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EPA **Project Summary**

Reduction of Total Toxic Organic Discharges and VOC Emissions from Paint Stripping Operations Using Plastic Media Blasting

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Three depainting methods were compared for their ability to strip Army communications shelters: chemical stripping, sandblasting, and plastic media blasting (PMB). Each process was studied with respect to the economics, the environmental impact, and the quality of the product. Currently, large pieces of military equipment constructed of various alloys and composite materials are either sandblasted or chemically stripped. These methods have economic and environmental drawbacks. PMB is being evaluated by the U.S. Air Force for depainting military aircraft, and is currently being introduced to commercial aviation. The purpose of this study was to determine if the PMB method is applicable to Army communications shelters and whether it would be advantageous for the Army to convert to this procedure both from the perspective of process efficiency and pollution reduction.

Chemical stripping of communications shelters was studied at McClellan Air Force Base, Sacramento Air Logistics Center (SAALC). Sandblasting and PMB were studied at the Sacramento Army Depot (SAAD). Each process was studied for paint removal efficiency, surface quality equipment requirements, labor and material costs, and quantities and type of waste pollutants generated.

The PMB process was determined superior to the chemical stripping process and marginally better than sandblasting based upon the evaluation criteria. This report presents study results of the three methods evaluated and compares their respective efficiencies, processing costs, and waste generation.

This Project Summary was developed by EPA's Water Engineering Research Laboratory, Cincinnati, OH, to announce key findings of the research project conducted in cooperation with the U.S. Army Toxic and Hazardous Materials Agency and is fully documented in a separate report of the same title (see Project Report ordering information at back).

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Introduction

Until recently there have been three main methods for depainting large equipment - sandblasting, vegetable-matter blasting, and chemical stripping. Vegetable-matter blasting has decreased significantly in use because it generates dust with a high explosive potential and does not perform well against many of the newer paints. Sandblasting cannot be used on many composites and is very difficult to use on soft alloys and light, thin materials. Chemical stripping generates large quantities of contaminated waste waters that are classified as hazardous under the Resource Conservation and Recovery Act (RCRA). Plastic Media Blasting (PMB) has been identified as a viable paint removal method for aircraft and other equipment constructed of soft metal alloys such as aluminum alloys. Ths report presents the results of a study comparing the technical performance, the economics, and the environmental costs of PMB, chemical stripping, and sandblasting.

EPA has promulgated an effluent regulation governing the discharge of liquid waste from metal-finishing operations. Under RCRA other forms of waste discharge have also come under increasing regulatory pressure including paint-stripping discharges. The U.S. Army operates several metal-finishing facilities that have large depainting operations. Thus, the Army is investigating methods of reducing hazardous waste from these facilities. The U.S. Army Toxic and Hazardous Materials Agency jointly conducted a study with EPA specifically for the purpose of determining if PMB could be a viable substitute in performance and environmental safety for the Army's paint-stripping processes now used for U.S. Army communications shelters.

The study of the various paint-removing methods took place between July and November 1985. The observations of chemical stripping were held at McClellan Air Force Base (SAALC) between July 24 and July 26, 1985. The observations of sandblasting and demonstration test of the PMB process were held between October 23 and November 1, 1985, at the Sacramento Army Depot (SAAD). The same type of equipment was depainted at both facilities.

Conclusions and Recommendations

- PMB process is an economically and environmentally viable alternative technology to chemical stripping and sandblasting for depainting major pieces of equipment fabricated from aluminum. In particular, it is a viable and desirable replacement for the current methods of depainting military communication shelters, which are typically minimally corroded aluminum.
- PMB's economic superiority to sandblasting is predominate only when the hand sanding necessary with sandblasting is taken into consideration. PMB generates a much smaller volume of waste in a more easily handled form than does sandblasting or chemical stripping.
- The economics of the PMB process are strongly dependent on the recycle rate of the media through the process.
- PMB will not clean heavy corrosion (such as rust).
- The PMB process requires a slightly higher skill level than sandblasting.
- Although the plastic media is normally considered inert, it is recommended that a study be undertaken to establish the toxicity and hazard potential of the dust from the PMB process.
- Several other questions with respect to treatability should also be addressed. They include:
  - Can the waste material be incinerated?
  - What are the products of incineration?
  - Can heavy metals from the entrained paint waste be pacified or recovered?
  - Can the waste material be cofired as a fuel supplement?

Process Descriptions

The project was conducted in two phases. The first phase entailed preparing a summary of current activity in the PMB field. The second phase included a comparative study of three major methods of depainting army communications shelters.

In Phase II, observations were made on each depainting process as it was applied to similar communications shelters. A list of the equipment, the area depainted, and the time required is given in Table 1. Small communications shelters resemble pickup campers and measure approximately 1.8 m long by 1.8 m wide by 2.0 m tall. Medium-size shelters resemble a large box on skids measuring approximately 3.5 m long by 2.1 m wide by 2.0 m tall. Both size shelters are constructed of an aluminum composite laminate with an outer skin thickness of about 1.0 mm and an inner skin thickness of 0.8 mm. The core is foamed plastic resin to which the skins are bonded.

Chemical stripping involves applying a liquid solvent to the object by spraying, painting, or dipping. The stripper is allowed to set until the paint softens. The softened paint is then removed either by scrubbing with brushes or spraying with high pressure water. The process is completed when the surface has been cleaned to the bare metal, rinsed, and dried. The water used to wash off the paint and stripper is one of the waste products from this process. The liquid waste will contain high levels of toxic organic chemicals as well as paint sludge. It is also estimated that >90% of the solvents in chemical paint stripper volatilize to the air. Thus the chemical stripping process results in air, water, and solid waste pollution.

Sandblasting is the process of impacting sand onto a surface using pneumatic pressure. Sand is usually blasted at about 4.9 to 5.6 kg/cm^2 pressure when used on aluminum. Sandblasting relies on the abrasive nature of the sand to break the paint layer and erode the paint from the substrate. The residual sand and paint dust combination is collected and disposed of in landfills. Dependent upon the concentration of toxic metal pigments in the sand, it may be considered a hazardous waste. An additional environmental contaminant is suspended dust that may escape the blasting facility.

PMB is similar to sandblasting although blasting takes place at a much lower pressure (1.4 to 2.8 kg/cm^2). The blasted media can be recovered and recycled, thus leaving for disposal a residue of only paint dust and chips and a few percent by weight of blasted media from attrited media dust. The residue, however, is a dry solid that must be treated as a hazardous waste. The volume of waste is significantly lower than that generated during sandblasting or chemical stripping.

Table 1. Equipment Cleaned in Project

	Equipment Item	Total Area Cleaned (m^2)	Total Clean Time (min)	Rate (m^2/min)
Chemical Stripping	1*	31.8	702	0.045
	2	16.8	1126	0.015
	3	35.9	1345	0.027
Sandblasting	4	17.6	24.4	0.725
	5	17.6	26.7	0.662
	6*	17.6	66.0	0.268
	7	22.2	33.0	0.673
	8*	22.2	67.3	0.330
	9	22.2	23.8	0.934
Hand Sanding	10	6.6	97.1	0.068
	11	3.35	50.0	0.067
PMB	12*	61.0	440	0.139
	13	33.0	221	0.150
	14	33.0	230	0.144
	15*	68.8	258	0.266
	16*	33.0	160	0.206

* Item painted in camouflage pattern.

Results

A summary of results of the study based on area cleaned, process costs, waste generated, and cleaning rate (in m^2/min) is presented in Table 2. Waste disposal quantities were estimated by measuring the amount of waste generated and normalizing to 100 m^2 depainted. These costs were obtained by contacting disposal companies. The results are shown in Table 3. Finally, Table 4 presents the results of chemical analysis for heavy metals of the solids from sandblasting and PMB. The high levels of chromium, lead, and zinc mark the paint waste and are the items of concern which warrant additional study.

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Table 2. Summary of Results

Process	Area (m^2)	Cost (\$/100 m^2)	Waste (kg/100 m^2)	Rate (m^2/min)
Chemical Stripping	85	4,856	95,500	0.029
Sandblasting	120	818	545	0.53*
Plastic Media	229	634	120	0.18

* Does not include required hand sanding.

Table 3. Waste Costs by Process for 100 m^2

Method	Waste Product	Amount (per 100 m^2)	Cost of Disposal (\$/100 m^2)
Chemical Stripping	Water	95,000 L	120*
	Sludge	550 L	112†
Sandblasting	Sand/Paint	545 kg	6.4‡
PMB	PMB/Paint	120 kg	17.5§

* 0.125¢/L (0.5¢/gal).
† \$35/175 L drum.
‡ \$2,100 for 90 tons.
§ \$35/175 L (50 gal drum with a plastic media density of 1.5 kg/l).

Table 4. Chemical Analysis of Sand, Clean PMB, and Waste Samples (mg/kg) for Heavy Metals.

	Clean Sand	Used Sand	Clean PMB	PMB Floor Dust	Average PMB Tunnel Dust*
Antimony	< 0.2	2.4	< 1	4	13
Arsenic	1.8	1	< 1	< 1	< 1
Cadmium	< 0.2	28	5	16	16
Chromium	7.4	240	5	72	120
Copper	3.8	6.6	2	4	4
Lead	1.2	160	< 1	64	330
Mercury	< 0.05	0.75	< 0.01	< 0.01	0.2
Nickel	5.2	8.6	37	81	30
Silver	< 0.02	1.8	< 1	< 1	< 1
Zinc	4.8	340	490	570	980

* Fines collected in air vent.

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The complete report, entitled "Reduction of Total Toxic Organic Discharges and VOC Emissions from Paint Stripping Operations Using Plastic Media Blasting," (Order No. PB 87-154 480/AS; Cost: $18.95, subject to change) will be available only from:

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