HWRIC RR-060

Paint Waste Reduction and Disposal Options

Volume I

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EXECUTIVE SUMMARY

The manufacture and use of paints and coatings is an important part of the Illinois economy. Illinois is among the top five states in the production of paints and coatings. In addition, most Illinois manufacturing industries and many of the small businesses, such as automobile body shops, use paint in their operations. Furthermore, households and residential/commercial painting contractors use large quantities of paint.

Both the manufacture and use of paint result in the generation of significant quantities of waste. The wastes generated occur in solid, liquid, and gaseous form and, because of the nature of paint, are hazardous or toxic in many cases.

The Illinois General Assembly amended the Solid Waste Management Act in 1989, directing the Illinois Department of Energy and Natural Resources (ENR) to

- "conduct a study to develop cost-effective, environmentally sound, and technically feasible waste paint disposal options for small businesses, including at least painting contractors, auto body shops, and households;" and

- "[develop] an effective public education program to inform small businesses and households about the best available waste paint reduction and management options." (Public Act 86-1026)

ENR is directed to "report to the Governor and the General Assembly on its activities ... with recommendations for legislation or regulations necessary to address the reduction and management of paint waste." This report was prepared to meet this requirement.

Throughout this report, the term "waste" is used to refer to *all* nonproduct outputs from manufacturing or using paint. This definition of waste includes releases to the air, water, and land. It also refers to waste generation ***before*** any treatment or recovery activities. In this report, the wastes associated with paint manufacture and use are broadly referred to as "paint-related waste."

ES.1 OBJECTIVES AND METHODOLOGY

Three primary objectives were identified for this project:

- Identify waste reduction and waste management options that can be implemented by both manufacturers and users of paint in Illinois.

- Make recommendations for an education program to help alleviate the problem.

- Suggest policy options to address the problem as defined by the project.

The first phase of the project involved conducting a thorough review of current literature and existing data sources to characterize the following:

- current waste reduction practices of Illinois manufacturers and users of paint;

- paints used and paint-related wastes generated in Illinois;

- the scope and magnitude of the paint-related waste problem in Illinois, including waste generation and waste management techniques and their impact on the environment;
- technically and economically feasible waste reduction options;
- additional data needs to be addressed in subsequent tasks;
- relevant terminology and recommendations for standardized definitions for the purposes of this project; and
- relevant state and federal legislation and associated regulations.

The second phase of the project was designed to gather additional data on paint-related operations in Illinois, the wastes those operations generate, and how those wastes are managed. In addition, Phase II gathered data on current paint-related waste reduction activities in Illinois and the potential for further waste reduction. Phase II focused on manufacturers and on industrial and commercial users, because sufficient information on household use was identified during the Phase I literature review. Phase II consisted of a survey of Illinois' paint manufacturers and industrial users and onsite investigations with manufacturers, users, and waste management facilities.

To assist in conducting this study, an Ad Hoc Advisory Group (AHAG) was formed. AHAG consists of representatives of Illinois paint manufacturers and industrial and commercial paint users. The Hazardous Waste Research and Information Center (HWRIC) recognized that issues associated with paint usage vary widely among industries, so AHAG was formed to provide as many points of view as possible. The group provided input throughout the course of this study and has reviewed this report.

The purpose of this study is to provide a broad overview of paint-related activities in Illinois and to try to assess the extent of paint-related waste disposal problems in Illinois. The results of this study indicate that the types of paints and paint usages vary greatly. Therefore, the findings of this study may not apply to all situations.

ES.2 PAINT CLASSIFICATION

For the purposes of this study, paints are classified based on the primary types of solvent they contain, recognizing that many paints contain a mixture of solvents. Using this approach, paints are classified as follows:

- waterborne,
- organic solvent-borne, or
- powder (dry, without solvent).

The term waterborne refers to coating systems that use water to some degree as the solvent. These types of coatings include aqueous emulsions (latex), colloidal dispersions, and water-reducible coatings. Although waterborne paints are not entirely free of organic solvents, they do generally decrease air emissions of volatile organic compounds (VOCs) during paint application, eliminate organic solvents for thinning, and reduce the use of organic solvents during clean-up.

The majority of “conventional” paints are organic solvent-borne. By their nature, organic solvent-borne coatings contain significant amounts of VOCs. High-solids coatings are being formulated to reduce VOCs. Wastes from organic solvent-borne paints are generally hazardous due to toxicity, flammability, or both. However, the relative ease of solvent recycling and the high Btu content of organic solvent wastes provide several possible avenues for waste recycling or reuse.

Powder coatings eliminate the use of a solvent. Powder coatings are applied dry using electrostatic spray, fluidized bed, and flame spray application techniques. In all cases, the powder that adheres to the object being painted is melted using heat to provide a continuous film. Because powder coatings do not begin to cure until they are heated, capturing and recycling powder overspray is possible, reducing this source of waste generation. VOCs are nearly eliminated with powder coatings because no organic solvent is used.

ES.3 PAINT LIFE CYCLE

The life cycle of paint covers all the stages of paint manufacturing and use, from the mining and manufacturing of inputs used in paint manufacturing to the ultimate disposal of the product that was painted. Paint usage has impacts on the environment at all stages of this life cycle, including

- manufacturing the raw materials to be used to make paint;
- manufacturing the paint itself;
- applying the paint;
- removing the paint, if required; and
- disposing of the item that had been painted (e.g., taking an old car to the junk yard).

In addition, the life cycle of paint includes transporting materials, managing wastes generated, and producing energy that is consumed throughout the life cycle. This study focuses on the paint manufacturing, application, and removal stages of the paint life cycle, with emphasis on the application and removal stages.

ES.4 PAINT MANUFACTURING PROCESS

The production of paint is a complex process involving dispersion of pigments and additives into a solution of resin and solvent, followed by relatively simple mixing operations. The most important step in the process is the initial pigment dispersion operation, sometimes termed “grinding.” Different types of paint are manufactured by changing the raw materials used and their relative quantities.

Most paint manufacturers produce many different types and colors of paint, including both organic solvent-borne and water-borne paints. Each type and color of paint is manufactured in a separate batch, and all manufacturing equipment is generally cleaned between batches of different types or colors of paint to prevent contamination. Equipment cleaning is the largest source of waste from paint manufacturing. Generally, an organic solvent is required to clean equipment after manufacturing an organic solvent-borne paint, while water can generally be used to clean equipment after manufacturing water-borne paints.

Wastes generated from paint manufacturing include the following:

- equipment cleaning wastes,
- air emissions of VOCs,
- pigment dust from air pollution control equipment (e.g., baghouse dust),
- empty raw material packages, bags, and containers,
- bags and cartridges from paint filtration equipment,
- paint that is “off-spec” (i.e., did not meet quality or customer specifications),
- paint returned from the retailer (e.g., because it had exceeded its shelf life), and
- waste paint or raw materials from accidental spills and discharges.

Some of these wastes, such as off-spec and returned paints, are commonly recycled and do not enter the waste stream.

Waste reduction options for paint manufacturers include the following:

- using less toxic raw materials;
- using less toxic cleaning solutions;
- using less cleaning solution by using mechanical cleaning methods (such as scraping) and by scheduling paint batches to reduce the number of times equipment must be cleaned;
- reusing cleaning solutions by adding as a raw material in a compatible batch or recovering organic solvents, if applicable;
- redesigning equipment and storage tanks to reduce VOC emissions; and
- implementing quality controls to reduce off-spec and returned paint, and reblending any off-spec or returned paints that are generated.

These waste reduction options do not apply to all paint manufacturing operations. The greatest barriers to implementing these changes are customer and quality specifications.

ES.5 PAINT APPLICATION PROCESS

Generally, the type of paint and the application method are critical to the performance of a coating. The general steps for paint application include

- surface preparation,
- paint application, and
- curing or drying.

The paint application process used depends on the type of surface to be coated, the type of coating, and the size and shape of the surface. Most household painting is done using brushes and rollers, with a small amount of spray application. Auto body shop painting is almost exclusively done using spray equipment, either conventional pressure spray or newer, high-volume, low-pressure spray equipment. For paints used as product coatings, the importance of a high-quality, durable finish demands tailoring of both the coating and the application technology.

The transfer efficiency is an important aspect of a paint application technology from the standpoint of waste generation. Transfer efficiency is the amount of paint applied to the object being painted, divided by the amount of paint used. Low paint transfer efficiencies can be the largest source of waste from paint application. Transfer efficiencies for a given type of paint formulation vary with the type of equipment used, the skill of the operator, and the object being painted.

Wastes generated from industrial paint application processes may be considered hazardous because of the presence of toxic metals (e.g., chromium, lead) and organic solvents (e.g., toluene, methyl ethyl ketone). Wastes generated during industrial paint application include the following:

- scrubber water, paint sludge, and filters from air pollution control;
- equipment cleaning wastes;
- aqueous waste and spent solvents from surface preparation;
- VOC emissions during paint application, curing, and drying;
- empty raw material containers; and
- obsolete or unwanted paint.

Residential paint use generates waste from equipment cleaning, VOC emissions, empty containers, and leftover paint.

Waste generation from paint application can be significantly reduced by substituting a paint with lower VOC content and by modifying paint application techniques to increase paint transfer efficiency. Both of these waste reduction options are limited by the type of product being painted and the quality of the finish required. Additional waste reduction options include the following:

- using less toxic surface preparation solutions and reusing or recycling the solutions;
- reducing equipment cleaning frequency by scheduling longer batches or using dedicated equipment; and
- reducing leftover paints by using better inventory controls and finding a user for leftover paints.

ES.6 PAINT REMOVAL PROCESS

For some architectural and industrial uses of paint, paint removal is required to inspect, repair, or repaint coated surfaces. Conventional paint removal techniques include manual scraping, sanding, sand blasting, and solvent stripping. Manual scraping and sanding are labor intensive; therefore, their application is limited to small-scale paint removal. Both sand blasting and solvent stripping, although widely used, generate wastes that pose environmental and health risks. Wastes generated in solvent stripping include air emissions of VOCs and large volumes of wastewater containing the solvent/paint residues. The use of sand and other silica-containing materials in sand blasting processes has been associated with lung disease in workers. Removing lead-containing paints poses particular waste generation problems. Abrasive blasting of lead-containing paints generates a fine lead dust that is highly toxic to workers.

Extensive research has been conducted to develop alternative paint removal processes that reduce risks to workers and the environment. These alternative processes include the following:

- blasting surfaces with alternative abrasive media, such as plastic media, sodium bicarbonate, or dry ice;
- spraying the surface with high-pressure water;
- heating the surface with lasers or flashlamps to loosen paint;
- cooling the surface with liquid nitrogen to loosen the paint; and
- immersing objects to be stripped in molten salt or hot-caustic baths.

The applicability of each of these techniques depends on the type of object being stripped and the properties of the paint being removed.

ES.7 PAINT-RELATED ACTIVITIES IN ILLINOIS

HWRIC conducted a literature review, mail survey, and site visits to determine

- the types of facilities generating paint-related waste in Illinois,
- the quantities and types of paint-related waste generated by Illinois facilities, and
- current waste reduction, management, and disposal practices for paint-related waste in Illinois.

Illinois ranked among the top five states in paint manufacturing in 1987 based on sales revenues, accounting for between 10 and 12 percent of total revenues from paint manufacturing in the United States (Rauch, 1990). In 1989, paint manufacturers in Illinois had air emissions of 1.57 million pounds of chemicals considered toxic under the Superfund Amendments and Reauthorization Act (SARA) (USEPA, 1991c). These facilities generated 32,700 tons of hazardous waste in 1986 (USEPA, 1990b).

Less data are available on paint usage in Illinois. Based on a small number of observations and anecdotal evidence, we were able to make some rough estimates of paint usage and related waste generation in Illinois. These estimates are further explained in Chapter 5.

Leftover paint is the largest source of paint waste from households. Data from a California study (Rathje et al., 1985) indicate that each household discards about 1.5 pounds of paint waste in municipal trash per year. Using this figure for Illinois households results in about 3,000 tons of household paint waste in municipal trash per year. In addition, households often store leftover paints and paint-related products. A 1987 study of households in the Champaign/Urbana and Decatur areas and of farmers in Champaign County found that roughly 50 percent of households and farms had varnish or paint thinner on their property at some time during the past year. Householders and farmers that had varnish onsite at the time of the survey on average had roughly 3 to 4 containers, and those with thinner onsite had roughly 2 to 3 containers on average (Liebert, 1988).

Information provided by the Illinois Automotive Service Association indicates that there are approximately 3,400 licensed auto body shops in Illinois, which service an estimated 1.6 million cars annually. Rough estimates based on population suggest that 1.5 million gallons of paint are used by auto body shops in Illinois. Primary types of waste generation by auto body shops include VOC emissions, from paint curing, spent filters from paint over-spray collection, and leftover paints.

The Illinois Department of Transportation (IDOT) is a major user of paint in Illinois. For fiscal year 1991, IDOT purchased 750,000 gallons of paint for traffic markings. IDOT projects that the use of these paints will generate 5,000 gallons of hazardous waste and 1,500 gallons of wastewater (Grey, 1991). IDOT also uses an estimated 73,000 gallons of paint per year for bridge maintenance and rehabilitation. Anecdotal evidence suggests that 29,000 gallons of paint waste is released due to paint overspray from bridge maintenance. Another source of paint-related wastes from IDOT is the removal of paint from bridges as part of maintenance operations. IDOT has suspended all bridge paint removal operations because of concern for worker exposure to concentrated lead dust.

Little state-wide data on paint-related waste generation from OEM product coatings were available. It is difficult to isolate the portion of waste generated by these facilities that was due to paint-related operations. One data source, the National Survey of Hazardous Waste Generators, indicates that paint application operations at Illinois facilities that were large quantity generators of hazardous waste generated approximately 8,000 tons of hazardous waste in 1986 (USEPA, 199Ob). This statistic does not include wastes generated from surface preparation and some equipment cleaning wastes. For many paint application operations, surface preparation and equipment cleaning are the largest sources of paint-related waste generation.

ES.8 CONCLUSIONS

The results of this study suggest that a variety of options are available to reduce paint-related waste generation, many of which have been implemented by Illinois paint manufacturers and users. Many of these waste reduction options are available at low cost in Illinois. The major barriers to implementing these options are a lack of technical information and the perception that waste generation is not a problem. The education program recommended in this report is designed to provide technical information on waste reduction and to educate users about the effects of waste generation, including the financial costs of waste generation.

Through the course of this study, we found that paint manufacturers are generally more advanced at reducing waste generation than paint users. In part, this difference is due to different perspectives on paint. Paint manufacturers are motivated to reduce paint-related wastes to maximize production of their finished product. Paint users, however, generally do not regard painting as their primary business, and painting is just a small fraction of their cost of goods sold. This fact does not imply that paint manufacturers in Illinois do not need to reduce waste. On the contrary, the site visits indicated that some paint manufacturers could further reduce their waste. This conclusion does support our study's focus on paint users rather than manufacturers.

The results of this study suggest that most paint-related liquid wastes from industry do not reach the environment untreated. These wastes are either treated in-house or handled by a solvent recycler or fuel blender. The study indicates that a viable liquid waste handling industry in Illinois recycles liquid paint-related wastes from both small and large paint users. We recommend efforts in educating firms on options for recycling liquid paint-related wastes.

The largest type of air emissions from both paint manufacturers and paint users is VOCs, which contribute to atmospheric ozone pollution. Currently, the Clean Air Act imposes regulations on some major sources of VOC emissions (i.e., facilities that release over 100 tons per year). This regulation has already served as an incentive for large facilities to use less paint and to switch to paints formulated with lower VOC content, such as high solids, waterborne, and powdered paints. The 1990 Clean Air Act Amendments lower thresholds for VOC emissions, making additional facilities subject to the Clean Air Act permitting provisions and control technologies. We recommend an education program targeted at facilities now subject to these regulations, to inform them of the regulatory requirements and how they can use waste reduction to comply with the regulations. Waste reduction options include switching to paints formulated with lower VOC content and improving paint transfer efficiencies, which results in less paint being used and therefore decreased VOC emissions.

Further study is needed to determine the extent of environmental hazard due to land disposal of paint-related wastes. In particular, the leachate hazard of disposing of paint products in municipal landfills is unknown. Ensuring proper disposal of these wastes may require enhanced enforcement of special waste regulations for industry and commercial operations and establishing additional household hazardous waste collection programs.

ES.9 RECOMMENDATIONS

This section presents our recommendations for programs to promote paint-related waste reduction and environmentally sound disposal, including an education and public communication program. The state of Illinois prefers waste reduction or recycling to disposal whenever feasible. The following recommendations incorporate this state policy.

We recommend that the Ad Hoc Advisory Group (AHAG) be maintained to provide input in implementing the recommendations. The group would fulfill two functions. First, it would provide an insider's view of the complex issues related to paint use in a variety of industries. Second, because AHAG members can assure the effectiveness of recommended technologies, the group will encourage the implementation of recommended changes. In both of these functions, the group serves as a liaison between government agencies and the industries the members represent.

ES.9.1 Paint Manufacturers

We recommend an education program for paint manufacturers that includes information on technologies to reduce VOC emissions and waste management costs. In addition, paint manufacturers could identify profitable waste reduction opportunities by implementing full-cost accounting and materials accounting. Information on both accounting methods could also be included in an education program.

Paint manufacturers can play an important role in waste reduction and recycling for wastes generated from using paint. For example, paint manufacturers could participate in a household paint waste recycling program. We recommend that the state of Illinois solicit the participation of local paint manufacturers in recycling programs.

ES.9.2 Original Equipment Manufacturers (OEM) that Use Paint

The area that offers the greatest potential for waste reduction for OEM manufacturers is improving paint transfer efficiency. Generally, technologies are available to improve transfer efficiency. To encourage the implementation of these technologies, we recommend

- technology demonstrations,
- distributing vendor lists,
- a tax credit for capital expenditures, and
- case studies and news releases, to be distributed through trade associations and trade journals.

We recommend that steps be taken to ensure that all paint users are familiar with solvent and aqueous waste recycling opportunities. One option is to provide lists of recyclers to paint users. The site visit results also indicated that some fuel blenders are blending solid paint wastes such as filters from over-spray capture devices. We recommend this as an alternative to landfilling these solid paint-related wastes and recommend that the availability of this service be publicized through trade journals.

During the course of this study, we identified a problem with the disposal of solid paint-related wastes. Generally, these wastes are subject to Illinois special waste regulations and should be transported by a licensed special waste hauler to landtills licensed to accept the waste. However, these wastes are often disposed of in municipal landfills without the use of licensed haulers. This situation seems to be the result of a lack of information on special waste regulations and a lack of enforcement of these regulations. We recommend combining an education program on special waste regulations with additional steps to enforce these regulations. In addition to ensuring that these wastes are disposed of properly, these additional steps will draw greater attention to these solid wastes, and the additional costs and management steps required to comply with special waste regulations may provide an incentive to reduce these wastes.

ES.9.3 Auto Body Shops

One important source of waste generation from auto body repair shops is leftover paints. We recommend that any leftover paint products be reused onsite whenever possible. For example, old paints can be blended with thinner and used as an undercoating. Thinners and paints that can not be reused onsite should be managed by a solvent recycler or fuel blender. We recommend that an education campaign be initiated to ensure that all auto body shops are familiar with these recycling opportunities.

A second area that offers the potential for waste reduction from auto body shops is improving transfer efficiency. As improving transfer efficiency results in less paint being used and therefore reduced paint purchasing costs, there is a direct financial incentive for auto body shops to improve paint transfer efficiency. We recommend that Illinois encourage this improvement by relating information on changes in application techniques.

As with OEM manufacturers, we found through the course of this study indications that auto body shops are not disposing of their solid wastes in accordance with special waste regulations. Again, we recommend combining an education program on special waste regulations with additional steps to enforce these regulations.

Educational materials targeted at auto body shops could be distributed through trade journals and automotive paint vendors. Also, small regional conferences could be held to demonstrate new technologies.

One problem unique to auto body repair shops is the potentially large number of small, part-time operations conducted in a residential garage or backyard. We identified no information on such operations during the course of this study, but such shops may not utilize the recommended methods of waste disposal, including solvent recyclers and licensed special waste haulers. Contacting such operations as part of an education program would be difficult. One option is to make information on practices to reduce waste generation available through paint vendors.

ES.9.4 Household Paint Users

Household users of paint should observe the following guidelines to reduce household paint waste generation:

- Buy only as much paint as needed to complete a job.
- Use good application procedures to minimize spills and the amount of paint used.
- Store paints properly to ensure they maintain their effectiveness.
- Find a user for any leftover paints (e.g., donate to a church, school, or community theater).

We recommend that these guidelines be included in education materials such a brochures and posters displayed at paint retailers. These education materials should also include specific instructions for proper disposal of paint-related wastes.

We also recommend that Illinois study the possibility of establishing a household latex paint recycling program, in conjunction with county governments and local paint manufacturers. Prior to initiating such a program, a viable market for the reblended paints must be secured. Illinois should explore the possibility of the state purchasing the recycled paint. Paint cans collected at a household paint collection may also be recycled. Further study is needed to identify potential metal recyclers and markets for the recycled product.

The potential for leachate formation from paint and its associated hazard are unknown at this time. Because of their mobility, we recommend that liquid paints and paint-related wastes not be disposed of in municipal landfills. Some communities recommend allowing paint-related wastes to dry and then disposing of them in municipal landfills. For organic solvent-borne paints and thinners, the evaporation of VOCs during drying contributes to air pollution. Therefore, we do not recommend that the state of Illinois advocate this method of disposing of wastes containing organic solvents. Instead, we recommend that these products be collected through household hazardous waste collection programs and then sent to a solvent recycler for management.

For latex paint waste, we recommend that toxic chemical leachate procedure (TCLP) testing be conducted to determine the potential leachate hazard of dried latex paint. Even if studies determine that dried latex paint does not pose a leachate hazard, finding another user for the paint or taking it to a collection center for reblending are preferred to air-drying and landfilling the paint.

ES.9.5 Household Painting Contractors

The results of this study suggest that household painting contractors generate paint waste and manage their wastes in the same manner as household users. The education materials recommended for households are also applicable to painting contractors.

We recommend a latex recycling program for household users of paint. This program is also applicable to painting contractors. However, Illinois special waste regulations and federal RCRA regulations might impose additional constraints on recycling paint from commercial contractors. Additional permitting and administrative steps may be required to comply with these regulations.

Currently, paint wastes from household painting contractors are disposed of in municipal landfills. Further study is needed to determine the potential leachate hazard these wastes pose in municipal landfills. If studies determine that these wastes do pose a leachate hazard, we recommend that they be collected in household hazardous waste collections. This may require exemptions from special waste regulations and steps taken to ensure compliance with federal RCRA regulations.

ES.9.6 Educational MateriaIs

All educational materials should be developed with the appropriate trade associations. Their participation will improve material quality and promote their wider distribution. The educational materials can be grouped into three categories:

- reinforcement material for those already conscious of the need for effective paint-related waste management methods and who would benefit from guidance and support from those in their industry;
- training material for those employees and supervisors in industries whose attention to this area currently is limited; and
- public information items designed to inform and hopefully influence some modest change in public practice.

The reinforcement material should focus on practices that could be adopted or should be avoided by similar companies in industry. The following types of reinforcement materials could be developed:

- articles on the introduction of a cost-saving and waste-reducing new technology in a particular industry;
- news releases from HWRIC on innovative ways to reduce and manage paint-related wastes, which cover different industries that generate varying quantities of paint-related wastes;
- short slide or tape presentations that show the technology used by one or more industries to reduce paint-related waste generation;
- short reports for senior management in paint manufacturing or in industries that are major users of paint. The reports should highlight progress made in waste reduction and recommend additional steps that might be taken with management support; and
- booklets containing case studies demonstrating how profits have increased through waste reduction practices.

Training materials for both employees and supervisors can be used for initial and ongoing employee training. Several options for training materials are available:

- Posters can emphasize different waste reduction steps that can be implemented by employees.
- Reminder sheets can be distributed to new employees at orientation sessions or posted as reminders. The materials should be specific to each industry and should stress best practices and the value of these practices.
- Guides can be created for managers to conduct 5- to 15-minute reminder sessions on the best use of paint material and legally acceptable steps for paint disposal.

- Checklists can be developed for managers to evaluate employees who are using or disposing of paint and to suggest ways to correct or improve employee practices using very short on-the-job training.

- Guides can be created for managers to review overall progress made in transfer efficiency and in developing effective disposal methods. These guides would be in questionnaire form, which managers could require first-line supervisors to complete periodically.

Public awareness materials include those items designed for household users that could be put on paint cans, distributed by paint and hardware stores, or given out through the schools. These materials should be developed in cooperation with paint manufacturers and paint retailers. The public awareness material should be simple and recommendations should be easy to implement. Different types of public awareness materials are available:

- Paint manufacturers in the state could copy and give single sheets of suggestions for paint use and disposal to retail outlets for distribution to their customers.

- Adaptations of that same information could be provided to science teachers in elementary and secondary schools in a form that students can take home to remind parents. Material also could be adapted for use in vocational education courses in high schools and community colleges.

- News releases could be sent out in a regular sequence to newspapers in the state to remind the general public of effective paint use and disposal methods.

- Recycling centers could make information on recycling and on proper disposal of paint-related wastes available to the clients they serve. The material also could be provided to Cooperative Extension Service (CES) offices throughout the state; CES is actively involved in promoting improved waste management.

ES.10 FUNDING FOR RECOMMENDED PROGRAMS

Each of the above recommendations will require additional funding to implement. This section includes examples of funding alternatives.

For paint manufacturers and other manufacturers that use paint, one funding option is a fee on emissions of toxic chemicals reported in the Toxic Release Inventory (TRI). Auto body shops are not subject to TRI reporting requirements and therefore would not be subject to a fee on TRI emissions. Options to finance an education program targeted at this industry include a fee on paint purchases or an increase in licensing fees.

Currently, Illinois assesses a fee on generators of hazardous waste and special wastes. Increasing this fee is another possible source of funding for a paint waste reduction program. Most Illinois paint manufacturers and industrial and commercial paint users are included in this fee requirement.

A third funding option is the Clean Air Act fee. Some of the funds generated by this fee could be apportioned for educational programs targeted at paint manufacturers and industrial users of paint.

Waste reduction programs targeting household paint contractors and household users of paint could be financed through a fee on paint purchases. The tax could vary by the type of paint purchased, with a larger tax for paints that cannot be recycled and are thus more expensive to dispose of.

A second funding option for programs related to household users of paint is a drop-off fee for household hazardous waste collections. The disadvantage of this funding option is that it discourages proper disposal of household hazardous waste.

Household waste reduction programs could be financed through an increase in tipping fees charged by municipal solid waste landfills. An increase in tipping fees is relevant because reducing waste going into these landfills is a major goal of a paint waste reduction program.

ES.11 REPORT OVERVIEW

This report describes the life cycle of paint. Chapter 1 provides background information on the constituents in paint, the paint life cycle, and regulatory issues. Chapters 2, 3, and 4 describe paint manufacturing, application, and removal processes (respectively), the wastes that are generated from those processes, and options to reduce the generation of those wastes. Chapter 5 presents specific information on paint-related activities in Illinois. Chapter 6 discusses the waste reduction and disposal options applicable in Illinois for paint-related wastes. Finally, Chapter 7 presents recommended policies for paint-related waste management and waste reduction in Illinois, including recommendations for an education program.

As part of this study, we conducted onsite investigations with paint manufacturers, users, and waste management facilities. The results of these investigations were used in the analyses and recommendations made in this report. Complete documentation of these investigations is available as a separate document (HWRIC TR-008).

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CHAPTER 1

INTRODUCTION

The manufacture and use of paints and coatings is an important part of the Illinois economy. Illinois is among the top five states in the production of paints and coatings. In addition, most Illinois manufacturing industries and many of the small businesses, such as automobile body shops, use paint in their operations. Furthermore, households and residential/commercial painting contractors use large quantities of paint.

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Chapters 2 to 4 present the results of Phase I.

The second phase of the project was designed to gather additional data on paint-related operations in Illinois, the wastes those operations generate, and how those wastes are managed In addition, Phase II gathered data on current paint-related waste reduction activities in Illinois and the potential for further waste reduction. Phase II focused on manufacturers and on industrial and commercial users, because sufficient information on household use was identified during the Phase I literature review. Chapter 5 presents the results of Phase II, which consisted of a survey of Illinois' paint manufacturers and industrial users and onsite investigations with manufacturers, users, and waste management facilities.

To assist in conducting this study, an Ad Hoc Advisory Group (AHAG) was formed. AHAG consists of representatives of Illinois paint manufacturers and industrial and commercial paint users. The Hazardous Waste Research and Information Center (HWRIC) recognized that issues associated with paint usage vary widely among industries, so AHAG was formed to provide as many points of view as possible. The group provided input throughout the course of this study and was invited to review this report.

'The purpose of this report is to provide a broad overview of paint-related activities in Illinois and to try to assess the extent of paint-related waste disposal problems in Illinois. The results of this study indicate that the types of paints and paint usages vary greatly. Therefore, the findings of this study may not apply to all situations.

1.2 PAINT COMPONENTs

Paint can be defined as a fluid material that when spread over a surface in a thin layer will form a solid, cohesive, and adherent film (Morgans, 1990). Paint is generally considered to consist of a mixture of the following components:

- pigment,
- binder,
- solvent, and
- additives

In paint, the combination of binder and solvent is referred to as the paint "vehicle." Pigment and additives are dispersed within the vehicle. The type and proportion of each of the components determine the properties of a particular paint. The various components of paint also determine the characteristics of the waste generated in its manufacture and use, including the potential environmental hazard and the available waste management options. Some of the most common paint components are described below.

1.2.1 Pigments

Pigments are small particles of solid organic or inorganic material that are incorporated into the paint vehicle. The pigment confers color and opacity and influences the environmental resistance and the flow properties of the paint. Other materials known as extenders add little color or opacity but are incorporated to modify paint flow properties, gloss, and mechanical properties.

The pigment type used in a paint formulation affects the toxicity of the waste produced. Pigments that can be toxic include compounds containing antimony, barium, cadmium, chromium (in the form of chromate), and lead (metallic and lead compounds) (Morgans, 1990). Use of many of these heavy metal pigments is being discontinued. The majority of organic pigments, however, are accepted as reasonably safe (Morgans, 1990). Possible exceptions are barium toners that contain soluble barium. Table l-l lists some of the most common pigments.

Table l-l. Some Common Pigments

	Inorganic	Organic
Natural	Silicon Dioxide Talc Clay Calcium Carbonate Iron Oxide	Madder Logwood
Synthetic	Titanium Dioxide zinc oxide Antimony Oxide Lead Sulfate Iron Oxides Red Lead Cadmium Red Lead Silicochromate Lead Chromates Zinc Chromates Cadmium Yellow Calcium Plumbate Chromium Oxide Prussian Blue (potassium ferric ferrocyanide) Ultramarine Blue (an aluminosilicate) Aluminum Metallics Zinc Metallics Lead Metallics	Toluidine Red Arylamide Red Hansa Yellow Benzidine Yellow Pigment Green B Phthalocyanine Blue Carbon Black

Sources: Boxall and Fraunhofer, 1977

1.2.2 Binder

The binder is the portion of the paint that provides film continuity and adhesion to the substrate. The binder is the primary component that remains after the paint has cured[1] Binders in paints are natural or artificial polymeric resin materials. Paints can be classified based on the polymeric material(s) that make up the binder, recognizing that for certain types of binders the solvents used to dissolve or disperse the binder can be water or organic chemicals.

Some resin solutions may contribute to the volatile organic compound (VOC) content of the paint. When cured, most resins used as paint binders are nontoxic and insoluble in water. Listed below are some of the types of binders used in paint formulation (Boxall and Fraunhofer, 1977):

- oleoresinous
  - linseedoil
  - tung oil
  - oiticica oil
- alkyd resins
- **amino** resins
- vinyl resins
- acrylic resins
- epoxy resins
- polyurethane resins
- chlorinated rubber
- cellulosic polymers
- phenolic resins

1.2.3 Solvents

Solvents, including water, are volatile liquids added to paints in or&r to disperse or dissolve the binder component and to modify the viscosity of the coating. In paints with binders based on convertible resins (i.e., those that undergo chemical reaction upon curing), solvents are added to enable the coating to be applied by a suitable technique. In paints based on nonconvertible resins that do not undergo chemical reaction during drying, the solvents perform a more complex function in determining the final quality of the resultant film and the drying time. Furthermore, many paint application techniques requite the paint to have a narrow range of solvent-controlled physical and electrical properties. In these cases, it is common practice to blend two or more solvents to obtain the desired performance.

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[1]The paint forms a film when the binder converts to a solid. This occurs through chemical reactions such as addition or condensation polymerization, oxidation polymerization, or evaporation of the solvent in which the binder is carried (Boxall and Fraunhofer, 1977). Collectively, these are referred to as paint curing or drying processes.

Solvents used in paints are released through evaporation in limited quantities during paint manufacturing and in large quantities by design when paint dries or cures. The Clean Air Act Amendments of 1990 will reduce the use of many common organic solvents because they lead to the generation of atmospheric ozone. The amended Clean Air Act will phase out the production of some organic solvents that contribute to ozone depletion, such as l,l,l-trichloroethane (see Section 1.5.1).

A wide range of organic chemicals are used as solvents in paint. Table l-2 lists some organic solvents commonly used in paint formulation. Generally, these chemicals are classified as hazardous due to toxicity, ignitability, or both. Organic solvents are highly mobile and present a strong potential for groundwater contamination if they enter a landfill. Most organic solvents are relatively easily recycled or can be blended for fuel or incinerated.

Table 1-2. Common Organic Solvents Used in Paint Formulation

Solvent	Flash Point (°F)	Toxicity[a]	RCRA Hazardous	Industrial Toxics Program[b]	Air Toxics Program[c]
Aliphatic Hydrocarbons:					
Mineral Spirits	104	NR	Yes	No	No
Aromatic Hydrocarbons:					
Toluene	43	5	Yes	Yes	Yes
Xylene	78	5	Yes	Yes	Yes
Esters:					
Ethyl Acetate	24	11	Yes	No	No
Butyl Acetate	72	14	Yes	No	No
Ketones:					
Acetone	0	9.75	Yes	No	No
Methyl Isobutyl Ketone	73	2.08	Yes	Yes	Yes
Methyl Ethyl Ketone	22	3.4	Yes	Yes	Yes
Glycol Ethers:					
Ethylene Glycol Monoethyl Ether	202	3	No	No	No
Alcohols:					
Ethyl Alcohol	55	6	Yes	No	No
Butyl Alcohol	<100	0.79	Yes	No	No

[a]Toxicity, LD50 (oral), in grams of toxic material per kilogram of body weight

[b]Chemicals in the 1989 Toxic Release Inventory (TRI) targeted by USEPA for reduction due to toxicity and large quantities released (USEPA, 1991c).

[c]Under the 1990 Clean Air Act amendments.

Sources: USEPA, 1991a; ***Hazardous Waste Consultant,*** 1991b; 40 CFR 261.30.

1.3 PAINT CLASSIFICATION

Paint classification can be approached in many different ways. From the standpoint of waste reduction and disposal, a convenient method is to classify paints based on the primary type of solvent they contain, recognizing that many paints contain a mixture of solvents. Using this approach paints can be classified as follows:

- waterborne,
- organic solvent-borne, or
- powder (dry, without solvent).

1.3.1 Waterborne Coatings

The term waterborne refers to coating systems that use water to some degree as the solvent. These types of coatings include aqueous emulsions (latex), colloidal dispersions, and water-reducible coatings.

Emulsion, or latex, coatings are made from polymers that are synthesized in water and contain a surfactant. Emulsion paints are formed by emulsion polymerization (i.e., by introducing a liquid monomer into water and causing polymerization of that monomer within small droplets). These coatings consist of discrete particles of high molecular weight polymer dispersed in an aqueous media. Emulsion paints are manufactured using a variety of polymeric resins. ‘Resins used in emulsion paint vehicles include styrene-butadiene copolymers, polyvinyl acetate, acrylics, alkyds, and polystyrene. The term “latex” has become synonymous with emulsion paints, but latex specifically refers to an emulsion of rubber particles. Latex coatings are used primarily for architectural purposes. They have proven to be generally unacceptable for use in industrial finishing due to problems associated with application (Gardon, 1973).

Water-reducible coatings are coatings that use water in part as a solvent and that can be reduced (thinned) using water. These coatings can be applied effectively using a wide range of application techniques. Water-reducible coatings are more chemically complex than latex coatings. In water-reducible coatings chemical structures (polar groups) are incorporated into the polymer to make it soluble in water. The polymers used in water-reducible coatings are copolymers (polymers made with more than one kind of monomer) that are synthesized in water-miscible organic solvents such as alcohols and esters. Incorporated in these polymers is a small percentage of a monomer containing carboxylic acid. These acid groups are then neutralized by bases such as ammonia or amines to result in a product that is soluble in water. The water-reducible coating does contain organic solvents. A high boiling point, water-miscible organic solvent is required to aid coalescence of the polymer after the water leaves the paint film. During curing of the water-reducible coating, the water, solvent, and bases (ammonia or amines) evaporate, leaving a material that is no longer soluble in water. Chemicals that induce cross-linking of the polymer as the coating cures can be added to improve coating durability.

Waterborne paints are not entirely free of organic solvents. Normally, a waterborne paint requires an organic coalescing solvent. The coalescing solvent enables the deposited paint film to have fluidity for smooth curing after the water has evaporated.

VOCs in waterborne paints can vary; one manufacturer provided the following data for water reducible paints used as product coatings:

- Water reducible enamel (suitable for use on electronic business machines, computers, etc.) VOC = 2.3 pounds per gallon.

- Water reducible baking enamel (suitable for interior and exterior general finishing of metal products) VOC = 2.3 pounds per gallon.

- Water reducible shopcoat primer (for use as primer coat with above products) VOC = 2.8 pounds per gallon.

For waterborne emulsions (latex paints), data obtained from the National Paint and Coatings Association (NPCA) suggest median values for VOC of approximately 0.39 pounds per gallon (NPCA, 1989). The South Coast Air Quality Management District in California recommends a limit of 2.1 pounds per gallon.

Waterborne paints have advantages over some types of organic solvent-borne coatings because they generally decrease VOC emissions, eliminate organic solvents for thinning, and reduce the use of organic solvents during clean-up. When wastewater is generated in waterborne painting, (such as in water-wall paint booths), the wastewater contains fewer toxic organics because of the limited organic solvents in the paint. There are, however, two key disadvantages to waterborne paints. First, the surface to be painted must be completely free of oil film or the paint will not adhere well. Secondly, waterborne coatings require longer drying times or oven drying.

1.3.2 Organic Solvent-borne Coatings

Many "conventional" paints are organic solvent-borne. Nearly every type of binder material can be used in formulating organic solvent-borne paints. Included among organic solvent-borne paints are "oil-based" paint, most industrial and special coatings, primers, and wood finishes.

By their nature, organic solvent-borne coatings contain significant amounts of VOCs. High-solids coatings are being formulated to reduce VOCs. The solids content required in order for a coating to be considered a high-solids coating is not clearly established, Rauch (1990) defines high-solids coatings as having over 60 percent solids. The higher solids content produces a coating using less solvent, but modifications to spraying equipment are required due to the greater viscosity of high-solids coatings. Also, the reduced solvent content makes high-solids coatings less tolerant to contaminants on the surface being coated (Higgins, 1989).

Wastes from organic solvent-borne paints are generally hazardous due to toxicity, flammability, or both. However, the relative ease of solvent recycling and the high Btu content of organic solvent wastes provide several possible avenues for waste recycling or reuse.

1.3.3 Powder Coatings

Powder coatings entirely eliminate the use of a solvent and consist of resin, pigment, curing agents, catalysts, reinforcing filler, flow control agents, and other minor ingredients. The use of powder coatings continues to expand; in 1990 they made up

8 percent of the industrial finishing market (Bocchi, 1991). Powder coatings are applied dry using electrostatic spray, fluidized bed, and flame spray application techniques. In all cases, the powder that adheres to the object being painted is melted using heat to provide a continuous film.

Thermosetting and thermoplastic resins are used in making powder coatings. With both types, the powder melts, flows, and forms a continuous film when heat is applied. Thermoplastic resins used in powder coatings are nylon, polyvinyl chloride, fluoropolymers, and polyolefins. Thermoplastic resins are used mostly in applications requiring a thick film. The majority of powder coating resins are thermosetting. These include epoxy, polyester, polyurethane, and acrylic resins for thin-film applications.

Because powder coatings do not begin to cure until they are heated, it is possible to design spray booths to capture and recycle powder overspray. The result is potentially very high overall transfer efficiencies, in the range of 90 to 97 percent.

Powder coatings offer significant environmental benefits. VOCs are nearly eliminated because no organic solvent is used in powder coatings. In addition, little overspray waste (either solid or liquid) is generated because of the high transfer efficiency. After using a powder coating system for one year, one appliance manufacturer stated, “To date we have generated a total of 30 pounds of waste. We had a budget for waste disposal with our wet (paint) system in excess of $60,000 a year. We’ve dropped that to nearly nothing” (Stevens, 1990).

Most of the disadvantages of powder coating systems are related to application. As with waterborne coatings, the substrate being coated must be completely clean for good adhesion of the powder. Organic solvent-borne paint systems are more tolerant of contaminants because the solvent can dissolve the contaminants in small quantities. Another disadvantage related to powder coatings application is the need to heat the parts being coated for most application methods. This can present difficulties in the case of large, very heavy, or heat sensitive items. A third difficulty associated with application can occur in electrostatic powder spray systems for objects with certain surface geometries. For some geometries, electric fields can become established which prevent uniform deposition of the paint powder.

Powder coating technology is rapidly developing, increasing the number of products that can be coated using powder. Small-scale powder coating equipment is becoming available for use by smaller manufacturing operations. Powder coatings present a very viable option for reducing environmental impacts of industrial painting operations.

1.4 PAINT LIFE CYCLE

The life cycle of paint covers all the stages of paint manufacturing and use, from the mining and manufacturing of inputs used in paint manufacturing to the ultimate disposal of the product that was painted. Paint usage has impacts on the environment at all stages of this life cycle.

Figure l-l shows an overview of the paint life cycle. The major stages of the life cycle shown include the following:

- manufacturing the raw materials to be used to make paint;
- manufacturing the paint itself;

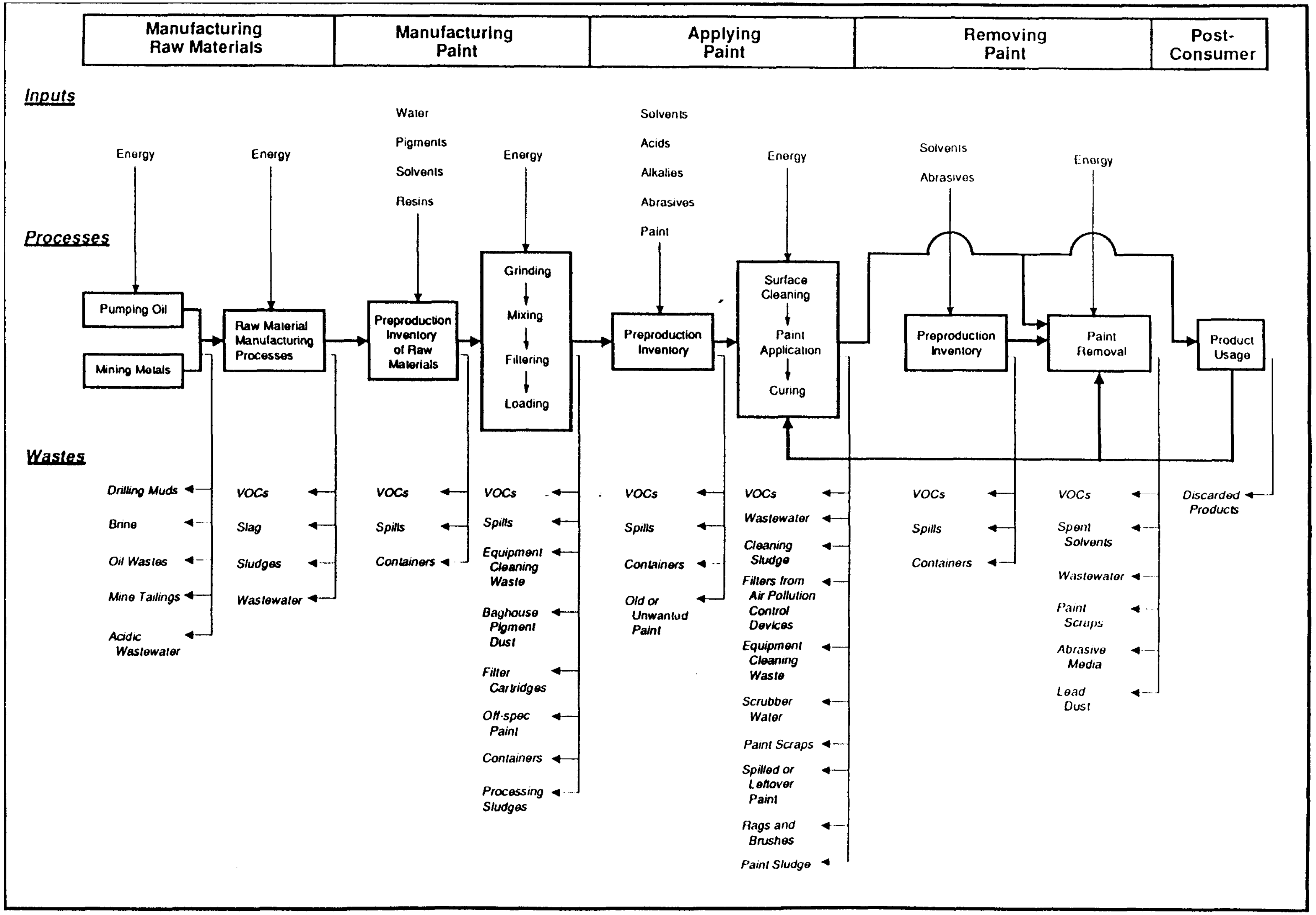

Figure 1-1. Paint Life Cycle and Associated Waste Generation

- applying the paint;
- removing the paint, if required; and
- disposing of the item that had been painted (e.g., taking an old car to the junk yard).

In addition, the life cycle of paint includes transporting materials, managing wastes generated, and producing energy that is consumed throughout the life cycle. This study focuses on the paint manufacturing, application, and removal stages of the paint life cycle, with emphasis on the application and removal stages.

Figure l-l shows the primary inputs used at each stage of the paint life cycle. Many of these inputs are toxic, flammable, or caustic. For example, heavy metals can be used as pigments and mercury can be used as a biocide in paint formulations. In addition, organic solvents such as those used in paint formulations, as paint thinner, as paint remover, and to clean equipment may contribute to ozone and other environmental pollution.

Figure l-l also shows wastes generated at each stage of the paint life cycle. Many of these wastes pose an environmental or health risk, partly because of the use of hazardous or toxic inputs in paint formulations.

1.5 WASTE MANAGEMENT REGULATIONS

As described above, paint-related waste released at each stage in the paint life cycle can pose environmental or health risks. To reduce this risk, the federal government and the state of Illinois regulate the generation and management of many of these wastes. Applicable regulations depend on

- the environmental medium to which the waste is released and
- the regulatory status of the generator.

Following is a general summary of regulations governing the management of paint-related waste.

1.51 Air Releases

Sources of air releases from paint manufacturing and use include releases of

- VOCs, which contribute to ozone pollution;
- heavy metal dust from pigments and, in the case of mercury, biocides used in paint formulations; and
- atomized paint from spray applications.

The federal Clean Air Act regulates air releases. Prior to 1990, major provisions of the Clean Air Act included the National Ambient Air Quality Standards (NAAQS) (40 CFR 50) and the National Emission Standards for Hazardous Air Pollutants (NESHAP) (40 CFR 61).

The 1990 Clean Air Act amendments will have a major impact on paint manufacturing and use. Under the amendments, a new Air Toxics Program replaces the

NESHAP program. The Air Toxics Program will require mandatory emission control technologies for sources of 189 listed hazardous air pollutants, including some organic solvents and heavy metals used in paint formulations ***(Hazardous Waste Consultant,*** 1991b).

The NAAQS program has been revised to address ozone pollution. The new ozone standards will require many currently unregulated sources to comply with NAAQS nonattainment provisions. Regulations for ozone pollution will include annual reporting requirements for VOC emissions, mandatory reductions in VOC emissions, and, in severe and extreme nonattainment areas, annual fees of $5,000 per ton of VOC emitted by a source in excess of the baseline amount, with the baseline to be determined by U.S. Environmental Protection Agency (USEPA) based on either actual VOC emissions or VOC emissions allowed under the source’s permit. In addition, USEPA is required to study VOC emissions from consumer and commercial products and establish regulatory controls to lower VOC emissions. Possible regulatory controls include chemical reformulation, product or feedstock substitution, repackaging, and directions for use, consumption, and storage ***(Hazardous Waste Consultant,*** 1991b). These requirements could result in reductions in the VOC content of paints.

A stratospheric ozone protection program has also been included in the Clean Air Act amendments. This new program will require the phase-out of production of ozone-depleting chemicals, including chloroflourocarbons (CFCs), halons, carbon tetrachloride, methyl chloroform, and hydrochloroflourocarbons (HCFCs) ***(Hazardous Waste Consultant,*** 1991b). Some of these chemicals, such as l,l,l-trichloroethane, are currently used in paint formulations ***(Industrial Finishing,*** 1990).

Finally, the 1990 amendments include a permitting program that will require most regulated stationary sources of air emissions to obtain permits and comply with monitoring and reporting requirements. The permitting provisions will also include annual fees ***(Hazardous Waste Consultant,*** 1991b).

1.52 Wastewaters

Wastewaters are generated due to equipment cleaning, surface preparation, and the rinsing of a surface after paint removal. Paint-related wastewaters can contain organic solvents, heavy metals, and other toxic materials used in paint formulations, surface preparation, and equipment cleaning.

Under the federal Clean Water Act, most point sources of wastewater (e.g., discharge pipes) discharging to waterways require a National Pollutant Discharge Elimination System (NPDES) permit. Permits specify levels of toxicity and other characteristics that must be achieved prior to discharge. Pretreatment of the wastewater prior to discharge is generally necessary. Common wastewater treatment activities include settling to remove paint sludge and elementary neutralization.

Discharging paint into municipal sewage without pretreatment is illegal in Illinois. Nonetheless, small quantities of paint are released into municipal sewage when rinsing paint brushes and other equipment. Reliable data on the quantities of paint wastewaters disposed of in this manner are not available.

1.5.3 Hazardous Wastes

Wastes that exceed regulatory thresholds for ignitability, corrosivity, reactivity, or toxicity are considered hazardous under federal Resource Conservation and Recovery Act (RCRA) regulations. As shown in Table 1-2, many of the organic solvents commonly used in paint formulations are RCRA hazardous. In addition, heavy metals used in paint formulations can result in wastes classified as RCRA hazardous waste due to toxicity, depending on the concentration of metals in the waste and other characteristics. MateriaIs used for surface preparation and equipment cleaning can also result in the generation of RCRA hazardous waste.

Facilities that generate more than 1,000 kilograms per month or accumulate more than 1,000 kilograms of RCRA hazardous waste are considered "large" quantity generators, or LQGs. LQGs must manage RCRA hazardous waste in RCRA-permitted waste management units, in hazardous waste recovery processes, or in wastewater treatment processes regulated under the Clean Water Act. In addition, a manifest must accompany RCRA hazardous waste shipped offsite.

The National Survey of Hazardous Waste Generators (Generator Survey) (USEPA, 1990b) was a national survey of LQGs in 1986 conducted by the USEPA. The survey data indicated an estimated 164 Illinois facilities that generated paint-related waste in 1986 were LQGs of RCRA hazardous waste. These facilities generated an estimated 41,000 tons of RCRA hazardous paint-related waste. These numbers underestimate the quantity of paint-related hazardous waste generated by LQGs as they do not include wastes generated from surface preparation and some equipment cleaning wastes.

The most common paint-related waste management activities conducted onsite by LQGs were wastewater treatment, solvent recovery, and fuel blending; these are listed in Table 1-3.

Table 1-3. Onsite Management of RCRA Hazardous Paint Waste Generated by LQGs in Illinois in 1986

Waste Management Activity	Quantity Managed (tons)	Percentage of Total Quantity
Wastewater treatment	9,300	23
Solvent recovery and fuel blending[a]	8,700	21
Solvent recovery	6,100	15
Incineration	2,700	7
Fuel blending	1,300	3

[a]These wastes are managed consecutively. Fit, organic solvents are recovered. The residual sludges are then blended for fuel.

Note: Only the top waste management activities are shown. Total quantity generated was 41.000 tons.

Source: USEPA, 1990b

Of the 41,000 tons of RCRA hazardous paint waste generated by LQGs in 1986, 29,000 tons, or 71 percent, was sent offsite for management. Over 95 percent of paint waste LQGs shipped RCRA hazardous paint waste offsite. Solvent recovery, reusing the waste as fuel, and incineration were the most common offsite waste management activities (see Table l-4). Of those LQGs shipping hazardous waste offsite for management, 125 shipped their wastes to management facilities outside the state of Illinois. In addition, 58 non-Illinois waste management facilities received this waste in 1986. Table l-5 shows the most common out-of-state waste management activities for RCRA hazardous paint wastes generated by LQGs in Illinois and the number of out-of-state management facilities handling Illinois hazardous paint waste.

As Tables l-3, l-4, and l-5 show, RCRA hazardous paint-related wastes generated by LQGs are often burned for fuel recovery. Previously, burning hazardous waste for energy and material recovery in boilers and industrial furnaces had been exempt from many RCRA regulations. In 1991, USEPA issued new regulations designed to require that boilers and industrial furnaces comply with essentially the same standards as hazardous waste incinerators ***(Hazardous Waste Consultant,*** 1991a). These new regulations will require that most boilers and industrial furnaces

- meet destruction and removal efficiency standards;
- have controls on products of incomplete combustions;
- meet emission standards for heavy metals, hydrogen chloride and chlorine gas, and particulates; and
- comply with RCRA-permitting requirements.

To avoid meeting these new regulatory requirements, some operators of boilers and industrial furnaces may choose to discontinue burning hazardous waste. The amount of paint-related waste burned for energy recovery, therefore, might decline.

According to federal regulations, small quantity generators are classified as generators of at least 100 kilograms (220 pounds) per month but less than 1,000 kilograms (2,200 pounds) per month of RCRA hazardous waste. Federal regulations require that SQGs notify USEPA (through IEPA) of their hazardous waste activities and obtain a USEPA generator number. SQGs must use hazardous waste management facilities and transporters permitted to handle the types of waste they generated. A hazardous waste manifest must accompany all shipments of hazardous waste generated by SQGs (Kraybill, 1990).

Conditionally exempt generators (CEGs) generate less than 100 kilograms (220 pounds) of RCRA hazardous waste per month. CEGs that do not accumulate more than 1,000 kilograms (2,200 pounds) of RCRA hazardous waste at any one time are exempt from federal RCRA regulations (Kraybill, 1990). Households are also exempt from RCRA regulations.

Table l-4. Offsite Management of RCRA Hazardous Paint Waste in Illinois in 1986[a]

Waste Management Activity	Number of LQGs	Percentage of LQGs[b]
Fuel blending and reuse as fuel	45	27.4
Incineration	44	26.8
Solvent recovery and reuse as fuel	33	20.1
Solvent recovery	26	15.9
Other	9	5.5
Total Offsite Management	157	95.7

[a]Includes hazardous paint waste generated by Illinois LQGs only.

[b]Percentage of all Illinois LQGs of paint waste in 1986 (164 generators).

Source: USEPA, 1990b.

Table 1-5. Out-of-State RCRA Hazardous Waste Management of Illinois Paint Waste in 1986[a]

Waste Management Activity	Number of Out-of-State Waste Management Facilities	Percentage of Out-of-State Waste Management Facilities
Incineration	29	50
Solvent recovery	19	32
Solvent recovery and fuel blending	17	29
Fuel blending and reuse as Fuel	15	26
Fuel blending	12	21
Solidify and landfill	8	14
Total	58[b]	100[b]

[a]Includes hazardous paint waste generated by Illinois LQGs only.

[b]A single out-of-state waste management facility may conduct more than one hazardous waste management activity. Totals shown are without double counting.

Source: USEPA, 1990b.

1.5.4 Illinois Special Wastes

The state of Illinois further regulates most solid waste generated by industrial and commercial facilities, known as “special wastes.” Illinois special wastes include RCRA hazardous waste, infectious hospital waste, and nonhazardous (under RCRA definitions) industrial process and pollution control wastes.

Generators of more than 100 kilograms (220 pounds) per month of special wastes must obtain an Illinois identification number and receive specific authorization for disposal of their special waste. Authorized special waste haulers and waste management facilities must be used, and all shipments of special wastes must be accompanied by a special waste manifest (Kraybill, 1990). In addition to these special waste regulations, generators of RCRA hazardous waste are subject to all applicable federal regulations.

In 1986, an estimated 8,000 cubic yards of paint products were manifested as special waste by generators of more than 100 kilograms per month of special waste. This quantity does not include paint-related wastes such as pigments, solvents, and resins as these products could not be directly attributed to paint usage and production. A total of 1.79 million cubic yards of special waste were manifested during the same time period (Perry, 1989).

Generators of less than 100 kilograms (220 pounds) per month of special waste are exempt from many parts of the Illinois special waste regulations. These generators must obtain a state identification number and waste stream authorization and must send their wastes to a waste management facility licensed to handle that type of waste. They can transfer their special wastes themselves without a permit or manifest (Kraybill, 1990). The quantity of special waste generated by these generators is not known due to their exclusion from manifesting requirements.

1.55 Household Paints

A 1985 study of Marin County, California, estimates an average household paint waste landfilled of 1.51 pounds per year (Meiorin and Purin, 1989). In 1986, Illinois had an estimated 4.2 million households (U.S. Bureau of the Census, 1987). Using the Marin County estimate, an estimated 6.3 million pounds (over 3,000 tons) of paint waste was landfilled from households in Illinois in 1986.

Paint and related products can contain toxic or hazardous components that may contribute to groundwater contamination if improperly disposed of. Reliable data on the contribution of these products to contamination are not available (USEPA, 1988). This section discusses regulations concerning paints for household use.

1.5.5.1 Toxicity of Household Paints

Until recently mercuric compounds, used as a biocide in latex (a water-borne paint), were unregulated in paint. The mercury constituent of the paint slowly vaporizes after application and can cause brain damage and central nervous system disorders. In 1989, approximately 30 percent of latex paint sold contained some level of mercury ***(Consultant,*** 1990). In 1990, USEPA approached the manufacturers of the mercuric compounds used in latex paint and they agreed to voluntarily amend their Federal

Insecticide, Fungicide, and Rodenticide Act (FIFRA) registrations; these compounds can no longer be used in interior latex paint. In May 1991, the FIFRA registrations were further amended to exclude the use of mercury in exterior latex paints ***(HHWMN,*** 1991). No new paints of any kind will contain mercury. However, latex paints manufactured before these changes that contain mercury may continue to be stored and used by households (Seattle Solid Waste Utility, 1990a).

Lead has been used in paint as a pigment, as a drying compound, for corrosion protection, and to enhance hardness and high-gloss. Lead from peeling paint or paint dust can cause brain damage and central nervous system disorders. In 1978, the Consumer Products Safety Commission set a lead concentration maximum of 0.06 percent for household uses of paint. Higher concentrations of lead can be used on industrial products or ***structural*** steel ***(Consultant,*** 1990). As with mercury, households may have accumulated older paints with concentrations of lead above this regulatory limit that still must be disposed of.

Art and hobby paints are generally exempt from the regulations governing constituents in architectural paints. Toxic substances that these products can contain include arsenic, asbestos, lead, formaldehyde, antimony, cadmium, manganese, and mercury (Hirschhorn and Oldenburg, 1991).

1 5.5.2 Household Paint Disposal Regulations

Under federal law, household wastes are exempt from hazardous waste regulation and can be disposed of in municipal solid waste landfills. However, some states and local governments, concerned with potential contamination of groundwater or surface waters, have further regulated paint waste disposal. For example, California regulations ban the disposal of liquid wastes in solid waste landfills. California considers liquid paints containing lead or organic solvents hazardous and sends these wastes to a hazardous waste treatment, storage, and disposal facility. The state is currently looking into the potential for solidifying liquid latex paint and then landfilling it. Currently, however, the state recommends treating latex paint as a hazardous waste (in part because of potential mercury content). Dried organic solvent and latex paints and empty paint cans can be landfilled in California (Meiorin and Purin, 1989).

In Illinois, paint and related wastes can be legally disposed of in solid waste landfills, although some local solid waste haulers and municipal landfills in the state do not accept paint products for disposal. McHenry County in Illinois advises residents to allow latex paints to evaporate prior to landfilling. Residents are advised to allow organic solvent based paints to evaporate outdoors prior to landfilling or to save the paint for a household hazardous waste collection event (McHenry County Illinois Department of Solid Waste Management, 1991).

IEPA annually sponsors six to ten local household hazardous waste collections. IEPA pays for the cost of waste collection, packaging, transportation, and disposal, while the sponsoring community handles all publicity and promotion ***(IEPA News,*** 1990a). During their 1988 household hazardous waste collection, Champaign County collected 5,628 containers of hazardous materials from 451 contributing units (i.e., households, farm operations, or group quarters). Approximately 20 percent of these containers were organic solvent-borne paints. It is important to note that container size and capacity varies; the actual volume of paint waste collected was not determined (Oldakowski, 1990).

A bill banning the disposal of liquid paint, paint removers and thinners, and other potentially hazardous household wastes from solid waste landfills was introduced in the Illinois legislature in 1991 (SB 0633). The bill was passed by the Senate but was referred to interim study by the House Energy and Environment Subcommittee.

1.6 WASTE REDUCTION

To reduce the risks wastes pose to human health and the environment, to reduce worker exposure to hazardous substances, and to conserve resources, both government and industry have adopted waste reduction policies (policies to reduce or eliminate the generation of waste at its source). Waste reduction techniques include the following:

- modification or redesign of processes,
- in process (closed-loop) recycling,
- reformulation or redesign of the product,
- product substitution,
- raw materials substitution, and
- improved maintenance, housekeeping, and operating practices.

Environmentally sound recycling is the preferred waste management activity for waste generation that cannot be eliminated. Recycling includes blending old paints to make new, usable paints; recovering and reusing spent solvents; and reusing waste as fuel to generate energy. Chapters 2, 3, and 4 of this report include descriptions of waste reduction and recycling techniques to reduce the generation of waste at three stages in the paint life cycle: paint manufacturing, application, and removal. The following discussion summarizes government policies designed to encourage waste reduction.

1.6.1 Federal Waste Reduction Programs

The federal Pollution Prevention Act of 1990 establishes pollution prevention as a "national objective." The Act establishes as national policy the pollution prevention hierarchy, declaring that pollution should be prevented at the source whenever feasible, while pollution that cannot be prevented should be recycled (USEPA, 1991c).

The federal government has initiated several waste reduction programs applicable to paint. For example, RCRA requires hazardous waste generators that ship hazardous waste offsite to certify that the waste has been reduced to the extent that is technically and economically feasible.

Under the federal Industrial Toxics Program (33/50 Program), major generators of 17 targeted toxic chemicals are encouraged to voluntarily reduce their emissions. The toxic pollutants were targeted because of their toxicity and the quantities released (USEPA, 1991a). The paint manufacturing industry had the fourth largest releases of these targeted toxic chemicals during 1988, based on data reported for the Toxic Release Inventory (TRI) (USEPA, 1991c).

The Clean Air Act, as amended in 1990, will require reductions in releases of VOCs from paint manufacturing and usage. However, if a facility successfully reduces its emissions by 90 percent, the facility can apply to USEPA for a temporary waiver from complying with the new regulations. for six years (Hazardous ***Waste Consultant,*** 1991 b).

USEPA has developed the Pollution Prevention Information Clearinghouse (PPIC) to encourage transfer of information on pollution prevention. PPIC includes a computerized Pollution Prevention Information Exchange System that can be accessed by industry and government officials. The computerized system includes a bibliography of pollution prevention information sources and case studies.

Finally, USEPA has developed several funding programs to the states to encourage their development of pollution prevention initiatives. These include the RCRA Integrated Training and Technical Assistance (RITTA), the Waste Reduction Innovative Technology Evaluation (WRITE), and the Pollution ***Prevention*** Incentives for States Grants (PPIG) programs. Illinois has received several of these contracts to support its waste reduction efforts (HWRIC, 1991).

1.6.2 Illinois Waste Reduction Programs

The 1989 Illinois Toxic Pollution Prevention Act (PA 86-914) states that toxic pollution prevention is the preferred means for achieving compliance with environmental laws and regulations. This Act establishes a toxic pollution prevention technical assistance program to provide technical information on pollution prevention to industry and citizens. It also includes provisions for the development and submission of voluntary toxic pollution prevention innovation plans.

The Illinois Toxic Pollution Prevention Act established the Office of Pollution Prevention within the Illinois Environmental Protection Agency IEPA). Among the Office’s programs are an Industrial Materials Exchange Service to encourage recycling and an internship program that provides companies with engineering graduate students to assist in implementing pollution prevention. In 1990, one intern developed a program to reduce paint and solvent waste and to recover product from paint sludges (IEPA, 1990b).

The Illinois Hazardous Waste Research and Information Center (HWRIC), a division of ENR, has been mandated to study ways to reduce the volume of hazardous waste generated and to assess the threat hazardous waste poses to human health and the environment. HWRIC has promoted waste reduction in Illinois through the following four major program activities:

- providing direct technical assistance to Illinois industries, communities, and citizens;

- encouraging waste reduction through the use of the Governor’s Pollution Prevention Awards;

- encouraging waste reduction through the Recycling and Reduction Techniques matching fund and research programs; and

- providing information dissemination and technology transfer through HWRIC's library, clearinghouse, and computerized bibliographic information system, and through participation in seminars and workshops across the state.

With additional support from USEPA, HWRIC is providing waste reduction training for IEPA personnel and is evaluating the use of innovative engineering and scientific technologies to prevent pollution. For more information on HWRIC waste reduction activities, refer to ***the Illinois Hazardous Waste Research and Information Center Annual Report (HWRIC,*** 1991).

1.7 REPORT OVERVIEW

This report describes the life cycle of paint. Chapters 2, 3, and 4 describe paint manufacturing, application, and removal processes (respectively), the wastes that are generated from those processes, and options to reduce the generation of those wastes. Chapter 5 presents specific information on paint-related activities in Illinois. Chapter 6 discusses the waste reduction and disposal options applicable to Illinois paint-related wastes. Chapter 7 presents recommended policies for paint-related waste management and waste reduction in Illinois, including recommendations for an education program. As part of this study, we conducted onsite investigations with paint manufacturers, users, and waste management facilities. The results of these investigations were used in the analyses and recommendations made in this report. Complete documentation of these investigations is available as a separate document (HWRIC TR-008).

CHAPTER 2

PAINT MANUFACTURING

2.1 PAINT MANUFACTURING PROCESSES

The production of paint is a complex process involving dispersion of pigments and additives into a solution of resin and solvent, followed by relatively simple mixing operations. The most important step in the process is the initial pigment dispersion operation, sometimes termed “grinding.” A number of types of machines are used in the grinding operations; among the most common are ball mills, disc mills, and sand mills.

The ball mill consists of a cylindrical drum containing small balls that can be metal, pebbles, or steatite. In use, the pigment, vehicle, and other additives are introduced into the drum and the whole unit rotates continuously. As the mill rotates, the pigment is dispersed by the rubbing action of pigment caught between balls and between the balls and the drum surface.

A disc mill consists of a circular saw-toothed metal blade attached to a shaft, which rotates at high speed. The blade is immersed in the tank of material being dispersed. As the blade rotates, shear and mixing forces are generated in the media. While primarily mixing occurs, some particle size reduction may occur through impact with the mixing blade. Disc mills provide fast dispersion and are excellent for many types of latex paints.

A sand mill consists of a water-cooled cylinder containing sand and agitator blades. The agitator blades generate rapid movement of the sand particles. The violent agitation of the sand produces shearing of the pigment particles. The dispersed mixture leaves the mill through a screen, which retains the sand particles.

After dispersion, additional vehicle, solvent, and other additives are added to the ground mixture through simple mixing operations. When the paint is found to meet specifications it is filtered and packaged. Figure 2-1 provides a general overview of the paint manufacturing process.

Different types of paint are manufactured by changing the raw materials used and their relative quantities. Organic solvent-borne paint manufacturing begins by mixing and grinding resins, dry pigments, extenders, organic solvents, and plasticizers. Tints and thinners (consisting of organic solvents) are then added and mixed into the batch. Water-borne paints are made by mixing water, ammonia, and a dispersant. Dry pigments and extenders are then added and the mixture is ground. Finally, resins, plasticizers, antifoaming agents, a polyvinyl acetate emulsion, and more water are added and mixed.

Most paint manufacturers produce many different types and colors of paint, including both organic solvent-borne and water-borne paints. Each type and color of paint is manufactured in a separate batch, and all manufacturing equipment is generally cleaned between batches of different types or colors of paint to prevent contamination. Generally, an organic solvent is required to clean equipment after manufacturing an organic solvent-borne paint, while water can generally be used to clean equipment after manufacturing water-borne paints. In addition, caustic or alkaline cleaning solutions are generally used to remove dried paint from equipment.

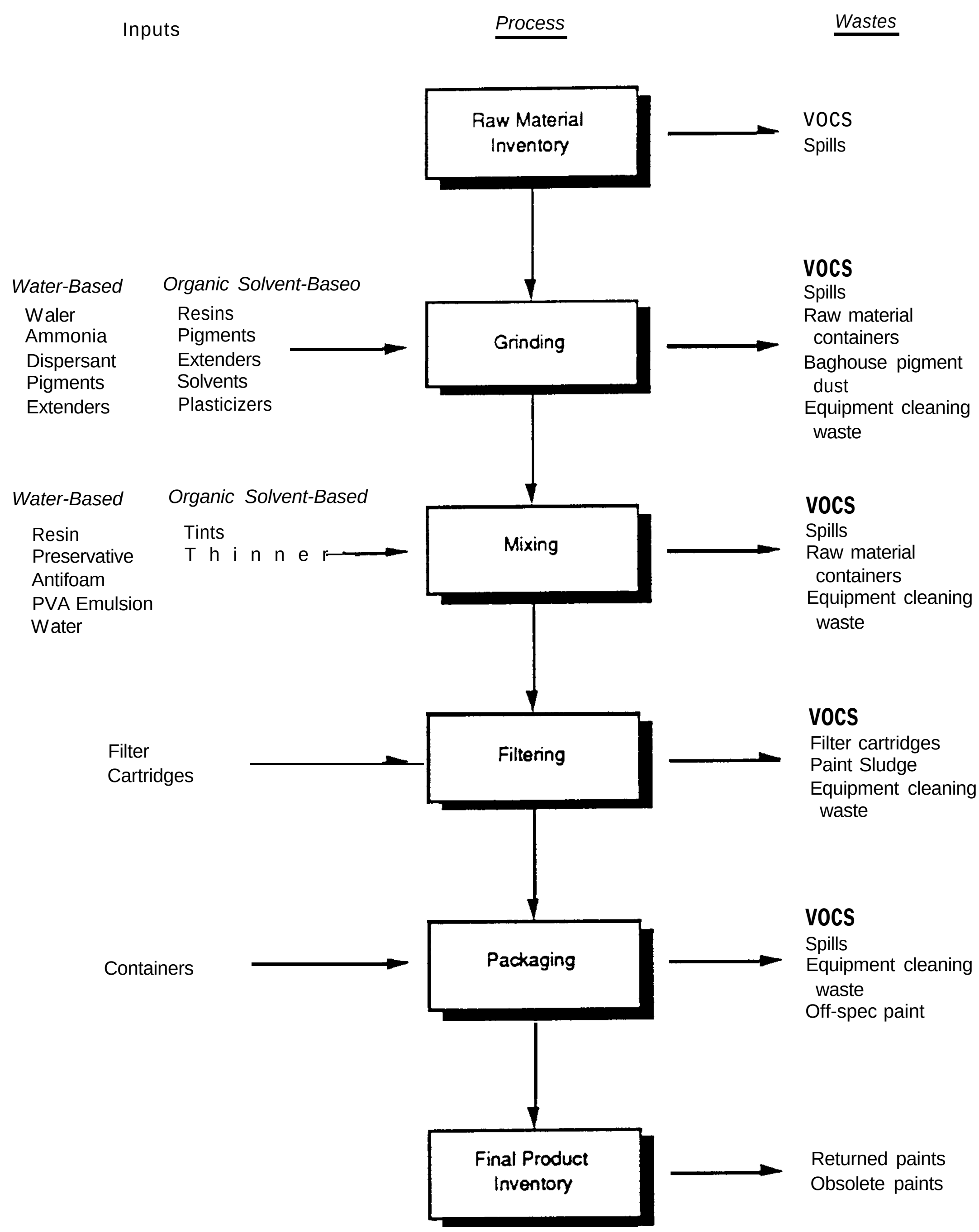

Figure 2-l. Paint Manufacturing Process and Waste Generation

Source: USEPA, 1990a, p. 7.

2.2 WASTE GENERATION

Wastes generated from paint manufacturing include the following:

- equipment cleaning wastes,
- air emissions of VOCS,
- pigment dust from air pollution control equipment (e.g., baghouse dust),
- empty raw material packages, bags, and containers,
- bags and cartridges from paint filtration equipment,
- paint that is "off-spec" (i.e., did not meet quality or customer specifications),
- paint returned from the retailer (e.g., because it had exceeded its shelf life), and
- waste paint or raw materials from accidental spills and discharges.

Some of these wastes are recycled and do not enter the waste stream.

Equipment cleaning is the largest source of waste from paint manufacturing. An estimated 80 percent of waste generated is due to cleaning manufacturing equipment (USEPA, 1986). These wastes include

- spent organic solvents,
- wastewater,
- acids or alkalines, and
- paint sludge.

The paint characteristics that affect the volume of wash wastes are drying time, curing mechanism, and solvent type (water or organic). For example, drying time determines if the mix tank must be cleaned soon after use or some hours later. A slightly longer drying time in the mix tank would allow the manufacturer more flexibility in scheduling tank washing. Similarly, the curing mechanism affects the drying time and also determines to some extent the difficulty of removing the dried film. Depending on the curing mechanism, the dried paint may or may not be soluble in its original solvent. Thus, the type of cleaning solution (and its potential environmental hazard) are affected by the paint curing mechanism.

The solvent type also affects the drying time and ease of removal of the cured paint. In addition, the solvent type determines the degree to which the rinse wastes can be recycled into the next paint product. Under ideal conditions, rinse waste can be stored and incorporated into the next batch of paint. The applicability of this varies for different circumstances. Paints incorporating organic solvents may be more sensitive to the mix of solvent, requiring tighter control of the type and quantity of solvent used in rinsing operations. In some cases reusing rinse water from latex paint operations may be difficult if the rinse water must be stored for more than a day. In such cases, the potential for bacterial contamination of the water may preclude its use in the next batch of paint.

The use of organic solvents in paint formulations or to clean equipment generates waste in the form of VOC vapors. The evaporation characteristics of each solvent will affect the volume and degree of environmental hazard of the VOC waste. For paint manufacturers, VOCs can be reduced by covering mixing tanks. VOC emissions from vents on solvent tanks can be reduced by changes in the vent design and by using equipment to recondense the solvent vapors.

Many of the chemicals used in paint manufacturing are considered toxic chemicals under Title III of the Superfund Amendments and Reauthorization Act (SARA). These include heavy metals and organic solvents. In addition, many of these chemicals have been targeted for voluntary waste reduction by USEPA in its 33/50 Program based on their potential hazard and the quantity released to the environment (USEPA, 1991 a). Table 2-l shows the quantity of SARA toxic chemicals released in Illinois by paint manufacturers during 1989. All the releases are to the air. Table 2-1 also indicates chemicals that are targeted under the Industrial Toxics Program.

Table 2-l. Air Emissions of SARA Toxic Chemicals by Illinois Paint Manufacturers in 1989

Chemical	Air Emissions (pounds)	Percentage of Total Air Emission@
Methyl Ethyl Ketone[b]	375,682	23.9
Xylene (mixed isomers)	298,008	19.0
Toluene[b]	272,101	17.3
Acetone	253,589	16.1
Dichloromethane[b]	68,688	4.4
Glycol Ethers	49,932	3.2
Methyl Isobutyl Ketone[b]	48,845	3.1
Ethylbenzene	48,178	3.1
Methanol	45,911	2.9
1, 1, 1-Trichloroethaneb	25,504	1.6
All Others	84,995	5.4
Total	1,571,433	100.0

[a]Percentage of total quantity of toxic chemicals released in Illinois by paint manufacturers in 1989 and reported in the Toxic Release Inventory.

[b]these chemicals have been targeted by USEPA under the 33/50 Program for reduction due to their toxicity and the large quantities released.

Source: USEPA, 1991c.

Wastes from paint manufacturing that exceed regulatory thresholds for toxicity, reactivity, corrosivity, or flammability may be considered hazardous under the federal RCRA. Data from Generator Survey (USEPA, 1990b) indicate that, in 1986, an estimated 65 Illinois paint manufacturers were LQGs of RCRA hazardous waste (see Section 1.5.3 for definitions of LQGs and RCRA hazardous waste). These manufacturers generated an estimated 32,733 tons of hazardous waste, less than 1 percent of the total quantity of hazardous waste generated by all Illinois LQGs in 1986. Over half of the paint-manufacturing hazardous waste contained solvents. Other common types of hazardous waste generated include hazardous wastewater, organic paint sludge, and organic paint (see Figure 2-2). Table 2-2 shows the most common sources of hazardous waste generated by paint manufacturers. The three most common sources--caustic cleaning, still bottom removal, and cleaning of process equipment-generate equipment cleaning wastes. These three sources generate 65 percent of all hazardous waste generated by paint manufacturers that are LQGs.

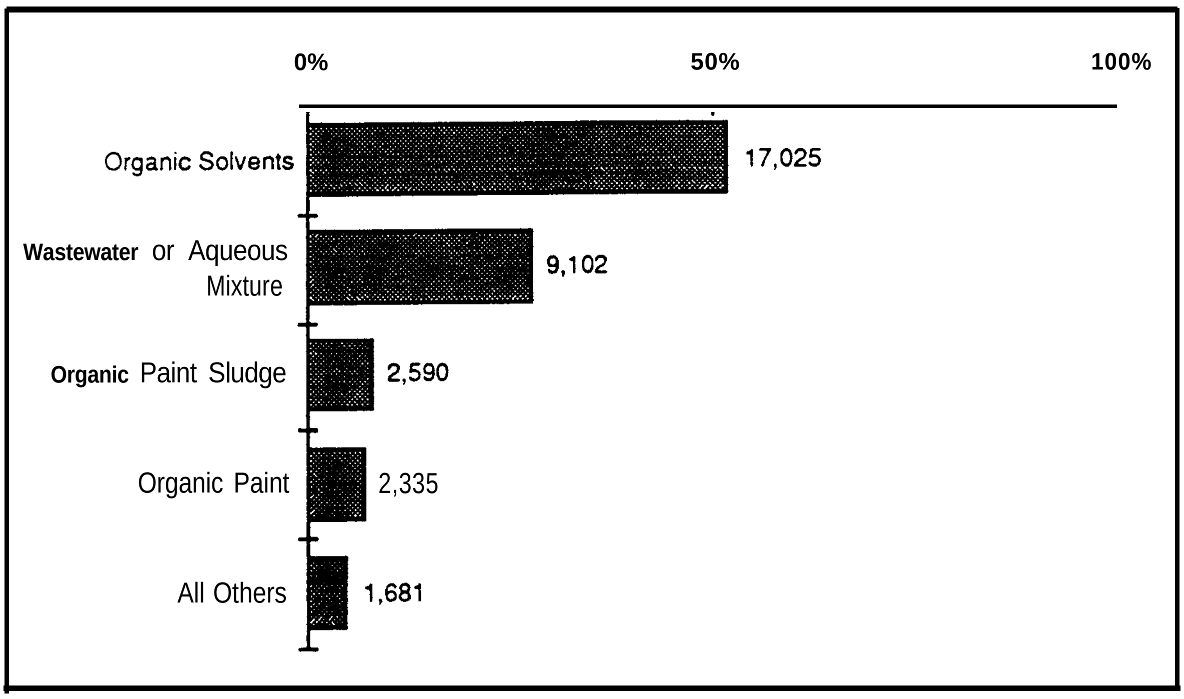

Figure 2-2. Most Common Types of Hazardous Waste Generated by Paint Manufacturers in Illinois in 1986 (tons)

Note: Numbers indicate the quantity of hazardous waste generated in tons prior to recycling or treatment by large quantity generators. The total quantity of hazardous waste generated by Illinois paint manufacturers was 32,733 tons.

Source: USEPA, 1990b

Table 2-2. Sources of Hazardous Waste from Paint Manufacturers in Illinois in 1986

Source	Number of Facilities	Quantity Generated (tons)	Percentage of Total Quantity
Caustic cleaning	2	9,137	28
Still bottom removal	8	8,497	26
Cleaning of process equipment	24	3,654	11
Off-spec material	1	2,335	7
Spray rinsing	2	1,997	6
All others		7,113	22
Total	65[a]	32,733	100

[a]A single facility may generate waste from more than one source. Total shown is without double counting.

Source: USEPA, 1990b.

2.3 WASTE REDUCTION OPTIONS

The following discussion describes techniques to reduce the quantity and toxicity of paint manufacturing waste. Table 2-3 summarizes this discussion.

2.3.1 Product Substitution or Reformulation

As described in Section 1.2, the hazardous and toxic characteristics of waste result in part from the raw materials used in paint formulation. Shifting to less toxic inputs or from organic solvent-borne to other types of paint greatly reduces the hazard of wastes generated Shifting from organic solvent-borne paints also reduces the need for organic solvents to clean equipment, allowing the substitution of less hazardous cleaning solutions.

The greatest barrier to implementing this type of waste reduction is customer specifications. For example, the U.S. Department of Transportation requires the use of cadmium (a toxic metal) as a pigment in road paint because it produces a brighter yellow than comparably priced substitutes. Lockheed, Inc., tested water-borne paint for its aircraft and found durability was sacrificed (Higgins, 1989). Nonetheless, as regulations on reducing VOC emissions and managing hazardous waste become more stringent, markets are expanding for new substitute products.

2.3.2 Reduce VOC Emissions

The two primary sources of VOC emissions from paint manufacturing are from the use of organic solvents to clean equipment and from the organic solvents and resins used as raw materials in paint formulations. As &scribed in Section 2.3.1, VOC emissions from raw materials can be reduced by manufacturing high-solids, waterborne, or powder coatings

Table 2-3. Waste Reduction Techniques for Paint Manufacturing

Technique	Description	Effects	Caveats
Substitute raw materials.	Substitute less toxic pigments for heavy metals. Substitute organic bactericides for mercury-containing bactericides. Substitute slurried pigments for powdered pigments.	Reduces toxicity for all waste streams. Reduces baghouse pigment dust	Applicability depends on customer specifications and raw material availabilitv.
Substitute or reformulate product.	Shift from organic solvent-borne to water-borne, high-solids, or dry-powdered paints.	Reduces toxicity for all waste streams. Reduces air emissions. Allows substitution of alkaline or water for organic solvents to clean equipment.	Applicability depends on customer specifications.
Substitute cleaning materials.	Substitute water or alkaline solutions for organic solvent+ Use high-pressure water systems.	Reduces toxicity of equipment cleaning waste. Reduces VOC air emissions.	May not be suitable for organic solvent-borne paints.
Recycle equipment cleaning wastes.	Use waste as an input in another batch of paint. Remove paint sludge and reuse waste for cleaning equipment. Distill waste and recover solvent.	Reduces the quantity of equipment cleaning waste.	Using waste as input may reduce product quality.
Reduce cleaning frequency.	Dedicate equipment lines to a single type of paint Maximize length of a production run for each type of paint. Schedule production batches progressively from light- to dark-colored paint.	Reduces the quantity of equipmentcleaning waste. If organic solvents are used to clean, reduces air emissions.	Changes in scheduling or equipment usage may not be feasible for a particular operation.
Reduce off-spec and returned paint.	Improve quality control. operating procedures, and employee training. Improve inventory controls and marketing activities. Increase use of automation.	Reduces quantity of paint waste. Reduces loss of paint product.	Automation may require large capital expenditures.

CONTINUED

Table 2-3. Waste Reduction Techniques for Paint Manufacturing (continued)

Technique	Description	Effects	Caveats
Reduce quantity of solution used per cleaning.	Clean equipment before paint dries. Use manual or automatic scrapers. Use plastic or foam pigs to clean pipes. Improve operating practices. Install nonstick liners on mix tanks. Use countercurrent rinse methods.	Reduces quantity of equipment-cleaning waste. If organic solvents are used to clean, reduces air emissions. Scrapers and pigs reduce lost paint product.	
Reformulate off-spec and returned paint.	Blend off-spec and returned paints into new paint batches.	Reduces quantity of paint waste. Reduces loss of paint product.	May reduce product quality.
Recover spilled raw materials.	Recover; spilled materials and reintroduce them to the manufacturing processes.	Reduces waste from spills. including cleaning solution required. Reduces usage of raw materials.	Reintroducing spilled material may reduce product quality.
Reduce raw material packages.	Purchase materials in water-soluble packages. Buy materials in bulk.	Reduces quantity of waste packages.	Depends on availability from vendor. Water-soluble packages may reduce product quality and are applicable for water-borne products only.
Recover raw material packages.	Clean and return raw material packages to vendor for reuse.	Reduces quantity of waste packages.	Requires vendor's participation.
Modify filtration processes.	Use screen or bag filters that can be cleaned and reused rather than cartridge filters.	Reduces waste filters.	
Reduce air emissions	Modify bulk storage tank. Install dedicated baghouse systems. Reduce usage of organic solvents.	Reduces VOC emissions and pigment dust.	

rather than conventional solvent paints. Switching to waterborne paints also eliminates the need for organic solvents to clean equipment, further reducing VOC emissions (USEPA, 199Oa). Such product reformulation is limited by customer specifications, however.

Modifying bulk storage tanks can reduce the evaporation of solvents and resins in storage, reducing air emissions and raw material losses (USEPA, 1990a). Reducing raw material losses can result in cost savings. Modifications to tanks to reduce VOC emissions include the following:

- using conservation vents,
- converting to floating roof designs,
- using nitrogen blanketing,
- using refrigerated coils,
- using lean-oil or carbon absorbers, and
- using vapor compressors.

Redesigning open processing equipment such as mixing tanks can also reduce VOC emissions, although such changes require capital expenditures. For example, some users of horizontal sand mills (rather than vertical mills) report reductions in VOC emissions.

VOC emissions from equipment cleaning can be reduced by substituting caustic rinses for organic-solvent cleaners. As mentioned above, switching to water-borne paints reduces the need for organic solvents in cleaning, thus eliminating this source of VOC emissions. For organic solvents that are used to clean equipment, VOC emissions can be reduced by installing closed tanks or using one of the methods described above to reduce VOC evaporation. In addition to reducing air emissions, these methods reduce the loss of solvents and therefore decrease solvent use.

2.3.3 Reduce Quantity and Toxicity of Cleaning Waste

As shown in Table 2-2, the most common source of waste from paint manufacturing is from cleaning manufacturing equipment. The toxicity of cleaning wastes can be reduced by substituting less toxic cleaning solutions, such as high-pressure water or alkaline solutions, for organic solvents. Such a substitution also reduces air emissions of VOCs. However, water or alkaline solutions may not be suitable for use in organic solvent-borne paints.

Equipment cleaning wastes can also be reduced by cleaning equipment less frequently. Batch production runs can be scheduled to maximize the length of a single production run or to manufacture compatible batches (e.g., light to dark) that do not require thorough cleaning between production runs. Cleaning frequency can also be reduced by dedicating equipment lines to the production of a single type of paint, which allows equipment to be cleaned occasionally rather than after each batch (USEPA, 1990a).

The quantity of solution required for each cleaning can be reduced by minimizing the amount of dried paint residue on equipment. If possible, equipment should be cleaned before paint dries. Plastic or foam “pigs” can be used to clean pipes. Manual or automatic scrapers can be used to remove paint from the sides of tanks, reducing the amount of residual dried paint on tank walls. Using scrapers or pigs also reduces the loss of paint product (USEPA, 1990a). Improved operating practices also ensure that only the minimum amount of cleaning solution required is used. For some applications, liquid displacers have been used inside filter housings to reduce the volume of material inside the housing. This reduces the waste generated each time the filter housings are drained to change products or filters (Waste Advantage, Inc., 1988).

The amount of equipment cleaning waste for disposal can be reduced by recycling. Cleaning solutions can be reused if paint sludge is removed. Spent cleaning solvents can be recovered. For some applications, the waste can be used as an input in the next compatible batch of paint; however, such reuse may reduce product quality. One paint manufacturer reduced waste cleaning solvent generation from 25,000 gallons to just 400 gallons by scheduling compatible paint batches and segregating and reusing cleaning solvents (Lorton, 1988).

2.3.4 Reduce or Recover Off-Spec and Returned Paints

Off-spec and returned paints reduce plant productivity and represent unproductive uses of resources. Such paint waste can be reduced (and productivity can be improved) by improving quality controls, operating procedures, and employee training. Automating manufacturing processes can also reduce off-spec paint. Improved inventory controls and marketing practices can reduce returned paints. For example, obsolete paints can be marketed for alternative uses at reduced costs. Often off-spec and returned paints can be blended into new paint batches. Careful quality control is required to ensure that reblending does not reduce product quality (USEPA, 1990a).

2.3.5 Reduce Waste from Spills

Improving operating practices to reduce the amount of spilled material is the best way to reduce waste from spills. Installing better overflow controls and training employees in handling materials are two ways to reduce spills. When spills do occur, spilled materials should be collected and reintroduced into the manufacturing process (USEPA, 1990a). However, reintroducing spilled material may reduce product quality.

2.3.6 Reduce Package Waste

Raw material packaging can be minimized by buying raw materials in bulk. However, tight inventory controls must be put in place to ensure that waste isn’t generated from expiration of materials, contamination, or spills. Container waste can be reduced by using water-soluble packages that can be blended into water-borne products; however, this may affect product quality. Finally, raw material packages can be cleaned and returned to the vendor for reuse or sent to a metals recycler (USEPA, 1990a).

2.3.7 Reduce Filter Wastes

Cartridge filters must be periodically replaced, so used filters are disposed of as waste. Filter waste can be reduced by using screen or bag filters that can be cleaned and reused; however, waste is generated from the cleaning operation. Improving pigment dispersion during grinding operations reduces the frequency of changing the filter (USEPA, 1990a).

2.3.8 Quality Control

Another method that may find some application in waste reduction is the use of statistical process/quality control procedures. Generally, these procedures consist of regression-based control charts for different process variables, but the simple act of recording and plotting data without regression analysis can also be useful. Such procedures could help in reducing production of off-specification paints and may even identify some overlooked methods for reducing waste.

For example, one Glidden plant formed a quality team to identify methods to reduce the amount of wastewater entering the plant water treatment facility (Schrantz, 1990). The team examined each wastewater source and measured the amount coming from each. They observed tank cleaning operations and identified the most effective cleaning methods. The team drafted a set of washdown procedures and produced a training video. All washdown operators participated in making the video. The end result was a one-third reduction in the amount of water entering the waste treatment facility.

If paint manufacturers regularly gathered and analyzed data related to waste generation, similar savings might occur. For example, examination of data from one manufacturer of product coatings indicated that, on **a** monthly basis, organic solvent waste equaled about 5 percent of monthly production. During some months, however, organic solvent waste was only 3 percent of monthly production, nearly a 50 percent reduction, even though the amount of organic solvent-borne paint produced was greater. One possible reason for the reduction could have been production of paint in larger batch sizes, reducing the amount of tank cleaning performed per gallon produced. Identifying this and other possible causes for the significant decrease in solvent waste generation in certain months could be used as a starting point in developing ways to reduce solvent wastes.

CHAPTER 3

PAINT APPLICATION

3.1 PROCESS DESCRIPTION

Paint and other surface coatings are used to provide decoration and protection to a product. Generally, the type of paint and the application method are critical to the performance of the coating. The general steps for paint application include

- surface preparation,
- paint application, and
- curing or drying.

In addition, cleaning the equipment used in each of these steps generates waste. Figure 3-l shows the general steps in paint application processes, the materials used, and the wastes generated.

3.1.1 Surface Preparation

Surface preparation improves the bond between the coating material and the surface. Preparation can include removing old paint as well as contaminants and oils. Chapter 4 provides a description of paint removal processes. The types of surface preparation used vary depending on the material to be painted, the paint to be used, and the desired properties of the resulting finish.

Surface preparation of wood depends in part on the type of wood and its intended use. Preparation methods include sanding and applying fillers, sealers, preservatives, and primers.

Methods for surface preparation of metals are extensive. The first step can be a cleaning operation to remove any mill scale and/or rust on the metal surface. This is accomplished using blast cleaning with abrasives, flame cleaning, or acid pickling. Metals that have oil or grease on their surface are cleaned by solvent wiping or vapor degreasing. Solvents used include trichloroethylene, perchloroethylene, and 1, 1, 1 trichloroethane. Oils and grease can also be removed using alkaline degreasing solutions such as sodium hydroxide, sodium carbonate, sodium phosphate, sodium metasilicate, and borax. Alkali degreasing agents must be completely removed prior to painting, which often requires several rinses. Following cleaning, a conversion coating may be applied to metal surfaces using a phosphating process. In the phosphating process the metal surface is treated with a dilute solution of phosphoric acid. The phosphate process results in a microcrystalline layer that improves the surface for paint application, providing better adhesion and some corrosion protection.

Plastics to be painted may be roughened with mildly abrasive media, in some cases plastic shot. Vapor degreasing may also be used to prepare plastic surfaces for paint. For some plastics, the surface may be oxidized using ultraviolet light activated chemicals, corona discharge, or acid pre-soaks (Roobol, 1990).

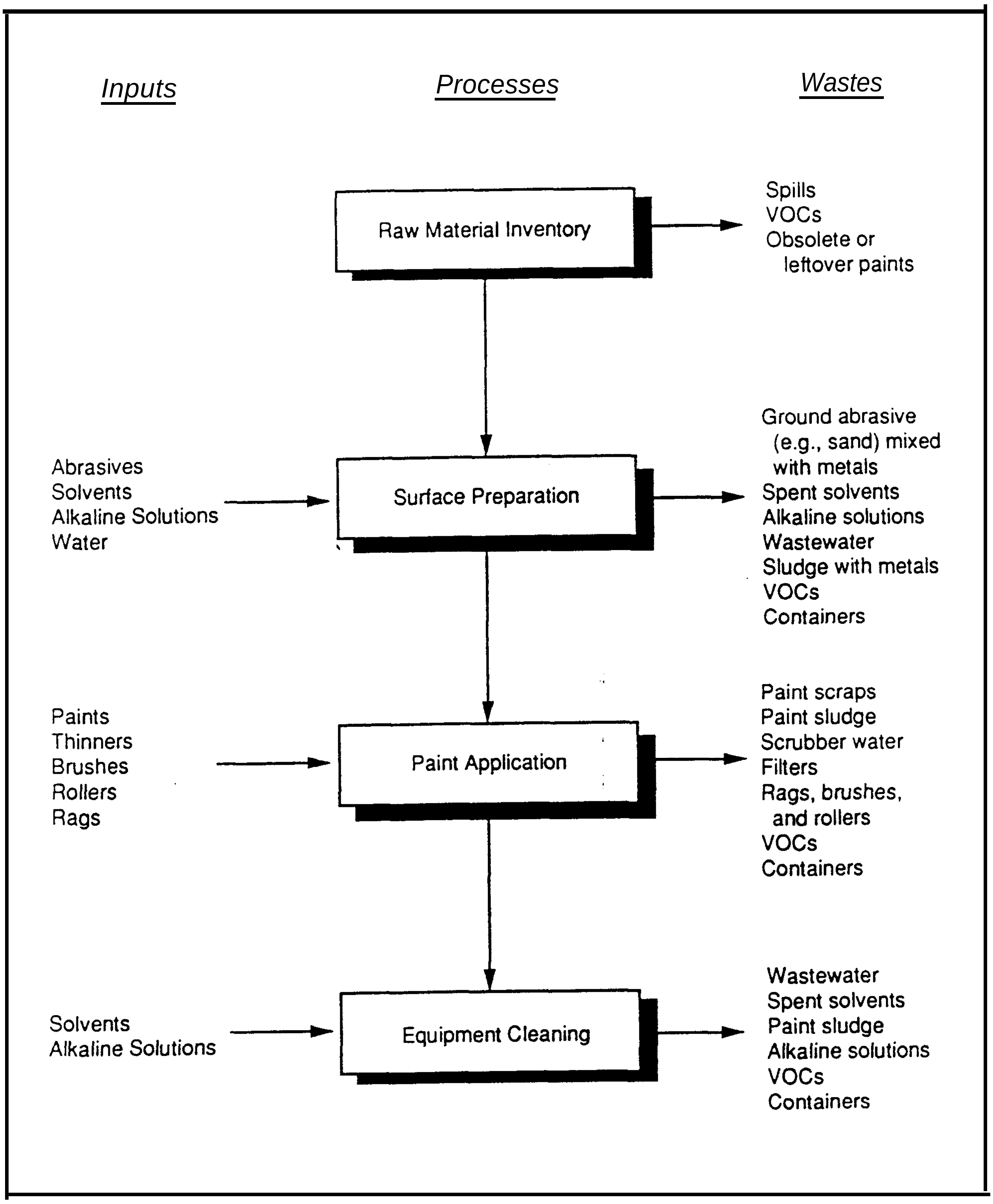

Figure 3-1. Paint Application Process and Waste Generation

3.1.2 Paint Application

Which paint application process is used depends on the type of surface to be coated, the type of coating, and the size and shape of the surface. Most household painting is done using brushes and rollers, with a small amount of spray application. Auto body shop painting is almost exclusively done using spray equipment, either conventional pressure spray or newer, high-volume. low-pressure spray equipment. For paints used as product coatings, the importance of a high-quality, durable finish demands tailoring of both the coating and the application technology. Table 3-l describes various paint application processes and gives examples of the types of surfaces for which the processes are applicable (Higgins, 1989; Morgans, 1990; and Peterson and Young, 1989).

The transfer efficiency is an important aspect of a paint application technology from the standpoint of waste generation. Transfer efficiency is the amount of paint applied to the object being painted, divided by the amount of paint used. Transfer efficiencies for a given type of paint formulation vary with the type of equipment used, the skill of the operator, and the object being painted. Transfer efficiencies can range from 15 to 99 percent. Table 3-2 gives typical transfer efficiencies for industrial paint application processes. Efficiencies of brushes and rollers used in residential painting are estimated to be 95 percent.

3.1.3 Curing

Once the paint material is applied to the surface, a curing process takes place that converts the fluid or resinous paint binder into a hard, tough, and adherent film. What occurs when a paint dries or cures depends on whether it is made of a convertible or nonconvertible binder. If the binder is convertible, some form of chemical reaction occurs during curing, converting the paint to a solid film that is no longer soluble in its original solvent component. Paints made with nonconvertible binders do not undergo chemical reaction upon curing. As they dry, only the loss of solvent through evaporation takes place. The resulting films remain soluble in the original solvent component.

For paints with convertible binders, curing can take place through ambient temperature oxidation (as in most enamel and organic solvent-borne paints), through chemical reactions with another component (as in two-pack systems such as epoxy and polyurethanes), and by baking. Additional curing mechanisms include infrared radiation ultraviolet radiation, and irradiation using electron beams. Infrared curing is used for automobile finishes, industrial vehicles, and electric motors. Ultraviolet curing is frequently used for wood and metal finishing. Ultraviolet curing offers advantages from a waste reduction standpoint because little VOC is used in paints made for ultraviolet curing. However, ultraviolet curing equipment is costly and can pose problems for worker safety.

Paints that cure by a mechanism whose initiation can be controlled, such as radiation or baking, offer an advantage in terms of waste reduction because any overspray does not cure and thus is more readily recycled. Powder paints in particular make use of this advantage; because they cure by baking, almost all powder overspray can be captured and reused. These techniques are not applicable to residential paint use.

Table 3-1. Paint Application Processes

Process	Description	Applications	Wastes Generated
Brush	Manual application of slow-drying solvent or water-borne paints.	Small-scale application (used by homeowners)	Solvent and paint solids from cleaning brush
Hand roller	Manual application using roller saturated with paint from a shallow tray.	Large, flat areas (e.g., walls) (used by homeowners)	Solvent from cleaning paint roller, trays
Dip coating	Objects are immersed in tank filled with paint.	Car and tractor parts, tools, electrical components	Cleaning waste when paint in dipping tank is changed
Flow coating	Paint flows over the objects or is directed at objects from nozzles.	Large objects, or objects of intricate shape	Equipment cleaning waste when paint is changed
Cumin coating	Panels are carried by conveyor through a curtain of paint dispensed from nozzles or slit pipe.	Large, flat panels of wood or hardboard	Equipment cleaning waste when paint is changed
Direct roller coating	Sheets are fed through roller that applies the paint	Sheet materials, e.g., strip metal and boards; used to decorate cans and other metal objects	Equipment cleaning waste when paint is changed
coil coating	Coiled metal strip is uncoiled pretreated, roller coated with paint, cured, then recoiled.	Coiled metal strips	Equipment cleaning waste when paint is changed
Tumbling or barrel coating	Objects and paint are placed in a barrel and tumbled to coat uniformly.	Large numbers of small, irregularly shaped objects (e.g., screws, clips)	Equipment cleaning waste when paint is changed
Centrifuging	Objects are placed in a wire basket dipped in paint, then centrifuged to remove surplus paint	Small objects that would be damaged in tumbling (e.g., jewelry)	Equipment cleaning waste
Spray application	Object is sprayed with atomized paint; paint is atomized using compressed air or hydraulic pressure.	Industrial commercial products, military equipment, etc. May be used by homeowners or painting contractors.	Paint overspray; scrubber water, filters, and paint sludge from air pollution control; and equipment cleaning waste
Silk-screen coating	Stencil is applied to silk or mesh screen is placed on the object; paint is then applied with a squeegee.	Used when sharp definition is required (e.g., to apply lettering or decoration)	Equipment cleaning waste

CONTINUED

Table 3-1. Paint Application Processes (continued)

Process	Description	Applications	Wastes Generated
Electro-deposition	Object is submerged in an aqueous bath: ionized organic material is deposited through the action of an impressed direct current.	Metallic or other electrically conductive objects (e.g., auto-body coating)	Equipment cleaning waste
Fluidized bed powder coating	Object is heated above the melting point of the resin and then dipped in the fluidized bed of dry powder.	Metallic or other objects that can withstand high temperatures	
Electrostatic spraying powder coating	Powder is deposited using electrostatic spraying, then cured in ovens.	Objects that can withstand high temperatures	Powder overspray that is collected and reused
Flame spraying powder coating	Powder sprayed through a gun is melted in a high-temperature flame.	Large objects that wouldn't fit in conventional curing ovens	Overspray forms hardened paint waste
Plasma powder coating	Dry powder is fed into an extremely hot gas stream and sprayed at the object.	Large objects that wouldn't fit in conventional curing oven	Overspray forms hardened paint waste

Sources: Higgins, 1989; Morgans, 1990; Peterson and Young, 1989.

Table 3-2. Estimated Transfer Efficiencies For Various Painting Technologies

Application Technology	Transfer Efficiency (percentage)[a]
Brushes and Rollers	80 - 95
Air Atomized, Conventional	30 - 60
Air Atomized, Electrostatic	68 - 87
Pressure Atomized, Conventional	40 - 70
Pressure Atomized, Electrostatic	85 - 90
Centrifugally Atomized, Electrostatic	85 - 95
Dip, Flow, and Curtain Coating	75 - 90
Roll Coating	90 - 98
Electrocoating	90 - 99
Powder Coating	50 - 99

[a]Transfer efficiency equals the amount of paint applied to the surface divided by total amount of paint used.

Sources: Gardon and Prane, 1973; Brewer, 1980.

3.2 WASTE GENERATION

Wastes generated from industrial paint application processes may be considered hazardous because of the presence of toxic metals and organic solvents. Wastes generated during industrial paint application include the following:

- scrubber water, paint sludge, and filters from air pollution control:
- equipment cleaning wastes;
- aqueous waste and spent solvents from surface pretreatment;
- VOC emissions during paint application, curing, and drying;
- empty raw material containers; and
- obsolete or unwanted paint.

In addition, residential paint use generates waste from equipment cleaning, VOC emissions, empty containers, and leftover paint.

Paint transfer inefficiency can be the largest source of waste from paint application processes. Paint used but not applied to the surface being coated (e.g., paint overspray) generally becomes waste. Paint-laden air from overspray is often filtered through a water scrubber that removes the paint from the air. The scrubber water is generally recycled, and the paint sludge is disposed of, often as a hazardous waste (Higgins, 1989).

Evaporation of organic solvents is another important source of waste. The entire solvent component of organic solvent-borne paints eventually evaporates. In addition, organic solvents used to thin paint, to clean equipment, and to prepare surfaces for coating are sources of air pollution. The USEPA and some states have regulated emissions of VOCs from paint coatings, and further reductions will be required in the future under the amended federal Clean Air Act (see Section 1.5.1). These restrictions will have an impact on the amounts and types of solvents used in coatings and those used for cleaning.

Equipment cleaning is a third major source of waste generation from paint application. Generally, all paint application equipment must be cleaned after each use to prevent dry paint residue and avoid contaminating batch processes. In addition, brushes and rollers can be cleaned after each use to remain pliable. Wastes generated include spent organic solvents, aqueous cleaners, wastewater, and paint sludge. (Alternatively, airtight containers are used to store rollers so that cleaning isn't required). Generally, solvent-based paints require organic solvents for clean-up. Less toxic cleaning solutions can be used to clean up water-borne paints. The resultant wastes are also less toxic (Higgins, 1989).

3.3 WASTE REDUCTION

Techniques to reduce the quantity and toxicity of waste generated from paint application are described below. Table 3-3 summarizes this discussion.

Table 3-3. Waste Reduction Techniques for Paint Application

Technique	Description	Effects	Caveats
Use alternative paint	Substitute water-borne, powdered, or high-solids paints for solvent-based paints. Use paints that have less toxic pigments.	Reduces the toxicity of paint sludge and paint scraps. Powdered paints eliminate scrubber water and paint sludges from overspray. Reduces need for organic solvents for cleaning or paint thinning. Reduces VOC emissions.	Substitute paints must meet quality specifications. Powdered and high-solids paints require new or modified application processes that generally aren't available for homeowners or small businesses.
Reduce quantity of solution used for surface preparation.	Reduce solvent evaporation by installing tank lids, increasing freeboard space, and installing freeboard chillers. Extend life of cleaning solution by removing solids and adding components to increase efficacy, when needed. Redesign rinsing system to reduce rinsewater usage (e.g., use water sprays, reduce drag out).	Reduces quantity of spent solvents, aqueous solutions, and rinsewater from surface preparation. Reduces use of raw materials.	
Reduce toxicity of solutions used for surface preparation.	Use physical or mechanical methods. Use less toxic solvents or aqueous solutions.	Reduces toxicity of surface preparation wastes. Reduces VOC emissions.	
Recycle surface preparation wastes.	Recover and reuse spent solvents. Reuse nonhalogenated solvents as fuel. Recover metals from surface preparation **solutions.**	Reduces the quantity of surface cleaning wastes.	
Increase transfer efficiency.	Use electrostatic spraying to increase transfer efficiency. use flow coating, roller coating, or electrodeposition to increase transfer efficiency. Improve operating practices.	Reduces paint loss due to overspray. Reduces paint sludge, scrubber water, and spent filters from air pollution control.	Electrostatic spraying and electrodeposition require electrically conductive surface. Applicability of coating processes depends on shape of surface. Electrodeposition requires water-borne paints. High investment costs.

CONTINUED

Table 3-3. Waste Reduction Techniques for Paint Application (continued)

Technique	Description	Effects	Caveats
Reduce equipment cleaning frequency.	Revise schedules to reduce switching paints. Use dedicated equipment use proportional mixing.	Reduces the quantity of equipment cleaning waste. If solvents are used reduces VOC emissions.	Changes in scheduling or equipment usage may not be feasible.
Substitute cleaning materials.	Use less toxic solvents or high-pressure alkaline solutions.	Reduces toxicity of cleaning wastes. Reduces VOC emissions.	May require longer cleaning time. High pressure requires new or modified equipment.
Recycle cleaning solution.	Remove paint sludge and reuse cleaning solution. Recover and reuse spent solvents. Reuse nonhalogenated solvents as fuel.	Reduces quantity of equipment cleaning waste.	Test reused cleaning solutions to determine effectiveness; may need to add virgin materials to maintain the strength of the cleaning solution.
Reduce wastes from air pollution control.	Improve transfer efficiency. Switch from wet to dry paint booth. Use screen or bagfilters that can be cleaned and reused. Reuse scrubber water. Reuse paint sludge as a filler material or as fuel.	Reduces the quantity of waste from air pollution control.	Improving transfer efficiency and installing dry paint booths require capital investments. Reuse of paint sludge in coating formulation depends on quality specifications.
Reduce old or unwanted paints.	Implement inventory controls.' Find a user through a "drop and swap" or waste exchange. Reuse the paint as fuel Return paints to the manufacturer for reblending.	Reduces quantity of paint waste Reduces loss of raw materials.	"Drop and swap" programs aren't widely available and are generally for household paints only Returning paints for reblending depends or manufacturer's requirements.
Reduce raw material containers.	Buy bulk quantities. Reuse containers. Recover metals from **containers.**	Reduces quantity of container waste.	Bulk quantities may contribute to old or unwanted paint waste.

3.3.1 Substitute or Reformulate Raw Materials

The hazardous and toxic characteristics of waste from paint application result in part from the toxicity of the paint used. Using paints formulated with less toxic materials reduces the hazard of the waste generated. Substituting water-borne, powdered, or high-solids paints for conventional organic solvent-borne paints reduces the need for organic solvents for cleaning equipment or thinning paints, and they reduce VOC emissions. A metal furniture manufacturing company reportedly eliminated all VOC emissions by switching from organic solvent-borne to powdered paint (Kohl, 1984). In addition, powdered paints eliminate the generation of scrubber water, paint sludges, and dry filter waste from overspray capture devices.

The use of substitute paints is limited by coating quality specifications and the type of surface to be coated. For example, powdered coatings are only applicable for surfaces that can withstand high temperatures. In addition, powdered and high-solids paints may require new or modified equipment.

3.3.2 Reduce Quantity and Toxicity of Surface Preparation Wastes

Wastes from surface preparation include spent solvents, rinsewaters, contaminated aqueous solutions, and spent abrasive materials. Waste reduction techniques for wastes from surface preparation include reducing the amount of cleaning solution used, substituting less hazardous cleaning solutions, and reusing and recycling the cleaning waste.

To reduce the amount of cleaning solution used in surface preparation, solids and accumulated sludge should be removed from cleaning baths to extend the life of the bath. In addition, solvent cleaning solutions can be conserved by reducing loss due to evaporation. Techniques to reduce evaporation include installing tank lids, increasing freeboard space, installing freeboard chillers or refrigerated coils, and reducing drag out. Rinsewaters can be conserved by reducing drag out and by installing water spray systems that use small amounts of water. Finally, physical and mechanical methods, such as blasting or sanding, can prepare metal surfaces for paint application. These methods produce smaller quantities of dry waste and can eliminate the need for some cleaning solutions.

Organic solvents used to clean surfaces prior to painting emit VOCs that contribute to atmospheric ozone. Replacing these with alkaline solutions or mechanical abrasive techniques eliminates this sources of VOC emissions. The hazard of using abrasives such as sand or stone, which generate a fine silt mixed with metals, can be reduced by using synthetic abrasives that are more durable.

Finally, wastes from surface preparation can be recycled. As mentioned above, solutions can be progressively mused by removing accumulated sludges or oils. This technique is applicable for both industry and households. Metals removed from treatment solutions can be reused. For example, ferrous salts removed from pickling bath solutions can be sold to ink, dye, and pigment manufacturers. Organic solvents can be recovered for reuse. Nonhalogenated spent solvents can be burned as fuel.

3.3.3 Increase Paint Transfer Efficiency

In conventional spray painting operations, large quantities of waste are generated from paint overspray and rebound, including paint sludge, scrubber water, and filters. Wastes from paint application can be reduced by increasing the transfer efficiency of paint application processes. For example, electrostatic spraying and electrodeposition in immersion can increase transfer efficiency over conventional spray application. However, both electrodeposition and electrostatic spraying require electrically conductive surfaces for application. Direct application methods such as roller coating and flow coating also increase paint transfer efficiency. The applicability of these techniques, however, depends on the shape of the surface being coated.

Even greater improvements may be possible by more major changes in application technique such as going from a conventional spray system to an electrocoat or powder coating system. Other options include changing to a powder coating system or to a paint formulation that remains fluid indefinitely unless subject to heat or other curing mechanisms. A paint booth system by Grace Robotics Incorporated (1990) is designed to work with liquid high-solids bake coatings. The spray booth captures overspray and recycles it to the spray system; the manufacturer claims paint utilization of up to 99 percent.

The waste reduction techniques described above require changes in paint application processes and therefore require capital investment. Improvements in operating practices for existing spraying processes can also improve transfer efficiency, although they are not as effective as process changes. Proper adjustment and regular cleaning of spray guns ensure optimum spraying results. Improved operator training may also enhance the efficiency of existing application processes.

3.3.4 Reduce Equipment Cleaning Waste

Generally, paint application equipment is cleaned prior to applying different types or colors of paint. Reducing cleaning frequency by revising production schedules to consolidate production runs or dedicating application equipment to a single type of paint can reduce equipment cleaning waste. The quantity of cleaning waste is also reduced by utilizing proportional mixing of paints at the point of paint application; this eliminates the need to clean paint mixing tanks. The toxicity of equipment cleaning wastes can be reduced by replacing organic solvents with less toxic or nontoxic solutions. A longer cleaning time may be required when using less toxic solvents.

Wastes from clean-up can be reduced through more effective cleaning methods such as pressure spraying, using heated fluids in place of organic solvents, and using mechanical means such as scraping or wiping instead of just rinsing. More advanced systems such as agitated solvent rinse tanks or use of ultrasonics are possible. Replacing solvent usage with high-pressure alkaline solutions reduces the release of VOCs from cleaning equipment; however, this requires installing new equipment.

Equipment cleaning wastes can be recycled. Cleaning solutions should be reused until they are no longer effective. Sludges can be removed and additives introduced to extend the life of cleaning solutions. Spent cleaning solvents can be recovered for reuse, and spent nonhalogenated solvents can be reused as fuel. One medium-sized body shop reduced its waste disposal by 40 percent by recycling spent cleaning solvents onsite (Peterson and Young, 1989).

3.3.5 Reduce Wastes from Air Pollution Control

Using air pollution control devices designed to capture paint overspray generates large quantities of waste. Improving the transfer efficiency of paint application processes reduces or eliminates this source of waste. Section 3.3.3 describes techniques to improve transfer efficiency. Switching from a wet to a dry paint booth may reduce the volume of waste generated. Dry paint booths use filters rather than water scrubbers to remove paint from the air and eliminate the generation of scrubber wastewater. However, dry paint booths generate waste filters and paint solids that must be landfilled, while wastes from wet paint booths can be recycled. A life cycle assessment is required to determine the "best" method.

3.3.6 Reduce Obsolete or Unwanted Paints

In addition to generating a hazardous waste, unused paints represent an unproductive use of materials. Better inventory controls to reduce the generation of this waste paint include purchasing only the amount of paint required, using the oldest paints in an inventory first (first in, first out), and standardizing paint types and colors to minimize the number of different types of paint in inventory.

Leftover paint waste is often generated from household painting. This problem can be reduced by education to improve skills in estimating the surface area to be painted. Also, some changes in sales policies for residential paint could be helpful. In an informal conversation with a large manufacturer of architectural paint for home owners, it was proposed that consumers should be able to purchase quart containers of paint without paying a price premium. To qualify, the consumer would have to purchase a minimum quantity of paint. The reaction to this suggestion was that it might be possible as long as the consumer could not return unopened containers for credit. Even with this restriction, such a program could reduce household paint waste.

If unused paint wastes are generated, finding another user for the paint is one method of reducing waste generation. For household paint use, leftover paints could be taken to a "drop and swap" for exchange or donated to a community group. Drop and swap programs are not currently available in Illinois. Paints could also be returned to the paint manufacturer for reblending or reused onsite for an application with less stringent specifications. Organic solvents can be recovered from organic solvent-borne paints and reused. Finally, unused paints can be reused as fuel if their concentrations of heavy metals and PCBs are within regulatory limits, although waste reduction is preferred to this reuse.

3.3.7 Reduce Container Waste

Containers that held toxic or hazardous raw materials must often be disposed of as hazardous waste. Container waste can be reduced by buying materials in bulk quantities. However, bulk quantities can contribute to old or unwanted paint waste. Another way to reduce container waste is recycling. Empty paint containers are recyclable. Containers can be cleaned and returned to the vendor for reuse. Metals can be recovered from metallic containers.

CHAPTER 4

PAINT REMOVAL

For some architectural and industrial uses of paint, paint removal is required to inspect, repair, or repaint coated surfaces. Examples include scraping loose paint on a house prior to repainting, removing paint from commercial airplanes prior to inspection. and removing old coats of lead-containing paints because of human health and environmental risks.

4.1 CONVENTIONAL PAINT REMOVAL PROCESSES

Conventional paint removal techniques include manual scraping, sanding, sand blasting, and solvent stripping. Manual scraping and sanding are labor intensive and therefore their application is limited to small-scale paint removal. Both sand blasting and solvent stripping, although widely used, generate wastes that pose environmental and health risks. Extensive research has therefore been conducted to develop alternative paint removal processes that reduce these risks. Section 4.3 describes alternative processes that have been and are being developed.

Abrasive blasting, conventional sand blasting, and glass bead blasting have been used extensively to remove paint from metal surfaces. In the abrasive blasting process, the abrasive media (e.g., sand) is propelled against the painted surface by compressed air; the impact loosens the paint. Sand blasting is the most commonly used method of removing paint from heavy steel surfaces. It is commonly used to remove paint from the hulls of ships, from large storage tanks, from pipes used in the petroleum and chemical industries, and from the exterior walls of concrete and masonry buildings. Because sand blasting can damage soft surfaces, it is not applicable for removing paint from smooth wood or thin or delicate metal surfaces (Higgins, 1989). Figure 4-l illustrates the abrasive blasting process.

For softer surfaces not suitable for sand blasting, softer abrasive media such as rice hulls and walnut shells have been used with only limited success (Higgins, 1989). Although reasonably effective, these media are subject to bacterial growth during storage, which poses a health risk to workers.

Solvent stripping is most often used on soft surfaces not suitable for abrasive blasting, such as aluminum, plastic, or wood. In conventional solvent snipping processes, organic solvents or mixtures of organic solvents and other chemicals are applied to the painted surface to physically destroy the paint or the bond between the paint and the surface. Phenolic- or methylene chloride-based solvents are commonly used. The solvent can be applied directly to the surface, or the painted object can be dipped into a solvent bath. The solvent and dissolved paint are then removed using pressurized water or by scraping. Figure 4-2 describes the solvent stripping process.

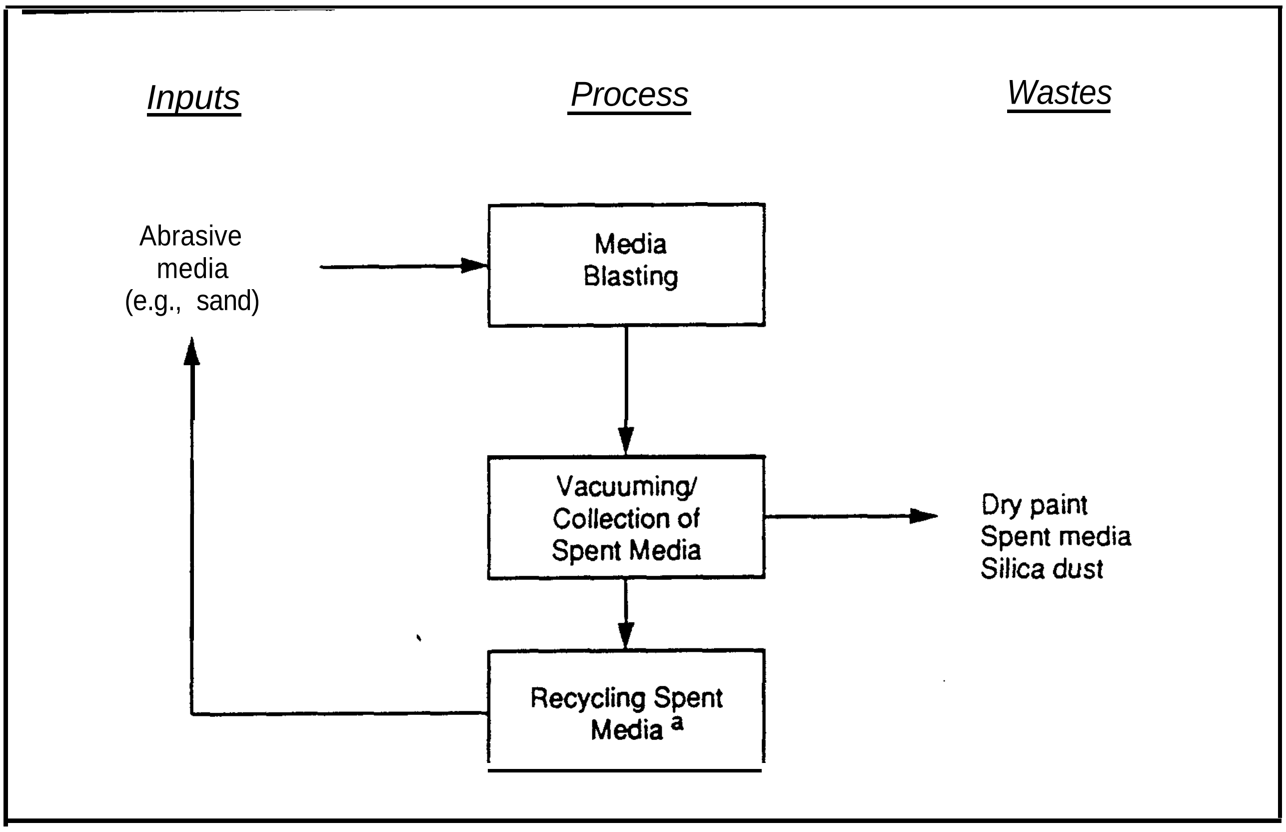

Figure 4-l. ‘Abrasive Blasting Process and Waste Generated

[a]Not applicable for all types of abrasive media

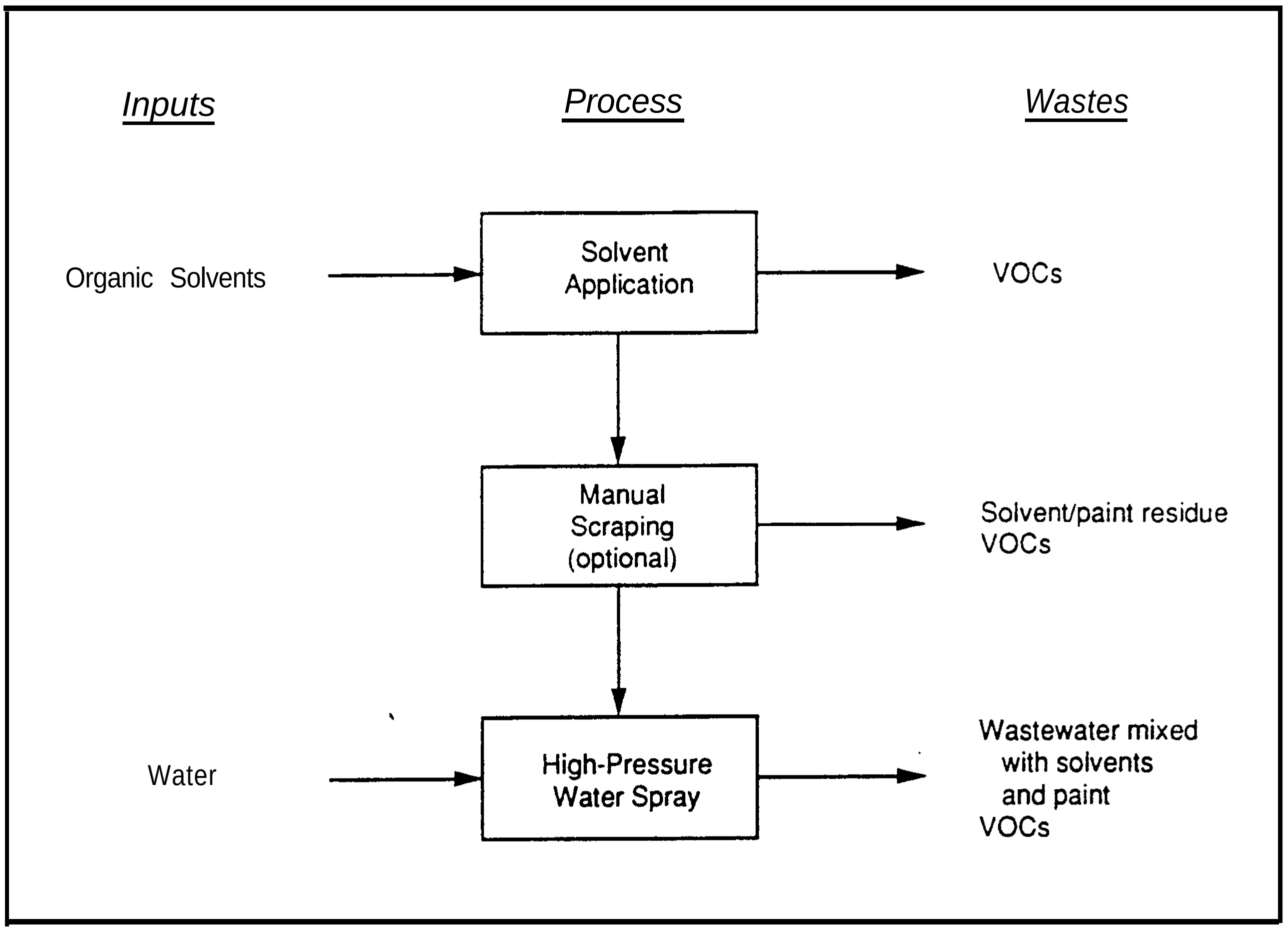

Figure 4-2. Solvent Stripping Process and Waste Generated

4.2 WASTE GENERATION

Both sand blasting and solvent stripping processes generate hazardous wastes. Wastes generated in solvent stripping include air emissions of VOCs and large volumes of wastewater containing the solvent/paint residues. The wastewater requires treatment to remove the solvent/paint residue prior to discharge.

The use of sand and other silica-containing materials in sand blasting processes has been associated with lung disease in workers. For some uses, slags from smeltering operations have been substituted for sand to eliminate this risk. Sand blasting also generates dry paint waste, which may contain heavy metals. The dry paint residue and the spent abrasive media (e.g., sand or slag) are generally hazardous and may be landfilled or incinerated.

Removing lead-containing paints poses particular waste generation problems. Abrasive blasting generates a tine lead dust that is highly toxic to workers. Environmental regulations require total containment of the area being blasted, which results in workers' exposure to very concentrated lead particles. Workers have experienced health problems including lead intoxication and elevated blood-lead levels (lead concentrations greater than 25 micrograms per deciliter of whole blood) (Janssen, 1990). In addition, the costs of containment, collection, treatment, and disposal of the resultant waste are three to five times the before-containment costs. These problems have led the Illinois Department of Transportation to suspend all paint removal from bridges until alternatives can be found.

4.3 WASTE REDUCTION

The following activities reduce the quantity or toxicity of waste generated from paint removal. Most of these activities require changes in waste removal processes. Such process changes often require large initial investments that may be unavailable for small firms. Table 4- 1 summarizes this discussion.

4.3.1 Rinsewater Reduction

Conventional solvent stripping processes generate large quantities of wastewater. The wastewater is generated from high-pressure water sprays used to remove the loosened paint and solvent from the surface and from cleaning the work area to remove solvent/paint residue. Water use can be reduced by manually scraping the dissolved paint from the surface and collecting the residue in plastic or metal troughs. This reduces the amount of water required to remove the paint and eliminates the need to rinse the floor. Some water is still required to remove any remaining solvent/paint residue from the surface, but less wastewater is generated. Manual scraping is labor intensive and may not be feasible for large surfaces.

Table 4-1. Waste Reduction Techniques for Paint Removal

Technique	Description	Effects	Caveats
Rinse water reduction.	Collect paint and solvent solution. Filter and reuse stripper solvent.	Reduces the quantity of wastewater from rinsing after solvent paint stripping. Reduces the quantity of virgin solvent used.	Collecting the paint/solvent solution is labor intensive. Recovered solvents may require additives.
Solvent substitution.	Immerse objects in molten salt or hot caustic bath instead of solvent bath.	Reduces VOC emissions.	High temperatures preclude use for some surfaces, including nonmetals. Caustic strippers are only applicable for removing caustic-sensitive paints from steel.
Abrasive media substitution.	Use plastic media or dry ice as abrasive media. Use high-pressure water sprays.	Eliminates use of sand and related health risks. Eliminates spent media waste (plastic media are recyclable and dry ice evaporates). Plastic media blasting can be substituted for solvent stripping, eliminating VOCs and spent solvent waste.	Dry ice generates CO_2 gas, which is a greenhouse gas and can affect worker health. Dry ice process requires large capital investment. Can damage the surface.
Substitute pulsed light for abrasive media.	Use lasers or flashlamps to heat and loosen paint.	Eliminates spent media waste.	Requires large capital investments. Reliability, effects on surfaces, and air pollutants released are uncertain and further research is necessary.

A second means of reducing the quantity and toxicity of wastewater is IO recover and reuse the spent solvents. Initial rests of solvent recovery by the Air Force showed some loss of solvent effectiveness (Higgins, 1989). Virgin materials could be added as needed to improve solvent effectiveness. Solvent collection requires large volumes of water or is labor intensive.

4.3.2 Solvent Substitution

To reduce VOC emissions, objects to be stripped can be immersed in molten salt or hot caustic baths rather than organic solvent baths. In each case, the heat destroys the paint. The molten salt bath cannot be used on aluminum, some alloys, and nonmetallics because of the high temperatures involved (900’ F). Salt baths are used in the automotive and appliance industries. The hot caustic bath operates at lower temperatures (200’ F) than the salt bath, but the process is only applicable for removing caustic-sensitive paints from steel surfaces because the caustic corrodes most other materials, including aluminum. Caustic baths are also currently used by industry (Higgins, 1989).

43.3 Abrasive Media Substitution

To reduce the risk of lung disease associated with the use of sand and other silica-containing materials, other blasting media such as steel slags have been substituted for sand. As mentioned above, walnut shells and rice hulls have been used as abrasive media. Though effective, bacterial growth in the media poses worker health risks.

Plastic media have been developed to be used with conventional blasting equipment. The plastic media can be separated from the dry paint waste and reused, reducing the generation of spent media waste. The plastic media can be specifically engineered for different surfaces. Plastic media blasting therefore can be used to remove paint from surfaces that would be damaged by conventional abrasive blasting. Plastic media blasting has been used to replace solvent stripping, eliminating the release of VOCs and the generation of spent solvent waste and wastewater from rinsing.

Plastic media blasting has been used successfully to remove a number of different types of coatings from different surfaces, resulting in significant savings in energy and labor (Higgins, 1989). However, using excessive air pressure in the blasting operation or holding the blast nozzle too close to the painted surface can damage the surface. Improved operating practices should reduce this damage. In addition, some surfaces (e.g., aluminum aircraft skin) have a tendency to work-harden as a result of plastic media blasting.

Sodium bicarbonate granules have also been used in abrasive blasting. Sodium bicarbonate is not hazardous and may provide coagulation benefits in wastewater treatment facilities.

Dry ice is another alternative blasting material to reduce silica waste generation. In the process, dry ice is propelled against the painted surface using conventional blasting equipment. Both the cold temperature of the dry ice and the abrasive force of blasting loosen the paint from the surface. The dry ice evaporates, leaving only the dry paint waste. The process does generate air emissions of carbon dioxide, which can affect worker health. Also, soft surfaces such as aluminum can be damaged by dry ice blasting.

4.3.4 Removal Process Substitution

Extensive research has been conducted to develop alternative paint removal processes that reduce waste generation. This section describes alternative processes that have been and are being developed.

Flashlamp stripping uses high-energy quartz lamps to heat the paint, loosening it from the surface. The process has been successful at removing paint from both composite and metallic surfaces without damaging the surfaces. It can also selectively strip the top coats of paint while leaving the primer undamaged (USAF, 1987). Flashlamp stripping has been found to be difficult to use and to have a high initial investment cost (Higgins, 1989).

Laser systems are similar to flashlamp stripping. A laser fired at a painted surface heats the paint, loosening it from the surface. Tests of laser systems have demonstrated that paint is completely removed from test surfaces. However, the technique is still in the experimental stages and many questions relating to reliability, effects on surfaces, effects on nearby electronic equipment, and air pollutants still need to be researched. In addition, laser systems require large capital outlays (Higgins, 1989). Finally, further research is needed to determine if additional safety procedures are required to protect workers and the public from laser/electro-optical dangers (Janssen, 1990).

High-pressure water-jet blasting is currently used to remove paint build-up from the floor gratings of paint booths. Its use in other applications is being considered. Questions about such applications include the reliability and control of the system, waste generation, potential damage to surfaces, worker safety, and the ability to remove a wide range of coatings (Higgins, 1989).

Cryogenic processes require spraying the surface with liquid nitrogen to lower the surface temperature to -100’ F and thereby loosen the paint. The paint is loosened because the coating and the surface contract at different rates because of the low temperatures. The loosened paint is then removed using plastic media blasting (Higgins, 1989). This process is useful for coatings that cannot be removed by plastic media blasting alone. It is only applicable for removing paint from relatively small surfaces.

CHAPTER 5
PAINT-RELATED ACTIVITIES IN ILLINOIS

5.1 INTRODUCTION

HWRIC conducted a literature review, mail survey, and site visits to determine

- the types of facilities generating paint-related waste in Illinois,
- the quantities and types of paint-related waste generated by Illinois facilities, and
- current waste reduction, management, and disposal practices for paint-related wastes in Illinois.

This chapter presents information on these paint-related activities in Illinois.

5.2 STUDY METHODOLOGY

HWRIC used the results of the literature review to identify data gaps and to structure the subsequent survey and site visits. The literature review identified little data on paint usage and associated waste generation. More detailed data were available for paint manufacturing activities, but detailed, current descriptions of waste reduction activities undertaken by paint manufacturers were not available. The mail survey and site visits were undertaken to fill in these data gaps. This section describes the methodology used to conduct the mail survey and site visits.

5.2.1 Survey Methodology

HWRIC conducted the voluntary mail survey, "Reducing and Managing Paint-Related Wastes" (Paint Survey), of Illinois paint manufacturers and paint users to obtain the following information:

- the quantities and types of multimedia waste generated due to paint-related activities,
- how paint-related wastes are currently managed,
- the extent of waste reduction activities for paint-related wastes, and
- waste reduction information sources used and information needed by Illinois facilities.

Because the survey was voluntary and conducted through the mail, it was determined that we would not obtain a response rate sufficient to support making estimates for the entire population of paint manufacturers and users in Illinois. Instead, the Paint Survey was designed to provide an indication of the types of paint-related waste generation, management, and reduction in Illinois. The results of the survey do indicate what waste reduction and waste management options are available to Illinois firms. They also indicate how Illinois firms get information on waste reduction and what types of information they need. These data have been used to develop a proposed education and communication program in Illinois.

In addition, respondents to the Paint Survey were invited to provide any comments relevant to HWRIC's study. Comments received have been incorporated into this report. All survey responses and comments are confidential; therefore, the identities of survey respondents are not included in this report. Appendix A includes copies of the Paint Survey questionnaires.

The Paint Survey sample included industries in the survey that were expected to

- use or manufacture paint,
- have relatively small firms based on the numbers of employees, and
- represent a variety of paint-related activities.

Table 5-l lists the industries included in the survey and the estimated number of facilities in Illinois for each industry. Within each industry shown, HWRIC randomly selected facilities to receive the Paint Survey. Because Illinois House Bill 1356 specifically referred to painting contractors and auto body shops, the survey was sent to a larger number of these industries. Table 5-1 shows the number of facilities in each industry that received a survey.

Table 5-l also shows the number of facilities responding to the Paint Survey in each industry. Approximately 16 percent of facilities surveyed responded. One-third of the respondents indicated that they did not manufacture or use paint. These facilities fall into three groups:

- facilities in Paint and Related Coatings Manufacturing industry (Standard Industrial Classification [SIC] code 2851) that manufactured sealants rather than paints

- automobile mechanics that do not do any body work (e.g., painting) and were incorrectly included in Auto Body Repair (SIC 7532), and

- manufacturers who do not use any paint but who HWRIC suspected painted their products as part of their manufacturing operations. Many of these facilities contract out their painting work.

Response rates to the Paint Survey ate not sufficient to make statistically accurate estimates of data for all Illinois paint manufacturers or users. In addition, a large percentage of facilities that did respond were unable to quantify some or all of the waste they generated GeneraIly, these are conditionally exempt small quantity generators, which are exempt from federal or state regulations that would require them to measure the quantity of waste generated. Nonetheless, the survey responses do provide an indication of some of the types of waste generation and waste reduction activities conducted by Illinois facilities and the information Illinois facilities have available on waste reduction opportunities.

Table 5-l. Number of Facilities Surveyed and Responding

SIC	Description	Illinois Facilities[a]	Facilities Surveyed	Facilities Responding	
				Paint	No Paint
1721	Painting and paper hanging	2,315	150	17	0
2434	Wood kitchen cabinets	218	15	1	0
2499	Wood products, n.e.c.[b]	118	15	1	4
2511	Wood household furniture	111	15	1	1
2514	Metal household furniture	20	5	0	0
2851	Paint manufacturing	114	35	6	6
3411	Metal cans	21	5	1	1
3412	Metal shipping barrels and	22	5	2	0
3442	Metal doors, sash, and trim	86	5	0	1
3444	Sheet metal work	306	20	1	4
3469	Metal stampings, n.e.c.[b]	139	20	1	3
3479	Metal coating, engraving (coil coaters)	177	20	1	2
3499	Fabricated metal products, n.e.c.[b]	273	20	0	3
3523	Farm machinery and equipment	91	5	0	1
3531	Construction machinery	40	5	0	0
3564	Blowers and fans	61	3	1	0
3585	Air conditioning, heating equipment	39	2	0	0
3631	Household cooking equipment.	9	1	0	0
3632	Household refrigerators and	3	1	0	0
3633	Household laundry equipment	4	1	1	0
3635	Electric housewares and fans	29	1	0	0
3639	Household appliance manufacturers, n.e.c.[b]	2	1	0	0
3711	Motor vehicles and passenger car bodies	2	5	0	0
3713	Truck and bus bodies	27	5	0	0
3714	Motor vehicle parts and accessories	208	10	1	0
3743	Railroad equipment	35	5	0	1
7532	Auto body repair shops	3187	150	22	2
	Total	7,661	525	57	29

*Source: American Business Information, 1991

[b] n.e.c. = not elsewhere classified

5.2.2 Site Visit Methodology

We arranged each site visit through telephone contacts with the management of the candidate facility. If the facility indicated an interest in participating in the study, we sent a copy of the appropriate site visit questionnaire to the facility for review. Appendix B contains a copy of the questionnaire. After allowing time for the facility to review the questionnaire, we made a follow-up telephone contact to either set a date for the site visit or to eliminate the facility from further consideration.

In general, all site visits consisted of three phases. In the first phase we conducted an entry interview to discuss the objectives of the project, the overall information goals of the visit, and the nature of the site being visited. During this phase of the site visit, we requested permission to tape record the remainder of the interview. During this initial meeting, we discussed the paint manufacturing or paint use process occurring at the site in detail to insure a complete understanding prior to beginning the actual inspection of the process. The majority of the site visit questionnaire was also completed at this time. We identified items of information requiring lead time to acquire at the end of the inspection portion of the site visit. The duration of the entrance interviews varied from one to four hours depending on the nature of the site.

The second phase of each site visit consisted of the actual inspection of the paint use or manufacturing process. Regardless of the process type, the inspection followed the process from the receipt of raw materials through production activities, to the completion of the product (paint or finished article). We also examined storage tanks, containers, and packages of raw materials and/or paints to verify data gathered during the entrance interview. The inspection concentrated on identifying points of waste generation, quantities and types of waste generated, and methods of disposal, reuse, or recycling. In particular, we identified and inspected ultimate disposal points of liquid and solid wastes. During some of the site visits, we took photographs of the process to document the inspection. The duration of the inspection phase varied from about one to four hours depending on the process being inspected.

The third and final meeting of each site visit consisted of an exit interview. At this meeting we discussed the results of the inspection and completed any remaining items of the site visit questionnaire. We developed a summary of accomplishments and open questions at the close of the meeting and determined follow-up responsibilities. In several instances, we made additional telephone contacts following the site visit to clarify items from the questionnaire or the site inspection.

We selected candidate sites from among Illinois paint users, manufacturers, and paint waste processing facilities. Paint manufacturers visited included both large and small manufacturers of architectural (household) paints and product coatings. The paint users we visited also included both large and small facilities, including auto body shops, wood cabinet manufacturers, construction equipment manufacturers, container manufacturers, and “job shop” painting companies.

5.3 PAINT MANUFACTURING IN ILLINOIS

5.3.1 Description of Illinois Paint Manufacturers

Based on sales revenues, Illinois ranked among the top five states in paint manufacturing in 1987, accounting for between 10 and 12 percent of total revenues from paint manufacturing in the United States. On a dollar basis, the East North Central region of the United States (consisting of Ohio, Indiana, Illinois, Michigan, and Wisconsin) accounted for 31.8 percent of U.S. paint shipments in 1987 (Rauch, 1990). Direct data on the quantity of paint manufactured in Illinois could not be identified. Assuming a linear relationship between sales dollars and gallons manufactured, we estimate that in 1989 Illinois manufactured 130 million gallons of paint. This is based on a total production in the United States of 1,194 million gallons in 1989 (Department of Commerce, 1990).

Using sales revenues, 49 percent of the paints manufactured in Illinois in 1990 were architectural coatings, 39 percent were product coatings, and 12 percent were special purpose coatings (Rauch, 1990). A 1991 market study projected that of the paint manufactured in Illinois, 43 percent is water-borne, 54.3 percent is organic solvent-borne, and 2.7 percent is powder (Beels, 1990).

We identified specific Illinois paint manufacturers using the 1990 Illinois ***Manufacturers Directory*** (1990), ***the Thomas Register*** (1990), and ***the Paint Red Book*** (Palmer, 1990). These sources identified 114 manufacturers of paints and coatings in Illinois of which 90 are located in the Chicago area. Figure 5-l shows the number of employees for Illinois paint manufacturers based on the 59 Illinois companies listed in the ***Paint Red Book*** (about 50 percent of the paint manufacturers in Illinois). About 50 percent of Illinois manufacturers listed employ 50 or fewer people. Surprisingly, many of the smaller companies produce a wide range of paint types. **As an** example, the paint types listed in the ***Paint Red Book*** for a small, Illinois-based paint company that employs ten people, include the following:

- Alkyd
- Aluminum
- ceIlulose
- Chlorinated rubber
- Epoxy
- 0leoresinous
- Polyurethane
- Shellac
- Silicone
- Vinyl coatings
- Zinc chromate primer
- Water soluble
- Air dry enamel
- Lacquers
- High solids
- Waterborne systems

Table 5-2 shows the types of paint manufactured by Illinois facilities responding to the Paint Survey. Five of the six respondents manufactured organic solvent-borne paints. These five facilities manufacture product coatings, special purpose coatings, or both. The one respondent that does not manufacture organic solvent-borne paints makes only water-borne coatings for architectural use. None of the survey respondents manufacture powder coatings.

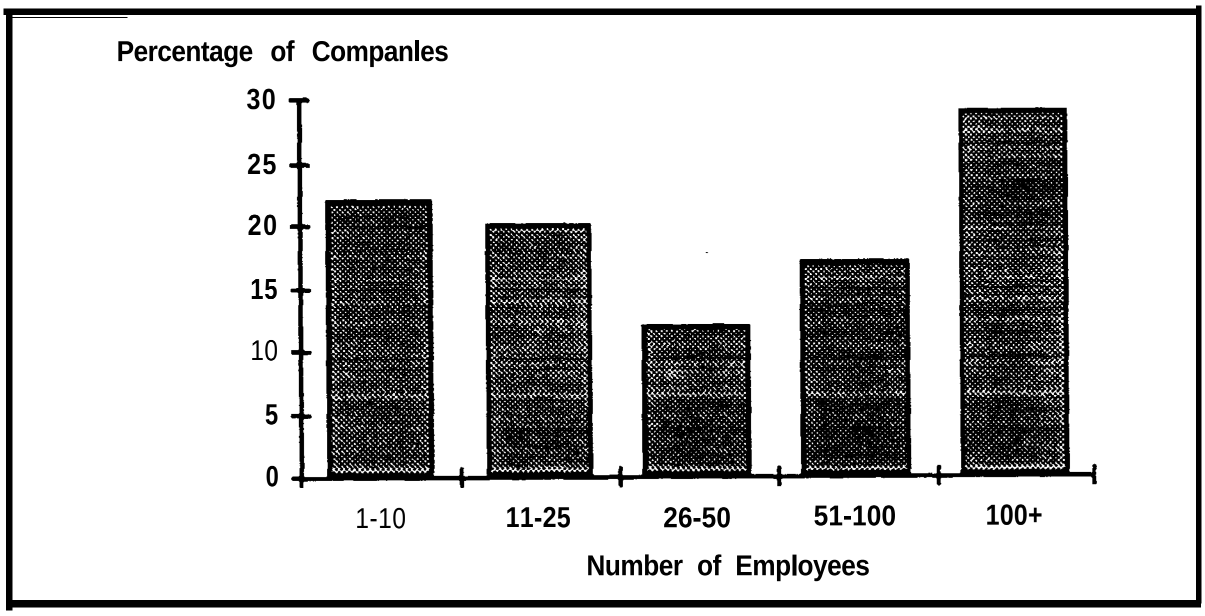

Figure 5-1. Size Distribution of Illinois Paint Manufacturer@

Source: Palmer, 1990.

[a]Includes only the 59 Illinois paint manufacturers listed in the *Paint Red Book (Palmer,* 1990).

Table 5-2. Types of Paint Manufactured by Paint Survey Respondents

Type of Coating	Number of Respondents
Organic solvent-borne coatings only	2
Water-borne coatings only	1
Both organic solvent- and water-borne coatings	3
Powder coatings	0
Total	6

5.3.2 Waste Generated by Illinois Paint Manufacturers

A major source of waste generation from paint manufacturing is equipment cleaning. Table 5-3 shows equipment cleaning methods used by paint manufacturers responding to the Paint Survey. In general, the quantity or toxicity of cleaning wastes can be minimized by using water or scraping to clean equipment or by reducing the number of times equipment is cleaned (e.g., not cleaning between every batch).

Table 5-3. Cleaning Techniques Used by Paint Manufacturers Responding to Paint Survey

		Number of Facilities by Type of Paint	
Equipment Cleaning Technique	**Total Number of Facilities**	**Organic Solvent Based Coatings**	**Water Based coatings**
Virgin organic solvents	2	2	1
Recovered organic solvents	3	3	1
Water	4	0	4
Manual or automatic scraping	1	1	1
Equipment not cleaned between batches	2	2	1
Total[a]	6	5	4

[a]Totals shown are without double-counting.

Table 5-4 shows preliminary estimates of the quantities of waste generated by Illinois paint manufacturers. These data were compiled from the Generator Survey (USEPA, 1990b) and TRI (USEPA, 1991c) data and from preliminary site visits with three Illinois paint manufacturers. Caution should be exercised in interpreting these rough estimates.

Table 5-4. Preliminary Estimates of Paint-Related Waste Generation and Management for Paint Manufacturers in Illinois

Waste Stream	Annual Quantity (Tons)	Reuse/ Recycle (Offsite)	Fuel Blending	Inciner-ation	Municipal Water Treatment	Municipal Landfill	Special Waste Landfill
Air-Emitted VOCs	786[a]	N/A	N/A	0%	N/A	N/A	N/A
Solvents	17,025[b]	50%	50%	0%	0%	0%	0%
Aqueous Waste	**9,102**[b]	**0%**[c]	**10%**[d]	**0%**	**90%**	**0%**	**0%**
Paint Sludge	**2,590**[b]	**0%**	**40%**	**20%**	**0%**	**0%**	**40%**
waste Paint	**2,335**[b]	**0%**	**40%**	**20%**	**0%**	**0%**	**40%**
Other	1,681[b]	N/I	N/I	N/I	N/I	N/I	N/I

N/A = not applicable.

N/I = no information available.

[a]This quantity is for manufacturers subject to reporting requirements under Section 313 of the Community Right-to-Know Act

[b]These quantities are for LQGs only. The quantity generated by non-LQGs **is estimated to be** relatively small.

[c]This material is often recycled/reused within a paint manufacturing facility. Waste quantities shown in this table reflect amounts that could not be internally reused or recycled.

[d]Some plants that manufacture primarily organic solvent-borne paints mix their aqueous and solvent wastes to result in a material that still has sufficient BTU content to be accepted by **a fuel** blender.

Note: The data in this table do not include solid wastes such as paint filters, paint cans, pigment bags, and similar materials that paint manufacturing plants may frequently dispose of in municipal landfills.

Source: USEPA, 1991c; USEPA, 1990b; site visits.

As an aid in interpreting the data, consider what takes place in three typical plants manufacturing paint in Illinois. First consider two plants making organic solvent-borne coatings. One plant collects the organic solvent used in cleaning operations and reclaims a portion (approximately 60 percent) onsite by distillation. The plant mixes the remaining solvent waste with paint waste solids (from various sources including air pollution control equipment) and with the small quantities of aqueous wastes that may be generated. This mixture is then sent to a fuel blender. The second plant collects the organic solvent used in cleaning operations and sends it to a solvent recycler. The recycler processes the solvent by distillation, which results in reclaimed solvent and paint sludge. The reclaimed solvent is sold back to the paint manufacturer and the paint sludge is disposed of in a landfill or by incineration. Both plants emit VOCs to the air through evaporation from storage tanks and the paint manufacturing process.

Second, consider a large plant making latex (a waterborne paint). This plant uses only small amounts of organic solvent and does not have a significant organic solvent waste stream. Its primary waste streams are solid wastes from pollution control equipment, spent filters, pigment bags, and aqueous wastes from equipment cleaning. The plant sends the waste from its air pollution control equipment along with the spent filters to a special waste landfill. Pigment bags are disposed of in the municipal landfill. The plant treats the aqueous waste stream onsite to result in two streams: an effluent that is sent to the municipal water treatment plant, and paint sludge that is sent to a waste hauler. The waste hauler dewaters the sludge and disposes of the solids either in a landfill or by incineration.

Comparing the magnitude of wastes generated by the Illinois paint industry with the quantity of paint produced provides estimates of the material efficiency of the industry. In Section 5.3.1 we estimated that the annual production of paint in Illinois is 130 million gallons. If we assume an average density of 8 pounds per gallon this amounts to production of 520,000 tons of paint per year. The total quantity of waste generated by paint manufacturers after recycling (assuming 50 percent of organic solvent waste is recovered) amounts to approximately 25,000 tons, based on data in Figure 2-2. The material efficiency for the industry in terms of product produced per material input is 520,000 divided by 545,000 or 95.4 percent.

5.3.3 Waste Reduction by Illinois Paint Manufacturers

Five of the six paint manufacturers responding to the Paint Survey considered reducing their waste generation from paint manufacturing. Of these, only three facilities actually made any changes in their paint manufacturing operations to reduce waste generation. Two facilities reformulated their product to reduce waste generation and three facilities reduced waste generation by changing their equipment cleaning procedures.

Table 5-5 shows the reasons facilities gave for considering waste reduction for their paint manufacturing operations. The most commonly cited reason was to improve and protect the environment. Other common reasons were to reduce waste management costs and potential liability.

Respondents to the survey also indicated the barriers to reducing or further reducing their waste generation from paint manufacturing. Table 5-6 shows these results. While no single barrier dominates the list, customer specifications and the high cost of waste reduction were the most commonly listed barriers. In addition, two of the six respondents indicated that there are no barriers to waste reduction.

For wastes that cannot be reduced, Illinois prefers recycling or reuse rather than treatment or disposal. Table 5-7 shows the number of paint manufacturers responding to the Paint Survey that recycled or reused their paint-related wastes. Five of the six survey respondents recovered their paint manufacturing wastes. The two types of recycling used were organic solvent recovery and blending waste as fuel.

Table 5-5. Reasons for Waste Reduction in Paint Manufacturing as Reported by Paint Survey Respondents

Reason	Number of Facilities Considering Waste Reduction	Number of Facilities Implementing Waste Reduction	
		Paint Formulation	Equipment Cleaning
Comply with environmental regulations	2	1	1
Comply with OSHA regulations	1	1	1
Reduce waste management costs	3	2	3
Reduce costs other than waste management	2	2	2
Meet customer demands	1	0	0
Reduce potential liability	3	2	2
Improve and protect the environment	4	2	2
Total[a]	5	2	3

[a] Totals shown are without double-counting.

Table 5-6. Barriers to Reducing Waste Generation from Paint Manufacturing as Reported by Paint Survey Respondents

Barrier	Number of Facilities: Implementing Waste Reduction	Number of Facilities: Not Implementing Waste Reduction
Technology not available	1	0
Would affect product	1	0
Customer specifications	1	1
Lack of technical information	0	1
High cost	1	1
Uncertainty/risk	1	0
Alternative materials not available	0	1
Other	0	0
Total, Barriers[a]	1	2
No Barriers	1	1
unknown	1	0

[a] Totals shown are without double-counting.

Table 5-7. Recycling by Paint Manufacturers Responding to the Paint Survey

Type of Recycling	Number of Facilities
Organic solvent recycling	4
Fuel blending	2
Total, facilities recycling[a]	5

[a] Total shown is without double-counting.

5.4 PAINT APPLICATION IN ILLINOIS

5.4.1 Description of Paint Applications in Illinois

Table 5-8 reports the national total quantity of paint used by general type of use. Architectural coatings are described by the U.S. Bureau of the Census (1987) as "stock type or shelf goods formulated for normal environmental conditions and general application on new and existing residential, commercial, institutional, and industrial structures." Special purpose coatings include paints for refinishing automobiles (used by auto body shops), refinishing machinery, traffic marking, and aerosol packaging. They are described as stock items and are differentiated from architectural coatings in that they are formulated for special purposes and environmental conditions. The Bureau of the Census describes product coatings-OEM as "coatings formulated specifically for OEMs to meet conditions of application and product requirements and applied to such products as part of the manufacturing process."

Data on total Illinois consumption of paint are not available. Using certain assumptions, however, estimating paint use for some selected sectors of Illinois paint users is possible. The following sections describe some of these sectors.

Table 5-8. Quantity of Paint Used Nationally in 1990 by Type of Use (Millions of Gallons)

Architectural Coatings	***530***	
General Public		***276***
Contractors		***160***
Commercial Accounts		***74***
Government and Exports		***20***
Product Coatings-Original Equipment Manufacturers	***335***	
Special Purpose Coatings	165	
Total	1,030	

Source: Rauch, 1990

5.4.1.1 Households and Painting Contractors

Households and painting contractors use architectural coatings. Overall, 63 percent of exterior architectural paints were waterborne in 1990, but for homes the figure was 80 percent. Eighty-two percent of interior paints were waterborne (Rauch, 1990).

As shown in Table 5-8, the general public (households) accounted for 26.8 percent and painting contractors accounted for 15.5 percent of the paint consumed in the United States in 1990 (Rauch, 1990). Assuming that paint consumption by these sectors is related to population, we estimated the use of paint by these sectors in Illinois by scaling the data in Table 5-8 based on the ratio of the national and state of Illinois populations. Based on the data in Table 5-8, estimated national paint use by households is 1.133 gallons per person-year and for contractors is 0.657 gallons per person-year. Applying these values to the Illinois population results in an estimate of paint use of 12.7 million gallons per year by households and 7.3 million gallons per year by contractors.

5.4.1.2 Automobile Body Repair Shops

Information from the Illinois Automotive Service Association indicates that approximately 3,400 licensed auto body shops operate in Illinois. An unknown number of unlicensed facilities also operate in Illinois. Auto body shops use paints class&xl as special purpose coatings (Rauch, 1990). Of the special purpose coatings, automobile and truck refinishing is the largest user. Like architectural coatings, the use of paints for refinishing automobiles is likely related to population. Thus, using the same procedure as for households, it is possible to estimate the amount of paint used in Illinois by auto body shops. Nationally, about 32 million gallons of paint were used by auto body shops in 1989 (Rauch, 1990). The estimated Illinois consumption, based on population, would be 1.5 million gallons. This estimate does not include organic solvents used to thin paint for spray application.

5.4.1.3 Manufacturers

Paint use by manufacturers is included under the category of product coatings-OEM (original equipment manufacturer). Due to the concentration of industry in Illinois, the percentage of total paint use in the state that is product coatings is likely higher than for the nation as a whole. We were unable to estimate paint consumption by the manufacturing industry in Illinois with existing data. However, we did determine qualitatively which Illinois industries are likely to be large paint consumers.

Figure 5-2 indicates which Illinois industries are likely to be large consumers of paint for products coatings (Rauch, 1990). The top three users in the product coatings category are manufacturers of containers, automobiles, and wood furniture. Because all these industries are represented in Illinois and are large users of paint, it is likely that they are among the major paint-consuming manufacturing industries in Illinois.

5.4.2 Wastes Generated from Paint Application

Although there are a variety of paint users in Illinois, there are four primary mechanisms for generating paint-related wastes:

- surface preparation,
- VOCs emitted as part of paint application and curing,
- paint transfer inefficiency, and
- cleaning of painting equipment.

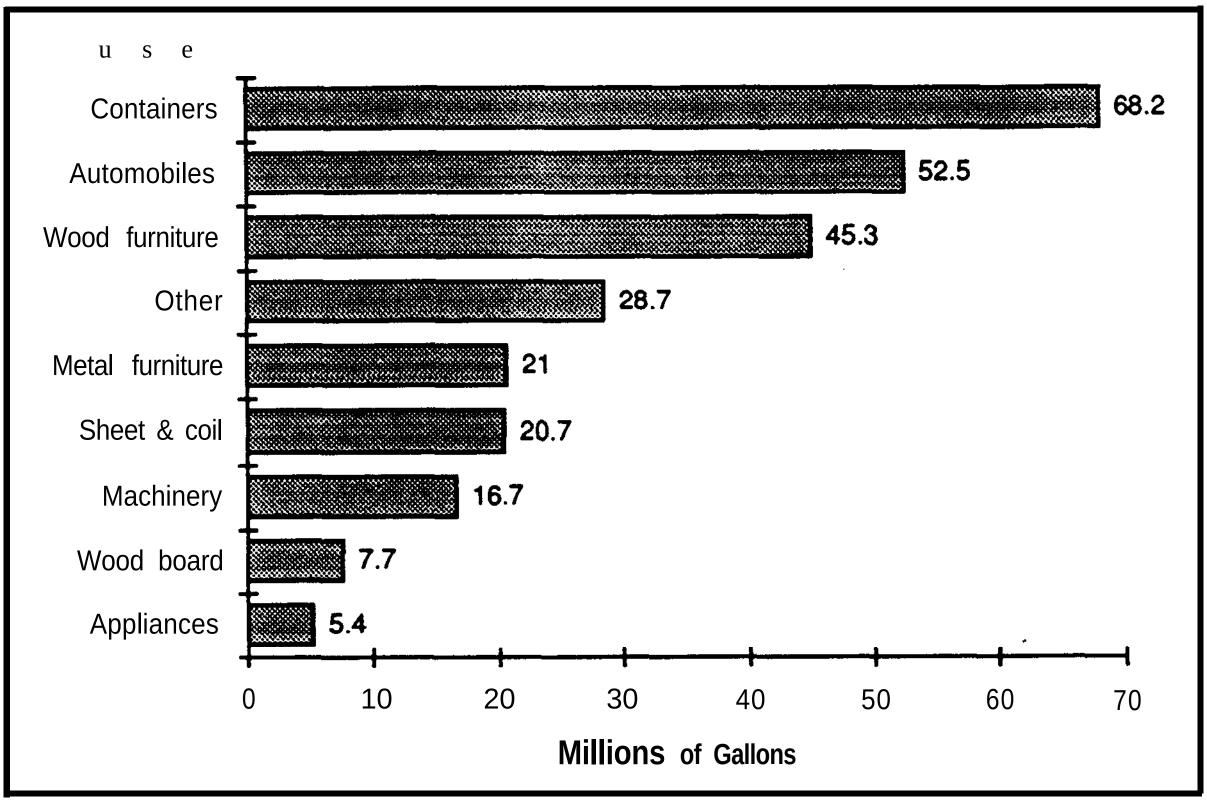

Figure 5-2. Quantities of Paint Applied Nationally as Product Coatings in 1990

Source: Rauch, 1990.

The Paint Survey collected data on each of these activities by Illinois facilities.

Table 5-9 shows the types of surface preparation conducted by Illinois facilities responding to the Paint Survey. Physical abrasion was used most often by survey respondents. This includes manual sanding as well as abrasive blasting. These methods are commonly used to remove paint (see Section 5.5.2). The spent abrasive material is generated as a waste.

Table 5- 10 shows the number of survey respondents using organic, water, and powder paints in 1990 and the quantity of paint used by industry. In general, the quantity of VOCs emitted from paint curing is greater from organic solvent-borne paints than from water-borne or powdered paints. Organic solvent based paints are most commonly used by Illinois facilities responding to the survey. Survey respondents in the Painting and Paper Hanging industry (SIC 1721), however, use more water-borne paint than organic solvent based paints, although a large number of these facilities use both types of paints.

Table 5-9. Surface Preparation Methods Used by Paint Survey Respondents Applying Paint

Surface Preparation Method	Number of Facilities
Physical abrasion	32
Water cleaning	18
Organic solvent cleaning	14
Alkaline or acid cleaning	8
None	6
Phosphate or similar conversion coating	4
Other	3
Unknown	1
Total[a]	51

[a]Total shown is without double-counting.

Table 5-10. Types of Paint Used by Industry for Paint Survey Respondents Applying Paint

	Organic Solvent-Based Paint		Water-Based Paint		Powder Paint	
SIC	Number of Respondents	Quantity (gallons)	Number of Respondents	Quantity (gallons)	Number of Respondents	Quantity (pounds)
1721	12	8,248	15	37,895	1	5,000
2434	1	150	0	0	0	0
2499	1	30	1	190	0	0
2511	1	1,000	0	0	0	0
3411	1	130,000	0	0	0	0
3412	2	26,158	1	9,245	0	0
3444	1	6	1	1	0	0
3469	1	800	0	0	0	0
3479	1	1,150	0	0	0	0
3564	1	5,000	0	0	0	0
3633	1	21,000	1	750	0	0
3714	1	4	0	0	0	0
7532	19	4,546	3	26	1	0
Total	43	198,092	22	48,107	2	5,000

Paint transfer efficiencies, and therefore the quantities of waste generated, vary by the paint application method. Table 5-11 shows the paint application methods used by survey respondents. Table 3-2 shows typical paint transfer efficiencies for various application methods. The method most commonly used by survey respondents, conventional spraying, has relatively low transfer efficiencies of 30 to 60 percent. This means that 40 to 70 percent of paint used is overspray, or waste. Hand-held rollers and brushes are the next most often used by survey respondents. These have relatively high transfer efficiencies (80 to 95 percent) and generate less waste.

Table 5-11. Paint Application Methods Used by Paint Survey Respondents

Application Method	Number of Facilities
Conventional spraying	36
Roller	16
Brush	9
Other	5
Dip, flow, or curtain coating	3
Electrostatic spraying	2
Powder spraying	1
Silk screen coating	1

Table 5-12 shows the methods used by survey respondents to clean their paint application equipment. Although virgin organic solvents were used most often, a large number of facilities used recovered solvents to clean their equipment.

Based on the data available, we developed the following estimates for selected types of paint-related waste generation for several groups of Illinois paint users. In developing these estimates, we made the following assumptions regarding the composition of paints used based on our discussions with paint industry experts and review of material safety data sheets provided by paint users:

- Household paint
  - average paint density = 9.5 pounds per gallon
  - solids per gallon = 3.5 pounds per gallon
  - volatile organic component = 1.0 pounds per gallon[1]

[1] Data available in the NPCA study, "Survey of Architectural Coating Sales of 1987 for VOC Content" (NPCA, 1989). suggest median values for VOC in household latex paint of approximately 0.39 pounds per gallon. Data provided by the Illinois Paint Council indicate that these paints account for about 80 percent of household paint usage. Information provided by the Council indicates that the remaining 20 percent of household paint may contain between three and four pounds per gallon VOC, suggesting an overall average VOC content of about one pound per gallon for household paints.

Table 5-12. Methods Used to Clean Paint Application Equipment by Paint Survey Respondents

Cleaning Method	Number of Facilities
Virgin organic solvents	26
Recovered or recycled organic solvents	23
Water	18
Other	7
Equipment is not cleaned between batches	1
Alkaline solutions	0
unknown	1
Total[a]	51

[a] Total shown is without double-counting.

- Paint used in auto repair
  - average paint density = 8.0 pounds per gallon
  - solids per gallon = 3.0 pounds per gallon
  - volatile organic component = 5.0 pounds per gallon
- Paint used in bridge maintenance
  - average paint density = 11.0 pounds per gallon
  - solids per gallon = 8.0 pounds per gallon
  - volatile organic component = 3.0 pounds per gallon

5.4.2.1 *Households*

Painting by households includes exterior and interior house painting and other small paint jobs such as painting furniture, decks, and lawn and garden equipment. The largest use is likely for painting houses. A 1987 study of households in the Champaign/Urbana area and Decatur and of farmers in Champaign County found that roughly 50 percent of households and farms had varnish and paint thinner on their property at some time during the past 12 months. Householders and farmers that had varnish onsite at the time of the survey on average had roughly 3 to 4 containers, and those with thinner onsite had roughly 2 to 3 containers on average (Liebert, 1988).

Transfer efficiency for household painting is high, estimated at 95 percent using brushes or rollers. The primary sources of waste are leftover paint, clean-up solvents, rags, drop clothes, and masking materials.

Data from a California study (Rathje et al., 1985) indicate that each household discards about 1.5 pounds of paint waste in municipal trash per year. Using this figure for Illinois households, we estimate that 3,150 tons per year of household paint waste is discarded in Illinois.

VOCs released from household paint during curing are estimated to be 1.0 Rounds VOC per gallon of paint. Applying this value for the estimated 12.7 million gallons per year of paint used by households gives an estimated VOC release of 12.7 million pounds per year.

Estimating organic solvent waste and other wastes generated by clean-up in household painting is more difficult. The amount of solvent used may be relatively the same regardless of the amount of paint that is applied. That is, clean-up of brushes after painting a garage door may not differ from clean-up after painting an entire house. Similarly, estimating the amount of solid wastes contaminated with paint is also difficult.

54.22 Auto Body Shops

Data on waste generation for auto body repair shops are available from a study by SCS Engineers (SCS, 1987), from an auto body shop site visit, and from data gathered from telephone contact with two additional body shops located in Illinois. The primary sources of paint-related waste in auto body shops are leftover paints, VOCs from paint curing, paint overspray, and equipment clean-up. With typical overspray collection mechanisms (dry filters) used in auto body shops, overspray is sent to a municipal or special waste landfill for disposal in the form of dry paint on filters.

Wastes generated can be estimated as follows. First, the transfer efficiency of painting operations is assumed to be 60 percent. VOC content is assumed to be 5.0 pounds per gallon. The previously estimated annual use of paint is l,500,000 gallons. Applying the transfer efficiency to this value results in an estimate of 600,000 gallons or 900 tons per year of waste from overspray. VOCs emitted from paint curing are estimated at 3,750 tons per year.

We estimated the amount of organic solvent waste generated in cleaning operations based on the data from the SCS study, the site visit, and the two other auto body shops contacted. The average quantity of organic solvent used per car serviced was 0.58 gallons.

Information provided by the Illinois Automotive Service Association indicates that the average Illinois body shop services 480 cars per year, and that there are approximately 3,400 licensed auto body shops in Illinois. Using these data, we estimate that 948,000 gallons of mixed solvent and paint waste are generated per year. Assuming 85 percent of this volume is reclaimed, there remain 142,000 gallons, or 710 tons of paint sludge per year.

5.4.2.3 Illinois Department of Transportation

The Illinois Department of Transportation (IDOT) provided some data on paint-related waste generation during bridge maintenance and rehabilitation. Based on data provided by IDOT, we estimate that 73,000 gallons of paint are used per year for the purpose of bridge maintenance and rehabilitation. Transfer efficiencies will vary depending on the operating conditions, the operator skills, and the type of equipment used. Assuming a transfer efficiency of 60 percent, the resultant paint waste is 29,200 gallons or 117 tons per year of overspray waste. Because the painting occurs under uncontrolled conditions, the ultimate fate of the overspray is the immediate environment of the bridge. VOC emissions from IDOT bridge maintenance and rehabilitation are estimated at 110 tons per year based on 3.0 pounds of VOC per gallon. Data were not available to estimate equipment clean-up wastes from bridge maintenance.

IDOT uses two types of paint for traffic markings (Grey, 1991). Polyolefin, an organic solvent-borne paint, is used for road markings. For fiscal year 1991, IDOT purchased 700,000 gallons of polyolefin paints. IDOT projects that the use of this paint during the fiscal year will generate 5,000 gallons of hazardous waste and 1,000 gallons of wastewater. The hazardous waste is generated from cleaning the striping machines at the end of a work period (usually a day) and is a mixture of xylene (an organic solvent used to clean the equipment) and paint. The hazardous waste is shipped offsite for management and burned in a closed containment furnace. The wastewater generated from using polyolefin paints is generated from hydroblasting the paint storage tanks to clean them at the end of the striping season each year. This waste is also managed offsite.

IDOT also uses a water-borne paint for traffic markings. The waterborne paint is used for specialty sign paintings. For fiscal year 1991, IDOT purchased 50,000 gallons of water-borne paint. IDOT estimates this paint will generate 500 gallons of waste paint mixed with water from equipment cleaning (Grey, 1991).

5.4.3 Waste Reduction by Illinois Industries Applying Paint

Of the 51 paint users responding to the Paint Survey, only 24 considered implementing waste reduction for their paint application operations. Of those facilities considering waste reduction, almost all (21 facilities) actually changed their paint application operations to reduce waste generation. The most common waste reduction activities implemented were changes in the type of paint used and in equipment cleaning procedures, although a large number of facilities (15 facilities) indicated changing the techniques used to apply paint. The most commonly cited change in application techniques was a switch from conventional to high-volume low-pressure (HVLP) spray guns. Table 5-13 shows the number of respondents considering and implementing waste reduction by industry.

Table 5-14 shows the reasons respondents changed their paint application operations to reduce waste generation. The reasons most commonly cited were to comply with environmental regulations and to reduce potential liability.

Table 5-15 shows the barriers to waste reduction for paint application operations experienced by facilities that implemented and those that did not implement waste reduction. The barriers experienced by the two groups of respondents differed. Most commonly cited barriers for facilities that implemented waste reduction included the following:

- waste reduction technology not available,
- changes to reduce waste would affect product quality,
- customer specifications, and
- alternative materials not available.

Barriers cited most often by facilities that did not implement waste reduction are a lack of technical information and the high cost of implementing waste reduction.

IDOT has developed a waste reduction program for its traffic markings (Grey, 1991). IDOT recently switched from chlorinated rubber paints to polyolefin paints, in part to reduce waste generated, although data are not yet available as to how much waste was reduced due to the change. Also, IDOT has a policy to change all paint storage tanks to stainless steel tanks over time. Because less paint sticks to the stainless steel, the amount of waste generated from cleaning the tanks will be reduced. Finally, changes in paint handling and operating procedures have been implemented to reduce waste ***generation.*** DOT has set a goal to reduce the generation of hazardous waste to 2,000 gallons per year.

For wastes that cannot be eliminated, the state of Illinois prefers environmentally sound recycling rather than treating and disposing of wastes. Table 5-16 shows the number of Paint Survey respondents that recycled their paint-related wastes.

Table 5-13. Waste Reduction in Paint Application by Industry as Reported by Paint Survey Respondents

SIC	Total Number of Respondents in Industry	Number of Respondents Considering Reduction	Number of Respondents Implementing Waste Reduction: Paint Used	Paint Application	Surface Preparation	Equipment Cleaning	Total
1721	17	7	7	5	2	7	7
2434	1	0	0	0	0	0	0
2499	1	0	0	0	0	0	0
2511	1	0	0	0	0	0	0
3411	1	1	0	0	0	0	0
3412	2	2	2	0	0	2	2
3444	1	0	0	0	0	0	0
3469	1	0	0	0	0	0	0
3479	1	0	0	0	0	0	0
3564	1	0	0	0	0	0	0
3633	1	1	1	0	0	1	1
3714	1	0	0	0	0	0	0
7532	22	13	10	10	3	11	11
Total	51	24	20	15	5	21	21

Table 5-14. Reasons for Waste Reduction in Paint Application as Reported by Paint Survey Respondents

Reason	Number of Respondents Considering Waste Reduction	Number of Respondents Implementing Waste Reduction				
		Paint Used	Paint Application	Surface Preparation	Equipment Cleaning	Total
Comply with environmental regulations	20	16	12	4	17	17
comply with OSHA regulations	13	10	10	3	11	11
Reduce waste management costs	16	13	11	5	14	14
Reduce costs other than waste management	12	10	8	1	10	10
Improve process efficiency	15	13	11	4	14	14
Meet customer demands	4	4	4	0	4	4
Meet community demands	5	4	4	2	4	4
Reduce potential liability	17	14	11	4	15	15
Improve and protect the environment	14	13	12	5	14	14
Other	2	2	2	1	2	2
Total[a]	24	20	15	5	21	21

[a]Totals shown are without double-counting.

Table 5-15, Barriers to Reducing Waste Generation from Paint Application for Paint Survey Respondents

Barrier	Number of Respondents	
	Implementing Waste Reduction	Not Implementing Waste Reduction
Technology not available	9	6
Would affect product	9	4
Customer specifications	9	3
Lack of technical information	6	12
High Cost	8	10
Uncertainty/risk	3	3
Alternative materials not available	9	6
Other	1	3
Total, barriers[a]	19	22
No barriers	1	6
unknown	1	2

[a]Totals shown are without double-counting.

Table 5-16. Number of Paint Survey Respondents Recycling Their Paint Application Waste

Type of Recycling	Number of Respondents
Organic solvent recycling	22
Fuel blending	4
Metals recycling	2
Total, facilities recycling[a]	25

[a] Total shown is without double-counting.

5.5 PAINT REMOVAL IN ILLINOIS

5.5.1 Description of Illinois Paint Removers

For facilities responding to the Paint Survey, all facilities that removed paint also applied paint For these facilities, paint removal was part of the surface preparation prior to painting. Paint was removed generally because the old paint was no longer effective (e.g., cracked or peeling), although one respondent removed paint for inspection.

Table 5-17 shows the numbers of survey respondents in each industry that apply and remove paint for each industry. For comparison purposes, the table also shows the number of facilities responding to the survey that only applied paint. For the Auto Body Repair (7532) industry, most of the facilities applying paint also remove paint. About half the facilities applying paint in Painting and Paper Hanging (SIC 1721) also remove paint.

Table 5-17. Number of Paint Survey Respondents Applying and Removing Paint by Industry

SIC	Number of Respondents Applying Paint Only	Number of Respondents Applying and Removing Paint	Total Number of Respondents
1721	8	9	17
2434	1	0	1
2499	1	0	1
2511	1	0	1
3411	1	0	1
3412	1	1	2
3444	0	1	1
3469	1	0	1
3479	1	0	1
3564	1	0	1
3633	0	1	1
3714	1	0	1
7532	7	15	22
Total	24	27	51

5.5.2 Wastes Generated by Paint Removal

One waste generated by all paint removal operations is paint residue, or the old paint that was removed. Other wastes generated from paint removal vary by the technique used to remove the paint. Table 5-18 shows the paint removal techniques used by Paint Survey respondents. Solvent stripping was used most often by respondents. This generates waste in the form of air emissions of VOCs and the spent solvent. Of the 14 respondents using solvent stripping to remove paint, 5 respondents recover their spent solvent for reuse. Other paint removal techniques commonly used by respondents include manual scraping and sanding, either manually or using small, hand-held sanders. Each of these techniques generate only minimal amounts of waste, including paint residue and spent sandpaper.

Table 5-18. Methods Used to Remove Paint by Paint Survey Respondents

Method	Number of Respondents
Solvent snipping	14
Scraping	12
Other	12
Sand blasting	8
High pressure water sprays	6
Heat softening/low temperature ashing	3
Molten salt or caustic bath	2
Abrasive blasting: slag	1
Lasers or flashlamps	0
Abrasive blasting: dry ice or baking soda	0
Abrasive blasting: other materials	0
Abrasive blasting: plastic media	0
Unknown	3
Total[a]	27

[a] Total shown is without double-counting.

One type of paint removal of particular concern in Illinois is the removing of paint from bridges as part of maintenance operations. As discussed in Section 4.2, IDOT has suspended all paint removal from bridges because of concern for workers' exposure to concentrated lead dust during paint removal operations. Paint removal from bridges in Illinois is estimated to generate 7,000 tons of paint-bearing sand or coal slag per year. Because paints used for bridges contain lead, the paint residue from paint removal also contains lead.

5.5.3 Waste Reduction for Paint Removal Operations in Illinois

Of the 27 facilities that responded to the Paint Survey and removed paint, only eight facilities considered reducing their waste generation from paint removal and only four facilities actually changed their paint removal activities to reduce waste generation. Table 5- 19 shows the number of facilities considering and implementing waste reduction for their paint removal operations by industry. Roughly one-third of respondents in the Painting and Paper Hanging (1721) and Auto Body Repair (7532) industries considered reducing their paint removal wastes, and only one auto body shop and two Painting and Paper Hanging firms actually implemented waste reduction. In addition, one manufacturer of household laundry equipment reduced its wastes from paint removal.

Table 5-19. Waste Reduction in Paint Removal by Industry for Paint Survey Respondents

SIC	Total Number of Respondents Removing Paint	Number of Respondents Considering Waste Reduction[a]	Number of Respondents Implementing Waste Reduction[a]
1721	9	3	2
3412	1	0	0
3444	1	0	0
3633	1	1	1
7532	15	4	1
Total	27	8	4

[a] Includes waste reduction for paint removal operations only.

Table 5-20 shows the reasons why facilities considered and implemented waste reduction for their paint removal operations. Reasons most commonly cited by respondents include complying with environmental regulations and reducing waste management costs.

Twenty-two of the twenty-seven survey respondents removing paint indicated that there are barriers to reducing waste generation from paint removal. The most commonly cited barrier was a lack of technical information. Other common barriers include the unavailability and expense of waste reduction techniques. Table 5-21 shows the barriers to reducing waste generation as reported by the responding Paint Survey facilities. Table 5-21 further breaks down the data on barriers by number of facilities that implemented waste reduction and those who did not.

Table 5-20. Reasons for Waste Reduction in Paint Removal as Reported by Paint Survey Respondents

Reason	Number of Respondents: Considering Reduction	Number of Respondents: Implementing Waste Reduction
Comply with environmental regulations	5	3
Comply with OSHA regulations	3	2
Reduce waste management costs	3	1
Reduce costs other than waste management	4	3
Meet customer demands	2	0
Meet community demands	1	1
Reduce potential liability	4	2
Improve and protect the environment	4	2
Other	2	0
Unknown	1	1
Total[a]	8	4

[a]Totals shown are without double-counting.

Table 5-21. Barriers to Reducing Waste Generation from Paint Removal as Reported by Paint Survey Respondents

Barrier	Number of Respondents: Implementing Waste Reduction	Number of Respondents: Not Implementing Waste Reduction
Technology not available	2	9
Would affect product	0	2
Customer specifications	1	0
Lack of technical information	3	11
High cost	2	7
Uncertainty/risk	0	2
Alternative materials not available	1	5
Other	0	2
Total, barriers[a]	4	18
No barriers	0	5
unknown	0	0

[a] Totals shown are without double-counting.

In addition to the barriers to waste reduction shown in Table 5-21, several respondents indicated in their comments that the ***small*** quantity of waste generated from paint removal was a barrier to waste reduction. This indicates a perception that because so little waste is generated from paint removal, waste reduction is not necessary. This comment was made by facilities for which paint removal is not a major part of their business activity; rather, it is undertaken only occasionally as a prelude to their painting activities.

5.6 WASTE REDUCTION PROGRAMS FOR ILLINOIS FIRMS

Sections 5.3, 5.4, and 5.5 of this report include descriptions of paint-related waste reduction activities undertaken by paint manufacturers and users in Illinois. Comparing these paint-related activities to general facility waste reduction programs provides insight into how facilities have integrated waste reduction into their businesses. The following discussion of waste reduction programs is based on responses to the Paint Survey. Although the small sample size for the survey prohibits estimating activity for the entire state, the responses do indicate what some Illinois firms are doing to reduce their waste.

Table 5-22 shows the numbers of facilities considering waste reduction and those that have in place a waste reduction program. For the purposes of the Paint Survey, a facility is considered to have a waste reduction program if it has at least one of the following program elements:

- employee training/awareness program,
- employee incentives program to reward employees for reducing waste generation,
- written waste reduction policy,
- cost accounting program that charges the costs of waste management to the production activity that generated the waste,
- quantitative waste reduction goals, or
- waste audits that identify quantities and sources of waste generation.

Table 5-22. Number of Facilities Considering Waste Reduction by Reason as Reported by Paint Survey Respondents

Reason	Number of Respondents Considering Waste Reduction		Number of Respondents with a Waste Reduction Program[a]	
	Manufacture	Use	Manufacture	Use
Comply with environmental regulations	3	23	3	19
Comply with OSHA regulations	1	17	1	14
Reduce costs waste management	5	21	5	19
Reduce costs other than waste management	1	14	1	12
Meet customer demands	1	2	1	2
Meet community demands	0	8	0	7
Reduce potential liability	5	20	5	17
Improve and protect the environment	5	22	5	17
Other	0	4	0	2
Total[b]	6	30	6	29

[a] Of facilities considering waste reduction, the number of facilities that had at least One of the program elements defined in Table 5-23.

[b] Totals shown are without doublecounting.

All of the paint manufacturers responding to the Paint Survey have a waste reduction program at their facilities. However, Section 5.3.3 showed that only half of the paint manufacturers responding to the survey (3 facilities) actually implemented waste reduction for their paint manufacturing activities. Of the 51 paint users responding to the survey, only 30 facilities considered waste reduction and 29 have a facility waste reduction program. **As discussed in** Sections 5.4.3 and 5.5.3 above, only 21 facilities implemented waste reduction for their paint application operations and 4 facilities implemented waste reduction for their paint removal operations.

Table 5-23 describes the program elements for respondents that have waste reduction programs. For paint manufacturers, the most common program elements are employee training/awareness and conducting waste audits. Most of the waste reduction programs for paint users also included employee training/awareness. The second most common waste reduction program element for paint users is quantitative waste reduction goals, although less than 40 percent of respondents with waste reduction programs had these goals.

Table 5-23. Number of Facilities with Waste Reduction Programs as Reported by Paint Survey Respondents

Program Element	Number of Manufacturers	Number of Users
Employee training/awareness	4	23
Employee incentives	1	0
Written waste reduction policy	1	4
Cost accounting	0	8
Quantitative waste reduction goals	2	11
Waste audits	3	5
Other	0	1
Total[a]	**5**	29

[a] Totals shown are without double-counting.

Paint Survey respondents also provided information on their sources of information about waste reduction. The most commonly used sources for both paint manufacturers and users are trade journals and vendors. This result is consistent for facilities with and without waste reduction programs. Nine paint users responding to the survey indicated that no sources of information on waste reduction were used. Four of these facilities have waste reduction programs. Table 5-24 shows these results.

Table 5-24. Sources of Information about Waste Reduction as Reported by Paint Survey Respondents

Information Source	Total Number of Respondents Using Source		Number of Respondents with a Waste Reduction Program[a]	
	Manufacture	Use	Manufacture	Use
Trade journals	5	34	5	22
Other periodicals	1	8	1	7
Industry associations	3	15	3	14
Local government	0	1	0	1
State government	0	5	0	4
Federal government	0	1	0	1
Vendors	4	28	4	20
Customers	0	3	0	2
Employees	2	10	2	9
Other	1	1	1	0
Total, facilities using information source[b]	6	40	6	25
No information sources used	0	9	0	4
Unknown	1	2	1	0

[a] Out of the facilities using the information source indicated, the number that had any of the waste reduction program elements listed in Table 5-23.
[b] Totals shown are without doublc-counting.

To assist HWRIC in developing a waste reduction education program, the Paint Survey asked respondents what types of additional information on waste reduction would be useful. As Table 5-25 shows, both paint manufacturers and users indicated a need for technical information on technologies to reduce waste generation and on alternative products and raw materials. One paint manufacturer and eleven paint users responded that they do not need any additional information on waste reduction. Of the eleven paint users indicating that they do not need any information, only three facilities have a waste reduction program.

Table 5-25. Types of Waste Reduction Information Needed by Paint Survey Respondents

Type of Information	Total Number of Respondents		Number of Respondents With a Waste Reduction Program[a]	
	Manufacture	Use	Manufacture	Use
Technical information	4	28	4	18
Financial information	2	16	2	11
Onsite technical assistance	1	12	1	9
Alternative products and materials	4	21	4	15
Other	0	0	0	0
Total facilities needing information[b]	5	37	5	26
No information needed	1	11	1	3
Unknown	0	3	0	0

[a] Out of the facilities requesting the type of information indicated, the percentage that had any of the waste reduction program elements listed in Table *5-23.*

b Totals shown are without double-counting.

Table 5-26 shows the types of waste reduction information Paint Survey respondents need by industry. Approximately 70 percent of respondents in Painting and Paper Hanging (SIC 1721) and Auto Body Repair (SIC 7532) industries need information, and most respondents in the remaining industries require waste reduction information.

Table 5-26. Types of Waste Reduction Information Needed by Survey Respondents

CHAPTER 6
WASTE MANAGEMENT, DISPOSAL, AND REDUCTION OPTIONS FOR ILLINOIS

6.1 INTRODUCTION

After reviewing the waste reduction methods available for paint-related wastes and the existing paint waste generation and reduction activities in Illinois, HWRIC identified options for managing, disposing of, and reducing paint-related wastes in Illinois. This chapter discusses those options. As directed by the Illinois General Assembly (Public Act 86-1026), this discussion focuses on options for small businesses and households that use paint, although a brief discussion of options for large businesses is included for comparison.

6.2 LARGE BUSINESSES

The disposal options for paint-related waste are growing. Through the literature search, we identified several companies who handle Illinois paint wastes, including Chemical Waste Management, Safety-Kleen, Ashland Chemicals, Avganic, and Environmental Purifcation Industries (EPI). EPI is a new firm that specializes in recycling waste paint sludges into useable raw material. In addition, one Illinois manufacturing facility we visited has developed a method for using paint solids reclaimed from aqueous sludge in making low-grade paint. Listed below are some of the current options for disposing of paint-related wastes, in roughly preferential order.

- Process aqueous paint sludges to produce salable material for undercoating or low-grade paint.
- Recycle waste organic solvent for use in cleaning operations.
- Recycle organic solvent sludges for raw material.
- Sell excess or over-age raw materials to aftermarket jobbers who advertise in a paint and coatings journal or through a waste exchange.
- Reuse organic solvent sludges for energy recovery either onsite or offsite.
- Dispose by incineration at sites licensed to receive special waste.
- Landfill solid special wastes at sites licensed to receive special waste.

6.3 SMALL BUSINESSES

Paint waste generated from small businesses can be managed using the same techniques as large businesses (see Section 6.2). However, some states are concerned that SQGs and CEGs are not properly managing their waste because disposal options are unavailable, costly, or complicated. These states have initiated pilot programs designed to simplify and reduce the cost of hazardous waste management.

Minnesota established a pilot CEG hazardous waste collection program in conjunction with local household hazardous waste collections. Although federal RCRA regulations allow participation in such a program, Minnesota law prohibits CEGs from transporting their hazardous waste without a license. Special waivers from this requirement were issued for the pilot project. A 55-gallon maximum per participant was established because of transportation safety concerns and, in part, because Minnesota believed larger generators could and should arrange for private disposal. Participants funded all project and disposal costs. Twelve CEGs participated in the project, five of whom brought paint for disposal. Of the 292 gallons of bulked liquid collected, 66.5 gallons were paint. Paint dust from a spray booth accounted for 80 pounds of the 414 pounds of lab-packed or solid waste collected. One participant commenting on the project said it is generally difficult to “get a hazardous waste firm to be interested in very small quantities and usually the price is exorbitant” (Brooks and Eggleston, 1990).

In Washington, Chemical Processors, Inc. (Chempro), a hazardous waste management firm, conducted a three-month pilot project to collect CEG hazardous waste. Qualifying CEGs can drop off their hazardous waste on designated days once a month for management. To ensure that quantities are below RCRA regulatory thresholds Chempro will not accept over 220 pounds of RCRA hazardous waste or over 2.2 pounds of RCRA acutely hazardous wastes from a participant in a single month. Chempro advertises that the pilot program is designed to offer CEGs a “less complicated and speedier method to dispose of hazardous waste in compliance with state and federal regulations” (Chemical Processors, Inc., 1989).

Anchorage, Alaska, has also established a CEG collection program, designed to collect and store hazardous waste from households and CEGs. Paint waste has been a major component of the wastes collected from both households and CEGs. The city established the collection program to help keep hazardous waste out of the wastewater treatment plant and the new solid waste landfill. A study of Anchorage’s CEGs found that about 20 percent of hazardous waste generated by CEGs was disposed of in the sewer system and 37 percent in the solid waste landfill Disposal of hazardous wastes in the solid waste landfill or sewer system is illegal is Anchorage (Meade, 1990).

Participation has been lower than expected in the Anchorage collection program. The city found that although the collection program can decrease CEGs’ waste hauling costs by up to 50 percent from private hazardous waste transport, many of the CEGs are still illegally dumping in the solid waste landfill To increase participation, the city plans to lower collection charges and increase inspections at the landfill to discourage illegal dumping (Meade, 1990).

6.3.1 Painting Contractors

The Paint Survey results suggest that one major obstacle to waste reduction by small companies is a perception that little or no waste of any consequence is generated. This perception was especially common among painting contractors. One survey respondent answered that the barrier to waste reduction for his firm was that he was "not sure there is any need to change." A second respondent mentioned that his is a "small, part-time business [and] waste is not a problem."

An educational program that provides painting contractors with information on waste generation and proper disposal would be useful. The following comment from one painting contractor responding to the Paint Survey illustrates this need:

> I work in private homes and clean up my equipment as most home owners would do. Brushes and rollers are washed out in the sink and anything else is thrown out in the garbage. If things like old paints or solvents are to be treated and disposed of separate from regular garbage then that information needs to be more available to us because I have never seen any regulations on it.

The McHenry County ***Illinois*** Department of Solid Waste Management (1991) has produced an informational brochure on household paint disposal, ***Paint Management and Disposal Guide.*** It is distributed to residents that call the County for information on managing their paint wastes and has been distributed to several local retailers to be used by their customers. In addition to describing proper paint disposal procedures, the brochure provides guidance on waste reduction and proper storage of leftover paints to increase their shelf life (see Se&ion 6.4.3).

Although buying too much paint is a source of waste from households, the results of the Paint Survey indicate that this is not as much of a problem for painting contractors. Several respondents indicated that they had little leftover paint; presumably, contractors would be more experienced than an individual homeowner at purchasing the right amount of paint. Any leftover paints are generally given to the homeowner to be used for touch-ups. Thus, leftover paints from painting contractors become household paint waste.

The Paint Survey results suggest that an effective means of contacting painting contractors would be through the paint retailers. Information brochures on proper waste management and disposal practices could be distributed to painting contractors through the retailers, as is the case in McHenry County. One survey respondent suggested that paint retailers would be "great sites" for the collection of leftover paints, since his company goes to the paint retailer almost every day to purchase supplies.

6.3.2 Auto Body Shops

The results of the Paint Survey indicate that several auto body shops in Illinois have made significant changes in their operations to reduce waste generation. Most of the auto body shops that made changes in their operations to reduce waste generation made ***all*** of the following changes: switching from siphon-fed to HVLP spray guns, switching to less toxic paints, and changing their equipment cleaning procedures. In addition, many of the auto body shops reuse their organic solvents, send the solvents offsite for recovery, or use recovered solvents to clean their equipment.

Results from the Paint Survey suggest that the information and resources to reduce waste generation are available to Illinois auto body shops. Nonetheless, only 11 of the 22 facilities responding to the Paint Survey implemented waste reduction for their paint application operations. The challenges of a state waste reduction program are then (1) how to contact the facilities that haven't implemented waste reduction and (2) how to impact those facilities so that they do implement waste reduction.

Eighteen of the 22 auto body shops responding to the Paint Survey accessed sources of information on waste reduction. The most commonly used sources of information were trade journals (used by 16 facilities) and ***vendors*** (used by 12 facilities). Of these, the source most readily available for a public education campaign is trade journals. In addition, several auto body shops indicated that their *only* source of information was from other shops through word of mouth. Regional meetings is an option for these facilities, using direct mail or trade associations to publicize these events, although the ability of such an event to attract body shops that don't generally participate in trade associations or read trade journals is questionable.

The second issue to resolve is what types of information would be most effective at encouraging waste reduction by auto body shops. Fifteen of the 22 facilities responding to the Paint Survey indicated a need for additional information on waste reduction (see Table 5-26). These facilities were evenly divided on what types of information they required; technical information, financial information, onsite technical assistance, and information on alternative materials were all requested. Information on technologies, finances, and alternative materials could be provided through trade journals. This source could also be used to publicize the resources available from HWRIC and other state agencies.

In addition to information on waste reduction, trade journals could be used to communicate information on regulatory issues, such as disposing of paint wastes in special waste landfills. Although Illinois law requires most of the wastes from auto body shops to be disposed of in special waste landfills, the survey responses suggest that some facilities may not be complying with these regulations. Because information on waste management and disposal was not known to most survey respondents, conclusive information on this is not available.

Table 6-l shows the barriers to reducing paint-related wastes indicated by auto body shops responding to the Paint Survey. Both those auto body shops that have implemented waste reduction and those that have not indicated that high cost was a barrier to implementing waste reduction. Additional study is requited to identify the source of the high cost and policy options to make waste reduction techniques more accessible to auto body shops.

Table 6-1. Barriers to Reducing Paint-Related Waste Generation for Auto Body Repair Shops Responding to the Paint Survey

Barrier	Number of Auto Body Shops		
	Implementing Waste Reduction	Not Implementing Waste Reduction	Total
Technology not available	5	2	7
Would affect product	5	1	6
Customer specifications	3	0	3
Lack of technical information	2	3	5
High cost	5	3	8
Uncertainty/risk	0	0	0
Alternative materials not available	4	2	6
Other	0	3	3
Total, barriers[a]	10	7	17
No barriers	1	2	3
unknown	0	2	2

[a] Totals shown are without double-counting.

6.4 HOUSEHOLDS

Currently, household paint-related wastes can be disposed of in municipal solid waste landfills in Illinois (although some local haulers will not accept paint). The extent to which disposal of liquid household paint in landfills contributes to leachate hazards has not been determined. Concern for potential leachate hazard has led some states including California (Meiorin and Purin, 1989) and Washington (Seattle Solid Waste Utility, 199Oa, 199Ob) to study the effect of solidifying liquid paint prior to landfilling. Preliminary results of the Seattle study indicated that lead did not leach from the liquid paint but did leach from the solidified paint Changes in the pH during the solidification process are suspected to contribute to this problem. Further studies will be conducted to test this theory. All states identified in this study do allow the disposal of paint containers with dried paint in municipal landfills, although recycling the paint cans is the preferred option.

6.4.1 Household Hazardous Waste Collections

To reduce the quantities of household hazardous waste disposed of in solid waste landfills, many communities have established household hazardous waste collections. Generally, these are one-day events held periodically to allow households to drop off their wastes at collection sites.

In general, about 50 percent of the waste collected is paint waste. The paint collected at San Bernardino County, California, collection sites is on average ten years old (HHWMN, 199Oc). Many programs collect only organic solvent based paints, which generally fall under the RCRA definition of hazardous wastes. California, Minnesota, and Washington also recommend collecting latex because of potential mercury and lead content. Also, where the latex paint is recycled, the volume of solid waste disposed of is reduced. For communities collecting both organic solvent-borne paints and water-borne paints, about half the paint waste collected is latex. GeneralIy, older communities tend to have larger quantities of organic solvent-borne paints (HHWMN, 199Oc).

Organic solvent-borne paints collected at waste collections are generally treated as a hazardous waste; most are burned for energy recovery. Up to 10 percent of organic solvent-borne paint waste may test over 50 parts per million for polychlorinated biphenyls (PCBs). The federal Toxic Substances Control Act requires burning these wastes in an incinerator licensed for PCBs. Twenty to thirty percent of solvent paint collected is reusable as paint, although recycling organic solvent-borne paints is not common (HHWMN, 199Oc). See Section 6.4.3 for a discussion of recycling paint waste.

Latex paint waste collected is reused as paint whenever possible. The proportion of paint that is reusable varies in part by climate. Paint that has frozen and then thawed cannot be used In Minnesota, approximately 45 percent of latex collected is reusable. Latex paint recycling is further discussed in Section 6.4.3. Most collection programs treat latex paint that is not reused as hazardous waste, blending it for fuel or disposing of it in a hazardous waste landfill (HHWMN, 199Ob). Seattle is currently experimenting with solidifying latex waste for safe disposal in solid waste landfills. Although further tests are needed, preliminary results indicate a potential lead leachate problem (Seattle Solid Waste Utility, 199Oa).

For the last few years, IEPA has sponsored six to ten local household hazardous waste collections annually. IEPA pays for the cost of waste collection, packaging, transportation, and disposal, while the sponsoring community handles all publicity and promotion (IEPA, 199Oa). A 1988 Champaign County household hazardous waste collection brought in 5,628 containers of hazardous materials. Approximately 20 percent of these containers were organic solvent-borne paints. It is important to note that container size and capacity varies; the actual volume of paint waste collected was not determined (Oldakowski, 1990).

Problems exist with household hazardous waste collections. Participation rates are low on average, as low as one or two percent of households (Meiorin and Purin, 1989). The portion of hazardous materials actually diverted from the solid waste landfills is unknown. Disposal of the hazardous substances collected is very costly for the sponsoring agencies (Spencer, 1989). Some communities recycle the hazardous wastes collected to help offset these disposal costs.

6.4.2 Recycling Opportunities for Household Paint Waste

Many communities that collect household paint wastes have instituted programs to recycle the paint products. Of these programs, the most common and least expensive are programs that give away the reusable paints, either to public agencies and nonprofit groups or to residents through 'drop and swap" programs. Other programs reprocess the leftover paints, sometimes adding virgin ingredients as needed to improve the quality and performance of the recycled paint. The reprocessed paint is generally distributed to public agencies and used in public housing and graffiti abatement programs.

An important step in recycling programs is sorting the paint waste. In general, approximately 50 percent of latex paint collected and 20 to 30 percent of organic solvent-borne paint collected is reusable, although the reuse of organic solvent-borne paints is not common (HHWMN, 1990c). Paint cans are opened and checked for possible contamination, solidification, "souring," separation, or congealing. Paints exhibiting any of these characteristics are not reusable and are generally disposed of as hazardous wastes. In addition, collected paint may be screened for potential toxic content. White, orange, or yellow paints manufactured before 1973 may contain lead in concentrations exceeding regulatory limits (Seattle Solid Waste Utility, 199Oa). Latex paints labeled "mildew-resistant" may have a high mercury content; such paints should be reused only for exterior applications (HHWMZV, 199Oa). In its pilot solvent paint recycling project, the city of Seattle also rejected metal primers, shellacs, stain sealers, metallic paints, and other specialty paints as likely to contain mercury, lead, or pesticides (Seattle Solid Waste Utility, 1990b). Finally, paints that are reusable are often sorted by color, light-colored paints are generally preferred by ***users.***

For drop and swap programs, reusable paints are generally given away in their original containers. For other recycling programs, **transportation costs can be reduced** by consolidating the paint into 55-gallon drums. The process of opening each can and scraping out the paint takes about one hour per drum (HHWMN, 199Oc).

In a pilot project, Seattle tested reprocessing organic solvent-borne paints for potential sale to residents or public agencies. Collected organic solvent-borne paints were carefully sorted to eliminate paints with hazardous constituents or that were no longer useable. Paints were then sorted and consolidated based on color. The consolidated paint was taken to a local organic solvent-borne paint manufacturer and tested for hazardous components. No hazardous components were detected that compromised the use of the paint. A second set of tests was conducted to determine the quality characteristics of the paint. Although virgin ingredients were added to the paint to improve its performance, the recycled paint could not meet the quality specifications. The resultant low-quality paint was determined not to be sufficiently marketable. Seattle determined that a market price of $4 per gallon would be required for such a low-grade material. At that price, recycling the solvent-based paint would cost an estimated $23,000 more than hazardous waste disposal over a five-year period. In addition, the city questioned whether an organic solvent-borne paint ***should be*** marketed to residents, given that the government currently encourages residents to use latex. Based on the results of this pilot project, the city did not recommend organic solvent-borne paint reprocessing (Seattle Solid Waste Utility, 199Ob).

In a second pilot project, Seattle studied the potential for reprocessing and marketing leftover latex paints. As with the solvent paint project, a critical step in the latex recycling was to carefully sort the paints to eliminate unusable paints or paints with hazardous constituents. The consolidated paint was tested for ethylene and diethylene glycols and heavy metal concentrations. (The federal government has set a labeling threshold of 10 percent concentration for each glycol.) All constituents tested were below regulatory thresholds. The paint was also tested for quality, and ingredients were added to improve performance. Subsequent lab tests demonstrated that the recycled paint was of medium quality, a conclusion that was confirmed through field tests and interviews with users of the paint. The paint was sold to paint contractors through retail paint stores at a cost of $5 per gallon (Seattle Solid Waste Utility, 199Oa).

Based on the results of this pilot project, Seattle recommends a permanent latex paint recycling program with the resultant recycled paint sold to public agencies in the area. It was determined that these agencies provide a sufficient market for current quantities of recycled paint; eventually, residentiaI markets can be developed to allow for growth of the quantities produced This program would also support city and state procurement practices that favor recycled products. Initially, the city would retain ownership of the paint and contract with a paint manufacturer and a distributor. After a dependable market has been established, Seattle would contract with a paint company that would assume ownership of the paint and handle all reprocessing and marketing. Seattle estimates that recycling ***45*** percent of the latex paint collected will cut latex paint disposal costs by 25 percent (Seattle Solid Waste Utility, 1990a).

McHenry County, Illinois, is developing a pilot household paint recycling project (Fisher, 1991). The county plans to hold a one-day household paint collection, with collection points set up in each of the three major municipalities in the county. At the collection sites, latex and solvent paints will be separated, and paints will be further sorted based on color (light or dark) and use (interior or exterior). A local paint manufacturer will then test the paint for contaminants, toxic metals, and quality and reblend the paints. The county will provide all administration and staffing for the collection events, and the paint manufacturer will incur all costs for testing and reblending. The pilot project is designed to determine the following:

- quantities of paint that could be collected,
- fraction of the paint collected that is recoverable,
- level of contaminants and toxic components in the recovered paint,
- public acceptance of the recycled product, and
- costs and revenues associated with recycling the paint

The Association of Bay Area Governments (ABAG) in Oakland, California, has identified several barriers to paint recycling:

- A steady, high volume of paint is required to make the recycling practical.
- Manufacturers or retailers have little incentive to participate.
- Hazardous waste permits may be required for storage and licenses for haulers.
- There is potential liability for contaminants in the paint, and testing every drum for a variety of potential contaminants is costly.
- Latex paints may contain mercury, solvents, or PCBs.

Like the Seattle study, ABAG concludes that latex paints offer the greatest potential for recycling. ABAG recommends careful screening of collected paints to exclude paints containing PCBs, mercury, or contaminants. ABAG also suggests that state and local governments take responsibility for distributing recycled paints for use in government operations to avoid extensive warranty and marketing efforts. Finally, programs could be established to recognize paint recycling efforts to provide an added incentive for recycling (Meiorin and Purin, 1989).

6.4.3 Other Waste Reduction Options for Household Paint Waste

Although recycling paint wastes can be more cost-effective and environmentally sound than disposing of the waste, the state of Illinois prefers reductions of waste generation at its source. Household paint waste reduction programs would encourage residents to purchase only the amount of paint needed and to use the least toxic product available for the job.

Working with the National Paint and Coating Association (NPCA) and local retailers, the state could encourage retailing practices that reduce leftover paints. For example, smaller quantities of paint could be sold for prices comparable to larger quantities. Current retailing practice is to sell small quantities at a much higher price per gallon than large quantities, encouraging larger purchases of paint In addition, retailers could be encouraged to take back unopened cans of paint for resale. These unopened cans could be classified as retrograde materials and therefore would not require waste handling permits (Meiorin and Purin, 1989).

A public education campaign could also encourage paint waste reduction. Information could be provided on the following:

- how to determine the correct amount of paint required;
- how to use less toxic paint products for different applications, or what toxic components users should be aware of; and
- how to properly store leftover paints so that they can be reused (e.g., don’t let the paint freeze or add other materials to the paint).

The Paint Management and Disposal Guide (McHenry County, 1991) instructs householders on how to reduce paint waste generation, including the following suggestions:

- Buy only as much as you need
- Buy latex (rather than ***organic*** solvent-borne) paints whenever possible.
- Give away leftovers to churches, schools, or friends.
- If paint is saved store it properly to maintain its quality.

The guide is partly a response to the frequent number of questions concerning proper paint waste management received by the McHenry County Department of Solid Waste Management. Several local paint retailers have asked for copies of the guide to provide to their customers (Fisher, 1991).

Although they do not fall under the category of waste reduction, education programs could also include information to help users reduce their exposure to toxic substances (e.g., instructions to use only in well-ventilated areas and to minimize children's exposure to fumes). The ***Paint Management and Disposal Guide also*** includes instructions for the proper disposal of paint wastes (McHenry County, 1991).

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

The results of this study suggest that a variety of options are available to reduce paint-related waste generation, many of which have been implemented by Illinois paint manufacturers and users. Many of these waste reduction options are available at low cost in Illinois. The major barriers to implementing these options are a lack of technical information and the perception that waste generation is not a problem. The education program discussed in this chapter is designed to provide technical information on waste reduction and to educate users about the effects of waste generation, including the financial costs of waste generation.

Through the course of this study, we found that paint manufacturers are generally more advanced at reducing waste generation than paint users. In part, this difference results from different perspectives on paint. Paint manufacturers are motivated to reduce paint-related wastes to maximize production of their finished product. Paint users, however, generally do not regard painting as their primary business, and painting is just a small fraction of their cost of goods sold. This fact does not imply that paint manufacturers in Illinois do not need to further reduce waste. On the contrary, the site visits indicated that some paint manufacturers could further reduce their waste. This conclusion does support our study's focus on paint users rather than manufacturers.

Our study suggests that most paint-related liquid wastes from industry do not reach the environment untreated. These wastes are either treated in-house or handled by a solvent recycler or fuel blender. The study indicates that the liquid waste handling industry in Illinois manages liquid paint-related wastes from both small and large paint users. However, one very small paint user visited during the course of this study was unaware of solvent recycling opportunities. We recommend efforts to educate firms of this size about options for handling liquid paint-related wastes, as described below. In addition, we recommend specific steps, also described below, for handling liquid paint wastes from households and household painting contractors.

The largest type of air emissions from both paint manufacturers and paint users is VOCs, which contribute to atmospheric ozone pollution. Currently, the Clean Air Act imposes regulations on major sources of VOC emissions (i.e., facilities that release over 100 tons per year). This regulation has already served as an incentive for large facilities to use less paint and to switch to paints formulated with lower VOC content, such as high solids, waterborne, and powdered paints. The 1990 Clean Air Act Amendments lower thresholds for VOC emissions, making additional facilities subject to the Clean Air Act permitting provisions and control technologies. We recommend an education program targeted at facilities now subject to these regulations, to inform them of the regulatory requirements and how they can use waste reduction to comply with the regulations. Waste reduction options include switching to paints formulated with lower VOC content and improving paint transfer efficiencies, which results in less paint being used and therefore reduced VOC emissions.

Further study is needed to determine the extent of environmental hazard due to land disposal of paint-related wastes. In particular, the leachate hazard of disposing of paint products in municipal landfills is unknown. Paint products containing toxic metals, organic solvents, or pesticides pose the greatest potential environmental threat. We recommend that these products be recycled in an environmentally sound manner or disposed of in a landfill registered to receive that type of waste. Implementing this recommendation may require enhanced enforcement of special waste regulations for industry and commercial operations and establishing additional household hazardous waste collection programs. These options are further discussed below.

For the purposes of conducting this study, an Ad Hoc Advisory Group (AHAG) was formed. AHAG consists of representatives of Illinois paint manufacturers and industrial and commercial paint users, Although initially formed to provide input and review for this study, we recommend that this group be maintained to provide input in implementing the recommendations. The group would fulfill two functions. First, it would provide an insider's view of the complex issues related to paint use in a variety of industries. The results of this study indicate that paint use and the types of paint used vary greatly, and any technological assistance must be tailored for each applicable industry. Second, we recognize that implementing any change involves some risk and uncertainty. Because AHAG members can ensure the effectiveness of recommended technologies, the group will encourage the implementation of recommended changes. In both functions, the group serves as a liaison between government agencies and the industries that the members represent.

This chapter presents our recommendations for programs to promote paint-related waste reduction and environmentally sound disposal, including an education and public communication program. The state of Illinois prefers waste reduction or recycling to disposal whenever feasible. The following recommendations incorporate this state policy.

7.1 RECOMMENDATIONS FOR PAINT MANUFACTURERS

Waste reduction has been implemented to comply with environmental regulations and to reduce waste management costs. The results of this study suggest that paint manufacturers have made significant progress in reducing their waste generation. Probably the greatest incentive to reduce waste generation for paint manufacturers has been to reduce materials cost and the loss of product.

Two recent regulatory changes, when implemented, will create additional incentives for paint manufacturers to reduce waste generation. The 1990 Clean Air Act Amendments require reductions in VOC emissions and the VOC content of paint. Waste reduction options can be implemented to reduce VOC emissions. Revised RCRA regulations increase regulatory requirements on the burning of hazardous waste for fuel, a common waste management practice for paint-related wastes. This regulation could decrease the availability and increase the cost of reusing hazardous waste as fuel. Waste reduction could reduce these waste management costs.

An education program for paint manufacturers could include information on technologies to reduce VOC emissions and waste management costs. In addition, paint manufacturers could identify profitable waste reduction opportunities by implementing full-cost accounting and materials accounting. Information on both these accounting methods could also be included in an education program.

Finally, paint manufacturers can play an important role in waste reduction and recycling for wastes generated from using paint. For example, reducing the VOC content of paint reduces VOC emissions at the manufacturing facility and during paint application and curing. Paint manufacturers could also participate in a household waste recycling program. Participation could include taking back and reusing empty paint cans or reblending leftover paints collected from households. We recommend that the state of Illinois solicit the participation of local paint manufacturers in recycling programs.

7.2 RECOMMENDATIONS FOR INDUSTRIAL USERS OF PAINT

Because OEM manufacturers' primary business is not painting, they do not always realize the amount of paint-related waste they are generating. Therefore, educating these firms on the costs of paint-related waste generation and potential waste reduction options should be the focus of a waste reduction program.

The area that offers the greatest potential for waste reduction for OEM manufacturers is improving paint transfer efficiency. Because transfer inefficiencies are a large source of solid, liquid, and air emissions and a source of paint loss, improving them is a financial incentive. Generally, technologies are available to improve transfer efficiency. To encourage the implementation of these technologies, we recommend

- technology demonstrations,
- the distribution of vendor lists,
- a tax credit for capital expenditures, and
- case studies and news releases (to be distributed through trade associations and trade journals).

Liquid paint-related wastes generated by OEM manufacturers are usually sent offsite to solvent recyclers or fuel blenders. We found this an excellent way to manage these wastes and do not recommend any alternatives. But we do recommend that steps be taken to ensure that all users are familiar with recycling opportunities. For example, one step provides lists of recyclers to paint users. The site visit results also indicated that some fuel blenders are blending solid paint wastes such as filters from overspray capture devices. We recommend this as an alternative to landfilling these solid paint-related wastes and recommend that the availability of this service be advertised through trade journals.

New RCRA regulations on fuel blending have been issued that might affect the cost and availability of fuel blending. In particular, manufacturers of wood products expressed concern about these new regulations during site visits. We recommend further evaluation of the impacts of these regulations on disposal options for paint-related wastes. One possible result of these regulations, if they do limit fuel blending opportunities, would be to provide additional incentives for waste reduction.

During the course of this study, we identified a problem with the disposal of solid paint-related wastes. Generally, these wastes are subject to Illinois special waste regulations and should be transported by a licensed special waste hauler to landfills licensed to accept the waste. However, these wastes are often disposed of in municipal landfills without using licensed haulers. This situation seems to result from a lack of information on special waste regulations and a lack of enforcement of these regulations. We recommend combining an education program on special waste regulations with additional steps to enforce these regulations. In addition to ensuring that these wastes are disposed of properly, these additional steps will draw greater attention to these solid wastes, and the additional costs and management steps required to comply with special waste regulations may provide an incentive to reduce these wastes.

7.3 RECOMMENDATIONS FOR AUTO BODY REPAIR SHOPS

Auto body repair shops generate paint-related wastes similar to those generated by OEM manufacturers. The major differences are that auto body shops are generally smaller with less available resources and paint usage is generally a larger part of their businesses.

One important source of waste generation from auto body shops is leftover thinners and paints. We recommend that any leftover paint products be reused onsite whenever possible. For example, old paints can be blended with thinner and used as an undercoating. Thinners and paints that cannot be reused onsite should be managed by a solvent recycler or fuel blender. We recommend that Illinois initiate an education campaign be initiated to ensure that all auto body shops are familiar with these recycling opportunities. One option to increase familiarity with recycling opportunities is to compile lists of available recyclers for paint users and include instructions to maximize the recyclability of their wastes.

A second area that offers the potential for waste reduction from auto body shops is improving transfer efficiency. Because improving transfer efficiency results in less paint being used and therefore reduced paint purchasing costs, auto body shops have a direct financial incentive to improve paint transfer efficiency. We recommend that Illinois encourage this improvement by relating information on changes in application techniques. Information could be distributed through trade journals and paint vendors. Also, small regional conferences could be held to demonstrate the new technology.

As with OEM manufacturers, we found indications that auto body shops are not disposing of their solid wastes in accordance with special waste regulations. Again, we recommend combining an education program on special waste regulations with additional steps to enforce these regulations. These steps could encourage the proper disposal of these wastes, and the greater attention and costs imposed by the special waste regulations may provide an incentive to reduce these wastes. A second option is to requite new auto body shops to demonstrate that they have arranged for a licensed waste hauler, as part of obtaining an auto body license.

One problem unique to auto body repair shops is the potentially large number of unlicensed shops. These shops include small, part-time operations conducted in a residential garage or backyard We identified no information on such operations during the course of this study, but such shops may not utilize the recommended methods of waste disposal, including solvent recyclers and licensed special waste haulers. Contacting such operations as part of an education program would be difficult. One option is to make information on practices to reduce waste generation available through paint vendors.

7.4 RECOMMENDATIONS FOR HOUSEHOLD USERS OF PAINT

Household users of paint should observe the following guidelines to reduce household paint waste generation:

- Buy only as much paint as needed to complete a job.
- Buy the least-toxic paint available for a given application.
- Use good application procedures to minimize spills and drippage and the amount of paint used.
- Store paints properly to ensure they maintain their effectiveness.
- Find a user for any leftover paints (e.g., donate to church, school, or community theater).

We recommend that these guidelines be included in education materials such a brochures and posters displayed at paint retailers. These education materials should also include specific instructions for proper disposal of paint-related wastes.

We also recommend that Illinois study the possibility of establishing a household latex paint recycling program, in conjunction with county governments and local paint manufacturers. Prior to initiating such a program, Illinois must secure a viable market for the reblended paints. The state could explore the possibility of purchasing the recycled paint Paint cans collected at a household paint collection can also be recycled. Further study is needed to identify potential metal recyclers and markets for the recycled product.

The potential for leachate formation from paint and its associated hazards is unknown at this time. Because of their mobility, we recommend that liquid paints and paint-related wastes not be disposed of in municipal landfills.

Some communities recommend allowing paint-related wastes to dry and then disposing of them in municipal landfills. For organic solvent-borne paints and thinners, the evaporation of VOCs during drying contributes to air pollution. Therefore, we do not recommend that the state of Illinois advocate this method of disposing of wastes containing organic solvents. Instead, we recommend that these products be collected through household hazardous waste collection programs and then sent to a solvent recycler for management.

For latex paint waste, we recommend that toxic chemical leaching procedure (TCLP) testing be conducted to determine the potential leachate hazard of dried latex paint. Even if studies determine that dried latex paint does not pose a leachate hazard, finding another user for the paint or taking it to a collection center for reblending is preferred to air-drying and landfilling the paint.

7.5 RECOMMENDATIONS FOR HOUSEHOLD PAINTING CONTRACTORS

The results of this study suggest that household painting contractors generate paint waste and manage their wastes in the same manner as household users. The education materials described in Section 7.4 are also applicable to painting contractors. Painting contractors do not have the same incentives to minimize paint use as householders, because they pass on all the costs of the paint to their clients. Nonetheless, a painter who uses less paint could have a competitive advantage.

In Section 7.4, we recommend a latex recycling program for household users of paint that is also applicable to painting contractors. However, Illinois special waste regulations might impose additional constraints on recycling paint from commercial contractors. If applicable, we recommend exempting latex paint from special waste regulations to allow contractors to participate in a latex recycling program.

A second potential regulatory constraint on recycling is federal RCRA regulations. Unlike household wastes, wastes from painting contractors are not automatically exempt from RCRA hazardous waste regulations. If it cannot be determined, through sorting or testing paint waste, that all wastes taken to a latex paint recycling center are non-hazardous (based on RCRA definitions), a collection facility would need to assure that each firm drops off less than 22 gallons of hazardous paint waste in a single month and that no waste remains onsite for longer than 90 days.

Currently, paint wastes from household painting contractors are disposed of in municipal landfIlls. As explained in Section 7.4, further study is needed to determine the potential leachate hazard these wastes pose in municipal landfills. If these wastes do pose a leachate hazard, we recommend that they be collected in household hazardous waste collections. This may require exemptions from special waste regulations and as described above, steps taken to ensure compliance with federal RCRA regulations.

7.6 RECOMMENDED EDUCATION PROGRAM

The following educational program recommendations were developed from a review of the information collected during this study. Paint Survey results indicated the sources of information currently used by Illinois firms and the types of additional information firms require. The site visits provided information on processes used to manufacture and apply paint, management attitudes toward the use and disposal of paint, and management attitudes toward the adoption of new technologies or procedures. A third source of information was the variety of educational material and reports in the HWRIC resource collection, along with guides to paint use and waste management developed in other states. These materials demonstrated both effective and ineffective ways of promoting improved paint use and disposal methods.

The site visits indicated that managers would be willing to make changes if those changes result in increased profitability, safety, compliance with state and federal regulations, or, to a lesser extent, an improved public image. The site visits also highlighted the extent to which training is irregular and depends on an informal apprentice-to-expert progression. Although this training may be effective, instructions passed on by employees may not be consistent, even if the same employee provides the instruction.

These recommendations are based on the recognition that Illinois firms have different levels of expertise in and resources for reducing and managing paint-related waste. They take into account the differing abilities of paint users, in particular, to adopt new procedures. We also recognize the limited number of changes any paint manufacturer or user is likely to make. Therefore, the education materials we recommend are designed to suggest changes that are easy to adopt and to provide benefits that are immediately evident.

7.6.1 Conceptual Basis For Educational. Program Recommendations

Three concepts were used to develop the recommended education program:

- the use of case studies to demonstrate effective and ineffective practices;
- the effectiveness of insiders in encouraging the adoption of new practices; and
- the use of effective on-the-job training to change behavior.

Case studies are valuable for suggesting practices that could be applied in similar settings. For example, conclusions based on the site visits conducted as part of this study could be generalized to other firms in a similar setting. The site visits could be used to develop case studies.

The site visits were complemented by a literature search that examined when and how a variety of minor and major changes are made. In particular, we reviewed literature that emphasizes the credibility of “insiders” (those already accepted as members of a particular group) who try a new approach and find it of value. The fact that these insiders have adopted a new approach increases the likelihood others will do the same (Rogers, 1983). In addition, research by Havelock (1976) points out that the successes and failures of early adopters are powerful examples to more conservative and less innovative colleagues.

Finally, many studies of training as a factor in achieving behavioral change were evaluated. Houle’s (1972) work on the importance of limited objectives for each training session and the clarity of the subject matter covered at these sessions is an important guide to developing training programs. Houle further points out that individual instructional activities should fit into a larger context, so that individual efforts to improve performance are related for example, to improved company profitability or increased compliance with state and federal regulations.

In his guidelines for effective educational programs, Houle also suggests two important factors that have a significant impact on the willingness of an individual to listen and to learn: “need to know” and “teachable moments.” Employees have a need to know if the training information eliminates an evident gap in knowledge or skill and if the information can be used immediately. A teachable moment occurs when employees have the time, energy, and attitude to be active learners.

In addition to the Houle material, studies of industrial training (Jacobs, Kerrigan and Luke, 1987) recommend that what was presented in training be included in job performance expectations. For example, if procedures for handling small spills were demonstrated in training, then employees should be expected to clean up spills using those procedures. These studies suggest that reminding employees of the material covered in training and rewarding them for following established procedures strengthen behavior. Research on reinforcement (Grippen and Peters, 1984) suggests that informing employees of performance expectations through training can change behavior. The research also suggests that people understand a process better when it is broken down into small segments.

In all training activities, the role of supervisors with direct and continuing employee contact is critical. Martin Broadwell (1967) points out that supervisors who provide on-the-job instruction, monitor performance, and correct employees who err are effective trainers. The supervisor's continuing observation and emphasis on following correct procedures is particularly important

7.6.2 Description of Educational Materials

These recommendations address materials for an overall education program as well as the specific products that could be made available to paint manufacturers and the variety of paint users in Illinois. Special attention is given to auto body repair shops, household users, and commercial painters.

The educational materials can be grouped into three categories:

- reinforcement material for those already conscious, to some extent, of the need for effective paint-related waste management methods and who would benefit from guidance and support from those in their industry;

- training material for those employees and supervisors in industries whose attention to this area is limited; and

- public information items designed to inform and potentially influence some modest change in public practice.

All material should be developed with the appropriate trade associations to increase the likelihood of the materials being used. Participation by trade associations will improve material quality and promote wider distribution. In addition, their active involvement and support for this educational program add credibility.

7.6.2.1 Reinforcement Materials

Reinforcement material includes items such as news releases, trade journal articles, and brief presentations at trade association meetings that emphasize effective practices and recognize specific companies and individuals responsible for developing these practices. Brief case studies or easily understood descriptions are especially important to show what actually is being done in various ***manufacturing*** and use settings, the results achieved, and the resulting cost-savings. The focus should be on what has and hasn't worked, the reasons why, and the lessons that can be learned from each experience. Table 7-l lists topics for this material. Because much can be learned from unsuccessful efforts to use and dispose of paint, paint manufacturers and commercial users of paint should be encouraged to provide information on both success and failure.

Table 7-1. Topics for Articles, Presentations, and Case Studies

1. Topics demonstrating successful practices and procedures
   a. Effective techniques for reuse of clean-up solvent
   b. The development of effective waste management teams
   c. Effective techniques for cleaning equipment
   d. Effective methods for rapid and complete clean-up of small spills
   e. The successful introduction of new technology
   f. The development of waste reduction methods that lead to cost recovery
   g. Effective techniques to increase transfer efficiency
   h. Effective techniques to monitor transfer efficiency
   i. Use of mass balance material accounting practices

2. Topics demonstrating unsuccessful efforts
   a. A description of biodegradable cleaners which didn't work
   b. The inefficiencies of a solvent recovery still
   c. The difficulties in blending unused solid raw materials
   d. The ineffectiveness of using a high pressure spray system

Along with the descriptions of effective and ineffective waste reduction, guides for auditing practices in the different settings could be developed as accompanying materials. By combining the descriptions with the guides, readers will have a two-part source of useful information. Table 7-2 lists the types of information that could be included in an audit guide.

Table 7-2. Procedures To Be Included in an Audit Guide

1. Inventory Control
a. Procedures for checking in, dating and labeling new materials
b. Procedures for controlling access to new materials
c. Procedures for checking labels, leaky containers, dripped materials and aged materials
d. Procedures for reducing potential spills
2. Storage methods
a. Procedures for assuring containers are kept closed
b. Procedures for keeping different types of waste separated
c. Procedures for separating waste that may react with each other
d. Procedures for using containers compatible with the wastes
e. Procedures for checking that containers are in good condition
3. Disposal methods
a. Procedures for contacting, evaluating and contracting with a registered hauler
b. Proper completion of a hazardous waste manifest to transport waste
c. Use an approved disposal facility

Case studies should focus on practices that could be adopted or should be avoided by other companies or businesses. A simple format should be developed for the case studies, such as the one suggested in Table 7-3. The Washington State Department of Ecology prepared a booklet, "Success Through Waste Reduction: Proven Techniques From Washington Businesses'* (Washington State, 1989), that could be used as a guide to writing case studies.

Additional types of reinforcement materials that would be useful include the following:

- articles on the introduction of cost-saving and waste-reducing new technologies;
- news releases from HWRIC on innovative ways to reduce and manage paint-related wastes;
- short slide or tape presentations that show the technology used by one or more industries to reduce paint-related waste generation;
- short reports for senior management in paint manufacturing or in industries that are major users of paint The reports should highlight progress made in waste reduction and recommend additional steps that might be taken with management support; and

Table 7-3. Suggested Outline for Case Studies

1. The Setting Emphasize the situation before action was taken, with attention to such areas as the amount of waste generated and the amount of material needed to paint a product or a surface. **2.** The Problem Provide information on what the problem was and why it existed. **3.** Steps Taken Include information on who led the change, steps taken to increase acceptance of the changes, and the extent of attitude and behavior change that was required. **4.** Results Include information on cost savings, affect on product quality, compliance with the law, and improved public image.

. booklets containing case studies demonstrating how profitability has been increased through waste reduction practices.

The strength of these materials is their reliance on information from paint manufacturing and use in Illinois. The cooperation, support, and involvement of the various trade associations as these items are developed will increase their value and use.

7.6.2.2 Training Materials

Training materials can be used for initial and ongoing employee training, particularly in those businesses and industries that use paint and employ individuals who could improve their use and waste disposal methods. These materials will be for both employees and supervisors; a great deal of emphasis will be placed on the role that first-line supervisors play in training and in reinforcing sound paint use and disposal habits. Based on the importance of reinforcement, the material also should contain specific suggestions for follow-up. The material will pay particular attention to possible employee slippage through lack of attention to their work and to the reappearance of bad habits. Some of the material for employees can be adapted for use by community colleges and vocational centers to be used in their automotive training curriculum Table 7-4 contains a list of topics that could be covered at training sessions. A variety of existing guides on the disposal of hazardous waste could be used to prepare this training material.

Table 7-4. Topics for Training Sessions

1. Initial training for new employees
   a. Employee's responsibilities and their contribution to company success
   b. The specific tasks to complete employee's responsibilities
   c. The areas in need of particular attention
      - Equipment operation
      - Position of materials when being painted
      - Where waste can occur in application of paint
      - Where spills are most likely
      - Regular clean up of the work area
      - Clean up in special circumstances, such as an unexpected spill

2. Ongoing reinforcement training
   a. Specific improvements needed in machine operation
   b. Waste reduction possible through greater attention to the amount of paint used
   c. Improve clean up of equipment and work areas
   d. Preparation of products or surfaces prior to painting

The training material should be very simple, short, and easily reproduced by individual companies or businesses. Ideally, the material should be in a package that would allow a manager or supervisor to select individual items for short training sessions. Typically, these sessions should be no longer than 20 minutes and be focused on one or two topics. In addition, materials should have similar formats so that instructors can develop a simple routine to follow. Several options for training materials are available:

- Posters can emphasize different waste reduction steps that employees can implement.

- Reminder sheets can be distributed to new employees at orientation sessions or posted as reminders. The materials should be specific to each industry and should stress best practices and the value of these practices. Table 7-5 contains a sample version of a reminder sheet.

Table 7-5. Sample Reminder Sheet for an Auto Repair Shop

1. Clean up spills immediately with sawdust or some other absorbent.
2. Do not let waste accumulate--clean up small spills immediately with a mop or rag.
3. Launder dirty rags on a regular basis.
4. Use a drip pan if you expect a leak when working on parts of the engine.
5. Keep a log of larger spills to document quantity.
6. Keep parts cleaning equipment near service bays.
7. Allow cleaned parts to drain thoroughly.

- Guides can be created for managers to conduct 5- to 15-minute reminder sessions on the best use of paint material and legally acceptable steps for paint disposal.
- Checklists can be developed for supervisors and managers to evaluate employees who are using or disposing of paint and to suggest ways to correct or improve employee performance, using short on-the-job training sessions. An adaptation of these checklists could be used by managers to evaluate how effective supervisors are at observing employee performance and correcting it by working with individuals or by conducting group training sessions.
- Guides can be created for managers to review overall progress made in transfer efficiency and in developing effective disposal methods. These guides would be in questionnaire form, which managers could require first-line supervisors to complete periodically.

The information gathered from monitoring can be used by managers to applaud progress and to suggest needed improvement. Information obtained over a period of time can demonstrate how much has been accomplished through consistent use of clear performance standards.

7.6.2.3 Public Awareness MateriaIs

Public awareness material includes those items designed for household users that could be put on paint cans, distributed by paint and hardware stores, or given out through the schools. These materials should be developed in cooperation with paint manufacturers and paint retailers and could be an example of how these industries are involved in improving the quality of the environment through promoting effective paint management practices. The material should be specific, such as addressing how to best use paint to touch up a car or how to dispose of cans of leftover paints. Appendix C contains a list of the types of material already available and suggests how these materials might be modified.

Public awareness material should be simple and easily included with paint products that are sold to the general public or distributed to students. Different types of public awareness materials are needed:

- Paint producers in the state could copy and give single sheets of suggestions for paint use and disposal to retail outlets for distribution to their customers.

- Adaptations of that same information could be provided to science teachers in elementary and secondary schools in a form that students can take home to remind parents. Material also could be adapted for use in vocational and adult education courses in high schools and community colleges.

- News releases could be sent out in a regular sequence to newspapers in the state to remind the general public of effective paint use and disposal methods.

- Recycling centers could make information (especially that related to leftover paints from home improvement projects) available to the clients they serve. That information could suggest disposal methods for the solids left after drying. The material also could be provided to Cooperative Extension Service (CES) offices throughout the state; CES is actively involved in promoting improved waste management.

7.6.2.4 Evaluation Methods

Some thought should be given to evaluating the effectiveness and impact of the various educational products. Determining exactly to what extent materials and programs have led to changes in behavior and performance is difficult. Simple evaluation forms could be developed to determine the degree to which existing training material was accepted and used, how it was used, and the perceived value of the various items. Following are three examples of simple evaluation methods that could be used.

- Pre-addressed post cards which contain six to eight forced choice (true/false or scaled) questions and are inserted in case study booklets or included with training slide or tape presentations.
- A one-page evaluation form, along with a pre-addressed return envelope, included with the training material, that either supervisors or managers could complete and return to HWRIC.
- A similar evaluation form sent to high school or community college instructors who use training material in their automotive classes.

7.7 FUNDING FOR RECOMMENDED PROGRAMS

Each of the above recommendations will require additional funding to implement. This section includes suggestions for funding alternatives.

For paint manufacturers and other manufacturers that use paint, one funding option is a fee on emissions of toxic chemicals reported in the Toxic Release Inventory (TRI). Many paint-related wastes are toxic chemicals subject to TRI reporting. If this fee were related to the amount of emissions, it would provide a financial incentive for Illinois firms to reduce their paint-related wastes.

A second funding option is the Clean Air Act fee. Some of the funds generated by this fee could be apportioned for educational programs targeted at paint manufacturers and industrial users of paint

Auto body shops are not subject to TRI reporting requirements and therefore would not be subject to a fee on TRI emissions. Options to finance an education program targeted at this industry include a fee on paint purchases or an increase in licensing fees. A fee on paint purchases has the added benefit of increasing the financial incentive to use paint more efficiently. A disadvantage of increasing licensing fees is that these fees are paid only by the licensed members of the industry; thus, the licensed shops would be financing technical assistance for non-licensed shops, which would not be equitable.

Currently, Illinois assesses a fee on generators of hazardous waste and special wastes. Increasing this fee is another possible source of funding for a paint waste reduction program. Many Illinois paint manufacturers and industrial and commercial paint users are included in this fee requirement.

Waste reduction programs targeting household paint contractors and household users of paint could be financed through a fee on retail paint purchases. The fee could vary by the type of paint purchased, with a larger fee for paints containing organic solvents or specialty paints that may contain pesticides. These types of paint may be more toxic or may generate more waste. Such a fee would provide a financial incentive to use paint more efficiently, buy only as much paint as needed, store paint properly to prolong its shelf life, and purchase the least toxic or waste-generating type of paint Such a fee would be less effective at reducing paint waste from paint contractors because the clients bear all the costs of paint purchased by contractors.

A second funding option for programs related to household users of paint is a drop-off fee for household hazardous waste collections. The disadvantage of this funding option is that it discourages proper disposal of household hazardous waste. To be effective, such a fee would have to be accompanied by a ban on the disposal of household hazardous wastes and paint products in municipal landfills that included an effective enforcement component.

Household waste reduction programs could be financed through an increase in tipping fees charged by municipal solid waste landfills. An increase in tipping fees is relevant because reducing waste going into these landfills is a major goal of a paint waste reduction program.

Paint manufacturers and users are receptive to suggestions that will reduce waste generation and therefore operating expenses. Development of educational programs to promote pollution prevention is essential to the development of proper waste management practices by paint manufacturers and users alike. This will only be possible through implementation of one or more of the funding options suggested above.

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GLOSSARY

ABAG. Association of Bay Area Governments.

AHAG. Ad Hoc Advisory Group.

Additive. Any substance added in small quantities to another substance usually to improve properties. Also sometimes called Modifier.

Airless Spraying. Process of atomization of paint by forcing it through an orifice at high pressure. This effect is often aided by the vaporization of the solvents, especially if the paint has been previously heated. The term is not generally applied to those electrostatic spraying processes which do not use air for atomization.

Aliphatic Solvents. Solvents composed primarily of straight-chain hydrocarbons; examples: kerosene, naphtha, mineral spirits. Aromatic hydrocarbon content may range from less than 1% to about 35%.

Architectural Coatings. Coatings intended for application to interior or exterior surfaces of residential, commercial, institutional, or industrial buildings-as opposed to industrial coatings. They are protective and decorative finishes applied at ambient temperatures. These coatings are distributed through wholesale-retail channels and purchased by the general public, painters, building contractors and others. Also called Trade Sales Coatings.

Aromatic Solvents. Solvents made of compounds that contain an unsaturated ring of carbon atoms, typified by benzene's structure. Xylene and toluene are aromatic solvents used in coatings.

Baghouse. Mechanical air handling system to collect and filter out airborne particulates from the work environment. The separated particulate material is then deposited into a container (e.g., a 55-gallon drum) for further handling and disposal.

Binder. Nonvolatile portion of the liquid vehicle of a coating. It binds or cements the pigment particles together and the paint film as a whole to the material to which it is applied.

CEG. Conditionally exempt generator.

CES. Cooperative Extension Service.

CFC. Chloroflouroarbons.

Chlorinated Solvent. An organic solvent that contains chlorine atoms as part of the molecular structure. For example, methylene chloride and 1,l,l-trichoroethane, the most common, are used in aerosol spray containers and in traffic paint. See also Halogenated Solvents.

Coating. (1) Generic term for paints, lacquers, enamels, printing inks, etc. (2) A liquid, liquefiable or mastic composition which is converted to a solid protective, decorative, or functional adherent film after application as a thin layer.

Coil Coating. Process wherein a continuous coil of metal is unwound, cleaned, surface-treated, coated, heat-cured, cooled, and coiled in one operation. The coated coil is subsequently unwound and formed into any number of products, such as house siding, Venetian blinds, and automotive and appliance parts.

Convertible Coating. Irreversible transformation of a coating after its film formation to a film insoluble in the solvent from which it was deposited. This can be effected by oxidation, thermal crosslinking or catalytic curing.

Deposition Efficiency. See Transfer Efficiency.

Dispersant. Additive that increases the stability of a suspension of powders (pigments) in a liquid medium. Also know as Dispersing Agent.

Dispersion, Pigment. Suspension of pigment particles uniformly in a medium such as a paint vehicle, plastic matrix, etc. The process of dispersing the pigment involves the separation of individual pigment particles, and coating them with the medium.

Dispersion. Process of dispersing a dry powder (or pigments) in a liquid medium in such a way that the individual particles of the powder become separated from one another and are reasonably evenly distributed throughout the entire liquid medium. The dispersion process can be segmented into three distinct phases. In practice, these stages overlap and occur simultaneously rather than consecutively during the dispersion process. The three stages are: (1) wetting; (2) particle separation; and (3) stabilization. Wetting involves replacement of the pigment-air and pigment-moisture interface with the pigment-vehicle interface. During the particle separation stage, reduction of pigment agglomerates and aggregates is affected. Development and maintenance of a homogeneous distribution of pigment particles (aggregates) in the liquid media is achieved during the stabilization stage. See also Dispersion, Pigment.

Electrostatic Spraying. Methods of application spraying in which an electrostatic potential is created between the article to be coated and the atomized paint particles. The charged particles of paint are attracted to the article being painted and are there deposited and discharged. The electrostatic potential is used in some processes to aid the atomization of the paint.

Emulsion Paint. Paint, the vehicle of which is an emulsion of binder in water. The binder may be oil, oleoresinous varnish, resin or other emulsifiable binder. Not to be confused with a latex paint in which the vehicle is a latex.

Enamel. Topcoat which is characterized by its ability to form a smooth surface; originally associated with a high gloss, but may also include lower degrees of gloss, i.e., flat enamels.

ENR. Illinois Department of Energy and Natural Resources.

EPI. Environmental Purification Industries.

Extender (Pigment). A specific group of achromatic pigments of low refractive index (between 1.45 and 1.70) incorporated into a vehicle system whose refractive index is in a range of 1.5 to 1.6. Consequently, they do not contribute significantly to the hiding power of paint. They are used in paint to: reduce cost, achieve durability, alter appearance (e.g., decrease in gloss), control rheology and influence other desirable properties. If used at sufficiently high concentration, an extender may contribute dry hiding and increase reflectance.

FIFRA. Federal Insecticide, Fungicide, and Rodenticide Act.

Gloss. Subjective term used to describe the relative amount and nature of mirror-like (specular) reflection. Different types of gloss are frequently arbitrarily differentiated, such as sheen, distinctness-of-image gloss, etc. Trade practice recognizes the following stages, in increasing order of gloss: Flat (or matte)-practically free from sheen, even when viewed from oblique angles (usually less than 15 on 85° meter); Eggshell-usually 20-35 on 60° meter; Full gloss-smooth and almost mirror-like surface when viewed from all angles, usually above 70 on 60° meter.

Grinding. Process by which pigment particles ate reduced in size, mechanically.

Halogenated Solvents. The solvents containing halogen (usually chlorine) have improved solvency compared with the hydrocarbons from which they are derived and in addition flammability is reduced. Some of these are highly toxic, and precautions must be taken to avoid inhalation of their vapors. See also Chlorinated Solvents.

Hazardous Substance. A substance which, by reason of being explosive, flammable, poisonous, corrosive, oxidizing, or otherwise harmful, is likely to cause death or injury. Element or compound which, when discharged in any quantity, presents an imminent and substantial danger to the public health or welfare.

HCFC. Hydrchloroflourocarbons.

Heavy Metals. Metallic elements with high molecular weights generally toxic to plant and animal life. Examples: mercury, chromium, cadmium, arsenic, lead, etc.

High Solids Coatings. Usually paints with greater than 60% solids by volume are considered high-solids coatings, although the term is often applied to any coating that meets any of EPA’s Control Technique Guidelines. Formally, under California’s Rule 66, a high-solids paint is one containing not less than 80% solids by volume.

HVLP. High-volume, low-pressure.

HWRIC. Hazardous Waste Research and Information Center.

IEPA. Illinois Environmental Protection Agency.

Industrial Finishes or Coatings. Coatings which are applied to factory-made articles (before or after fabrication), usually with the help of special techniques for applying and drying-as opposed to trade sales paints. Also refereed to as (Industrial) Product Finishes. See Architectural Coatings.

Industrial Maintenance Paints. High performance coatings which are formulated for the purpose of heavy abrasion, water immersion, chemical, corrosion, temperature, electrical, or solvent resistance. See also Maintenance Paints.

Industrial Product Finishes. See Industrial Finishes or Coatings.

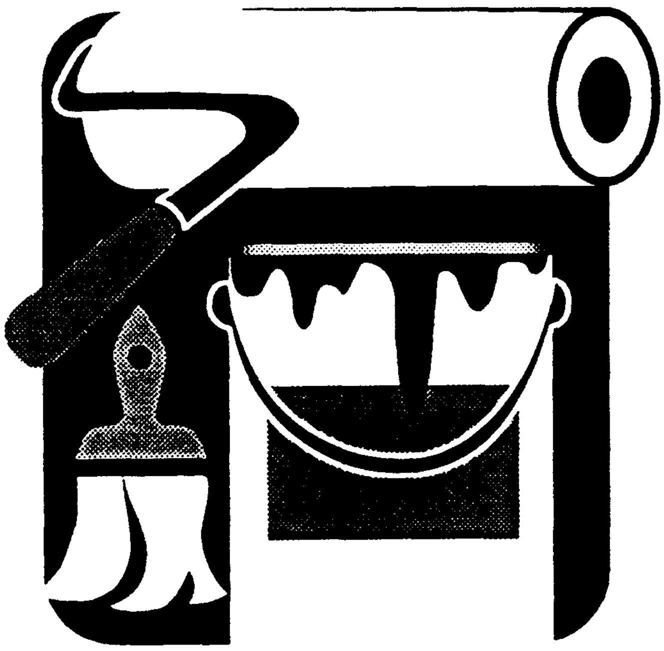
Lacquer. Coating composition which is based on synthetic thermoplastic film-forming material dissolved in organic solvent and which dries primarily by solvent evaporation.

APPENDIX A

PAINT SURVEY QUESTIONNAIRES

HAZARDOUS WASTE RESEARCH & INFORMATION CENTER
One East Hazelwood Drive
Champaign, Illinois 61820
(217) 333-8940

Reducing and Managing Paint-Related Wastes



ENR Illinois Department of Energy and Natural Resources

WHO IS **CONDUCTING THIS SURVEY?**

The Illinois Hazardous Waste Research and information Center (HWRIC), a division of the Department of Energy and Natural Resources. HWRIC is a **non-regulatory** agency providing technical assistance to Illinois industries. Research Triangle Institute has been hired by HWRIC to administer this survey on its behalf.

WHY IS **HWRIC CONDUCTING THIS SURVEY?**

The Illinois legislature directed the Department of Energy and Natural Resources to conduct a study to develop

- “cost effective, environmentally sound, and technically feasible waste paint disposal options for small businesses...” and
- **‘aneffective** public education program to inform small businesses and households about the best available waste paint reduction and management options.”

This voluntary survey supports this **legislatively-mandated study.**

WHAT IS HWRIC GOING TO DO WITH THE RESULTS?

Information will be used to:

- design a program to provide you with the **Information** you need to reduce your paint waste generation, reduce your management costs, and properly dispose of your paint waste.
- make recommendations to the legislature about cost effective **disposal** options for waste paint.

WHO IS GOING TO SEE THE RESULTS?

HWRIC and **its contractors.** All responses are completety **confidential** and will be reported on an aggregate level only. No **specific information about your facility will be reported.**

AFTER COMPLETING THIS SURVEY:

Please return the completed questionnaire to Research Triangle Institute in the envelope provided. No postage is necessary. Please **return the questionnaire** no later than

WEDNESDAY, JULY 31

THANK YOU FOR YOUR HELP IN COMPLETING THIS STUDY.

WHAT YOU NEED TO KNOW TO COMPLETE THIS SURVEY

1. Answer all questions **for your facility.** That is, just include operations at your location. If your company has more than one location, please include information just for the location receiving this survey.

2. **Paint** is defined throughout this questionnaire to include paint and all **related coatings,** including, but not limited to, varnishes, stains, lacquers, and enamels.

3. **Paint related waste** is any non-product output from your paint manufacturing, paint application, or paint removal operations at your facility. This includes waste from paint inventories, from surface preparation prior to paint application, from cleaning painting equipment, and from air pollution control for your painting operations. Please report information before any recycling or treatment (e.g., report the quantity of spent solvents before any solvent recovery).

4. If you don't know **the answer to any question,** please **enter "DK" for "don't know"** in the blank for the question. If a question is not applicable to the operations at your facility, please enter **"NA"** for **"not applicable" in the blank** for the question.

5. The last page of this booklet has **space for any comments or explanations** you wish to provide. If you have a comment that applies to **a** particular question in this survey, please include the question number in your comments.

What are the paint-related activities currently at this facility?

(Please circle one number corresponding to your answer.)

		Applicable Parts of the Questionnaire
01	Applying paint ***only***	***Please complete Parts A, B, D, and E***
02	Removing paint only	***Please complete Parts A, C, D, and E***
03	Applying **and** removing paint	***Please complete Parts A, B, C, D, and E***
04	This facility does not **apply or** remove paint	***Please complete Part E***

A. FACILITY WASTE REDUCTION INFORMATION

(To be completed by facilities applying of removing paint)

Waste reduction is a change in the operations at this facility to reduce the quantity or toxicity of wastes that are generated *before* treatment. Waste reduction activities include

- substitution or modification of raw materials
- changes in production processes
- changes in product design
- changes in housekeeping and operations
- recycling or reusing wastes.

The following questions will help HWRIC to develop a waste reduction information program designed to meet the needs of Illinois facilities.

Questlons 1 to 5 apply* to all *waste reduction activities at this facility.

1. **Has this facility considered changes In Its operations to reduce the generation of Waste?** *(Circle one number.)*

   01 Yes *(CONTINUE TO NEXT QUESTION)*

   02 No *(GO TO QUESTION 3)*

2. **Why has this facility considered such changes?** *(Circle all numbers that apply.)*

   01 To comply with environmental regulations (EPA or IEPA)

   02 To comply with Occupational Safety and Health Association (OSHA) regulations

   03 To reduce the cost of waste management

   04 To reduce costs other than waste management costs

   05 To meet customer demands

   06 To meet community demands

   07 To reduce potential liability

   08 To improve and protect the quality of the environment

   09 Other *(specify):* ______________________________

3. **Has this facility Implemented any of the following programs designed to encourage reductions In waste generation at this facility?**
(Circle all numbers that apply.)

01 Employee training/awareness program

02 Employee incentives program to reward employees for reducing waste generation

03 Written waste reduction policy

04 Cost accounting: charge the costs of waste management to the production activity that generated the waste

05 Quantitative waste reduction goals

06 Conduct waste audits to identify quantities and sources of waste generation

07 Other *(specify):* ____________________

08 None

4. **What sources has this facility used to get information about how to reduce Its waste generation and the benefits of waste reduction?**
(Circle all numbers that apply. If this facility has not used any sources, circle "none':)

01 Trade journals

02 Other periodicals

03 Industry associations

04 Local government

05 State government

06 Federal government

07 Vendors

08 Customers

09 Employees

10 Other *(specify):*

11 None

5. **What types of additional waste reduction information would be useful to this facility?**
(Circle all numbers that apply.)

01 Technical information on technologies to reduce waste generation

02 Financial information on the costs and benefits of waste reduction

03 Onsite technical assistance

04 Information on alternative products and raw materials

05 Other *(specify):* ______________________________

06 None

B. PAINT APPLICATION ACTIVITIES

(To be completed by facilities that apply paint)

The following questions pertain only to this facility's **paint application and related activities.** The information will help HWRIC understand how this facility generates waste from using paint, so that HWRIC can develop an effective education and disposal program.

6. What Is the total quantity of each type Of paint this facility used in its paint application operations during 1990?
*(Enter the quantity in gallons. If none of **a** type of paint was used, enter "0" in the space provided.)*

Type of Paint	Total Quantity Used
a. Organic solvent based coatings:	____,____,____ gallons
b. Water based coatings:	____,____,____ gallons
c. Powder coatings:	____,____,____ pounds

7. What paint application technologies does this facility use for each type of paint?
(Circle all numbers that apply.)

	Organic Solvent Based Coatings	Water Based Coatings	Powder Coatings
a. Conventional spraying	01	02	03
b. Electrostatic spraying	01	02	03
c. Powder spraying	01	02	03
d. Fluidized bed powder coating	01	02	03
e. Dip, flow, or curtain coating	01	02	03
f. Roller coating	01	02	03
g. Tumbling, centrifuging, or barrel coating	01	02	03
h Silk screen coating	01	02	03
i Electrodeposition	01	02	03
j. Other *(specify)* : ____________	01	02	03

8. **List a product code or the name of the product for the six products to which this facility applied the largest quantity of paint in 1990. What is the quantity of each type of paint this facility used during 1990 (in gallons) for each product listed?**
(Please use the product codes from the Appendix at the end of this questionnaire. If a product code for a product is not listed, please write the product name in the space provided.)

	Organic Solvent Based Coatings (gallons)	Water Based Coatings (gallons)	Powder Coatings (pounds)
(1) Product code ___ or product: ______	___,___,___	___,___,___	___,___,___
(2) Product code ___ or product: ______	___,___,___	___,___,___	___,___,___
(3) Product code ___ or product: ______	___,___,___	___,___,___	___,___,___
(4) Product code ___ or product: ______	___,___,___	___,___,___	___,___,___
(5) Product code ___ or product: ______	___,___,___	___,___,___	___,___,___
(6) Product code ___ or product: ______	___,___,___	___,___,___	___,___,___

9. **Does this facility measure the paint transfer efficiency for the paint application techniques it uses? The transfer efficiency is the quantity of paint that coats the surface divided by the total quantity of paint used.**
(Circle one number.)

01 YES, for *all* application techniques used

02 YES, for some application techniques used

03 NO, we do not measure the transfer efficiency of any application techniques

04 Don't know

10. **What kinds of surface preparation does this facility do prior to painting?**
(Circle all numbers that apply.)

01 Physical abrasion

02 Organic solvent cleaning

03 Alkaline or acid cleaning

04 Water cleaning

05 Phosphate or similar conversion coating

06 Other *(specify):* ____________________

07 None

08 Don't know

11. **After applying a batch of paint, how does this facility clean its application equipment?**
(Circle all numbers that apply.)

01 Virgin organic solvents

02 Recovered or recycled organic solvents

03 Alkaline solutions

04 Water

05 Other *(specify.):* ____

06 Equipment is not cleaned between batches

07 Don't know

Questions 12 to 19 apply to paint-application *waste* reduction *activities at* *this* *facility. Please answer only for wastes from this facility's paint application and* associated *operations.*

12. **Has this facility considered making any changes In its paint application operations** since **1987 to reduce the generation of *paint-related* Waste?**
(Circle one number.)

    01 Yes *(CONTINUE TO NEXT QUESTION)*
    02 **No** *(GO TO QUESTION 79)*

13. **Why has this facility considered changing Its paint application operations to reduce waste generation?**
(Circle all *numbers that* apply.)

    01 To comply with environmental regulations (EPA or IEPA)
    02 To comply with Occupational Safety and Health Association (OSHA) regulations
    03 To reduce the cost of waste management
    04 To reduce costs other than waste management costs
    05 To improve process efficiency
    06 To meet customer demands
    07 To meet community demands
    08 To reduce potential liability
    09 To improve and protect the quality of the environment
    10 Other *(specify):* ____________________

14. **Has this facility made any changes In Its paint application since 1987 to reduce its paint-related waste generation?**
(Circle one number.)

    01 Yes *(CONTINUE TO NEXT QUESTION)*
    02 No *(GO TO QUESTION 19)*

15. Has this facility modified **its application techniques to increase transfer efficiency?**
(Circle one number.)

01 Yes - Old technique: ______________________

New technique: ______________________

02 No

16. Has this facility changed surface preparation materials or procedures to reduce waste generation?
(Circle one number.)

01 Yes - Old preparation: ______________________

New preparation: ______________________

02 No

17. Has this facility Implemented any of the following to reduce the generation of waste from cleaning Its paint application equipment?
(Circle all numbers that apply.)

01 Rescheduling paint batches (e.g., light to dark or longer production runs)

02 Dedicating equipment to a single type of paint

03 Reusing cleaning wastes several times to clean different batches

04 Switching to less toxic cleaning solutions

05 Other *(specify):* ______________________

06 None

18. **Has this facility changed the type or formulation of paint It uses to reduce waste generation?**
(Circle all numbers that apply.)

01 Switch to high-solids paint

02 Switch to **water-based** paint

03 Switch to powdered paint

04 Switch to paints with less toxic components in their formulations (other than switching to water-based, high-solids, or powdered paints)

05 Other *(specify):* ______________________

06 None

19. **What are the barriers to reducing or further reducing paint-related waste generation at** this **facility?**
(Circle all numbers that apply.)

01 Technology not available

02 Further change would affect product quality

03 Customer specifications

04 Lack of technical information

05 High cost

06 Too much uncertainty or risk associated with changes to reduce waste

07 Alternative products/raw materials not available

08 Other *(specify):* ______________________

09 None

C. PAINT REMOVAL ACTIVITIES

(To be completed by facilities that remove paint)

The following questions pertain only to this facility's **paint removal and related activities.** The information will help HWRIC understand *how* this facility generates waste from using paint, so that HWRIC can develop an effective education and disposal program.

20. From what objects did this facility remove paint In 1990?
(Please enter a code from the Appendix at the end of this questionnaire for each object. If a code is nor listed, please write *the name of the object in the space provided. List only the eight (8) objects from which the largest quantities of paint were removed in 7990.)*

Object	Number of Objects from which Paint was Removed In 1990
a. ______	___,___,___
b. ______	___,___,___
c. ______	___,___,___
d. ______	___,___,___
e. ______	___,___,___
f. ______	___,___,___
g. ______	___,___,___
h. ______	___,___,___

21. Why **does this facility remove the paint?**
(Circle all numbers that apply.)

01 For inspection

02 Because paint was no longer effective (e.g., cracked, peeling, missing)

03 Because a different color was desired

04 Other *(specify):* ______

22. **What methods does this facility use to remove paint?**
(Circle all numbers that apply.)

01 Sand blasting

02 Abrasive blasting: slag

03 Abrasive blasting: plastic media

04 Abrasive blasting: dry ice or baking soda

05 Abrasive blasting: other materials *(specify):* ____________________

06 Solvent stripping

07 Scraping

08 Molten salt or caustic bath

09 High pressure water sprays

10 Lasers or flashlamps

11 Heat softening/low temperature ashing

12 Other (specify): ______________________________

23. **If using abrasive blasting, does this facility collect and reuse the abrasive media?**
(Circle one number.)

01 Yes

02 No

03 This facility doesn't use abrasive blasting

24. **If using solvent stripping, does this facility recover spent solvents?**
(Circle one number.)

01 Yes

02 No

03 This facility doesn't use solvent stripping

Questions 25 to 28 apply **to paint-removal** ***waste reduction activities at this facility*** *(that is, answer* only ***for*** **wastes** ***from this facility's paint removal and associated operations).***

25. **Has this facility considered making any changes in its paint removal operations since** 1987 **to reduce the generation of *paint-related* waste?**
(Circle one number.)

01 Yes *(CONTINUE TO NEXT QUESTION)*
02 No *(GO TO QUESTION 28)*

26. **Why has this facility considered changing Its paint removal operations to reduce waste generation?**
(Circle all numbers that apply.)

01 To comply with environmental regulations (EPA or IEPA)
02 To comply with Occupational Safety and Health Association (OSHA) regulations
03 To reduce the cost of waste management
04 To reduce costs other than waste management costs
05 To meet customer demands
06 To meet *community* demands
07 To reduce potential liability
08 To improve and protect the quality of the environment
09 Other *(specify):* ______________________

27. **Has this facility made any changes in its paint removal since 1987 to reduce its paint-related waste generation?**
(Circle one number.)

01 Yes - Old technique: ______________________
New technique: ______________________
02 No

28. **What are the barriers to reducing or further reducing paint-related waste generation at this facility?**

(Circle all numbers that apply.)

01 Technology not available

02 Further change would affect product quality

03 Customer specifications

04 Lack of technical information

05 High *cost*

06 Too much uncertainty or risk associated with changes to reduce waste

07 Alternative products/raw materials not available

08 Other *(specify):* ______________________________

09 None

D. WASTE GENERATION AND MANAGEMENT

(To be completed by facilities that apply of remove paint)

The following questions pertain to this facility's **paint application, removal, and related activities.** The information will help HWRIC understand the types and quantities of paint-related waste this facility generates, so that HWRIC can develop cost effective disposal options.

Please note that where the following questions ask for quantity information, you have the option of reporting the quantities in tons or gallons. Please circle the unit of measure you used for each quantity reported.

29. What is the quantity of waste from paint application, removal, and related operations entering each of the following management processes onsite **during 1990?**
*(For each type **of waste management,** enter the **quantity of paint-related** waste managed using that activity onsite (at this facility) and circle the appropriate unit of **measure.)***

	Waste Management Processes	**Onsite Quantity**	**Unit of Measure** Tons	Gallons
a.	Solvent recovery:	___,___,___	01	02
b.	Metals recovery:	___,___,___	01	02
c.	Blending and reuse as fuel:	___,___,___	01	02
d.	Incineration (not as energy source):	___,___,___	01	02
e.	Solidification:	___,___,___	01	02
f.	Wastewater treatment:	___,___,___	01	02
g.	Hazardous waste landfill:	___,___,___	01	02
h.	Special waste landfill:	___,___,___	01	02
i.	Municipal landfill:	___,___,___	01	02
j.	Other *(specify):* ________	___,___,___	01	02

30. **What Is the quantity of waste from paint application, removal, and related operations entering each of the following management processes off** site **during 1990? What** Is **the cost for** offsite **waste management?**
(Enter the quantity of paint-related waste managed using each activity offsite (at another location) in 1990 and the typical charge for the waste management (dollars per ton or dollars per gallon). Circle the unit of measure used for the quantity and for the cost.)

	Waste Management Processes	Offsite Quantity	Cost per Unit (tons or gallons)	Unit of Measure: Tons	Unit of Measure: Gallons
a.	Solvent recovery:	____,____,____	$ __,____.__	01	02
b.	Metals recovery:	____,____,____	$ __,____.__	01	02
c.	Blending and reuse as fuel:	____,____,____	$ __,____.__	01	02
d.	Incineration (not for energy recovery):	____,____,____	$ __,____.__	01	02
e.	Solidification:	____,____,____	$ __,____.__	01	02
f.	Wastewater treatment:	____,____,____	$ __,____.__	01	02
g.	Hazardous waste landfill:	____,____,____	$ __,____.__	01	02
h.	Special waste landfill:	____,____,____	$ __,____.__	01	02
i.	Municipal landfill:	____,____,____	$ __,____.__	01	02
j.	Other *(specify)*: ____________ ____________	____,____,____	$ __,____.__	01	02

31. **What is the quantity of waste generated during 1990 from this facility's paint** application **operations In each of the following categories?**
(Enter each quantify in the blanks provided and circle the appropriate unit of measure.)

		Quantity	Unit of Measure: Tons	Unit of Measure: Gallons
a.	Spent solvents from surface preparation or paint removal:	___,___,___	01	02
b.	Wastewaters from surface preparation or paint removal (including spent caustic baths):	___,___,___	01	02
c.	Sludge from surface preparation or paint removal:	___,___,___	01	02
d.	Spent abrasive media from surface preparation or paint removal:	___,___,___	01	02
e.	Paint scraps and sludge from paint application:	___,___,___	01	02
f.	Scrubber water from spray booths:	___,___,___	01	02
g.	Spent solvents from cleaning application equipment:	___,___,___	01	02
h.	Wastewaters and aqueous wastes from cleaning application equipment:	___,___,___	01	02
i.	Solid wastes, including brushes, rags, and containers:	___,___,___	01	02
j.	Others *(specify):* ______________ ______________	___,___,___	01	02
k.	**Total, all paint related Wastes:**	___,___,___	01	02

32. **What is** the **total** quantity air **emissions** of volatile organic compounds (VOCs), including both fugitive and **stack** emissions, released in 1990 due to this **facility's** paint application or removal **operations?**
(Enter the quantity of emissions and circle the appropriate unit of measure.)

	Source of VOCs		Unit of Measure	
			Tons	Gallons
a.	Surface preparation or paint removal:	___ ___ ___ , ___ ___ ___ , ___ ___ ___	01	02
b.	Paint application and curing:	___ ___ ___ , ___ ___ ___ , ___ ___ ___	01	02
c.	Cleaning equipment:	___ ___ ___ , ___ ___ ___ , ___ ___ ___	01	02

33. **What is the total quantity of waste from paint application and removal operations** released to **each of the following during 1990?**
(Enter the quantity and circle the appropriate unit of measure.)

			Unit of Measure	
		Quantity	**Tons**	**Gallons**
a.	Surface waters, including under a Clean Water Act permit (NPDES):	___ ___ ___ , ___ ___ ___ , ___ ___ ___	01	02
b.	Municipal wastewater (sewage):	___ ___ ___ , ___ ___ ___ , ___ ___ ___	01	02
c.	Shipped offsite (other than as municipal wastewater):	___ ___ ___ , ___ ___ ___ , ___ ___ ___	01	02

APPENDIX: CODES FOR OBJECTS PAINTED OR FROM WHICH PAINT IS REMOVED

These codes are to be used to complete Question 8 (Part B) and Question 20 (Part C). If this facility applied paint to or removed paint from an object not listed here, please write the name of the object in the space provided.

Code	Description
21	individual homes
22	commercial buildings
23	architectural: other
24	wood cabinets
25	wood furniture
26	other wood products
27	metal furniture
28	metal cans
29	metal barrels or drums
30	sheet metal
31	metal stampings
32	machined or molded metal components
33	farm machinery
34	construction machinery
35	industrial blowers, air conditioning, or heating equipment
36	household appliances
37	automobile bodies
38	truck bodies
39	automobile parts
40	railroad equipment

COMMENTS AND EXPLANATIONS

HWRIC is interested in any comments you may have about this questionnaire or this study in general. Please use the space provided below to make any relevant comments. If commenting on or explaining your response to a particular question in this questionnaire, please reference the question number.

Questlon Number	Comment/Explanation

WHO IS CONDUCTING THIS SURVEY?

The Illinois Hazardous Waste Research and Information Center (HWRIC), a division of the Department of Energy and Natural Resources. HWRIC is **a non-regulatory** agency providing technical assistance to Illinois industries. Research Triangle Institute has been hired by HWRIC to administer this survey on its behalf.

WHY IS HWRIC CONDUCTING THIS SURVEY?

The Illinois legislature directed the Department of Energy and Natural Resources to conduct a study to develop

- "cost effective, environmentally sound, and technically feasible waste paint disposal options for small businesses..." and
- "an effective public education program to inform small businesses and households about the best available **waste** paint reduction and management options."

This **voluntary** survey supports this **legislatively-mandated study.**

WHAT IS HWRIC GOING TO DO WITH THE RESULTS?

Information will be used to:

- design a program to provide you with the information you need to reduce your paint waste generation, reduce your management costs, and properly dispose of your paint waste.
- make recommendations to the legislature about **cost effective disposal options** for waste paint.

WHO IS GOING TO SEE THE RESULTS?

HWRIC and its contractors. All responses are completely **confidential** and will be reported on an aggregate level only. **No specific Information about your facility will be reported.**

AFTER COMPLETING THIS SURVEY:

Please return the completed questionnaire to Research Triangle Institute in the envelope provided. No postage is necessary. Please **return the questionnaire** no later than

WEDNESDAY, JULY 31

THANK YOU FOR YOUR HELP IN COMPLETING THIS STUDY.

WHAT YOU NEED TO KNOW TO COMPLETE THIS SURVEY

1. Answer all questions for **your facility.** That is, just include operations at your location. If your company has more than one location, please include information just for the location receiving this survey.

2. **Paint** is defined throughout this questionnaire to include paint and all **related coatings,** including, but not limited to, varnishes, stains, lacquers, and enamels.

3. **Paint related waste** is any non-product output from your paint manufacturing, paint application, or paint removal operations at your facility. This includes waste from paint inventories, from surface preparation prior to paint application, from cleaning painting equipment, and from air pollution control for your painting operations. Please report information before any recycling or treatment (e.g., report the quantity of spent solvents ***before*** any solvent recovery).

4. If you don't know the answer to any question, please enter "DK" **for "don't know"** in the blank for the question. If a question is not applicable to the operations at your facility, please enter "NA" **for "not applicable"** in the blank for the question.

5. The last page of this booklet has space for any comments or explanations you wish to provide. If you have a comment that applies to a particular question in this survey, please include the question number in your comments.

A. FACILITY WASTE REDUCTION INFORMATION

Waste reduction is a change in the operations at this facility to reduce the quantity or toxicity of wastes that are generated before treatment. Waste reduction activities include

- substitution or modification of raw materials
- changes in production processes
- changes in product design
- changes in housekeeping and operations
- recycling or reusing wastes.

The following questions will help HWRIC to develop a waste reduction information program designed to meet the needs of Illinois facilities.

***Questions 1 to 5 apply* to all *waste reduction* activities at *this* facility.**

1. **Has this facility considered changes In Its operations to reduce the generation of waste?** *(Circle one number.)*

   01 Yes *(CONTINUE TO NEXT QUESTION)*

   02 No *(GO TO QUESTION 3)*

2. **Why has this facility considered such changes?** *(Circle all numbers that apply.)*

   01 To comply with environmental regulations (EPA or IEPA)

   02 To comply with Occupational Safety and Health Association (OSHA) regulations

   03 To reduce the cost of waste management

   04 To reduce costs other than waste management costs

   05 To meet customer demands

   06 To meet community demands

   07 To reduce potential liability

   08 To improve and protect the quality of the environment

   09 Other *(specify):* ____________________

3. **Has this facility Implemented any of the following programs designed to encourage reductions In waste generation at this facility?**
(Circle all numbers fhat apply.)

01 Employee training/awareness program

02 Employee incentives program to reward employees for reducing waste generation

03 Written waste reduction policy

04 Cost accounting: charge the costs of waste management to the production activity that generated the waste

05 Quantitative waste reduction goals

06 Conduct waste audits to identify quantities and sources of waste generation

07 Other *(specify):* ______________________

08 None

4. **What sources has this facility used to get Information about how to reduce Its waste generation and the benefits of waste reduction?**
*(Circle all numbers that apply. If this facility has not used any sources, circle *none".)*

01 Trade journals

02 Other periodicals

03 Industry associations

04 Local government

05 State government

06 Federal government

07 Vendors

08 Customers

09 Employees

10 Other (specify): ______________________

11 None

5. **What types of additional waste reduction Information would be useful to this facility?**
(Circle all numbers that apply.)

01 Technical information on technologies to reduce waste generation

02 Financial information on the costs and benefits of waste reduction

03 Onsite technical assistance

04 Information on alternative products and raw materials

05 Other (specify): ____________________

06 None

D. GENERAL FACILITY INFORMATION

Please answer the following general questions about this facility (i.e., just operations at this location). HWRIC will use this information to group this facility into categories with other, similar facilities.

21. **What Is the name of this facility?**

Name of Facility: ____________________

22. **What Is the name of the parent company (If any)?**

Name of Parent Company: ____________________

23. **What Is the mailing address of this facility?**

Street Address or P.O. Box: ____________________

City: ____________________ State: __________ Zip: ________

24. **What Is the county In which this facility Is physically located?**

County: ____________________

25. **Who can we contact If we have any technical questions about this survey?**

Name: ____________________

Title: ____________________

Phone Number: |_|_|_| - |_|_|_| - |_|_|_|_|

B. PAINT MANUFACTURING ACTIVITIES

The following questions pertain only to this facility's **paint manufacturing activities.** The information will help HWRIC understand *how* this facility generates waste from paint manufacturing, so that HWRIC can develop an effective education and disposal program.

Please answer questions 6 to 8 for* each *type of paint this facility manufactures: organic solvent based coatings,* water *based coatings, and powdered coatings.

6. **What Is the total quantity of each type of coating this facility manufactured during 1990?**
(Enter the quantity in gallons. If none of a type of paint was used, enter /0" in the space provided.)

Type of Coating	Total Quantity Manufactured
a. Organic solvent based coatings:	___ , ___ , ___ gallons
b. Water based coatings:	___ , ___ , ___ gallons
c. Powder coatings:	___ , ___ , ___ pounds

7. **What are the predominant end uses for each type of paint manufactured at your facility?**
(Circle all numbers that apply.)

	Organic Solvent Based Coatings	Water Based coatings	Powder Coatings
a. Architectural coating	01	02	03
b. Product coating	01	02	03
c. Special purpose coating	01	02	03
d. Other *(specify):* ____________________	01	02	03
e. This type of paint is not manufactured	01	02	03

8. **After manufacturing a batch of paint, how does this facility clean its manufacturing equipment?**
(Circle all numbers that apply.)

	Organic Solvent Based Coatings	Water Based Coatings	Powder Coatings
a. Virgin organic solvents	01	02	03
b. Recovered organic solvents	01	02	03
c. Water	01	02	03
d. Manual or automatic scraping	01	02	03
e. Plastic or foam pigs	01	02	03
f. Other *(specify):* ________________ ________________	01	02	03
g. Equipment is not cleaned between batches	01	02	03
h Don't know	01	02	03

Questions 9 to 15 apply* to paint-manufacturing *waste reduction activities at this* facility. *Please* *answer* only *for wastes from this facility's paint manufacturing and associated operations.

9. **Does this facility measure how much waste is generated from Its paint-related activities per unit of output?**
(Circle one number.)

01 Yes
02 No

10. **Has this facility considered making any changes in its paint manufacturing operations since 1987 to reduce the generation of *paint-relatedwaste?***
(Circle one number.)

01 Yes *(CONTINUE TO NEXT QUESTION)*
02 No *(GO TO QUESTION 15)*

11. **Why has this facility considered changing its paint manufacturing** operations **to reduce waste generation?**
(Circle all numbers that apply.)

01 To comply with environmental regulations (EPA **or** IEPA)

02 To comply with Occupational Safety and Health Association (OSHA) regulations

03 To reduce the cost of waste management

04 To reduce costs other than waste management costs

05 To meet customer demands

06 To meet community demands

07 To reduce potential liability

08 To improve and protect the quality of the environment

09 Other *(specify):* ____________________

12. **Has this facility made any changes In Its paint manufacturing since 1987 to reduce its paint-related waste generation?**
(Circle one number.)

01 Yes *(CONTINUE TO NEXT QUESTION)*
02 No *(GO TO QUESTION 15)*

13. **Has this facility implemented any of the following to reduce the generation of waste from cleaning its paint manufacturing equipment?**
(Circle all numbers that apply.)

01 Scheduling longer production runs

02 Scheduling light-to-dark production runs

03 Dedicating equipment to a single type of paint

04 Reusing cleaning wastes several times to clean different batches

05 Reusing cleaning wastes as an input into paint formulations

06 Other *(specify):* ____________________

07 None

14. **Has this facility changed the type or formulation of paint manufactured to reduce waste generation?**
(Circle all numbers that apply.)

01 switch to high-solids paint

02 Switch to water-based paint

03 Switch to powdered paint

04 Switch to paints with less toxic components in their formulations (other than switching to water-based, high-solids, or powdered paints)

05 Other (specify): ____________________

06 None

15. **What are the barriers to reducing or further reducing paint-related waste generation at this facility?**
(Circle all numbers that apply)

01 Technology not available

02 Further change would aft affect product quality

03 Customer specifications

04 Lack of technical information

05 High cost

06 Too much uncertainty or risk associated with changes to reduce waste

07 Alternative products/raw materials not available

08 Other (specify): ____________________

09 None

C. WASTE GENERATION AND MANAGEMENT

The following questions pertain to this facility's **paint manufacturing and related activities.** The information will help HWRIC understand the types and quantities of paint-related waste this facility generates, so that HWRIC can develop cost effective disposal options.

Please ***note that where the following questions ask for quantity informatlon,*** *you have the option of reporting* ***the*** *quantities In tons or* ***gallons. Please*** circle ***the unit of measure you used for*** *each quantity reported.*

16. What Is the quantity of waste from paint manufacturing and related operations entering each of the following management processes onsite during 1990?
(For each type *of waste management, enter the quantity of paint-related waste managed using that activity onsite (at this facility) and circle the appropriate unit of measure.)*

	Waste Management Processes	Onsite Quantity	Unit of Measure Tons	Gallons
a.	Solvent recovery:	___,___,___	01	**02**
b.	Metals recovery:	___,___,___	01	**02**
c.	Blending and reuse as fuel:	___,___,___	01	**02**
d.	**Incineration (not for energy recovery):**	___,___,___	01	**02**
e.	Solidification:	___,___,___	01	**02**
f.	Wastewater treatment:	___,___,___	01	**02**
g.	Hazardous waste landfill:	___,___,___	01	**02**
h.	Special waste landfill:	___,___,___	01	**02**
i.	Municipal landfill:	___,___,___	01	**02**
j.	Other *(specify):* ________ ________	___,___,___	01	**02**

17. **What is the quantity of waste from paint manufacturing and related operations entering each of the following management processes** offsite **during 1990? What is the cost for** offsite **waste management?**
(Enter the quantity of paint-related waste managed using each activity *offsite (at another location) in 1990 and the typical charge for the waste management (dollars per ton or dollars per gallon). Circle the unit of measure used for the quantity and for the cost.)*

	Waste Management Processes	Offsite Quantity	Cost per Unit (tons or gallons)	Unit of Measure Tons	Unit of Measure Gallons
a.	Solvent recovery:	___,___,___	$ __,___.__	01	02
b.	Metals recovery:	___,___,___	$ __,___.__	01	02
c.	Blending and reuse as fuel:	___,___,___	$ __,___.__	01	02
d.	Incineration (not for energy recovery):	___,___,___	$ __,___.__	01	02
e.	Solidification:	___,___,___	$ __,___.__	01	02
f.	Wastewater treatment:	___,___,___	$ __,___.__	01	02
g.	Hazardous waste landfill:	___,___,___	$ __,___.__	01	02
h.	Special waste landfill:	___,___,___	$ __,___.__	01	02
i.	Municipal landfill:	___,___,___	$ __,___.__	01	02
j.	Other *(specify)*: ____________ ____________	___,___,___	$ __,___.__	01	02

18. **What Is the quantity of waste generated during 1990 from this facility's paint manufacturing operations in each of the following categories?**
(Enter each quantity in the blanks provided and circle the appropriate unit of measure.)

			Unit of Measure	
		Quantity	**Tons**	**Gallons**
a.	Waste from grinding operations:	___,___,___	01	02
b.	Spent solvents from cleaning equipment:	___,___,___	01	02
c.	Aqueous waste from cleaning equipment:	___,___,___	01	02
d.	Paint sludge from cleaning equipment:	___,___,___	01	02
e.	Baghouse pigment dust:	___,___,___	01	02
f.	Waste from spills, or off-spec or returned product:	___,___,___	01	02
g.	Solid waste and spent filters (other than paint sludge):	___,___,___	01	02
h.	Others (specify): ______			
	______	___,___,___	**01**	02
i.	**Total, all paint-related wastes:**	___,___,___	**01**	02

19. **What Is the total quantity air emissions of volatile organic compounds** (VOCs), **Including both fugitive and stack emissions, released In 1990 due to this facility's paint manufacturing operations?**
(Enter the quantity of emissions and circle the *appropriate unit of measure.)*

	Source of VOCs	Quantity	Unit of Measure: Tons	Unit of Measure: Gallons
a.	From paint mixing, grinding, and packaging:	____,____,____	01	02
b.	From cleaning equipment:	____,____,____	01	02

20. **What Is the total quantity of waste from paint manufacturing operations released to each of the following during 1990?**
(Enter the quantity and circle the appropriate unit of measure.)

		Quantity	Unit of Measure: Tons	Unit of Measure: Gallons
a.	Surface waters, including under a Clean Water Act permit (NPDES):	____,____,____	01	02
b.	Municipal wastewater (sewage):	____,____,____	01	02
c.	Shipped offsite (other than as municipal wastewater):	____,____,____	01	02

26. **Circle the range for the total sales revenues for this facility during the 1990 fiscal year. If sales revenues are available only for the parent company, please estimate the** range for this **facility only.**

01 $0 to 100,000

02 $100,001 to 500,000

03 $500,001 to 1,000,000

04 $1,000,001 to 10,000,000

05 $10,000,001 to 75,000,000

06 Greater than $75,000,001

27. **Circle the range for the total number of full-time employees at this facility In 1990.** Include **part-time and contract employees based on their full-time equivalent.**

01 1 to 15

02 16 to 50

03 51 to 150

04 151 to 500

05 501 to 1,000

06 Greater than 1,001

28. **What is the regulatory status of this facility?**
(Circle all numbers that apply.)

01 Generated in ANY one month during 1990 more than 1,000 kg of hazardous waste or more than 1 kg of **acutely** hazardous waste under the federal Resource Conservation and Recovery Act (RCRA)

02 Generated in ANY one month during 1990 more than 100 kg but less than **1,000 kg of** hazardous waste under RCRA

03 Subject to the federal Community Right-to-Know Act (Title III of the Superfund Amendment and Reauthorization Act, SARA)

04 Discharge wastewater under a National Pollution Discharge Elimination System (NPDES) permit

05 None of the above

06 Don’t know

COMMENTS AND EXPLANATIONS

HWRIC is interested in any comments you may have about this questionnaire or this study in general. Please use the space provided below to make any relevant comments. If commenting or explaining your response to a particular question in this questionnaire, please reference the question number.

Question **Number**	**Comment/Explanation**

APPENDIX B

SITE VISIT QUESTIONNAIRE

2 General Information for All Sites

Company Name	____________________
Division	____________________
Street Address	____________________
City/State/Zip	____________________
Name of Contact	____________________
Title/Position	____________________
Telephone Number	____________________
Type of Business	____________________
SIC Code	____________________
Number of Employees	
Production/Manufacturing	____________________
Painting Operations	____________________
Administration	____________________
Environmental Staff	____________________
Annual Gross Sales (Units) For Year Ending 19	____________________

3 Questions for Paint Manufacturers

I. Types of paint

1. What types of paint do you manufacture? How much of each?

   a. Organic solvent borne
   b. Water borne
   c. Powder

2. What are the trade names for these paints?

3. What information can you provide on the formulations of these paints?

   a. Do any formulations contain heavy metal pigments or additives?
   b. Are any of the formulations particularly toxic?
   c. Has the proportion of water-borne to solvent-borne paints manufactured changed over time, if so how?

4. Can you provide MSDS sheets?

5. What industries are the primary customers for your paint products?

6. How are your paints packaged? (Cans, toters, etc.) Typical sizes?

7. Are any of your paints formulated to reduce VOCs or otherwise reduce impact on the environment? Which paints?

8. Are any of your paints formulated to reduce waste either in manufacture or application?

9. Are your paints best suited for any particular application technique? Which paints? Which techniques?

10. Are any of your paints custom manufactured to meet specifications of a particular customer?

II. How paints are manufactured

1. Please provide a simple flow chart of your paint manufacturing process. Use the reverse side of this form if necessary, or attach additional sheets.

2. What types of equipment are used in your manufacturing process? Can you provide some idea of the age of your equipment and its initial cost?

   a. Grinding mills (number. type, manufacturer)
   b. Mixers (number, type, manufacturer)
   c. Storage/holding tanks
   d. Other equipment

3. How many people do you employ in manufacturing paint? Do they receive any specialized training? Who performs clean-up, manufacturing staff or maintenance personnel?

4. What are the raw materials for each of your paint products?

5. What processes do you use in the manufacture of your paints? How do these processes vary from one paint type to the next?

III. Waste Generation in the Manufacture of Paint

1. What types of waste do you generate and how much of each?

    a. VOCs (other air toxics, particulate etc.)

    b. Liquid wastes
        i. organic solvents
        ii. aqueous wastes
        iii. waste paint

    c. Solid wastes
        i. spent filters
        ii. other paint bearing solids

2. What are the primary causes of waste in your operations?

    a. evaporation of solvents
    b. equipment cleaning (describe methods used)
    c. off-spec. paint
    d. spills
    other

3. How do the waste types and quantities vary by paint type?

Paint Type	Waste(s)	Quantity

4. How often are waste streams assessed? What personnel are involved in waste assessment?

5. What cost impacts do wastes have on your operations?

   a. materials
   b. energy
   c. labor
   d. other (waste management and disposal, capital expenditures, etc.)

6. Do you believe the current trends in paint formulation make it easier, or more difficult, to control waste in the paint manufacturing process?

7. Are you aware of the New Clean Air Act Requirements? Do you have Air Permit(s)?

IV. Waste Reduction Methods

1. Do you have a waste reduction plan for your facility?

2. What methods have you tried to reduce wastes?

Waste Stream	Waste Minimization Method
a. Equipment cleaning waste	Use mechanical wipers on mix tanks Use high pressure wash systems Install teflon liners on mix tanks Use foam/plastic pigs to clean lines Reuse equipment cleaning wastes Schedule production to minimize cleaning Clean equipment immediately Use countercurrent rinse methods Use alternate cleaning agents Increase spent rinse settling time Use de-emulsifiers on spent rinses
b. Spills and off-spec. paint	Increase use of. automation Use appropriate clean-up methods Recycle back into process Implement better operating procedures
c. Leftover inorganic pigment in bags and packages	Use water soluble bags and liners Use recyclable/lined/dedicated containers
d. Air emissions including pigment dust	Modify bulk storage tanks Use paste pigments Install dedicated baghouse systems Reduce usage of organic solvents
e. Filter cartridges	Improve pigment dispersion Use bag or metal mesh filters
f. Obsolete products and customer returns	Blend into new products
g. General	Use statistical process control and data analysis to identify opportunities for waste reduction

3. Have you integrated your quality control programs with waste reduction?

4. What methods of waste reduction have been successful for you?

5. What methods of waste reduction have been unsuccessful? Why?, what lessons were learned? (Technical limitations, personnel limitations, etc)

6. What is your organization's overall approach to waste reduction?

   a. Employee incentives
   b. Waste management accounting
   c. Identify waste management responsibility
   d. Who are waste management decision makers

7. What are your sources of information on waste reduction technologies? (trade shows, magazine articles. training courses, etc.)

8. What obstacles have you encountered in your efforts to reduce waste in your paint manufacturing operation?

V. Paint Related Waste Management

1. How do you manage (dispose, treat; recycle) the wastes which are generated in your paint manufacturing operation?

   a. VOCs (recapture, incinerate, etc.)
   b. Organic solvent liquids (recycle. incinerate, fuel blending)
   c. Aqueous wastes (dedicated treatment facilities. de-water, etc.)
   d. Solid wastes (municipal landfill. special waste landfill)

2. What costs are associated with these waste management activities?

3. Is there anything the State can do to help you reduce the volume and/or toxicity of paint related waste generated at your facility. (Not just compliance assistance)

4 Questions for Users of Paint

I. Description of Operations

1. What kind of product (or service) do you produce? If applicable, please provide a simple flow diagram indicating where painting is a portion of your process or service. Try to indicate where paint related waste generation occurs.

2. How do you use paint in your manufacturing (or service) operations?

a. What kind of surface preparation. do you perform as part of your painting operations?

b. What kind of application techniques do you use in your painting operations?

c. Do you routinely calculate paint transfer efficiency?

d. How much paint do you use for each product (or service)?

e. How much does the cost of paint influence the cost of your product (or service)?

f. Which is greater, the cost of paint, or the cost to apply it?

g. What percentage of your total costs are paint related?

3. How many people do you employ in painting operations? Do they receive any specialized training'? Who performs clean-up, manufacturing staff or maintenance personnel?

4. What kinds of paint do you use?

   a. Do you have a set of specifications for the paints used in your operations? If so, what are the specifications?

   b. What types of thinners do you use? Amounts?

   c. What factors were most important in developing your paint specifications? (cost. performance, application technique, environmental concerns etc.)

   d. Is the paint formulation you use essential to the quality of your product (or service)?

   e. Have you had to switch paint types due to environmental regulations or concerns? If so, what type of paint did you previously use?

II Waste Generation in Painting Operations

1. How much waste do you generate in your painting operations?

    a. What types of waste do you generate and how much of each?

        i. VOCs (air toxics, particulate, etc.)
        ii. organic solvents
        iii. aqueous wastes (pretreatment rinses, post-paint rinse. spray booths, etc)
        iv. solid wastes (empty paint containers. filters, masking, etc.)

2. Where do you generate more waste?

    in surface preparation
    t: the actual painting operation (transfer efficiency)
    VOCs released in paint curing
    i. equipment clean-up
    e. other (spills. rework, etc.)

3. How do the waste types' and quantities vary by paint type and application technique?

Paint Type	Waste(s)	Quantity

4. How often are waste streams assessed? What personnel are involved in waste assessment?

5. What are the primary causes of waste in your painting operations?

6. What cost impacts do wastes have on your operations?

   a. materials
   b. energy
   c. labor
   d. other (waste management and disposal, capital expenditures, etc.)

7. Do you believe the current trends in paint formulation make it easier, or more difficult. to *control* waste in *your* painting process?

8. Are you aware of the New Clean Air Act Requirements? Do you have Air Permit(s)?

III. Waste Reduction Methods

1. Do you have a waste reduction plan for your facility?

2. What methods have you tried to reduce wastes?

   a. What were the motivations for waste reduction?
   b. What costs/savings were associated with reducing paint related wastes?
   c. Have you switched paints as part of your waste reduction efforts?

3. Have you integrated your quality control programs with waste reduction?

4. What methods of waste reduction have been successful for you?

5. What methods of waste reduction have been unsuccessful? Why?, what lessons were learned? (Technical limitations, personnel limitations, etc)

6. What is your organization's overall approach to waste reduction?

   a. Employee incentives
   b. Waste management accounting
   c. Identify waste management responsibility
   d. Who are waste management decision makers

7. What are your sources of information on waste reduction technologies? (trade shows, magazine articles, training courses. etc.)

8. What obstacles have you encountered in your efforts to reduce waste in your painting operation?

V. Paint Related Waste Management

1. How do you manage (dispose, treat, recycle) the wastes which are generated in your painting operation?

    a. VOCs (recapture. incinerate, etc.)
    b. Organic solvent liquids (recycle, incinerate, fuel blending)
    c. Aqueous wastes (dedicated treatment facilities, de-water, etc.)
    d. Solid wastes (municipal landfill, special waste landfill)

2. What costs are associated with these waste management activities?

3. Is there anything the State can do to help you reduce the volume and/or toxicity of paint related waste generated at your facility. (Not just compliance assistance)

APPENDIX C

PUBLIC AWARENESS MATERIALS CURRENTLY AVAILABLE

This list contains seven public information items already available and comments on the ones containing a format or information presentation method that could be followed when future material is prepared.

1. ***Citizen's Guide to Pesticides,*** prepared by the USEPA, April, 1990. The value of this guide lies in the comprehensiveness of the topics covered and the clarity of the writing. The most effective section of the guide is the section on tips for handling pesticides; the approach used in that section could be copied in fact sheets made available in a variety of ways.

2. ***Disposal: Do It Right-Managing Household Wastes,*** prepared by The Household Products Disposal Council This pamphlet is short, easy to read, and contains a number of clear dos and don'ts. Of particular value are the suggestions on how to read product labels. This format also could be copied for new material to be developed.

3. ***Fact Sheet: Waste Reduction for Automotive Repair Shops,*** prepared by California Department of Health Services, 1989. This fact sheet contains useful background information on this subject, including a list of specific suggestions and a list of additional publications to consult. This document is an excellent example for additional fact sheets.

4. ***Hazardous Waste Reduction: The Bottom*** *Line,* prepared by Waste Pollution Control Federation. This brochure contains a number of useful suggestions but in a confusing format of charts and suggestions. It is the least useful of the material reviewed.

5. ***Household Hazardous Waste-What You Should and Shouldn't Do,*** prepared by Water Pollution Control Federation. One part of this brochure, the section on poisoning your water, is very effective because it contains information describing hazardous materials and their dangers, along with ways to handle this material A chart of how to dispose of waste is hard to follow.

6. ***Paint Disposal...The Right Way,*** prepared by National Paint & Coatings Association. This very short brochure contains general disposal options for latex and solvent-based paint products. The suggestions are clear but not made emphatically enough or graphically to underscore the message.

7. ***Understanding the Small Quantity Generator: Hazardous Waste Rules,*** prepared by USEPA, 1986. This is an excellent comprehensive booklet on the subject, written in an easy to understand form. The only concern is whether small business owners and managers would read it, given its length.