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ENVIRONMENTAL RESEARCH BRIEF

Waste Minimization Assessment for a Manufacturer of Outdoor Illuminated Signs

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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 hazardous waste but 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 Tennessee inspected a plant making large and small outdoor signs with the use of steel channels and sheeting, plastic sheeting, paint, adhesives, electrical wiring, and hardware. The team's report, detailing their findings and recommendations, identified the greatest opportunities to minimize waste in the painting, cleaning, and letter gluing operations. The greatest savings would result from the reactivation of an unused electrostatic paint spray system.

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 the authors.

Introduction

The amount of hazardous 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 hazardous 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 hazardous waste but 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 Tennessee's (Knoxville) WMAC. The assessment teams have considerable direct experience with process operations in manufacturing plants and also have the knowledge and skills needed to minimize hazardous 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 $50 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

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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 locates the sources of hazardous waste in the plant and identifies 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 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

A waste minimization assessment was done for a plant making various sizes and styles of illuminated outdoor signs. The plant annually produces approximately 10,400 signs ranging in size from 18 x 18 in. to 13 x 13 ft.

The materials used by the plant to produce the signs include steel channels and sheeting, plastic sheeting, paint, adhesives, electrical wiring, and hardware.

To reduce its emission of hazardous waste, the plant had already installed a distillation unit for solvent recovery and a down-draft paint booth system with electrostatic painting capabilities.

Process Operations

The following processes are involved in producing the signs.

- Steel stock is cut to desired measurements for components to make sign frames.
- Electrical wiring, sockets, and ballasts are fastened to the interior frame surfaces.
- Frames are manually spray primed and painted.
- Plastic sheeting is cut to desired shape for sign faces.
- Some sign faces are vacuum-formed to create raised lettering or protrusions on sign faces.
- Sign faces that have been vacuum-formed are lettered. The faces are initially sprayed with a masking medium. When dry, the masking medium is cut from the areas requiring paint and sign faces are painted with a hand-held spray gun.
- The remaining sign faces are lettered by fastening preformed plastic letters to the faces with an adhesive or by silk screen painting the desired pattern onto the face.
- Silk screen surfaces are cleaned with Hi-Sol 10 or methylethyl ketone (MEK) to remove paint. The solvent used depends on the ease of removal of the paint.
- Paint spray guns are cleaned using xylene or KH5000*, depending upon the type of paint used.
- Paint/solvent mixtures from the screen cleaning and spray gun cleaning are distilled to recover usable solvents. Paint sludge and unreclaimed xylene, Hi-Sol 10, and KH5000 are shipped off-site as hazardous waste.

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 (treatment and disposal) costs are given in Table 1.

The WMAC team investigated various options for minimizing the plant's generation of hazardous waste. Waste minimization opportunities related to the sign frame paint booths, the silk screen cleaning operation, and the letter gluing operation are described in Tables 2, 3, and 4, respectively. For each opportunity, the type of waste, the possible waste reduction and associated savings, and the implementation cost along with the payback time are given in the tables. The quantities of hazardous waste currently generated by the plant and possible waste reduction depend on the production level of the plant. All values stated should be considered in that context.

It should be noted that, in most cases, the economic savings of the minimization opportunities result 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.

Additional Recommendations

In addition to the recommended waste minimization opportunities, the WMAC team indicated that the plant personnel should

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

Table 1. Summary of Current Waste Generation

Waste Generated	Source of Waste	Annual Quantity Generated (gal)	Annual Waste Management Cost
Paint and primer residue	Paint booth for large sign frames. Dried paint/primer dust is removed from the walls of the booth. Paint overspray is also collected by a down-draft air system into a flowing water stream; the paint/primer residue is recovered from the water stream with the use of a centrifuge.	385	$14,080
	Paint booth for small sign frames. Dried paint/primer dust is removed from the tables, walls, ceiling, and floor.	275	4,440
	Paint booth for spray painting of sign faces. Dried paint/primer dust is removed from the walls and floors of the booth.	550	9,080
Evaporation of paint thinner (KH5000)	Paint booth for large sign frames.	43	0[1]
	Paint booth for small sign frames.	30	0[1]
Evaporation of methylene chloride	Letter gluing operation. A substantial amount of methylene chloride evaporates into the plant air as methylene chloride is used to facilitate bonding the letters to the sign faces.	330	0[2]
Evaporation of Hi-Sol 10 and Hi-Sol 10 not recovered from distillation process	Cleaning silk screens.	4,125	4,710[3]
Evaporation of MEK	Cleaning silk screens.	330	0[4]
Evaporation of xylene and xylene not recovered from distillation process	Cleaning paint spray guns.	154	9,740[3]
Evaporation of KH5000 and KH5000 not recovered from distillation process	Cleaning pain spray guns.	185	4,710[3]
Spent, contaminated paint sludge	Distillation process for recovery of cleaning solvents.	165	14,450[5]

[1] Currently there are no waste management costs associated with the evaporation of the paint thinner.
[2] Currently there are no waste management costs associated with the evaporation of the methylene chloride.
[3] Cost of off-site removal of unreclaimable solvent and cost of operating distillation process.
[4] Currently there are no waste management costs associated with the evaporation of methylethyl ketone.
[5] Cost of off-site removal of paint sludge and cost of operating distillation process.

make an ongoing effort to identify superior alternatives to presently used solvents to minimize hazardous wastes.

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Table 2. Options for Minimizing Waste Generated in the Paint Booths for Large and Small Sign Frames

Waste Generated	Minimization Opportunity	Annual Waste Reduction Quantity	Annual Waste Reduction Percent	Net Annual Savings [1]	Implementation Cost	Payback Years
Paint/primer residue	Reactivate the currently unused electrostatic paint spray system	495 gal[2]	75	$25,410	$4,400	0.2
Paint thinner (KH5000)		55 gal [3]	75	180		
	Use paint atomization spray equipment having adjustable cross-sectional areas for maximum paint application efficiency for the particular frame being sprayed.	165 gal [2]	25	8,470	6,000	0.7
		18 gal [3]	25	60		
	Retrain paint application personnel to use techniques employing minimal distance from spray gun to target area and minimum overspray at piece edges.	66 gal[2]	10	3,390	3,000	0.9
		7 gal[3]	10	20		

[1] Includes savings on disposal costs and raw materials.
[2] Primer
[3] Thinner

Table 3. Options for Minimizing Waste Generated by the Silk Screen Cleaning Process

Waste Generated	Minimization Opportunity	Annual Waste Reduction Quantity	Annual Waste Reduction Percent	Gross Annual Savings [1]	Implementation Costs Operating Cost	Implementation Costs Capital Cost	Payback Years
Hi-Sol 10[2]	Minimize the amount of residual paint left on the screens before cleaning with solvents. Use smal sharp-edged scraping tools and hand-held compressed air spray nozzles to remove residual paint before solvent cleaning.	2,063 gal	50	$8,540	$9,300[3]	$700	0.15
MEK		165 gal	50	580			
Spent, contaminated paint sludge		55 gal	33	4,820			
Hi-Sol 10 evaporation	Construct an enclosure to serve as a screen spray cleaning booth. Evaporative loss of solvents will be minimized as a result of using an automatic cleaning system in an essentially air-tight space.	3,300 gal	80	9,900		$22,880	2.1
MEK		264 gal	80	920			

[1] Includes savings on raw materials.
[2] Evaporation of Hi-Sol 10 and Hi-Sol 10 not recovered from distillation process.
[3] Additional costs include increased labor costs associated with more thorough mechanical removal and off-site removal costs of dried paint waste.

Table 4. Options for Minimizing the Evaporative Loss of Methylene Chloride used for Letter Gluing

Waste Generated	Minimization Opportunity	Annual Waste Reduction		Net Annual Savings [1]	Implementation Cost	Payback Years
		Quantity	Percent			
Methylene chloride	Use a template to maintain position of letters during overnight curing in place of methylene chloride.	330 gal	100	$1,980	$200	0.1
	Use a removable adhesive tape to hold the letters in place while the glue is cured overnight.	330 gal	100	1,980	100	0.05
	Fix the letters to the signs using mechanical means such as fasteners. Eliminate the use of adhesives.	330 gal	100	5,260 [2]	1,500	0.3

[1] Includes savings on raw materials.
[2] Includes savings associated with the elimination of the cost of adhesives.

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