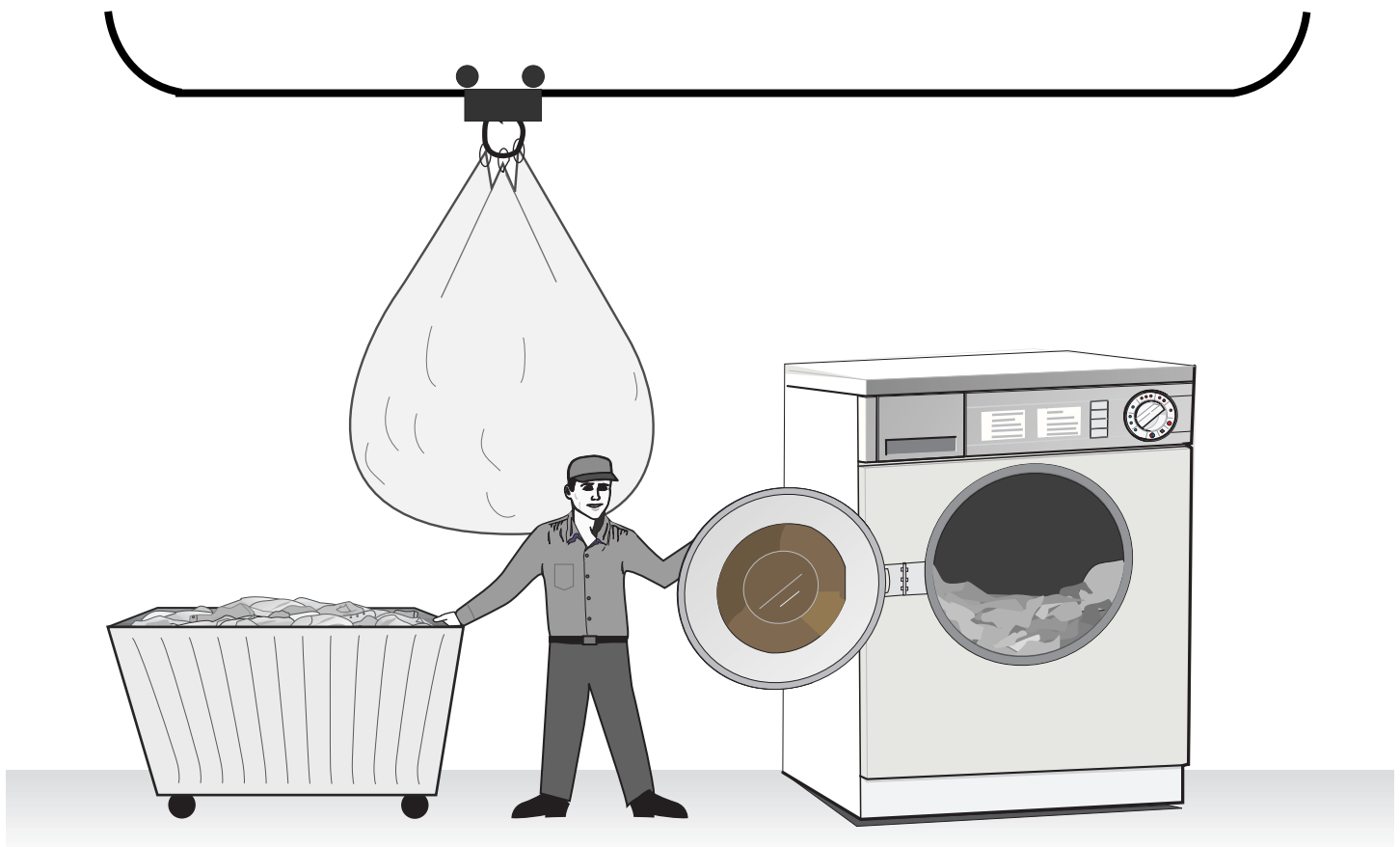




Technical Development Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category



**TECHNICAL DEVELOPMENT DOCUMENT FOR
PROPOSED PRETREATMENT STANDARDS
FOR EXISTING AND NEW SOURCES
FOR THE
INDUSTRIAL LAUNDRIES POINT SOURCE CATEGORY**

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FOREWORD

This document delineates the development of the proposed pretreatment standards for the Industrial Laundries Point Source Category. Throughout the document, EPA refers to many commonly used titles and phrases by their acronyms to avoid spelling them out each time. As an aid to the reader, EPA has included in Chapter 16 a glossary of commonly used acronyms and definitions of terms used throughout the document.

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CHAPTER 1

BACKGROUND

1.1 Introduction

This chapter presents background information supporting the development of effluent limitations guidelines and standards for the Industrial Laundries Point Source Category. Section 1.2 presents the legal authority to regulate the industrial laundries industry. Section 1.3 discusses the Clean Water Act, the Pollution Prevention Act, and the Regulatory Flexibility Act as amended by the Small Business Regulatory Enforcement Fairness Act, as well as prior regulation of the industrial laundries industry.

1.2 Legal Authority

This regulation for the Industrial Laundries Point Source Category is being proposed under authority of sections 301, 304, 306, 307, 308, and 501 of the Clean Water Act (the Federal Water Pollution Control Act Amendments of 1972, 33 U.S.C. 1251 et seq., as amended by the Clean Water Act of 1977, Pub. L. 95-217, and the Water Quality Act of 1987, Pub. L. 100-4), also referred to as "the CWA" or "the Act."

1.3 Background

1.3.1 Clean Water Act

The Federal Water Pollution Control Act Amendments of 1972 established a comprehensive program to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters" (section 101(a)). To implement the Act, EPA is to issue effluent limitations guidelines, pretreatment standards, and new source performance standards for industrial dischargers.

These guidelines and standards are summarized briefly below:

1. Best Practicable Control Technology Currently Available (BPT) (section 304(b)(1) of the Act).

BPT effluent limitations guidelines are generally based on the average of the best existing performance by plants of various sizes, ages, and unit processes within the category or subcategory for control of pollutants.

In establishing BPT effluent limitations guidelines, EPA considers the total cost of achieving effluent reductions in relation to the effluent reduction benefits, the age of equipment and facilities involved, the processes

employed, process changes required, engineering aspects of the control technologies, non-water quality environmental impacts (including energy requirements) and other factors as the EPA Administrator deems appropriate (section 304(b)(1)(B) of the Act). The Agency considers the category- or subcategory-wide cost of applying the technology in relation to the effluent reduction benefits. Where existing performance is uniformly inadequate, BPT may be transferred from a different subcategory or category.

2. Best Available Technology Economically Achievable (BAT) (sections 304(b)(2)(B) and 307(a)(2) of the Act).

In general, BAT effluent limitations represent the best existing economically achievable performance of plants in the industrial subcategory or category. The Act establishes BAT as the principal national means of controlling the direct discharge of priority pollutants and nonconventional pollutants to navigable waters. The factors considered in assessing BAT include the age of equipment and facilities involved, the process employed, potential process changes, and non-water quality environmental impacts, including energy requirements (section 304(b)(2)(B)). The Agency retains considerable discretion in assigning the weight to be accorded these factors. As with BPT, where existing performance is uniformly inadequate, BAT may be transferred from a different subcategory or category. BAT may include process changes or internal controls, even when these technologies are not common industry practice.

3. Best Conventional Pollutant Control Technology (BCT) (section 304(a)(4) of the Act).

The 1977 Amendments added section 301(b)(2)(E) to the Act establishing BCT for discharges of conventional pollutants from existing industrial point sources. Section 304(a)(4) designated the following as conventional pollutants: biochemical oxygen demanding pollutants (BOD), 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).

BCT is not an additional limitation, but replaces BAT for the control of conventional pollutants. In addition to other factors specified in section 304(b)(4)(B), the Act requires that BCT limitations be established in light of a two part "cost-reasonableness" test. [*American Paper Institute v. EPA*, 660 F.2d 954 (4th Cir. 1981)]. EPA's current methodology for the

general development of BCT limitations was issued in 1986 (51 FR 24974; July 9, 1986).

4. New Source Performance Standards (NSPS) (section 306 of the Act).

NSPS are based on the best available demonstrated treatment technology. New plants have the opportunity to install the best and most efficient production processes and wastewater treatment technologies. As a result, NSPS should represent the most stringent numerical values attainable through the application of the best available demonstrated control technology for all pollutants (i.e., conventional, nonconventional, and priority pollutants). In establishing NSPS, EPA is directed to take into consideration the cost of achieving the effluent reduction and any non-water quality environmental impacts and energy requirements.

5. Pretreatment Standards for Existing Sources (PSES) (section 307(b) of the Act).

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). The Act requires pretreatment standards for pollutants that pass through POTWs or interfere with POTWs' treatment processes or sludge disposal methods. The legislative history of the 1977 Act indicates that pretreatment standards are to be technology-based and analogous to the BAT effluent limitations guidelines for removal of toxic pollutants. For the purpose of determining whether to promulgate national category-wide pretreatment standards, EPA generally determines that there is pass through of a pollutant and thus a need for categorical standards if the nationwide average percent of a pollutant removed by well-operated POTWs achieving secondary treatment is less than the percent removed by the BAT model treatment system.

The General Pretreatment Regulations, which set forth the framework for the implementation of categorical pretreatment standards, are found at 40 CFR Part 403. Those regulations contain a definition of pass through that addresses localized rather than national instances of pass through and does not use the percent removal comparison test described above (52 FR 1586; January 14, 1987).

6. Pretreatment Standards for New Sources (PSNS) (section 307(b) of the Act).

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, like the new direct 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.

1.3.2 Pollution Prevention Act (PPA)

In the Pollution Prevention Act of 1990 (42 U.S.C. 13101 *et seq.*, Pub.L. 101-508, November 5, 1990), Congress declared pollution prevention to be the national policy of the United States. The Act declares that pollution should be prevented or reduced whenever feasible; pollution that cannot be prevented should be recycled or reused in an environmentally safe manner wherever feasible; pollution that cannot be recycled should be treated; and disposal or release into the environment should be chosen only as a last resort. 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)). This proposed regulation for the Industrial Laundries Point Source Category was reviewed for its incorporation of pollution prevention as part of EPA's effort. Chapter 8 of this document describes the results of this effort.

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

Under the Regulatory Flexibility Act (RFA), 5 U.S.C. 601 *et seq.*, as amended by SBREFA, EPA generally is required to conduct an initial regulatory flexibility analysis (IFRA) describing the impact of the proposed rule on small entities. Under section 605(b) of the RFA, if the Administrator certifies that the rule will not have a significant impact on a substantial number of small entities, EPA is not required to prepare the IFRA.

Although this proposed rule minimizes impacts on small businesses through an exclusion, EPA conducted an IFRA pursuant to section 603(b) of the RFA addressing:

- The need for, objectives of, and legal basis for the rule.
- A description of, and where feasible, an estimate of the number of small entities to which the rule would apply.
- The projected reporting, recordkeeping, and other compliance requirements of the rule, including an estimate of the classes of small

entities that would be subject to the rule and the types of professional skills necessary for preparation of the report or record.

- An identification, where practicable, of all relevant federal rules which may duplicate, overlap, or conflict with the proposed rule.
- A description of any significant regulatory alternatives to the proposed rule which accomplish the stated objectives of applicable statutes and which minimize any significant economic impact of the proposed 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.
 - Clarification, consolidation, or simplification of compliance and reporting requirements under the rule for such small entities.
 - The use of performance rather than design standards.
 - An exclusion from coverage of the rule, or any part thereof, for such small entities. Based on the IRFA and other factors, this proposed rule incorporates an exclusion to eliminate disproportionate impacts on small businesses and also reduces the number of small businesses affected by the proposed rule.

Pursuant to the RFA as amended by SBREFA, EPA convened a Small Business Advocacy Review Panel. The Panel is comprised of 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 RFA, and collected the advice and recommendations of small entity representatives. For this proposed rule, the small entity representatives included owners of small industrial laundries and trade association representatives. The Panel prepared a report (available in the administrative record for this rulemaking) that summarizes their outreach to small entities and the comments submitted by the small entity representatives. The Panel's report also presents their findings on issues related to the elements of an IRFA.

1.3.4 Prior Regulation of the Industrial Laundries Point Source Category

The Federal Water Pollution Control Act Amendments of 1972 established a program to clean up the nation's waters that consisted of, along with other requirements, a program of establishing technology-based effluent limitations guidelines for point source dischargers by industry categories and a timetable for issuing these guidelines. Pursuant to a 1976

settlement agreement and subsequently the 1977 Clean Water Act Amendments, EPA was required to develop a program and adhere to a schedule in promulgating effluent limitations guidelines and pretreatment standards for 65 "toxic" pollutants and classes of pollutants, for 21 major industries. Moreover, the Agency is required by section 301 (d) of the Federal Water Pollution Control Act Amendments of 1972 and the Clean Water Act of 1977 to review and revise, if necessary, effluent limitations promulgated pursuant to sections 301, 304, 306, 307, 308, and 501 of the Act.

The Auto and Other Laundries Category, of which industrial laundries was a subcategory, was one of the categories mandated for study and possible effluent limitations guidelines and standards development by the 1976 Settlement Agreement. Several studies were undertaken in 1977 through 1980 to collect more information about the industrial laundries industry, including two surveys (1977 and 1979) and wastewater sampling and analysis programs conducted in 1978 (screening and verification study). However, in 1982, the Auto and Other Laundries Category, including the industrial laundries subcategory, was excluded from regulation. The industrial laundries subcategory was excluded because, based on assessments made at that time, it was determined that 95 percent of the industry discharged pollutants that could be treated by POTWs and that did not pass through, interfere with, or otherwise prove incompatible with the operation of POTWs.

However, following these assessments, additional data were collected by the Industrial Technology Division (ITD - now Engineering and Analysis Division (EAD)) as part of work efforts in conjunction with EPA's Office of Solid Waste's Resource Conservation and Recovery Act (RCRA) Program in 1985 through 1987. In 1986, EPA published its Domestic Sewage Study (DSS), which identified industrial laundries as potential contributors of large amounts of hazardous pollutants to the POTWs. Based on information gathered to that point, the Agency compiled a profile of the industrial laundries industry that was published as a Preliminary Data Summary in 1989.

Section 304(m) of the Clean Water Act (33 U.S.C. 1314(m)), added by the Water Quality Act of 1987, requires EPA to establish schedules for (i) reviewing and revising existing effluent limitations guidelines and standards ("effluent guidelines"), and (ii) promulgating new effluent guidelines. On January 2, 1990, EPA published an Effluent Guidelines Plan (55 FR 80), in which schedules were established for developing new and revised effluent guidelines for several industrial categories. In addition, the plan listed several industrial categories that were to be studied to determine whether rulemakings to develop effluent guidelines and standards should be initiated. One of those categories was the Industrial Laundries Point Source Category, based on the results of the 1985 to 1987 work contained in the DSS.

Natural Resources Defense Council, Inc. (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. Reilly, Civ. No. 89-2980). The plaintiffs charged that EPA's plan did not meet the requirements of section 304(m). A Consent Decree (the "304(m) Decree") in this litigation was entered by the Court on January 31, 1992 (57 FR 19748), which established

schedules for, among other things, EPA's proposal and promulgation of effluent guidelines for a number of categories, including the Industrial Laundries Point Source Category. The most recent Effluent Guidelines Plan update was published on February 26, 1997 (62 FR 8726). This plan requires, among other things, that EPA propose effluent limitations guidelines and pretreatment standards for the Industrial Laundries Point Source Category by September 1997 and take final action by June 1999. Further modification of the Decree in August 1997 set the proposal date no later than November 7, 1997.

CHAPTER 2

SUMMARY

2.1 Introduction

The proposed regulations for the industrial laundries industry include pretreatment standards for the control of wastewater pollutants. This chapter presents a summary of the proposed rule. Section 2.2 presents a brief overview of the industry, Section 2.3 discusses the scope of the proposed rule, Section 2.4 describes the proposed exclusion to the rule, and Sections 2.5 through 2.7 summarize the proposed pretreatment standards and effluent limitations guidelines.

2.2 Overview of the Industrial Laundries Industry

The industrial laundries industry includes facilities that launder or dry clean industrial garments and uniforms, shop towels, printer towels/rags, mops, mats, and dust-control items. Either the laundry facilities or their customers own the laundered items. Many facilities covered by the proposed rule also wash other items not classified as industrial laundry items, such as linen supply garments, linen flatwork, health-care items, and miscellaneous other items.

Industrial laundry facilities are located in all 50 states and all 10 EPA Regions. By state, the largest number of laundries are located in California. By EPA Region, the largest concentration of laundries is in Region IV. Most of the laundering facilities are situated in large urban areas. EPA estimates that there are 1,747 industrial laundry facilities nationwide.

Industrial laundries vary in size from one- to two-person shops to large corporations that operate many facilities nationwide. The industry shows a corresponding wide range of annual laundry production. Facilities laundering more than 15,000,000 pounds per year account for approximately eight percent of the total industry, whereas facilities laundering less than 3,000,000 pounds per year account for approximately 37 percent of the total industry. Approximately 10 percent of the facilities that meet EPA's definition of an industrial laundry launder less than 1,000,000 pounds per year.

Facilities launder most items using water washing. Water washing involves washing items in water. Some facilities launder items using dry cleaning, which involves washing items in an organic solvent. In some cases, facilities combine the two processes to wash items that have large amounts of both water-soluble and organic solvent-soluble soils. When water washing and dry cleaning are performed in series without drying the items between the water and solvent phases, the process is called dual-phase washing. The order in which these processes are performed depends on the solvent used, type of soil, and drying energy requirements. Some mops are laundered through a combination of water washing and oil treatment. The oil is applied to the mop to help collect dust.

Facilities water-wash nearly 97 percent of their items using a standard process. Approximately one percent of laundered items are dry-cleaned, including some items that are dry-cleaned and then water-washed. Dual-phase washing and mop cleaning with water and oil each accounts for less than one percent of the total production. The remaining laundry items are processed using other cleaning operations (e.g., oil cleaning of mops in a process that does not use any water).

Based on data collected by EPA for this rulemaking, industrial laundries use over 90 percent of all incoming service water as laundry process water, followed in descending amounts by sanitary water, noncontact cooling water, and boiler water. Chemicals frequently used in industrial laundry operations include alkaline solutions, detergents, bleach, antichlor, sour, softeners, and starch. A variety of other items that are added to some wash formulas include enzymes, builders, oil treatment chemicals, water conditioners, dyes, stain treatment chemicals, and bactericides. The primary pollutants discharged by industrial laundries are all of the conventional pollutants except fecal coliform (oil and grease, biochemical oxygen demand (BOD₅), and total suspended solids (TSS)), and a number of priority and nonconventional pollutants, including copper, lead, zinc, ethylbenzene, toluene, and total petroleum hydrocarbons (TPH), measured as silica gel treated hexane extractable material. All of the industrial laundries identified by EPA discharge their process wastewater to publicly owned treatment works (POTWs).

2.3 Scope of the Proposed Regulation

The proposed pretreatment standards apply to process wastewater discharges from new and existing industrial laundries. EPA is proposing the following definition of industrial laundries: An industrial laundry is any facility that launders industrial textile items from off site as a business activity (i.e., launders industrial textile items for other business entities for a fee or through a cooperative arrangement). Either the industrial laundry facility or the off-site customer may own the industrial laundered textile items. This definition includes textile rental companies that perform laundering operations. Laundering means washing with water, including water washing following dry cleaning. This rule would not apply to laundering exclusively through dry cleaning. Industrial textile items include, but are not limited to industrial: shop towels, printer towels/rags, furniture towels, rags, mops, mats, rugs, tool covers, fender covers, dust-control items, gloves, buffing pads, absorbents, uniforms, filters, and clean room items. If any of these items are used for hotels, hospitals, or restaurants, they are not industrial items.

The proposed rule would not apply to discharges from on-site laundering at industrial facilities, laundering of industrial textile items originating from the same business entity, and facilities that exclusively launder linen items, denim prewash items, new items (i.e., items directly from the textile manufacturer, not yet used for their intended purpose), any other laundering of hotel, hospital, or restaurant items, or any combination of these items. This proposed rule would apply to hotel, hospital, or restaurant laundering of industrial textile items. In addition, this rule would not apply to discharges from the oil-only treatment of mops. Linen items include sheets, pillowcases, blankets, bath towels and washcloths, hospital gowns and robes,

tablecloths, napkins, tableskirts, kitchen textile items, continuous roll towels, laboratory coats, household laundry (such as clothes, but not industrial uniforms), executive wear, mattress pads, incontinence pads, and diapers (this list is meant to be all-inclusive).

For facilities covered under the industrial laundry definition, wastewater from all water-washing operations would be covered, including the washing of linen items, as long as these items do not constitute 100 percent of the items washed.

2.4 Exclusion

Under Pretreatment Standards for Existing Sources (PSES), EPA is proposing to exclude existing facilities that launder less than one million pounds of incoming laundry per calendar year and less than 255,000 pounds of shop and/or printer towels/rags per calendar year. EPA proposes this exclusion to eliminate the unacceptable economic impacts on these smaller facilities. The excluded facilities would be disproportionately adversely impacted relative to all facilities covered by this rule. Most of the excluded facilities are small entities under the Small Business Administration (SBA) definition of small entity. The excluded facilities account for less than three percent of the pollutant removals from U.S. waters than would occur if the rule were implemented without the exclusion.

Under Pretreatment Standards for New Sources (PSNS), EPA is proposing no exclusions for new sources since the economic projections indicate that there would be no barrier to entry as a result of the proposed new source standards.

2.5 Pretreatment Standards for Existing Sources (PSES)

EPA is proposing PSES numerical limitations based on chemical precipitation technology treatment of industrial laundry wastewater for 11 priority and nonconventional pollutants. The pretreatment standards are applicable to all process wastewater discharged by facilities that are within the scope of the rule. Industrial laundries laundering less than one million pounds per year of industrial laundry and less than 255,000 pounds per year of shop and/or printer towels/rags are excluded from regulation under PSES. PSES are presented in Table 2-1.

2.6 Pretreatment Standards for New Sources (PSNS)

EPA is proposing PSNS based on chemical precipitation of industrial laundry wastewater for 11 priority and nonconventional pollutants. The new source standards are applicable to all process wastewater discharged by industrial laundries that meet the definition of a new source. PSNS are presented in Table 2-1.

Table 2-1**Proposed PSES and PSNS for the Industrial Laundries Industry**

Pollutant or Pollutant Property	Proposed PSES and PSNS for End-of-Pipe Monitoring Points	
	Maximum for any 1 day (mg/L)	Monthly Average (mg/L)
Copper	0.24	--- ¹
Lead	0.27	--- ¹
Zinc	0.61	--- ¹
Bis(2-ethylhexyl) Phthalate	0.13	--- ¹
Ethylbenzene	1.64	--- ¹
Naphthalene	0.23	--- ¹
Tetrachloroethene	1.71	--- ¹
Toluene	2.76	--- ¹
<i>m</i> -Xylene ²	1.33	--- ¹
<i>o</i> -& <i>p</i> -Xylene ²	0.95	--- ¹
TPH (as SGT-HEM) ³	27.5	15.4

¹EPA is not proposing monthly average limitations for these pollutants.

²EPA is proposing the use of EPA Methods 1624 and 624 for the analysis of xylenes, even though xylenes are not specifically listed as an analyte in either of these methods (promulgated at 40 CFR Part 136). EPA used data obtained from the analysis of xylenes by these two methods in the development of the proposed industrial laundry standards.

³TPH (as SGT-HEM) is total petroleum hydrocarbons measured by the silica gel treated-hexane extractable material analytical method proposed January 23, 1996 (Method 1664).

2.7 Effluent Limitations Guidelines for Direct Dischargers

EPA has not identified any direct dischargers in the industrial laundries industry or any candidate indirect dischargers, or transfer of performance data from facilities in other industries or from pilot-scale test results for determining the appropriate level of performance to set limitations for direct discharging new sources; therefore, EPA has not developed effluent limitations guidelines for direct wastewater discharges to surface waters. As a result, the Agency is reserving effluent limitations guidelines and standards for the following levels of control for the Industrial Laundries Point Source Category: Best Practicable Control Technology Currently Available (BPT), Best Conventional Pollutant Control Technology (BCT), Best Available Technology Economically Achievable (BAT), and New Source Performance Standards (NSPS).

CHAPTER 3

DATA COLLECTION METHODOLOGY AND INFORMATION SOURCES

3.1 Introduction

In 1992, EPA published a notice in the Federal Register (57 FR 19748) indicating its intent to develop effluent limitations guidelines and standards for the industrial laundries industry. EPA collected information necessary for the development of this rule from many sources. EPA initially collected data on a broad group of laundry facilities that included industrial laundries as well as linen laundries, denim prewash facilities, and other laundry facilities. These data were necessary to define the scope and applicability of the regulation. Throughout this chapter, the term "laundry" is used to indicate that information was collected from industrial laundries as well as other laundry facilities. The scope and applicability of the proposed regulation are discussed in detail in Chapter 6.

This chapter summarizes the information collection activities undertaken and the information sources used for this proposed rulemaking, as follows:

- Section 3.2 summarizes data collection efforts prior to 1992;
- Section 3.3 discusses the questionnaire activities conducted since 1992;
- Section 3.4 summarizes EPA's site visit program conducted from 1993 through 1997;
- Section 3.5 discusses EPA's sampling program conducted from 1993 through 1996;
- Section 3.6 presents other industry-collected data efforts;
- Section 3.7 discusses data collected from publicly owned treatment works (POTWs);
- Section 3.8 summarizes literature searches performed on the industrial laundries industry;
- Section 3.9 summarizes other sources of data on the industrial laundries industry; and
- Section 3.10 presents the references used in this section.

3.2 Summary of Data Collection Prior to 1992

Prior to 1992, EPA conducted several studies of the laundries industry. These efforts consisted of the following:

- The 1971 EPA survey of 160 industrial laundries, linen services, and diaper services (Section 3.2.1);
- The 1975 data collection at 73 facilities (Section 3.2.2);
- The 1977 data collection portfolio (DCP) for approximately 70 facilities (Section 3.2.3);
- The 1978 screening and verification analysis studying samples from approximately 10 facilities for priority pollutants (Section 3.2.4);
- The 1979 laundries survey (Section 3.2.5); and
- The 1985 through 1987 Industrial Technology Division (ITD)/Resource Conservation and Recovery Act (RCRA) sampling program and development of the Preliminary Data Summary for the Industrial Laundries Industry (1) (Section 3.2.6).

Sections 3.2.1 through 3.2.6 describe each of these data-gathering efforts in more detail.

3.2.1 1971 Survey

EPA's first study of the industrial laundries industry, initiated in 1971, involved sending a survey to 160 facilities. These facilities were all members of the Institute of Industrial Launderers (IIL, now the Uniform and Textile Service Association (UTSA)) or the Linen Supply Association of America (LSAA, now the Textile Rental Services Association of America (TRSA)) and included industrial laundries, linen services, and diaper services. In addition to wastewater analytical data obtained from the survey, EPA collected sampling data for conventional and nonconventional pollutants and some metals at a small number of facilities.

3.2.2 1975 Data Collection

In 1975, EPA initiated sampling and analysis of wastewaters generated by the Auto and Other Laundries Point Source Category, of which the industrial laundries industry was identified as a subcategory. These early programs concentrated primarily on collecting data on conventional and nonconventional pollutants and trace metals. EPA collected samples at 73 laundries for conventional pollutants (pH, biochemical oxygen demand (BOD₅), total suspended

solids (TSS), and oil and grease) and nonconventional pollutants (chemical oxygen demand (COD), total organic carbon (TOC), and phosphorus).

3.2.3 1977 Data Collection Portfolio (DCP)

In 1977, EPA sent a data collection portfolio (DCP) to a number of laundry facilities including industrial laundries (SIC Code 7218), power laundries (SIC Code 7211), linen supply laundries (SIC Code 7213), and institutional laundries. Completed DCPs were received from approximately 70 industrial laundries. The survey requested the following types of information:

- Type of laundry;
- Number of hours/day and days/year of operation and number of employees;
- Types of processes;
- Production information;
- Types of customers serviced;
- Laundering chemicals used;
- Water usage;
- Effluent discharge;
- Information on wastewater treatment and in-plant controls;
- Recommendations for design features;
- Space available for treatment;
- Available priority pollutant data; and
- Unique features.

3.2.4 1978 Sampling Program

In 1978, EPA initiated a sampling program to determine the presence and concentrations of 129 priority pollutants, which were identified from the 65 toxic pollutants and classes of pollutants (and subsequently reduced to 126 priority pollutants), as defined by the Consent Decree (see Section 1.3.4 for discussion of the Consent Decree), in wastewaters from facilities in the Auto and Other Laundries Point Source Category. EPA sampled a total of 40

facilities for toxic and conventional pollutants using automatic time-compositing equipment during operating hours at each facility. In most cases, sampling was for one day only. At facilities where wastewater treatment was in place, EPA collected samples of both treatment influent and effluent. EPA also sampled an industrial laundry using a dissolved air flotation (DAF) treatment system over a one-month period to obtain data on the variability of this type of treatment system.

3.2.5 1979 Laundries Survey

In 1979, EPA sent a survey to 31 industrial laundries and 14 linen laundries in five major cities to determine the availability of sufficient space for installation of treatment systems. Approximately 50 percent of the survey dealt specifically with available space at facilities without treatment. Other information obtained included:

- Business classification;
- Number of hours/day and days/year of operation and number of employees;
- Processes used;
- Production information;
- Water usage;
- Effluent discharge;
- In-plant controls used; and
- Wastewater treatment practiced.

In 1981, EPA chose not to establish effluent limitations for the Auto and Other Laundry Point Source Category, of which industrial laundries was a subcategory, because EPA determined that 95 percent of the discharged pollutants were amenable to treatment by POTWs and did not pass through, interfere with, or prove otherwise incompatible with the operation of POTWs. Therefore, no further data collection efforts were undertaken until 1985.

3.2.6 Industrial Technology Division (ITD)/Resource Conservation and Recovery Act (RCRA) Sampling Program and Development of the Preliminary Data Summary (1985 through 1987)

EPA conducted a program to obtain wastewater and solid waste samples at five industrial laundries located in different regions of the U.S. EPA used information obtained during previous data-gathering efforts in conjunction with advice and assistance from the UTSA (known as the Institute of Industrial Launderers (IIL) at the time) to select seven laundries for site visits. Four of these facilities were sampled in 1986 and 1987. The fifth facility was sampled in 1985 as part of the Domestic Sewage Study (discussed in Section 3.9.3).

At the industrial laundry sampled in 1985, EPA collected composite samples of the final effluent after a settling basin over the course of one operating day. EPA collected wastewater samples from untreated wastewater streams and final effluent wastewater streams at the four other industrial laundry facilities. EPA sampled these four facilities for two consecutive days and composited the wastewater over the course of each operating day. EPA collected final effluent samples from two dissolved air flotation systems, one ultrafiltration system, and a settling basin.

EPA analyzed the samples for conventional pollutants, priority and nonconventional organic pollutants, priority and nonconventional metal pollutants, and other nonconventional pollutants, which later comprised the "ITD List of Analytes".

Other sources of information about the industrial laundries industry investigated during this time period included:

- Telephone interviews with, and visits to, personnel at EPA regional and state offices, industry trade associations, and representative industrial laundries;
- Telephone interviews with POTW representatives; and
- Literature review, including research reports, journals and magazines, computer-based abstract databases, and computer-based censuses.

The information collected during this time period was used to prepare the Preliminary Data Summary for the Industrial Laundries Industry (1) and formed the basis for EPA's decision to develop effluent limitations guidelines and standards for the Industrial Laundries Point Source Category.

3.3 Summary of Industrial Laundries Questionnaire Activity Since 1992

EPA's first step in developing the current proposed rule for the industrial laundries industry was to gather current data from the industry, under the authority of section 308 of the Clean Water Act. EPA sent four screener questionnaires to different segments of the laundry industry between 1993 and 1995 to collect information to be used in identifying the population of the laundry industry, developing the scope of the regulation, and determining which facilities should receive a more detailed questionnaire. Based on data collected from the screener survey and a search of the Dun & Bradstreet listing for laundry facilities, EPA sent a detailed questionnaire to a subset of identified laundry facilities. Based on the responses to the detailed questionnaire, EPA sent a monitoring questionnaire to a subset of the facilities that had received a detailed questionnaire. These data-gathering efforts are described in more detail below. Additional details on the data-gathering efforts are found in the Statistical Support Document for Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category (2). Copies of nonconfidential questionnaires are contained in the administrative record for this rulemaking.

3.3.1 Screener Questionnaires

EPA conducted four separate mailings of slightly different screener questionnaires to develop the scope of the regulation, identify the population of the industry, and select facilities to receive the more detailed questionnaire. EPA also used the screener questionnaires to characterize the industry and to determine that industrial laundries population. More details on determining the industrial laundries population are provided in the Statistical Support Document (2). Summarized industry characterization data are provided in Chapters 4, 5, and 8 of this document. The four different screener questionnaires and their mailings are discussed in the following sections.

The 1993 Industrial Laundries Industry Screener Questionnaire

In 1993, EPA developed and mailed out the two-page 1993 Industrial Laundries Industry Screener Questionnaire to a large number of industrial laundries to solicit updated information on the industry. The purpose of this screener questionnaire was to characterize the industry and to determine which facilities may be in-scope for the proposed rule. The screener questionnaire requested information on the relative amounts and types of items received for laundering, the type of waste treatment operations, the amount of water used, and wastewater disposal practices. A blank copy of the questionnaire, along with copies of the nonconfidential portions of the completed screener questionnaires, are contained in Section 6.2 of the administrative record for this rulemaking.

EPA sent the screener questionnaire to a total of 1,751 facilities. EPA selected 1,745 of these facilities from the UTSA customer and prospective customer lists, the Textile Rental Service Association (TRSA) mailing list, and the Occupational Safety and Health

Administration's (OSHA) list of violations for industrial laundries. EPA added six facilities to the list as a result of companies requesting screeners for their facilities that had not received one.

Of the 1,751 screener questionnaires mailed, 1,543 were returned. In addition, three facilities that were not on the mailing list received a copy of the screener from their parent company and returned the completed copy, bringing the total of completed screener questionnaires returned to 1,546. A summary of the results of the mailout of the screener questionnaires is shown in the following table.

Status of 1993 Screener Questionnaire	Number of Questionnaires
Returned	1,546 ¹
Screener undeliverable or facility known to be out-of-scope	86
Nonresponsive	122
Duplicate facilities found	46 ²
Total	1,754

¹Three facilities not on the original mailing list completed and returned the questionnaire at the request of their parent company.

²This number is included in the number of screeners returned.

EPA received the screener questionnaire responses, reviewed them for completeness and accuracy, and entered the information into a database. EPA contacted by telephone respondents who provided incomplete or contradictory technical information to obtain correct information.

1993 Industrial Laundries Industry Supplemental Screener Questionnaire

The Dun & Bradstreet listing was used to identify industrial laundries not captured by the trade association mailing lists developed for the original screener questionnaire. Facilities listed in Dun & Bradstreet with primary SIC codes of 7218 (industrial laundries) or 7213 (linen supply laundries) and facilities with secondary SIC codes of 7218 were identified and compared to the original screener questionnaire mailing list. EPA selected 200 facilities identified from the Dun & Bradstreet listing to receive the supplemental screener questionnaire to obtain more data representative of the entire industry as follows: 100 facilities with a primary SIC code of 7218; 60 facilities with a primary SIC code of 7213; and 40 facilities with a secondary SIC code of 7218. The table below summarizes the results of the supplemental screener questionnaire mailing.

Status of Supplemental Screener Questionnaire Mailing

Status of D&B Screener Questionnaires	Number of Questionnaires
Returned	134
Screener undeliverable	34
Nonresponsive	32
Total	200

EPA received the screener questionnaire responses, reviewed them for completeness and accuracy, and entered the information into a database. EPA contacted by telephone respondents who provided incomplete or contradictory technical information to obtain correct information.

Large Industrial Laundry Screener

Abbreviated screener questionnaires were sent to five large industrial laundry companies to identify facilities owned by these five companies that were not identified from the original screener questionnaire or the supplemental screener questionnaire. Abbreviated screener questionnaires were also sent to four additional facilities that were not included on the mailing list for the original screener due to lack of address information. Information from the abbreviated screener was used to determine the industrial laundry industry population.

1995 Industrial Laundries Industry Screener Questionnaire

In response to comments from industrial laundry and linen trade associations, EPA mailed 100 modified screener questionnaires in January 1995 to hospitals, hotels, and prisons that potentially operate on-site laundries. These facilities are not traditional industrial facilities, but generate wastewater from laundering. EPA randomly selected 25 facility addresses from each of the following four sources:

- A list provided by the TRSA;
- A list provided by the UTSA;
- Responses to Question 25 (Q25) in Part B of the Industrial Laundries Detailed Questionnaire; and
- National Association of Institutional Linen Management (NAILM) members.

The 1995 screener questionnaire requested the following information: discharge status (i.e., direct, indirect, zero), water use information, amount of laundry accepted from off site and its annual production, number of employees, SIC code, percentage of items laundered (both

generated on site and accepted from off site), and type of treatment system. The main goal of this effort was to obtain a snapshot of the activities of on-site laundries to determine if they should be included in the scope of the proposed regulations. Of the 100 screener questionnaires mailed, EPA received 86 responses.

3.3.2 1994 Industrial Laundries Industry Questionnaire (Detailed Questionnaire)

EPA designed the 1994 Industrial Laundries Industry Questionnaire (detailed questionnaire) to collect detailed technical and economic information from industrial laundry and linen facilities. EPA sent the detailed questionnaire to laundry facilities selected from the 1993 Industrial Laundries Industry Screener Questionnaire database (screener questionnaire database) and from the Dun & Bradstreet database. EPA used the information reported by the respondents in the detailed questionnaire to develop an industry profile, characterize industry production and water use, develop pollutant loadings and reduction estimates, and develop compliance cost estimates, as discussed throughout this document. A blank copy of the detailed questionnaire, along with copies of the nonconfidential portions of the completed detailed questionnaires, are contained in the administrative record for this rulemaking.

Detailed Questionnaire Recipient Selection and Mailing

EPA mailed the detailed questionnaire in June and July 1994 to 250 selected laundry facilities. EPA selected 24 facilities from the Dun & Bradstreet database and 226 facilities from the industrial laundries industry screener database. After mailing the questionnaires, EPA deactivated the questionnaires for one of the selected Dun & Bradstreet facilities and three of the selected screener questionnaire facilities because they were closed, out of scope, or otherwise unable to respond to the questionnaire. EPA replaced these facilities with other facilities not previously selected. The methods used to select the recipients of the detailed questionnaires are described in the Statistical Support Document (2). A summary of the results of the mailout of the 254 detailed questionnaires is shown in the following table.

Activity	Number of Sites
Mailed detailed questionnaire (four questionnaires were mailed to replace four facilities determined to be inactive within a few days of the initial mail out)	254 ¹
Questionnaires received	231
Questionnaires not received	23
Questionnaires deactivated (deactivated because facility closed, facility was a pretest facility, facility destroyed by fire, facility did not generate laundry wastewater, or otherwise could not provide the necessary information)	16 (Not received-12) (Received-4)
Questionnaires with sufficient technical and economic information to perform the analyses necessary to develop the proposed rule.	208

¹EPA originally selected 250 recipients of the detailed questionnaire and later selected another four to replace facilities that had been deactivated.

In addition, EPA mailed pretest questionnaires to nine facilities in November 1993. Although not identical, the pretest questionnaire contained questions similar to the questionnaire mailed in June and July 1994. EPA received eight pretest questionnaire responses.

Information Collected by the Detailed Questionnaire

This section describes the information collected in each part of the detailed questionnaire and the reasons this information was collected. The Information Collection Request (ICR) (3) for this project contains further details on the types of information collected and the potential use of the information.

EPA developed the detailed questionnaire in conjunction with the industrial laundries trade associations (TRSA and UTSA), EPA's Office of Pollution Prevention and Toxics, and EPA's Office of Solid Waste to collect information necessary to develop effluent guidelines and standards for the industrial laundries industry. EPA sent a draft version of the questionnaire to nine pretest facilities, and incorporated comments from these facilities into the final version of the detailed questionnaire.

The detailed questionnaire comprised the following parts:

- Part A: Technical Information
 - Section 1: Facility Identification,
 - Section 2: Operating Information; and
- Part B: Financial and Economic Information
 - Section 1: Facility Financial Information,
 - Section 2: Owner Company Financial Information,
 - Section 3: Parent Company Financial information.

Part A, Section 1 requested information necessary to identify the site and to determine wastewater discharge locations (to surface water or POTWs). The information requested in this section included site name, address, parent company name, address, site contact, age of facility, major modifications made to the facility, operating hours and days, permits held by the facility, and wastewater discharge location.

Part A, Section 2 was divided into the following subparts:

- Process Operations and Production Information;
- Water Use and Conservation Practices; and
- Wastewater Treatment Operations.

The section on process operations and production information requested detailed information on laundering processes, types of items laundered, production of laundered items, types of customers, laundering formulas, laundering chemicals, laundering equipment, and pollution reduction activities. EPA used the information collected in this section to determine the types and amounts of each item laundered at a facility, the types of customers a facility has, the amount of laundering chemicals and water used for laundering each item type, and pollution reduction practices at laundry facilities.

The section on water use and conservation practices requested detailed information on water intake amounts for various uses, water conservation practices in place, wastewater generation and discharge locations, and a facility process diagram showing a water balance for the facility and wastewater treatment in place. EPA used this information to evaluate the overall water use and wastewater discharge for the site.

The section on wastewater treatment operations requested detailed information on wastewater treatment operations, costs of wastewater treatment equipment, wastewater sample collection, wastewater treatment residual types and generation amounts, costs of residual disposal, and space availability at the facility. EPA used this information to evaluate current treatment in place at industrial laundries facilities and the costs of operating this treatment.

Part B requested detailed financial and economic information for each site and the owner companies of each site. Detailed information on this section is presented in the Economic Assessment of Proposed Pretreatment Standards for Existing and New Sources for the Industrial Laundries Point Source Category (4).

Data Review and Data Entry

EPA completed a detailed engineering review of Part A of the detailed questionnaires to evaluate the accuracy of information provided by the respondents. The engineering review also included coding responses to questions to facilitate data entry into the detailed questionnaire database. The Data Element Dictionary for the Industrial Laundries Industry Questionnaire Part A Database (5) contains the codes used by reviewers. EPA contacted, by telephone, respondents who provided incomplete or contradictory technical information to obtain correct information.

EPA developed a database for the technical information provided by the detailed questionnaire respondents. After engineering review and coding, data from the detailed questionnaires were double-key entered using a data entry and verification system. Reviewers of the questionnaire verified errors in the double-key entry. EPA entered basic information (i.e., name, address, telephone number, etc.) for all 254 facilities into the database. EPA entered other information provided by the 231 facilities responding to Part A. EPA also entered the information for three pretest facilities.

Compilation of Respondent Data

EPA compiled information reported in the detailed questionnaire and summaries of this information are located in Chapters 4, 5, and 8 of this document. These chapters include information on facility location, process and production information, water use and discharge practices, and wastewater characteristics and treatment.

3.3.3 Detailed Monitoring Questionnaire

In 1995, EPA mailed a detailed monitoring questionnaire (DMQ) to 37 industrial laundries that received the detailed questionnaire. After reviewing responses to the detailed questionnaire, EPA identified facilities with available monitoring data that could be used to identify effluent discharge quality after certain treatment technologies and in conjunction with laundering certain industrial items. EPA selected the industrial laundries that would receive the DMQ based on the following criteria:

- Facilities that EPA sampled;
- Facilities with paired monitoring data (i.e., facilities that monitor both influent and effluent pollutant concentrations);
- At least one facility with each technology being considered for inclusion in the regulatory options; and
- Facilities that had no treatment (or that have gravity settling and screens only) to characterize industrial laundry raw wastewater.

The DMQ requested that facilities submit analytical data identified in their detailed questionnaire responses and any additional data that were available (e.g., raw wastewater data, POTW data, chemical vendor data, wastewater treatment vendor data, disposal company data). The facilities were also asked to include a process diagram for verification of sampling points. All 37 recipients completed and returned their DMQ.

Data Review and Data Entry

EPA completed a detailed engineering review of the DMQs to evaluate the accuracy of information provided by the respondents. The engineering review also included coding of responses to questions to facilitate data entry into the DMQ database. The Data Element Dictionary for the DMQ Database (6) contains the codes used by reviewers. EPA contacted, by telephone, respondents who provided incomplete or contradictory technical information to obtain correct information.

EPA developed a database for the technical information provided by the DMQ respondents. After engineering review and coding, data from the DMQ were double-key entered

using a data entry and verification system. Reviewers of the questionnaires verified errors in the double-key entry. EPA entered information for all 37 facilities into the DMQ database.

Compilation of Respondent Data

EPA compiled information reported in the DMQ responses and summarized it in Chapter 5 of this document, which includes information on wastewater characteristics. DMQ data were also used to develop the standards for the industrial laundries industry, as presented in Chapter 9 of this document and the Statistical Support Document (2).

3.4 Summary of EPA's Site Visit Program (1993-1997)

EPA conducted 32 site visits to industrial laundry facilities between 1993 and 1997 to collect information about industrial laundries processes, water use practices, pollution reduction practices, wastewater treatment technologies, and waste disposal methods. EPA also visited these sites to evaluate potential sampling locations (as described in Section 3.5 of this document). In general, EPA visited sites to encompass a range of industrial laundry facilities and other facilities, such as linen facilities, hospital cooperative laundries, and denim prewash facilities, to determine the scope of the regulation.

3.4.1 Criteria for Site Visit Selection

EPA based site selection on information in responses to the screener and detailed questionnaires. In addition to choosing sites of varying sizes, EPA used the

following general criteria to select sites that encompassed the range of processes and treatment technologies within the industrial laundries industry:

- The site laundered a broad range of industrial items;
- The site performed specific operations, such as denim prewashing or dry cleaning followed by water washing;
- The site had wastewater treatment technologies that were believed to be representative of the "best" within the industry;
- The site split heavy and light wastewater streams; and
- The site practiced water reuse.

3.4.2 Types of Information Collected

EPA documented information for each site visit in a site visit report. During the site visits, EPA collected the following information for each facility:

- Types of laundering processes conducted and the types of items laundered, as well as the production volume of each item;
- Types of customers served;
- Types and sizes of laundering equipment used;
- Types, amounts, and disposition of wastewater generated;
- Types of pollution reduction activities performed;
- Types of wastewater treatment technologies operated; and
- Logistical information for sampling.

3.5 Summary of EPA's Sampling Program (1993-1996)

EPA conducted sampling episodes at eight facilities between 1993 and 1996 to obtain data on the characteristics of industrial laundry wastewaters and to assess the following: the loading of pollutants to POTWs from industrial laundries; the effectiveness of technologies designed to reduce and remove pollutants from industrial laundries wastewater; and the variation of wastewater characteristics across item type.

3.5.1 Criteria for Sampling Site Selection

EPA used information collected during industrial laundry site visits to identify candidate sites for sampling. EPA used the following general criteria to select sites for sampling:

- The site accepted a variety of items for laundering; and
- The site operated in-process source reduction or end-of-pipe treatment technologies that were considered for technology option development.

After selecting a site for sampling, EPA prepared a detailed sampling and analysis plan, based on the information contained in the site visit report and follow-up correspondence with the site contact. The sampling and analysis plans were prepared to ensure collection of samples that would be representative of the sampled waste streams, and 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.

3.5.2 Information Collected

In addition to wastewater samples, EPA 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 wastewater sample;
- Design and operating parameters for source reduction and treatment technologies characterized during sampling;
- Information about site operations that had changed since the site visit or that was not included in the site visit report; and
- Temperature and pH of the sampled wastewater streams.

EPA documented all data collected during sampling episodes in the sampling episode report for each sampled site; the sampling episode reports are contained in the administrative record for this rulemaking. The sampling episode reports also contain preliminary technical analyses of treatment system performance.

3.5.3 Sample Collection and Analysis

All samples were collected, preserved, and transported according to EPA protocols as specified in EPA's Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants (7) and the Industrial Laundries Quality Assurance Project Plan (QAPP). These documents are contained in the administrative record for this rulemaking.

In general, EPA collected composite samples from the wastewater streams from laundering operations over the course of the operating day. Most facilities were sampled for a five-day consecutive period. For item-specific sampling, EPA collected wastewater samples from individual laundered loads during each discharge from the washer and composited the samples. EPA collected the required types of quality control samples as described in the QAPP, such as blanks and duplicate samples, to verify the precision and accuracy of sample analyses.

EPA had samples shipped via overnight air transportation to EPA-approved laboratories, which analyzed the samples for metal and organic pollutants and additional parameters (including several water quality parameters). The laboratories analyzed metal pollutants using EPA Method 1620 (8), volatile organic pollutants using EPA Method 1624 (9), and semivolatile organic pollutants using EPA Method 1625 (10). Tables A-1 and A-2 in Appendix A list the metal and organic pollutants, respectively, analyzed using these methods. The laboratories analyzed oil and grease and total petroleum hydrocarbons (TPH) using the proposed Method 1664 (11). Method 1664 measures oil and grease as hexane extractable material (HEM) and measures TPH as silica gel treated-hexane extractable material (SGT-HEM). Method 1664 measures a different fraction of oil and grease and TPH than is measured by the currently approved methods, which use freon. Table A-3 in Appendix A lists other parameters analyzed during the sampling program and the methods by which they were analyzed (12, 13).

Quality control measures used in performing all analyses complied with the guidelines specified in the analytical methods and in the 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 wrote an SER to document the sampling episode, the data collected during sampling, the analytical results, and the technical analyses of the results. The SERs include sampling and analysis plans and correspondence with site personnel as appendices.

3.6 Other Industry-Supplied Data

In 1977, TRSA sponsored a wastewater study of linen and industrial laundries. In addition to pH, this study analyzed wastewater for the following 10 pollutants: BOD₅, TSS, oil and grease, lead, mercury, nickel, cadmium, zinc, total chromium, and TOC. The two-part study first analyzed untreated wastewater from 20 laundries and then analyzed untreated and treated wastewater from five laundries.

The first part of the study presented sampling and analytical data from 20 linen and industrial laundries. Samples were collected for untreated wastewater at 15-minute intervals during an 8- to 10-hour period and composited based on the flow rate at the time of sampling. The wastewater flow was calculated from process water meter readings and flow readings in the wastewater treatment system. The process water flows were used to calculate maximal pollutant loadings. These are maximal loadings because all of the water metered into the facility is not discharged as wastewater. The production normalized pollutant loading level was based on the maximal pollutant loading level and the actual poundage of laundry produced on the sampling days. The types of items laundered on the sampling days were not reported; soil classification provided information on the soil loading only. Also, from the sampling point location information, it was difficult to determine the exact location of the sampling point and the source of wastewater sampled. In some cases, the untreated wastewater sampled may have passed through settling pits or screens before sampling.

The second part of the TRSA study presented data from five linen and industrial laundries. All of these laundries had treatment systems in place. Four facilities had DAF systems and one facility had a proprietary filter system. Sampling was conducted as described for the first part of the study, except that both untreated and treated wastewater samples were collected. Process water flows were used to calculate maximal pollutant loadings, and wastewater flows in the treatment system were used to calculate actual pollutant loadings. The production normalized pollutant loading level was based on the maximal pollutant loading level and the average poundage of clean, dry laundry produced per week at the facility.

This study included information on the percentages of different types of items laundered at sampled laundries, although no information was provided on the types of articles laundered during the sampling days. Also, the descriptions of the sampling point locations were more extensive than those presented in the first part of the study. Diagrams of the wastewater treatment systems were provided and the operations of the treatment systems were discussed briefly. Unfortunately, several of the facilities sampled experienced difficulties with their treatment system during the sampling days. Also, the production normalized pollutant loading levels were based on average production levels instead of actual production levels, which were used in the first part of the study.

3.7 POTW Data

The Association of Metropolitan Sewerage Agencies (AMSA), in an effort to assist EPA in collecting data for the development of effluent guidelines and standards for the industrial laundries industry, developed and distributed a questionnaire to its member POTWs in 1993. The questionnaire asked the POTWs to provide already-collected data on industrial laundries, which were defined as facilities with the SIC code of 7218 (facilities that supply laundered and dry-cleaned work uniforms, wiping towels, safety equipment (such as gloves, flame-resistant clothing), dust covers and cloths, and other items to commercial and industrial facilities). The questionnaire asked the POTWs for the following information about the industrial launderers that discharge to their facilities:

- Identify facilities that discharge to the POTW that do industrial laundering on a contract basis (outside of their normal business classification) that are not classified as an industrial laundry (i.e., hotels, hospitals, prisons, etc.);
- Identify whether facilities discharge directly or indirectly to the POTW;
- Specify what numerical discharge standards the POTW applies to industrial laundries (i.e., local limits, category-specific local limits, other limits);
- Provide the following specific information for each industrial laundry that discharges to the POTW:

- Industrial user information (facility location information, average daily wastewater discharge in gallons per day, and permit information);
- Industrial discharge sampling information, including the following: whether the sample point contained only industrial laundry wastewater, and, if not, what other types of waste streams; whether the wastewater was treated prior to the sampling point; types of treatment used; and the types of pollution prevention techniques used at the facility; and
- Sampling data for each sampling point (either POTW or Industrial User (IU) self-monitoring data) for calendar year 1992 (including parameter, measurement, type of sample, whether an EPA-approved method was used to analyze the sample, and, if not, what type of method was used).

Approximately 280 POTWs returned completed questionnaires. EPA analyzed the data included in the responses to the questionnaires and used the data to evaluate current local limits imposed on industrial laundries. The completed questionnaires can be found in the administrative record for this rulemaking.

3.8 Summary of Literature Searches

EPA has conducted several searches of the open literature throughout the development of this proposed regulation to provide information on the industrial laundries industry. The sources searched have included the following:

- Journal articles and technology brochures (early 1970 through 1986);
- Census of Service Industries, Department of Commerce (1982);
- Computerized databases containing information on treatment technologies for industrial laundries (1986);
- Lists of industrial laundries from various on-line searching methods (1986); and
- POTW and State Water Quality Agency lists (1986).

EPA conducted other literature searches in 1993 to gather publicly available information on the industrial laundries industry. EPA conducted one literature search to obtain information about industrial laundries wastewater, wastewater treatment technologies, operations, and costs of operations, and also a search to obtain information about printer towels/rags, wipers, and shop towels.

The literature search focused on the following topics: waste streams, waste treatment technologies, operations, and costs of operation. The following databases were searched:

<u>Database</u>	<u>Description</u>
Water Resources Abstracts	Water resources topics
Waternet	Index of the American Water Works Association Publications
NTIS	Government-sponsored research, development, and engineering reports and analysis
COMPENDEX	Engineering and technology applications
ENVIRONMENTAL	Environmental Sciences
Pollution Abstracts	Pollution control and research
Books in Print	Books in print, forthcoming books, and books going out of print in the U.S.
LC Mark	Library of Congress catalogued publications
Textile Technology Digest	Worldwide coverage of textiles and related subjects
World Textiles	Textiles in areas of technology and management

As part of the literature search, EPA identified three trade journals important in the industrial laundries industry: Textile Rental, Industrial Launderer, and Laundry News. These journals provide up-to-date information on the industrial laundries industry. EPA has conducted regular reviews of these journals during the development of this regulation.

EPA conducted a separate literature search for data on pollution prevention in the industrial laundries industry by examining various on-line databases, including EPA's Pollution Prevention Information Exchange System (PIES).

3.9 Summary of Other Data Sources

In developing the industrial laundries effluent guidelines, EPA also evaluated the following existing data sources:

- The Office of Research and Development (ORD) Risk Reduction Engineering Laboratory (RREL) treatability database;
- The Fate of Priority Pollutants in Publicly Owned Treatment Works (50 POTW Study) database;
- The Domestic Sewage Study (DSS);
- Canadian studies; and
- Industrial Pollution Prevention Project.

These data sources and their uses in the development of the industrial laundries rulemaking are discussed below.

3.9.1 Risk Reduction Engineering Laboratory Treatability Database

EPA's ORD developed the 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 for various pollutants. This database includes physical and chemical data for each pollutant, the types of treatment used to treat the specific pollutants, the type of wastewater treated, the size of the POTW, and the treatment concentrations achieved. EPA used this database to assess POTW percent removals of various pollutants.

3.9.2 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 (14), 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 POTW percent removals of various pollutants.

3.9.3 The Domestic Sewage Study

In February 1986, EPA issued the Report to Congress on the Discharge of Hazardous Wastes to Publicly Owned Treatment Works (15), 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 that are a threat to the treatment capability of these POTWs and were not regulated by national categorical pretreatment regulations. Among the unregulated sources were industrial laundries, which tend to discharge significant quantities of toxic and hazardous pollutants on a facility-specific basis. During the course of the DSS, EPA contacted a number of state and local agencies to obtain toxic pollutant data and other relevant data. EPA used the information in the DSS in developing the Preliminary Data Summary for the Industrial Laundries Point Source Category (1).

3.9.4 Canadian Studies

EPA studied other sources of data, as described below, to obtain as comprehensive a picture of the industrial laundries industry as possible. One of these sources was the Ministry of the Environment and Energy (MOEE) of Canada. As in the U.S., industrial laundries in Canada have been found to be a source of oil and grease in sewer systems. The MOEE's Municipal/Industrial Strategy for Abatement (MISA) section and the Ontario, Canada industrial laundries associations conducted a survey of Canadian industrial laundries to assess the amount of oil and grease and other pollutants that were being discharged into the sewer systems. The survey was conducted to obtain an overview of the industrial laundries industry, the sources of contamination, and the treatment used to reduce the pollutant loads to the sewers.

The laundries surveyed in this report included industrial laundries, linen establishments, and commercial launderers and excluded retail-only, coin-operated, dry cleaning, and health-care facilities. The industrial laundries processed industrial garments and wiper towels, which, according to this survey, were considered major sources of oil and grease. The survey showed that many industrial laundries in this study used some pretreatment; however, only four facilities used advanced pretreatment techniques, and several facilities did not pretreat their wastewater.

In addition, the Ontario Laundry Industry Pollution Prevention Task Force has been meeting regularly to discuss pollution prevention measures in the laundries industry and how to promote those practices. The Task Force comprises the following entities: Ontario Ministry of Environment and Energy, Metro Toronto, City of Brantford, and several Canadian laundries, some of which represent the laundry associations Dry Cleaners and Launderers Institute (DCLI) and Textile Rental Institute of Canada (TRIO). In 1994, the Task Force held a workshop on

pollution prevention in the laundries industry, which discussed pollution prevention in general, how using pollution prevention practices benefits industrial laundries, and approaches to and techniques for reducing waste in the industry.

3.9.5 Industrial Pollution Prevention Project

EPA has undertaken several pollution prevention-related activities involving the industrial laundries industry. Some of the efforts were Agency-wide, including ORD and EPA's Region IX, while other efforts were included as part of the engineering studies in the development of the proposed rule.

The Agency-wide efforts, called the Industrial Pollution Prevention Project (IP3), were multimedia and examined how industrial pollution prevention can be incorporated into EPA's regulatory framework and how the pollution prevention ethic can be promoted throughout industry, the public, and government. A report summarizing the results of these efforts, entitled Industrial Pollution Prevention Project (IP3) - Summary Report (16), included the results of two case studies involving industrial laundries. More detailed discussions of the two studies are contained in the individual reports, Pollution Prevention at Industrial Laundries: Assessment Observations and Waste Reduction Options (17), and Pollution Prevention at Industrial Laundries: A Collaborative Approach in Southern California (18). These studies identified a number of "best management practices" (BMPs) and water and energy savings technologies as potential pollution prevention at industrial laundries.

Similarly, during the engineering study phase of the development of the proposed rule, a number of potential pollution prevention practices and technology applications were identified. Section VI of the preamble to the proposed rule and Chapters 8 and 10 of this document discuss the pollution prevention technologies and practices and their uses with respect to this proposed rule.

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CHAPTER 4

INDUSTRY PROFILE

4.1 Introduction

Chapter 4 discusses the processes, items, customers, chemicals, facilities and equipment, and pollution reduction activities found in the industrial laundries industry. Most of the data presented in this chapter are from facility responses to the 1994 Industrial Laundries Industry Detailed Questionnaire. EPA sent the detailed questionnaires to 250 facilities, and 231 facilities returned the questionnaire, as described in Section 3.3.2 of this document. Two hundred eight (208) facilities that responded to the detailed questionnaire provided sufficient data to perform complete technical and economic analyses. EPA defined 193 of these facilities as being in scope (industry scope is discussed in detail in Chapter 6). The percentages and number of facilities performing various processes discussed in this section were estimated based on the responses from the 193 in-scope facilities, and then extrapolated to represent the industry population of 1,747 facilities, using appropriate survey weights. The following topics are discussed in this section:

- Section 4.2 discusses the geographic location, relative size, types of items laundered, customers, and Standard Industrial Classification (SIC) code distribution of facilities in the industrial laundries industry;
- Section 4.3 discusses general information on industrial laundering processes and chemicals used in the laundering processes;
- Section 4.4 discusses facilities and equipment used at industrial laundries;
- Section 4.5 presents pollution reduction activities;
- Section 4.6 discusses trends within the industry;
- Section 4.7 lists treatment technologies in use; and
- Section 4.8 presents the references used in this section.

4.2 Overview of the Industry

This section provides an overview of the industrial laundries industry. This overview comprises general information pertaining to the industry, including geographic location, SIC codes, facility size, types of items laundered, and customers.

4.2.1 Geographic Distribution of Facilities

Information on geographic distribution was based on the 1993 Industrial Laundries Screener Questionnaire. This questionnaire was completed by 1,500 industrial laundries that were identified by trade association mailing lists. Only industrial laundries that reported generating laundry process wastewater and discharged that wastewater to a publicly owned treatment works (POTW) were used to determine the geographic distribution of facilities. These facilities are located in all 50 states and in all 10 EPA Regions, as well as several U.S. territories. Figure 4-1 and Table 4-1 present the geographic distribution of these facilities. By state, the greatest number of in-scope laundries (102 facilities) are in California. By EPA region, the greatest number of in-scope laundries (203 facilities) are in Region V, followed by Region IV, which has 181 facilities. Most of the laundries are located in large urban areas.

4.2.2 SIC Codes Reported

The facilities responding to the detailed questionnaire reported 7218 (Industrial Laundries) and 7213 (Linen Supply Laundries) as their primary SIC codes. Other secondary and tertiary SIC codes reported were 7211 (Power Laundries, Family and Commercial), 7216 (Dry-cleaning Plants, except rug cleaning), and 7219 (Laundry and Garment Services, not elsewhere classified).

4.2.3 Facility Size

Industrial laundries vary in size from one- to two-person shops to large corporations that operate many facilities nationwide. For the purpose of this section, EPA based the relative size of each facility on the pounds of dirty (as-received) laundry washed per year.

Table 4-2 presents the national estimates of the number of industrial laundries by production category. Annual laundry production per facility ranges from 44,100 to 32,600,000 pounds and the total annual industry production is 9,360,000,000 pounds. Although a smaller percentage of large facilities exist (more than 15 million pounds/year (lbs/yr) production) than small facilities (less than 1 million lbs/yr production), the larger facilities represent a significant percentage of the total industry production. One hundred thirty-eight (138) facilities launder more than 15 million lbs/yr each. These facilities represent 8 percent of the facilities in the industry, but their combined production (2,660,000,000 lbs/yr) accounts for 28 percent of the total industry production. Facilities laundering less than 1 million lbs/yr represent 10 percent of the facilities in the industry and account for less than 1 percent of the total industry production.

4-3

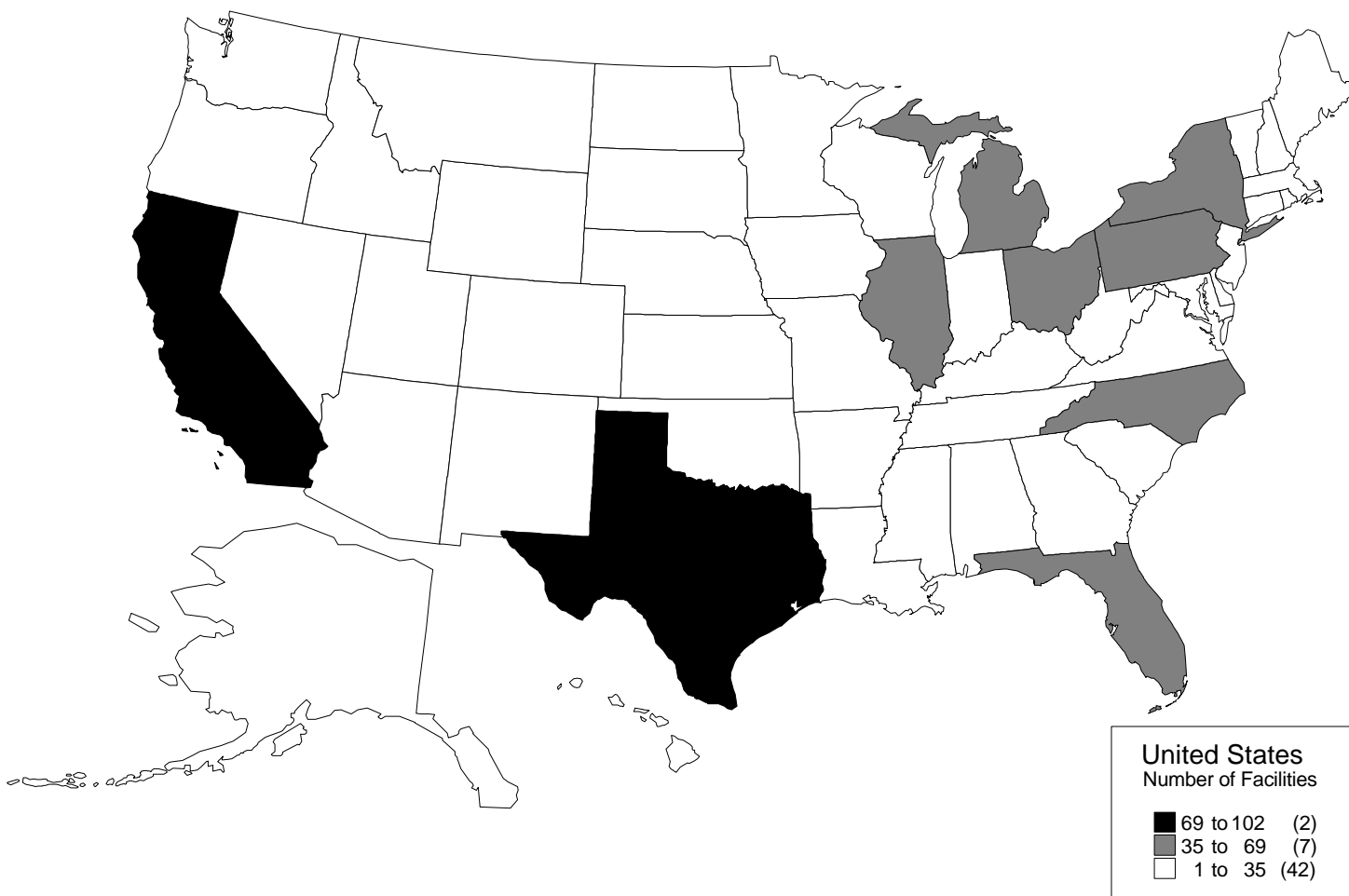


Figure 4-1
Geographic Distribution of Industrial Laundries

Table 4-1
Geographic Distribution of Industrial
Laundries by State and Region

Region/State	Number of Facilities in Region/State ¹
Region I	55
Connecticut	11
Maine	4
Massachusetts	29
New Hampshire	6
Rhode Island	4
Vermont	1
Region II	72
New Jersey	19
New York	51
Puerto Rico	2
Region III	101
Delaware	4
District of Columbia	3
Maryland	17
Pennsylvania	49
Virginia	21
West Virginia	7
Region IV	181
Alabama	14
Florida	42
Georgia	28
Kentucky	27
Mississippi	6

Table 4-1 (Continued)

Region/State	Number of Facilities in Region/State¹
North Carolina	35
South Carolina	13
Tennessee	16
Region V	203
Illinois	42
Indiana	33
Michigan	36
Minnesota	17
Ohio	56
Wisconsin	19
Region VI	131
Arkansas	18
Louisiana	16
New Mexico	10
Oklahoma	15
Texas	72
Region VII	57
Iowa	14
Kansas	8
Missouri	24
Nebraska	11
Region VIII	36
Colorado	16
Montana	3
North Dakota	1
South Dakota	4
Utah	6

Table 4-1 (Continued)

Region/State	Number of Facilities in Region/State¹
Wyoming	6
Region IX	136
Arizona	14
California	102
Guam	3
Hawaii	8
Nevada	9
Region X	39
Alaska	4
Idaho	8
Oregon	14
Washington	13

¹Number of facilities is based on number of facilities identified by the 1993 Industrial Laundries Screener Questionnaire, that reported generating laundry process wastewater and discharged that wastewater to a POTW.

Table 4-2**Industrial Laundry
Size Distribution**

Production Category (lbs/yr)	Estimated Number of Facilities¹	Estimated Percentage of Total Number of Facilities Reporting Production Data	Total Estimated Production for this Category (lbs/yr)	Estimated Percentage of Total Production
< 1,000,000	167	10	76,600,000	<1
1,000,000 to < 3,000,000	475	27	886,000,000	10
3,000,000 to < 6,000,000	629	36	2,740,000,000	29
6,000,000 to <9,000,000	199	11	1,390,000,000	15
9,000,000 to < 15,000,000	139	8	1,600,000,000	17
> 15,000,000	138	8	2,660,000,000	28
Total	1,747	100	9,360,000,000	100

¹Number of facilities is estimated based on the 193 in-scope facilities, extrapolated to represent the entire industry.
Source: 1994 Industrial Laundries Industry Detailed Questionnaire

4.2.4 Items Laundered

As reported by the in-scope facilities, industrial laundries wash a variety of items. The three primary categories of items reported in the detailed questionnaire responses were industrial laundry items, linen laundry items, and other items. Typically, industrial laundry items include industrial garments, shop towels, printer towels, floor mats, and fender covers. Linen items typically include linen garments, flatwork/full dry linen, and health-care items. Other items are specialty items or items that are not generally considered to be either industrial laundry items or linen items. Brief descriptions of industrial laundry, linen items, and other items are provided in Chapter 5.

Table 4-3 presents the number of facilities that launder each item and the percentage of total production by item. Many facilities reported laundering several items. The total extrapolated item-specific production reported in the detailed questionnaire is 9,360,000,000 lbs/yr (calculated by summing the item-specific subtotals reported in the detailed questionnaire and extrapolating the data to represent the entire industry).

The detailed questionnaire requested production data for twelve specific items (questionnaire category codes B01 through B12), as listed on Table 4-3. EPA requested facilities to report any items laundered that did not fall in the B01 through B12 categories and place them in category B13 (Other Items). Based on item types and descriptions provided by the facilities, EPA created supplemental categories B14 through B24 for these “other” B13 items. Items that could not be classified in categories B14 through B24 remained in the B13 “other” category. Because the data for category codes B13 through B24 were collected through “write-in” responses rather than through pre-printed selections, EPA believes that the data for category codes B13 through B24 may not represent total industry production.

4.2.5 Customers

Industrial laundries wash items for many different types of customers, ranging from gasoline stations to restaurants. The pollutants present on an item laundered depend primarily on the customer who used the item and the specific use of the item. For instance, a shop towel from a gasoline station is more likely to have a high concentration of oil and grease or total petroleum hydrocarbon than a napkin from a restaurant. Table 4-4 lists the laundered items reported in the detailed questionnaire responses, the typical customers using these items, and the percentage of the total industry production of each item laundered from each customer. For example, automobile repair, services, dealers, and gas stations represent 31.1 percent of the customers who use industrial garments.

Table 4-3**Types of Items Laundered**

Item Type¹	Estimated Number of Facilities Laundering Item	Estimated Percentage of Total Facilities	Estimated Percentage of Total Production²
Industrial Garments (B01)	1,441	82.5	24.4
Shop Towels, Industrial Wipers, etc. (B02)	1,332	76.2	3.7
Printer Towels (B03)	480	27.5	1.4
Floor Mats (B04)	1,644	94.1	19.3
Mops, Dust Cloths, Tool Covers, etc. (B05) ³	1,400	80.1	1.3
Linen Garments (B06)	942	53.9	2.9
Linen Flatwork/Full Dry Linen (B07)	1,364	78.1	35.2
Health-Care Items (B08)	648	37.1	7.9
Fender Covers (B09)	687	39.3	<1
Continuous Roll Towels (B10) ³	927	53.1	1.2
Clean Room Garments (B11)	28	1.6	<1
Clean Wipes (B12)	-	-	-
Other Items (B13) ⁴	31	1.8	<1
Laundry Bags (B14)	28	1.6	<1
Family Laundry (B15)	84	4.8	<1
Absorbents (B16)	-	-	-
New Items (B17)	74	4.2	1.6
Executive Wear (B18)	43	2.5	<1
Miscellaneous Not Our Goods (NOG) (B19)	14	< 1	<1
Rewash Items (B20)	38	2.2	<1
Airline Carpet and Seat Covers (B22)	-	-	-

Table 4-3 (Continued)

Item Type¹	Estimated Number of Facilities Laundering Item	Estimated Percentage of Total Facilities	Estimated Percentage of Total Production²
Filters (B23)	7	< 1	<1
Buffing Pads (B24)	6	<1	<1
Total	-	-	100

¹The codes in parentheses are from the detailed questionnaire and were used in the questionnaire database.

²Total industry production is estimated based on data from the detailed questionnaire from the 193 in-scope facilities, extrapolated using appropriate survey weights to represent the entire industry.

³One facility (with a survey weight of 1.3333) did not report production for this item; therefore, the estimated percentage of total production may be less than the actual amount processed.

⁴Includes items not specified in detailed questionnaire responses.

Source: 1994 Industrial Laundries Industry Detailed Questionnaire

Table 4-4**Typical Customers for Each Type of Item Laundered**

Item Type¹	Customers¹	Percentage of Total Production of Item from Customer²
Industrial Garments (B01)	<ul style="list-style-type: none"> - Automobile Repair, Services, Dealers, Gasoline Stations (C01) - Special Trade Contractors for Building Construction (C02) - Dwellings and Other Building Services (C03) - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Chemicals and Allied Products Manufacturing (C05) - Transportation, Communication, Utility, and Sanitary Services (C07) - Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08) 	31.1 10.2 5.49 17.2 9.65 10.5 11.1
Shop Towels, Industrial Wipers, etc. (B02)	<ul style="list-style-type: none"> - Automobile Repair, Services, Dealers, Gasoline Stations (C01) - Special Trade Contractors for Building Construction (C02) - Dwellings and Other Building Services (C03) - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Chemicals and Allied Products Manufacturing (C05) - Transportation, Communication, Utility, and Sanitary Services (C07) 	48.1 6.74 5.14 19.6 7.52 6.12
Printer Towels (B03)	<ul style="list-style-type: none"> - Publishing and Printing Industries (C06) - Other Laundries (C20) 	86.1 13.4
Floor Mats (B04)	<ul style="list-style-type: none"> - Automobile Repair, Services, Dealers, Gasoline Stations (C01) - Dwellings and Other Building Services (C03) - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Chemicals and Allied Products Manufacturing (C05) - Transportation, Communication, Utility, and Sanitary Services (C07) - Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08) 	26.8 11.0 11.4 5.92 6.63 24.7

Table 4-4 (Continued)

Item Type¹	Customers¹	Percentage of Total Production of Item from Customer²
Mops, Dust Cloths, Tool Covers, etc. (B05)	<ul style="list-style-type: none"> - Automobile Repair, Services, Dealers, Gasoline Stations (C01) - Dwellings and Other Building Services (C03) - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Transportation, Communication, Utility, and Sanitary Services (C07) - Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08) - Health Services (C10) 	15.4 23.1 8.17 7.37 20.2 7.46
Linen Garments (B06)	<ul style="list-style-type: none"> - Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08) 	91.1
Linen Flatwork/Full Dry (B07)	<ul style="list-style-type: none"> - Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08) - Hotel and Lodging Establishments (C09) 	85.2 14.1
Health-Care Items (B08)	<ul style="list-style-type: none"> - Health Services (C10) - Customer Not Reported (C11)³ 	90.8 8.65
Fender Covers (B09)	<ul style="list-style-type: none"> - Automobile Repair, Services, Dealers, Gasoline Stations (C01) - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Transportation, Communication, Utility, and Sanitary Services (C07) 	77.1 11.6 8.24
Continuous Roll Towels (B10)	<ul style="list-style-type: none"> - Automobile Repair, Services, Dealers, Gasoline Stations (C01) - Special Trade Contractors for Building Construction (C02) - Dwellings and Other Building Services (C03) - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Transportation, Communication, Utility, and Sanitary Services (C07) - Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08) 	21.1 7.31 8.33 9.51 9.23 29.2

Table 4-4 (Continued)

Item Type¹	Customers¹	Percentage of Total Production of Item from Customer²
Clean Room Garments (B11)	<ul style="list-style-type: none"> - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Chemicals and Allied Products Manufacturing (C05) - Customer Not Reported (C11)³ - Electronics Industry (C18) 	17.2 21.2 28.2 30.3
Laundry Bags (B14)	<ul style="list-style-type: none"> - Automobile Repair, Services, Dealers, Gasoline Stations (C01) - Special Trade Contractors for Building Construction (C02) - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Publishing and Printing Industries (C06) - Transportation, Communication, Utility, and Sanitary Services (C07) - Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08) 	23.7 9.34 5.82 7.52 39.2 9.25
Family Laundry (B15)	<ul style="list-style-type: none"> - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08) - Families (C23) 	8.92 8.33 69.8
Absorbents (B16)	<ul style="list-style-type: none"> - Industrial Metal, Machinery, and Equipment Manufacturing (C04) - Publishing and Printing Industries (C06) - Retail/Wholesale Stores (C12) - Miscellaneous Service Industries (C15) - Agricultural Industry (C16) - Miscellaneous Manufacturing (C19) 	13.2 6.79 19.3 19.9 5.61 16.8
New Items (B17)	<ul style="list-style-type: none"> - Retail/Wholesale Stores (C12) - Miscellaneous Manufacturing (C19) - Textile Manufacturing (C24) 	31.8 27.2 41.0
Executive Wear (B18)	<ul style="list-style-type: none"> - Other Laundries (C20) - General Offices (C21) - Families (C23) 	56.3 36.2 5.47
Miscellaneous Not Our Goods (NOG) (B19)	<ul style="list-style-type: none"> - Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08) 	96.0

Table 4-4 (Continued)

Item Type¹	Customers¹	Percentage of Total Production of Item from Customer²
Rewash Items (B20)	- Transportation, Communication, Utility, and Sanitary Services (C07)	94.0
Filters (B23)	- Chemicals and Allied Products Manufacturing (C05) - Wood Product/Furniture Manufacturing (C14)	17.3 82.7
Buffing Pads (B24)	- Eating/Drinking Establishments, Food/Beverage Manufacturing and Processing, and Food Stores (C08)	100

¹The codes in parentheses are from the detailed questionnaire and were used in the questionnaire database.

²Customers representing less than 5 percent of the total production for an item are not shown in the table; therefore, the percentages may not add up to 100 percent for each item.

³ Production data were provided for these items; however, the percentage of customers not reported by the facilities were greater than 5 percent.

Source: 1994 Industrial Laundries Industry Detailed Questionnaire

4.3 Laundering Processes

For all laundering processes, the methods by which the items are received, sorted, and transported to the washing area are similar. Industrial laundries receive soiled items in trucks and weigh the items before washing. These items are typically sorted based on item type, fabric type, color, degree and/or type of soil, and ownership. Sorted items are then placed in slings or carts, which are either automatically or manually moved to the washing area. The items are then cleaned using the appropriate process.

Table 4-5 presents laundering processes reported by the facilities responding to the detailed questionnaire, as well as the percentage of total production laundered by each process and the number of facilities performing each process. Many facilities reported conducting more than one of the listed processes. One process included in Table 4-5, dyeing of new fabrics is not considered a laundering process by EPA. (Chapter 6 discusses the scope of the industry under this proposed regulation.) The remaining processes listed in Table 4-5 can be divided into two basic categories: processes that generate wastewater and processes that generate little or no wastewater. The individual processes within these categories are described in more detail below.

4.3.1 Water-Using/Wastewater-Generating Processes

Laundering processes that use significant amounts of water and generate wastewater include water-washing processes and dual-phase washing. Almost all (97 percent) of the industry's production involves water-washing processes. Of the 1,747 in-scope facilities, 1,443 perform water washing on 100 percent of their production. Water washing is performed on almost all items. Brief descriptions of the different water-using processes are provided below.

Water Washing

Water washing involves the washing of soiled items in a water/chemical solution. The concentration, type, and amount of chemicals added during the water-washing process depend on the item type and the degree to which items are soiled. Wash formulas are used to determine the different washing cycles used in water washing, including the chemicals added. Wash formulas are also used to set the order, number, and duration of each wash cycle that is performed during the water-washing process. The typical order of these cycles and brief descriptions of the processing operations that occur in each cycle are described below.

In typical water-washing processes, the first cycle is the flush, which is defined as any rinsing operation prior to bleaching. This cycle removes loosely attached solids and a portion of the water-soluble soils. The next cycle is the break, during which items are treated with an alkali solution that swells the cellulosic fibers, allowing the soil to be more readily

Table 4-5
Laundering Processes
Reported in the Detailed Questionnaire

Process ¹	Estimated Number of Facilities Performing the Process	Estimated Percentage of Facilities Performing the Process	Estimated Percentage of Total Production ²
Water Washing (A01)	1,725	99	97
Dual-Phase Washing - Petroleum solvent wash followed by water washing (A02)	18	1	<1
Dual-Phase Washing - Water wash followed by perchloroethylene solvent wash (A03)	0	0	0
Dry Cleaning - Charged system (A04)	125	7	<1
Dry Cleaning - Fresh soap added to each load (A05)	80	5	<1
Dry Cleaning - No soap added (A06)	80	5	<1
Dry Cleaning Followed by Water Washing (drying between steps) (A12)	29	2	<1
Dust Control Mop Treatment - Water wash followed by oil treatment applied outside wash wheel (A10)	692	40	1
Dust Control Mop Treatment - Water wash followed by oil treatment applied inside wash wheel (A11)	67	4	<1
Dust Control Mop Treatment- Water wash followed by unspecified oil treatment (A07)	22	1	<1
Dust Control Mop Treatment - Oil only (A08)	57	3	<1
Stone/Acid Washing of Denim (A13)	11	1	1
Dyeing (A14) ³	1	<1	<1
Total	-	-	100

¹The codes in parentheses are from the detailed questionnaire and were used in the questionnaire database.

²Percentages reported are estimated based on the 193 in-scope facilities, extrapolated using appropriate survey weights to represent the entire industry.

³This process is not considered a laundering process by EPA.

Source: 1994 Industrial Laundries Industry Detailed Questionnaire

removed. Detergents may also be added during the break cycle. Sudsing occurs after the break cycle and is the cycle in which the actual washing of the items occurs. During sudsing, detergent is added in varying concentrations and the items are agitated until they are clean. After sudsing, a bleaching cycle may be performed, during which the detergent is replaced with a bleach solution and agitation continues. Following the sudsing and bleaching cycles, a rinsing cycle is typically performed, which removes the excess alkali and soap from the items. Additional chemicals are added in the blueing/brightening cycle to whiten/brighten the items. The final operation in water washing is the finish, which involves souring or acidifying the final bath water to a pH of 5, which prevents the yellowing of fabrics by sodium bicarbonate during pressing.

Dual-Phase Processing

Some facilities combine the water-washing and dry-cleaning processes to wash items that have large amounts of both organic-solvent-soluble and water-soluble soils. When these processes are performed in series, without drying the item between the solvent and water phases, the process is called dual-phase processing. The order in which these processes are carried out is determined by the solvent used, type of soil, and drying energy requirements. Dual-phase processing involving a petroleum solvent wash followed by water washing is used by only one percent of the industry. None of the facilities responding to the detailed questionnaire reported performing dual-phase processing involving water washing followed by solvent wash.

Water-Washing of Mops

This process entails first water washing mops and then applying oil to the mops by a sprayer either outside or inside the washer. This method of washing mops generates wastewater.

4.3.2 Non-Water-Using/Non-Wastewater-Generating Processes

Several laundering processes generate little if any wastewater. Processes that generate small amounts of wastewater include various methods of dry cleaning (charged system, fresh soap added to each load, and no soap added). Dust control mop treatment using only oil is the only industrial laundry process that generates no wastewater. Each of the processes represents less than one percent of the total industry production and is described in more detail below.

Dry Cleaning

Dry cleaning involves the use of an organic solvent instead of an aqueous detergent solution to clean laundry items. Water washing of certain items causes hydrophilic fibers to swell and undergo dimensional changes, causing wrinkles and shrinkage that can be avoided by the use of dry-cleaning solvents. These solvents dissolve soils at low temperatures and under relatively mild conditions, unlike water washing, which usually involves high temperatures and the use of harsh chemicals, such as alkalis and bleaches. The primary solvents

used by industrial laundries are perchloroethylene (“perc”) and petroleum-based solvent. Because these solvents are typically expensive and are considered hazardous wastes, they are commonly recycled and reused in subsequent dry-cleaning loads. During dry cleaning, the solvent becomes contaminated with dirt, oil, and grease removed from the items processed. To minimize the solvent contamination, industrial laundries use multiple solvent rinses to process items. As with water washing, the first few rinses typically contain the most pollutants, and subsequent rinses become less contaminated.

The general process steps for dry cleaning are similar to those for water washing. The items may be washed and dried in the same unit or washed in one unit and manually transferred to a dryer. In the drying step, steam is injected into the unit to volatilize the solvent. The steam and solvent are captured in a condenser. The water/solvent mixture is transferred to a phase separator where the solvent and water are separated. The solvent is either reused or contract hauled off-site for disposal. The water is discharged to a POTW either with or without pretreatment. The three major methods of dry cleaning items at industrial laundries are listed below.

- 1) Charged system: A small percentage of water and detergent (between 0.5 percent and 4 percent) is added to the dry-cleaning solvent. The water and detergent concentration in the solvent is maintained throughout the washing processes by using conductivity meters to control the addition of water and detergent automatically.
- 2) Fresh soap added to each load: A given amount of soap or detergent is added at the beginning of each load; no additional detergent is added during the cleaning cycle. Because the process is not monitored as closely as the charged system, excess water, soap, and energy may be expended with this system.
- 3) No soap added: This method uses only a dry-cleaning solvent.

Oil Treatment of Dust Mops

At some facilities, dust mops are not water-washed but are cleaned and treated with heated oil instead of water. After cleaning, the oil is extracted from the mops, leaving them coated with the desired quantity of treatment oil. The dirty oil is then purified by filtration and is reused. This is a closed-loop processing system that uses no process water.

4.3.3 Chemicals Used in Industrial Laundries

Industrial laundries use a variety of chemicals in their laundering processes. Chemicals that are frequently added to wash formulas include:

- Alkaline solution - to swell the fibers in the items;
- Detergent - to remove soil from the items;
- Bleach - to brighten the items;
- Antichlor - to remove excess bleach from the items;
- Sour - to reduce the pH of the water to prevent yellowing of the items;
- Softener - to soften the items; and
- Starch - to finish the items.

A variety of other chemicals are added to some wash formulas, including enzymes, builders, oil treatment chemicals, water conditioners, dyes, stain treatment chemicals, and bactericides.

Table 4-6 lists, based on the detailed questionnaire, the types of chemicals that are added during laundering operations, the number of facilities that add each chemical, the amount of each chemical added per year and the number of facilities that reported using the chemical but did not report the amount of the chemical used. Facilities that did not report chemical amounts were included in the number of facilities that added the chemicals, but they were not reflected in the amounts of chemicals added per year. As shown in Table 4-6, the two chemicals added most frequently to industrial laundering processes (besides detergent) are bleach and sour. The majority of the facilities (89 percent) use bleach as part of their laundering process. Eighty-one percent of the facilities use sour to prevent the yellowing of laundered items.

Some facilities reported using a chemical for more than one purpose. For these facilities, Table 4-6 includes only the primary purpose of the chemical. The amounts of mop oil treatment and dry-cleaning solvents listed in Table 4-6 are lower than actual use because many respondents who reported conducting mop oil treatment or dry cleaning processes did not report the amounts of chemicals used in these processes.

Table 4-7 presents the average amount of detergent added per pound of laundry for the items laundered in the greatest amounts. Buffing pads, filters, shop towels, and printer towels require on average the highest amounts of detergent per pound of laundry, whereas health-care items and floor mats require significantly less detergent per pound of laundry.

Table 4-6

**Industrial Laundering Wash Formula Chemicals
Reported in the Detailed Questionnaire**

Type of Chemical	Estimated Number of Facilities Adding Chemical	Total Estimated Amount Added (gal/yr) ¹	Total Estimated Amount Added (lb/yr) ¹
Detergent	1,742	3,923,590	105,087,072
Bleach	1,562	5,603,861	3,768,844
Sour	1,419	639,586	4,942,014
Antichlor	1,059	200,546	2,144,738
Softener/Antistatic	990	329,038	1,074,365
Starch	972	198,754	8,741,770
Alkaline Solution	547	2,018,373	7,256,211
Mildewcide/Bactericide	533	81,304	955,824
Solvent-Based Detergent	470	530,513	0
Dye Products	436	46,127	456,012
Builder	275	851,861	1,962,176
Oil Treatment Chemical	258	1,552,455	33,314
Stain Treatment Chemical	157	3,879	124,059
Water Conditioner	141	53,920	1,467,531
Miscellaneous Others ²	105	239,056	32,140
Solvent (Dry Cleaning)	116	244,278	0
Enzymes	55	861	42,160
Denim Treatment	9	23,018	12,874

¹Some facilities reported using a specific type of chemical but did not provide the amount added per year. Therefore, the total amounts added per year do not necessarily represent the total industry chemical use. In the detailed questionnaire, facilities were given the choice of reporting the amount of a chemical in either pounds per year or gallons per year. Quantities listed are additive, not inclusive.

²This category includes chemicals such as pH adjustors, lubricants, fabric coatings, emulsifiers, dispersants, and desizers.

Source: 1994 Industrial Laundries Industry Detailed Questionnaire

Table 4-7
Amounts of Detergent Added Per Pound of Laundry
for Items Most Often Laundered

Item ¹	Average Gallons of Detergent Added per Pound of Laundry ²	Average Pounds of Detergent Added per Pound of Laundry ²
Industrial Garments (B01)	0.00166	0.0235
Shop Towels, Industrial Wipers, etc. (B02)	0.0112	0.0322
Printer Towels (B03)	0.0237	0.0355
Floor Mats (B04)	0.000393	0.00537
Mops, Dust Cloths, Tool Covers, etc. (B05)	0.00259	0.0213
Linen Garments (B06)	0.00223	0.0212
Linen Flatwork/Full Dry (B07)	0.00177	0.0228
Health-Care Items (B08)	0.000575	0.00898
Fender Covers (B09)	0.00189	0.0230
Continuous Roll Towels (B10)	0.00123	0.0142
Clean Room Garments (B11)	0.00299	0.0123
Other (B13)	0.000500	---
Laundry Bags (B14)	---	0.0202
Family Laundry (B15)	0.000667	0.0124
New Items (B17)	0.000696	0.00605
Executive Wear (B18)	0.00136	0.00865
Miscellaneous NOG (not our goods) (B19)	0.00771	---
Rewash Items (B20)	---	0.0314
Filters (B23)	---	0.0486
Buffing Pads (B24)	0.0489	---

¹The codes in parentheses are from the detailed questionnaire and were used in the questionnaire database.

²Facilities were given the choice of reporting the amount of detergent in either pounds per year or gallons per year. These averages reflect the average amount of detergent added, for facilities/formulas that add either liquid detergent or powdered detergent, not a combination of the two. Quantities listed are additive, not inclusive.

Source: 1994 Industrial Laundries Industry Detailed Questionnaire

4.4 Facilities and Equipment

Table 4-8 presents the history of industrial laundries construction and startup from before 1940 to 1995. Facility construction refers to the year the building that the facility operates in was built. Facility startup refers to the year that actual industrial laundry processing began. As shown in the table, construction of laundries has fluctuated to some degree over the years. In the 1940s, construction of facilities dipped, then rose in the 1960s, and has declined somewhat into the 1990s. The time periods for the start of laundering operations generally parallel the facility construction time periods.

Industrial laundries typically operate five days per week with one or two shifts per day. Based on information provided in responses to the detailed questionnaire, the average number of operating hours per day is 11 (the range is 5 to 24 hours) and the average number of operating days per year is 261 (the range is 203 to 365 days).

The types of laundering equipment used at these facilities include washing equipment, drying equipment, and finishing equipment. In addition, some facilities have machines specially designed to launder specific items, such as continuous roll towels, mats and rugs, and mops. The most common types of washing equipment used in the industry are washers, extractors, washer-extractors, tunnel washers, and dry-cleaning units; descriptions of these five equipment types are provided below.

4.4.1 Washers, Extractors, and Washer-Extractors

Washers in industrial laundries wash and rinse items without removing excess water. Extractors remove excess rinse water from items after laundering or, in some cases, remove excess liquids from dirty items. Some washers automatically deposit the wash load into adjacent extractors, but others must be emptied manually at the completion of the washing cycle and the laundry deposited into an extractor. Washer-extractors come equipped with an internal extractor where both the washing and extraction of excess liquids occurs in one machine.

Conventional washers used in industrial laundries can handle loads of 15 to 1,200 pounds, as reported by facilities responding to the detailed questionnaire. The average capacity reported by facilities in the detailed questionnaire is 421 pounds per load. The equipment consists of a perforated horizontal cylinder rotating in a shell. The cylinder is equipped with ribs that lift the items as the cylinder rotates and drops them back into the washing solution. Conventional washers are traditionally equipped with thermometers for temperature control, gauges for control of water levels, timers, and devices to reverse the direction of rotation every four or five revolutions.

Table 4-8

**Age of Facilities and Start of Laundry/Dry-Cleaning Operations
(Estimated Percentage of Total Facilities in Each Time Period)**

Time Period	Estimated Number of Facilities Constructed¹	Estimated Number of Facilities Starting Laundry or Dry-Cleaning Operations
Before 1940	478 (27%)	385 (22%)
1940-1949	108 (6%)	107 (6%)
1950-1959	199 (11%)	192 (11%)
1960-1969	318 (18%)	365 (21%)
1970-1979	207 (12%)	247 (14%)
1980-1989	178 (10%)	274 (16%)
1990-1995	113 (6%)	164 (9%)
Not Specified	147 (8%)	14 (<1%)
Total ²	1,747 (100%)	1,747 (100%)

¹Percentages reported are estimated based on the 193 in-scope facilities, extrapolated using appropriate survey weights to represent the entire industry.

²Totals may not equal 100% due to rounding.

Source: 1994 Industrial Laundries Industry Detailed Questionnaire

4.4.2 Tunnel Washers

Tunnel washers are washers that operate in a continuous mode. In a tunnel washer, the items move forward through the washer by an “Archimedes screw” arrangement. Rinse water at the discharge end of the washer is recycled back to the first section of the washer. Water, steam, and laundry chemicals are mechanically injected into the washer, and, following washing, the load is moved by conveyor to extractors and dryers.

4.4.3 Dry-Cleaning Units

Dry-cleaning units are similar to those used in water washing, except that the fabrics are cleaned in an organic solvent instead of a detergent solution. Standard dry-cleaning equipment consists of a rotating cylinder in a stationary shell and one or more solvent storage tanks, a filter system for cleaning the solvent as it is used, a solvent/water separator, distillation equipment for solvent purification, and often a device for recovering solvent vapors (a condenser or an activated carbon filter). The water separated from the solvent is discharged with other process wastewater.

4.4.4 Equipment Use and Age

Tables 4-9 and 4-10 present information on the types of laundry process equipment reported by industrial laundries and the age of this equipment, respectively. As shown in Table 4-9, 95 percent of the facilities have washer-extractors and 42 percent of the facilities own separate washers and extractors. Overall, separate washers and extractors are slightly older than washer-extractors. Facilities reported few tunnel washers and, of those reported, most were purchased in the 1980s or 1990s. Most of the dry-cleaning units reported were also purchased in the 1980s and 1990s. Table 4-10 indicates that 68 percent of all laundry equipment was reported to be 15 years old or less, even though only 16 percent of the facilities were built in the past 15 years and only 25 percent of the facilities started laundering operations in the past 15 years.

4.5 Pollution Prevention Activities

Based on the detailed questionnaire responses, extrapolated to represent the entire industry, 503 facilities have a written pollution prevention policy. Seven hundred forty (740) facilities of the 1,747 extrapolated facilities conduct pollution prevention activities prior to the laundering process (pre-process activities) and 473 of these facilities conduct pollution prevention activities during the laundering process (in-process activities).

Tables 4-11 and 4-12 list the types of pre-process and in-process pollution prevention activities, respectively, reported in responses to the detailed questionnaire. Chapter 8 discusses these activities in greater detail. Although the detailed questionnaire specifically requested that wastewater treatment and water reuse/reduction information not be reported in

Table 4-9

Types of Laundry Processing Equipment Reported in the Detailed Questionnaire

Type of Equipment¹	Estimated Number of Facilities Reporting Equipment²	Estimated Percentage of Total Facilities Reporting Equipment
Washer-Extractors (D02)	1,668	95.47
Separate Washers (D01)	737	42.20
Separate Extractors (D03)	740	42.36
Dry-Cleaning Units (D04)	252	14.40
Tunnel Washers (D05)	39	2.23
Continuous Roll Towel (CRT) Washers (D07)	35	2.00
Closed-Loop Oil Washers (D08)	34	1.98
Other (Unspecified) (D06)	8	<1
Dip Tanks (D10)	6	<1
Mat/Rug Washers (D09)	0	0

¹The codes in parentheses are from the detailed questionnaire and were used in the questionnaire database.

²Percentages and number of facilities reported are estimated based on 190 in-scope facilities that responded to the question, extrapolated using appropriate survey weights to represent 1,743 facilities.

Source: 1994 Industrial Laundries Industry Detailed Questionnaire

Table 4-10

**Age of Laundry Processing Equipment
Reported in the Detailed Questionnaire
(Percentage of Equipment Type Installed in Each Time Period)**

Time Period	Estimated Number of Units Installed										
	Washers	Washer-Extractors	Extractors	Dry-Cleaning Units	Tunnel Washers	CRT Washers	Closed-Loop Oil Washers	Mat/Rug Washers	Dip Tanks	Other (Unspecified)	Total
Before 1960	43 (1.3%)	0	22 (1.2%)	0	0	0	0	0	0	0	65 (<1%)
1960-1969	529 (15.4%)	114 (1.3%)	193 (10.7%)	18 (3.2%)	0	4 (10.8%)	11 (32.4%)	0	0	0	869 (6.0%)
1970-1979	1,323 (38.6%)	1,452 (16.9%)	341 (18.9%)	63 (11.3%)	0	14 (37.8%)	1 (2.9%)	0	0	8 (100%)	3,202 (22%)
1980-1989	924 (26.9%)	3,763 (43.7%)	857 (47.6%)	253 (45.4%)	28 (45.2%)	17 (45.9%)	22 (64.7%)	0	0	0	5,864 (40.3%)
1990-1995	524 (15.3%)	2,930 (34%)	347 (19.3%)	219 (39.3%)	34 (54.8%)	2 (5.4%)	0	0	0	0	4,056 (27.9%)
Not Specified	86 (2.5%)	357 (4.1%)	42 (2.3%)	4 (<1%)	0	0	0	0	6 (100%)	0	495 (3.4%)
Total ¹	3,429	8,616	1,802	557	62	37	34	0	6	8	14,551

¹Totals may not equal 100 percent due to rounding.

Source: 1994 Industrial Laundries Industry Detailed Questionnaire

Table 4-11**Pre-Process Pollution Prevention Activities**

Activity	Estimated Number of Facilities Performing Activity	Estimated Percentage of Total Number of Facilities Reporting Pre-Laundering Activities¹
Items with Free Liquids Refused	447	60
Certain Items Refused	273	37
Miscellaneous Activities	26	4
Items Centrifuged to Remove Liquids	6	1
Items Sent to Another Site with Wastewater Treatment	67	9
Steam/Air Stripping of Volatile Organics from Items	2	<1
Items Dry-Cleaned Before Water Washing	24	3
Items Presorted to Remove Objects	32	4

¹Percentages are estimated based on a total of 740 extrapolated facilities (responses of in-scope facilities that reported pre-process pollution prevention activities).

Source: 1994 Industrial Laundries Industry Detailed Questionnaire

Table 4-12**In-Process Pollution Prevention Activities**

Activity	Estimated Number of Facilities Performing Activity	Estimated Percentage of Total Number of Facilities Reporting In-Process Activities¹
Change in Laundering/Dry-Cleaning Chemicals Used ²	132	28
Liquid Injection System for Wash Chemical Addition ²	109	23
Wastewater Treatment	79	17
Improved Housekeeping ²	49	10
Improved Training of Employees ²	149	31
Water Softening ²	46	10
Equipment Modifications/Installations	43	9
Removal of Lint Before Air Venting to Atmosphere	26	5
Miscellaneous Activities	25	5
Reduced Fuel Consumption	6	1
Recycling of Laundry Materials	3	1

¹Percentages are estimated based on the extrapolated responses of 473 extrapolated facilities (responses of in-scope facilities that reported in-process pollution prevention activities).

²Data for these specific in-process pollution prevention activities were specifically requested in the detailed questionnaire.

Source: 1994 Industrial Laundries Industry Detailed Questionnaire

response to these questions, several facilities provided this information. (Water reuse/reduction information was specifically requested by the detailed questionnaire in a different section and is discussed in greater detail in Chapter 8).

Table 4-11 shows that the pre-process pollution reduction activity that was performed by most facilities was the refusal of items with free liquids. These items are commonly shop towels and printer towels.

The detailed questionnaire requested data for five specific in-process pollution prevention activities. Facilities were requested to report any additional in-process pollution prevention activities; these activities were labeled as “other.” Based on descriptions provided by the facilities, supplemental pollution prevention categories were then created for these “other” activities. Table 4-12 presents data for the five activities specified in the questionnaire, as well as for the remaining seven activities. According to responses to the detailed questionnaire, the facilities reporting pollution prevention activities are equally distributed through all production category sizes. As shown in Table 4-12, the two most common in-process pollution reduction activities were change in laundering/dry-cleaning chemicals used and the use of a liquid injection system for wash chemical addition.

4.6 Trends in the Industry

Several business and operating trends are emerging in the industrial laundries industry, including changes in industrial laundry processes, facility size, and pollution reduction technologies. These trends are discussed in greater detail below.

4.6.1 Trend Away from Dry Cleaning

Many facilities are moving away from dry-cleaning because of the hazardous nature of the dry cleaning solvents and the expense of their disposal. Nineteen percent of the facilities responding to the detailed questionnaire reported owning dry-cleaning units. The largest percentage (45%) of dry-cleaning units was purchased in the 1980s; only 39% of all dry-cleaning units in operation today were purchased between 1990 and 1995, as shown in Table 4-10. The facilities that do operate dry cleaning units have moved away from perchlorethylene as a solvent and are now using petroleum based solvents.

4.6.2 Trend of Small Facilities being Purchased by Larger Firms

In the past several years, there has been a trend toward large firms purchasing smaller firms. Larger firms realize an economy of scale in their operations and can often offer lower prices than smaller companies. Many smaller single-owner companies are finding it difficult to compete with the larger multi-facility firms due to the rising costs of both washroom and treatment equipment, the difficulty in raising capital, the utilization of new technologies, and the

requirement of more professional management (1). Because of this increased difficulty to compete, these smaller facilities are being purchased by the larger firms.

There are many reasons that the larger firms are purchasing smaller facilities. One of the benefits of a large firm is that they have the capability to offer many specialized laundering services, (e.g., laundering of cleanroom items). In essence, the larger firms are more diversified and thus have the capability to process laundry and treat the wastewater generated from a variety of customers. A recent analysis showed that the largest five firms control about 55 percent of the market (1).

4.6.3 Trends in Equipment and Technologies

The industry as a whole is moving towards automation in the washing, drying, folding, and packaging of items laundered. This includes practices ranging from installing automatic detergent dispensers in the washers to purchasing washer-extractors instead of separate washers and extractors. Another trend is the installation of tunnel washers; these washers have a built-in “reuse cycle” where the final rinse water is automatically cycled back to the first rinse. The use of these washers lowers the average water used per pound of item laundered and thus saves the facilities money.

The pre-process pollution prevention activities reported by facilities responding to the detailed questionnaire were initiated primarily in the late 1980s to 1994. The trend within the industry appears to be to continue and increase pollution prevention activities. Some of these pollution prevention activities include the installation of more efficient washers and extractors, detergents that allow for lower wash temperatures and a lower pH for the removal of oils and grease from the items, and the installation of more sophisticated wastewater treatment systems. Chapter 8 discusses pollution prevention practices in more detail.

4.7 Treatment Technologies in Use

The principal types of wastewater treatment reported by industrial laundries in the detailed questionnaire include gravity settling, screens, equalization/neutralization, air flotation, clarification, and oil/water separation. Chapter 8 discusses wastewater treatment technologies used by the industry in greater detail.

4.8 References

1. K. Koepper. “Don’t Count Out More Public Company Acquisitions.” Industrial Launderer. August 1997: page 24.

CHAPTER 5

WATER USE AND WASTEWATER CHARACTERIZATION

5.1 Introduction

This chapter discusses water use practices for the industrial laundries industry and presents a raw wastewater characterization of item-specific and total wastewater streams at industrial laundries. The water use data presented in this chapter are from the 193 in-scope facilities responding to the 1994 Industrial Laundries Industry Detailed Questionnaire (in-scope facilities are those that meet the definition of an industrial laundry as presented in Chapter 6, regardless of annual production). Where appropriate, these data have been extrapolated using statistically-derived survey weights to represent the entire industry.

The remainder of this chapter is presented as follows:

- Section 5.2 discusses the sources of industrial laundry service water and the uses of service water within the industry;
- Section 5.3 discusses wastewater volume by type of discharge;
- Section 5.4 discusses water conservation measures implemented by the industrial laundries industry;
- Section 5.5 discusses characterization of raw wastewater by item laundered; and
- Section 5.6 discusses characterization of total, heavy, and light raw wastewater streams.

5.2 Sources of Service Water and Water Use

This section provides information on sources of service water and water use breakdown as reported by industrial laundries responding to the detailed questionnaire.

5.2.1 Sources of Service Water at Industrial Laundries

Service water in the industrial laundries industry refers to any water used at a facility, ranging from sanitary water to laundry process water. The primary source of service water at industrial laundries is a water authority or municipal source. Well water is also used as service water at some facilities. None of the industrial laundries that responded to the detailed questionnaire reported surface water as the direct intake source of their service water. Table 5-1 presents the sources of service water for the industrial laundries industry; these data have been extrapolated to represent the entire industry.

5.2.2 Use of Service Water at Industrial Laundries

Industrial laundries use service water for a variety of purposes. Table 5-2 presents the various uses of service water, the number of facilities reporting each use, and the percentage of the total industry service water represented by each use. These amounts are based on the first use of the service water. Water recycle/reuse is not included in Table 5-2. Table 5-2 is based on available data from the detailed questionnaire extrapolated to represent the entire industrial laundries industry.

Laundry Process Water Use.

The majority of service water is used for laundry processes. As discussed in Chapter 4, the laundering processes that use water and generate wastewater include:

- Water washing;
- Dual-phase washing; and
- Dust control mop treatment (water washing of mops followed by oil treatment).

Facilities use varying amounts of laundry process water per pound of laundry processed due to the following factors:

- Type of items laundered;
- Customers;
- Soil loading on items;
- Laundering chemicals used in wash formulas; and
- Laundry processing equipment used.

Process water use at a facility is most directly related to the quantity of items laundered. Figure 5-1 shows the distribution of facilities by amount of laundry process water used per pound of laundry processed. Water used in laundry processing comprises the service water that is allocated to laundry processing, the process water that is reused before and/or after wastewater treatment, and the water from other processes that is reused as laundry process water (e.g., noncontact cooling water). This water use was normalized to account for all laundry production from processes that generate wastewater. The average amount of wastewater discharged per pound of laundry processed is 2.74 gallons per pound. Over 86 percent of the industry uses between 1 and 4 gallons of process water per pound of laundry that is water-washed.

Table 5-1**Service Water Sources**

Service Water Source	Estimated Number of Facilities By Source¹	Estimated Percentage of Total Facilities By Source
Water Authority/Municipal Source Only	1,572	90
Private Well Only	1	< 1
Water Authority/Municipal Source and Private Well	174	10
Surface Water (Directly)	0	0
Total	1,747	100

¹Based on responses to the detailed questionnaire from the 193 in-scope facilities, extrapolated to represent the entire industrial laundries industry.
Source: 1994 Industrial Laundries Industry Detailed Questionnaire

Table 5-2
Service Water Use

Service Water Use	Estimated Number of Facilities By Use¹	Estimated Percentage of Total Service Water By Use
Laundry Process Water	1,745	92.1
Sanitary Water	1,670	3.1
Floor/Equipment Washing	956	<1
Boiler Water	599	1.8
Vehicle Washing	584	<1
Noncontact Cooling Water	490	1.4
Water Softener Regeneration Water	94	<1
Other Uses Not Reported	72	<1
Wastewater Treatment	37	<1
Air Conditioning	26	<1
Landscaping	25	<1
Dish Washing	22	<1
Irrigation	1	<1
Total	-	100

¹Number of facilities reporting water use is based on the responses to the detailed questionnaire from 193 in-scope facilities, extrapolated to represent the entire industrial laundries industry. The number of facilities reporting each service water use is based on the first use of the service water. One facility reported using service water first as noncontact cooling water, then as process water. This facility has a survey weight of 2.
Source: 1994 Industrial Laundries Industry Detailed Questionnaire

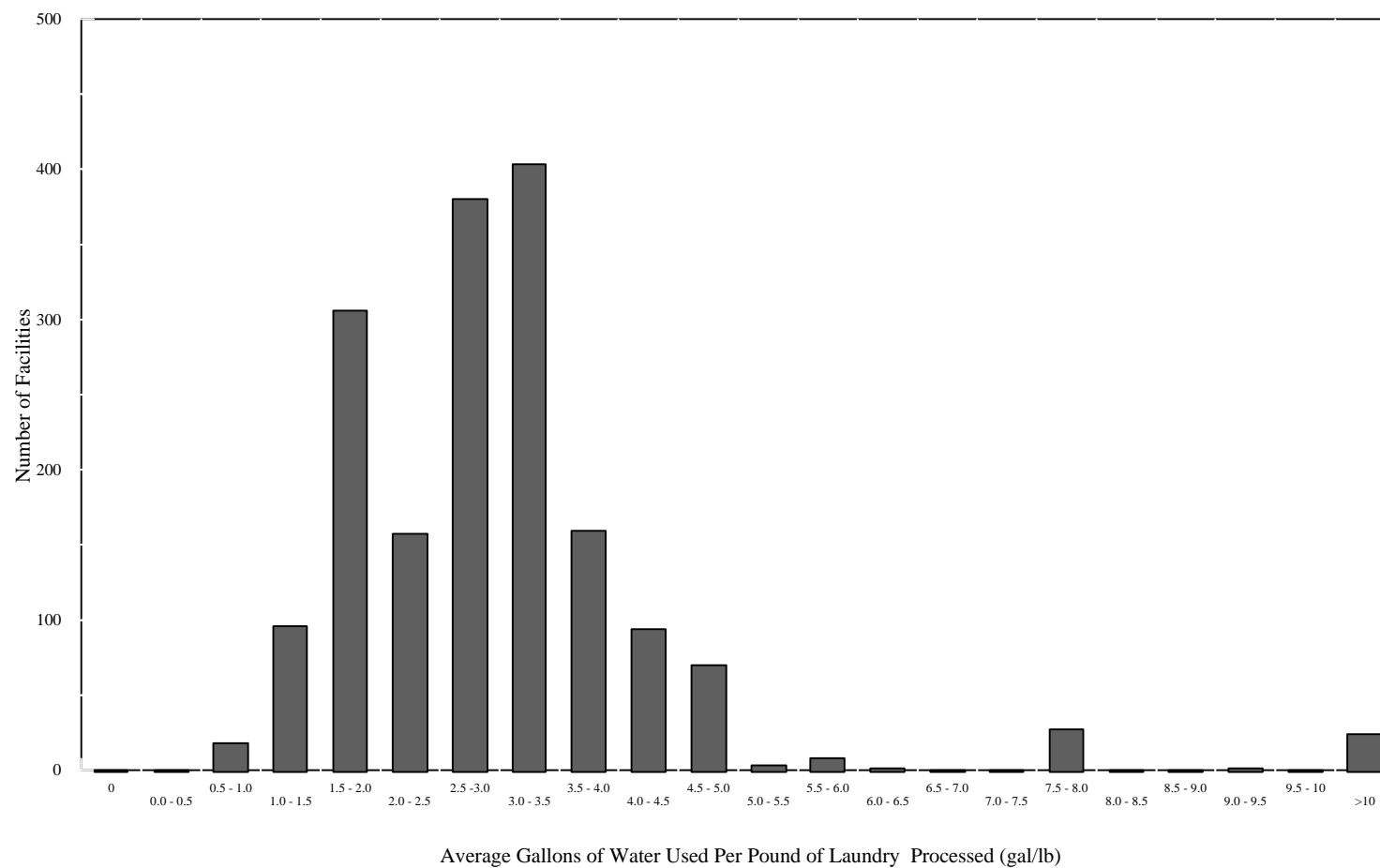


Figure 5-1. Distribution of Facilities by Production Normalized Laundry Process Water Use¹

¹ Based on responses to the detailed questionnaire from the 193 in-scope facilities, extrapolated to represent the entire industry.

Water use is also related to type of item laundered. An analysis of item-specific water use per pound of laundry processed (gal/lb) was conducted using data from facility responses to the detailed questionnaire. Table 5-3 presents the item-specific water use in gallons of water per pound of laundry (gal/lb) by process as reported by the 193 in-scope facilities responding to the detailed questionnaire. These amounts were calculated from information provided in the wash formulas reported by facilities. For most items, EPA calculated a median water use ranging from 2.40 to 3.30 gal/lb. Denim prewashing of new items requires the highest use of water with a median value of 5.40 gal/lb. Water washing of buffing pads requires the least amount of water (0.50 gal/lb), but this amount is based on information from only one facility.

Other Industrial Laundry Water Uses.

Although most of the incoming service water used at industrial laundries (92.1 percent) is used as laundry process water, there are a number of other service water uses, as presented in Table 5-2. After laundry process water, sanitary water accounts for the second largest amount (3.1 percent) of total service water used at industrial laundries. Boiler water accounts for the third most significant use of service water (1.8 percent), followed closely by noncontact cooling water (1.4 percent). Noncontact cooling water includes water used in evaporative coolers and other heat exchangers. Approximately 95 percent of the facilities that reported noncontact cooling water use recycle their noncontact cooling water. In many instances, the recycled water is used as laundry process water. Other uses of service water at industrial laundries include vehicle washing, floor/equipment washing, and water used in wastewater treatment systems. These uses each represent less than one percent of the total service water used at industrial laundry facilities.

5.3 Wastewater Volume by Type of Discharge

All of the in-scope facilities that responded to the detailed questionnaire discharge laundry wastewater to a POTW. Some facilities also discharge some of their process wastewater to off-site disposal or land application. None of the facilities reported discharging laundry process wastewater or noncontact cooling water directly to surface water. Residual wastewater found in the sludge and oil wastes generated during wastewater pretreatment is also disposed of off site or land applied. Table 5-4 presents process wastewater discharge practices reported by the facilities that responded to the detailed questionnaire.

Figure 5-2 shows the distribution of facilities by amount of laundry process wastewater discharged per pound of laundry processed. The total wastewater discharged comprises the laundry process wastewater that is discharged to a POTW, the laundry process wastewater that is land applied, and the laundry process wastewater that is shipped off site for disposal. This calculated wastewater discharge was normalized for all laundry production

Table 5-3**Item-Specific Water Use¹**

Item²	Process³	Mean (gal/lb)	Median (gal/lb)	Standard Deviation (gal/lb)	Estimated Number of Facilities in Calculations
Industrial Garments (B01)	A01	2.66	2.40	1.47	148
	A02	3.73	2.80	2.46	3
Shop Towels (B02)	A01	4.18	3.10	8.73	126
Printer Towels (B03)	A01	4.12	3.60	2.32	65
	A02	3.70	3.80	0.29	3
Floor Mats (B04)	A01	1.87	1.60	0.98	163
	A02	2.10	2.10	0.00	1
Mops, Dust Cloths, Tool Covers, etc. (B05)	A01	3.00	2.80	1.57	83
	A07	3.03	2.90	1.58	45
Linen Supply Garments (B06)	A01	3.51	3.30	1.62	99
Linen Flatwork/Full Dry (B07)	A01	3.03	2.80	1.34	121
Health-Care Items (B08)	A01	2.53	2.40	1.02	67
Fender Covers (B09)	A01	3.55	2.70	3.65	65
Continuous Roll Towels (B10)	A01	2.88	2.40	4.32	79
Clean Room Garments (B11)	A01	2.93	3.00	0.52	9
Other (B13)	A01	4.00	4.00	0.00	1
Laundry Bags (B14)	A01	1.45	1.45	0.45	2

Table 5-3 (Continued)

Item ²	Process ³	Mean (gal/lb)	Median (gal/lb)	Standard Deviation (gal/lb)	Estimated Number of Facilities in Calculations
Family Laundry (B15)	A01	3.35	3.05	1.28	6
New Items (B17)	A01	3.00	2.75	1.17	6
	A13	5.63	5.40	1.76	3
Executive Wear (B18)	A01	4.74	2.90	4.67	5
Miscellaneous NOG (Not Our Goods) (B19)	A01	3.00	3.00	0.00	1
Rewashed Items (B20)	A01	2.18	2.10	0.77	5
Filters (B23)	A01	4.20	4.20	1.20	2
Buffing Pads (B24)	A01	0.50	0.50	0.00	1

¹ The process/item gallon-per-pound ratios were calculated from water washing formula data provided in Table C of the detailed questionnaire. This analysis was performed using data from the 193 in-scope facilities; the data were not extrapolated to represent the entire industry. The ratios for each formula at a facility were calculated and the ratios were averaged for each item/process combination at individual facilities. The number of times the formula was used per day was taken into account. The facility-specific ratios were then used to calculate an industry mean and median gallon/pound ratio for each item/process combination. There were no usable data to calculate the water use requirements for absorbents, clean wipes, or airline carpet and seat covers.

² The codes in parentheses reflect the item codes used in the detailed questionnaire.

³ Process codes used in the detailed questionnaire:

A01 - Water Washing

A02 - Dual Phase Washing: Petroleum solvent wash followed by water washing

A07 - Dust Control Mop Treatment: Water washing followed by oil treatment

A13 - Denim Prewash

Source: 1994 Industrial Laundries Industry Detailed Questionnaire

Table 5-4**Discharge Practices of Industrial Laundries¹**

Discharge Practice	Estimated Number of Facilities Discharging Laundry Process Wastewater (Percent of Facilities)	Estimated Number of Facilities Discharging Noncontact Cooling Water (Percent of Facilities)
Discharge to POTW	1,747 (100%)	313 (18%)
Off-Site Disposal	221 (13%)	0 (0%)
Land Application	84 (5%)	0 (0%)
Discharge to Surface Water	0 (0%)	0 (0%)

¹Based on responses to the detailed questionnaire from the 193 in-scope facilities, extrapolated to represent the entire industry. Some facilities reported more than one discharge practice.

Source: 1994 Industrial Laundries Industry Detailed Questionnaire

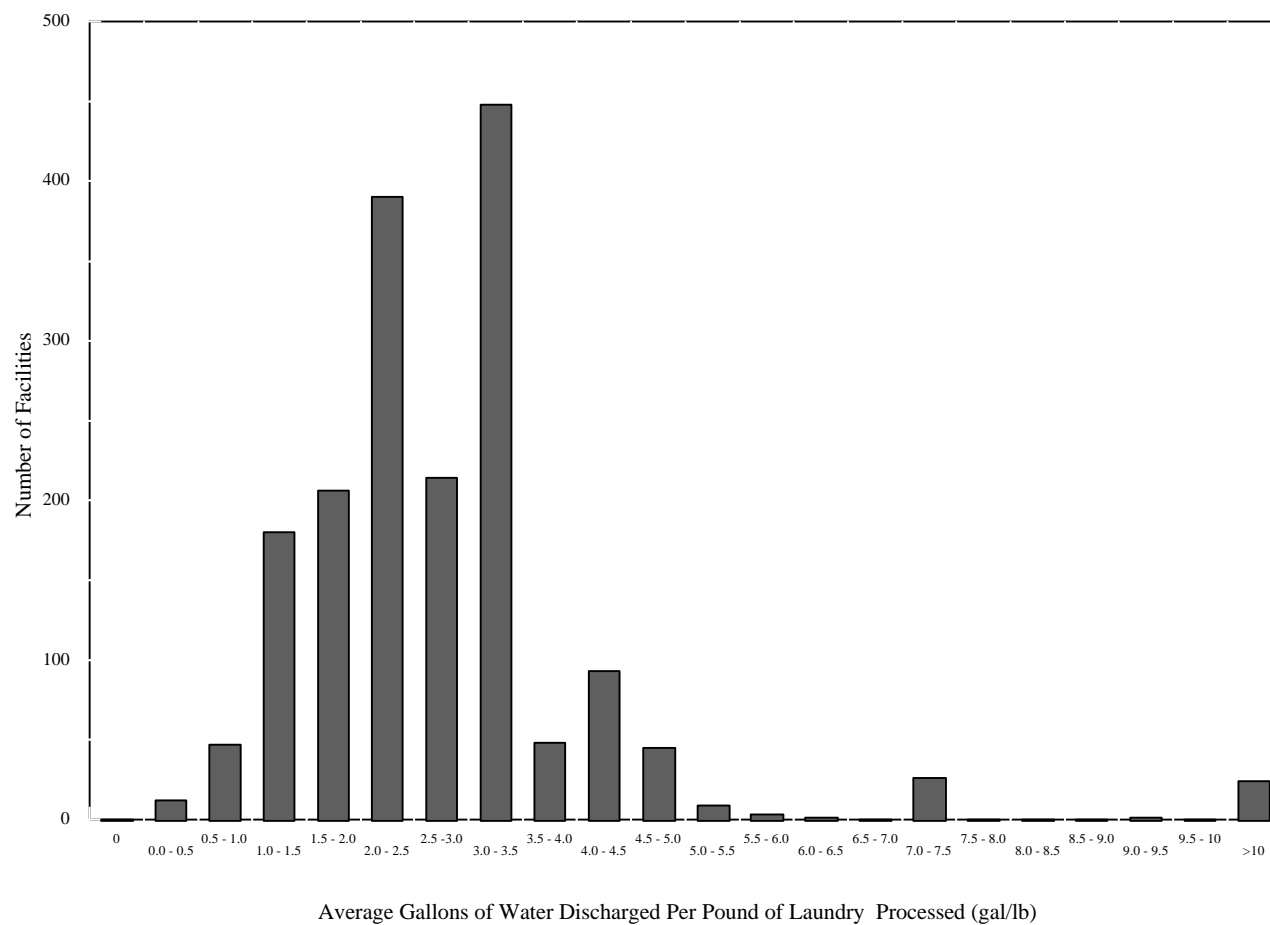


Figure 5-2. Distribution of Facilities by Production Normalized Laundry Process Water Discharge¹

¹ Based on responses to the detailed questionnaire from the 193 in-scope facilities, extrapolated to represent the entire industry.

from processes that generate wastewater. Over 60 percent of the facilities discharge between 1.5 and 3.5 gallons of process wastewater per pound of laundry that is water-washed.

A comparison of the values in Figures 5-1 and 5-2 shows that more laundry process water is used than is discharged. This difference is due to evaporation losses and laundry process wastewater recycle/reuse before and after wastewater treatment. (The average evaporation loss reported by facilities in the detailed questionnaire was approximately 10 percent. For 81 percent of the facilities, the difference between laundry process water use and discharge is less than 0.5 gal/lb. Most of the reported amounts of laundry process wastewater discharged are estimates; less than 15 percent of the facilities measure the amount of wastewater that is discharged at their facilities.

5.4 Water Conservation Measures

Approximately 85 percent of the facilities that responded to the detailed questionnaire reported performing some type of water conservation practice. Table 5-5 presents activities that were reported as standard water conservation techniques at industrial laundries. Table 5-5 also presents the reported water use reduction due to implementation of these conservation practices. As shown in the table, prompt attention to faulty equipment, leaks, and other problems is practiced by the greatest number of laundries, followed by routine monitoring of water use. Chapter 8 provides additional information on wastewater recycle/reuse.

5.5 Characterization of Raw Wastewater by Item Laundered

As discussed in Chapter 4, items laundered at industrial laundries can have significantly different pollutant loads based on item type and customer. This section presents raw wastewater characterization data for specific items laundered for the 72 pollutants most frequently detected in industrial laundry wastewater. Table 5-6 presents for the 72 pollutants the mean pollutant concentration by item type. Table B-1 in Appendix B of this document presents for the 72 pollutants the minimum, maximum, and mean concentrations, as well as the number of times each pollutant was analyzed, the number of times the pollutant was detected, and the percentage of times the pollutant was detected, by item type.

5.6 Characterization of Total, Heavy, and Light Raw Wastewater Streams

This section presents raw wastewater characterization data for total, heavy, and light raw wastewater streams at industrial laundries. EPA sampling program data and detailed monitoring questionnaire (DMQ) data from facilities that do not split their wastewater stream were used to characterize total raw wastewater streams. The total stream is then discharged, with or without treatment, to a POTW. EPA sampling program data from facilities that split their wastewater streams were used to characterize heavy and light wastewater streams. The heavy and light wastewater streams were designated as such by the sampled facilities; generally, the heavy wastewater stream is generated from laundering items with high pollutant

Table 5-5**Water Conservation Practices and Water Use Reduction**

Water Conservation Practice	Water Reduction Range (gal/day)	Estimated Number of Facilities With This Practice¹	Percentage of Total Facilities With This Practice¹
Prompt Attention to Faulty Equipment, Leaks, and Other Problems	0 - 25,000	1,180	68%
Routine Monitoring of Water Use	0 - 57,693	996	57%
Installation of Laundering Equipment That Uses Less Water	16 - 165,000	266	15%
Implementation of Alternative Laundry Wash Formulas That Require Less Water	6 - 26,000	261	15%
Reuse of Noncontact Cooling Water as Process Makeup Water	150 - 31,623	246	14%
Recycling/Reuse of Laundry Wastewater Before Treatment	60 - 53,000	155	9%
Implementation of Alternative Production Processes That Require Less Water	82 - 20,000	44	2%
Other Practices	200 - 6,000	19	1%
Installation of Automatic Monitoring and Alarm Systems on In-plant Discharges	500 - 7,985	17	1%
Recycle/Reuse of Laundry Wastewater After Treatment	3,000 - 29,000	13	1%
Reuse of Nonlaundry Wastewater as Laundry Process Water	8,967	4	<1%

¹Based on responses to the detailed questionnaire, extrapolated to represent entire industry. Only 1,468 extrapolated facilities responded to this question. Percentages are based on the entire estimated industry of 1,747.
Source: 1994 Industrial Laundries Industry Detailed Questionnaire

Table 5-6

Wastewater Characterization for Item Specific Wastewater at Industrial Laundries

Constituent Name	Mean Concentration (mg/L) ¹			
	Industrial Garments	Shop Towels	Printer Towels	Mats
Conventionals				
Biochemical Oxygen Demand 5-Day (BOD ₅)	386	2,060	3,940	248
Oil and Grease (measured as HEM)	91	2,550	5,890	84
Total Suspended Solids (TSS)	348	4,590	1,250	365
Priority Organics				
1,1,1-Trichloroethane	0.0550	5.16	4.50	1.60
1,2-Diphenylhydrazine	0.110	1.36	1.00	0.0200
4-Chloro-3-methylphenol	0.178	1.03	0.433	0.0100
Bis(2-ethylhexyl) Phthalate	0.224	3.30	19.0	2.02
Butyl Benzyl Phthalate	0.0550	0.678	5.55	0.0197
Chlorobenzene	0.0550	0.313	0.467	0.0100
Chloroform	0.0550	0.370	0.370	0.0100
Di- <i>n</i> -butyl Phthalate	0.0550	0.678	3.20	0.0100
Di- <i>n</i> -octyl Phthalate	0.0600	0.678	1.24	0.0494
Ethylbenzene	0.151	6.25	13.2	0.283
Isophorone	0.0550	0.678	0.500	0.361
Methylene Chloride	0.0558	5.28	0.614	0.442
Naphthalene	0.0550	2.88	9.64	0.0244
Phenol	0.0702	0.381	0.500	0.0100
Tetrachloroethene	0.0550	8.03	3.92	0.125
Toluene	0.0666	4.81	20.5	1.29
<i>trans</i> -1,2-Dichloroethene	0.0550	0.456	0.371	0.0100
Trichloroethene	0.0550	0.294	0.476	0.0100
Nonconventional Organics				
2-Butanone	0.275	1.92	3.09	0.579
2-Methylnaphthalene	0.0550	0.946	0.836	0.0100
2-Propanone	0.313	3.98	49.7	2.11
4-Methyl-2-pentanone	0.275	1.88	2.07	0.458
α-Terpineol	0.0550	0.874	1.07	0.0825
Benzoic Acid	0.450	3.23	3.30	0.231
Benzyl Alcohol	0.0699	0.678	0.500	0.0724
Hexanoic Acid	0.0885	0.373	0.433	0.0737
<i>m</i> -Xylene	0.0100	1.69	1.44	0.520
<i>n</i> -Decane	0.0550	49.5	90.6	1.98
<i>n</i> -Docosane	0.0632	0.949	0.668	0.0130
<i>n</i> -Dodecane	0.0630	18.2	23.1	0.121

Table 5-6 (Continued)

Constituent Name	Mean Concentration (mg/L) ¹			
	Industrial Garments	Shop Towels	Printer Towels	Mats
<i>n</i> -Eicosane	0.0694	29.8	1.29	0.0166
<i>n</i> -Hexacosane	0.130	1.83	2.01	0.0197
<i>n</i> -Hexadecane	0.0759	9.85	9.51	0.0305
<i>n</i> -Octacosane	0.0956	1.11	0.402	0.0100
<i>n</i> -Octadecane	0.0471	11.4	2.43	0.0152
<i>n</i> -Tetracosane	0.0679	0.831	0.605	0.0100
<i>n</i> -Tetradecane	0.0634	16.9	7.89	0.0190
<i>n</i> -Triacotane	0.0620	0.926	0.626	0.0306
<i>o</i> -& <i>p</i> -Xylene	0.0100	0.563	1.08	0.291
<i>p</i> -Cresol	0.0550	0.373	0.433	0.0100
<i>p</i> -Cymene	0.0764	2.54	12.4	0.0100
Pentamethylbenzene	0.0550	0.678	0.500	0.0100
Priority Metals and Elements				
Antimony	0.454	0.211	0.0556	0.0203
Arsenic	0.0116	0.0238	0.00313	0.00380
Beryllium	0.000758	0.00100	0.00100	0.00100
Cadmium	0.0246	0.391	0.0253	0.00950
Chromium	0.0936	0.478	2.65	0.0806
Copper	0.672	6.65	11.0	0.220
Lead	0.214	7.34	8.91	0.307
Mercury	0.000408	0.00122	0.000230	0.000430
Nickel	0.103	0.600	0.101	0.0543
Selenium	0.0102	0.0138	0.0177	0.00460
Silver	0.00710	0.174	0.207	0.0171
Thallium	0.00360	0.00467	0.00767	0.0120
Zinc	1.47	13.9	3.62	1.06
Nonconventional Metals and Elements				
Aluminum	5.19	11.3	8.22	3.42
Barium	0.254	3.98	4.53	0.214
Boron	0.195	1.81	0.670	0.0500
Cobalt	0.0171	0.336	0.614	0.0135
Iron	9.70	55.2	8.51	6.87
Manganese	0.139	1.18	0.898	0.115
Molybdenum	0.0213	0.351	2.10	0.0240
Tin	0.0922	0.270	0.0990	0.0439
Titanium	0.148	0.199	0.184	0.0100
Vanadium	0.00700	0.0433	0.00900	0.00920
Yttrium	0.00215	0.00810	0.00570	0.00500

Table 5-6 (Continued)

Constituent Name	Mean Concentration (mg/L) ¹			
	Industrial Garments	Shop Towels	Printer Towels	Mats
Bulk Nonconventionals				
Chemical Oxygen Demand (COD)	1,740	14,000	16,900	80
Total Organic Carbon (TOC)	359	1,950	2,740	186
Total Petroleum Hydrocarbon (measured as SGT-HEM)	47	1,630	1,730	33

Table 5-6 (Continued)

Constituent Name	Mean Concentration (mg/L) ¹			
	Mops	Steam-Tumbled Printer Towels	Items Dry Cleaned Prior to Water Washing	Linen Supply Items
Conventionals				
Biochemical Oxygen Demand 5-Day (BOD ₅)	1,150	1,440	113	881
Oil and Grease (measured as HEM)	286	1,720	NA	108
Total Suspended Solids (TSS)	1,100	1,320	82	269
Priority Organics				
1,1,1-Trichloroethane	1.04	0.0118	NA	0.00833
1,2-Diphenylhydrazine	0.200	0.0800	NA	0.0200
4-Chloro-3-methylphenol	0.100	0.0400	NA	0.0100
Bis(2-ethylhexyl) Phthalate	1.10	8.77	NA	0.574
Butyl Benzyl Phthalate	0.895	0.366	NA	0.0944
Chlorobenzene	0.0550	0.0100	NA	0.00833
Chloroform	0.0565	0.0100	NA	0.889
Di- <i>n</i> -butyl Phthalate	0.434	0.117	NA	0.0306
Di- <i>n</i> -octyl Phthalate	0.108	0.325	NA	0.0572
Ethylbenzene	0.0550	0.0100	0.0458	0.00833
Isophorone	0.100	0.0400	NA	0.0100
Methylene Chloride	0.0767	0.0100	NA	0.0112
Naphthalene	0.471	0.226	NA	0.108
Phenol	0.100	0.0432	NA	0.0674
Tetrachloroethene	0.0550	0.0100	NA	0.00833
Toluene	0.0597	0.0436	0.225	0.0241
<i>trans</i> -1,2-Dichloroethene	0.0550	0.0100	NA	0.00833
Trichloroethene	0.0550	0.0100	NA	0.00833
Nonconventional Organics				
2-Butanone	1.13	0.0500	NA	0.0500
2-Methylnaphthalene	0.432	0.0400	NA	0.0164
2-Propanone	2.22	0.681	NA	0.0607
4-Methyl-2-pentanone	0.275	0.0500	NA	0.0500
α-Terpineol	0.100	0.0400	NA	0.0339
Benzoic Acid	2.35	0.977	NA	0.150
Benzyl Alcohol	0.610	0.819	NA	0.202
Hexanoic Acid	0.216	0.384	NA	0.0279
<i>m</i> -Xylene	0.100	0.0151	NA	0.0100
<i>n</i> -Decane	0.965	0.499	NA	2.63
<i>n</i> -Docosane	0.157	0.131	NA	0.0392
<i>n</i> -Dodecane	8.07	2.65	NA	0.270
<i>n</i> -Eicosane	0.291	3.05	NA	0.0862

Table 5-6 (Continued)

Constituent Name	Mean Concentration (mg/L) ¹			
	Mops	Steam-Tumbled Printer Towels	Items Dry Cleaned Prior to Water Washing	Linen Supply Items
<i>n</i> -Hexacosane	0.210	0.0904	NA	0.0267
<i>n</i> -Hexadecane	1.07	91.6	NA	0.160
<i>n</i> -Octacosane	0.221	0.0633	NA	0.0212
<i>n</i> -Octadecane	0.875	1.48	NA	0.0720
<i>n</i> -Tetracosane	0.100	0.0724	NA	0.0630
<i>n</i> -Tetradecane	1.47	12.8	NA	0.140
<i>n</i> -triacontane	0.163	0.0587	NA	0.0551
<i>o</i> -& <i>p</i> -Xylene	0.100	0.0146	NA	0.0100
<i>p</i> -Cresol	0.100	0.0400	NA	0.0100
<i>p</i> -Cymene	0.100	0.0400	NA	0.108
Pentamethylbenzene	0.100	0.0400	NA	0.0100
Priority Metals and Elements				
Antimony	0.0556	0.0261	NA	0.114
Arsenic	0.0178	0.00380	0.00500	0.156
Beryllium	0.00100	0.00100	NA	0.00100
Cadmium	0.0373	0.0358	0.0825	0.0219
Chromium	0.184	0.275	0.0933	0.0492
Copper	3.52	4.86	0.668	0.527
Lead	1.76	0.957	0.519	0.151
Mercury	0.00840	0.000200	0.000150	0.00165
Nickel	0.195	0.0372	0.0200	0.0771
Selenium	0.00460	0.0230	NA	0.151
Silver	0.0160	0.0653	0.00500	0.0291
Thallium	0.00240	0.0120	NA	0.00700
Zinc	5.32	2.10	0.450	0.381
Nonconventional Metals and Elements				
Aluminum	17.3	2.80	NA	3.08
Barium	0.953	1.63	NA	0.301
Boron	0.327	0.0500	NA	0.0970
Cobalt	0.0620	0.202	NA	0.00990
Iron	31.9	2.62	NA	3.26
Manganese	0.638	0.277	NA	0.0812
Molybdenum	0.0940	2.64	NA	0.0263
Tin	0.128	0.0761	NA	0.0290
Titanium	0.307	0.0178	NA	0.0654
Vanadium	0.0320	0.0221	NA	0.00990
Yttrium	0.00500	0.00500	NA	0.00470

Table 5-6 (Continued)

Constituent Name	Mean Concentration (mg/L) ¹			
	Mops	Steam-Tumbled Printer Towels	Items Dry Cleaned Prior to Water Washing	Linen Supply Items
Bulk Nonconventionals				
Chemical Oxygen Demand (COD)	5,410	9,000	638	844
Total Organic Carbon (TOC)	518	1,770	NA	401
Total Petroleum Hydrocarbon (measured as SGT-HEM)	111	468	NA	12

¹The detection limit concentration was used in calculations for data points reported as non-detects.
 NA - Not Available. No data were available for this constituent.

loadings and the light wastewater stream is generated from laundering items with low pollutant loadings. At some facilities, the heavy stream is generated from wastewater from the first several breaks of laundering a variety of items. The heavy stream is typically treated and combined with the untreated light stream prior to discharge to a POTW.

Tables 5-7 through 5-9 present for 72 pollutants the mean concentrations for heavy, light, and total raw wastewater streams. Table B-2 in Appendix B of this document presents for the 72 pollutants the minimum, maximum, and mean concentrations, as well as the number of times the pollutant was analyzed, the number of times the pollutant was detected, and the percentage of times the pollutant was detected. In general, the concentrations of pollutants in heavy wastewater streams are greater than the concentrations of pollutants in total wastewater streams, and the concentrations of pollutants in total wastewater streams are greater than the concentrations of pollutants in light wastewater streams.

Table 5-7

**Wastewater Characterization Data for Heavy Wastewater
Streams at Industrial Laundries**

Pollutant	Mean Concentration¹ (mg/L)
Conventionals	
Biochemical Oxygen Demand 5-Day (BOD ₅)	4,160
Oil and Grease (measured as HEM)	2,950
Total Suspended Solids (TSS)	2,320
Priority Organics	
1,1,1-Trichloroethane	1.16
1,2-Diphenylhydrazine	2.60
4-Chloro-3-methylphenol	0.260
Bis(2-ethylhexyl) Phthalate	11.6
Butyl Benzyl Phthalate	8.96
Chlorobenzene	0.271
Chloroform	0.296
Di- <i>n</i> -butyl Phthalate	1.45
Di- <i>n</i> -octyl Phthalate	0.599
Ethylbenzene	3.65
Isophorone	0.207
Methylene Chloride	0.854
Naphthalene	5.07
Phenol	0.303
Tetrachloroethene	1.79
Toluene	9.69
<i>trans</i> -1,2-Dichloroethene	0.271
Trichloroethene	1.27
Nonconventional Organics	
2-Butanone	25.5
2-Methylnaphthalene	0.892
2-Propanone	8.49
4-Methyl-2-pentanone	5.82

Table 5-7 (Continued)

Pollutant	Mean Concentration¹ (mg/L)
α -Terpineol	0.379
Benzoic Acid	3.36
Benzyl Alcohol	1.56
Hexanoic Acid	0.210
<i>m</i> -Xylene	4.47
<i>n</i> -Decane	86.5
<i>n</i> -Docosane	0.504
<i>n</i> -Dodecane	29.5
<i>n</i> -Eicosane	4.41
<i>n</i> -Hexacosane	0.354
<i>n</i> -Hexadecane	9.49
<i>n</i> -Octacosane	0.370
<i>n</i> -Octadecane	4.00
<i>n</i> -Tetracosane	0.316
<i>n</i> -Tetradecane	7.23
<i>n</i> -Triacontane	0.366
<i>o</i> -& <i>p</i> -Xylene	3.59
<i>p</i> -Cresol	0.204
<i>p</i> -Cymene	3.55
Pentamethylbenzene	0.412
Priority Metals and Elements	
Antimony	0.788
Arsenic	0.0125
Beryllium	0.00142
Cadmium	0.121
Chromium	0.296
Copper	5.37
Lead	1.60
Mercury	0.000816
Nickel	0.266
Selenium	0.0174

Table 5-7 (Continued)

Pollutant	Mean Concentration¹ (mg/L)
Silver	0.199
Thallium	0.00989
Zinc	7.79
Nonconventional Metals and Elements	
Aluminum	9.97
Barium	3.63
Boron	4.93
Cobalt	0.449
Iron	42.1
Manganese	1.51
Molybdenum	0.668
Tin	0.130
Titanium	0.344
Vanadium	0.0381
Yttrium	0.0101
Bulk Nonconventionals	
Chemical Oxygen Demand (COD)	13,700
Total Organic Carbon (TOC)	2,790
Total Petroleum Hydrocarbon (measured as SGT-HEM)	1,440

¹The detection limit concentration was used in calculations for data points reported as non-detects.

Table 5-8

**Wastewater Characterization Data for Light Wastewater
Streams at Industrial Laundries**

Pollutant of Concern	Mean Concentration ¹ (mg/L)
Conventionals	
Biochemical Oxygen Demand 5-Day (BOD ₅)	568
Oil and Grease (measured as HEM)	154
Total Suspended Solids (TSS)	344
Priority Organics	
1,1,1-Trichloroethane	0.0160
1,2-Diphenylhydrazine	0.220
4-Chloro-3-methylphenol	0.0411
Bis(2-ethylhexyl) Phthalate	1.10
Butyl Benzyl Phthalate	0.0690
Chlorobenzene	0.0160
Chloroform	0.0455
Di- <i>n</i> -butyl Phthalate	0.104
Di- <i>n</i> -octyl Phthalate	0.0667
Ethylbenzene	0.0620
Isophorone	0.0400
Methylene Chloride	0.0213
Naphthalene	0.358
Phenol	0.105
Tetrachloroethene	0.0977
Toluene	0.0553
<i>trans</i> -1,2-Dichloroethene	0.0160
Trichloroethene	0.0160
Nonconventional Organics	
2-Butanone	0.147
2-Methylnaphthalene	0.0566
2-Propanone	0.518
4-Methyl-2-pentanone	0.240

Table 5-8 (Continued)

Pollutant of Concern	Mean Concentration¹ (mg/L)
α -Terpineol	0.123
Benzoic Acid	0.306
Benzyl Alcohol	0.102
Hexanoic Acid	0.0557
<i>m</i> -Xylene	0.0555
<i>n</i> -Decane	0.354
<i>n</i> -Docosane	0.0591
<i>n</i> -Dodecane	0.973
<i>n</i> -Eicosane	0.124
<i>n</i> -Hexacosane	0.0465
<i>n</i> -Hexadecane	0.330
<i>n</i> -Octacosane	0.0432
<i>n</i> -Octadecane	0.0850
<i>n</i> -Tetracosane	0.0680
<i>n</i> -Tetradecane	0.103
<i>n</i> -Triacontane	0.0492
<i>o</i> -& <i>p</i> -Xylene	0.0765
<i>p</i> -Cresol	0.0400
<i>p</i> -Cymene	0.0473
Pentamethylbenzene	0.0787
Priority Metals and Elements	
Antimony	1.32
Arsenic	0.00653
Beryllium	0.000938
Cadmium	0.0211
Chromium	0.113
Copper	0.858
Lead	0.348
Mercury	0.000715
Nickel	0.101
Selenium	0.0133

Table 5-8 (Continued)

Pollutant of Concern	Mean Concentration¹ (mg/L)
Silver	0.00432
Thallium	0.00313
Zinc	1.47
Nonconventional Metals and Elements	
Aluminum	4.65
Barium	0.421
Boron	0.391
Cobalt	0.0264
Iron	10.3
Manganese	0.184
Molybdenum	0.0357
Tin	0.0625
Titanium	0.206
Vanadium	0.0138
Yttrium	0.00313
Bulk Nonconventionals	
Chemical Oxygen Demand (COD)	1,410
Total Organic Carbon (TOC)	338
Total Petroleum Hydrocarbon (measured as SGT-HEM)	85

¹The detection limit concentration was used in calculations for data points reported as non-detects.

Table 5-9

**Wastewater Characterization Data for Total Raw Wastewater
Streams at Industrial Laundries**

Pollutant	Mean Concentration¹ (mg/L)
Conventionals	
Biochemical Oxygen Demand 5-Day (BOD ₅)	879
Oil and Grease (measured as HEM)	1,450
Total Suspended Solids (TSS)	849
Priority Organics	
1,1,1-Trichloroethane	0.334
1,2-Diphenylhydrazine	0.0984
4-Chloro-3-methylphenol	0.070
Bis(2-ethylhexyl) Phthalate	5.42
Butyl Benzyl Phthalate	0.139
Chlorobenzene	0.155
Chloroform	0.0344
Di- <i>n</i> -butyl Phthalate	0.273
Di- <i>n</i> -octyl Phthalate	0.103
Ethylbenzene	0.681
Isophorone	0.0790
Methylene Chloride	0.390
Naphthalene	1.72
Phenol	0.0861
Tetrachloroethene	3.69
Toluene	2.49
<i>trans</i> -1,2-Dichloroethene	0.0230
Trichloroethene	0.0211
Nonconventional Organics	
2-Butanone	2.98
2-Methylnaphthalene	0.157
2-Propanone	12.8
4-Methyl-2-pentanone	1.89

Table 5-9 (Continued)

Pollutant	Mean Concentration¹ (mg/L)
α -Terpineol	0.326
Benzoic Acid	0.779
Benzyl Alcohol	0.0753
Hexanoic Acid	0.0854
<i>m</i> -Xylene	5.56
<i>n</i> -Decane	97.0
<i>n</i> -Docosane	0.680
<i>n</i> -Dodecane	6.75
<i>n</i> -Eicosane	2.12
<i>n</i> -Hexacosane	0.529
<i>n</i> -Hexadecane	5.57
<i>n</i> -Octacosane	0.103
<i>n</i> -Octadecane	1.82
<i>n</i> -Tetracosane	1.63
<i>n</i> -Tetradecane	5.08
<i>n</i> -Triacontane	0.160
<i>o</i> -& <i>p</i> -Xylene	3.02
<i>p</i> -Cresol	0.0713
<i>p</i> -Cymene	0.143
Pentamethylbenzene	0.313
Priority Metals and Elements	
Antimony	0.0945
Arsenic	0.0185
Beryllium	0.00752
Cadmium	0.0574
Chromium	0.263
Copper	1.36
Lead	0.809
Mercury	0.00110
Nickel	0.165
Selenium	0.0648

Table 5-9 (Continued)

Pollutant	Mean Concentration¹ (mg/L)
Silver	0.0278
Thallium	0.0248
Zinc	2.16
Nonconventional Metals and Elements	
Aluminum	5.86
Barium	1.18
Boron	0.701
Cobalt	0.184
Iron	30.9
Manganese	0.504
Molybdenum	0.386
Tin	0.176
Titanium	0.166
Vanadium	0.0710
Yttrium	0.0127
Bulk Nonconventionals	
Chemical Oxygen Demand (COD)	5,290
Total Organic Carbon (TOC)	1,440
Total Petroleum Hydrocarbon (measured as SGT-HEM)	530

¹The detection limit concentration was used in calculations for data points reported as non-detects.