United States
Environmental Protection
Agency

Research and Development

Risk Reduction
Engineering Laboratory
Cincinnati, OH 45268

EPA/600/S-92/032 Sept. 1992

EPA

ENVIRONMENTAL RESEARCH BRIEF

Waste Minimization Assessment for a Manufacturer of Injection-Molded Car and Truck Mirrors

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Abstract

The U.S. Environmental Protection Agency (EPA) has funded a pilot project to assist small- and medium-size manufacturers who want to minimize their generation of waste but who lack the expertise to do so. Waste Minimization Assessment Centers (WMACs) were established at selected universities and procedures were adapted from the EPA *Waste Minimization Opportunity Assessment Manual* (EPA/625/7-88/003, July 1988). The WMAC team at the University of Louisville performed an assessment at a plant that manufactures injection-molded car and truck mirrors — over 2.5 million/yr. Purchased parts and injection-molded plastic parts manufactured onsite are painted as needed and assembled. The team's report, detailing findings and recommendations, indicated that a large quantity of waste is generated by the painting process and that waste plastic also is generated in significant amounts. The greatest cost savings can be achieved in this plant by using an alternate method of disposing of the waste paint sludge generated in the paint booths.

This Research Brief was developed by the principal investigators and EPA's Risk Reduction Engineering Laboratory, Cincinnati, OH, to announce key findings of an ongoing research project that is fully documented in a separate report of the same title available from University City Science Center

Introduction

The amount of waste generated by industrial plants has become an increasingly costly problem for manufacturers and an additional stress on the environment. One solution to the problem of waste is to reduce or eliminate the waste at its source.

University City Science Center (Philadelphia, PA) has begun a pilot project to assist small- and medium-size manufacturers who want to minimize their formation of waste but who lack the inhouse expertise to do so. Under agreement with EPA's Risk Reduction Engineering Laboratory, the Science Center has established three WMACs. This assessment was done by engineering faculty and students at the University of Louisville's WMAC. The assessment teams have considerable direct experience with process operations in manufacturing plants and also have the knowledge and skills needed to minimize waste generation.

The waste minimization assessments are done for small- and medium-size manufacturers at no out-of-pocket cost to the client. To qualify for the assessment, each client must fall within Standard Industrial Classification Code 20-39, have gross annual sales not exceeding $75 million, employ no more than 500 persons, and lack inhouse expertise in waste minimization.

The potential benefits of the pilot project include minimization of the amount of waste generated by manufacturers, reduced waste treatment and disposal costs for participating plants, valuable experience for graduate and undergraduate students who participate in the program, and a cleaner environment without more regulations and higher costs for manufacturers.

Methodology of Assessments

The waste minimization assessments require several site visits to each client served. In general, the WMACs follow the procedures outlined in the EPA *Waste Minimization Opportunity Assessment Manual* (EPA/625/7-88/003, July 1988). The WMAC staff locate the sources of hazardous waste in the plant and identify the current disposal or treatment methods and their associated costs. They then identify and analyze a variety of ways to reduce or eliminate the waste. Specific measures to

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achieve that goal are recommended and the essential supporting technological and economic information is developed. Finally, a confidential report that details the WMAC's findings and recommendations (including cost savings, implementation costs, and payback times) is prepared for each client.

Plant Background

The plant produces injection-molded car and truck mirrors. Over 2.5 million mirrors are produced each year.

Manufacturing Processes

Raw materials used by the plant include resins, paint, finishing material, mirror glass, and miscellaneous parts. The following processes are involved in making the product.

Injection Molding

The resins used to produce the plastic mirror parts by injection molding are dried in a gas-fired dryer prior to processing. Repelletized scrap is blended with some of the new resin material.

Ten injection-molding presses are operated continuously. The resin is melted by the machines' heaters and injected into the mold. The set mold is released and scrap is removed from the part; scrap plastic is discarded or repelletized for recycle.

The parts are then trimmed to remove excess plastic, inspected, cleaned with alcohol and mineral spirits, and buffed. Finished parts are sent to the painting department or directly to the assembly area.

Painting

Parts are painted in one of three water-curtain paint booths. The required paint is diluted with thinner as needed and mixed with the appropriate catalyst.

Automatic spray guns and manual spray guns for touch-up apply the paint. Parts are dried in a natural gas-fired oven and inspected for defects. The last step of the paint process is the cleaning of parts with solvent (acetone/xylene) after which the parts are sent to the assembly area.

Assembly

The various types of mirrors are assembled from the manufactured and purchased parts. The products are tested, inspected, and packaged for shipping. An abbreviated process flow diagram is shown in Figure 1.

Existing Waste Management Practices

The plant already had made the following efforts to manage and minimize its wastes.

- Plastic pallets, foam padding, cardboard strips, and plastic bags received as packing materials are reused by the shipping department.
- A portion of the unfinished waste plastic is repelletized and reused in the injection molding machines.
- Paint is purchased on an as-needed basis to avoid the problems associated with disposal of paint held past its shelf-life.
- Defective zinc mirror-housings are recycled.

Waste Minimization Opportunities

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

Table 2 shows the opportunities for waste minimization that the WMAC team recommended for the plant. The current plant practice, the proposed action, the possible waste reduction and associated savings, and the implementation cost along with the payback times are given in the table. The quantities of hazardous waste currently generated by the plant and possible waste reduction depend on the production level of the plant. 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 hazardous waste treatment and disposal. Other savings not quantifiable by this study include a wide variety of possible future costs related to changing emissions standards, liability, and employee health. 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.

Additional Recommendations

In addition to the opportunities recommended and analyzed by the WMAC team, several additional measures were considered. These measures were not completely analyzed because

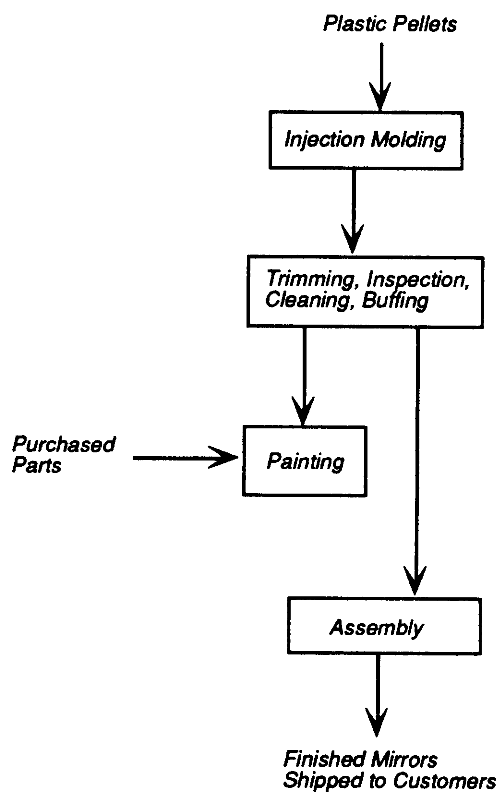

Figure 1. Abbreviated Process Flow Diagram.

of insufficient data or minimal savings as indicated below. They were brought to the plant's attention for future reference, however, since these approaches to waste reduction may increase in attractiveness with changing plant conditions.

- Use hair nets, lint-free clothing, and other related items for dust control in the paint spray areas in order to reduce the number of parts rejected after the painting process. This opportunity was not analyzed completely because of the difficulty in quantifying the potential savings.
- Transfer paint from one container to another using a hand pump in order to reduce spillage. The WMAC recommends testing of this suggestion to determine if the pump would transfer the paint satisfactorily.
- Install an onsite wastewater treatment plant to process and recycle wastewater from the paint spray booths. This opportunity may not be cost-effective for a plant of this size.
- Investigate the possibility of replacing the solvent-based paints with powder coatings. The WMAC could not determine if changes in the coating would meet customer specifications and therefore could not develop a recommendation in this area.
- Reduce evaporative losses of solvents by covering open containers.

This opportunity would yield minimal savings.

This research brief summarizes a part of the work done under Cooperative Agreement No. CR-814903 by the University City Science Center under the sponsorship of the U.S. Environmental Protection Agency. The EPA Project Officer was Emma Lou George.

Table 1. Summary of Current Waste Generation

Waste Generated	*Source of Waste*	*Annual Quantity Generated*	*Annual Waste Management Cost*
Unusable paint	*Raw materials handling. Paint that has been held beyond its shelf-life is disposed of offsite as a hazardous waste.*	*50 gal*	*$5,275*[1]
Paint sludge	*Spray paint booths. Paint sludge removed from the water pumps of the spray paint booths and other paint wastes are combined and disposed of offsite as a hazardous waste.*	*21,040 gal*	*1,182,620*[1]
Wastewater/solvent	*Spray paint booths. Solvent used to clean the paint spray guns is sprayed into the water curtains of the spray paint booths; the aqueous emulsion that forms in the pumps is removed and disposed of offsite as a hazardous waste.*	*72,000 gal*	*105,640*[1]
Waste solvent	*Parts cleaning. Waste solvent from parts cleaning is sent to a secondary fuels program for disposal.*	*14,020 gal*	*101,940*[1]
Plastic waste	*Materials handling, injection molding, and painting. Waste plastic is sent to an offsite nonhazardous landfill.*	*637,500 lb*	*32,510*
Empty paint cans	*Painting operation. Empty 5-gal and 1-gal metal cans are sent to an offsite nonhazardous landfill.*	*720 cu yd*	*7,200*
Miscellaneous trash	*Various processes. Waste cardboard, small plastic pieces, and broken mirror glass are sent to an offsite nonhazardous landfill.*	*4,080 cu yd*	*24,480*
Wooden pallets	*Receiving department. Used wooden pallets are sent to an offsite nonhazardous landfill.*	*1,180 cu yd*	*7,000*

[1] *Includes raw material costs*

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Table 2. Summary of Recommended Waste Minimization Opportunities

Current Practice	*Proposed Action*	*Waste Reduction and Associated Savings*
Plastic waste generated by the plant is discarded in dumpsters and disposed of in an offsite nonhazardous landfill.	*Segregate the different types of plastic waste and sell the waste to a waste plastic dealer.*	*Waste reduction = 573,750 lb/yr* *Waste disposal savings = $29,270/yr* *Additional labor cost = $18,360/yr* *Revenue received = $2,870/yr* *Net cost savings = $13,780/yr* *Implementation cost = $0* *Simple payback is immediate.*
Empty steel paint-cans are discarded in a dumpster and disposed of in an offsite nonhazardous landfill.	*Sell the cans to a steel can recycler. (The amount of dried paint in the cans must be minimized.)*	*Waste reduction = 720 cu yd/yr* *Waste disposal savings = $7,200/yr* *(Revenue received is offset by hauling cost.)* *Implementation cost = $0* *Simple payback is immediate.*
Wooden pallets are discarded and disposed of in an offsite nonhazardous landfill.	*Give the pallets to a pallet rebuilder to eliminate disposal costs.*	*Waste reduction = 1,185 cu yd/yr* *Waste disposal savings = $7,000/yr* *Implementation cost = $0* *Simple payback is immediate.*
Paint sludge from the spray paint booths is sent offsite to a hazardous waste disposal facility.	*Send the paint sludge to a facility that dries the wet sludge thereby yielding a dry powder of lesser volume for disposal.*	*Waste disposal savings = $24,300/yr* *Implementation cost = $0* *Simple payback is immediate.*
Waste solvent from the cleaning operation is sent to a secondary fuels program.	*Install a small batch distillation system to reclaim used solvent. Ship still bottoms offsite.*	*Waste reduction = 9,820 gal/yr* *Waste disposal savings = $17,850/yr* *Raw material savings = $53,550/yr* *Operating cost of system = $780/yr* *Net cost savings = $70,620/yr* *Implementation cost = $33,000* *Simple payback = 0.5/yr*
A mixture of acetone and xylene is used for parts cleaning.	*Replace the currently used solvent with a di-basic ester in order to reduce volatile organic compound emissions and disposal costs.*	*Increased raw material cost = $12,750/yr* *Waste disposal savings = $20,150/yr* *Net cost savings = $7,400/yr* *Implementation cost = $0* *Simple payback is immediate.*
Waste paint sludge from the paint booth pumps is manually scooped out each shift and disposed of as hazardous waste.	*Install hydroclones to remove paint solids from the paint booth water. The hydroclones will use centrifugal force to coagulate the paint solids and remove them from the sump. The water will be recirculated to the paint booths. The new system should also reduce the amount of water from the system that must be disposed of.*	*Waste reduction = 76,500 gal/yr* *Waste disposal savings = $189,200/yr* *Operating cost of system = $9,300/yr* *Net cost savings = $179,900/yr* *Implementation cost = $26,000* *Simple payback = 0.1 yr*
Spray-gun cleaning solvent is sprayed directly into the water curtains of the paint spray booths.	*Spray the solvent into a collection container for disposal.*	*Waste reduction = 33,130 gal/yr* *Waste disposal savings = $39,800/yr* *Implementation cost = $0* *Simple payback is immediate.*

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