



ENVIRONMENTAL RESEARCH BRIEF

Waste Minimization Assessment for a Manufacturer of Refurbished Railcar Bearing Assemblies

F. William Kirsch and Gwen P. Looby*

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 Tennessee performed an assessment at a plant that rebuilds railcar bearing assemblies — approximately 163,200 bearing components per year. Bearings are disassembled, washed, then inspected. "Premium" bearings, those still within specifications, are reassembled with new grease and bearing seals, packaged, and shipped. Nonpremium bearings are buffed, rinsed in hot water, and then chrome plated to build up the bearing surfaces. After chroming, the parts are rinsed, baked, and allowed to air cool. Cooled bearings are reassembled with new grease and seals, then packaged and shipped. The team's report, detailing findings and recommendations, indicated that the majority of waste was generated during the railcar bearing cleaning operation and that the greatest savings could be obtained by instigating onsite wastewater treatment and recirculating recovered water to reduce (90%) water consumption in the railcar bearing cleaning operation.

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 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 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 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

*University City Science Center, Philadelphia, PA 19104.



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 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 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

This plant refurbishes railcar bearing assemblies for outside customers. Its 120 employees produce approximately 163,000 bearing assemblies annually.

Manufacturing Processes

This plant rebuilds railcar bearing assemblies. Raw materials include bearing lubricant (grease), new bearing seals, chrome plating constituents (chromic acid and sulfuric acid), alkaline detergent, and rust preventative.

The following steps are involved in refurbishing the railcar bearings:

- Bearings, which are shipped to the plant from outside customers, are disassembled and parts are separated. Lubricant is removed by manually wiping off the bearing parts, placing the parts in a centrifugation device, and wiping off any residual lubricant. Discarded grease is disposed of offsite as nonhazardous waste. Spent seals are disposed of in municipal waste.
- Bearing parts are then washed in an alkaline-detergent solution and rinsed. Contaminated water is shipped offsite for disposal as a nonhazardous waste. Next, the bearings are inspected to ensure proper surface thickness along the cone surface. Those bearings that meet specifications and are characterized as "premium" are reassembled with new grease and bearing seals while the bearings that are identified as "nonpremium" are transferred to the chrome shop for electroplating buildup of the inside surfaces of the bearings. In the chrome shop, the bearing surfaces are buffed then rinsed in hot water. The parts are then racked and dipped in the chromic acid plating tanks. After chroming, the parts are rinsed in hot and then cold water. Chromic acid sludge that results from chrome shop operations is shipped offsite as hazardous waste. Parts are then baked

in a dry-off oven, cooled, and reassembled with new grease and seals.

Existing Waste Management Practices

- Trivalent chrome that is produced during chroming operations is regenerated into hexavalent chrome for reuse, thereby greatly reducing the amount of waste generated and the cost of raw materials and waste removal.
- The plant has sealed all but the sanitary sewer drains and ships offsite all nonhazardous waste water generated from bearing cleaning operations to avoid interaction with the liquid municipal waste treatment agency (POTW).
- Plant personnel reduce residual drag-out from the chroming operations by individually rinsing each part and rack above the chrome and rinse tanks, thus reducing the concentrations of plating metals in the chromic acid sludge that is shipped offsite as a hazardous waste. This additional rinsing operation also supplies make-up water to the chrome plating baths to compensate for evaporative losses.

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 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 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.

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
Spent grease	Cleaning of railcar bearings. Grease that is removed from the bearing parts is disposed of offsite.	2,750 gal	\$13,200
Spent bearing seals	Disassembly of railcar bearings. Spent bearing seals are disposed of in municipal trash.	326,400 units	3,150
Contaminated wash and rinse water	Cleaning of railcar bearings. The wash and rinse water used in cleaning the bearings is shipped offsite as nonhazardous waste.	249,975 gal	50,050
Chromic acid sludge	Chroming processes. Chrome sludge that results from the rinsing and plating operations in chrome shop is shipped offsite as hazardous waste.	660 gal	33,530

Table 2. Summary of Recommended Waste Minimization Opportunities

Waste Stream Reduced	Minimization Opportunity	Annual Waste Quantity	Reduction Percent	Net Annual Savings	Implementation Cost	Payback Years
Contaminated wash and rinse water	Install a closed wastewater treatment system and recirculate the water for bearing cleaning	244,480 gal	98	\$32,170	\$41,880	1.3
Chromic acid sludge	Install a chromic acid recovery system. It is estimated that 90% of the chromic acid can be purified and reused in the chroming	165 gal	25	15,120	42,700	2.8

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