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Project Summary

Nonprocess Solvent Use in the Furniture Refinishing and Repair Industry: Evaluation of Alternative Chemical Strippers

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Solvent-based chemical strippers are currently used in the furniture repair and refinishing industry to remove both traditional and emerging low-VOC (volatile organic compound) wood furniture coatings. The purpose of this research was to evaluate the feasibility of using alternatives to high VOC/HAP (hazardous air pollutant) solvent-based chemical strippers that are currently used in the furniture repair and refinishing industry to remove both traditional high-VOC lacquer and emerging, low-VOC, wood furniture coatings. Five alternative chemical strippers, consisting of one industrial and four retail chemical strippers, were screened. The specific objectives of this research were to:

1. **Conduct a laboratory evaluation of the performance of five alternative chemical stripper formulations and compare their performance to that of a traditional solvent-based chemical stripper formulation on three coatings types found on wood furniture substrates.**
2. **Assess, in a furniture refinishing facility, the use of the best performing alternative chemical stripper on traditional furniture coatings and new emerging low-VOC furniture coatings.**

Alternative chemical strippers were evaluated based on their stripping effectiveness compared to a methylene-chloride-based stripper. A panel experienced in chemical stripping evaluated the samples and selected the most effective chemical stripper for further evaluation. An on-site assessment of the best performing alternative chemical stripper from the screening evaluation took place at a Durham, NC, furniture refinishing facility.

This Project Summary was developed by the National Risk Management Reserch Laboratory's Air Pollution Prevention and Control Division, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Project Background

Ozone nonattainment and air toxic problems are among the most difficult environmental issues facing the U.S. Although most large stationary sources of volatile organic compound (VOC) emissions are covered by present or imminent regulations, small perennial area sources of VOC emissions may contribute significantly to the ozone nonattainment problem. According to a U.S. Environmental Protection Agency (EPA) source, "collectively small area sources may contribute as much as 50% of VOC emissions."

Significant contributors to these environmental issues are VOC emissions that result from the use of a wide range of commercial/consumer products. Because VOC emissions from most consumer/commercial products cannot be controlled by traditional add-on control devices, they must be mitigated by pollution prevention techniques, such as product substitution, product reformulation, use procedure alterations, and other methods that reduce or eliminate VOC and air toxic emissions. As defined by the Clean Air Act Amendments (CAAA) of 1990:

> The term consumer or commercial product means any substance, product (including paints, coatings, and solvents),

or article (including any container or packaging) held by any person, the use, consumption, storage, disposal, destruction, or decomposition of which may result in the release of VOCs. The term does not include fuels or fuel additives regulated under Section 211, or motor vehicles, nonroad vehicles, and nonroad engines as defined under Section 216.

A preliminary approach for evaluating environmental problems associated with nonprocess solvent uses is to conduct a study to quantify and qualify VOC emissions from consumer/commercial products. Using this approach, researchers can assess the product's[1] potential contribution to increased urban ozone levels and establish criteria for reducing environmental impacts.

Researchers have initiated several studies of the emissions from various categories of traditional consumer products. Traditional consumer products for the purposes of this report include:

- personal care products (e.g., hair sprays, deodorants, mouthwash),
- household products (e.g., cleaners, laundry products, air fresheners),
- automotive care products (e.g., brake cleaners, polishes, antifreeze),
- adhesives and sealants (e.g., household glues, wallpaper pastes, caulks),
- lawn and garden care products (e.g., insecticide sprays and foggers, herbicides), and
- coatings and coating removers (e.g., spray paints, chemical strippers, lacquers)

The definition of consumer or commercial products contained in the CAAA is broad. It defines traditional consumer products and nontraditional consumer products, such as paints, coatings, and solvents, used in commercial and industrial facilities. Within this definition is some uncertainty concerning the types of materials, products, and/or processes that should be included. Examples of these uncertainties include solvent-containing roofing materials and paving asphalt. As research efforts continue in this area, the scope of consumer or commercial products will be better defined.

[1]Nonprocess solvents are defined as solvents used by industry, commercial operations, and/or individual consumers and are not a part of a manufacturing production line or incorporated into a product or chemically modified as part of the manufacturing process. Nonprocess solvents usually evaporate either during or shortly after their use. Cleaning and lubricating solvents are generally considered nonprocess solvents. An exception to this is in-process parts cleaning, such as vapor degreasing

The research presented in this report has developed from two previously completed studies. The primary purpose of the first study was to gather and evaluate existing data on nonprocess solvents used in 15 different business categories. Based on that study, several business categories were selected for further, more detailed evaluation. The furniture refinishing and repair industry was one business category selected for further research. The focus of the second study addressed the use of nonprocess solvents for furniture refinishing and repair, emissions from these solvents, and opportunities for pollution prevention. The second study final report has been submitted to EPA for publication.

Although the second study focused on emissions of nonprocess solvents that are defined as VOCs, the scope was broadened to include nonprocess solvent use of 1,1,1-trichloroethane (1,1,1-TCA) and methylene chloride (CH_2C1_2). By definition, VOCs are organic compounds that participate in atmospheric photochemical reactions, contributing to the formation of tropospheric ozone. Because these chemicals have negligible photochemical reaktivity, 1,1,1-TCA and CH_2C1_2 are not classified as VOCs. However, both compounds are classified by the EPA as Hazardous Air Pollutants (HAPs). In addition, 1,1,1-TCA is classified as a Class 1, Group V controlled substance because of its stratospheric ozone depletion potential. Both 1,1,1-TCA and CH_2Cl_2 are used in a variety of nonprocess applications; therefore, information was gathered on the use of these chemicals as well. The complete project objectives for the second study were to assess the uses and emissions from nonprocess solvents used for furniture refinishing and repair, and to recommend pollution prevention and control measures that could be used to reduce these emissions.

Evaluation of solvent-based chemical strippers represents current research. Initially, five chemical strippers were screened and the most effective alternative chemical stripper was selected for further evaluation. Alternative chemical strippers were evaluated based on their stripping effectiveness compared to a standard CH_2Cl_2-based stripper. An onsite assessment took place at a local furniture refinishing facility in Durham, NC. The EPA, RTI, four North Carolina coating suppliers, one local lumber supply company, and two local furniture refinishing facilities participated in this project. This report presents the results of this segment of research.

The information contained in this report is likely to benefit the furniture refinishing industry. Therefore, this report is intended to be a source for technology transfer. Results will be made available to users of solvent-based chemical strippers who are seeking environmentally acceptable alternatives to these products and local agencies that help these individuals.

Conclusion and Recommendations

The first objective of this project was to conduct a laboratory evaluation of the performance of alternative chemical strippers and compare their performance to that of a traditional solvent-based chemical stripper on wood furniture coatings. From the laboratory evaluation, Chemical Stripper 4 (d-Limonene) was selected as the best alternative chemical stripper. Its average quality of coating removal was ranked as 7.9 on a scale from 0 to 10. The refinishers on the panel of evaluators admired the condition of the wood coupons treated with Chemical Stripper 4.

The second objective was to assess Chemical Stripper 4 in a furniture repair and refinishing facility. The refinisher performed the onsite assessment using a chair seat, a square table top and a circular table top, and was pleased with the removal quality following treatment of Chemical Stripper 4 on the three surfaces. He was equally pleased to know that the formation did not include constituents identified as toxic chemicals. However, he expressed some concern regarding the cost of the alternative chemical stripper. The refinisher was given the remainder of the 1-gal (3.8-L) sample, a copy of the product information, and the name of the supplier with whom to establish personal contact. The use of the alternative chemical stripper as a viable substitute was left to the discretion of the refinisher at the host facility.

In addition to a viable substitute for solvent-based chemical strippers based on the effectiveness of the alternative chemical strippers, the potential effect of the alternative chemical stripper on air emissions and the related cost were determined. Although VOC emission estimates are higher for Chemical Stripper 4 (d-Limonene), it does not contain constituents identified as HAPs. In addition, emission estimates were based on the amount of chemical stripper used per area. The total surface area covered using each chemical stripper in this study was roughly the same; however, the film thickness and the amount of each individual chemcial stripper applied to the wooden coupons were different. (The manufacturer's directions and suggestions were followed to achieve the best performance of each chemical stripper.)

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The complete report, entitled "Nonprocess Solvent Use in the Furniture Refinishing and Repair Industry: Evaluation of Alternative Chemical Strippers," (Order No. PB96-96-153416; Cost: $35.00, subject to change) will be available only from:
National Technical Information Service
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The EPA Project Officer can be contacted at:
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