United States Environmental Protection Agency
Research and Development
Risk Reduction Engineering Laboratory
Cincinnati, OH 45268
EPA/600/S-94/014 September 1994

EPA ENVIRONMENTAL RESEARCH BRIEF

Waste Minimization Assessment for a Manufacturer of Coated Parts

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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. In an effort to assist these manufacturers, 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). That document has been superseded by the *Facility Pollution Prevention Guide* (EPA/600/R-92/088, May 1992). The WMAC team at Colorado State University performed an assessment at a plant that produces specialty coated parts—approximately one million per year. Special-purpose coatings such as chromate conversion, zinc phosphating, and paint are applied to customer-supplied aluminum, steel, and plastic parts. The team's report, detailing findings and recommendations, indicated that rinse water is the waste stream generated in the greatest quantity and that significant waste reduction could be achieved by redirecting the effluent from one rinse to another.

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, Philadelphia, PA.

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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 generation is to reduce or eliminate the waste at its source.

University City Science Center has begun a pilot project to assist small and medium-size manufacturers who want to minimize their generation of waste but who lack the in-house 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 Colorado State University's (Fort Collins) 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 in-house expertise in waste minimization.

The potential benefits of the pilot project include minimization of the amount of waste generated by manufacturers and reduction of waste treatment and disposal costs for participating plants. In addition, the project provides 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 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 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 produces specialty coated aluminum, steel, and plastic parts. It operates 2,210 hr/yr to produce approximately 1 million units.

Manufacturing Process

The plant operates as a job shop to apply special purpose surface coatings to customer-supplied parts. The specific jobs and raw materials used vary widely over time. Coatings applied to the parts include chromate-conversion, zinc phosphating, and organic coatings, including paints and specialized coatings.

Parts that receive conversion coatings are first cleaned in a heated alkaline bath, rinsed, desmutted in a nitric/sulfuric acid solution, and rinsed again. Then the parts are immersed in a heated chromic acid solution to form a corrosion-resistant coating, rinsed again, and air dried.

Parts that receive zinc phosphate coatings are first cleaned in a heated alkaline bath and rinsed. Then the parts are soaked in the zinc phosphating bath to impart a protective coating, rinsed, and soaked in a sealing rinse.

Several dry paint booths are used to apply other coatings including solvent-based paints and EMF shielding. Primer application occurs first and is followed by two applications of topcoat. Following paint application the parts are passed through an oven, touched up as needed, and inspected.

Figure 1 depicts the processes used in this plant and the waste streams generated.

Existing Waste Management Practices

This plant already has implemented the following techniques to manage and minimize its wastes:

- High volume, low pressure (HVLP) paint guns are used for most painting to reduce overspray. The plant reported that it has realized paint usage reductions of 30-35% and savings of over $50,000/yr since implementing this practice.
- Operators use care in raising parts bins slowly from process solutions and allow sufficient drainage time to reduce drag-out.
- Some solvents are recovered onsite for reuse.

Waste Minimization Opportunities

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

Table 2 shows the opportunities for waste minimization that the WMAC team recommended for the plant. The minimization 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 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 also should 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 may 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**.

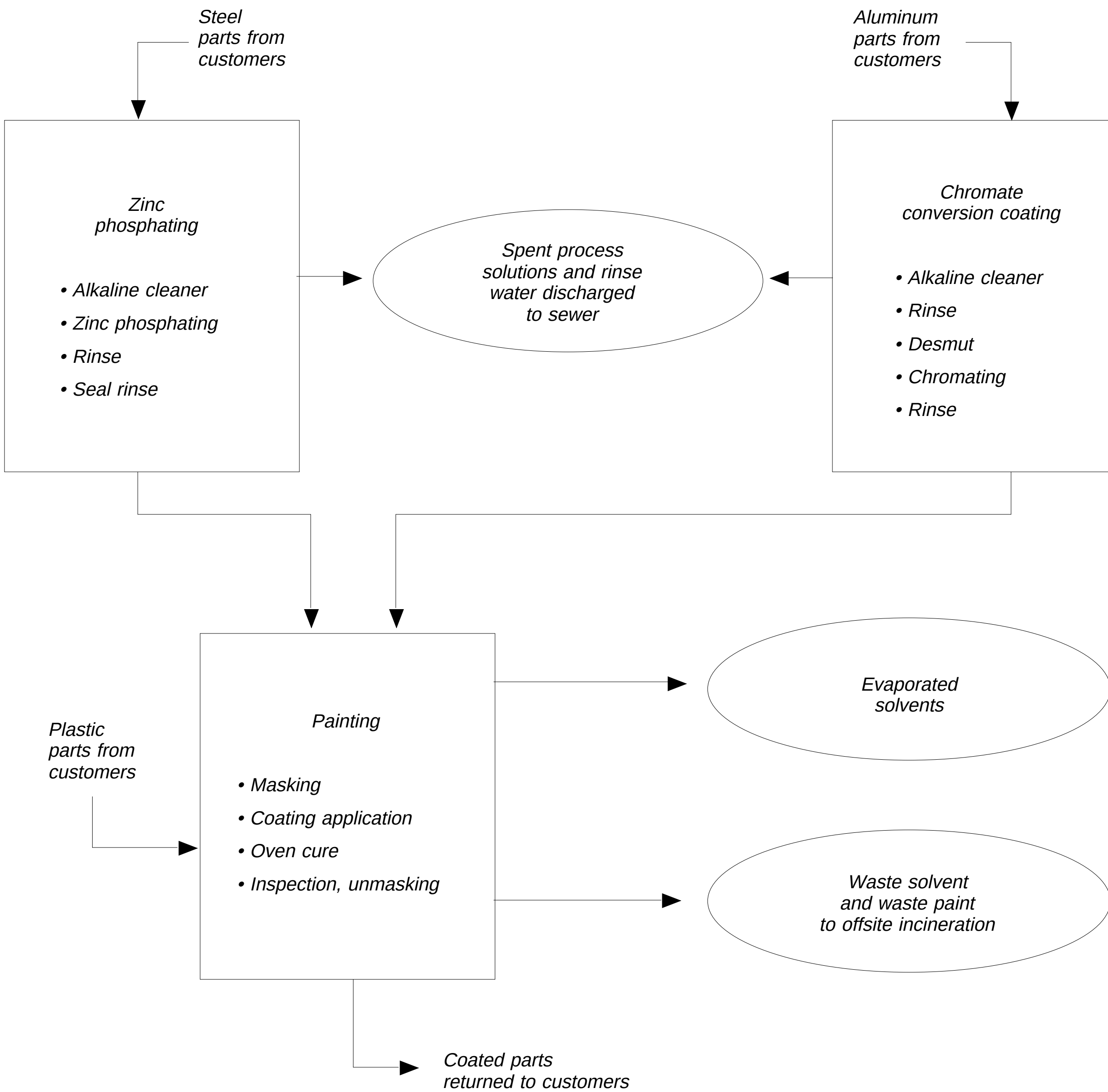

Figure 1. *Abbreviated process flow diagram.*

Table 1. *Summary of Current Waste Generation*

Waste Generated	Source of Waste	Annual Quantity Generated (lb)	Waste Management Method	Annual Waste Management Cost*
Cleaning, desmut, and coating solutions	Chromate conversion line	7,500	Combined and sewered	$1,030
Cleaning, coating, and sealing solutions	Zinc phosphating line	8,500	Combined and sewered	2,890
Rinse water	Chromate conversion and zinc phosphating lines	24,800,000	Sewered	5,780
Spent methyl ethyl ketone	Paint line	1,700	Shipped offsite for incineration	1,300
Spent xylene	Paint line	1,380	Shipped offsite for incineration	900
Spent toluene	Paint line	1,850	Shipped offsite for incineration	1,240
Spent isopropyl alcohol	Paint line	420	Shipped offsite for incineration	830
Spent methyl isobutyl ketone	Paint line	1,700	Shipped offsite for incineration	1,640
Spent lacquer thinner	Paint line cleanup	840	Shipped offsite for incineration	640
Paint sludge	Paint line	2,200	Shipped offsite for incineration	2,440
Evaporated methyl ethyl ketone	Paint line	2,330	Evaporates to plant air	870
Evaporated xylene	Paint line	600	Evaporates to plant air	180
Evaporated lacquer thinner	Paint line cleanup	2,420	Evaporates to plant air	900
Evaporated ethyl alcohol	Paint line cleanup	70	Evaporates to plant air	110
Evaporated 1,1,1-trichloroethane	Vapor degreasing	170	Evaporates to plant air	130

* Includes waste treatment, disposal, and handling costs and applicable raw material costs.

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