



## Project Summary

# Improved Equipment Cleaning in Coated and Laminated Substrate Manufacturing Facilities (Phase I)

Beth W. McMinn and Jill B. Vitas

As a result of the Pollution Prevention Act of 1990, the Environmental Protection Agency (EPA) established the 33/50 Program which calls for voluntary industry reductions in releases of 17 high-priority toxic chemicals, listed by mass of emissions:

Toluene  
Xylenes  
1,1,1-Trichloroethane  
Dichloromethane  
Methyl Ethyl Ketone  
Chromium and Compounds  
Lead and Compounds  
Cadmium and Compounds  
Carbon Tetrachloride  
Trichloroethylene  
Methyl Isobutyl Ketone  
Tetrachloroethylene  
Benzene  
Chloroform  
Nickel and Compounds  
Cyanide and Compounds  
Mercury and Compounds

The goal of the 33/50 program is to reduce the total amount of these chemicals released into the environment and transferred off-site by 33% by the end of 1992 and by 50% by the end of 1995. These reductions will be based upon the Toxic Release Inventory System (TRIS), with 1988 as the base year.

*This Project Summary was developed by EPA's Air and Energy Engineering Research Laboratory, 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).*

## Introduction

In support of the 33/50 Program and EPA's pollution prevention goals, the Agency's Air and Energy Engineering Research Laboratory (AEERL) is investigating ways to reduce air emissions of these 17 chemicals through pollution prevention. The Pollution Prevention Act of 1990 defines pollution prevention as "any practice which reduces the amount of any hazardous substance, pollutant, or contaminant entering the waste stream or otherwise released to the environment (including fugitive emissions) prior to recycling, treatment, or disposal; and reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants." Pollution prevention efforts offer economic and reduced health and ecological risk benefits to many sectors of society that are not available through traditional pollution control methods.

In 1991, AEERL representatives met with industry, academia, and state environmental agency representatives to identify several source categories deserving of pollution prevention research. Two criteria were used to select the industrial categories for study: annual toxics emissions and the potential for pollution prevention opportunities. First, the TRIS was reviewed to identify categories with the greatest mass emissions of the 33/50 chemicals. Categories with the greatest emissions were then ranked according to the potential for successful pollution prevention projects resulting in significant reductions of 33/50 chemical releases. One of the industries identified during the 1991



meeting was the adhesives-coated and laminated paper manufacturing industry [Standard Industrial Classification (SIC) 2672]. This industry was chosen because of significant air emissions of 33/50 Program chemicals methyl ethyl ketone (MEK) and toluene as reported through the TRIS.

In October 1991, a meeting was held between AEERL, pollution prevention experts, and representatives of the adhesives-coated and laminated paper manufacturing industry to discuss specific pollution prevention projects that would support the 33/50 Program. Meeting participants indicated that emissions of toluene and MEK from equipment cleaning operations are second only to emissions from the coatings and coating application steps, and, therefore, would present a good opportunity for the implementation of pollution prevention techniques. As a result of this meeting and preliminary industry inquiries, the scope of the industry investigation was later expanded to include other coating and substrate varieties (such as those included in SIC 2671-Coated and Laminated Packaging Paper and Plastics Film) because the manufacturing methods and cleaning processes are similar; therefore, technology transfer is possible over a wider range of industries.

## Project Objectives

This report presents the results of a Phase I study to characterize current equipment cleaning practices in the coated and laminated substrate manufacturing industry, to identify alternative cleaning technologies, and to identify demonstrable technologies and estimate their emissions impacts. In order to successfully accomplish these objectives, information was collected from several sources including literature searches, industry questionnaires, plant visits, pollution prevention experts, and industry and trade association personnel.

Literature searches of EPA on-line databases, local university library databases, and Dialog<sup>®</sup> were conducted. The Pollution Prevention Information Clearinghouse (PPIC) and the Pollution Prevention Information Exchange System (PIES) were accessed on a biweekly basis. The E-Mail capabilities of PIES were also used to communicate with other PIES users with knowledge of the coated and laminated substrate manufacturing industry.

The second source of project background information was data retrieved through industry questionnaires. Two questionnaires had been distributed earlier to 14 adhesive-coated and laminated paper

manufacturers, primarily pressure sensitive tape manufacturers and tag and label manufacturers. A separate questionnaire was prepared for manufacturers operating under either SIC 2672 or SIC 2641 (Paper Coating and Glazing) depending on their SIC. Neither questionnaire was sent to more than eight manufacturers. The results of the questionnaires were clarified through follow-up contacts with the recipients and through revised questionnaires. Over 30 additional facilities (i.e., not recipients of the original questionnaires) were contacted for further information on equipment cleaning practices. The second group of facilities contacted represented the expanded scope of the research project, and consisted of facilities involved in the coating and laminating of flexible substrates (SIC 2671) as well as those included in SIC 2672.

In addition to conducting literature searches and distributing two industry questionnaires, contacts were made with industry and pollution prevention experts with the Massachusetts Office of Technology Assistance (OTA), the North Carolina Office of Waste Reduction (OWR), the Pressure Sensitive Tape Council (PSTC), the Tag and Label Manufacturers Institute (TLMI), and equipment manufacturing firms.

The final source of project and industry information was compiled during seven site visits (two of which were conducted previously). The trip reports and associated data for these facilities were combined with the information resulting from the additional five trips. Together, these information gathering efforts provided the background needed to accurately describe the coated and laminated substrate manufacturing industry, to evaluate the range of equipment cleaning methods used in the industry, to identify demonstrable technologies, and to form the foundation for the project's Phase II and III efforts.

Phase II activities will begin upon the completion of Phase I. Phase II of the project will be the actual demonstration of selected alternative technologies. This phase will quantify air emissions and other media wastes, record production parameters, and make other observations and measurements necessary to assess the impacts of the alternative technology. The final phase of the project (Phase III) is to conduct technology transfer. Focused documents such as conference papers, journal articles, and newsletters will be prepared and presented at industrial workshops, pollution prevention conferences, and other events where industrial application of pollution prevention technologies is discussed.

## Report Organization

This report is divided into five chapters and three appendices. Chapter 2 identifies and describes current manufacturing and cleaning practices. It includes an overview of the industry's use of raw materials, coating application equipment, current cleaning techniques, current cleaning solvents, and resulting waste streams.

Chapter 3 describes the evolution of the industry questionnaires and the methodology by which the recipients were selected. Chapter 3 also summarizes efforts to compile and tabulate the questionnaires' results. This chapter identifies current industry trends in coating formulations, current trends in equipment cleaning methodologies and technologies, and opportunities for pollution prevention research as indicated by the questionnaire respondents.

Chapter 4 discusses some of the pollution prevention alternatives to currently used equipment cleaning techniques and materials. This chapter also briefly identifies some of the opportunities for retrofitting current processing equipment to allow for the use of waterbased coatings.

Chapter 5 summarizes and evaluates pollution prevention demonstration opportunities. Appendix A lists coated and laminated substrate facilities with annual sales greater than \$1 million. Appendix B lists SIC 2671 and 2672 facilities and their associated emissions as they appear in the TRIS. Appendix C contains reports of the seven trips involved in this investigation and identification of the improved equipment cleaning methods for the coated and laminated substrate manufacturing industry.

## Summary

Facilities within the coated and laminated substrate manufacturing industry tend to operate in one of two segments: (1) large facilities operating coating lines dedicated to one type of product, such as masking tape or label stock; and (2) batch processors or plants that manufacture comparatively small quantities of a wide variety of high value-added products.

Both segments of the coated and laminated substrate manufacturing industry use essentially the same cleaning methods, even though the segments differ substantially in the range of substrates, coatings, and application equipment used at the plants. The solvents required to clean equipment in a coated and laminated substrate manufacturing facility are, in large part, determined by the resin (e.g., rubber) in the coating formulation.

AEERL plans to conduct demonstrations in facilities that represent the two industry segments. The first demonstration facility will be a facility operating lines dedicated to one product type. The focuses at this facility would be the implementation and evaluation of a cleaning solvent substitute, improved operating practices, and process modifications such as Teflon coated rollers. AEERL has discovered, through contacts with industry personnel, that some "dedicated line" facilities are

pursuing these options while others are not. The focus at the second type of facility, the batch processor, would be geared toward improving the efficiency of cleaning operations. AEERL has found that the nature of the batch processing business requires a high degree of cleaning between jobs and that this cleaning often takes place much more frequently than does cleaning at dedicated line facilities. The objective at the batch processor would be to calculate the minimum amount of

cleaning solution necessary to achieve the required degree of cleanliness. A second objective at this facility would be to identify the optimum method of administering the cleaning solution. The details and the results of both facility studies would be documented in a final report. It is intended that the case studies described in the final report will assist not only the dedicated line facilities and the batch processors, but also those facilities that have characteristics of each.

*B. W. McMinn and J. B. Vitas are with TRC Environmental Corporation, Chapel Hill, NC 27514.*

*Michael Kosusko is the EPA Project Officer (see below).*

*The complete report, entitled "Improved Equipment Cleaning in Coated and Laminated Substrate Manufacturing Facilities (Phase I)," (Order No. PB94-141157; Cost: \$27.00; subject to change) will be available only from*

*National Technical Information Service*

*5285 Port Royal Road*

*Springfield, VA 22161*

*Telephone: 703-487-4650*

*The EPA Project Officer can be contacted at*

*Air and Energy Engineering Research Laboratory*

*U.S. Environmental Protection Agency*

*Research Triangle Park, NC 27711*

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Center for Environmental Research Information  
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