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EPA ENVIRONMENTAL RESEARCH BRIEF

Waste Minimization Assessment for a Manufacturer of Aluminum Cans

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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 Colorado State University inspected a plant producing more than one billion aluminum cans each year for a local beverage producer. After the cans have been formed, they are cleaned and painted. These two operations generate the waste: most can cleaning wastes are treated and sewered, and the hazardous painting and inking operations' wastes are shipped to a hazardous waste disposal facility. The on-site treatment facility treats the can washing effluent so that the oil can be hauled to an oil recycler, the sludge disposed of off-site, and the clarified liquid discharged to the sewer. Because the plant had already initiated many steps to minimize and manage its wastes, the WMAC's team report, detailing theirfindings and recommendations, was only able to suggest that a nonhazardous reagent be substituted for the presently used reagent that contains from 2% to 4% ammonium fluozirconate. The can washing sludge would then be nonhazardous, and all of the hazardous waste disposal costs could be saved.

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 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 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.

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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 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

The plant evaluated for this waste minimization assessment produces 12-ounce aluminum **cans** for **a** local beverage producer. It operates 24 hr/day, 7day/wk, virtually year-round to produce more than one billion cans annually. The facility operates two identical process lines.

Manufacturing Process

Aluminum coil stock is the major raw material used to manufacture aluminum beverage cans.

The aluminum coils **are** placed onto spools feeding the cupper machines. As the coils are unwound, they pass through **a** lubricator. Lubricating the aluminum protects the dies in the cupper machines.The aluminum is hydraulically pushed into the cup dies to produce cups. The cups are then fed into extruders where a ram pushes the cups through dies to form can bodies. After the cans leave the extruders, they are trimmed to the proper depth. A pneumatic conveyor system then moves the cans from the extruders through automated spray- washing machines.

The can washing process consists of a pre-wash, a wash, a rinse, a treatment stage, a city-water rinse, and a deionized water rinse. Incoming city water enters the process at the city-water rinse stage and flows in a countercurrent direction through the rinse and pre-wash stages. Spent rinse water flows to the on-site wastewater treatment facility, which will be discussed below.

Proprietary reagents containing sulfuric acid and hydrofluoric acid are added to water in the wash stage to clean the inner surfaces of the cans. A proprietary reagent that contains nitric acid, hydrofluoric acid, and ammonium fluozirconate is added to water in the treatment stage to provide smooth inner can surfaces.

The final, closed-loop rinse of deionized water removes mineral residues left by the city water. After the rinse, the contaminated water is pumped through activated carbon adsorption filters and an ion exchange unit. The anion and cation exchange resins are regenerated about every l-l *R* months using hydrochloric **acid** and sodium hydroxide. Effluent from resin regeneration is neutralized separately from the remainder of the **wastewater** and discharged to the sewer. The carbon filters are backwashed when the pressure drop across the filters reaches **about** 6 psi. The backwash is neutralized with the resin regeneration effluent and discharged to the sewer.

The cans are dried in gas-fired drying ovens at a temperature of 106°F. A base coat of paint is then applied to the outside of the cans and is dried in a gas-fired oven. Next, the customer's insignia is printed on the outside of the cans with ink; the cans **are** dried again **after** printing. A final coat of clear lacquer is applied to the outer can surface. The inside surfaces of the cans are painted with a water-based vinyl coating. A final 30 sec drying stage at 385°F serves as a final cure for all coats of paint.

Liquid hazardous wastes are generated from the painting and inking operations in the form of excess paint and ink cleaned from machinery. Most of the paint wastes are from the water-based **paint** used to coat the inner can surfaces. Although the paints and inks are water-based, they contain ethylene glycol monobutyl ether, n-butyl alcohol, dimethylethanolamine, and 2-butoxyethanol; the paint wastes are considered hazardous and are shipped to a hazardous waste disposal facility.

Aflanging process is used to provide the cans with a necked top. The finished cans are inspected, palletized, and stored in the warehouse to await shipping.

Wastewater from the various stages of the can washer flows to a series of overflowing tanks for the initial stages of treatment. In the first tank, ferric chloride is added, and the pH is adjusted to less than 3 with sulfuric acid. The second tank contains **an** absorbent cloth oil skimmer that generally operates for 15 min/hr. The oil that is recovered flows to a 10,000-gal split tank. Sulfuric acid is added to that tank to lower the pH to 4 and to break most of the oil-water emulsion that forms. The remaining emulsion is de- emulsified by heating to 160°F. Waste oil is collected in a storage tank and is periodically hauled to an oil recycler who filters and distills the used oil and sells the product as industrial fuel.

Lime is added in the third tank to raise the pH to about 9 and to precipitate aluminum hydroxide, calcium fluoride, calcium sulfate, ferric hydroxide, and magnesium hydroxide from the wastewater. The fourth tank is an overflow tank for the precipitates and supernatant. A polymer is added in that fourth tank to flocculate the solids and clarify the liquid.

The effluent from the fourth tank flows to the center of a large clarifier. Flocculated solids settle to the bottom of the clarifier and form a sludge. The clarified liquid meets the effluent limits set by the local publicly owned treatment works (POTW) and is discharged to the sewer.

Sludge is periodically pumped from the bottom of the clarifier to **a** storage tank. A pump transfers the sludge to a filter press to remove excess water before shipping and disposal. The sludge from the filter press contains about 67% solids by weight.

Existing Waste *Management Practices*

Beforethe WMAC team's assessment, this plant had taken the following steps to minimize and manage its hazardous wastes:

- collects scrap aluminum for recycling;
- has reduced water use in the can washing operation

- to the lowest possible rate;
- has reduced the concentrations of chemicals used in the *can* washing operations to the lowest possible values;
- uses a filter press to reduce the water content of hazardous sludge before shipment off-site for disposal; and
- has an oil recycler collect waste oil from the extruder coolant system.

Waste Generation

Most of the hazardous waste generated by this plant comes from the can washing operation. Water laden with oil, hydrofluoric acid, sulfuric acid, nitric acid, and ammonium fluozirconate is treated on-site and discharged to the sewer. Sludge containing calcium fluoride, calcium sulfate, magnesium sulfate, and ammonium fluozirconate is precipitated from the rinse water treatment process and hauled off-site for disposal.

Liquid hazardous wastes are generated by the painting and inking lines.

Table 1 summarizes the principal sources of waste, their amounts, and the treatment and disposal costs.

Summary of Recommended Waste Minimization

Table 2 briefly describes the current plant practice, the recommended waste minimization opportunity (WMO), and savings and cost data.

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Table 1. Summary of Current Waste Generation

Waste Generated	Source of Waste	Annual Quantity Generated	Annual Waste Management Costs Treatment	Disposal
Tap-water rinses	Can washer	30,699,OOO gal	$55,000	$11,850
Paint wastes	Painting line	5,400 gal		35.200
Sludge	Waste water treatment	888,300 lb		147,800

Table 2. **Summary of Recommended Waste Minimization Opportunity**

Present Practice	Proposed Action	Waste Reduction and Associated Savings
The reagent used to treat the surface of the *cans* contains 2% to 4% ammonium fluozirconate.	Substitute a nonhazardous reagent that contains nitric acid and hydrofluoric acid for the hazardous reagent currently used. Replacing the present reagent with one that will not produce a hazardous sludge will eliminate the need for disposal at a hazardous waste disposal facility. There is no cost difference between these two reagents.	Waste reduction = 888,300 lb Cost reduction = $133,060 implementation cost = $0 Payback is immediate.

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