USAFOEHL REPORT

88-067EQ0165DSC

Wastewater Characterization and Hazardous Waste Survey Reese AFB TX

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April 1988

Final Report

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USAF Occupational and Environmental Health Laboratory
Human Systems Division (AFSC)
Brooks Air Force Base, Texas 78235-5501

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The USAFOEHL conducted a wastewater and hazardous waste characterization survey from 21 to 30 September 1987 at Reese AFB, Lubbock County, Texas. The scope of the survey included the characterization of the wastewater exiting the main oil-water separator, entering and exiting the sewage treatment plant into the sewage lake, in the industrial lake, and from 19 points in the sanitary and storm sewer system. Hazardous waste management surveys were conducted at 28 locations generating or accumulating potentially hazardous waste.

Priority pollutants were found in the sanitary and storm system, in the surface impoundments and in a septic system. Apparently all industrial discharges containing hazardous constituents have not been eliminated from the sanitary and stormwater systems. Priority pollutants found in the influent of the sewage treatment plant and in

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the sewage lake were not significant in nature or concentration. Pretreatment and removal of hazardous constituents from the wastewater will be required if the hazardous material cannot be prevented from entering the wastewater stream.

The hazardous waste management program was deficient in several areas, such as insufficient hazardous waste management training, lack of baseline analytical data, inadequate segregation of wastes prior to containerization, inadequate hazardous waste accumulation sites, and lack of documentation at the shop level concerning amounts and types of wastes generated.

Recommendations included: (1) eliminating all hazardous constituents from entering the sanitary or storm water system, (2) routing shop drains to the sanitary sewer and upgrading the sewage treatment system, (3) installing positive controls in shop drains near operations involving hazardous waste to prevent any from entering the sewer, (4) implementing a waste management training program, (5) upgrading hazardous waste accumulation sites, and (6) increasing the amount of hazardous waste testing.

ACKNOWLEDGEMENTS

The authors greatly appreciate the technical expertise and hard work provided by the other members of our survey team, 1Lt Bob Tetla, 2Lt Charlie Attebery, 2Lt Tony Zimmer, SSgt Mary Fields and Sgt Roberto Rolon, without whose valuable assistance this survey could never have been accomplished.

We also acknowledge SMSgt John Tice and the staff of the Bioenvironmental Engineering Section for the support given us during the survey. Thanks for making time and room for us while everything else was going on.

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I. INTRODUCTION

USAF Hospital Reese (ATC) SGPB requested the USAF Occupational and Environmental Health Laboratory assist in: (1) identification and characterization of waste streams leading to the main oil/water separator discharging to the industrial lake, (2) characterization of waste streams into the sewage treatment plant and discharge from the sewage treatment plant to the lake, (3) evaluation of existing chemical waste management practices, and (4) exploring opportunities to minimize hazardous waste generation.

The wastewater and hazardous waste characterization survey was conducted from 21 to 30 September 1987 by Lt Col Robert D. Binovi, 1Lt Francis E. Slavich, 1Lt Robert A. Tetla, 2Lt Charles W. Attebery, 2Lt Anthony T. Zimmer, SSgt Mary M. Fields and Sgt Roberto Rolon. SMS John Tice, NCOIC Bioenvironmental Engineering and Capt Michael Keller, the Environmental Coordinator were points of contact.

The scope of the survey included the characterization of the wastewater exiting the main oil/water separator, entering the sewage treatment plant in the sewage lagoon, into and exiting the industrial lagoon, and from 19 points in the sanitary and storm sewer system. Solid waste operations were surveyed at 28 operations throughout the base.

II. DISCUSSION

A. Introduction

Reese AFB is located in Lubbock County in the southern high plains region of Texas, approximately ten miles west of the city of Lubbock. The base working population was approximately 2400 military and 715 civilians. Approximately 1600 live on base.

The region surrounding Reese is semiarid and thus subject to highly variable temperatures, rainfall, and wind. During this survey the weather was pleasant with the maximum and minimum average temperatures of 78 and 54°F respectively. A total of .20 inches of rain fell during the survey.

The 64th Flying Training Wing (ATC) mission is to train top quality military pilots with the greatest efficiency and the minimum possible cost. Industrial operations stem from facility, vehicle, and T-37 and T-38 aircraft maintenance.

B. Sewerage System

The base has separate sanitary and storm drainage systems. Industrial effluent is discharged into both systems. In general, most industrial shops discharge to the storm system.

The storm system has twin oil/water separators in line before discharging to a small 35 acre playa lake. The lake serves as a water hazard for the first hole of the golf course and the base picnic area adjoins it. Water can be pumped from this industrial playa lake to the sewage effluent lake during high water conditions.

The sanitary system discharges to a 1941 Hayes Process 0.25 MGD treatment plant. Effluent from the plant is discharged to ponds connected to the 91 acre sewage treatment playa lake. Playa lakes are common disposal methods for effluent in this area, because of the fairly impermeable nature of the subsurface, high evaporation rates and high irrigation requirements. Most of the sewers feed to the plant by gravity, except for the main housing area sewer east of Spur 309, which is serviced by a lift station.

The Hayes process sewage treatment plant is one contiguous tank, consisting of standard grit chamber and comminuter, a primary settling tank, aerating tank, secondary settling tank, secondary aerating tank, a third settling tank, and chlorination basin.

The Texas Water Commission last issued a permit to dispose of wastes in the playa lakes in 1985. However, under the suspicion that hazardous wastes were being introduced into the playas, USEPA Region VI issued a Notice of Noncompliance and a Compliance Order which banned the disposal of hazardous wastes into the surface impoundments on base. EPA gave the base two options in the Compliance Order, to either "clean close" the playas by removing the standing liquid, waste and waste residue, and the underlying contaminated saturated and unsaturated soils or petition for the removed material to be delisted as a hazardous waste.

To petition to delist the material, the Base would have to demonstrate that none of the material to be removed is hazardous waste according to 40 CFR 261.3 or Subpart D of Part 261 (3). If the base's petition is denied, the closure plan must proceed, and the material must be disposed of as a hazardous waste. The base submitted a draft closure plan for both playas and coordinated with members of the Texas Water Commission. Because the interim permit status ended on 8 November 1985 Reese AFB was required to submit a closure plan. At the same time Reese AFB requested that the submission of the closure plan in no means meant that the petition to delist was being abandoned.

A Working Group, consisting of HQ ATC, USAFOEHL and base personnel met in mid July 1987 to prepare a written respose to the 23 violations contained in the EPA Notice of Noncompliance of 1 July 1987. Initially, the Ecology and Environment, Inc. Installation Restoration Program Phase II report and data from the base's monitoring programs were to be used in developing the waste analysis plan, a closure plan, and a groundwater monitoring plan.

The first priority for the base was to satisfy the compliance schedule by ending hazardous waste discharge into the industrial lake. In order to comply, the USAFOEHL Consultant Services Division was contacted to perform a hazardous waste and wastewater characterization survey.

C. Survey Procedures

1. Wastewater Characterization Survey

a. Flow - A calibrated 16" weir was installed in the outfall from the main oil/water separator into the industrial lake. The location can be seen in Figure 1. A Manning dipper was installed so that it could sense water depth behind the weir through a hole in the pipe. The dipper was calibrated at zero percent flow as water just flowed through the V-notch. One hundred percent was artificially set at 25" as this was the minimum depth that the instrument would allow to be set. A totalizer in the meter kept track of total flow.

Figure 1. Industrial Lake, Outfall From Main Oil/Water Separators

b. Sampling

(1) Sampling Site Numbers and Locations. A list of locations and type of wastewater sampling sites is included in Table 1. Approximate locations of the sampling sites are shown in Figure 2.

(2) Sampling Frequency

Five days of 24-hour equiproportional samples composited hourly were taken at Sites 1-4 for most parameters (two days of sampling for volatile and semivolatile organic compounds). A two-day 24-hour sample composited hourly was taken at site 10. Grab samples were taken at sites 6 and 18. A one-day 24-hour sample composited hourly was taken at the remaining sites except when noted. Composite samples were collected with Isco 2700 Automatic Wastewater Composite Samplers.

The strategy for determining how many samples to analyze from any given site was based on the available resources, observations made during walk through inspections, changing nature of the wastewater, probability of finding a particular parameter in the time frame, and type of analysis. Volatile organic compound sampling, of course, was obtained by grab sampling.

(3) Sampling Analyses. The method of analysis and sample preservation prescribed for each parameter is listed in Table 2. A summary of sampling sites and corresponding analyses are included in Attachment 1.

TABLE 1. WASTEWATER SAMPLING SITE LOCATIONS

Site	Location	Type
1	Sewage treatment plant influent	Sanitary
2	Sewage treatment plant effluent	Pond
3	Industrial lake outfall	Pond
4	Main oil/water separator	Storm
5	Auto hobby shop separator, bldg 505	Storm
6	Fire training area	Pond
7	Housing lift station, bldg 6823	Sanitary
8	Nondestructive inspection, bldg 89	Sanitary
9	Base photo lab, bldg 73	Sanitary
10	Chemical cleaning, bldg 51	Storm
11	Refueling vehicle maintenance, bldg 43	Sanitary
12	Fuel cell repair separator, bldg 60	Storm
13	Base reproduction, bldg 91	Sanitary
14	Corrosion control washrack, bldg 96	Storm
15	Corrosion control sandtrap, bldg 59	Storm
16	Hangars 82/92, manhole	Storm
17	Pavement & grounds and separator, bldg 566, washrack,	Storm
18	Test cell	Leach Field
19	Hospital manhole, bldg 1500	Sanitary
20	Communications, bldg 20	Sanitary
21	Transportation, manhole	Storm
22	BX service station, bldg 552	Sanitary

TABLE 2. ANALYSIS AND SAMPLE PRESERVATION METHODS

PARAMETER	PRESERVATION	EPA METHOD(1)	WHERE	WHO
Chemical Oxygen Demand	H_2SO_4	410.4	Brooks AFB	USAFOEHL
Chloride	none	325	Brooks AFB	USAFOEHL
pH	none	A423(2)	on-site	USAFOEHL
Temperature	none	170.1	on-site	USAFOEHL
Oils and Grease	H_2SO_4	413	Brooks AFB	USAFOEHL
Phenols	H_2SO_4	604	Salt Lake	DATACHEM
Pesticides	H_2SO_4	608	Brooks AFB	USAFOEHL
Volatile Halocarbons	H_2SO_4	8240 (3)	Salt Lake	DATACHEM
Acid/Base/Neutrals	4C	8270 (3)	Salt Lake	DATACHEM
Total Organic Carbon	H_2SO_4	415	Brooks AFB	USAFOEHL
Total Petroleum Hydrocarbons	H_2SO_4	418	Brooks AFB	USAFOEHL
Metals	HNO_3	200.7	Brooks AFB	USAFOEHL
Total Cyanide	NaOH	335	Brooks AFB	USAFOEHL
Nitrate-Nitrite	H_2SO_4	353	Brooks AFB	USAFOEHL
Ammonia	H_2SO_4	350	Brooks AFB	USAFOEHL
Kjeldahl Nitrogen	H_2SO_4	305	Brooks AFB	USAFOEHL
Total Phosphorous	H_2SO_4	365	Brooks AFB	USAFOEHL
Total Suspended Solids	4°C	A209F	on-site	USAFOEHL
Sulfate	none	375.2	Brooks AFB	USAFOEHL
Surfactants-MBAS	none	425.1	Brooks AFB	USAFOEHL
Characteristic Hazardous Waste	none	SW846	Brooks AFB	USAFOEHL

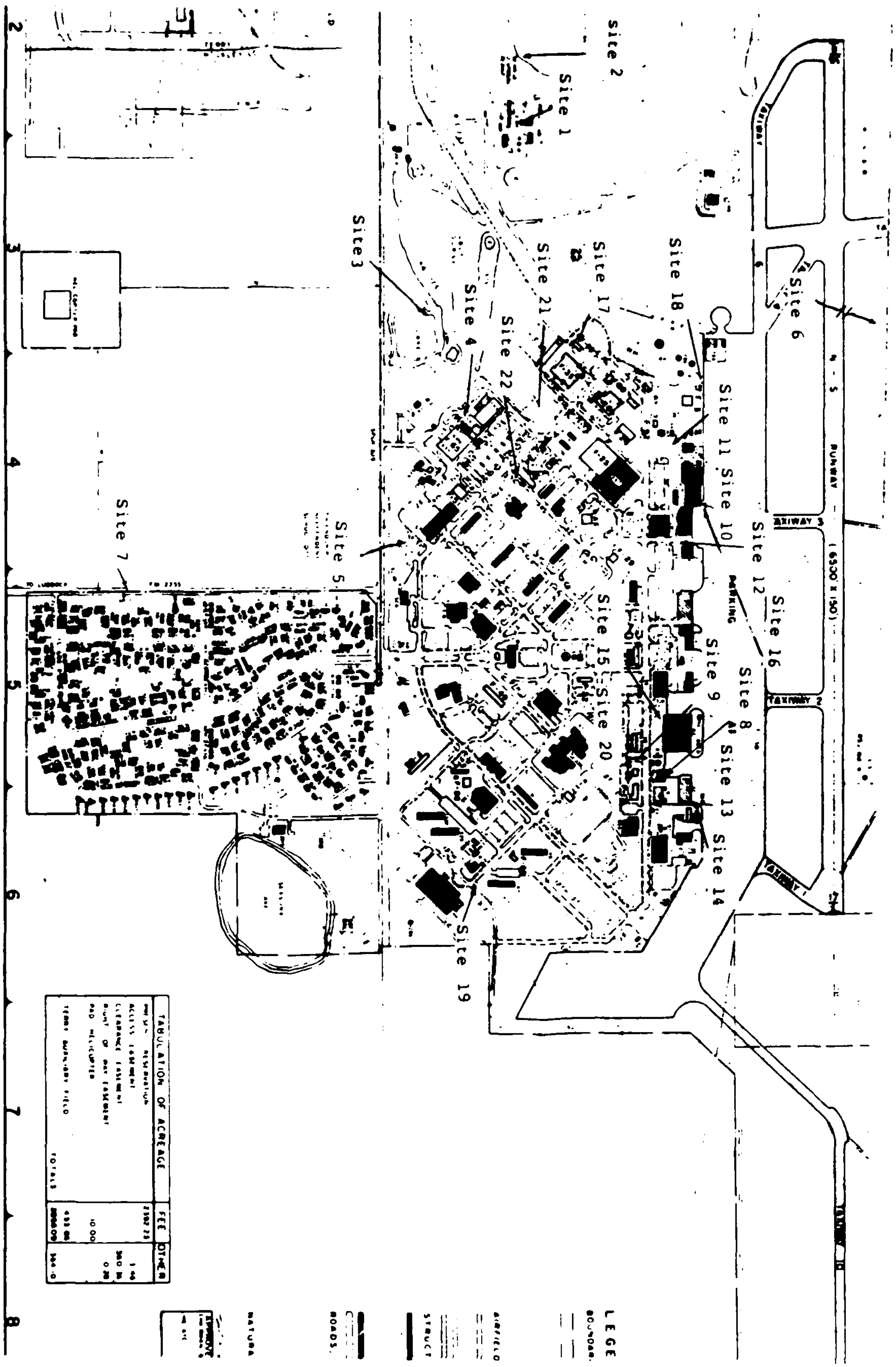

Figure 2. Site Locations

D. Hazardous Waste Survey

1. The first step of the survey was to review the Reese AFB hazardous waste management plan. Seven categories of waste generated on Reese AFB were determined from the review of the waste disposal survey form (Attachment 2) and an inventory of waste disposal practices on base was developed. After this preliminary waste assessment, the survey team proceeded to visit all of the major industrial shops on Reese AFB to observe industrial activities, discuss chemical waste disposal practices with shop personnel, and hand out waste disposal survey form. The following individuals were contacted to discuss their respective areas of responsibility in the hazardous waste management program:

SMS Tice, NCOIC, Bioenvironmental Engineering, SGPB, AUTOVON 838-3327
Capt Keller, Environmental Coordinator, DEEV, AUTOVON 838-3914
1Lt Mawm, Waste Oil and Fluids Monitor, 64 OMS/MAOF, AUTOVON 838-6013
Mr Gillum, Environmental Planner, DEEV, AUTOVON 838-3914

2. Summary of Forecasted Wastes

Based on the information received on our waste survey forms, a summary of the annual forecasted wastes generated on Reese AFB is shown by category in Table 3. Almost two-thirds of the wastes generated at Reese AFB are either waste oils or fuels. The remaining one-third is mostly comprised of waste fluids, paints, thinners, and solvents. In fact 96% of all wastes fall into one of the first five categories.

TABLE 3. CATEGORIES OF WASTE AT REESE AFB

CATEGORY	PRODUCT	TOTAL (GAL/YR)	% TOTAL OF ALL CATEGORIES
1	Waste Fuels	10006	33.4
2	Waste Oil	8724	29.2
3	Waste Fluids	3742	12.5
4	Waste Solvents and Strippers	3257	10.9
5	Waste Paints and Thinners	3060	10.2
6	NDI and Photo Wastes	704	2.4
7	Waste Acids and Bases	421	1.4
	TOTAL:	29914	100.0

2. Hazardous Waste Program Operation

The hazardous waste management program at Reese AFB operates under fairly general guidelines, and in an informal manner. The program is overseen by the Base Environmental Coordinator, who is responsible for keeping records of the amounts of wastes generated, and managing and procuring disposal contracts for waste oil/fluids and hazardous waste. Currently, the Defense Reutilization and Marketing Office, DRMO, has no responsibilities and does not participate in the hazardous waste management program. Wastes are collected and temporarily stored at various accumulation sites throughout the base that are monitored by shop personnel and listed in Table 4. There is no formal hazardous waste management training program for accumulation site managers, and individual shops do not keep monthly logs of wastes generated. Waste oil/fluids are disposed of through a local contract. 1Lt Mawm of the 64 OMS/MAOF is the monitor for this portion of the program. He notifies Capt Keller, the environmental coordinator, who in turn notifies the contractor for pick-up. The contractor keeps a log of the amount of oil/fluids which are pumped out during each servicing operation. Individual shop managers notify Capt Keller when a full hazardous waste drum needs to be taken to the Base Temporary Storage Facility. The individual shops are responsible for labeling and transporting their own hazardous waste to the facility, and delivering the Form 1348 to Capt Keller.

Waste fuel is managed by personnel from Supply POL. The fuel is collected in bowsers located on the flight line, tested, and if uncontaminated returned to the distribution system; otherwise, the fuel is placed in a waste fuel tank and transported to the fire training pit for burning by the Fire Department. Personnel from Liquid Fuels Maintenance also pump out fuel/water separators located on base and transport the waste fuel to the fire training pit. A log of the amounts of waste fuel reclaimed or disposed of is not maintained.

The Temporary Storage Facility for base wide hazardous waste accumulation is located at the old Base Test Cell. The site is presently inadequate and does not have a permit under the Resource Conservation and Recovery Act (RCRA); thus, Reese AFB has just 90 days to dispose of their hazardous waste once the shop managers notify Capt Keller that they have a full drum. A new storage site conforming to the RCRA regulations is supposed to be built within the next two years.

3. Description of Industrial Activities and Waste Disposal Practices

The following is a shop-by-shop description of Reese AFB's industrial processes, the chemicals used in these processes, and the disposal practices for wastes generated by these processes:

Shop: Jet Engine Test Cell — Bldg: T-40
Shop Supervisor: Mr Koron — AUTOVON: 838-3157

Shop personnel install, test, and make minor repairs on J-85 and J-69 jet engines. Personnel generate approximately one quart of waste JP-4 per engine test. The fuel discharges to a fuel/water separator which is pumped out by Liquid Fuels Maintenance personnel and taken to the fire training pit. The shop performs about 200 engine tests per month. Waste oil

(MIL-7808) is collected and placed in a 55 gallon drum at the shop collection site. The oil is disposed of by contract on a monthly basis. Personnel use B&B 3100 jet engine path cleaner for engine washing at a 5:1 dilution ratio. The cleaner and rinsewater are discharged to the fuel/water separator. A log of wastes generated is not maintained by the shop.

TABLE 4. REESE AFB WASTE ACCUMULATION SITES

SITE	NUMBER OF DRUMS	POINT OF CONTACT	TYPES OF WASTE
Bldg 52	4	TSgt Burton	JP-4, PD-680, Mixed fluids, Hydraulic fluid
Bldg 50 (AGE)	5	TSgt Wallace	Oils, Hydraulic fluid, Fuels, PD-680
Test Cell	2	Mr Koron	Oils
Bldg 170 (ACE)	3	MSgt Espinosa	Oils, Hydraulic fluid
Bldg 92	3	SSgt Heffler	Oils, Hydraulic fluid, Photo and NDI wastes
Bldg 59	1	TSgt Arnold	Paints and Thinners
Bldg 102	1	TSgt McGlinchy	Paints and Thinners
Battery Shop	1	Mr Taylor	Battery acid

Shop: AGE   Bldg: 50
Shop Supervisor: MSgt Berg   AUTOVON: 838-3157

AGE personnel are responsible for the inspection, maintenance, and repair of all AGE support equipment. This shop utilizes one 50 gallon PD-680 tank for parts cleaning. The tank is cleaned out on a monthly basis with the waste PD-680 placed in a 55 gallon mixed fluids drum. The shop is scheduled to convert to Safe-T-Sol citric solvent in lieu of PD-680. Waste oil and hydraulic fluid is collected in buckets and placed in 55 gallon drums. The PD-680 and fluids are picked up by contractor on a monthly basis. A small amount of waste JP-4 is collected in a 10 gallon bowser and taken to the waste fuel tank at POL. Waste drums are stored on pallets at the shop's collection site which is located next to a floor drain. The site is not diked. Personnel use a pressure sprayer to clean equipment at the shop's washrack. Aircraft cleaning compound is used at a 1:1 dilution ratio for this purpose.

Shop: Chemical Cleaning
Shop Supervisor: Mr Morris

Bldg: 51
AUTOVON: 838-3988

This shop cleans basic J-85 and J-69 jet engine components, and nonpowered AGE equipment by utilizing mixed chemicals in spraying and dipping procedures. Most of the waste generated at this shop results from various chemicals dripping from parts which are dipped into tanks (See Figure 3). This drag-out is caught in a drainage trough which discharges to the storm drainage system, and subsequently to the base industrial playa lake. Wastes generated in this shop are included in Attachment 3. The only waste which is drummed as hazardous is a hot paint stripper contained in a 165 gallon vat. This is changed out on a quarterly basis, and shop personnel transport the waste drums to the Temporary Storage Facility. The remaining vats are topped off when losses from evaporation and drag-out become significant; with the exception of the hot water rinse tank which is discharged down the storm drain approximately twice per year. The shop also has a 165 gallon vat of Safe-T-Sol solvent which has never been changed out. A disposal practice for this waste will be formulated upon determination of whether or not the spent solvent is hazardous.

Shop personnel also operate a bead-blasting unit for stripping paint from small parts. The waste residue is placed in plastic bags and thrown in the trash. No sampling has been performed to determine the characteristics of this waste. Spent rags are also thrown in the trash. Personnel also perform cadmium electroplating in building 59 about 2 to 3 times per week. Cadmium and chromium trioxide rinsewaters are discharged down the storm drain.

Figure 3. Chemical Cleaning Facility

Shop: Wheel and Tire | Bldg: 52
Shop Supervisor: Mr Lara | AUTOVON: 838-3050

Personnel in this shop assemble, disassemble, wash, clean, and replace worn parts on T-38 and T-37 main and nose wheels. The shop uses three vats of Safe-T-Sol solvent for parts cleaning and degreasing. Two of the vats contain 20 gallons and the third has a capacity of 40 gallons. They are changed out on a quarterly basis and drummed as waste Safe-T-Sol. If sampling results indicate the waste is hazardous it is disposed of accordingly. Currently the waste drums are stored at the Bldg 52 accumulation site. Trichloroethane is used to rinse bolts, and the waste solvent is drummed as hazardous waste and transported to the Base's Temporary Storage Facility. The shop performs spot painting with enamel paint. Spent spray cans are thrown in the trash. Dirty rags from parts cleaning are also disposed of in the trash.

Shop: Pneudraulics | Bldg: 52
Shop Supervisor: TSgt Roy | AUTOVON: 838-3396

Personnel in the Pneudraulics Shop are responsible for removing, replacing, and repairing hydraulic components on the T-37 and T-38 aircraft. The shop operates two tester units, each contain approximately 30 gallons of hydraulic fluid. The testers are changed out twice a year and the waste fluid is drummed and placed at the Bldg 52 accumulation site where it is disposed of through contract. Personnel also generate about 20 gallons per month of brake fluid from flight line bleeding operations. This waste is placed in the mixed fluids drum at the ACE flight accumulation site and disposed of through contract. The shop has two Safe-T-Sol vats which contain 25 gallons each. The vats are changed out biweekly and the waste is drummed at the Bldg 52 site. Dirty rags are thrown in the trash, and no log of waste amounts is maintained at the shop.

Shop: Propulsion Branch | Bldg: 52
Shop Supervisor: TSgt Burton | AUTOVON: 838-3367

This shop performs scheduled and unscheduled maintenance on J-85 and J-69 jet engines and accessory components. Personnel generate approximately 160 gallons of waste oil and hydraulic fluid per month. This waste is drummed and stored at the Bldg 52 accumulation site where it is disposed of by contract. About 25 gallons of waste fuel is drummed and disposed of by contract. The Accessory Component shop utilizes 5 gallon vats containing Safe-T-Sol, carbon remover, and PD-680, respectively. The carbon remover is drummed as hazardous waste and transported to the Temporary Storage Facility. PD-680 is drummed and disposed of by contract, and the Safe-T-Sol is drummed and personnel await sampling results to determine its characteristics before a permanent disposal method is implemented.

Shop: Battery Shop | Bldg: 52
Shop Supervisor: Mr Taylor | AUTOVON: 838-3433

This shop services nickel-cadmium (Ni-Cd) and lead-acid batteries. Bad cells from Ni-Cd batteries are drained into a drum and disposed of as hazardous waste (about 10 ozs/week). The bad cells are turned in to DRMO. Lead-acid batteries are also drained into drums and disposed of as hazardous waste. The casings are neutralized with baking soda and turned in to DRMO. This generates approximately 55 gallons of hazardous waste per eight month period. Neutralized acid solution has never been analyzed for characteristic hazardous waste, therefore, no baseline information exits on this solution.

Shop: Corrosion Control — Bldg: 59
Shop Supervisor: Mr Lamgert — AUTOVON: 838-3565

Corrosion Control personnel at Bldg 59 are responsible for refinishing of T-37 and T-38 aircraft components and support equipment. This shop presently operates one waterfall paint booth; however, the shop is in the process of converting the shop area into a dry paint booth facility. The paint booth trough is cleaned out every 10 days and the sludge is drummed as hazardous waste. The wastewater is discharged to the storm drainage system. One or two gallons of waste polyurethane, enamel, and lacquer paints is generated per month, along with 50 to 60 gallons of waste paint thinner. All wastes are placed in the same hazardous waste drum and transported on a biweekly basis to the Temporary Storage Facility. Personnel do perform some small parts stripping inside the shop. The parts are rinsed in the trough of the paint booth and this is discharged to the storm drainage system. Dirty rags are disposed of in the trash.

Shop: Machine Shop — Bldg: 59
Shop Supervisor: MSgt Brigham — AUTOVON: 838-3503

Shop personnel manufacture T-37 and T-38 aircraft support components; repair aircraft and AGE equipment; remove and replace studs, bushings, gearing, and other small hardware; and install heli-coils. The shop has a 25 gallon vat of Safe-T-Sol which has never been changed out. Approximately 25 gallons of waste lubricating oils are generated semiannually and placed in the mixed fluids drum at the Bldg 52 accumulation site for contract disposal.

Shop: Fuel System Repair — Bldg: 60
Shop Supervisor: MSgt Rodriguez — AUTOVON: 838-3383

This shop is responsible for the repair of aircraft fuel systems, including replacement of fuel cells, pumps, probes, and transmitters on T-37 and T-38 aircraft. Personnel utilize a 50 gallon PD-680 tank; however, the shop is scheduled to convert to Safe-T-Sol. The PD-680 tank has never been changed out. There is a drainage trench in the work area to catch fuel spills which is connected to a fuel/water separator. The separator is pumped out by liquid fuels maintenance and the fuel taken to the Fire Training pit for burning. The shop also operates a boost pump tester which contains a test fluid, MIL-C-7024B, which is also discharged to the fuel/water separator upon change-out. Some methyl ethyl ketone is used in a wipe-on application and allowed to evaporate. Dirty rags are disposed of in the dumpster.

Shop: Fire Department — Bldg: 74
Shop Supervisor: MSgt Stewart — AUTOVON: 838-3257

This shop generates very little waste. Maintenance on the fire trucks is performed by Transportation Vehicle Maintenance, thus the Fire Department has no solvent vats for parts cleaning or degreasing. The shop uses approximately 45 gallons of Aqueous Film Forming

Foam (AFFF) every six months. The AFFF is not premixed with water, thus, any which remains after a training burn is kept in the truck tank until it can be used in a subsequent exercise. Personnel wash the fire trucks daily using an alkaline soap. The wastewater discharges to the sanitary sewer system.

Shop: Air Repair — Bldg: 82
Shop Supervisor: SMSgt Hall — AUTOVON: 838-3320

This shop generates very small amounts of waste oil and hydraulic fluid. The oil is mopped up from the floor using an Airwick Cleaner. The cleaner solution is drummed and placed at the Bldg 92 collection site (110 gallons/month). No disposal practice has been implemented for this waste, and no baseline analysis has been performed to characterize it.

Shop: NDI — Bldg: 89
Shop Supervisor: MSgt Parker — AUTOVON: 838-3630

Personnel are responsible for performing oil analyses and inspection of T-37 and T-38 structural components using ultrasonic eddy current, magnetic particle, liquid penetrant, and radiographic inspection methods. The shop generates 5 to 6 gallons per month of waste oil from the oil analysis spectrometer. 1,1,1-Trichloroethane is mixed with the oil to clean the instrument, and this mixture is drummed and placed at the Bldg 92 accumulation site and disposed of by contract.

Dye penetrant inspection is an open system which uses a penetrant, emulsifier, and a rinse area. Parts are sequentially dipped into the penetrant, removed and placed in the emulsifier, rinsed, and allowed to drip dry. The part is then sprayed with a developer and passed through a drying oven before inspection and final rinsing. The 55 gallon penetrant and emulsifier tanks are changed out every six months and discharged to the sanitary sewer system. The rinsewater generated during the sequential dipping process and the developer also discharge to the sanitary sewer system. Approximately 20 gallons of Magnaflux Magnetic Inspection Compound is generated every six months. This too is discharged to the sewer system.

Spent fixer from x-ray photo developing is sent through a silver recovery unit. The recovered silver is turned in to DRMO. Spent activator, developer, and stabilizer are discharged to the sanitary sewer on a weekly basis. An analysis performed by Biospherics Inc. on the fixer/developer wastestream in March of 1986 indicated the waste was ignitable at 31 degrees Celsius which classifies the discharge as hazardous. Additionally, the pH of the wastestream was 4.74.

Shop: Reproduction — Bldg: 91
Shop Supervisor: Mr Ham — AUTOVON: 838-3475

Personnel reproduce copies of letters and documents of all types (8-1/2 x 11 and 8-1/2 x 14) by the offset process. This shop generates approximately 10 gallons per month of blanket cleaner and 2 gallons per month of copier dispersant. These wastes are drummed together as hazardous waste and placed at the Bldg 92 accumulation site. The drum is labeled as waste perchloroethylene. Waste activator which contains hydroquinone is disposed of in the trash (1/2 gallons per month).

Shop: T-38 Flight Line Maintenance — Bldg: 92
Shop Supervisor: SSgt Heffler — AUTOVON: 838-3309

This shop is responsible for scheduled and unscheduled maintenance on T-38 aircraft. Maintenance operations generate 30 gallons per month of waste oil and 50 gallons per month of waste hydraulic fluid. These wastes are drummed and placed at the shop accumulation site where they are disposed of by contract. Approximately 100 gallons per month of waste JP-4 is drained into fuel bowsers; taken to the POL waste fuel tank; and then transported to the fire training pit for fire training exercises by POL personnel. Shop personnel also perform spot painting with spray cans and brushes. Any waste generated from this operation is disposed of in the trash. The shop also utilize two 30 gallon Safe-T-Sol vats for parts cleaning. These have never been changed out. Approximately 50 gallons per month of spent soap solution from floor washing is drummed and stored at the shop accumulation site, however, none had been disposed of at the time of the survey.

Shop: Corrosion Control — Bldg: 102
Shop Supervisor: TSgt McGlinchy — AUTOVON: 838-3661

Shop personnel perform complete sanding and painting of T-37 and T-38 aircraft, and AGE equipment; and are responsible for the T-37 and T-38 aircraft washrack facility. Personnel perform one complete aircraft painting per week on an average (See Figure 4). The planes are first sanded, then washed with an alkaline compound. The plane is then rinsed (rinsewater discharges to the oil/water separator and then to the storm drainage system) and the bare spots are treated with alodine. The shop generates approximately 30 gallons of waste polyurethane paints and epoxy primers per week. This is drummed as hazardous waste and stored in the shop's self-contained waste storage container before transport to the Base Temporary Storage Facility. Waste paint thinners are drummed with the waste paints and primers. The shop also operates a touch-up painting hangar at Bldg 96. Approximately three touch-ups are done on a weekly basis. Waste filters from the touch-up facility are disposed of in the trash without analyses.

Personnel are also responsible for the operation of the T-37 and T-38 washracks. An average of 4 planes per day are washed using aircraft soap at a 5:1 - 8:1 dilution ratio. All drains discharge to the oil/water separator and then to the storm drainage system. Personnel utilize approximately 70 gallons per month of aircraft soap.

Shop: T-37 Flight Line Maintenance (ACE Flight) — Bldg: 170
Shop Supervisor: MSgt Espinosa — AUTOVON: 838-3669

This shop is responsible for launch, recovery, flight inspections, and periodic phase inspections for T-37 aircraft. Personnel also perform weekly tail washes. Approximately 90 gallons per month of waste oil and hydraulic fluid is generated. Wastes are drummed at the shop accumulation site and disposed of by base contract. Waste JP-4 (45 gallons/month) is drained into bowsers and taken to the POL waste fuel tank to be transported to the fire training pit and burned by the Fire Department. Aircraft tail washes are performed using a soap from Brulin Chemical Co. (NSN: 6850P815MX). Rinsewater is discharged to the storm drainage system.

Figure 4. Paint Facility

Shop: Photo Shop | Bldg: 340
Shop Supervisor: Mr Wilkins | AUTOVON: 838-3475

This shop exposes and processes color and black and white film. Very little waste is generated. Spent fixer is taken off base for silver recovery (about 2 gallons/month). Personnel utilize an automatic print processor with fixer and developer contained which is changed out every quarter. Developer is discharged down the drain into the sanitary sewer.

Shop: Transportation Maintenance | Bldg: 460
Shop Supervisor: Mr Lewis | AUTOVON: 838-3696

Personnel are responsible for the maintenance, repair, and painting of installation vehicles, including aircraft refueling trucks. Personnel generate approximately 30-40 gallons per week of waste oil and fluids which are placed in a 300 gallon above ground tank and serviced by contract on a bimonthly basis. Waste antifreeze is drummed as hazardous waste and taken to the Temporary Storage Facility. The shop has three Safety Kleen vats which are serviced every six weeks. The shop operates one waterfall paint booth that is cleaned out quarterly. The waste sludge is disposed of in the dumpster and the wastewater is discharged to the storm drainage system with out prior analysis. Waste paints and thinners are placed in the 300 gallon waste oil tank. Personnel utilize a 35 gallon vat of caustic soda for cleaning radiators which is drained into the sanitary sewer system every six months. Refueling Maintenance generates waste JP-4 which drains into a fuel/water separator and is pumped out by POL and taken to the fire training pit for disposal.

Shop: Auto Hobby — Bldg: 503
Shop Supervisor: Mr Sanches — AUTOVON: 838-3241

The Auto Hobby Shop provides a wide range of facilities for customers to use while servicing their private automobiles. The shop generates about 85 gallons of waste oil per month, which is collected in an underground tank; pumped out; and disposed of by contract. Waste hydraulic and transmission fluids are discharged down the storm drain by customers, however, amounts could not be quantified. The shop has three Safety Kleen vats which are changed out on a monthly basis. Customers also have access to a dry paint booth. Spent filters from the booth are disposed of in the trash, however, no baseline analysis has been performed to characterize the filters as hazardous waste. Customers supply their own paints and thinners, and have disposal responsibility for these wastes. Spent antifreeze is discharged down the storm drain, along with soap solution used for floor cleaning. Dirty rags are disposed of in the dumpster.

Shop: BX Service Station — Bldg: 552
Shop Supervisor: Mr Hill — AUTOVON: 838-4965

The BX Service Station provides routine maintenance and service for private automobiles of active duty, retired, and dependent military members. The shop has a 500 gallon underground tank for the storage of spent motor oil and fluids which is pumped out every quarter by contractor. Personnel also use one 10 gallon Safety Kleen vat for parts degreasing. The Safety Kleen solvent is changed out every six weeks. Dirty rags are disposed of in the trash.

Shop: CE Paint Shop — Bldg: 555
Shop Supervisor: Mr Wright — AUTOVON: 838-3467

This shop performs interior and exterior painting of base facilities. The shop has one waterfall paint booth that has never been changed out. Approximately 15 gallons per month of waste thinners is drummed as hazardous waste and taken to the Temporary Storage Facility. Most paint is used up in process. However, a small amount is disposed of in the trash. No stripping is performed in the shop. The operation was slated to go to contract operation on 1 Oct 1987.

Shop: CE Power Production — Bldg: 555
Shop Supervisor: Mr Beaudoin — AUTOVON: 838-3775

Personnel are responsible for the operation and maintenance of emergency gas and diesel powered generator sets. Waste oil is drained from the generators into 5-gallon cans and then placed in 55-gallon drums at Bldg 2104 (about 110 gallons/year). Approximately 10 gallons per year of waste diesel fuel is generated and disposed of in the waste oil drums. The shop has a 10-gallon vat of PD-680 that is changed out twice a year. The spent solvent is used to wash equipment at the Heavy Equipment Maintenance washrack. Personnel also neutralize about 2 batteries per month on the washrack with the electrolyte discharging into the storm drain. Ten gallons per month of waste antifreeze are either discharged down the drain or disposed of in the waste oil drums. Dirty rags are thrown in the trash.

Shop: CE Heavy Equipment Maintenance — Bldg: 566
Shop Supervisor: MSgt Gonzalez — AUTOVON: 838-3631

Shop personnel perform routine maintenance and washing of heavy equipment. The shop generates about 3-5 gallons of waste oil per month that is discharged to the storm drain. Personnel wash 10 or 11 vehicles per month using Brulin Inc. General Purpose Cleaner at a 5:11 to 8:11 dilution ratio. Rinsewater is discharged into the storm drain.

Shop: Liquid Fuels Maintenance — Bldg: 777
Shop Supervisor: Mr Burnette — AUTOVON: 838-3904

This shop inspects, repairs, and maintains stationary liquid fuel distribution and storage systems; and removes and disposes of waste fuel. The four aboveground storage tanks must be cleaned out every four years. Each tank generates from 300-600 gallons of sludge that is drummed as hazardous waste and taken to the Temporary Storage Facility. Personnel are also responsible for pumping out the fuel/water separators at Bldg 60, Bldg 40, and the waste fuel tank at Bldg 797, and transporting the waste fuel to the fire training pit for burning. An average of 800 gallons per month of waste fuel is taken to the pit.

Shop: Hospital X-ray — Bldg: 1500
Shop Supervisor: MSgt Tharmington — AUTOVON: 838-3183

Personnel utilize approximately five gallons of fixer and developer per week. The fixer goes through silver recovery before discharge into the sanitary sewer system. Recovered silver is turned in to the silver recovery monitor and then to DRMO. All waste developer is discharged to the sanitary sewer.

Shop: Hospital Dental Clinic — Bldg: 1500
Shop Supervisor: TSgt Hiett — AUTOVON: 838-3711

This shop has an automatic film processor. Recovered silver is turned in to medical maintenance and then to DRMO. After recovery, spent fixer and developer are discharged into the sanitary sewer system. Precapsulated amalgam is collected and stored in a bottle, and then turned in for silver recovery.

Shop: Golf Course Maintenance — Bldg: 2002
Shop Supervisor: Mr Adams — AUTOVON: 885-2462

Personnel are responsible for the repair of grounds maintenance equipment. Approximately 10 gallons per month of waste oil and fluids are drummed at the shop and disposed of by contract. The shop has a 16 gallon vat of naphtha which had only been in use for a week at the time of this survey. Personnel also generate 5 gallons per month of waste fuel that is drummed and serviced by contract.

Shop: Entomology | Bldg: 2003
Shop Supervisor: Mr Kiser | AUTOVON: 838-3663

All waste chemicals from this shop are discharged into an enclosed underground disposal tank (2 gallons/month). The tank is pumped out when chemicals are needed for spraying around the flight line. All waste chemicals are mixed together. They include: Malathion, Dursban, Diazinon, Pramitol, Round-up, and 2,4-D.

4. Summary of Waste Disposal Practices at Reese AFB

a. Waste JP-4 from flight line and maintenance operations is collected in bowsers or discharged into fuel/oil separators. POL personnel tests the fuel, and if uncontaminated it is returned to the system; otherwise it is placed in a waste fuel tank and subsequently transported to the fire training pit to be burned.

b. Waste oils and fluids are either collected and placed in drums at the accumulation sites or in tanks at other shops, i.e., vehicle maintenance, auto hobby, etc. The wastes are then disposed of through local contract.

c. Waste solvents are drummed, placed at the accumulation sites, and either disposed of as hazardous waste or pumped out as mixed fluids by the local oil/fluid contractor. Since the base has just recently purchased the Safe-T-Sol solvent for several shops, personnel have not had to change out their vats. A permanent disposal practice for Safe-T-Sol will be implemented after establishing baseline analytical results.

d. Waste paints, strippers, and thinners are drummed and disposed of as hazardous waste.

e. Waste battery acid is drummed and disposed of as hazardous waste.

f. Electroplating wastes are discharged down the drain.

g. Photographic and NDI wastes are either drummed and disposed of as hazardous waste or discharged down the drain.

h. Spent rags are generally disposed of in the trash.

E. Wastewater Characterization Survey

1. Introduction - Contaminant concentrations and physical and chemical parameter values are presented in the following section to characterize the various wastewater streams sampled during the survey. Some of the concentrations reported illuminate potential problems with disposal methods. Others simply contribute to the identifying characteristics of the wastewater that reflect the types of materials being disposed of through the sewers.

2. Flow - Unfortunately the Manning flowmeter in the shipment was not sensitive enough to produce meaningful continuous flow data from the separator discharge into the industrial lake. Several instantaneous measurements were recorded from the calibrated weir.

They were 12,500 gpd and 19,700 gpd at 1000 and 1015 on Tuesday, 29 September; 1930 gpd at 0815 on Wednesday, 30 September; and 2760 gpd at 0830 on Thursday, 1 October.

3. Sanitary Sewer System

a. Sampling Sites: Eight sites in the sanitary sewer system were sampled. The following is a description of the sites and significant findings at each site. The complete analyses results are found in Attachment 4.

(1) Site 1: Five days of samples were taken at the grit chamber at the influent of the sewage treatment plant. Semivolatile organic priority pollutants results showed commonly occurring phthalates (diethyl, di-n-butyl, and bis(2-ethylhexyl) in the range of 11-200 µg/L resulting most probably from full components or adhesives used in plastic water and waste pipe. Detectable, but not significant, levels of 1.2 and 1,4 chlorobenzene were found entering the plant. No significant levels of phenols (4 - 40 µg/L) were found. The wastewater was not a characteristic hazardous waste.

(2) Site 7: The sample was taken from the influent channel of the housing area lift station, building 6823. The COD (120 µg/L) and TOC (67 µg/L) were characteristic of the domestic nature of this waste stream. The wastewater was not a characteristic hazardous waste.

(3) Site 8: The sample was taken in sanitary manhole B1-4 by damming the service connection from the Nondestructive Inspection, building 89, with a sandbag. Visual appearance of this sample revealed a green liquid, apparently as a result of dumping the dye penetrant into the sewer. Chemical analysis in the wastewater revealed a high COD and TOC concentration, 2050 µg/L and 420 µg/L, respectively. The wastewater was not a characteristic hazardous waste.

(4) Site 9: The sample was taken from manhole C1-2, collecting the two service connections from the Photo Lab, building 73. Dichlorobenzene (150 µg/L) and phenol (63 µg/L) along with phthalates were found in the sewer. The COD result (365 mg/L) was in the range of domestic sewage. Some silver (0.5 mg/L) was found. The wastewater was not a characteristic hazardous waste.

(5) Site 11: The sample was taken from manhole D1-4, collecting the floor drains and sanitary wastes from the Refueling Vehicle Maintenance, building 43. Rinsewater having low COD (75 µg/L) and TOC (42 µg/L) values, and low oils and grease characterize this discharge. The wastewater was not a characteristic hazardous waste.

(6) Site 13: The sample was taken from manhole B1-3, collecting from the service connection at Base Reproduction, building 91. A COD of 720 mg/L indicated a wastewater of possible industrial nature, however, other more definitive testing was not performed. Characteristic hazardous waste testing (metals, cyanides, etc.) did not show hazardous waste characteristics were present, indicating the higher than normal COD apparently resulted from some organic compounds.

(7) Site 19: The sample was taken from manhole A2-1, in the sewer across the street from the Hospital, building 1500. The low COD indicates the sample was primarily domestic sewage. A small concentration of silver (11 µg/L) was detected along with trace amounts of dichlorobenzene and phenol. The wastewater was not a characteristic hazardous waste.

(8) Site 20: The sample was taken from manhole C1-2, picking up sanitary wastes from the Communications and Communications Maintenance, buildings 20 and 7. Some dichlorobenzene was found (150 µg/L). The COD concentration (175 mg/L) indicated the domestic nature of this wastewater. The wastewater was not a characteristic hazardous waste.

(9) Site 22: The sample was taken from manhole D2-9, servicing the BX service station, building 552. The COD result (190 mg/L) indicated domestic wastewater discharge. The wastewater was not a characteristic hazardous waste.

4. Storm Drainage System

a. Sampling Sites: Nine sites in the storm drainage system were sampled. The following is a description of the sites and the significant findings:

(1) Site 4: Five days of sampling were collected at the convergence of the two outfall lines from the main oil/water separators located in the Civil Engineering parking lot near building 555. This discharge represents the major contributor of industrial wastewater into the industrial lake. Significant quantities of volatile organic compounds were found in this discharge in the two days of sampling. Quantities of the volatile, 1,1,1-trichloroethane (96,8), trans 1,2-dichloroethene (37,100), tetrachloroethene (110,230), and trichloroethene (77,320) were significant in samples from both days. Phthalates were detected as well as a small quantity of 1,4-dichlorobenzene (14 µg/L). No significant quantities of heavy metals or oils and grease in the wastewater were found. The sample possessed no hazardous waste characteristics.

(2) Site 5: A one-day hourly composite sample was collected from the discharge line of the large oil/water separator located southwest of the auto hobby shop, building 505. The separator discharges into the storm drain and then into the industrial lake. Although only COD, TOC and hazardous waste parameters were analyzed at this site, the low COD (100 mg/L) and TOC (40 mg/L) indicate a wastewater relatively free from petroleum hydrocarbons and not a characteristic hazardous waste.

(3) Site 10: Two days of 24-hour composite samples were collected from a line extending into the manhole located on the flight line loading ramp at nonpowered AGE, building 52. The drains from the new Chemical Cleaning Shop, building 51, have been connected to an existing line left over from the demolition of an adjacent building. The effluent from the chemical cleaning shop mixes with the discharge from the hangars 82/92, identified as site 16. The COD (15 mg/L) and TOC (6 mg/L) indicate water with little organic strength. However, this shop seems to be one source of the trichloroethane, dichloroethene, dichlorobenzene, and trichloroethene found at site 4. The wastewater was not a characteristic hazardous waste.

(4) Site 12: A one-day 24-hour composite sample was taken from the discharge of the oil/water separator servicing the Fuel Cell Repair shop, building 60. The water phase of the separator apparently discharges to the storm drains on the flight line to the north of the

building. The COD (720 mg/L) indicated small quantities of fuel or other substance in the discharge from this shop. Unfortunately, an oil and grease sample was not submitted which would have been more definitive of the origin of the contamination. The wastewater did not contain enough fuel to exhibit the hazardous waste ignitability characteristic, or other hazardous waste characteristics, however.

(5) Site 14: A one-day 24-hour composite sample was taken from the storm water manhole connecting the corrosion control washrack separator near building 96 with the system. A small quantity of tetrachloroethene (6.1 μg/L) was detected along with toluene (91 μg/L). Toluene, used as a paint thinner, is a listed hazardous waste. The discharge of oil and grease is limited to reasonable levels (12.9 mg/L). The wastewater was not a characteristic hazardous waste.

(6) Site 15: A one-day 24-hour composite sample was taken from a sand trap attached to the drain line from the plating and corrosion control shop, building 59, before connecting to the storm drain. Oils and grease or metals were not a problem; however, this shop also contributes to the volatile organic compounds found at site 4. 1,1,1-trichloroethene was found in a large concentration (6500 μg/L), along with a whole family of chlorinated hydrocarbons, vinyl chloride, chloroethane, 1,1-dichloroethane, 1,1-dichloroethene, trans-1,2-dichloroethene, and trichloroethene. The wastewater did not exhibit the characteristics of a hazardous waste.

(7) Site 16: A one-day 24-hour composite sample was taken from a storm manhole described earlier as Site 10. Wastewater from the hangars flows through this manhole. The drainpipe from the Chemical Cleaning shop (site 10) protrudes into the manhole and the discharge falls and mixes with the wastewater from the hangars. Thus, the site 16 sample was collected upgradient from the site 10 discharge. The hangars wastestream represents a moderate strength wastewater, 412 mg/L of COD and 18 mg/L of surfactants were found. The samples indicate that the hangars are another source of volatile organic priority pollutants as a high concentration of 1,1,1-trichloroethane (1400 μg/L) was detected, along with the commonly detected dichlorobenzene and phthalates. The was water was not a characteristic hazardous waste.

(8) Site 17: A one-day 24-hour composite sample was taken from the discharge of the Pavement and Grounds washrack separator at the discharge end. The wastewater was relatively uncontaminated with a COD less than 10 mg/L and oils and grease less than 1 mg/L. The wastewater was not a characteristic hazardous waste.

(9) Site 21: A grab sample was taken from a manhole servicing the Vehicle Maintenance complex floor drains. The grab sample was obtained because the sampler failed to composite the sample. For the most part, vehicle maintenance had been curtailed while a new vehicle maintenance building was being constructed. This sample was taken from a manhole located in the new civil engineering parking lot on the northern side of the civil engineering building across the street from the vehicle maintenance buildings. The wastewater had a low COD of 80 mg/L and practically no oils and grease (<1 mg/L). The wastewater was not a characteristic hazardous waste.

5. Lakes, Septic System and Discharge to Grade

a. Two sites that dispose of wastewater either through discharge into a leach field or discharge to grade were sampled:

(1) Site 6: A grab sample was collected from the fire training area impoundment. Water in this impoundment is drained to grade. The wastewater was not a characteristic hazardous waste; however, high concentrations of COD (1500 mg/L) and oils and grease (1840 mg/L) were found. Components of fuel, the priority pollutants, benzene (0.18 mg/L), toluene (0.44 mg/L) and ethylbenzene (0.037 mg/L) were found in moderate levels.

(2) Site 18: A grab sample was collected from the discharge of the oil/water separator at the engine test cell, building 40. This sample had high COD and TOC (7600 and 2400 mg/L, respectively), primarily due to the fuel in the separator. The fuel components, benzene (2.2 mg/L), toluene (9.8 mg/L), and ethylbenzene (4.5 mg/L) were found in large quantities. This wastewater was a characteristic hazardous waste, having the hazardous characteristic of ignitability.

b. Sample sites were selected from playa lakes on base. They were:

(1) Site 2: The sample was obtained at the outfall pipe as the pipe extended into the sewage lake. Five days of sampling were performed at this location. No phenols, PCBs, or pesticides were detected at this site. 1-2- and 1-4-Chlorobenzene, toluene, and trichlorofluoromethane were detected but at levels at or below the quantifiable limit of the instrument. Phthalates were found in the effluent.

(2) Site 3: Five days of sampling were taken at the lift pumps at the industrial lake. No phenols, PCBs, or pesticides were detected at this site. 1,1,1-Trichloroethane and tetrachloroethene were detected but at levels below the instrument's quantifiable limit. Phthalates were found in the effluent.

III. CONCLUSIONS

A. Wastewater Characterization Survey

1. It was not feasible to analyze for all parameters included in 40 CFR 261 Appendix VIII, hazardous constituents (4), at every location. From a review of the shop's chemical inventory and the constraints on the USAFOEHL and contractors analytical capabilities, a sampling strategy evolved around testing hazardous constituents from the priority pollutant list.

Texas Industrial Waste Management Rules, Groundwater Protection Standard (5) applies to surface impoundments receiving hazardous waste. The constituents governed are those in Appendix VIII. Concentrations of Appendix VIII chemicals are set by the Texas Water Commission and may not exceed the background concentration in the aquifer. Table 1, Maximum Concentration of Constituents for Groundwater Protection (included in Attachment 5), governs maximum concentrations of some metals and pesticides by generally following Safe

Drinking Water Act standards. Since the storm drainage and sanitary sewage systems are connected to surface impoundments, if any priority pollutants are discharged into either system, the impoundments would be regulated by this regulation.

2. Priority pollutants were found in the sanitary sewage system. Dichlorobenzene, phenol, and the phthalates were found throughout the sanitary system. The best guess where the dichlorobenzene and phenol came from is either from a detergent or disinfectant being used at the hospital and other places around base.

3. The storm drainage system discharging into the industrial lake contained priority pollutants readily traceable to the industrial processes. The sources of the chlorinated solvents are degreasers rinsed into the system from corrosion control, building 59, the chemical cleaning building, and hangars 82/92. Samples from building 59 had by far the greatest concentrations of trichloroethene. The discharge from the hangars contained the greatest concentrations of trichloroethane.

4. Hazardous wastes in the milligrams per liter range were found in the surface impoundment at the fire training area and in the septic tank at the engine test cell. Jet fuel contains significant concentrations of the priority pollutants, toluene and benzene which when disposed of in this nature would subject these discharges to the same regulation as discussed above.

5. Apparently all industrial discharges have not been eliminated from the sanitary and stormwater system. All shop drains should at least be connected to the sanitary sewage system and be limited to discharge of nonhazardous wastewater. Pretreatment and removal of hazardous constituents from a wastewater would be required if the hazardous material cannot be prevented from entering the wastewater stream. The sanitary system is very close to being free from priority pollutants as just chlorobenzene and phthalates were detected. Phthalates probably are originating from PVC pipe joints, and therefore, seemingly uncontolled. The chlorobenzene, apparently contained in an industrial type cleaner, can be removed from the wastewater by product substitution.

6. The sewage treatment plant utilizes the Hayes Process. This process uses a series of settling chambers and aeration basin, aeration without the benefit of mixed liquor. The plant has no trouble meeting limitations for domestic wastes (BOD, TSS, etc.); however, it is not permitted to receive industrial wastes. Since the survey scope did not include an evaluation of the plant, it is difficult to determine its effectiveness in treating priority pollutants. Some degree of removal of priority pollutants may be occurring, as the concentrations of analyzed priority pollutants in the effluent were consistently lower than concentrations in the influent. The plant with modifications could serve as an industrial pretreatment plant in the event the base combined (storm, sanitary, domestic) system is connected to a municipality POTW.

7. The Jet Engine Test Cell septic system and the Fire Training area allow a direct link between soluble components of fuels (xylene, toluene, benzene) to be introduced into the subsurface, eventually into the underlying aquifer.

B. Hazardous Waste Survey

1. The Reese AFB hazardous waste management program is deficient in several areas, most notably:

a. lack of a sufficient hazardous waste management training program for accumulation site managers and shop personnel,

b. lack of baseline analytical data to substantiate current disposal practices,

c. inadequate segregation of wastes prior to containerization,

d. inadequate hazardous waste accumulation sites,

e. a lack of documentation at the shop level concerning amounts and types of wastes generated.

2. A comprehensive training program for accumulation site managers and shop personnel which addresses; applicable hazardous waste regulations, health hazards associated with each shop's specific chemicals, environmental and regulatory consequences of illegal disposal practices, proper handling and transportation practices, and information on the abilities and limitations of oil/water separators, is a necessity. Most of the problems with hazardous waste management at Reese AFB can be attributed to personnel unaware of correct practices and procedures. Throughout the survey it was apparent that individual shop managers did not understand the operation of the overall program, or their contribution within that program. Many shop personnel did not know whether their shop discharged to a storm drain or the sanitary sewer system; consequently, they had no idea where their particular discharge was destined, or if the discharge was allowed under current regulations.

3. Several shops are not adequately segregating wastes. Hydraulic fluid was observed in the fire training pit, indicating either illegal dumping or mixing of hydraulic fluid with waste JP-4. Vehicle maintenance shop personnel are disposing of their waste paints and thinners in their waste oil tank; and several accumulation sites have mixed fluids drums with undocumented contents. Additionally, the Bldg 52 accumulation site was the only storage site that had secure drums, although the Bldg 92 site was enclosed by a fence. Illegal mixing of wastes often occurs at sites when access is not controlled and drums are not secured. None of the shops keep individual records or logs of generated waste amounts and disposal practices. Sample results from two drums of supposed waste Safe-T-Sol generated at the Wheel and Tire shop showed that the waste was a mixture of PD-680, 1,1,1-trichloroethane, and Safe-T-Sol. The addition of 1,1,1 trichloroethane to the barrel changed the drums classification to a hazardous waste by the mixing rule.

4. Generally, the waste accumulation sites at Reese AFB are not in compliance with RCRA standards. The Bldg 52 site is the only one which has a cement floor and dike, is secure, and is covered. The remainder of the sites are deficient in one or more of these three areas. Additionally, each site does not have a central manager responsible for monitoring access and keeping records of the amounts and types of wastes deposited. The Base Temporary Storage Facility also has several deficiencies which should be corrected. The site is not secure;

personnel are not monitored while depositing wastes; and there is a large storm drain opening at the corner of the site which discharges to the industrial lake. Illegal dumping into this drain could easily occur.

5. Historical analytical data on each waste and wastestream being generated on Reese AFB are important components of a comprehensive waste management program. There are several wastes on Reese AFB which are being disposed of without adequate baseline information to validate the particular disposal practice:

a. The battery shop in Bldg 52 disposes of all waste battery acid as hazardous waste; however, it is possible that the acid could be neutralized and disposed of in the sanitary sewer system if analytical results confirm the neutralized solution is not hazardous.

b. Filters from the dry paint booths on base (corrosion control, auto hobby shop, and vehicle maintenance) are being disposed of in the trash without baseline characteristic hazardous waste results. These filters often have levels of toxic metals, usually chromium, which classify them as a hazardous waste.

c. Wastewater and sludge from the waterfall paint booth at the vehicle maintenance shop are being disposed of without baseline analyses. The wastewater is being discharged to the storm drain and the sludge is being disposed of in the trash.

d. Wastewater from the Bldg 59 corrosion control shop is being discharged to the storm drain without baseline analysis. This shop performs small parts stripping which is rinsed into the paint booth trough, then discharged with the wastewater. High levels of trichloroethene and other chlorinated hydrocarbons were found in this discharge.

e. Several wastes generated by the Chemical Cleaning shop are being disposed of without test documentation to show that the wastes are not hazardous. Wastewater from the hot rinse tank in Bldg 60, and from the cadmium and chromium trioxide rinse tanks in the plating shop are being discharged to the storm drain. Waste from the bead blasting operation is being put in plastic bags and thrown in the trash. Each of these wastes could have significant concentrations of toxic metals.

f. Personnel in Bldg 82, Air Repair, and Bldg 92, T-38 Maintenance shops, are drumming spent soap solution used for floor cleaning without adequate documentation. This waste has not been characterized as hazardous by past analyses.

g. A number of other wastes in the Vehicle Maintenance shop are being disposed of improperly. Waste paints and thinners are disposed of in the shop's waste oil tank. Waste antifreeze is being drummed as hazardous waste. Antifreeze is biodegradable and can usually be discharged to the sanitary sewer system after dilution with water. Caustic soda from the shop's radiator cleaning vat is being discharged down the drain. The pH of caustic soda generally classifies this waste as hazardous.

h. Personnel from the CE Power Production shop are neutralizing spent batteries, and using spent PD-680 to clean their equipment on the Heavy Equipment Maintenance washrack.

i. Customers at the Auto Hobby shop are responsible for disposing of their own paint and thinner wastes, however, no guidance or adequate disposal containers are provided for this purpose. Consequently, it is possible that a significant amount of these wastes are disposed of down the drain.

j. NDI personnel are disposing of their waste inspection chemicals down the drain. The shop is supposed to use the Bldg 92 accumulation site for drummed wastes, however, no drums from the NDI shop have been disposed of in the past year. Spent penetrant, emulsifier, and magnaflux need to be tested for characteristic hazardous waste to determine proper disposal practices. Recent sampling results indicated that the shop's fixer/developer photographic wastestream was ignitable at 88 degrees Fahrenheit, and thus considered hazardous waste. At the time of this survey it was also being discharged down the drain.

k. Photographic fixer/developer wastes from the hospital x-ray and dental labs are being discharged down the drain without baseline analytical results.

l. Spent cleaning rags throughout the base are being disposed of in the trash. These rags could possibly be recycled and reused through an exchange program with the Base or commercial linen service.

6. Waste minimization practices at Reese AFB could prove very effective for reducing the amounts of solvent degreasing, and paint thinner wastes. Reese AFB personnel generate over 2500 gallons per year of waste paint and thinners, with the great majority of this waste being attributed to thinners. Personnel also generate more than 2000 gallons per year of degreasing solvents. According to a report by NEESA (4), the Naval Energy and Environmental Support Activity, these wastes can be effectively reclaimed through the use of solvent recovery stills. The minimum amount of waste needed for the recovery program to be cost effective is 500 gallons per year for solvent degreasers, and 700 gallons per year for paint thinners; however, these amounts will depend on the purchase and disposal costs of the particular compound. Attachment 6 shows the equation and assumptions used to calculate break-even values.

7. Stills have been very effective in recovering paint thinning compounds such as methyl ethyl ketone, toluene, and other epoxy and enamel thinners. The recovered compounds do not have the same component proportions as the originals, and thus should not be reused as thinners; however, they are suitable for reuse as spray gun and painting equipment cleaners. Polyurethane paint and thinner mixtures are apparently not amenable to solvent recovery because the waste tends to clog the still. Personnel could possibly minimize these wastes through volatilization of the thinner, by allowing the polyurethane mixture to harden before the waste is drummed.

8. Reclamation of degreasing solvents could be very cost effective, particularly since the base is in the process of converting from PD-680 to Safe-T-Sol. The latter is a limonene solvent which poses less of an occupational exposure hazard, but costs four to five times as much as PD-680. A list of the shops still utilizing PD-680 at the time of this survey is included as Attachment 3 Tab D. Limonene is a biodegradable compound; consequently, the base is currently sampling spent Safe-T-Sol to see if it can be disposed of down the sanitary sewer system. Even if results indicate that this method of disposal is a feasible option, reclamation and reuse of the spent Safe-T-Sol has the potential for significant savings of dollars. Here

again, the reclaimed solvent will not have the same component proportions as the original solvent, but this is usually not critical for cold cleaning applications. Reprint of the NEESA report 20.3-012, "In-House Solvent Reclamation" (6), is included as Attachment 6.

VI. RECOMMENDATIONS

1. All hazardous constituents must be eliminated from the sanitary and storm drainage system. This can be accomplished by product substitution, waste minimization, and hazardous waste containment, or pretreatment.

2. Drains from the industrial shops connected to the storm drainage system need to be routed into the sanitary sewer system. The sewage treatment plant needs to be upgraded to provide biological treatment of substances such as detergents and biodegradable solvents such as Safe-T-Sol. These chemicals are not hazardous substances but are industrial chemicals needing to be degraded before the playa. The engine test cell should be sewered. The fire training pit should be constructed on an impervious slab with diking to prevent chemicals from percolating into the soil.

3. The solution ultimately to the industrial waste disposal problem may be for the base to connect with the closest trunk sewer in the county. The existing plant could be converted into a pretreatment plant if necessary to comply with the effluent limitations of the county. The planning for the closure of the industrial lake should continue with the ultimate recovery of the site and the continued groundwater monitoring program a future goal.

4. Positive control measures (locked valves) should be installed in drains near hazardous waste generating operations to prevent hazardous waste entering the storm or sanitary system.

5. A comprehensive waste management training program for accumulation site managers and shop personnel which integrates the offices of the Base Environmental Coordinator and the Base Bioenvironmental Engineer should be developed. The program should address applicable hazardous and solid waste regulations, health hazards associated with each shop's specific chemicals, environmental and regulatory consequences of illegal disposal practices, proper handling, segregation, and transportation practices, and information on the abilities and limitations of oil/water separators to handle various wastestreams.

6. Individual shop managers and accumulation site managers should keep monthly logs which detail the amounts and types of waste generated by the shop or stored at the accumulation site. These records should be periodically checked for agreement with those kept by the environmental coordinator.

7. In order to facilitate proper segregation of wastes, each shop should have a separate waste collection container for each type of waste generated by the shop. The container should be clearly marked, labeled, and placed in a visible and easily accessible location in the shop.

8. Hazardous waste accumulation sites, including the Base Temporary Storage Facility, at Reese AFB should be upgraded so that each site has a cement floor and dike, is covered, and is secure from tampering and unauthorized dumping. Each site should have a central monitor responsible for controlling the influx of all wastes to be temporarily stored at the site.

9. The storm drain at the Base Temporary Storage Facility should be sealed to prevent any possible illegal discharge of wastes. Additionally, waste drums at the site should be placed on the concrete pad, and not on the bare ground.

10. The Base Bioenvironmental Engineer and Environmental Coordinator should work together to develop a baseline hazardous waste analysis plan. The plan should consist of routine sampling to characterize and establish background data on all hazardous wastestreams and operations on Reese AFB, including random spot check sampling of hazardous waste drums. The following wastes should be sampled as soon as possible and analyzed for characteristic hazardous waste, i.e., Corrosivity, Ignitability, Reactivity, and EP Toxicity:

a. Spent filters from the paint booths at the Bldg 102 Corrosion Control, Auto Hobby, and Vehicle Maintenance shops.

b. Wastewater and sludge from the waterfall paint booths at the Vehicle Maintenance and Bldg 59 Corrosion Control shops.

c. Wastewater from the hot rinse tank and waste from the bead blasting facility in Bldg 60, Chemical Cleaning.

d. Rinsewater from the cadmium plating and chromium trioxide tanks in the electroplating shop in Bldg 59.

e. The spent soap solution drummed by the Bldg 82 Air Repair shop, and the building 92 T-38 Maintenance shop.

f. The discharge from the caustic soda vat at the Vehicle Maintenance shop.

g. All wastes generated by the NDI shop, including spent penetrant, emulsifier, magnaflux, and the fixer/developer photographic wastestream.

h. Photographic fixer/developer wastestreams from the hospital x-ray lab and the dental clinic.

i. Waste antifreeze from the Vehicle Maintenance shop.

11. The Auto Hobby shop should provide a hazardous waste drum for disposal of waste paints and thinners generated by the patrons. All customers using the shop's painting facilities should be trained in correct waste disposal practices by shop personnel.

12. Vehicle Maintenance shop personnel should immediately discontinue disposing of their paint and thinner wastes in their waste oil tank. Paint and thinner wastes should be drummed and disposed of as hazardous waste.

13. Vehicle Maintenance shop personnel should discontinue drumming and disposing of waste antifreeze as hazardous waste without baseline data. Waste antifreeze is biodegradable and can be diluted and disposed of down the sanitary sewer system if sampling results indicate that it is not hazardous from metal contamination.

14. DEEV personnel should investigate the possibility of establishing a base wide program to recycle spent rags through the base laundry or a commercial linen service.

15. Reese AFB DEEV personnel should investigate the economic feasibility of using solvent stills to reclaim paint thinners and spent solvent wastes. If the study indicates that this approach would not be economical, and sampling results indicate that spent Safe-T-Sol cannot be discharged down the drain without pretreatment, then the Base should consider procuring a service contract with a solvent company such as Safety Kleen Corp that supplies new solvent and hauls off spent solvent, eliminating the bases hazardous waste responsibilities.

REFERENCES

1. APHA, Standard Methods for the Examination of Water and Wastewater, 16th Ed., American Public Health Association, Washington DC, (1985).

2. SEPA, Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-020, Cincinnati OH, (1983).

3. USEPA, Test Methods for Evaluating Solid Waste, SW-846, 3d. Ed., (1986).

4. Office of the Federal Register, Protection of the Environment, 40CFR Part 261 App. VIII, (1986)

5. Texas Industrial Waste Management Rules, Texas Administrative Code, 335.15 (1986).

6. NEESA, In-House Solvent Reclamation, NEESA 20.3-012, Naval Energy and Environmental Support Activity, Port Hueneme CA, (1984).

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Attachment 1

Site Analysis Summary

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SITE/ANALYSIS SUMMARY

Site Number

Parameters	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Chemical Oxygen Demand	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
pH	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Temperature	X	X	X	X	X	X		X	X	X	X	X	X	X	X
Oils and Grease	X	X	X	X		X				X	X		X	X	
Phenols	X	X	X	X				X		X					
Pesticides	X	X	X	X											
Volatile Hydrocarbons	X	X	X	X		X			X	X				X	
Acid/Base/Neutrals	X	X	X	X		X			X	X				X	
Total Organic Carbon	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Metals	X	X	X	X	X		X	X		X	X				
Total Cyanide	X	X	X	X			X	X		X					
Nitrate-Nitrite	X	X	X	X											
Ammonia	X	X	X	X											
Kjeldahl Nitrogen	X	X	X	X											
Total Phosphorous	X	X	X	X											
Total Suspended Solids	X	X	X	X											
Phenols	X	X	X	X				X		X					
PCBs	X	X	X	X					X	X					
Pesticides	X	X	X	X					X	X					
Pet. Hydrocarbons	X	X	X	X		X						X		X	
Chlorides	X	X	X	X											
Surfactants (MBAS)	X	X	X	X		X					X			X	
Char. Haz. Waste.	X	X	X	X		X			X				X	X	X

Site Number

Parameter	16	17	18	19	20	21	22
Chemical Oxygen Demand	X	X	X	X	X	X	X
pH	X	X	X	X	X	X	X
Temperature	X	X			X		
Oils and Grease		X				X	
Phenols							
Pesticides							
Volatile Hydrocarbons	X		X	X	X	X	
Acid/Base/Neutrals	X		X	X	X	X	
Total Organic Carbon	X	X	X	X	X	X	X
Metals				X			
Total Cyanide							
Nitrate-Nitrite							
Ammonia							
Kjeldahl Nitrogen							
Total Phosphorous							
Total Suspended Solids							
Sulfate							
Surfactants-MBAS	X	X				X	
Phenols							
PCB							
Pesticides							
Pet. Hydrocarbons							
Chlorides							
Surfactants	X	X				X	
Char. Haz. Waste	X	X	X	X	X	X	X

Attachment 2

Waste Disposal Survey Form

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Shop: Building Number:
Shop Supervisor: Autovon:
Shop Duties:

CATAGORIES OF WASTE AND DISPOSAL METHODS

TYPE OF WASTE	DISPOSAL METHOD *(D,DD)	AMOUNT GENERATED (per month)	COMMENTS
1. PAINT WASTES			
2. WASTE THINNERS			
3. $ STRIPPING WASTE			
4. $ WASTE ACIDS			
5. WASTE BATTERY ACID			
6. $ SOAPS			
7. $ OILS			
8. TRANSMISSION FLUID			
9. BRAKE FLUID			
10. HYDRAULIC FLUID			
11. JET FUEL			
12. AUTOMOTIVE FUEL			
13. ANTIFREEZE			
14. $ SOLVENTS			
15. $ DEGREASANTS			
16. $ PHOTO WASTES			
17. $			

$ specify the types used on next page
* USED DISPOSAL CODES BELOW:

D-DRUMMED
RTT-RETURNED TO FUEL TANKS
UIP-USED IN PROCESS
DD-DOWN DRAIN
FTP-GOES TO FIRE TRAINING PIT
KIT-KEPT IN TANK
NDD-NEUTRALIZED FIRST THEN PLACED DOWN DRAIN
O-OTHER (specify)
RDD-RINSED OFF AND RINSEWATER GOES DOWN DRAIN
E-EVAPORATED
SRDD-SILVER RECOVERY UNIT THEN DOWN DRAIN
NA-NOT APPLICABLE

SPECIFIC CHEMICALS USED

STRIPPERS

Name of Stripper	Manufacturer	Amt used/wk	National Stock Number

SOLVENTS/DEGREASANTS

Name of Solvent	Manufacturer	Amt used/wk	National Stock Number

SOAPS

Name of Soap	Manufacturer	Amt used/wk	National Stock Number

OILS

Name of Oil	Amt used/week	Disposal Method

Chemical listing (cont.)

ACIDS

Name of Acid	Manufacturer	Amt used/wk	National Stock Number

PHOTO CHEMICALS

Name of Chemical	Manufacturer	Amt used/wk	National Stock Number

NDI CHEMICALS

Name of Chemical	Manufacturer	Amt used/wk	National Stock Number

Other Chemicals Not Listed

Name of Chemical	Manufacturer	Amt used/wk	National Stock Number

Shop supervisors signature: ______________________

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Attachment 3

Categories and Quantities of Waste
Generated at Reese AFB

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CATEGORIES AND QUANTITIES OF WASTE GENERATED AT REESE AFB

CATEGORY 1: WASTE FUELS

SHOP DISPOSAL	PRODUCT	YEARLY QTY. (GALS)	METHOD(*)
Jet Engine Test Cell	JP-4	600.0	DD/FTP
Propulsion Branch	JP-4	300.0	D
Fuel System Repair	JP-4	330.0	DD/FTP
AGE	JP-4	24.0	D
CE Power Production	Diesel Fuel	12.0	D
Flight line Maintenance (T-38)	JP-4	1200.0	PIT/FTP
ACE Flight (T-37)	JP-4	540.0	PIT/FTP
Liquid Fuels Maintenance	JP-4	7000.0	RTT/FTP
	TOTAL:	10006.0	

*refer to Attachment 2 for the Key to disposal codes

CATEGORY 2: WASTE OIL

SHOP DISPOSAL	PRODUCT	YEARLY QTY. (GALS)	METHOD
Jet Engine Test Cell	7808 Oil	480.0	D
AGE	Lube and Engine Oils	660.0	D
Wheel and Tire	Lube Oil	24.0	D
Propulsion Branch (J-85, J-69)	Engine Oil	1320.0	D
NDI	Engine Oil	60.0	D
Auto Hobby Shop	Motor Oil	1020.0	PIT
Vehicle Maintenance	Motor Oil	1920.0	PIT
Heavy Equipment Maint.	Motor Oil	60.0	D
Power Production	Motor Oil	120.0	D
Flight Line Maintenance (T-38)	7808 Oil	360.0	D
Ace Flight (T-37)	7808 Oil	1080.0	D
Ground Equipment Maintenance	Motor Oil	120.0	D
BX Service Station	Motor Oil	1500.0	PIT
	TOTAL:	8724.0	

CATEGORY 3: WASTE FLUIDS

SHOP DISPOSAL	PRODUCT	YEARLY QTY. (GALS)	METHOD
AGE	Hydraulic Fluid	660.0	D
Pneudraulics	Hydraulic Fluid	360.0	D
Propulsion Branch	Hydraulic Fluid	660.0	D
Machine Shop	Hydraulic Fluid	50.0	D
Vehicle Maintenance	Brake, Transmission and Hydraulic Fluids	480.0	PIT
Flight Line Maintenance (T-38)	Hydraulic Fluid	600.0	D
ACE Flight (T-37)	Hydraulic Fluid	480.0	D
Grounds Equipment Maint.	Brake Fluid	12.0	D
BX Service Station	Brake and Transmission Fluid	500.0	PIT

TOTAL: 3742.0

CATEGORY 4: WASTE SOLVENTS AND STRIPPERS

SHOP DISPOSAL	PRODUCT	YEARLY QTY. (GALS)	METHOD
AGE	PD-680	600.0	D
Wheel and Tire Shop	Safe-T-Sol	320.0	D
Pneudraulics	Safe-T-Sol	360.0	D
Chemical Cleaning	Safe-T-Sol, and Hot Stripper	720.0	D
Propulsion Branch	Safe-T-Sol, Carbon Remover, and PD-680	960.0	D
Fuel System Repair	PD-680	50.0	D
Machine Shop	Safe-T-Sol	50.0	D
CE Power Production	PD-680	30.0	DD
Flight Line Maintenance (T-38)	Safe-T-Sol	120.0	D
Grounds Equipment Maint.	Naphtha	35.0	D
Bldg 59 Corrosion Control	Stripper	12.0	D
	TOTAL:	3257.0	

CATEGORY 5: WASTE PAINTS AND THINNERS

SHOP DISPOSAL	PRODUCT	YEARLY QTY. (GALS)	METHOD
Bldg 59 Corrosion Control	Paints and Thinners	1320.0	D
Bldg 102 Corrosion Control	Paints and Thinners	1200.0	D
CE Paint Shop	Paints and Thinners	180.0	D
Vehicle Maintenance	Paints and Thinners	360.0	PIT
	TOTAL:	3060.0	

CATEGORY 6: NDI AND PHOTOGRAPHIC WASTES

SHOP DISPOSAL METHOD	PRODUCT	YEARLY QTY. (GALS)	METHOD
NDI	Penetrant and Emulsifier	220.0	D
NDI	Waste Magnaflux	40.0	DD
NDI	Developer, Fixer, Activator and Stabilizer	240.0	DD
Reproduction	Blanket Cleaner and Copier Dispersant	144.0	D
Photo Shop	Developer	60.0	DD
	TOTAL:	704.0	

CATEGORY 7: WASTE ACIDS AND BASES

SHOP DISPOSAL	PRODUCT	YEARLY QTY. (GALS)	METHOD
Chemical Cleaning	Sulfuric, Hydrochloric, and Phosphoric Acids	120.0	UIP
NDI	Developing Acids	24.0	DD
Bldg 59 Corrosion Control	Alodine	24.0	DD
Bldg 102 Corrosion Control	Alodine	72.0	UIP
Vehicle Maintenance	Waste Sodium Hydroxide	70.0	DD
CE Power Production	Battery Acid	36.0	NDD
Bldg 52 Battery Shop	Battery Acid	75.0	D
	TOTAL:	421.0	

Attachment 4

Wastewater Characterization Analyses Results

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TEMPERATURE, pH, AND CONDUCTIVITY RESULTS

Site	Date	Temp (C)	pH	Conductivity (µmhos)
1	23 Sep 87	25	7.21	70
1	24 Sep 87	25	7.33	330
1	25 Sep 87	25	7.65	330
1	28 Sep 87	--	7.58	620
1	29 Sep 87	26	7.45	422
2	23 Sep 87	21.8	7.8	710
2	24 Sep 87	24.5	7.65	720
2	25 Sep 87	24.5	7.53	410
2	28 Sep 87	--	7.52	680
2	29 Sep 87	26	7.75	342
3	23 Sep 87	22	8.31	61
3	24 Sep 87	21	8.63	117
3	25 Sep 87	19.5	8.66	108
3	28 Sep 87	--	9.08	71
3	29 Sep 87	21	9.09	89
4	23 Sep 87	22	7.4	550
4	24 Sep 87	22.5	7.65	720
4	25 Sep 87	21.5	7.52	400
4	28 Sep 87	--	7.43	209
4	29 Sep 87	22	7.59	181
5	23 Sep 87	20	7.07	160
6	28 Sep 87	--	6.58	460
7	23 Sep 87	24	7.32	250
8	23 Sep 87	19	7.78	270
9	28 Sep 87	--	8.22	620
10	24 Sep 87	17	7.47	170
11	24 Sep 87	22	7.41	250
12	25 Sep 87	19.5	6.92	160
13	25 Sep 87	22	8.51	620
14	28 Sep 87	20.5	7.22	385
15	28 Sep 87	19	7.78	250
16	28 Sep 87	--	8.42	255
17	28 Sep 87	17.5	8.09	324
18	29 Sep 87	--	6.51	470
19	29 Sep 87	--	8.12	305
20	29 Sep 87	23	8.42	730
21	29 Sep 87	--	7.45	--
22	30 Sep 87		7.92	340

TOTAL NONFILTERABLE RESIDUE

1	Sewage Treatment Influent	84
2	Sewage Treatment Effluent	9
3	Industrial Lake	9
4	Main Oil/water Separator	21

EPA METHOD 8240 GC/MS METHOD FOR VOLATILE ORGANICS RESULTS

Site	Date	Description	Parameter	Result (μg/L)
1	29 Sep 87	Influent STP	chloroform	BDL
			toluene	BDL
			1,2- & 1,4-dichlorobenzene	30
1	30 Sep 87	Influent STP	trichlorofluoromethane	3.7
			1,2- & 1,4-dichlorobenzene	6.7
			toluene	BDL
2	29 Sep 87	Effluent STP	1,2- & 1,4-dichlorobenzene	BDL 2
	30 Sep 87	Effluent STP	trichlorofluoromethane	3.5
			1,2- & 1,4-dichlorobenzene	5.5
			toluene	BDL
3	29 Sep 87	Industrial Lake	1,1,1-trichloroethane	BDL
3	30 Sep 87	Industrial lake	1,1,1-trichloroethane	BDL
			tetrachloroethene	BDL
4	29 Sep 87	Main o/w Sep.	trans-1,2-dichloroethene	37
			1,1,1-trichloroethane	7.9
			trichloroethene	77
			tetrachloroethene	110
			toluene	BDL
4	30 Sep 87	Main o/w Sep.	dichloromethane	32
			trans-1,2-dichloroethene	100
			1,1,1-trichloroethane	96
			trichloroethene	320
			tetrachloroethene	230
			toluene	BDL
			1,2- & 1,4-dichlorobenzene	17
6	28 Sep 87	Fire Training Pit	benzene	180
			toluene	440
			ethylbenzene	37
9	29 Sep 87	Photo lab	1,2- & 1,4-dichlorobenzene	150
10	29 Sep 87	Chemical cleaning	1,1-dichloroethane	BDL
			trans-1,2-dichloroethene	4.9
			1,1,1-trichloroethane	110
			tetrachloroethene	9.6
			1,3-dichlorobenzene	8.3
			1,2- & 1,4-dichlorobenzene	23
			trichloroethene	4.6

EPA METHOD 8240 (CONT)

Site	Date	Description	Parameter	Result (µg/L)
10	30 Sep 87	Chemical cleaning	trans-1,2-dichloroethene	2.3
			1,1,1-trichloroethane	16
			chlorodibromomethane	BDL
			tetrachloroethene	BDL
			1,3-dichlorobenzene	8.6
			1,2- & 1,4-dichlorobenzene	11
14	29 Sep 87	Corrosion Cont. bldg. 96	tetrachloroethene	6.1
			toluene	91
			ethylbenzene	BDL
15	29 Sep 87	Corrosion Control	vinyl chloride	120
			chloroethane	27
			dichloromethane	21
			1,1-dichloroethane	640
			1,1-dichloroethene	110
			trans-1,2-dichloroethene	41
			1,1,1-trichloroethane	6500
			trichloroethene	2.8
			tetrachloroethene	13
			toluene	15
			1,3-dichlorobenzene	10
			1,2- & 1,4-dichlorobenzene	87
			total Xylene	12
			ethylbenzene	BDL
16	29 Sep 87	Hangars 82/92	1,1,1-trichloroethane	1400
18	28 Sep 87	Engine Test Cell	benzene	2200
			toluene	9800
			ethylbenzene	4500
19	29 Sep 87	Hospital	1,2- & 1,4-dichlorobenzene	28
			1,1,1-trichloroethane	BDL
			chlorodibromomethane	BDL
20		Comm. maint.	1,2- & 1,4-dichlorobenzene	110
21	30 Sep 87	Transportation	benzene	BDL
			1,2- & 1,4-dichlorobenzene	30

DETECTED EPA METHOD 604 PHENOLS CONCENTRATION RESULTS

Site	Date	Description	Compound	µg/L
1	23 Sep 87	STP Influent	Phenol	13.
			Methyl phenol isomer	24.
1	24 Sep 87		Phenol	4.5
1	25 Sep 87		Phenol	6.0
1	28 Sep 87		Phenol	17.0
			Methyl phenol isomer	40.0
1	29 Sep 87		Phenol	6.5
2	23 Sep 87		None detected	--
2	24 Sep 87		None detected	--
2	25 Sep 87		None detected	--
2	28 Sep 87		None detected	--
2	29 Sep 87		Nonyl phenol	.91
			4-Tetramethyl isobutyl phenol	.66
3	23 Sep 87	Industrial Lake	None detected	--
3	24 Sep 87		None detected	--
3	25 Sep 87		None detected	--
3	28 Sep 87		None detected	--
3	29 Sep 87		None detected	--
4	23 Sep 87	Main o/w sep.	2,4-Dimethyl phenol	16.
4	24 Sep 87		2,4-Dimethyl phenol	5.8
4	28 Sep 87		Phenol, nonyl	22.
4	29 Sep 87		Phenol	.65
8	23 Sep 87	NDI	Phenol	5.4
			Methyl phenol isomer	15.0
10	24 Sep 87	Chemical cleaning	None detected	--
10	25 Sep 87	Chemical cleaning	None detected	--

EPA METHOD 608 RESULTS FOR PESTICIDES AND PCBs

Site	Date	Description	Parameter	Result
1	23 Sep 87	Influent STP	PCB, Pesticide	ND
1	25 Sep 87		PCB, Pesticide	ND
1	28 Sep 87		PCB, Pesticide	ND,ND
1	29 Sep 87		PCB, Pesticide	ND,ND
2	23 Sep 87	Effluent STP	PCB	ND
2	24 Sep 87		PCB	ND
2	25 Sep 87		PCB	ND
2	28 Sep 87		PCB, Pesticide	ND,ND
2	29 Sep 87		PCB Pesticide	ND,ND
3	23 Sep 87	Industrial Lake	PCB	ND
3	24 Sep 87		PCB	ND
3	25 Sep 87		PCB	ND
3	28 Sep 87		PCB, Pesticide	ND,ND
3	29 Sep 87		PCB, alpha-BHC	ND, 0.06 µg/L
4	23 Sep 87	Main o/w separator	PCB	*
4	24 Sep 87		PCB	ND
4	28 Sep 87		PCB, Pesticide	ND,ND

* indicates sample was lost in a laboratory accident

EPA METHOD 8270 GC/MS METHOD FOR SEMIVOLATILE ORGANICS RESULTS

Site	Date	Description	Parameter	Result (µg/L)
1	28 Sep 87	Influent STP	diethyl phthalate	13
			di-n-butyl phthalate	11
			bis(2-ethylhexyl) phthalate	80
1	29 Sep 87	Influent STP	1,3-dichlorobenzene	2.7
			diethyl phthalate	5.1
			di-n-butyl phthalate	3.6
			bis(2-ethylhexyl)phthalate	200
2	28 Sep 87	Effluent STP	diethyl phthalate	7.1
			di-n-butyl phthalate	3.2
			bis(2-ethylhexyl)phthalate	15
2	29 Sep 87	Effluent STP	bis(2-ethylhexyl)phthalate	6.6
2	30 Sep 87	Effluent STP		
3	28 Sep 87	Industrial Lake	1,3-dichlorobenzene	3.2
			1,4-dichlorobenzene	9.9
			bis(2-ethylhexyl)phthalate	26
			diethylphthalate	BDL
3	29 Sep 87	Industrial lake	diethyl phthalate	4.2
			di-n-butyl phthalate	7.5
			bis(2-ethylhexyl)phthalate	25
4	28 Sep 87	Main o/w Sep	1,4-dichlorobenzene	14
			diethyl phthalate	14
			di-n-butyl phthalate	5.8
			bis(2-ethylhexyl)phthalate	75
			naphthalene	BDL
4	29 Sep 87	Main o/w Sep	diethyl phthalate	BDL
			bis(2-ethylhexyl)phthalate	45
9	28 Sep 87	Photo lab	phenol	63
			1,4-dichlorobenzene	120
			diethyl phthalate	6.8
			bis(2-ethylhexyl)phthalate	46
10	28 Sep 87	Chemical cleaning	1,3-dichlorobenzene	6.6
			1,2-dichlorobenzene	BDL
			diethyl phthalate	BDL
			bis(2-ethylhexyl)phthalate	6.9
10	29 Sep 87	Chemical cleaning	1,3-dichlorobenzene	5.8
			1,2-dichlorobenzene	11
			di-n-butyl phthalate	BDL
			bis(2-ethylhexyl)phthalate	6.7

EPA METHOD 8270 GC/MS METHOD FOR SEMIVOLATILE ORGANICS RESULTS

Site	Date	Description	Parameter	Result (µg/L)
14	28 Sep 87	Cor. Control	bis(2-ethylhexyl)phthalate	75
15	29 Sep 87	Cor. Cont. bldg. 59	1,3-dichlorobenzene	BDL
			1,4-dichlorobenzene	BDL
			1,2-dichlorobenzene	14
			diethyl phthalate	2.4
			bis(2-ethylhexyl)phthalate	18
16	28 Sep 87	Hangars 82/92	1,3-dichlorobenzene	3.5
			1,4-dichlorobenzene	3.6
			1,2-dichlorobenzene	54
			diethyl phthalate	5.0
			di-n-butyl phthalate	3.0
			bis(2-ethylhexyl)phthalate	220.0
19	29 Sep 87	Hospital	phenol	3.8
			1,3-dichlorobenzene	BDL
			1,2-dichlorobenzene	18
			di-n-butyl phthalate	10
			bis(2-ethylhexyl)phthalate	20
20		Comm Maint.	1,4-dichlorobenzene	150.
			diethyl phthalate	8.4
			di-n-butyl phthalate	3.7
			bis(2-ethylhexyl)phthalate	80
21		Transportation	1,4-dichlorobenzene	130
			diethyl phthalate	7.1
			d-n-butyl phthalate	2.8
			bis(2-ethylhexyl)phthalate	87
22		BX Service Station	bis(2-ethylhexyl)phthalate	10

OTHER ORGANIC AND INORGANIC CHEMICAL ANALYSES RESULTS

Site	1	2	3	4	5	6	7	8
	(avg)	(avg)	(avg)	(avg)				
Parameter								
COD	163	42	27	166	100	1500	120	2050
TOC	58	13	10	44	40	470	67	420
Oils & Grease	26.5	<1.0	<.3	11.6	1840			
Ext. Pet. Hydro.	15.2	<11.2	<1	8.2	1326			
Ammonia	25.6	24.3	<.2	3.1				
Nitrate	<0.1	<.22	<.01	.17				
Nitrite	<0.2	<7.2	<.02	.04				
TKN	42	27.8	<2.0	.4				
Phosphorous	11.3	8.1	.5	10.0				
Cyanide	.01	.02	<.01	<.01				
Arsenic	<.01	<.01	<.01	<.01	<.01			
Cadmium	<.01	<.01	<.01	<.02	<.01			
Chromium	<.05	<.05	<.05	<.05	<.05			
Copper	<26.8	<.02	<.02	.08	<.02			
Lead	<.02	<.02	<.02	<.02	<.02			
Mercury	<.001	<.001	<.001	<.001	<.001			
Nickel	<.05	<.05	<.05	<.06	<.05			
Selenium	<.01	<.01	<.01	<.01	<.01			
Silver	<.011	<.01	<.01	<.01	<.01			
Zinc	172.2	<.05	<.05	.093	.068			
Antimony	<.01	<.01	<.01	<.01	<.01			
Beryllium	<.01	<.01	<.01	<.01	<.01			
Thallium	<.01	<.01	<.01	<.01	<.01			
Chloride	56	66.4	2.3	11				
TSS	105.6	30.0	14.4	23.2				
Sulfate	26.6	48.4	7.8	34.8				
Surfactants	4.1	28	<1.5	.42				0.2

OTHER ORGANIC AND INORGANIC CHEMICAL ANALYSES RESULTS (cont.)

Site / Parameter	9	10 (avg)	11	12	13	14	15
COD	365	15	75	720	410	275	27
TOC	87	6	42	69	79	68	9
Oils & Grease		B	7.8			12.9	
Ext. Pet. Hydro.		B	4.3			10.1	
Ammonia							
Nitrate							
Nitrite							
TKN							
Phosphorous							
Cyanide	.76	<.01					
Arsenic	<.01	<.01				<.01	
Cadmium	.011	<.01				.014	1.463
Chromium	.050	<.05				<.05	1.814
Copper	.024	<.02				.07	.177
Lead	<.020	<.20				<.02	<.02
Mercury	<1	<1				<1	<1
Nickel	<.050	<.50				<.05	.062
Selenium	<.010	<.01				<.01	<.01
Silver	.555	<.01				<.01	<.01
Zinc	.365	<.05				.220	.846
Antimony	<.010	<.01				<.01	.014
Beryllium	<.010	<.01				<.01	<.01
Thallium	<.010	<.01				<.01	<.01
Chloride							
TSS							
Sulfate							
Surfactants			<.1			0.3	

ORGANIC AND INORGANIC CHEMICAL ANALYSES RESULTS (cont.)

Site	16	17	18	19	20	21	22
Parameter							
COD	412	<10	7600	75	175	80	190
TOC	115	7	2400	17	52	25	50
Oils & Grease		0.6				0.6	
Ext. Petro. Hydro.		<1				<1	
Ammonia							
Nitrate							
Nitrite							
TKN							
Phosphorous							
Cyanide							
Arsenic				<.01			
Cadmium				<.01			
Chromium				<.05			
Copper				.043			
Lead				<.02			
Mercury				<1			
Nickel	.12	<.01		<.05	<.05	<.05	<.05
Selenium				<.01			
Silver				.011			
Zinc				.064			
Antimony				<.010			
Beryllium				<.010			
Thallium							
Chloride							
TSS							
Sulfate							
Surfactants	18	<.1				<.1	

B = broken in transit or at the analytical laboratory
BDL = Detected but at a level below the methods published detection limit

CHARACTERISTIC HAZARDOUS WASTE ANALYSES

		EP TOX mg/l								Ig.	Cor.	React.		
Site	Date	As	Ba	Cd	Cr	Pb	Hg	Se	Ag	140F	pH	CN	S	Spec
1	9/23	<.01	<1.0	<.01	0.25	<.1	<.001	<.01	<.01	N	N	N	N	W
1	9/24	<.01	<1.0	<.01	0.27	<.1	<.001	<.01	<.01	N	N	N	N	W
1	9/25	<.01	<1.0	<.01	0.26	<.1	<.001	<.01	<.01	N	N	N	N	W
1	9/28	<.01	<1.0	<.01	<.05	<.1	<.01	<.01	<.01	N	N	N	N	W
1	9/29	<.01	<1.0	<.01	<.05	<.1	<.01	<.01	<.01	N	N	N	N	W
2	9/23	<.01	<1.0	<.01	0.26	<.1	<.001	<.01	<.01	N	N	N	N	W
2	9/24	<.01	<1.0	<.01	0.28	<.1	<.001	<.01	<.01	N	N	N	N	W
2	9/25	<.01	<1.0	<.01	0.38	<.1	<.001	<.01	<.01	N	N	N	N	W
2	9/28	<.01	<1.0	<.01	<.05	<.1	<.01	<.01	<.01	N	N	N	N	W
3	9/23	<.01	<1.0	<.01	0.24	<.1	<.001	<.01	<.01	N	N	N	N	W
3	9/24	<.01	<1.0	<.01	0.27	<.1	<.001	<.01	<.01	N	N	N	N	W
3	9/25	<.01	<1.0	<.01	0.27	<.1	<.001	<.01	<.01	N	N	N	N	W
3	9/28	<.01	<1.0	<.01	0.05	<.1	<.01	<.01	<.01	N	N	N	N	W
3	9/29	<.01	<1.0	<.01	<.05	.12	<.01	<.01	<.01	N	N	N	N	W
4	9/23	<.01	<1.0	<.01	0.26	<.1	<.001	<.01	<.01	N	N	N	N	W
4	9/24	<.01	<1.0	<.01	0.27	<.1	<.001	<.01	<.01	N	N	N	N	W
4	9/25	<.01	<1.0	<.01	0.28	<.1	<.001	<.01	<.01	N	N	N	N	W
4	9/28	<.01	<1.0	.01	<.05	<.1	<.01	<.01	<.01	N	N	N	N	W
4	9/29	<.01	<1.0	<.01	<.05	0.1	<.01	<.01	<.01	N	N	N	N	W
5	9/23	<.01	<1.0	<.01	0.29	<.1	<.001	<.01	<.01	N	N	N	N	W
6	9/28	.03	<1.0	.04	<.05	.18	<.01	<.01	<.01	N	N	N	N	W
7	9/23	<.01	<1.0	<.01	0.4	<.1	<.001	<.01	<.01	N	N	N	N	W

CHARACTERISTIC HAZARDOUS WASTE ANALYSES

		EP TOX mg/l								Ig.	Cor.	React.		
Site#	Date	As	Ba	Cd	Cr	Pb	Hg	Se	Ag	140F	pH	CN	S	Spec
8	9/23	<.01	<1.0	<.01	0.24	<.1	<.001	<.01	<.01	N	N	N	N	W
9	9/28	<.01	<1.0	<.01	0.06	.11	<.01	<.01	.06	N	N	N	N	W
10	9/24	<.01	<1.0	<.01	0.26	<.1	<.001	<.01	<.01	N	N	N	N	W
10	9/25	<.01	<1.0	<.01	0.24	<.1	<.001	<.01	<.01	N	N	N	N	W
11	9/24	<.01	<1.0	<.01	0.27	<.1	<.001	<.01	<.01	N	N	N	N	W
12	9/25	<.01	<1.0	<.01	0.28	<.1	<.001	<.01	<.01	N	N	N	N	W
13	9/25	<.01	<1.0	<.01	0.28	<.1	<.001	<.01	<.01	N	N	N	N	W
14	9/29	<.01	<1.0	<.01	<.05	<.1	<.01	<.01	<.01	N	N	N	N	W
15	9/28	<.01	<1.0	.09	0.69	0.12	<.01	<.01	<.01	N	N	N	N	W
16	9/28	<.01	<1.0	<.01	<.05	.23	<.01	<.01	<.01	N	N	N	N	W
17	9/28	<.01	<1.0	<.01	<.05	0.1	<.01	<.01	<.01	N	N	N	N	W
18	9/28	<.01	<1.0	<.01	0.18	.18	<.01	<.01	<.01	Y	N	N	N	1
19	9/29	<.01	<1.0	<.01	<.05	0.1	<.01	<.01	<.01	N	N	N	N	W
20	9/29	<.01	<1.0	<.01	<.05	<.1	<.01	<.01	<.01	N	N	N	N	W
21	9/29	<.01	<1.0	<.01	<.05	<.1	<.01	<.01	<.01	N	N	N	N	W
22	9/29	<.01	<1.0	<.01	<.05	<.1	<.01	<.01	<.01	N	N	N	N	W

Ig. = Ignitability, closed cup flash point, 140 degrees F
Cor. pH = Corrosivity, pH < 6.0
React. = Analyses for cyanide and sulfide
Spec = Infrared Spectrograph
N = None
W = Essentially Water
1 = 1% petroleum distillate / 99% water

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Attachment 5

Texas Industrial Waste Management Rules

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§335.157. Required Programs.

(a) Owners and operators subject to §335.156 of this title (relating to Applicability of Groundwater Monitoring and Response); this section and §§335.158 through 335.166 of this title (relating to Groundwater Protection Standard; Hazardous Constituents; Concentration Limits; Point of Compliance; Compliance Period; General Groundwater Monitoring Requirements; Detection Monitoring Program; Compliance Monitoring Program; and Corrective Action Program) must conduct a monitoring and response program as follows:

(1) Whenever hazardous constituents under §335.159 of this title (relating to Hazardous Constituents) from a regulated unit are detected at the compliance point under §335.161 of this title (relating to Point of Compliance), the owner or operator must institute a compliance monitoring program under §335.165 of this title (relating to Compliance Monitoring Program).

(2) Whenever the groundwater protection standard under §335.158 of this title (relating to Groundwater Protection Standard) is exceeded, the owner or operator must institute a corrective action program under §335.166 of this title (relating to Corrective Action Program).

(3) Whenever hazardous constituents under §335.159 of this title (relating to Hazardous Constituents) from a regulated unit exceed concentration limits under §335.160 of this title (relating to Concentration Limits) in groundwater between the compliance point under §335.161 of this title (relating to Point of Compliance) and the downgradient facility property boundary, the owner or operator must institute a corrective action program under §335.166 of this title (relating to Corrective Action Program).

(4) In all other cases, the owner or operator must institute a detection monitoring program under §335.164 of this title (relating to Detection Monitoring Program).

(b) The commission will specify in the facility permit or in a compliance plan the specific elements of the monitoring and response program. The commission may include one or more of the programs identified in subsection (a) of this section in the facility permit or in a compliance plan as may be necessary to protect human health and the environment and will specify the circumstances under which each of the programs will be required. The commission will establish the programs specified in subsections (a)(1) - (3) of this section in a compliance plan. If the owner or operator is not otherwise subject to compliance monitoring, the detection monitoring program will be established in the facility permit. In deciding whether to require the owner or operator to be prepared to institute a particular program, the commission will consider the potential adverse effects on human health and the environment that might occur before final administrative action to incorporate such a program could be taken.

§335.158. Groundwater Protection Standard.

The owner or operator must comply with conditions specified in the facility permit that are designed to ensure that hazardous constituents under §335.159 of this title (relating to Hazardous Constituents) entering the groundwater from a regulated unit do not exceed the concentration limits under §335.160 of this title (relating to Concentration Limits) in the uppermost aquifer underlying the waste management area beyond the point of compliance under §335.161 of this title (relating to Point of Compliance) during the compliance period under §335.162 of this title (relating to Compliance Period). The commission will establish this groundwater protection standard in the compliance plan when hazardous constituents have entered the groundwater from a regulated unit.

§335.159. Hazardous Constituents.

(a) The commission will specify in the compliance plan the hazardous constituents to which the groundwater protection standard of §335.158 of this title (relating to Groundwater Protection Standard) applies. Hazardous constituents are constituents identified in Appendix VIII of 40 Code of Federal Regulations Part 261 that have been detected in groundwater in the uppermost aquifer underlying a regulated unit and that are reasonably expected to be in or derived from waste contained in a regulated unit, unless the commission has excluded them under subsection (b) of this section.

(b) The commission will exclude an Appendix VIII constituent from the list of hazardous constituents specified in the compliance plan if it finds that the constituent is not capable of posing a substantial present or potential hazard to human health or the environment. In deciding whether to grant an exemption, the commission will consider the following:

  (1) Potentially adverse effects on groundwater quality, considering:

    (A) The physical and chemical characteristics of the waste in the regulated unit, including its potential for migration;

    (B) The hydrogeological characteristics of the facility and surrounding land;

    (C) The quantity of groundwater and the direction of groundwater flow;

(D) The proximity and withdrawal rates of groundwater users;
(E) The current and future uses of groundwater in the area;
(F) The existing quality of groundwater, including other sources of contamination and their cumulative impact on the groundwater quality;
(G) The potential for health risks caused by human exposure to waste constituents;
(H) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents;
(I) The persistence and permanence of the potentially adverse effects; and

(2) Potentially adverse effects on hydraulically-connected surface water quality, considering:
(A) The volume and physical and chemical characteristics of the waste in the regulated unit;
(B) The hydrogeological characteristics of the facility and surrounding land;
(C) The quantity and quality of groundwater, and the direction of groundwater flow;
(D) The patterns of rainfall in the region;
(E) The proximity of the regulated unit to surface waters;
(F) The current and future uses of surface waters in the area and any water quality standards established for those surface waters;
(G) The existing quality of surface water, including other sources of contamination and the cumulative impact on surface water quality;
(H) The potential for health risks caused by human exposure to waste constituents;
(I) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents; and
(J) The persistence and permanence of the potentially adverse effects.

(c) In making any determination under subsection (b) of this section about the use of groundwater in the area around the facility, the commission will consider any identification of underground sources of drinking water and exempted aquifers made under §331.13 of this title (relating to Exempted Aquifer).

§335.160. Concentration Limits.

(a) The commission will specify in the compliance plan concentration limits in the groundwater for hazardous constituents established under §335.159 of this title (relating to Hazardous Constituents). The concentration of a hazardous constituent:

(1) Must not exceed the background level of that constituent in the groundwater at the time that limit is specified in the plan;

(2) For any of the constituents listed in Table 1 of subsection (b)(1) of this section, must not exceed the respective value given in that table if the background level of the constituent is below the value given in Table 1; or

(3) Must not exceed an alternate limit established by the commission under subsection (b) of this section.

(b) The commission will establish an alternate concentration limit for a hazardous constituent if it finds that the constituent will not pose a substantial present or potential hazard to human health or the environment as long as the alternate concentration limit is not exceeded. In establishing alternate concentration limits, the commission will consider the following:

(1) Potentially adverse effects on groundwater quality, considering the maximum concentration of constituents for groundwater protection described in the following Table 1:

Table 1

Maximum Concentration of Constituents for Groundwater Protection

Constituent	Maximum Concentration[1]
Arsenic	0.05
Barium	1.0
Cadmium	0.01
Chromium	0.05
Lead	0.05
Mercury	0.002
Selenium	0.01
Silver	0.05
Endrin (1, 2, 3, 4, 10.10-hexachloro-1,7-epoxy-1, 4, 4a, 5, 6, 7, 8, 9a-octahydro-1, 4-endo, endo-5,8-dimethano naphthalene)	0.0002
Lindane (1, 2, 3, 4, 5, 6-hexachlorocyclohexane, gamma isomar)	0.004
Methoxychlor (1, 1,1-Trichloro-2, 2-bis (p-methoxy-phenylethane)	0.1
Toxaphene (C(--H(--Cl, Technical chlorinated camphene, 67-69 percent chlorine)	0.005
2-4-D (2, 4-Dichlorophenoxyacetic acid)	0.1
2, 4, 5-TP Silvex (2, 4, 5-Trichlorophenoxypropionic acid)	0.01

[1]Milligrams per liter.

(A) The physical and chemical characteristics of the waste in the regulated unit, including its potential for migration;
(B) The hydrogeological characteristics of the facility and surrounding land;
(C) The quantity of groundwater and the direction of groundwater flow;
(D) The proximity and withdrawal rates of groundwater users;
(E) The current and future uses of groundwater in the area;
(F) The existing quality of groundwater, including other sources of contamination and their cumulative impact on the groundwater quality;
(G) The potential for health risks caused by human exposure to waste constituents;
(H) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents;
(I) The persistence and permanence of the potentially adverse effects; and

(2) Potentially adverse effects on hydraulically-connected surface-water quality, considering:
(A) The volume and physical and chemical characteristics of the waste in the regulated unit;
(B) The hydrogeological characteristics of the facility and surrounding land;
(C) The quantity and quality of groundwater, and the direction of groundwater flow;
(D) The patterns of rainfall in the region;
(E) The proximity of the regulated unit to surface waters;
(F) The current and future uses of surface waters in the area and any water quality standards established for those surface waters;
(G) The existing quality of surface water, including other sources of contamination and the cumulative impact on surface-water quality;
(H) The potential for health risks caused by human exposure to waste constituents;
(I) The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents; and
(J) The persistence and permanence of the potentially adverse effects.

(c) In making any determination under subsection (b) of this section about the use of groundwater in the area around the facility the commission will consider any identification of underground sources of drinking water and exempted aquifers made under §331.13 of this title (relating to Exempted Aquifer).

Attachment 6

In-House Solvent Reclamation,
NEESA 20.3-012

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Naval
Environmental
Protection
Support
Service

FOREWORD

Navy industrial operations use substantial quantities of organic solvents. The disposal of used solvents presents an environmental problem and a significant cost to shore activities. The Navy has initiated the Used Solvent Elimination (USE) Program to reduce the disposal of organic solvents by 1 October 1986. Reclamation and reuse of solvents will reduce the volume for disposal, reduce virgin solvent procurement, and save substantial amounts of money.

This report contains an economic analysis of payback periods, non-economic factors such as organizational and regulatory requirements, and several Naval case histories. Background information such as description of the types of solvents commonly used in the Navy and reclamation equipment is also provided. Naval activities can benefit from present Naval experience presented in this report.

Comments concerning this report or requests for reports should be forwarded to Commanding Officer, Naval Energy and Environmental Support Activity, Code 112W, Port Hueneme, California 93043.

W. L. NELSON, LCDR, CEC, USN
Environmental Officer
Naval Energy and Environmental Support Activity

Executive Summary

Solvent reclamation is a practical and economically viable way for many naval activities to save money and simplify shop operations. Depending on the specific solvent used, reclamation can save up to 70% of the cost for buying new solvent plus up to 95% of the cost for disposing of the used solvent. The biggest single factor affecting the economics and payback for solvent reclamation is the volume of solvent to be processed.

For a single solvent program the following minimum quantities for a 3-year payback will generally prove economical:

- Mineral Spirits: 1500 gallons per year
- Degreasers: 500 gallons per year
- Epoxy Paint Thinners: 700 gallons per year

Naval Shipyards (NSY) and Naval Air Rework Facilities (NARF) use the majority of the solvents in the Navy. Certain activities such as Naval Air Stations (NAS), Ship Intermediate Maintenance Activities (SIMA) and Naval Stations (NAVSTA) with large maintenance operations may generate substantial quantities of used solvents. Estimated quantities for the activities are as follows:

Activity	Mineral Spirits (gal/yr)	Degreasers (gal/yr)	Paint Thinner (gal/yr)
NSY	500-7500	100-750	2500-10,000
NARF	1000-12,500	200-1000	1250-5000
NAS	250-2500	50-500	1250-5000
SIMA	250-7500	50-750	1250-5000
NAVSTA	250-750	50-750	1250-5000

The six categories of solvent used in the Navy are:

- Cold cleaning of metal parts
- Vapor degreasing
- Paint thinning and cleanup
- Paint removal
- Cleaning of electrical parts
- Refrigerants in cooling systems

The categories most suited to small to medium scale solvent reclamation are cold cleaning, vapor degreasing, paint cleanup wastes, and cleaning of electrical parts. Reclamation of solvents used in refrigeration is economically feasible, although not on a small scale.

Reclamation is accomplished by distilling used solvents to separate the clean solvent from any contaminants accumulated in the use cycle. A wide variety of automatic stills are commercially available that are simple to use and will produce specification quality clean solvent. Small shop operations can accumulate used solvents for periodic reclamation in a 15 gallon per day batch still. At the other end of the spectrum, large port facilities may be able to use continuous feed equipment processing several hundred gallons per day.

Factors to consider when evaluating solvent reclamation include:

- o Types and volumes of solvents used
- o Acceptability of recycled solvents for primary and alternative uses
- o Potential still location and available utilities
- o Assignment of operating responsibility
- o Local solid waste and air regulations and any permit requirements

This report provides general information on the types of various solvents used by the Navy, the economics and payback potential for different solvents and solvent still sizes, and some Navy case histories. One naval activity had a 1 1/2 year payback for small batch recovery of paint thinner for cleaning of spray equipment. Depending on the specific types and volumes of solvents, commercially available stills have provided total payback of capital investment in the one-year to three-year time frame.

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1.0 Introduction

The majority of naval activities generate less than 60,000 gallons per year of used solvents. Therefore, this investigation focuses on easily-operated reclamation stills capable of processing up to 60,000 gallons per year.

This report provides conclusions and recommendations based upon histories at naval activities. A detailed description of solvents commonly used in the Navy is also presented with characteristics of the solvents so a secondary use may be determined for a recycled solvent if the primary use is considered too sensitive for a recycled product. Organizational and labor requirements are discussed along with descriptions of various distillation equipment and regulatory requirements.

Appendix A describes the Navy Used Solvent Elimination (USE) Program. Economic discussions on the payback for several solvent categories at various use volumes are presented in Appendix B.

2.0 Case Histories, Conclusions and Recommendations

2.1 Conclusions and Recommendations

Recent Navy experience proves that solvent recovery is economically feasible. For example, Norfolk Naval Shipyard paint and sandblast shop uses a 15-gallon-per-day reclamation still to recover waste epoxy reducer which is reused for cleaning spray equipment. The payback period has been calculated to be 1 1/2 years with an initial investment of less than $9,000 for purchase and installation of the still.

The quality of the recovered solvent may be a factor in the reuse consideration. The recovered product may have nominally different characteristics than the virgin solvent. As an example, one activity procured a still to recover ultra-pure heptane used in calibration operations. The recovered heptane did not meet the tight specifications required for calibration; however, the still is now used to recover mineral spirits. Most solvent use in the Navy is for cleaning where less restrictive volatility and specific gravity specifications are common.

Before installing a reclamation unit, state and local environmental regulations should be considered. Policies and guidelines for small solvent recovery stills are being formulated and may vary from area to area. Some areas require air pollution permits for any solvent processing equipment. Some state and local agencies classify reclamation stills as hazardous waste treatment facilities. Development of regulatory requirements is still in progress and should be evaluated for each application.

Responsibility of the reclamation still should be assigned to a single shop. If responsibility is shared between several shops, each shop may be reluctant to supply personnel to operate the still or schedule its use. With the responsibility assigned to one shop, the shop leader can schedule the operation of the still to accommodate the shop's requirements of used solvents.

2.2 Case Histories

The conclusions and recommendations presented in section 2.1 are based on naval experience. Two case histories described below are specific examples of solvent recovery at naval activities.

2.2.1 Norfolk Naval Shipyard: The sandblasting and paint shop installed a Finish Engineering Model LS-15 still in March 1984 to recover waste epoxy reducer used to clean spray equipment. This still is used solely by the paint shop which has complete responsibility for the segregation of waste solvent and operation of the unit. The still is located in the spray room where the shop conducts their painting operations.

The still has operated well, averaging about 75 percent recovery. The shop is procuring a vacuum unit for the still to boost recovery. The thinner is composed primarily of methyl ethyl ketone, toluene, and cellosolve acetate. The residual liquid not distilled by the unit is believed to be mostly cellosolve acetate.

The support operations for the reclamation still have been minimal. The used solvent is placed directly into the still removing the use of 55 gallon drums to store the used solvents. A funnel with a 3 foot diameter opening with a screen to catch any objects such as rags that may be in the used solvent is placed over the mouth of the still. Any solvent spilled while being transferred to or removed from the still is caught in a drip pan below the unit. It takes 2 hours or less to train personnel to operate the still. All shop personnel are trained to operate the still. Maintenance simply consists of a weekly check of the oil level. At this time, environmental permits are required for the operation of their reclamation unit.

This project was funded by the Naval Sea Systems Command through the tool performance program. However, the Chief of Naval Operations has since initiated the USE program (Appendix A). Future solvent reclamation projects can be funded with environmental restoration funds managed by the Naval Facilities Engineering Command. The specific economics of the recovery still at the Norfolk Naval Shipyard are as follows:

Cost of Still:	$4,825
Cost of Installation:	$3,800
Cost of Appurtenances:	Minimal
Cost of New Solvent:	$ 4.30 per gallon
Cost of Operation:	$ 0.15 per gallon
Typical Volumes:	50 gallons per week
Cost of Additional Manpower:	$ 0
Cost of Disposal of Still Bottoms:	$ 2.20 per gallon

To determine payback period at discount factor of 10 percent, the following equation is used. The equation is discussed in more detail in Appendix B.

$$V(ES+(1-E)W)-(A/P:i:n)(D+I)-UV-M = 0$$

Where:

- V = Volume of waste solvent generated by activity or shop (gallons)
- E = Recovery efficiency of still (decimal fraction)
- S = Cost of solvent ($/gallon)
- W = Waste disposal costs for solvent and still bottoms ($/gallon)
- (A/P:i:n)= Appropriate capital recovery factor to evaluate payback period
- D = Cost of distillation unit ($)
- I = Cost of installation and appurtenances of still ($)
- U = Cost of utilities in reclaiming solvent ($/gallon)
- M = Cost of additional labor (varies with size and operational requirements of still; assume $0 for under 3500 gallons per year, $2500 between 3500 and 13,000 gallons per year and $7500 for over 13,000 gallons per year)

Rearranging the above equation and substituting $0.1(1.1)^n/(1.1)^n-1$ yields

$$V(ES+(1-E)W-U)-M = (D+I)0.1(1.1)^n/(1.1)^n-1$$

Substituting in the given values, the payback period is 1 1/2 years.

$$52 \text{ weeks/year}(50 \text{ gal/week})(\quad 0.75(\$4.30/\text{gal})-\$0.15/\text{gal}-0.25(\$2.20/\text{gal}))$$
$$= (\$4,825 + \$3,800)(0.1)(1.1)^n/(1.10)^n-1$$

solve for n, n = 1.5 years.

2.2.2 Naval Air Rework Facility Norfolk: A 50 gallon-per-hour steam injection still was installed in mid-1983 to reclaim heptane from calibration operations. The still did not produce heptane of acceptable quality, so it was used to reclaim suitable quantities of mineral spirits instead.

Since still bottoms are limited to aliphatic solvents, waste disposal costs are avoided by using still bottoms as boiler fuel. If halogenated solvents were reclaimed, still bottoms would have to be hauled off-site.

Economic data is given below. Since the still has been operated on an intermittent basis, no economic analysis is presented.

Cost of Still:	$58,000
Cost of Installation:	$ 2,000
Cost of Operation:	$ 0.03 per gallon
Cost of Solvent:	$ 1.60 per gallon
Net Cost Savings:	$ 1.00 per gallon

3.0 Solvent Use in the Navy

The use of solvents at naval activities can be classified by six categories:

a. cold cleaning of metal parts
b. vapor degreasing
c. paint thinning and cleanup
d. paint removal
e. cleaning of electrical parts
f. refrigerants in cooling systems

The categories most suited to small-scale solvent reclamation are cold cleaning, vapor degreasing, paint cleanup wastes, and cleaning of electrical parts. Reclamation of solvents used in refrigeration is feasible, although not on a small scale.

It should be noted that the majority of solvents are used by the Naval Shipyards and Naval Air Rework Facilities. Certain activities, such as Naval Air Stations with large maintenance operations, may generate moderate amounts of waste solvents. In general, however, most naval activities will not generate sufficient quantities of waste solvents to make reclamation highly cost-effective. Also of interest, the use of contract reclaimers will not be economical for small activities due to high transportation costs. For a detailed evaluation of contract reclamation, see Naval Air Development Center Report No. NADC-78028-60, A Pollution Abatement Concept, Reclamation of Naval Air Rework Facilities Waste Solvent, Phase I.

3.1 Cold Cleaning of Metal Parts

Cold cleaning of metal parts is common at maintenance shops, particularly where engine work is performed. Cold cleaning is normally conducted either by rinsing parts in a bucket containing a cleaning solvent or in a sink where solvent is pumped through a flexible nozzle onto the part.

Almost all cold cleaning is conducted using aliphatic hydrocarbons such as stoddard solvents or mineral spirits (Federal Specification PD-680). These solvents are characterized by low to moderate volatility, moderate solvent power and low cost ($1.50-$2.00 per gallon). These solvents are manufactured primarily by straight distillation of crude oil where a cut is redistilled and separated into several fractions of specific boiling ranges. The distilled fractions are then chemically treated to remove objectionable compounds in order to minimize corrosive effects and improve the odor and color. Although batches of specific solvents may have equivalent boiling ranges and solvent power, the chemical constituents may vary markedly. Stoddard solvents consist of approximately 50 percent paraffins, 30 percent naphthenes and 20 percent aromatics, although these percentages vary substantially among batches.

Cold cleaning solvents are generally disposed when the soil content is sufficiently high to inhibit efficient cleaning or the solvent power declines. Waste solvent is then stored in a waste solvent drum or waste-oil tank for collection and disposal. Some activities, who periodically replace dirty solvent with fresh solvent in vendor-supplied cleaning stations, make use of commercial solvent vendors. The cost savings are approximately 20 percent over the cost of traditional procurement and approximately 50 percent when disposal-avoidance is considered.

Stoddard solvents and mineral spirits are amenable to reclamation by distillation although vacuum or high temperature options are necessary since the distillation range of these solvents typically varies from 300°F to 400°F. Due to the non-critical nature of cold cleaning, quality assurance should not be necessary, although testing for corrosiveness may be desirable if cleaning of sulfur-contaminated parts is conducted.

3.2 Vapor Degreasing

Vapor degreasing is typically found in shops where machining and metal finishing operations are conducted. The most common degreasers used by the Navy are tetrachloroethylene and 1-1-1 trichloroethane, both of which are chlorinated hydrocarbons. These solvents are used in vapor degreasing tanks where a layer of saturated solvent vapor is contained in the tank to remove oil and grease films from metal parts before finishing operations. Degreaser solvents are very volatile causing large losses through evaporation. Chillers on the degreasers are designed to reduce the evaporation loss.

Degreaser solvent should normally be changed when the contamination level reaches approximately 25 percent by volume or when the solids level reaches the bottom of the heating element or coats strip-heated electric and steam-jacketed units with a 1/4-inch layer of solids. Shop personnel may be reluctant to reclaim solvents from degreasers when a thick sludge is permitted to accummulate in the degreaser bottom, resulting in reduced retention of distillable solvent. This is particularly a problem where parts contaminated with solids are cleaned in vapor degreasers. This waste solvent can still be reclaimed, although yields may be low.

Tetrachloroethylene and 1-1-1 trichloroethane are readily reclaimed using standard distillation units since the distillation ranges are relatively low (248°F-252°F for tetrachloroethylene and 158°F-190°F for 1-1-1 trichloroethane).

Disposal of chlorinated solvents is expensive. The chlorine content is extremely corrosive during combustion and rules out incineration in most instances. Also, the poor degradation characteristics and high solvent power of chlorinated hydrocarbons increases the possiblity of groundwater contamination if disposed of improperly.

3.3 Paint Cleanup Wastes

Several types of solvents are used for thinning paints depending upon the kind of coating. Generally, oxygenated solvents such as methyl ethyl ketone (MEK) are used for epoxy and PVC coatings; aromatics such as toluene and xylene are used for chlorinated rubber, phenolic, and vinyl alkyd coatings while mineral spirits are used for alkyd and oil-based coatings. Thinner formulations rarely consist of a single compound, but are usually carefully formulated mixtures designed to provide specific thicknesses, coverages, and drying times.

Waste solvents are generated from paint operations by leftover paint and cleanup of equipment. Generally, shop personnel will mix a few more gallons than required for a job to ensure they do not run out of paint before the job is completed. This results in a few gallons of waste paint per operation that could be distilled for the solvent. Likewise, several gallons of paint thinner will be used after painting to clean the equipment. Cleanup is the major generator of paint wastes at most activities.

Solvents can be readily extracted from paint wastes using distillation units although vacuum units or high temperature options will be required for most applications. The recovered product cannot be expected to have the same component proportions as the original paint diluent and should not be used as thinner. However, the recovered product will be suitable for cleanup since formulation requirements for cleaning solvents are neither precise nor critical. Since most paint waste consists of waste cleanup solvent, reclamation for reuse in cleaning equipment is feasible and frequently cost-effective.

Epoxy coating wastes tend to gel with time due to the catalytic hardening of the coating. However, Norfolk Naval Shipyard has successfully recovered waste epoxy reducer used for cleanup of spray equipment. No experience with recovering solvent from waste epoxy was found during the investigations.

3.4 Paint Stripping

Paint stripping and carbon removal generate large amounts of waste at large industrial activities such as Naval Shipyards and Naval Air Rework Facilities. These wastes consist of a solvent gel heavily contaminated with paint solids.

No activity was found to be reclaiming solvent from paint stripping waste although the wastes typically contain a large proportion of methylene chloride. A NARF can generate 25,000 gallons per year of paint stripping waste which offers a substantial potential to recover methylene chloride. Methylene chloride is a common chlorinated hydrocarbon which could be used in vapor degreasers or surplused via the local Defense Property Disposal Office (DPDO). Due to formulation requirements, there appears to be little potential for recycling methylene chloride in-house as a paint stripper. It should also be noted that it is unproven whether methylene chloride can be effectively recovered from a small distillation unit, or that quality requirements could be met.

3.5 Precision Cleaning

Freons are highly volatile solvents which leave very little residue and are very suitable for cleaning of delicate equipment such as electronics where it is desired to minimize residual material. Due to the high volatility of these solvents, very little waste is accumulated since evaporative losses are large. Although the unit price of freons is high, the low waste recovery rate tends to make the reclamation of waste cleaning freons unpromising in itself. However, it should be noted that freons are amenable to reclamation and could be distilled in any unit set up to reclaim other wastes such as paint thinners and degreasing solvents.

3.6 Refrigerants

Several shipyards reclaim waste freon refrigerant from cooling systems. These activities typically reclaim approximately 40,000 gallons per year via large distillation units or contract solvent reclaimers.

4.0 Solvent Characteristics

Since small-scale reclamation equipment may not necessarily reclaim waste solvents to virgin quality, particularly in the case of paint thinners, it is necessary to determine whether the reclaimed product is suitable for reuse. This requires understanding what solvent characteristics are important in assessing solvent quality and how to apply these characteristics in evaluating reuse of solvents.

The important qualities in evaluating reclaimed solvent are the solvent power, volatility, and corrosivity. Other qualities relatively minor in evaluating solvent quality but which may be important for specific purposes are residue, appearance, color, and specific gravity.

4.1 Solvent Power

Solvent power is the ability of the solvent to dissolve a given product. The solvent power can be measured by several tests, but the kauri-butanol value, aniline point, and dilution ration are the most commonly used.

The kauri-butanol value is the point at which a solvent added as a thinner will cloud a solution of kauri resin dissolved in butanol. For calibration purposes, n-heptane has a kauri-butanol value of 25, while chemically pure toluene has a value of 100.

The aniline point of a solvent is the minimum temperature in degrees Fahrenheit, at which equal volumes of solvent and aniline become immiscible. Lower aniline points imply higher solvent power.

Dilution ratios are measured by titrating hydrocarbon solvent into a unit volume of n-butyl acetate and the solvent to be tested to reach the cloud point or a precipation.

Due to composition variations, solvent powers may vary somewhat, even for specific solvents. Table 1 shows solvent power values for several solvents.

TABLE 1. Solvent Powers for Various Solvents

	Kauri-Butanol Value	Aniline Point	Dilution Ratio
Mineral Spirits	29-45	143-145	1.1-1.4
Xylene	94-98	10.4	---
Toluene (industrial grade)	96-104	8.8	3.85
Freon 113	32	---	---

It is important to realize that use of solvents with too much solvent power can pose problems such as solvent retention and increased costs. Other considerations are health effects of high-powered solvents which are generally more volatile than low-powered solvents and are more likely to exceed Threshold Limit Values (TLVs) for occupational air quality. Toluene, for instance, has the same TLV as Stoddard Solvent (mineral spirits), but the much greater volatility means the ventilation and safety requirements are higher than for Stoddard Solvents.

4.2 Volatility

Volatility of solvents is an important parameter since the retention time of a solvent must be sufficiently long to allow dissolution of the solvent, but also short enough to provide acceptable drying times. The exact volatility requirements is dependent upon the use. For instance, cold cleaning of parts in baths or buckets requires a relatively low volatile solvent to permit brushing and rinsing of the part. Vapor degreasing requires a volatile solvent to generate a dense vapor blanket to remove oil and grease from parts.

The distillation range is a good indicator of the evaporation characteristics of a solvent. Highly volatile solvents generally have low initial and final boiling points. The range between the lower and upper boiling points is also a rough indication of chemical purity, with narrow ranges implying higher purity. Less volatile petroleum-based solvents usually have higher and much broader boiling ranges. A larger percentage of the solvent evaporating at lower boiling points implies that the solvent consists mostly of less volatile fractions. Note that the distillation range of blended solvents will vary over time as lighter fractions are lost through evaporation and heavier fractions are not as efficiently recovered during distillation. Distillation ranges for several solvents are presented in Table 2.

TABLE 2. Distillation Ranges for Several Common Solvents

	Initial Boiling Point	10%	50%	90%	Final Boiling Point
Stoddard Solvent (Typical)	310°F	332°F	337°F	363°F	394°F
Toluene (industrial)	230°F	231°F	232°F	233°F	234°F
MEK	173°F	---	---	---	178°F
1-1-1 Trichloroethane	162°F	164°F	---	182°F	190°F
Freon 113	118°F	---	---	---	---

Two other means of assessing volatility are the evaporation rate and the vapor pressures. The evaporation rate is determined by placing a measured volume of solvent on a metal plate or sheet of filter paper and timing the period required for evaporation. The evaporation rate is usually expressed as a ratio to a reference solvent. Vapor pressure also indicates the tendency to evaporate; higher vapor pressures correspond to higher volatility. Since vapor pressure is dependent upon temperature, vapor pressures are always expressed with a reference temperature.

4.3 Corrosivity

Corrosivity is rarely a problem with solvents except when cleaning parts containing sulfurous contamination or using 1-1-1 trichloroethane to clean aluminum. Corrosivity is easily measured by placing metal strips in heated solvent and examining for corrosion after a period of 10 to 60 minutes. Trichloroethane may degrade into hydrochloric acid and polymeric residue in the presence of aluminum unless sufficient inhibitor is present. The inhibitor is a proprietary compound which is carried over with the solvent during distillation. However, distillation of 1-1-1 trichloroethane at high temperatures (over 190°F) can also break down the solvent and increase corrosivity. Thus, it is prudent to monitor reclaimed 1-1-1 trichloroethane for corrosivity.

4.4 Minor Characteristics

The only minor characteristic likely to be important to naval operations is residue. Cleaning of electrical parts and precision elements such as gyrocompass bearings requires that very little residue remain after cleaning. The most common solvent for these applications is Freon 113, Type I which is very pure. An U. S. Air Force activity was found to be reclaiming Freon 113 for parts cleaning but was unable to process to the Type I level, and thus used the reclaimed Freon for preliminary cleaning.

Other possible minor characteristics of interest in specific cases are color and appearance of solvents used in dry cleaning and the specific gravity of solvents used in certain types of multi-fluid cleaning systems.

5.0 Organization and Labor Requirements

In order to maximize the percentage of solvents reclaimed, it is necessary that the handling of waste solvents and still operation mesh as conveniently as possible with operations within shops generating the wastes. Proper location and assignment of a solvent still within the organization of an activity is an important consideration in developing a solvent reclamation program. The two alternatives that should be considered are either the location of a batch-still at individual shops, or a high-volume still at a centralized facility.

5.1 Shop Installations

Small batch stills work particularly well in shops generating less than 50 gallons per day of waste solvents where used solvents are accumulated in a drum for periodic distillation. The advantages of locating a still in a shop is that no extensive segregation, transportation or record keeping is required to reclaim solvents. Eliminating the cost of transporting solvents greatly enhances the economics of small-scale solvent reclamation since transportation costs within an activity can be approximately $4,000 per year for a two-man pickup crew operating 5 hours each week. Since small stills can operate unattended, no additional manpower is required because equivalent manpower would be expended to dispose of waste solvent and dispense new solvent if waste solvent was not reclaimed.

Another advantage of setting up small stills in shops is that scheduling problems and turnaround time tends to be reduced since shops usually use only one or two types of solvents in low quantities, and frequently follow a set routine. Segregation and storage of waste solvents are also simplified in a shop, since personnel can usually empty waste solvent directly into the still after use and thus, avoid storing waste solvents.

5.2 Centralized Facilities

Centralized facilities are usually more economical for activities using large volumes of solvents from several sources since capital costs will be lower. The major problems with centralized facilities are that an efficient collection system is required and proper segregation is more difficult to enforce. However, the experience at Robins AFB where a large centralized still handling 55 gallons per hour is in place indicates that segregation and collection are not severe problems. Waste solvents are stored in labeled drums at 38 designated collection points. Drums are picked up periodically and stored at the still site until distilled into reclaimed products. When unsegregated mixtures are suspected, a sample is analyzed at the laboratory and the responsible shop is notified if improper segregation is verified. Although the centralized system has had occasional problems with segregation, the system works well resulting in annual savings of $350,000.

5.3 Labor Needs

The labor requirements for solvent stills are low. Batch-type stills require loading once per day which generally takes one person between 15 to 30 minutes to open the still, clean out the still liner if necessary, pour in the waste solvent, and turn on the heating element and condenser cooling water. No further attendance is required since the still will shut off automatically.

Continuous-type units require personnel to load new drums to feed the unit and remove full drums of reclaimed solvent. Although constant attendance is not required, the still must be checked occasionally. NARF Norfolk has one operator monitoring their still during operations, while Robins AFB uses two personnel. Constant attendance of personnel is not needed to operate the still at Robins AFB, but it is required by the base safety department.

Little training is required to operate solvent reclamation stills. Batch stills are on the same level of operating difficulty as simple appliances such as kitchen stoves. Continuous feed stills are only slightly more difficult to operate. Minimal time is required to train personnel for most applications.

6.0 Distillation Equipment

Small-scale distillation equipment is readily available to reclaim most petroleum-based solvents used at naval activities. In general, these units require little manpower to operate, a minimum of operator training, and occupy relatively little space. Batch units are capable of reclaiming 15 to 100 gallons per day of waste solvents, depending on the size of the unit installed. Larger continuous-feed units are available which can process up to 100 gallons per hour. Most naval activities generate waste solvents at a rate less than 100 gallons per work day.

6.1 Batch-Type Units

Installation requirements for batch-distillation units consist of sufficient space in a suitable environment, utility hookups, and adequate access. Space requirements for small batch units are low, generally under 50 square feet. Stills must also be located in a sheltered well-ventilated environment where solvent vapors cannot accumulate. Utility requirements vary with the manufacturer. The most common utility requirements are electricity, cooling water, and drainage. Some units do not require cooling water; other units may require compressed air or steam. Consumption rates for utilities are low. A typical range would be to 8 KW for electricity and 0.3 to 0.5 gpm for cooling water. Installation of electrical hookups should normally follow National Electrical Code Class 1, group D, Division 1 requirements for explosion-proof construction. Sufficient access must be provided to permit carting of drums to the unit and unencumbered pouring of solvent into the still.

A typical batch still consists of a boiler in which a nylon liner is inserted to contain the still-bottoms, a heating element to heat the boiler, a condenser to liquify the solvent vapor, and a reservoir to receive reclaimed solvent. An example of a batch distillation unit is at Norfolk Naval Shipyard and is shown in Figure 6.1. Some distillation units are equipped with a vacuum option which lowers the effective boiling range of the waste solvent and permits reclamation of higher boiling solvents such as mineral spirits. Other units are either incapable of distilling high-boiling solvents or do so by modifying the still with a high-temperature option. The simplicity of small stills reduces maintenance to very low levels.

Operations of small batch stills is simple. A shop employee inserts a nylon liner into the boiler, pours in the waste solvent, clamps down the boiler cover, turns on the cooling water and starts the unit. A thermostat monitors the boiler and shuts off the still when the distillation cycle is completed. After several uses, the boiler liner is removed and disposed of as still bottoms. Most still-bottoms are considered as hazardous waste under the Resource Conservation and Recovery Act (RCRA) and must be disposed of accordingly. However, the amount of waste requiring disposal is reduced 70% to 95% by distillation.

6.2 Continuous-Feed Units

Large continuous-feed units require much more space than small units and higher rated utility connections. Space requirements can exceed 400 square feet and 440 V electrical connections are typically required. Other utilities required may include steam, cooling water, drainage and compressed air.

Continuous-feed units operate in various modes, but the most common are heated boiler units and steam injection units. Heated boiler units are designed to pump waste solvent from a storage tank into the boiler where the solvent is vaporized. Then the solvent vapors pass through a water or air-cooled condenser where they are liquified and gravity fed into a storage container. Steam injection units mix steam and solvent together to form an azeotrope which has a lower boiling point than the solvent alone. The azeotrope vapor is liquified in a condenser, then passes into a separator where the solvent and water fractions separate. Although steam injection can produce an acceptable product provided that the solvent is immiscible and purity requirements are not strict, contamination of the water fraction by chlorinated solvents will probably violate pretreatment standards for discharge.

Continuous-feed distillation units are slightly more difficult to operate than batch units, but do not require much training and can be operated by shop personnel. Manpower requirements are similar to those for small batch units.

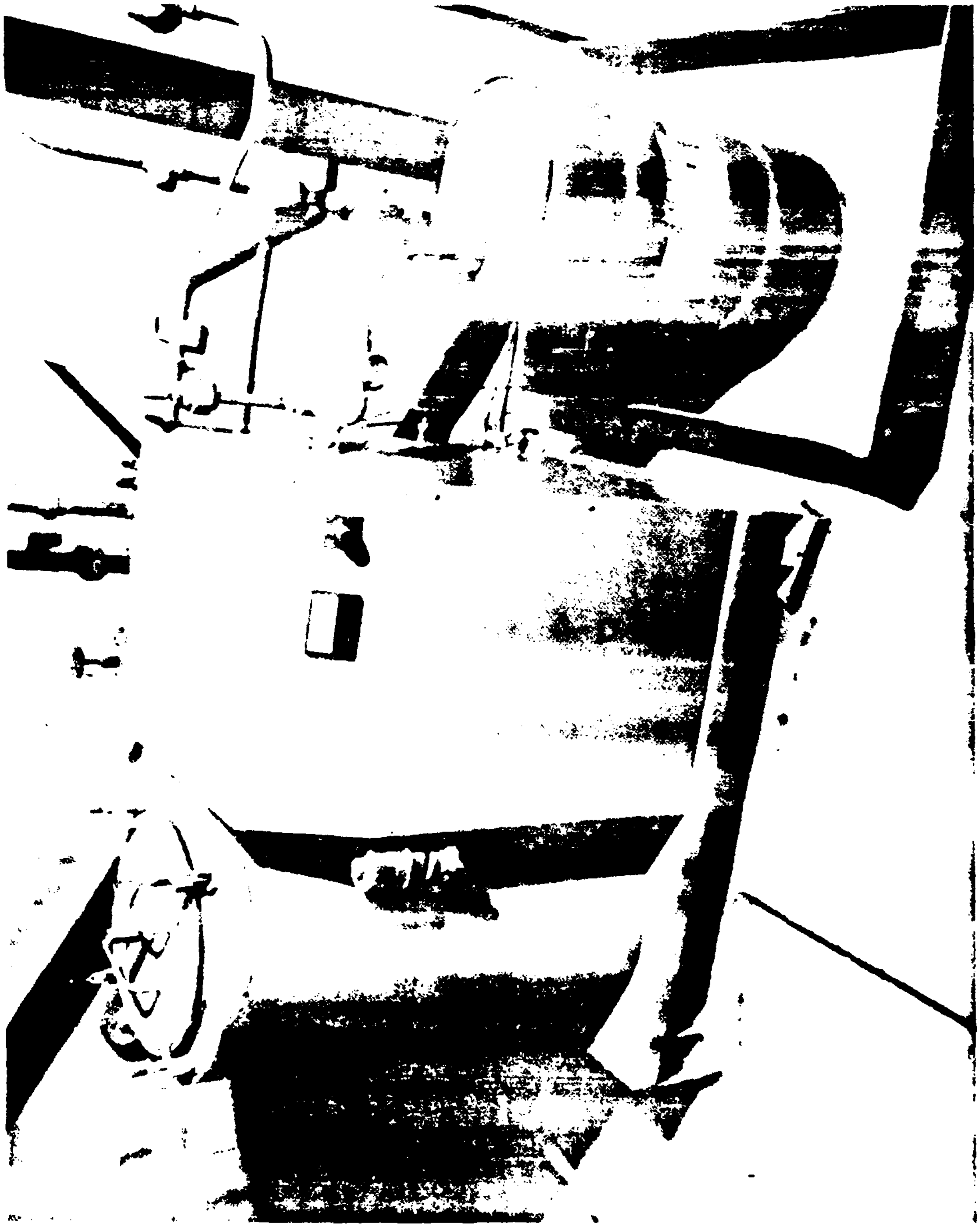

Figure 6.1 Small still at Norfolk Naval Shipyard.

7.0 Regulatory Requirements

7.1 Navy Requirements

New DOD policy has initiated the Used Solvent Elimination (USE) program to eliminate as far as possible the disposal of organic solvents. The Navy USE program requires activities that generate 400 gallons or more of waste solvents per year to attempt to eliminate the disposal of used solvents by 1 October 1986. The accepted methods for eliminating waste solvents include: (1) change the process of using solvents to reduce or eliminate waste solvent; (2) substitute other materials that will minimize health and environmental effects; or (3) recycle used solvents. Details are in Appendix A. Any recycled solvents must be included in part C of the Hazardous Waste Annual Report (OPNAVINST 5090.1, Appendix F) due each 1 February for the previous calendar year. A Solvent Management Report (TAB A of Appendix A) is required by 1 December 1984, 1985 and 1986.

7.2 Non-Navy Requirements

In addition to the Navy requirements, non-Navy policy and regulations for small batch solvent recovery stills may vary from region to region. Some state and regional agencies may require air pollution permits, others may consider the recovery still to be a hazardous generator or even a hazardous waste treatment facility. The complexity and cost of local requirements must be included in any recycling decisions.

Air pollution permits are usually granted by local or regional agencies. The factors considered by agencies in determining whether to issue a permit usually consist of the exposed surface area of the vessel, material to be processed by the unit, and the anticipated emission quantities. In general, solvent stills are not large emitters, but emission information should be obtained from the manufacturer if required.

Solvent reclamation units may be classified as hazardous waste generators or treatment facilities, depending upon the interpretation by the regulatory agency. Information required by the agency before issuance of a permit will generally consist of the type of process used, type of wastes generated, and quantities of waste generated. Obtaining a hazardous waste permit may take a substantial amount of time, particularly if a still is classified as a treatment facility. Due to the newness of hazardous waste regulations, many agencies have not developed firm policies on whether to regulate small solvent reclamation stills. Exact permit requirements and application times must therefore be investigated on a case-by-case basis.

APPENDIX A

Navy Used Solvent Elimination (USE) Program

A.1 Definition. Organic Solvent. All organic fluids used for cleaning, thinning, calibration or similar purpose. Solvents include hydrocarbons, halogenated hydrocarbons, oxygenated hydrocarbons, mixtures and similar materials.

A.2 Applicability. The USE program applies directly to any Navy activity which generates more than 400 gallons per year of any organic used solvent. Activities with lesser generation rates are also encouraged to implement used solvent elimination programs, as practical.

A.3 Policy. The disposal of used solvents, whether as a waste through Defense Property Disposal Offices, or directly by the Navy, is not acceptable at applicable Navy activities, with certain exceptions. The exceptions are:

a. Used organic solvent recycling byproducts, i.e., "still bottoms".

b. Where the "USE Plan" shows recycling or sale of the used solvent are not viable options, and such plan has been reviewed and approved by knowledgeable personnel of a flag officer command.

A.4 Implementation Deadlines. Initially, resources (technical assistance, funding) will be concentrated on activities that generate the larger volumes of used organic solvents.

a. Large volume generators. The following activities shall fully implement the USE program as applicable (paragraph A.2) by 1 October 1986:

CHNAVMAT

NAVSHIPYD Portsmouth, NH
NAVSHIPYD Philadelphia, PA
NAVSHIPYD Portsmouth, VA
NAVSHIPYD Charleston, SC
NAVSHIPYD Long Beach, CA
NAVSHIPYD Mare Island, CA
NAVSHIPYD Puget Sound, WA
NAVSHIPYD Pearl Harbor, HI
NAVORDSTA Louisville, KY
PWC Norfolk, VA
PWC Pearl Harbor, HI
NAVAIREWORKFAC Norfolk, VA
NAVAIREWORKFAC Cherry Pt, NC
NAVAIREWORKFAC Jacksonville, FL
NAVAIREWORKFAC Pensacola, FL
NAVAIREWORKFAC Alameda, CA
NAVAIREWORKFAC San Diego, CA
NAVUSEAWARENGSTA Keyport, WA
NAVWPNSUPPCEN Crane, IN
NAVAVIONICCEN Indianapolis, IN
NAVWPNSTA Yorktown, VA
NAVAIRENGCEN Lakehurst, NJ

CINCPACFLT

NAVSHIPREPFAC Yokosuka, JA

CINCLANTFLT

NAS Jacksonville, FL
NAS Cecil Field, FL

CNET

NAS Pensacola, FL

b. Other applicable activities. Full implementation by 1 October 1987. Reporting requirements for 1 December 1984, 1985 and 1986 (paragraph A.7) apply.

A.5 USE Program Options. Every option (except material substitution) must include as a first consideration segregation of used solvents by type from other used solvent types and wastes. Options for eliminating the disposal of used organic solvents include:

a. Process changes to reduce or eliminate the generation of used organic solvents.

b. Material substitution to minimize adverse health/environmental effects of used organic solvents.

c. In-house recycling with return of usable product for use at Navy or other DOD activity.

d. Outside recycling by commercial or other (Navy, non-Navy) recycler and return of usable product.

e. Use as fuel (only solvents with less than 4000 parts per million (ppm) chlorine).

f. Sale through DPDO.

A.6 Activity USE Program Plan. The plan shall generally consist of three basic parts, as follows:

a. Existing situation: Lists the quantities of the various organic solvents used, where and how the solvents are used, how the used solvents are handled (segregated), their final disposition, cost of disposition, and proceeds from the sale of used solvent as well as the allocation of sale proceeds.

b. Proposals: An economic investigation of means to meet USE program objectives. Options in paragraph A.5 shall be considered as well as any others consistent with USE objectives. The investigation shall consider all used organic solvents generated at the activity and include investigation of overall recycling (by solvent type, work site, or other breakdown) as well as partial recycling. Requirements for segregation of used organic solvents and compliance with local, state and federal regulations shall be considered.

c. Implementation Schedule. Present final recommendations for disposition of all used organic solvents, as well as implementation schedules, in accordance with paragraph A.3.

A.7 Reporting requirements

a. OPNAVINST 5090.1, Appendix F, Part C. An existing requirement.

b. Army/Navy/Air Force/DLA Annual Solvent Management Report (TAB A). Submit to NAVFACENGCOM by 1 December in each 1984, 1985 and 1986.

c. Report names of all activities estimated to generate more than 400 gallons per year of any organic used solvent to NAVFACENGCOM by 1 April 1985.

ARMY/NAVY/AIR FORCE/DLA ANNUAL SOLVENT MANAGEMENT REPORT

Name of Activity

	On-Post Recycle	Off-Post Recycle	Sale Through DPDO	Date Solvent Management Program Initiated	Remarks

NOTES

1. This form to be filled out by any activity that uses any of the means of organic solvent management listed on the form, regardless of the quantity of used solvent generated.
2. Indicated by "x" under appropriate column the type of solvent management program initiated.
3. Use of non-chlorinated solvents as fuel is considered "recycling".

TAB A

APPENDIX B

Requirements for Economical Solvent Reclamation

Cost effective solvent reclamation is dependent upon recovering sufficient volumes of reuseable solvent to payback the cost of installing and operating a solvent still. The major cost parameters to consider in evaluating the potential economics of a solvent reclamation program are as follows:

D - Cost of Distillation unit ($)

E - Recovery efficiency of still (decimal fraction)

I - Cost of installation and appurtenances of still

M - Cost of additional labor (varies with size and operational requirements of still; assume $0 for under 3500 gallons per year, $2,500 between 3500 and 13,000 gallons per year and $7500 for over 13,000 gallons per year)

S - Cost of solvent ($/gallon)

U - Cost of utilities in reclaiming solvent ($/gallon)

V - Volume of waste solvent generated by activity or shop (gallons)

W - Waste disposal costs for solvent and still bottoms ($/gallon)

(A/P:i:n) - appropriate capital recovery factor to evaluate payback period

These parameters may be combined to form an equation representing the parameter interactions at specific payback periods as follows:

$$V(ES+(1-E)W) - (A/P:i:n)(D+I) - UV - M = 0$$

Using this equation it is possible to calculate break-even volumes of solvents for various applications and payback periods. Minimum estimated quantities of solvents required to break even in three years are as follows:

- Mineral Spirits: 1500 gallons per year
- Degreasers: 500 gallons per year
- Waste Paint Thinner (Epoxy): 700 gallons per year

It should be noted, however, that many non-industrial activities will not be able to generate sufficient quantities of waste solvents to economically justify reclamation. The following sections examine the economics of in-house solvent reclamation for the major categories of solvent use.

B.1 Cold Cleaning

Solvents used for cold cleaning of metal parts tend to have relatively low cost, low volatility, and high boiling points. These factors make cost-effective recovery high volume dependent because of the more expensive reclamation equipment required and the low value of the solvent. However, the low losses from evaporation do tend to make reclamation more favorable, although the high boiling points require more expensive equipment. Payback periods calculated using the cost equation and the assumptions listed on the following page are shown in Figures 1 to 3.

Assumptions:

Cost of still (D):	\$ 8,600 for under 3500 gallons per year
	\$17,700 for under 3500-13,000 gallons per year
	\$45,000 for 13,000-60,000 gallons per year
Installation Cost (I):	1.5 D
Recovery Efficiency (E):	0.95
Additional Manpower (M):	See original assumptions
Solvent Cost (S):	\$1.75 per gallon
Utility Costs (U):	\$0.25 per gallon
Waste Disposal Costs (W)	\$1.00 per gallon, \$2.00 per gallon, \$3.00 per gallon
Discount Factor (i):	10%

Due to the high sensitivity to waste disposal costs for the small (15 gpd) and medium (55 gpd) size distillation units, economic analyses were conducted using three disposal costs. For the large distillation unit (250 gpd) where the waste disposal cost is less influential, the economic analysis was conducted at the median disposal cost of \$2.00 per gallon.

B.2 Vapor Degreasing Solvents

Since solvents used for vapor degreasing are volatile and expensive, they are ideally suited for cost-effective reclamation. These low-boiling solvents require the least expensive reclamation stills. Cost assumptions in developing figures 4 to 6 are:

Cost of Still (D):	\$ 4,600 for under 3500 gallons per year
	\$12,000 for 3500 to 13,000 gallons per year
	\$30,500 for 13,000 to 60,000 gallons per year
Solvent Cost (S):	\$4.50 per gallon (Figure 4); \$5.50 per gallon (Figure 5); \$6.50 per gallon (Figure 6)
Waste Disposal Cost (W):	\$2.00 per gallon

Other costs are the same as for cold cleaning solvents.

B.3 Paint Wastes and Thinners

The composition of waste paints and waste paint thinners varies markedly depending upon the manufacturer and application. Since the primary purpose of reclaiming paint thinners is for reuse in cleaning paint spray equipment, the exact composition is not important so long as the reclaimed solvent is compatible with the paint to be cleaned from the equipment. Since most paint thinners are mixtures, vacuum type distillation units are required since one or more components of the thinner usually have high boiling points. The assumptiors used in developing the payback curves are those given for reclaiming cold cleaning solvents except that solvent costs range from \$2.00 to \$4.50 per gallon. Payback curves are given in Figures 7 to 9.

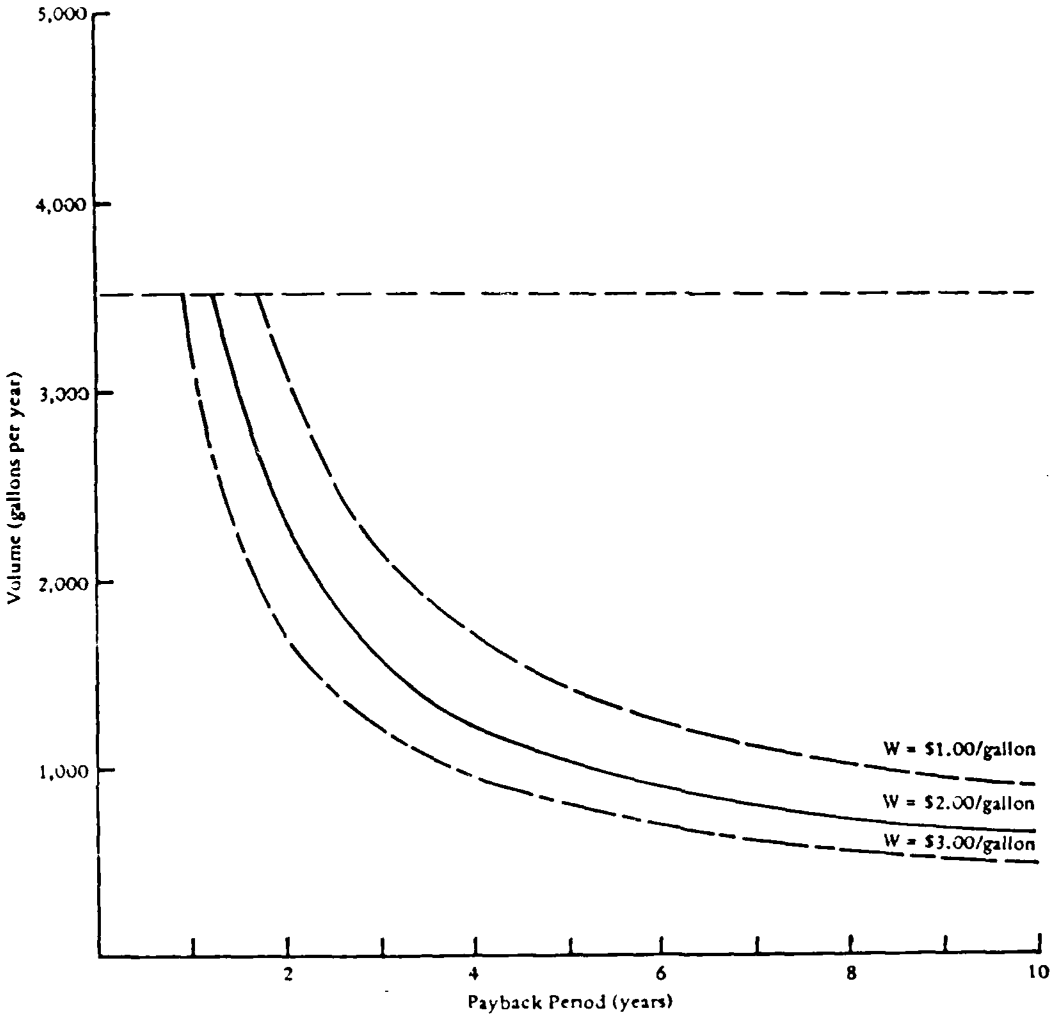

Figure 1. Reclamation of cold cleaning solvents via small batch stills (15 gpd).

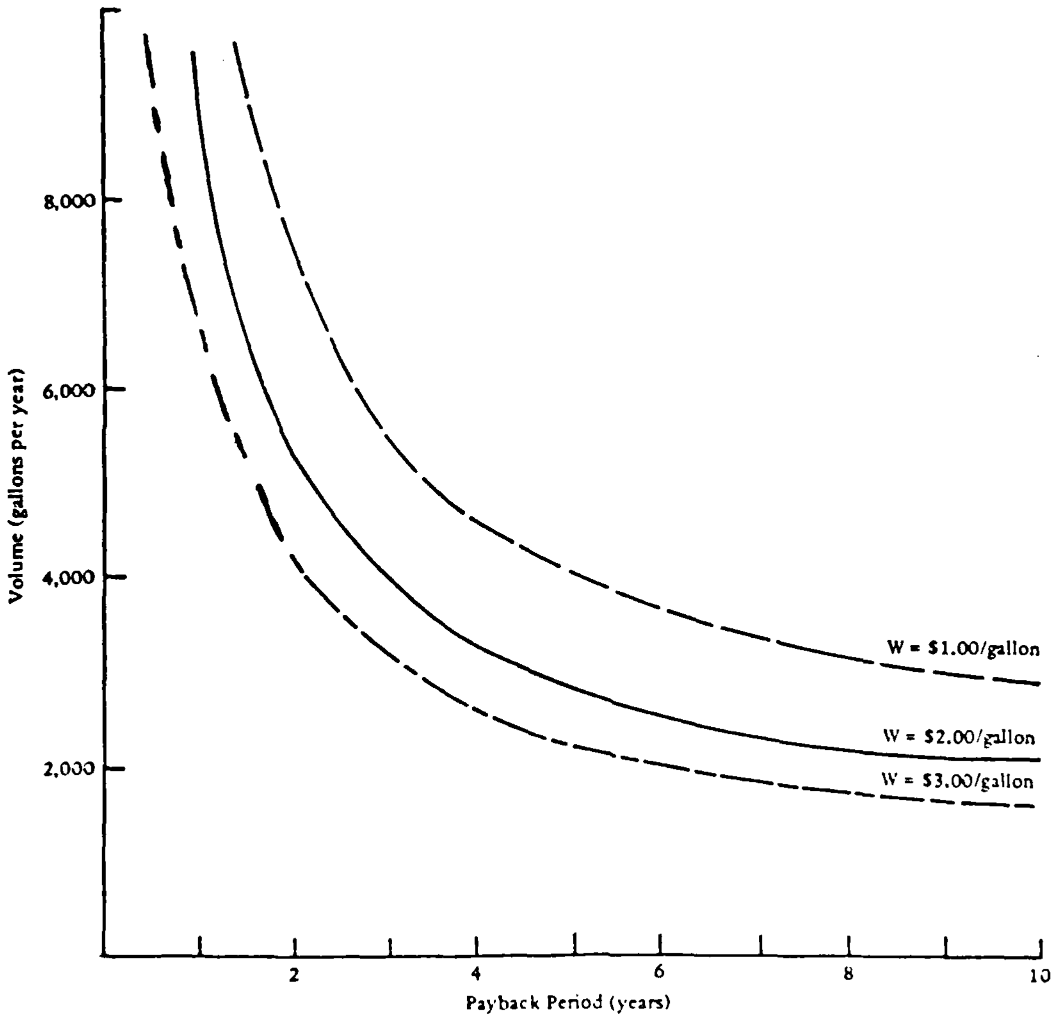

Figure 2. Reclamation of cold cleaning solvents via medium batch stills (55 gpd).

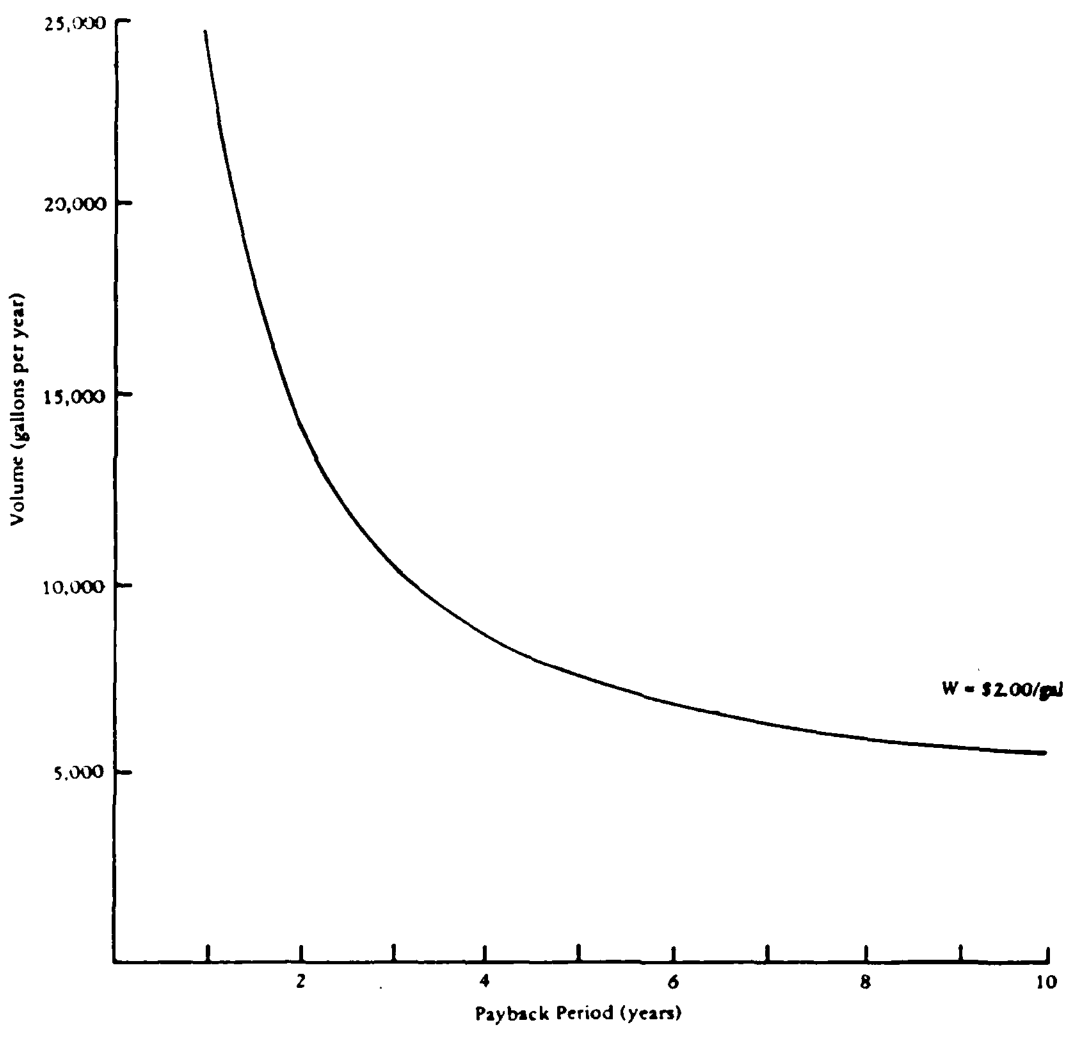

Figure 3. Reclamation of cold cleaning solvents via a large continuous still (250 gpd).

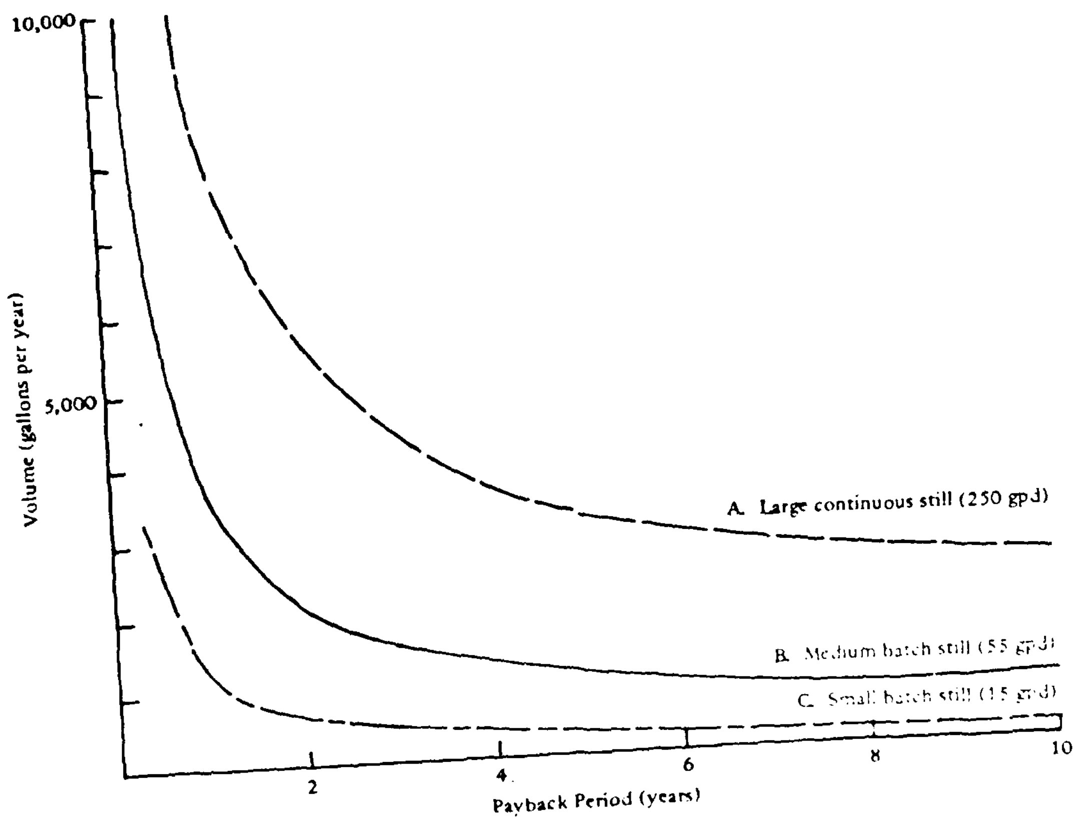

Figure 4. Reclamation of vapor degreasing solvents
(chlorinated hydrocarbon solvents, $4.50 gallon)

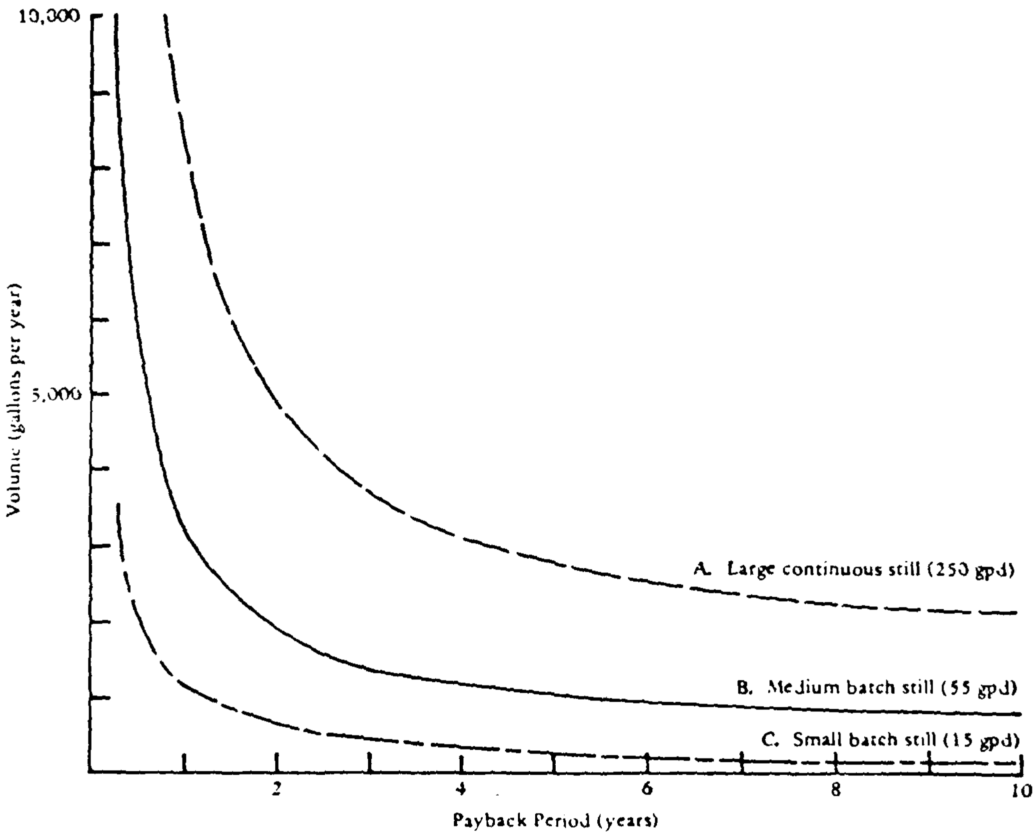

Figure 5. Reclamation of vapor degreasing solvents (chlorinated hydrocarbon solvents, $5.50/gallon).

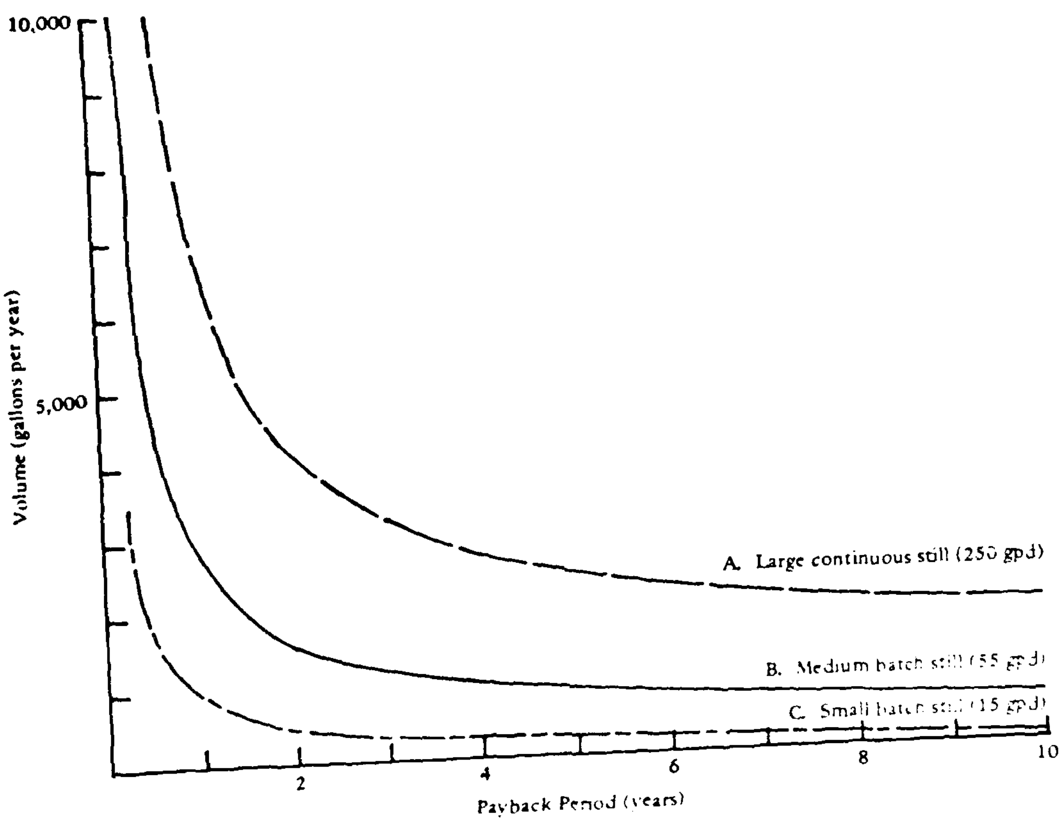

Figure 6. Reclamation of vapor degreasing solvents (chlorinated hydrocarbon solvents, $6.50/gallon).

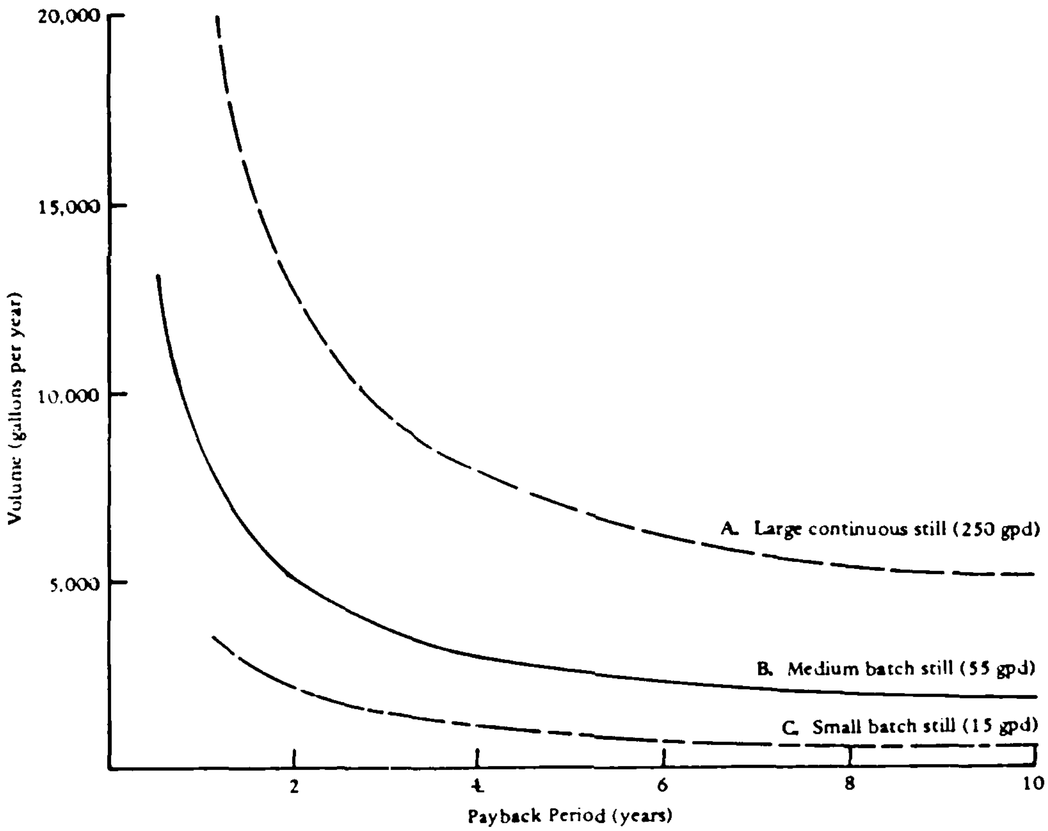

Figure 7. Reclamation of waste paint thinner ($2.00/gallon).

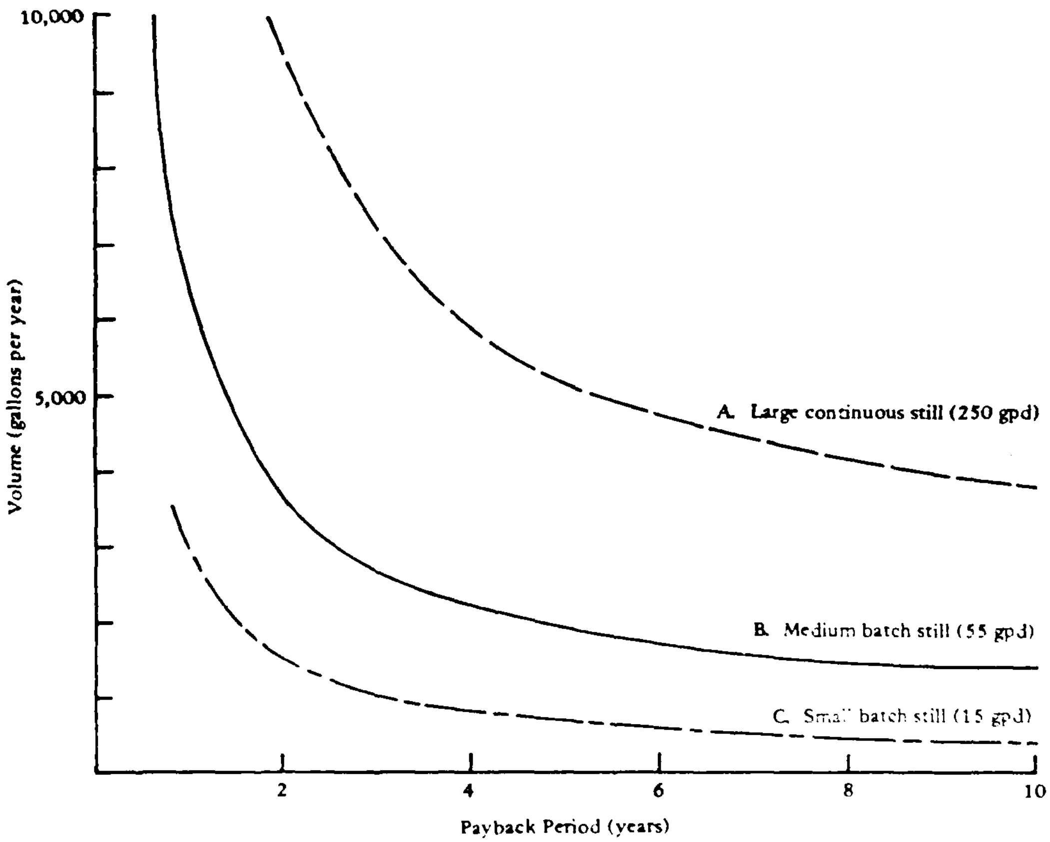

Figure 8. Reclamation of waste paint thinner ($3.25/gallon).

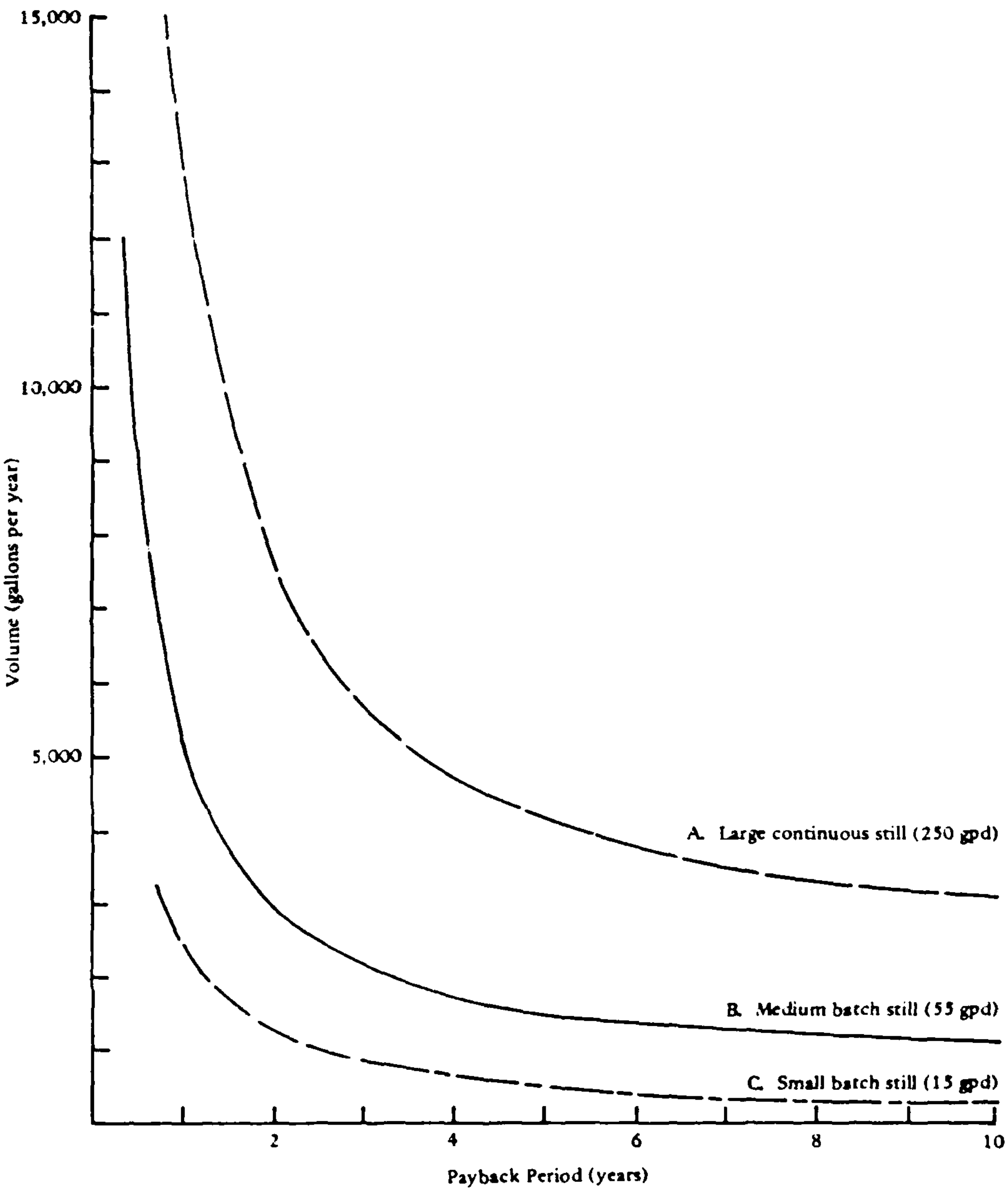

Figure 9. Reclamation of waste paint thinner ($4.50/gallon).

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