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ENVIRONMENTAL RESEARCH BRIEF

Waste Reduction Activities and Options for a Manufacturer of Paints Primarily for Metal Finishing

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Abstract

The U.S. Environmental Protection Agency (EPA) funded a project with the New Jersey Department of Environmental Protection and Energy (NJDEPE) to assist in conducting waste minimization assessments at 30 small- to medium-sized businesses in the state of New Jersey. One of the sites selected was a facility that produces paints primarily intended for metal finishing. A site visit was made in 1990 during which several opportunities for waste minimization were identified. These opportunities include improved solvent handling techniques, reuse of some solvent washing wastes, and changes in equipment washing techniques. Implementation of the identified waste minimization opportunities was not part of the program. Percent waste reduction, net annual savings, implementation costs and payback periods were estimated.

This Research Brief was developed by the Principal Investigators and EPA's Risk Reduction Engineering Laboratory in Cincinnati, OH, to announce key findings of this completed assessment.

Introduction

The environmental issues facing industry today have expanded considerably beyond traditional concerns. Wastewater, air emissions, potential soil and groundwater contamination, solid waste disposal, and employee health and safety have become increasingly important concerns. The management and disposal of hazardous substances, including both process-related wastes and residues from waste treatment, receive significant attention because of regulation and economics.

As environmental issues have become more complex, the strategies for waste management and control have become more systematic and integrated. The positive role of waste minimization and pollution prevention within industrial operations at each stage of product life is recognized throughout the world. An ideal goal is to manufacture products while generating the least amount of waste possible.

The Hazardous Waste Advisement Program (HWAP) of the Division of Hazardous Waste Management, NJDEPE, is pursuing the goals of waste minimization awareness and program implementation in the state. HWAP, with the help of an EPA grant from the Risk Reduction Engineering Laboratory, conducted an Assessment of Reduction and Recycling Opportunities for Hazardous Waste (ARROW) project. ARROW was designed to assess waste minimization potential across a broad range of New Jersey industries. The project targeted 30 sites to perform waste minimization assessments following the approach outlined in EPA's *Waste Minimization Opportunity Assessment Manual* (EPA/625/7-88/003). Under contract to NJDEPE, the Hazardous Substance Management Research Center at the New Jersey Institute of Technology (NJIT) assisted in conducting the assessments. This research brief presents an assessment of a manufacturer of paints primarily for metal finishing (1 of the 30 assessments performed), and provides recommendations for waste minimization options resulting from the assessment.

Methodology of Assessments

The assessment process was coordinated by a team of technical staff from NJIT with experience in process operations, basic chemistry, and environmental concerns and needs. Because the EPA waste minimization manual is designed to be primarily applied by the inhouse staff of the facility, the degree

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of involvement of the NJIT team varied according to the ease with which the facility staff could apply the manual. In some cases, NJIT's role was to provide advice. In others, NJIT conducted essentially the entire evaluation.

The goal of the project was to encourage participation in the assessment process by management and staff at the facility. To do this, the participants were encouraged to proceed through the organizational steps outlined in the manual. These steps can be summarized as follows:

- Obtaining corporate commitment to a waste minimization initiative
- Organizing a task force or similar group to carry out the assessment
- Developing a policy statement regarding waste minimization for issuance by corporate management
- Establishing tentative waste reduction goals to be achieved by the program
- Identifying waste-generating sites and processes
- Conducting a detailed site inspection
- Developing a list of options which may lead to the waste reduction goal
- Formally analyzing the feasibility of the various options
- Measuring the effectiveness of the options and continuing the assessment.

Not every facility was able to follow these steps as presented. In each case, however, the identification of waste-generating sites and processes, detailed site inspections, and development of options was carried out. Frequently, it was necessary for a high degree of involvement by NJIT to accomplish these steps. Two common reasons for needing outside participation were a shortage of technical staff within the company and a need to develop an agenda for technical action before corporate commitment and policy statements could be obtained.

It was not a goal of the ARROW project to participate in the feasibility analysis or implementation steps. However, NJIT offered to provide advice for feasibility analysis if requested.

In each case, the NJIT team made several site visits to the facility. Initially, visits were made to explain the EPA manual and to encourage the facility through the organizational stages. If delays and complications developed, the team offered assistance in the technical review, inspections, and option development.

The Paint Manufacturer

The facility is a producer of paints, used primarily in the metal finishing industry including automobile refinishing applications. This business requires production of a large variety of colors and finish types, most in relatively small quantities. The specifications of their customers allow a very narrow range of variation in color and appearance of the finished product. This severely limits the flexibility the company has in changing production processes.

The production of the various types of paints is conceptually very simple. Required operations include mixing and blending (under carefully specified conditions) raw materials either purchased from vendors or shipped from other company sites. No manufacturing of paint constituents takes place at this facility. After formulation and blending, the paints are transferred to a variety of containers for shipment to the customer. The processing equipment is cleaned prior to preparation of the next batch. The cleaning operation typically includes multiple rinses with solvent in order to remove the pigments and additives remaining from the previous batch.

Paint production uses a solvent or liquid carrier to dissolve or suspend the components of the coating system. This process is a large user of solvents. At present, the preponderance of the solvents used in these applications are organic. However, there is a trend In the coatings industry toward water-based products where customer demands and product performance criteria are met. The technology for water-based coatings has not been sufficiently advanced to address all such demands and performance requirements. Therefore, solvent-based paints and coatings will be required for some time.

The company has already instituted a program of pollution prevention. This is perhaps best illustrated by the acquisition and use of a large capacity still which allows recovery and reuse of the solvents from the equipment washing operations. Other pollution prevention efforts have been carried out in conjunction with the corporate research and development group. This lead to the reduction or elimination of the use of heavy metal-containing dyes and pigments in products produced by this facility.

Waste Streams and Existing Waste Management

This particular facility presents a challenge in describing waste streams. The presence of an operating solvent recovery system means that the actual waste streams sent offsite are relatively insignificant in terms of the total effluent from the process before the solvent distillation. Moreover, where there is a significant level of air emissions to be addressed, the meaning of the term "treatment and disposal costs" has to be strained to include simple loss of the value of materials.

The major RCRA waste from this facility is the still bottoms from the recovery/recycling/reuse of waste solvents from the equipment washing process. About 250 drums of this material are produced annually from the facility and are sent offsite for disposal. This quantity represents 10% to 20 % of the volume of waste solvents which were sent for disposal prior to the installation of the distillation equipment.

Another waste stream results from quality control samples of finished batches which are retained at the facility for a period of time for examination if customer problems or complaints come in about specific batches of paint. After the retention period, the samples are discarded as hazardous waste. Approximately one quart size samples are collected and retained. The typical current practice is to recover the solvent from these retained samples through the solvent recovery system. There was no information available on the number of these samples generated and retained each year.

Another waste stream identified was a waste oil stream from equipment maintenance and repair. This stream averages 3 to 4 drums per year and is sent offsite for recycling and recovery.

The greatest pollution prevention challenge at this facility is not RCRA-type waste streams. Rather it consists of stack emissions and fugitive air emissions. SARA Title III reporting and additional estimates indicated that approximately 200,000 lb of solvent are emitted to the atmosphere annually. The facility intends to address this situation using a pollution prevention approach.

Summary of Waste Minimization Opportunities

The type of waste currently generated by the facility, the source of the waste, the quantity of the waste and the annual treatment and disposal costs are given in Table 1.

Table 2 shows the opportunities for waste minimization recommended for the facility. The type of waste, the minimization opportunity, the possible waste reduction, the net annual savings, and the implementation cost along with the payback times are given in the table. The quantities of waste currently generated at the facility and the possible waste reduction depend on the level of activity of the facility. All values should be considered in that context.

It should be noted that the economic savings of the minimization opportunities in most cases result from the need for less raw material and from reduced costs associated with waste treatment and disposal. It should also be noted that the savings given for each opportunity reflect the savings achievable when implementing each waste minimization opportunity independently, and do not reflect duplication of savings that would result when the opportunities are implemented in a package. Also, no equipment depreciation is factored into the calculations.

The decision to add solvent distillation capabilities at the facility significantly reduced the volume of waste shipped from the site for treatment. It did, however, engender a new waste stream at the site. These still bottoms present a particular challenge from a waste reduction perspective: to minimize the still bottoms stream. Some possible options include: identification of beneficial uses for the still bottoms; recovery of valuable materials from the bottoms; and change in operating practices to reduce the quantity and type of materials which appear in the still bottoms.

In the absence of specific information about the content of the still bottoms (which would be variable at best), it is not possible to suggest specific options regarding beneficial uses for this material. Similarly, it is not possible to discuss specific options for recovery of valuable materials from the bottoms. These questions can be effectively addressed after data about the composition of the still bottoms is collected.

In general, it is assumed that the materials in the still bottoms consist of residues which are contained in the solvents as they enter the facility, product residues from equipment rinsing and cleaning, and manufacturing residues from disposal of products or raw materials. Modification of equipment rinsing and cleaning practices to reduce the amount of solids in the rinses would result in a decrease in the quantity of solids in the still bottoms.

One approach which may accomplish some of this objective would be to segregate washings from equipment used for transfer of raw materials from washings of equipment used for finished batches. These washings would then be distilled separately. Such segregation and distillation of raw material solutions should result in concentrated solutions of the raw materials which could be used in production, rather than as a component of still bottoms for disposal.

The majority of the still bottoms result from washing of equipment from the finished batches of coatings. The best opportu-

Table 1. *Summary of Current Waste Generation*

Waste Generated	*Source of Waste*	*Annual Quantity Generated*	*Annual Waste Management Costs*
Still Bottoms	*Residue from solvent recovery and recycling*	*250 drums*	*$65,000*
Waste Oil	*Obtained from equipment maintenance and repair*	*4 drums*	*$130*
VOC Emissions	*Fugitive and stack emissions of solvents used throughout the facility*	*200,000 lb*	*$40,000 (This cost represents the estimated value of the solvents lost to the atmosphere.)*

Table 2. *Summary of Waste Minimization Opportunities*

Waste Stream Reduced	*Minimization Opportunity*	*Annual Waste Reduction*		*Net Annual Savings*	*Implementation Cost*	*Payback Years**
		Quantity	*Percent*			
Still Bottoms	*Segregation and recovery of concentrates from washings of raw materials for reuse.*	*5 drums*	*2%*	*$3,100*	*$1,000*	*0.3*
	Reprocessing of retained samples	*1 drum*	*0.5%*	*$325*	*$0*	*immed*
VOC Emissions	*Develop and institute program of leak detection and correction. Reevaluate manufacturing processes in light of pollution prevention goal.*	*180,000 lb*	*90%*	*$36,000*	*$150,000*	*4.2*
			(It should be recognized that a program such as this is a multi-year effort so the total cost will not be incurred in any single year.)			

* *Savings result from reduced raw material, and treatment and disposal costs when implementing each minimization opportunity independently.*

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nity for reduction of this component lies in scheduling of batches in terms of colors and coating types. If appropriately scheduled, less rinsing may be required, particularly in moving from lighter colors to darker colors. On the other hand, it must be recognized that this facility has very tight specifications for color reproducibility because many of their customers do color matching. From a total pollution prevention perspective, it may be preferred to thoroughly rinse the equipment and collect the resulting still bottoms rather than risk the potential disposal of an entire batch of paint.

For impact on emission reduction, attention should be given to the sources of the emissions and on the potential options for emission reduction. As indicated previously, more than 200,000 lb of SARA 313 emissions are reported annually from this facility. Approximately 70% of this total amount represents fugitive air emissions. The material emitted in largest quantity is acetone, representing about 50% of the fugitive air emissions and about 48% of the total emissions from the facility.

Before developing a slate of options for addressing this challenge, the company examined the question of how such large losses could have been accepted for so many years. All of the manufacturing operations met the company standards for material use, therefore there was no reason to question the quantity of materials purchased and the quantity which actually went into the product.

Upon further questioning about how the company manufacturing standards were determined, it was concluded that when the product was first manufactured, careful records were kept and maintained for the first three or four batches. These records included information about materials used. Then with the addition of a slight margin for error, these quantities became the manufacturing standard. This means that whatever procedures were used in the past which may contribute, in this case, to elevated levels of fugitive emissions are perpetuated unless new questions are raised by an "outside" process such as this one.

The list of volatile chemicals which make up the fugitive air emissions consists of the solvents which are used in the manufacture of the coating products at the facility. In addition, acetone is used as a solvent for equipment cleaning. This provides two different avenues to be explored for pollution prevention options. The solvent used in direct production is essentially fixed in terms of how much solvent must be in the product shipped to the customers, therefore any reduction in emissions from this part of the operation must result from changes in losses from spills and leaks, incomplete transfers, and evaporation.

Because much of the material flow in the facility is a mechanized movement from large storage tanks to production vessels, there are opportunities for leaks at seals and connections. A high priority option could be to check the entire solvent supply system for leaks. Based upon experiences at other facilities, particular attention should be given to seals and to pumps. Regular inspection for such leaks should be a part of the program.

There are also opportunities for evaporative losses when the production vessels are being filled and operated. Certainly, air displacement is necessary in the tanks to allow proper filling. The ability to cap the tanks and use of a vapor recovery system with a condenser could have a significant impact upon evaporative losses. Depending upon the quality of such condensate, it could be returned directly to the production vessel resulting in an immediate reduction in total material used for each batch. Alternatively, the recovered solvent could be sent to the distillation process for purification prior to reuse.

Evaporative losses can also occur during the filling operations for the containers which go to the consumers. A contained process for this filling operation to allow for solvent recovery by condensation could be investigated. Alternatively, revised filling procedures with smaller container openings to reduce evaporative surfaces would reduce fugitive air emissions from this source. Process engineering and design efforts will be required in order to address these options.

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