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ENVIRONMENTAL RESEARCH BRIEF

Waste Reduction Activities and Options for a Manufacturer of Writing Instruments

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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 manufactures writing instruments. A site visit was made in 1990 during which several opportunities for waste minimization were identified. These opportunities include reformulation of ink, reuse of rinse waters, changes in scheduling of ink production runs, and changes in degreasing 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 writing instruments manufacturer (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 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.

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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 Writing Instruments Manufacturer

The facility is an integrated manufacturer of writing instruments. The process used involves fabrication of plastic components usually prepared by injection molding, and assembly of the components including metal components which are generally produced offsite. Many of the writing instruments are filled with ink at the facility prior to shipment to the users.

There are four major production areas at this facility, all of which play an important role in the production of the final product. One area consists of an injection molding operation where the writing instrument bodies are created from melted plastic pellets. The major waste stream from this operation is the plastic fragments which are snapped off from the writing instruments bodies after formation. These materials are usually picked up by a broker for reuse.

The second area is the assembly area where components of the writing instruments are assembled. There is very little waste from this area except for degreasing and acid wastes which are generated when etching the components. Some degreasing steps with chlorinated solvents are used to facilitate connections between the metal and plastic components. Some of the stainless steel components are pickled and have parts numbers etched on. This produces an acid waste stream.

The third area is the ink production area where pigments and additives are mixed with solvent in large tanks according to specification to produce the colors and consistencies of ink required. Both solvent-based and water-based inks are produced. The company is moving in the direction of more water-based inks.

The fourth area is the ink filling area, where the ink is put into the writing instruments. Typically this is accomplished with metering pumps. The pumps and the attendant tubing need to be cleaned between runs to prevent cross-contamination. The filled writing instruments are packaged and shipped to customers. Some of the writing instruments are shipped without ink. Ink is also sold in containers to previous purchasers of the instruments.

The company has already identified and established some positive pollution prevention initiatives. The increased use of water-based inks to replace solvent-based inks is a good example of this. There is also a research and development program to find an alternative to heavy metal containing dyes. This effort is limited by the relatively poor availability of substitute colorants without heavy metal contents.

Waste Streams and Existing Waste Management

Ten individual waste streams were identified from the manufacturing operations. A rinsing wastewater stream results primarily from rinsing procedures in the ink manufacturing room. These procedures include rinsing of mixing tanks and filtration units. In addition, rinses from cleaning the ink transfer containers and pumps also enter the waste stream. There is also a contribution from the rinsing of chromium plated tips used in assembly of the writing instruments. About 30,000 gal of this wastestream are generated annually. The major component of environmental concern is chromium, although the formulated inks contain other heavy metals that would also cause concern. The wastestream is sent to a commercial wastewater treatment facility.

A water-based waste ink stream consists largely of material from flushing of ink pumps used in filling operations and from off-specification materials being scrapped. The stream also contains residues from laboratory testing. The component of environmental concern in this stream is chromium, although other heavy metals used in ink formulation may also be in the waste stream. The annual volume of this stream is about 800 gal, which is sent to a commercial treatment facility.

A flammable waste ink stream is similar to the water-based stream described above except that it is composed of organic solvents. The annual volume of this waste stream is about 200 gal, which is sent to a commercial treatment facility and usually incinerated. The major component of environmental concern is acetone and related organic solvents.

An ink spill solids stream has an annual volume of about 12,000 lb. It consists primarily of residues from cleanup of manufacturing equipment and ink dispersing equipment as well as some off-specification product. It also contains residues from spills including adsorbent materials used to facilitate cleanups. The major components of environmental concern are heavy metals, particularly chromium. The stream is sent to a commercial treatment facility where it undergoes solidification, stabilization, or fixation procedures prior to landfilling.

A solvent-based ink spill solids stream is similar to the preceding stream except that it involves solvent-based inks. Approximately 1500 lb of this material are generated annually. It is sent offsite for treatment or disposal, typically by incineration.

Waste solvent from degreasing operations comes from both manufacturing and maintenance activities. The solvents are typically chlorinated materials. About 300 gal of this waste are generated annually and are disposed of by incineration offsite.

A waste oil stream from equipment maintenance results from procedures carried out on equipment. The annual volume of this stream is about 400 gal.

A waste stream composed of oily rags results from maintenance operations. The rags are used primarily for wiping and cleaning the equipment during maintenance procedures as well as occasionally being used for spill cleanup. The rags are disposed of offsite by consolidation and solidification prior to landfilling. The annual volume of this stream is about 2500 lb.

A waste acid stream results from pickling activities carried out with stainless steel components, as well as from etching procedures used to mark parts numbers on some of these components. The annual volume of this stream is about 60 gal. It is currently treated offsite by pH adjustment and subsequent biological treatment.

An acid cleanup solids wastestream results from the same activities described above but primarily represents the wipers used on the stainless steel components which have been pickled, etched, rinsed, or soldered. The annual volume of this stream is about 80 lb. It is treated by consolidation and solidification prior to landfilling.

Summary of Waste Minimization Opportunities

Table 1 presents the type of waste currently generated by the plant, the sources of waste, the quantity of waste, and the annual treatment and disposal costs (where known and available).

Table 2 presents 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 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, result 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. Also, no equipment depreciation is factored into the calculations.

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Table 1. *Summary of Current Waste Generation*

Waste Generated	*Source of Waste*	*Annual Quantity Generated*	*Annual Waste Management Costs*
Rinsing Wastes	*Rinsing equipment in ink production area*	*30,000 gal*	*$10,000*
Waste Aqueous Ink	*Flushing of ink pumps and disposal of off-spec products*	*800 gal*	*$2,000*
Flammable Waste Ink	*Flushing of ink pumps and disposal of off-spec products*	*200 gal*	*$500*
Ink Spill Solids (Aqueous)	*Residues from machinery cleaning and adsorbents from spill control*	*12,000 lb*	*$15,000*
Ink Spill Solids (Flammable)	*Residues from machinery cleaning and adsorbents from spill control*	*1,500 lb*	*$2,000*
Solvent	*Degreasing*	*300 gal*	*$2,000*
Waste Oil	*Equipment maintenance*	*400 gal*	*$800*
Oily Rags	*Maintenance operations*	*2500 lb*	*$3,000*
Waste Acid	*Etching and pickling of metal*	*60 gal*	*$1,000*
Acid Cleanup Solids	*Wipers for metal after pickling or etching*	*80 lb*	*$400*

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Table 2. *Summary of Waste Minimization Opportunities*

Waste Stream Reduced	Minimization Opportunity	Annual Waste Reduction Quantity	Percent	Net Annual Savings	Implementation Cost	Payback Years*
Rinsing Wastes	Schedule batch production where possible to go from light to dark colors to reduce the need for extended rinsing of equipment	3000 gal	10%	$1,000	$0	immed
Rinsing Wastes	For rinses from filling equipment segregate them and then use them as makeup water for the next similar batch.	1500 gal	5%	$500	$200	0.4
Ink Spill Solids	Institute spill prevention plan to improve movement of materials around the facility, improve transfer techniques between containers, catch spills to reduce need for cleanup	3,000 lb	25%	$3,750	$500	0.2
Flammable Ink Wastes	Improve scheduling of production runs	20 gal	10%	$50	0	immed
Flammable Ink Spills	Devise spill prevention plan	375 lb	25%	$500	$500	1.0
Degreasing Solvent	Change to non-chlorinated solvent	(actual volume may stay constant, but level of risk would decrease)				
Oily Rags	Investigate use of commercial laundry for cleaning of maintenance wipes †	2500 lb	100%	$3000	$2400 (This is an annual charge)	0.8

* Savings result from reduced raw material, and treatment and disposal costs when implementing each minimization opportunity independently.
† Addresses minimization of waste rags, but not of the oily wastes contained in them.

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