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ENVIRONMENTAL RESEARCH BRIEF

Waste Reduction Activities and Options for a Fabricator and Finisher of Steel Computer Cabinets

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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 fabricator and finisher of steel computer cabinets. A site visit was made in 1990 during which several opportunities for waste minimization were identified. These opportunities include improved painting technology, rationalization of metal-working oils and coolants, and changes in degreasing solvent management. 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 NJIT assisted in conducting the assessments. This research brief presents an assessment of a fabricator and finisher of steel computer cabinets (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 Steel Computer Cabinet Fabricator

The production of the steel cabinets is fundamentally a three step operation: cutting and shaping the sheet metal; applying the finish; and assembling the cabinet. The facility operates as a job shop, depending on orders from computer equipment manufacturers. The computer manufacturer sets the specifications for the cabinets and the facility is responsible for producing items which meet the specifications. The facility uses complex technology, such as computer-aided design and manufacturing techniques in the metal cutting and shaping applications.

The cutting and shaping is highly automated involving computer-aided design and computer-aided manufacturing equipment and processes. This technology is useful in minimizing waste of materials because care and effort is put into optimum parts layout and reduction of redundancy. However, the metal-working activity requires a wide variety of metal-working fluids and oils. It is not clear why so many different types of these liquids are used; presumably it is based on recommendations of the manufacturers of each of the machines.

After the metal-working stage, the metal parts are vapor degreased using 1,1,1-trichloroethane as solvent. Following the degreasing, the metal surface is etched using nitric acid and then sodium hydroxide. The etching process is useful in promoting adherence of the paint to the metal surface. The cleaned and etched surface is primed and then painted.

The facility has three painting systems: a conventional air-assisted spray, an electrostatic disc spray, and a powder coating system. The paint system used depends upon the type of coating desired and the physical properties of the coating system which must be used. The type of coating and other finish conditions are usually specified by the computer company which is the customer of this facility. The specifications required by the customers limit the ability of the facility to optimize a pollution prevention initiative.

After being painted the metal parts are assembled, inspected, and shipped to the customer.

The company has already committed itself to technological excellence and has made substantial investments to optimize its manufacturing capability. This philosophy has now been extended to efforts in pollution prevention. An example of this is the acquisition of the equipment for powder coating.

Waste Streams and Existing Waste Management

The metal-working fluids are reused until the properties of the fluid are no longer sufficient for the cooling/lubricating function needed. At that time they are drummed and sent for disposal offsite. About 7100 gal of this material is disposed of annually.

The vapor degreaser is used until the grease and oil content reduces the effectiveness of the chlorinated solvent. At that time the degreaser is emptied and the contaminated solvent is sent offsite for disposal. It is estimated that about 7000 lb of this waste stream is generated annually.

The etching process (typically used for aluminum parts) generates 110 gal of nitric acid waste and 440 gal of caustic waste annually. These waste streams are also sent offsite for disposal.

The painting process generates VOC emissions which were not quantified as well as sludges, thinners, and clean up wastes. The total quantity of wastes from sludges, thinners, and cleanups is about 3300 gal each year. This material is also sent offsite for disposal. In addition, about 2360 gal of spent filters from the spray booths are sent offsite for disposal each year.

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 and associated 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 possible waste reduction depend

Table 1. *Summary of Current Waste Generation*

Waste Generated	Source of Waste	Annual Quantity Generated	Annual Costs
Metal Working Fluids	Lubricants and coolants from metal cutting and forming	7,100 gal	$48,200
Chlorinated Solvent	Vapor degreasing operation	7,000 lb	$3,200
Nitric Acid	Surface etching process	110 gal	$160
Caustic Solution	Surface etching process	440 gal	$1,320
Paint and Thinner	Residue and clean up from painting	3,300 gal	$15,380
Contaminated Filters	Capture of overspray in spray booth	2,360 gal	$13,860

Table 2. *Summary of Waste Minimization Opportunities*

Waste Stream Reduced	Minimization Opportunity	Annual Waste Reduction Quantity	Annual Waste Reduction Percent	Net Annual Savings	Implementation Cost	Payback Years*
Metal Working Fluids	Select the smallest number possible of fluid types. Larger volumes of the same fluid should make recycling possible. A mobile recycling service may be possible.	1778 gal	25%	$12,000	0	immed.
Chlorinated Solvent	If chlorinated solvent is required, consider an onsite distillation capability Another alternative would be to investigate water based degreasing systems. Such a system would eliminate vapor emissions and would present less risk than the current system. It is not known, however, if currently available alternatives would meet performance characteristics for this system.	5600 lb	80%	$4240	$5,000	1.2
Nitric Acid and Caustic Etching Wastes	It may be permissible to combine these two streams at the site resulting in at least a portion, depending upon the initial pH which can be discharged to the POTW.	220 gal	50%	$740	0	immed.
Thinners, Paints, and Clean up Solvents	Segregate by solvent type and paint clean up type. Use contaminated solvent as first pass through in clean up of spray equipment. Use mildly contaminated solvent as thinner for next batch of paint. Any metal particles should produce a liquid which is not hazardous. This should be confirmed by appropriate testing. Disposal as non-hazardous water solution would significantly lower disposal costs.	660 gal	20%	$3700	$2,000	0.5
Contaminated Filters	Improve capture efficiency of spraying by selection of most effective spray system and appropriate adjustment of the system.	787 gal	33%	$6620	$20,000	3.0
			(When the value of the paint saved is also considered the savings becomes much greater. Paint at $100 per gal yields an additional annual savings of $49,000, shortening the payback period to less than one year.)			

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

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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 opportunity in most cases results from the need for less raw material and from reduced present and future 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. Savings not quantifiable by this study include a wide variety of possible future costs related to changing emission standards, liability, and employee health. Also, the equipment depreciation is not factored into the calculations.

There is substantial opportunity for pollution prevention at this facility in the area of coating application technology. A significant portion of the total waste stream from this facility is related to paint application. Therefore efforts to make more efficient use of the coating and to reduce the need for cleaning and capture of paint which is not employed in coating the product will be a positive contributor to pollution prevention.

At the time of the assessment there was a particular problem with a specialty paint which was being used in large volumes with poor covering efficiencies. The viscosity of the paint and curing catalyst system was very high, even after thinning by the prescribed procedure. As a result, only about 40% of the paint was actually getting on the computer cabinets because of overspray caused by the inability to effectively control the spraying equipment. Because the paint/catalyst combination cost about $100/gal this was an economic problem, and because the overspray was captured on filters in the spray booth and sent offsite for disposal as hazardous waste, it was also a pollution problem.

An option suggested as a result of the assessment was to investigate the use of a high volume low pressure (HVLP) spraying system. Use of such a system has improved the covering efficiency to 60% resulting in cost savings both in material purchasing and in waste treatment costs.

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