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# Hazardous Waste Minimization and Treatment Opportunities in the Eighth U.S. Army and the U.S. Army, Japan

by
Byung J. Kim

The Hazardous and Solid Waste Amendments to the Resource Conservation and Recovery Act of 1984 declare hazardous waste reduction to be a national policy. The Army has established a hazardous waste minimization goal of a 50 percent reduction in the quantity of hazardous wastes it generates by 1992, as compared to the baseline calendar year 1985.

This report assesses the hazardous waste management needs of the Eighth U.S. Army, and the U.S. Army, Japan, and identifies and recommends appropriate technologies to help the Army achieve its waste minimization goal. The hazardous waste management system in the United States is compared to parallel systems in Japan and Korea, to outline the most effective and economical manner to treat hazardous wastes in compliance with U.S. Environmental Protection Agency regulations and Korean and Japanese laws. Specific minimization and treatment strategies include disposal, recycling, or reuse of pentachlorphenols, polychlorinated biphenyls, used oils and waste solvents, automotive batteries and antifreeze, and sandblasting medium.

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Byung J. Kim

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U.S. Army Construction Engineering Research Laboratory (USACERL)
2902 Newmark Drive, PO Box 9005
Champaign, IL 61826-9005

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# FOREWORD

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This study was performed for the Environmental Division (EN), U.S. Army Construction Engineering Research Laboratory (USACERL) by Dr. Byung J. Kim. Dr. Chai Gee, of USACERL, and Mr. Felix Moran, of Southern Illinois University at Carbondale, conducted the literature survey on hazardous waste minimization and treatment technologies. Mr. Bernard Donahue, of USACERL, assisted in doing field work in Korea and provided technical advice on hazardous waste minimization. MAJ Robert Ryczek of the U.S. Pacific Environmental Health Engineering Agency compiled some of the data on hazardous material and hazardous waste used in this report. COL Edward Kane is Commander of FEAK. COL Robert Brown is the Assistant Chief of Staff, Engineer, EUSA. Dr. James Hartman is Chief, EUSA Environmental Program Office. Dr. Edward W. Novak is Acting Chief, USACERL-EN. The USACERL technical editor was Mr. William J. Wolfe, Information Management Office.

COL Everett R. Thomas is Commander and Director of USACERL, and Dr. L.R. Shaffer is Technical Director.

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## 1 INTRODUCTION

### Background

The Hazardous and Solid Waste Amendments (HSWA) of 1984 declare hazardous waste reduction to be a national U.S. policy. Hazardous waste (HW) reduction, which is often used as a synonym for hazardous minimization or pollution prevention, is in reality a new approach to environmental management, made necessary because conventional pollution abatement or control technologies simply shift pollutants from one medium to another. In response to this national policy, the Army has set environmental quality goals to conserve natural resources, prevent pollution, and minimize the generation of wastes by creating Army programs to recycle and reuse materials.[1] To achieve this, the Army has established a hazardous waste minimization goal of a 50 percent reduction in the quantity of hazardous wastes generated by 1992, as compared to the baseline calendar year 1985 (Draft AR 200-1, Para 6-9. b).

The revised AR 200-1 contains more detailed requirements for overseas installation environmental programs than the 1982 regulation. Overseas installations may find it difficult to comply with environmental regulations that do not apply to their unique environmental circumstances. Furthermore, Continental U.S. (CONUS) hazardous waste minimization and treatment technologies may not be applicable to the overseas installations because of the different regulatory, socioeconomic, and technological requirements in the host countries. Also, the limited manpower available to environmental programs in overseas installations, the lack of guidance, and the bureaucracy and communication difficulties common in host country environmental agencies are major problems which impede effective hazardous waste management and minimization programs.

Up to this point, the Army has not attempted to collect and analyze or evaluate the potential for hazardous waste minimization in overseas installations. This study explores the hazardous waste minimization opportunities for four installations, in the Eighth U.S. Army (EUSA) and the U.S. Army in Japan (USARJ).

### Objectives

The objectives of this study were to: (1) assess the hazardous waste management needs of EUSA and USARJ installations, (2) identify, evaluate, and where necessary, adopt responsive hazardous waste minimization technologies, and (3) develop an appropriate technical guidance to help in the adoption and use of these technologies.

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[1] Army Regulation (AR) 200-1, *Environmental Protection and Enhancement* (Headquarters, Department of the Army [HQDA], April 1990).

## Approach

Four installations were selected for this study: Camp Carroll and Yongsan Military Reservation in Korea, and Camp Zama and Sagami Depot in Japan. Hazardous waste management/minimization surveys were conducted at these four installations. The pertinent host country hazardous waste regulations were collected and compared with U.S. regulations and Army policy. Major Command (MACOM) and installation personnel and Army experts were interviewed.

Supply channel records were reviewed to identify incoming major hazardous materials. Hazardous waste disposal quantity and cost data, and Reutilization, Transfer, Donation, and Sales (RTDS) data were collected from the Defense Reutilization and Marketing Service (DRMS), Battle Creek, Michigan. These data were analyzed and appropriate hazardous waste minimization strategies were developed for these four installations.

## Scope

Although this study was designed to explore hazardous waste minimization opportunities in all Army overseas installations, actual study was limited to investigation of hazardous waste management and minimization technologies for the four selected installations in Korea and Japan. These four installations typify hazardous waste management practice and minimization opportunities at Army installations in Korea and Japan. However, an individual hazardous waste minimization study would be needed to implement a hazardous waste minimization program at any particular installation.

## Mode of Technology Transfer

It is recommended that information in this report be included in the EUSA and USARJ hazardous waste management and minimization plans. This report will also serve as a reference for the Army Environmental Office, EUSA, USARJ, and Army communities to better explain the EUSA and USARJ hazardous waste management and minimization programs, and to develop overseas installation hazardous waste minimization strategies. Workshops have been completed during 1990 and more are planned to help train EUSA and USARJ personnel in the implementation of this strategy.

## Comparison of U.S. and Host Country Requirements

Table 1 compares the U.S. hazardous waste management system with its counterparts in Korea and Japan. The RCRA (Resource Conservation and Recovery Act [1984]) definition of hazardous waste is based on characteristics and specific sources of hazardous waste, while Korean and Japanese definitions are based on the type of waste-generating industry, specifically designated hazardous substances, and specific disposal standards and methods. In other words, Korean and Japanese hazardous wastes are defined in terms of how safely industrial wastes are managed and disposed of.

**Table 1**

***U.S., Japanese, and Korean Hazardous Waste Regulations***

| Category | Place | Terminology |
|---|---|---|
| Laws | USA | "RCRA," 1976, amended by the "Hazardous and Solid Waste Amendments" (HSWA), 1984 |
| | Japan | "Waste Disposal and Public Cleansing Law" No. 137, 1970, amended 1983 |
| | Korea | "Waste Management Law" No. 3904, 31 December 1986. |
| Regulations | USA | Title 40, Code of Federal Regulations (40 CFR), secs. 260-280 (September 1988) |
| | Japan | "Cabinet Order for Implementation of the Waste Disposal and Public Cleansing Law" No. 336, 1986 |
| | Korea | "Presidential Decree for Implementing Waste Management Law" No. 12119, 1 Apr 1987; Order To Implement the Waste Management Law of the Ministry of Health and Social Welfare No. 802, 1987 |
| Objectives | USA | To protect the health and the environment, to conserve resources, and to reduce or eliminate the generation of hazardous waste as quickly as possible |
| | Japan | To preserve the living environment and to improve public health through appropriate disposal of wastes |
| | Korea | To preserve the natural and human environment through appropriate disposal of waste, and therefore to improve public health and to preserve a clean environment |
| Elements | USA | Solid waste, hazardous waste, underground storage tanks |
| | Japan | Domestic wastes, industrial wastes |
| | Korea | General wastes, industrial wastes |

## Definition of Hazardous Wastes

The definition of "hazardous waste" differs in Korea and Japan from the U.S. definition. In Korea and Japan, "industrial wastes" is the term most closely corresponding to "hazardous wastes" in the United States.

*USA*

The RCRA defines "hazardous waste" as "waste which, because of its quantity, concentration, or physical, and chemical characteristics, may pose a hazard to human health or the environment." The U.S. Environmental Protection Agency (USEPA) defines hazardous wastes by their characteristics or by inclusion on a hazardous waste list. The characteristics include: (1) ignitability (flash point less than 140 °F; ignitable compressed gas or oxidizer per Department of Transportation (DOT) regulations), (2) corrosivity ($pH<2$, or $pH>12.5$; or corrodes steel [>1/4 in./yr at 55 °C]), (3) reactivity, or (4) toxicity (Toxicity Characteristic Leaching Procedure [TCLP] in 40 CFR, Part 261, Appendix II).

Parts 261.31-33 of 40 CFR list hazardous wastes from nonspecific sources (F wastes), specific sources (K wastes), and discarded commercial chemical products (P and U tables). The Toxic Substance Control Act bans manufacturing of new PCB items and establishes the requirements for existing PCB items.

*Japan*

"Industrial wastes" in Japanese law is synonymous with "hazardous wastes" in the United States. The Waste Disposal and Cleansing law defines "industrial wastes" as the wastes comprised of ashes, sludge, waste oil, waste acid and alkali, waste plastics resulting from business activities and any wastes defined by Cabinet Order.

Article 1 of the Cabinet Order for Implementation of the Waste Disposal and Public Cleansing Law defines the following hazardous wastes:

1. Waste paper that is generated from pulp, paper and paper product industries and publishing companies, and PCB-applied paper

2. Waste wood that includes waste from the construction industry, manufacturers of pulp, lumber, and wood products (including furniture), and wholesalers of imported lumber, and demolition debris

3. Waste fibers from the textile industry

4. Solid wastes related to animals and plants that have been used as raw materials in food and pharmaceutical industries

5. Waste rubber, metal, glass, and ceramics

6. Slags

7. Concrete pieces from demolition activities

8. Animal excrement and dead animals from the livestock industry

9. Soot and dust generated from smoke and soot emitting facilities, which is defined by Article 2 of the Cabinet Order for Implementing the Air Pollution Law, and facilities incinerating sludge, waste oil, waste acid and waste alkali, waste plastics, and PCB-applied paper and metal

10. Substances processed from cinders, sludge, and waste oil, waste acid and alkali, and substances processed from any of the aforementioned wastes, which, for the purpose of disposal, do not fall under the said waste category.

*Korea*

"Industrial wastes" in Korean law is also synonymous with "hazardous wastes" in the United States. The Waste Management Law defines industrial wastes as "sludge, debris, waste oil, waste acid and alkali, waste rubber and synthetic resins, and other wastes defined by the Ministry of Health and Social Welfare (MOHSA) Order to Implement the Waste Management Law." The Order classifies industrial wastes:

1. Designated industrial wastes include designated hazardous industrial wastes, waste oils, waste synthetic resins, and waste acids and alkalis. Designated hazardous industrial wastes consist of cadmium, cyanide, organic phosphate, lead, hexavalent chromium, arsenic, mercury, polychlorinated biphenyls (PCB)/pentachlorophenyl (PCP), copper and their compounds, whose concentrations exceed the extraction criteria in the Ministry order. Waste oils include lubrication oils, mineral oils, vegetable oil and fat, pitch, and solvents. Waste acids and alkalis include hydrochloric acid, sulfuric acid, nitric acid, sodium hydroxide solution, and others with pH less than or equal to 2.0, or higher than or equal to 12.5.

2. General industrial wastes are classified into organic industrial wastes and inorganic industrial wastes. Organic industrial wastes include waste paper, waste wood, tannery wastes, food industry wastes, waste rubber, animal excrements, and domestic waste sludge. Inorganic wastes include waste metal, waste ceramics, slags, ashes and residues, construction and demolition debris, dust and soot collected by particulate control devices, waste sand, and asbestos. The Ministry Order provides standards and methodologies for the industrial waste treatment facilities.

The purpose of Korean hazardous waste regulations is similar to that of the Japanese regulations, primarily to control industrial pollution. The Director of the Industrial Waste Management Division of the Korean Environmental Administration was interviewed to clarify the Korean hazardous waste regulations (Appendix A).

## Hazardous Waste Management Requirements

Hazardous waste management includes proper handling, analysis, record keeping, storage, transportation, and disposal of hazardous wastes. Hazardous waste management requirements in the United States differ from those in Japan and Korea.

*Hazardous Waste Minimization*

In the United States, the HSWA established waste minimization as a national policy. The HSWA states that:

> The Congress hereby declares it to be the national policy of the United States that, where feasible, the generation of hazardous waste is to be reduced or eliminated as expeditiously as possible. Waste nevertheless generated should be treated, stored, or disposed of so as to minimize the present and future threat to human health and the environment. (sec 101 [b])

The USEPA requires wastes generators to sign a manifest to ensure that a hazardous waste minimization program is in place and to describe their hazardous waste minimization efforts in a biannual report.

In Japan and Korea, waste generators must endeavor to lessen the amount of wastes by reuse of wastes.

*Quantity Limitation*

In the United States, small quantity generators (SQG), who generate between 100 kg and 1000 kg a month of hazardous wastes, are treated differently from other waste generators. For example, an SQG can store hazardous wastes for 180 days, whereas larger generators may only store wastes for 90 days.

In Korea, the businessmen who generate the designated hazardous wastes must register at the Mayor's or Province Governor's office, if generated volume is more than: (1) 1000 kg a year of designated hazardous industrial wastes, (2) 2000 kg a year of waste oil, (3) 5000 kg a year of synthetic resin, (4) 5000 kg a year of waste acid and alkalis, or (5) 5000 kg a year of total designated industrial wastes.

In Japan, the Waste Disposal and Cleansing Law and the Cabinet Order do not address any quantity limits.

*Generator's Responsibility and Liability*

U.S. waste generators have the ultimate responsibility for their hazardous wastes from manufacture to disposal. Waste generators must obtain an USEPA ID number, manifest and keep records, and certify that they have made waste minimization efforts.

Korean waste generators are required to properly dispose of their industrial wastes themselves or through an industrial waste disposal contractor. Generators must try to minimize waste through technology development and reuse. Generators must check contractors' capability before entrusting hazardous wastes to them. When a hazardous waste is entrusted to a contractor, disposal responsibility rests with the contractor.

Japanese businessmen are required to dispose of hazardous wastes by themselves, through government agencies, or by a contracting/qualified hazardous waste businessperson. Once a hazardous waste is entrusted to a contractor, the disposal responsibility rests with the contractor. Generators must try to lessen the amount of wastes by regeneration or reuse of wastes.

*Storage*

U.S. waste generators may not store hazardous wastes more than 90 days. The USEPA grants permits for storage facilities to store hazardous wastes longer than 90 days, and longer storage time is allowed for SQGs.

Korean hazardous waste contractors are required to treat waste within 90 days from the contract award date. However, waste generators must treat or dispose of the hazardous wastes in the sequence of their generation, to avoid secondary pollution.

*Transportation*

U.S. waste generators must meet U.S. Department of Transportation (DOT) regulations governing packaging, labeling, placarding, and handling requirements.

Korean requirements are less stringent. In Korea, signs on the vehicle front and back reading "Vehicle carrying designated hazardous industrial wastes," in red letters on a white background, are required.

*Underground Storage Tank and Contingency Program*

Unlike the United States, Japan and Korea have no Underground Storage Tank (UST) program that regulates petroleum products and hazardous substances stored in underground tanks. Emergency response programs are not comprehensively developed in Japan and Korea.

*Hazardous Waste Analysis*

Each country has its own standard method.

*State and Local Regulations*

In the United States, the RCRA provides the mechanism for States to manage their own hazardous waste programs after authorization by the USEPA. Some States' regulations are more stringent than the Federal regulations. A comparison of States' requirements can be found in USACERL Technical Report N-88/23.[2] Although local regulations are generally less comprehensive than Federal and State regulations, counties, cities, and villages may have additional requirements.

In both Japan and Korea, Prefecture, Province, and local hazardous waste regulations are not stringent, but should not be ignored.

[2] Byung J. Kim et al, *Conceptual Basis for a Hazardous Waste Component of the Army Environmental Data Management System (AEDMS)*, Technical Report (TR) N-88/23/ADA200435 (U.S. Army Construction Engineering Research Laboratory [USACERL], September 1988).

*Cleanup of Past Dumping Sites*

In the United States, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Superfund Amendments and Reauthorization Act (SARA) require cleanup of past dumping sites and emergency planning for communities.

In Japan and Korea, programs to clean up past dumping sites and emergency planning in relation to hazardous waste are insignificant in comparison with U.S. programs.

## Final Disposal

*USA*

Permitted treatment, storage, and disposal (TSD) facilities are required to treat, store, and dispose of hazardous wastes. In the United States, treatment and final disposal methods are regulated by specific standards. The HSWA bans disposal of bulk or noncontainerized liquid hazardous waste at landfills. The USEPA establishes performance standards for TSD facilities. For example, incinerators must remove 99.99 percent of each primary organic hazardous constituent specified in its permit. Table 2 lists landfill restrictions initiated since 1986.

*Japan*

In Japan, industrial wastes are commonly incinerated. The resulting residue is the focus of final disposal. Two common final disposal methods are ocean dumping and landfill. Ocean dumping (after proper treatment) is an option used only when landfill is unavailable.

**Table 2**

**U.S. Hazardous Wastes Landfill Restrictions Initiated Since 1986**

| Chemicals | Date of Ban |
|---|---|
| Solvents and dioxin | Nov 1986 |
| California lists | July 1987 |
| Listed wastes | |
| First third | Aug 1988 |
| Second third | June 1989 |
| Third third | May 1990 |

The prime goal of Japanese hazardous waste regulations is to regulate industrial pollution. When industrial waste generators choose to collect, transport, and dispose of the wastes by themselves, the standards established by the Cabinet Order for the Waste Disposal and Cleansing Law (Article 6) must be met. Standards of special interest are:

1. Industrial landfill sites shall be enclosed and marked as industrial landfill sites or as dangerous industrial landfills.

2. Cinders, sludges, and their solidified products from the listed disposal facilities containing mercury, cadmium, lead, hexavalent chromium, arsenic, copper, zinc compounds, or fluoride should be disposed of at a dangerous industrial landfill.

3. Waste PCBs and PCB containing oil will be incinerated to meet the standards stipulated by the Ordinance of the Prime Minister's Office (OPMO).

4. A dangerous industrial landfill site must be isolated from public waters and groundwater.

5. PCB-contaminated items, which include industrial wastes, PCB-applied waste paper, and waste plastics and metals to which PCB is attached or sealed, shall not be landfilled unless:

a. PCBs are removed in advance

b. Such substances are incinerated and meet the OPMO standards

c. When method a. or b. above is not practical, a method stipulated separately by the Director General of the Environment Agency is used.

The Ordinance of the Prime Minister's Office on Effluent Standards establishes a total of 26 effluent limitations for all industries. The Enforcement Regulation of the Air Pollution Control Law establishes toxic substance emission standards for: cadmium, chlorine, hydrogen chloride, fluorine, hydrogen fluoride, silicon fluoride, and lead compounds.

Ocean dumping is allowed for: cinders without PCBs; sludges without PCBs, waste pesticides, oil, phenol, mercury, cadmium, lead, organic phosphorus, hexavalent chromium, arsenic, cyanide, organic chloride, copper, zinc, fluoride, and their compounds; sludge containing mercury after being calcinated; waste acid or alkali of a pH between 5 and 9; some treated PCB materials.

However, even for these allowed industrial wastes, ocean dumping should not be conducted when there is a viable landfill alternative.

In addition to the Japanese government regulations, U.S. Army Installations may have to comply with the Prefecture and local Government regulations.

*Korea*

Article 12 of the MOHSA Order to implement the Waste Management Law establishes these industrial waste treatment standards:

1. Designated hazardous industrial wastes shall be landfilled after treatment such as high temperature thermal destruction, oxidation, reduction, and/or fixation.

2. Designated hazardous industrial wastes will be treated to meet the following maximum concentrations of contaminant, based on the Korean extraction test results: cadmium, 0.1 mg/L; cyanide, 1 mg/L; organic phosphate, 1 mg/L; lead, 1 mg/L; hexavalent chromium, 0.5 mg/L; arsenic, 0.5 mg/L; mercury, 0.005 mg/L; PCB and PCP, 0.003 mg/L; and copper, 3 mg/L.

3. When designated hazardous industrial wastes exceed the maximum concentrations, solidification using cement will be used.

4. When solidification is not sufficient to dispose of hazardous industrial wastes, they should be disposed of at a designated hazardous industrial waste landfill.

5. Waste oil should be incinerated and ashes should be landfilled. Water separated from oil before incineration should contain not more than 0.5 mg/L of oil.

6. Waste synthetic resins should be incinerated.

7. Waste acids and alkalis should be neutralized to a pH between 5.0 and 9.0. The residue will be dewatered to a moisture content of less than 85 percent.

Article 48 of the MOHSA Order establishes permit conditions for industrial waste treatment businesses. Table 7 to the Annex to the MOHSA Order defines the minimum capacity of designated hazardous industrial waste treatment facilities as follows:

1. High temperature thermal destruction facilities should meet the following conditions:

   a. The temperature of gas at the exit of a combustion chamber should be 1100 °C or higher.

   b. Gas retention time in the combustion chamber should be at least 3 sec.

2. The minimum area of a landfill is 3300 $m^2$ and the minimum volume is 10,000 $m^3$. A landfill is required to install facilities to prevent the pollution of public water and groundwater and to prevent and treat leachate. A monitoring well should be provided. Signs reading "Designated Hazardous Industrial Waste Landfill" should be placed at entrances and exits. The outside wall of a landfill should be constructed of concrete at least 15 cm thick, with a compression stress of 210 $kg/cm^2$ or higher or the equivalent. The inner liner should be constructed of concrete 10 cm thick or the equivalent.

Figure 1 summarizes the Korean Ministry of Environment requirements for hazardous waste disposal. EUSA installations must comply with all host country regulations. To fully comply with Korean environmental regulations, EUSA installations should be familiar with the Korean Water Pollution Control Law, Air Pollution Control Law, and Marine Pollution Control Law, in addition to the Waste Management Law. In January 1990, the Ministry of Environment has been elevated from an Administration to a

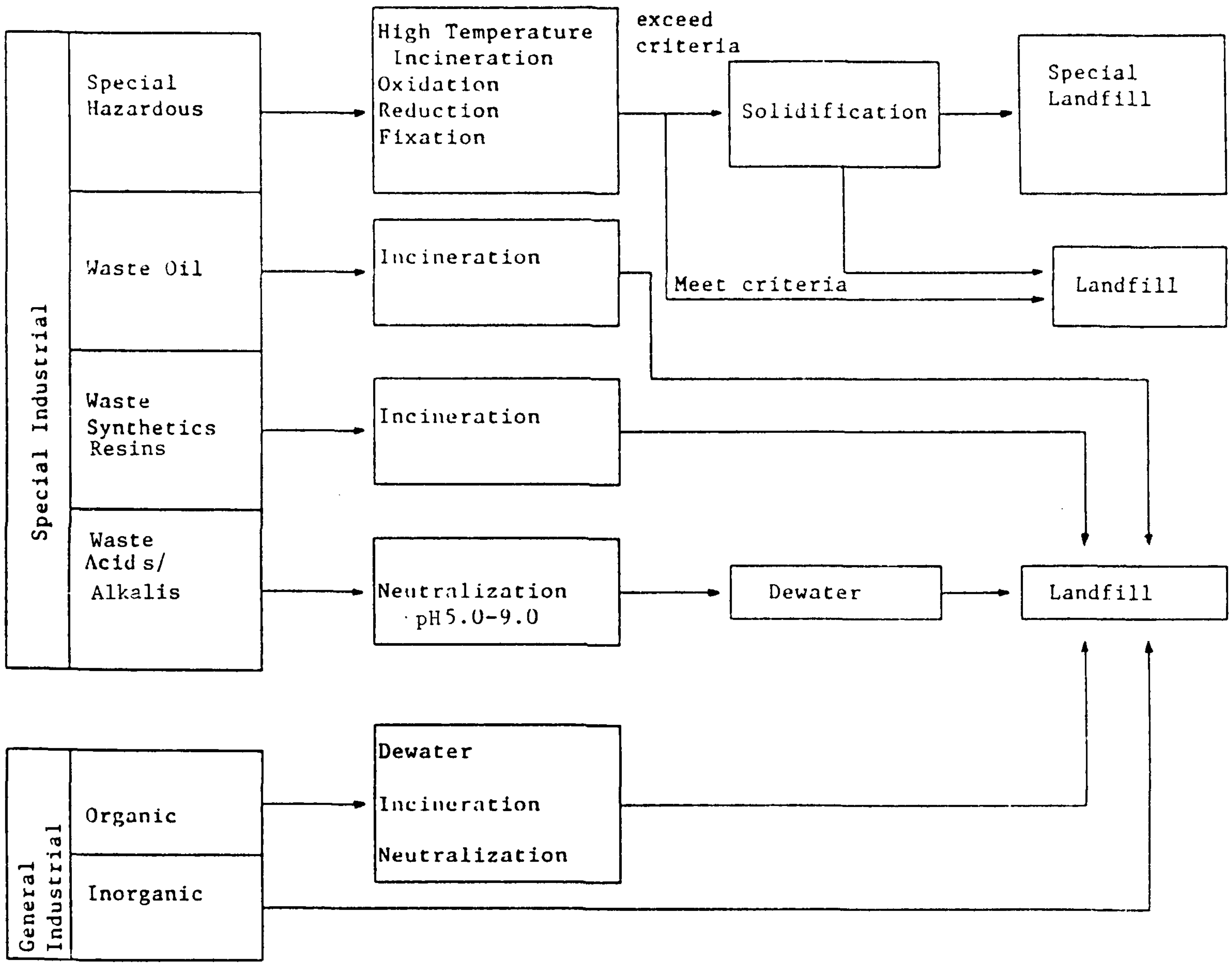


Figure 1. Industrial waste treatment/disposal methods.

Cabinet level and the revised laws have been submitted to Congress for approval. Effective February 1991, six new environmental laws will be implemented.

Unlike the United States or Japan, a Korean Government-funded Environmental Management Corporation is available for hazardous waste disposal. The Corporation owns six industrial and hazardous waste treatment plants.

## DOD, Army, MACOM, Installation, and DRMO Requirements

### *DOD*

The memorandum[3] from the Office of the Assistance Secretary of Defense (OASD), changed DOD policy on treatment of hazardous wastes from "environmentally acceptable disposal"[4] to "hazardous waste minimization." The memorandum from OASD stated that foreign-made PCB items could be retrograded to CONUS because they would not be interpreted as "imported items."[5] However, the USEPA rejected DRMS' request to retrograde the DOD-owned but foreign-manufactured PCB items, because the Toxic Substance Control Act prohibits importing PCB items.[6]

### *Army*

AR 200-1 prescribes DA policies, responsibilities, and procedures to protect the environmental quality. AR 200-1 includes details on the Army hazardous waste management program and guidelines for preparing an installation hazardous waste management plan. Chapters 5 and 6 of AR 420-47[7] had previously addressed Army hazardous waste management, yet were superceded by the new AR 200-1. AR 420-47 details the Army hazardous waste management program and provides guidelines for preparing an installation hazardous waste management plan.

AR 200-1 states the overseas installation commander's additional environmental program responsibility as follows:

> Commanders will maintain cooperative relationships with the regulatory agencies in the host countries or jurisdictions, and comply with the substantive pollution control standards of general applicability in the host countries or jurisdictions. (par. 1-6)
>
> PCBs and PCB items in overseas installations will remain under control of U.S. Forces. "Control" means being responsible for the use of PCBs and PCB items, including requirements for record keeping, reporting, notification, labeling, safe storage, inspection for leaks, rapid cleanup of spills, inventory, and disposal. The control of PCBs and PCB items should be consistent with applicable Status of Forces Agreements (SOFAs) or other agreements. In the absence of any such agreement, the host nation laws will be respected. Proper disposal may require retrograding the PCB wastes to an approved disposal facility in the U.S. unless a disposal facility exists in the host nation. (par. 5-9. c.)

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[3]Hazardous Waste Minimization Memorandum (Office of the Assistant Secretary of Defense [OASD], 6 February 1987).
[4]Defense Environmental Quality Program Policy Memorandum (DEQPPM) No. 80-5 (OASD, 13 May 1980).
[5]DEQPPM No. 81-4 (OASD, 18 September 1981).
[6]Letter from the Director, Office of Toxic Substances to DRMS Environmental Protection Agency (EPA) (22 May 1986).
[7]AR 420-47, *Solid and Hazardous Waste Management* (Headquarters, Department of the Army [HQDA], December 1984).

Commanders will comply with the more stringent of Army or host nation requirements for underground storage tanks (USTs). (par. 5-10. a.)

Commanders will comply with Headquarters, Department of the Army [HQDA] waste minimization requirements in general but not the specifics of inapplicable CONUS-limited Federal and State regulations. (par. 6-4. n.)

The Army's hazardous waste minimization goal is to achieve a 50 percent reduction of the quantity of hazardous waste generated by 31 Dec 1992, when compared to a baseline of calendar year 1985. Although the Army's hazardous waste minimization goal does not include host country listed hazardous wastes (i.e., not RCRA wastes), the Army requires minimization of those wastes also. (par. 6-9. b. [1])

*EUSA*

A draft proposed hazardous waste regulation, titled *Hazardous Waste Management Program* and dated April 1987, has not been finalized and implemented because of lack of manpower and resources. This EUSA regulation recommended an Area Environmental Coordinator (AEC) at each Directorate of Engineering and Housing (DEH) or Directorate of Facilities Engineering (DFE). Until 1 October 1989, only one Department of the Army civilian and one Korean National environmental engineer were authorized at EUSA. Currently seven environmental engineers and one intern at EUSA Environmental Program Office are responsible for overall operation and maintenance of water, wastewater, and solid waste systems, in addition to hazardous waste management. Six of the eight AEC have been hired.

The General Accounting Office (GAO) survey in 1989 pointed out that:

- Lack of priority may have resulted in a lack of progress in the environmental program
- Some installations had not yet designated area hazardous waste managers
- Hazardous waste quantity data was fragmented
- PCB analysis, storage, and turn-in recordkeeping requirements were not met in some areas
- Lack of procedural guidelines and training in hazardous waste management for field personnel was noted
- No installation had yet acquired a complete library of Republic of Korea (ROK) hazardous waste regulations.
- Field visits revealed a lack of spill plans and procedures
- Deficiencies in hazardous waste handling, signs, and storage areas were noted
- Although the Defense Reutilization and Marketing Office (DRMO) had disposed of 448 drums of PCBs through an in-country disposal contractor with a Korean Office of Environment permit, no records were found for either a permit or disposal monitoring.

*USARJ*

The emphasis of USARJ Supplement 1 to AR 420-47, *Solid and Hazardous Waste Management*[8] centers on hazardous waste minimization. The supplement requires the installation to prepare a hazardous waste minimization plan and the Deputy Chief of Staff (DCS) Engineer to approve the plan. The DCS Engineer also designates a USARJ HW minimization coordinator.

USARJ also has a MACOM Environmental Coordinator at the Office of Deputy Chief of Staff, Engineer—the only environmental engineer/scientist at the MACOM level. The U.S. Forces, Japan (USFJ) Environmental Coordinator with USFJ/J4 (Logistics) works for the U.S. Chairman of the SOFA Environmental Subcommittee. The storage limitations in USARJ Supplement 1 to AR 420-47 are:

- U.S.-made PCB items will be disposed of within 60 days from the initial date of storage
- Spent lithium batteries and PCP-treated wood will be properly disposed of, or removed within 60 days from the date of arrival.

The USFJ Environmental Coordinator has sought another one-time opportunity to waive the import ban of foreign-made PCB items.[9]

*Installations*

Camp Zama and Sagami Depot. Camp Zama and Sagami Depot belong to the 17th Area Support Group. In accordance with USAGH Regulation No. 420-47, *Hazardous Waste Management Plan,*[10] DEH 17th Area Support Group acts as the Installation Hazardous Waste Manager for Camp Zama and Sagami Depot. The regulation requires generating activities to:

- Develop an SOP for each hazardous waste generated
- Turn in hazardous materials and wastes to DRMO, thereby meeting the specific disposal instructions
- Transport hazardous wastes to DRMO or TSD facilities and meet the most stringent requirement of DA, DOT, or Government of Japan regulations
- Implement a hazardous waste minimization program
- Collect waste solvent and turn in to the Director of Maintenance (DOM) for recycling.

Appendix E of the USAGH regulation provides these hazardous waste disposal instructions:

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[8] U.S. Army, Japan (USARJ) Supplement 1 to AR 420-47, *Solid and Hazardous Waste Managemen.* (Headquarters [HQ], USARJ/IX Corps, 29 December 1986).

[9] Letter, U.S. Forces, Japan (USFJ), Subject: Environmental Review Assessing Return of DOD-Owned PCBs from Japan to CONUS (8 February 1988).

[10] U.S. Army General Headquarters (USAGH) Regulation No. 420-47, *Hazardous Waste Management Plan* (HQ, 17th Area Support Group, 1 August 1989).

- Turn in friable asbestos to DRMO and dispose of nonfriable asbestos at an industrial landfill

- Turn in PCBs or PCB-contaminated PCB items to DRMO for storage. Based on the Japanese criterion for identifying PCB transformers by labeled information, no PCB transformers have been identified in 17th ASG installations. When transformers are unserviceable, they should be tested.

- Turn in PCP ammo boxes to DRMO. Crystallized PCP will not be turned in to DRMO and loose dust must be vacuumed and sealed by paint.

The Environmental Management Office coordinates and monitors environmental compliance for the DEH 17th Area Support Group. It currently has a Spill Prevention, Control, and Countermeasure Plan (SPCCP) and an Installation Spill Contingency Plan (ISCP), both dated 15 May 1989.

DRMO, Sagami has established hazardous waste turn-in procedures for USARJ installations.[11] The memo requires wastes to be identified, packaged, labeled, and transported properly, and PCB items with higher than 50 PPM to be returned.

Yongsan Garrison and Camp Carroll. DEH-Yongsan has a draft SPCCP and ISCP. Camp Carroll Safety Office prepared an Installation Hazardous Waste Management Plan including an SPCCP and ISCP.[12] Camp Carroll's Safety Office has also established a Hazard Communication Program, and has issued guidelines to recover used oil and to prevent asbestos exposure during brake and clutch servicing.

DRMO. Bupyong established guidance for turn-in of PCB, lithium batteries, PCP-treated ammunition boxes, CARC residue, asbestos, and DS2.

## Hazardous Material and Wastes Data

No attempt was made to mass balance hazardous materials and wastes within a period of 1 year. Rather, hazardous material data gives an idea of what kind of materials enter EUSA installations. Hazardous waste data was collected from generation points.

### *Hazardous Material Data*

In response to a USACERL request, the U.S. Army Pacific Environmental Health Engineering Agency (USAPEHEA) attempted to identify the hazardous material issued to Camp Carroll, Yongsan, and Sagami Depot. Hazardous material supplied to Camp Carroll is listed in Appendix B. Selection criteria were USAPEHEA-screened Federal Supply Classes (FSC). It was found that most hazardous materials were ignitable paint-related items and some solvents. To assess the quantity of hazardous waste generation, annual average hazardous waste generation data was collected by interview with waste

[11]Letter, DRMO-WJAJ, Subject: Turn-In of Hazardous Material/Hazardous Waste (HM/HW) to the Defense Reutilization and Marketing Office Serving You in That Area (26 March 1989).

[12]Letters of Instruction, DRMO-WKA, Subjects: Turn-in of Polychlorinated Biphenyl to DRMO Bupyong; Turn-in/Disposal of PCP Treated Ammo Boxes; Turn-in of Lithium Batteries to DRMO Bupyong; Turn-in of DS2 Decontaminating Agent; Turn-in of CARC Materials to DRMO Bupyong; Turn-in of Asbestos Items to DRMO Bupyong (1 August 1989).

generators. The Environmental Division of USACERL is presently compiling more comprehensive data on hazardous material for EUSA installations.[13] It is anticipated that the data will be available in FY91.

*Hazardous Wastes Data*

The Yongsan Garrison has served as the headquarters for EUSA, United Nations Command, and U.S. Forces, Korea since the Korean war. Therefore, activities in Yongsan include supporting headquarters offices, liaison units, and the community center for Area III. Area III covers Yongsan, Camp Market, Camp Colbern, K-16, and other adjacent small facilities. A FEAK master planning document shows the Yongsan Garrison population to be about 25,000. Yongsan Garrison generates typical nonindustrial hazardous wastes. USACERL conducted a hazardous waste survey for Yongsan (Table 3). Negotiated quantity for the slop and waste oil pickup contract generated from Yongsan in FY90 was 2208 gal. Hazardous waste generation data is shown in Tables 3 to 6.

Camp Carroll serves as the Headquarters, U.S. Army Materiel Support Center, Korea (USAMSC-K) and provides general service maintenance and supply support for all U.S. military units in the Republic of Korea. Major units assigned to Camp Carroll include a Transportation Battalion, a Signal Battalion, and a MEDSOM Battalion. Because of maintenance and repair activities, Camp Carroll is the largest hazardous waste generator in EUSA. Population in Camp Carroll is about 4000. Major hazardous waste generators include:

- Bldg No. 326 and 327, Major assembly plant: Repair and rebuild engines and transmissions. Operational units generating hazardous wastes include several cold cleaning tanks using stoddard solvent (PD-680 type II), vapor degreasing unit using 1,1,1-trichloroethane, steam part cleaner using caustic soda, carburetor cleaning using cleaning compounds.

- Bldg No. 662, 665, 668, and 675, Heavy Equipment Division, has a CARC facility and a sand-blasting facility.

Slop and waste oil generation data is also included in Appendix C. Since Camp Humphreys' waste oil burning facility has been closed down, waste oil and slop oil have been released to a contractor without segregation. (Some of the quantities in Appendix C are duplicated in Tables 3 to 6.)

Camp Zama serves as the headquarters of the U.S. Army, Japan and generates nonindustrial type hazardous wastes from offices and other supporting activities. Sagami depot receives, stores, and maintains theater of war reserves. Since the completion of the Vietnam War, depot activity has been minimal. Total population for Camp Zama and Sagami Depot is about 2500. Hazardous waste inventory data for Camp Zama and Sagami Depot were available in 17th ASG Regulation No. 420-47. USACERL investigators visited hazardous waste generation points to analyze hazardous waste minimization opportunities at these locations. (Note: When DEH hazardous waste inventory data and operators' interview data disagree, the larger quantity is used.) Based on data provided by DEH, 17th Support Group, PCB and suspected PCB item storage data (as of October 1989) in Japan is summarized as follows:

1. Total number of transformers stored: 182

[13] This work is being performed under Military Interdepartmental Purchase Request (MIPR) FEAK-5001-90, "Comprehensive EUSA Hazardous Wastes Management Program."

Table 3

Yongsan Hazardous Waste Data

| Building Number | Activities | Hazardous Wastes | Annual Quantity | Unit |
|---|---|---|---|---|
| 1016 | Boiler plant | Blowdown | Unknown | |
| 1053 | Electrical shop | PCB transformer | Unknown | |
| | | Batteries | Unknown | |
| 1095 | Motor maintenance | S, B, O* | Unknown | |
| 1114 | Craft shop | Hypo solution | Unknown | |
| 1173 | Motor maintenance | Solvent | 150 | gal |
| | | Used oil* | 960 | gal |
| 1183 | Med research lab | Toxic chemical | Unknown | |
| 1196, 1197, and 1199 | Motor maintenance | S, B, O | Unknown | |
| 1222 | KOAX car care center | Korean contractor | | |
| 1300 | Paint shop | Paint wastes | None | |
| 1384 | Pest control shop | Pesticide | None | |
| 1344 | DEH heavy equip. shop | Cleaning solvent | 660 | gal |
| | | Battery | 360 | each |
| | | Used oil | 4620 | gal |
| 2259 | Moyer service club (for entire Area III) | Film fixer | 600 | gal |
| 2701 | Vehicle maintenance | S, B, O | Unknown | |
| 4815 | Motor maintenance | S, B, O | Unknown | |
| 4878 | Auto craft shop | Solvent (PD-680, type II) | 450 | gal |
| | | Battery | 24 | each |
| | | Used oil | 1800 | gal |
| 5107 | Dental clinic #2 | X-ray film waste | Unknown | |
| 5255 | Dry cleaning | Solvent filter | 120 | each |
| | | Solvent perchloroethane (PCE) | None | gal |
| 5712 | Motor maintenance | S, B, O | Unknown | |
| 5855 and 5857 | Motor maintenance | S, B, O | Unknown | |
| 7005 | 121 Hospital | Lab chemicals | Unknown | |
| | | X-ray film waste | Unknown | |

*Note: S, B, O stands for solvent, batteries, and used oil.

## Table 4
## Camp Carroll Hazardous Waste Data

| Building Number | Activities | Hazardous Wastes | Annual Quantity | Unit |
|---|---|---|---|---|
| 305 | Supply and transport | S, O | Unknown | |
| 309 | Small arms. Optical, chemical equipment | Solvent | None | |
| | | (trichloroethylene) | 660 | gal |
| | | Solvent (type II) | 110 | gal |
| | | Dichromate acid | 5 | gal |
| 326 and 327 | Major assembly plant | Used oil | Not avail | |
| | | Solvent (PB-680 type II) | 13,200 | gal |
| | | Solvent (trichloroethylene) | 660 | gal |
| | | Cutting oil | None | |
| | | Caustic soda (drained) | Unknown | |
| 345 | Dry cleaning | Filter | Unknown | |
| | | Slop oil | Unknown | |
| 388 | Art and craft | Solvent | 20 | gal |
| 405 | Direct support maintenance | Battery | 1200 | each |
| | | Slop and waste oil | 8250 | gal |
| 407 | MP Co. | Waste oil | 1100 | gal |
| | | Slop oil | 1100 | gal |
| | | Battery | Unknown | |
| 502 | Machine and fabrication | Used oil | 550 | gal |
| | | Solvent (type II) | 550 | gal |
| | | Cutting oil | None | |
| 510 | Electric and communication equip repair | Paint residue trash | | |
| | | Mineral spirit | None | |
| | | Solvent (type II) | 110 | gal |
| | | Used oil | 220 | gal |
| 561 | 2nd Engineer | Waste and slop oil | 1000 | gal |
| 662, 665, 668, and 675 | Combat vehicle, tactical. Construction equipment and battery shop | Sandblast wastes | 100 | ton |
| | | CARC residue | Unknown | |
| | | Asbestos shoes | 2 | drum |
| | | Battery acid | 2400 | gal |
| 1501 | Yonwha Station | Slop oil | Unknown | |
| | 6 MEDSOM incineration of expired medical supp | Medical supply | N/A | |
| | 6 MEDSOM motor pool | S, B, O | Unknown | |
| 658 and 825 | Tactical vehicle maintenance | Slop and waste oil | 3180 | gal |
| | | Battery | Unknown | |
| 915 | Transportation | Battery | 2400 | each |
| | | Waste oil | 600 | gal |
| | | Slop oil | 600 | gal |

*Defense Rentilization and Marketing Region, Pacific (DRMR-PAC) Korea Sales Office has a sales contract to sell contaminated and used POL products to a Korean buyer. The estimated annual generation quantity is 32,000 gal.

## Table 5

### Camp Zama Hazardous Waste Data

| Building Number | Activities | Hazardous Wastes | Annual Quantity | Unit |
|---|---|---|---|---|
| 654 | Heavy equip shop | Used oil | 440 | gal |
| | | Solvent (PD-680, type 1) | 550 | gal |
| | | Battery acid | 25 | gal |
| 602 | DOM motor pool | Used oil | 940 | gal |
| | | Solvent (cleaning compound) | 1800 | gal |
| | | Battery | 150 | each |
| | Auto craft shop | Used oil | 330 | gal |
| | PX garage (contract operation) | Used oil | 2000 | gal |
| | | Solvent | 20 | gal |
| | | Battery acid | 380 | gal |
| | Aircraft maintenance | Used oil | 260 | gal |
| | | Solvent | 440 | gal |
| 102 | Criminal invest. lab | Hypo solution | 60 | gal |
| | | Other chemicals | None | |
| 650 | Pest control shop | Container trash | | |
| | | Rinse water reuse | | |
| 316 | Craft shop | Hypo solution | 50 | gal |
| | | Mineral spirit (1,1,1-trichloroethane) | None | |
| | Laundry | Dry cleaning filter | Unknown | |
| | | Sludge from solvent recycle | 56 | gal |
| 704 | Dental clinic | Hypo solution | 15 | gal |
| | | Spent amalgam | 8 | lb |
| 704 | Medical x-ray | Hypo solution | 240 | gal |
| 704 | Pathology lab and medical clinic | Acetone and alcohols | Unknown | |
| | | Infectious wastes | Unknown | |
| 668 | Paint shop | Thinner | None | |
| | | Wet paint | None | |
| 668 | Heating shop (contract operation) | Blow down | Unknown | |
| 668 | Electrical shop | PCB transformers | Unknown | |
| | Ref and AC shop | Solvent | 10 | gal |
| | DEH sanitary lab | PCB samples | Unknown | |
| | | Chemicals | Almost none | |
| | EHEA lab | PCB samples | Unknown | |
| | | Chemicals | Almost none | |
| | DOM machine repair | Solvent | 10 | gal |

*Note: Battery generation quantity at building #602, Camp Zama during FY89 was unusually high, because most batteries for old cars were replaced that year.

## Table 6

### Sagami Depot Hazardous Waste Data

| Building Number | Activities | Hazardous Wastes | Annual Quantity | Unit |
|---|---|---|---|---|
| 165-S4* | DOM vehicle maintenance shop | Used oil | 2000 | gal |
| | | Solvent (recycled) | 2000 | gal |
| | | Battery | 360 | each |
| | | Asbestos brake shoes | Unknown | |
| 165 | DOM machine repair | Solvent | 30 | gal |
| | | Cutting oil | None | |
| 176-S4 | DOM care and preservation shop | Used oil | 55 | gal |
| | | Solvent | 440 | gal |
| 173-S1 | DOM furniture repair shop | Used oil | 20 | gal |
| | | Solvent | 120 | gal |
| 161-S9 | DEH heavy equipment shop | Used oil | 165 | gal |
| | | Solvent | 55 | gal |
| | | Battery acid | 40 | gal |

*Note: At the time of visit, a solvent recovery still at building #165-S4 was in operation.

2. Total number of oil switches, capacitors and filters: 118

3. Number of transformers for:

   - Less than 50 ppm: 32 each
   - Between 50 and 500 ppm: 32 each
   - More than 500 ppm: 46 each
   - 0 ppm: 14 each
   - Without record: 58 each.

DRMO-Sagami data[14] indicated that total disposal cost for hazardous waste was $98,403, consisting of $84,403 for PCPs and $14,000 for other wastes, including adhesives, antifreeze, cleaning compound, corrosion preventive, coating compounds, DS-2, enamel, insecticides, lacquer, paint, resin, scale-removing compounds, sealing compound, thinner, varnish, epoxy, developer, hypo solution, methyl ethyl ketone, pH standard, sulfuric acid, alcohol, xylene, and 1,1,1-trichloroethane.

It was extremely difficult to collect DRMO-Bupyong data directly from DRMO-Bupyong, DRMR-Hawaii, and DRMS. The USAPEHEA provided the disposal data for DRMO-Bupyong listed in Table 7.

[14]Letter, DRMO-WJA, Subject: Funding for Hazardous Waste (18 January 1989).

Table 7

DRMO Disposal Data

| Nomenclature | Quality | Costs |
|---|---|---|
| **FY87** | | |
| Mercury waste (22 Maint Co) | 10 lb | $64 |
| Battery acid (257 Sig Co) | 21 can | $31 |
| Expired medical (6th MEDSOM) | 43 triwall bx | $10,686 |
| Solvent sludge (dry clean) | 17 drum | $811 |
| Friable asbestos (DEH area III) | 2580 lb | $1772 |
| Hypo solution (6th MEDSOM) | 35 drum | $1645 |
| Transformer oil | 448 drum | $58,142 |
| Total | | $83,151 |
| **FY88** | | |
| Battery acid (257th Sig Co) | 97 can | $141 |
| Expired medical (6th MEDSOM) | 55 triwall bx | $13,276 |
| Hypo solution (6th MEDSOM) | 17 drum | $781 |
| Solvent sludge (dry clean) | 31 drum | $356 |
| Total | | $14,454 |
| **FY89** (partial) | | |
| Sandblast residue | 86 ton | $14,333 |
| Expired medical (6th MEDSOM) | 59 triwall | $14,240 |
| Solvent sludge (dry clean) | 35 drum | $482 |
| Hypo solution (6th MEDSOM) | 25 drum | $1057 |
| Total | | $30,112 |

# 3 HAZARDOUS WASTE MINIMIZATION AND TREATMENT

## Background

The HSWA of 1984 declares waste reduction to be national policy and requires hazardous waste generators to certify that, whenever economically practical, programs are in place to reduce the volume and toxicity of hazardous waste. The Office of Technology Assessment (OTA) pointed out that, since pollution control for one medium could mean that waste was merely transferred to another medium, treatment could not be considered as a minimization method.[15] Waste minimization should be achieved at the source.

The USEPA defines waste minimization as:

> The reduction, to the extent feasible, of hazardous waste that is generated or subsequently treated, stored or disposed of, including any source reduction or recycling activity undertaken by the generator that results in either (1) The reduction of total volume or quantity of hazardous waste, or (2) The reduction of toxicity of the hazardous waste, or both, so long as such reduction is consistent with the goal of minimizing present and future threats to human health and the environment.[16]

An OASD memorandum[17] was issued to outline DOD hazardous waste minimization policy. Draft AR 200-1 (25 May 1989) established the Army's hazardous waste minimization goal as a 50 percent reduction of hazardous waste generation quantity compared with CY 1985 baseline. However, the Army does consider treatment as a minimization alternative.

Hazardous waste minimization methods proven to be successful include:

- Changed materials purchasing and control methods
- Improved housekeeping
- Changed production or operation methods
- Substitution of less toxic materials
- Reduction in wastewater flow
- Segregation of wastes
- Recycling or reclamation of wastes
- Treatment of waste to reduce volume or toxicity.[18]

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[15] *Serious Reduction of Hazardous Waste*, (U.S. Congress, Office of Technology Assessment [OTA], 1986).
[16] *Minimization of Hazardous Waste* (USEPA, October 1986).
[17] Hazardous Waste Minimization Memorandum (OASD, 6 February 1987).
[18] Thomas Higgins, *Hazardous Waste Minimization Handbook* (Lewis Publishers, Chelsea, 1989).

**Minimization and Treatment Technologies for Specific Waste Streams**

Based on the hazardous material and wastes data in Chapter 2 and discussions with EUSA and USARJ hazardous waste managers, the following hazardous waste streams of most concern were identified:

1. PCP ammunition boxes: DRMO Sagami used 85 percent of hazardous waste disposal costs for retrograde of the boxes to CONUS in FY 87.

2. PCB and PCB-contaminated items: USFJ is seeking an USEPA waiver for PCB item import ban. Both EUSA and USARJ have difficulty in managing PCB items.

3. Waste Solvents: Solvents in the EUSA are sold to a DRMR-PAC contractor. No recycling units are operated on EUSA installations.

4. Used Oil: Based on a study, Camp Humphreys' burning facility for used oil was closed. Used oil is now sold to a DRMR-PAC contractor.

5. Waste Batteries and Acids: Both the EUSA and the USARJ generate a large number of batteries.

6. Antifreeze: Many vehicle maintenance facilities dispose of antifreeze as slop oil.

7. DS-2: Some installations have storage difficulties.

8. Paint wastes, hospital wastes, and photography wastes are common wastes that most Army installations generate.

To meet the RCRA, DOD, and DA requirements, EUSA and USARJ will be able to formulate their own strategies to minimize hazardous waste disposal quantity and disposal expenses. In this chapter, the current status of hazardous waste minimization and treatment technologies for each waste stream is discussed, and an appropriate hazardous waste minimization strategy is proposed.

1. PCP-treated ammunition boxes:

a. Background: EUSA and USARJ have spent millions of dollars to return PCP ammunition boxes to CONUS for disposal. However, a PCP ammunition box has never been hazardous material or hazardous waste, nor is it a hazardous waste by the new USEPA definition. 40 CFR Part 261 (March 1990) defines the regulatory level of PCP as 100 mg/L by TCLP. U.S. Army Environmental Hygiene Agency's (USAEHA) recent data indicates that PCP ammunition boxes are not hazardous.[19] The results of the October 1990 USACERL analyses of ammunition boxes sampled from EUSA installations confirmed the USAEHA's results.

PCP ammunition boxes are no longer purchased by the DOD. However, it will take some time until the existing stocks are exhausted. It is a DOD policy to continue to use the stockpile for their intended purpose until the PCP-treated ammunition boxes and pallets become unserviceable because of deterioration of wood fiber. The letter "P" marks wood treated with PCP and other preservative items.

[19]Personal discussion with Mr. Murray Brown, USAEHA, Aberdeen Proving Ground, MD (June 1990).

Zinc naphthenate, copper naphthenate, and copper-8-quinolinolate are substitutes for PCP. The letters "PB," "PC," and "PA" mark these boxes, respectively.

Although PCP-treated wood boxes are not hazardous, PCP itself is a listed hazardous waste due to the very small amount of contaminated polychlorinated dibenzodioxines (PCDD) and polychlorinated dibenzofurans (PCDF) produced as byproducts of PCP manufacturing (40 CFR 261.31, USEPA F027). In 1986, the USEPA proposed including PCP in the toxicity characteristic list (40 CFR 261.24) at a level of 3.6 ppm by TCLP.

In 1983, the USAEHA analyzed the performance of the Army's contaminated waste processor (CWP) to dispose of explosive-contaminated PCP ammunition boxes and found that PCDD and PCDF were not detected but that hydrochloric acid (HCL) and chlorine ($CL_2$) were detected. At that time, PCP-treated wood that was not explosive-contaminated was sold to the public with a disclaimer by the Defense Property Disposal Office (DPDO), now the DRMO. In 1987, the USAEHA provided technical guidance on PCP handling and disposal, recommending that PCP-treated material be managed as a special waste using an EPA-proposed level of 3.6 ppm by TCLP. The USAEHA found that 53 percent of PCP-treated wood samples exceeded the 3.6 ppm limitation. Nevertheless, the new regulatory level, which has not yet been incorporated into the guidance, is 100 ppm.

In 1979, the USAPEHEA advised EUSA and USARJ installations not to dispose of PCP-treated wood by open burning. Environmental coordinators in the overseas installations contacted host country environmental regulatory agencies seeking a solution to the problem of contaminated wood disposal. The responses were that no systems were available in these countries to dispose of these "hazardous wastes." The U.S. Army was encouraged to seek its own solution. The Defense Logistics Agency (DLA) and EUSA contacted the Korean Office of Environment many times to obtain an approval for the incineration of ammunition boxes at Korean private incinerators because there were no hazardous waste landfills in Korea. The Korean Government requested that DRMS prove that there would be no adverse impact from incinerating PCP material. The USEPA conducted a test program and concluded that incineration produced a removal efficiency of more than 99.99 percent,[20] generated less TCDD and TCDF than detection limits at a minimum combustion temperature of 980 °C, and included more than 3 percent oxygen in the offgas and a gas retention of 2 seconds.[21] The Korean Office of Environment told the EUSA to wait until a government hazardous waste incinerator had been constructed. At present, this facility has been completed but disposal has not been implemented. DRMOs for EUSA and USARJ continue to return ammunition boxes to CONUS.

The Japanese Waste Disposal and Cleansing Law does not address PCP-treated wood. However, Korean Waste Management Law defines PCP items with 0.003 ppm or more in extracted solution as a special hazardous industrial waste (Article 2. MOHSA Order to Implement the Waste Management Law). This 0.003 mg/L is an unreasonably low limitation compared with 100mg/L in the United States. It appears that the limitation for wastewater effluent was misapplied to PCP-treated wood. The Korean Ministry of Environment (MOE) is presently revising all environmental regulations. This review represents an opportunity to discuss these limitations with the Korean MOE, and to suggest that the MOE revise the limitations based on current scientific evidence.

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[20] Letter from the USEPA (7 February 1984).

[21] *Incineration of Pentachlorophenol Treated Wood, Toole Army Depot, Final Report* (U.S. Army Environmental Hygiene Agency [USAEHA], 1983); *Controlled Air Incineration of Pentachlorophenol-Treated Wood*, EPA-600/S2-84089 (USEPA, July 1984); *Pentachlorophenol Treated Materials Handling and Disposal*, Technical Guide No. 146 (USAEHA, October 1987).

b. Proposed strategy

(1) Coordination with the following agencies: Office of the Assistant Secretary of Defense (Environment); Office of the Deputy Assistant Secretary of the Army for Environment, Safety and Occupational Health Office; Army Environmental Office; Army Material Command (AMC); DRMS; U.S. Army Toxic and Hazardous Material Agency (USATHAMA) and the USAEHA. An appropriate authority will officially acknowledge that PCP ammunition boxes are not hazardous waste. USACERL personnel will provide technical assistance and coordinate the liaison.

(2) DRMO-Bupyong and EUSA (FEAK Environmental Program Office and J-4) will evaluate alternatives to dispose of PCP ammunition boxes as nonhazardous items. RTDS by DRMO is a priority consideration.

(3) The following provisions should be made before RTDS activities: An inspection program must be implemented to certify that the ammunition boxes are not contaminated with explosives, that no crystallization is observed on the boxes, and that open burning of wood is prohibited. (PCP boxes showing evidence of crystallization may present health hazards to the workers.)

2. PCB and PCB-contaminated items:

a. Background: PCBs exhibit many useful characteristics. They are stable, have a low vapor pressure, low flammability, high heat capacity, low electrical conductivity, and a high dielectric constant. Unfortunately, these chemicals can enter the animal body through skin, lungs, and the food chain, and are accumulated in fatty tissue. The USEPA has determined that PCBs may cause adverse reproductive effects, developmental toxicity, and tumor development in the human body. Because of these health and environmental hazards, the use and disposal of PCBs are stringently regulated.

In 1976, the USEPA issued 40 CFR Part 761 to implement the Toxic Substance Control Act (TSCA), prohibiting the manufacture, processing, distribution, and use of PCB items. Two exceptions for continued use were: (1) use in a totally enclosed manner, and (2) use without presenting an unreasonable risk of injury to health or the environment. Also regulated were marking, labeling, and placarding; and the storage and disposal of PCB items. The USEPA provided three concentration ranges: PCB-free, which is less than 50 ppm, PCB-contaminated, which contains from 50 to 500 ppm, and PCB, which contains more than 500 ppm.

DLA, DRMS, DRMOs, and the Logistics and Environmental staff of EUSA and USARJ could not find any solution for the problems of PCB transformers. For more than 10 years, attempts to coordinate hazardous waste management with host countries have met with difficulty. Important unresolved issues include: (1) whether the host country can help with PCB transformer disposal, and (2) how host countries dispose of their own PCB transformers. Commonly, the U.S. Army has been refused such help on the basis that host countries often store spent transformers without treatment, and on the perception that the U.S. Army is better equipped to handle its own wastes.

It should be noted that Korean and Japanese Governments do not regulate PCB items in the same manner as does the USEPA. In Korea, Article 2 of the MOHSA Order to Implement the Waste Management Law designates PCB concentrated to 0.003 mg/L or more in extracted solution, as a special hazardous industrial waste. This standard is considerably lower than the USEPA's 50 mg/L cutoff. The 0.003 mg/L limit may have been the minimum detection level when the law was written. In fact, the Korean Ministry of Environment does not have any regulation to implement control of PCB transformers.

Both Korean Electric Power Corporation (KEPCO) and Korean Office of Environment representatives have reported that they were not aware of any problems in the storage or disposal of PCBs.

Article 1. (1) and (2) of Japan's Cabinet Order for Implementation of the Waste Disposal and Cleansing Law defines waste paper, metal pieces, and soot with residual PCB as industrial wastes. Article 6. (1) j of the Cabinet Order states that: "The landfill of waste PCBs, etc. shall be conducted after such waste PCBs, etc. have been incinerated in an incinerator, thereby producing cinders or other substances that meet the standards stipulated by the Ordinance of the Prime Minister's Office."

Article 6. (1) n of the Cabinet Order states that: "The landfill of PCB-polluted substances shall be conducted according to one of the following methods: removal in advance; incineration in a proper incinerator to meet the standards set by the Ordinance of the Prime Minister's Office; solidification, or other methods stipulated by the Director General of the Environmental Agency.

Article 3, Paragraph 1 of the Water Pollution Control Act requires effluent standards to be established by ordinances of the Prime Minister's Office. Article 1 of the Ordinance of the Prime Minister's Office on Effluent Standards establishes a maximum limit of 0.003 mg/L for PCB.

The Electrical Equipment Division, Mechanics and Information Industry Bureau, Ministry of Trade and Industry (MTI), Japan, provides guidance titled "Concerning Handling of PCB-Containing Electrical Equipment" (September 1984), including these guidelines:

- Use of any new electrical system containing PCB is prohibited (Ministry order No.70)
- Users shall store industrial wastes, until disposed of, without hindering conservation of the living environment (Article 12.4, Waste Disposal and Public Cleansing Law)
- Industrial wastes should be stored to prevent spills, groundwater contamination, dispersion into air, and insect breeding (Technical Standards to Store Industrial Wastes)
- Recordkeeping and marking are required (Memorandum of Heavy Industry Bureau and Public Works Bureau)
- A list of 17 PCB item manufacturers and 69 PCB item labels shall be used as references for identification
- A source list may be used to gather further information and to write report forms.

An environmental coordinator at DEH, 17th Area Support Group, provided additional information on PCB. At a meeting with the Industrial Waste Disposal Office, Ministry of Health and Social Affairs, a Japanese official stated that PCB in oil should be tested by Japanese Industrial Standard No. K0093 ("Test Method for PCB in Wastewater") and a standard 0.003 mg/L of PCB in oil should be met. In 1985, several new Japanese-made transformers were found to contain PCBs (one contained 17 mg/L). The manufacturer could not measure PCB concentrations by the method prescribed in JIS K0093. Instead, a method to measure PCBs in lubricant was used to confirm the DEH's finding. The experience indicates: (1) that new Japanese transformers do in fact contain PCBs, (2) that PCB could not be measured by JIS

No. K0093, and (3) that the 0.003 ppm standard is inappropriate for tests of PCB transformers. It is likely that the standard was adopted wholesale from the Water Pollution Control Act without consideration for test methods or the enclosed use allowed by electrical transformers.

Since the Japanese Government identifies PCB transformers by labels, their own PCB transformers contain a PCB concentration of several tens of percent (several hundred thousand ppm). It should be noted that the maximum concentration of USARJ PCB transformers is far less than new Japanese transformers, at 6000 ppm (most contain less than 1000 ppm). USARJ transformers are not labeled according to the Japanese MTI guidance. From a practical and procedural standard, all USARJ PCB transformers already meet Japanese criteria.

b. Minimization and treatment technologies

(1) Reuse: The TSCA does not regulate PCB items with a concentration of less than 50 ppm. Therefore, mineral oils with less than 50 ppm PCB concentration can be reused and recycled. However, any waste oil (including fuel, motor, gear, cutting, transmission, hydraulic, and dielectric oil) containing any detectable concentration of PCBs cannot be used as a sealant, coating, dust-control agent, pesticide or herbicide carrier, or rust preventative.[22]

(2) Retrofill and reclassification: A PCB transformer is energized allowing PCB leach-out from the core after PCB oil is replaced with a specially prepared PCB-free fluid. The replacement is repeated until the oil PCB concentration becomes less than 50 mg/L. The USEPA requires a 90-day reclassification period after which the transformer may be filled with permanent dielectric fluid. Initial treatment takes about 12 to 24 hours and subsequent treatment requires 6 to 10 hours. Sometimes a processor is attached to the transformer after initial replacement to destroy residual PCB.

(3) Chemical treatment: A number of chemical processes have been successfully used to destroy PCBs in dielectric fluids with concentrations up to 10,000 ppm. Those processes also allow reuse of dielectric fluids. The chemical processes attack the PCB molecules at the chlorine-carbon bonds, stripping the chlorine from the biphenyl molecules. The biphenyls are then polymerized to form insoluble sludge.

The dechlorination reagents used are proprietary, but generally use metallic sodium and solvents to form an organosodium complex. This reagent reacts with PCBs to form sodium chloride and polyphenylene polymer. After the reaction has completed, a small amount of water may be added to destroy excess sodium reagent through the formation of sodium hydroxide. Typically 2 to 3 percent of the original fluid volume of the waste is generated in these processes.

(4) Incineration: Only high-efficiency incinerators approved by the USEPA may be used to destroy PCBs at concentrations greater than 500 ppm. Incinerators burning PCB liquids must meet the following criteria: 2-second dwell time at 1200±100 °C and 3 percent excess oxygen; or 1.5-second dwell time at 1600±100 °C and 2 percent excess oxygen in the stack gas. Combustion efficiency must be at least 99.9 percent. Once operation conditions have been met, the destruction and removal efficiency must be no less than 99.9999 percent. Commonly available incineration technologies in the U.S. include liquid injection, rotary kiln, multiple hearth, fluidized bed, and coincineration. Liquid injection systems are widely used because of low capital, operation, and maintenance costs. Disadvantages of this method

[22] H.M. Freeman, Ed., *Standard Handbook of Hazardous Waste Treatment and Disposal* (McGraw-Hill, New York, 1988).

include clogging of feed nozzles and high sensitivity to waste-heating values. Rotary kiln systems can incinerate several kind of wastes simultaneously, but they are expensive and require skilled operators. Cement kiln systems may also be used to destroy PCBs. However, public and workers' acceptance should be considered. Mobile incinerators for use from a trailer or a ship are also available.[23]

PCBs in concentrations between 50 and 500 ppm may be burned in a high-efficiency boiler. The boiler must meet the following criteria:

- It must be rated at a minimum of 14.6 MW (50 million Btu/h).
- For gas- or oil-fired boilers, CO concentration in the flue gas must be less than 50 ppm.
- For coal-fired boilers, the CO concentration in the stack cannot exceed 100 ppm.
- Excess oxygen must be at least 3 percent.
- The waste cannot exceed 10 percent by volume of the total fuel fed to the boiler.
- Waste can only be fed into the boiler when it is at operating temperature.
- Specific process-monitoring and operating procedures must be followed.

(5) Landfill: Landfilling wastes with concentrations of PCB less than 50 mg/L is not regulated, but hazardous waste landfill is recommended. PCBs in concentrations of more than 500 mg/L may not be landfilled. Landfilling PCBs between 50 and 500 ppm requires USEPA approval with stringent technical provisions to prevent migration and leaching.

(6) Other methods: Innovative treatment methods include microbiological treatment, ultrasonic radiation, plasma system, catalytic oxidation, catalytic hydrogenation, hydrothermal decomposition, and photodegradation. Detailed discussion of these technologies is beyond the scope of this report.

c. Proposed strategy

(1) Discussion: The concept of PCB management differs among the three nations. The USEPA distinguishes three different concentration categories and prohibits mixing of the three types of waste. The Japanese Government enforces removal of transformers labelled as containing PCBs. The Korean Government does not have implementation regulations for the use of PCB transformers.

At present, the USFJ are pursuing a one-time waiver from the USEPA's PCB import ban. However, it should be noted that such waivers are only stopgap measures.

The Japanese Government does permit an export of the USFJ's PCB transformers with less than 50 mg/L to a third country. However, the USFJ may not wish to export items to a third country for disposal since the action may present a negative image.

It should be noted that the 0.003 mg/L of PCB standard in Japan is based upon limits for wastewater treatment plant effluent, which requires different standards from those for transformers used in an enclosed manner. The limitations on transformers should be different from those for wastewater, and should balance with other hazardous waste limitations, which are based on risk assessment. The Korean standard for PCB is also 0.003 ppm in extracted solution. It appears that the Japanese and Korean standards were

[23]H.M. Freeman.

based on the detection capability limitation at the time of the enactment of the standards. In the near future, the USEPA will propose 0.5 ppb (0.0005 mg/L) of PCB as the maximum contaminant level in drinking water.[24] In this case, the USEPA has also used the current analytical detection limit as the criterion, rather than a health risk assessment. USARJ installations have noted that new Japanese transformers exceed the PCB concentration of 0.003 ppm. (One contained 17 ppm.)

Again, the criterion of 0.003 ppm is not appropriate for PCB transformers. Transformers at USARJ installations contain lower concentrations of PCBs than Japanese PCB transformers. Moreover, the transformers in the U.S. Army storage would not have been classified as PCB items were they in Japanese facilities. Furthermore, it should be noted that the TSCA limitation of 500 ppm is a criterion determined by policy. U.S. and Japanese standards are created on different bases, with different assumptions. It is difficult to judge which limitation is better.

Based on a preliminary evaluation of alternatives in section 2 above, the most feasible in-country disposal methods are incineration, for PCB more than 500 ppm, and use of a high-efficiency boiler, for PCBs with a concentration of 500 ppm or less.

(2) Recommendations: Japanese and Korean PCB regulations should be complied with. New transformers bought from Japanese or Korean manufacturers should be used in a totally enclosed manner. Neither the USEPA nor host governments require subsequent PCB testing for locally manufactured transformers. In-house rebuilding and interior repair of transformers should be prohibited. The DRMO should dispose of unserviceable transformers in accordance with Japanese or Korean procedures. One option is to lease transformers from the Korean or Japanese Government, or a Korean or Japanese Company.

Two technical committees (one for Korea and one for Japan) should be formed to establish a strategy for the disposal of existing PCB transformers. For each committee, members will include host country representatives, MACOM and installation representatives, USEPA and private experts on PCB disposal, and a USACERL coordinator. The committee will compile information on the current PCB disposal technologies, actual operation data, and facility availability in the host country. Members will visit U.S. facilities to discuss the issue with national experts. Based on the information available, the committees will assess the risk of in-country disposal and make recommendations on the best methods of compliance with host country regulations.

3. Waste Solvents

a. Background: Solvent cleaning and degreasing operations can be categorized as: (1) cold cleaning (solvent application either by brush or dipping), (2) vapor degreasing (used for the high flashpoint chlorinated hydrocarbons such as 1,1,1-trichloroethane or methylene chloride, in the vapor phase, to clean metallic surfaces, and (3) precision cleaning (cleaning of workpieces prior to application of final surface coatings). Solvent has a great recycling potential with little capital and operation costs.

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[24] Personal communication with Mr. Khanna, Criteria and Standards Division, USEPA (June 1990).

b. Minimization technologies

(1) Segregation: Without segregation, no effective recycling and management of wastes are expected. Especially in EUSA installations, the need for segregation cannot be exaggerated. Before Korean environmental regulations are enforced, the current practice of mixing wastes with slop oil must be stopped.

(2) Substitution: Alternatives to chlorinated solvents include alkaline cleaners and high pressure hot water washer. Flammable petroleum distillate (PD) Type I can be substituted with PD type II.

(3) Reuse and recycling: High quality solvents once used for precision cleaning can be reused for cleaning other items requiring less purity. Distillation and condensation is a very effective process to recycle solvents.

(4) Process and equipment modification and good housekeeping: small modifications can result in hazardous waste minimization. Techniques include: (1) covering all solvent cleaning units, (2) using refrigerated free board on vapor degreaser units, and (3) improving draining before and after cleaning (Freeman, Table 5.1.3). Randolph (1989) details solvent minimization methods.[25]

c. Proposed strategy: The EUSA has not actively participated in the Army's Used Solvent Elimination (USE) program because DRMR-PAC was able to sell used solvents to a Korean contractor under the slop oil contract. However, it is more economical for EUSA to recycle solvents. Furthermore, when Korean Environmental regulations are more stringently enforced, the EUSA will have to pay a disposal fee. Also, since it is more economical to recover solvent on site, it may be a good opportunity for the EUSA to start a solvent recovery program. Table 8 shows two locations where distillation systems should be installed.

**Table 8**

**Locations for Distillation Systems**

| Location | Activity | Annual Generation Volume |
|---|---|---|
| Camp Carroll | A consolidated point at Major assembly plant | total 20,380 gal |
| Bldg 327 | Major assembly plant | 13,200 gal |
| Bldg 405 | Direct support maintenance | 4000 gal |
| Bldg 658 | Tactical vehicle maintenance | 3180 gal |
| Yongsan | Consolidated point in Camp Coiner | --- |

[25] E.R. Randolph, *Solvent Waste Reduction Alternatives*, EPA/625/4-89/021, Ch. 9 (USEPA, 1989).

Payback periods for buildings 327, 425, and 658 in Camp Carroll and Yongsan consolidated point will be 1, 2.5, 3.7, and, if an individual recycling system is installed at each building, 4 years.[26] When a consolidated point is established at the major assembly plant, Camp Carroll, the payback period will be less than a year.

4. Waste oil

a. Background: Waste oil refers to lubricating oils that have gone through their intended use cycle. The USEPA estimated that 50 percent of the used oil is burned as fuel, while 30 percent is discharged to the land or sewers. In the EUSA, the Camp Humphrey waste oil plant was closed down for economic study reasons and used oil is now released to Korean contractors under a sales contract. In the USARJ, Camp Zama and Sagami Depot turn in used oil to Hakozaki Terminal. The terminal often cannot accept the used oil because of limited capacity.

b. Minimization and treatment:

(1) Combustion: 40 CFR part 266, subpart E, defines regulations for used oil burned for energy recovery. Table 9 shows used-oil fuel specifications.

The burning of used oil fuel that does not meet the specifications would be limited to high-efficiency industrial boilers, industrial process furnaces, or boilers demonstrating compliance with the performance standards for hazardous waste incinerators.

Commercial boilers demonstrate destruction efficiencies of greater than 99.9 percent for organic constituents typically found in waste oil.

Used-oil space heaters are considered to be a reasonably efficient means of disposing of waste oil generated on site. The USEPA has provided a conditioned exemption from the prohibition of burning of off-specification fuels in used oil space heaters. The referenced conditions are: (1) that the heater burn the oil generated by the facility, (2) that the heater be designed with a maximum capacity of not more than 0.5 MBtu/h, and (3) that the combustion gases vent to the ambient air.

Industrial boilers are defined as utility boilers that supply heated liquid or steam for manufacturing processes. These systems usually burn a blend of recycled used oil and virgin fuels. The USEPA may allow off-specification used oil at industrial boilers to encourage energy recovery rather than disposal.

(2) Re-refining: Currently available technologies have the capability to yield a recycled oil product with characteristics comparable to virgin lube oil. Refiners are currently not operating at system capacity due to demand for waste oil as fuel.

[26]Robert H. Salvesen, Ch. 10 p 81.

**Table 9**

**Used-Oil Fuel Specifications**

| Constituent/Property | Allowable Level |
|---|---|
| Arsenic | 5 ppm maximum |
| Cadmium | 2 ppm maximum |
| Chromium | 10 ppm maximum |
| Lead | 100 ppm maximum |
| Flash point | 100 °F minimum |
| Total halogen | 4000 ppm maximum* |

*Used oil containing more than 1000 ppm total halogens is considered a hazardous waste under the presumption that the oil is blended with hazardous wastes. Suppliers of oils in this category must demonstrate by analysis that the oil does not contain more than 100 mg/L of any one hazardous constituent.

b. Proposed strategy:

(1) The experience at Camp Humphrey indicated that a Korea-wide collection of waste oil may not be economical. However, small systems to burn near the waste oil generation site will be economical.

(2) Waste oil should be used as fuel within the installation that generates the waste. Used-oil space heaters and blenders will be provided at several locations for demonstration purposes. USACERL should be tasked to provide technical assistance.

5. Waste batteries and antifreeze solution

a. Background: Not all installations have battery acid neutralization systems. Because DRMOs in Japan and Korea require draining of sulfuric acid before turning in lead batteries, there is potential that battery acid may be emptied into the sewer system. Paragraph D. d. of the DRMS Manual 6050.1, *Environmental Compliance for the DRMS Hazardous Property Program* (February 1990), states:

> (1) The liquid electrolyte in most storage batteries (most notably sulfuric acid in automotive batteries) is hazardous because it is corrosive. The DRMO will accept physical custody of undrained, unserviceable lead acid and nickel cadmium batteries, provided:
>
> (a) The DRMO has adequate space and material handling equipment available.
> (b) The batteries are nonleaking.

(c) If pallets are used, batteries are secured using nonmetallic strapping material and are not stacked more than two layers high.

Undrained, unserviceable lead acid batteries can withstand long periods of storage at 20 °F (-7 °C).

Commercial systems for recycling antifreeze are available, yet none are currently used on either EUSA or USARJ installations. In the absence of an antifreeze recycling systems, after coordination with the Utilities Division or the Sanitation Branch Chief, antifreeze solution may be discharged into a sewer system instead of being collected into a used-solvent containers.

b. Recommendations:

(1) The EUSA and USARJ environmental offices should petition to DRMOs to gain approval for activities to turn in lead acid batteries without draining sulfuric acid, in accordance with DRMS policy.

(2) Antifreeze should be discharged into the sewer system.

(3) Antifreeze recycling should be considered.

(4) Battery acid recycling snould also be considered.

6. Depainting (sandblasting) waste

a. Background: A USATHAMA report[27] discusses the advantages of abrasive blasting. Plastic media blasting (PMB) is a relatively new process to replace chemical stripping of military aircraft. PMB eliminates hazardous chemicals and effectively reduces manpower requirements. However, cost effectiveness and hazardous waste reduction potential of PMB is not competitive with aggressive media such as sand and alternative low silica minerals. Because of the low cost, the aggressive media is recycled little, if at all. As a result, the spent media has a low heavy metal concentration and is not considered a hazardous waste, so the disposal costs are low even though the volume is large. Despite the USATHAMA description, the DRMO, Bupyong still disposes of sand wastes from Camp Carroll as hazardous waste. This was done based on USAEHEA's Extraction Procedure Analysis results, which showed an excess of lead and chromium over standards. USACERL tests have also demonstrated that the waste sand is hazardous waste based on the RCRA standards for lead and chromium. Article 2 of the Korean Waste Management Law defines waste sand as general industrial waste and allows landfilling of this waste.

b. Recommendation

(1) Further research should determine the sources of high levels of lead and chromium in sandblasting waste.

(2) In the future, PMB should be considered as a replacement for sand. Even though Camp Carroll generates about 100 tons of waste sand annually, PMB waste volume will be very small because PMB can be recycled.

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[27] *Implementation of Plastic Media Blasting (PMB) at U.S. Army Depots*, Draft Report prepared for the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) by Arther D. Little, Inc. (1988).

# 4 CONCLUSIONS AND RECOMMENDATIONS

To explore hazardous waste minimization opportunities in EUSA and USARJ, this report has analyzed and compared regulations and requirements governing hazardous wastes for U.S. Army installations located in the United States, Korea, and Japan.

Specific hazardous waste minimization and treatment strategies recommended in this study are:

1. PCP ammunition boxes should be considered as nonhazardous material. USACERL should be tasked to coordinate a liaison with the appropriate Army organizations to draw a consensus on this concept and to declare the Army position on PCP ammunition boxes.

2. DRMOs should develop a strategy for RTDS of PCP ammunition boxes.

3. To fully comply with Korean and Japanese PCB regulations, EUSA and USARJ should use locally purchased or leased transformers in a totally enclosed manner. Individual PCB chemical testing and interior repair of the transformers are not recommended.

4. Technical committees should be formed to evaluate in-country disposal of existing PCB items in EUSA and USARJ and to recommend the best available disposal methods that comply with host country standards.

5. Used oil and waste solvents should be segregated at the source.

6. Distillation systems should be installed at two locations, in Camp Carroll and Yongsan Garrison, to recycle waste solvents.

7. Burning of used oil in custom-made space heaters should be tested and demonstrated in EUSA and USARJ installations.

8. Lead acid batteries should be turned in to DRMO based on DRMS' guidance (sulfuric acid should not be drained before turn-in). Battery acid recycling should be considered.

9. Spent antifreeze should be reclaimed. Until installations obtain antifreeze recycling systems, antifreeze should be discharged into the sewer system in EUSA.

10. Plastic media blasting may replace sandblasting to allow for the recycling of the aggressive medium.

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## APPENDIX A:

## INFORMATION FROM THE KOREAN MINISTRY OF ENVIRONMENT

CECER-EN (340a)

MEMORANDUM FOR RECORD

SUBJECT: HW discussion with EA

1. In order to compile the host country hazardous waste management requirements, I met Mr. Sea-Pyong Kim, Chief, Industrial Waste Management Division; Mr. Hack-Yop Kim, a Section Chief of the Division, ROK Environment Administration, at the Division Office from 14:00 through 16:00 hour, 8 Sept 89.

2. Major items of discussion are summarized as follows:

a. The purpose of my visit to EUSA is to exploit the hazardous waste minimization opportunities for EUSA and USARJ installations. I have not noticed any environmental compliance problem in EUSA. However, FEAK by its own initiative considers improving the hazardous waste management system to more effectively manage the hazardous wastes by using CERL expertise in FY90 and 91. For both my current and future works, I need to discuss with them the Korean hazardous waste requirements.

b. Question: What are hazardous waste regulations?

Answer: They are Waste Management Act, President's Implementation Order, Implementation Regulations.

c. Question: What are hazardous wastes in Korea?

Answer: They consist of special industrial wastes and general industrial wastes. The classifications can be found in Appendix 1 of Waste Management Implementation Regulations.

d. Question: The U.S. Army is not an industry. Do we still have to comply with the industrial wastes regulations?

Answer: Yes, the U.S. Army has to comply with the industrial wastes regulations if any hazardous wastes exit from the U.S. Army physical boundary lines.

Note: This answer implies that Korean Government does not want to perform on-base inspections of EUSA activities.

e. Question: What are acceptable hazardous waste disposal methods in Korea?

Answer: See the attached chart. Generator's own treatment and disposal is preferred method. However, generators can hire their own contractors to treat/dispose or recycle the wastes. The contractors should have valid Korean Environment Administration permits for their activities.

f. Question: What are acceptable hazardous waste analyses methods?

Answer: Korean standard methods address analyses procedures and requirements. Recommend that EUSA use Korean Environment Administration approved laboratories.

g. Question: Is sandblast waste classified as a general industrial waste?

Answer: It can be regarded as a waste sand generated from shipping and metal casting industries. Therefore, it is a general industrial waste.

h. Question: What are labeling and placarding requirements for hazardous wastes?

Answer: Korean Toxic Substance Act and Dangerous Property Handling Act govern the requirements. Undersigned suggested that both English and Korean signs be posted on the hazardous waste containers exiting from U.S. Army installations. The suggestion is acceptable to Environment Administration.

i. Question: Can EUSA use the Korea Environmental Management Corporation (EMC)?

Answer: Yes.

Note: EMC is an ROK owned and operated hazardous waste disposal company.

j. Question: Can PCP ammo boxes be disposed of at an EMC incinerator? Why not?

Note: Mr. Sea-Pyong Kim's predecessor promised to permit EUSA's PCP ammo boxes at the EMC's Whaseong plant when completed.

Answer: Since the Whaseong plant is in operation, Environment Administration can consider the disposal of PCP boxes there. There are still some technical questions and expect a meeting with COL Cooper, new ----/EUSA JAG. My comments " I'll provide any technical assistance if needed. I'll be able to contact the USEPA Combustion Research Laboratory if necessary. It had conducted PCP box incineration study for EUSA. I pointed out that monitoring of ashes and emissions for every burying would not be practical and suggested that combustion loading be determined under the practical combustion condition and a regular quality assurance program be developed.

k. Environment Administration recommended that EUSA use Environment Administration approved contractors for waste disposal and reutilization.

l. Question: Do you have storage time limitations for generators?

Answer: No: However, a disposal facility has to dispose of hazardous wastes within 90 days.

m. Question: What is the generator's liability after hazardous wastes are turned in to an Environment Administration permitted disposal contractor?

Answer: None. However, quality assurance program may be needed.

BYUNG KIM, P.E., Ph.D.
Environmental Engineer,
CERL

cf: COL Kane, Commander, FEAK
Dr. Hartman

**APPENDIX B:**

**HAZARDOUS MATERIAL DATA**

Hazardous Material Issued to Directorate for Supply and Transportation U.S. Army Material Support Center, Korea, Camp Carroll In FY88

| NSN | Nomenclature | Haz Waste Characteristic, if Disposed of |
|---|---|---|
| Paints | | |
| 8010 00 079 3750 | Spray, Silver | "I" |
| 8010 00 111 8069 | Enamel, Alkyd, Camo Olive Drab | "I"; Cr, Pb pigment |
| 8010 00 111 8356 | Enamel, Alk, Camo, Blk | "I"; Pb pigment |
| 5610 00 141 7838 | Walkway Compound | "I" |
| 8010 00 160 5852 | Varnish | "I" |
| 8010 00 165 4420 | Varnish, Int Floor | "I" |
| 8010 00 165 8573 | Primer, Red, Lead | "I"; Cr, Pb pigment |
| 8010 00 165 8574 | Primer, Red | "I"; Cr, Pb pigment |
| 8010 00 165 8627 | Stain, Mahogany | "I" |
| 8010 00 166 0746 | Stain, Lt Oak | "I"; "T" (MEK) |
| 8010 00 264 5837 | Paint, Olive | "I"; "T" (MEK) |
| 8010 00 281 2072 | Stain, Dk Oak | "I"; "T" (MEK) |
| 8010 00 281 2075 | Stain, Dk Mahogany | "I" |
| 8010 00 286 7744 | Enamel, White, In/Ex | "I"; Pb pigment |
| 8010 00 286 7758 | Enamel, Alkyd, Gloss Yellow | "I"; Cr, Pb pigment |
| 8010 00 291 0599 | Paint, White, Int | "I" |
| 8010 00 297 0547 | Paint, Black | "I" |
| 8010 00 297 0585 | Paint, Yellow | "I"; Cr, Pb pigment |
| 8010 00 297 0589 | Enamel, Alkyd, Black | "I" |
| 8010 00 297 0593 | Enamel, Yellow, Zinc-Chromate | "I"; Cr pigment |
| 8010 00 298 2298 | Enamel, LtGray 16376 | "I" |
| 8010 00 298 3862 | Enamel, Alkyd, Black | "I" |
| 8010 00 527 2045 | Enamel, Yellow, 13538 | "I"; Cr, Pb pigment |
| 8010 00 527 2050 | Enamel, Alkyd, Black | "I" |
| 8010 00 527 3194 | Enamel, Green | "I" |
| 8010 00 527 3198 | Enamel, Alkyd, Red | "I" |
| 8010 00 527 3199 | Enamel, Red for Ext | "I"; Pb pigment |
| 8010 00 530 5565 | Enamel, Gray | "I"; Pb pigment |
| 8010 00 584 3149 | Enamel, Spray, OD | "I"; Cr, Pb pigment |
| 8010 00 584 3150 | Lacquer, White Spray | "I" |
| 8010 00 584 3154 | Lacquer, Spray, Light Green, 14491 | "I"; "T" (MEK) |
| 8010 00 597 7858 | Enamel, Lt Green | "I" |
| 8010 00 597 7862 | Enamel, Field Drab | "I"; Pb pigment |
| 8010 00 598 5219 | Enamel, Alkyd, Blue | "I" |
| 8010 00 598 5460 | Enamel, Brown | "I"; "T" (MEK) |

| | | |
|---|---|---|
| 8010 00 598 5464 | Enamel, Olive Drab | "I"; Cr, Pb pigment |
| 8010 00 599 9201 | Walkway Cmpnd | "I" |
| 8010 00 616 7496 | Enamel, Gray | "I"; "T" (MEK) |
| 8010 00 616 9143 | Enamel, Black, Spray | "I" |
| 8010 00 616 9144 | Enamel, Flat Gray | "I" |
| 8010 00 664 4761 | Enamel, White, Gloss | "I"; Cr, Pb pigment |
| 8010 00 664 7081 | Enamel, Green, Blkbrd | "I"; Cr, Pb pigment |
| 8010 00 702 1053 | Lacquer, Yellow, Camo | "I"; Cr pigment (?) |
| 8010 00 721 9479 | Enamel, Orange, Spray | "I" |
| 8010 00 721 9742 | Lacquer, Brwn, Spray 10075 | "I"; "T" (Methylene Chloride) |
| 8010 00 721 9743 | Lacquer, Red, Spray | "I" |
| 8010 00 721 9751 | Lacquer, Aluminum | "I" |
| 8010 00 782 5556 | Deck-Covering Cmpd | "I" |
| 8010 00 782 9356 | Enamel, Flat White | "I" |
| 8010 00 815 2692 | Paint, Aluminum | "I" |
| 8010 00 899 8825 | Coating, Primer, Grn | "I"; Cr pigment |
| 8010 00 900 3650 | Paint, DOT Yellow | "I"; Pb pigment |
| 8010 00 926 2153 | Filler | "I" |
| 8010 00 965 2391 | Enamel, Gray | "I" |
| 8010 00 988 1458 | Enamel, Alkyd, Blue | "I" |
| 8010 01 123 9278 | Enamel, Forest Green | "I"; Pigment (?) |
| 8010 01 193 0516 | Primer, Epoxy CARC | "I"; MIK |
| 8010 01 229 7540 | Coating, Aliph, Polymer Black, CARC | "I"; MIK, xylene, toluene |
| 8010 01 229 7543 | Coating, Brwn, CARC | "I"; MIK, xylene, toluene |

## Coatings

| | | |
|---|---|---|
| 8030 00 244 1299 | Corrosion Prev | Cr pigment |
| 8030 00 252 8301 | Corrosion Prev (Stoddard Solv Type I) | "I" |
| 8030 00 526 1605 | Corrosion Prev | "I" |

## Solvents and Thinners

| | | |
|---|---|---|
| 8010 00 160 5788 | Thinner, Dope & Lac | "I" |
| 8010 00 160 5794 | Thinner, Enamel | "I" |
| 8010 00 160 5800 | Remover, Paint | "I"; "T" (Methylene Chloride) |
| 6810 00 184 4800 | Trichloroethylene | "T" |
| 6850 00 224 6663 | Cleaner, Bore | "I" |
| 8010 00 242 2089 | Thinner, Paint | "I" |
| 8010 00 558 7026 | Thinner, Paint | "I" |
| 8010 00 597 8234 | Remover, Paint, Slvnt | "I"; "T" (Methylene Chloride) |
| 6850 00 823 7861 | Fluid, Engine Start | "I" |
| 6850 00 926 2275 | Cmpnd,Clning,Windshld | "I" |

Corrosives

| | | |
|---|---|---|
| 6810 00 249 9354 | Electrolyte, DF-2 | "C" (Sulfuric Acid Spent electrolyte from Pb-acid btrys may contain Pb |
| 6810 00 255 0472 | Calcium Hypochlorite | |
| 6850 00 551 9577 | Corrosion Remover | "C" (Phosphoric Acid) |
| 6850 00 656 1291 | Corrosion Remover | "C" (Phosphoric Acid) |

NOTES:

1. "I" - Ignitable, Flash Point less than 140°F
   "T" - Toxic, either listed as such, or could fail EP Toxicity Test.
   "C" - Corrosive, Ph less than or equal to 2 or greater than 12.5

2. The following components are listed as hazardous wastes in 40 CFR 261.33(e) and (f):
   a. MEK - Methyl ethyl ketone; HW No. U159
   b. TCE - Trichloroethylene; HW No. U228
   c. MIK - Methyl isobutyl ketone; HW No. U161
   d. Methylene Chloride; HW No. U080
   e. Toluene; HW No. U220
   f. Xylene; HW No. U239

3. All paints with pigments containing Chrome (Cr) and/or Lead (Pb) may or may not be a hazardous waste as dried pigment. Each dried pigment must be subjected to the TCLP Test before it can be disposed of to determine if the pigment is hazardous.

4. All of the materials listed as possible hazardous wastes solely because of the category "I" are hazardous only because of the flammability of the solvent system in the material. The dried or cured product is not a hazardous waste, such as dried paint residues in cans.

Hazardous Material Issued to Directorate of Maintenance U.S. Army Material Support Center, Korea, Camp Carroll in FY88

| NSN | Nomenclature | Haz Waste Characteristic, if Disposed of |
|---|---|---|
| **Paints** | | |
| 8010 00 067 5434 | Primer | "I"; Pb pigment |
| 8010 00 079 2570 | Enamel | "I" |
| 8010 00 079 3754 | Enamel | "I"; "T" (MEK) |
| 8010 00 082 2439 | Epoxy Coating | "I" |
| 8010 00 082 2450 | Primer Coating (many formulae) | "I"; Cr, Pb pigment |
| 8010 00 087 0102 | Enamel | "I" |

| | | |
|---|---|---|
| 8010 00 111 7943 | Enamel | "I"; Cr, Pb pigment |
| 8010 00 111 7988 | Enamel | "I"; Pb pigment |
| 8010 00 111 8005 | Enamel | "I"; Pb pigment |
| 8010 00 111 8129 | Enamel | "I"; Cr, Pb pigment |
| 8010 00 111 [illegible] | Enamel | "I"; Pb pigment |
| 8010 00 118 2456 | Epoxy Coating | "I"; (KT not defined) |
| 8010 00 141 2952 | Lacquer | "I" |
| 5610 00 141 7838 | Walkway Compound | "I" |
| 8010 00 142 9279 | Primer Coating (many formulae) | "I"; Cr, Pb pigment |
| 8010 00 160 5852 | Varnish | "I" |
| 8010 00 161 5718 | Primer Coating | "I"; Cr, Pb pigment |
| 8010 00 161 7275 | Primer Coating | "I"; Cr, Pb pigment |
| 8040 00 165 8614 | Adhesive | "I" |
| 8010 00 168 8810 | Varnish | "I" |
| 8010 00 244 1299 | Corrosion | "I"; Cr pigment |
| 8010 00 246 6443 | Turpentine | "I" |
| 8040 00 275 8100 | Adhesive | "I" |
| 8010 00 286 7748 | Enamel | "I"; Cr, Pb pigment |
| 8010 00 286 7758 | Enamel | "I"; Cr, Pb pigment |
| 8010 00 286 7839 | Enamel | "I" |
| 8010 00 290 6983 | Lacquer Trichloroethane) | "I"; "T" (1,1,1- |
| 8010 00 290 6984 | Black Spray | "I" |
| 8010 00 297 0553 | Enamel | "I"; Cr, Pb pigment |
| 8010 00 297 0547 | Enamel | "I" |
| 8010 00 297 0584 | Enamel | "I"; Cr, Pb pigment |
| 8010 00 297 0585 | Enamel | "I"; Cr, Pb pigment |
| 8010 00 297 0586 | Enamel, Olive Drab | "I"; Cr, Pb pigment |
| 8010 00 297 0589 | Enamel | "I" |
| 8010 00 297 0591 | Enamel | "I"; Pb pigment |
| 8010 00 297 2012 | Enamel | Probably "I",no Data |
| 8010 00 298 2287 | Enamel | "I"; "T" (MEK) |
| 8010 00 298 2296 | Enamel | "I"; Cr, Pb pigment |
| 8010 00 298 2298 | Enamel | "I"; Pb pigment |
| 8010 00 298 3859 | Enamel | "I"; Cr, Pb pigment |
| 8010 00 515 0800 | Enamel | "I"; Cr, Pb pigment |
| 8010 00 515 2208 | Enamel | "I"; Cr, Pb pigment |
| 8010 00 515 2211 | Primer Coating | "I"; Cr, Pb pigment |
| 8010 00 527 2045 | Enamel | "I"; Cr, Pb pigment |
| 8010 00 527 2050 | Enamel | "I" |
| 8010 00 527 3197 | Enamel | "I"; Cr, Pb pigment |
| 8010 00 527 3198 | Enamel | "I" |
| 8010 00 527 3202 | Enamel | "I" |
| 8010 00 530 5565 | Enamel | "I"; Pb pigment |
| 8010 00 577 4225 | Enamel | "I" |
| 8010 00 582 5382 | Lacquer | "I"; "T" (MEK) |
| 8010 00 584 3149 | Lacquer,Olive Drab | "I"; Cr, Pb pigment |
| 8010 00 584 3154 | Lacquer | "I"; "T" (MEK) |
| 8010 00 598 5052 | Enamel | "I" |
| 8010 00 616 0015 | Enamel | Probably "I", [illegible]ta |

| | | |
|---|---|---|
| 8010 00 616 7488 | Enamel | "I"; Cr, Pb pigment |
| 8010 00 616 7496 | Enamel | "I"; "T" (MEK) |
| 8010 00 616 9144 | Enamel | "I" |
| 8010 00 664 4761 | Enamel | "I"; Cr, Pb pigment |
| 8010 00 664 5678 | Aluminum Coating | "I" |
| 8010 00 664 7105 | Coating Compound | "I" |
| 8010 00 664 7468 | Heat Resistent Paint | "I" |
| 8010 00 721 9743 | Red Spray Paint | "I" |
| 8010 00 721 9744 | Lacquer | "I";Cr(?),Pb pigment |
| 8010 00 721 9751 | Lacquer | "I" |
| 8010 00 843 3461 | Adhesive | "I" |
| 8010 00 878 5761 | Lacquer | "I"; Cr pigment |
| 8010 00 899 8825 | Primer Coating | "I"; Cr pigment |
| 8010 00 900 1622 | Enamel | "I" |
| 8010 00 901 1059 | Enamel | "I"; Cr, Pb pigment |
| 8010 00 901 1061 | Enamel | "I"; Cr, Pb pigment |
| 8010 00 943 7128 | Paint Remover (Lots of formulae) | "I"; Cr, Chlorinated "T" Hydrocarbons |
| 8010 00 023 4261 | Polyurethane | "I"; "T" (MEK), Cr Pb |

<u>Thinners</u>

| | | |
|---|---|---|
| 8010 00 162 5289 | Thinner | "I" |
| 8010 00 181 8079 | Thinner | "I"; "T" |
| 8010 00 181 8080 | Thinner | "I" |
| 8010 00 558 7026 | Thinner | "I" |
| 6850 00 584 4070 | Xylene | "I" |

<u>Solvents</u>

| | | |
|---|---|---|
| 6850 00 285 8012 | Solvent, Dry Cleaning, Type II | Only Type I is a HW (FP<140 F) |

<u>Oils</u>

| | | |
|---|---|---|
| 6850 00 141 2946 | Coating Cmpd Oxid (63%NaOH, 33%$Na_2NO_3$) | "C" |
| 6810 00 551 1487 | 1,1,1-Trichloroethane | "T"; Listed |
| 6810 00 664 0387 | 1,1,1-Trichloroethane | "T"; Listed |
| 6850 00 823 7861 | Fuel, Engine (90% diethyl ether) | "I" |

<u>Battery Acid</u>

| | | |
|---|---|---|
| 6810 00 249 9354 | Battery Acid($H_2SO_4$) | "C"; Pb if used in lead-acid batteries |

NOTES:

1. The following components are listed as hazardous wastes in 40 CFR 261.33(e) and (f):

   a. MEK - Methyl ethyl Ketone; HW No. U159

b. 1,1,1-Trichloroethane; HW No. U226
c. Xylene; HW No. U239

2. All paints with pigments containing Chrome (Cr) and/or Lead (Pb) may or may not be a hazardous waste as dried pigment. Each dried pigment must be subjected to the EP Toxicity Test before it can be disposed of to determine if the pigment is hazardous.

3. All of the materials listed as possible hazardous wastes solely because of the category "I" are hazardous only because of the flammability of the solvent system in the material. The dried or cured product is not a hazardous waste, such as dried paint residues in cans.

**APPENDIX C:**

**WASTE OIL/SLOP OIL GENERATION**
**USAMSC-K AND CAMP CARROLL**

| Organization | Unit Est* (gal/yr) | FY 87 (gal/yr) | FY 88 (gal/yr) | FY 89 (gal/yr) (to Apr19) |
|---|---|---|---|---|
| USAMSCK | | | | |
| Dir for Maint | -- | -- | 1,200 W | -- |
| 1. Heavy Equip Div | 12,000 W<br>1,200 S | 4,050 W<br>(See PCD) | 1,375 W<br>3,205 S | 3,905 W<br>1,155 S |
| 2. Maj Assbly Div | 12,000 W<br>24,000 S | (See PCD) | 3,410 W<br>9,880 S | 5,895 W<br>5,720 S<br>3,630 ? |
| 3. Prod Control Div | -- | no data W<br>21,000 S | 150 W<br>16,375 S | no data |
| 4. Spec Shops Div | 1,380 W<br>1,620 S | (See PCD) | no data | 220 S |
| Dir for Sup & Trans | | | | |
| 1. Care & Pres Div | 9,600 W<br>9,600 S | 3,400 W<br>750 S | 7,100 W<br>1,350 S | 1,49[illegible]<br>W+S |
| Dir for Trans | | | | |
| 1. TMP | 6,000 W<br>2,400 S | (See PCD) | no data W<br>2,350 S | 1,870<br>W+S<br>660 ? |
| 2. MHE | 1,200 W<br>600 S | (See PCD) | (See PCD) | no data |
| Associated Units and Supporting Activities | | | | |
| Dir of Ret Supply & Maint - 20 TH ASG | | | | |
| 1. Coll/Reclam Br | -- | 950 S** | 400 S | 1,100 S |
| 2. POL Br | -- | 900 S | no data | no data |
| 3. Dir Spt Maint | -- | no data | | 1,650 W<br>165 S<br>495 ? |
| 46th Trans Co | 3,000 W<br>3,600 S | 2,000 W<br>--- | 850 W<br>935 S | 365 W<br>100 S<br>375 ? |

| | | | | |
|---|---|---|---|---|
| 307th Sig Bn | 1,200 W | no data | 920 W | no data |
| 802nd Engr Bn ("D" Co) | -- / -- | 900 W / no data | 500 W / 385 S | 330 W+S |
| 20th QM Co (PDSK) (Waegwan) | -- | 100 W / 55 S | 20 W / 200 S | 715 W+S |
| Total Waste Pol | 89,400 (Unit Est) | 34,105 | 50,605 | 29,845 (6 months) |

Units Generating Waste Pols But Not Recorded on DEH Pickup Vouchers

1. 6th MEDSOM - Started operation in FY 89. Generates only small quantities of waste oil. Have had no pickup in FY 89.

2. 260th MP Co - Estimated waste POLs at 100 gal/yr waste oil and 20 gal/yr slop oil. Prior to FY 89 had been turning waste POLs in to someone else's collection point for pickup. Have had no pickup in FY 89.

Notes:

* - Unit estimates were provided to the Camp Carroll DEH waste oil/slop oil pickup contract representative in July 88 in order for DRMS, Bupyong to prepare a Korea-wide consolidated waste POL disposal contract which went into effect in FY 89.

** - Although the contractor designated the POLs as slop oil, the waste POLs are almost entirely the draining from transmissions, crankcases and radiators from vehicles turned into what is essentially the installation junk and cannibalization yard.

W - Waste Oil is defined as contaminated diesel fuel, used transmission oil, used crank case oil, and other fuels, lubricants and hydraulic fluids suitable for purification and blending for heating fuel. This category of waste POLs was established to allow for heat recovery from these waste POLs at the Camp Humphreys heating plant. This disposal/reuse method was discontinued in mid-FY 88 because it was not cost-effective.

S - Slop Oil is defined as gasoline, reject fuels, synthetic solvents, paint thinners, alcohols, and other non-mineral based lubricants that could not be used in the heat recovery plant at Camp Humphreys.

? - The gallons of waste POLs in this category were not marked as either waste or slop oil on the contractor's pickup vouchers.

1. Since the implementation of the new Waste POL Disposal Contract in FY89, segregation of waste oils from slop oils is no longer required. Some units continue to segregate out of habit, while others now consolidate all their waste POLs.

2. Prior to FY 87 most of the waste POLs at Camp Carroll were collected in a central location (PCD) prior to pickup, so unit generation rates are not available. The Production Control Division is strictly a management operation and has no operational activities, such as maintenance. Unit pickup points have been established since FY 87. Camp Carroll has undergone many changes in tenant units and in operations. Waste POL generation rates reflect the changing mission and operations of the installation.

3. The data for this compilation was taken from vouchers submitted by the waste POL pickup contractor to the DEH contract representative at Camp Carroll and from interviewing personnel at individual units.

## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ASG | Area Support Group |
| CARC | Chemical agent resistant coating |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| $CL_2$ | Chloride |
| CONUS | Continental United States |
| CWP | Contaminate Waste Processor |
| DA | Department of the Army |
| DCS | Deputy Chief of Staff |
| DEH | Directorate of Engineering and Housing |
| DFE | Directorate of Facilities Engineering |
| DLA | Defense Logistics Agency |
| DOD | Department of Defense |
| DOM | Director of Material |
| DOT | Department of Transportation |
| DPDO | Defense Property Disposal Officer |
| DRMS | Defense Reutilization and Marketing Service |
| EUSA | Eighth U.S. Army |
| FEAK | Facilities Engineering Activities, Korea |
| FSC | Federal Supply Classes |
| GAO | Government Accounting Office |
| HCL | Hydrochloric acid |
| HSWA | Hazardous and Solid Waste Amendments (1984) |
| HW | Hazardous waste |

| | |
|---|---|
| KEPCO | Korean Electric Power Corporation |
| MACOM | Major Command |
| MOE | Korean Ministry of environment |
| MT | Japanese Ministry of Trade and Industry |
| OASD | Office of the Secretary of Defense |
| OPMO | Ordinance of the (Korean) Prime Minister's Office |
| OTA | Office of Technology Assessment |
| PCB | Polychlorinated biphenyls |
| PCDD | Polychlorinated dibenzodioxines |
| PCDF | Polychlorinated dibenzofurans |
| PCE | Perchloroethane |
| PCP | Pentachlorophenyls |
| PD | Petroleum Distillate |
| PMB | Plastics Media Blasting |
| RCRA | Resource Conservation and Recovery Act (1984) |
| RTDS | Reutilization, Transfer, Donation, and Sale |
| SARA | Superfund Amendments and Reutilization Act |
| SOFA | Status of Forces Agreement |
| SQG | Small Quantity Generator |
| TCLP | Toxicity Characteristic Leaching Procedure |
| TSCA | Toxic Substance Control Act |
| TSD | Treatment, Storage, and Disposal |
| USAEHA | U.S. Army Environmental Hygiene Agency |
| USAMSC-K | U.S. Army Materiel Support Center, Korea |
| USAPEHEA | U.S. Army Pacific Environmental Health Engineering Agency |

| | |
|---|---|
| USARJ | U.S. Army, Japan |
| USARJ/J4 | U.S. Army, Japan (Logistics) |
| USATHAMA | U.S. Army Toxic and Hazardous Material Agency |
| USEPA | United States Environmental Protection Agency |
| USFJ | U.S. Forces, Japan |
| UST | Underground Storage Tank |

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