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Project Summary

Waste Minimization Audit Report: Case Studies of Minimization of Solvent Wastes and Electroplating Wastes at a DOD Installation

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The U.S. Environmental Protection Agency (EPA) is encouraging hazardous waste generators to develop programs to reduce the generation of hazardous waste. To foster such programs, the Agency's Office of Research and Development Hazardous Waste Engineering Research Laboratory (ORD/HWERL) is supporting the development and evaluation of a model hazardous waste minimization audit (WMA) procedure using the EPA hierarchy of waste minimization (WM) options, with source reduction being more desirable and recycle/reuse less desirable. Treatment options, although not considered WM, are evaluated if neither of the former alternatives is available. The WMA procedure was tested initially in several facilities in 1986. WMAs were conducted at generators of a number of generic hazardous wastes, including corrosives, heavy metals, spent solvents, and cyanides.

In 1987, the HWERL WMA program concentrated on ORD's top priority RCRA K and F waste list. Audits were conducted at generators of K071 and K106 wastes (mercury cell chloralkali plants), K048-K052 wastes (sludges and solids from petroleum refining), F002-F004 wastes (spent solvents), and F006 wastes (wastewater treatment sludges from electroplating operations). This Project Summary covers a WMA carried out at a DOD installation responsible for the rehabilitation of worn Army tanks. This audit was aimed at developing WM options for F002, F004, and F006 wastes.

The WMA carried out at the DOD installation's electroplating facility resulted in the development of three source reduction options and two recycle/reuse options for cadmium/cyanide waste as well as two source reduction options for chromium waste. Successful implementation of appropriate combinations of these options could result in the DOD installation being able to achieve EPA delisting of the F006 wastewater treated sludge. Payback period for the incremental investment needed to achieve these WM results, could range from four months to 1.9 years depending on the choice of options. Savings in present F006 waste disposal costs could amount to $120,000 annually.

The WMA carried out at the DOD installation's paint stripping solvent facilities resulted in two alternative source reduction options being developed by the audit team. Implementation of either of these two options could result in payback period for the incremental investment involved ranging from 6 to 8 months with savings in waste solvent disposal costs of $53,000 annually.

This Project Summary was developed by EPA's Hazardous Waste 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).

Introduction

The national policy objectives established under the 1984 Hazardous and Solid Waste Amendments to the Resource Conservation and Recovery Act of 1976 include the goal of reducing or eliminating hazardous waste as expeditiously as possible. To promote waste minimization activities, the Hazardous Waste Engineering Research Laboratory (HWERL) of the U.S. Environmental Protection Agency (EPA), Office of Research and Development, has undertaken a project to develop and test a waste minimization audit (WMA) procedure. It is envisioned that such a procedure would be useful to generators of hazardous waste as they search for waste minimization alternatives. The present HWERL project expands on an audit procedure developed and tested in 1986 by conducting additional WMAs in cooperating industrial and government facilities. This project is one of several current audit efforts being supported by HWERL.

This study presents the elements of a WM program, of which the audit procedure is a central component and includes details of the WMA procedure, its development, and its final recommended form. A case study is presented using this WMA procedure, and covers audits performed at a DOD installation that includes facilities which generate listed wastes F002 and F004 as well as a facility which generates listed waste F006. Findings and conclusions resulting from these audits are presented below.

Description of the WMA Procedure

The function of the WMA procedure is to force the use of an orderly step-by-step procedure for conducting an audit at a host site. The initial WMA procedure was developed in earlier work, and was further refined during the course of the present EPA-sponsored audit effort. This procedure is applicable to the development of both categories of WM options (source reduction and recycling/reuse) as well as to the development of treatment options.

The team employed in carrying out the audit described in the full report was composed entirely of employees of an outside consulting/engineering firm. Following selection of the host facility there were eight sequential steps executed by the audit team:

1. Preparation for the audit.
2. Host site pre-audit visit.
3. Waste stream selection.
4. Host site waste minimization audit visit.
5. Generation of WM options.
6. Preliminary WM options evaluation (including preparation of preliminary cost estimates) and ranking of options in three categories (effectiveness, extent of current use, and potential for future application).
7. Presentation, discussion, and joint review of options with plant personnel.
8. Final report preparation and presentation to host site managmeent.

This procedure was followed in carrying out the WMAs summarized below.

Results of the WMA Conducted at a Generator of F002 and F004 Waste: Audit at a DOD Installation Paint Stripping Facility

A DOD installation in the South, a portion of whose facilities is devoted to the rehabilitation of worn Army tanks was studied in a WMA for the reduction of F002 and F004 wastes. These listed F wastes are partially defined in 40 CFK 261.32 as follows:

- F002: Spent halogenated solvents including methylene chloride.
- F004: Spent non-halogenated solvents including cresols and cresylic acid.

At three buildings in the DOD installation, tank part paint stripping facilities using methylene chloride solvent formulations (containing phenolic-type constituents to enhance solvent action), generate F002 and F004 wastes. F002 and F004 wastes include:

- Approximately 20,000 gallons per year of spent methylene chloride-based paint stripping solvent and about sixty, 55-gallon drums of paint sludge are generated in the paint stripping operations and sent offsite for hazardous waste disposal. Spent solvents are presently disposed of in bulk approximately every 6 months. Drummed hazardous paint sludges are shipped offsite within 90 days of accumulation.
- Wastewaters from stripped parts rinsing operations are sent to the onsite wastewater treatment plant where biological treatment is used to reduce phenol level to meet NPDES permit requirements prior to discharge.

The audit team studied possible source reduction and recycle/reuse options for these wastes. The focus of this effort was primarily on ways to prolong the life of the paint stripping solvents as the most effective short-term options. The long-term waste reduction options, i.e., development of non-solvent formulations and other paint removal techniques, could not be meaningfully addressed in this study.

The most promising source reduction options for paint stripping solvent waste reduction were:

- Continuous centrifugation of the paint stripping solvent to remove paint sludge as it is generated thus preventing buildup of this sludge in the stripping tanks and significantly extending the life of the solvent.
- As an alternative to continuous centrifugation of the solvent, continuous 2-stage basket/cartridge filtration of the solvent to prevent paint sludge buildup.

In summary, it is believed that successful implementation of either of these options could result in solvent life being extended to at least one year prior to replacement. In this regard, a small scale test by a centrifuge vendor on a sample of spent solvent heavily loaded with paint sludge, indicated that clear solvent could be produced by this technique. Each of the six main paint stripping solvent tanks at the facility would be equipped with either a solid-bowl type centrifuge or a basket/cartridge type 2-stage filter. Table 1 summarizes the results of the preliminary technical and economic feasibiliy study of these two options. Annual waste solvent disposal cost would be cut in half (approximately $50,000 per year savings) if either of these two options were adopted, with

Table 1. *Tabulated Projected Costs and Required Site Modifications: WM Options for DOD Installation F002 and F004 Wastes*

WM Option[1]	Waste Source	Option Description	Proposed Equipment Modifications	Estimated Installed Cost ($)	Estimated Annual Direct Operating Cost[2] ($/yr)	Required Site Modifications	Payback Period (years)
(1)	Waste paint stripping solvent disposal	Continuous removal of paint sludge from solvent (using a solid bowl centrifuge). Solvent replaced annually.	Add a pump and solid bowl centrifuge to each of the six paint stripping solvent tanks; unit operates at about 5 gpm flow rate.	50,000	5,000	Adequate floor space is available in front of each of these stripping tanks to permit installation without major existing equipment relocation.	0.5
(2)	Waste paint stripping solvent disposal	Continuous removal of paint sludge from solvent (using a two-stage filtration unit). Solvent replaced annually.	Add a pump and two-stage filtration unit to each of the six paint stripping solvent tanks (first stage is basket type filter for large pieces and second stage is a porous metal filtration cartridge for micron-size particles).	60,000	9,000	Adequate floor space is available in front of each of these stripping tanks to permit installation without major existing equipment relocation.	0.67

[1]All options shown are source reduction options.
[2]Other than the cost of replacing spent paint stripping solvent, which is estimated separately.

payback periods ranging from 0.5 to 0.7 year.

Results of the WMA Conducted at a Generator of F006 Waste: Audit at the DOD Installation Electroplating Facilities

Electroplating operations at the DOD installation are conducted in one building and include cadmium plating of miscellaneous cleaned and/or remachined tank parts using cadmium/cyanide (Cd/CN) solutions in either an automatic barrel plating line or a manual rack plating line. Chromium (Cr) plating of appropriately prepared tank parts is conducted in a rack plating line. Both plating operations are fairly standardized.

The facility has been experiencing significant problems in meeting NPDES permit limitations for Cd and CN in the treated wastewater discharge. Thus, the audit team focused primarily on waste reduction options which could reduce or eliminate Cd and CN levels in the raw waste (principally rinsewaters from both Cd plating lines). Approximately 2,000 gallons per day of these wastewaters typically containing 20 mg/l of Cd and 25 mg/l CN are discharged from the electroplating facility. About 35,000 gallons per day of Cr-bearing waste averaging 110 to 120 mg/l Cr are also discharged from this facility.

A study of the electroplating operations that generate F006 waste (including discussions between the audit team and plant personnel), led the audit team to develop a total of five WM options for Cd/CN plating-related waste and two WM options for Cr plating-related waste. These options include commercially demonstrated processing techniques designed to minimize or eliminate Cd, Cr, and CN levels in the rinsewater wastes as well as reducing the amounts of wastewater. These options together with their estimated capital and operating costs are summarized in Table 2. One proposed source reduction option: electrolytic reverse current destruction of CN (both simple and complexed) in the still rinse tanks of the two Cd plating lines during the plant downtime period, is currently being evaluated at the facility. One proposed recycle/reuse option: recovery of Cd from the two plating lines' still rinse tanks, has since been implemented and appears to have resulted in the facility being able to consistently meet the Cd limit in their NPDES permit.

It is believed that successful implementation of appropriate combinations of these WM options could result in the DOD installation being able to achieve EPA delisting of the F006 wastewater treatment sludge as well as meeting Cd and CN permit limits in the NPDES discharge. Payback periods for the incremental investment involved range from 6 months to 1.9 years. Savings in the present F006 waste disposal costs could amount to $120,000 annually if the F006 waste can be delisted.

Table 2. Tabulated Projected Costs: WM Options for DOD Installation F006 Wastes[1]

WM Option	Waste Source	Option Type	Option Description	Proposed Equipment Modifications	Estimated Installed Cost ($)[1]	Estimated Annual Operating Cost ($/yr)
(a)(1)	CD/CN Barrel Plating Line	Source reduction	Use of electroclean rinse waters as feed to pickling rinse water tank	Water piping and pump	$ 1,000	$ 500
(a)(2)	Cd/CN Manual Plating Line	Source reduction	Use of electroclean rinse waters as feed to pickling rinse water tank	Water piping and pump	1,000	500
(b)(1)	Cd/CN Barrel Plating Line	Source reduction	Destruction of cyanides in still rinse tank	Insertion of SS cathodes and anodes in still rinse tank and operation in a CN destruction mode during plating line downtime	2,000	10,000
(b)(2)	Cd/CN Manual Plating Line	Source reduction	Destruction of cyanides in still rinse tank	Insertion of SS cathodes and anodes in still rinse tank and operation in a CN destruction mode during plating line downtime	2,000	10,000
(c)(1)	Cd/CN Manual Plating Line	Source reduction	Improved dragout recovery; drain board, spray/fog rinsing nozzles over plating tank	Add drain board between Cd plating tank and still rinse tank; install spray/fog rinse	1,500	1,000
(c)(2)	Chromium Manual Plating Line	Source reduction	Improved dragout recovery; drain board, spray/fog rinsing	Add drain board between Cr plating tank and still rinse tank; install spray/fog rinse nozzles over plating tank	1,500	1,000
(d)	Both Cd/CN Plating Lines	Recycle/ reuse	Evaporation of Cd/CN rinse water discharge and recycle to both plating lines in appropriate quantities to maintain individual plating bath water balances	Install evaporation unit and auxiliaries in Building 114 basement near Cd/CN waste sump	79,000	27,000
(e)(1)	Cd/CN Barrel Plating Line	Recycle/ reuse	Plating out of cadmium in still rinse tank	Insertion of SS cathodes and anodes in still rinse tank to operate in a Cd plating mode during plating line downtime	Use the same equipment as in (b)	20,000
(e)(2)	Cd/CN Manual Plating Line	Recycle/ reuse	Plating out of cadmium in still rinse tank	Insertion of SS cathodes and anodes in still rinse tank to operate in a Cd plating mode during plating line downtime	Use the same equipment as in (b)	20,000
(f)	Chromium Manual Plating Line	Source reduction	Improved dragout recovery: replacement of running rinse tank with spray chamber	Install suitable banks of spray nozzles in empty running rinse tank	5,000	2,000
(g)	Chromium Manual Plating line	Source reduction	Reduction of chromium metal losses from hood vents over plating tanks	Add layer of plastic balls on surface of chromium plating tanks	Nil	Nil

[1]Order of magnitude costs (± 50 percent accuracy).

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The complete report, entitled "Waste Minimization Audit Report: Case Studies of Minimization of Solvent Wastes and Electroplating Wastes at a DOD Installation," (Order No. PB 88-166 780/AS; Cost: $14.95, subject to change) will be available only from:

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