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ENVIRONMENTAL RESEARCH BRIEF

Waste Minimization Assessment for a Manufacturer of Rebuilt Railway Cars and Components

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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 that rebuilds approximately 2,000 railway cars (open, flat, and freight) each year and that refurbishes wheel assemblies and air brake systems. The team's report, detailing their findings and recommendations, indicated that the greatest opportunities to minimize waste came from the railcar painting operation where paint and primer solids and sludge are generated. The team recommended installing an electrostatic spray paint system for priming and painting to reduce the overspray losses.

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.

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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

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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 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 completed for a plant that refurbishes railway cars, wheel sets, and air brake equipment. The plant rebuilds approximately 2,000 railcars each year.

Manufacturing Process

Several types of open, flat, and freight cars are received and refurbished. The plant also rebuilds air brake systems and wheel assemblies that are used on the railcars being refurbished or that are shipped off-site to other facilities of this company.

The following steps are involved in the refurbishing of railcars:

- Mechanical cleaning of cars. Mechanical shakers are used to loosen dirt and other residue from the internal and external surfaces of the cars. The debris falls through a grating in the floor and is periodically collected and disposed of as nonhazardous waste.

- Secondary cleaning of cars. Cars are then subjected to high-pressure water cleaning. The spent water and residue resulting from the washing is collected in a floor drain that leads to an outdoor on-site clarifier and pH adjustment facility. The solids obtained by clarification are considered nonhazardous. Water is directed to the municipal sewer.

- Removing damaged parts and systems to be replaced.

- Removing paint coatings. A steel grit blast system, which consists of an overhead motor-driven impeller that slings the steel grit against the cars' metal surfaces, removes paint chips. The paint chips and grit are collected through a grating in the floor and are conveyed to an outdoor cyclone where reusable grit is recycled and paint dust and spent grit are separated in a baghouse and collected in barrels for off-site shipment as hazardous waste.

- Applying primer. After the stripping, primer is applied with the use of hand-held spray guns. Overspray, which collects on the walls and floor of the primer area, is occasionally scraped off, collected in barrels, and disposed of as hazardous waste.

- Reassembling cars. Repairs are made to the cars' exteriors, and then the cars are reassembled.

- Applying paint. Paint is applied with the use of hand-held spray guns. Paint overspray on the floor and walls is periodically scraped up and disposed of as hazardous waste.

The wheel set rebuilding involves the following:

- Resurfacing wheels. Wheel sets having no major flaws are resurfaced on a lathe before being reused.

- Washing axles. Wheels having major flaws are removed from their axles, collected, and sold as scrap metal. Axles that can be recycled are washed with a water-based caustic solution containing a rust-preventative to remove grease and idrt. Contaminiated water is screened and sent to an oil separator and then to the outdoor clarifier and pH adjustment system. Sludge from the axle wash system is collected in barrels and disposed of as hazardous waste. Oil separated from water is collected in barrels and sold to an outside contractor.

- Assembling wheel sets. New wheels are joined to the recycled axles.

Air brake rebuilding involves the following:

- Removing external debris. A plastic bead blast system removes external debris from the air brake assemblies. Spent beads and debris are collected in barrels and shipped off-site as hazardous waste.

- Solvent cleaning. The air brakes are disassembled and cleaned with solvents. A vendor supplies the cleaning solvents and is responsible for periodically renewing the solvents and for removing spent solvents.

- Reassembling air brake systems.

Existing Waste Management Practices

This plant has discontinued using methylene chloride in the axle wash process, installed a wastewater treatment facility, and contracted with an outside supplier to reclaim solvent used in air brake component cleaning in order to minimize and manage its hazardous wastes.

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 treatment and disposal costs are given in Table 1.

Table 2 shows the opportunities for waste minimization that the WMAC team recommended for the plant. 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 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, 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. It should also be noted that the savings given for each minimization opportunity reflect the savings achievable when implementing each opportunity independently and do not reflect duplication of savings that would result when the waste minimizations 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 analyzed completely because of insufficient data, implementation difficulty, or a projected lengthy payback as indicated below. Since one or more of these approaches to waste reduction may, however, increase in attractiveness with changing conditions in the plant, they were brought to the plant's attention for future consideration.

Those additional recommendations include:

- Install a custom-designed system in the grit blast area to effect a separation of spent steel grit and paint residue. To the extent the two materials can be separated, the volume of hazardous waste (paint and spent contaminated steel grit) can be reduced by the amount of the spent steel grit, that is not hazardous. Concepts for the paint and steel separation include the use of an electromagnet or flotation system. Since such systems would be capital intensive in relation to the savings, payback is not attractive at this time.

- Use a mechanical axle precleaning before the caustic wash. By using mechanical brushing, some relatively dry residue can be removed from the axles in a concentrated form for disposal rather than as part of the sludge obtained from the present wash system. Technical difficulties may be associated with oil or grease contamination of a rotating brush, and savings would likely be small and payback lengthy at this time.

- Install an ultrasonic axle wash system to eliminate the caustic wash waste water stream. This measure would be relatively capital intensive and would have a lengthy payback.

- Eliminate air drafts in railcar painting sheds to minimize primer and paint mist being blown away from the surfaces to which the spray is directed. On windy days, air currents through the paint shed areas are apparently responsible for a significant amount of the overspray waste. Because of the limited time to observe these effects, it was not possible to quantify potential waste reduction.

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 Brian A. Wesfall.

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Table 1. Summary of Current Waste Generation

Waste Generated	Source of Waste	Annual Quantity Generated	Annual Waste Mangement Cost
Paint chips and spent steel grit	Steel grit blast system.	225 ton[1] 214 ton[2]	$95,560
Paint and primer solids and sludge	Railcar painting operation.	56,042 lb	36,860
Evaportaed solvents	Railcar painting operation.	6,000 gal	0[3]
Axle wash sludge	Axle cleaning operation.	2,400 lb	5,350
Paint chips and spent plastic beads	Brake component cleaning operation.	900 lb	5,200

[1] Steel grit
[2] Paint chips
[3] Currently, the plant reports no waste management costs associated with the evaporation of the solvents.

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Table 2. Summary of Recommended Waste Minimization Opportunities

Waste Generated	Minimization Opportunity	Annual Waste Reduction Quantity	Annual Waste Reduction Percent	Net Annual Savings	Implementation Cost	Payback Years
Paint and primer solids and sludge and evaporated solvents	Install an electrostatic spray paint system for priming and painting to reduce overspray losses.	580 gal[1] 85 gal[2]	15 1	$11,080 [5,6]	$58,320	5.3
	Retrain paint personnel to improve spray technique and thus reduce overspray losses.	197 gal[1] 300 gal[2]	5 5	4,820[5]	3,500	0.7
Dirt contaminated with paint and primer	Cover dirt floors of the paint and primer areas with plastic sheets to collect paint and primer residue. Currently 10% of the paint and primer waste removed is dirt.	2,802 lb	5	1,540[6]	0[7]	0
Paint chips and spent steel grit	Modify the blast operation to remove 75% of coating rather than the current 90%. Plant personnel have indicated that it is possible to remove less of the coatings without a detrimental effect on product quality.	37 ton[3] 36 ton[4]	17 17	24,980[5]	13,500	0.5

[1] Paint and primer
[2] Solvent
[3] Steel grit
[4] Paint chips
[5] Includes savings on raw materials
[6] Total savings reducted by annual operating cost
[7] Implementation requires annual operating cost but no capital cost

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