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Project Summary

Evaluation of Alternatives to Toxic Organic Paint Strippers

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A study was undertaken to survey commercially available paint stripping formulations and identify those whose use would result in lower total toxic organics (TTO) loading in stripping operation wastewaters without decreasing the effectiveness or efficiency of the stripping operation. Data were gathered by means of a literature review, a survey of potential suppliers, and bench scale tests of alternative stripping formulations identified as having potential for reducing the level of released TTO. The chemical composition of an epoxy stripper (MS-111)* used extensively in military installations was compared with commercially available alternatives having the potential to reduce TTO in stripping wastewaters. The paint stripping operation at the Sacramento Army Depot (SAAD) was studied to establish a basis for designing bench scale tests that would compare the performance characteristics.

The bench scale tests of SAAD-supplied samples and the selected alternative formulations identified three stripping formulations that met the performance standards experienced by MS-111 and that were expected to significantly reduce TTO levels in stripping operation wastewaters.

This Project Summary was developed by EPA's Water Engineering Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

*Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

Introduction

Background

This study was undertaken to identify commercially available paint strippers that would reduce TTO (as defined in 40 CFR Part 413) levels in stripping operation wastewaters. A review of industry literature identified alternatives that had potential for reducing TTO. Bench scale tests were performed to identify each alternative's performance characteristics and potential for reducing TTO in stripping operation wastewaters.

Total Toxic Organics in Stripping Operations Wastewaters

Contributors to TTO enter stripping operation wastewaters principally through "dragout," a term applied to material that adheres to metal parts as they are removed from the stripping tank. This material is deposited in the rinse water or removed in the hot water/steam lancing operation and is discharged to the floor drain system. Two substances present in most stripping formulations contribute to TTO levels: methylene chloride and phenol.

SAAD Paint Stripping Operation

SAAD refurbishes communication and other electronic equipment and the enclosures used to house the equipment. The majority of the equipment encountered at SAAD is fabricated from aluminum, and exposure to hot caustic liquid would cause severe corrosion. Accordingly, cold, acidic, organic, solvent-based stripping formulations are used. The primary formulation used

at SAAD is MS-111, the trade name of an epoxy stripper produced by Miller-Stephenson Chemical Company, Inc. The formulation contains (by volume) 85% methylene chloride, 10% phenol, 5% formic acid, and less than 1% surfactant. The substance of greatest concern is methylene chloride, a major contributor to the TTO found in stripping operation wastewaters. Of lesser concern is phenol, which also contributes to TTO but in far smaller amounts.

Materials to be stripped are loaded into a large wire mesh basket and lowered into the cold strip (MS-111) tank for approximately 20 minutes. The exact submergence time in the stripper is left to the operator's judgement, since stripping efficiency is often affected by the shape of the pieces and the way they are packed in the basket. After a short drainage period, the basket is dipped briefly into a hot (170°F) caustic solution to neutralize the acidity of the stripping solution. After draning the caustic solution, the basket is submerged in a water rinse tank. Finally, the parts are individually cleaned with a high pressure steam/hot water lance.

Methods

Identification of Alternative Paint Strippers

Materials safety data sheets (MSDS) or other literature describing the chemical composition of stripping products was solicited from 68 potential suppliers. A review of this information yielded a listing of formulations judged to have the potential to meet performance requirements and reduce TTO levels in stripping operation wastewaters primarily because these formulations contained less methylene chloride than did the MS-111. The chemical composition of the formulations selected for study are presented in Table 1.

Table 1. Chemical Composition of Candidate Strippers

Supplier	Trade Name	Composition* Chemical	Percent
Nalco Chemical Co.	84TB-227	Cyclic amide	100
GAF	140641	N-methyl-2-pyrrolidone	100
Enthone, Inc.	S-26	Methylene chloride	<50
		Phenol	<20
		Formic acid	<5
Savogran Co.	Stripeeze	Methylene chloride	<20
		Toluene	<40
		Methanol	<30
		Acetone	<25
		Paraffin wax	<2
Savogran Co.	Kutzit	Methylene chloride	<30
		Methanol	<30
		Toluene	<30
		Acetone	<30
		Paraffin wax	<2
Mitchell-Bradford Chemical Company	Quick Strip-8	Methylene chloride	60
		An acid	--
Miller-Stephenson Chemical Company	MS-111	Methylene chloride	85
		Phenol	10
		Formic acid	5
		Surfactant	<1
Oakite Products	ALM (Ambient)	Monoethyl amine	10
		Furfuryl alcohol	<10
		Tributyl phosphate	<5
		Sodium hydroxide	<1
Oakite Products	FHS	Butyl cellosolve	35
		Formic acid	15
		Mixed Aromatics	10
		Diisobutyl ketone	10
		Dodecylbenzene sulfonic acid	?
		Hydrofluoric acid	<5
Oakite Products	ALM (180°)		
Enthone, Inc.	S-26 Diluted 1:1 With Water		

*From materials safety data sheets or updated information from suppliers.

Bench Scale Test Program

The bench scale test program was designed to simulate operation conditions at SAAD and to provide performance data on alternative stripping formulations for comparison with MS-111. Test procedures were prepared to obtain data on the efficiency of removal of the paint finishes typically encountered in the SAAD refurbishing operation. Personnel conducting the tests were instructed to note any abnormal precautions required in the handling of strippers, to record weight loss data on the coupons tested, and to provide detailed comments on the results of a visual inspection following the stripping and stream lansing operations.

Results

Test Evaluation Procedures

Performance of each candidate formulation was evaluated against requirements of SAAD for surface preparation before applying new coatings and was compared with the performance of MS-111 on similar paint samples specifically prepared for the bench scale tests. Only stripping formulations demonstrating the capability to remove all types of SAAD-provided paint samples were considered viable alternatives to MS-111.

Summary Comparison of Alternative Formulations

Comparisons were based primarily on visual examination of the sample coupons in accordance with stripping operation evaluation procedures at SAAD; however, physical data were also analyzed. Before and after the stripping operation, each paint sample coupon was weighed and its thickness was measured. Although these data did not provide a precise measurement of stripping efficiency, they did tend to support

the conclusion reached through visual inspection. Stripping efficiency for all of the formulations tested is summarized in Table 2.

Overall Evaluation and Ranking of Alternative Strippers

Viable alternatives to MS-111 must be available commercially and must have demonstrated the capability of removing all types of paint encountered in refurbishing equipment at the SAAD. Candidate strippers satisfying these criteria must next be judged on their potential for eliminating or reducing the TTO in the stripping operation wastewaters. Based on the concentration of methylene chloride and phenol, as reported in the MSDS or provided by the supplier, the three acceptable alternatives are ranked as follows:

- Enthone S-26 diluted 1:1 with water—60% reduction in TTO expected;
- Mitchell-Bradford Quick Strip No. 8—33% reduction in TTO expected and
- Enthone S-26 (undiluted)—22% reduction in TTO expected.

Table 2. *Effectiveness of Commercial Paint Strippers*
Percent of Top Coat Removed After 20-Minute Submergence

	Paint Type							
Paint Stripper	*Enamel on Zinc*	*Enamel on Zinc Chro-mate*	*Enamel on Zinc Chro-mate*	*Epoxy on Primer*	*Poly-amide on Epoxy*	*Poly-amide on Water Reduce*	*Poly-amide on Zinc Chro-mate*	*Poly-amide on Epoxy*
*MS-111 MC**	100	100	100	100	100	100	100	100
MC 100	100	100	100	100	100	100	100	
S-26 MC (Dil.)	100	100	100	100	100	100	100	100
QS No. 8 MC	100	100	99	3	100	100	100	100
ALM (Hot)+	100	100	100	0	100	100	100	100
FHS	100	100	100	0	50	95	20	0
GAF 140641#	100	100	50	0	0	0	0	0
Nalco 84TB227	100	100	20	0	0	0	0	0
Stripeeze MC	100	100	75	0	0	0	0	0
Kutzit MC	100	100	50	0	0	0	0	0
*ALM***	100	100	25	0	0	0	0	0

**Contains methylene chloride.*
+Stripper heated to 82°C (180°F) as recommended by supplier.
#Pure chemical compound; no commercial formulations available. Also recommended to be used hot, although not known prior to the test.
***Same formulation as "X" tested at room temperature.*

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The complete report, entitled "Evaluation of Alternatives to Toxic Organic Paint Strippers," (Order No. PB 86-219 177/AS; Cost: $16.95, subject to change) will be available only from:
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5285 Port Royal Road
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