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ENVIRONMENTAL RESEARCH BRIEF

Waste Reduction Activities and Options for a Manufacturer of Fire Retardant Plastic Pellets and Hot Melt Adhesives

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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 fire retardant plastic pellets and hot melt adhesives. The manufacturing process for the plastic pellets uses a batch procedure in mixers where resins are combined with flame retardants and other additives. The mix is allowed to solidify and formed into pellets. The hot melt adhesive is produced by extruding a polymer with the necessary additives followed by washing and pelletizing. A site visit was made in 1990 during which several opportunities for waste minimization were identified. Options identified included changes in sequencing of production, modifications of wastewater treatment practices, changes in hydraulic oil use and reuse practices. 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 the manufacturing of fire retardant plastic pellets and hot melt adhesives (1 of the 30 assessments performed) and provides recommendations for waste minimization options resulting from the assessment.

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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 in-house 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.

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.

No sampling or laboratory analysis was undertaken as part of these assessments.

Facility Background

The facility is a manufacturer of plastic pellets with fire retardant properties. The pellets are typically used for wire and cable coating and insulation. The facility also manufactures hot melt adhesives used primarily for metal-metal bonding.

The facility is located in a rural area and employs about 120 people. In addition to the equipment used directly for production, there are tanks used for wastewater treatment and a pond where non-hazardous water is piped.

Manufacturing Processes

The production of the plastic formulation for the wire insulation pellets takes place in a Banbury mixer. Powdered polyethylene resins and various combinations of additives including brominated fire retardants, fillers, and colorants such as antimony oxide and carbon black are metered in and mixed. The resulting composition is spread onto a conveyor for hardening and then mechanically chopped into pellets.

The hot melt adhesive process requires combining and melting polypropylene, acrylic acid, and an organic peroxide in an extruder. The specific organic peroxide used changes depending upon the desired performance characteristics of the final product. The mixed melt is extruded onto a ventilated conveyor and transported to a slurry washing station. The washed product is pelletized and dried before packaging as the finished product.

Existing Waste Management Activities

The company has already instituted some environmental practices designed to encourage reuse of materials and to minimize worker risk. Their willingness to participate in this study indicates the interest of the management of the facility in strengthening their pollution prevention activities. The two major product lines are substantially different in their manufacturing steps; the waste management practices and requirements for the two therefore differ.

The plastic pellet process utilizes a low hazard material and is essentially a mixing process with little or no potential for emissions. There is a potential for dust emission during the mixing step. This is addressed using hydraulic oil dust seals at each end of the mixer rotor. This oil, contaminated with mixture ingredients, drips into 5-gal containers. When these containers are filled the accumulated oil is emptied into a 55-gal drum where the heavier materials settle to form a sludge. Periodically, the oil is pumped out for recycling and the sludge is mixed with clay and landfilled. Approximately 3200 gal of waste oil and 200 drums of sludge are generated each year. In addition, water from housekeeping operations and from cleaning the mixers is collected in sumps and pumped to tanks to allow skimming of oil for recycling. The oil-free water, about 50,000 gal/day is pumped to the pond onsite.

The hot melt adhesive production process involves a scrubbing process for the captured air emissions produced after the extrusion step. The exhaust from a hood is passed through a water scrubber. The contaminant which is acrylic acid is retained by the water. After about one week in the scrubber, the water is pH adjusted and sent to a storage tank. Water used in product washing is similarly treated and sent to the storage tank about once a week. The accumulated wastewater (about 7,000 gal/wk) is sent offsite for disposal at a cost of about $0.42/gal. The level of acrylic acid is about 1%. This process also produces waste peroxide. When product types are changed, the practice at the facility is to purge the peroxide metering apparatus with the peroxide material to be used in the next batch. The collected purge material is then a mixture of organic peroxides. The quantity of this material varies depending upon production rates, but about 1-2 quarts is produced with each purge. The mixture is accumulated in drums at the site. Presently, the facility is seeking an effective disposal practice for this mixture of wastes. The manufacturer recommends disposal by incineration, after mixing with oil to a level of peroxide no greater than 5% of the mixture.

The appearance of the facility shows that the management and employees recognize the waste reduction value of careful movement of raw materials, good maintenance of equipment, and spill control and spill prevention activities.

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 time 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.

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. Also, no equipment depreciation is factored into the calculations.

* Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Regulatory Implications

There are potential regulatory implications of pollution prevention initiatives at this facility. Any changes in the scrubbing system may be impacted by the requirements of the air permit. If any permit conditions need to be changed then implementation of pollution prevention concepts may be delayed. The pond at the facility which currently receives non-hazardous aqueous streams may be impacted by changing water discharge regulations. In that case additional operational changes may be required to address new regulations. The accumulation of mixed organic peroxides at the facility must be done in accordance with RCRA and state regulations. Overall, a facility such as this should encourage implementation of additional pollution prevention practices.

This Research Brief summarizes a part of the work done under cooperative Agreement No. CR-815165 by the New Jersey Institute of Technology under the sponsorship of the New Jersey Department of Environmental Protection and Energy and the U.S. Environmental Protection Agency. The EPA Project Officer was Mary Ann Curran. She can be reached at:

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Table 1. *Summary of Current Waste Generation*

Waste Generated	*Source of Waste*	*Annual Quantity Generated*	*Annual Waste Management Costs*
Waste Hydraulic Oil	*Oil dust seals on Banbury mixers*	*3200 gal*	*$1,600*
Oil Sludges	*Process residues captured by oil in the mixer*	*200 drums*	*40,000*
Acrylic Acid Contaminated Water	*Air scrubber from adhesive hood and washing of product*	*364,000 gal*	*153,000*
Mixed Peroxides	*Material used to purge raw material metering system*	*20 drums (estimated)*	*120,000 (based on estimated incineration costs as recommended by manufacturer)*

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Table 2. Summary of Recommended Waste Minimization Opportunities

Waste Stream Reduced	Minimization Opportunity	Annual Waste Reduction		Net Annual Savings	Implementation Cost	Payback Years *
		Quantity	Percent			
Waste Oil	Filtration or centrifugation of oil allowing reuse	1600 gal	50	$3,200	$10,000	3
Wastewater Containing Acrylic Acid	Evaluate scrubber water and wash water to determine which has the lower level of acrylic acid. Use the one with the lower level as the makeup for the other. This will reduce the total volume of water used.	109,000 gal	30	45,800	200	immed.
	Removal of acrylic acid from water by ion exchange or reverse osmosis allowing water reuse and producing another type of waste stream with higher levels of acrylic acid.	328,000 gal	90	67,000	75,000	1.1
Mixed Organic Peroxides	Use air purge capability designed into equipment. Keep separate the air-purged peroxides and use them in the next batch. Some washing with solvent such as hexane of critical mechanical parts may be desired, generating a much smaller waste stream.	18 drums	90	110,000	100	immed.

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

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