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# EPA ENVIRONMENTAL RESEARCH BRIEF

## Pollution Prevention Assessment for a Manufacturer of Electroplated Truck Bumpers



Richard J. Jendrucko*, Thomas N. Coleman*, Brian T. Hurst*, 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. 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 That document has been superseded by the *Facility Pollution Prevention Guide* (EPA/600/R-92/088, May 1992).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 the University of Tennessee performed an assessment at a plant that manufactures electroplated bumpers and miscellaneous parts for trucks. Steel and aluminum parts received from a nearby facility are cleaned, rinsed, etched, and electroplated. The team's report, detailing findings and recommendations, indicated that a considerable amount of wastewater treatment sludge is generated from the onsite treatment of wastewater, and that significant waste reduction and cost savings could be achieved by reducing drag-out from the plating tanks.

This Research Brief was developed by the principal investigators and EPA's National Risk Management Research 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.

### 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 (Philadelphia, PA) 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 National Risk Management Research 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 pollution prevention opportunity 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 pollution prevention.

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 pollution prevention assessments require several site visits to each client served. In general, the WMACs follow the

* University of Tennessee, Department of Engineering Science and Mechanics
** University City Science Center, Philadelphia, PA

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 electroplates various types of bumpers and miscellaneous parts for trucks. Approximately 100,000 parts are produced by this plant each year.

### *Manufacturing Process*

Steel and aluminum sheet stock is stamped into various shapes at a nearby company facility. The resulting parts are manually buffed and polished. A coating of rust-inhibiting oil is applied to the steel parts in order to minimize surface corrosion during transportation and storage at the electroplating facility.

As parts are required for electroplating, they are removed from their packaging and inspected. Parts that pass inspection are placed onto racks for processing. The parts that do not pass inspection are manually buffed and sanded onsite to repair defects.

An overhead hoist is used to transfer the racked parts to a series of tanks where parts are cleaned, rinsed, etched, and copper, nickel, and chrome electroplated. After the parts have been plated and rinsed in a final heated tank, they are removed from the racks and allowed to air dry.

During a final inspection, each part is cleaned using paper towels. Any surface irregularities in the plated parts are identified and repaired. Parts passing final inspection are packaged and stored until shipment.

An abbreviated process flow diagram for the production of plated bumpers is shown in Figure 1.

### *Existing Waste Management Practices*

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

- Two filter presses and a drying oven are used to reduce the volume of hazardous wastewater treatment sludge shipped offsite.
- Filtration units have been installed on the major plating tanks to remove contaminants so that the life of the active solutions can be extended.

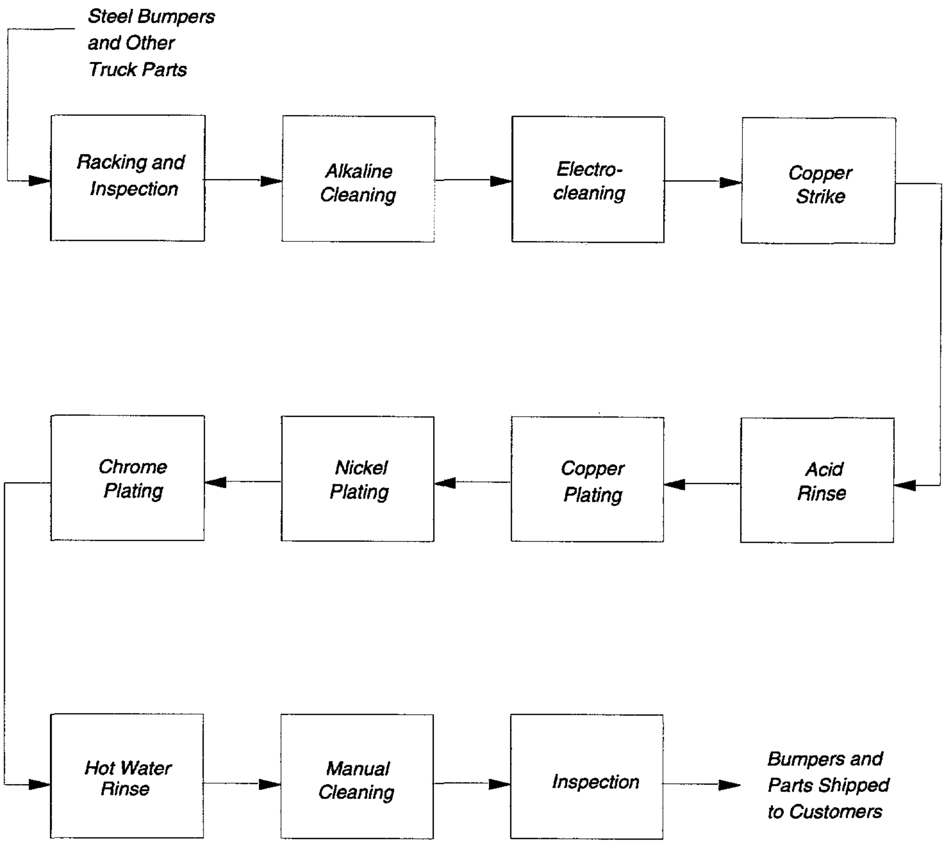


***Figure 1.*** *Abbreviated process flow diagram for steel bumper electroplating.*

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## Pollution Prevention Opportunities

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

Table 2 shows the opportunities for pollution prevention that the WMAC team recommended for the plant. The opportunity, the type of waste, the possible waste reduction and associated savings, and the implementation cost along with the simple 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 opportunities, 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 pollution prevention opportunity independently and do not reflect duplication of savings that may result when the opportunities are implemented in a package.

## Additional Recommendation

In addition to the opportunities recommended and analyzed by the WMAC team, one additional measure was considered. This measure was not analyzed completely because of a lack of sufficient information. Since this approach to pollution prevention may, however, increase in attractiveness with changing conditions in the plant, it was brought to the plant's attention for future consideration.

- Reduce the number of parts that must be coated with rust-inhibiting oil at the fabrication plant through careful scheduling of part fabrication, shipping, and electroplating operations.

This research brief summarizes a part of the work done under Cooperative Agreement No. CR-819557 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 Stream Generated* | *Source of Waste* | *Waste Management Method* | *Annual Quantity Generated (lb/yr)* | *Annual Waste Management Cost** |
|---|---|---|---|---|
| *Miscellaneous solid waste* | *Unpacking of parts (primarily)* | *Shipped offsite to municipal landfill* | *2,160 yd³* | *$14,380* |
| *Cleaning solution and rinse water* | *Cleaning of steel parts prior to plating* | *Sewered* | *20,961,000* | *10,800* |
| *Cyanide-contaminated rinse water* | *Rinse following copper-strike coating of steel parts and surface treatment of aluminum parts* | *Treated in onsite wastewater treatment plant; sewered* | *7,806,000* | *6,800* |
| *Acid rinsing solution* | *Acid rinse following copper-strike of steel parts and surface treatment of aluminum parts* | *Treated in onsite wastewater treatment plant; sewered* | *165,000* | *140* |
| *Rinse water from electroplating* | *Rinses following copper- and chrome-plating of steel and aluminum parts* | *Treated in onsite wastewater treatment plant; sewered* | *26,502,000* | *23,100* |
| *Rinse water from electroplating* | *Rinse following nickel-plating of steel and aluminum parts* | *Treated in onsite wastewater treatment plant; sewered* | *14,442,000* | *12,590* |
| *Alkaline cleaning solution and rinse water* | *Alkaline cleaning of aluminum parts prior to plating* | *Sewered* | *8,118,000* | *4,180* |
| *Caustic and zinc oxide cleaning solution and rinse water* | *Zinc cleaning of aluminum parts prior to plating and rinsing of parts following acid cleaning* | *Treated in onsite wastewater treatment plant; sewered* | *20,608,000* | *17,960* |
| *Contaminated nitric acid cleaning solution* | *Acid cleaning of aluminum parts prior to plating* | *Treated in onsite wastewater treatment plant; sewered* | *165,000* | *140* |
| *Rinse water* | *Rinse following surface treatment of aluminum parts prior to copper plating* | *Treated in onsite wastewater treatment plant; sewered* | *488,000* | *420* |
| *Evaporated water* | *Heated tanks in electroplating lines* | *Evaporates to plant air* | *6,963,000* | *2,650[1]* |
| *Contaminated filter tubes* | *Filtering of plating solutions* | *Shipped offsite for disposal as hazardous waste* | *3,850* | *30,550* |
| *Wastewater treatment sludge* | *Onsite wastewater treatment plant* | *Shipped offsite for disposal as hazardous waste* | *179,190* | *78,280* |

**Includes waste treatment, disposal, and handling costs*
*[1] Includes raw material cost*

***Table 2.*** *Summary of Recommended Pollution Prevention Opportunities*

| Pollution Prevention Opportunity | Waste Stream Reduced | Annual Waste Reduction Quantity (lb/yr) | Annual Waste Reduction Per Cent | Net Annual Savings | Implementation Cost | Simple Payback (yr) |
|---|---|---|---|---|---|---|
| Reduce drag-out from plating tanks by utilizing spray rinsing and drag-out boards. Install rinse devices above each plating and wash tank to spray a mist of water onto part racks as they are removed from the tanks. Drag-out boards should be installed between tanks in series. This opportunity will lead to savings in plating chemical purchases and reduced generation of wastewater treatment sludge. | Wastewater treatment sludge | 53,800 | 30 | $ 41,200 | $ 31,300 | 0.8 |
| Reuse effluent from the onsite wastewater treatment system in the rinsing stations following each plating tank in the steel parts electroplating line. | Rinse water | 25,725,000 | 37 | 11,860 | 19,700 | 1.7 |
| Meter the wastewater leaving the plant in order to reduce sewer charges. Currently, sewer charges are assessed based on the total amount of water purchased by the plant. | n/a | n/a | n/a | 3,270 | 8,700 | 2.7 |
| Utilize available covers on all heated process tanks during periods of light or non-production in order to reduce evaporative water losses. | Evaporated water | 3,482,000 | 50 | 1,320 | 0 | immediate |

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