. The surveyed sites represent an estimated industry population of more than 44,000 sites that discharge either directly to surface waters or indirectly through a POTW. Second, because only a portion of the MP&M universe was sampled, EPA used its sampling data to model an aggregated influent to treatment concentration for each survey site based on the survey subcategory and the unit operations the site performs. Section 12.0 discusses the use of unit operation sampling data. Additionally, the



Agency made engineering assumptions based on national information from standard engineering costing publications, equipment vendors, and industry-wide data. Thus, for any given model site, the estimated costs and loads may deviate from those that the site would actually incur. However, EPA considers the compliance costs to be accurate when evaluated on an industry-wide, aggregate basis.

### 11.2.2 Wastewater Streams and Flow Rates

EPA used wastewater discharge parameters (e.g., production rates, flow, and operation schedule) to calculate wastewater generation and discharge rates. The cost model uses these flow rates to estimate the capacity of treatment units needed for each wastewater stream. Using information from survey responses, follow-up letters, and phone calls, EPA first classified each process wastewater stream by the type of unit operation generating the wastewater (e.g., machining, electroplating, acid treatment). For each unit operation, EPA then determined production rate, operating schedule, wastewater discharge flow rate, and discharge destination. Some sites provided all the information needed for each wastewater stream, but others did not. EPA determined the wastewater discharge parameters as described below:

- **Production rate.** In survey responses, sites reported production rates in surface area processed, mass of metal removed, or air flow rate, depending on the unit operation. Production expressed in terms of surface area represented surface finishing or cleaning operations; mass of metal removed represented metal removal operations such as machining and grinding; and air flow rate represented air pollution control operations. For blank responses, EPA statistically imputed production rates using other data provided in the site's survey or by using data for similar unit operations reported in other MP&M surveys. The general methodology as well as specific production calculations can be found in DCN 36200 in Section 28.2 of the rulemaking record.
- **Operating schedule.** EPA used survey responses to represent the operating rate (hours per day (hpd) and days per year (dpy)) of each unit operation. For blank responses, EPA used the following:
  - The maximum hpd and dpy reported by the site for other unit operations, if reported by the site, or
  - The survey response for wastewater treatment system operating schedule, if the site provided a wastewater treatment operation schedule, or
  - 8 hpd and 260 dpy. This estimate represents the median work schedule for MP&M sites.

- Wastewater discharge flow rate.** For each process wastewater stream, most sites reported the total wastewater discharge flow rate from the unit operation and associated rinses. For sites that reported performing a unit operation but did not report a discharge flow rate, EPA statistically imputed wastewater flow rates using other data provided in the site's survey or by using data for similar unit operations reported in other MP&M surveys. The general methodology as well as specific calculations for sites' wastewater flow rates can be found in DCN 36200, in Section 28.2 of the rulemaking record.
- Discharge destination.** EPA used survey responses to determine the discharge destination of each unit operation (surface water, POTW, no discharge, contract haul, or other alternatives) and the level of treatment prior to discharge (none, pollution prevention, chemical precipitation, sedimentation, etc.). In many cases, a site had multiple discharge destinations. EPA assumed no costs would be incurred at baseline for wastewater streams not discharged to POTWs or surface waters (i.e., those contracted for off-site disposal, deep-well injected, discharged to septic systems, reused on site, or otherwise not discharged (recycled, evaporated, etc.)). For sites that did not report a discharge destination for some or all operations, EPA used other MP&M survey information (e.g., types of discharge permits, discharge destination of other unit operations, process flow diagrams) to determine the stream discharge destination. For details on determination of site discharge destination, see Section 24.6.1 of the rulemaking record, DCNs 17881, 17825, and 17826.

EPA then used the completed wastewater discharge information to create the first of three cost model input databases, Model Site Profile 1 (MSP1). Table 11-3 summarizes the information contained in MSP1.

**Table 11-3**  
**Information Contained in MSP1**

Field Name	Description
SiteID	Random Site Identification Number assigned by EPA.
UPNum	Unit operation number as reported in the survey. (See Section 4.0 for a list of unit operations performed at MP&M facilities.)
UPExt	Unit operation extension. Each unique unit operation was given a new extension (e.g., electroless nickel plating might be UP20-1 and electroless copper plating might be UP20-2).
UPRinse	Unit operation rinse indicator. "0" designates a unit operation, "R" designates a unit operation rinse.

**Table 11-3 (Continued)**

<b>Field Name</b>	<b>Description</b>
StreamID	A consolidation of the fields UPNum, UPRinse, and UPEExt used by the cost model (UPNum+UPRinse+"UPEExt).
SiteDest	Overall site wastewater discharge destination as determined by the survey.
Weights	Industry Weighting Factor; this number indicates how many sites the survey represents on a national basis (see Section 3.0 for more information).
FLOW	Unit operation discharge flow in gallons per hour.
PROD	Unit operation production in PNP per hour.
PNP	Production-normalizing parameter; standard cubic feet per minute, square feet, or pounds of metal removed depending on the unit operation.
PNF	Production-normalized flow, equivalent to FLOW/PROD.
HPD	Hours per day that the unit operation operates.
DPY	Days per year that the unit operation operates.
TANKVOL	Unit operation tank volume in gallons.
NUMUNITS	Number of individual units represented by the unit operation (e.g., 30 machines performing the same operation, operating the same hours and days, and using the same process chemicals would be represented by one unit operation in MSP1 but would have a numunits of 30).
BASEMET	Base metal of the part on which the operation is being performed.
METAPPL	Metal being applied by the unit operation (where appropriate).
DEST	Stream discharge destination as determined by the detailed unit operation information.
RinseCode	Rinse water code used to determine the level of pollution prevention currently in place at the site. Refer to Section 5.3.2.2 of the rulemaking record, DCN 15773, for specific code definitions.
Equipment Code	Equipment code used to determine the amount of equipment currently in place at the site. Refer to pollution prevention documentation for specific code definitions.
MCTIP	Indication of whether the stream has machine coolant treatment in place (yes/no).
IXTIP	Indication of whether the stream has ion exchange treatment in place (yes/no).
PCTIP	Indication of whether the stream has paint curtain treatment in place (yes/no).

### 11.2.3 Wastewater Pollutant Concentrations

EPA developed pollutant concentrations for the model sites' wastewater streams. The cost model tracks two concentrations for each wastewater stream: the baseline pollutant concentration and the post-compliance pollutant concentration. The baseline pollutant concentration represents what the site currently discharges. The post-compliance pollutant concentration represents what the site would discharge after installing the regulatory option technology.

EPA assigned each wastewater stream a baseline pollutant concentration for each pollutant of concern (POC) in the second input database named MSP2. The cost model used this

information to calculate both costs and pollutant loadings. The remainder of this section describes how the cost model used pollutant concentration data to estimate costs. Section 12.0 discusses how the cost model used these data to estimate pollutant loadings. Table 11-4 summarizes the information contained in MSP2.

**Table 11-4**  
**Information Contained in MSP2**

Field Name	Description
SiteID	Random Site Identification Number assigned by EPA.
StreamID	A consolidation of the fields UPNum, UPRinse, and UPEExt used by the cost model (UPNum+UPRinse+"-"+UPEExt).
PollCode	Pollutant identification code (e.g., CU, NA, TS). Refer to analytical data documentation (Section 5.3.2.2 of the rulemaking record, DCN 15773) for specific code definitions.
CHEM_NAM	Chemical Name (e.g., copper, sodium, total suspended solids). Refer to analytical data documentation for specific code definitions.
PollConc	Pollutant concentration as defined through analytical data (mg/L). Refer to Section 12.0 for concentration development information.

#### 11.2.4 Technology in Place

The term “technology in place” refers to those treatment technologies installed and operating at a model site. EPA recognizes the importance of identifying which wastewater streams were already being treated. For example, sites with technology in place that met or exceeded the option technology would incur no additional costs, and sites with some technology in place would need only parts of the option technology. Sites with technology in place that met or exceeded the option technology but did not treat all of the required streams with this technology would incur costs to increase capacity, if required. Therefore, EPA identified technology in place from survey responses, which documented the technology in place at the time of the survey response. EPA’s surveys cover two base years: 1989 and 1996. Because EPA has two base years for this industry, where EPA received updated TIP information up to the later base year of 1996, EPA incorporated this updated information in its analyses. The cost model used these data to determine what components of the option technology a site would need, as in Example 11-1 at the end of this section.

The regulatory options include two types of wastewater treatment: (1) in-process pollution prevention and source reduction (pollution prevention) and (2) end of pipe. EPA determined the technologies in place for all unit operations, both pollution prevention and end of pipe; however, some sites did not provide information on the pollution prevention technology in place. The following paragraphs describe in detail how EPA determined pollution prevention technologies in place for these sites.

### Determination of Pollution Prevention Technology In Place

Although both the 1989 and 1996 MP&M Detailed Surveys requested detailed information on end-of-pipe treatment in place, only the 1996 MP&M Detailed Survey requested information about a site's in-process pollution prevention technologies. Where available, EPA determined pollution prevention technology in place based on survey responses (e.g., for all 1996 survey respondents). For other model sites, the Agency determined pollution prevention technology in place based on other survey information. For example, EPA examined the model site's production-normalized flow rate (PNF). The PNF is the volume of wastewater generated per unit of production, as described in the following equation:

$$\text{PNF} = \frac{\text{FLOW}}{\text{PROD}} \quad (11-1)$$

where:

PNF = Production-normalized flow, gallons per ton;  
 FLOW = Annual wastewater discharge, gallons per year; and  
 PROD = Annual production, tons per year.

Generally, the less wastewater generated per volume of production, the better the pollution prevention technology in place. Therefore, if the site PNF was below the median PNF calculated for the industry for that pollution prevention technology, then EPA assumed the site had the pollution prevention technology in place. For example, if a 1989 survey site reported a machining wastewater stream with a PNF below the median PNF for centrifugation and pasteurization of machining coolants, then the Agency assumed that the model site had a machining coolant regeneration/recycling system in place. The median PNFs estimated for each technology are detailed in Section 24.6.1 of the rulemaking record, DCN 17885.

### Determination of Rinse Scheme Technology In Place

EPA used a similar method to determine which sites had efficient rinse schemes. For unit operations without the option rinse technology in place, EPA estimated costs to install and operate a two-stage countercurrent cascade rinse. EPA used the following parameters in designing rinse technology upgrades:

- **Rinse technology in place.** EPA determined which of the following rinse technologies sites had in place:
  - Two overflow rinse tanks,
  - One overflow rinse tank,
  - One stagnant tank followed by one overflow tank,
  - One spray rinse, or
  - Two-stage countercurrent cascade rinsing.

For sites that did not provide information on their rinse scheme, EPA classified their rinse type based on the PNF for the industry. First EPA calculated site-specific PNFs for all rinses with data. Next, the Agency calculated the median industry PNFs for each rinse type. Finally, EPA assigned each unknown stream a rinse type corresponding to the stream's PNF.

For more information on the median PNF calculations and the PNFs associated with each rinse type, see Section 24.6.1 of the rulemaking record, DCN 17885.

- **Tank volume.** The cost model uses unit operation tank volume as a design parameter for countercurrent cascade rinsing, but the Agency did not request this information in the surveys. EPA estimated additional tank volume needed based on the annual discharge flow rate.

EPA then estimated what new pollution prevention equipment a site would need to meet the regulatory option. Sites with countercurrent cascade rinsing in place would not require rinse upgrades. Sites with parts of countercurrent cascade rinsing, such as tanks but not enough piping, were allocated costs for the piping and pumps needed. Additional information on the rinse flow reduction methodology can be found in Section 24.6.1 of the rulemaking record, DCN 17885. Section 11.3.3 also discusses flow reduction methodology.

### **Determination of End-of-Pipe Technologies in Place**

EPA reviewed survey data for each model site to assess the end-of-pipe technologies in place (e.g., chemical reduction of chromium, sludge pressure filtration). EPA found some technologies in place that were not part of the regulatory options but achieve removals equivalent to the option technology. For example, the Agency considered vacuum filtration equivalent to pressure filtration for sludge dewatering. EPA also assumed that some sedimentation and oil treatment systems qualified as treatment in place for multiple options. For example, if a site had microfiltration in place for solids removal, EPA considered that equivalent treatment for either microfiltration or clarification. If a site had a clarifier in place, EPA considered it equivalent for clarification, but not for microfiltration. Table 11-5 lists the technologies that EPA considered equivalent to the option technologies. EPA also found technologies that it did not consider equivalent to option technologies. For example, EPA did not consider oil/water separation equivalent to dissolved air flotation in the advanced technology options. Conversely, the Agency considered dissolved air flotation to achieve equivalent or better pollutant removals than oil/water separation. EPA assumed that sites specifying only chemical precipitation also had a clarifier and vice versa. In addition, the Agency assumed sites with treatment systems in place have the associated chemical feed systems. Assumptions regarding treatment technologies in place at each model site are discussed in detail in Section 6.5, DCN 15799, and Section 24.6.1, DCN 17888, of the rulemaking record.

**Table 11-5****Treatment Technologies Considered Equivalent to the Option Technologies**

<b>Technology Specified by Option</b>	<b>Technologies Considered Equivalent or Better to the Option Technologies</b>
Chelated metals treatment	Chelated metals treatment
Chemical emulsion breaking and gravity oil/water separation	Chemical emulsion breaking and gravity oil/water separation Chemical emulsion breaking and gravity flotation Dissolved air flotation General oil water separation <sup>a</sup> Ultrafiltration
Chemical precipitation and sedimentation	Chemical precipitation Sites without chemical precipitation and (1) with ion exchange were assumed to have technology equivalent to chemical precipitation and clarification (2) with dissolved air flotation assumed to have technology equivalent to given chemical precipitation and clarification <sup>a</sup> (3) with pH adjustment and sludge dewatering/filter press were assumed to have technology equivalent to chemical precipitation, clarification, and sludge dewatering/filter press <sup>a</sup>
Chromium reduction	Chromium reduction
Clarification	Clarification Microfiltration Dissolved air flotation (where no other chemical precipitation is present) <sup>a</sup>
Cyanide reduction	Cyanide reduction Ion exchange
Dissolved air flotation	Dissolved air flotation Ultrafiltration
Filter press	Filter press Vacuum filtration
Microfiltration for solids removal	Microfiltration
Multimedia filtration	Multimedia filtration
Sludge dewatering	Sludge dewatering Gravity thickener Sludge settling tank
Ultrafiltration for oil removal	Ultrafiltration for oil removal

<sup>a</sup>These technologies are considered equivalent only for the purpose of defining treatment in place, not as a proven method of meeting the final limits.

EPA also used survey data to determine the capacity of the end-of-pipe technologies in place at the model sites for the following parameters:

- **Operating schedule.** EPA used the operating schedule (hpd and dpy) for each treatment unit supplied by sites. For blank responses, EPA determined the schedule using the following:
  - The maximum hpd and dpy reported for other treatment units,
  - The maximum hpd and dpy reported for the unit operations, if all hpd and dpy responses for all treatment units were blank,
  - The maximum hpd and dpy reported by the site for other unit operations associated with other treatment units, or
  - 8 hpd and 260 dpy, if all hpd and dpy survey responses were blank for unit operations and treatment units.
- **Wastewater streams treated.** For blank responses, EPA determined which wastewater streams were treated by the technology in place using survey process flow diagrams or survey responses regarding the destination of individual process wastewater streams. If this information was not provided, EPA used the cost model logic described in Section 11.3 to help assign streams to technologies (e.g., EPA assumed that cyanide-bearing streams were treated through cyanide destruction, if the site currently had it in place).

EPA used the operating schedule and wastewater stream flows treated by the technology to define the capacity needed for each technology using the following equation:

$$V \times SA = \frac{Q}{HLR} \quad (11-2)$$

where:

V	=	Volume of tank needed, gallons;
SA	=	Surface area of tank, gallons per foot;
Q	=	Discharge flow, gallon per minute; and
HLR	=	Hydraulic loading rate. EPA set the HLR to 1,000 gallons per square foot per day.

The Agency determined design capacity from one of two flows: the survey-provided design capacity flow (when available) or the model design capacity flow as derived from the 122 percent of baseline flow. The methodology for calculating the model flow is



discussed in detail in Section 11.3.4. EPA also accounted for those sites that may need to increase wastewater treatment capacity as a result of the process changes associated with some of EPA's technology options. Section 11.3.4 presents how EPA accounted for baseline end-of-pipe technologies with insufficient capacity. Also, more details on capacity calculations are in Section 6.7, DCN 15902, and Section 24.6.1, DCN 17903, of the rulemaking record. All stream-by-stream treatment-in-place information was then incorporated into the final input database MSP3. Table 11-6 summarizes the information contained in MSP3.

**Table 11-6**  
**Information Contained in MSP3**

<b>Field Name</b>	<b>Description</b>
SiteID	Sited Identification Number assigned by EPA.
UPNum	Unit operation number as reported in the survey.
UPPrefix	Identifier that indicates if the UPNum refers to a unit operation, in-process pollution prevention operation, or treatment unit. EPA used this field to aid in the creation of MSP3 (e.g., UP or TU).
UPExt	Unit operation extension. Each unit operation was given a new extension (e.g., electroless nickel plating might be UP20-1 and electroless copper plating might be UP20-2).
OldExt	Field used in the creation of MSP1 and MSP3.
UPSuffix	Unit operation rinse indicator. "0" designates a unit operation, "R" designates a unit operation rinse.
StreamID	A consolidation of the fields UPNum, UPRinse, and UPExt used by the cost model (UPNum+UPRinse+"UPExt).
MODULE	Indicates which treatment units the site currently has in place.
HPD	Hours per day that the treatment unit operates.
DPY	Days per year that the treatment unit operates.
SITEDCF	The design capacity flow reported by the site in survey data (gph).
DCF	The design capacity flow populated during cost model operation. This is equivalent to the larger of the following: the sitedcf or a minimum dcf calculated in the cost model. Refer to cost model documentation (Section 24.6.1, DCN 17890) for complete DCF creation information (gph).

#### **11.2.4.1 Baseline Model Runs**

The baseline run simulated the current treatment practices at each model site. The cost model uses baseline costs to determine the incremental costs for each regulatory option. EPA first performed a baseline run of the cost model to determine the following parameters:

- Estimated baseline O&M costs incurred by sites in 2001 dollars;
- Estimated baseline non-water quality impacts such as electricity usage, sludge generation, and waste oil generation;

- Estimated baseline pollutant effluent concentrations (see Section 12.0); and
- Capacity flow rate of each wastewater treatment technology in place.

#### **11.2.4.2 Post-Compliance Model Runs**

Following the baseline model run, EPA then ran a post-compliance cost model run for each regulatory option. Each cost model run calculated the following values:

- Incremental capital investment costs incurred by sites in 2001 dollars;
- O&M costs incurred by sites in 2001 dollars;
- Non-water quality impacts such as electricity usage, sludge operation, and waste oil generation; and
- Pollutant loadings discharged after installation of the option technology (see Section 12.0).

EPA calculated incremental O&M costs as the difference between baseline and post-compliance, using the following equation:

$$\text{O\&M Costs}_{\text{Incremental}} = \text{O\&M Costs}_{\text{Treated}} - \text{O\&M Costs}_{\text{Baseline}} \quad (11-3)$$

EPA used the same methodology to calculate incremental values for non-water quality impacts and pollutant loadings.

#### **11.2.4.3 New Source Model Runs**

EPA also ran new source cost model runs for the General Metals, Metal Finishing Job Shops, Non-Chromium Anodizing, Printed Wiring Board, and Oily Wastes Subcategories. These runs estimated the costs a new source would incur in meeting the new source standards considered for Part 438. Model sites were used to calculate total construction and operating costs associated with a brand new treatment system consisting of the appropriate option technology. Each cost model run calculated the following values:

- Total, rather than incremental, capital investment costs incurred by sites in 2001;
- Total, rather than incremental, O&M costs incurred by sites in 2001 dollars;

- Total, rather than incremental, monitoring costs incurred by sites in 2001 dollars;
- Non-water quality impacts such as electricity usage, sludge operation, and waste oil generation; and
- Pollutant loadings discharged after installation of the option technology (see Section 12.0).

The model estimated total costs for new sources to meet the considered 438 limitations as follows:

Subcategory <sup>a</sup>	Discharge Destination	Number of MP&M Sites	Capital Costs (\$2001)	Annual Costs (\$2001)	Annualized Costs (\$2001)
General Metals	Direct	794	116,844,985	310,919,560	324,321,680
	Indirect	10,307	1,851,638,823	2,268,371,865	2,480,754,838
Metal Finishing Job Shops	Direct	12	5,546,098	2,612,444	3,248,581
	Indirect	1,542	372,340,073	276,027,559	318,734,965
Non-Chromium Anodizing	Direct	None Identified			
	Indirect	122	76,369,114	112,525,473	121,285,010
Printed Wiring Board	Direct	8	3,128,633	2,697,791	3,056,645
	Indirect	818	230,533,415	255,151,103	281,593,286
Oily Wastes	Direct	2,585	79,678,368	101,830,335	110,969,444
	Indirect	26,608	575,295,361	1,629,178,524	1,695,164,902

<sup>a</sup>EPA did not perform new source cost model runs for the Railroad Line Maintenance or Shipbuilding Dry Dock Subcategories because, as discussed in the preamble to the final rule, EPA determined that national regulation of discharges in these subcategories is unwarranted at this time.

Note that for metal-bearing subcategories, EPA then costed new sources to operate two separate chemical precipitation and solids separation steps in series. This was done to address concerns raised by commentors that single-stage precipitation and solids separation may not achieve sufficient removals for wastewaters that contain significant concentrations of a wide variety of metals that precipitate at disparate pH ranges. To calculate the addition of a second stage of treatment, EPA doubled the original treatment costs.

### 11.3 General Methodology for Estimating Costs of Treatment Technologies

This subsection discusses the methodology for estimating costs, including the components of cost (Section 11.3.1), the sources and standardization of cost data (Section 11.3.2), the cost model (Section 11.3.3), and assumptions made during the costing effort (Section 11.3.4).

### 11.3.1 Components of Cost

The components of the capital and annual costs and the terminology used in developing these costs are presented below.

#### Capital Investment Costs

The capital investment costs consist of two major components: direct capital costs and indirect capital costs. The direct capital costs include:

- Purchased equipment cost, including ancillary equipment (e.g., piping, valves, controllers);
- Delivery cost (based on the equipment weight and a shipping distance of 500 miles); and
- Installation/construction cost (including labor and site work).

EPA derived the direct components of the total capital cost separately for each treatment unit or pollution prevention technology. When possible, EPA obtained costs for various sizes of preassembled, skid-mounted treatment units from equipment vendors. If costs for these units were not available, EPA obtained catalog prices for individual system components (e.g., pumps, tanks, feed systems) and summed these prices to estimate the cost for the treatment unit.

Indirect capital costs consist of secondary containment, engineering, contingency, and contractor fees. These costs together with the direct capital costs form the total capital investment. EPA estimates the indirect costs as percentages of the total direct capital cost, as shown in Table 11-7.

#### Annual Costs

Annual costs include the following:

- **Raw material costs** - Chemicals and other materials used in the treatment processes (e.g., sodium hydroxide, sulfuric acid, sodium hypochlorite);
- **Operating labor and material costs** - The labor and materials directly associated with operation of the process equipment;
- **Maintenance labor and material costs** - The labor and materials required for repair and routine maintenance of the equipment;

- **Energy costs** - Calculated based on total energy requirements (in kiloWatt hours (kW-hrs)); and
- **Monitoring and analytical costs** - The periodic sampling and analysis of wastewater effluent samples to ensure that discharge limitations are being met.

**Table 11-7****Components of Total Capital Investment**

Item Number	Item	Cost	Source
1	Equipment capital costs including required accessories	Total equipment cost	MP&M cost model capital cost curves
2	Site work, including demolition, concrete repair, and build out	3% of total equipment cost	Attachment 1 (DCN 16027, Section 6.7.1)
3	Shipping cost, based on weight of equipment and 500-mile shipping radius	Technology-specific cost, see individual cost module	Attachment 2 (DCN 16027, Section 6.7.1)
4	Installation, based on estimated number of hours for each technology at a rate of \$29.67/hour	Technology-specific cost, see individual cost module	MP&M cost modules
5	Direct capital cost	Sum of items 1 through 4	
6	Engineering/administrative and legal costs	10% of item 5	Attachment 1 (DCN 16027, Section 6.7.1)
7	Secondary containment/land costs	10% of item 5	Attachment 3 (DCN 16027, Section 6.7.1)
8	Total plant cost	Sum of items 5 through 7	
9	Contingency	15% of item 8	Attachment 1 (DCN 16027, Section 6.7.1)
10	Contractor's fee	5% of item 8	Attachment 1 (DCN 16027, Section 6.7.1)
11	Total capital investment	Sum of items 8 through 10	

**11.3.1.1 Total Annualized Costs**

EPA calculated total annualized costs (TAC) from the capital and annual costs. The Agency assumed a 7-percent discount rate over an estimated 15-year equipment life, using the following equation:

$$\text{Annualized Cost} = (\text{Incremental Capital Cost}) \times 0.1147 + (\text{Incremental Annual Cost})(\mathbf{11-4})$$

### 11.3.2 Sources and Standardization of Cost Data

EPA obtained capital and annual cost data for the technologies that constitute EPA's technology options (see Section 9.0) from equipment vendors, literature, and MP&M sites. The Agency used specific data from the 1989 and 1996 MP&M Detailed Surveys whenever possible; however, the required types of data were often either not collected or not supplied by the sites. The major sources of capital cost data were equipment vendors, while the literature sources provided most of the annual cost information.

- **Capital Equipment.** EPA obtained information on capital equipment from vendors in 1998; specific cost estimates for technologies are included in Section 6.7.1 of the rulemaking record.
- **Chemicals.** EPA used the Chemical Marketing Reporter from December 1997 to obtain chemical prices (2). A list is in Section 6.7.1 of the rulemaking record, DCN 15890.
- **Water and Sewer Costs.** EPA based water and sewer use prices on average data collected through an EPA Internet search of various public utilities located throughout the United States for years ranging from 1996 to 1999. The average water and sewer use charges were \$2.03 per 1,000 gallons and \$2.25 per 1,000 gallons, respectively. The results of the Internet search can be found in Section 6.7.1 of the rulemaking record, DCN 15890.
- **Energy.** EPA used average electricity prices from the U.S. Department of Energy's Energy Information Administration. The average electrical cost to industrial users from 1994 to 1996 was \$0.047 per kW-hr (see Section 6.7.1 of the rulemaking record, DCN 15890).
- **Labor.** EPA used a labor rate of \$29.67 per hour to convert the labor requirements of each technology into annual costs. The Agency obtained the base labor rate from the Monthly Labor Review, which is published by the U.S. Bureau of Labor Statistics of the U.S. Department of Labor. Excluding the maximum and minimum values, EPA used the largest remaining monthly value for 1997 for production labor in the fabricated metals industry, \$12.90 per hour, as a conservative estimate. The Agency added 15 percent of the base labor rate for supervision and 100 percent for overhead to obtain the labor rate of \$29.67 per hour (3). See Section 6.7.1 of the rulemaking record, DCN 15890.
- **Off-Site Treatment/Disposal.** EPA estimated average costs of contracting for off-site waste treatment/disposal using data from the 1996 MP&M Detailed and Screener Surveys, as discussed in Section 11.4.4.

The Agency estimated costs to dispose of RCRA hazardous metal hydroxide sludge from Pollution Prevention and Control Technology for Plating Operations (4). Table 11-8 presents the treatment/disposal costs for various waste types. See Section 6.7.1 of the rulemaking record, DCN 16023.

- Monitoring Costs.** MP&M effluent monitoring costs were developed based on sampling frequency, the cost per analysis, and the labor to collect the samples. Monitoring costs vary depending on the current regulatory status of the facility. The following subsections describe the MP&M monitoring frequency requirements and the estimated incremental monitoring costs for each MP&M subcategory.

**Table 11-8**

**Costs for Contracted Off-Site Treatment/Disposal of Various Waste Types**

Waste Type	Cost (\$/gallon)
RCRA hazardous nonhazardous paint sludge	3.70
RCRA hazardous metal hydroxide sludge (3)	1.95
RCRA nonhazardous oil	0.86
Solvent (paint and paint stripping waste)	2.85
Oily wastewater	1.33
General metal-bearing wastewater	2.00
Cyanide-bearing wastewater	5.64
Hexavalent chromium-bearing wastewater	3.51
Chelated metal-bearing wastewater	1.40

Source: 1996 MP&M Detailed and Screener Surveys.

EPA standardized capital and annual cost data to 1996 dollars (the most current year for which EPA collected survey data). Final industry cost estimate numbers are then converted to 2001 dollars using the Engineering News-Record Construction Cost Index. For cases where EPA's information is not representative of 1996, EPA adjusted the cost estimates using RS Means Building Construction Historical Costs as shown in Table 11-9 (see Section 6.7.1 of the rulemaking record, DCN 15890).

**Table 11-9****RS Means Building Construction Historical Cost Indexes**

<b>Year</b>	<b>Index</b>
1989	92.1
1990	94.3
1991	96.8
1992	99.4
1993	101.7
1994	104.4
1995	107.6
1996	110.2
1997	112.8
1998	114.4

Source: Historical Cost Indexes, RS Means Building Construction Cost Data, 56th Annual Edition, 1998, page 594 (1).

**Monitoring Frequency for Metal-Bearing Subcategories**

When developing costs for the Part 438 effluent limits considered for the metal-bearing subcategories, EPA considered a monitoring frequency of once per week for regulated pollutants. EPA calculated the costs for the Part 438 limitations assuming the monitoring frequencies listed in Table 11-10. See Section 24.6.1 of the rulemaking record, DCN 17911.

**Sampling and Analysis Costs**

EPA developed sampling labor and equipment requirements based on its experience gained during the MP&M sampling episodes. The Agency determined laboratory analysis costs for each regulated pollutant by contacting PEL Laboratories in Tampa, Florida. Using the monitoring frequency, labor hours to collect samples, the loaded labor rate (\$29.67/hour), and the cost per analysis, EPA estimated the annual monitoring costs for various facilities.



**Table 11-10**

**Monitoring Frequencies Used to Develop Part 438 Limitations Considered  
for Metal-Bearing Subcategories**

Regulated Pollutant	Sample Type	Samples/week	Samples/month	Samples/year
Cadmium	Composite	1	4	48
Chromium	Composite	1	4	48
Copper	Composite	1	4	48
Lead	Composite	1	4	48
Nickel	Composite	1	4	48
Silver	Composite	1	4	48
Tin	Composite	1	4	48
Zinc	Composite	1	4	48
Cyanide (total)	Composite	1	4	48
Oil and grease (as HEM)	Grab	4	12	192
pH	Composite	1	4	48
Total Toxic Organic (TTO) parameter <sup>a</sup>	Grab	0	1	12

<sup>a</sup>Sum of volatile organics, semivolatile organics, pesticides and PCBs.

Incremental monitoring costs for metal-bearing MP&M facilities depended on their current regulatory status. Incremental costs for facilities currently regulated by Part 433 or assumed to be meeting Part 433 (e.g., direct-discharging facilities in the General Metals Subcategory) to comply with the limits considered for existing and new source Part 438 resulted from:

- Adding tin to the list of regulated pollutants;
- Lowering the effluent limit for lead, which requires analysis by graphite furnace atomic adsorption (\$28/sample) rather than inductively coupled plasma (\$20/sample); and
- Increasing the number of samples for oil and grease from one to four during each sampling event.

Incremental sampling labor costs result from the need to collect four oil and grease samples rather than one during the facility's daily processing period. The annual incremental monitoring cost for a Part 433 facility to comply with the limits considered for Part 438 were approximately \$22,000 for the metal-bearing subcategories (see Section 24.6.1 of the rulemaking record, DCN 17911). These incremental monitoring costs are conservative (e.g., some Part 433 facilities may be currently collecting four oil and grease grab samples per monitoring day and some that generate oily waste may have either implemented an Organics Management Plan or are already collecting 12 TTO samples per year).

Costs for new source facilities (not including existing facilities that become new source facilities) result from the purchase or rental of sampling equipment, sampling labor, and laboratory analysis. The monitoring and analytical cost for these new source facilities to comply with the considered effluent limits was \$41,000 for the metal-bearing subcategories (see Section 24.6.1 of the rulemaking record, DCN 17911).

### **Monitoring Frequency for Oil-Bearing Subcategories**

EPA evaluated monitoring frequency separately for the Oily Wastes, Railroad Line Maintenance, and Shipbuilding Dry Dock Subcategories due to the high percentage of survey- and comment-supplied DMR sampling data in each of these subcategories. One hundred percent of the direct discharging railroad line maintenance facilities supplied sampling data and some associated sampling frequency information. Ninety-two percent of the direct discharging oily wastes facilities, with treatment in place, supplied sampling data and some associated sampling frequency information. Fifty percent of the shipbuilding dry dock facilities supplied sampling data and some associated sampling frequency information.

Direct discharging MP&M facilities in the Oily Wastes Subcategory will be required to monitor their discharges for total suspended solids (TSS) and oil and grease. Based on the supplied information, for the Part 438 limitations, EPA calculated incremental monitoring costs assuming all direct discharging facilities are currently analyzing at least one TSS and oil and grease sample per month. Therefore, incremental monitoring costs for these facilities is zero<sup>1</sup>. Monitoring frequencies are determined by the permit writer and must be a minimum of once per year. The monitoring frequency specified in MP&M National Pollutant Discharge Elimination System (NPDES) permits will vary depending upon the size of the facility, potential impacts on receiving waters, compliance history, and other factors, including monitoring policies or regulations required by permit authorities. EPA encourages permit writers to require all facilities subject to the Part 438 limitations to collect a minimum of one TSS and oil and grease sample per month. Facilities may monitor more frequently than specified in their permits; however, the results must be reported in accordance with Part 122.41(1)(4)(ii) for direct dischargers.

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<sup>1</sup>Based on the information in its database, EPA concludes most facilities currently collect one sample per month. During EPA sampling events, EPA collected four grab samples at each sampling point each day. These samples were analyzed individually with the results composited mathematically to obtain a single daily concentration for each pollutant at each sampling point. While the final limitations are based on these composited values, the analytical method allows a facility to composite multiple grab samples prior to analysis. Therefore, analytical costs should remain constant for these facilities even if permit writers require them to collect a composite, rather than grab sample.

### 11.3.3 Development of the Cost Model

The cost model consists of the following programming components:

- Model shell;
- Model drivers;
- Data storage files; and
- Technology modules.

The model shell includes a program that creates various menus and user interfaces that accepts user inputs and passes them to the appropriate memory storage areas. The model drivers are programs that access technology modules in the proper order for each option and process model-generated data. Data storage files are databases that contain cost model input and output data. Information typically stored in data storage files includes:

- Flow, production, and operating data associated with each wastewater stream;
- Pollutant concentrations associated with each wastewater stream; and
- Site-specific data regarding existing technologies in place (discussed in Section 11.2.4).

Technology modules are programs that calculate costs and pollutant loadings for a particular pollution control technology. EPA developed cost modules for the pollution prevention and end-of-pipe technologies included in the regulatory options for the MP&M industry.

The technology drivers perform the following functions for each technology costed for a site (if applicable):

- Locate and open necessary input data files;
- Store input data entered by the user;
- Open and run the appropriate technology modules; and
- Calculate and track model outputs.

Table 11-11 lists the treatment technology modules that are used in the cost model. Section 11.5 discusses the technology modules.

In the context of the MP&M cost program, “model” refers to the overall computer program and “module” refers to a computer subroutine that generates costs and pollutant loadings for a specific in-process or end-of-pipe technology or practice (e.g., chemical precipitation and sedimentation, contract hauling). EPA adapted some modules from previous

EPA rulemaking efforts for the metals industry and developed others specifically for this rulemaking effort.

**Table 11-11**

**Wastewater Treatment Technologies and Source Reduction  
and Recycling Practices for Which EPA Developed Cost Modules**

In-Process Technologies and Practices	End-Of-Pipe Technologies and Practices
Countercurrent cascade rinsing Centrifugation and pasteurization of machining coolants	Chemical reduction of hexavalent chromium Cyanide destruction Chemical reduction of chelated metals Chemical emulsion breaking and gravity oil/water separation Chemical emulsion breaking and dissolved air flotation Gravity oil emulsion breaking (baseline only, see Section 11.3.4) Ultrafiltration for oil removal Contract hauling of solvent degreasing wastewaters Chemical precipitation Inclined clarification for solids removal Microfiltration for solids removal Sludge thickening Sludge pressure filtration Multimedia filter (baseline only, see Section 11.3.4)

Source: MP&M Surveys, MP&M Site Visits, Technical Literature.

### 11.3.3.1 Modeling Technology Options

The model drivers access technology modules in the proper order for each technology option (e.g., in-process flow control and pollution prevention followed by end-of-pipe treatment). The drivers' logic dictates which unit operations feed which treatment technologies. EPA assumed wastewater destination based on unit operation wastewater characteristics: cyanide-bearing wastewater feeds cyanide destruction and flowing rinses feed countercurrent cascade rinsing. Table 11-12 lists the assigned unit operations feeding each treatment technology. Note that a unit operation can feed more than one treatment technology or in-process pollution prevention technology. EPA assumed that the model sites commingled all MP&M wastewater generated for treatment by chemical precipitation, inclined clarification or microfiltration for solids removal, sludge thickening, and sludge pressure filtration, except for wastewater from the Oily Wastes, Shipbuilding Dry Dock, and Railroad Line Maintenance Subcategories, and except for solvent-bearing wastewater, for which EPA estimated costs for off-site disposal.

**Table 11-12**

**List of Unit Operations Feeding Each Treatment Unit  
or In-Process Technology**

Treatment Technology/Pollution Prevention Technology	Unit Operations Feeding Technology <sup>a</sup>
Countercurrent cascade rinsing	Acid treatment with chromium rinse
	Acid treatment without chromium rinse
	Alkaline cleaning for oil removal rinse
	Alkaline treatment with cyanide rinse
	Alkaline treatment without cyanide rinse
	Anodizing with chromium rinse
	Anodizing without chromium rinse
	Aqueous degreasing rinse
	Barrel finishing rinse
	Chemical conversion coating without chromium rinse
	Chemical milling rinse
	Chromate conversion coating rinse
	Corrosion preventive coating rinse
	Electrochemical machining rinse
	Electroless plating rinse
	Electrolytic cleaning rinse
	Electroplating with chromium rinse
	Electroplating with cyanide rinse
	Electroplating without chromium or cyanide rinse
	Electropolishing rinse
	Heat treating rinse
	Salt bath descaling rinse
	Solvent degreasing rinse
	Stripping (paint) rinse
	Stripping (metallic coating) rinse
	Testing rinse
	Washing finished products rinse
	Carbon black deposition rinse

**Table 11-12 (Continued)**

<b>Treatment Technology/Pollution Prevention Technology</b>	<b>Unit Operations Feeding Technology<sup>a</sup></b>
Countercurrent cascade rinsing (cont.)	Galvanizing/hot dip coating rinse
	Mechanical plating rinse
	Laundering rinse
	Cyanide rinsing
	Ultrasonic machining rinse
	Phosphor deposition rinse
Centrifugation and pasteurization of machining coolant	Multiple unit operation rinse
	Grinding
	Machining
Centrifugation of painting water curtains	Painting - spray or brush
	Painting - immersion
Chemical emulsion breaking and oil/water separation OR Dissolved air flotation OR Ultrafiltration system for oil removal	Alkaline cleaning for oil removal and rinse
	Alkaline treatment without cyanide
	Aqueous degreasing
	Assembly/disassembly
	Electrical discharge machining rinse
	Electrolytic cleaning
	Electroplating without chromium or cyanide
	Floor cleaning and rinse
	Grinding
	Grinding rinse
	Heat treating
	Impact deformation and rinse
	Machining and rinse
	Painting - spray or brush
	Painting - immersion
	Pressure deformation
	Steam cleaning rinse
	Stripping (paint)

**Table 11-12 (Continued)**

<b>Treatment Technology/Pollution Prevention Technology</b>	<b>Unit Operations Feeding Technology<sup>a</sup></b>
Chemical emulsion breaking and oil/water separation OR Dissolved air flotation OR Ultrafiltration system for oil removal	Stripping (metallic coating) rinse
	Testing
	Thermal cutting rinse
	Washing finished products and rinse
	Bilge water
	Mechanical plating
	Photo image developing
	Photo imaging
	Steam cleaning
	Vacuum impregnation
	Laundering
	Calibration
	Centrifugation and pasteurization of machining coolant
Chemical reduction of hexavalent chromium	Acid treatment with chromium and rinse
	Anodizing with chromium and rinse
	Chromate conversion coating and rinse
	Electroplating with chromium and rinse
	Stripping (paint)
	Wet air pollution control - chromium
	Chromium drag-out reduction and rinse
Chemical reduction of chelated metals	Electroless plating and rinse
Cyanide destruction	Alkaline treatment with cyanide and rinse
	Electroplating with cyanide and rinse
	Cyanide rinsing and rinse
	Cyanide drag-out destruction and rinse
	Wet air pollution control - cyanide
Solvent hauling	Solvent degreasing

<sup>a</sup>A unit operation can feed more than one treatment technology or in-process pollution prevention technology. EPA assumed that the model sites commingled all MP&M wastewater generated for treatment by chemical precipitation, inclined clarification or microfiltration for solids removal, sludge thickening, and sludge pressure filtration, except for wastewater from the Oily Wastes, Shipbuilding Dry Dock, and Railroad Line Maintenance Subcategories, and except for solvent-bearing wastewater, for which EPA estimated costs for off-site disposal.

### 11.3.3.2 Modeling Flow Reduction

Figure 11-2 shows the logic used by the cost model to apply the in-process flow reduction to each model site. EPA estimated flow reductions resulting from applying in-process pollution prevention technologies to any streams that did not already have the technology in place (see Section 11.2.4). The estimated flow reductions are as follows:

- EPA estimated a 20- to 80-percent flow reduction achieved by converting the current rinse scheme in place to countercurrent cascade rinsing (DCN 15993, Section 6.7.1 of the rulemaking record and Section 15.0 of this document and 1996 survey data). The flow reduction applied depends on the rinse scheme currently in place. An 80-percent flow reduction corresponds to converting a high-flow two-stage continuous overflow rinse to a two-stage countercurrent cascade rinse. A 20-percent flow reduction corresponds to converting a stagnant rinse followed by a continuous overflow rinse to a two-stage countercurrent cascade rinse. EPA computed the flow reductions based on information collected in the MP&M surveys.
- EPA assumed that centrifugation and pasteurization of machining coolants reduced coolant use by 80 percent (see Section 6.7.1 of the rulemaking record, DCN 15802). EPA assumed that a site combined all wastewater from machining operations prior to centrifugation and pasteurization of machining coolants.
- EPA assumed that centrifugation of painting water curtains allowed 100 percent reuse of the treated wastewater in the painting booth, or zero discharge (sludge removed from the centrifuge is contract hauled). EPA assumed a site combined wastewater from painting streams prior to paint curtain centrifugation.

### 11.3.3.3 Modeling End-of-Pipe Treatment for Metal Bearing Subcategories

The logic used by the model drivers to access end-of-pipe technologies varies depending on whether the subcategory is primarily metal bearing or oil bearing. Figure 11-3 presents the logic used by the cost model to apply the end-of-pipe treatment technologies and practices for the following metal-bearing wastewater subcategories: General Metals, Metal Finishing Job Shops, Non-Chromium Anodizing, Printed Wiring Board, and Steel Forming and Finishing. In developing costs, EPA assumed sites would segregate wastewater streams according to pollutant characteristics (chromium, cyanide, chelated metals, oil, and solvent). Segregating wastewater streams provides the most efficient and effective treatment of wastes. Because treating solvent-bearing waste streams may require Treatment Storage and Disposal (TS&D) permitting, EPA assumed model sites would contract for off-site disposal of solvent-bearing wastewater streams, while the other segregated wastewater streams would receive



preliminary treatment. The cost model assumed that effluent from preliminary treatment technologies would be combined with other wastewater streams that did not require preliminary treatment prior to estimating the cost of treating the combined wastewater. Model drivers also direct treatment unit order; for example, sludge from chemical precipitation goes to thickening and pressure filtration prior to off-site disposal. EPA assumed wastewater from chemical precipitation and sedimentation systems would be discharged to either a surface water or POTW according to the model site's current discharge destination (see Section 11.3.4 for general discharge status assumptions for sites with multiple discharge destinations).

#### **11.3.3.4 Modeling End-of-Pipe Treatment for Oily Subcategories**

The model drivers access modules to simulate oily wastewater treatment. Figure 11-4 presents the logic used to apply the end-of-pipe treatment technologies and pollution prevention practices for the Oily Wastes, Railroad Line Maintenance, and Shipbuilding Dry Dock Subcategories. Each of these subcategories generates wastewater that primarily contains oily constituents and low concentrations of dissolved metals; therefore, EPA did not include chemical precipitation and sedimentation following oil treatment for these subcategories.

#### **11.3.3.5 Model Output**

The model drivers track output including the following site-specific information for each technology:

- Total direct capital costs;
- Total direct annual costs;
- Electricity used and associated cost;
- Sludge generation and associated disposal costs;
- Waste oil generation and associated disposal costs;
- Water-use reduction and associated cost credit;
- Chemical usage reduction and associated cost credit;
- Effluent flow rate; and
- Effluent pollutant concentrations.

Section 11.6 discusses calculation specifics for each technology module.

### **11.3.4 General Assumptions Made During the Costing Effort**

This subsection presents general assumptions that EPA included in the cost model. Section 11.4 discusses specific assumptions made for NODA and post-NODA analyses. Section 11.6 discusses technology-specific assumptions.

### **Baseline Year Determination**

EPA estimated costs for the MP&M industry for the base years 1989 and 1996 (the years in which survey data were collected). The Agency included sites (or operations) that operated during the 1989 and 1996 calendar years in the cost and loadings analyses if the site operated at least one day during the respective calendar year. If a site (or operation) shut down before 1996, it was removed from the costing and pollutant loadings analyses. If a site (or operation) commenced after 1989 (Phase I) or 1996 (Phase II), EPA did not include the site (or operation) in the costing or pollutant loadings analyses. See Section 3.1 for additional information regarding EPA's use of 1996 as the base year for its analyses for this rule. Furthermore, if a site did not discharge wastewater to surface water or a POTW in 1989 (Phase I) or 1996 (Phase II) (e.g., was a zero or alternative discharger), then EPA excluded the site from the costing and pollutant loadings analysis.

If EPA has information that a Phase I site installed or significantly altered its wastewater treatment systems before 1996, EPA used the updated data. Also, if a site changed its discharge status before 1996, EPA used the updated discharge status in its analyses. Some sites provided information during the comment period that corrected information submitted with their survey. For example, a Phase 1 site may have completed its survey as having no treatment for oily discharges but submitted information during comment that it had installed treatment prior to 1996. In these cases, EPA revised the input data to reflect the corrected site information.

### **Capacity of End-of-Pipe Technology in Place**

For sites with technology in place, EPA assessed the design capacity flow for each treatment unit using the derived design capacity flow from the larger of two values: the site's reported survey design capacity flow or the flow calculated by the cost model baseline run, as described in Section 11.2.4, assuming the baseline flow is 78 percent of the design capacity flow. MP&M survey data indicate, on average, that flow entering the treatment units is 78 percent of the design flow reported by the survey respondent. Therefore, rather than assuming that the site is operating at 100 percent of the design capacity when survey information is unavailable, EPA assumed the site is operating at 78 percent of the design capacity. Therefore, flows can increase by as much as 22 percent over the current flow before either additional treatment capacity or contract hauling is required (see Section 6.7 of the rulemaking record, DCN 15902). The Agency determined the need for greater capacity using the following logic:

- If the technology was not in place at the model site, then EPA assigned capital costs to the site for a treatment unit of sufficient capacity.
- If the technology was in place at the model site with sufficient capacity to treat all of the applicable MP&M wastewater, then EPA assigned no additional capital costs.

- If the site had a technology in place equivalent to the option technology but with insufficient capacity to treat all the applicable MP&M wastewater, then EPA assumed the site would operate the existing system at full capacity. EPA assigned costs for the option technology train to run in parallel with the existing treatment to handle the additional flow.

### **Contracting for Off-Site Treatment/Disposal in Lieu of Treatment**

EPA assessed the cost to contract for off-site treatment/disposal of wastewater compared to on-site treatment. Because many MP&M sites have flow rates less than the minimum design capacity for treatment, EPA determined that some model sites would contract for off-site disposal of wastewater rather than treat it on site. If off-site disposal was less expensive than treatment on site, EPA assumed the site would dispose of the wastewater off site. EPA compared off-site disposal versus on-site treatment for individual technologies and their influent flow rates, rather than on the total site wastewater treatment system. For example, a site may find it less expensive to contract for off-site disposal of cyanide-bearing wastewater than to install and operate a cyanide destruction treatment system. However, it would still be less expensive to treat all other wastewater streams on site. To determine whether treatment on site was less expensive than contracting for off-site disposal, EPA compared total annualized costs assuming an equipment life expectancy of 15 years and an annual interest rate of 7 percent.

EPA used MP&M survey data to determine the unit cost (\$/gal or \$/lb) to contract for off-site treatment/disposal for various waste types (see Section 6.7.1 of the rulemaking record, DCN 16023). EPA compared the costs of the following technologies to contracting for off-site disposal in lieu of treatment costs:

- Centrifugation and pasteurization of machining coolants;
- Centrifugation of painting water curtains (general metal-bearing waste and paint sludge);
- Chemical reduction of hexavalent chromium;
- Cyanide destruction;
- Chemical reduction of chelated metals;
- Chemical emulsion breaking and gravity oil/water separation;
- Dissolved air flotation;
- Ultrafiltration for oil removal;

- Chemical precipitation and sedimentation; and
- Sludge pressure filtration.

In the case of wastewater requiring chemical precipitation and sedimentation treatment, EPA compared the costs of contracting for off-site disposal of the untreated end-of-pipe wastewater to the cost of the entire treatment system, which includes chemical precipitation, sedimentation (gravity clarification or microfiltration), sludge thickening, and pressure filtration.

### **Equipment Size Ranges**

EPA developed equipment cost equations for each component of the treatment technologies. The equations are valid between the minimum and maximum sizes (e.g., flow rates, volume capacities) from which EPA developed the equations. For wastewater capacities below the minimum range of validity, the cost model designed the equipment at the minimum size. For wastewater capacities above the maximum range of validity, the cost model designed multiple units of equal capacity to operate in parallel.

### **Batch Schedules**

EPA designed either batch or continuous systems, depending on each model site's operating schedule and discharge flow rate. The Agency also designed wastewater treatment operations such that the minimum system would be operated at capacity. For example, if the minimum cyanide destruction system was 480 gallons per batch, and a site generated 80 gallons of cyanide-bearing wastewater per day, then the cost model designed the cyanide destruction system to treat a 480-gallon batch once every six days.

### **Dilute Influent Concentrations**

In rare cases, high wastewater flow rates at some sites resulted in pollutant concentrations below the long-term average technology effectiveness concentrations (discussed in Section 10.0) even after flow reduction from in-process pollution prevention practices. In these cases, EPA assumed the site did not require treatment to meet the EPA option for that wastewater stream and therefore did not include end-of-pipe costs.

## **11.4 Specific Methodology and Assumptions Used to Estimate Costs for Treatment Technologies**

EPA made many changes in cost model assumptions and methodology made based on comments submitted during both the proposed rule and the NODA comment periods. This subsection describes the changes to proposal methodology and assumptions that EPA used to estimate both the costs presented in the NODA and those developed for the final rule. The methodology and assumptions used for the costs presented in the Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Metal Products & Machinery

Point Source Category (EPA 821-B-00-005) are discussed in that document. EPA updated information regarding unit operations, discharge status, operating schedule, and flow throughout the costing effort, based on industry comments and corrections to submitted survey data.

#### **11.4.1 NODA Cost Estimates**

For the costs presented in the NODA, EPA revised the following inputs and logic of the proposed cost model:

- Pollutant concentration;
- Subcategorization scheme;
- Discharge status;
- Wastewater treatment determination;
- Wastewater flow;
- Treatment modules;
- Statistical weighting factors; and
- Post processing.

EPA also added an option: upgrading treatment from 40 CFR 413 standards to those of 40 CFR 433. The remainder of this subsection describes all these changes in detail.

#### **Pollutant Concentrations**

EPA revised the calculation of pollutant concentrations from unit operations. First, the Agency incorporated additional data submitted with comments and from the Phase III sampling (see Section 3.0 for details on data sources). Next, EPA reclassified sampling data unit operations, including revising one sample point to be a drag-out rinse and adding more printed wiring board unit operations (see Section 12.0 for details). See Section 24.7 of the rulemaking record, DCN 17890, for details of these changes.

#### **Subcategorization Scheme**

In response to industry comments, EPA made the following adjustments to the subcategorization scheme for analyses presented in the NODA:

- Printed Wiring Board Assembly facilities in the Metal Finishing Job Shops Subcategory were moved to the General Metals Subcategory. Facilities that perform only Printed Wiring Board Assembly operations remained in the General Metals Subcategory.
- Printed Wiring Board Job Shops were moved from the Metal Finishing Job Shops Subcategory into the Printed Wiring Board Subcategory.

- Additional unit operations were included in the Oily Wastes Subcategory based on new sampling data and data submitted with comments.
- Zinc platers were defined and segregated from the General Metals and Metal Finishing Job Shops Subcategories for some analyses for EPA's consideration of a zinc platers subcategory or segment.

### **Discharge Status**

For NODA analyses, EPA revised the discharge status determination for sites submitting MP&M Phase I surveys to better reflect the MP&M Phase II discharge status hierarchy. The discharge status for all sites was thus based on the following assumptions:

- EPA considered a site with a direct discharging stream as direct, regardless of any indirect or zero-discharging streams (i.e., all streams at the site were considered to be direct);
- EPA considered a site with an indirect discharging stream and no direct streams as indirect, regardless of any zero-discharging streams; and
- EPA considered a site with no direct or indirect streams a contract-haul, reuse, or zero-discharge site.

### **Wastewater Treatment Determination**

EPA updated the treatment in place based on the following additional comment data and new assumptions:

- In response to industry comments, EPA considered end-of-pipe ion exchange equivalent to cyanide destruction for sites discharging cyanide-bearing wastewater. See Section 20.3 of the rulemaking record, DCN 17947, for the industry comment information.
- For sites responding to the Short and Municipality Surveys, EPA no longer considered neutralization/pH adjustment equivalent to chemical precipitation. EPA considered only neutralization/pH adjustment with clarification or sludge removal equivalent to chemical precipitation.
- EPA assumed that sites with baseline pollutant concentrations less than the option technology pollutant concentrations did not require any additional treatment.
- EPA verified cost model input database accuracy versus the site surveys and resolved inconsistencies, such as stream discharge destination.

## **Wastewater Flow**

EPA revised flow imputations for sites not reporting unit operation discharges. The sum of imputed flows was verified to be less than the total reported facility flow, where available. Additionally, EPA excluded recirculated flow from the imputation to reduce the potential for overinflated imputations. See Section 16.6.1 of the rulemaking record, DCN 27711.

## **Statistical Weighting Factors**

EPA incorporated new statistical weighting factors. The Agency adjusted some Phase I survey weights to account for additional zero dischargers and to exclude ineligible facilities. See Section 19.5 of the rulemaking record, DCN 36086.

## **Post Processing**

EPA adjusted model logic, allowing treatment costs to be estimated on individual wastestreams for the Railroad Line Maintenance and Steel Forming and Finishing Subcategories. EPA also allowed for cost savings from the addition of pollution prevention technologies.

## **40 CFR 413 to 433 Upgrade Analysis**

To consider the industry comment that the proposed standards were too stringent, EPA examined a new option: to upgrade from the 40 CFR 413 standards to 40 CFR 433 standards. EPA approximated compliance costs and load reductions associated with upgrading facilities from the Electroplating (40 CFR 413) rule to the Metal Finishing (40 CFR 433) rule. The 40 CFR 413 rule, promulgated in 1981, is based on older technology than the 40 CFR 433 rule, promulgated in 1983. Section 9.0 presents the option technology associated with the Part 413 to 433 Upgrade Analysis. Section 11.5 discusses how EPA estimated costs for each component of the option technology, and Section 12.0 discusses how EPA estimated the pollutant loadings reductions associated with the Upgrade Analysis.

### **11.4.2 Post-NODA Cost Estimates**

Following receipt of industry comment on the analyses presented in the NODA, EPA revised parts of the costing approach. The remainder of this subsection describes the changes made between the NODA and promulgation: how EPA incorporated new data received and revised assumptions and parts of the costing methodology.

## **Treatment Modules Updates**

EPA revised and updated treatment modules. Most notably, EPA added monitoring costs for tin, sulfide, and lead for all sites. EPA revised the off-site disposal methodology to haul nickel-bearing wastewater prior to chemical precipitation if the model determines not to treat via chemical precipitation and sedimentation. EPA also added costs for

sand (multimedia) filters as a technology option. For more details on these and other revisions, refer to Section 16.6.1, DCN 16741, and Section 24.6.1, DCN 17935, of the rulemaking record.

### **Discharge Status**

Post-NODA, EPA altered its discharge status determination to allow a site to have multiple discharge statuses (e.g., direct discharge, indirect discharge, and zero discharge). The approach was changed to more accurately reflect the actual site situation. At the time of the proposed rule and the NODA, EPA classified discharge status for an entire site, instead of each wastestream. For analyses after the NODA, EPA assigned a discharge status to each wastewater treatment system.

### **Flow Estimates**

EPA revised the flow imputation methodology used to estimate flows for sites that did not provide them. The new methodology allowed for zero discharge as a possible imputation result. See Section 28.2 of the rulemaking record, DCN 36200 for more detail on imputed flows.

### **Treatment in Place**

In response to industry comments to ensure proper consideration of the baseline treatment in place, EPA reconsidered additional treatment technologies equivalent to the option technologies:

- EPA now considers end-of-pipe and in-process ion exchange equivalent to cyanide destruction for cyanide-bearing wastestreams without any other cyanide treatment;
- EPA now considers end-of-pipe and in-process ion exchange equivalent to chemical precipitation plus a filter press for metals-bearing wastestreams without other metals treatment;
- Dissolved air flotation is considered equivalent to chemical precipitation treatment for metals-bearing wastestreams without other metals treatment for the 413 to 433 Upgrade option;
- Any type of oily wastewater treatment (e.g., belt skimming) is equivalent to chemical emulsion breaking and oil/water separation; and
- The presence of a holding tank and sludge removal after some chemical addition is now considered equivalent to chemical precipitation followed by clarification.



## **11.5 Costing Methodologies for Direct Discharging Oil-Bearing Subcategories**

Commentors supplied additional DMR and sampling data during the post-proposal and post-NODA comment periods. Due to the small number of model facilities in each of the oil-bearing subcategories and the high percentage of supplied DMR sampling data, EPA was able to use site-specific effluent discharge information as a major part of the costing process. (One hundred percent of the direct discharging railroad line maintenance facilities supplied sampling data and some associated sampling frequency information. Ninety-two percent of the direct discharging oily wastes facilities, with treatment in place, supplied sampling data and some associated sampling frequency information. Fifty percent of the shipbuilding dry dock facilities supplied sampling data and some associated sampling frequency information.) The methodology used in each of the oil-bearing subcategories is discussed below.

### **11.5.1 Oily Wastes Costing Methodology**

For the Oily Wastes Subcategory, EPA calculated the costs for the final rule through the following methodology. If a model site had provided DMR data, it was reviewed to determine baseline compliance with the final MP&M LTAs. If the data indicated the model site was currently meeting the LTAs, no additional costs were applied to the site. If the DMR data indicated the model site was not currently meeting the LTAs, and the survey indicated that the facility had Option 6 technology (or equivalent) in place, then the cost model output was reviewed. If the model determined that pollution prevention (P2) could be added to the site, then only P2 costs were assigned. It was assumed that adding P2 would lower the flow into the treatment system and help increase the system removals. If the site already had P2 in place, then a one-time upgrade cost was added. This upgrade cost was intended to help the facility better operate their treatment system through use of a consultant, subsequent operator training, and some additional treatment control equipment. The upgrade was considered a capital cost and totaled \$10,700 (\$2001). This is made up of the costs listed below (for more details on how each of these costs were derived, see DCN 17906 located in Section 24.6.1 of the rulemaking record):

- \$5,500 for consultant fees;
- \$2,200 for operation training; and
- \$3,000 for a new pH meter.

If the DMR data indicated the model site was not currently meeting the LTAs, and the survey indicated that the facility did not have Option 6 technology (or equivalent) in place, then the cost model output was used.

If the model site did not have DMR data, it was reviewed to determine the level of treatment in place. If the survey indicated the facility did have Option 6 technology (or equivalent) in place, then EPA set the baseline discharge concentrations to the median of the DMR data. Because the calculated medians for oil and grease and TSS were below the final MP&M LTA's, no additional costs were added. (Note that, if they had been above the final MP&M LTA's, then EPA would have added a one-time upgrade cost.) If the survey indicated

the facility did not have Option 6 technology (or equivalent) in place, then the cost model output was used.

### **11.5.2 Railroad Line Maintenance Costing Methodology**

For the Railroad Line Maintenance (RRLM) Subcategory, the AAR survey information discussed in Section 3.0 was used. Each survey contained information on effluent concentrations, flow, and treatment currently in place. The AAR surveys indicated that all direct discharging facilities in the RRLM Subcategory currently use wastewater treatment equivalent to or better than Option 6. Additionally, most of the facilities have NPDES daily maximum permit limitations for oil and grease (as HEM) and TSS as 15 and 45 mg/L, respectively. Based on this information, EPA concluded that these oil and grease (as HEM) and TSS daily maximum limits represent the average of the best performances of facilities utilizing Option 6 technology.

EPA evaluated the compliance costs associated with establishing BPT daily maximum limitations equivalent to 15 and 45 mg/L for oil and grease (as HEM) and TSS, respectively, and concluded all facilities currently meet a daily maximum oil and grease limit of 15 mg/L and most currently monitor once per month. With one exception, all facilities are currently meeting a TSS daily maximum limit of 45 mg/L. If EPA had decided to develop Part 438 limitations for this subcategory, it would have estimated incremental costs associated with bringing this one facility into compliance with the TSS limit.

### **11.5.3 Shipbuilding Dry Dock Costing Methodology**

No additional costs were estimated for this subcategory. Following proposal, EPA received comments and supporting data indicating that its estimates of current pollutant discharges from this subcategory were overestimated. In particular, commentors claimed that current discharges of oil and grease were minimal and that national regulation was not warranted for this subcategory. EPA incorporated the additional information provided by commentors into its analysis and now concludes that direct discharges from these facilities generally contain minimal levels of all pollutants. In particular, current oil and grease discharges from these facilities are not detectable (< 5 mg/L) or nearly not detectable. EPA has similarly determined that TSS discharges are, on average, minimal. The data show that TSS discharges may increase episodically, particularly when the dry dock is performing abrasive blasting operations. However, EPA has concluded that these episodic discharges from six facilities do not warrant national regulation. If EPA had decided to develop Part 438 limitations for this subcategory, it would have estimated incremental costs associated with lowering and/or controlling the episodic TSS discharges.

## **11.6 Design and Costs of Individual Pollution Control Technologies**

This subsection discusses in detail the design and costing of the individual technologies that compose the technology options. Table 11-13 presents the capital and annual cost equations for the specific equipment mentioned in each technology description below. When

tanks were a component of an option, EPA estimated that each wastestream would need only one tank, unless the technology required a reserve tank, such as chemical emulsion breaking. EPA estimated the tank volume needed based on Equation 11-2 in Section 11.2.4. The remainder of this subsection describes the tank requirements of each individual technology. Additional documentation is available in Section 24.6.1 of the rulemaking record, DCN 17885.

### **11.6.1 Countercurrent Cascade Rinsing**

The Agency estimated costs for countercurrent cascade rinses for flowing rinses at the model sites. The countercurrent cascade rinse module estimates a cost and flow reduction associated with the conversion to a two-stage countercurrent rinse. Section 15.2.4 gives more information on countercurrent cascade rinsing flow reduction as related to the site's existing rinse scheme.

EPA estimated capital and annual costs based on the model site's current rinse schemes. The module included capital and annual costs for the following equipment when necessary.

- A second rinse tank with a volume equal to the volume of the existing tank;
- Transfer pumps and piping; and
- An air-agitation system.

EPA assumed there would not be additional O&M costs for replacing the current rinse scheme with a two-stage countercurrent cascade rinse. Direct annual costs for this module included increased energy costs but a reduced water cost due to water-use reduction. EPA calculated the water savings obtained from converting the rinse to countercurrent cascade and used a water cost of \$2.03 per 1,000 gallons to subtract the cost savings from the site's total annual cost.

### **11.6.2 Centrifugation and Pasteurization of Machining Coolant**

EPA estimated costs for centrifugation and pasteurization of machining coolant for machining and grinding operations discharging water-soluble or emulsified coolant (listed in Table 11-13). EPA estimated the costs of a liquid-liquid separation centrifuge to remove solids and tramp oils and a pasteurization unit to reduce microbial growth. The costed systems included the following equipment in Table 11-13:

- High-speed, liquid-liquid separation centrifuge;
- Pasteurization unit; and
- Holding tanks for large-volume applications.

EPA provided a 50-percent excess capacity to account for fluctuations in production resulting from flow rates greater than 14 gallons per minute. The Agency developed capital and annual cost estimates from vendor data on packaged systems of different capacities. Direct annual costs included O&M labor and materials, energy costs, sludge and waste oil disposal costs, and a cost credit for water- and coolant-use reduction. EPA estimated maintenance labor at one hour per week and operating labor at one hour per shift.

Based on site visit and vendor information, EPA assumed that this technology can reduce coolant discharge by 80 percent. The Agency based the amount of coolant and water saved on the model site recycling 80 percent of the coolant and discharging a 20-percent blowdown stream to oil treatment. From site visit and vendor information, EPA estimated the coolant solution to be 95 percent water and 5 percent coolant.

### **11.6.3 Centrifugation of Painting Water Curtains**

EPA estimated costs for centrifugation of painting water curtains (listed in Table 11-13), which included a centrifuge and a holding tank large enough to hold flow for one hour. Direct annual costs included O&M labor and materials, energy costs, sludge disposal costs, and a cost credit for water-use reduction. EPA estimated maintenance labor at one hour per week and operating labor at one hour per shift.

EPA assumed that a model site reused all water discharged from the centrifugation system in painting operations, and contracted for off-site disposal of the sludge from the system. EPA estimated off-site disposal costs using the average paint sludge hauling costs reported in the 1996 MP&M Detailed Survey. Because actual disposal costs depend more on site-specific conditions (e.g., paint type and spray-gun cleaner requirements) than RCRA hazard classification, EPA estimated costs by averaging the costs for RCRA hazardous and nonhazardous paint sludges together. (See Table 11-14 for off-site disposal costs and Section 11.6.4 for more detailed information.)

**Table 11-13****MP&M Equipment Cost Equations<sup>a</sup>**

Equipment	Equation	Range of Validity
Countercurrent cascade rinsing	<b>A</b> = $[(0.0004 \times \text{TANKVOL} + 0.2243)] \times \text{DPY} \times \text{HPD} \times 0.047$ - $[(Y - \text{CCFLOW}) \times 60 \times \text{HPD} \times \text{DPY} \times 0.00203]$	
	<b>C</b> = $6.047 \times \text{TANKVOL} + 3,784.3$ ; Tank, piping, and pump	
	<b>C</b> = $0.5077 \times \text{TANKVOL} + 1077.8$ ; Piping and pump	
	<b>C</b> = $8 \times 29.67$ ; Labor only	
Machine coolant regeneration system (including holding tanks)	<b>A</b> = $[18 \times 0.047 \times \text{DPY} \times \text{HPD} \times \text{NUM}] + [(\text{HPD}/8) \times \text{DPY} \times 29.67 \times \text{NUM}] + [(\text{DPY}/5) \times 29.67 \times \text{NUM}] + [0.002 \times Y \times 60 \times \text{HPD} \times \text{DPY} \times 1.95] + [0.05 \times Y \times 60 \times \text{HPD} \times \text{DPY} \times 0.86] - [0.05 \times 0.80 \times Y \times 60 \times \text{HPD} \times \text{DPY} \times 9.03] - [0.95 \times 0.8 \times Y \times 60 \times \text{HPD} \times \text{DPY} \times 0.00203]$	$Y \leq 14$
	<b>C</b> = 41,422	$Y \leq 1$
	<b>C</b> = 110,205	$1 < Y \leq 2$
	<b>C</b> = 142,831	$2 < Y \leq 6$
	<b>C</b> = 164,009	$6 < Y \leq 10$
	<b>C</b> = 191,331	$10 < Y \leq 14$
Paint curtain centrifuge	<b>A</b> = $[0.047 \times \text{KW} \times \text{HPD} \times \text{DPY}] + [(\text{HPD}/8) \times \text{DPY} \times 29.67] + [(\text{DPY}/5) \times 29.67] + [\text{TSS} \times 3.785/106 \times 2.2/0.4 \times Y \times 60 \times \text{HPD} \times \text{DPY}/8.5 \times 3.7] - [(Y \times 60 \times \text{HPD} \times \text{DPY}) - (\text{TSS} \times 3.785/10^6 \times 2.2/0.4 \times Y \times 60 \times \text{HPD} \times \text{DPY}/8.35)] \times 0.00203$	$Y \leq 53$
	<b>C</b> = 7,254 (kW = 0.4)	$Y \leq 8$
	<b>C</b> = 10,325 (kW = 1.5)	$8 < Y \leq 13$
	<b>C</b> = 47,104 (kW = 2.2)	$13 < Y \leq 26$
	<b>C</b> = 62,936 (kW = 3.7)	$26 < Y \leq 53$

**Table 11-13 (Continued)**

Equipment	Equation	Range of Validity
Feed system, aluminum sulfate (alum)	$A = 0.35 \times 0.7456 \times \text{HPD} \times \text{DPY} \times 0.047$	$Y < 10$
	$C = 6,622$	$Y \leq 1$
	$C = 142.88 \times Y + 6,412$	$1 < Y < 10$
	$A = [1.36 \times \text{HPD} \times \text{DPY} \times 0.047] + [0.0006615 \times Y \times 60 \times \text{HPD} \times \text{DPY}] + [(\text{HPD}/8) \times \text{DPY} \times 29.67] + [(\text{DPY}/5) \times 29.67]$	$10 \leq Y < 350$
	$A = [1.49 \times \text{HPD} \times \text{DPY} \times 0.047] + [0.0006615 \times Y \times 60 \times \text{HPD} \times \text{DPY}] + [(\text{HPD}/8) \times \text{DPY} \times 29.67] + [(\text{DPY}/5) \times 29.67]$	$Y \geq 350$
	$C = 9.7882 \times Y + 9,718.7$	$10 \leq Y \leq 350$
Feed system, calcium chloride, continuous	$A = [[(0.0061 \times Y) + 1.1696] \times \text{HPD} \times \text{DPY} \times 0.047] + [0.00125 \times Y \times 60 \times \text{HPD} \times \text{DPY}]$	$Y \leq 350$
	$C = 10,299$	$Y \leq 10$
	$C = 28.805 \times Y + 10,683$	$10 < Y \leq 350$
Feed system, calcium hydroxide (lime), continuous	$A = 0.25 \times 0.7456 \times \text{HPD} \times \text{DPY} \times 0.047$	$Y < 10$
	$C = 8,489$	$Y \leq 1$
	$C = 47.713 \times Y + 8,445$	$1 < Y < 10$
	$A = [[(0.0006 \times Y) + 1.2961] \times \text{HPD} \times \text{DPY} \times 0.047] + [0.000117 \times Y \times 60 \times \text{HPD} \times \text{DPY}]$	$10 \leq Y \leq 350$
	$C = 24.586 \times Y + 12,830$	
Feed system, ferric sulfate, continuous	$A = 0.35 \times 0.7456 \times \text{HPD} \times \text{DPY} \times 0.047$	$Y < 10$
	$C = 5,200$	$Y \leq 1$
	$C = 52.991 \times Y + 5,118$	$1 < Y < 10$
	$A = [[(0.0009 \times Y) + 1.3313] \times \text{HPD} \times \text{DPY} \times 0.047] + [0.0000434 \times Y \times 60 \times \text{HPD} \times \text{DPY}]$	$10 \leq Y \leq 350$
	$C = 11.56 \times Y + 9,762.9$	

**Table 11-13 (Continued)**

Equipment	Equation	Range of Validity
Feed system, polymer	$A = [0.2833 \times \text{HPD} \times \text{DPY} \times 0.047] + [0.001 \times Y \times 60 \times \text{HPD} \times \text{DPY}]$	$Y < 10$
	$C = 3,686$	
	$A = [(0.0034 \times Y) + 1.4171] \times \text{HPD} \times \text{DPY} \times 0.047 + [0.001 \times Y \times 60 \times \text{HPD} \times \text{DPY}]$	$10 \leq Y \leq 350$
	$C = 20.685 \times Y + 9,822$	
Feed system, sodium hydroxide, continuous (caustic)	$A = [0.1864 \times \text{HPD} \times \text{DPY} \times 0.047] + [0.0042 \times Y \times 60 \times \text{HPD} \times \text{DPY}]$	$Y < 10$
	$C = 4,503$	
	$A = [(0.0071 \times Y) + 1.1584] \times \text{HPD} \times \text{DPY} \times 0.047 + [0.0042 \times Y \times 60 \times \text{HPD} \times \text{DPY}]$	$10 \leq Y \leq 350$
	$C = 77.564 \times Y + 21,506$	
Feed system, sulfuric acid	$A = [0.0373 \times \text{HPD} \times \text{DPY} \times 0.047] + [0.000222 \times Y \times 60 \times \text{HPD} \times \text{DPY}]$	$Y < 10$
	$C = 4,110$	
	$A = [(0.0023 \times Y) + 1.683] \times \text{HPD} \times \text{DPY} \times 0.047 + [0.000222 \times Y \times 60 \times \text{HPD} \times \text{DPY}]$	$10 \leq Y \leq 350$
	$C = 56.416 \times Y + 17,769$	
Chemical emulsion breaking, coalescent plate separator (gravity oil/water separator) [requires sulfuric acid, alum, caustic, and polymer feed systems]	$A = [(0.0019 \times Y + 2.009) \times 0.7456 \times \text{HPD} \times \text{DPY} \times 0.047] \times \text{NUM} + [29.67 \times (\text{HPD}/8) \times \text{DPY}] + [(\text{DPY}/5) \times 29.67] \times \text{NUM} + [3.664 \times Y \times \text{HPD} \times \text{DPY}]$	$Y \leq 8$
	$C = 42,261$	$Y \leq 2$
	$C = 3,916.2 \times Y + 30,278 + 2,452 \times Y + 1,132$	$2 < Y \leq 8$
	$A = [(0.096 \times Y + 2.039) \times 0.7456 \times \text{HPD} \times \text{DPY} \times 0.047] \times \text{NUM} + [29.67 \times (\text{HPD}/8) \times \text{DPY}] + [(\text{DPY}/5) \times 29.67] \times \text{NUM} + [3.664 \times Y \times \text{HPD} \times \text{DPY}]$	$8 < Y \leq 200$
	$C = 86,720$	$8 < Y \leq 15$
	$C = 845.43 \times Y + 65,284 + 2,452 \times Y + 1,132$	$15 < Y \leq 200$
	See ultrafiltration for oil removal.	$Y < 4.42$
Dissolved air flotation [requires lime, ferric sulfate, and polymer feed systems]	$A = [(0.0728 \times Y + 3.072) \times \text{HPD} \times \text{DPY} \times 0.047] + [0.0045 \times Y \times 60 \times \text{HPD} \times \text{DPY}] + [29.67 \times \text{HPD} \times \text{DPY}] + [(\text{DPY}/5) \times 29.67] + [0.86 \times 0.0003 \times Y \times 60 \times \text{HPD} \times \text{DPY}] + [0.86 \times 0.071 \times Y \times 60 \times \text{HPD} \times \text{DPY}]$	$4.42 \leq Y \leq 350$
	$C = 1,125.4 \times Y + 137,936$	

**Table 11-13 (Continued)**

Equipment	Equation	Range of Validity
Ultrafiltration for oil removal	$A = [(0.71 \times Y + 5.46) \times \text{HPD} \times \text{DPY} \times 0.047] + [0.4 \times Y + 0.3] + [0.5 \times \text{HPD} \times \text{DPY} \times 29.67] + [(\text{DPY}/5) \times 29.67] + [65.78 \times Y + 193.46] + [(27,123 \times Y / (24 \times 365 \times 60)) \times 0.86 \times 60 \times \text{HPD} \times \text{DPY}]$	$Y \leq 406$
	$C = 157,700$	$Y \leq 8$
	$C = 3,596 \times Y + 235,146$	$8 < Y \leq 406$
Batch oil-emulsion breaking with gravity flotation [requires sulfuric acid, alum, and polymer feed systems]	See dissolved air flotation.	$Y < 100$
	$A = [(0.65 \times Y + 49.7) \times \text{HPD} \times \text{DPY} \times 0.047] + [\text{HPD} \times \text{DPY} \times 29.67] + [(\text{DPY}/5) \times 29.67] + [0.022 \times Y \times 60 \times \text{HPD} \times \text{DPY} \times 0.86]$	$100 \leq Y \leq 300$
	$C = 17,204 \times Y + 2,000,000$	
Chromium reduction system, sodium metabisulfite	$A = [2.4225 \times \text{HPD} \times \text{DPY} \times 0.047] + [0.002608 \times Y \times 60 \times \text{HPD} \times \text{DPY}] + [(\text{HPD}/8) \times \text{DPY} \times 29.67] + [(\text{DPY}/5) \times 29.67]$	$Y \leq 45$
	$C = 20,892$	$Y \leq 1$
	$C = 261.7 \times Y + 24,249$	$1 < Y \leq 45$
Alkaline chlorination with hypochlorite feed system (for cyanide destruction)	$A = [4.845 \times \text{HPD} \times \text{DPY} \times 0.047] + [0.012418 \times Y \times \text{HPD} \times \text{DPY} \times 60] + [0.125 \times \text{HPD} \times \text{DPY} \times 29.67] + [(\text{DPY}/5) \times 29.67]$	$Y \leq 200$
	$C = 28,862$	$Y \leq 1$
	$C = 29,793 \times Y^{0.19}$	$1 < Y \leq 200$
Chelation breaking with dithiocarbamate treatment	$A = [2.4225 \times \text{HPD} \times \text{DPY} \times 0.047] + [0.000583 \times Y \times 60 \times \text{HPD} \times \text{DPY}] + [(\text{HPD}/8) \times \text{DPY} \times 29.67] + [(\text{DPY}/5) \times 29.67]$	$Y \leq 45$
	$C = 20,892$	$Y \leq 1$
	$C = 261.7 \times Y + 24,249$	$1 < Y \leq 45$



**Table 11-13 (Continued)**

Equipment	Equation	Range of Validity
Chemical precipitation [requires sulfuric acid, caustic, and polymer feed systems]	$A = [0.932 \times \text{HPD} \times \text{DPY} \times 0.047] + [(\text{DPY}/5) \times 29.67] + [(\text{HPD}/8) \times \text{DPY} \times 29.67]$	$Y < 5$
	$C = 8,900$	$Y \leq 0.5$
	$C = 626.6 \times Y + 8,550$	$0.5 < Y < 5$
	$A = [[(0.0571 \times Y) + 0.0123] \times \text{HPD} \times \text{DPY} \times 0.047] + [(\text{DPY}/5) \times 29.67] + [(\text{HPD}/8) \times \text{DPY} \times 29.67]$	$5 \leq Y \leq 350$
	$C = 784.54 \times Y + 34,216$	
Clarifier, slant-plate (lamella)	$A = 2 \times (\text{DPY}/5) \times 29.67$	$Y \leq 400$
	$C = 9,740$	$Y < 2$
	$C = 15,057$	$2 \leq Y < 10$
	$C = 74.896 \times Y + 31,401$	$10 \leq Y \leq 400$
Filtration, multimedia	$A = [[(0.0504 \times Y) + 1.0139] \times \text{HPD} \times \text{DPY} \times 0.047] + [(\text{HPD}/8) \times \text{DPY} \times 29.67] + [(\text{DPY}/5) \times 29.67]$	$Y \leq 800$
	$C = 35,115$	$Y \leq 15$
	$C = 240.85 \times Y + 27,269$	$15 < Y \leq 800$
Microfiltration system for metals removal	$A = [(0.3 \times Y + 6.3) \times \text{HPD} \times \text{DPY} \times 0.047] + [3.4 \times Y] + [0.5 \times \text{HPD} \times \text{DPY} \times 29.67] + [(\text{DPY}/5) \times 29.67] + [184.2 \times Y + 155.2]$	$Y \leq 400$
	$C = 74,081$	$Y \leq 5$
	$C = 1,728.3 \times Y + 69,337$	$5 < Y \leq 400$
Sludge thickening	$A = [0.246 \times \text{HPD} \times \text{DPY} \times 0.047] + [2 \times (\text{DPY}/5) \times 29.67]$	$Y < 0.5$
	$C = 74.306 \times Y \times 60 + 3,746$	
	$A = [3.7 \times \text{HPD} \times \text{DPY} \times 0.047] + [2 \times (\text{DPY}/5) \times 29.67]$	$0.5 \leq Y \leq 45$
	$C = 2334.8 \times Y + 77,429$	

**Table 11-13 (Continued)**

Equipment	Equation	Range of Validity
Filter press, plate-and-frame	$A = [(60 + (30 \times DPY \times 2)) \times NUM] + [FT3 \times DPY \times 7.48 \times 1.95]$	$CFT3 \leq 6$
	$A = [(60 + (60 \times DPY \times 2)) \times NUM] + [FT3 \times DPY \times 7.48 \times 1.95]$	$CFT3 \leq 12$
	$A = [(60 + (90 \times DPY \times 2)) \times NUM] + [FT3 \times DPY \times 7.48 \times 1.95]$	$CFT3 > 12$
	$C = [1,658.8 \times FT3] + 17,505$	$0.85 < FT3 \leq 76.5$

<sup>a</sup>All costs are calculated in 2001 dollars.

Variable Definitions:

- C - Direct capital costs (1996 dollars).
- A - Annual costs (1996 dollars).
- Y - Influent equipment flow (gallons per minute).
- HPD - Operating hours per day.
- DPY - Operating days per year.
- FT3 - Daily cake volume (FT<sup>3</sup>) from all presses.
- IPFLOW - GPH
- TANKVOL - Volume of countercurrent rinsing tank (gallons).
- CCFLOW - Flow rate after countercurrent rinsing is supplied (gallons per minute).
- kW - Kilowatts.
- CFT3 - Cake volume (FT<sup>3</sup>) per cycle per press (assume two cycles per day).
- NUM - Number of units.
- TSS - Influent TSS concentration (mg/L).

#### **11.6.4 Contracting for Off-Site Treatment and Disposal**

The Agency estimated costs for off-site treatment and disposal of various types of wastes generated on site. These waste types include:

- Painting and paint stripping/solvent wastewater;
- Paint sludge;
- Wastewater containing oil and grease and organic pollutants;
- Waste oils/sludges;
- Chromium-bearing wastewater;
- Cyanide-bearing wastewater;
- Chelated metal-bearing wastewater;
- General metal-bearing wastewater; and
- Metal-bearing sludge.

Except for F006 hazardous waste, EPA estimated costs for off-site transportation and treatment/disposal of each waste type in dollars per gallon of waste using averages of cost data provided in the 1996 MP&M Detailed Survey for off-site disposal of specific wastewater streams. EPA applied these costs throughout the cost model using the logic in Table 11-14.

#### **11.6.5 Feed Systems and Chemical Dosages**

Feed systems are components of almost every option technology. EPA developed three types of cost modules for feed systems: treatment-specific, generic, and low-flow. EPA determined dosage, equipment, and other design specifics for treatment-specific feed systems, whenever data were available. For feed systems with no specific information available, EPA developed a generic feed system module, using literature or engineering judgement to select dosages and equipment. For feed systems with low-flow treatment systems, EPA developed low-flow polymer, sodium hydroxide, sulfuric acid, alum, lime, and ferric sulfate feed modules, with lower fixed capital and energy costs for flow rates of less than 600 gallons per hour. EPA also developed lower energy costs for alum feed systems with flow rates below 350 gallons per minute. Table 11-15 lists the treatment technologies that use feed systems.

**Table 11-14****Logic Used for Off-Site Treatment and Disposal Cost Estimates**

Type of Waste	Estimated Cost	Data Source
Painting and paint stripping wastewater	\$2.85 per gallon	Costs for off-site disposal of solvent-bearing wastewater as reported in the 1996 MP&M Detailed Survey
Paint sludge generated by the painting water curtain centrifugation system	\$3.70 per gallon	Average values reported in the 1996 MP&M Detailed Surveys for hazardous and nonhazardous waste
Wastewater bearing oil and grease or other organic pollutants	\$1.33 per gallon	Values reported in the 1996 MP&M Detailed Survey
Waste oil generated by machining coolant centrifugation and pasteurization, chemical emulsion breaking and gravity oil/water separation, dissolved air flotation, and ultrafiltration	\$0.86 per gallon	Values reported in the 1996 MP&M Detailed Survey
Waste sludge generated by dissolved air flotation	\$0.86 per gallon	Values reported in the 1996 MP&M Detailed Survey
Hexavalent chromium-bearing wastewater	\$3.51 per gallon	Values reported in the 1996 MP&M Detailed Survey
Cyanide-bearing wastewater	\$5.64 per gallon	Values reported in the 1996 MP&M Detailed Survey
Chelated metal-bearing wastewater	\$1.40 per gallon	Values reported in the 1996 MP&M Detailed Survey
Metal-bearing wastewater	\$2.00 per gallon	Values reported in the 1996 MP&M Detailed Survey
Metal-bearing sludge, generated by the sludge pressure filtration system and the machining coolant centrifugation and pasteurization system	\$1.95 per gallon	The value reported in <u>Pollution Prevention and Control Technology for Plating Operations</u> (4) for F006 hazardous wastes

Additional details are provided in Section 6.7.1 of the rulemaking record, DCN 16023.

**Table 11-15****Treatment Technologies That Use Feed Systems**

<b>Treatment Technology</b>	<b>Feed Systems Required</b>
Chemical emulsion breaking and gravity oil/water separation	Sulfuric acid Polymer Alum
Dissolved air flotation	Lime Ferric sulfate Polymer
Batch oil emulsion breaking with gravity flotation	Polymer Sulfuric acid Alum
Chemical reduction of hexavalent chromium	Sulfuric acid Sodium metabisulfite
Cyanide destruction	Sodium hydroxide Sulfuric acid Sodium hypochlorite
Chemical reduction/precipitation of chelated metals	Sulfuric acid Dithiocarbamate
Chemical precipitation	Sulfuric acid Polymer Caustic

Sources: Pollution Prevention and Control Technology for Plating Operations (4) and MP&M Sampling Data.

To determine the required chemical dosage for each technology, the Agency used either the Pollution Prevention and Control Technology for Plating Operations (4) or chemical usage data from sampled MP&M sites with the option technology in place. Table 11-16 lists the chemical dosage used to estimate costs and the source from which the dosage was derived.

Capital and annual costs from feed systems were not reported individually in cost model outputs but were added into the overall treatment system capital and annual costs. The cost model included the capital and annual costs for the following equipment in the feed system capital costs:

- Raw material storage tank;
- Day storage tank with mixer;
- Chemical metering pumps;
- pH controller; and
- Supporting piping and valves.

**Table 11-16**  
**Treatment Dosage Information**

Feed system	Chemical Concentration Required (mg/L)	Data Source
Polymer feed system	20	(4)
Continuous sodium hydroxide feed system	1,685	(4)
Continuous hydrated lime feed system	376	(4)
Continuous sulfuric acid feed system	699	(4)
Continuous ferric sulfate feed system	74	(5)
Continuous aluminum sulfate (alum) feed system	648	(5)
Continuous calcium chloride feed system	830	(4)

Sources: Pollution Prevention and Control Technology for Plating Operations (4) and MP&M Sampling Data.

#### 11.6.6 Chemical Emulsion Breaking and Gravity Oil/Water Separation

EPA estimated costs for chemical emulsion breaking and gravity oil/water separation systems to separate and remove oil and grease and TSS. The Agency assumed that model sites commingled all oil-bearing wastewater streams prior to treatment. Table 11-12 lists the unit operations that discharge wastewater streams that feed oil removal treatment units.

For chemical emulsion breaking systems, the module included capital and annual costs for the following equipment:

- Flow equalization tank;
- Two emulsion breaking tanks;
- Two mixers;
- Sulfuric acid feed system (see Section 11.6.5);
- Polymer feed system (see Section 11.6.5);
- Alum feed system (see Section 11.6.5);
- Sodium hydroxide feed system (see Section 11.6.5); and
- Wastewater pumps.

Emulsion breaking was followed by oil removal using a coalescent plate separator. For oil removal systems, EPA estimated capital and annual costs for the following equipment:

- Feed pumps;
- Belt skimmer; and
- Oil/water separator.

Direct annual costs included O&M labor and materials, energy costs, raw materials (e.g., sulfuric acid, alum, polymer, sodium hydroxide), and waste oil disposal costs. EPA also included costs for off-site reclamation of waste oil. EPA also estimated waste oil generation to be 7.1 percent of the influent flow, based on MP&M survey data.

#### **11.6.7 Dissolved Air Flotation**

For the Shipbuilding Dry Dock Subcategory, EPA estimated costs for dissolved air flotation systems to separate and remove oil and grease, suspended solids, and organic pollutants. The Agency assumed that shipbuilding model sites commingled all oil-bearing wastewater streams prior to treatment.

The module included capital and annual costs for the following equipment:

- Flow equalization tank;
- Feed pumps;
- Oil/water separator;
- Chemical treatment tank;
- Lime feed system (see Section 11.6.5);
- Ferric sulfate feed system (see Section 11.6.5);
- Polymer feed system (see Section 11.6.5);
- Dissolved air flotation system with pressure tank and programmable logic controller (PLC);
- Oil storage tank; and
- Final pH adjustment tank.

Direct annual costs included O&M labor and materials, energy costs, raw materials (e.g., hydrated lime, ferric sulfate, polymer), and waste oil and sludge disposal costs. EPA also estimated costs for off-site reclamation of the waste oil and sludge. Hydrated lime and ferric sulfate flows were added to the discharge flow, while polymer volume was considered negligible. EPA estimated generation of waste oil and sludge as 7.1 and 0.03 percent of the influent flow, respectively, based on the MP&M survey data. Because dissolved air flotation systems are not typically used for flow rates of less than 265 gallons per hour (gph), EPA estimated costs for ultrafiltration oil removal for model sites with flows of less than 265 gph.

### **11.6.8 Ultrafiltration System for Oil Removal**

EPA estimated costs for ultrafiltration systems to separate and remove oil and grease, suspended solids, and organic pollutants. This technology differs from chemical emulsion breaking with oil/water separation, which was used to develop Option 6 costs (see 11.6.6). The Agency assumed that model sites commingled all oil-bearing wastewater streams prior to treatment and that flow rates greater than the maximum costed system (406 gallons per minute) required multiple systems.

The module included capital and annual costs for the following equipment:

- Spiral-wound membrane filtration modules;
- Process and chemical tanks;
- Steel skid;
- Recirculation tank;
- Recirculation pump;
- Bag filter;
- Fix-mounted cleaning system;
- Sludge pump; and
- Electrical components (pH control/monitoring, temperature control, flow meter, pressure gauges).

Direct annual costs included O&M labor and materials, energy costs, cleaning chemicals, membrane replacement, and waste oil disposal costs. EPA estimated costs for off-site reclamation of waste oil. EPA estimated waste oil generation as 5.2 percent of the influent flow, based on MP&M survey data.

### **11.6.9 Batch Oil Emulsion Breaking with Gravity Flotation**

EPA estimated costs for batch oil emulsion breaking with gravity flotation systems to separate and remove oil and grease, suspended solids, and organic pollutants. This technology differs from chemical emulsion breaking with oil/water separation, which was used to develop Option 6 costs (see 11.6.6). Gravity flotation uses a large tank, with oil recovered over weirs, and is typically seen at large sites such as automotive manufacturing. The Agency assumed that model sites commingled all oil-bearing wastewater streams prior to treatment.



Although batch emulsion breaking with gravity flotation is not part of the MP&M technology options, EPA estimated baseline operating costs and pollutant removals for sites that had this technology in place at baseline. The module included capital and annual costs for the following equipment:

- Polymer feed system (see Section 11.6.5);
- Sulfuric acid feed system (see Section 11.6.5);
- Alum feed system (see Section 11.6.5);
- Two mechanically cleaning bar screens;
- Three batch wastewater treatment tanks;
- Two segregated waste tanks;
- Three skim and saleable oil storage tanks;
- Two oil cooking tanks;
- Pumps;
- One air compressor;
- Six mixers (segregation, saleable oil, and oil cooker tanks); and
- Ancillary equipment (pipes and valves, heat trace, controls, and programmable logic controller (PLC)).

Direct annual costs included O&M labor, energy costs, raw materials (e.g., polymer, sulfuric acid, alum), and waste oil disposal costs. EPA also estimated costs for off-site reclamation of waste oil. Flows from sulfuric acid and alum were added to the treatment flow, while the polymer volume was considered negligible. EPA assumed the model sites discharged treatment effluent to the chemical precipitation and sedimentation system. EPA estimated generation of waste oil as 2.2 percent of the influent flow, based on MP&M survey data. This technology is typically used for flow rates of greater than 6,000 gallons per hour, whereas dissolved air flotation is used for flow rates of between 265 and 6,000 gallons per hour and ultrafiltration for oil removal for flow rates of less than 265 gallons per hour.

#### **11.6.10 Chemical Reduction of Hexavalent Chromium**

EPA estimated costs for batch and continuous systems to reduce hexavalent chromium to trivalent chromium prior to chemical precipitation and sedimentation. Note that the sedimentation portion of this treatment is discussed in Section 11.6.14. The Agency assumed that model sites commingled all chromium-bearing wastewater streams prior to treatment and that all chromium in the wastewater was in the hexavalent form.

The Agency estimated costs for batch treatment for flow rates of less than or equal to 600 gallons per day and continuous systems for flow rates of greater than 600 gallons per day. The module included capital and annual costs for the following equipment:

- Fiberglass reaction tank;
- Mixer;
- Sulfuric acid feed system;

- Sodium metabisulfate feed system;
- Flow equalization tank;
- Effluent pump; and
- pH and oxidation-reduction potential (ORP) meters.

Direct annual costs included O&M labor and materials, energy costs, and raw materials (e.g., sulfuric acid, sodium metabisulfite). EPA based flow-dependent costs on the volume of wastewater from chromium-bearing unit operations flowing into the system, before treatment chemicals were added to the flow. EPA assumed model sites discharged the treatment effluent to the chemical precipitation and sedimentation system.

#### **11.6.11 Cyanide Destruction**

EPA estimated costs for batch and continuous alkaline chlorination systems to destroy cyanide prior to chemical precipitation and sedimentation. The Agency assumed that model sites commingled all cyanide-bearing wastewater streams prior to treatment and did not send cyanide-free wastewater streams to the cyanide destruction system.

The Agency estimated costs for batch treatment for flow rates of less than or equal to 600 gallons per day and continuous systems for flow rates of greater than 600 gallons per day. The module included capital and annual costs for the following equipment:

- Two reaction tanks (batch treatment uses a single tank, with the second tank operating as a batch-holding tank);
- Mixers;
- Sodium hydroxide feed system;
- Sulfuric acid feed system;
- Sodium hypochlorite feed system;

- Effluent pumps; and
- pH and ORP meters.

Direct annual costs included O&M labor and materials, energy costs, and raw materials (e.g., sodium hydroxide, sulfuric acid, sodium hypochlorite). EPA based flow-dependent costs on the volume of wastewater from cyanide-bearing unit operation flowing into the system, before treatment chemicals were added to the flow. The Agency assumed model sites discharged the treatment effluent to the chemical precipitation and sedimentation system. EPA also assumed that all other pollutant concentrations remained unchanged in this treatment unit.

#### **11.6.12 Chemical Reduction/Precipitation of Chelated Metals**

EPA estimated costs for batch and continuous chemical reduction/precipitation of chelated metal systems to break and precipitate electroless plating complexes (e.g., copper or nickel complexes) prior to chemical precipitation and sedimentation. The Agency assumed that model sites commingled all chelated metal-bearing wastewater streams prior to treatment.

The Agency estimated costs for batch treatment for flow rates of less than or equal to 600 gallons per day and continuous systems for flow rates of greater than 600 gallons per day. The module included capital and annual costs for the following equipment:

- Fiberglass reaction tank;
- Mixer;
- Sulfuric acid feed system;
- Dithiocarbamate feed system (see Section 8.4.4);
- Flow equalization tank;
- Effluent pump; and
- pH and ORP meters.

Direct annual costs included O&M labor and materials, energy costs, and raw materials (e.g., sulfuric acid, dithiocarbamate). EPA based flow-dependent costs on the volume of wastewater from chelated metal-bearing unit operations flowing into the system, before treatment chemicals were added to the flow. The Agency assumed that model sites discharged treatment effluent to the chemical precipitation and sedimentation system. Based on analytical data for the systems EPA sampled, EPA assumed that concentrations of carbon disulfide and dithiocarbamate increased across the system.

#### **11.6.13 Chemical Precipitation**

The Agency estimated costs for continuous chemical precipitation systems. EPA estimated costs for low-flow systems for model sites with influent flow rates of less than or equal to 300 gallons per hour. EPA assumed that the model sites commingled all MP&M wastewater generated for treatment by this technology, except for wastewater from the Oily Wastes,

Shipbuilding Dry Dock, and Railroad Line Maintenance Subcategories. In addition, EPA assumed that sites would contract for off-site disposal of solvent-bearing wastewater.

The module included capital and annual costs for the following equipment:

- Sulfuric acid feed system (see Section 11.6.5);
- Polymer feed system (see Section 11.6.5);
- Caustic feed system (see Section 11.6.5);
- Equalization tank;
- Rapid-mix tank for precipitation;
- Flocculation tank;
- Final pH-adjustment tank;
- System feed pumps; and
- Rapid and flocculation mixers.

Direct annual costs included O&M labor, energy costs, and raw materials (e.g., sulfuric acid, polymer, caustic). The module assumed that the amount of TSS leaving the chemical precipitation system was equivalent to the sum of influent TSS and the dissolved solids that are converted to suspended solids when caustic is added to the wastewater. The approach for calculating suspended solids generated from dissolved solids is documented in Section 6.7.1 of the rulemaking record, DCN 16363. EPA estimated that the effluent flow rate from this system equaled the influent flow rate because additional flow from treatment chemical addition was negligible. EPA designed the cost model to include recycled water from the sludge thickener and filter press. In addition, the Agency assumed that model sites discharged effluent from the chemical precipitation system to either clarification or microfiltration.

#### **11.6.14 Sedimentation by Slant-Plate Clarifier**

The Agency estimated costs for sedimentation using slant-plate (lamella) clarifier systems. EPA estimated costs for low-flow systems for model sites with influent flow rates of less than or equal to 600 gallons per hour. EPA designed this system to treat effluent from the chemical precipitation system.

The module included capital and annual costs for the following equipment:

- Slant-plate clarifier; and
- One-time training costs for operators to meet MP&M clarifier limits instead of the baseline 40 CFR 433 Metal Finishing effluent guideline limits (see Section 24.6.1, DCN 17906, of the rulemaking record).

EPA estimated costs associated with achieving long-term average effluent concentrations for all pollutants treated by chemical precipitation with clarification (see Section 10.3). EPA calculated the amount of sludge generated using model-calculated site-specific

influent pollutant concentrations for the commingled wastewater. The Agency assumed the sludge was 3 percent solids (5) and was discharged to a sludge-thickening tank (see Section 11.6.17) and that model sites discharged treatment effluent to surface water or a POTW. Direct annual costs included maintenance labor and materials. EPA included costs for operating labor in the chemical precipitation module and included costs for pumps in the chemical precipitation and the sludge-thickening modules.

#### **11.6.15 Multimedia Filtration**

The Agency estimated costs for a multimedia filter to continuously remove filterable suspended solids. The system was designed as a polishing step for effluent from the clarifier. Although EPA did not include this technology in the MP&M technology options, it estimated baseline operating costs and pollutant removals for sites that had multimedia filters in place at baseline.

The module included capital and annual costs for the following equipment:

- Multimedia filter skid;
- Holding tank for clarifier effluent (clear well); and
- Media filter feed pump.

Based on data collected during an MP&M sampling episode, the Agency assumed filter backwash to be 1.2 percent of the influent flow to the chemical precipitation unit and that model sites discharged filtrate from this system to surface water or a POTW. Direct annual costs included O&M labor and energy costs. EPA incorporated waste disposal costs for solids at sites operating multimedia filters.

#### **11.6.16 Microfiltration for Solids Removal**

The Agency estimated costs for microfiltration for solids separation, assuming that flow rates of greater than the maximum costed system (406 gallons per minute) required multiple systems.

The module included capital and annual costs for the following equipment:

- Tubular membrane filtration modules;
- Carbon steel skid;
- Recirculation tank;
- Recirculation pump;
- Air back pulse system;
- Cleaning system;

- Sludge pump; and
- All associated instruments and controls.

EPA calculated the amount of sludge generated by this system using model-calculated site-specific influent pollutant concentrations for the commingled wastewater. Based on data collected during an MP&M sampling episode, the Agency assumed the sludge was 3.2 percent solids and was discharged to a sludge-thickening tank (see Section 11.6.17). EPA assumed model sites discharged microfiltration effluent to surface water or a POTW. Direct annual costs included O&M labor and materials (e.g., replacement membranes, cleaning chemicals) and energy costs.

#### **11.6.17 Sludge Thickening**

The Agency estimated costs for sludge thickening by gravity settling for the sludge discharged from slant-plate clarifiers and microfilters. EPA assumed the sludge-thickening system discharged 60 percent of influent flow as sludge, thus increasing the solids content of the sludge from 3 to 5 percent for clarifier sludges and from 3.2 to 5.3 percent for microfiltration sludges (6). EPA assumed that the model sites discharge thickened sludge to a pressure filter for further dewatering (see Section 11.6.18), and that they returned the remaining 40 percent of influent flow (supernatant) to the chemical precipitation system. The module included capital and annual costs for the following equipment:

- Sludge-thickening unit (package system); and
- Clarified water return pump.

Direct annual costs included O&M labor and energy costs.

#### **11.6.18 Sludge Pressure Filtration**

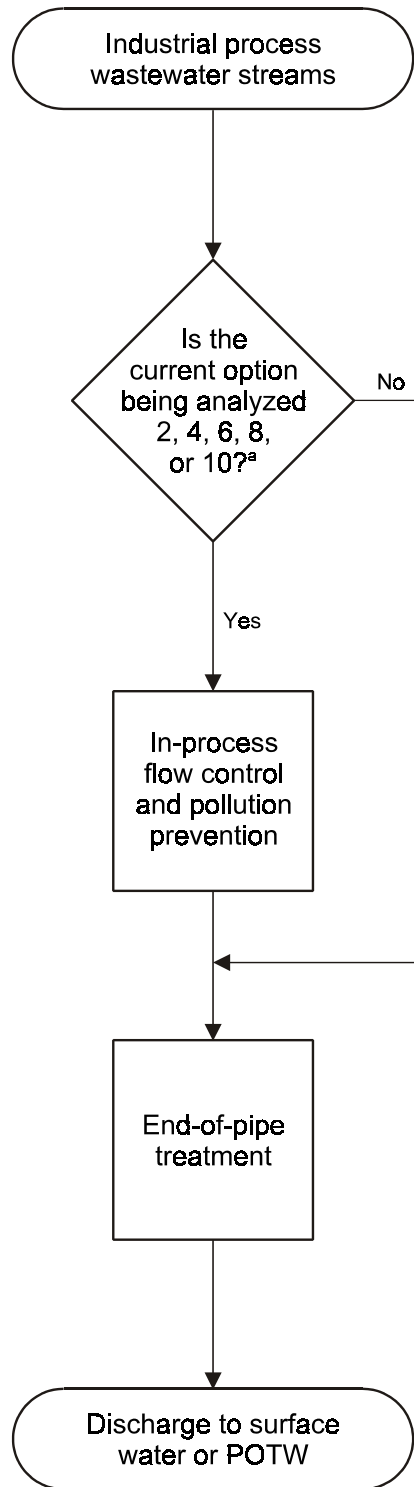
The Agency estimated costs for the plate-and-frame filter presses, estimating the number needed to increase the solids content of the sludge from approximately 5 to 35 percent (5). The module included capital and annual costs for the following equipment:

- Recessed plate or plate-and-frame filter press; and
- Two double-diaphragm sludge pumps.

Direct annual costs included O&M labor and sludge disposal costs. EPA assumed model sites contracted for off-site disposal of the denatured sludge (see Section 11.3.2 and Table 11-4). EPA also assumed these sites discharged the filtrate from this system to the chemical precipitation and sedimentation system.

## **11.7        References**

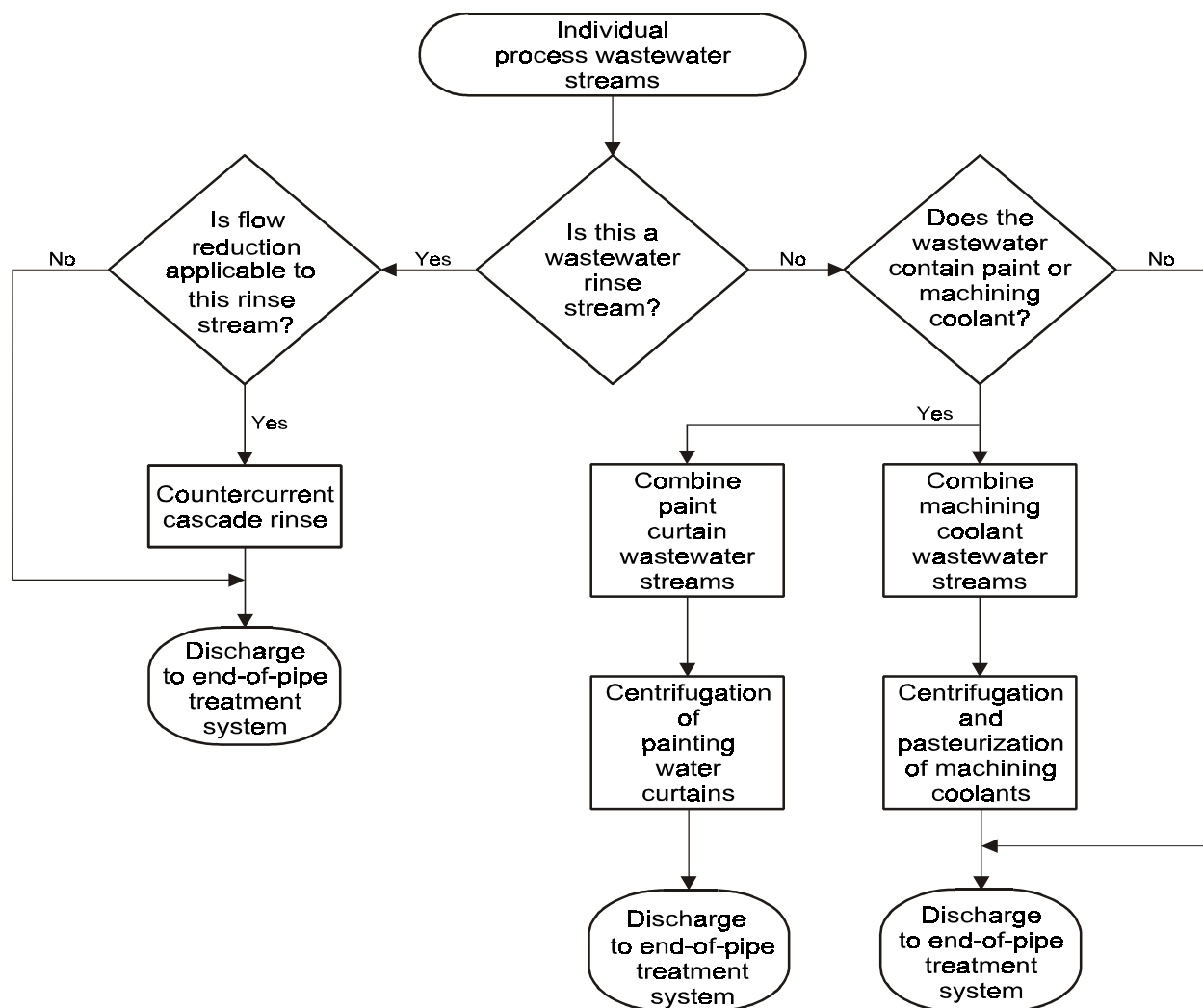
1.        RS Means Building Construction Cost Data, 56th Annual Edition. 1998, page 594. Historical Cost Indexes.
2.        Chemical Marketing Reporter. December 1997.
3.        U.S. Bureau of Labor Statistics. Monthly Labor Review. 1997.
4.        Cushnie, George C., CAI Engineering (prepared for NCMS/NAMF). Pollution Prevention and Control Technology for Plating Operations.
5.        Cherry, Kenneth F. Plating Waste Treatment. Chapter 3. Ann Arbor Sciences Publishers, Inc., Ann Arbor, MI, 1982.
6.        Eckenfelder, W. Wesley. Principals of Water Quality Management. Chapter 11. CBI Publishing Company, 1980.



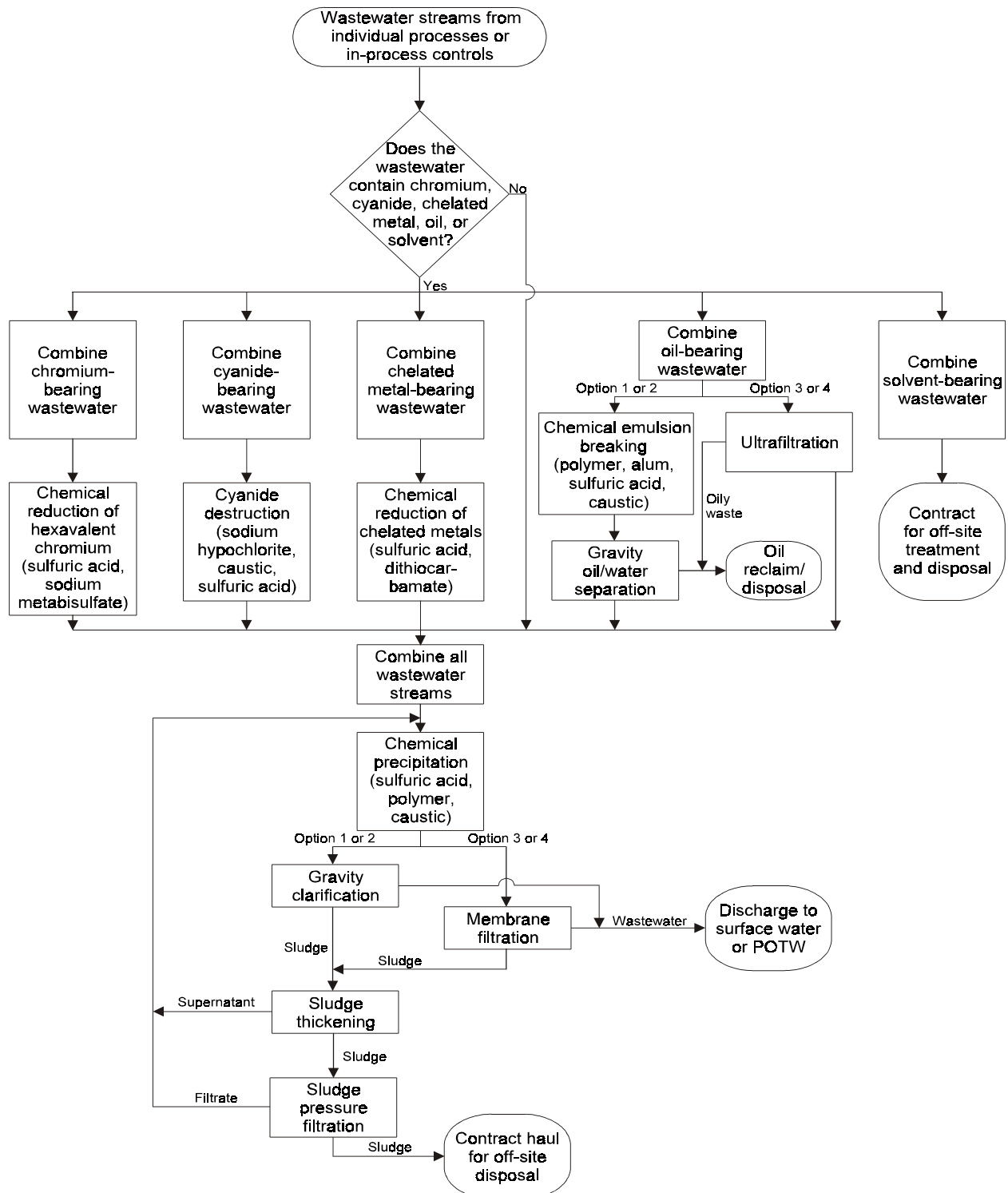
<sup>a</sup>See Section 9.0 for descriptions of the 10 technology options.

**Figure 11-1. Relationship Between In-Process and End-of-Pipe Technologies and Practices**

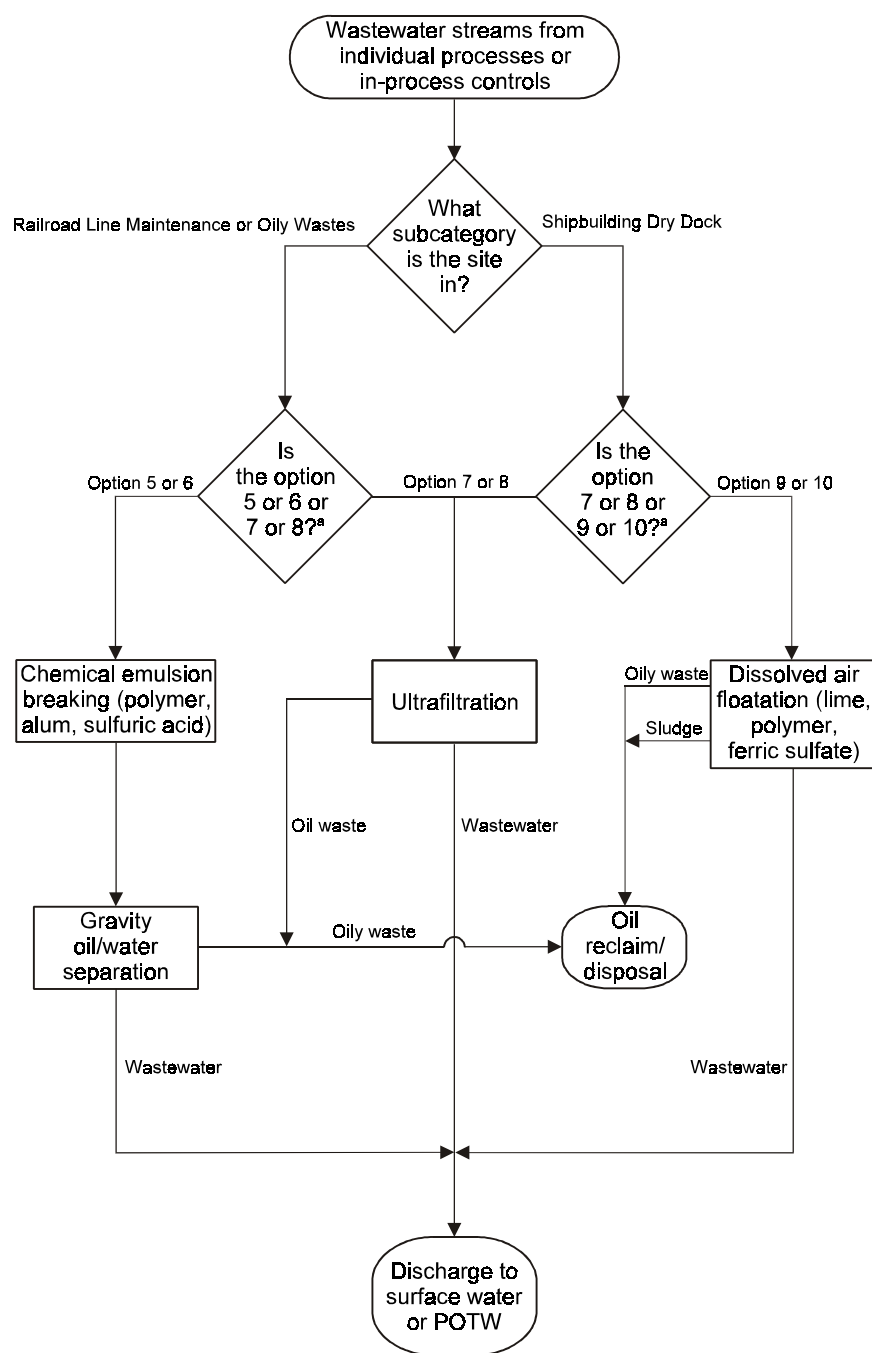




**Figure 11.2. Components of Total Capital Investments**



**Figure 11-3. Logic Used to Apply End-of-Pipe Technologies and Practices for the Following Subcategories: General Metals, Metal Finishing Job Shops, Non-Chromium Anodizing, Printed Wiring Board, and Steel Forming and Finishing**



<sup>a</sup> See Section 9.0 for descriptions of the 10 technology options.

**Figure 11-4. Logic Used to Apply End-of-Pipe Technologies and Practices for the Following Subcategories: Oily Wastes, Railroad Line Maintenance, and Shipbuilding Dry Dock**

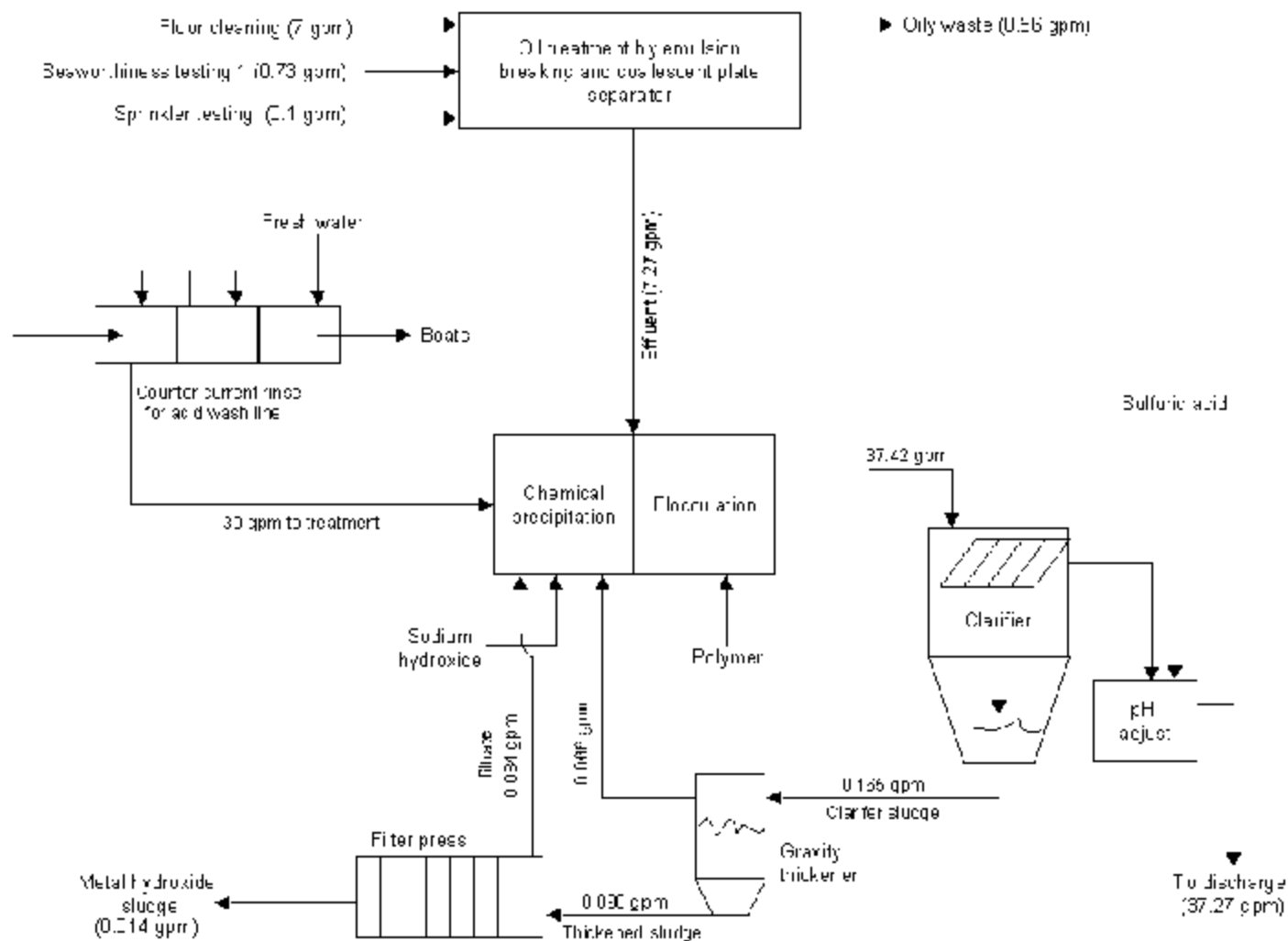


Figure 11-5. Example Treatment Facility for General Metals Subcategory Direct Discharger

## 12.0 POLLUTANT LOADING AND REDUCTION ESTIMATES

This section describes EPA's approach for modeling the MP&M industry annual pollutant loadings and removals for each technology option described in Section 9.0. In general, this approach consists of three major steps:

1. *Estimate baseline pollutant loading from each MP&M model site.* Wastewater discharged from MP&M unit operations goes to either on-site treatment, publicly owned treatment works (POTWs), or directly to surface waters. EPA used survey data from each model site to determine the destination of each waste stream. EPA estimated discharged pollutant concentrations from: EPA sampling data, industry-supplied data, and existing limitations. EPA estimated loadings by multiplying the discharged pollutant concentrations by the discharged flow. The baseline pollutant loading refers to the total amount of pollutants discharged from the model site to surface waters or POTWs for the base year of the survey.
2. *Estimate baseline pollutant loadings for the MP&M industry.* EPA multiplied the site-specific baseline wastewater loadings by the corresponding statistically derived weighting factors (see Section 3.0) for each model site. EPA summed the weighted loadings across all sites to estimate industry-wide baseline wastewater pollutant loadings.
3. *Estimate option-specific pollutant loadings and removals for the MP&M industry.* The option-specific pollutant loadings represent the total industry pollutant loadings in MP&M wastewater that would be discharged to surface water or POTWs after complying with a particular regulatory option.

Key terms for pollutant loadings and removals are defined below:

- **Model sites** - Facilities used in the EPA Costs & Loadings Model to represent the industry nationally. These facilities responded in the MP&M detailed survey that they discharge MP&M wastewater.
- **Long-term average** - Average pollutant concentrations achieved over a period of time by a facility, subcategory, or technology option.
- **Baseline concentration** - Pollutant concentration (milligrams per liter (mg/L)) in wastewater currently discharged to surface water or a POTW. If the facility has wastewater treatment in place, the baseline concentration is the pollutant concentration in wastewater discharged from final treatment. If the facility does not have treatment in place, the baseline concentration is the commingled concentration of all unit operation wastewater discharged.

- **Baseline loadings** - Modeled pollutant loadings, in pounds per year (lbs/yr), in MP&M wastewater currently being discharged to surface water or to POTWs for the base year of the model site's survey. These loadings reflect wastewater treatment in place at model sites in the year 1996.
- **Option loadings** - Also referred to as post-compliance loadings. Pollutant loadings, in lbs/yr, in MP&M wastewater that would be discharged to surface water or to POTWs after complying with a regulatory option. EPA calculated the loadings assuming that all MP&M facilities would achieve long-term average effluent pollutant concentrations associated with the technology options.
- **Pollutant reductions** - The difference between baseline loadings and option loadings for each regulatory option.
- **Weighting factor** - Statistically derived values for each model site used to reflect all facilities in the MP&M industry. (See Section 10.0, DCN 16118 of the rulemaking record). EPA multiplied the baseline or option loadings for each model site by its corresponding weighting factor to estimate industry-wide baseline or option loadings.
- **Toxic pound-equivalents** - Pollutant loadings, in pound-equivalents per year (PE/yr), in MP&M wastewater. A pound-equivalent (PE) is a pound of pollutant weighted for its toxicity to human and aquatic life.

Unless specified otherwise, EPA estimated baseline pollutant loadings and reductions for all pollutants identified in Section 7.0 as pollutants of concern. EPA used data from several sources to estimate pollutant loadings and reductions, including data from EPA sampling episodes, the existing 40 CFR 413 and 433 regulations, EPA's Permit Compliance System (PCS) database, pretreatment coordinators, states, and industry. See Section 3.0 for additional discussion on EPA's data collection efforts.

Note that all tables appear at the end of this section.

## **12.1 Estimation of Unit Operation Wastewater Pollutant Concentrations**

EPA used sampling data and industry-supplied data (included in Sections 5.0 and 15.0 in the rulemaking record) to estimate subcategory-specific wastewater pollutant concentrations for each of the MP&M unit operations that generate wastewater at MP&M model sites.

### **12.1.1 Unit Operation Wastewater Data Collection**

EPA's "unit operations database" comprises EPA sampling data and industry-supplied data. EPA collected unit operations wastewater discharged from 56 sites for 96 unit

operations. Industry supplied EPA with wastewater data for 15 unit operations. Throughout this section, the terms “sampling point” and “sample” refer to the following:

- **Sampling point** - The physical location at which samples are collected. Example sampling points include a wastewater treatment influent stream, an electroplating bath, or a cleaning rinse. A sampling point captures the wastewater characteristics of a specific unit operation or a group of unit operations.
- **Sample** - The unique volume of wastewater collected for analysis at a sampling point. A sample can include several different aliquots collected for analysis of multiple parameters. Each sample represents a unique period of time. EPA typically collected multiple samples from sampling points that represented flowing waste streams (e.g., wastewater treatment systems, rinses).

#### **12.1.2 Calculation of Pollutant Concentrations for Each Unit Operation for Each Sampling Point from EPA or Industry-Supplied Sampling Data**

EPA collected both grab and composite samples to characterize MP&M unit operations. EPA generally collected grab samples for nonflowing streams where the pollutant concentrations were not expected to vary significantly over the sampling period. EPA generally collected composite samples (typically 24-hour composites) for flowing streams. For oil and grease, EPA collected a series of grab samples as specified by the analytical method. In some cases, EPA had to mathematically aggregate two or more samples to obtain a single value that could be used in calculations to represent a single waste stream. This occurred with field duplicates and grab samples collected over time. For each sample point, EPA aggregated field duplicates first, grab samples second, and multiple-day samples third. In cases where the sampled pollutants were not detected in the wastewater, EPA used the sample-specific detection limit as the pollutant concentration. EPA calculated pollutant concentrations for each sampling point using the following approach:

- *Average the duplicate sample concentrations.* As discussed in Section 3.0, EPA collected duplicate samples at many sampling points as a quality control measure. Industry-supplied data submitted with comments on the MP&M proposal also contained duplicate samples. Where duplicate samples were collected at a sampling point, EPA averaged the concentrations of the two samples to develop a single pollutant profile for the sampling point for that 24-hour period.
- *Average the grab sample aliquot concentrations.* EPA averaged the concentrations of all grab sample aliquot fractions (i.e., for oil and grease) collected during a 24-hour period in order to estimate a representative 24-hour composite for that parameter.

- *Average multiple sample concentrations for each sampling point.* For flowing wastewater streams (e.g., rinses), EPA and industry typically collected multiple samples at a single sample point to account for variability over time of the discharges from these streams. EPA averaged the concentrations of the composite or grab samples collected on each day at the same sampling point. For example, if EPA collected three one-day composite samples of an acid treatment rinse at the same sampling point, it averaged the concentrations of each pollutant on each of the three days to develop a single pollutant profile for the sampling point for that episode.

### **12.1.3 Estimation of Pollutant Concentrations for Each Subcategory and Unit Operation**

EPA estimated pollutant concentrations for each unit operation performed in a given subcategory (as reported in the MP&M detailed surveys). For example, EPA estimated pollutant concentrations for UP-4 (acid treatment without chromium) separately for sites in the General Metals Subcategory and for sites in the Metal Finishing Job Shops Subcategory. For electroplating and electroless plating operations, EPA estimated the pollutant concentration(s) of the applied metal(s) separately from other bath constituents to account for the dependency of these operations on high concentrations of the applied metal(s). EPA used the following steps to estimate the subcategory-specific unit operation wastewater pollutant concentrations at model MP&M sites:

1. Identified, for each subcategory, all unit operations reported in the detailed surveys (see Section 12.1.3.1);
2. Estimated pollutant concentrations for each unit operation in a given subcategory (see Section 12.1.3.2);
3. Estimated an applied metal concentration in the bath and in the rinse for each electroplating and electroless plating operation for each subcategory (see Section 12.1.3.3); and
4. Modeled pollutant concentrations for each model site unit operation (see Section 12.1.3.4).

These steps are described in the following subsections.

#### **12.1.3.1 Identification of Unit Operations Reported in the Detailed Surveys**

EPA queried the MP&M detailed survey database to identify all unit operations discharging wastewater, as well as all types of electroplating and electroless plating operations (defined by applied metal).



### 12.1.3.2 Estimation of Wastewater Pollutant Concentrations for Each Unit Operation/Subcategory Combination

For each subcategory, EPA calculated the average wastewater pollutant concentrations for each unit operation. For example, EPA averaged the wastewater pollutant concentrations for all acid cleaning operations (using the wastewater pollutant concentrations calculated at each sampling point) at facilities in the General Metals Subcategory. EPA also separately estimated wastewater pollutant concentrations for unit operations for the “zinc plater” segments of the Metal Finishing Job Shops and General Metals Subcategories.

Additionally, EPA combined the sampling data for all metal-bearing subcategories (with the exception of data from printed wiring board facilities<sup>1</sup>) and calculated the average wastewater pollutant concentrations for each unit operation. EPA did the same for all oil-bearing subcategories. EPA used the average unit operation concentrations calculated for metal-bearing subcategories and oil-bearing subcategories to estimate pollutant concentrations from unit operations in subcategories with no unit operation concentration data.

Based on comments received on the MP&M proposed rule, EPA modified the calculation of unit operation wastewater pollutant concentrations for the following pollutants:

- *Cyanide.* EPA set the cyanide pollutant concentration equal to zero for all non-cyanide-bearing unit operation wastewaters. (EPA sampling data included incidental cyanide concentrations for non-cyanide-bearing unit operations due to drag-out or unspecified sources.)
- *Total Sulfide.* EPA estimated wastewater pollutant concentrations for total sulfide using all results from Phase I and II sampling (Method 376.1) and an average of the results from Methods 376.2 and 4500-S2E from Phase III sampling. EPA used all three analytical methods (376.1, 376.2, and 4500-S2E) to measure total sulfide in Phase III sampling (i.e., post-proposal sampling); however, EPA did not use sampling data from Method 376.1 from Phase III due to possible interferences.
- *Oil and Grease.* EPA estimated wastewater pollutant concentrations for oil and grease using all Phase II and III data, but included Phase I data only in cases where no Phase II or III data were available for that unit operation in the Oily Wastes, Railroad Line Maintenance, and Shipbuilding Dry Dock Subcategories. EPA used a different analytical method to measure for oil and grease during Phase I sampling than during Phase II and III sampling. EPA used Method 413.2 during Phase I sampling (a freon-extractable method). EPA used Method 1664 during Phase II and Phase III sampling (measures oil and grease as hexane extractable material).

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<sup>1</sup>EPA omitted data from the Printed Wiring Board Subcategory due to the high concentration of specific metals (i.e., copper) common to primarily the printed wiring board industry.

- *Sodium, Calcium, and Total Dissolved Solids.* EPA set the wastewater pollutant concentrations for these pollutants equal to zero for all unit operation wastewaters in all subcategories. EPA set the pollutant removals for sodium and calcium equal to zero in response to Phase I comments on the wide use of these two treatment chemicals, which results in elevated removals estimates. EPA set the loads removals for total dissolved solids (TDS) equal to zero because many treatment chemicals also elevate TDS concentrations.

Based on comments received on the MP&M proposed rule, EPA modified the calculation of unit operation wastewater pollutant concentrations for the following specific cases:

- *Testing.* EPA used data from radiator pressure testing operations to estimate unit operation wastewater pollutant concentrations for all testing unit operations at model sites in the oil-bearing wastewater subcategories and hydraulic testing unit operations in the metal-bearing wastewater subcategories. EPA used dye penetrant testing data to estimate wastewater pollutant concentrations in all other types of testing in the metal-bearing wastewater subcategories. EPA did not include the other EPA-sampled testing data (from alpha-case detection testing and engine performance testing coolant operations) based on the unique composition of wastewater for these site-specific operations.
- *Unit Operations with a Greater Rinse Concentration than Bath Concentration.* After averaging sampling data across samples for a particular sampling point, EPA found instances where the modeled bath had a lower concentration than for the same pollutant in the associated rinse. In these cases, EPA set the bath wastewater pollutant concentration equal to the rinse wastewater pollutant concentration.

Based on comments received on the MP&M proposed rule, EPA modified the calculation of unit operation wastewater pollutant concentrations for certain pollutants in the Non-Chromium Anodizing Subcategory:

- *Chromium, Hexavalent Chromium, Lead, and Cadmium.* EPA set the wastewater pollutant concentrations for these pollutants equal to zero for all unit operation wastewaters in the Non-Chromium Anodizing Subcategory. EPA defined the Non-Chromium Anodizing Subcategory as sites that have no chromium present in any operation on site. Therefore, EPA did not expect chromium or hexavalent chromium to be present at non-chromium anodizing facilities. EPA also did not expect lead or cadmium to be used in unit operations at non-chromium anodizing facilities based on the metal types processed by this subcategory.

For further details, refer to the memorandum entitled “MP&M Pollutant Loadings Methodology Changes from Proposal” located in the rulemaking record (Section 16.7, DCN 16764).

### **12.1.3.3 Estimation of Applied Metal Concentrations Using Available Analytical Data**

While the pollutant concentrations in many MP&M unit operations are somewhat dependent on the type of metal processed, pollutant concentrations are heavily dependent on the applied metal in the electroplating and electroless plating operations. For example, chromium electroplating operations and rinses contain higher concentrations of chromium than other metals, while electroless nickel plating operations and rinses contain higher concentrations of nickel than other metals. EPA estimated the pollutant concentrations of the plated metal(s), referred to as “applied” metals, separately from other constituents in the bath and rinse to account for the dependency of the pollutant concentrations in these operations and rinses on these metal(s). When developing the model pollutant concentrations for these two unit operations, EPA designated the metal(s) applied to the surface of the product as the “applied metals” to distinguish them from other nonplated metals in the process bath. EPA also designated these metals that wash off the product during the process rinse as the “applied metals” in the rinse.

To more adequately represent the metals concentrations in the wastewater from electroplating and electroless plating operations, EPA used a different approach for applied metals and other plating bath constituents in these operations. Due to budget constraints, EPA did not obtain sampling data for every type of plating solution and rinse reported in the detailed surveys and was therefore unable to estimate separately the pollutant concentrations for each type of plating. EPA modeled the pollutant concentrations in electroplating and electroless plating solutions using the following approach:

1. EPA calculated the total applied metal concentrations for each plating bath for which EPA had collected data. If a sampling point had two applied metals (e.g., zinc and cobalt), the two pollutant concentrations were summed to get a total applied metal concentration. If a sampling point had one applied metal, the concentration for that metal was the total applied metal concentration.
2. For each subcategory, EPA calculated the median total applied metal concentration for all plating baths for which EPA had sampling data. EPA calculated these median concentrations separately for electroplating and electroless plating baths. EPA then modeled the total metal concentration in the bath at the model site as the median concentration of total metals for which EPA had data. Note that the Agency had sufficient data to estimate the total applied metal concentration on a subcategory-specific basis, but not on a pollutant-specific basis. For subcategories with no available applied metal data, EPA used the median of all total applied metal concentration data across all subcategories.

3. EPA calculated the average concentration for all nonapplied pollutants across the plating baths (separating electroplating from electroless plating baths). For example, EPA calculated the cadmium concentration in all baths other than cadmium electroplating baths. EPA then modeled the concentration of the nonapplied pollutants as the average concentration for the pollutant across the plating baths.

EPA followed the same approach for estimating pollutant concentrations in electroplating and electroless plating unit operation rinses. For further detail, refer to the memorandum entitled “MP&M Pollutant Loadings Data Transfer for Base/Applied Metals” located in the rulemaking record (Section 16.7, DCN 16763).

#### **12.1.3.4 Modeling of Pollutant Concentrations for Each Model Site Unit Operation**

To estimate the pollutant concentrations for each model site unit operation, EPA first identified the unit operations performed by the model sites in each subcategory. For unit operations for which it had collected pollutant concentration data, EPA modeled the wastewater pollutant concentrations using the corresponding unit operation average wastewater pollutant concentrations calculated from sampling data for that unit operation in the same subcategory. For example, EPA calculated the average concentrations for all pollutants of concern identified in alkaline cleaning operations in the General Metals Subcategory, and applied these average concentrations to all alkaline cleaning operations reported in the surveys for this subcategory.

When EPA did not have pollutant concentration data for a unit operation within a subcategory, EPA transferred pollutant concentrations from unit operations expected to have similar wastewater characteristics, based on process considerations. Process considerations include the following: the purpose of the unit operation (e.g., metal removal, contaminant removal); the purpose of the process water use (e.g., contact cooling water, cleaning solution, rinse water); and typical bath additives (e.g., acids, organic solvents, metal salts). EPA transferred available pollutant concentration data to the model sites using the following hierarchy:

1. If EPA sampled the same unit operation bath (or rinse) at facilities in more than one subcategory, including the same subcategory as the model site, the Agency used available analytical data for the same operation in the same subcategory to estimate wastewater pollutant concentrations for the model site unit operation. For example, if available analytical data for a unit operation exist for both the General Metals and the Metal Finishing Job Shops Subcategories, EPA transferred data from only the General Metals Subcategory to model the wastewater pollutant concentrations for the same unit operation at a model site in the General Metals Subcategory.
2. If EPA sampled the same unit operation bath (or rinse) at facilities in only one MP&M subcategory, even if it is a different subcategory than that of the model site, the Agency transferred these data to the same unit

operation bath (or rinse) at model sites. For example, if available analytical data for a unit operation exist only for the General Metals Subcategory, EPA transferred these data to model the wastewater pollutant concentrations for the same unit operation at a model site in any other subcategory.

3. If EPA did not have unit operation sampling data from a site in Subcategory A, then EPA used unit operation sampling data from a site in a similar subcategory (e.g., if Subcategory A is a metal-bearing subcategory, data from another metal-bearing subcategory was used). The Agency used available analytical data for the same operation in similar subcategories to estimate wastewater pollutant concentrations for the model site unit operation. For example, if available analytical data for a unit operation bath (or rinse) exist from both metal-bearing wastewater facilities and oil-bearing wastewater facilities, EPA used the following approach. If the model site is designated as one of the metal-bearing wastewater subcategories, only available analytical data from other metal-bearing wastewater subcategorized facilities were used to estimate wastewater pollutant concentrations. EPA used the same approach for oil-bearing wastewater subcategories.
4. If EPA did not sample a unit operation bath (or rinse) that is the same as the unit operation at a model site, the Agency used the available analytical data for a unit operation bath (or rinse) that has similar wastewater characteristics, but are within the same subcategory, to estimate wastewater pollutant concentrations for the model site unit operation. Due to budget constraints, EPA did not collect data for 22 baths and 24 rinses, representing approximately 8.3 percent of the total MP&M discharge flow rate. The basis for these estimates are discussed in the memorandum entitled “Data Transfers Between Unit Operations” located in the rulemaking record (Section 16.7, DCN 17767).

Supporting documentation for all data transfers of unit operation pollutant concentrations is contained in Section 16.7 of the MP&M rulemaking record.

## **12.2      Estimation of Industry Baseline Pollutant Loadings**

Industry baseline wastewater pollutant loadings are modeled pollutant loadings in MP&M wastewater discharged to surface waters or to POTWs for the base year of the detailed surveys, supplemented by additional site information provided to EPA. These loadings reflect wastewater treatment in place at model sites in the year 1996. EPA estimated baseline pollutant loadings using the effluent pollutant concentrations, unit operation flows provided in the questionnaire (as described in Section 11.2.2), and effluent flows from treatment (estimated by the EPA Costs & Loadings Model as described in Section 11.3.3). EPA estimated the baseline pollutant loadings using the approaches described in this subsection.

### 12.2.1 Estimation of Baseline Pollutant Concentrations from Sites in the Metal-Bearing Subcategories

For the final rule, EPA revised its methodology for estimating baseline pollutant concentrations in metal-bearing subcategories. The final methodology varies depending on whether or not the stream is treated or untreated and also by its current regulatory status.

#### 12.2.1.1 Estimation of Effluent Pollutant Concentrations for Untreated Streams

EPA used the following steps to estimate the wastewater pollutant concentrations for each pollutant of concern (POC) in wastewater discharged from model sites without treatment:

1. *Estimated wastewater pollutant concentrations for each unit operation that discharges wastewater from the site without treatment.* EPA estimated unit operation wastewater pollutant concentrations using the methodology described in Section 12.1. EPA notes that the unit operations data were significantly revised between the proposal and the Notice of Data Availability (NODA), and have been revised further based on comments on the NODA (see DCN 16764 in Section 16.7 of the rulemaking record).
2. *Incorporated limits on wastewater discharged from sites regulated by 40 CFR 413 only (Baseline for the 413 to 433 Upgrade Analysis).* For the final rule, in response to comments, EPA accounted for sites that are currently regulated by and complying with Part 413. For streams not currently receiving treatment at model sites subject to Part 413, but not Part 433, EPA assumed the sites achieved the monthly average limitation for Part 413 regulated parameters (i.e., set the wastewater pollutant concentrations equal to the Part 413 limits (as opposed to achieving the long-term average (LTA) concentration)). EPA noted that the Part 413 limit for cyanide is different for small platers than for large platers. For parameters not regulated by Part 413, EPA estimated wastewater pollutant concentrations from the unit operations data. MP&M facilities covered under Part 413 only include some, but not all, indirect dischargers in the Printed Wiring Board, Metal Finishing Job Shops, and General Metals Subcategories. EPA conducted a unique analysis to determine the costs and loads associated with the upgrade of facilities regulated under Part 413 to meet the Part 433 limits. EPA used the methodology described in this section to estimate baseline pollutant concentrations of untreated streams for this analysis.
3. *Incorporated limits on wastewater discharged from sites regulated by 40 CFR 433 (or Parts 413 and 433).* For the final rule, in response to comments, EPA accounted for sites that are currently regulated by and

complying with 40 CFR 413 and 433, or 433 only. EPA assumed the untreated streams achieved the monthly average limitation for Part 433 regulated parameters (i.e., set the wastewater pollutant concentrations equal to the Part 433 limits (as opposed to achieving the LTA concentration)). For parameters not regulated by Part 433, EPA estimated wastewater pollutant concentrations from the unit operations data. MP&M facilities covered under Part 433 include all direct and some indirect dischargers in the Printed Wiring Board and Metal Finishing Job Shops Subcategories, and some direct and indirect dischargers in the General Metals and Non-Chromium Anodizing Subcategories.

4. *Incorporated limits on wastewater discharged from sites not regulated by 40 CFR 413 or 433 (Baseline for the Local Limits to 433 Upgrade Analysis).* For the final rule, in response to comments, EPA also incorporated changes to take into account the compliance of indirect dischargers in the General Metals Subcategory, not currently regulated by Parts 413 or 433, with local limits. Although EPA could not obtain actual local limits for all facilities, EPA gathered local limits data from 213 POTWs in seven EPA Regions to develop national median local limit values. (see DCN 17844 of the rulemaking record for a list of the data and the median value for each parameter). EPA assumed the untreated streams achieved the national median local limit for all parameters regulated by Part 433 in untreated streams. For parameters not regulated by Part 433, EPA estimated wastewater pollutant concentrations from the unit operations data. EPA conducted a unique analysis to determine the costs and loads associated with the upgrade of facilities not regulated under Parts 413 or 433 to meet the Part 433 limits. EPA used the methodology described in this section to estimate baseline pollutant concentrations of untreated streams for this analysis.
5. *Estimated commingled wastewater concentrations for all untreated streams.* EPA combined the wastewater from all unit operation discharges that are not sent through treatment. EPA calculated the commingled concentration of each POC in the combined MP&M wastewater based on pollutant concentrations and flow rates of each stream.

#### **12.2.1.2 Estimation of Effluent Pollutant Concentrations for Treated Streams**

EPA used the Costs & Loadings Model (see Section 11.0) to estimate the pollutant concentrations in wastewater discharged from the treatment technology at each model site. EPA used the following steps to estimate the wastewater pollutant concentrations for each POC in treated discharged wastewater:

1. *Estimated wastewater pollutant concentrations for each unit operation that discharges wastewater to treatment.* EPA estimated unit operation

wastewater pollutant concentrations using the methodology described in Section 12.1. EPA notes that the unit operations data were significantly revised between the proposal and the NODA, and have been revised further based on comments on the NODA (see DCN 16764 in Section 16.7 of the rulemaking record).

2. *Estimated wastewater concentrations in influent to treatment (commingled wastewater concentrations for all treated streams).* EPA combined the wastewater from all unit operations that discharge to treatment. EPA calculated the commingled (treatment influent) concentration of each POC in the combined MP&M wastewater, based on pollutant concentrations and flow rates of each stream. The treatment influent concentrations are required to estimate baseline costs (see Section 11.0).
3. *Estimated wastewater concentrations in effluent from treatment.* EPA used the Costs & Loadings Model (see Section 11.0) to estimate the pollutant concentrations in wastewater discharged from each model site wastewater treatment unit. The following summarizes the pollutant concentrations for the various treatment technologies reported for the metal-bearing subcategories.
  - *Treatment Equivalent to the Metal Finishing (40 CFR 433) Best Available Treatment (BAT).* EPA assumed that all streams that undergo treatment equivalent<sup>2</sup> to the Metal Finishing (40 CFR 433) BAT technology basis are treated to achieve the LTAs promulgated at 40 CFR 433 for those parameters regulated under Part 433 (433 parameters). EPA assumed that parameters not regulated under Part 433 (non-433 parameters) are treated to achieve the LTAs based on MP&M BAT (Option 2) sampled sites.
  - *Microfiltration for Solids Removal Technology.* For streams treated by a membrane system, EPA assumed that the membrane technology could treat to a lower concentration than the 433 LTAs. Therefore, EPA assumed the membrane technology could achieve the lower of the LTAs calculated based on MP&M sampled sites using membrane technology or the 433 LTAs.
  - *Chemical Reduction of Chelated Metals.* For streams treated by a chelation breaking system, EPA assumed the reduction of chelated metals to the elemental state. The concentrations of carbon disulfide and dithiocarbamate (DTC) increase in the chelation breaking module to account for addition of treatment chemicals.

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<sup>2</sup>Refer to Table 11-5 for treatment technologies considered equivalent to chemical precipitation and sedimentation.



- *Oil Treatment (Chemical Emulsion Breaking and Oil/Water Separation) and Batch Oil Emulsion Breaking with Gravity Flotation.* EPA assumed oil treatment and batch oil emulsion breaking technologies could achieve the LTAs calculated based on MP&M sampled sites using chemical emulsion breaking with gravity oil/water separation.
- *Ultrafiltration (for Oil Removal).* EPA assumed ultrafiltration technologies could achieve the LTAs calculated based on MP&M sampled sites using ultrafiltration (for oil removal).
- *Dissolved Air Flotation (DAF).* EPA assumed DAF technology could achieve the 433 limits for all 433 parameters. For non-433 parameters, EPA assumed DAF technology could achieve the LTAs calculated based on MP&M sampled sites using DAF technology.
- *Cyanide Destruction and Ion Exchange.* EPA assumed cyanide destruction and ion exchange technologies could reduce the amount of cyanide in cyanide-bearing wastewater. EPA assumed total cyanide, amenable cyanide, and weak-acid dissociable cyanide are reduced to the LTAs calculated based on MP&M sampled sites using cyanide destruction. The concentration of chloroform increases in the cyanide destruction module to account for the reduction process.
- *Chemical Reduction of Hexavalent Chromium.* EPA assumed hexavalent chromium reduction could reduce the amount of hexavalent chromium to achieve the LTA calculated based on MP&M sampled sites using hexavalent chromium reduction. The concentration of trivalent chromium increases in the hexavalent chromium reduction module to account for the conversion process.

Note that if the treated effluent concentration for a pollutant was more than its corresponding treatment influent concentration (obtained in step 2 above), EPA retained the treatment influent concentration to estimate the baseline concentration for that pollutant.

4. *Incorporated limits on wastewater discharged from sites regulated by 40 CFR 413 only (Baseline for the 413 to 433 Upgrade Analysis).* For the final rule, in response to comments, EPA accounted for sites that are currently regulated by and complying with Part 413 only. For streams receiving treatment at model sites subject to Part 413, but not Part 433, EPA assumed the sites achieved the LTAs for Part 413 regulated parameters (i.e., set the wastewater pollutant concentrations equal to the

Part 413 LTA concentration). EPA noted that 40 CFR 413 only sets limitations on lead, cadmium, and cyanide for small platers. EPA assumed small platers achieved the monthly limit average for those additional parameters regulated by Part 413 for large platers. For parameters not regulated by Part 413, EPA assumed sites achieve the baseline pollutant concentrations for the treatment technology. MP&M facilities covered under Part 413 only include some indirect dischargers in the Printed Wiring Board, Metal Finishing Job Shops, and General Metals Subcategories. EPA conducted a unique analysis to determine the costs and loads associated with the upgrade of facilities regulated under Part 413 to meet the Part 433 limits. EPA used the methodology described in this section to estimate baseline pollutant concentrations of treated streams for this analysis.

5. *Incorporated limits on wastewater discharged from sites not regulated by 40 CFR 413 or 433 (Baseline for the Local Limits to 433 Upgrade Analysis).* For the final rule, in response to comments, EPA also incorporated changes to take into account the compliance of indirect dischargers in the General Metals Subcategory, not currently regulated by Parts 413 or 433, with local limits. Although EPA could not obtain actual local limits for all facilities, EPA gathered local limits data from 213 POTWs in seven EPA Regions to develop national median local limit values. (see DCN 17844 of the rulemaking record for a list of the data and the median value for each parameter). EPA assumed the treated streams achieved one-half of the national median local limit values<sup>3</sup> for all parameters regulated by Part 433. For parameters not regulated by Part 433, EPA assumed the treated streams achieved the national median local limit values. EPA conducted a unique analysis to determine the costs and loads associated with the upgrade of facilities not regulated under Parts 413 or 433 to meet the Part 433 limits. EPA used the methodology described in this section to estimate baseline pollutant concentrations of treated streams for this analysis.

### **12.2.1.3 Estimation of Commingled Effluent Pollutant Concentrations from Sites**

EPA combined the wastewater from treated and untreated streams. EPA calculated the commingled baseline effluent pollutant concentration of each POC in the combined MP&M wastewater based on pollutant concentrations and flow rates of each stream (treated and untreated).

EPA received comments that, although the concentration of chemical oxygen demand (COD) in discharged wastewater is not regulated by Parts 413 or 433 (unlike oil and

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<sup>3</sup>EPA used 1/2 the median value to take into account that facilities do not operate treatment systems to achieve the limit, but some value below the limit to account for variability.

grease and total suspended solids), it is typically regulated by local limits. EPA reviewed data from the Permit Compliance System (PCS) and found that, while COD is not generally regulated by local limitations, a small number of facilities do have COD restrictions. EPA found similar results for total kjeldahl nitrogen (TKN) and ammonia as nitrogen (NH)<sup>4</sup>. Since EPA could not identify which sites in PCS may have been subject to MP&M, EPA conducted its analysis using information from process wastewater dischargers from facilities in the 3000 series SIC codes. Using information from those sites with COD, TKN, and NH limitations, EPA calculated a single local limit value for each parameter. These values are 175, 35.67, and 19.3 mg/L for COD, TKN, and NH, respectively. EPA compared the baseline pollutant concentrations it predicted for these pollutants at each site. If these concentrations were in excess of the local limit value, then EPA set the concentration for the commingled MP&M wastewater discharged from each model site in metal-bearing wastewater subcategories equal to the local limit value. Details are provided in the memorandum “Loadings Methodology for Cost Model Run 4” (DCN 17846 in Section 24.7 of the rulemaking record).

### **12.2.2 Estimation of Baseline Pollutant Concentrations from Sites in the Oil-Bearing Subcategories**

For the proposal and the NODA, EPA’s methodology to estimate baseline pollutant concentrations for facilities in oil-bearing wastewater subcategories was similar to the one used at that time for metal-bearing wastewater subcategories. EPA received comment on the proposal and NODA that this methodology overestimated baseline pollutant concentrations for Shipbuilding Dry Dock, Railroad Line Maintenance, and Oily Waste sites. In response to these comments, EPA significantly revised its methodology for estimating baseline pollutant concentrations in the oil-bearing wastewater subcategories. Because EPA has different types of information in its database for each oil-bearing wastewater subcategory, it used different methods to represent baseline pollutant concentrations for each oil-bearing wastewater subcategory. The final methodologies used for each oil-bearing wastewater subcategory are described individually below.

#### **12.2.2.1 Estimation of Baseline Pollutant Concentrations from Sites in the Shipbuilding Dry Dock Subcategory**

For the final rule, EPA used its sampling data and industry supplied long-term monitoring data to estimate baseline pollutant concentrations for this subcategory. This data includes pollutant concentrations measured at two EPA sampling episodes and those reported in three years of Detailed Monitoring Reports (DMR) covering numerous dry dock discharges from a single shipbuilding dry dock facility. In estimating baseline pollutant concentrations in this manner, EPA looked at the individual data points as well as averages for its conclusions. See DCNs 17859 and 17860 in Sections 24.6.1 and 24.5.1 of the final rulemaking record for additional information. Note that for the final rule, EPA only estimated baseline concentrations for total suspended solids (TSS) and oil and grease because EPA had previously determined that

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<sup>4</sup>EPA reviewed these parameters because they were important in estimating benefits (see the Economic, Environmental, and Benefits Analysis for the Final MP&M Rule (EEBA)).

discharges from these facilities contain minimal concentrations of toxic organic and metal pollutants.

#### **12.2.2.2 Estimation of Baseline Pollutant Concentrations from Sites in the Railroad Line Maintenance Subcategory**

In response to proposal and NODA comments, EPA revisited its database of direct discharging Railroad Line Maintenance facilities. EPA found that many of the facilities in its database would not be subject to this rule because they discharged only noncontaminated stormwater or wastewater resulting from refueling operations (neither of which is subject to the final rule). As a result of this review, EPA concluded its database was insufficient to make any regulatory decisions on direct discharging Railroad Line Maintenance facilities.

However, as part of its comments on the proposed rule and as discussed more fully in the NODA (67 FR 38755), the American Association of Railroads (AAR) provided a census listing of each Railroad Line Maintenance direct discharging facility known to them. For each facility, AAR provided a description of treatment technologies, a summary of effluent data, including flow rates, permit limits, and a process flow diagram or description of the operations. For the final rule, EPA used this information to create a new database representing direct discharging Railroad Line Maintenance facilities.

EPA's final database consists of nine direct discharging Railroad Line Maintenance facilities. Six of the nine facilities use technologies consistent with the Option 6 technology basis, two use technologies consistent with the Option 10 technology basis, and one uses biological treatment.

For the final rule, EPA did not need to model effluent pollutant concentrations for each of the final database facilities. Rather, EPA used the summary effluent data provided for each facility to represent baseline oil and grease and TSS concentrations in the Railroad Line Maintenance Subcategory. For additional information, see DCN 17861 in Section 24.6.1 of the rulemaking record. Note that EPA considered only TSS and oil and grease because it had previously determined that discharges in this subcategory contain few pounds of toxic pollutants.

#### **12.2.2.3 Estimation of Baseline Pollutant Concentrations from Sites in the Oily Wastes Subcategory**

For the final rule, EPA estimated baseline pollutant concentrations using a different methodology for treated and untreated streams in the oily waste subcategory.

**Treated Streams:** Where EPA had survey information (DMR data) for a particular site with treatment, EPA used that information as the baseline pollutant concentration. For half of the oily waste subcategory facilities with treatment, however, EPA had to estimate baseline pollutant concentrations. In all of these cases, EPA determined the treatment currently in place would achieve equivalent or greater removals to the

treatment technology considered as the technology basis for limitations in this subcategory (Option 6). Therefore, where EPA did not have DMR data for a facility with treatment in place, EPA estimated its baseline pollutant concentrations as the median effluent concentrations of the DMR data from facilities with the option 6 technology.

**Untreated Streams:** EPA had DMR data for one site that indicated no treatment. Therefore, EPA used this data as the baseline pollutant concentrations for this facility. For the remaining sites without treatment, EPA had to estimate baseline pollutant concentrations. For these sites, EPA estimated unit operation wastewater pollutant concentrations using the methodology described in Section 12.1. EPA notes that it significantly revised the unit operations data between the proposal and the NODA, and between the NODA and final rule based on comments on the NODA (see DCN 16764, in Section 16.7 of the rulemaking record). EPA combined the wastewater from all unit operation discharges that are not sent through treatment. EPA calculated the commingled concentration of each POC in the combined MP&M wastewater based on pollutant concentrations and flow rates of each stream.

### **12.2.3 Estimation of Model Site Baseline Loadings**

EPA estimated the pollutant loadings (lbs/yr) in effluent wastewater (treated or untreated) discharged from each MP&M model site. EPA estimated pollutant-specific baseline loadings by multiplying the effluent pollutant concentration of the pollutant by the corresponding effluent wastewater flow rate. To determine site-specific pollutant baseline loadings for sites that have both treated and untreated streams, EPA summed the estimated pollutant-specific baseline loading from the untreated effluent and the treated effluent. EPA estimated site-specific baseline loadings by summing site-specific pollutant baseline loadings for all pollutants considered.

For direct dischargers in the General Metals Subcategory, EPA additionally compared the baseline pollutant loadings from EPA's Costs & Loadings Model to available DMR data. EPA obtained DMR data for 18 of the model sites. The MP&M model did not overestimate baseline loadings for 12 of these 18 model direct discharging facilities (or approximately two-thirds of these facilities). The relative percent difference (in pound-equivalents) of the model baseline loadings and those estimated using DMR data is 14 percent. Based on this analysis, EPA concluded that the MP&M model estimates of baseline pollutant loadings are reasonable and appropriate.

### **12.2.4 Estimation of Industry-Wide Baseline Pollutant Loadings**

EPA multiplied the site-specific baseline wastewater loadings by the corresponding statistically derived weighting factors (see Section 3.0) for each model site. EPA summed the weighted loadings across all sites in each subcategory to estimate subcategory-specific baseline wastewater pollutant loadings. EPA also summed the weighted

loadings across all sites to estimate industry-wide baseline wastewater pollutant loadings. Table 12-2 presents the estimated baseline pollutant loadings by subcategory for direct and indirect dischargers.

### **12.3      Estimation of Industry Option Pollutant Loadings**

Industry option pollutant loadings (i.e., post-compliance pollutant loadings for the technology option) represent the total loadings of pollutants in all MP&M wastewater that would be discharged to surface waters or POTWs after complying with the regulatory option. The estimation of industry option pollutant loadings for each subcategory is described in the following subsections.

#### **12.3.1      Estimation of Industry Option Pollutant Loadings for Sites in the Metal-Bearing Subcategories**

*Direct Dischargers (General Metals Subcategory).* EPA estimated option effluent concentrations assuming that all direct discharging MP&M facilities in the General Metals Subcategory would achieve long-term average effluent pollutant concentrations associated with the MP&M sampled sites performing BAT (Option 2, including chemical precipitation with clarification). EPA estimated effluent concentrations for all pollutants of concern (listed in Section 7.0). Note that if the long-term average effluent concentration for a pollutant was more than its corresponding treatment influent concentration (based on unit operation wastewater concentrations), EPA retained the treatment influent concentration to estimate the option effluent concentration for that pollutant.

*Indirect Dischargers - 413 to 433 Upgrade Analysis for sites regulated by 40 CFR 413 only (General Metals, Printed Wiring Board, and Metal Finishing Job Shop Subcategories).* EPA estimated option effluent concentrations assuming all indirect discharging MP&M facilities in metal-bearing subcategories, currently regulated by 40 CFR 413 only, would achieve long-term average effluent pollutant concentrations associated with the BAT sites sampled under development of 40 CFR 433 (at the option). EPA estimated effluent concentrations only for pollutants regulated under 40 CFR 433.

*Indirect Dischargers - Local Limits to 433 Upgrade Analysis for sites regulated by local limits (General Metals Subcategory).* EPA estimated option effluent concentrations assuming all indirect discharging facilities in the General Metals Subcategory, not currently regulated by 40 CFR 413 or 433, would achieve long-term average effluent pollutant concentrations associated with the BAT sites sampled under development of 40 CFR 433 (at the option). For pollutants regulated under local limits, but not regulated under Part 433, EPA assumed the facilities would achieve the national median local limit values. EPA estimated effluent concentrations only for pollutants regulated under local limits.

EPA then estimated post-compliance pollutant loadings for each model facility by multiplying the treated effluent concentration by its wastewater flow rate to obtain a mass loading (in pounds) for each pollutant. Finally, EPA estimated site-specific option loadings.

EPA summed the mass loadings for all pollutants in the final effluent discharged from the model site.

### **12.3.2 Estimation of Industry Option Pollutant Loadings for Sites in the Shipbuilding Dry Dock Subcategory**

Because EPA concluded that national regulation of discharges from the Shipbuilding Dry Dock Subcategory is unwarranted<sup>5</sup>, EPA did not assess option pollutant loadings for this subcategory.

### **12.3.3 Estimation of Industry Option Pollutant Loadings for Sites in the Railroad Line Maintenance Subcategory**

For this subcategory, EPA used information in its database on current permit limitations for facilities operating the Option 6 technology to estimate post-compliance pollutant loadings. All of the facilities that operate the Option 6 technology have a daily maximum oil and grease limit of 15 mg/L. For TSS, half of the facilities have a daily maximum limit of 45 mg/L while the other half have no limit. Based on this information, the oil and grease and TSS daily maximum limits representing the average of the best performing Option 6 facilities would be 15 mg/L and 45 mg/L, respectively. To estimate pollutant loadings for each model facility, EPA multiplied these maximum limits by the wastewater flow (provided in the survey) to obtain a mass loading (in pounds) for TSS.

### **12.3.4 Estimation of Industry Option Pollutant Loadings for Sites in the Oily Wastes Subcategory**

EPA calculated the loadings assuming that all Oily Wastes sites would achieve long-term average effluent pollutant concentrations associated with the MP&M sampled sites performing BAT (Option 6, including chemical emulsion breaking with gravity oil/water separation).

First, EPA estimated the pollutant concentrations in the effluent from treatment at each model site, using the LTAs calculated from MP&M BAT sampled sites. The calculated LTAs for oil and grease and TSS are 18.89 mg/L and 44 mg/L, respectively. Note that if the long-term average effluent concentration for a pollutant was more than its corresponding treatment influent concentration (based on unit operation wastewater concentrations), EPA retained the treatment influent concentration to estimate the option concentration for that pollutant.

Second, EPA estimated site-specific pollutant loadings. EPA multiplied the pollutant concentrations in the final effluent (discharged from the model site) by the wastewater

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<sup>5</sup>See Section VI.H of the final preamble for additional discussion.

flow rate (calculated in the EPA Costs & Loadings Model, or provided in the DMR) to obtain a mass loading (in pounds) for each pollutant.

Finally, EPA estimated site-specific option loadings. EPA summed the mass loadings for all pollutants in the final effluent discharged from the model site.

## 12.4 **Estimation of Pollutant Reductions**

Option pollutant reductions represent the incremental amount of pollutants removed by each technology option with respect to EPA's estimated baseline pollutant loadings. EPA estimated baseline pollutant loadings as explained in Section 12.2. EPA estimated option pollutant loadings as explained in Section 12.3. EPA estimated pollutant reductions as follows:

1. *Estimated site-specific, pollutant-specific option removals.* EPA calculated the difference between the model site's baseline pollutant loadings and option pollutant loadings. For direct dischargers, EPA considered all pollutants of concern, with the exception of boron, sodium, calcium, and total dissolved solids. For indirect dischargers, EPA considered only pollutants regulated under 40 CFR 433. EPA further reduced the model site's option-specific pollutant removals for indirect dischargers by their corresponding POTW percent removal (listed in Table 12-1) to account for treatment that will occur at the POTW. A detailed discussion of how EPA developed pollutant-specific POTW percent removals is provided in Section 7.3.1 of the Technical Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Metal Products and Machinery Point Source Category.
2. *Modified site-specific, pollutant-specific option removals.* First, if the option-specific concentration for certain pollutant(s) was greater than the estimated baseline concentration for a model site, EPA set option-specific loadings for the pollutant(s) equal to the baseline loadings at those sites (EPA set the option-specific pollutant removal for that model site equal to zero). This was the case if the pollutant long-term average concentration for the treatment currently in place at the site was lower than that for EPA's treatment technology option (i.e., a model facility uses membrane technology, but EPA's option technology is chemical precipitation). Second, EPA set all removals of boron equal to zero. EPA determined that boron is not removed by most of the selected option treatment technologies, as discussed in the NODA. For additional details, refer to the memorandum entitled "Treatment System Removal of Boron from MP&M Wastewaters" in Section 16.7, DCN 16758 of the rulemaking record.
3. *Estimated toxic site-specific, pollutant-specific option removals.* EPA also calculated the site-specific, pollutant specific removals in toxic



pound-equivalents. A pound-equivalent (PE) is a pound of pollutant weighted for its toxicity to human and aquatic life. EPA multiplied the site-specific option pollutant removals (in pounds) by the corresponding toxic-weighting factor (TWF).

4. *Estimated site-specific option removals.* EPA summed the pollutant removals for all pollutants at the model site.
5. *Estimated industry-wide option loadings and removals.* For each option, EPA multiplied the site-specific option loadings and removals (accounting for POTW removals for indirect dischargers) by the corresponding statistically derived weighting factors for each model site. EPA summed the weighted loadings and removals across all sites in each subcategory to estimate subcategory-specific option loadings and removals for each option. EPA also summed the weighted loadings and removals across all sites to estimate industry-wide option loadings and removals.

Table 12-3 presents the estimated selected option pollutant loadings by subcategory for direct and indirect dischargers. Tables 12-4 and 12-5 present the estimated pollutant removals by the selected option in pounds (for direct dischargers only) and pound-equivalents (for both direct and indirect dischargers), respectively.

Note that, for the final rule, EPA did not provide option pollutant loadings or reductions for the Shipbuilding Dry Dock or Railroad Line Maintenance Subcategories. EPA concluded that pollutant removals associated with national regulation of these subcategories would be negligible. See DCNs 17859 and 17861 in Section 24.6.1 of the rulemaking record for more detailed discussion of the Shipbuilding Dry Dock and Railroad Line Maintenance Subcategories, respectively.

**Table 12-1****POTW Removal Percentages For Each MP&M Pollutant of Concern**

<b>Chemical Name</b>	<b>POTW Percent Removal</b>	<b>Source</b>
1,1,1-Trichloroethane	90.45	a
1,1-Dichloroethane	70	a
1,1-Dichloroethene	77.51	c
1,4-Dioxane	45.8	b
1-Bromo-2-Chlorobenzene	77.32	c
1-Bromo-3-Chlorobenzene	77.32	c
1-Methylfluorene	84.55	b
1-Methylphenanthrene	84.55	b
2,4-Dimethylphenol	77.51	c
2,4-Dinitrophenol	77.51	c
2,6-Dinitrotoluene	77.51	c
2-Butanone	96.6	b
2-Hexanone	77.32	c
2-Isopropylnaphthalene	77.32	c
2-Methylnaphthalene	28	b
2-Nitrophenol	26.83	a
2-Propanone	83.75	b
3,6-Dimethylphenanthrene	84.55	b
4-Chloro-3-Methylphenol	63	b
4-Methyl-2-Pentanone	87.87	b
4-Nitrophenol	77.51	c
Acenaphthene	98.29	a
Acetophenone	95.34	b
Acrolein	77.51	c
Alpha-Terpineol	94.4	b
Aluminum	91.36	a
Amenable Cyanide	57.41	c
Ammonia As Nitrogen	38.94	a
Aniline	93.41	b
Anthracene	77.51	c
Antimony	66.78	a
Arsenic	65.77	a
Barium	15.98	a
Benzoic Acid	80.5	b
Benzyl Alcohol	78	b

**Table 12-1 (Continued)**

Chemical Name	POTW Percent Removal	Source
Beryllium	71.66	c
Biphenyl	96.28	b
Bis(2-Ethylhexyl) Phthalate	59.78	a
BOD 5-Day (Carbonaceous)	89.12	a
Boron	30.42	a
Butyl Benzyl Phthalate	81.65	a
Cadmium	90.05	a
Calcium	8.54	a
Carbon Disulfide	84	b
Chemical Oxygen Demand (COD)	81.3	a
Chloride	57.41	c
Chlorobenzene	96.37	a
Chloroethane	77.51	c
Chloroform	73.44	a
Chromium	80.33	a
Cobalt	6.11	a
Copper	84.2	a
Cyanide	70.44	a
Di-N-Butyl Phthalate	84.66	a
Di-N-Octyl Phthalate	68.43	a
Dibenzofuran	77.32	c
Dibenzothiophene	84.68	b
Dimethyl Phthalate	77.51	c
Diphenyl Ether	77.32	c
Diphenylamine	77.32	c
Ethylbenzene	93.79	a
Fluoranthene	42.46	a
Fluorene	69.85	a
Fluoride	61.35	
Gold	32.52	c
Hexanoic Acid	84	b
Hexavalent Chromium	57.41	c
Iron	81.99	a
Isobutyl Alcohol	28	b
Isophorone	77.51	c
Lead	77.45	a
m+p Xylene	77.32	c

**Table 12-1 (Continued)**

Chemical Name	POTW Percent Removal	Source
m-Xylene	95.07	b
Magnesium	14.14	a
Manganese	35.51	a
Mercury	71.66	c
Methyl Methacrylate	99.96	b
Methylene Chloride	54.28	a
Molybdenum	18.93	a
n,n-Dimethylformamide	87	b
n-Decane	9	b
n-Docosane	88	b
n-Dodecane	95.05	b
n-Eicosane	92.4	b
n-Hexacosane	71.11	b
n-Hexadecane	71.11	b
n-Nitrosodimethylamine	77.51	c
n-Nitrosodiphenylamine	90.11	b
n-Nitrosopiperidine	77.32	c
n-Octacosane	71.11	b
n-Octadecane	71.11	b
n-Tetracosane	71.11	b
n-Tetradecane	71.11	b
n-Triacontane	77.32	c
Naphthalene	94.69	a
Nickel	51.44	a
o+p Xylene	65.4	b
o-Cresol	52.5	b
o-Xylene	77.32	c
Oil and Grease (as HEM)	86.08	a
p-Cresol	71.67	b
p-Cymene	99.79	b
Phenanthrene	94.89	a
Phenol	95.25	a
Phosphorus	32.52	c
Pyrene	83.9	b
Pyridine	95.4	b
Selenium	34.33	b
Silver	88.28	a

**Table 12-1 (Continued)**

Chemical Name	POTW Percent Removal	Source
Sodium	2.69	a
Styrene	93.65	b
Sulfate	84.61	b
Tetrachloroethene	84.61	a
Thallium	71.66	c
Tin	42	a
Titanium	91.82	a
Toluene	96.18	a
Total Dissolved Solids	8	b
Total Kjeldahl Nitrogen	57.41	c
Total Organic Carbon (TOC)	70.28	a
Total Petroleum Hydrocarbons (as SGT-HEM)	57.41	c
Total Phosphorus	57.41	c
Total Recoverable Phenolics	57.41	c
Total Sulfide	57.41	c
Total Suspended Solids	89.55	a
Trichloroethene	77.51	c
Trichlorofluoromethane	77.32	c
Tripropyleneglycol Methyl Ether	52.4	b
Vanadium	9.51	a
Weak-Acid Dissociable Cyanide	57.41	c
Yttrium	32.52	c
Zinc	79.14	a

Note: See the rulemaking record for further detail for the sources.

a - November 5, 1999 Updated 50-POTW Study. Influent Concentration 10xML, 5xML, then 20 ppb.

b - RREL Database. Compiled for the CWT effluent guideline or the 1995 Phase I Proposal.

c - Average POTW removals calculated by classification code from sources a and b.

**Table 12-2****Summary of Baseline Annual Pollutant Loadings Discharged by Subcategory<sup>a</sup>**

Subcategory	Discharge Status	Options Evaluated Since Proposal	NODA				Final Rule			
			Number of Sites	Pound Equivalents (PE/yr) <sup>b</sup>	Pounds (lbs/yr)		Number of Sites	Pound Equivalents (PE/yr) <sup>b</sup>	Pounds (lbs/yr)	
					Total <sup>b</sup>	TSS/Oil and Grease (as HEM)			Total <sup>b</sup>	TSS/Oil and Grease (as HEM)
General Metals	Direct	Option 2	1,521	2,009,351	174,459,398	7,322,917	228	270,336	13,555,899	1,297,831
	Indirect	Option 2, 1 MGY cutoff	2,354	6,234,209	1,106,541,984	41,557,113	NA			
		Upgrade Option	NA				429	391,340	369,856	NA
		50% Local Limits	NA				628	236,171	222,457,659	13,512,840
Metal Finishing Job Shops	Direct	Option 2	24	3,358	950,820	21,111	NA			
	Indirect	Option 2	1,270	438,866	63,845,074	2,002,275	NA			
		Upgrade Option	NA				314	82,633	146,194	NA
Non-Chromium Anodizing	Direct <sup>c</sup>	Option 2 (model site)	35	2,405,434	219,633,506	4,665,748	19	3,924	1,444,780	29,944
	Indirect	Not Proposed	NA							
Printed Wiring Board	Direct	Option 2	4	527	70,681	1,584	NA			
	Indirect	Option 2	840	923,431	82,596,963	4,040,990	NA			
		Upgrade Option	NA				354	73,624	130,639	NA
Steel Forming and Finishing	Direct	Option 2	Not Covered by MP&M							
	Indirect	Option 2								
Oily Wastes	Direct	Option 6	2,749	11,149	30,585,116	5,709,823	2,382	3,351	6,454,146	588,817
	Indirect	Option 6, 2 MGY cutoff	288	78,247	189,374,738	46,336,329	NA			

**Table 12-2 (Continued)**

Subcategory	Discharge Status	Options Evaluated Since Proposal	NODA				Final Rule			
			Number of Sites	Pound Equivalents (PE/yr) <sup>b</sup>	Pounds (lbs/yr)		Number of Sites	Pound Equivalents (PE/yr) <sup>b</sup>	Pounds (lbs/yr)	
					Total <sup>b</sup>	TSS/Oil and Grease (as HEM)			Total <sup>b</sup>	TSS/Oil and Grease (as HEM)
Railroad Line Maintenance	Direct	Option 10	31	865	300,188	17,531	NA			
		Option 6	NA				9	NA		
	Indirect	Not Proposed	NA							
Shipbuilding Dry Dock	Direct	Direct	6	1,925	10,762,301	8,523,580	6	NA		
	Indirect	Not Proposed	NA							

Source: EPA Costs &amp; Loadings Model.

<sup>a</sup>Baseline loads reflect the load after treatment, or raw loads if there is no treatment in place.<sup>b</sup>Does not include sodium, calcium, total dissolved solids, and boron.<sup>c</sup>EPA's data collection efforts did not identify any direct discharging non-chromium anodizing facilities.

NA - Not applicable.

**Table 12-3****Summary of Selected Option Annual Pollutant Loadings Discharged by Subcategory<sup>a</sup>**

Subcategory	Discharge Status	Options Evaluated Since Proposal	NODA				Final Rule			
			Number of Sites	Pound Equivalents (PE/yr) <sup>b</sup>	Pounds (lbs/yr)		Number of Sites	Pound Equivalents (PE/yr) <sup>b</sup>	Pounds (lbs/yr)	
					Total <sup>b</sup>	TSS/Oil and Grease (as HEM)			Total <sup>b</sup>	TSS/Oil and Grease (as HEM)
General Metals	Direct	Option 2	1,521	1,011,672	43,517,771	1,508,435	228	263,433	11,733,086	1,007,624
	Indirect	Option 2, 1 MGY cutoff	2,354	508,173	158,758,380	3,957,147	NA			
		Upgrade Option	NA				429	89,012	112,968	NA
		50% Local Limits	NA				628	99,666	89,456,128	820,566
Metal Finishing Job Shops	Direct	Option 2	24	1,707	292,154	5,618	NA			
	Indirect	Option 2	1,270	139,820	33,732,992	705,244	NA			
		Upgrade Option	NA				314	42,945	61,831	NA
Non-Chromium Anodizing	Direct <sup>c</sup>	Option 2 (model site)	35	12,698	6,263,130	449,851	19	1,879	1,193,263	19,297
	Indirect	Not Proposed	NA							
Printed Wiring Board	Direct	Option 2	4	341	45,733	1,055	NA			
	Indirect	Option 2	840	114,167	38,526,836	1,100,894	NA			
		Upgrade Option	NA				354	42,068	61,041	NA
Steel Forming and Finishing	Direct	Option 2	Not Covered by MP&M							
	Indirect	Option 2								
Oily Wastes	Direct	Option 6	2,749	5,781	3,483,987	191,913	2,382	667	943,466	102,722
	Indirect	Option 6, 2 MGY cutoff	288	33,064	38,007,435	1,679,345	NA			



**Table 12-3 (Continued)**

Subcategory	Discharge Status	Options Evaluated Since Proposal	NODA				Final Rule			
			Number of Sites	Pound Equivalents (PE/yr) <sup>b</sup>	Pounds (lbs/yr)		Number of Sites	Pound Equivalents (PE/yr) <sup>b</sup>	Pounds (lbs/yr)	
					Total <sup>b</sup>	TSS/Oil and Grease (as HEM)			Total <sup>b</sup>	TSS/Oil and Grease (as HEM)
Railroad Line Maintenance	Direct	Option 10	31	832	228,830	12,674	NA			
		Option 6	NA				9	NA		
	Indirect	Not Proposed	NA							
Shipbuilding Dry Dock	Direct	Direct	6	1,869	502,953	34,786	6	NA		
	Indirect	Not Proposed	NA							

Source: EPA Costs &amp; Loadings Model.

<sup>a</sup>Option loads reflect the load after the implementation of the MP&M technology basis for each subcategory.<sup>b</sup>Does not include sodium, calcium, total dissolved solids, and boron.<sup>c</sup>EPA's data collection efforts did not identify any direct discharging non-chromium anodizing facilities.

NA - Not applicable.

**Table 12-4****Industry Pollutant Removals in Pounds (for Direct Dischargers)**

Subcategory	Options Evaluated Since Proposal	NODA Removals (lbs)			Final Rule Removals (lbs)			Option Promulgated?
		Total	TSS/Oil and Grease (as HEM)	Priority and Nonconventional Metals/Organics	Total	TSS/Oil and Grease (as HEM)	Priority and Nonconventional Metals/Organics	
General Metals	Option 2	130,941,626	5,814,481	5,693,724	1,822,813	290,207	56,320	No
Metal Finishing Job Shops	Option 2	658,666	15,492	35,661	NA			No
Non-Chromium Anodizing	Option 2 (model site)	213,370,375	4,215,897	37,401,639	251,517	10,646	16,159	No
Printed Wiring Board	Option 2	24,949	530	1,078	NA			No
Steel Forming and Finishing	Option 2	Not Covered by MP&M						No
Oily Wastes	Option 6	27,101,129	5,517,909	108,748	5,510,680	486,094	11,271	Yes
Railroad Line Maintenance	Option 10	71,358	4,857	482	NA			No
	Option 6	NA			NA			No
Shipbuilding Dry Dock	Option 10	10,259,349	8,488,793	1,796	NA			No

Source: EPA Costs &amp; Loadings Model.

Note: Loadings estimates presented in this table will not equal those presented in the EEBA. EEBA estimates do not include loadings for facilities that are projected to close in the baseline.

NA- Not applicable.

**Table 12-5****Industry Pollutant Removals in Pound-Equivalents**

Subcategory	Discharge Status	Options Evaluated Since Proposal	NODA		Final Rule		Option Promulgated?
			Number of Sites	Pollutant Removals (PE)	Number of Sites	Pollutant Removals (PE)	
General Metals	Direct	Option 2	1,521	997,678	228	6,903	No
	Indirect	Option 2, 1 MGY cutoff	2,354	1,360,332	NA		No
		Upgrade Option	NA		429	39,734	No
		50% Local Limits	NA		628	39,630	No
Metal Finishing Job Shops	Direct	Option 2	24	1,652	NA		No
	Indirect	Option 2	1,270	95,149	NA		No
		Upgrade Option	NA		314	6,034	No
Non-Chromium Anodizing	Direct	Option 2 (model site)	35	2,392,735	19	2,045	No
	Indirect	Not Proposed	NA				No
Printed Wiring Board	Direct	Option 2	4	186	NA		No
	Indirect	Option 2	840	153,653	NA		No
		Upgrade Option	NA		354	5,157	No
Steel Forming and Finishing	Direct	Option 2	Not Covered by MP&M				No
	Indirect	Option 2	Not Covered by MP&M				No
Oily Wastes	Direct	Option 6	2,749	5,367	2,382	2,684	Yes
	Indirect	Option 6, 2 MGY cutoff	288	14,385	NA		No
Railroad Line Maintenance	Direct	Option 10	31	34	NA		No
		Option 6	NA		9	NA	No
	Indirect	Not Proposed	NA				No
Shipbuilding Dry Dock	Direct	Option 10	6	56	6	NA	No
	Indirect	Not Proposed	NA				No

Source: EPA Costs &amp; Loadings Model.

Note: Loadings estimates presented in this table will not equal those presented in the EEBA. EEBA estimates do not include loadings for facilities that are projected to close in the baseline.

NA - Not applicable.

## 13.0 NON-WATER QUALITY IMPACTS

Sections 304(b) and 306 of the Clean Water Act require EPA to consider non-water quality environmental impacts (including energy requirements) associated with effluent limitations guidelines and standards. To comply with these requirements, EPA considered the potential impact of the MP&M final rule on energy consumption, air emissions, and solid waste generation. Section 9.0 discusses the final rule technology options.

While it is difficult to balance environmental impacts across all media and energy use, the Agency has determined that the benefits associated with compliance with the limitations and standards justify the multimedia impacts identified in this section (see Chapters 12 through 16 of the Economic, Environmental, and Benefits Analysis of the Final Metal Products and Machinery Rule (EEBA) (EPA-821-B-03-002) for a discussion on the environmental benefits associated with this final regulation).

Section 13.1 discusses the energy requirements for implementing wastewater treatment technologies at MP&M facilities. Section 13.2 presents the impact of the technologies on air emissions, and Section 13.3 discusses the impact on wastewater treatment sludge and waste oil generation. Section 13.4 presents the reference used in this section.

### 13.1 Energy Requirements

EPA estimates that compliance with this rule will result in a net increase in energy consumption at MP&M facilities. Table 13-1 presents estimates of energy usage for the selected technology option.

**Table 13-1**

#### **Energy Usage for the Selected Technology Option**

<b>Selected Option</b>	<b>Incremental Energy Required<sup>a</sup> (kiloWatt hrs/yr)</b>
<u>Basic Technology with Water Conservation and Pollution Prevention</u> <ul style="list-style-type: none"> <li>Option 6: End-of-pipe chemical emulsion breaking and gravity separation; plus in-process flow control and pollution prevention technologies (Oily Wastes).</li> </ul>	350,676

Source: EPA Costs & Loadings Model.

<sup>a</sup>The amount of additional energy required (from baseline) if the technology option is implemented, summed for all regulated facilities.

This annual incremental net energy increase for the MP&M final rule is minimal (< 0.001 percent) when compared with the total electricity used by the entire United States in 1997 (3,123 billion kiloWatt hours (KWH)) (1). Additionally, EPA expects that this small increase in energy usage will not result in any increase of air emissions impacts from the electric power generation facilities providing the additional energy.

## 13.2 Air Emissions Impacts

The in-process and end-of-pipe technologies included in the technology options for this rule do not generate significant air emissions. The additional air emissions generated by the technology options will not hinder facilities' ability to comply with EPA's national emission standards for hazardous air pollutants (NESHAPs).

EPA is developing NESHAPs under Section 112 of the Clean Air Act (CAA) to address air emissions of the hazardous air pollutants (HAPs) listed in Section 112(b) of the CAA. Below is a list of current and upcoming NESHAPs that affect MP&M sites (see EPA's Air Toxics Web site, <http://www.epa.gov/ttn/atw/>, for more information and updates):

- Chromium Emissions from Hard and Decorative Chromium Electroplating and Chromium Anodizing Tanks - Proposed December 16, 1993 and promulgated on January 25, 1995;
- Halogenated Solvent Cleaning - Proposed November 29, 1993 and promulgated on December 2, 1994;
- Aerospace Manufacturing - Proposed June 6, 1994 and promulgated on September 1, 1995;
- Shipbuilding and Ship Repair (Surface Coating) - Proposed December 6, 1994 and promulgated on December 15, 1995;
- Large Appliances (Surface Coating) - Proposed December 22, 2000 and promulgated on July 23, 2002;
- Metal Furniture (Surface Coating) - Proposed April 24, 2002;
- Metal Can (Surface Coating) - Signed November 26, 2002;
- Automobile and Light-Duty Truck Manufacturing (Surface Coating) - Signed November 26, 2002; and
- Miscellaneous Metal Parts and Products (Surface Coating) - Proposed August 13, 2002.

These NESHAPs define the maximum achievable control technology (MACT) for emissions of HAPs. Like effluent guidelines, MACT standards are technology-based. The CAA specifies criteria for determining MACT for new and existing sources.

Halogenated HAP solvents (e.g., methylene chloride, perchloroethylene, trichloroethylene, 1,1,1-trichloroethane, carbon tetrachloride, and chloroform) used for cleaning

in the MP&M industry can be a source of hazardous air emissions. EPA believes the final MP&M rule will not affect the use of solvents containing halogenated hazardous air pollutants in the MP&M industry. This rule neither requires nor discourages the use of aqueous cleaners in lieu of halogenated HAP solvents.

Additionally, because the final rule would not allow any less stringent control of VOCs or organic HAPs than is currently in place at MP&M facilities, EPA does not predict any net increase in air emissions from volatilization or organic pollutants due to the final rule. As such, EPA expects no adverse air impacts to occur as a result of the final rule.

### 13.3 Solid Waste Generation

Solid waste generated at the regulated MP&M sites consists of waste oil removed in wastewater treatment. EPA estimates that compliance with this final rule will result in an increase in MP&M waste oil generation.

Based on the Agency's detailed questionnaire, EPA estimates that MP&M facilities covered by this final rule generated 13.5 million gallons of waste oil in 1996. Table 13-2 presents the amount of additional waste oil expected to be generated as a result of implementing the technology option.

**Table 13-2**

#### **Waste Oil Removed by the Selected Option**

Selected Option	Incremental Waste Oil Removed <sup>a</sup> (million gal/yr)
<u>Basic Technology with Water Conservation and Pollution Prevention</u> <ul style="list-style-type: none"> <li>Option 6: End-of-pipe chemical emulsion breaking and gravity separation; plus in-process flow control and pollution prevention technologies (Oily Wastes).</li> </ul>	2.4

Source: MP&M Costs & Loadings Model.

<sup>a</sup>The amount of additional oil removed (from baseline) if the technology option is implemented, summed for all regulated facilities.

Removing oil from MP&M wastewater prior to discharge to surface waters results in an increase in waste oil generation from baseline to the final rule option (Option 6). The increase in waste oil generation reflects better removal of oil from the wastewater, and does not reflect an increase in overall oil use at MP&M facilities.

MP&M facilities usually either recycle waste oil on or off site, or contract for off-site disposal of the waste oil as either a hazardous or nonhazardous waste. For the purpose of compliance cost estimation, EPA assumed that all sites contracted for off-site disposal of waste oil; however, EPA expects that some of the waste oil can be recycled either on or off site.

## 13.4

### **References**

1. The Energy Information Administration. Electric Power Annual 1998 Volume 1, Table A1, 1998. <http://www.eia.doe.gov/>.

## **14.0 LONG-TERM AVERAGES AND EFFLUENT LIMITATIONS AND STANDARDS**

This section presents the MP&M effluent guidelines for each regulatory level of control required by the Clean Water Act (CWA) for direct and indirect dischargers, and presents the technology basis for the limitations and standards. Section 2.0 provides more details on the different regulatory levels of control. Direct dischargers are sites that discharge wastewater to a surface water. Indirect dischargers are sites that discharge wastewater to a publicly owned treatment works (POTW).

EPA is only promulgating limitations and standards for direct dischargers (existing and new) for one of the subcategories in the January 2001 proposal: Oily Wastes. These limitations and standards are codified in 40 CFR 438, Subpart A. The final limitations are concentration-based limitations with an allowable pH range.

EPA decided not to establish limitations for existing and new direct dischargers in seven subcategories listed in the January 2001 proposal (General Metals, Metal Finishing Job Shops, Printed Wiring Board, Non-Chromium Anodizing, Steel Forming and Finishing, Railroad Line Maintenance, and Shipbuilding Dry Dock). EPA also decided not to establish standards for new and existing indirect dischargers (PSES and PSNS) for all eight subcategories listed in the January 2001 proposal (including the Oily Wastes Subcategory in the final MP&M rule).

Sections 14.1 through 14.8 discuss EPA's rationale for the selected technology options and summarize the effluent guidelines for each of the regulatory levels of control for each of the subcategories listed in the January 2001 proposal. Section 10.0 contains detailed information on those facilities whose data EPA used to calculate the BPT limitations, and presents the statistical methodology for developing numerical limitations. Section 9.0 describes in detail all of the MP&M technology options evaluated for the final rule, and Sections 11.0 and 12.0 discuss estimated compliance costs and pollutant loadings and removals, respectively, for these technology options. All supporting economic and financial analyses can be found in the Economic, Environmental, and Benefits Analysis of the Final Metal Products & Machinery Rule (EEBA) (EPA-821-B-03-002). Cost-effectiveness analyses can be found in the EEBA and Section 26.0 of the rulemaking record, DCN 37900.

EPA is promulgating performance-based limitations and standards to control direct discharges; these limitation and standards do not require the use of any particular pollution prevention or wastewater treatment technology. Rather, a facility may use any combination of pollution prevention and wastewater treatment technology to comply with the limitations. Direct dischargers must also comply with NPDES regulations (40 CFR 122).

### **14.1 General Metals Subcategory**

EPA is not revising or establishing any limitations or standards for facilities that would have been subject to this subcategory. Such facilities will continue to be regulated by the



General Pretreatment Standards (Part 403), local limits, permit limits, and Parts 413 and/or 433, as applicable.

#### **14.2      Metal Finishing Job Shops Subcategory**

EPA is not revising any limitations or standards for facilities that would have been subject to this subcategory. Such facilities will continue to be regulated by the General Pretreatment Standards (Part 403), local limits, permit limits, and Parts 413 and/or 433, as applicable.

#### **14.3      Non-Chromium Anodizing Subcategory**

EPA is not revising limitations or standards for any facilities that would have been subject to this subcategory. Such facilities will continue to be regulated by the General Pretreatment Standards (Part 403), local limits, permit limits, and Parts 413 and/or 433, as applicable.

#### **14.4      Printed Wiring Board Subcategory**

EPA is not revising any limitations or standards for facilities that would have been subject to this subcategory. Such facilities will continue to be regulated by the General Pretreatment Standards (Part 403), local limits, permit limits, and Parts 413 and/or 433, as applicable.

#### **14.5      Steel Forming and Finishing Subcategory**

EPA is not revising limitations or standards for any facilities that would have been subject to this subcategory. Such facilities will continue to be regulated by the General Pretreatment Standards (Part 403), local limits, permit limits, and Iron and Steel effluent limitations guidelines (Part 420) as applicable.

#### **14.6      Oily Wastes Subcategory**

EPA is promulgating limitations and standards for existing and new direct dischargers in the Oily Wastes Subcategory based on the proposed Option 6 technology (see Section 9.0). EPA is not promulgating pretreatment standards for existing or new indirect dischargers in this subcategory.

##### **14.6.1      Best Practicable Control Technology (BPT)**

As discussed in Section 9.7.1, EPA is establishing BPT pH limitations and daily maximum limitations for two pollutants, oil and grease as hexane extractable material (oil and grease (as HEM)) and total suspended solids (TSS), for direct dischargers in the Oily Wastes Subcategory based on the proposed technology option (Option 6). Option 6 technology includes

the following: (1) in-process flow control and pollution prevention, and (2) oil/water separation by chemical emulsion breaking and skimming (see Section 9.0 for additional details on the Option 6 technology).

In its analyses, EPA estimated that facilities will monitor once per month for oil and grease (as HEM) and TSS. EPA expects that 12 data points for each pollutant per year will yield a meaningful basis for establishing compliance with the promulgated limitations through long-term trends and short-term variability in oil and grease (as HEM) and TSS pollutant discharge loading patterns.

Although EPA is not changing the technology basis from that proposed, EPA is revising all of the proposed Oily Wastes Subcategory BPT limitations. This is due to incorporation of additional data and revisions to the data sets used to calculate the promulgated limitations (see 67 FR 38754).

**Table 14-1**

**BPT Effluent Limitations for the Oily Wastes Subcategory**

<b>Regulated Parameter</b>	<b>Maximum Daily mg/L (ppm)</b>
Total Suspended Solids (TSS)	62
Oil and Grease (as HEM)	46
pH	a

<sup>a</sup>Discharges must remain within the pH range 6 to 9.

These BPT limitations regulate process wastewater discharges from “oily operations” at existing or new direct dischargers engaged in manufacturing, rebuilding, or maintenance of metal parts, products, or machines used in any of the 16 industrial sectors listed in Section 1.1 and 40 CFR 438.1. EPA has defined “oily operation” in Section V.A of the preamble to the final rule, 40 CFR 438.2(f), and Appendix B to Part 438.

Wastewater discharges from other subcategories listed in the January 2001 proposal will continue to be regulated by existing categorical regulations (e.g., 40 CFR 413, 433, 420), General Pretreatment Standards (40 CFR 403), local limits, or permit limits. When a facility segregates “oily operations” process wastewaters from other process wastewaters, the NPDES permit writer will use the limitations and standards in the final rule for those “oily operations” process wastewaters (40 CFR 438). When a facility commingles “oily operations” process wastewaters with other process wastewaters already covered by other effluent limitations guidelines or with process wastewaters from metal-bearing operations (as defined in 438.2), the entire commingled stream is not regulated by the final rule. This provision must be examined for each point source discharge at a given facility and is codified at 438.1(b).

#### **14.6.2 Best Conventional Pollutant Control Technology (BCT)**

EPA is promulgating effluent limitations for conventional parameters (e.g., pH, TSS, oil and grease) equivalent to BPT for this subcategory because it identified no technologies that can achieve greater removals of conventional pollutants than the selected BPT technology basis that also pass the BCT cost test (see Section 9.7.2).

#### **14.6.3 Best Available Technology Economically Achievable (BAT)**

EPA proposed to control toxic and nonconventional pollutants by using BAT limitations based on Option 6 technology. As described in Section 9.7.3, EPA is not promulgating BAT limitations for specific pollutant parameters. EPA will achieve control of toxic organics and other priority and nonconventional pollutant discharges in Oily Wastes Subcategory process wastewaters through use of the oil and grease (as HEM) limitation.

#### **14.6.4 New Source Performance Standards (NSPS)**

EPA is promulgating NSPS that would control pH and the same conventional pollutants controlled at the BPT and BCT levels (see Section 9.7.4).

#### **14.6.5 Pretreatment Standards for Existing Sources (PSES)**

EPA proposed to establish PSES for existing indirect dischargers in the Oily Wastes Subcategory based on the Option 6 technology (i.e., the same technology basis that is being promulgated for BPT/BCT/NSPS for this subcategory) with a “low-flow” exclusion of 2 million gallons per year (MGY) to reduce economic impacts on small businesses and administrative burden for control authorities. EPA is not promulgating PSES for existing indirect dischargers in the Oily Wastes Subcategory (see Section 9.7.5). These facilities remain subject to the General Pretreatment Standards (40 CFR 403) and local limits, as applicable.

#### **14.6.6 Pretreatment Standards for New Sources (PSNS)**

EPA proposed to establish PSNS for indirect dischargers in the Oily Wastes Subcategory based on the Option 6 technology (i.e., the same technology basis that is being promulgated for NSPS for this subcategory) with a “low-flow” exclusion of 2 MGY to reduce economic impacts on small businesses and reduce administrative burden to POTWs. EPA rejected Option 6 technology as the basis for PSNS in the Oily Wastes Subcategory. EPA has selected “no further regulation” for new Oily Wastes Subcategory indirect dischargers and is not revising PSNS for new Oily Wastes Subcategory indirect dischargers (see Section 9.7.6). These facilities remain subject to the General Pretreatment Standards (40 CFR 403) and local limits, as applicable.

**14.7            Railroad Line Maintenance Subcategory**

EPA is not establishing limitations or standards for any facilities that would have been subject to this subcategory. Permit writers and control authorities will establish controls using best professional judgment (BPJ) to regulate wastewater discharges from these facilities.

**14.8            Shipbuilding Dry Dock Subcategory**

EPA is not establishing limitations or standards for any facilities that would have been subject to this subcategory. Permit writers and control authorities will establish controls using BPJ to regulate wastewater discharges from these facilities.

## 15.0 IMPLEMENTATION

This section provides guidance to permit writers and the regulated community for implementing the MP&M effluent limitations guidelines and standards. Section 15.1 describes the MP&M effluent guidelines' applicability, Section 15.2 summarizes compliance dates, Section 15.3 presents guidance on developing limits, and Section 15.4 summarizes monitoring requirements.

### 15.1 Applicability of the MP&M Effluent Guidelines

The MP&M Point Source Category regulates oily operation process wastewater discharges to surface waters from existing or new industrial facilities (including facilities owned and operated by federal, state, or local governments) engaged in manufacturing, rebuilding, or maintenance of metal parts, products, or machines for use in any of the 16 MP&M industrial sectors. Please note the underlined language in the previous sentence. A facility may be subject to the MP&M effluent guidelines even if it is not in one of the MP&M industrial sectors. For example, EPA considers a facility performing machining as part of the "Bus & Truck" industrial sector if it maintains metal parts for truck trailers. Process wastewater means wastewater as defined at 40 CFR 122 and 401, and includes wastewater from air pollution control devices (see 40 CFR 438.2(g)). EPA notes that the MP&M effluent guidelines only regulate process wastewaters from wet air pollution control for organic constituents (see 40 CFR 438.2(f)). Oily operations are listed at 40 CFR 438.2(g) and defined in Appendix B to Part 438 (see also Section 4.0 of this document).

Manufacturing is the series of unit operations necessary to produce metal products and is generally performed in a production environment. Rebuilding/maintenance is the series of unit operations necessary to disassemble used metal products into components, replace the components or subassemblies or restore them to original function, and reassemble the metal product. Rebuilding and maintenance operations are intended to keep metal products in operating condition and can be performed in either a production or a nonproduction environment. The 16 industrial sectors are described in further detail in the following subsection. Additionally, some facilities are excluded by definition from the MP&M effluent guidelines (see Section 15.1.3).

EPA collected data on a wide variety of facilities engaged in manufacturing, rebuilding, or maintenance of metal parts, products, or machines for use in the 16 MP&M industrial sectors (see Section 3.0). The range of manufacturing, rebuilding, or maintenance operations involved the following types of metal parts, products, or machines: (1) parts, products, or machines composed of metal or metal alloys, and/or (2) parts, products, or machines with metal surfaces. In particular, EPA notes that metal parts or products can have a nonmetal substrate with a metal surface. For example, a plastic part with a metal surface is considered a "metal part" under MP&M effluent guidelines when it is manufactured, rebuilt, or maintained for use in one of the 16 industrial sectors. Oily operation process wastewaters on this metal part would be subject to the MP&M effluent guidelines provided there are no exclusions from the

guidelines as described in the applicability section of the rule. Another specific example of a metal part is a laminate composed of a metal surface and nonmetal substrate. In this particular case, the laminate manufacturing process involves pressing a fiberglass web between two sheets of copper foil for a part in electronic equipment. If a facility performs oily operations on this laminate (a “metal part” because it has a metal surface), then any resulting process wastewater would be subject to the MP&M effluent guidelines provided there are no exclusions from the guidelines as described in the applicability section of the rule. EPA notes that lead crystal is not a metal part or product as it does not have a metal surface.

### **15.1.1 MP&M Industrial Sectors**

The MP&M Point Source Category encompasses manufacturing, rebuilding, or maintenance of metal parts, products, or machines for use in the following industrial sectors:

- Aerospace;
- Aircraft;
- Bus and Truck;
- Electronic Equipment;
- Hardware;
- Household Equipment;
- Instruments;
- Mobile Industrial Equipment;
- Motor Vehicle;
- Office Machines;
- Ordnance;
- Precious Metals and Jewelry;
- Railroad;
- Ships and Boats;
- Stationary Industrial Equipment; and
- Miscellaneous Metal Products.

The MP&M sectors manufacture, maintain, and rebuild metal products under more than 200 different Standard Industrial Classification (SIC) codes. Typical products in the MP&M industrial sectors are listed in Appendix A to 40 CFR 438 and Appendix A of this document includes a list of example SIC codes and North American Industrial Classification System (NAICS) codes that may further clarify the description of the above industrial sectors.

The final rule also covers direct discharges of wastewater from MP&M operations related to maintenance and repair of metal products, parts, and machinery at military installations (i.e., federal facilities) as well as facilities owned or operated by state or local governments. For example, the rule covers wastewater generated from the maintenance and repair of aircraft, cars, trucks, buses, tanks (or other armor personnel carriers), and industrial equipment – these operations are commonly performed at military installations and state or local government maintenance facilities.

The MP&M effluent guidelines do not apply to maintenance or repair of metal parts, products, or machines that takes place only as ancillary activities at facilities not included in the 16 MP&M industrial sectors. EPA estimates that these ancillary repair and maintenance activities would typically discharge *de minimis* quantities of process wastewater. For example, wastewater discharges from repair of metal parts at oil and gas extraction facilities are not subject to the final rule. The Agency has concluded that permit writers will establish limits using best professional judgment (BPJ) to regulate wastewater discharges from ancillary waste streams for direct dischargers (see 66 FR 433). EPA has not received any information during the rulemaking that would contradict this conclusion.

Alternatively, EPA is including oily operation process wastewater discharges from activities related to maintaining or repairing aircraft or other related (metal) equipment (e.g., baggage-handling vehicles) at airports when those oily operation process wastewaters are not already covered by another effluent guidelines regulation (see Section 15.1.3).

### **15.1.2 Regulated Subcategory in the MP&M Effluent Guidelines**

EPA evaluated the following subcategories for the MP&M final rule: General Metals, Metal Finishing Job Shops, Non-Chromium Anodizing, Printed Wiring Board, Steel Forming and Finishing, Oily Wastes, Railroad Line Maintenance, and Shipbuilding Dry Dock. See Section 6.0 for a further discussion on the subcategorization structure EPA evaluated for the final rule. As discussed in Section 9.0, the MP&M effluent guidelines apply only to facilities in the Oily Wastes Subcategory (40 CFR 438, Subpart A). The Oily Wastes Subcategory applies to all of the 16 industrial sectors listed in the previous section. Section 6.0 further defines the Oily Wastes Subcategory.

### **15.1.3 Facilities Not Subject to the MP&M Effluent Guidelines**

Certain facilities and process wastewaters are not subject to the MP&M guidelines. These are listed at 40 CFR 438.1 (b) through (e) and are more fully described below.

#### **Overlap With Metal-Bearing Operations and Existing Effluent Limitations Guidelines and Standards**

MP&M effluent guidelines do not apply to process wastewaters from metal-bearing operations (see Section 4.0) or process wastewaters that are subject to the limitations and standards of other effluent limitations guidelines (e.g., Metal Finishing (40 CFR 433) or Iron and Steel Manufacturing (40 CFR 420)). EPA also established effluent guidelines for 11 other industries that may perform unit operations or process parts that are sometimes found at MP&M sites. These effluent guidelines are:

- Electroplating (40 CFR 413)<sup>1</sup>;
- Nonferrous Metals Manufacturing (40 CFR 421);
- Ferroalloy Manufacturing (40 CFR 424);
- Battery Manufacturing (40 CFR 461);
- Metal Molding & Casting (40 CFR 464);
- Coil Coating (40 CFR 465);
- Porcelain Enameling (40 CFR 466);
- Aluminum Forming (40 CFR 467);
- Copper Forming (40 CFR 468);
- Electrical & Electronic Components (40 CFR 469); and
- Nonferrous Metals Forming & Metal Powders (40 CFR 471).

Under the proposed rule, there was overlapping coverage between Parts 413, 433, and the proposed Part 438. See Table 15-1, which clarifies the coverage of Parts 413 and 433 and new Part 438 with respect to the subcategories evaluated for regulation in the final rule.

In general, when unit operations and their associated wastewater discharges are already covered by an existing effluent guideline, they will remain regulated under that effluent guideline. Additionally, these wastewater discharges will continue to be regulated by General Pretreatment Standards (40 CFR 403), local limits, and permit limits, as applicable. The limitations and standards in the Oily Wastes Subcategory (40 CFR 438, Subpart A) apply to process wastewater generated by “oily operations” that are discharged directly to surface waters and are not otherwise covered by other effluent limitations guidelines and standards.

The MP&M effluent guidelines also do not apply to process wastewaters from oily operations commingled with process wastewaters already covered by other effluent limitations guidelines or with process wastewaters from metal-bearing operations. When a facility segregates oily operation process wastewaters from other process wastewaters, the NPDES permit writer will use the MP&M limitations and standards for those oily operation process wastewaters and use the applicable limitations and standards for their other discharges. When a facility commingles oily operation process wastewaters with other process wastewaters already covered by other effluent limitations guidelines or with process wastewaters from metal-bearing operations, the entire commingled stream is not regulated by the MP&M limitations and standards. This provision must be examined for each point source discharge at a given facility and is codified at 40 CFR 438.1(b).

Table 15-1 summarizes the coverage of industrial operations by each MP&M subcategory evaluated for the final rule.

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<sup>1</sup>Part 413 applies only to indirect discharging job shops and independent printed circuit board manufacturers in operation prior to August 31, 1982.



**Table 15-1**

**Clarification of Coverage by MP&M Subcategory  
Evaluated for the Final Rule**

<b>Subcategory Evaluated for the Final Rule</b>	<b>Continue to Cover Under 40 CFR 413<sup>a</sup> (Electroplating)</b>	<b>Continue to Cover Under 40 CFR 433 (Metal Finishing)</b>	<b>Cover Under 40 CFR 438 (Metal Products &amp; Machinery)</b>
General Metals (Including Continuous Electroplaters) <sup>b</sup>	Existing indirect dischargers covered by Part 413.	New and existing direct and indirect dischargers covered by Part 433.	None
Metal Finishing Job Shops	Existing indirect dischargers covered by Part 413.	New and existing direct and indirect dischargers covered by Part 433.	None
Non-Chromium Anodizing	Existing indirect dischargers covered by Part 413.	New and existing direct and indirect dischargers covered by Part 433.	None
Printed Wiring Board (Printed Circuit Board)	Existing indirect dischargers covered by Part 413.	New and existing direct and indirect dischargers covered by Part 433.	None
Steel Forming and Finishing <sup>c</sup>	NA	NA	None
Oily Wastes	NA	NA	All new and existing direct dischargers under this subcategory (See 438.10).
Railroad Line Maintenance	NA	NA	None
Shipbuilding Dry Dock	NA	NA	None

NA - Not applicable.

<sup>a</sup>Part 413 applies only to indirect discharging job shops and independent printed circuit board manufacturers in operation prior to August 31, 1982.

<sup>b</sup>Part 413 specifically excludes continuous electroplaters. Instead they are covered by Part 433.

<sup>c</sup>These facilities will continue to be subject to Part 420.

### **Applicability of MP&M Effluent Guidelines to Washing Operations**

Wastewater discharges resulting from the washing of cars, aircraft, or other vehicles, when performed only for aesthetic or cosmetic purposes, are not subject to the MP&M effluent guidelines. Direct discharges resulting from the washing of cars, aircraft, or other vehicles, when performed as a preparatory step prior to one or more successive manufacturing, rebuilding, or maintenance operations, are subject to the MP&M effluent guidelines. This provision is codified at 40 CFR 438.1(c). For example, if an auto repair facility washes a vehicle in order to perform painting (an oily operation covered by the final rule), that wash water from the vehicle is considered an oily operation process wastewater. Aesthetic or cosmetic wastewater discharges commingled with directly discharged MP&M oily operation process wastewaters must be accounted for as nonregulated wastewaters using the building-block approach to develop facility-specific permits limits (see Section 15.3 for additional information on using the building-block approach).

### **Applicability of MP&M Effluent Guidelines to Railroad Line Maintenance Facilities and Railroad Overhaul or Heavy Maintenance Facilities**

Wastewater discharges from railroad line maintenance facilities are not subject to the MP&M effluent guidelines. Wastewater discharges from railroad overhaul or heavy maintenance facilities may be covered by the MP&M effluent guidelines (Subpart A), the Metal Finishing Point Source Category (40 CFR 433), or by other effluent limitations guidelines, as applicable. This provision is codified at 40 CFR 438.1(d).

Facilities engaged in the manufacture, overhaul, or heavy maintenance of railroad engines, cars, car-wheel trucks, or similar parts or machines (“railroad overhaul or heavy maintenance facilities”) typically perform different unit operations than railroad line maintenance facilities. Railroad line maintenance facilities perform routine cleaning and light maintenance on railroad engines, cars, car-wheel trucks, or similar parts or machines, and discharge wastewater exclusively from oily operations. These facilities only perform one or more of the following operations: assembly/disassembly, floor cleaning, maintenance machining (wheel truing), touch-up painting, and washing.

Railroad overhaul or heavy maintenance facilities are engaged in the manufacture, overhaul, or heavy maintenance of railroad engines, cars, car-wheel trucks, or similar parts or machines. These facilities typically perform one or more of the same operations as railroad line maintenance facilities and one or more of the following operations: abrasive blasting, alkaline cleaning, aqueous degreasing, corrosion preventive coating, electrical discharge machining, grinding, heat treating, impact deformation, painting, plasma arc machining, polishing, pressure deformation, soldering/brazing, stripping (paint), testing, thermal cutting, and welding.

Permit writers will need to examine operations at each railroad overhaul or heavy maintenance facility to determine whether they fall under the MP&M effluent guidelines, the Metal Finishing Point Source Category (40 CFR 433), or other effluent limitations guidelines.

For example, process wastewaters from metal-bearing operations (e.g., stripping (paint)) at railroad overhaul or heavy maintenance facilities are not subject to the MP&M effluent guidelines (i.e., stripping (paint) is a metal-bearing operation).

### **Other Wastewaters Not Subject to the MP&M Effluent Guidelines**

Other wastewaters and facilities not subject to the MP&M effluent guidelines are codified at 40 CFR 438.1(e) and are described below.

The MP&M effluent guidelines do not apply to nonprocess wastewater. Nonprocess wastewater means sanitary wastewater, noncontact cooling water, water from laundering, and noncontact stormwater. Nonprocess wastewater also includes wastewater discharges from nonindustrial sources such as residential housing, schools, churches, recreational parks, shopping centers as well as wastewater discharges from gas stations, utility plants, and hospitals. EPA considers stormwater that is commingled with MP&M oily operation process wastewater (i.e., contact stormwater) prior to treatment or discharge subject to the MP&M effluent guidelines. Sanitary wastewater, noncontact cooling water, water from laundering, and noncontact stormwater commingled with directly discharged MP&M oily operation process wastewaters must be accounted for as nonregulated wastewaters using the building-block approach to develop facility specific permits limits (see Section 15.3).

The MP&M effluent guidelines also do not apply to wastewater discharges from oily operations introduced into a publicly owned treatment works (POTW) or a federally owned and operated treatment works treating domestic sewage (TWTDS), as defined at 40 CFR 122.2. These wastewater discharges will be subject to General Pretreatment Standards (40 CFR 403), local limits, permit limits, and other effluent guidelines, as applicable.

The MP&M effluent guidelines also do not apply to wastewater discharges in or on dry docks and similar structures, such as graving docks, building ways, marine railways, lift barges at shipbuilding facilities (or shipyards), and ships that are afloat. This provision is codified at 40 CFR 438(e)(5) and applies only to process wastewater generated and discharged from oily operations and metal-bearing operations inside and outside ships (including bilge water and dry dock stormwater) that occur in or on dry docks or similar structures.

In addition to these dry dock wastewaters, three other types of water streams are in or on dry docks and similar structures: flooding water, dry dock ballast water, and stormwater. Flooding water enters and exits the dry dock or similar structure prior to performing any MP&M operations. For example, in a graving dock, the gates are opened, allowing flooding water in and ships to float inside the chamber. Then the flooding water is drained, leaving the ship's exterior exposed so shipyard employees can repair and maintain the ship's hull. Dry dock ballast water serves a similar purpose. It is used to lower (or sink) a floating dry dock so that a ship can float over it. Then the dry dock ballast water is pumped out, raising the dry dock with the ship on top. Flooding water and dry dock ballast water are not directly associated with MP&M operations. Finally, because these structures are located outdoors and are exposed to the elements,

stormwater may fall in or on the dry dock or similar structures. All three of these wastewaters (i.e., flooding water, dry dock ballast water, and stormwater) are excluded from the scope of the MP&M effluent guidelines.

However, the Agency is including direct discharges of process wastewater from oily operations that is generated at other shipyard locations (“on-shore” operations) in the MP&M regulation rule (assuming the other exclusions of Parts 438.1 and 438.10 do not apply). EPA included wastewaters from these oily “on-shore” shipbuilding operations (e.g., machining, floor cleaning, solvent degreasing, dye penetrant testing, and grinding) in the Oily Wastes Subcategory. Such oily operations are typically found in a machine shop in the shipyard. Wastewaters subject to the Shipbuilding Dry Dock exclusion commingled with directly discharged MP&M oily operation process wastewaters must be accounted for as nonregulated wastewaters using the building-block approach to develop facility specific permits limits (see Section 15.3).

Also, EPA is not including wastewater generated onboard ships when they are afloat (i.e., not in dry docks or similar structures). For U.S. military ships, EPA is in the process of establishing standards under the Uniform National Discharge Standards (UNDS) pursuant to Section 312(n) of the Clean Water Act (CWA) (see 64 F.R. 25125; May 10, 1999) to regulate discharges of wastewater generated onboard these ships when they are in U.S. waters and are afloat (e.g., at a shipyard’s dock).

For reasons discussed in the preamble to the final rule and Section 9.0, wastewater generated by facilities primarily performing drum reconditioning and cleaning to prepare metal drums for resale, reuse, or disposal are also not subject to the MP&M effluent guidelines. This provision only covers facilities in the Industrial Container and Drum Cleaning (ICDC) industry. This industry is within the 1987 Standard Industrial Classification (SIC) Code 7699 (Repair Shops and Related Services, Not Elsewhere Classified). All other facilities in this SIC code are included in the “Miscellaneous Metal Products” MP&M industrial sector (see Appendix A and Section 15.1.1). The ICDC industry includes facilities that clean and recondition metal and plastic drums and intermediate bulk containers (IBCs) for resale, reuse, or disposal. ICDC facilities can be further classified as facilities that either burn open-head steel drums or wash plastic or tight-head (i.e., bung-type) steel drums and IBCs. Most ICDC facilities purchase used drums or containers that they clean and recondition for resale.

EPA estimates that most ICDC facilities discharge ICDC wastewater and that all or almost all of these facilities discharge indirectly to a POTW. EPA has not identified any facilities that discharge directly to surface waters. EPA also estimates that a portion of the industry achieves zero discharge by hauling the wastewater to a centralized waste treatment facility, or disposing of the wastewater by land application or evaporation. Alternatively, some ICDC facilities achieve zero discharge by recycling or reusing 100 percent of its wastewater (see Section 22.1, DCN 17933 and Section 24.1, DCN 17853 of the rulemaking record).

For reasons discussed in the preamble to the final rule and Section 9.0, the following wastewater discharges are also not subject to the MP&M effluent guidelines:

- Process wastewater generated by maintenance and repair activities at gasoline service stations (SIC Code 5541), passenger car rental facilities, or utility trailer and recreational vehicle rental facilities (SIC Code 7514 or 7519); and
- Wastewater from gravure cylinder and metallic platemaking conducted within or for printing and publishing facilities (SIC Code 2796).

Figure 15-1 shows the MP&M permitting process flow chart.

## **15.2 Compliance Dates**

New and reissued federal and state NPDES permits to MP&M direct dischargers must include the limitations and standards in the MP&M effluent guidelines. The permits must require immediate compliance with such limitations. If the permitting authority wishes to provide additional time for compliance, the permit authority should consider issuance of an enforcement order that provides for a schedule for compliance.

New sources must comply with the new source performance standards (NSPS) of the MP&M rule at the time they commence discharging MP&M process wastewater. The Agency considers a discharger a new source if its construction commences 30 days after the publication date of the final rule in the Federal Register.

## **15.3 Limits Development**

To develop limits for process wastewaters covered by the MP&M effluent guidelines, a permit writer must first determine if the process wastewater is subject to the regulation by determining the type of discharge (i.e., direct) and examining the unit operation(s) that generate the process wastewater (see Section 15.1 and Section 6.0). This requires careful consideration of the applicability criteria in Sections 438.1 and 438.10 of the final rule. After the permit writer determines that a process wastewater is subject to the MP&M effluent guidelines, the next step is to determine the applicable limitations and standards. Table 15-2 presents the concentration-based MP&M effluent guidelines for new and existing direct dischargers in the Oily Wastes Subcategory (40 CFR 438, Subpart A). The permit writer must then apply these limitations and standards to the MP&M process wastewater directly discharged from the facility.

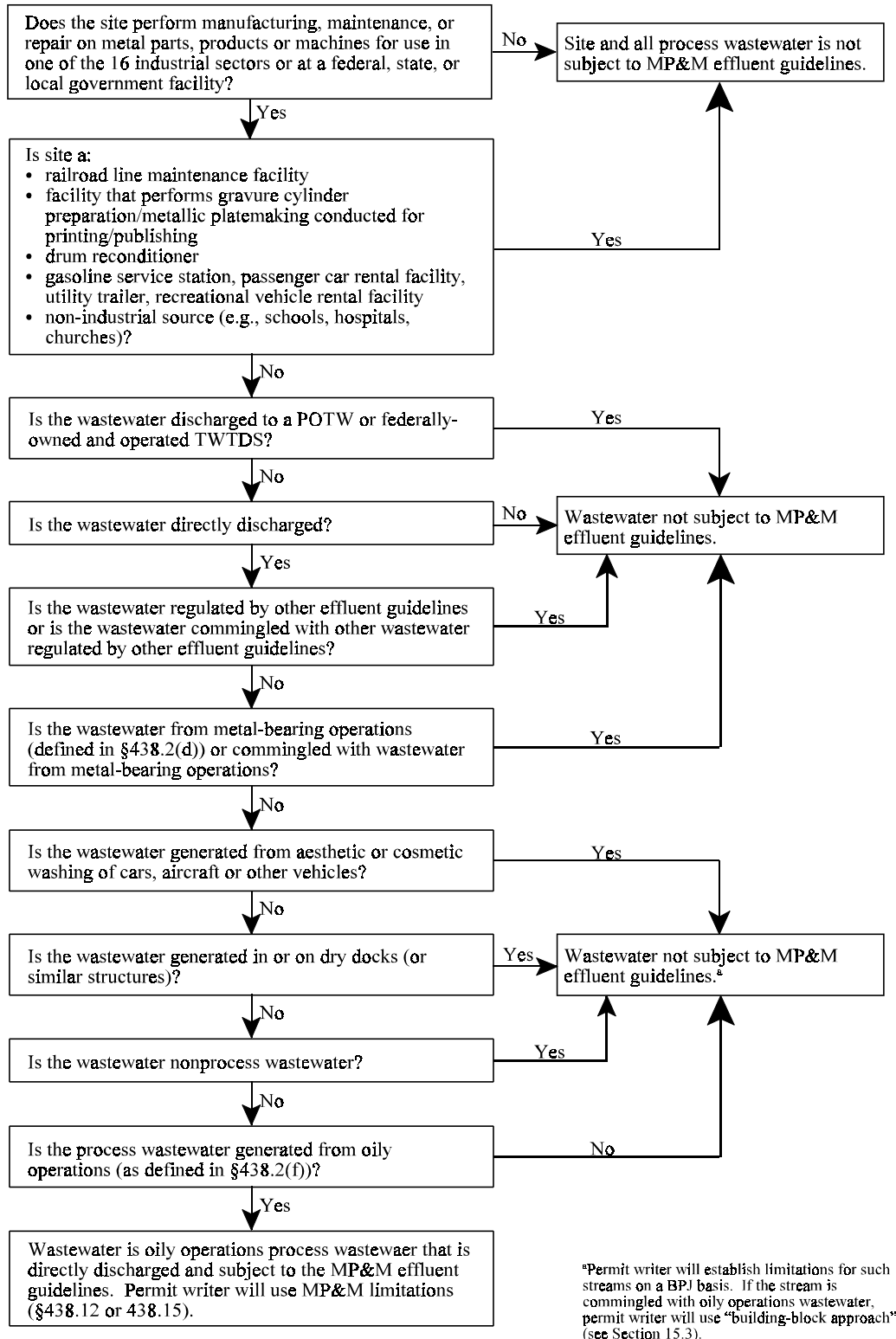


Figure 15-1. MP&amp;M Permitting Process Flow Chart

**Table 15-2**

**Effluent Limitations Guidelines for the MP&M Point Source Category  
(40 CFR 438)**

<b>BPT/BCT/NSPS - Oily Wastes Subcategory</b>	
<b>Regulated Parameter</b>	<b>Maximum Daily mg/L (ppm)</b>
Total Suspended Solids (TSS)	62
Oil and Grease (as HEM)	46
pH	a

<sup>a</sup>Discharges must remain within the pH range 6 to 9.

When oily operations are commingled prior to treatment or discharged with nonprocess (e.g., noncontact cooling water) or nonregulated wastewater (e.g., wastewater from aesthetic cleaning of vehicles), the permit writer will establish nonregulated limitations for such streams on a BPJ basis. The permit writer will establish limitations for the combined stream using the “building-block” approach, using a flow-weighted combination of the applicable guideline limitations (found in Table 15-2) and the BPJ limitation for the nonprocess wastewater or nonregulated waste stream. For further information, see EPA NPDES Permit Writers Manual, Chapter 5, pp. 61-63 (1).

Although EPA is not promulgating mass-based limitations in the final MP&M rule, permit writers may want to develop mass-based limitations, if appropriate (e.g., a facility does not have adequate water conservation practices). The National Pollutant Discharge Elimination System (NPDES) regulations at 40 CFR 122.45(f) require permit writers to develop mass-based limitations for direct dischargers except in cases where the limitations are expressed in other units of measurement (e.g., a concentration).

For MP&M facilities that have good water conservation practices, concentration-based rather than mass-based effluent limitations may be sufficient. However, the Agency anticipates that MP&M facilities that have been using the best pollution prevention and water conservation practices may request that the permit writer establish mass-based limits in their permit.

Since MP&M effluent guidelines are concentration-based limitations and standards, NPDES permit writers will include these limitations and standards in NPDES permits for MP&M facilities. NPDES permit writers may also establish mass-based limits in addition to the MP&M concentration-based limitations and standards for MP&M facilities (see 122.45(f)(2)). In such cases, the NPDES permit will require the permittee to comply with both mass-based and concentration-based limits.

Because EPA did not promulgate mass-based limitations and because it did not codify the method to determine the flow rate in these cases, the permit writer may use methods other than historical flow and production data to calculate mass-based limitations. EPA has published several documents that provide guidance for determining the appropriate process wastewater flow rate and establishing mass-based limitations (1, 2, 3).

EPA based the final concentration-based MP&M effluent limitations on the performance of in-process pollution prevention and flow-reduction technologies followed by end-of-pipe treatment. In-process technologies include: conductivity meters, flow restrictors, and countercurrent cascade rinsing for flowing rinses; at-the-source machine coolant recycling; and at-the-source paint curtain recycling. The end-of-pipe treatment for the Oily Wastes Subcategory is chemical emulsion breaking and oil/water separation (see Sections 8.0 and 9.0). EPA is promulgating performance-based limitations and standards to control direct discharges; these limitations and standards do not require the use of any particular pollution prevention or wastewater treatment technology. Rather, a facility may use any combination of pollution prevention and wastewater treatment technology to comply with the limitations. Direct dischargers must also comply with other applicable regulations (e.g., NPDES regulations (40 CFR 122)).

The MP&M effluent guidelines also do not apply to process wastewaters from oily operations commingled with process wastewaters already subject to other effluent limitations guidelines or with process wastewaters from metal-bearing operations. When a facility segregates oily operation process wastewaters from other process wastewaters, the NPDES permit writer will apply the MP&M limitations and standards for those oily operation process wastewaters (at that outfall) and apply the applicable limitations and standards for their other discharges (at the other outfall(s)). For additional guidance regarding limits development, see EPA's NPDES Permit Writers' Manual (1).

## **15.4      Compliance Monitoring**

Permit writers must establish requirements for regulated facilities to monitor their effluent to ensure that they are complying with permit limitations. As specified in 40 CFR 122.41, 122.44, and 122.48, all NPDES permits must specify requirements for using, maintaining, and installing (if appropriate) monitoring equipment; monitoring type, intervals, and frequencies that will provide representative data; analytical methods; and reporting and recordkeeping. The NPDES program requires permittees (with certain specific exceptions) to monitor for limited pollutants and report data at least once per year.

The Agency has not promulgated specific monitoring requirements or monitoring frequencies in the MP&M regulation; therefore, permit authorities may establish monitoring requirements and monitoring frequencies at their discretion. The Agency notes, however, that in developing the Part 438 limitations, EPA considered a monthly sampling frequency. In addition, Part 136 requires facilities to collect grab samples for oil and grease. In developing the Part 438 oil and grease limitations, EPA generally collected four grab samples in a 24-hour monitoring



day. The sample types for pH can range from a one-time grab sample during a monitoring day to continuous sampling for a monitoring day where pH is a critical aspect of the wastewater treated or the wastewater treatment operation.

## **15.5        References**

1.            U.S. Environmental Protection Agency. NPDES Permit Writers' Manual. EPA-833-B-96-003, December 1996.
2.            U.S. Environmental Protection Agency. Guidance Manual For the Use of Production-Based Pretreatment Standards and the Combined Wastestream Formula. EPA-833-B-85-201, September 1985.
3.            U.S. Environmental Protection Agency. Guidance Manual for Electroplating and Metal Finishing Pretreatment Standards. EPA-440/1-84-091g, February 1984.

## 16.0 GLOSSARY OF TERMS

This glossary includes a collection of the terms used in this document and an explanation of each term. To the extent that definitions and explanations provided in this glossary differ from those in EPA regulations or other official documents, they are intended for use in understanding this manual only.

**Act** - The Clean Water Act.

**Administrator** - The Administrator of the U.S. Environmental Protection Agency.

**Agency** - U.S. Environmental Protection Agency (also referred to as “EPA”).

**Ambient Water Quality Criteria (AWQC)** - Water quality criteria set ambient levels of individual pollutants or parameters, or describe conditions of a water body that, if met, will generally protect the designated use of the water. Water quality criteria are developed to protect aquatic life and human health, and, in some cases, wildlife from the deleterious effects of pollutants.

**AMSA** - Association of Metropolitan Sewerage Agencies

**Best Available Technology Economically Achievable (BAT)** - Technology-based standard established by the Clean Water Act (CWA) as the most appropriate means available on a national basis for controlling the direct discharge of toxic and nonconventional pollutants to navigable waters. BAT effluent limitations guidelines, in general, represent the best existing performance of treatment technologies that are economically achievable within an industrial point source category or subcategory. Best available technology economically achievable is defined by Section 304(b)(2)(B) of the Clean Water Act.

**Best Conventional Pollutant Control Technology (BCT)** - Technology based standard for the discharge from existing industrial point sources of conventional pollutants including BOD, TSS, fecal coliform, pH, oil and grease. The BCT is established in light of a two-part “cost reasonableness” test which compares the cost for an industry to reduce its pollutant discharge with the cost to a POTW for similar levels of reduction of a pollutant loading. The second test examines the cost-effectiveness of additional industrial treatment beyond BPT. EPA must find limits which are reasonable under both tests before establishing them as BCT.

**Best Management Practices (BMP)** - Sections 304(e), 308(a), 402(a), and 501(a) of the CWA authorize the Administrator to prescribe BMPs as part of effluent limitations guidelines and standards or as part of a permit.

**Best Practicable Control Technology Currently Available (BPT)** - The first level of technology-based standards established by the CWA to control pollutants discharged to waters of the U.S. BPT effluent limitations guidelines are generally based on the average of the best existing performance by plants within an industrial category or subcategory.

**Best Professional Judgment (BPJ)** - Best professional judgement. The method used by permit writers to develop technology-based NPDES permit conditions on a case-by-case basis using all reasonably available and relevant data.

**Biochemical Oxygen Demand (BOD)** - A measurement of the amount of oxygen utilized by the decomposition of organic material, over a specified time period (usually 5 days) in a wastewater sample; it is used as a measurement of the readily decomposable organic content of a wastewater (see Appendix B).

**Categorical Industrial User (CIU)** - An industrial user subject to National categorical pretreatment standards.

**Categorical Pretreatment Standards** - Limitations on pollutant discharges to publicly owned treatment works promulgated by EPA in accordance with Section 307 of the Clean Water Act that apply to specified process wastewaters of particular industrial categories.

**Chemical Oxygen Demand (COD)** - A measure of the oxygen-consuming capacity of inorganic and organic matter present in wastewater. COD is expressed as the amount of oxygen consumed in mg/l. Results do not necessarily correlate to the biochemical oxygen demand (BOD) because the chemical oxidant may react with substances that bacteria do not stabilize (see Appendix B).

**Clean Air Act (CAA)** - Clean Air Act (42 U.S.C. 7401 *et seq.*, as amended).

**Clean Water Act (CWA)** - 33 U.S.C. 1251 *et seq.*, as amended.

**Code of Federal Regulations (CFR)** - These regulations are published by the U.S. Government Printing Office. A codification of the general and permanent rules published in the *Federal Register* by the executive departments and agencies of the federal government. Title 40 of the CFR contains the environmental regulations.

**Composite Sample** - Sample composed of two or more discrete samples. The aggregate sample will reflect the average water quality covering the compositing or sample period.

**Confidential Business Information (CBI)** - Section 308 of the CWA authorizes EPA to collect information, including confidential business information, in support of developing effluent guidelines. When requested to do so, EPA is required to consider information to be confidential and to treat it accordingly if disclosure would divulge methods or processes entitled to protection as trade secrets.

**Contract Hauling** - The removal of any waste stream from a site by a company authorized to transport and dispose of the waste, excluding discharges to sewers or surface waters.

**Control Authority** - The term “control authority” as used in Section 403.12 refers to: (1) the POTW if the POTW’s submission for its pretreatment program (§403.3(t)(1)) has been approved in accordance with the requirements of §403.11; or (2) the approval authority if the submission has not been approved.

**Conventional Pollutants** - Pollutants typical of municipal sewage, and for which municipal secondary treatment plants are typically designed; defined by Federal Regulation (40 CFR §401.16) as BOD, TSS, fecal coliform bacteria, oil and grease, and pH.

**Corrosion preventive coating** - The application of removable oily or organic solutions to protect metal surfaces against corrosive environments. Corrosion preventive coatings include, but are not limited to: petrolatum compounds, oils, hard dry-film compounds, solvent-cutback petroleum-based compounds, emulsions, water-displacing polar compounds, and fingerprint removers and neutralizers. Corrosion preventive coating does not include electroplating, or chemical conversion coating operations.

**Cost-effectiveness (CE)** - A ratio of compliance costs (in 1981\$) to the toxic pounds of pollutants removed in terms of pound-equivalents (PE).

**Daily Discharge** - The discharge of a pollutant measured during any 24- hour period that reasonably represents a calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the daily discharge is calculated as the total mass of the pollutant discharged during the day. For pollutants with limitations expressed in other units of measurement (e.g., concentration) the daily discharge is calculated as the average measurement of the pollutant throughout the day (see 40 CFR §122.2).

**Direct Capital Costs** - One-time capital costs associated with the purchase, installation, and delivery of a specific technology. The MP&M cost model estimates direct capital costs.

**Direct Discharger** - An industrial discharger that introduces wastewater to a water of the United States with or without treatment by the discharger.

**Director** - The Regional Administrator or State Director, as the context requires, or an authorized representative. When there is no approved State program, and there is an EPA administered program, Director means the Regional Administrator. When there is an approved State program, “Director” normally means the State Director.

**Discharge Monitoring Report (DMR)** - The form used to report self-monitoring results by NPDES permittees. DMRs must be used by approved States as well as by EPA.

**Dissolved air flotation (DAF)** - A wastewater treatment technology (see Section 8.0).

**Economic, Environmental, and Benefits Analysis of the Final Metal Products & Machinery Rule (EEBA)** - This document (EPA-821-B-03-002) presents the methodology employed to assess economic impacts and environmental impacts and benefits of the final rule and the results of the analysis.

**Effluent Limitation** - Any restriction imposed by the Director on quantities, discharge rates, and concentrations of pollutants which are discharged from point sources into waters of the United States, the waters of the contiguous zone, or the ocean.

**Effluent Limitations Guidelines (ELG)** - A regulation published by the Administrator under Section 304(b) of CWA that establishes national technology-based effluent requirements for a specific industrial category.

**Emission** - Passage of air pollutants into the atmosphere via a gas stream or other means.

**End-of-Pipe Treatment (EOP)** - Refers to those processes that treat a facility waste stream for pollutant removal prior to discharge.

**EPA** - The U.S. Environmental Protection Agency (also referred to as “the Agency”).

**Existing source** - For this rule, any facility from which there is or may be a discharge of pollutants, the construction of which is commenced before the publication of the MP&M final final regulations.

**Facility** - A place of business that manufactures, rebuilds, or maintains metal parts, products, or machines (also referred to as “site”). See Section 1.0 for the applicability of the MP&M final rule. The facility includes all contiguous and noncontiguous property with established boundaries owned, operated, leased, or under control of the business entity. The property may be divided by public or private right-of-way.

**Federal Register (FR)** - This document is published by the U.S. Government Printing Office. A publication making available to the public regulations and legal notices issued by federal agencies.

**Federally Owned Treatment Works (FOTW)** - Any device or system owned and/or operated by a U.S. federal agency to recycle, reclaim, or treat liquid sewage or liquid industrial wastes.

**Full Time Equivalents (FTE)** - This is related to the number of employees at a given facility.

**Fundamentally Different Factors (FDF)** - Those components of a petitioner’s facility that are determined to be so unlike those components considered by EPA during development of the MP&M final rule that the facility is worthy of a variance (see Section XI.C.1 of the preamble to the final rule).

**General Metals (GM) Subcategory** - As discussed in Section 9.0, EPA proposed, but did not promulgate, a separate subcategory for these facilities.

**Grab Sample** - A sample which is taken from a wastestream on a one-time basis without consideration of the flow rate of the wastestream and without consideration of time.

**Hazardous Air Pollutant (HAP)** - Substances listed by EPA as air toxics under Section 112 of the Clean Air Act.

**Hazardous Waste** - Any material that meets the Resource Conservation and Recovery Act definition of “hazardous waste” contained in 40 CFR 261.

**Hexane Extractable Material (HEM)** - A method-defined parameter that measures the presence of relatively nonvolatile hydrocarbons, vegetable oils, animal fats, waxes, soaps, greases, and related material that are extractable in the solvent n-hexane (see Appendix B).

**Indirect Capital Costs** - One-time capital costs that are not technology-specific and are represented as a multiplication factor that is applied to the direct capital costs estimated in the MP&M cost model.

**Indirect Discharge** - The introduction of pollutants into a municipal sewage treatment system from any nondomestic source (i.e., any industrial or commercial facility) regulated under Section 307(b), (c), or (d) of the CWA.

**Influent** - Wastewater entering a facility wastewater treatment unit.

**Information Collection Request (ICR)** - The Paperwork Reduction Act (44 U.S.C. 3501 *et seq.*) stipulates that every federal agency, including EPA, must obtain approval from the Office of Management and Budget before collecting the same or similar information from 10 or more members of the public.

**Local Limits** - Conditional discharge limits imposed by municipalities upon industrial or commercial facilities that discharge to the municipal sewage treatment system.

**Long-term average (LTA)** - For purposes of the pretreatment standards, average pollutant levels achieved over a period of time by a facility, subcategory, or technology option.

**Maximum Achievable Control Technology (MACT)** - Air pollution control applicable to hazardous air pollutants (HAPs) - see NESHAPS.

**Maximum daily discharge limitation** - Definitions provided at 40 CFR 122.2 state that the "maximum daily discharge limitation" is the "highest allowable 'daily discharge.'" Daily discharge is defined as the "'discharge of a pollutant' measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling." Section 10.0 describes the data selection and calculations used to develop the final rule limitations.

**Metal-bearing operations** - One or more of the operations listed in 40 CFR 438.2(d). See also Section 1.0.

**Metal Finishing Job Shops (MFJS) Subcategory** - As discussed in Section 9.0, EPA proposed, but did not promulgate, a separate subcategory for these facilities.

**Metal Products and Machinery (MP&M)** - A regulation published by the Administrator under Section 304(b) of CWA that establishes national technology-based effluent requirements for the Metal Products and Machinery Point Source Category.

**Million gallons per year (MGY)** - Unit of effluent discharge.

**Minimum Level** - The lowest concentration that can be reliably measured by an analytical method.

**Mixed-Use Facility** - Any municipal, private, U.S. military or federal facility that contains both industrial and commercial/administrative buildings at which one or more industrial sites conduct operations within the facility's boundaries.

**National Emissions Standards for Hazardous Air Pollutants (NESHAPS)** - Emissions standards set by EPA for an air pollutant that may cause an increase in fatalities or in serious, irreversible, or incapacitating illness.

**National Pollutant Discharge Elimination System (NPDES)** - The national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under Sections 307, 318, 402, and 405 of CWA.

**New Source** - As defined in 40 CFR 122.2 and 122.29, and 403.3(k), a new source is any building, structure, facility, or installation from which there is or may be a discharge of pollutants, the construction of which commenced for purposes of compliance with New Source Performance Standards and Pretreatment Standards for New Sources after the promulgation of the final rule under Clean Water Act Sections 306 and 307(c).

**New Source Performance Standards (NSPS)** - Technology-based standards for facilities that qualify as new sources under 40 CFR §122.2 and 40 CFR §122.29. Standards consider that the new source facility has an opportunity to design operations to more effectively control pollutant discharges.

**Non-Chromium Anodizing (NCA) Subcategory** - As discussed in Section 9.0, EPA proposed, but did not promulgate, a separate subcategory for these facilities.

**Noncontact Cooling Water** - Water used for cooling that does not come into direct contact with any raw material, intermediate product, by-product, waste product, or finished product. This term is not intended to relate to air conditioning systems.

**Nonconventional Pollutants** - All pollutants that are not included in the list of conventional or toxic pollutants in 40 CFR 401. Includes pollutants such as chemical oxygen demand (COD), total organic carbon (TOC), nitrogen, and phosphorus.

**Nondetect Value** - Samples below the level that can be reliably measured by an analytical method. This is also known, in statistical terms, as left-censored (i.e., value having an upper bound at the sample-specific detection limit and a lower bound at zero).

**Nonprocess Wastewater** - Sanitary wastewater, noncontact cooling water, water from laundering, and noncontact stormwater. Nonprocess wastewater for this part also includes wastewater discharges from nonindustrial sources such as residential housing, schools, churches, recreational parks, shopping centers as well as wastewater discharges from gas stations, utility plants, and hospitals (see 40 CFR 438.2(e)).

**Non-Water Quality Environmental Impact (NWQI)** - Deleterious aspects of control and treatment technologies applicable to point source category wastes, including, but not limited to air pollution, noise, radiation, sludge and solid waste generation, and energy used.

**North American Industry Classification System. (NAICS)** - This system is a unique method for classifying business establishments. Adopted in 1997 to replace the old Standard Industrial Classification (SIC) system, it is the industry classification system used by the statistical agencies of the United States.

**Notice of Data Availability (NODA)** - This Federal Register notice was published in June 5, 2002 (67 FR 38752). See Section 2.0.

**NRDC** - Natural Resources Defense Council.

**NRMRL** - EPA's National Risk Management Research Laboratory (formerly RREL - EPA's Risk Reduction Engineering Laboratory).

**NSCEP** - EPA's National Service Center for Environmental Publications (<http://www.epa.gov/ncepi>).

**OCPSF** - Organic Chemicals, Plastics, and Synthetic Fibers Manufacturing Point Source Category (40 CFR 414).



**Off Site** - Outside the boundary of the facility.

**Oily operations** - One or or more of the operations listed in 40 CFR 438.2(f). See also Section 1.

**Oily Wastes Subcategory (OWS)** - A subcategory (Subpart A) of the Metal Products and Machinery Point Source Category (40 CFR 438).

**OMB** - U.S. Office of Management and Budget.

**On Site** - Within the boundary of the facility.

**Operating and Maintenance (O&M) Costs** - Costs related to operating and maintaining a treatment system, including the estimated costs for compliance wastewater monitoring of the effluent.

**ORP** - Oxidation-reduction potential.

**PE** - Pound-equivalents (units used to weight toxic pollutants).

**pH** - A measure of the hydrogen ion concentration of water or wastewater; expressed as the negative log of the hydrogen ion concentration in mg/l. A pH of 7 is neutral. A pH less than 7 is acidic, and a pH greater than 7 is basic.

**Point Source** - Any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fixture, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel, or other floating craft from which pollutants are or may be discharged.

**Pollutant** - Dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials (except those regulated under the Atomic Energy Act of 1954, as amended (42 U.S.C. 2011 et seq.)), heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into water.

**Pollutant of Concern (POC)** - EPA evaluated wastewater to determine the presence of priority, conventional, and nonconventional pollutant parameters. See Section 7.0 for the criteria EPA used to identify pollutants of concern (POCs) and regulated pollutants.

**Pollution Prevention** - The use of materials, processes, or practices that reduce or eliminate the creation of pollutants or wastes. It includes practices that reduce the use of hazardous and nonhazardous materials, energy, water, or other resources, as well as those practices that protect natural resources through conservation or more efficient use. Pollution prevention consists of source reduction, in-process recycle and reuse, and water conservation practices.

**Pollutant Prevention Act of 1990 (PPA)** - 42 U.S.C. 13101 *et seq.*, Public Law 101-508, November 5, 1990.

**Pretreatment** - The reduction of the amount of pollutants, the elimination of pollutants, or the alteration of the nature of pollutant properties in wastewater prior to or in lieu of discharging or otherwise introducing such pollutants into a publicly owned treatment works.

**Pretreatment standards for existing sources (PSES)** - PSES are designed to prevent the discharge of pollutants that pass through, interfere with, or are otherwise incompatible with the operation of publicly-owned treatment works (POTWs), including sludge disposal methods at POTWs. Pretreatment standards for existing sources are technology-based and are analogous to BAT effluent limitations guidelines.

**Pretreatment standards for New sources (PSNS)** - Like PSES, PSNS are designed to prevent the discharges of pollutants that pass through, interfere with, or are otherwise incompatible with the operation of POTWs. PSNS are to be issued at the same time as NSPS. New indirect dischargers have the opportunity to incorporate into their plants the best available demonstrated technologies. The Agency considers the same factors in promulgating PSNS as it considers in promulgating NSPS.

**Printed Wiring Board (PWB) Subcategory** - As discussed in Section 9.0, EPA proposed, but did not promulgate, a separate subcategory for these facilities.

**Priority Pollutants** - The 126 pollutants listed in 40 CFR 423, Appendix A.

**Privately Owned Treatment Works (PrOTW)** - Any device or system owned and operated by a private company that is used to recycle, reclaim, or treat liquid industrial wastes not generated by that company.

**Process Wastewater** - Wastewater as defined at 40 CFR 122 and 401, and includes wastewater from noncontact, nondestructive testing (e.g., photographic wastewater from nondestructive X-ray examination of parts) performed at facilities subject to this part and includes wastewater from air pollution control devices (see 40 CFR 438.2).

**Production-Normalized Flow (PNF)** - Volume of wastewater generated per unit of production.

**Publicly Owned Treatment Works (POTW)** - A treatment works, as defined by Section 212 of the CWA, that is owned by the State or municipality. This definition includes any devices and systems used in the storage, treatment, recycling, and reclamation of municipal sewage or industrial wastes of a liquid nature. It also includes sewers, pipes, and other conveyances only if they convey wastewater to a POTW treatment plant.

**Railroad Line Maintenance (RRLM) Subcategory** - As discussed in Section 9.0, EPA proposed, but did not promulgate, a separate subcategory for these facilities.

**Resource Conservation and Recovery Act of 1976 (RCRA)** - This law (42 U.S.C. Section 6901 *et seq.*) regulates the generation, treatment, storage, disposal, or recycling of solid and hazardous wastes.

**SBA** - U.S. Small Business Administration.

**Self-Monitoring** - Sampling and analyses performed by a facility to determine compliance with a permit or other regulatory requirements.

**Semivolatile Organic Compound (SVOC)** - A measure of semivolatile organic constituents performed by isotope dilution gas chromatography/mass spectrometry (GC/MS), EPA Method 1625.

**SGP** - EPA's National Metal Finishing Strategic Goals Program.

**Shipbuilding Dry Dock (SDD) Subcategory** - As discussed in Section 9.0, EPA proposed, but did not promulgate, a separate subcategory for these facilities.

**SIC** - Standard Industrial Classification, a numerical categorization scheme used by the U.S. Department of Commerce to catalog economic activity according to product type.

**Significant Industrial User (SIU)** - An indirect discharger that is the focus of control efforts under the national pretreatment program; includes all indirect dischargers subject to national categorical pretreatment standards, and all other indirect dischargers that contribute 25,000 gpd or more of process wastewater, or which make up five percent or more of the hydraulic or organic loading to the municipal treatment plant, subject to certain exceptions.

**Silica Gel Treated Hexane Extractable Material (SGT-HEM)** - A method-defined parameter that measures the presence of mineral oils that are extractable in the solvent n-hexane and not absorbed by silica gel (see Appendix B).

**Site** - See "Facility."

**Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA)** - Public Law 104-121, March 29, 1996.

**Source Reduction** - Any practice that reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise being released into the environment prior to recycling, treatment, or disposal. Source reduction can include equipment or technology modifications, process or procedure modifications, substitution of raw materials, and improvements in housekeeping, maintenance, training, or inventory control.

**Steel Forming and Finishing (SFF) Subcategory** - As discussed in Section 9.0, EPA proposed, but did not promulgate, a separate subcategory for these facilities.

**Stormwater** - Stormwater runoff, snow melt runoff, and surface runoff and drainage (see 40 CFR §122.26(b)(13)).

**Surface Water** - Waters of the United States, as defined at 40 CFR 122.2.

**Technical Development Document (TDD)** - Development Document for the Final Effluent Limitations Guidelines and Standards for the Metal Products & Machinery Point Source Category (EPA-821-B-03-001).

**Technology in Place (TIP)** - Refers to those technologies that the Agency considered to be installed and operating at a model site.

**Technology-Based Effluent Limit** - A permit limit for a pollutant that is based on the capability of a treatment method to reduce the pollutant to a certain concentration.

**Total Annualized Cost (TAC)** - Cost calculated from the capital and annual costs assuming a 7-percent discount rate over an estimated 15-year equipment life.

**Total Capital Investment (TCI)** - Total one-time capital costs required to build a treatment system (i.e., sum of direct and indirect capital costs).

**Total Kjeldahl nitrogen (TKN)** - Measure of reduced forms of nitrogen (see Appendix B).

**Total Maximum Daily Load (TMDL)** - The amount of pollutant, or property of a pollutant, from point, nonpoint, and natural background sources, that may be discharged to a water quality-limited receiving water. Any pollutant loading above the TMDL results in violation of applicable water quality standards.

**Total Organic Carbon (TOC)** - A nonconventional bulk parameter that measures the total organic content of wastewater (see Appendix B).

**Total Organics Parameter (TOP)** - Measure of toxic organics developed for the MP&M proposed rule. EPA developed a list of organic pollutants, called the Total Organics Parameter (TOP), using the list of organic priority pollutants and other nonconventional organic pollutants that met EPA's POCs criteria for the MP&M rule. Of the nonconventional organic chemicals on the MP&M POCs list, EPA included only those that were removed in appreciable quantities by the selected technology option (based on toxic weighted pound-equivalents) in two or more subcategories. The TOP list is comprised of all of the priority and nonconventional organic pollutants listed in Table 16-1.

**Table 16-1**

**Priority and Nonconventional Organic Pollutants Comprising the Total Organics Parameter**

<b>Priority Organic Pollutants</b>	
1,1,1-Trichloroethane	Di-n-Butyl Phthalate
1,1-Dichloroethane	Di-n-Octyl Phthalate
1,1-Dichloroethylene	Dimethyl Phthalate
2,4-Dimethylphenol	Ethylbenzene
2,4-Dinitrophenol	Fluoranthene
2,6-Dinitrotoluene	Fluorene
2-Nitrophenol	Isophorone
4-Chloro-m-cresol	Methylene Chloride
4-Nitrophenol	n-Nitrosodimethylamine
Acenaphthene	n-Nitrosodiphenylamine
Acrolein	Naphthalene
Anthracene	Phenanthrene
Benzyl Butyl Phthalate	Phenol
Bis(2-Ethylhexyl) Phthalate	Pyrene
Chlorobenzene	Tetrachloroethene
Chloroethane	Toluene
Chloroform	Trichloroethylene
1-Methylfluorene	Biphenyl
1-Methylphenanthrene	Carbon Disulfide
2-Isopropyl naphthalene	Dibenzofuran
2-Methylnaphthalene	Dibenzothiophene
<b>Nonconventional Organic Pollutants</b>	
3,6-Dimethylphenanthrene	n-Hexadecane
Aniline	n-Tetradecane
Benzoic Acid	p-Cymene

**Total Petroleum Hydrocarbons (TPH)** - A method-defined parameter that measures the presence of mineral oils that are extractable in Freon 113 (1,1,2-trichloro-1,2,2-trifluoroethane) and not absorbed by silica gel (see Appendix B).

**Total Suspended Solids (TSS)** - A measure of the filterable solids present in a sample, as determined by the method specified in 40 CFR 136. (see Appendix B).

**Total Toxic Organics (TTO)** - A parameter that is the summation of all quantifiable values greater than 0.01 milligrams per liter for the toxic organics (see 40 CFR 433.11(e)).

**Toxic Release Inventory (TRI)** - Database of toxic releases in the United States.

**Toxic Substances Control Act (TSCA)** - 15 U.S.C. 2601 *et seq.*

**Toxic weighting factor (TWF)** - A factor developed for various pollutants using a combination of toxicity data on human health and aquatic life and relative to the toxicity of copper. EPA uses toxic weighting factors in determining the amount of toxicity that a pollutant may exert on human health and aquatic life.

**Treatment** - Any method, technique, or process designed to change the physical, chemical, or biological character or composition of any metal-bearing, oily, or organic waste so as to neutralize such wastes, to render such wastes amenable to discharge, or to recover metal, oil, or organic content from the wastes.

**Treatment Effectiveness Concentration** - Treated effluent pollutant concentration that can be achieved by each treatment technology that is part of an MP&M regulatory option.

**Treatment, Storage, and Disposal Facility (TSDF)** - A facility that treats, stores, or disposes of hazardous waste in compliance with the applicable standards and permit requirements set forth in 40 CFR 264, 265, 266, and 270.

**Treatment Works Treating Domestic Sewage (TWTDS)** - Includes all POTWs and other facilities that treat domestic wastewater, and facilities that do not treat domestic wastewater, but that treat or dispose of sewage sludge.

**Unit Operations** - All processes performed on metal parts, products, or machines in their manufacture, maintenance, or rebuilding.

**Upset** - An exceptional incident in which there is unintentional and temporary noncompliance with the permit limit because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

**U.S.C.** - The United States Code.

**Variability factor** - Used in calculating a limitation (or standard) to allow for reasonable variation in pollutant concentrations when processed through extensively and well designed

**Volatile Organic Compound (VOC)** - A measure of volatile organic constituents performed by isotope dilution gas chromatography/mass spectrometry (GC/MS) (see Appendix B).

**Wet Air Pollution or Odor Pollution Control System Scrubbers** - Any equipment using water or water mixtures to control emissions of dust, odors, volatiles, sprays, or other pollutants.

**Zero discharger** - A facility that does not discharge pollutants to waters of the United States or to a POTW. Included in this definition are discharge or disposal of pollutants by way of evaporation, deep-well injection, off-site transfer to a treatment facility, and land application.

## **Appendix A**

### **EXAMPLE NAICS AND SIC CODES FOR THE METAL PRODUCTS & MACHINERY FINAL EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS**



## Appendix A

### Example NAICS and SIC codes for the Metal Products & Machinery Final Effluent Limitations Guidelines and Standards

The scope of the MP&M regulation includes facilities that discharge process wastewater from oily operations and manufacture, maintain, or rebuild metal parts, products, or machines used in the following sectors: Aerospace, Aircraft, Bus & Truck, Electronic Equipment, Hardware, Household Equipment, Instruments, Mobile Industrial Equipment, Motor Vehicles, Office Machines, Ordnance, Precious Metals and Jewelry, Railroad, Ships and Boats, Stationary Industrial Equipment, and Miscellaneous Metal Products. In addition, state, local and federal government facilities that discharge wastewater from oily operations and manufacture, maintain, or rebuild metal parts, products or machines (e.g., a town that operates its own bus, truck, and/or snow removal equipment maintenance facility) are also covered by the MP&M rule.

EPA also evaluated job shops and printed wiring board facilities for the final rule (see Section 6.0). As described in Section 9.0, these facilities are not regulated by the MP&M effluent guidelines.

Table A-1 lists of example Standard Industrial Classification (SIC) codes and North American Industrial Classification System (NAICS) codes associated with the various MP&M industrial sectors and the two industrial sectors also reviewed for the final rule. Please note that this list is not intended to be exhaustive, but rather it provides a guide regarding entities that may be within the scope of the MP&M industry.

**Table A-1**

### Example SIC and NAICS Codes Associated with MP&M Industrial Sectors

Example NAICS and SIC Codes for the MP&M Industrial Sectors		
NAICS Code	SIC Code	Standard Industrial Classification Groups
<i>Aerospace</i>		
33641400	3761	Guided Missiles and Space Vehicles
33641500	3764	Guided Missile and Space Vehicle Propulsion
33641900	3769	Other Space Vehicle and Missile Parts

**Table A-1 (Continued)**

Example NAICS and SIC Codes for the MP&M Industrial Sectors		
NAICS Code	SIC Code	Standard Industrial Classification Groups
<i>Aircraft</i>		
33641100	3721	Aircraft
33641200	3724	Aircraft Engines and Engine Parts
33641300 33291220 33399520 33399620	3728	Aircraft Parts and Auxiliary Equipment
48811110 48811910 48819000 56172020	4581	Airports, Flying Fields, Airport Terminal Services
<i>Bus And Truck</i>		
33621120	3713	Truck and Bus Bodies
33621200	3715	Truck Trailers
48511100 48511200 48511300 48511900	4111	Local and Suburban Transit
48532000 48541020 48599100 48599920 62191090	4119	Local Passenger Transit, N.E.C.
48521000	4131	Intercity and Rural Bus Transportation
48551010	4141	Local Bus Charter Service
48551020	4142	Bus Charter Service, Except Local
48849010	4173	Bus Terminal and Service Facilities
48411010 48411020	4212	Local Trucking without Storage
48412100 48412200 48421020	4213	Trucking, Except Local
48411030 48411040	4214	Local Trucking with Storage

**Table A-1 (Continued)**

<b>Example NAICS and SIC Codes for the MP&amp;M Industrial Sectors</b>		
<b>NAICS Code</b>	<b>SIC Code</b>	<b>Standard Industrial Classification Groups</b>
<i>Bus and Truck (Continued)</i>		
49211010 49221000	4215	Courier Services, Except by Air
48849020	4231	Trucking Terminal Facilities
<i>Electronic Equipment</i>		
33421000	3661	Telephone and Telegraph Apparatus
33422010	3663	Radio and Television Broadcast and Communications Equipment
33429000	3669	Communications Equipment, N.E.C.
33441100	3671	Electron Tubes
33441400	3675	Electronic Capacitors
33441610 33441620	3677	Electronic Coils and Transformers
33441700	3678	Connectors for Electronic Applications
33422020 33441820 33441900 33632210	3679	Electronic Components, N.E.C.
33451010 33451110 33451610 33451910 33512920 33599920 33911410	3699	Electrical Machinery, Equipment, and Supplies, N.E.C.
<i>Hardware</i>		
32312220	2796	Platemaking and Related Services
33281100	3398	Metal Heat Treating
33243910	3412	Metal Shipping Barrels, Drums, Kegs, Pails
33221110	3421	Cutlery
33221210 33221240	3423	Hand and Edge Tools, Except Machine Tools and Handsaws
33221300	3425	Hand Saws and Saw Blades
33243920	3429	Hardware, N.E.C.

**Table A-1 (Continued)**

Example NAICS and SIC Codes for the MP&M Industrial Sectors		
NAICS Code	SIC Code	Standard Industrial Classification Groups
<i>Hardware (Continued)</i>		
33341410	3433	Heating Equipment, Except Electric and Warm Air Furnace
33231210	3441	Fabricated Structural Metal
33231300	3443	Fabricated Plate Work (Boiler Shops)
33243930	3444	Sheet Metal Work
33232310	3446	Architectural and Ornamental Metal Work
33231100	3448	Prefabricated Metal Buildings and Components
33231220	3449	Miscellaneous Metal Work
33272100	3451	Screw Machine Products
33272200	3452	Bolts, Nuts, Screws, Rivets, and Washers
33211100	3462	Iron and Steel Forgings
33211500	3466	Crowns and Closures
33221400	3469	Metal Stamping, N.E.C.
33291210	3492	Fluid Power Valves and Hose Fittings
33261100	3493	Steel Springs
33291920	3494	Valves and Pipe Fittings, Except Brass
33451810	3495	Wire Springs
33261830	3496	Miscellaneous Fabricated Wire Products
33299620	3498	Fabricated Pipe and Fabricated Pipe Fitting
33243940 33251020 33211700 33721540 33991420	3499	Fabricated Metal Products, N.E.C.
33351210	3541	Machine Tools, Metal Cutting Types
33351300	3542	Machine Tools, Metal Forming Types
33351400	3544	Special Dies and Tools, Die Sets, Jigs and Fixtures, and Industrial Molds
33351500	3545	Machine Tool Access and Measuring Devices
33399100	3546	Power Driven Hand Tools
33999320	3965	Fasteners, Buttons, Needles, Pins

**Table A-1 (Continued)**

<b>Example NAICS and SIC Codes for the MP&amp;M Industrial Sectors</b>		
<b>NAICS Code</b>	<b>SIC Code</b>	<b>Standard Industrial Classification Groups</b>
<i>Household Equipment</i>		
33712400	2514	Metal Household Furniture
33721400	2522	Office Furniture, Except Wood
33712710	2531	Public Building and Related Furniture
33721530	2542	Partitions and Fixtures, Except Wood
33792000	2591	Drapery Hardware and Window Blinds/shades
33712720 33911310	2599	Furniture and Fixtures, N.E.C.
33299800	3431	Metal Sanitary Ware
33291300	3432	Plumbing Fittings and Brass Goods
33232120	3442	Metal Doors, Sash, and Trim
33522100	3631	Household Cooking Equipment
33522200	3632	Household Refrigerators and Home and Farm and Freezers
33522400	3633	Household Laundry Equipment
33521100 33341420	3634	Electric Housewares and Fans
33521210	3635	Household Vacuum Cleaners
33521220 33522800	3639	Household Appliances, N.E.C.
33511000	3641	Electric Lamps
33593100	3643	Current-Carrying Wiring Devices
33593200	3644	Noncurrent-Carrying Wiring Devices
33512120	3645	Residential Electrical Lighting Fixtures
33512200	3646	Commercial, Industrial, and Institutional
33512910	3648	Lighting Equipment, NEC
33431000	3651	Radio/Television Sets Except Communication Types
81131030 81141220	7623	Refrigeration and Air-conditioning Service and Repair Shops

**Table A-1 (Continued)**

Example NAICS and SIC Codes for the MP&M Industrial Sectors		
NAICS Code	SIC Code	Standard Industrial Classification Groups
<i>Instruments</i>		
33451120	3812	Search, Detection, Navigation, Guidance, Aeronautical, Nautical Systems and Instruments
33911100	3821	Laboratory Apparatus and Furniture
33451200	3822	Automatic Environmental Controls
33451300	3823	Process Control Instruments
33451400	3824	Fluid Meters and Counting Devices
33451500	3825	Instruments to Measure Electricity
33451620	3826	Laboratory Analytical Instruments
33331420	3827	Optical Instruments and Lenses
33451920	3829	Measuring and Controlling Devices, N.E.C.
33911210 33911220	3841	Surgical and Medical Instruments and Apparatus
32229120 33451020 33911320	3842	Orthopedic, Prosthetic and Surgical Supplies
33911420	3843	Dental Equipment and Supplies
33451700	3844	X-ray Apparatus and Tubes
33451030	3845	Electromedical Equipment
33911500	3851	Ophthalmic Goods
81121210 81121310 81121910 81141120 81141210	7629	Electric Repair Shop
<i>Job Shops<sup>a</sup></i>		
33281300	3471	Plating and Polishing
33281200 33991210 33991410	3479	Metal Coating and Allied Services

**Table A-1 (Continued)**

<b>Example NAICS and SIC Codes for the MP&amp;M Industrial Sectors</b>		
<b>NAICS Code</b>	<b>SIC Code</b>	<b>Standard Industrial Classification Groups</b>
<i><b>Mobile Industrial Equipment</b></i>		
33221220 33311100 33392210	3523	Farm Machinery and Equipment
33221230 33311200	3524	Garden Tractors and Lawn and Garden Equipment
33312000 33392310 33651010	3531	Construction Machinery and Equipment
33313100	3532	Mining Machinery and Equipment, Except Oil Field
33392320	3536	Hoists, Industrial Cranes and Monorails
33243950 33299960 33392400	3537	Industrial Trucks, Tractors, Trailers
33699220	3795	Tanks and Tank Components
<i><b>Motor Vehicle</b></i>		
33637000	3465	Automotive Stampings
33631100	3592	Carburetors, Piston Rings, Valves
33632100	3647	Vehicular Lighting Equipment
33632220	3694	Electrical Equipment for Motor Vehicles
33611100 33611200 33612000 33621110 33621130 33699210	3711	Motor Vehicle and Automobile Bodies
33621130	3714	Motor Vehicle Parts and Accessories
33621300	3716	Mobile Homes
33699110	3751	Motorcycles
33621410	3792	Travel Trailers and Campers
33699900	3799	Miscellaneous Transportation Equipment
48531000	4121	Taxicabs
44131030	5013	Motor Vehicle Supplies and New Parts

**Table A-1 (Continued)**

Example NAICS and SIC Codes for the MP&M Industrial Sectors		
NAICS Code	SIC Code	Standard Industrial Classification Groups
<i>Motor Vehicle (Continued)</i>		
44111000	5511	Motor Vehicle Dealers (New and Used)
44112000	5521	Motor Vehicle Dealers (Used Only)
44121000	5561	Recreational Vehicle Dealers
44122100	5571	Motorcycle Dealers
44122900	5599	Automotive Dealers, N.E.C.
53211200	7515	Passenger Car Lease
81112110 81112120 81112130	7532	Top, Body, and Upholstery Repair and Paint Shops
81111200	7533	Auto Exhaust Systems
81111300	7537	Auto Transmission Repair
81111100	7538	General Automotive Repair
81111810 81111820 81111830 81111840 81111890	7539	Auto Repair Shop, N.E.C.
81119100 81119820	7549	Auto Services, Except Repair and Carwashes
<i>Office Machines</i>		
33411100	3571	Electronic Computers
33411200	3572	Typewriters
33411300	3575	Computer Terminals
33411910	3577	Computer Peripheral Equipment, N.E.C.
33411920	3578	Calculating, Accounting Machines Except Computers
33451820	3579	Office Machines, N.E.C.
81121230	7378	Computer Maintenance and Repairs
54151220 54151910 33451820	7379	Computer Related Services, N.E.C.



**Table A-1 (Continued)**

Example NAICS and SIC Codes for the MP&M Industrial Sectors		
NAICS Code	SIC Code	Standard Industrial Classification Groups
<i>Ordnance</i>		
33299200	3482	Small Arms Ammunition
33299300	3483	Ammunition, Except for Small Arms
33299400	3484	Small Arms
33299500	3489	Ordnance and Accessories, N.E.C.
<i>Precious Metals and Jewelry</i>		
33451830	3873	Watches, Clocks, and Watchcases
33991120	3911	Jewelry, Precious Metal
33991220	3914	Silverware, Plated Ware and Stainless
33991300	3915	Jewelers' Materials and Lapidary Work
33991430	3961	Costume Jewelry
81149010	7631	Watch, Clock, Jewelry Repair
<i>Printed Circuit Boards<sup>a</sup></i>		
33441200	3672	Printed Circuit Boards
<i>Railroad</i>		
33391120 33651020	3743	Railcars, Railway Systems
48211100	4011	Railroad Transportation
48211200	4013	Railroad Transportation
<i>Ships and Boats</i>		
33661100	3731	Ship Building and Repairing
33661200 81149020	3732	Boat Building and Repairing
48311100	4412	Deep Sea Foreign Transportation
48311310	4424	Deep Sea Domestic Transportation
48311320	4432	Freight Transportation Great Lakes
48321110	4449	Water Transportation of Freight, N.E.C.
48311410	4481	Deep Sea Passenger Transportation
48311420	4482	Ferries

**Table A-1 (Continued)**

<b>Example NAICS and SIC Codes for the MP&amp;M Industrial Sectors</b>		
<b>NAICS Code</b>	<b>SIC Code</b>	<b>Standard Industrial Classification Groups</b>
<i>Ships and Boats (Continued)</i>		
48321220 48721010	4489	Water Passenger Transportation, N.E.C.
48831010	4491	Marine Cargo Handling
48321120	4492	Towing and Tugboat Service
71393000	4493	Marinas
48831020 48833020 48833030 48839010 53241110	4499	Water Transportation Services, N.E.C.
<i>Stationary Industrial Equipment</i>		
33361100	3511	Steam, Gas, Hydraulic Turbines, Generating Units
33639910	3519	Internal Combustion Engines, N.E.C.
33313200	3533	Oil Field Machinery and Equipment
33392100	3534	Elevators and Moving Stairways
33392220	3535	Conveyors and Conveying Equipment
33299700	3543	Industrial Patterns
33351600	3547	Rolling Mill Machinery and Equipment
33399210	3548	Electric and Gas Welding and Soldering
33351800	3549	Metal Working Machinery, N.E.C.
33329210	3552	Textile Machinery
33321000	3553	Woodworking Machinery
33329100	3554	Paper Industries Machinery
33329310	3555	Printing Trades Machinery and Equipment
33329400	3556	Food Products Machinery
33329810	3559	Special Industry Machinery, N.E.C.
33391110	3561	Pumps and Pumping Equipment
33299100	3562	Ball and Roller Bearings
33391200	3563	Air and Gas Compressors

**Table A-1 (Continued)**

Example NAICS and SIC Codes for the MP&M Industrial Sectors		
NAICS Code	SIC Code	Standard Industrial Classification Groups
<i>Stationary Industrial Equipment (Continued)</i>		
33341200 33341100	3564	Blowers and Exhaust and Ventilation Fans
33399300	3565	Industrial Patterns
33361200	3566	Speed Changers, High Speed Drivers and Gears
33399400	3567	Industrial Process Furnaces and Ovens
33361300	3568	Mechanical Power Transmission Equipment, N.E.C.
33399910	3569	General Industrial Machinery, N.E.C.
33331100	3581	Automatic Merchandising Machines
33331200	3582	Commercial Laundry Equipment
33639100	3585	Refrigeration and Air and Heating Equipment
33391300	3586	Measuring and Dispensing Pumps
33331920	3589	Service Industry Machines, N.E.C.
33399510	3593	Fluid Power Cylinders and Actuators
33399610	3594	Fluid Power Pumps and Motors
33399700	3596	Scales and Balances, Except Laboratory
33399920	3599	Machinery, Except Electrical, N.E.C.
33531120	3612	Transformers
33531300	3613	Switchgear and Switchboard Apparatus
33531210	3621	Motors and Generators
33599910	3629	Electric Industrial Apparatus, N.E.C.
53241210	7353	Heavy Construction Equipment Rental, Leasing
53221000 53229990 53231000 53241190 53241290 53242010 53249020 56299120	7359	Equipment Rental, Leasing, N.E.C.

**Table A-1 (Continued)**

Example NAICS and SIC Codes for the MP&M Industrial Sectors		
NAICS Code	SIC Code	Standard Industrial Classification Groups
<i>Miscellaneous Metal Products</i>		
33299940	3497	Metal Foil and Leaf
33331520	3861	Photographic Equipment and Supplies
33999200	3931	Musical Instruments
33699120	3944	Games, Toys, Children's Vehicles
33992000	3949	Sporting and Athletic Goods, N.E.C.
33994100	3951	Pens and Mechanical Pencils
33994300	3953	Marking Devices
33995000	3993	Signs and Advertising Displays
33999500	3995	Burial Caskets
33221270 33299980 33512130	3999	Manufacturing Industries, N.E.C.
81149030	7692	Welding Repair
48839030 81149090 56162200 56179010 81121220 81121990 81131010 81141110 81141290	7699	Repair Shop, Related Service
<i>Continuous Electroplaters</i>		
33281300	3399	Electroplating, Plating, Polishing, Anodizing, and Coloring

Source: U.S. Census Bureau, North American Industrial Classification System,  
<http://www.census.gov/epcd/www/naics.html>.

N.E.C. - Not elsewhere classified.

<sup>a</sup>Industrial sector considered, but not included, in Part 438.

## **Appendix B**

### **ANALYTICAL METHODS AND BASELINE VALUES FOR THE METAL PRODUCTS AND MACHINERY INDUSTRY**

## APPENDIX B

### ANALYTICAL METHODS AND BASELINE VALUES

- B.1 Nominal Quantitation Limits
- B.2 Baseline Values
- B.3 Analytical Results Reporting Conventions
- B.4 Analytical Methods
  - B.4.1 EPA Methods 1624, 1625, 1664, and OIA-1677 (Volatile Organics, Semivolatile Organics, SGT-HEM, HEM, and Available Cyanide)
  - B.4.2 EPA Methods 1620 and 200.7 (Metals)
  - B.4.3 EPA Method 335.1 (Amenable Cyanide)
  - B.4.4 EPA Methods 350.2 and 350.3 (Ammonia as Nitrogen)
  - B.4.5 EPA Method 405.1 and SM 5210B (BOD<sub>5</sub> and Carbonaceous BOD)
  - B.4.6 EPA Methods 410.1, 410.2, and 410.4 (Chemical Oxygen Demand)
  - B.4.7 EPA Method 325.3 (Chloride)
  - B.4.8 EPA Method 340.2 (Fluoride)
  - B.4.9 EPA Method 218.4, SM 3111A, and SM 3500D (Hexavalent Chromium)
  - B.4.10 EPA Method 150.1 and SM 4500H (pH)
  - B.4.11 EPA Methods 375.2 and 375.4 (Sulfate)
  - B.4.12 EPA Methods 335.2 and 335.3 (Total Cyanide)
  - B.4.13 EPA Method 160.1 and SM 2540C (Total Dissolved Solids)
  - B.4.14 EPA Method 351.3 (Total Kjeldahl Nitrogen)
  - B.4.15 EPA Method 415.1 (Total Organic Carbon)
  - B.4.16 EPA Methods 420.1 and 420.2 (Total Phenols)
  - B.4.17 EPA Methods 365.2 and 365.3 (Total Phosphorus)
  - B.4.18 EPA Methods 376.1 and 376.2, SM 4500D and SM 4500E, and D4658 (Total Sulfide)
  - B.4.19 EPA Method 160.2 and SM 2540D (Total Suspended Solids)
  - B.4.20 EPA Methods 204.1 and 7041 (Antimony)
  - B.4.21 EPA Methods 206.2 and 7060A (Arsenic)
  - B.4.22 EPA Method 231.2 (Gold)
  - B.4.23 EPA Method 239.1 (Lead)
  - B.4.24 EPA Methods 245.1 and 245.2 (Mercury)
  - B.4.25 EPA Method 265.2 (Rhodium)
  - B.4.26 EPA Methods 270.2 and 7740 (Selenium)
  - B.4.27 EPA Method 272.1 (Silver)
  - B.4.28 EPA Methods 279.1 and 7841 (Thallium)
  - B.4.29 EPA Methods 624 and 625 (Volatile Organics and Semivolatile Organics)
  - B.4.30 EPA Method 630.1 (Ziram)
- B.5 Analytical Method Development Efforts

The analytical methods described in this appendix were used to determine pollutant levels in wastewater samples collected by EPA and industry at a number of metal products and machinery facilities. (Sampling efforts are described in Section 3.0) In developing the rule, EPA used data from samples collected by EPA and industry to determine the levels of amenable cyanide, ammonia as nitrogen, available cyanide, biochemical oxygen demand (BOD), carbonaceous biochemical oxygen demand, chemical oxygen demand (COD), chloride, fluoride, hexavalent chromium, metals, oil and grease (measured as hexane extractable material (HEM)), pH, semivolatile organics, silica gel-treated hexane extractable material (SGT-HEM), sulfate, total cyanide, total dissolved solids (TDS), total Kjeldahl nitrogen (TKN), total organic carbon (TOC), total phenols, total phosphorus, total sulfide, total suspended solids (TSS), volatile organics, and ziram. As explained in Section 7.0, EPA is regulating a subset of these pollutants.

Sections B.1 and B.2 of this appendix provide explanations of nominal quantitation limits and baseline values. Section B.3 describes the reporting conventions used by laboratories in expressing the results of the analyses. Section B.4 describes each analytical method and the corresponding baseline values that EPA used in determining the pollutants of concern. Section B.5 discusses analytical method development efforts. Table B-1 identifies the analytical methods and baseline values for each pollutant, identifies each pollutant by Chemical Abstract Service Registry Number, indicates whether the samples were collected by EPA and/or by industry, and lists the nominal quantitation value for the method used.

## **B.1            Nominal Quantitation Limits**

The nominal quantitation limit is the smallest quantity of an analyte that can be reliably measured with a particular method, using the typical (nominal) sample size. The protocols used for determination of nominal quantitation limits in a particular method depend on the definitions and conventions that EPA used at the time the method was developed. The nominal quantitation limits associated with the methods addressed in this section fall into three categories.

- 1)            The first category pertains to EPA Methods 1624, 1625, 1664, and OIA-1677, which define the minimum level (ML) as the lowest level at which the entire analytical system must give a recognizable signal and an acceptable calibration point for the analyte. These methods are described in Section B.4.1.
- 2)            The second category pertains specifically to EPA Method 1620, and is explained in detail in Section B.4.2.
- 3)            The third category pertains to the remainder of the chemical methods in which a variety of terms are used to describe the lowest level at which measurement results are quantitated. In some cases (especially with the classical wet chemistry analytes) the methods date to the 1970s and 1980s when different concepts of quantitation were employed by EPA. These methods typically list a measurement range or lower limit of

measurement. The terms differ by method and, as discussed in subsequent sections, the levels presented are not always representative of the lowest levels laboratories currently can achieve.

For those methods associated with a calibration procedure, the laboratories demonstrated through a low-point calibration standard that they were capable of reliable quantitation at method-specified (or lower) levels. In such cases these nominal quantitation limits are operationally equivalent to the ML (though not specifically identified as such in the methods).

In the case of titrimetric or gravimetric methods, the laboratory adhered to the established lower limit of the measurement range published in the methods. Details of the specific methods are presented in Sections B.4.3 through B.4.30.

## **B.2            Baseline Values**

As described further in Section 7.0, in determining the pollutants of concern, EPA compared the reported concentrations for each pollutant to a multiple of the baseline value. As described in Section B.3 and shown in Table B-1, for most pollutants, the baseline value was set equal to the nominal quantitation limit for the analytical method. EPA made two general types of exceptions which are briefly described below. Section B.4 provides additional details about these exceptions in the context of the analytical methods.

The first type of exception was for baseline values that were different than the nominal quantitation limits in the analytical methods. When the baseline values were lower, EPA made these exceptions because the laboratory submitted data that demonstrated that reliable measurements could be obtained at lower levels for those pollutants. When the baseline values were higher, EPA concluded that the nominal quantitation limit for a specified method was less than the level that laboratories could reliably achieve and adjusted the baseline value upward.

The second type of exception was for baseline values set at a common value for multiple analytical methods for the same pollutant. For some analytes, EPA permitted the laboratories to choose between methods to accommodate sample characteristics and/or industry used a different analytical method than EPA. When these methods had different nominal quantitation limits, EPA generally used the one with the lowest value or the one associated with the method used for most samples.



### **B.3                    Analytical Results Reporting Conventions**

The laboratories reported each analytical result either as a numeric value or as not quantitated<sup>1</sup>. A numeric result indicates that the pollutant was quantitated<sup>2</sup> in the sample. Most analytical results were reported as liquid concentrations in weight/volume units (e.g., micrograms per liter ( $\mu\text{g/L}$ )), except for the pH data, which were reported in "standard units" (SU). For solid samples, the results were provided in weight/weight units (e.g., milligrams per kilogram ( $\text{mg/kg}$ )). In those instances, EPA converted the solids results into weight/volume units by using a conversion factor based on the percentage of solids in the samples.

For example, the result for a hypothetical pollutant X would be reported as "15 g/L" when the laboratory cannot quantitate the amount of pollutant X in the sample as being 15 g/L. When the laboratory cannot quantitate the amount of pollutant X in the sample, the laboratory would report that the analytical result indicated a value less than the sample-specific quantitation limit of 10 g/L (i.e., "<10 g/L"). The actual amount of pollutant X in that sample is between zero (i.e., the pollutant is not present) and 10 g/L. The sample-specific quantitation limit for a particular pollutant is generally the smallest quantity in the calibration range that can be measured reliably in any given sample. Reporting a pollutant as nonquantitated does not mean that the pollutant is not present in the wastewater; it merely indicates that analytical techniques (whether because of instrument limitations, pollutant interactions, or other reasons) do not permit its measurement at levels below the sample-specific quantitation limit.

In its calculations, EPA generally substituted the reported sample-specific quantitation limit for each nonquantitated result. As described in Section B.4.1, EPA substituted the baseline value for the nonquantitated result when the sample-specific quantitation limit was less than the baseline value. In addition, when the detected quantitated value was below the baseline value, EPA substituted the baseline value for the measured value and considered these values to be nonquantitated in the statistical analyses.

### **B.4                    Analytical Methods**

EPA and industry analyzed all metal products and machinery facility wastewater samples using methods identified in Table B-1. (As explained in Section 7.0, EPA is regulating only a subset of these analytes.) In analyzing samples, EPA generally used analytical methods approved at 40 CFR 136 or methods that EPA has used for decades in support of effluent guidelines development. Exceptions for use of nonapproved methods are explained in the method-specific subsections that

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<sup>1</sup>Elsewhere in this document and in the preamble to the rule, EPA may refer to pollutants as "not detected" or "nondetected." This appendix uses the terms "not quantitated" or "nonquantitated" rather than not detected or nondetected.

<sup>2</sup>Elsewhere in this document and in the preamble to the rule, EPA may refer to pollutants as "detected." This appendix uses the term "quantitated" rather than detected.

follow. EPA proposed limitations or standards based only upon data generated by methods approved in 40 CFR 136. Table B-1 provides a summary of the analytical methods, the associated pollutants measured by the method, the nominal quantitation levels, and the baseline levels. The following sections provide additional information supporting the summary in Table B-1.

The following sections describe the methods used to determine pollutant levels in wastewater samples collected at metal products and machinery facilities. Each section states whether the method is approved at 40 CFR 136 (even if the pollutant was not proposed to be regulated), provides a short description of the method, identifies the nominal quantitation limit, and explains EPA's choice for the baseline value.

#### **B.4.1 EPA Methods 1624, 1625, 1664, and OIA- 1677 (Volatile Organics, Semivolatile Organics, HEM, SGT-HEM, and Available Cyanide)**

EPA used Methods 1624, 1625, 1664, and OIA-1677 to measure volatile organics, semivolatile organics, n-hexane extractable material (HEM)/silica gel treated n-hexane extractable material (SGT- HEM) and available cyanide, respectively. Industry used Method 1664 to measure HEM and SGT-HEM. Methods 1624, 1625, 1664, and OIA-1677 are approved at 40 CFR 136.

These methods use the minimum level (ML) of quantitation. The ML is defined as the lowest level at which the entire analytical system must give a recognizable signal and an acceptable calibration point for the analyte. When an ML is published in a method, the Agency has demonstrated that the ML can be achieved in at least one well-operated laboratory. When that laboratory or another laboratory uses that method, the laboratory is required to demonstrate, through calibration of the instrument or analytical system, that it can achieve pollutant measurements at the ML.

For volatile organics, semivolatile organics, HEM/SGT-HEM, and available cyanide, EPA used the method-specified MLs as the baseline values. In determining the pollutants of concern and in calculating the HEM/SGT-HEM standards, EPA substituted the value of the ML and assumed that the measurement was not quantitated when a quantitated value or sample-specific quantitation limit was reported with a value less than the ML specified in the method. For example, if the ML was 10 g/L and the laboratory reported a quantitated value of 5 g/L, EPA assumed that the concentration was nonquantitated with a sample-specific quantitation limit of 10 g/L. The objective of this comparison was to identify any results for the pollutants reported below the method-defined ML. Results reported below the ML were changed to the ML to ensure that all results used by EPA were reliable. In most cases, the quantitated values and sample-specific quantitation limits were equal to or greater than the baseline values.

#### **B.4.2 EPA Methods 1620 and 200.7 (Metals)**

EPA used Method 1620 to measure the concentrations of metals. While Method 1620 is not listed at 40 CFR 136 as an approved method, it represents a consolidation of the analytical

techniques in several 40 CFR 136-approved methods, such as Method 200.7 (inductively coupled plasma atomic emission (ICP) spectroscopy of trace elements) and Method 245.1 (mercury cold vapor atomic absorption (CVAA) spectroscopy). This method was developed specifically for the effluent guidelines program. Method 1620 includes more metal analytes than are listed in the approved methods and contains quality control requirements at least as stringent as the 40 CFR 136-approved methods. Some industry-supplied results for aluminum, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, magnesium, manganese, molybdenum, nickel, sodium, vanadium, and zinc were determined by Method 200.7. Other industry-supplied results for metals were determined by EPA Methods 204.1, 206.2, 231.2, 239.1, 245.1, 245.2, 265.2, 270.2, 272.1, 279.1, 7041, 7060A, 7740, and 7841.

Method 1620 employs the concept of an instrument detection limit (IDL). The IDL is defined as "the smallest signal above background noise that an instrument can detect reliably."<sup>3</sup> Data reporting practices for Method 1620 analyses follow conventional metals reporting practices used in other EPA programs, in which values are required to be reported at or above the IDL. In applying Method 1620, IDLs are determined on a quarterly basis by each analytical laboratory and are, therefore, laboratory-specific and time-specific. Although Method 1620 contains MLs, these MLs pre-date EPA's recent refinements of the ML concept described earlier. The MLs associated with Method 1620 are based on a consensus opinion reached between EPA and laboratories during the 1980s regarding levels that could be considered reliable quantitation limits when using Method 1620. These limits do not reflect advances in technology and instrumentation since the 1980s. Consequently, the IDLs, which are more reflective of current analytical capabilities, were used as the lowest values for reporting purposes, with the general understanding that reliable results can be produced at or above the IDL. Although the baseline values were derived from the MLs (or adjusted MLs) in Method 1620, EPA used the laboratory-reported quantitated values and sample-specific quantitation limits, which captured concentrations down to the IDLs, in its data analyses.

In general, EPA used the MLs specified in Method 1620 as the baseline values. However, EPA adjusted the baseline value for lead to 50 : g/L and boron to 100 : g/L. In Method 1620, lead has an ML of 5 : g/L for graphite furnace atomic absorption (GFAA) spectroscopy analysis; EPA determined, however, that it was not necessary for the laboratories to measure down to such low levels, and that lead could be analyzed by inductively coupled plasma atomic emission (ICP) spectroscopy. Consequently, the ML requirement was adjusted to 50 : g/L, the ML for the ICP method. In Method 1620, boron has an ML of 10 : g/L, but laboratory feedback years ago indicated that laboratories could not reliably achieve this low level. As a result, EPA only required laboratories to measure values at 100 : g/L and above. Thus, EPA adjusted the baseline value to 100 : g/L.

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<sup>3</sup>Keith, L.H., W. Crummett, J. Deegan, R.A. Libby, J.K. Taylor, G. Wentler (1983). "Principles of Environmental Analysis," Analytical Chemistry, Volume 55, Page 2217.

**B.4.3 EPA Method 335.1 (Amenable Cyanide)**

Amenable cyanide was measured using Method 335.1, which is approved at 40 CFR 136. Industry also supplied data determined by Method 335.1. Method 335.1 utilizes either a titrimetric or colorimetric procedure to measure amenable cyanide.

Method 335.1 has a lower measurement range limit of 0.02 milligrams per liter (mg/L) for the colorimetric procedure and a lower measurement range limit of 1 mg/L for the titrimetric procedure. The nominal quantitation limit of 0.02 mg/L was used as the baseline for all amenable cyanide results, since it is the lower value of the two.

**B.4.4 EPA Methods 350.2 and 350.3 (Ammonia as Nitrogen)**

Ammonia, as nitrogen, was measured using Methods 350.2 and 350.3, both of which are approved at 40 CFR 136. Method 350.2 utilizes colorimetric, titrimetric, or electrode procedures to measure ammonia. Method 350.3 uses a potentiometric procedure to measure ammonia.

Method 350.2 has a lower measurement range limit of 0.20 mg/L for the colorimetric and electrode procedures, and a lower measurement range limit of 1.0 mg/L for the titrimetric procedure. Method 350.3 has a lower measurement range limit of 0.03 mg/L for the potentiometric procedure. Rather than use different baseline values for the same pollutant, EPA used 0.03 mg/L as the baseline value from Method 350.3 because it represents the lowest value at which ammonia as nitrogen can be measured reliably.

**B.4.5 EPA Method 405.1 and SM 5210B (BOD<sub>5</sub> and Carbonaceous BOD<sub>5</sub>)**

Biochemical oxygen demand (BOD<sub>5</sub>) and carbonaceous BOD<sub>5</sub> (cBOD<sub>5</sub>) were measured using Method 405.1 and Standard Method (SM) 5210B, both of which are approved at 40 CFR 136. BOD<sub>5</sub> and cBOD<sub>5</sub> are determined by the same method, except that an organic compound is added to the cBOD<sub>5</sub> test to inhibit nitrogenous oxygen demand. If the sample does not include any nitrogenous demand to inhibit, the results should be comparable for BOD<sub>5</sub> and cBOD<sub>5</sub>.

Method 405.1 and SM 5210B are identical and the nominal quantitation limit, which is expressed in the methods as the lower limit of the measurement range at 2 mg/L, is the same for both forms of BOD<sub>5</sub>. EPA used this nominal quantitation limit of 2 mg/L as the baseline value in determining the pollutants of concern.

**B.4.6 EPA Methods 410.1, 410.2, and 410.4 (Chemical Oxygen Demand)**

Chemical Oxygen Demand (COD) was measured using Methods 410.1, 410.2, and 410.4, all of which are approved at 40 CFR 136. Method 410.4 is a colorimetric procedure. Methods 410.1 and 410.2 are titrimetric procedures that follow identical analytical protocols; they

differ only in the range of COD concentration that they are designed to measure. Reagent concentrations and sample volumes are adjusted to accommodate a wide range of sample concentrations, since the dynamic range of the chemistry used to detect COD is somewhat limited. Data from all three of these methods are directly comparable.

Method 410.1 is designed to measure mid-level concentrations (greater than 50 mg/L) of COD and is associated with a nominal quantitation limit of 50 mg/L. Method 410.2 is designed to measure low-level concentrations in the range of 5-50 mg/L. Method 410.4 has a measurement range of 3-900 mg/L for automated procedures and measurement range of 20-900 mg/L for manual procedures. EPA contracts required that laboratories measure down to the lowest quantitation limit possible for whatever method is used. Therefore, if the laboratory analyzes a sample using Method 410.1 and obtains a nonquantitated result, it must reanalyze the sample using Method 410.2. Thus, the quantitation limit reported for nonquantitated was 5 mg/L, unless sample dilutions were required for complex matrices.

For all COD data, EPA used the baseline value of 5 mg/L that is associated with the lower quantitation limit for the titrimetric procedures because most of the data used to determine COD were obtained by the titrimetric procedures (i.e., Methods 410.1 and 410.2).

#### **B.4.7 EPA Method 325.3 (Chloride)**

Chloride was measured using Method 325.3, which is approved at 40 CFR 136. Method 325.3 is a titrimetric procedure and measures concentrations greater than 1 mg/L; therefore, EPA used the baseline value of 1 mg/L.

#### **B.4.8 EPA Method 340.2 (Fluoride)**

Fluoride was determined by Method 340.2, which is approved at 40 CFR 136. Method 340.2 is a potentiometric procedure that uses a fluoride electrode. The nominal quantitation limit of 0.1 mg/L is expressed in the method as the lower limit of the measurement range. This nominal quantitation limit was used as the baseline value for fluoride.

#### **B.4.9 EPA Method 218.4, SM 3111A, and SM 3500D (Hexavalent Chromium)**

For EPA sampling episodes, hexavalent chromium was determined by Method 218.4 and SM 3500D, which are approved at 40 CFR 136. Industry supplied data generated by SM 3111A which is not approved at 40 CFR 136. Method 218.4 utilizes atomic absorption for the determination of hexavalent chromium after chelation and extraction. SM 3500D is a colorimetric procedure using reaction with diphenylcarbazide to produce a color proportional to  $\text{Cr}^{6+}$  concentration. SM 3111A utilizes flame atomic absorption spectrometry to measure  $\text{Cr}^{6+}$  or total Cr.

In Method 218.4, SM 3111A, and SM 3500D, the nominal quantitation limit or lower limit of the measurement range is 0.01 mg/L. Because EPA used Methods 218.4 and SM 3500D for analysis, the nominal quantitation limit of 0.01 mg/L was used as the baseline value for all hexavalent chromium results.

#### **B.4.10 EPA Method 150.1 and SM 4500H (pH)**

For EPA sampling episodes, pH was determined by Method 150.1. For industry-supplied data, pH was determined by SM 4500H. Both methods are approved at 40 CFR 136. For Method 150.1 and SM 4500H, the pH of a sample is determined electrometrically using either a glass electrode in combination with a reference potential or a combination electrode. There are no nominal quantitation limits for either Method 150.1 or SM 4500H.

#### **B.4.11 EPA Methods 375.2 and 375.4 (Sulfate)**

For EPA sampling episodes, sulfate was measured by Methods 375.2 and 375.4. For industry-supplied data, sulfate was measured by Method 375.4. Both of these methods are approved at 40 CFR 136. Method 375.2 is a colorimetric procedure that uses the decrease in color caused by the formation of barium sulfate to measure the sulfate concentration. Method 375.4 measures the turbidity created by the insoluble barium sulfate in solution. A dispersant/buffer is added to the solution to aid in creating uniform suspension of the barium sulfate.

The nominal quantitation limit (also the lower limit of the measurement range) for Method 375.2 is 0.50 mg/L. The nominal quantitation limit (also the lower limit of the measurement range) for Method 375.4 is 1 mg/L. EPA used the baseline value of 1 mg/L that is associated with the higher quantitation limit for all the sulfate data, rather than having multiple baseline values, because most of the sulfate data was determined by Method 375.4.

#### **B.4.12 EPA Methods 335.2 and 335.3 (Total Cyanide)**

EPA determined total cyanide using Method 335.2. Industry determined total cyanide by Methods 335.2 and 335.3. Both methods are approved at 40 CFR 136. Method 335.2 uses either titration with silver nitrate, or colorimetry with an organic dye, to measure total cyanide. Method 335.3 uses an automated distillation-colorimetry procedure for continuous flow analytical systems that utilizes UV oxidation to measure total cyanide.

The nominal quantitation limit for Method 335.2, expressed in the method as the lower limit of the measurement range, is 0.02 mg/L. The nominal quantitation limit for Method 335.3, also expressed as the lower limit of the measurement range, is 0.005 mg/L. Because EPA used Method 335.2, the Agency used the nominal quantitation limit of 0.02 mg/L as the baseline value for all total cyanide results.

**B.4.13 EPA Method 160.1 and SM 2540C (Total Dissolved Solids)**

EPA determined total dissolved solids (TDS) by Method 160.1. Industry determined TDS by SM 2540C. Both methods are approved at 40 CFR 136 under "residue-filterable." Method 160.1 and SM 2540C are gravimetric methods with a lower limit of the measurement range of 10 mg/L; this value is the nominal quantitation limit. The nominal quantitation limit of 10 mg/L is also the baseline value.

**B.4.14 EPA Method 351.3 (Total Kjeldahl Nitrogen)**

EPA determined total Kjeldahl nitrogen (TKN) by Method 351.3, which is approved at 40 CFR 136. Method 351.3 is a manual colorimetric analysis that has a lower measurement range limit, which is also the nominal quantitation limit, of 1.0 mg/L. The nominal quantitation limit of 1.0 mg/L is also the baseline value.

**B.4.15 EPA Method 415.1 (Total Organic Carbon)**

EPA determined total organic carbon (TOC) by Method 415.1, which is approved at 40 CFR 136. Method 415.1 is a combustion (or oxidation) method with a lower measurement range limit of 1 mg/L. EPA used this nominal quantitation limit of 1 mg/L as the baseline value.

**B.4.16 EPA Methods 420.1 and 420.2 (Total Phenols)**

In EPA's database, the terms "total phenols" and "total recoverable phenolics" are used synonymously. The term "total recoverable phenolics" is used in the titles of Methods 420.1 to 420.4. While "total recoverable phenolics" could be considered a more accurate term for what is measured in any of these related methods, both terms refer to an aggregate measure of compounds with a phenol-like or "phenolic" structure. The use of the adjective "recoverable" simply recognizes that there are some compounds that are not measured, as well as other related compounds in this class. Thus, the method reports what can be recovered from the sample under the conditions of the analysis.

The methods for the analysis of total phenols employ the reagent 4-aminoantipyrine (4AAP), which reacts with phenolic compounds to produce a dark red product, an antipyrine dye. The concentration of the phenolic compounds is determined by measuring the absorbance of the sample at a wavelength of 460 to 520 nm, depending on the method. The methods are calibrated using a series of standards containing the single compound phenol. Methods 420.1 and 420.2, the two methods approved at 40 CFR 136, provide several options for sample preparation and analysis, including a preliminary distillation designed to remove interferences, and a chloroform extraction procedure in Method 420.1 that is designed to improve the sensitivity of the method. Both methods also provide information on the concentrations of the calibration standards that may be prepared for a given set of procedural options.

The methods themselves do not contain a required calibration range. Each laboratory can, and does, establish a calibration range based on its use of the method. EPA used a baseline value of 0.05 mg/L because this was the most commonly reported sample-specific detection limit in EPA's sampling episode data (these data included more concentrated samples than effluent).

#### **B.4.17 EPA Methods 365.2 and 365.3 (Total Phosphorus)**

EPA determined total phosphorus by Methods 365.2 and 365.3. Both methods are approved at 40 CFR 136. Total phosphorus represents all of the phosphorus present in the sample, regardless of form, as measured by the persulfate digestion procedure.

The two methods differ only in the preparation of one of the reagents. Method 365.2 specifies the separation of the ammonium molybdate and the antimony potassium tartrate from the ascorbic acid reagent. Method 365.3 allows for combining these reagents into a single solution. Because the chemistry is unaffected, the data are directly comparable.

These methods have the same nominal quantitation limit of 0.01 mg/L. EPA used this value as the baseline value for total phosphorus.

#### **B.4.18 EPA Methods 376.1 and 376.2, SM 4500D and SM 4500E, and D4658 (Total Sulfide)**

EPA determined total sulfide by Methods 376.1, 376.2, and SM 4500E, all of which are approved at 40 CFR 136. Industry determined sulfide by SM 4500D and ASTM Method D4658. SM 4500D is approved at 40 CFR 136, while ASTM Method D4658 is not approved at 40 CFR 136. Method 376.1 and SM 4500E utilize an iodine solution to oxidize any sulfide present in the sample. The remaining iodine is then titrated with sodium thiosulfate in the presence of a starch solution. The quantity of iodine added to the sample and the titrant required to neutralize the remaining iodine give the sulfide concentration by calculation. Method 376.2 and SM 4500D use the reaction of the sulfide ion with ferric chloride and dimethyl-*P*-phenylenediamine to produce deeply colored methylene blue. The color is proportional to the sulfide concentration. ASTM Method D4658 utilizes an ion-selective electrode to determine sulfide ion in water.

EPA collected sulfide data for 236 samples in seven post-proposal sampling episodes using Methods 376.1, 376.2, and SM 4500E (EPA Episode numbers 6455, 6456, 6457, 6458, 6461, 6462, and 6463). These samples were collected from both process wastewaters prior to treatment and effluent wastewater after treatment. EPA reviewed the analytical data from these 236 samples and compared the three different methods. The study is included in the rulemaking record (see Section 16.2 of the rulemaking record, DCN 16941) and a summary of the findings are in the notice of data availability (67 FR 38754; June 5, 2002).



The nominal quantitation limit for Method 376.1 and SM 4500E, which is also the lower limit of the measurement range, is 1.0 mg/L. The nominal quantitation limit for Method 376.2 and SM 4500D is 0.5 mg/L. The nominal quantitation limit for D4658, which is also the lower limit of the measurement range, is 0.04 mg/L. Rather than use different baseline values for the same pollutant, EPA used the 1.0 mg/L as the baseline value from Method 376.1 because the majority of the data were determined by this method.

#### **B.4.19 EPA Method 160.2 and SM 2540D (Total Suspended Solids)**

EPA determined total suspended solids (TSS) by Method 160.2. Industry determined TSS by SM 2540D. Both methods are approved at 40 CFR 136 under "residue-non-filterable." Method 160.2 and SM 2540D are gravimetric methods with a lower limit of the measurement range of 4 mg/L; this value is also the nominal quantitation limit. The nominal quantitation limit of 4 mg/L is the baseline value.

#### **B.4.20 EPA Method 204.1 and 7041 (Antimony)**

Industry determined antimony by Methods 204.1 and 7041. Method 204.1 is approved at 40 CFR 136. Method 7041 is from *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846). Although Method 7041 is not listed at 40 CFR 136, it is approved for analyses of samples under the RCRA regulations at 40 CFR 261. Method 204.1 utilizes direct-aspiration atomic absorption as the determinative technique to measure antimony. Method 7041 utilizes the furnace technique in conjunction with an atomic absorption spectrophotometer.

The nominal quantitation limit (also the lower limit of the measurement range) for Method 204.1 is 1.0 mg/L. The nominal quantitation limit (also the lower limit of the measurement range) for Method 7041 is 20 : g/L. Rather than use different baseline values for the same pollutant, EPA used the minimum level of 20 : g/L for antimony from Method 1620 as the baseline value, because this was the method that EPA used for the determination of antimony.

#### **B.4.21 EPA Method 206.2 and 7060A (Arsenic)**

Industry determined arsenic by Methods 206.2 and 7060A. Method 206.2 is approved at 40 CFR 136. Method 7060A is from *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846). Although Method 7060A is not listed at 40 CFR 136, it is approved for analyses of samples under the RCRA regulations at 40 CFR 261. Methods 206.2 and 7060A utilize the furnace technique in conjunction with an atomic absorption spectrophotometer.

The nominal quantitation limit (also the lower limit of the measurement range) for Method 206.2 and Method 7060A is 5.0 : g/L. Rather than use different baseline values for the same pollutant, EPA used the minimum level of 10 : g/L for arsenic from Method 1620 as the baseline value, because this was the method that EPA used for the determination of arsenic.

**B.4.22 EPA Method 231.2 (Gold)**

EPA determined gold by Method 231.2, since this parameter is only semiquantitatively analyzed by Method 1620. Method 231.2 is approved at 40 CFR 136. Method 231.2 utilizes the furnace technique in conjunction with an atomic absorption spectrophotometer. The nominal quantitation limit for gold, which is also the lower limit of the measurement range, is 5 : g/L. The nominal quantitation limit is also the baseline value.

**B.4.23 EPA Method 239.1 (Lead)**

Industry determined lead by Method 239.1, which is approved at 40 CFR 136. Method 239.1 utilizes direct-aspiration atomic absorption as the determinative technique to measure lead. The nominal quantitation limit of 0.1 mg/L is expressed in the method as the lower limit of the measurement range. Rather than use different baseline values for the same pollutant, EPA used the minimum level of 50 : g/L for lead from Method 1620 from the ICP technique, as the baseline value since this was the method that EPA used for the determination of lead.

**B.4.24 EPA Methods 245.1 and 245.2 (Mercury)**

Industry determined mercury by Methods 245.1 and 245.2, both of which are approved at 40 CFR 136. The methods utilize cold vapor atomic absorption as the determinative technique to measure mercury. The nominal quantitation limit for both methods is 0.2 : g/L, which is also expressed as the lower limit of the measurement range. The nominal quantitation limit matches the nominal quantitation limit from Method 1620, which EPA used to determine mercury. The nominal quantitation limit is the same as the baseline value of 0.2 : g/L.

**B.4.25 EPA Method 265.2 (Rhodium)**

EPA determined rhodium by Method 265.2, since this parameter is only semiquantitatively analyzed by Method 1620. Method 265.2 is approved at 40 CFR 136. Method 265.2 utilizes the furnace technique in conjunction with an atomic absorption spectrophotometer. The nominal quantitation limit for rhodium, which is also the lower limit of the measurement range, is 20 : g/L. The nominal quantitation limit is also the baseline value.

**B.4.26 EPA Methods 270.2 and 7740 (Selenium)**

Industry determined selenium by Methods 270.2 and 7740. Method 270.2 is approved at 40 CFR 136. Method 7740 is from *Test Methods for Evaluating Solid Waste, Physical/ Chemical Methods* (SW-846). Although Method 7740 is not listed at 40 CFR 136, it is approved for analyses of samples under the RCRA regulations at 40 CFR 261. Methods 270.2 and 7740 utilize the furnace technique in conjunction with an atomic absorption spectrophotometer.

The nominal quantitation limit for Method 270.2 and Method 7740, which is also lower limit of the measurement range, is 5.0 : g/L. Rather than use different baseline values for the same pollutant, EPA used the minimum level of 5 : g/L for selenium from Method 1620 as the baseline value, since this was the method that EPA used for the determination of selenium.

#### **B.4.27        EPA Method 272.1 (Silver)**

Industry determined silver by Method 272.1, which is approved at 40 CFR 136. Method 272.1 utilizes direct-aspiration atomic absorption as the determinative technique to measure silver. The nominal quantitation limit of 0.1 mg/L is expressed in the method as the lower limit of the measurement range. Rather than use different baseline values for the same pollutant, EPA used the minimum level of 10 : g/L for silver from Method 1620 as the baseline value, since this was the method that EPA used for the determination of silver.

#### **B.4.28        EPA Methods 279.1 and 7841 (Thallium)**

Industry determined thallium by Methods 279.1 and 7841. Method 279.1 is approved at 40 CFR 136. Method 7841 is from *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods* (SW-846). Although Method 7841 is not listed at 40 CFR 136, it is approved for analyses of samples under the RCRA regulations at 40 CFR 261. Method 279.1 utilizes direct-aspiration atomic absorption as the determinative technique to measure thallium. Method 7841 utilizes the furnace technique in conjunction with an atomic absorption spectrophotometer.

The nominal quantitation limit for Method 279.1, which is also the lower limit of the measurement range, is 1.0 mg/L. The nominal quantitation limit for Method 7841, which is also the lower limit of the measurement range, is 5 : g/L. Rather than use different baseline values for the same pollutant, EPA used the minimum level of 10 : g/L for thallium from Method 1620 as the baseline value, since this was the method that EPA used for the determination of thallium.

#### **B.4.29        EPA Methods 624 and 625 (Volatile Organics and Semivolatile Organics)**

EPA included industry-supplied data from Methods 624 and 625, both of which are approved at 40 CFR 136. Methods 624 and 625 are GC/MS methods, similar to Methods 1624 and 1625, except that Methods 624 and 625 do not utilize isotope dilution. The nominal quantitation limits are expressed as the lower limit of the measurement range, typically the concentration of the lowest calibration standard. However, rather than use different baseline values for the same pollutants (Methods 624 and 625 have many of the same analytes as Methods 1624 and 1625), EPA used the minimum levels that are listed in Methods 1624 and 1625 as the baseline values, since these methods were used by EPA for the determination of volatile and semivolatile organic analytes.

**B.4.30 EPA Method 630.1 (Ziram)**

Ziram was determined by Method 630.1. There are no methods approved at 40 CFR 136 for ziram. In this method, the sample is digested with acid to yield CS<sub>2</sub> by hydrolysis of the dithiocarbamate moiety. The evolved CS<sub>2</sub> is extracted from the water with hexane and the extract is injected into a GC. The nominal quantitation limit was determined by a low-point calibration standard. The nominal quantitation limit for ziram is 10 : g/L and was used as the baseline value.

**B.5 Analytical Method Development Efforts**

Section 304(h) of the Clean Water Act directs EPA to promulgate guidelines establishing test procedures for the analysis of pollutants. These methods allow the analyst to determine the presence and concentration of pollutants in wastewater. The methods are used for compliance monitoring, for filing applications for the NPDES program under 40 CFR 122.21, 122.41, 122.44 and 123.25, and for the implementation of the pretreatment standards under 40 CFR 403.10 and 403.12. To date, EPA has promulgated methods for all conventional and toxic pollutants, and for some nonconventional pollutants.

Currently approved methods for metals and wet chemistry parameters are included in the table of approved inorganic test procedures at 40 CFR 136.3, Table I-B. Table I-C at 40 CFR 136.3 lists approved methods for measurement of nonpesticide organic pollutants, and Table I-D lists approved methods for the toxic pesticide pollutants and for other pesticide pollutants. Dischargers must use the test methods promulgated at 40 CFR 136.3 or incorporated by reference in the tables, when available, to monitor pollutant discharges from the metal products and machinery (MP&M) industry, unless specified otherwise in 40 CFR 413, 433, 438, 463, 464, 467, and 471, or by the permitting authority.

Table I-C does not include six of the MP&M semivolatile organic pollutants and one of the MP&M volatile organic pollutant that EPA is regulating in the rule. Although these pollutants are missing from Table I-C, the analyte list for Method 1624 contains the volatile organic pollutant and the analyte list for Method 1625 contains the six semivolatile organic pollutants. EPA promulgated both of these methods for use in Clean Water Act measurement programs at 40 CFR 136, Appendix A.

As a part of the rule, EPA will allow the use of modified versions of Methods 624 and 1624 for the determination of the additional volatile organic pollutant and modified versions of Methods 625 and 1625 for the determination of the additional six semivolatile organic pollutants.

The modifications to Methods 624, 625, 1624, and 1625 have been included in the Docket for the rule. The modifications to Methods 624, 625, 1624, and 1625 consist of text, performance data, and quality control (QC) acceptance criteria for the additional analytes. This information will allow a laboratory to practice the methods with the additional analytes as an integral part. EPA conducted an interlaboratory validation study on the modifications to these methods. The

data from the interlaboratory study and the proposed modifications to the method were made available for public comment in a notice of data availability (see Section B.4.18). EPA is promulgating these method modifications for monitoring MP&M industry wastewaters at 40 CFR 136 in the rule.

As part of the rule, the following pollutants will be added to their respective analyte lists for the MP&M industry only:

Methods	Pollutant	CAS Number
EPA Methods 624/1624	carbon disulfide	75-15-0
EPA Methods 625/1625	aniline	62-53-3
EPA Methods 625/1625	3,6-dimethylphenanthrene	1576-67-6
EPA Methods 625/1625	2-isopropylnaphthalene	2027-17-0
EPA Methods 625/1625	1-methylfluorene	1730-37-6
EPA Methods 625/1625	2-methylnaphthalene	91-57-6
EPA Methods 625/1625	1-methylphenanthrene	832-69-9

**Table B-1****Analytical Methods and Baseline Values**

Analyte	Method	CAS Number	Samples Collected and Analyzed by	Nominal Quantitation Value (mg/L)	Baseline Value (mg/L)
Amenable Cyanide	335.1	C025	EPA, Industry	0.02	0.02
Ammonia as Nitrogen	350.2	766417	EPA	0.05	0.05
	350.3			0.03	
Available Cyanide	OIA-1677	C054	EPA	0.002	0.002
BOD	405.1	C003	EPA	2.00	2.00
Carbonaceous BOD	5210B	C002		2.00	
Chemical Oxygen Demand	410.1	C004	EPA	50.00	5.00 <sup>a</sup>
	410.2			5.00	
	410.4(automated) <sup>b</sup>			3.00	
	410.4(manual) <sup>b</sup>			20.00	
Chloride	325.3	16887006	EPA	1.00	1.00
Fluoride	340.2	16984488	EPA	0.10	0.10
HEM, SGT-HEM	1664	C036, C037	EPA, Industry	5.00	5.00
Hexavalent Chromium	218.4	18540299	EPA	0.01	0.01
	3111A		Industry	0.01	
	3500D		EPA	0.01	
Metals	1620	c	EPA	c	c
	200.7	c	Industry	c	c
pH	150.1	C006	EPA	N/A	
	4500H		Industry	N/A	
Semivolatile Organics	1625	c	EPA	c	c
	625		Industry		
Sulfate	375.2	14808798	EPA	3.00	1.00
	375.4		EPA, Industry	1.00	
Total Cyanide	335.2	57125	EPA, Industry	0.02	0.02
	335.3		Industry	0.005	
TDS	160.1	C010	EPA	10.00	10.00
	2540C		Industry	10.00	
TKN	351.3	C021	EPA	1.00	1.00
TOC	415.1	C012	EPA	1.00	1.00
Total Phenols	420.1	C020	EPA	d	0.05
	420.2			d	
Total Phosphorus	365.2	14265442	EPA	0.01	0.01
	365.3			0.01	

**Table B-1 (Continued)**

Analyte	Method	CAS Number	Samples Collected and Analyzed by	Nominal Quantitation Value (mg/L)	Baseline Value (mg/L)
Total Sulfide	376.1	18496258	EPA	1.00	1.00
	376.2			0.10	
	4500D		Industry	0.50	
	4500E		EPA	1.00	
	D4568		Industry	0.04	
TSS	160.2	C009	EPA	4.00	4.00
	2540D		Industry	4.00	
Volatile Organics	1624	c	EPA	c	c
	624		Industry		
Ziram	630.1	137304	EPA	0.01	0.01

<sup>a</sup>The baseline value was adjusted to reflect the lowest nominal quantitation limit of the titrimetric procedures (i.e., 410.1, 410.2, and 5220B). See Section B.4.6 for a detailed explanation.

<sup>b</sup>Method 410.4 lists two different quantitation limits that are dependent upon whether the automated or manual protocols were followed. The automated method limit =3 mg/L and the manual method limit =20 mg/L.

<sup>c</sup>The method analyzed a number of pollutants each with its own CAS number, baseline value, and nominal quantitation limit.

<sup>d</sup>The method does not have a required calibration range. The baseline value is based upon the most frequently reported sample-specific detection limit.

## **Appendix C**

### **WASTEWATER CHARACTERISTICS**



## Appendix C

### WASTEWATER CHARACTERISTICS

This appendix summarizes the characteristics of wastewater generated by unit operations evaluated for the final rule and discharged to wastewater treatment systems. The wastewaters characterized in this appendix can be grouped into the following types of wastewaters:

- c Hexavalent chromium-bearing wastewater;
- c Cyanide-bearing wastewater;
- c Oil-bearing and organic pollutant-bearing wastewaters;
- c Chelated metal-bearing wastewater; and
- c Metal-bearing wastewater.

EPA evaluated a number of unit operations for the May 1995 proposal, January 2001 proposal, and June 2002 NODA (see Tables 4-3 and 4-4). However, EPA selected a subset of these unit operations for regulation in the final rule (see Section 1.0). For this appendix, the term "proposed MP&M operations" means those operations evaluated for the two proposals, NODA, and final rule. The term "final MP&M operations" means those operations defined as "oily operations" (see Section 1.0, 40 CFR 438.2(f), and Appendix B to Part 438) and regulated by the final rule.

Sections C.1 through C.5 summarize, for each type of wastewater, analytical data obtained during the MP&M regulatory development process for unit operations and influents to the wastewater treatment systems. These subsections present the number of samples analyzed, the number of times each pollutant was detected, and the minimum, maximum, mean, and median pollutant concentrations. Oil-bearing and organic pollutant-bearing wastewaters are characterized in Section 5.0.

Analytical data from the MP&M sampling program, including data obtained from sanitation districts, facilities performing proposed MP&M operations, and MP&M industry trade associations, are in the sampling episode reports located in Sections 5.2 and 15.3 of the rulemaking record.

#### **C.1      Hexavalent Chromium-Bearing Wastewater**

Hexavalent chromium-bearing wastewater exhibits high concentrations of hexavalent chromium and may contain other metals, and generally has a low pH of approximately 2. Sections C.1.1 and C.1.2 present chromium data for process water and associated rinse water and for the influent to the chromium reduction process, respectively.

### C.1.1 Process Water and Rinse Water

Hexavalent chromium is present in process bath wastewater from various unit operations (e.g., chromic acid anodizing, chromate conversion coating, and chromium electroplating). Table C-1 presents the number of samples collected and analyzed during EPA's sampling program for unit operations and associated rinses that generate hexavalent chromium-bearing wastewater.

**Table C-1**

#### Number of Process and Rinse Water Samples for Unit Operations That Generate Hexavalent Chromium-Bearing Wastewater

Unit Operation	No. of Process Water Samples	No. of Rinse Water Samples
Acid Treatment with Chromium	1	3
Anodizing with Chromium	2	7
Chromate Conversion Coating (Or Chromating)	16	23
Electroplating with Chromium	4	10
Wet Air Pollution Control	6	NA

Source: MP&M Sampling Program.

NA - Not applicable. No associated rinse.

The mean total and hexavalent chromium concentrations in process bath water from these operations are 24,120 milligrams per liter (mg/L) and 10.0 mg/L, respectively. In the associated rinses, the mean concentrations for total and hexavalent chromium are 156 mg/L and 10.3 mg/L, respectively. Table C-2 summarizes total and hexavalent chromium concentration data for the process bath water and rinse water samples with detected concentrations for the unit operations listed in Table C-1.

**Table C-2**

#### Chromium Concentration Data for Process Water and Rinse Water

Source	Chromium Form	No. of Samples Analyzed	No. of Detects	Concentration (mg/L)			
				Minimum	Maximum	Mean	Median
Process Water	Total	29	29	0.045	139,000	24,120	2,990
	Hexavalent	2	1	10.0	10.0	10.0	10.0
Rinse Water	Total	43	43	0.22	1,762	156	12.8
	Hexavalent	6	6	2.1	21.2	10.3	8.0

Source: MP&M Sampling Program.

### C.1.2 Influent to Chromium Reduction Process

Facilities performing proposed MP&M operations usually segregate hexavalent chromium-bearing wastewater and treat it in a chromium reduction unit before commingling it with other process wastewater for further treatment. This segregated wastewater requires preliminary treatment to reduce hexavalent chromium to trivalent chromium because the chemical precipitation systems typically used to treat the commingled wastewater do not effectively treat hexavalent chromium. Typical chrome treatment involves chromium reduction using sulfur dioxide, sodium bisulfite, sodium metabisulfite, peroxide, or ferrous sulfate (see Section 8.4.1). Table C-3 presents the total and hexavalent chromium concentration data for samples of the influent to the chromium reduction process collected during EPA's sampling program. The treatment influent typically represents several commingled wastestreams, most of which are rinses. The influent-to-treatment concentrations are typically lower than the concentrations of process and rinse water due to the number of high-flow, low-concentration rinses that are commingled prior to treatment.

**Table C-3**

#### **Chromium Concentration Data for the Influent to the Chromium Reduction Process**

Form of Chromium	No. of Samples Analyzed	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Total Chromium	54	54	0.2	432	54.8	18.2
Hexavalent Chromium	21	18	0.027	20	6.7	4.0

Source: MP&M Sampling Program.

### C.2 Cyanide-Bearing Wastewater

Cyanide-bearing wastewater exhibits high concentrations of cyanide and metals such as copper, cadmium, and zinc, and generally has a high pH of approximately 12. Electroplating baths usually are the source of the high concentrations of cyanide. Cyanide may be analyzed as total cyanide (i.e., all forms included), amenable cyanide (i.e., cyanide present in forms amenable to treatment using alkaline chlorination), or weak-acid-dissociable cyanide (i.e., cyanide that dissociates in a weak acid). Sections C.2.1 and C.2.2 present cyanide concentration data for cyanide-bearing wastewater generated in proposed MP&M operations and in the influent to the cyanide treatment processes, respectively.

### C.2.1 Process Water and Rinse Water

Table C-4 presents the number of process and rinse water samples collected and analyzed during EPA's sampling program for proposed MP&M operations that generate cyanide-bearing wastewater.

**Table C-4**

#### **Number of Process and Rinse Water Samples for Unit Operations That Generate Cyanide-Bearing Wastewater**

Unit Operation	No. of Process Water Samples	No. of Rinse Water Samples
Alkaline Treatment with Cyanide	2	4
Electroplating with Cyanide	11 <sup>a</sup>	13
Wet Air Pollution Control	3	NA

Source: MP&M Surveys and MP&M Site Visits.

<sup>a</sup>Does not include one sample from a gold-cyanide electroplating bath that was analyzed only for metals.

NA - Not applicable. No associated rinse.

Cyanide is used as a complexing agent in electroplating and cleaning baths and is present in wastewater generated in the wet air pollution control systems. Table C-5 summarizes the total and amenable cyanide concentration data for the process water and rinse water samples with detected concentrations for the unit operations listed in Table C-4.

**Table C-5**

#### **Cyanide Concentration Data for Process Water and Rinse Water**

Source	Cyanide Form	No. of Samples Analyzed	No. of Detects	Concentration (mg/L)			
				Minimum	Maximum	Mean	Median
Process Water	Total	15	15	2.6	100,000	16,521	5,200
	Amenable	1	0	NA	NA	NA	NA
Rinse Water	Total	17	17	0.054	135	38	12.7
	Amenable	3	3	61.5	135	100	104

Source: MP&M Sampling Program.

NA - Not applicable. No samples were analyzed for amenable cyanide.

### C.2.1 Influent to Cyanide Treatment Process

Facilities performing proposed MP&M operations usually segregate cyanide-bearing wastewater generated and treat it in a cyanide reduction process before commingling it with other process wastewater for further treatment. This preliminary treatment prevents cyanide complexes from forming in the commingled wastewater. Typical cyanide treatment methods include alkaline chlorination with sodium hypochlorite or chlorine gas or ozone oxidation (see Section 8.4.3). These complexes decrease the effectiveness of chemical precipitation, the technology typically used to treat the commingled wastewater. Table C-6 summarizes the cyanide concentration data for the influent to cyanide treatment process. The treatment influent typically represents several commingled wastestreams, most of which are rinses. The influent-to-treatment concentrations are typically lower than the concentrations of process and rinse water due to the number of high-flow, low-concentration rinses that are commingled prior to treatment.

**Table C-6**

#### **Cyanide Concentration Data for Influent to the Cyanide Treatment Process**

Form of Cyanide	No. of Samples Analyzed	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Total Cyanide	101	98	0.024	1,110	50.7	6.1
Amenable Cyanide	70	65	0.01	394	34.4	3.15

Source: MP&M Sampling Program.

### C.3 Oil-Bearing and Organic Pollutant-Bearing Wastewaters

Oil-bearing wastewater exhibits high concentrations of oil and concentrations of organic pollutants. Oil-bearing wastewater is classified as containing either free (floating) oils or oil/water emulsions. As previously discussed above, “oily operations” are defined and regulated in the final rule and described in Section 4.0. The wastewater from oily operations is characterized in Section 5.0. In addition, EPA collected data on two proposed MP&M operations (Bilge Water and Dry Dock) that also generate oil-bearing and organic pollutant-bearing wastewaters. EPA is not regulating these two operations as EPA excluded the proposed Shipbuilding Dry Dock Subcategory from the final rule (see Section 9.0). Sampling episode reports for the proposed Shipbuilding Dry Dock Subcategory are located in Sections 5.2 and 15.2 of the rulemaking record.

### C.4 Chelated Metal-Bearing Wastewater

Chelated metal-bearing wastewater exhibits high concentrations of metals, usually copper or nickel. Section C.4.1 discusses the various unit processes that generate chelated metal-

bearing wastewater and presents process water and rinse water pollutant concentration data for those processes collected during EPA's sampling program. Section C.4.2 discusses the pollutant concentration data for the influent to chelation-breaking preliminary treatment systems.

#### **C.4.1 Process Water and Rinse Water**

Facilities performing proposed MP&M operations use chelating agents in unit operations to prevent metals from being precipitated in the process bath. Electroless plating processes and associated rinses are the most common proposed MP&M operations that generate chelated metal-bearing wastewater. Some cleaning operations also generate chelated metal-bearing wastewater.

To characterize process waters and associated rinse waters for proposed MP&M operations that use chelating agents, EPA collected 37 samples of electroless plating solutions and rinses from electroless nickel plating, or from electroless copper. The maximum concentration of nickel in the process water and the rinses was 7,530 mg/L and 378 mg/L, respectively. The maximum concentration of copper in the process water and the rinses was 14,200 mg/L and 138 mg/L, respectively. Only one sample of tin was taken from process water, which had a concentration of 3.8 mg/L. Other metals typically plated using electroless plating include gold, palladium, and cobalt.

#### **C.4.2 Influent to Chelate-Breaking Preliminary Treatment System**

Typical chemical precipitation and sedimentation treatment processes do not remove chelated metals; therefore, facilities performing proposed MP&M operations usually segregate and pretreat chelated metal-bearing wastewater to break down the metal chelates before commingling it with other metal-bearing wastewaters. Preliminary treatment may consist of chemical reduction using reducing agents such as sodium borohydride, hydrazine, dithiocarbamate (measured analytically as ziram) or sodium hydrosulfite; high pH precipitation using calcium hydroxide or ferrous sulfate; or filtering the chelated metals out of solution (see Section 8.4.4).

EPA measured copper in concentrations ranging from 570 to 700 mg/L in the influent to the preliminary treatment systems for electroless copper processes. EPA measured nickel in concentrations ranging from 0.149 to 480 mg/L in the influent to the preliminary treatment systems for electroless nickel processes. Copper and nickel electroless plating are the most prevalent electroless plating operations seen at facilities performing proposed MP&M operations.

#### **C.5 Metal-Bearing Wastewater**

All of the wastewaters generated in proposed MP&M operations can contain metals, including the wastewaters described in the previous subsections. Section C.5.1 discusses proposed MP&M operations not presented in the previous subsections that generate metal-bearing wastewater and presents pollutant concentration data for the process water and rinse water for those operations.

Section C.5.2 presents pollutant concentration data for the influent to chemical precipitation systems used to treat metal-bearing wastewater.

### **C.5.1 Process Water and Rinse Water**

Table C-7 lists the proposed MP&M operations that generate metal-bearing wastewater and presents the number of samples of process water and rinse water collected and analyzed in EPA's sampling program for each unit operation.

Facilities performing proposed MP&M operations typically use metals in the process baths for unit operations such as electroplating and stripping. Tables C-8 and C-9 summarize the pollutant concentration data for process water and rinse water, respectively, collected during the MP&M sampling program for unit operations generating metal-bearing wastewater. As shown in the tables, the metal priority pollutants most frequently detected in samples of process water were copper, zinc, chromium, nickel, and lead. Nonconventional metal pollutants frequently detected include iron, magnesium, boron, barium, manganese, and aluminum. The process water and rinses also typically contained oil and grease, total suspended solids, and low concentrations of organic pollutants.

### **C.5.2 Influent to the Chemical Precipitation Treatment Systems**

Typically, facilities performing proposed MP&M operations segregate their wastewaters by type and treat them in preliminary treatment systems. After preliminary treatment, facilities performing proposed MP&M operations usually commingle the wastewater with other process wastewater and treat the commingled wastewater in an end-of-pipe treatment system. Generally, the end-of-pipe treatment consists of chemical precipitation and sedimentation (see Section 8.5.1). When high concentrations of metals are present in the wastewater, sites may use preliminary batch chemical precipitation and sedimentation to ensure that the high concentrations do not cause an upset in the end-of-pipe treatment system. Facilities performing proposed MP&M operations may also contract haul concentrated baths to centralized waste treatment facilities. Table C-10 summarizes the pollutant concentration data obtained from sampling the influent to end-of-pipe chemical precipitation with sedimentation and chemical precipitation with membrane filtration systems for metal-bearing wastewater.

**Table C-7**

**Number of Process Water and Rinse Water Samples Collected and Analyzed for Unit Operations That Generate Metal-Bearing Wastewater**

<b>Unit Operation</b>	<b>No. of Process Water Samples<sup>a</sup></b>	<b>No. of Rinse Water Samples<sup>a</sup></b>
Abrasive Jet Machining	3	3
Acid Treatment without Chromium	27	65
Anodizing without Chromium	4	3
Carbon Black Deposition	2	3
Chemical Milling	4	9
Chemical Conversion Coating without Chromium	24	59
Electrochemical Machining	1	2
Electroless Plating	9	28
Electrolytic Cleaning	9	17
Electroplating without Chromium or Cyanide	24	48
Electropolishing	1	1
Painting-immersion (Including Electrophoretic, "E-coat")	1	6
Photo Image Developing	5	11
Photoresist Applications	0	0
Plasma Arc Machining	1	0
Salt Bath Descaling	0	4
Solder Flux Cleaning	1	4
Solder Fusing	0	3
Stripping (paint)	6	4
Stripping (metallic coating)	9	12

Source: MP&M Sampling Program.

<sup>a</sup>Unit operations for which no samples were collected are rarely performed or were not observed at facilities performing proposed MP&M operations.



**Table C-8**

**Process Water Pollutant Concentration Data for Unit Operations That  
Generate Metal-Bearing Wastewater**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Organic Priority Pollutants						
1,1-Dichloroethane	41	0	NA	NA	NA	NA
1,1-Dichloroethene	41	0	NA	NA	NA	NA
1,1,1-Trichloroethane	41	0	NA	NA	NA	NA
2-Nitrophenol	40	1	2.15	2.15	2.15	2.15
2,4-Dinitrophenol	36	1	335	335	335	335
2,4-Dimethylphenol	40	1	0.167	0.167	0.167	0.167
2,6-Dinitrotoluene	41	2	0.605	6.98	3.79	3.79
4-Chloro-3-Methylphenol	39	0	NA	NA	NA	NA
4-Nitrophenol	39	1	14.1	14.1	14.1	14.1
Acenaphthene	41	0	NA	NA	NA	NA
Acrolein	40	1	0.591	0.591	0.591	0.591
Anthracene	41	0	NA	NA	NA	NA
Bis(2-ethylhexyl) Phthalate	41	12	0.012	18.2	3.10	0.291
Butyl Benzyl Phthalate	41	0	NA	NA	NA	NA
Chlorobenzene	41	4	0.011	1.56	0.414	0.041
Chloroethane	41	0	NA	NA	NA	NA
Chloroform	41	3	0.012	0.218	0.080	0.012
Di-n-octyl Phthalate	41	2	0.639	1.42	1.03	1.03
Di-n-butyl Phthalate	41	0	NA	NA	NA	NA
Dimethyl Phthalate	41	0	NA	NA	NA	NA
Ethylbenzene	41	2	0.020	2.91	1.46	1.46
Fluoranthene	41	0	NA	NA	NA	NA
Fluorene	41	0	NA	NA	NA	NA
Isophorone	41	0	NA	NA	NA	NA
Methylene Chloride	41	3	0.011	0.173	0.080	0.056
N-Nitrosodimethylamine	41	1	6.67	6.67	6.67	6.67

**Table C-8 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Organic Priority Pollutants (continued)						
Naphthalene	41	2	0.024	0.208	0.116	0.116
Phenanthrene	41	0	NA	NA	NA	NA
Phenol	41	5	0.024	1,044	216	2.00
Pyrene	41	0	NA	NA	NA	NA
Tetrachloroethene	41	0	NA	NA	NA	NA
Toluene	41	2	0.014	0.032	0.023	0.023
Trichloroethene	41	6	0.010	0.058	0.026	0.023
Metal Priority Pollutants						
Antimony	129	50	0.002	3.56	0.359	0.090
Arsenic	129	62	0.001	16.4	0.655	0.080
Beryllium	129	39	0.001	3.87	0.270	0.030
Cadmium	132	74	0.002	57,100	791	0.203
Chromium	132	115	0.007	108,000	1,952	1.87
Copper	132	124	0.009	141,000	2,885	7.24
Lead	132	83	0.002	4,880	120	2.62
Mercury	129	25	0.0003	0.032	0.003	0.0009
Nickel	131	109	0.007	84,623	3,091	5.89
Selenium	129	30	0.001	8.00	0.659	0.051
Silver	132	57	0.001	14.4	0.503	0.075
Thallium	129	18	0.001	3.48	0.411	0.019
Zinc	131	118	0.005	53,200	2,750	15.7
Conventional Pollutants						
BOD 5-Day (Carbonaceous)	33	22	4.29	18,600	4,537	1,600
Oil and Grease (as HEM)	53	27	1.08	2,400	271	68.9
Total Suspended Solids	127	119	5.00	110,000	2,338	154
Nonconventional Organic Pollutants						
1-Bromo-2-Chlorobenzene	41	4	0.012	0.978	0.382	0.268
1-Bromo-3-Chlorobenzene	41	4	0.031	0.490	0.193	0.126
1-Methylfluorene	41	0	NA	NA	NA	NA
1-Methylphenanthrene	41	0	NA	NA	NA	NA

**Table C-8 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Nonconventional Organic Pollutants (continued)						
2-Butanone	40	12	0.070	26.1	4.61	1.43
2-Hexanone	41	1	5.02	5.02	5.02	5.02
2-Isopropyl-naphthalene	41	0	NA	NA	NA	NA
2-Methylnaphthalene	41	1	0.220	0.220	0.220	0.220
2-Propanone	41	27	0.052	250	11.3	0.485
3,6-Dimethylphenanthrene	41	0	NA	NA	NA	NA
4-Methyl-2-Pentanone	41	5	0.052	159	32.0	0.187
Acetophenone	41	0	NA	NA	NA	NA
Alpha-terpineol	41	0	NA	NA	NA	NA
Aniline	41	4	0.015	0.335	0.145	0.115
Benzoic Acid	41	8	0.051	8,098	1,037	27.2
Benzyl Alcohol	41	4	0.012	0.278	0.103	0.061
Biphenyl	41	0	NA	NA	NA	NA
Carbon Disulfide	41	1	0.053	0.053	0.053	0.053
Dibenzofuran	41	1	0.140	0.140	0.140	0.140
Dibenzothiophene	41	0	NA	NA	NA	NA
Diphenyl Ether	41	0	NA	NA	NA	NA
Diphenylamine	41	0	NA	NA	NA	NA
Hexanoic Acid	41	5	0.012	31.5	9.12	0.763
Isobutyl Alcohol	41	0	NA	NA	NA	NA
m-Xylene	14	2	0.020	5.06	2.54	2.54
m+p Xylene	27	0	NA	NA	NA	NA
Methyl Methacrylate	41	4	0.181	0.797	0.586	0.682
n-Decane	41	1	3.51	3.51	3.51	3.51
n-Docosane	41	1	0.142	0.142	0.142	0.142
n-Dodecane	41	1	1.27	1.27	1.27	1.27
n-Eicosane	41	1	0.030	0.030	0.030	0.030
n-Hexacosane	41	1	0.106	0.106	0.106	0.106
n-Hexadecane	41	0	NA	NA	NA	NA
n-Nitrosopiperidine	41	0	NA	NA	NA	NA

**Table C-8 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Nonconventional Organic Pollutants (continued)						
n-Octadecane	41	0	NA	NA	NA	NA
n-Tetracosane	41	1	0.097	0.097	0.097	0.097
n-Tetradecane	41	0	NA	NA	NA	NA
n-Triacontane	41	1	0.082	0.082	0.082	0.082
n,n-Dimethylformamide	41	3	0.032	0.123	0.064	0.036
o-cresol	41	2	0.023	0.195	0.109	0.109
o-xylene	27	0	NA	NA	NA	NA
o+p Xylene	14	2	0.910	2.01	1.46	1.46
p-Cymene	41	0	NA	NA	NA	NA
p-Cresol	41	3	0.011	0.513	0.192	0.054
Pyridine	41	0	NA	NA	NA	NA
Styrene	41	0	NA	NA	NA	NA
Trichlorofluoromethane	41	0	NA	NA	NA	NA
Tripropyleneglycol Methyl Ether	41	2	0.245	1.45	0.848	0.848
Nonconventional Metal Pollutants						
Aluminum	131	107	0.042	34,900	1,112	3.39
Barium	129	102	0.001	259	4.24	0.096
Boron	130	106	0.022	17,800	659	1.32
Calcium	129	125	0.054	2,250	130	23.4
Cobalt	129	81	0.003	4,700	73.5	0.660
Gold	1	1	0.392	0.392	0.392	0.392
Iron	131	122	0.011	374,000	7,051	13.4
Magnesium	129	106	0.085	960	73.8	15.2
Manganese	132	110	0.001	4,790	106	0.767
Molybdenum	130	87	0.001	197	5.40	0.237
Sodium	129	125	1.25	383,000	17,905	1,164
Tin	132	82	0.004	22,670	930	0.984
Titanium	129	84	0.002	13,250	180	0.303
Vanadium	129	68	0.001	1,495	23.5	0.066

**Table C-8 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Other Nonconventional Pollutants						
Ammonia as Nitrogen	66	53	0.060	44,800	2,922	10.0
Chemical Oxygen Demand (COD)	60	56	83.0	600,000	32,426	7,400
Chloride	69	53	1.00	328,300	20,901	240
Cyanide	10	7	0.027	0.510	0.153	0.120
Fluoride	69	58	0.140	55,500	1,034	5.10
Hexavalent Chromium	36	5	0.008	0.430	0.104	0.025
Sulfate	105	89	1.56	755,000	36,919	808
Total Dissolved Solids	125	123	87.0	1,000,000	135,033	64,100
Total Kjeldahl Nitrogen	49	42	0.480	40,000	2,584	42.0
Total Organic Carbon (TOC)	49	48	4.71	54,000	7,492	1,245
Total Petroleum Hydrocarbons (as SGT-HEM)	51	9	6.00	352	88.2	14.1
Total Phosphorus	30	21	0.020	11,000	945	11.0
Total Recoverable Phenolics	52	35	0.006	135	7.78	0.330
Total Sulfide	17	0	NA	NA	NA	NA

Source: MP&amp;M Sampling Program.

<sup>a</sup>Due to budgetary constraints, EPA did not analyze all samples for all pollutants.

NA - Not applicable.

**Table C-9**

**Rinse Water Pollutant Concentration Data for Unit Operations That  
Generate Metal-Bearing Wastewater**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Organic Priority Pollutants						
1,1-Dichloroethane	91	0	NA	NA	NA	NA
1,1-Dichloroethene	91	0	NA	NA	NA	NA
1,1,1-Trichloroethane	91	0	NA	NA	NA	NA
2-Nitrophenol	89	0	NA	NA	NA	NA
2,4-Dimethylphenol	91	0	NA	NA	NA	NA
2,4-Dinitrophenol	85	0	NA	NA	NA	NA
2,6-Dinitrotoluene	91	0	NA	NA	NA	NA
4-Chloro-3-Methylphenol	91	0	NA	NA	NA	NA
4-Nitrophenol	88	0	NA	NA	NA	NA
Acenaphthene	91	0	NA	NA	NA	NA
Acrolein	87	0	NA	NA	NA	NA
Anthracene	91	0	NA	NA	NA	NA
Bis(2-ethylhexyl) Phthalate	91	10	0.011	0.281	0.064	0.019
Butyl Benzyl Phthalate	91	0	NA	NA	NA	NA
Chlorobenzene	91	0	NA	NA	NA	NA
Chloroethane	91	0	NA	NA	NA	NA
Chloroform	91	49	0.010	0.063	0.025	0.022
Di-n-octyl Phthalate	91	1	0.013	0.013	0.013	0.088
Di-n-butyl Phthalate	91	6	0.014	0.190	0.098	0.013
Dimethyl Phthalate	91	1	0.021	0.021	0.021	0.021
Ethylbenzene	91	2	0.021	0.028	0.024	0.024
Fluoranthene	91	0	NA	NA	NA	NA
Fluorene	91	0	NA	NA	NA	NA
Isophorone	91	0	NA	NA	NA	NA
Methylene Chloride	91	1	0.011	0.011	0.011	0.011
n-Nitrosodiphenylamine	91	0	NA	NA	NA	NA
n-Nitrosodimethylamine	91	0	NA	NA	NA	NA

**Table C-9 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Organic Priority Pollutants (continued)						
Phenanthrene	91	0	NA	NA	NA	NA
Phenol	90	5	0.011	2.00	0.417	0.024
Pyrene	91	0	NA	NA	NA	NA
Tetrachloroethene	91	0	NA	NA	NA	NA
Toluene	91	0	NA	NA	NA	NA
Trichloroethene	91	3	0.010	0.018	0.015	0.015
Metal Priority Pollutants						
Antimony	261	42	0.002	0.158	0.026	0.011
Arsenic	261	63	0.001	0.308	0.018	0.006
Beryllium	261	13	0.001	0.059	0.010	0.001
Cadmium	265	62	0.002	6.93	0.310	0.011
Chromium	265	155	0.002	21.6	0.761	0.052
Copper	265	235	0.003	507	14.0	0.154
Lead	265	90	0.002	81.0	3.52	0.066
Mercury	261	25	0.0002	0.004	0.001	0.0004
Nickel	263	172	0.002	437	20.0	0.115
Selenium	261	39	0.001	0.412	0.019	0.003
Silver	265	55	0.001	0.962	0.047	0.010
Thallium	261	19	0.001	0.039	0.006	0.001
Zinc	265	187	0.002	13,700	168	0.019
Conventional Pollutants						
BOD 5-Day (Carbonaceous)	86	39	1.07	11,400	505	40.0
Oil and Grease (as HEM)	130	34	1.12	114	17.2	10.4
Total Suspended Solids	260	174	2.00	6,920	132	20.0
Nonconventional Organic Pollutants						
1-Bromo-2-Chlorobenzene	91	0	NA	NA	NA	NA
1-Bromo-3-Chlorobenzene	91	0	NA	NA	NA	NA
1-Methylfluorene	91	0	NA	NA	NA	NA
1-Methylphenanthrene	91	0	NA	NA	NA	NA
1,4-Dioxane	91	1	0.196	0.196	0.196	0.196

**Table C-9 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Nonconventional Organic Pollutants (continued)						
2-Hexanone	91	0	NA	NA	NA	NA
2-Isopropyl-naphthalene	91	0	NA	NA	NA	NA
2-Methylnaphthalene	91	0	NA	NA	NA	NA
2-Propanone	91	13	0.052	11.5	1.51	0.097
3,6-Dimethylphenanthrene	91	0	NA	NA	NA	NA
4-Methyl-2-Pentanone	91	2	0.190	17.4	8.80	8.80
Acetophenone	91	0	NA	NA	NA	NA
Alpha-Terpineol	91	0	NA	NA	NA	NA
Aniline	91	0	NA	NA	NA	NA
Benzoic Acid	91	6	0.108	4.31	1.21	0.659
Benzyl Alcohol	91	2	0.014	0.014	0.014	0.014
Biphenyl	91	0	NA	NA	NA	NA
Carbon Disulfide	91	0	NA	NA	NA	NA
Dibenzofuran	91	0	NA	NA	NA	NA
Dibenzothiophene	91	0	NA	NA	NA	NA
Diphenyl Ether	91	1	0.013	0.013	0.013	0.013
Diphenylamine	91	0	NA	NA	NA	NA
Hexanoic Acid	91	1	0.015	0.015	0.015	0.015
Isobutyl Alcohol	91	0	NA	NA	NA	NA
m-Xylene	20	2	0.036	0.076	0.056	0.056
m+p Xylene	71	0	NA	NA	NA	NA
Methyl Methacrylate	91	0	NA	NA	NA	NA
n-Decane	91	0	NA	NA	NA	NA
n-Docosane	91	1	0.012	0.012	0.012	0.012
n-Dodecane	91	0	NA	NA	NA	NA
n-Eicosane	91	0	NA	NA	NA	NA
n-Hexacosane	91	2	0.037	0.434	0.236	0.236
n-Hexadecane	91	1	0.057	0.057	0.057	0.057
n-Nitrosopiperidine	91	0	NA	NA	NA	NA
n-Octacosane	91	1	0.041	0.041	0.041	0.041



**Table C-9 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Nonconventional Organic Pollutants (continued)						
n-Tetracosane	91	1	0.018	0.018	0.018	0.018
n-Tetradecane	91	1	0.221	0.221	0.221	0.221
n-Triacontane	91	2	0.030	0.477	0.253	0.253
n,n-dimethylformamide	91	2	0.026	0.115	0.071	0.071
o-Cresol	91	0	NA	NA	NA	NA
o-Xylene	71	0	NA	NA	NA	NA
o+p Xylene	20	2	0.042	0.113	0.077	0.077
p-Cymene	91	0	NA	NA	NA	NA
p-Cresol	91	0	NA	NA	NA	NA
Pyridine	91	0	NA	NA	NA	NA
Styrene	91	0	NA	NA	NA	NA
Trichlorofluoromethane	91	0	NA	NA	NA	NA
Tripropyleneglycol Methyl Ether	91	1	8.48	8.48	8.48	8.48
Nonconventional Metal Pollutants						
Aluminum	263	161	0.022	76.9	1.61	0.192
Barium	261	207	0.001	2.90	0.064	0.028
Boron	263	179	0.016	363	4.38	0.180
Calcium	261	255	0.033	361	30.7	23.0
Cobalt	261	58	0.001	12.4	0.945	0.014
Gold	2	1	6.88	6.88	6.88	6.88
Iron	263	196	0.003	2,810	58.8	0.334
Magnesium	261	240	0.067	130	9.22	7.56
Manganese	265	171	0.001	68.3	1.52	0.024
Molybdenum	263	80	0.002	13.4	0.341	0.017
Sodium	261	257	0.277	55,800	710	60.0
Tin	265	105	0.002	828	11.6	0.052
Titanium	261	80	0.001	18.1	0.762	0.015
Vanadium	261	35	0.001	1.10	0.108	0.010

**Table C-9 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Other Nonconventional Pollutants						
Amenable Cyanide	3	3	0.340	1.97	1.05	0.830
Ammonia as Nitrogen	114	68	0.050	1,190	91.2	1.58
Chemical Oxygen Demand (COD)	107	84	5.20	20,400	614	44.0
Chloride	77	76	1.20	5,000	219	26.0
Cyanide	12	9	0.028	87.0	10.7	0.830
Fluoride	77	68	0.110	60.0	3.65	0.990
Hexavalent Chromium	90	17	0.011	0.063	0.023	0.019
Sulfate	163	158	1.64	7,120	306	54.0
Total Dissolved Solids	258	258	10.0	132,000	2,469	550
Total Kjeldahl Nitrogen	79	44	0.100	395	28.0	8.69
Total Organic Carbon (TOC)	129	114	1.16	6,110	230	12.0
Total Petroleum Hydrocarbons (as SGT-HEM)	129	7	5.25	13.0	7.86	7.75
Total Phosphorus	28	21	0.026	290	30.9	1.40
Total Recoverable Phenolics	100	42	0.005	2.85	0.192	0.013
Total Sulfide	45	0	NA	NA	NA	NA

Source: MP&amp;M Sampling Data.

<sup>a</sup>Due to budgetary constraints, EPA did not analyze all samples for all pollutants.

NA - Not applicable.

**Table C-10**

**Pollutant Concentration Data for the Influent  
to Chemical Precipitation Systems**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Organic Priority Pollutants						
1,1-Dichloroethane	171	0	NA	NA	NA	NA
1,1-Dichloroethylene	171	2	0.011	0.748	0.379	0.379
1,1,1-Trichloroethane	171	6	0.019	0.084	0.053	0.053
2,4-Dimethylphenol	162	0	NA	NA	NA	NA
2,4-Dinitrophenol	167	2	0.111	1.66	0.885	0.885
2,6-Dinitrotoluene	178	0	NA	NA	NA	NA
2-Nitrophenol	177	0	NA	NA	NA	NA
4-Chloro-m-Cresol	176	9	0.011	1.14	0.183	0.076
4-Nitrophenol	172	0	NA	NA	NA	NA
Acenaphthene	178	0	NA	NA	NA	NA
Acrolein	141	0	NA	NA	NA	NA
Anthracene	178	1	0.104	0.104	0.104	0.104
Benzyl Butyl Phthalate	178	2	0.009	0.010	0.009	0.009
Bis(2-ethylhexyl) Phthalate	178	43	0.008	0.298	0.052	0.030
Chlorobenzene	171	0	NA	NA	NA	NA
Chloroethane	171	0	NA	NA	NA	NA
Chloroform	171	68	0.010	0.824	0.097	0.031
Di-n-butyl Phthalate	178	6	0.007	0.066	0.030	0.018
Di-n-octyl Phthalate	178	1	0.012	0.012	0.012	0.012
Dimethyl Phthalate	175	1	0.0004	0.0004	0.0004	0.0004
Ethylbenzene	171	5	0.006	0.335	0.074	0.010
Fluoranthene	178	0	NA	NA	NA	NA
Fluorene	178	1	0.045	0.045	0.045	0.045
Isophorone	175	0	NA	NA	NA	NA
Methylene Chloride	171	10	0.008	0.172	0.043	0.023
n-Nitrosodimethylamine	175	2	0.065	0.070	0.067	0.067

**Table C-10 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Organic Priority Pollutants (continued)						
Naphthalene	178	3	0.012	0.054	0.035	0.038
Phenanthrene	178	3	0.041	0.112	0.071	0.060
Phenol	179	34	0.010	0.634	0.070	0.030
Pyrene	178	0	NA	NA	NA	NA
Tetrachloroethene	171	8	0.015	1.11	0.306	0.081
Toluene	171	6	0.009	2.77	0.534	0.019
Trichloroethylene	171	3	0.019	0.023	0.021	0.021
Metal Priority Pollutants						
Antimony	261	86	0.002	1.13	0.058	0.018
Arsenic	268	109	0.001	0.530	0.025	0.009
Beryllium	268	64	0.0002	3.23	0.228	0.004
Cadmium	457	170	0.0003	323	4.25	0.039
Chromium	469	444	0.001	1,350	9.92	0.676
Copper	472	467	0.010	665	13.9	0.480
Lead	465	376	0.002	159	3.44	0.416
Mercury	266	52	0.00003	0.012	0.001	0.0003
Nickel	467	457	0.012	2,101	18.3	1.47
Selenium	265	42	0.001	0.090	0.018	0.006
Silver	460	222	0.001	4.94	0.406	0.036
Thallium	265	26	0.001	0.112	0.011	0.002
Zinc	472	459	0.009	636	33.6	3.65
Conventional Pollutants						
BOD 5-Day (Carbonaceous)	133	86	2.40	609	64.4	26.0
Oil and Grease (as HEM)	236	159	0.570	32,000	428	12.1
Total Suspended Solids	334	314	4.00	11,400	803	120
Nonconventional Organic Pollutants						
1,4-Dioxane	166	6	0.033	2.41	0.788	0.584
1-Bromo-2-Chlorobenzene	169	2	0.011	0.012	0.012	0.012
1-Bromo-3-Chlorobenzene	169	5	0.026	0.067	0.045	0.038
1-Methylfluorene	169	2	0.111	0.189	0.150	0.150

**Table C-10 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Nonconventional Organic Pollutants (continued)						
2-Butanone	166	13	0.056	2.45	0.668	0.151
2-Hexanone	166	0	NA	NA	NA	NA
2-Isopropyl-naphthalene	169	0	NA	NA	NA	NA
2-Methylnaphthalene	173	2	0.076	0.205	0.140	0.140
2-Propanone	166	87	0.051	16.7	0.822	0.137
3,6-Dimethylphenanthrene	169	2	0.019	0.062	0.041	0.041
4-Methyl-2-Pentanone	166	10	0.120	1.36	0.308	0.181
Acetophenone	169	2	0.010	0.011	0.011	0.011
Alpha-terpineol	162	5	0.013	0.087	0.051	0.054
Aniline	173	6	0.013	0.052	0.023	0.017
Benzoic Acid	173	69	0.011	34.8	3.27	0.229
Benzyl Alcohol	173	9	0.005	0.080	0.028	0.013
Biphenyl	169	1	0.011	0.011	0.011	0.011
Carbon Disulfide	166	10	0.016	3.92	0.505	0.058
Dibenzofuran	173	0	NA	NA	NA	NA
Dibenzothiophene	169	2	0.015	0.025	0.020	0.020
Diphenyl Ether	169	0	NA	NA	NA	NA
Diphenylamine	165	1	0.033	0.033	0.033	0.033
Hexanoic Acid	169	23	0.010	0.461	0.053	0.017
Isobutyl Alcohol	166	0	NA	NA	NA	NA
m+p Xylene	96	0	NA	NA	NA	NA
m-Xylene	70	1	0.016	0.016	0.016	0.016
Methyl Methacrylate	166	3	0.019	0.039	0.030	0.032
n-Decane	166	3	0.029	0.031	0.031	0.031
n-Docosane	169	6	0.011	0.026	0.016	0.013
n-Dodecane	168	6	0.044	0.772	0.269	0.101
n-Eicosane	169	17	0.010	0.181	0.034	0.020
n-Hexacosane	169	12	0.012	0.041	0.027	0.028
n-Hexadecane	169	22	0.010	0.631	0.085	0.026
n-Nitrosopiperidine	169	0	NA	NA	NA	NA

**Table C-10 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Nonconventional Organic Pollutants (continued)						
n-Octadecane	169	25	0.011	0.493	0.072	0.024
n-Tetracosane	169	7	0.012	0.032	0.019	0.017
n-Tetradecane	169	14	0.016	1.01	0.174	0.058
n-Triacontane	169	4	0.011	0.031	0.019	0.017
n,n-Dimethylformamide	169	22	0.011	0.581	0.094	0.044
o+p Xylene	70	3	0.013	0.023	0.017	0.014
o-Cresol	169	0	NA	NA	NA	NA
o-Xylene	96	0	NA	NA	NA	NA
p-Cresol	169	10	0.013	0.030	0.019	0.017
p-Cymene	169	3	0.015	0.054	0.030	0.02
Pyridine	169	0	NA	NA	NA	NA
Styrene	173	8	0.010	0.188	0.041	0.022
Trichlorofluoromethane	171	6	0.029	0.109	0.045	0.033
Tripropyleneglycol Methyl Ether	169	23	0.064	5.21	1.83	1.05
Nonconventional Metal Pollutants						
Aluminum	268	246	0.055	132	8.68	2.38
Barium	266	241	0.003	9.91	0.251	0.058
Boron	253	232	0.057	81.3	3.53	0.787
Calcium	268	268	3.40	1,220	83.0	34.9
Cobalt	264	121	0.001	25.8	0.757	0.019
Gold	20	10	0.013	0.150	0.056	0.038
Iron	268	268	0.022	3,880	111	5.38
Magnesium	268	263	0.349	3,360	74.5	8.88
Manganese	453	452	0.001	109	4.04	0.870
Molybdenum	453	347	0.001	3.06	0.175	0.037
Sodium	268	268	17.7	9,600	460	211
Tin	442	341	0.004	1,440	14.2	0.199
Titanium	253	189	0.002	76.4	1.53	0.048
Vanadium	264	87	0.002	1.19	0.052	0.014

**Table C-10 (Continued)**

Pollutant	No. of Samples Analyzed <sup>a</sup>	No. of Detects	Concentration (mg/L)			
			Minimum	Maximum	Mean	Median
Other Nonconventional Pollutants						
Ammonia as Nitrogen	113	110	0.040	320	25.9	5.61
Chemical Oxygen Demand (COD)	203	194	1.50	13,000	532	122
Chloride	78	75	4.50	9,500	338	140
Cyanide	32	12	0.008	0.096	0.022	0.012
Fluoride	78	77	0.130	100	4.54	1.50
Hexavalent Chromium	133	50	0.010	21.0	0.771	0.060
Sulfate	177	170	18.0	6,125	469	318
Total Dissolved Solids	263	263	19.0	34,000	2,325	1,103
Total Kjeldahl Nitrogen	83	80	0.110	160	14.9	6.66
Total Organic Carbon (TOC)	175	146	3.57	400	73.5	46.9
Total Petroleum Hydrocarbons (as SGT-HEM)	143	52	5.00	93.0	20.4	10.0
Total Phosphorus	84	82	0.020	525	28.1	5.20
Total Recoverable Phenolics	188	110	0.006	13.0	0.387	0.047
Total Sulfide	95	31	0.150	28.0	5.20	1.03
Ziram	5	3	0.177	0.448	0.291	0.247

Source: MP&amp;M Sampling Program.

<sup>a</sup>Due to budgetary constraints, EPA did not analyze all samples for all pollutants.

NA - Not applicable.

## **Appendix D**

### **POLLUTION PREVENTION AND WATER CONSERVATION PRACTICES**



## Appendix D

### POLLUTION PREVENTION AND WATER CONSERVATION PRACTICES

EPA observed a number of pollution prevention and water conservation practices during site visits and sampling episodes, and MP&M surveys provided additional information on these practices (see Sections 3.0 and 8.0). Some common pollution prevention and water conservation methods for surface treatment include drag-out tanks, countercurrent cascade rinsing, manual and automatic rinse water shut-off, timed rinses, flow restrictors, conductivity meters, and in-process ion exchange and water recycle. In this appendix, EPA describes some of these common pollution prevention and water conservation methods used by facilities evaluated for the final rule (“MP&M facilities”) as a measure to assist a broader audience to achieve improved environmental performance and compliance, pollution prevention through source reduction, and continual improvement. **EPA is not promulgating or requiring any of these methods or mass-based limitations and standards in the MP&M effluent guidelines (see Section 15.0). The final limitations and standards in the MP&M effluent guidelines are concentration based and may be achieved using any method compliant with EPA regulations.**

#### **D.1            Pollution Prevention and Water Conservation Practices for Surface Treatment**

The Agency identified four categories of pollution prevention and water conservation practices and technologies that can be applied to reduce rinse-water use: drag-out reduction and/or drag-out recovery methods; improved rinse tank design and rinsing configurations; rinse-water use control devices; and, metal recovery and rinse-water reuse technologies. Surface treatment rinses include those following acid and alkaline treatment, anodizing, electroplating, electroless plating, and chemical conversion coating. Rinsing dilutes and removes the chemical film of drag-out remaining on parts and racks after processing in a chemical bath. In addition to conserving water use, some of these methods (especially those that affect drag-out and recover chemicals) also conserve raw materials, reduce pollutant loadings to wastewater treatment systems, and reduce treatment reagent requirements and sludge production. Within each of these categories are several specific practices and technologies. Table D-1 presents examples of these practices and technologies, as well as their applicability to the MP&M operations.<sup>1</sup> Table D-2 provides descriptions of these practices.

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<sup>1</sup>EPA evaluated a number of unit operations for the May 1995 proposal, January 2001 proposal, and June 2002 NODA (see Tables 4-3 and 4-4). However, EPA selected a subset of these unit operations for regulation in the final rule (see Section 1.0). For this Section, the term “proposed MP&M operations” means those operations evaluated for the two proposals, NODA, and final rule. The term “final MP&M operations” means those operations defined as “oily operations” (see Section 1.0, 40 CFR 438.2(f), and Appendix B to Part 438) and regulated by the final rule.

Table D-1

## Potential Water Conservation Methods for Surface Treatment Rinses

Practice	Alkaline Clean	Acid Clean	Hexavalent Chromium	Trivalent Chromium	Cadmium Zinc Cyanide	Cadmium Zinc Non-Cyanide	Acid Copper	Copper Cyanide	Watts, Woods, Other Nickels	Electro-less Nickel	Silver Cyanide	Gold Cyanide	Lead, Lead-Tin	Tin	Chrom-ate	Phos-phate	Chromic-AcidAnodize	Sulfuric Anodize
<b>Drag-out Reduction and Recovery</b>																		
Fog or spray rinsing over tank (110° F or higher)	✓	✓	✓	✓				✓	✓	✓				✓ <sup>a</sup>		✓	✓	
Controlled slow withdrawal	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Addition of wetting agent (when compatible)			✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Positioning work piece	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Long drip time	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
Drip shield	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Air knife	✓	✓	✓	✓	✓	✓					✓	✓			✓	✓		✓
Drag-out tank (heated)	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Drag-in/out tank	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
Lowest concentration	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Highest temperature	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<b>Rinse Tank Design and Innovative Configuration</b>																		
Countercurrent rinse	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Cascading rinse (cleaning)	✓	✓																
Spray rinse	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Good tank design <sup>b</sup>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
<b>Rinse Water Use Control</b>																		
Flow restrictors	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Timer controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Conductivity controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

**Table D-1 (Continued)**

Practice	Alkaline Clean	Acid Clean	Hexavalent Chromium	Trivalent Chromium	Cadmium Zinc Cyanide	Cadmium Zinc Non-Cyanide	Acid Copper	Copper Cyanide	Watts, Woods, Other Nickels	Electro-less Nickel	Silver Cyanide	Gold Cyanide	Lead, Lead-Tin	Tin	Chrom-ate	Phos-phate	Chromic-AcidAnodize	Sulfuric Anodize
<b>Metal Recovery and Rinse Water Reuse Technologies</b>																		
Evaporator <sup>c</sup>	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	
Ion exchange <sup>c</sup>					✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				
Electrolytic Recovery					✓	✓	✓	✓	✓	✓	✓	✓						
Electrodialysis <sup>c</sup>		✓			✓	✓			✓									
Reverse osmosis <sup>c</sup>					✓	✓	✓	✓	✓				✓	✓	✓			

Source: MP&M Site Visits, MP&M Surveys, Technical Literature.

<sup>a</sup> Alkaline tin only.

<sup>b</sup> For example, air or other agitation, minimum size, and inlet, outlet location opposite ends.

<sup>c</sup> Only common applications of this technology are checked.

**Table D-2**

**Descriptions of Pollution Prevention  
and Water Conservation Practices and Technologies**

Practice or Technology	Description
Air Knife	Air knives are usually installed over a process tank or drip shield and are designed to remove drag-out by blowing it off the surface of parts and racks. Drag-out is routed back to the process tank. Air knives are more effective with flat parts. They cannot be used to dry surfaces that passivate or stain due to oxidation.
Cascade Rinsing	Cascade rinsing is a method of reusing rinse water. Water from one rinsing operation is plumbed to another, less critical one before being discharged to treatment. Some rinse waters acquire chemical properties, such as low pH, that make them desirable for reuse in specific rinse systems. This is generally referred to as reactive rinsing.
Conductivity Controller	<p>Conductivity probes measure the conductivity of water in a rinse tank to regulate the flow of fresh water into the rinse system. Conductivity controllers consist of a controller, a meter with adjustable set points, a probe that is placed in the rinse tank, and a solenoid valve. As parts are rinsed, dissolved solids are added to the water in the rinse tank, raising the conductivity of the water. When conductivity reaches the set point, the solenoid valve opens to allow make-up water to enter the tank. When the conductivity falls below the set point, the valve shuts to discontinue the make-up water.</p> <p>In theory, conductivity control of rinse flow is a precise method of maintaining optimum rinsing conditions in intermittently used rinse operations. In practice, conductivity controllers work best with deionized rinse water. Incoming water conductivity may vary day to day and season to season, which forces frequent set-point adjustments. Suspended solids and nonionic contaminants (e.g., oil) are not detected by the conductivity probe and can cause inadequate rinsing.</p>
Countercurrent Cascade Rinsing	Countercurrent cascade rinsing refers to a series of consecutive rinse tanks that are plumbed to cause water to flow from one tank to another in the direction opposite of the work flow. Countercurrent cascade rinsing is widely used to reduce the discharge rate of rinse water. Fresh water flows into the rinse tank located farthest from the process tank and overflows, in turn, to the rinse tanks closer to the process tank. This technique is termed countercurrent rinsing, because the part and the rinse water move in opposite directions. Over time, the first rinse becomes contaminated with drag-out and reaches a stable concentration that is lower than the process solution. The second rinse stabilizes at a lower concentration, which enables less rinse water to be used than if only one rinse tank were in place. The more countercurrent cascade rinse tanks (three-stage, four-stage, etc.), the less water is needed to adequately remove the process solution.
Drag-in/Drag-out Rinsing	A drag-in/drag-out rinse system may be a single tank or two tanks plumbed together. Parts enter the rinse system before and after processing in the bath. As parts enter the process bath, they drag in process chemicals present in the drag-in/drag-out rinse rather than plain rinse water. This rinsing configuration is an effective recovery method for process baths that have low evaporation rates.

**Table D-2 (Continued)**

Practice or Technology	Description
Drag-out Tank	Drag-out tanks are rinse tanks that are initially filled with water and remain stagnant. Parts are rinsed in drag-out tanks directly after exiting the process bath. Gradually, the concentration of process chemicals in the drag-out tank rises. In the most efficient configuration, a drag-out tank is used after a heated process tank that has a moderate to high evaporation rate. Part of the fluid in the drag-out tank is returned to the process tank to replace the evaporative loss. The level of fluid in the drag-out tank is maintained by adding fresh water.
Drip Shields	Drip shields are installed between process tanks and rinse tanks to recover process fluid dripping off racks and barrels that would otherwise fall into rinse tanks or onto the floor. Often, drip shields are an inclined piece of polypropylene or other material that is inert to the process.
Drip Tanks	Drip tanks are similar to drag-out tanks except they are not filled with water. Parts exiting a process bath are held over the drip tank and the process fluid that drips from the parts is collected in the tank. When enough fluid is collected in the drip tank, it is returned to the process tank. Drip tanks are generally considered to be a less effective drag-out recovery practice than using drag-out tanks.
Electrodialysis	<p>Electrodialysis is a membrane technology used to remove impurities from and recover process solutions. With this technology, a direct current is applied across a series of alternating anion and cation exchange membranes to remove dissolved metal salts and other ionic constituents from solutions.</p> <p>An electrodialysis unit consists of a rectifier and a membrane stack. The stack consists of alternating anion- and cation-specific membranes that form compartments. As the feed stream enters the unit, each alternating membrane compartment becomes filled with either dilute or concentrate. When the compartments are filled, a direct current is applied across the membrane. Cations in a dilute compartment traverse one cation-specific membrane in the direction of the cathode, and are trapped in that compartment by the next membrane, which is anion-specific. Anions from the neighboring dilute compartment traverse the anion-specific membrane in the direction of the anode, joining the cations, and are likewise trapped in the concentrate compartment by the next cation-specific membrane. In this way, the feed stream is depleted of ions, and anions and cations are trapped in each concentrate compartment.</p> <p>The feed stream is often from the first rinse tank in a countercurrent series, with a concentration of 5 gallons per liter (g/L) or more of total dissolved solids (TDS). The concentrate, with a TDS concentration of 50 g/L or more and a volume of less than 10% of the feed stream, is returned to the process. The dilute, representing more than 90% of the feed stream at a TDS concentration of typically 1 g/L or less, is recycled as rinse water or discharged to treatment.</p>

**Table D-2 (Continued)**

Practice or Technology	Description
Electrolytic Recovery (Electrowinning)	<p>Electrolytic recovery is an electrochemical process used to recover metals from many types of process solutions, such as electroplating rinse waters and baths. Electrolytic recovery removes metal ions from a wastestream by processing the stream in an electrolytic cell, which consists of a closely spaced anode and cathode. Commercial equipment consists of several cells, a transfer pump, and a rectifier. Current is applied across the cell and metal cations are deposited on the cathodes. The wastestream is usually recirculated through the cell from a separate tank, such as a drag-out recovery rinse.</p> <p>Electrolytic recovery is typically applied to solutions containing nickel, copper, precious metals, and cadmium. Chromium and aluminum are poor candidates for electrolytic recovery. Drag-out recovery rinses and ion-exchange regenerant are common solutions that are processed using electrolytic recovery. Some solutions require pH adjustment prior to electrolytic recovery. Acidic, metal-rich, cation regenerant is an excellent candidate stream for electrolytic recovery, and is often electrolytically recovered without adjustment. In some cases, when the target concentration is reached, the wastestream is reused as cation regenerant.</p>
Evaporation	<p>Evaporation is a common chemical recovery technology. There are two basic types of evaporators: atmospheric and vacuum. Atmospheric evaporators, the more prevalent type, are relatively inexpensive to purchase and easy to operate. Vacuum evaporators are mechanically more sophisticated and are more energy-efficient. Vacuum evaporators are typically used when evaporation rates greater than 50 to 70 gallons/hour are required. Additionally, with vacuum evaporators, evaporated water can be recovered as a condensate and reused on site.</p> <p>A disadvantage of evaporation-based recovery is that all drag-out, including unwanted components, are returned and accumulate in the process bath. For this reason, deionized water is preferred as rinse water to prevent the introduction of water contaminants in the process bath.</p>
Flow Restrictor	<p>Flow restrictors prevent the flow in a pipe from exceeding a predetermined volume. They are commonly installed on a rinse tank's water inlet. These devices contain an elastomer washer that flexes under pressure to maintain a constant water flow regardless of pressure. Flow restrictors can maintain a wide range of flow rates, from less than 0.1 gal/min to more than 10 gal/min.</p> <p>As a stand-alone device, a flow restrictor provides a constant water flow. As such, for intermittent rinsing operations, a flow restrictor does not coordinate the rinse flow with drag-out introduction. Precise control with intermittent operations typically requires a combination of flow restrictors and rinse timers. However, for continuous rinsing (e.g., continuous electroplating machines), flow restrictors may be adequate for good water control.</p>
Fog or Spray Rinse Over Tank	<p>Fog or spray rinsing is performed over a process bath to recover drag-out. Draining over a process bath can be greatly enhanced by spray or fog rinsing, which dilutes and lowers the viscosity of the film of process fluid clinging to the parts. This method of drag-out recovery is only possible if the evaporation rate of the process fluid is moderate to high.</p>

**Table D-2 (Continued)**

Practice or Technology	Description
Good Tank Design	<p>Rinse tanks should be designed to remove the drag-out layer from the part and cause it to rapidly and thoroughly mix with the rinse water. Common elements of good tank design are positioning the inlet and outlet at opposite ends of the tank, using air or other agitation, using a flow distributor, and using the minimum size tank possible.</p>
Ion Exchange	<p>Ion exchange is a reversible chemical reaction that exchanges ions in a feed stream for ions of like charge on the surface of an ion-exchange resin. Resins are broadly divided into cationic or anionic types. Typical cation resins exchange <math>H^+</math> for other cations, while anion resins exchange <math>OH^-</math> for other anions.</p> <p>In practice, a feed stream is passed through a vessel, referred to as a column, which holds the resin. The feed stream is typically dilute rinse water. The exchange process proceeds until the capacity of the resin is reached (i.e., an exchange has occurred at all the resin facilities). A regenerant solution is then passed through the column. For cation resins, the regenerant is an acid, and the <math>H^+</math> ions replace the cations captured from the feed stream. For anion resins, the regenerant is a base, and <math>OH^-</math> ions replace the anions captured from the feed stream. The concentration of feed stream ions is much higher in the regenerant than in the feed stream; therefore, the ion-exchange process accomplishes both separation and concentration.</p> <p>Ion exchange is used for water recycling and/or metal recovery. For water recycling, cation and anion columns are placed in series. The feed stream is deionized and the product water is reused for rinsing. Often, closed-loop rinsing is achieved. The regenerant from the cation column typically contains the metal species, which can be recovered in elemental form via recovery. The anion regenerant is typically discharged to wastewater treatment. When metal recovery is the only objective, a single or double cation column unit containing selective resin is used. These resins attract divalent cations while allowing monovalent cations to pass, a process usually referred to as metal scavenging. Water cannot be recycled because contaminants other than the target cations remain in the stream exiting the column.</p>
Long Drip Time	<p>Long drip times over the process tank reduce the volume of drag-out reaching the rinsing system. Automatic lines can be easily programmed to include optimum drip times. On manual lines, racks are commonly hung on bars over process baths and allowed to drip. Barrels can be rotated over the process bath to enhance drainage. Some surfaces cannot tolerate long exposure to air due to oxidation or staining, and would therefore be unsuitable for extended drip times.</p>
Raising Bath Temperature	<p>Bath temperature and viscosity are inversely related. Operating at the highest possible bath temperature lowers viscosity and reduces drag-out. Higher bath temperatures also increase evaporation, which facilitates efficient recovery rinsing.</p>
Lowering Bath Concentration	<p>Operating at the lowest possible concentration reduces the mass of chemicals in a given volume of drag-out. Also, viscosity and concentration are directly related and lower process bath concentration lowers viscosity and reduces drag-out volume. Contaminants and other substances that build in concentration over the life of a process bath should be controlled at a low level, if possible.</p>
Part Position on Rack	<p>Positioning parts on racks to promote rapid draining includes minimizing the profile of the parts emerging from the bath, tilting and inverting cup-shaped parts, and avoiding placement of parts directly atop one another.</p>

**Table D-2 (Continued)**

Practice or Technology	Description
Slow Part Withdrawal	<p>The faster a part is removed from a process bath, the thicker the layer of fluid clinging to the part will be. A slower withdrawal rate reduces the thickness of the fluid layer and reduces drag-out. Generally, this method of drag-out reduction can only be practiced on automatic lines where the withdrawal velocity can be programmed.</p>
Reverse Osmosis	<p>Reverse osmosis is a membrane separation technology used for chemical recovery. The feed stream, usually relatively dilute rinse water or wastewater, is pumped to the surface of the reverse osmosis membrane at pressures of 400 to 1,000 psig. The membrane separates the feed stream into a reject stream and a permeate. The reject stream, containing most of the dissolved solids in the feed stream, is deflected from the membrane while the permeate passes through. Reverse osmosis membranes reject more than 99% of multivalent ions and 90% to 96% of monovalent ions, in addition to organic pollutants and nonionic dissolved solids. The permeate stream is usually of sufficient quality to be recycled as rinse water, despite the small percentage of monovalent ions (commonly potassium, sodium and chloride) that pass through the membrane.</p> <p>A sufficiently concentrated reject stream can be returned directly to the process bath. The reject stream concentration can be increased by recycling the stream through the unit more than once or by increasing the feed pressure. In multiple-stage units containing more than one membrane chamber, the reject stream from the first chamber is routed to the second, and so on. The combined reject streams from multistage units may, in some cases, have high enough concentrations to be returned directly to the bath.</p>
Timer Rinse Controller	<p>Rinse timers are electronic devices that control a solenoid valve. The timer usually consists of a button that, when pressed, opens the valve for a predetermined length of time, usually from 1 to 99 minutes. When the valve is open, make-up water is allowed to flow into a given tank. After the time period has expired, the valve is automatically shut. The timer may be activated either manually by the operator or automatically by the action of racks or hoists.</p> <p>Most rinse systems that are used intermittently benefit from the installation of a rinse timer, as operator error is eliminated. Rinse timers installed in conjunction with flow restrictors can provide precise control when the incoming water pressure may rise and fall. Rinse timers are less effective in continuous or nearly continuous rinse operations (e.g., continuous electroplating machines).</p>
Wetting Agents	<p>Wetting agents or surfactants may be added to some process baths to reduce viscosity and surface tension, thereby significantly reducing drag-out.</p>

Source: MP&M Site Visits, MP&M Surveys, Technical Literature.



### D.1.1 Drag-Out Reduction and Drag-Out Recovery

The quantity of water needed for good rinsing for a given system is proportional to the quantity of drag-out from a process bath. Facilities can implement various methods that minimize the rate of drag-out (measured as gallons per square foot of part surface area) and/or they can implement direct drag-out recovery. The drag-out rate for an individual process operation (e.g., cleaning or plating) depends on numerous factors, including process type, shape of parts processed, production equipment, and processing procedures, which include human factors. Of these factors, the shape of the parts and the type of device used to move the parts (e.g., racks, baskets, barrels) usually have the greatest influence on drag-out rates. Tables D-3 and D-4 present drag-out rate estimates from two sources in the literature for various shaped parts.

**Table D-3**

#### **Average Drag-Out Losses - from Soderberg's Work**

<b>Nature of Work Drainage</b>	<b>Drag-Out Rate (gal/1,000 ft<sup>2</sup>)</b>
<b>Vertical</b>	
Well drained	0.4
Poorly drained	2
Very poorly drained	4
<b>Horizontal</b>	
Well drained	0.8
Very poorly drained	10
<b>Cup Shapes</b>	
Well drained	8
Very poorly drained	24

Source: Reference 4.

**Table D-4****Average Drag-Out Losses - from Hogaboom's Work**

Electroplating Solution Type	Drag-Out Rate (gal/1,000 ft <sup>2</sup> )	
	Flat Surfaces	Contoured Surfaces
Brass	0.95	3.3
Cadmium	1	3.1
Chromium (33 oz/gal)	1.18	3
Chromium (53 oz/gal) <sup>a</sup>	4.53	11.9
Copper cyanide	0.91	3.2
Watts nickel	1	3.8
Silver	1.2	3.2
Stannate tin	0.83	1.6
Acid zinc	1.3	3.5
Cyanide zinc	1.2	3.8

Source: Reference 4.

<sup>a</sup>Increased viscosity, caused by an increase in concentration, can increase the drag-out volume approximately three times with less than double the concentration increase.

Several factors other than shape, some of which are interrelated, influence the drag-out rate for a given process and part. Table D-5 lists these and other key factors and describes their impact on drag-out rates. Also listed are examples of water conservation practices that reduce the generation of drag-out, and the major restrictions that are associated with these practices. Table D-6 shows the effect of altering the withdrawal rate and drain time.

Soderberg's data indicate that the shape of the part has a significant influence on drag-out rate. Cup-shaped parts, including intricately designed parts with internal surfaces, can generate five or more times the drag-out than flat surfaced parts with the same surface area. Hogaboom's data show a similar trend for flat versus contoured surfaces. These data also show that the type and concentration of the electroplating solution influence the drag-out rate. For example, some solutions, such as stannate tin, drain effectively, while others, such as concentrated chromium electroplating solutions (53 ounces per gallon (oz/gal) drain poorly. As to the type of device used to move parts, barrels (used to hold fasteners or other small parts that cannot be practically held by racks) generate more drag-out than racks, because of the surface area of the barrel and its tendency to hold the solution.

**Table D-5****Factors Affecting Drag-Out**

<b>Factor Affecting Drag-Out</b>	<b>Impact on Drag-out</b>	<b>Potential Pollution Prevention and Water Conservation Practices</b>	<b>Restrictions</b>
Bath Concentration	Concentration and drag-out are directly related.	Operate at lowest concentration possible. Remove all contaminants promptly.	Concentration range limited by process.
Bath Temperature	Higher temperatures lower drag-out by lowering viscosity.	Operate at highest possible temperature.	Temperature range limited by process.
Bath Viscosity	High viscosity raises drag-out by increasing the thickness of the fluid layer clinging to the part.	Operate at highest temperature and lowest concentration possible. Add wetting agent.	Concentration and temperature ranges limited by process. Wetting agent must be compatible.
Part Configuration	Cup shapes result in 8-20 times the drag-out volume of flat shapes.	Drain holes can be added to many cup-shaped parts to improve drainage of drag-out.	Functionality of parts may restrict use of drain holes or other changes to part configuration.
Part Orientation	Orientation on rack can be optimized to minimized drag-out.	Keep records of optimal orientations. Train operators.	None.
Withdrawal Rate	Doubling speed of withdrawal results in a fourfold increase in drag-out volume.	Program automatic equipment for slow withdrawal.	Impossible to consistently practice without automation.
Drain Time	Long drain times and barrel rotations greatly reduce drag-out.	Program automatic equipment for long drain times.	Impossible or difficult to consistently practice without automation. Drain time limited by staining or passivation of some coatings.
Rack versus Barrel	Barrels produce greater drag-out than racks.	(See "Rack/Barrel Design")	Part transport device is dictated by part size.
Rack/Barrel Design	Drag-out volume is related to barrel design.	Redesign barrels with largest holes possible.	Barrel design limited by part sizes and configurations.
Rack/Barrel Condition	Loose rack coating cause reservoirs of fluid to be transported with rack.	Maintain a schedule of maintenance and recoating.	None.
Operator Awareness	Poor operator awareness greatly increases drag-out or offsets other practices.	Require training programs for operators.	None.

Source: MP&amp;M Site Visits, MP&amp;M Surveys, Technical Literature.

**Table D-6****Effect of Withdrawal Rate and Drain Time on Drag-out Rate<sup>a</sup>**

<b>Micro-Etch Results</b>	<b>Withdrawal Rate (ft/min)</b>	<b>Time of Withdrawal (seconds)</b>	<b>Drain Time (seconds)</b>	<b>Total Time (seconds)</b>	<b>Drag-out (gal/1,000 ft<sup>2</sup>)</b>
Baseline	100	1.7	3.4	5.1	3.13
Slower rate of withdrawal	11	14.9	2.5	17.4	1.73
Intermediate withdrawal rate and longer drain time	40	4.3	12.1	16.4	1.83

<b>Electroless Copper Results</b>	<b>Withdrawal Rate (ft/min)</b>	<b>Time of Withdrawal (seconds)</b>	<b>Drain Time (seconds)</b>	<b>Total Time (seconds)</b>	<b>Drag-out (gal/1,000 ft<sup>2</sup>)</b>
Baseline	94	1.8	5.2	7	1.55
Slower Rate of Withdrawal	12	13.9	3.2	17	0.78
Intermediate Withdrawal Rate and Longer Drain Time	40	4.3	11.9	16.3	0.75

Source: Reference 4.

<sup>a</sup>The effects of changing the withdrawal rate and drain time were measured at a printed circuit board manufacturing facility.

The following is a list of drag-out reduction practices that facilities can implement on electroplating or surface finishing lines:

- Lower process solution viscosity and/or surface tension by decreasing chemical concentration, increasing bath temperature, or using wetting agents;
- Reduce drag-out volume by modifying rack/barrel design and perform rack maintenance to avoid solution trapping;
- Position parts on racks in a manner that avoids trapping solution;
- Reduce speed of rack/barrel withdrawal from process solution and/or increase dwell time over process tank;
- Rotate barrels over the process tank to improve drainage;
- Use spray/fog rinsing over the process tank (limited applicability);
- Use drip boards and return process solution to the process tank;

- Use drag-out tanks, where applicable, and return solution to the process tank; and
- Work with customers to ensure that part design maximizes drainage.

### **D.1.2 Improved Rinse Tank Design and Rinsing Configurations**

Rinse tank design and rinsing configuration greatly influence water usage. The key objectives for optimal rinse tank design are to quickly remove drag-out from the part and completely disperse the drag-out throughout the rinse tank. Achieving these objectives reduces the time necessary for rinsing and minimizes the concentration of contaminants on the part when it leaves the rinse tank. Examples of good design include locating water inlet and discharge points of the tank at opposite positions in the tank to avoid short-circuiting, and using air agitation for better mixing (5).

Various rinsing configurations are used by MP&M facilities. Having single-rinse tanks following each process tank is the most inefficient use of rinse water. Multiple-rinse tanks connected in series (i.e., countercurrent cascade rinsing) reduces the water needs of a given rinsing operation by one or more orders of magnitude. Spray rinsing can also reduce water use requirements, but the achievable percent reduction is usually less than for countercurrent cascade rinsing. Other configurations that reduce water use include cascade, reactive, and dual purpose rinses.

### **D.1.3 Rinse Water Use Control Devices**

Regardless of the type of rinsing configuration used, facilities can reduce their water use by coordinating water use and water use requirements. Matching water use to water use requirements can optimize the quantity of rinse water used for a given work load and tank arrangement (5). Not controlling water use negates the benefits of using multiple rinse tanks or other water conservation practices and increases water usage.

Facilities may wish to implement at least one effective method of water use control on all electroplating or surface finishing lines. Effective water use controls include, but are not limited to:

- Use of softened or deionized water for rinsing.
- Flow restrictors (flow restrictors as a stand-alone method of rinse water control are only effective with plating lines that have constant production rates, such as automatic plating machines. For other operations, there must also be a mechanism or procedure for stopping water flow during idle periods.).
- Conductivity controls.

- Timer rinse controls.
- Production-activated controls (e.g., spray systems activated when a rack or barrel enters/exits a rinse station).

#### **D.1.4 Metal Recovery and Rinse Water Reuse Technologies**

MP&M facilities use various technologies to recover metals drag-out and rinses and reuse the rinse water. The technologies most commonly used are evaporation, ion exchange, electrolytic recovery (also referred to as electrowinning), reverse osmosis, and electrodialysis. Table D-7 presents examples of metal recovery technologies and the drag-out/rinses to which they are primarily applied.

**Table D-7**

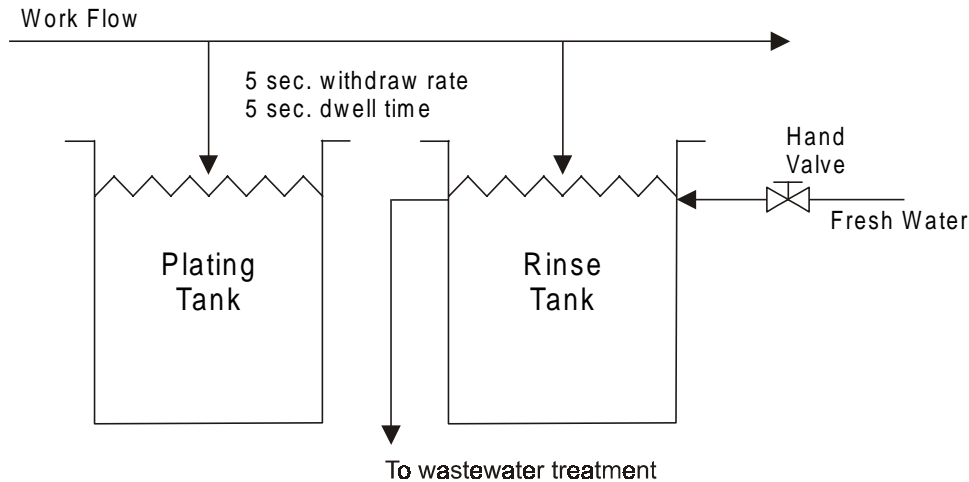
#### **Examples of Metal Recovery Methods**

<b>Chemistry or Process with Which Rinse is Associated</b>	<b>Recovery Technology</b>
Brass electroplating	Electrolytic recovery, evaporation
Cadmium (cyanide) electroplating	Electrodialysis, electrolytic recovery, evaporation, ion exchange, reverse osmosis
Cadmium (noncyanide) electroplating	Electrodialysis, electrolytic recovery, evaporation, ion exchange, reverse osmosis
Chromate conversion coating of aluminum	Evaporation
Chromium (hard) anodizing	Evaporation, mist eliminator
Chromium electroplating - decorative (Cr+6)	Evaporation
Chromium electroplating - decorative (Cr+3)	Evaporation
Copper (cyanide and sulfate) electroplating	Electrolytic recovery, evaporation, ion exchange, reverse osmosis
Gold electroplating	Electrolytic recovery, ion exchange
Lead-tin electroplating	Evaporation, ion exchange
Nickel electroplating	Electrodialysis, electrolytic recovery, evaporation, ion exchange, reverse osmosis
Nickel electroless plating	Evaporation, ion exchange
Nickel sealant	Reverse osmosis
Silver electroplating	Electrolytic recovery, evaporation, ion exchange
Zinc (cyanide) electroplating	Electrolytic recovery, evaporation, reverse osmosis
Zinc (noncyanide) electroplating	Electrolytic recovery, evaporation, ion exchange, reverse osmosis
Zincate	Evaporation

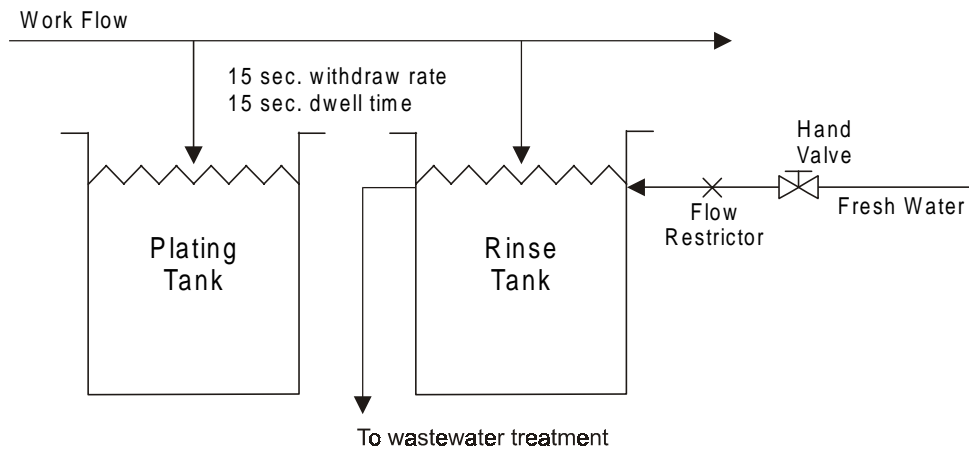
Source: Reference 5.

### D.1.5 Summary of Water Conservation Methods

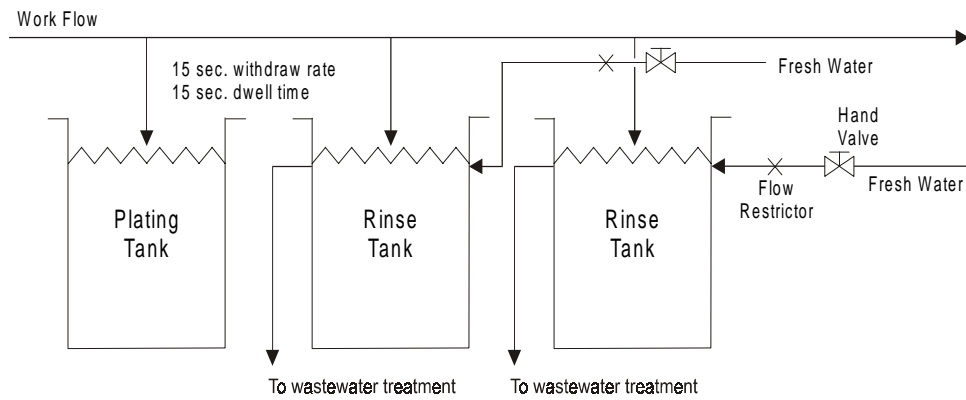
Figures D-1(a) through (f) present six examples of rinsing configurations with increasingly good levels of water use practices. Each of these rinse systems is described below. These configurations can be operated to provide adequate rinsing and are common at MP&M facilities. However, the quantity of water needed for the same rinse quality may vary by as much as two orders of magnitude from the lowest level to the best level of water use.



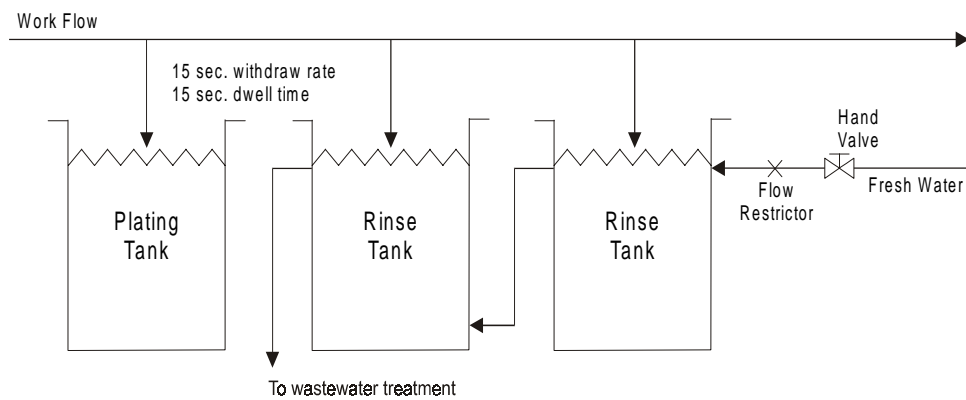
**Figure D-1(a). Single Rinse Tank**



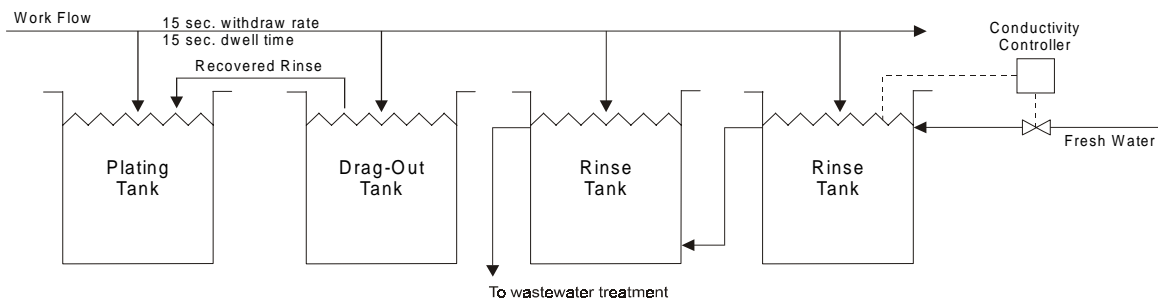
**Figure D-1(b). Single Rinse Tank with Flow Reduction**



**Figure D-1(c). Multiple Rinse Tanks with Flow Reduction**

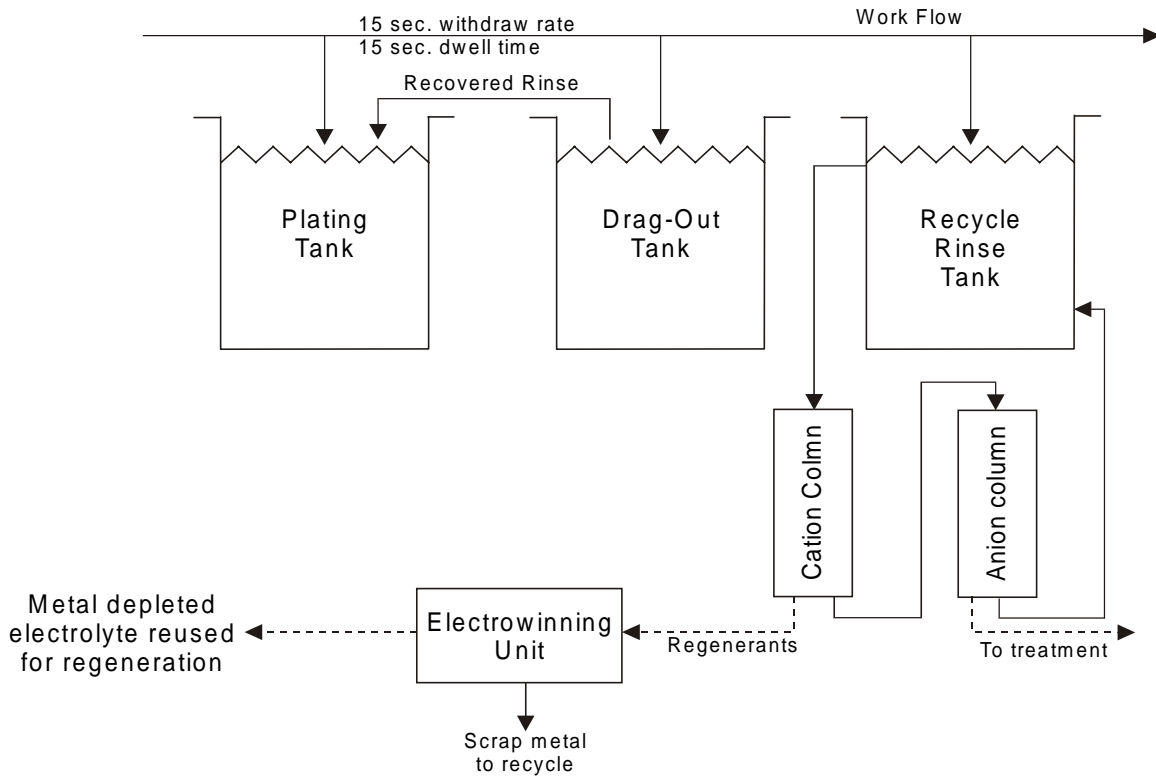


**Figure D-1(d). Countercurrent Rinsing with Flow Reduction**



**Figure D-1(e). Multiple Rinse Tanks with Flow Reduction and Drag-Out Recovery**





**Figure D-1(f). Multiple Rinse Tanks with Water Recycle, Drag-Out Recovery, and Metal Recovery**

Figure D-1(a) is an example of inefficient water use. This configuration uses a single-rinse tank with either continuous water flow or manual use control. To coordinate rinse water needs and use, the operator manually turns on the water valve to give the correct flow rate and then turns it off when the flow is no longer needed. The flow-rate setting will usually vary by operator and the water valve may be left open during idle production periods. The single rinse tank configuration uses rinse water at a very high rate, even if water use is coordinated with the introduction of drag-out. In the example shown, with a 1-gallon-per-hour (gph) drag-out rate, the rinse water requirement is 30 gallons per minute (gpm), based on rinsing of Watts nickel plating solution and a rinsing criterion of 50 milligrams per liter (mg/L) nickel. If water use and drag-out introduction are not coordinated, an even higher rinse water use rate would be needed to meet a given rinse criterion.

Figure D-1(b) shows a rinsing configuration where simple rinse water reduction methods have been implemented. The water use is still inefficient because a single rinse tank is used versus multiple rinse tanks. However, with this configuration, the drag-out rate is reduced by controlling the withdrawal rate of the part (increasing the withdrawal rate from 5 to 15 seconds) and by holding the part over the process tank (increasing dwell time from 5 to 15

seconds) to permit the drag-out to drip into the tank. The rinse water flow rate is controlled at a constant flow by a flow restrictor. The flow restrictor is usually sized to provide adequate rinsing at all times, and is more acceptable for constant production rates, such as those often found with automated plating machines. However, this configuration is inefficient when the work is intermittent because the rinse water flow rate must be set high enough to provide adequate rinsing during peak production periods. In addition, a large quantity of rinse water is wasted during low or idle production periods, unless the water flow is manually stopped.

Figure D-1(c) shows a rinsing configuration using multiple rinse tanks, which provides a moderately efficient use of water. This configuration is referred to as parallel rinsing, where each of the two rinse tanks are fed with fresh water and they each discharge to treatment. This arrangement can reduce water use to less than 50 percent of that used in Figure D-1(a).

Figure D-1(d) shows a more efficient rinsing configuration. This configuration is similar to that shown in Figure D-1(c), except that wastewater from the second rinse tank flows back into the first rinse tank to provide more efficient rinsing with less water use. Wastewater from the first rinse tank is then discharged to treatment. In this configuration, known as countercurrent cascade rinsing, the rinse water flows in a direction opposite to the part flow. This arrangement can reduce water use by more than 90 percent over the rinse configuration in Figure D-1(a).

Figure D-1(e) shows a very efficient rinsing configuration. There are three key elements to this rinse system: drag-out reduction/recovery, countercurrent cascade rinsing, and water-use control. This configuration reduces/recovers drag-out by controlling the withdrawal rate and dwell time and by installing a drag-out recovery tank. This tank can reduce the drag-out entering the countercurrent cascade rinses by up to 90 percent, depending on the surface evaporation rate of the process tank. A conductivity controller controls the feed to the countercurrent cascade rinses. This type of device coordinates water use with drag-out introduction and reduces the influence of human error found with manually controlled rinses. An alternative device is a timer rinse control, which is as effective as a conductivity controller when there is no variability in drag-out volume between rinsing events.

Figure D-1(f) shows a rinse system that uses an ion exchange/electrolytic recovery unit as a chemical recovery and water recycling technology. This rinsing configuration can reduce water use by more than 99 percent compared to the rinse configuration in Figure D-1(a), since wastewater is discharged only from the regeneration cycle of the ion-exchange unit.

Table D-1 presents examples of additional practices and technologies that could be components of a well-designed rinse system.

#### **D.1.6 Influences on Flow Rates**

Available data show that rinse water use rates are related to production when measured in terms of the surface area of parts processed. Other factors that influence rinse water

use rates include the drag-out rate (gallons per 1,000 square feet of workload), the rinse water purity criteria (mg/L metal), the concentration of TDS in the bath (mg/L TDS), rinse tank design and configuration (e.g., single overflow rinse versus countercurrent cascade rinse), and the type of rinse water flow control (e.g., manual versus conductivity controlled). Section D.1.5 discusses drag-out rinse tank design and configuration and rinse water flow control. The other factors are discussed below.

#### **D.1.6.1 Rinse Water Purity Criteria**

Rinse water purity criteria are the levels of tolerable contamination in the rinse water. These levels vary for different processes and types of products. For example, rinse water used after cleaning typically does not have to be as pure as rinse water used following plating, since rinse water that remains on the plated part (essentially the drag-out from the rinse tank) will leave spots after it evaporates if the concentration of dissolved solids in the rinse water is too high. Although preliminary and intermediate processing steps such as cleaning and etching usually do not require as pure a rinse water as final rinsing, the rinse water needs to be pure enough to stop chemical reactions (e.g., etching) and prevent the contamination of subsequent process solutions. Among plating processes, differences also exist in rinse water quality requirements. Parts plated for engineering or functional purposes (e.g., corrosion resistance) can often be rinsed in water that is significantly less pure than decoratively plated parts rinses.

High-purity water is needed for various rinsing operations. In some cases (e.g., electronics parts rinsing), tap water is not pure enough to serve as rinse water. Before use as rinse water for this type of operation, the source water is purified by reverse osmosis and/or ion exchange to remove dissolved solids and other constituents. Source water is sometimes treated even for common rinsing operations, especially when the water supply is high in dissolved solids.

The metal finishing industry has had rinse water quality requirements for decades. They are typically expressed in mg/L of TDS or in conductivity or resistivity units (resistivity is the inverse of conductivity). Table D-8 summarizes some generalized rinse criteria found in the literature (4).

**Table D-8****Generalized Rinse Criteria**

Type of Rinse	Normal Range for Adequate Rinsing (mg/L TDS)
Alkaline Treatment/Acid Treatment Rinse	400 to 1,000
Functional or Engineering Plating Rinse	100 to 700
Decorative or Bright Plating Rinse	5 to 40

Source: Reference 4.

**D.1.6.2 Bath Concentration**

The concentration of a bath (which can be expressed in g/L TDS) will affect the quantity of water needed for good rinsing. Baths that are more concentrated (i.e., higher TDS) will require more rinse water to meet the same rinse water purity criteria as a less concentrated bath. The bath concentration depends on the type of bath. For example, a typical acid zinc electroplating bath will have a TDS concentration of 166 g/L and a typical copper cyanide electroplating bath will have a TDS concentration of 250 g/L (6,7). For equal volumes of drag-out from these two baths, the copper cyanide rinse flow must be 1.5 times greater to achieve the same rinse quality criteria (i.e.,  $250/166 = 1.5$ ). This calculation does not account for the differences in viscosity that will also affect the volume of drag-out. For example, for flat surfaces, the drag-out rate for a 396-g/L chromic acid bath is 3.8 times greater than that of a 247-g/L bath (6,7). In some cases, the TDS concentration of the bath inadvertently increases due to a buildup of bath contaminants (e.g., iron may accumulate in a chromic acid bath due to the attack of the base metal). The TDS added by the contaminants may affect the drag-out rate in the same manner as its intended bath constituents (e.g., chromic acid). Therefore, operating a bath at the lowest concentration necessary to perform the job properly and maintaining bath contaminants at low levels is a significant pollution prevention measure.

**D.1.7 Technical Literature**

Table D-9 presents, for several types of rinses, calculated flow rates for a single-stage overflow rinsing configuration and a two-stage countercurrent cascade rinsing configuration. Both rinsing configurations are assumed to have flow control (i.e., water use is coordinated with drag-out introduction using a conductivity control or other device). This table presents the TDS concentration in the associated bath (from literature), the target TDS in the rinse (based on the rinsing criteria), the part type, the assumed drag-out rate, and two production normalized flow (PNF) values.

The first value, PNF 100% Control, is a calculated value based on the assumption that a facility perfectly coordinates work flow and rinse water use (e.g., using a conductivity controller). In actual operations, perfect coordination is nearly impossible to achieve because the quantity of rinse

**Table D-9****Rinse Water Required for Various Plating Processes Based on Literature Values**

Process	Rinse Configuration	TDS Concentration <sup>a</sup>	Target TDS Concentration in Rinse <sup>a</sup>	Part Type	Drag-out Rate <sup>a</sup>	PNF 100% Control (gal/ft <sup>2</sup> )	PNF 100%Excess (gal/ft <sup>2</sup> )
Acid Zinc	Single overflow	166 g/L	Functional: 100-700 mg/L (used 400 mg/L)	Flat	1.3 gal/1,000 ft <sup>2</sup>	0.54	1.1
				Contoured	3.5 gal/1,000 ft <sup>2</sup>	1.5	2.9
	2-stage countercurrent cascade	166 g/L	Functional: 100-700 mg/L (used 400 mg/L)	Flat	1.3 gal/1,000 ft <sup>2</sup>	0.024	0.048
				Contoured	3.5 gal/1,000 ft <sup>2</sup>	0.072	0.14
Silver Cyanide	Single overflow	370 g/L	Bright: 5-40 mg/L (used 20 mg/L)	Flat	1.2 gal/1,000 ft <sup>2</sup>	22	44
				Contoured	3.2 gal/1,000 ft <sup>2</sup>	58	120
	2-stage countercurrent cascade	370 g/L	Bright: 5-40 mg/L (used 20 mg/L)	Flat	1.2 gal/1,000 ft <sup>2</sup>	0.16	0.32
				Contoured	3.2 gal/1,000 ft <sup>2</sup>	0.43	0.87
Copper Cyanide	Single overflow	250 g/L	Functional: 100-700 mg/L (used 400 mg/L)	Flat	0.91 gal/1,000 ft <sup>2</sup>	0.57	1.1
				Contoured	3.2 gal/1,000 ft <sup>2</sup>	2	4
	2-stage countercurrent cascade	250 g/L	Functional: 100-700 mg/L (used 400 mg/L)	Flat	0.91 gal/1,000 ft <sup>2</sup>	0.023	0.046
				Contoured	3.2 gal/1,000 ft <sup>2</sup>	0.081	0.16
Acid Descale	Single Overflow	248 g/L	Clean: 400-1000 mg/L (used 700 mg/L)	Flat	1 gal/1,000 ft <sup>2</sup> (estimated)	3.5	7.1
				Contoured	3 gal/1,000 ft <sup>2</sup> (estimated)	11	21
	2-stage countercurrent cascade	248 g/L	Clean: 400-1000 mg/L (used 700 mg/L)	Flat	1 gal/1,000 ft <sup>2</sup> (estimated)	0.019	0.038
				Contoured	3 gal/1,000 ft <sup>2</sup> (estimated)	0.056	0.11
Alkaline Clean (Proprietary Chemistry)	Single overflow	90 g/L	Clean: 400-1000 mg/L (used 700 mg/L)	Flat	1 gal/1,000 ft <sup>2</sup> (estimated)	0.13	0.26
				Contoured	3 gal/1,000 ft <sup>2</sup> (estimated)	0.39	0.77
	2-stage countercurrent cascade	90 g/L	Clean: 400-1000 mg/L (used 700 mg/L)	Flat	1 gal/1,000 ft <sup>2</sup> (estimated)	0.011	0.022
				Contoured	3 gal/1,000 ft <sup>2</sup> (estimated)	0.033	0.066

Sources: References 4, 6, and 7.

<sup>a</sup>TDS concentrations are from References 6 and 7, based on bath formulations. Target TDS concentrations are based on criteria presented in Section 3.2.1 (Reference 4). Drag-out rates are from References 4 and 5 unless data were not available, in which case rates were assumed based on technical knowledge of the operations.

**Table D-9 (Continued)**

1. Acid zinc formulation:

ZnSO <sub>4</sub> (7H <sub>2</sub> O)	240 g/L
NH <sub>4</sub> Cl	15 g/L
Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub> (18H <sub>2</sub> O)	30 g/L
Licorice	1 g/L

2. Equation used to calculate rinse flow and flow per square foot for single overflow rinse:

Solving for Q:

Where:

D	=	Drag-out per ft <sup>2</sup> (gal)
C <sub>e</sub>	=	Target concentration of rinse (oz/gal)
C <sub>o</sub>	=	Concentration of process bath (oz/gal)
C <sub>r</sub>	=	Target concentration of final rinse (oz/gal)
M	=	Interval between drag-out events (minutes)
Q	=	Flow (gal/min)

Note: Any interval M can be chosen. Q, when divided by the work rate, ft<sup>2</sup>/M, yields the gal/ft<sup>2</sup> in the table and the gal/ft<sup>2</sup> number remains the same for any M.

3. Equation used to calculate 100 percent controlled flow and gallons per square foot for countercurrent cascade rinse:

xWhere n = number of rinse stages

For 50 percent controlled flow, Q was multiplied by a factor of 2.

With 100 percent controlled flow, the introduction of drag-out and rinse water into the rinse tank are perfectly coordinated and, therefore, the rinse water required to meet the target concentration of the final rinse is equal to Q. With 100 percent excess flow, the introduction of drag-out and rinse water are not perfectly coordinated and an excess of 100 percent of Q (or 2Q) is used to meet the target concentration of the final rinse.

4. Silver cyanide formulation (middle of high-speed bath range):

AgCN	97.5 g/L
KCN	152.5 g/L
K <sub>2</sub> CO <sub>3</sub>	52.5 g/L
KNO <sub>3</sub>	50 g/L
KOH	17 g/L

5. High-efficiency copper cyanide formulation:

CuCN	75 g/L
KCN	133 g/L
KOH	42 g/L

6. Acid descale formulation:

20% H <sub>2</sub> NO <sub>3</sub> (by volume)
1.5% HF (by volume)

All bath formulations and equations are from References 4, 6, and 7.

water needed to meet a given rinse criterion usually cannot be added exactly at the time that drag-out enters and is dispersed in the rinse tank. For example, when a barrel of parts is rinsed, it is usually placed in a rinse tank for 1 to 3 minutes. The rinse water volume needed to meet the rinse criterion may be 50 gallons or more. The flow rate of water into the rinse tank is typically less than 10 gpm (flow rates into rinse tanks vary depending on the pipe size and water pressure and may be reduced by a flow restrictor). Therefore, it may take 5 minutes to add the 50 gallons of rinse water. Because of this, actual water use rates will be higher than those presented in the column, PNF 100% Control. A reasonable assumption is that good water flow control will result in a PNF twice that of the calculated values that assume 100 percent control. These flows are shown as PNF 100% Excess.

## **D.2        Machining Operations**

Many machining operations use metal-working fluids to cool and lubricate parts and machining tools during cutting, drilling, milling, and other machining operations. These fluids become contaminated and begin to lose their working characteristics. If neglected, the fluids become unusable and require treatment and disposal. Through proper care, the life span of the fluids can be extended indefinitely. For most machining operations, prolonging metal-working fluid life reduces the cost of treatment and disposal, as well as the cost of fresh coolant.

Many MP&M facilities use some type of pollution prevention and water conservation practices for machining wastewaters. Some facilities have implemented numerous pollution prevention and water conservation methods and technologies that result in very low machining wastewater discharge rates and in some cases eliminate the discharge of machining fluids. Pollution prevention and water conservation practices are applicable to all machining operations; however, process-related factors and site-specific conditions may restrict the utility of certain methods.

### **D.2.1        Wastewater Generation from Machining Operations**

Various types of metal-working fluids, also termed cutting fluids and coolants, are used in machining operations to improve the life and function of machine tools. During machining, these fluids are circulated over working surfaces, reducing friction, cooling the tool and part, and removing metal chips from the work face. The type of fluid used depends on the type of machining being performed and the preference of the site. The fluids are broadly divided into four groups: straight oil (neat oils), synthetic oils, semisynthetic, and soluble oil. The most commonly used fluids are soluble oils, synthetics, and semisynthetics.

Water-soluble coolants are prepared by mixing a concentrated coolant with water in a 1:15 to 1:30 ratio to produce a fluid with a 90- to 98-percent water content. Most water-soluble coolants are suitable for light- and medium-duty operations. Synthetic coolants are designed for high cooling capacity, lubricity, and corrosion prevention. Common chemical agents in synthetics include: amines and nitrites for rust prevention; nitrates for nitrite stabilization; phosphates and borates for water softening; soaps and wetting agents for

lubrication; phosphorus, chlorine, and sulfur compounds for chemical lubrication; glycols to act as blending agents; and biocides to control bacteria growth. Semisynthetics contain small dispersions of oil in an almost otherwise organic water-dilutable system. Straight oils are good lubricants, but are less effective for cooling, and therefore are limited mostly to use in low-speed operations (8).

Metal-working fluids are periodically discarded because of reduced performance or development of a rancid odor. The fluids that contain a large percentage of oil typically are contract hauled as solid waste for disposal or recovery. Fluids with lower oil content typically are sent to a site's wastewater treatment system for treatment and subsequent discharge.

Metal-working fluids degrade mainly because of contamination with tramp oil and dirt and by bacterial growth, which can be accelerated by tramp oil contamination. Tramp oil contamination is caused mostly by oil from the part's surface during machining and by leaks of lubricating and hydraulic oils from the machine. Airborne dust or poor housekeeping practices can cause dirt to accumulate. Bacteria are initially contributed from the surfaces of the machine and parts and from the air. More than 2,000 known species of bacteria have been reported to affect and eventually destroy the stability of machining fluids (9). Bacteria feed on the fluids' chemicals, causing the fluids to lose lubricity and corrosion inhibition. Under anaerobic conditions, sometimes caused by floating tramp oil in coolant sumps, bacteria generate a hydrogen sulfide odor.

In addition to spent fluid, machining operations may generate wastewater from rinsing. Machined parts may be rinsed to remove fluid, chips and other foreign materials. However, parts typically are not rinsed following machining. More frequently, the fluid is permitted to remain on the part to inhibit corrosion, is wiped off using shop towels, or is cleaned in an alkaline cleaning or degreasing operation.

The quantity of wastewater generated by a machining operation depends primarily on the volume of work performed. Production volume can be roughly measured by the quantity of metal stock removed by turning, milling, boring, broaching, cutting and other machining operations. For most machining operations, the removed metal consists of small fragments called chips or fines. Most chips carry a thin film of fluid on their surfaces, which, when it drains, is another source of wastewater.

## **D.2.2      Pollution Prevention and Water Conservation Practices for Machining Operations**

The Agency has identified two categories of pollution prevention and water conservation practices and technologies that can be used to reduce metal-working fluid discharge: those used to prevent metal-working fluid contamination and those used to extend the life of machining fluids, including recovering and recycling metal-working fluids. Within each of these categories are several specific practices and technologies. Table D-10 presents several examples of these practices, which are discussed below. There may be other practices and



technologies not identified here that can reduce metal-working fluid discharge. Therefore, the list provided below is not exhaustive.

**Table D-10**

**Potential Pollution Prevention and Water Conservation Methods  
Applicable to Machining Operations**

Pollution Prevention/Water Conservation Method	Examples	Applicability
<b>Prevention of Metal-Working Fluid Contamination</b>		
Reduce contamination from tramp oil	Use coolant in hydraulic and other oil systems.	Applicable to most machines. In most cases, requires use of special fluid.
	Replace hydraulics with electrical systems.	Limited applicability. Practical only during major equipment overhaul.
	Machine maintenance.	Applicable to all machines. Should be performed at regularly scheduled intervals.
Reduce contamination from make-up water	Use deionized water for initial make-up of working fluid and to account for evaporative losses.	Applicable to all machining operations using a water-soluble fluid. Especially important in areas where the water supply is high in TDS.
Reduce contamination from sumps	Sterilize sumps during clean-out using steam.	Applicable to all machining operations. Especially important with large concrete sumps.
	Use metal inserts or coat walls of concrete sumps.	Applicable to in-ground concrete sumps.
<b>Extension of Metal-Working Fluid Life</b>		
Raw material substitution	Use high quality fluids with needed "additive package."	Most machining operations can benefit from the use of high-quality fluids that can extend fluid life, while reducing bacterial growth, improving lubricity, reducing friction, and providing corrosion protection.
Equipment modification	Replace sump's air agitation with mechanical agitation.	Applicable to central sumps with air agitation.
	Install tramp oil removal device.	Limited mainly to external sumps.
Fluid Monitoring	Measure pH, coolant concentration, tramp oil concentration, and bacterial count weekly or more frequently.	Applicable to all machining operations. Larger operations can use data for statistical process control.

**Table D-10 (Continued)**

Pollution Prevention/Water Conservation Method	Examples	Applicability
<b>Extension of Metal-Working Fluid Life (continued)</b>		
Metal-working fluid recycling	Use methods and technologies for removing fluid contaminants (e.g., filtration, centrifuge, pasteurization).	Simple filtration methods can be used by all machining operations. More sophisticated equipment is limited to larger operations.
	Recycle chip drainage.	Applicable to all machining operations. Requires clean handling and storage methods to prevent contamination.

Source: MP&M Site Visits, MP&M Surveys, Technical Literature.

### **D.2.2.1 Prevention of Metal-Working Fluid Contamination**

Facilities can implement various methods to reduce the amount of fluid contamination. Several of these methods are discussed below.

Reduction of Contamination From Tramp Oil. Tramp oil is a primary contaminant in machining fluids and for many facilities the major cause of metal-working fluid degradation. EPA has identified the following methods to reduce contamination of metal-working fluid with tramp oil.

- Use of Coolant in Hydraulic and Other Oil Systems. Some metal-working coolants are formulated to be used as hydraulic fluid and/or lubricant in concentrated form and as a coolant in its dilute form (i.e., diluted with water). When used as a hydraulic fluid or lubricant, leaks of the fluid will assimilate into the coolant without causing contamination.
- Replacement of Hydraulics with Electrical Systems. Hydraulic systems on some machines can be replaced by newer electrical systems that do not contain hydraulic fluid. This replacement could be economically performed during major equipment overhauls.
- Machine Maintenance. Machine design and age may affect the quantity of hydraulic oil that leaks to the metal-working fluid during machining operations. There are numerous hydraulic systems used with machines, depending on the type of machine. These systems will leak variable quantities of oil depending on design, sealing mechanisms, operating pressures, and other factors. Older machines, especially those that are not properly maintained, can leak excessively from hydraulic seals. Facilities

should implement scheduled maintenance of machines to check and repair sealing mechanisms.

Reduction of Contamination from Make-Up Water. Make-up water contributes to the dissolved solids content of the metal-working fluid, reducing fluid life. This problem occurs more rapidly when water with high TDS is used for evaporative make-up. Certain dissolved solids or minerals cause more problems for metal-working fluids than others. For example, chloride salts and sulfates corrode at levels of greater than 100 parts per million. Sulfates also promote the growth of sulfate-reducing bacteria that cause fluids to become rancid. When minerals become concentrated in the fluid, they can cause increased corrosion, gumming, and machine wear (6). Consequently, using hard water can reduce the fluid life. Deionized (DI) water can be used in place of hard water (DI units can be either purchased or rented).

Reduction of Contamination from Sumps. EPA has identified the following examples of methods to reduce contamination from metal-working fluid sumps:

- Steam Cleaning of Sumps. Machine coolant sumps harbor bacteria that degrade the fluids. If coolant sumps are not sterilized during cleanouts, residual bacteria may degrade the fresh coolant added to cleaned sumps. Steam cleaning the sumps during cleanout can eliminate bacteria.
- Sump Modification. Many coolant sumps are designed as in-ground concrete tanks, whose porous concrete surfaces absorb oil and promote bacterial growth. Improving the design of the sumps can extend fluid life. Potential design changes include inserting metal tanks and coating sump walls with fiberglass or other nonporous material.

Reduce Miscellaneous Contamination. Good housekeeping practices can extend metal-working fluid life by reducing contamination. Facilities can implement housekeeping procedures to keep floor sweepings, solvents, paint chips, soil, rags, paper, and other debris out of the coolant sumps.

#### **D.2.2.2      Extension of Metal-Working Fluid Life**

Facilities can implement several methods to extend the life of metal-working fluids. These include raw material substitution, equipment modification, and fluid monitoring, as discussed below.

Raw Material Substitution. As discussed above, four general types of metal-working fluids are used in machining operations. Within a given group of fluids, such as soluble oil, various formulations are used. Within each group, the major difference from one fluid to another is the “additive package.” Additives are included in most metal-working fluid formulations to improve fluid performance (e.g., improve lubricity, reduce friction, or increase corrosion protection) and increase life span (e.g., reduce bacterial growth). Costs of different

metal-working fluids can vary by 100 percent or more. Fluids with additive packages that do not meet the lubrication and cooling requirements of the specific machining operation may degrade faster than other metal-working fluids. These fluids will need to be replaced more often and increase overall operating costs. These fluids may also affect tool life, further increasing operating costs. Therefore, using the proper grade metal-working fluids can increase the life span of the fluid, reducing the generation of waste machining fluids and decreasing the overall operating costs.

Equipment Modification. EPA has identified the following examples of equipment modifications that can extend the life of machining fluids.

- Replacement of Air Agitation With Mechanical Agitation. Some facilities use air agitation in central coolant sumps to constantly mix the fluid and prevent phase separation and pooling of tramp oil. However, air agitation increases the activity of aerobic bacteria by adding oxygen, which causes the bacteria to consume fluid additives. An alternative method of mixing is mechanical agitation (i.e., pumping). Mechanical agitation mixes without increasing the oxygen concentration of the coolant.
- Removal of Tramp Oil. Machining fluid life can be extended by continuous, in-sump removal of tramp oil. Facilities can install continuous oil-skimming devices directly in the machine sump to remove tramp oil. Absorbent blankets, fabrics, or pillows can also remove tramp oil.

Fluid Monitoring. During use, the metal-working fluid undergoes various physical, chemical, and biological changes. If the properties of the fluid are monitored on a regular basis, the fluid can be adjusted before it is degraded. Parameters measured to monitor the fluid include: pH, coolant concentration (using a refractometer or titration kit), TDS, tramp oil (visual) and biological activity (using dip slides available from coolant suppliers and laboratories (6) or other methods). Facilities can use these data to guide periodic fluid adjustments and/or develop statistical process control (SPC) procedures. Facilities may wish to monitor fluid concentration at least weekly, if not daily, to identify contamination. The correct pH operating range of most coolants is 8.5 to 9.5. If the pH drops below the operating range, coolants may cause rusting and be prone to increased biological activity. Dilute concentrations can shorten tool life, increase biological activity, and cause rust. Rich concentrations can lead to foaming and tramp oil contributes to biological growth.

### **D.2.2.3 Metal-Working Fluid Recycling**

Most metal-working fluids can be recycled on-site by removing contaminants accumulated during use and storage. Recycling methods include settling, straining, skimming, simple filtration, membrane filtration, coalescing, centrifugation, cyclone separation, magnetic separation, and pasteurization. Some of these methods can be used in combination to recover

nearly 100 percent of the metal-working fluid. Facilities can purchase recycling equipment or hire commercial services that perform on-site processing (10,11,12). A self-contained recycling unit can be purchased that is specifically designed for smaller machine shops and is a complete sump maintenance and fluid recycling system in one unit (8). In most cases, facilities can facilitate metal-working fluid recycling by consolidating the types of machining fluids they use to one or two types of fluid.

Additional metal-working fluid can be recycled by chip drainage. Chip drainage can account for up to 50 percent of annual fluid use (11). During machining, the metal chips (scraps) become coated with fluid. Part of the fluid drains from the chips and part remains on the chips. In many cases, the chips and associated fluid drop to the floor and are manually collected in storage containers. Some machines send the chips and fluid to a storage container using automated equipment (e.g., belt or pneumatic conveyor). Fluid that drains from chips can be recycled rather than discharged, which may require design changes of chip handling and storage equipment.

#### **D.2.2.4 Design of the Machine Fluid System**

Fluids used in machining are stored either in sumps dedicated to individual machines (either internal or external to the machine), or in central sumps that serve multiple machines. Large machining operations typically use central sumps, whereas small machine shops tend to have individual sumps for each machine. Central systems usually contain three to five times greater volume of fluid per machine from individual sumps. The reservoir volumes of most machines with internal sumps are typically 10 to 50 gallons. External sumps serving a single machine typically have a volume of 1,000 to 2,500 gallons. Central sumps may have volumes that exceed 50,000 gallons.

The amount of make-up fluid in a central system amounts to a smaller percentage of total fluid than in a single machine operation. Consequently, the potential for bacterial degeneration is greater in central systems as the bacteria have a longer time in which to degrade the fluid (9). Further, central sumps are often unlined concrete basins, whose porous walls harbor bacteria and prevent complete disinfecting during cleanouts. This reduces the time needed for the bacteria to become reestablished (11). Additionally, the larger pumps used in central systems keep the tramp oils suspended in the fluid so they do not readily “float out,” adding to further bacterial attack. Central systems may require more maintenance than dedicated sumps to prevent bacterial growth.

#### **D.2.2.5 Machining Operations Performed**

The ratio of scrap metal (e.g., chips) generated to fluid used varies among machining operations. For example, metal cutting may generate large pieces of scrap metal using a small volume of fluid, whereas a milling operation usually produces a much smaller mass of chips for the same volume of fluid.

**D.2.2.6 Base Material Being Machined**

The type of base material being machined affects the quantity of metal-working fluid used. The hardness of base materials varies, which in turn affects the speed at which the base metal can be removed. Harder metals require more fluid than softer metals for the same operation.

**D.2.2.7 Climatic Conditions**

The temperature of the shop can affect the life span of metal-working fluid in that warmer temperatures may foster the growth of certain bacteria.

**D.2.2.8 Design and Age of Machines**

The design and age of machines may affect the quantity of hydraulic oil that is leaked to the metal-working fluid during machining operations. Numerous hydraulic systems are used with machines. These systems will leak variable amounts of oil depending on design, sealing mechanisms, operating pressures, and other factors. Older machines, especially those that are not properly maintained, can have hydraulic seals that excessively leak.

**D.2.2.9 Uniform Coolant Use**

Minimizing the number of different machine coolants used at a facility reduces the chance of formulation errors. When employees are familiar with fluid properties and coolant formulation chemistry, it is less likely that coolant batches will be prepared incorrectly, which many times requires the entire batch to be discharged to the on-site wastewater treatment facility. Facilities may also save money by purchasing larger volumes of coolant (i.e., economies of scale).

**D.3 Painting Operations**

Paint is applied to a base material for protective and decorative reasons in various forms, including dry powder, solvent-diluted formulations, and water-borne formulations. There are various methods of application, the most common being immersion and spraying. Water is used in painting operations in paint booth water-wash systems (water curtains), in water-borne formulations, in electrophoretic painting solutions and rinses, and in clean-up operations. This discussion is directed at water use in spray painting booths; however, this subsection also provides some information on rinsing following electrophoretic painting and water clean-up.

**D.3.1 Wastewater Generation from Painting Operations**

In spray painting, an organic coating is applied to a product. During manufacturing operations, spray painting is usually performed in a booth to control the introduction of contaminants and the release of solvent and paint to the work place and

environment, and to reduce the likelihood of explosions and fires. Paint booths are categorized into two types (dry filter or water wash) and by the method of collecting the overspray (i.e., the paint that misses the product during application). The type of booth design selected depends mainly on production requirements, including part size and configuration, production rate and transfer efficiency, the material being sprayed, and finish quality requirements.

Dry-filter booths use filters to screen out the paint solids, by pulling prefiltered air through the booth, past the spraying operation, and through the filter. The air entrains the overspray and is pulled through the filter, which collects the paint. Solvent evaporates from the paint, leaving the paint solids on the filter. Filters are periodically replaced when they become laden with paint solids and the air flow through them is restricted. Dry-filter booths are most often used when paint usage does not exceed 20 gallons/8-hour shift/10 feet of chamber width (13). At higher usage rates, the frequency of filter changes greatly increases operating costs (i.e., filter, filter disposal, cost, and labor).

The only water used with dry filter units is to clean painting equipment (e.g., guns and lines) when water-borne paints are used. The operation of dry-filter units is essentially dry when solvent-based paints are used.

Water-wash booths use a “water curtain” to capture paint overspray. Air containing entrained paint overspray is pulled through a circulating water stream, which “scrubs” the overspray from the air. There are two primary types of water-wash booths, side-draft and downward-draft. The basic difference between the two types is the way the air moves through the system to draw the paint overspray in for capture (14,15). Small operations typically use side-draft units and large and/or continuous operations use downward-draft units.

Water-wash booths use a water stream that recirculates from a sump or tank with a typical capacity of 200 to 5,000 gallons or more. Downward-draft systems normally contain much larger volumes of water than side-draft systems. Water is periodically added to the system as make-up for evaporative losses. The sump water is periodically discharged, usually during general system cleaning or maintenance. The discharge rate depends on various factors, including booth design, paint type, overspray rate, and the water treatment methods used. Water is also used to clean the painting equipment and the paint booth. Booth cleanup may involve using paint stripper to remove dried paint from the walls of the booth and the piping system.

A common practice in water-wash booth operation is to immediately detacify suspended paint solids to reduce maintenance problems and to subsequently separate and remove the solids from the water. The organic resins that make up the bulk of the paint coating are insoluble in water and tend to stay tacky if not treated with some other material added to the water (14,15). If left untreated, the tacky solids can plug recirculation pipes and pumps and adhere to wetted surfaces of the booth. Dissolved solids are either immediately precipitated and flocculated, removed by water treatment, or discarded when the sump is discharged.

Solids can be detacified and removed in various ways, depending on the type of paint used and the booth design. Detacification chemicals include sodium hydroxide (caustic), metal salts, clay, and polymers. Depending on the type of paint and the detacification chemical, the paint solids may either disperse or agglomerate. Agglomerated solids may either sink or float. In solids dispersal, the suspended solids increase in concentration as overspray enters the water. Subsequently, another chemical is added to the water that causes the dispersed solids to agglomerate into a dense floc, which is then removed.

There are various ways to remove paint solids from the booth water-wash system. These removal technologies vary in sophistication, automation, efficiency (removal and separation), and capital and operating costs. The most common methods include passive settling, skimming, screening, filtration (bag, roll bed, press), and centrifugal methods (hydrocyclone, centrifuge).

Besides spray painting, another common method of painting is electrophoretic painting (also known as electrocoating or electrodeposition), which is the process of coating a work piece by making it either anodic or cathodic in a bath that is generally an aqueous emulsion of the coating material. The electrophoretic painting bath contains stabilized resin, pigment, surfactants, and sometimes organic solvents in water. Electrophoretic painting is used primarily for primer coats (e.g., bodies for motor vehicles or mobile industrial equipment) because it gives a fairly thick, highly uniform, corrosion-resistant coating in relatively little time. During this process, precleaned parts carrying an electrical charge are immersed into the coating tank (paint) and then through a rinsing system. Rinsing removes excess paint (drag-out) from the parts. The typical rinsing procedure is a three-stage countercurrent cascade rinse, and may include both dip and spray rinsing. Typically, the final rinse is performed with deionized water.

Ultrafiltration is commonly used to separate and recover paint solids and recycle rinse water, by counter flowing the rinse water into the painting bath and running the bath through the ultrafilter. The ultrafilter removes excess water from the bath, recycles the paint solids to the bath, and recycles the water (permeate) to the rinse system. Occasional blowdown of rinse water is needed to purge the system of contaminants. Processing the rinse water through a reverse osmosis unit can reduce the volume of wastewater discharged (16).

### **D.3.2      Pollution Prevention and Water Conservation Practices for Painting Operations**

EPA has identified three categories of pollution prevention and water conservation practices that, if implemented, can reduce or eliminate wastewater discharges from painting operations: practices to reduce the quantity of paint entering the water system; recycling technologies for paint booth water; and conversion of water-wash booths to dry-filter booths. These are discussed in this subsection and summarized in Table D-11. It is possible, however, that facilities can reduce or eliminate wastewater discharges using different practices than those described here.



**Table D-11**

**Potential Pollution Prevention and Water Conservation Methods  
Applicable to Painting Operations**

<b>Pollution Prevention/Water Conservation Method</b>	<b>Examples</b>	<b>Applicability</b>
<b>Reduce the Quantity of Paint Entering the Water System</b>		
Improve spray painting operating practices	Provide operator training to improve racking and positioning of parts to reduce overspray, assure proper selection of nozzle for efficient spray pattern, improve work scheduling and reduce clean-outs, improve housekeeping.	Applicable to all spray painting operations.
Improve paint transfer efficiency	Replace inefficient conventional compressed air spray equipment with high-velocity/low-pressure equipment.	Applicable to most existing spray painting operations using conventional equipment. Will require some retraining of operators.
Install gun cleaning station	Use gun-cleaning station to clean guns and lines. Can prevent spraying of cleaning fluid/paint into booth.	Applicable to most solvent-based painting operations.
<b>Recycle Paint Booth Water</b>		
Recycle paint booth water through solids removal	Use booth water maintenance system that removes paint solids. Applicable technologies include weirs, filters, and centrifuges.	Applicable to most water-wash booths. Usually requires treatment of booth water with chemicals to produce solids that can be separated from water.
<b>Use Dry-Filter Booths</b>		
Use dry-filter booths instead of water-wash booths	Convert existing water-wash booth to a dry-filter booth.	Applicable to booths with low to moderate paint usage. In cases of high paint usage, dry filters clog too quickly.

Source: MP&M Site Visits, MP&M Surveys, Technical Literature.

### **D.3.2.1 Reducing the Quantity of Paint Entering the Water System**

Facilities can implement various methods to reduce the quantity of paint entering the water system. Three of these methods are discussed below.

Improving Spray Painting Operating Practices. Facilities can implement various practices that reduce the quantity of paint and other material entering the water system of a paint booth and thereby reduce the need to discharge wastewater. Generally, implementing these practices requires only operator training. These practices include: racking and positioning parts to minimize overspray; selecting the proper nozzle for an efficient spray pattern; scheduling work to reduce color changes and associated clean-outs of guns, lines, and pots; and housekeeping to prevent painting wastes and foreign materials from entering the booth's water system.

Improving Transfer Efficiency. The transfer efficiency (i.e., spray efficiency) is the amount of coating that is applied to the part divided by the amount of coating that is sprayed from the gun. It is reported as a percentage. The transfer efficiency depends on several factors, including the spraying equipment, part size and configuration, paint type, and operating methods. Improving the transfer efficiency can reduce booth water processing requirements.

During the past 15 to 20 years, spraying equipment has improved, primarily in response to more stringent air pollution regulations and rising paint costs. One of the key improvements has been replacement of conventional compressed air spray equipment by more efficient equipment. In terms of transfer efficiency, the common types of spray equipment are ranked as follows (shown in order of increasing efficiency with relative transfer efficiencies shown in parenthesis): conventional compressed air (25 percent), airless (35 percent), air assisted airless (45 percent), electrostatic, (65 percent), and high-volume/low-pressure (HVLP) (80 percent) (17). The HVLP equipment has been widely implemented due to the high transfer efficiency, as well as the low cost of converting from conventional compressed air equipment. The cost is primarily for the spray guns, since the compressors and other equipment are the same as for conventional compressed air painting equipment.

Installing Gun Cleaning Station. After use, spray-painting equipment must be cleaned to prevent a buildup of paint solids. Spray guns are often cleaned by spraying solvent through the lines and guns and into the booth. However, this practice increases the amount of paint entering the booth's water system and increases emissions of volatile organic compounds (VOCs). An alternative practice is to install gun-cleaning stations. A commercial gun-cleaning unit is designed to sit on top of a 55-gallon drum. The gun is connected to the solvent tank and the drum. Solvent is drawn through the gun and exits into the drum, where it can be recovered by distillation (18).

### **D.3.2.2 Booth Water Recycle**

Various methods and equipment can reduce or eliminate the discharge of the water used in water-wash booths. These methods and equipment prevent the continuous

discharge of booth waters by conditioning (i.e., adding detacifiers and paint-dispersing polymers) and removing paint solids. The least efficient paint booth water-wash system, in terms of water use, is one where the paint solids are not conditioned and accumulate until booth water must be replaced. Cleaning such systems typically involves draining or pumping the water from the booth reservoir and contract hauling the entire waste product. Due to high operating costs and downtime, this procedure is usually used only by low-production operations. Moderate- and high-production operations need daily, if not continuous, booth water maintenance to conserve water. The most basic form of booth water maintenance is removing paint solids by manual skimming and/or raking. These solids can be removed without water conditioning since some portion of solvent-based paints usually floats and/or sinks. With the use of detacifiers and paint-dispersing polymer treatments, facilities can implement more advanced methods of solids removal. Some common methods are discussed below.

Wet-Vacuum Filtration. Wet-vacuum filtration units consist of an industrial wet-vacuum head on a steel drum containing a filter bag. The unit vacuums paint sludge from the booth. The solids are filtered by the bag and the water is returned to the booth. Large vacuum units are also commercially available that can be moved from booth to booth by forklift or permanently installed near a large booth.

Tank-Side Weir. A weir attached to the side of a side-draft booth tank allows floating material to overflow from the booth and be pumped to a filtering tank for dewatering (14,15).

Consolidator. A consolidator is a separate tank into which booth water is pumped. The water is then conditioned by adding chemicals. Detacified paint floats to the surface of the tank, where it is skimmed by a continuously moving blade. The clean water is recycled to the booth (14,15).

Filtration. Various types of filtration units are used to remove paint solids from booth water. The booth water is pumped to the unit where the solids are separated, and the water is returned to the booth. The simplest filtration unit consists of a gravity filter bed with paper or cloth media. Vacuum filters are also used, some of which require precoating with diatomaceous earth (14,15).

Centrifuge Methods. Two common types of centrifugal separators are the hydrocyclone and the centrifuge. The hydrocyclone is used to concentrate solids. The paint booth water enters a cone-shaped unit under pressure and spins around the inside surface. The spinning increases the gravity, which causes most of the solid particles to be pulled outward to the walls of the cone. Treated water exits the top of the unit and the solids exit the bottom. Some systems have secondary filtration devices to further process the solids. The centrifuge works in a similar manner, except that the booth water enters a spinning drum, which imparts the centrifugal force needed to separate the water and solids. Efficient centrifugation requires close control of the booth water chemistry to assure a uniform feed. Also, auxiliary equipment such as booth water agitation equipment may be needed.

### **D.3.2.3 Conversion of Water-Wash Booths to Dry-Filter Booths**

Water-wash booths can be converted to or replaced by dry-filter booths. The dry-filter booths have the potential to eliminate the wastewater discharge, but they create a solid wastestream. The choice between using a water-wash booth or a dry-filter booth is primarily based on the amount of overspray. It is usually cost-effective to use a dry-filter booth when paint usage does not exceed 20 gallons/8-hour shift/10 feet of chamber width (13).

A 1989 U.S. Navy study concluded that conversion from wet to dry booths can be cost-effective for a range of operations. This study included a survey of military and industrial facilities that have successfully converted and an economic analysis based on typical Navy painting operational parameters (1).

### **D.3.3 Solvent, Paint Solids, and Other Components of Paint**

The chemical make-up of the paint can impact wastewater generation. The recirculated water in a water-wash booth contains the various constituents of the paint(s) being applied. With most solvent formulations, the solvents (e.g., xylene, toluene, methylene chloride) are not water-soluble, but can be water-miscible. Some exceptions, such as acetone and methyl ethyl ketone (MEK), are water-soluble. However, in most cases, the solvents are volatile and evaporate over time and exit the booth through the air exhaust system. The organic resins that make up the bulk of the paint coating are insoluble in water and tend to stay tacky if not treated with some additional material introduced to the water (14,15). If left untreated, the tacky solids can plug recirculation pipes and pumps and adhere to wetted surfaces of the booth. Other paint additives, such as wetting agents, pigments, and heavy metals (e.g., zinc and chromium salts) may be soluble in water. These constituents can be made partly insoluble and removed by adjusting the chemistry of the water.

Water-based paints present two problems with regard to water use. First, these paints disperse in water rather than agglomerate like solvent-based paints, making the maintenance of paint booth waters more difficult (14,15). Second, water is used to clean spraying equipment when water-based paints are applied, which may generate wastewater. A typical equipment-cleaning procedure is to flush with water, then solvent, then water (2).

### **D.3.4 Paint Booth Maintenance Requirements**

Water-wash paint booths are periodically shut down for maintenance, which usually involves removing the water in the booth. Various conditions can exist that may necessitate discharging the water, including odor, bacterial growth, foaming, TDS buildup, and the presence of corrosion and scale constituents.

Booth maintenance typically involves incidental repairs and cleaning the booth surfaces and piping system. Often facilities do maintenance according to a schedule, but periodic repairs may also necessitate an unplanned shut-down and clean-out. A common clean-out

procedure is to remove the accumulated paint solids from the water, transfer the water to a holding tank, and return the water after the maintenance is completed. Alternate methods are draining the booth water to a sewer or wastewater treatment system or having it hauled to a disposal site. Systems with accumulated paint solids on the wetted surfaces of the booth and in the piping system can be cleaned by circulating an alkaline cleaner or other chemical for dissolving paint. Since the amount of water discharged from water-wash paint booths is a function of the system's maintenance requirements, newer systems that require less maintenance will discharge less water. Therefore, one pollution prevention option for water-wash paint booths is to install new systems or upgrade existing systems to limit maintenance requirements.

## **D.4        Cleaning Operations**

Cleaning operations include aqueous degreasing, acid treatment, alkaline treatment, and electrolytic cleaning. Depending on the chemicals, equipment, and procedures used, these processes are commonly referred to as immersion, spray, or electrolytic alkaline cleaning; immersion, spray, or electrolytic acid cleaning or pickling; ultrasonic cleaning; and emulsion cleaning and parts washing.

Many MP&M facilities implement pollution prevention and water conservation methods and technologies that result in low cleaning wastewater discharge rates, and in some cases, eliminate the discharge of cleaning solutions. Pollution prevention and water conservation practices are applicable to all cleaning operations; however, process-related factors and site-specific conditions may restrict the utility of certain methods. This subsection identifies pollution prevention and water conservation practices and technologies applicable to cleaning operations.

### **D.4.1        Wastewater Generation From Cleaning Operations**

MP&M facilities commonly perform cleaning as a stand-alone operation or in combination with other proposed MP&M operations such as anodizing, electroplating, conversion coating, and painting. Cleaning removes surface contaminants that affect the appearance of parts or the ability to further process the parts. Various types of acidic and alkaline solutions are used for cleaning.

Alkaline cleaners are usually impacted by organic pollutants such as oil and grease. The effectiveness of most alkaline cleaners is reduced when the oil concentration of the bath is in the range of 1 to 5 g/L or more. Oil and grease enters the alkaline cleaning bath on the parts being processed. The rate of oil buildup depends on the production rate (measured in square feet per day) and the quantity and characteristics of the contamination on the parts. Acid treatment solutions and, to a lesser extent, alkaline treatment solutions accumulate dissolved metals from corrosion of the base metals being processed. The dissolved metal reduces the strength of the cleaning bath. As dissolved metal increases, additional acid or alkaline solution is added; however, at certain metal concentrations, the bath is no longer usable. The tolerable concentration of dissolved metals depends mostly on the type of acid or alkaline solution and the

function of the bath. The buildup rate of dissolved metal depends primarily on the production rate, type and concentration of acid or alkaline solution, type of base metal, duration of cleaning cycle, and bath temperature.

#### **D.4.2 Pollution Prevention and Water Conservation Practices for Cleaning Operations**

EPA identified three categories of pollution prevention and water conservation practices that, if implemented, can reduce or eliminate wastewater discharges from cleaning operations: housekeeping and maintenance, oil and suspended solids removal, and dissolved solids removal. These are discussed in this subsection and summarized in Table D-12. It is possible, however, that facilities can reduce or eliminate wastewater discharges using different practices than those described here.

**Table D-12**

#### **Potential Pollution Prevention and Water Conservation Methods Applicable to Cleaning Operations**

<b>Pollution Prevention/Water Conservation Method</b>	<b>Examples</b>	<b>Applicability</b>
Housekeeping and maintenance	Check the accuracy of temperature controls; remove sludge build-up from tanks, heat coils and temperature regulators; retrieve parts, racks, etc. dropped into the tanks; and check the integrity of tanks and tank liners.	Applicable to all cleaning operations.
Oil and suspended solids removal	Technologies used to remove oil and suspended solids from cleaning solutions, thereby extending the useful life span of the solutions (e.g., skimmers, coalescers, cartridge and membrane filters).	Suspended solids removal equipment (e.g., cartridge filters) are applicable to nearly all baths. The other types of equipment are applicable to most or all alkaline cleaning baths.
Dissolved solids removal	Various technologies and processes that remove dissolved metals from baths, including acid sorption, diffusion dialysis, and membrane electrolysis.	Applicable to acid and alkaline solutions that become contaminated with dissolved metal, usually due to etching of the basis metal.

Source: MP&M Site Visits, MP&M Surveys, Technical Literature.

#### **D.4.2.1 Housekeeping and Maintenance**

Facilities can implement various housekeeping and maintenance practices to reduce the quantity of cleaning solution discharge. Several of these practices are discussed below.

**Solution Testing.** The chemical make-up of cleaning solutions changes over time due to evaporative losses, water additions, cleaning chemical drag-out, chemical reactions, and drag-in of impurities. Because of these factors, cleaning baths lose strength, performance declines, and solutions require disposal. Many facilities operate cleaning baths on a three-step schedule: formulate, use, and discard. This procedure can be expensive and inefficient from a production standpoint, and generates large volumes of wastewater. For this reason, facilities should frequently test the strength of the cleaning solution and appropriate chemical additions needed to continue using the solution. By implementing testing and recordkeeping, facilities can reduce the disposal frequency of cleaning baths.

Most alkaline cleaning solutions are proprietary formulations, and the vendors of these solutions provide test methods for determining the condition of a bath. Also, commercial test kits are available that include generic test methods. For example, the strength of an alkaline cleaning solution can be tested using acid-base titration, which measures alkalinity. Also, there is a dual test method that indirectly measures the level of contamination in the cleaner. This process consists of titrating a measured sample of cleaner (e.g., 5 milliliters (ml)) and then adding a color indicator (phenolphthalein or methyl orange) with an acid of precise concentration (e.g., 1N solution of sulfuric acid). Phenolphthalein is used as the indicator to measure free alkalinity and methyl orange is used to measure total alkalinity. By performing both tests, the ratio of total alkalinity to free alkalinity can be calculated. A ratio close to 1 indicates that the cleaner is relatively free of contamination, while a higher ratio indicates that contamination exists. Facilities sometime use this ratio to determine if they should discharge a cleaning solution. For example, a common guideline used is that the solution is discarded when the ratio exceeds 2.0. The total alkalinity/free alkalinity test method does not work for all cleaners. Because of additives used, some alkaline cleaners do not have any free alkalinity. In such cases, the facility may want to perform more detailed tests to accurately determine the contaminant concentration (e.g., oil and grease measurement).

Similar test methods exist for acid cleaners. The most common parameters in acid cleaner test programs are acid concentration and dissolved metal concentration. The concentration of sulfuric acid or hydrochloric acid in pickling solutions is usually measured by titrating a sample of the solution with sodium carbonate and using a methyl orange indicator. Iron and other dissolved metals can also be measured by titration or by using laboratory analytical equipment such as an atomic adsorption spectrophotometer.

**Recordkeeping.** Maintaining accurate records of bath additive rates and bath lives can help facilities identify trends in solution use and focus on extending the lives of those that are

frequently discarded. Important records to keep are occurrences of chemical additions and solution dumps, production throughput, and chemical concentration data.

Miscellaneous Housekeeping and Maintenance. To obtain consistently good cleaning results and reduce their solution discharge, facilities should implement a regular schedule of housekeeping and maintenance. Tasks should include: checking the accuracy of temperature controls; removing sludge buildup from tanks, heating coils, and temperature regulators; retrieving parts, racks, and other foreign materials dropped into the tanks; and checking the integrity of tanks and tank liners.

#### **D.4.2.2 Oil and Suspended Solids Removal**

Cleaning baths accumulate oil and suspended solids during use. These contaminants eventually reach a concentration that interferes with the effectiveness of the cleaning process, despite the fact that most bath constituents remain usable. Also, contaminated cleaning baths may carry over contaminants to subsequent process solutions. As a result, cleaning baths are often discarded when they reach a certain concentration of contaminants. There are several technologies used to remove oil and suspended solids from cleaning solutions, thereby extending the useful life of the solutions. These technologies are primarily applicable to alkaline cleaning baths and are discussed below.

Free/Floating Oil Separation Devices. Separation devices for oil/water mixtures use the difference in specific gravity between oils and water to remove free or floating oil from wastewater. Common separation devices for cleaning solutions include skimming devices (disks, belts, and rotating drum oil skimmers) and coalescers. These devices are not suited for emulsified oil removal, which typically is addressed through chemical treatment or membrane filtration.

Skimming is a simple method of separating floating oil from cleaning solutions. Skimming devices are typically mounted onto the side of a tank and operate on a continuous basis. The disk skimmer is a vertically rotating disk (typically 12 to 24 inches in diameter) that is partially submerged into the liquid of a tank (typically 4 to 12 inches below the surface). The disk continuously revolves between spring-loaded wiper blades that are located above the surface. The adhesive characteristics of the floating oil cause it to adhere to the disk. As the disk surface passes through the wiper blades, the oil is removed and diverted to a run-off spout for collection. Maximum skimming rates typically range from 2 to 10 gallons per hour of oil. Belt and drum skimmers operate similarly, with either a continuous belt or drum rotating partially submerged in a tank. As the surface of the belt or drum emerges from the liquid, the oil that adheres to its surface is scraped (drum) or squeezed off (belt) and diverted to a collection vessel.

Coalescers separate liquids with specific gravity differences of 0.09 and greater. Coalescers are typically tanks containing a coalescing media that accelerates phase separation (3). A suction skimmer removes cleaning solution and oil from the process tank and pumps it to the coalescer. The media in the coalescers is a material such as polypropylene, ceramic, or glass



that attracts oil in preference to water (i.e., oleophilic). The oil/cleaner mixture passes through the unit and the oil adheres to the coalescing media. The oil forms droplets that conglomerate and rise to the surface of the tank, where a skimming device or weir removes them. According to Stoke's Law, the rise/fall velocity of a dispersed-phase droplet is exponentially increased with the droplet size. Therefore, the coalescing media separates the phases more rapidly than a common gravity settling device.

**Media Filtration Methods.** Filtration removes suspended solids from cleaning solutions. Common types of filters include cartridge filters, precoat diatomaceous earth filters, and sand or multimedia filters. Cartridge filters are available with either in-tank or external configurations; the in-tank filters typically are used for small tanks and the external filters for larger tanks. Most cartridges are disposable; however, washable and reusable filters are available, which further reduce waste generation. Precoat, sand, and multimedia filters are used mostly for large tank applications. The type of filter media used is based on the chemical composition of the bath. All filtration systems are sized based on solids loading and the required flow rate. Typical flow rates for cleaning solution applications are two to three bath turnovers per hour.

**Membrane Filtration.** Microfiltration and ultrafiltration are membrane-based technologies used primarily to remove emulsified oil and other colloids from cleaning solutions. The solution entering a microfiltration or ultrafiltration unit typically is prefiltered using media filters to remove large particulates. Various devices then trap or skim floating oils and allow heavier solids to settle. The solution is pumped into the membrane compartment, where the membrane traps remaining oil and grease while water, solvent and other cleaning bath constituents pass through. The fluid flows parallel to the membrane with enough velocity to remove the reject from the membrane surface. Ceramic membranes are available in various pore sizes ranging from several hundred angstroms to over 0.2 microns. The appropriate pore size is determined by the specific cleaner to be filtered. The capacity of a unit is based on the total area and flux rate of the membrane. Commercially available units range in capacity from less than 260 to more than 1,300 gallons per day.

#### **D.4.2.3 Dissolved Metals Removal**

Metals become dissolved in acid and alkaline cleaning solutions as a result of corrosion of the base metal. The dissolved metal forms salts or other compounds that reduce the strength of the cleaning bath. Technologies used to remove dissolved metals include acid sorption, diffusion dialysis, and membrane electrolysis, discussed below.

**Acid Sorption.** Acid sorption is an acid purification technology that is applicable to various acid treatment solutions, as well as other acidic baths (e.g., anodizing baths). The acid sorption unit resembles an ion-exchange column. The column contains a bed of alkaline anion exchange resin that separates the acid from the metal ions.

First, spent acid is pumped upward through the resin; the acid is absorbed by the resin while the metal ions pass through it. The resulting metal-rich, mildly acidic solution is collected at the top of the bed. Water is then pumped downward through the bed and desorbs the acid from the resin. The purified acid solution is collected at the bottom of the bed. This technology can recover approximately 80 percent of the free acid remaining in a spent acid treatment solution. Purification can be performed in a batch mode, but is most effective in a continuous flow mode (usually expressed in terms of the mass of metal removed from the acid solution per unit of time). Equipment capacity ranges from 100 grams/hour to several thousand grams/hour. Units are sized to remove metal near or above the rate at which the metal is being introduced. Typically, a facility determines a target level of metal concentration and sizes the unit to maintain that level.

Diffusion Dialysis. Diffusion dialysis is a membrane process that separates metal contaminants from the acid solution using an acid concentration gradient between solution compartments. Anion exchange membranes makeup the compartments. The membranes are usually assembled in a membrane stack, like that used with electrodialysis. The contaminated acid passes through one set of compartments and deionized water through the adjacent compartments. Acid is diffused across the membrane into the deionized water whereas metals are blocked due to their charge and the selectivity of the membrane. Unlike electrodialysis, this process uses no electrical potential. The acid diffuses because of the difference in acid concentration on either side of the membrane (i.e., material in high concentration moves to an area of low concentration).

Membrane Electrolysis. Membrane electrolysis is a bath maintenance technology that lowers or maintains the concentration of metallic impurities in cleaning solutions. This technology is also applicable to other metal-bearing solutions (e.g., electroplating, anodizing, and stripping solutions). This technology uses an ion-exchange membrane(s) and an electrical potential applied across the membrane(s). The membrane is ion-permeable and selective, permitting ions of a given electrical charge to pass through. Cation membranes allow only cations (e.g., copper, nickel, aluminum) to pass from one electrolyte to another, while anion membranes allow only anions (e.g., sulfates, chromates, chlorides, cyanide) to pass through. Bath maintenance units can be configured with cation or anion membranes, or both.

A typical application of membrane electrolysis is maintenance of an acid cleaning solution. The cleaning solution is placed in an anode compartment that is separated from a second electrolyte by a cation membrane. The solution in the cathode compartment (i.e., catholyte) is typically a dilute acidic or alkaline solution. When an electrical potential is applied, the dissolved metals in the cleaning solution migrate through the cation membrane into the catholyte. The catholyte is periodically discarded when it becomes saturated with metals.

### **D.4.3 Condition of the Surfaces Being Cleaned**

The condition of the parts being cleaned varies widely, both in terms of the types and quantities of contaminants present and the quantity of oil. For example, some parts may have been wiped clean and have only a light deposit of metal-working fluids, while other parts may be heavily coated. Since metal-working fluids (oils) present on the parts are removed during the cleaning process (aqueous degreasing), the rate of oil that is entering into the cleaning solution per square foot of part cleaned will vary. The type of oil entering the cleaning solution will also affect the cleaning fluid's life-span.

### **D.4.4 Cleaning Requirements**

Some processes, such as electroplating, require a high degree of cleanliness while others, such as phosphate conversion coating, may have less stringent requirements. The cleaning requirements will therefore vary within a facility, as well as from facility to facility, as will the type of cleaning process selected.

Some cleaning processes are more amenable to pollution prevention practices than others, based on the purpose of the cleaning process. For example, many electroplating processes require etching of the part's surface to enhance adhesion of the electroplated metal deposit. Surface etching introduces dissolved metal into the cleaning solution and will reduce its life-span.

### **D.4.5 Type of Cleaning Process and Equipment**

The life-span of cleaning solutions depends on the type of cleaning process (i.e., process chemistry and cleaning equipment). Numerous factors affect the selection of a cleaning process, including: type and characteristics of contaminants to be removed; type and condition of base metal; size and configuration of parts; degree of cleanliness required; processing capabilities at the site; subsequent operations to be performed; and financial considerations.

The factors that most affect the selection of process chemistry and equipment are the type of contaminants present on the parts, type of base metal, and the subsequent finishing operation, which in turn dictate the cleaning requirements. Contaminants present on parts can include both organic and inorganic contaminants. Examples of organic contaminants are machining fluids, miscellaneous oils, waxes, and buffing compounds, which are typically removed by solvents, detergents, and alkaline solutions. Examples of inorganic contaminants are scale, smut, and grinding residue, which are typically removed by acidic solutions. Various methods are used to apply the cleaning solution. For example, solutions can be applied by spraying or immersing, and can be applied electrolytically (including both anodic and cathodic cleaning). Application method is primarily based on the concentration and condition of the contaminant and the configuration of the parts.

The base material of the parts is also a consideration in selecting a cleaning process. Some base materials are chemically or physically altered by certain cleaning steps because of oxidation, etching, activation, and hydrogen embrittlement. Such changes may be either desirable or damaging. The base material is also important in considering the operating conditions of the cleaning process (e.g., concentration, temperature, current). Further, the base material contaminates the cleaning solution (e.g., etching during acid treatment) and therefore affects the life span of the solution.

## **D.5            References**

1. Ayer, Jacqueline and McElligott, Anthony. "Navy Paint Booth Conversion Feasibility Study (CR 89.004)." Naval Civil Engineering Laboratory, January 1989.
2. Joseph, Ron. "Low-VOC Waterborne Coatings," Metal Finishing Organic Finishing Guidebook and Directory Issue for '94. Metal Finishing. Hackensack, NJ, May 1994.
3. Batutis, Edward, F. "Keep Your Cleaners Clean," Products Finishing. October 1989.
4. Kushner, Joseph B. Water and Waste Control for the Plating Shop. Gardner Publications, Inc., 1976.
5. Cushnie, George C. Pollution Prevention and Control Technology for Plating Operations. National Center for Manufacturing Sciences, 1994.
6. Lownheim, Frederick A. Electroplating Fundamentals of Surface Finishing. McGraw-Hill Book Co., New York, NY, 1978.
7. Murphy, Michael, Ed. Metal Finishing Guidebook and Directory Issue for 1994. Metal Finishing. Hackensack, NJ, 1994.
8. University of Northern Iowa. Cutting Fluid Management in Small Machine Shop Operations. Iowa Waste Reduction Center, Cedar Falls, Iowa, undated.
9. Master Chemical Corporation. A Guide to Coolant Management.
10. Higgins, Thomas. Hazardous Waste Minimization Handbook. Lewis Publishers, Chelsea, MI, 1989.
11. Ebasco Environmental. Hazardous Waste Minimization Study, Air Force Plant No. 6. Final Report, Norcross, GA, 1992.

12. Freeman, H.M. Standard Handbook of Hazardous Waste Treatment and Disposal. McGraw-Hill, New York, NY, 1989.
13. Thomas, Barry, "Spray Booths," Metal Finishing Organic Finishing Guidebook and Directory Issue for '94. Metal Finishing. Hackensack, NJ, May 1994.
14. Monken, Alan. "Wastewater Treatment Systems for Finishing Operations," Metal Finishing Organic Finishing Guidebook and Directory Issue for '94. Metal Finishing. Hackensack, NJ, May 1994.
15. Monken, Alan. "Water Pollution Control for Paint Booths," Metal Finishing Organic Finishing Guidebook and Directory Issue for '94. Metal Finishing. Hackensack, NJ, May 1994.
16. Brewer, George. "Electrodeposition of Organic Coatings," Metal Finishing Organic Finishing Guidebook and Directory Issue for '94. Metal Finishing. Hackensack, NJ, May 1994.
17. Marg, Ken. "HVLP Spray Puts You into Compliance." Metal Finishing. March 1989.
18. Lighthall Industries, Lighthall<sup>TM</sup> SC 70 Gun Cleaner, Lighthall Industries, Santa Cruz, CA.

## **Appendix E**

### **MODIFIED DELTA-LOGNORMAL DISTRIBUTION**

## Appendix E

### MODIFIED DELTA-LOGNORMAL DISTRIBUTION

This appendix describes the use of the modified delta-lognormal distribution to model treated effluent data and the estimation of the episode long-term averages and variability factors used to calculate the limitations and standards.<sup>1</sup> This appendix describes the statistical methodology that was used to obtain the results presented in Section 10.0.

The modified delta-lognormal distribution is a generalization of the familiar two parameter lognormal distribution. This generalized model can be used to model data sets that are a mixture of lognormally distributed values and values that are censored and/or assigned a constant value such as zero or a sample-specific detection limit. When only measured (i.e., noncensored) values are present in the data, such as all the data sets used to determine the limitations, the modified delta-lognormal distribution is equivalent to the familiar two parameter lognormal distribution. Researchers have concluded that the lognormal distribution is often useful for environmental data.<sup>2,3</sup> Furthermore, EPA has found that the lognormal consistently provides a reasonably good fit to observed effluent data distributions.<sup>4</sup> In this appendix, EPA has described the full model, that is, the modified delta-lognormal distribution, because it was used to calculate some of the loadings used in other analyses supporting this rule. This model has been used to develop effluent limitations for currently regulated industries including the Iron and Steel industry and the Centralized Waste Treatment industry.

#### E.1 Basic Overview of the Modified Delta-Lognormal Distribution

EPA selected the modified delta-lognormal distribution to model pollutant effluent concentrations from the MP&M industry in developing the long-term averages and variability factors. A typical effluent data set from a sampling episode or self-monitoring episode (see Section 3.0 for a discussion of the data associated with these episodes) consists of a mixture of measured (detected) and nondetected values. The modified delta-lognormal distribution is appropriate for such data sets because it models the data as a mixture of measurements that follow a lognormal distribution and nondetect measurements that occur with a certain probability. The model also allows for the possibility that nondetect measurements occur at multiple sample-specific detection limits. Because the data appeared

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<sup>1</sup>In the remainder of this appendix, references to 'limitations' includes 'standards.'

<sup>2</sup>e.g., see Richard O. Gilbert, Statistical Methods for Environmental Pollution Monitoring, Van Nostrand Reinhold, New York, 1987.

<sup>3</sup>W.J. Owen and T.A. DeRouen, "Estimation of the Mean for Lognormal Data Containing Zeroes and Left-Censored Values, with Applications to the Measurement of Worker Exposure to Air Contaminants," *Biometrics* 36:707-719, 1980.

<sup>4</sup>See H.D. Kahn and M.B. Rubin, "Use of Statistical Methods in Industrial Water Pollution Control Regulations in the United States," *Environmental Monitoring and Assessment*, **12**: 129-148, 1989.

to fit the modified delta-lognormal model reasonably well, EPA has determined that this model is appropriate for these data.

The modified delta-lognormal distribution is a modification of the 'delta distribution' originally developed by Aitchison and Brown.<sup>5</sup> While this distribution was originally developed to model economic data, other researchers have shown the application to environmental data.<sup>6</sup> The resulting mixed distributional model, which combines a continuous density portion with a discrete-valued spike at zero, is also known as the delta-lognormal distribution. The delta in the name refers to the proportion of the overall distribution contained in the discrete distributional spike at zero; that is, the proportion of zero amounts. The remaining nonzero, noncensored (NC) amounts are grouped together and fit to a lognormal distribution.

EPA modified this delta-lognormal distribution to incorporate multiple detection limits. In the modification of the delta portion, the single spike located at zero is replaced by a discrete distribution made up of multiple spikes. Each spike in this modification is associated with a distinct sample-specific detection limit associated with nondetected (ND) measurements in the database.<sup>7</sup> A lognormal density is used to represent the set of measured values. This modification of the delta-lognormal distribution is illustrated in Figure 1.

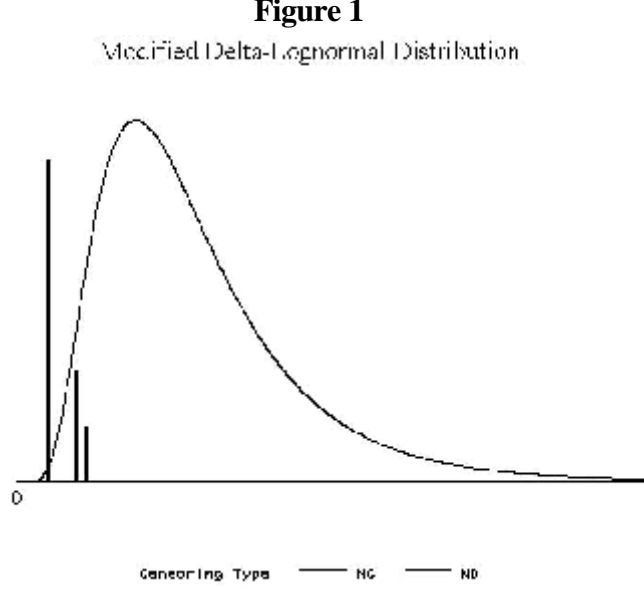
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<sup>5</sup>Aitchison, J. and Brown, J.A.C. (1963) The Lognormal Distribution. Cambridge University Press, pages 87-99.

<sup>6</sup>Owen, W.J. and T.A. DeRouen. 1980. "Estimation of the Mean for Lognormal Data Containing Zeroes and Left-Censored Values, with Applications to the Measurement of Worker Exposure to Air Contaminants." *Biometrics*, 36:707-719.

<sup>7</sup>Previously, EPA had modified the delta-lognormal model to account for nondetected measurements by placing the distributional "spike" at a single positive value, usually equal to the nominal quantitation limit, rather than at zero. For further details, see Kahn and Rubin, 1989. This adaptation was used in developing limitations and standards for the organic chemicals, plastics, and synthetic fibers (OCPSF) and pesticides manufacturing rulemakings. EPA has used the current modification in several, more recent, rulemakings.





The following two subsections describe the delta and lognormal portions of the modified delta-lognormal distribution in further detail.

## E.2 Continuous and Discrete Portions of the Modified Delta-Lognormal Distribution

The discrete portion of the modified delta-lognormal distribution models the nondetected values corresponding to the  $k$  reported sample-specific detection limits. In the model,  $*$  represents the proportion of nondetected values in the dataset and is the sum of smaller fractions,  $*_i$ , each representing the proportion of nondetected values associated with each distinct detection limit value. By letting  $D_i$  equal the value of the  $i^{\text{th}}$  smallest distinct detection limit in the data set and the random variable  $X_D$  represents a randomly chosen nondetected measurement, the cumulative distribution function of the discrete portion of the modified delta-lognormal model can be mathematically expressed as:

$$\Pr(X_D \leq c) = \frac{1}{d} \sum_{i: D_i \leq c} d_i \quad 0 < c \quad (\text{E-1})$$

The mean and variance of this discrete distribution can be calculated using the following formulas:

$$E(X_D) = \frac{1}{d} \sum_{i=1}^k d_i D_i \quad (\text{E-2})$$

$$\text{Var}(X_D) = \frac{1}{d} \sum_{i=1}^k d_i (D_i - E(X_D))^2 \quad (\text{E-3})$$

The continuous, lognormal portion of the modified delta-lognormal distribution was used to model the detected measurements from the MP&M industry database. The cumulative probability distribution of the continuous portion of the modified delta-lognormal distribution can be mathematically expressed as:

$$\Pr[X_C \leq c] = \Phi \left[ \frac{\ln(c) - m}{s} \right] \quad (\text{E-4})$$

where the random variable  $X_C$  represents a randomly chosen detected measurement,  $M$  is the standard normal distribution, and  $m$  and  $s$  are parameters of the distribution.

The expected value,  $E(X_C)$ , and the variance,  $\text{Var}(X_C)$ , of the lognormal distribution can be calculated as:

$$E(X_C) = \exp \left( m + \frac{s^2}{2} \right) \quad (\text{E-5})$$

$$\text{Var}(X_C) = [E(X_C)]^2 \left( \exp(s^2) - 1 \right) \quad (\text{E-6})$$

### E.3 Combining the Continuous and Discrete Portions

The continuous portion of the modified delta-lognormal distribution is combined with the discrete portion to model data sets that contain a mixture of nondetected and detected measurements. It is possible to fit a wide variety of observed effluent data sets to the modified delta-lognormal distribution. Multiple detection limits for nondetect measurements are incorporated, as are measured ("detected") values. The same basic framework can be used even if there are no nondetected values in the data set (in this case, it is the same as the lognormal distribution). Thus, the modified delta-lognormal distribution offers a large degree of flexibility in modeling effluent data.

The modified delta-lognormal random variable  $U$  can be expressed as a combination of three other independent variables, that is,

$$U = I_u X_D + (1 - I_u) X_C \quad (\text{E-7})$$

where  $X_D$  represents a random nondetect from the discrete portion of the distribution,  $X_C$  represents a random detected measurement from the continuous lognormal portion, and  $I_u$  is an indicator variable signaling whether any particular random measurement,  $u$ , is nondetected or noncensored (that is,  $I_u=1$  if  $u$  is nondetected;  $I_u=0$  if  $u$  is noncensored). Using a weighted sum, the cumulative distribution function from the discrete portion of the distribution (equation 1) can be combined with the function from the

continuous portion (equation 4) to obtain the overall cumulative probability distribution of the modified delta-lognormal distribution as follows,

$$\Pr(U \leq c) = \sum_{i: D_i \leq c} \mathbf{d}_i + (1 - \mathbf{d}) \Phi \left[ \frac{\ln(c) - \mathbf{m}}{\mathbf{s}} \right] \quad (\text{E-8})$$

where  $D_i$  is the value of the  $i^{\text{th}}$  sample-specific detection limit.

The expected value of the random variable  $U$  can be derived as a weighted sum of the expected values of the discrete and continuous portions of the distribution (equations 2 and 5, respectively) as follows

$$E(U) = \mathbf{d} E(X_D) + (1 - \mathbf{d}) E(X_C) \quad (\text{E-9})$$

In a similar manner, the expected value of the random variable squared can be written as a weighted sum of the expected values of the squares of the discrete and continuous portions of the distribution as follows

$$E(U^2) = \mathbf{d} E(X_D^2) + (1 - \mathbf{d}) E(X_C^2) \quad (\text{E-10})$$

Although written in terms of  $U$ , the following relationship holds for all random variables,  $U$ ,  $X_D$ , and  $X_C$ .

$$E(U^2) = \text{Var}(U) + [E(U)]^2 \quad (\text{E-11})$$

So using equation 11 to solve for  $\text{Var}(U)$ , and applying the relationships in equations 9 and 10, the variance of  $U$  can be obtained as

$$\text{Var}(U) = \mathbf{d} \left( \text{Var}(X_D) + [E(X_D)]^2 \right) + (1 - \mathbf{d}) \left( \text{Var}(X_C) + [E(X_C)]^2 \right) - [E(U)]^2 \quad (\text{E-12})$$

#### **E.4 Episode-specific Estimates Under the Modified Delta-Lognormal Distribution**

In order to use the modified delta-lognormal model to calculate the limitations, the parameters of the distribution are estimated from the data. These estimates are then used to calculate the limitations.

The parameters  $\hat{\mathbf{d}}_i$  and  $\hat{\mathbf{d}}$  are estimated from the data using the following formulas:

$$\begin{aligned}\hat{\mathbf{d}}_i &= \frac{1}{n} \sum_{j=1}^{n_d} I(d_j = D_i) \\ \hat{\mathbf{d}} &= \frac{n_d}{n}\end{aligned}\tag{E-13}$$

where  $n_d$  is the number of nondetected measurements,  $d_j, j = 1$  to  $n_d$ , are the detection limits for the nondetected measurements,  $n$  is the number of measurements (both detected and nondetected) and  $I(\dots)$  is an indicator function equal to one if the expression within the parentheses is true and zero otherwise. The "hat" over the parameters indicates that they are estimated from the data. When all of the data are noncensored,  $\hat{\mathbf{d}}$  is equal to zero and the modified delta-lognormal distribution is equivalent to the lognormal distribution.

The expected value and the variance of the delta portion of the modified delta-lognormal distribution can be calculated from the data as:

$$\hat{E}(X_D) = \frac{1}{\hat{\mathbf{d}}} \sum_{i=1}^k \hat{\mathbf{d}}_i D_i \tag{E-14}$$

$$\hat{Var}(X_D) = \frac{1}{\hat{\mathbf{d}}} \sum_{i=1}^k \hat{\mathbf{d}}_i (D_i - \hat{E}(X_D))^2 \tag{E-15}$$

The parameters of the continuous portion of the modified delta-lognormal distribution,  $\hat{\mathbf{m}}$  and  $\hat{\mathbf{s}}^2$ , are estimated by

$$\begin{aligned}\hat{\mathbf{m}} &= \sum_{i=1}^{n_c} \frac{\ln(x_i)}{n_c} \\ \hat{\mathbf{s}}^2 &= \sum_{i=1}^{n_c} \frac{(\ln(x_i) - \hat{\mathbf{m}})^2}{n_c - 1}\end{aligned}\tag{E-16}$$

where  $x_i$  is the  $i^{\text{th}}$  detected measurement value and  $n_c$  is the number of detected measurements. Note that  $n = n_d + n_c$ .

The expected value and the variance of the lognormal portion of the modified delta-lognormal distribution can be calculated from the data as:

$$\hat{E}(X_C) = \exp\left(\hat{\mathbf{m}} + \frac{\hat{\mathbf{s}}^2}{2}\right) \tag{E-17}$$

$$\hat{V}ar(X_C) = \left[ \hat{E}(X_C) \right]^2 \left( \exp(\hat{S}^2) - 1 \right) \quad (\text{E-18})$$

Finally, the expected value and variance of the modified delta-lognormal distribution can be estimated using the following formulas:

$$\hat{E}(U) = \hat{d} \hat{E}(X_D) + (1 - \hat{d}) \hat{E}(X_C) \quad (\text{E-19})$$

$$\hat{V}ar(U) = \hat{d} \left( \hat{V}ar(X_D) + \left[ \hat{E}(X_D) \right]^2 \right) + (1 - \hat{d}) \left( \hat{V}ar(X_C) + \left[ \hat{E}(X_C) \right]^2 \right) - \left[ \hat{E}(U) \right]^2 \quad (\text{E-20})$$

Equations 17 through 20 are particularly important in the estimation of episode long-term averages and variability factors as described in the following sections. These sections are preceded by a section that identifies the episode data set requirements.

Example:

Consider a facility that has 10 samples with the following concentrations:

Sample number	Measurement Type	Concentration (mg/L)
1	ND	10
2	ND	15
3	ND	15
4	ND	20
5	NC	25
6	NC	25
7	NC	30
8	NC	35
9	NC	35
10	NC	40

The ND components of the variance equation are:

$$D_1 = 10, \hat{d}_1 = 1/10$$

$$D_2 = 15, \hat{d}_2 = 1/5$$

$$D_3 = 20, \hat{d}_3 = 1/10.$$

Since  $\hat{\mathbf{d}} = 2/5$ , the expected value and the variance of the discrete portion of the modified delta-lognormal distribution are

$$\hat{E}(X_D) = \frac{1}{2/5} \left( \frac{1}{10} \times 10 + \frac{1}{5} \times 15 + \frac{1}{10} \times 20 \right) = 15,$$

$$\hat{Var}(X_D) = \frac{1}{2/5} \left( \frac{1}{10} \times (10-15)^2 + \frac{1}{5} \times (15-15)^2 + \frac{1}{10} \times (20-15)^2 \right) = 12.5.$$

The mean and variance of the log NC values are calculated as follows:

$$\hat{\mu} = \frac{\sum_{i=1}^{n_c} \ln(x_i)}{n_c} = \frac{(2 \times \ln(25) + \ln(30) + 2 \times \ln(35) + \ln(40))}{6} = 3.44$$

$$\hat{s}^2 = \frac{\sum_{i=1}^{n_c} (\ln(x_i) - \hat{\mu})^2}{n_c - 1} = \frac{(2 \times (\ln(25) - 3.44)^2) + (\ln(30) - 3.44)^2 + (2 \times (\ln(35) - 3.44)^2) + (\ln(40) - 3.44)^2}{5} = 0.0376$$

Then, the expected value and the variance of the lognormal portion of the modified delta-lognormal distribution are

$$\hat{E}(X_C) = \exp \left( 3.44 + \frac{0.0376}{2} \right) = 31.779$$

$$\hat{Var}(X_C) = [31.779]^2 (\exp(0.0376) - 1) = 38.695.$$

The expected value and variance of the modified delta-lognormal distribution are

$$\hat{E}(U) = \frac{2}{5} \times 15 + \left( 1 - \frac{2}{5} \right) \times 31.779 = 25.067$$

$$\hat{Var}(U) = \frac{2}{5} \times (12.5 + 15^2) + \left( 1 - \frac{2}{5} \right) \times (38.695 + 31.779^2) - 25.067^2 = 95.781.$$

### **E.4.1 Episode Data Set Requirements**

Estimates of the necessary parameters for the lognormal portion of the distribution can be calculated with as few as two distinct detected values in a data set. (In order to calculate the variance of the modified delta-lognormal distribution, two distinct detected values are the minimum number that can be used and still obtain an estimate of the variance for the distribution.)

If an episode data set for a pollutant contained three or more observations with two or more distinct detected concentration values, then EPA used the modified delta-lognormal distribution to calculate long-term averages and variability factors. If the episode data set for a pollutant did not meet these requirements, EPA used an arithmetic average to calculate the episode long-term average and excluded the dataset from the variability factor calculations (because the variability could not be calculated).

In statistical terms, each measurement was assumed to be independently and identically distributed from the other measurements of that pollutant in the episode data set.

The next two sections apply the modified delta-lognormal distribution to the data for estimating episode long-term averages and variability factors for the MP&M industry.

### **E.4.2 Estimation of Episode Long-Term Averages**

If an episode dataset for a pollutant meets the requirements described in the last section, then EPA calculated the long-term average using equation 19. Otherwise, EPA calculated the long-term average as the arithmetic average of the daily values where the sample-specific detection limit was used for each nondetected measurement.

### **E.4.3 Estimation of Episode Daily Variability Factors**

For each episode, EPA estimated the daily variability factors by fitting a modified delta-lognormal distribution to the daily measurements for each pollutant. The episode daily variability factor is a function of the expected value, and the 99th percentile of the modified delta-lognormal distribution fit to the daily concentration values of the pollutant in the wastewater from the episode. The expected value, was estimated using equation 19 (the expected value is the same as the episode long-term average).

The 99<sup>th</sup> percentile of the modified delta-lognormal distribution fit to each data set was estimated by using an iterative approach. First, the pollutant-specific detection limits were ordered from smallest to largest. Next, the cumulative distribution function,  $p$ , for each detection limit was computed. The general form, for a given value  $c$ , was:

$$p = \sum_{i:D_i \leq c} \hat{d}_i + (1 - \hat{d}) \Phi \left[ \frac{\ln(c) - \hat{m}}{\hat{s}} \right] \quad (\text{E-21})$$

where  $M$  is the standard normal cumulative distribution function. Next, the interval containing the 99<sup>th</sup> percentile was identified. Finally, the 99<sup>th</sup> percentile of the modified delta-lognormal distribution was calculated. The following steps were completed to compute the estimated 99<sup>th</sup> percentile of each data subset:

- Step 1      Using equation 21,  $k$  values of  $p$  at  $c=D_m$ ,  $m=1, \dots, k$  were computed and labeled  $p_m$ .
- Step 2      The smallest value of  $m$  ( $m=1, \dots, k$ ), such that  $p_m \leq 0.99$ , was determined and labeled as  $p_j$ . If no such  $m$  existed, steps 3 and 4 were skipped and step 5 was computed instead.
- Step 3      Computed  $p^* = p_j - \hat{d}_j$ .
- Step 4      If  $p^* < 0.99$ , then  $\hat{P}_{99} = D_j$   
                  else if  $p^* \geq 0.99$ , then

$$\hat{P}_{99} = \exp \left( \hat{m} + \hat{s} \Phi^{-1} \left[ \frac{0.99 - \sum_{i=1}^{j-1} \hat{d}_i}{1 - \hat{d}} \right] \right) \quad (\text{E-22})$$

where  $M^{-1}$  is the inverse normal distribution function.

- Step 5      If no such  $m$  exists such that  $p_m > 0.99$  ( $m=1, \dots, k$ ), then

$$\hat{P}_{99} = \exp \left( \hat{m} + \hat{s} \Phi^{-1} \left[ \frac{0.99 - \hat{d}}{1 - \hat{d}} \right] \right) \quad (\text{E-23})$$

The episode daily variability factor, VF1, was then calculated as:

$$VF1 = \frac{\hat{P}_{99}}{\hat{E}(U)} \quad (\text{E-24})$$

Example:€

Since no such  $m$  exists such that  $p_m > 0.99$  ( $m=1, \dots, k$ ), €



$$\hat{P}_{99} = \exp\left(3.44 + 0.194 \times \Phi^{-1}\left[\frac{0.99 - 0.4}{1 - 0.4}\right]\right) = 47.126.$$

The episode daily variability factor, VF1, was then calculated as:

$$VF1 = \frac{47.126}{25.067} = 1.880.$$

To identify situations producing unexpected results, EPA reviewed all of the variability factors. EPA used several criteria to determine if the episode daily variability factors should be included in calculating the option variability factors. One criteria that EPA used was that the daily variability factors should be greater than 1.0. A variability factor less than 1.0 would result in an unexpected result where the estimated 99<sup>th</sup> percentile would be less than the long-term average. This would be an indication that the estimate of  $\hat{S}$  (the log standard deviation) was unstable. A second criteria was that not all of the sample-specific detection limits could exceed the values of the noncensored values. All the episode variability factors used for the limitations and standards met these criteria.

## E.5 References

1. Aitchison, J. and J.A.C. Brown. 1963. *The Lognormal Distribution*. Cambridge University Press, New York.
2. Barakat, R. 1976. "Sums of Independent Lognormally Distributed Random Variables." *Journal of the Optical Society of America*, 66: 211-216.
3. Cohen, A. Clifford. 1976. Progressively Censored Sampling in the Three Parameter Log-Normal Distribution. *Technometrics*, 18:99-103.
4. Crow, E.L. and K. Shimizu. 1988. *Lognormal Distributions: Theory and Applications*. Marcel Dekker, Inc., New York.
5. Kahn, H.D., and M.B. Rubin. 1989. "Use of Statistical Methods in Industrial Water Pollution Control Regulations in the United States." *Environmental Monitoring and Assessment*. Vol. 12:129-148.
6. Owen, W.J. and T.A. DeRouen. 1980. Estimation of the Mean for Lognormal Data Containing Zeroes and Left-Censored Values, with Applications to the Measurement of Worker Exposure to Air Contaminants. *Biometrics*, 36:707-719.

7. U.S. Environmental Protection Agency. 2000. Development Document for Effluent Limitations Guidelines and Standards for the Centralized Waste Treatment Point Source Category. Volume I, Volume II. EPA 440/1-87/009.
8. U.S. Environmental Protection Agency. 2002. Development Document for Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category. EPA-821-R-02-004.