United States Environmental Protection Agency
Research and Development

Risk Reduction Engineering Laboratory
Cincinnati, OH 45268

EPA/600/S-94/011 September 1994

EPA

ENVIRONMENTAL RESEARCH BRIEF

Waste Minimization Assessment for a Manufacturer of Aerial Lifts

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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 That document has been superseded by the *Facility Pollution Prevention Guide* (EPA/600/R-92/088, May 1992).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 manufactures aerial manlifts, ventilating driers, and air driers. The production of aerial manlifts requires sawing, cutting, and machining of metal, zinc plating or painting, and assembly. For the most part, only assembly operations are required for production of the ventilating and air driers. The team's report, detailing findings and recommendations, indicated that the waste streams generated in the greatest quantity are spent rinse waters from plating and paint preparation, and the greatest cost savings could be achieved by replacing the currently used parts washer with a system that uses a less hazardous solvent.

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.

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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 (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 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.

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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 manufactures aerial manlifts (for use by electric and telephone utilities), ventilating driers, and air driers. Approximately 1,500 aerial lifts and several thousand miscellaneous items are manufactured annually during approximately 4,000 hr/yr of operation.

Manufacturing Process

The production of ventilating driers and air driers requires mostly assembly operations, but aerial manlift production requires a significant number of manufacturing processes.

Steel, in pipe, flat, and round stock form, is the raw material used in the greatest quantity in producing the lifts. Smaller quantities of aluminum, brass, copper, and bronze are also used. The steel stock is cut to length to form blanks using a power saw or a plasma cutting machine. Then the blanks are punched to the proper length and shape using presses. Additional machining, including bending, welding, grinding, milling, drilling, and lathe working, follows.

After machining, parts are either painted or zinc-plated. Parts that are to be zinc-plated are processed through a series of tanks containing solutions and rinses to clean, prepare, and plate the parts. Plated parts are sent to the assembly area.

Many of the parts to be painted are processed in a five-stage preparation and painting system. In the prep and paint line, parts are mounted onto a conveyor system which carries them through various operations including washing, phosphating, rinsing, drying, spray painting, and baking. Other parts are painted in a standard paint-booth type system or a stand-alone paint/bake oven. In those systems, parts are placed inside the booth or oven and are painted in batches. All parts that are painted are baked in the bake oven.

A significant amount of welding is required in the production of many of the products. Stock sheet metal is bent, punched, and form welded to produce the main structural members of the lifts. Sheet metal is welded to the structural components of the lifts. The lift parts are painted in the stand-alone paint booth.

In the assembly area, painted, plated, and miscellaneous parts are assembled into finished products. Hydraulic fluid is pumped into reservoirs. The completed lifts are inspected, hydraulically tested, stored, and then shipped to customers.

An abbreviated process flow diagram for the manufacture of aerial lifts is shown in figure 1.

Existing Waste Management Practices

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

- Spray-mist lubricant is used on the saw in order to avoid generating a hazardous waste stream.
- Scrap metal from the machining processes is recycled.
- Spent solvent generated in the painting area is recovered through distillation and reused.
- High-volume, low-pressure paint spray guns are used in the painting area thereby reducing overspray, paint usage, and solvent air emissions.

Waste Minimization 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 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 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 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.

Additional Recommendations

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 projected lengthy payback. Since this approach to waste reduction may, however, increase in attractiveness with changing conditions in the plant, it was brought to the plant's attention for future consideration.

- Reduce rinse water consumption and drag-out from the zinc-plating bath by installing counterflow rinsing and an atmospheric evaporator to evaporate excess water from the rinses.

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**.

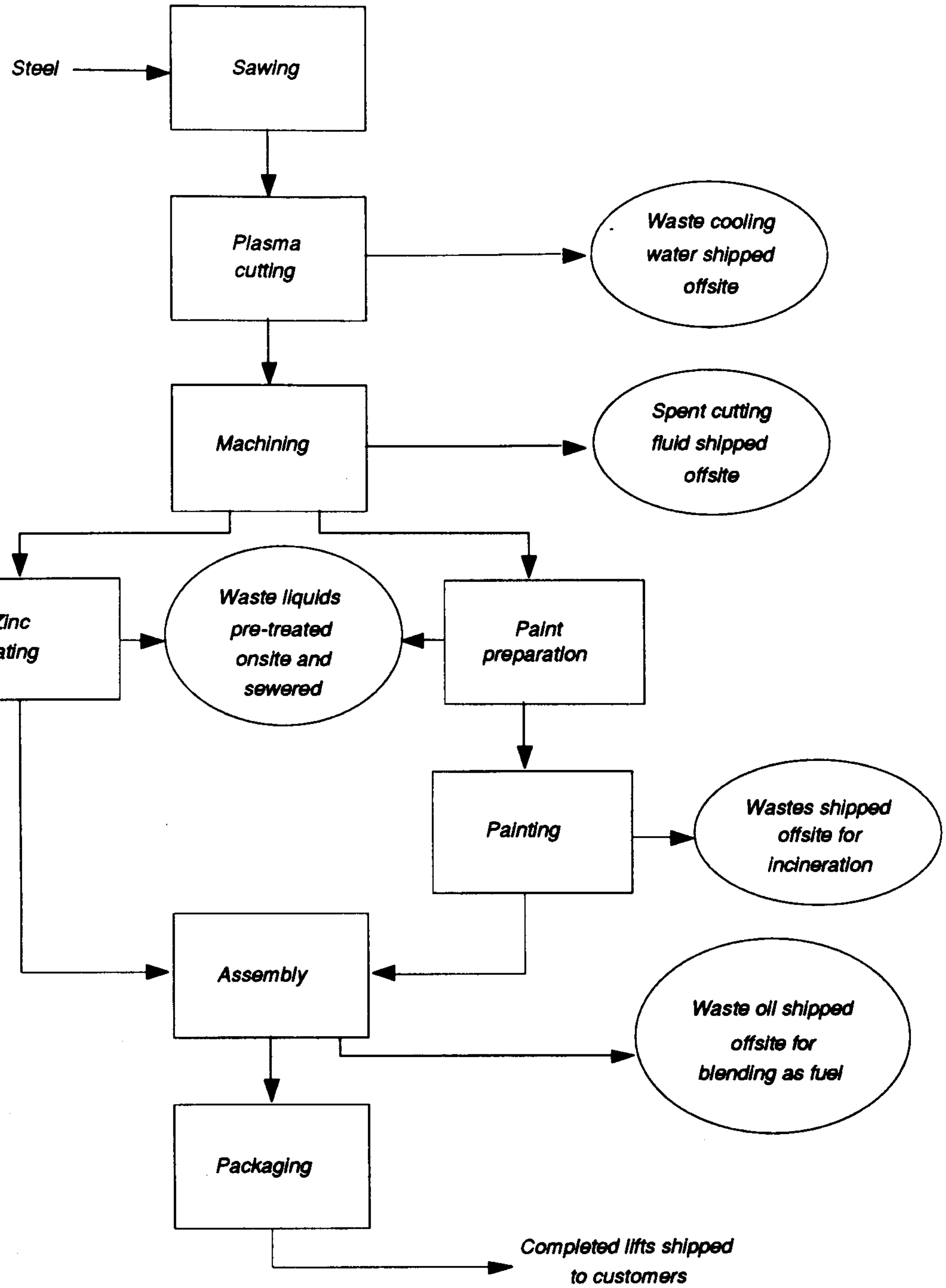

***Figure 1.** Abbreviated Process Flow Diagram for Lift Manufacturing.*

Table 1. *Summary of Current Waste Generation*

Waste Stream Generated	Source of Waste	Waste Management Method	Annual Quantity Generated (lb)	Annual Waste Management Cost[1]
Cooling fluid	Plasma cutting of metal	Shipped offsite; solidified and buried	21,870	$5,680
Cutting fluid	Machining operations	Shipped offsite; solidified and buried	36,440	6,530
Wastewater treatment sludge	Treatment of waste liquids from plating and paint preparation	Shipped offsite; buried	41,690	6,890
Rinse water	Metal plating	Treated onsite; sewered	6,122,550	1,980
Waste alkaline solutions	Metal plating	Treated onsite; sewered	29,990	10
Waste acidic solutions	Metal plating	Treated onsite; sewered	59,980	20
Alkaline cleaner	Preparation of metal for painting	Treated onsite; sewered	8,330	0
Overflow rinse water	Preparation of metal for painting	Treated onsite; sewered	26,660	0
Phosphating solution	Preparation of metal for painting	Treated onsite; sewered	8,330	0
Rinse water	Preparation of metal for painting	Treated onsite; sewered	992,940	320
Body wash	Cleaning of product bodies	Treated onsite; sewered	612,260	200
Paint solvent still bottoms	Onsite recovery of spent paint solvent used for paint gun cleaning	Shipped offsite; incinerated	2,020	8,910
Evaporated paint solvent	Cleaning of paint guns	Evaporates to plant air	2,270	1,570
Expired paint	Painting operations	Shipped offsite; incinerated	10,120	19,650
Paint cleaning solvent	Cleaning of paint guns	Shipped offsite; recycled or incinerated	410	1,310
Waste oil	Assembly of product	Shipped offsite; blended into boiler fuel	3,670	20
Absorbent clay	Cleanup of spills during assembly	Shipped to municipal landfill	5,640	570
Cardboard	Various sources	Shipped to municipal landfill	91,160	6,990
Nonreusable pallets	Various sources	Shipped to municipal landfill	72,000	3,880
Petroleum naphtha	Parts washers	Shipped offsite; recycled or incinerated	6,730	8,450

[1] Includes waste treatment, disposal, and handling costs, and applicable raw material costs.

Table 2. *Summary of Recommended Waste Minimization Opportunities*

Minimization Opportunity	Waste Stream Reduced	Annual Waste Reduction		Net Annual Savings	Implementation Cost	Simple Payback (yr)
		Quantity (lb)	Per cent			
Replace the currently used rental parts washer with a cleaning system that uses a less hazardous solvent.	Petroleum naphtha	6,730 [1]	100	$6,250 [2]	$8,840	1.4
Institute a formal cutting fluid management program.	Cutting fluid	31,700	87	4,800 [2]	8,000	1.7
Engage a recycling firm to collect the pallets that currently are shipped to a landfill.	Wooden pallets	0	0	3,580	0	0
Install an enclosed spray gun washer system to reduce evaporation of cleaning solvent.	Evaporated paint solvent	1,700	75	1,180	2,000	1.7
Replace clay absorbent used for cleanup with absorbent pads and a wringer.	Absorbent clay	5,640 [3]	100	540	700	1.3
Filter and reuse the plasma cutter cooling fluid.	Cooling fluid	11,000	50	460 [2]	1,050	2.3

[1] A total of 1,000 lb/yr of combined solvent and filter waste will be generated.
[2] Total possible savings have been reduced by a required annual operating cost.
[3] 740 lb/yr of waste oil and used pads will be generated.

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