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Report 2374

PLATING WASTES SURVEY

by

P. Gail Chesler, P. E.

November 1982

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Twenty-three DARCOM installations perform plating and other metal finishing operations covered by EPA's Plating Wastewater Pretreatment regulations. Wastewater flows vary from less than 100 gallons per day to over 150,000 gallons per day.

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DARCOM installations plate a large number of different metals. Research and development centers typically have the capability to plate all of the usual metals; a few plants plate only one metal or confine their activity to one process, such as anodizing.

In many cases, common problems exist. Disposal of sludges and concentrated process solutions are becoming more costly and time-consuming. Rinsewater volume controls in the plating shop are seldom satisfactory. The organizational structure at most DARCOM installations places control of treatment needs and responses in more than one person, making coordination difficult.

In this report, the similarities and differences reported by the 23 installations are described, providing a data base of DARCOM plating wastewater treatment. Subjects discussed include the variety in metals plated, volumes of wastewater flow, and efficiency of operations. Similarities are noted in basic treatment methods, in lack of recycle and recovery systems, and in problem areas.

Actual DARCOM plating wastewater treatment is described. Problems and successes of these shops are cited. Where appropriate, conclusions are drawn and suggestions are made.

SUMMARY

Twenty-three DARCOM installations perform plating and other metal finishing operations covered by Environmental Protection Agency (EPA) Plating Wastewater Pretreatment regulations. Wastewater flows vary from less than 100 gallons per day to over 150,000 gallons per day.

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Actual DARCOM plating wastewater treatment is described. Problems and successes of these shops are cited. Where appropriate, conclusions are drawn and suggestions are made.

PREFACE

The survey covered by this report was conducted by the Petroleum and Environmental Technology Division, Energy and Water Resources Laboratory, US Army Mobility Equipment Research and Development Command (USAMERADCOM). The effort (Work Unit C-7, WBS No. P147.01.04) was funded by the US Army Toxic and Hazardous Materials Agency (USATHAMA), Lead Laboratory for the DARCOM DO-48 Environmental Quality Program.

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PLATING WASTES SURVEY

I. INTRODUCTION

1. Subject. This report covers a survey of the 23 DARCOM installations engaged in metal plating and allied finishing operations relative to their pollution abatement programs. Information presented covers responses received on the following topics:

a. Volume of metal plating wastewater generated.

b. Wastewater characteristics.

c. Wastewater treatment systems currently in use or planned.

d. System costs.

e. Problems in meeting EPA, state, or local metal-bearing wastewater pretreatment standards.

II. INVESTIGATION

2. Procedure. The survey instrument generated by MERADCOM (Appendix A) was distributed to the following:

a. Armament Materiel Readiness Command (ARRCOM).

b. Depot System Command (DESCOM).

c. Test and Evaluation Command (TECOM).

d. Troop Support and Aviation Materiel Readiness Command (TSARCOM).

e. Missile Command (MICOM).

f. Tank-Automotive Command (TACOM).

g. Armament Research and Development Command (ARRADCOM).

h. Materials and Mechanics Research Center.

Three site visits were made by MERADCOM personnel to Watervliet Arsenal, Rock Island Arsenal, and Anniston Army Depot to provide in-depth exposure to plating and wastewater treatment facilities. Telephone calls to several plants were made to obtain up-to-date sludge disposal cost information and to clarify survey responses.

III. RESULTS

3. Survey Data. A summary of information based on the data furnished by each installation is given in Table 1. More complete data sheets for each installation responding positively are included as Appendix B.

Table 1 Installation Data Summary

Location	Flows from plating (gpd) & IWTP (gpd)	CN (1000 gpd)	Cr (1000 gpd)	Segregated	Treated Effluent Discharge	Concentrated Bath Disposal	Sludge Handling	Metal Finishing Operations
Anniston AD	82,000 200,000	10	48	yes	Direct	To batch tanks, then bled into treatment system	Filter press Sludge hauled	Chromium, cadmium, anodizing, etching, chromating, phosphating
ARRADCOM, Dover	I:4,000 2 days/week	-	2	yes	Direct	To drums and hauled	I: hauled from neutralization tanks by tanker	Printed circuit boards
	II:20,000	-	7	yes	Direct	Batch treated	II: lagooned and hauled	Most common metals
Corpus Christi AD (Naval Air Station)	120,000 185,000	10	50	yes	Direct	Pumped into tanks for off-site disposal	Filter press Sludge hauled	Chromium, cadmium, others as requested
Crane AAA (Naval Weapons Support Center)	44,000	14.5	7.2	yes	Direct	To holding tanks, then bled into system	Filter press Sludge hauled	Cadmium, zinc, bright dip, chromating, phosphating, others as requested

Location	Flows from plating (gpd) & IWTP (gpd)	CN (1000 gpd)	Cr (1000 gpd)	Segregated	Treated Effluent Discharge	Concentrated Bath Disposal	Sludge Handling	Metal Finishing Operations
Detroit Arsenal Tank Plant	100,000	low	yes*	no	POTW	Dumped to IWTP periodically	Sludge is underflow from settling tank. It is stored in 8,000 gallon tank prior to being hauled.	Surface treatment prior to painting
Iowa AAP	500-600 during 2-3 months per year	-	yes*				No thickening or dewatering	Brass, chrome, metal cleaning, phosphatizing
							Landfilled (delisted)	
Lake City AAP	100	-	0.1	no	Direct	Batch dump to licensed reclaimer	Air flotation	Chromium
	200,000						Lagooned	
Letterkenny AD	5,000	-	0.05	no	Direct	Hauled by contractor	No thickening or dewatering	Chrome electroplating
	130,000						Hauled	
Lone Star AAP	1,000	-	1	yes	To Red River AD until recently		New system; sludge disposal not yet required	Chrome, etching

*exact flows not known

Location	Flows from plating (gpd) & IWTP (gpd)	CN (1000 gpd)	Cr (1000 gpd)	Segre gated	Treated Effluent Discharge	Concentrated Bath Disposal	Sludge Handling	Metal Finishing Operations
Lousiana AAP	I: 2,000 II: 7,000	-	yes*	no	Direct	Lancy & Turner systems	I: lagooned II: vacuum filtered and contractor hauled	Phosphating Anodizing, chromating
Materials & Mechanics Research Center	under 1,000	0.5	insig	no	POTW	Non-CN Alkaline to the sewer, acids are neutralized and hauled, and solvents are hauled	Hauled by Fort Devon personnel	Cadmium, phosphating, other metals as requested
New Cumberland AD	2,500 14,000	0.3 Wastewater flows directly to sanitary sewer	0.3	no	Direct	To drums and hauled	Incinerated by contractor	Several common metals, anodizing, etching, chromating
Red River AD	flow not metered over 250,000	-	yes*	yes	Direct	Bled into treatment system	Sludge drying beds Hauled	Most metals as requested, anodizing, etching, chromating
Redstone Arsenal	100	sm Wastewater flows directly to sanitary sewer	-			Hauled		Copper, tin lead, nickel, gold, etching

*exact flows not known

Location	Flows from plating (gpd) & IWTP (gpd)	CN (1000 gpd)	Cr (1000 gpd)	Segregated	Treated Effluent Discharge	Concentrated Bath Disposal	Sludge Handling	Metal Finishing Operations
Riverbank AAP	70,000 150,000	0	1	yes	Direct	Flow direct to IWTP, except Cr and CN which are pretreated	Gravity thickener Lagooned	Zinc phosphate coating
Rock Island Arsenal	45,000	0	45	no	POTW	Dumps are batch treated and released to waste treatment facility	Filter press Contractor hauled	Several metals as requested
Sacramento AD	35,000	12	1	yes	POTW	Hauled	No thickening or dewatering Sludge is pumped to drums for landfill disposal	Several metals and surface treatment processes, printed circuit boards
Scranton AAP	11,000 (2,000 is recycled)	0	11	yes	POTW		Gravity thickener Landfilled (delisted)	Chromating, phosphating, prior to painting
Stratford Army Engine Plant	65,000 plating 42,000 other ind 200,000 total	0.65	46	no	Direct	Bled into treatment system slowly	Lagooned and then sludge drying beds Hauled	Several metals as requested, passivation, phosphating, anodizing

Location	Flows from plating (gpd) & IWTP (gpd)	CN (1000 gpd)	Cr (1000 gpd)	Segregated	Treated Effluent Discharge	Concentrated Bath Disposal	Sludge Handling	Metal Finishing Operations
Tank-Automotive Research and Development Center	300 when operational	yes*	yes*	yes	POTW	Dumps are batch treated and flow to holding tanks	Disposal by Detroit Army Tank Plant IWTP	Most metals as requested
Tobyhanna AD	20,000	4	2	yes	Direct	Drums are hauled by contractor	Filter pressed and contractor hauled in new system	Several metals as requested, anodizing, etching, phosphating
Watervliet Arsenal	61,500	0.2	61.3	yes	Direct	Dumps are bled in from storage tank	Sludge drying beds and contractor hauled	Several metals as requested, anodizing, etching, phosphating
White Sands	very low	0	0				Evaporation tanks Hauled	Anodizing only

*exact flows not known

IV. DISCUSSION

4. The Plating Operation and Wastewater Generation. Plating is a process in which a thin coat of metal is applied to the surface of a part which may be metal or non-metal. This coat of metal serves to protect the part from wear or corrosion, to increase its thickness, or may be integral to the function of the piece. As examples within DARCOM, gun barrels are chrome plated, worn machine parts are built up to original specifications, and printed circuit boards are copper plated.

For purposes of this study, plating wastewater also includes wastes generated by the other metal finishing operations which are covered by EPA's Electroplating Point Source Category regulations. These include anodizing, phosphating, and chromating.

As the workpiece is withdrawn from the metal plating bath or other process solution and submerged in the rinse tank, it carries with it excess liquid. The liquid, called "dragout," may be carried as a film on an open surface of the part or captured in recesses in the part. Dragout of processing baths into subsequent rinse tanks is a major source of pollution; in most shops, it is the main source.

Plating tanks sometimes spring a slow leak of which the plater may be unaware for several days, parts may drip plating solution over floor drains, and accidental overflows may occur when plating baths are being topped off with tap water.

There are several other waste-generating procedures in the plating shop. Process solutions which are discarded consist primarily of acid and alkaline cleaners. In addition, in a few DARCOM installations, metal plating baths are occasionally dumped, presumably to insure quality plating.

All of these contribute flows, either dilute or concentrated, to the Industrial Waste Treatment Plant (IWTP). The flow contains dissolved metals, acid and alkaline solutions, and frequently cyanide and other contaminants. Flow volumes vary widely within the DARCOM community. Figure 1 presents summarized flow volumes from DARCOM plating shops.

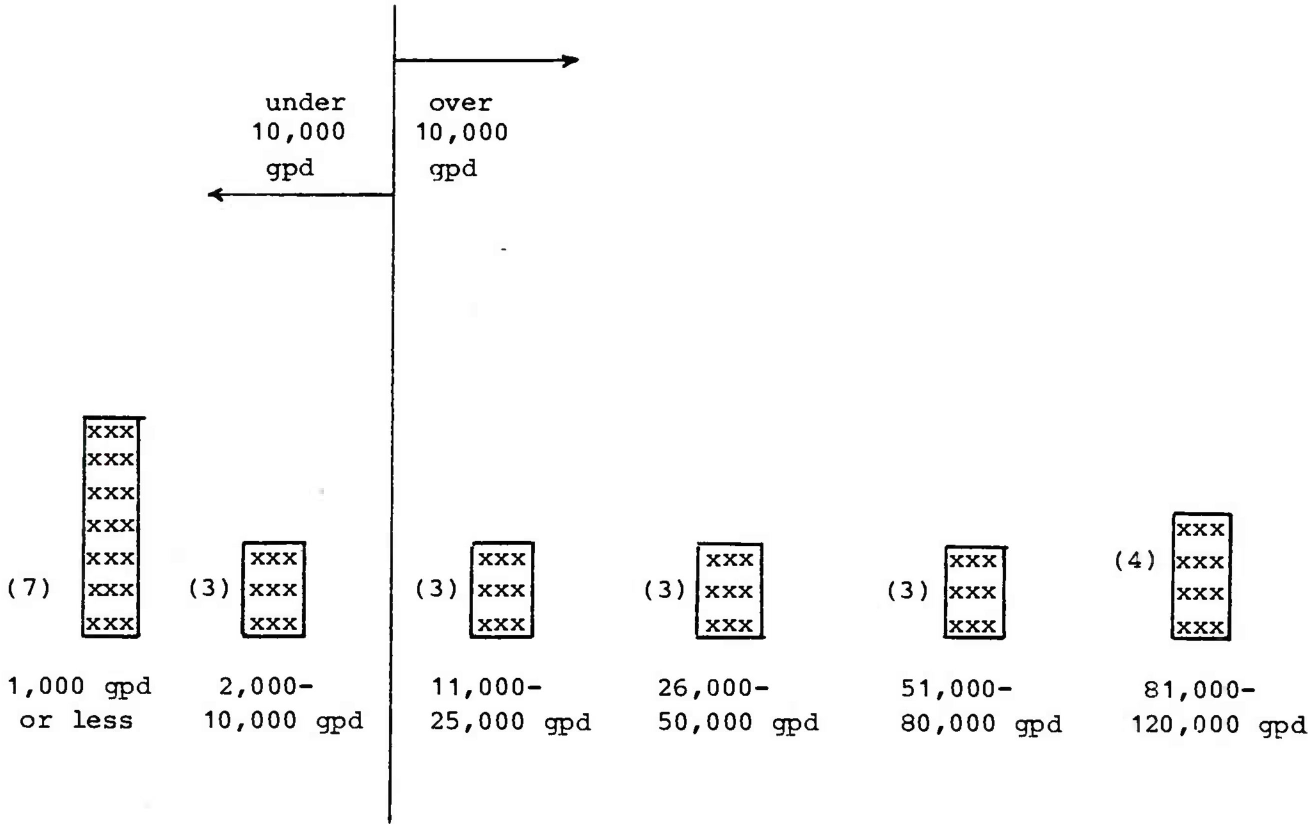

Figure 1. Flow volumes of plating wastewaters (number of DARCOM installations).

The survey requested information on plating shop effluent composition. This effluent then becomes influent to the IWTP. Few of the respondents were able to supply this data. A number of reasons exist for this situation. In many cases, chemical analysis of plating shop effluent had not been done; in several others, the plating work load was so variable that a "typical" sample could not be taken. This report, therefore, presents no statement relative to the concentration of metals or other contaminants in the wastewater going to the IWTP.

5. Limitations on Contaminant Content of Effluent After Treatment. Regulations which apply to the effluent from DARCOM plating wastewater treatment systems are set forth in several different ways.

NPDES permits may be written by EPA, by state authorities, or by local authorities. For DARCOM installations, permits are written as follows:

EPA only: 3

State authorities only: 12

Local authorities only: 3

EPA + state (2 permits): 4

EPA + local (2 permits): 1

EPA promulgated final rules on pretreatment of electroplating wastewaters in 46 FR 9462 (28 January 1981) as listed in Tables 2 and 3. Although there are few DARCOM installations to which these regulations apply, state and local authorities have used them as guidance in writing permits for those not permitted by EPA directly. Limitations may be more stringent and may cite other parameters.

New, more stringent "metal finishing" regulations were recently proposed in 47 FR 38462 (31 August 1982). Since these rules are not yet finalized, they have not been included here.

Table 2: Pretreatment Standards for Common Metals Facilities Discharging Less Than 10,000 Gallons per Day (46 FR 9462, January 28, 1981)

Pollutant or Pollutant Property	Maximum for Any 1 Day (mg/l)	Average of Daily Values for 4 Consecutive Monitoring Days Shall Not Exceed (mg/l)
Cyanide, amenable	5.0	2.7
Lead	0.6	0.4
Cadmium	1.2	0.7

Table 3: Pretreatment Standards for Common Metals Facilities Discharging More Than 10,000 Gallons per Day (46 FR 9462, January 28, 1981)

Pollutant or Pollutant Property	Maximum for Any 1 Day (mg/l)	Average of Daily Values for 4 Consecutive Monitoring Days Shall Not Exceed (mg/l)
Cyanide, total	1.9	1.0
Copper	4.5	2.7
Nickel	4.1	2.6
Chromium, total	7.0	4.0
Zinc	4.2	2.6
Lead	0.6	0.4
Cadmium	1.2	0.7
Total Metals	10.5	6.8

From information contained in survey responses, it is not possible to characterize all of the permits. It appears that the technology available suffices to meet the permits, although certain installations are not in compliance for a variety of reasons to be discussed in a later section of this report.

6. Wastewater Treatment by the Industrial Wastewater Treatment Plant (IWTP). Within the plating industry generally and within DARCOM specifically, conventional wastewater treatment typically consists of some subset of the unit operations presented in the following paragraphs. A schematic of these unit operations is presented in Figure 2.

a. Chromium Reduction. Hexavalent chromium enters the waste stream as a result of chromium plating, chromating, and other metal finishing operations. The metal in this state is extremely toxic. It is usually reduced to its trivalent state by addition of sulfur dioxide, sodium bisulfite, sodium metabisulfite, or ferrous sulfate. The reduction process is most effective at low pH levels (below 3.0), so sulfuric acid is added to lower the pH in this step. As trivalent chromium, the metal can then be precipitated as chromium hydroxide in a later operation.

The process has proven its effectiveness in industry and is well suited to automatic control. Possible limitations include: (1) Careful control over pH is required for effective reduction, (2) chemical interference may occur when mixed wastes are treated, and (3) post-chlorination may oxidize Cr(III) which escapes treatment back to Cr(VI) prior to discharge.

Among the 23 DARCOM installations covered in this report, 21 generate chromium wastewater flows (Figure 3). Three plants generate small amounts of chromium wastewaters which are not reduced. Four plants do not segregrate chromium-bearing wastewaters and therefore subject all flows (mixed) to the chromium reduction process. Twelve plants segregate the chrome flows and begin treatment with chrome reduction. For 2 of the 21, the treatment method was unclear from their survey reponses.

Several installations have experienced problems in meeting their NPDES permits on hexavalent chrome. As previously noted, pH levels below 3.0 facilitate the reduction process. Above pH 5.0, the reduction rate is slow, and a longer detention time would be required, but may not be possible in the given treatment system. Chemical feed equipment must be sized to supply both acid and reducing agent in sufficient amounts. When slugs of more concentrated wastes reach the IWTP, equipment may not provide chemicals in quantities to satisfy the demand. This would result in an effluent which had higher concentrations of contaminant.

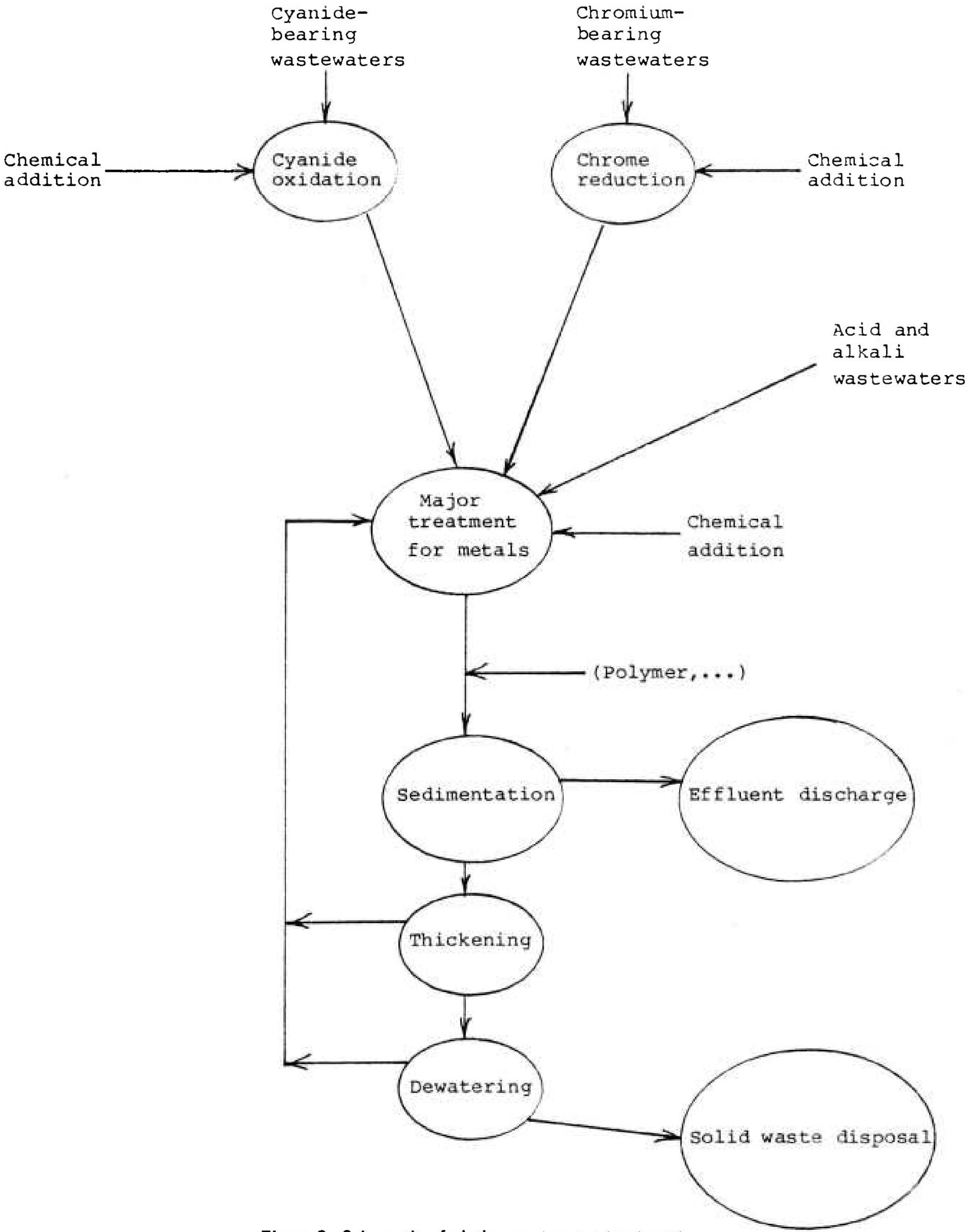

Figure 2. Schematic of plating wastewater treatment.

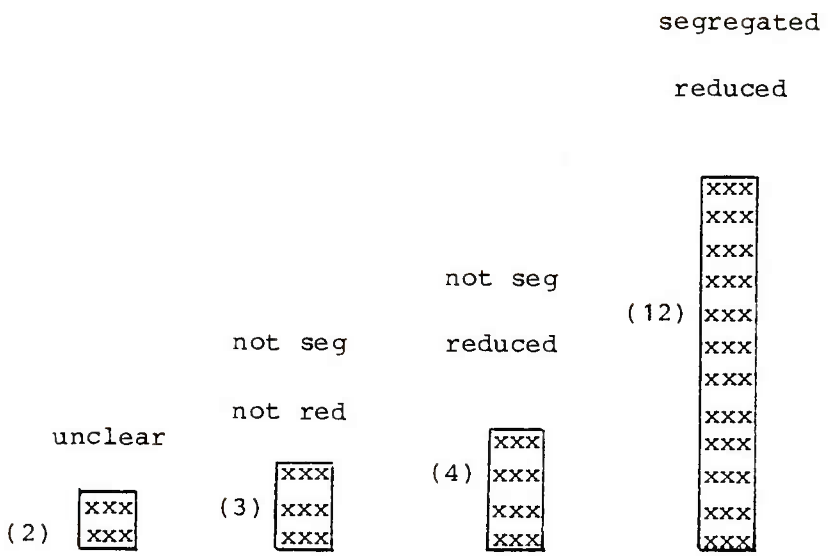

Figure 3. Treatment of chrome wastes (number of DARCOM installations).

In addition, for the four DARCOM installations where flows are not segregated but chrome reduction takes place, the lowering of pH and dosing with reducing agent is necessary for all wastewater flows whether or not they originated in chrome treatment. This places a burden on the chemical feed equipment. Another possible problem is the chemical interference of the non-chrome waste.

b. Cyanide Oxidation. Many operations in plating and heat treating contribute waste streams with high concentrations of cyanide. Copper, zinc, and cadmium are often plated from cyanide baths, for example. In most IWTPs, chlorine is used to oxidize the cyanide in this wastewater to cyanate. The cyanate is far less toxic than the cyanide and is not volatile. In some waste treatment facilities, a second stage of oxidation is provided to further oxidize the cyanates to carbon dioxide and nitrogen gas.

The process is known as alkaline chlorination, and both chlorine and caustic soda are added. Desirable pH for the reaction is in the range from pH 8 to 10.

The treatment method is effective, low in cost, and suitable for automatic control. Possible problem areas include: (1) careful pH control is required to avoid volatile intermediate products which are hazardous, and (2) in treating mixed wastes (non-segregated), chemical interfernce is possible.

Although many DARCOM plating shops have recently switched from cyanide to non-cyanide plating baths, there remain as many as 12 which must treat some cyanide-bearing wastewaters (Figure 4). Seven of these separate and oxidize cyanides. Two have cyanide-bearing wastewaters but do not use cyanide oxidation. One uses the process on non-segregated flows. Two others did not state treatment method.

Few comments were made on the survey regarding problems with cyanide treatment. One problem area is in dealing with slugs of concentrated wastes from the plating shop. The chemical feed equipment may be too small to keep pace with the demand of these wastes. For plants which do not segregate flows, chemical interference is expected.

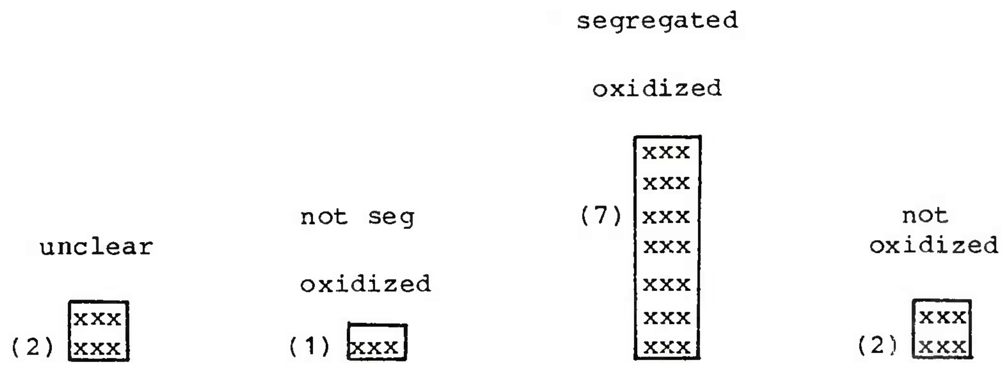

Figure 4. Treatment of cyanide wastes (number of DARCOM installations).

c. Hydroxide Precipitation. In this classic treatment method, the pH of the combined wastewaters is adjusted, usually by lime addition. At elevated pH, metal hydroxides have very low solubilities and will precipitate out when allowed to settle. The solubilities of various metal hydroxides are minimized at pH values between 8.0 and 10.0.

For optimum use of this process, it is important that there be enough excess hydroxide ion to drive the precipitation reaction to completion and to preserve the required alkaline pH. The sedimentation process must be properly designed to allow solids removal as well.

The treatment method has proven effectiveness within industry and is well suited to automatic control. Some of its limitations include (1) sludge quantities generated may be substantial and difficult to dewater, (2) chemical interferences are possible in treating mixed wastes, (3) chrome (VI) will not be removed by this technique, and (4) cyanide will interfere with the process.

Within DARCOM, 15 treatment plants use hydroxide precipitation to treat the flows from their plating shop. Five use some other wastewater treatment process, two installations provide no special treatment for plating wastewaters, and one did not state the treatment method.

When failures occur in this system, they are usually due to inadequate dosing of influent wastewater with lime. This may be the result of an increase in the concentration of raw wastes which produces a lime demand in excess of the feeder capacity.

d. Clarification and Effluent Discharge. Clarification occurs when metal hydroxides, suspended solids, and other settleable solids are separated from the liquids by which they are carried in the wastestream. Polyelectrolytes or alum are often added to enhance this process. The wastewaters go either to a sedimentation tank or to an air flotation system. The sedimentation tank was also referred to in survey responses as a clarifier or gravity settler. One DARCOM installation uses an air flotation system, and the other installations which provide treatment use sedimentation to separate solids from liquids.

Advanced techniques for solids/liquids separation include tube settlers and lamella settlers; advantages are accrued in space reduction and shortening of detention time. One DARCOM plant will install a lamella settler in the fall of 1982.

The effluent from the clarifier or settling basin is neutralized if required by the NPDES permit and discharged to a stream or local sanitary sewer or to the publicly-owned treatment works (POTW). The permit for discharge is determined, in part, on the basis of where the effluent goes.

Of the 23 DARCOM plating installations surveyed, 6 discharge effluent to a POTW and the rest discharge directly to a stream (Figure 5). One installation recycles a portion of its effluent back to the plating shop for reuse.

e. Sludge Thickening, Dewatering, and Disposal. There are two products which require ultimate disposal from the IWTP. The first is the clarified effluent described above; the second is the sludge collected in the clarifier underflow. Solids content of this underflow is customarily around 1 percent. For each doubling of the solids content, the volume of sludge is reduced by half. Since sludge disposal is expensive, volume reduction is cost effective.

A method which is often used to reduce sludge volume is gravity thickening. Sludge is fed to a thickening tank where rakes gently stir the sludge, allowing the liquid to rise and the sludge blanket to become more dense. Underflow from the gravity thickener tank may have a solids content of around 6 percent. It is not clear from survey responses how many installations have such a sludge thickening device.

Further reduction in sludge volume is accomplished by dewatering techniques. Methods used within the DARCOM community to dewater sludge are pressure filters, vacuum filters, lagoons, and sludge drying beds (Figure 6).

The highest solids content sludge comes from a pressure filter. The liquid sludge is pumped into the filter press where the sludge is gradually dewatered by applying high pressures to force much of the liquid out, leaving the solids behind. Sludge cake with 25 to 50 percent solids is commonly achieved. Five of the 23 plating waste treatment operations use pressure filters.

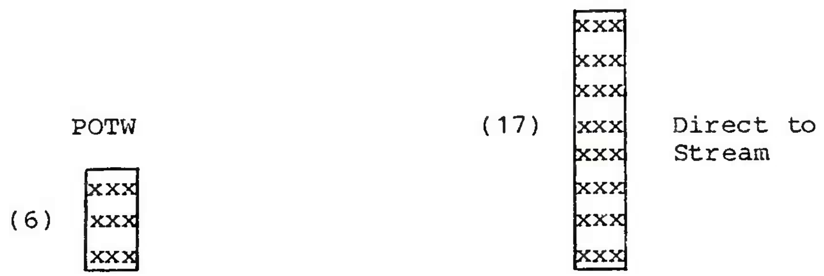

Figure 5. Discharge of treated effluent to stream or POTW.

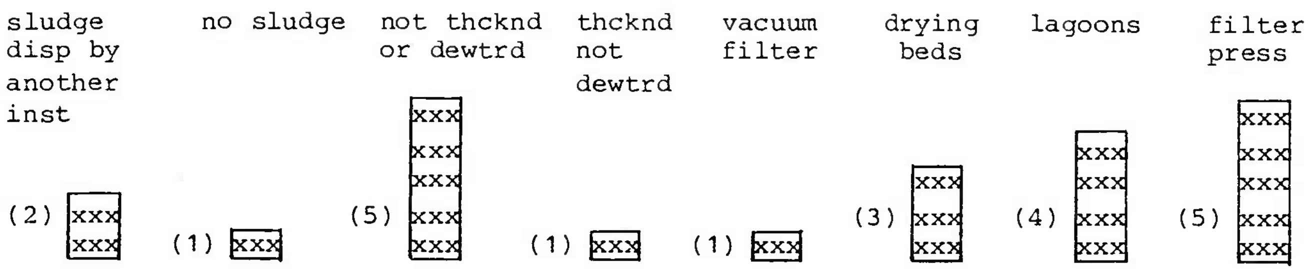

Figure 6. Methods for dewatering sludge (number of DARCOM installations*).

* The two installations which provide no pretreatment for metals were not included.

Advantages offered by the filter press include the following: (1) highest solids content are attained using this method, (2) few moving parts are involved, so maintenance is minimized, and (3) chemical pretreatment requirements are reduced. A possible disadvantage is that the filter cake must be manually released from the filter press.

Vacuum filtration gives solids contents from 15 to 30 percent, depending on what chemical additions are made to enhance the process. This process is commonly used with municipal sludge. Only one DARCOM installation uses this technique.

The vacuum filter operation uses cylindrical drum filters. As the drum rotates, part of it is immersed in a horizontal sludge tank. Sludge is drawn up onto the drum and the liquid portion is pulled into the drum while the cake solids are left outside. A scraping mechanism takes the solids off as the drum continues to rotate.

Even though the cake solids from this operation are high, the equipment is relatively expensive and is usually larger than an equivalent filter press. For plants with intermittent operations, such as most DARCOM installations, the filter equipment should be drained and washed each time it is taken out of service. This daily chore is labor-intensive and would be a disadvantage in many plants.

Lagooning is used in four DARCOM installations for sludge dewatering and/or disposal. Over time, liquids evaporate from the lagoons, leaving the solids. The method may be appropriate where land is abundantly available, but rainfall can add to the liquid in the lagoon, and groundwater monitoring may be necessary.

Sludge drying beds are used in three of the DARCOM locations for dewatering sludge. The sludge is piped or pumped onto sand beds where drainage and evaporation remove some of the liquid. After a period of time, the dried cake is removed mechanically along with some of the sand under it and landfilled. Solids contents are reported in the range of 7 to 15 percent. If the plant is located in an area with high rainfall, it is usually necessary to use covers.

Once the sludge has been dewatered as much as practicable, three methods of ultimate disposal are used: incineration, landfill, and contractor hauling. Since the waste is almost uniformly classified as hazardous, options on landfilling are limited. Incineration is energy intensive, subject to stringent air pollution regulations, and used in only one DARCOM installation (by contractor). In all other cases, the sludge is landfilled, either in approved on-site locations or off-site by contractor.

It is noteworthy that three DARCOM installations have been successful in having their sludge delisted.

f. Concentrated Wastes Disposal. For treatment of concentrated wastes or plating baths, four methods are used within DARCOM (Figure 7).

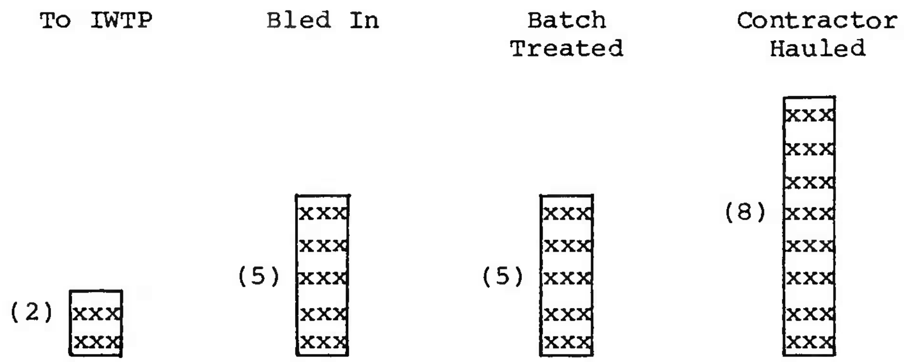

Figure 7. Concentrated wastes handling (number of DARCOM installations).

In five installations, the wastes are bled into the treatment system, usually from a holding tank which is controlled by IWTP personnel. Upset to the IWTP system is minimized using this method, though the concentration of the influent wastewater will be boosted substantially.

Bath dumps may be batch treated prior to discharge, usually in a holding tank in the IWTP. Five facilities use this method.

In two DARCOM shops, concentrated process waters are dumped into the plating shop effluent, usually after warning is passed to the IWTP. This shock load to the system upsets treatment and is likely to cause NPDES violations. Within industry, this procedure is seldom used, due to the cost of treating such a concentrated solution and the loss of the plating metals contained therein.

The fourth technique, used by eight shops, is pumping of the concentrated bath to a contractor truck which hauls this waste away.

Though survey respondents did not comment extensively on this topic, it appears that treatment of concentrated wastewaters presents a problem to many IWTPs, at least financially.

g. Other Treatment Methods. These final paragraphs on treatment methods are devoted to other methods used by small segments of the DARCOM community, as well as some methods used within the plating industry outside DARCOM which might bear investigation.

Three DARCOM installations use off-the-shelf treatment systems which include chromium reduction, hydroxide precipitation, and clarification.

Several other processes are used at various DARCOM installations. They include activated sludge, ion exchange, air flotation, evaporation, and sulfide precipitation.

Activated sludge is the treatment method used at two installations where plating wastewaters contribute only a minor portion of the total flow. Ion exchange is the principal treatment method at one DARCOM location and is available but not used at a second. Air flotation is used for solids/liquids separation at one IWTP where grease and oil are major constituents of the wastewater, and evaporation is used to treat anodizing wastewaters at one plant. Sulfide precipitation replaces hydroxide precipitation at one IWTP soon to come on-line (summer 1982). All of these processes are well described in the literature, but ion exchange and sulfide precipitation warrant further discussion here due to their general applicability.

Ion exchange is used in three modes within industry, for water purification and recycle, as an end-of-pipe treatment, and for metals recovery. In a typical application, the wastestream flows through a filter for suspended solids removal and then into an exchanger containing cation resins. Metallic ions such as copper and trivalent chromium are retained here. The flow continues on through an anion exchanger where hexavalent chromium, for example, would be retained. Subsequent regeneration of the resins is necessary to displace the ions which have been retained.

While the method has many applications, including recovering rinse waters, process chemicals, and metals, the resins are still under development and at this point the usefulness of the method may be limited. Limiting factors include the resin's sensitivity to wastewater temperature and damage which may be caused by certain acids and metals.

Ion exchange technology is commercially available and is used in many industrial plating shops. Its applicability to DARCOM requirements should be studied as the process continues to develop. Since the equipment is being used successfully at one DARCOM shop now, a test case exists.

Sulfide precipitation is a treatment method quite similar to hydroxide precipitation. The operational difference is in the chemical added, a sulfide rather than a hydroxide. A soluble sulfide precipitation plant will begin operation at a DARCOM installation during the fall of 1982. In this treatment, greater heavy metal removal is possible due to the lower solubilities of metal sulfides over metal hydroxides. The sludge which is formed is also easier to dewater than the gelatinous sludge which is produced by hydroxide treatment. A smaller volume of sludge results which has a higher percentage of solids. Careful pH control is necessary to prevent the formation of toxic hydrogen sulfide gas, and careful dosage control is necessary to avoid high levels of sulfide effluents which are toxic.

There are several other techniques which are used to treat plating wastes in industry not in the DARCOM community. These include membrane filtration, cross-flow filtration, peat adsorption, insoluble starch xanthate, and diatomaceous earth filtration. An investigation of these techniques and their relevance to DARCOM needs may be worth considering at some future time.

7. In-Plant Operations Control and Treatment Techniques. The plant referenced in this section is the plating shop. Wastewater to be treated in the IWTP is generated here, and every gram of pollutant avoided or gallon of rinsewater conserved contributes to treatment efficiency.

There are several techniques which can be used to abate metal finishing pollution at its point of generation. The next paragraphs describe the simplest and least expensive ones to install and use. Many other techniques are described in the literature, and an excellent reference is the EPA publication, "Control and Treatment Technology for the Metal Finishing Industry; In-Plant Changes" Technology Transfer, EPA 625/8-82-008, published in January 1982.

a. Proper Rinse Tank Design. Figure 8 shows a rinse tank with air agitation, flow control valve, and water supply delivery pipe all properly configured. The air agitation enhances the rinsing process by providing turbulence. It is an alternative to use of large volumes of rinse water which can serve the same purpose. Consideration must be given to avoiding oil contamination of the blower air. The flow control valve shown may be the non-electronic type mentioned in Paragraph 7c on Rinsewater Reduction. The water supply delivery pipe should deliver water to the bottom of the rinse tank to prevent short-circuiting and to maximize the efficiency of rinsing.

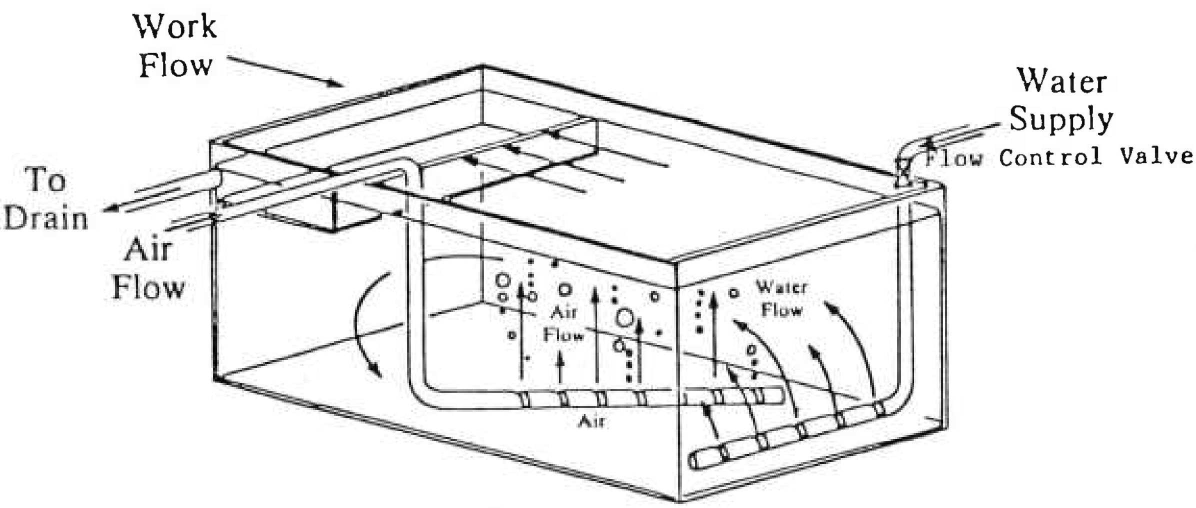

Figure 8. Proper rinse tank design.

b. Drag-out Reduction. Techniques mentioned in the literature for reducing drag out deal with placement of the workpiece on the rack, concentration of the metal in the plating bath, surface tension, viscosity, and temperature of the bath. These may be considered, but there are three techniques which are much simpler to implement and for which the pay back is quick. The first is use of a drain board between tanks which is slanted to return the drippings to the tank from which they came. The second is use of a drip tank; that is, an empty tank used to collect dripings which can then be recycled back into the process bath itself. Drip rods suitable for hooking single pieces or drip racks for numbers of similarly shaped pieces are commonly used for this purpose and have been installed in many DARCOM shops. Education of the platers is of key importance to insure that they allow these seconds of dripping. This dripping period represents a very small portion of the total time required for plating. The third is use of a still rinse as the first rinse tank. Air agitation creates the turbulence required for effective rinsing. The concentration of metal in this tank will progressively increase and the contents will be returned to the plating tank periodically, so long as there is sufficient evaporation from the plating tank itself. Minimizing dragout decreases the need for addition of process chemicals to the plating bath, keeps rinse waters cleaner, decreases the amount of chemicals requiring treatment in the IWTP, and lessens the volume of sludge which will be generated in the IWTP.

c. Rinsewater Reduction. A second major source of savings in pollution abatement is a reduction in the amount of rinsewater used. Counterflow rinse tanks are installed in many DARCOM plating shops and allow dramatic reductions in rinsewater volumes due to their effectiveness. Aeration of rinse tanks also gives better rinsing with less water. In many DARCOM shops, rinsewater flow controls have been installed; several varieties of conductivity flow controllers exist. Their mode of operation is simple; i.e., when the rinsewater becomes sufficiently contaminated, the probe senses that fact, and rinsewater is automatically fed into the rinse tank. When the water is renewed, the supply is turned off automatically. The electronic probes are most useful for a rinse tank which is seldom used. These probes have been installed in at least some tanks in approximately 70 percent of DARCOM's plating shops. They are not performing well in most shops, however. Problems encountered in using the probes result from their lack of ruggedness and need for frequent calibration and cleaning. Many platers are not content with the way they work and override the controls.

Non-electronic flow restrictors and combination flow restrictors-aerators are available and inexpensive. They allow a set volume of water to flow per minute on a continuous basis. These are being installed in one DARCOM plating shop and possibly exist in others. They are particularly appropriate for rinse tanks which are in continuous use.

Rinsewater recycling is a simple method by which platers may conserve water. Rinsewater from one tank is recycled for use at another rinse station. Three or four rinse tanks can be so connected, depending on the process. For example, the rinsewater used after an acid tank can be reused for rinsing after an alkaline cleaner. Not only is the volume of rinsewater cut by 50 percent, but the quality of rinsing at the second tank is likely to be improved. Figure 9 shows a possible arrangement for use of the technique.

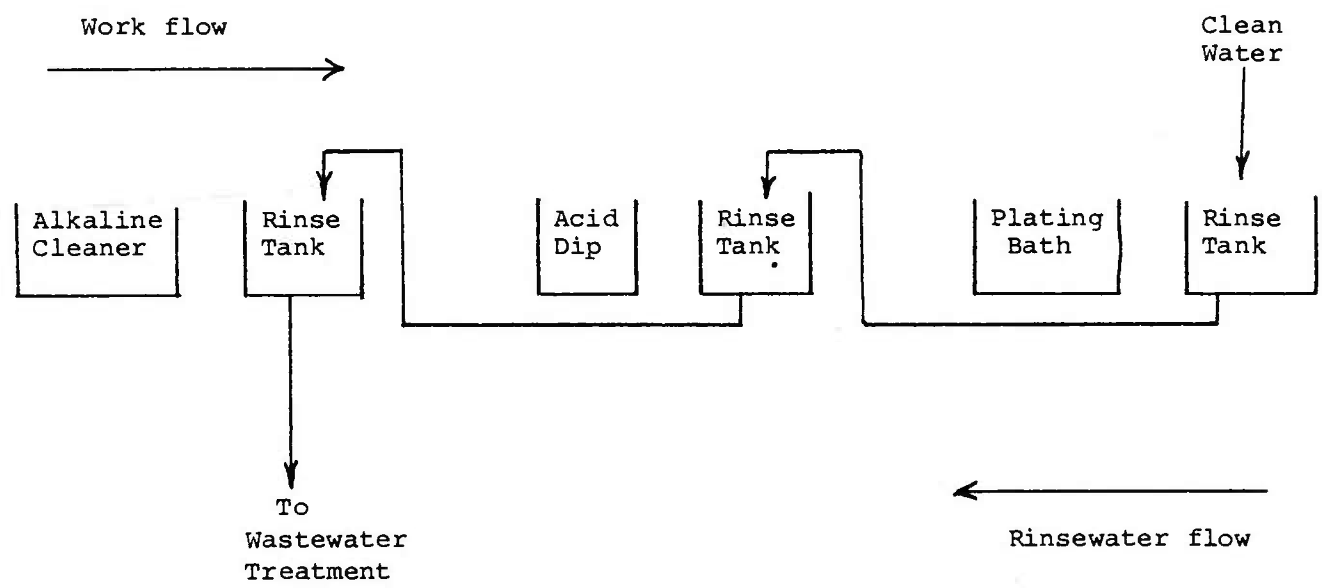

Figure 9. Rinsewater recycling.

d. Bath Dumps. A third major source of pollution abatement is in the area of dumps of strong process solutions. As previously described, these can be accommodated by slowly bleeding these solutions into the treatment system. Many dumps are unnecessary, however, and all should be carefully examined to confirm that the need to dump exists. Alternatives such as filtering and skimming are possible and good housekeeping practices among platers will reduce the need for disposal. Rarely should a plating bath be dumped. Dumping results in a tremendous shock to the treatment process as well as the loss of metals and the generation of tremendous volumes of sludge. Plating quality is of prime importance, but proper care can almost eliminate the need to dump plating baths.

DARCOM installations can effect the greatest reduction in pollution by implementing changes in these areas:

(1) Proper draining of plating and concentrated process solutions.

(2) Reduction in the amount of rinsewater used.

(3) Minimization of dumps of concentrated process solutions.

8. System Costs. Questionnaire respondents from several of the 23 DARCOM installations provided capital costs for building their wastewater treatment plants. Few, however, were able to quantify dollars spent for operation and maintenance of the IWTP. For this reason, costs of providing wastewater treatment at the IWTP are not included in this report.

A significant and quantifiable cost item is disposal of the sludge or concentrated wastes when they are hauled by a contractor. Costs for disposal of liquid wastes were lowest at one DARCOM installation where rates were quoted at around $0.45 per gallon for approved deep-well injection of the wastes. A low for solid wastes was $45 per cubic yard or $0.22 per gallon which gives a cost for disposing of the contents of a 55-gallon drum at $12.26. These two examples were unusual, for several other locations report prices for disposal of 55-gallon drums and contents from $150 to $300 per drum.

Continued use of contractors for disposal will become more difficult and expensive due to Resource Conservation and Recovery Act (RCRA) requirements now being implemented. Hazardous landfill sites are increasingly difficult to locate, and licensing requirements are becoming more stringent. DARCOM wastes are now being hauled across several states for disposal. Transportation manifests are more detailed. Costs for insurance against spills are increasing. Sludge disposal will be a major factor in the pollution abatement program at DARCOM installations.

9. Problems in Compliance, Coordination, and Metals Recovery. Problems encountered were:

a. Compliance. A number of treatment plants are not in compliance with their NPDES permits, though most survey respondents did not comment in this area. A few are not in compliance during many periods of the year, some infrequently, perhaps just in one metal. The reasons for the situation are not easy to pinpoint.

One possibility is the age and/or design of the treatment system at the IWTP. The system may not be able to provide the treatment required by today's plating wastewater loads. Six DARCOM installations are presently in the process of upgrading their facilities. For four installations, the upgrading consists of the construction of a new plant.

For example, a few installations have plating shops where chrome wastes are not segregated. Here the entire flow may be subject to chrome reduction, rather than just the rinsewater which is actually used in the chrome process. Cyanide wastes create problems, too, in that they will intefere with other processes when mixed wastewaters are treated.

After considering the IWTP, it is appropriate to look next at the influent to it. In Paragraph 7 of this report, several techniques are decribed for pollution abatement in the plating shop. Many survey respondents felt that a few platers were not sensitive to the impact which their actions have in the IWTP. One plater who leaves the rinsewater faucet fully open when no plating is being rinsed adds to the burden on the IWTP, since many chemicals are added based on volumes of flow. Electronic rinsewater flow controls are installed in many locations but are seldom effective. Other techniques referenced in Paragraph 7 could be used, but cooperation is called for between platers and IWTP personnel. At one DARCOM installation, platers have toured the IWTP, and communication lines have been established. This communication will facilitate better wastewater treatment.

The dumping of concentrated process solutions or metal plating baths, as previously mentioned, has tremendous impact on the IWTP in three areas: demand on chemical feeders, quantities of sludge generated, and likelihood of NPDES violations. When these dumps are absolutely neccssary, they should be carefully coordinated with IWTP personnel.

b. Coordination. The coordination of facilities, production, quality assurance, and environmental offices within each DARCOM installation is important, too, since each has impact on the quality of effluent discharged by the IWTP. In one typical DARCOM installation, the Facilities Engineering Division (FED) has the maintenance responsibility, including process equipment. The Quality Assurance Division (QAD) must ensure that plating meets government specifications, and the Production Division (PD) maintains adequate through-put of work in the plating shops. These divisions report to the Commanding Officer with no other common management level. FED should initiate changes which modify wastewater treatment, but FED has limited authority over QAD and PD to implement or enforce operating procedures. Informal communications lines exist in most DARCOM installations, but in isolated cases, good coordination comes about only after a permit violation has been brought to the attention of the Commanding Officer.

c. Metals Recovery. The increasing cost of replacing as well as treating chemicals lost to waste streams in the plating shop has provided an economic incentive for reclaiming these materials for reuse. The processes used all operate on the same principle; they concentrate the dragged-out plating solution contained in the rinse water so that the solution can be returned to the plating bath. Among the recovery processes are evaporation, reverse osmosis, ion exchange, and electrodialysis. Packaged treatment units are commercially available for the recovery of chromium, nickel, copper, and zinc, as well as the precious metals. Use of such a recovery process can result in an essentially closed system around a plating bath. Plating chemicals are used only for plating; none are sent down the drain. Rinse water is returned to the rinse tank after the metals have been removed, so no rinse water is sent to waste treatment. One DARCOM installation has recently installed a system for chrome recovery, but operational data are not yet available. Use of recovery processes is generally confined to the plating shop area.

Recovery of metals from the sludges which are generated when the waste stream reaches the IWTP has been shown to be unecomonical in studies conducted with mixed hydroxide sludges. Single metal recovery from single metal sludges is now used to a limited extent in industry. Nickel recovery from nickel carbonate sludge is an example. Solvent extraction and electrochemical and roasting have been used to recover metals from hydroxide wastewater treatment sludges. Economic projections are not favorable for either of these metal recovery techniques.

The benefits which could be derived from the application of a metals recovery system, either from the rinsewater or from the sludge, in any DARCOM installation must be determined on a case-by-case basis. In general, these operations are most cost-effective in high-volume, single metal plating operations. Several DARCOM installations fall into this category.

This area should be examined carefully for several reasons. First, metals which go down the drain are not being used for plating and must be replaced by additional metals in the plating bath. Second, there are shortages in certain metals and the cost of these and most other metals increases yearly. Third, more metals in the wastewater means that more sludge will be generated in the IWTP. This sludge is increasingly expensive to dispose of in hazardous landfills.

V. CONCLUSIONS

10. Conclusions. It is concluded that:

a. A data base of wastewater treatment facilities which service plating wastewater generators has been established (Section III and Appendix B).

b. Treatment needs vary within the DARCOM community; however, conventional treatment can satisfy most needs when the systems are properly maintained and operated.

c. In several instances, intermittent non-compliance can be attributed to slugs of concentrated metal solutions resulting from disposal of baths, either bled-in or dumped. Batch dumping of process solutions and plating baths causes substantial problems in treatment and can be avoided.

d. Some DARCOM installations are old, have non-segregated flows, and are likely candidates for improvements in waste treatment equipment.

e. In several installations where rinsewater controls have been installed, the systems do not operate satisfactorily because of improper installation and the sensitivity of the probes to damage.

f. Improved plating processes in many installations can reduce volumes of wastewater generated, amounts of metals lost in dragout, sludge volumes, and facilitate compliance with the NPDES permit. Improved plating quality may also result.

g. Internal coordination and communication among facilities, production, quality assurance, and environmental offices of DARCOM facilities are important for effective operation of the Industrial Wastewater Treatment Plant.

h. Sludge disposal is an expensive and time-consuming problem and is likely to become more so.

i. Few DARCOM installations use water recycle or metals recovery systems. Investigation of those methods currently being used in-house and by industry is appropriate.

j. Environmental officers at DARCOM installations are concerned about doing their jobs well, and generally get good cooperation from other involved personnel when they ask for it. DARCOM is supportive as well.

VI. SUGGESTIONS FOR PLATING WASTEWATER TREATMENT

11. Recommendations. This report was staffed by USATHAMA to DARCOM and other Department of Defense agencies. The recommendations which follow have been jointly agreed upon.

12. Individual Plating Installations. The following are recommended tasks for personnel at the individual plating installations:

a. Evaluate and optimize present wastewater treatment systems. Implement in-plant pollution abatement techniques, such as reduction of rinsewater volumes and proper draining of plated parts. Outside assistance may be required.

b. Coordinate any bath dumps which are required with IWTP personnel. Examine the causes of dumps with a goal of reducing the frequency of dumping of concentrated solutions.

c. At those plants using only gravity settling of sludge, augment the equipment with a sludge dewatering device. This will substantially reduce sludge handling costs.

d. Schedule a coordination meeting among the facilities, production, quality assurance, and environmental offices and personnel on at least an annual basis. The purpose of the meeting would be to discuss interrelated activities impacting on the installation's pollution abatement program.

13. Development of Improved Technology. The following are recommended tasks for development of improved technology:

a. Implement a program to provide on-site assistance at selected DARCOM installations. This program will optimize treatment operations, reduce costs, and assist in efforts to comply with NPDES permits. The on-site assistance should include:

(1) Presentation of low cost/no cost pollution abatement techniques.

(2) Inspection of plating shop and industrial wastewater treatment facilities.

(3) Coordination with installation personnel on the implementation of an improvement program for their shop.

b. Investigate selected advanced wastewater treatment techniques to determine their applicability at DARCOM installations. Three potential systems are soluble sulfide precipitation, ion exchange, and advanced clarification techniques.

c. Investigate off-the-shelf metals recovery units for use at DARCOM installations.

d. Develop methods for improved sludge volume reduction using existing technology, such as thickening and dewatering devices.

e. Develop improved sludge disposal technology.

f. Develop methods for improved use of existing water quantity control instrumentation, such as flow restrictors and probes.

g. Determine any real or potential regulatory or liability problems associated with plating wastewater treatment and sludge disposal.

h. Investigate the effect of complexing agents on wastewater treatment.

i. Investigate the fate of complexing agents in wastewater treatment.

Appendix A: Survey Used for Collecting Data from Installations

PLATING WASTES SURVEY

Return to: Commander
USAMERADCOM
DRDME-GS (G. Chesler)
Ft. Belvoir, VA 22060

Please return by 30 October 1981.

1.0 PLATING ESTABLISHMENT DATA

Installation ____________________

Address ____________________

____

____

____

Plating Facility Supervisor ____________________

Telephone: AV ____________________

Commercial ____________________

Industrial Wastewater Treatment Facility Supervisor ____________________

Telephone: AV ____________________

Commercial ____________________

Environmental Officer ____________________

Telephone: AV ____________________

Commercial ____________________

Attach copy of the plant's current effluent requirements document. Also indicate whether city ___, town ___, county ___, state ___, federal ___. Do these requirements apply to industrial wastewater treatment facility only _____ or to effluent when combined with domestic wastewater treatment facility effluent ___?

Total number of plating lines in facility ____________________

Types of parts and/or products plated ____________________

____

____

____

Principal raw materials used by the plating shop (metals, proprietary solutions, etc.). List approximate quantities in amounts per year.

____

____

____

____

____

2.0 SPECIFIC PLATING PROCESSES EMPLOYED

Check ( ) processes employed in the plant

Electroplating:

1. ___ Copper
2. ___ Nickel
3. ___ Chromium
4. ___ Zinc
5. ___ Cadmium
6. ___ Tin
7. ___ Solder
8. ___ Silver
9. ___ Gold
10. ___ Platinum
11. ___ Iron
12. ___ Anodizing
13. ___ Etching
14. ___ Milling
15. ___ Chromating
16. ___ Phosphating
17. ___ Immersion Plating

Electroless plating on plastics:

18. __ Copper
19. __ Nickel
20. ___ Gold
21. ___ Other, specify ______________

Electroless plating on metals (indicate metal plated and base metal):

22. __________ __________
23. __________ __________
24. __________ __________
25. __________ __________

Others:

26. ___ Electrochemical machining
27. ___ Polishing (electro or other)
28. ___ Electropainting
29. ___ Nonaqueous plating
30. ___ Coloring
31. ___ Other electrochemical processes
32. ___ Lead electroplating
33. ___ Bright dip
34. ___ Printed circuits

How was your work spread out among the categories of the above processes last year? (For example, "90% of the work done in this shop was zinc electroplating, 5% was cadmium electroplating and the rest was electroless nickel plating.") ______________________

____

____

____

3.0 COMPLEXING AGENTS

Complexing agents are used in many electroless plating processes. Examples of these agents include EDTA, NTA, lactic acid and thiourea. Are you using complexing agents? ____________ If yes, what is the effect of complexing agents on your waste treatment process?

____

____

____

4.0 WASTEWATER TREATMENT

4.1 Water Usage in Plating Shop

State the average gal/day used during plating plant operation

tap water ________________, recycled water __________,

and total water ____________.

4.2 Waste Streams from the Plating Process — Average gal/day

Cyanide bearing wastewater ____________

Chromium bearing wastewater ____________

All other wastewater (other rinses, etc.) ____________

Total wastewater flow from the plating shop into the industrial waste treatment facility ____________

Describe your method of dealing with concentrated batch dumps. For example, how are baths dumped when necessary? ________________

____

____

____

Are your chromium and cyanide waste streams segregated from other waste streams as listed above? Describe. ________________

____

____

4.3 In addition to plating shop wastewaters, are there other streams which contribute to the total volume of industrial wastewater requiring treatment? ________. If yes, please list contributing industrial operations and approximate volumes, if known.

____

____

____

4.4 Is the industrial wastewater treatment system working satisfactorily? Yes or no.__________ If not, please describe any problems.

____

____

____

____

____

____

____

____

____

____

4.5 What changes, if any, are planned for your industrial wastewater treatment system? ______________________________

____

____

____

____

4.6 Comment on Page A which follows regarding plating shop operations which have impact on the wastewater treatment process. For example, what rinsewater flow controls are installed? Do they accomplish their mission? Any other comments regarding this area of concern are welcome.

4.7 Waste Treatment Cost Information (conventional treatment)

(designations A, B, and C are used below in case you have more than one treatment system)

	Treatment System Name	Date Installed	Capital Costs	Operating Costs ($/yr)	Raw Waste Streams Treated (see par. 4.2)	Design Flow Level (gal/day)
A						
B						
C						

4.8 Waste Treatment Cost Information (for any recycle streams in the plating shop)

	Treatment System Name	Date Installed	Capital Costs	Operating Costs ($/yr)	Raw Waste Streams Treated (see par. 4.2)	Design Flow Level (gal/day)
A						
B						

4.9 Include below any other cost information applicable to this survey.

Page A

Comments (4.6) about plating shop operations which have impact on wastewater treatment.

4.10 From information available to you, please furnish average chemical analyses of effluents from (a) plating shop, (b) industrial wastewater treatment plant, (c) installation sewer discharge. This description should be in terms of 1)the plating metals, 2)flow, 3)pH, 4)temperature, 5)any other parameters listed in your effluent requirements. Please attach a description or write one on page B which follows.

5.0 SCHEMATIC OF PLATING OR COMBINED INDUSTRIAL WASTE TREATMENT SYSTEM

Draw your schematic using descriptors listed below or others which describe processes used in your system. Use page C for the schematic.

General description
01 Batch process
02 Continuous process
03 Integrated process
04 Other ____________ (specify)

In-Plant Processes
10 Reverse Osmosis
11 Ion Exchange
12 Evaporation
13 Electrodialysis
14 Pfaudler
15 Lancey
16 Innova
17 Wastesaver
18 Ultrafiltration
19 Other ____________ (specify)

End-of-Pipe Processes
20 Screening
21 Emulsion Breaking
22 Skimming
23 Chemical Oxidation (incl cyanide)
24 Chemical Reduction (incl chromium)
25 Neutralization
26 Chemical Precipitation
27 Flotation
28 Lagooning (for solids settling)
29 Clarification (with addition of coagulants)
30 Filtration
31 Ion Exchange
32 Reverse Osmosis
33 Adsorption
34 Evaporation (distillation)
35 Chlorination
36 Lagooning (for biological decomposition)
37 Other ____________ (specify)

Sludge Dewatering
40 Thickening
41 Centrifugation
42 Vacuum Filtration
43 Pressure Filtration
44 Other ____________ (specify)

Sludge Disposal
50 Lagooning
51 Land Fill
52 Incineration
53 Contractor Removal
54 Other ____________ (specify)

Oil Disposal
60 Incineration/Combustion
61 Processing for Reuse
62 Contractor Removal
63 Other ____________ (specify)

Water Discharge
70 Sanitary Sewer
71 Stream/River
72 Lake/Pond
73 Deep Well
74 Leach Field
75 Processing for Reuse
76 Other ____________ (specify)

note: Circle if the following are discharged into your industrial waste treatment facility: 80 Sanitary Wastes, 81 Noncontact cooling water, 82 Boiler Blowdown

Comments (4.10) which furnish effluent data on the plating shop, the industrial wastewater treatment system, the sewer discharge.

Comments (5.0) Industrial Wastewater Treatment System Schematic

APPENDIX B - SURVEY RESPONDENTS

This appendix contains a data sheet for each facility responding positively.

"No metal plating" responses were received from Kansas AAP, Lima Army Tank Plant, Sharpe AD, Sierra AD, and Tarheel Army Missile Plant.

No responses were received from Aberdeen, Dugway Proving Ground, Ft. Monmouth, Michigan Missile Plant, Mississippi AAP, Pueblo AD, or Tooele AD.

Installation: Anniston Army Depot

Metal Plating and Finishing Processes:

Chromium, cadmium, anodizing, etching, chromating, and phosphating

Wastewater Volumes:

Volume from plating shop: 82,000 gpd

Total volume processed by IWTP: 200,000 gpd

Volume of cyanide-bearing wastewater: 10,000 gpd

Volume of chrome-bearing wastewater: 48,000 gpd

Discharge IWTP effluent to: Direct to stream

Permit containing standards for that effluent issued by: State of Alabama

Discussion:

Treatment methods include batch treatment for chrome reduction and cyanide destruction. General rinses and effluent from the batch processes are subject to pH adjustment, polymer addition, flocculation, sedimentation, and discharge of effluent to the sanitary sewer system. Construction has recently been completed on a new waste treatment plant and electroplating facility.

Sludge is conditioned with lime and diatomaceous earth and dewatered in a filter press. Filter cake is hauled by contractor.

Concentrated baths are trucked to the IWTP and bled into the treatment system.

Installation: ARRADCOM, Dover

Metal Plating and Finishing Processes:

Area I: printed circuit boards, some electroless plating
Area II: most metals and surface treatment, some electroless plating

Wastewater Volumes:

Volume from plating shop: I: 4,000 gpd (2 days per week)
II: 20,000 gpd

Total volume processed by IWTP:

Volume of cyanide-bearing wastewater: none

Volume of chrome-bearing wastewater: I: 2,000 gpd; II: 7,000 gpd

Discharge IWTP effluent to: direct to stream

Permit containing standards for that effluent issued by: EPA

Discussion:

Treatment includes chrome reduction and chemical precipitation using sodium hydroxide on mixed waste streams. The Lancy System is used for treatment of certain wastes.

Sludge from Area I is pumped into tanker trucks and disposed of in an off-site hazardous landfill by contractor. Sludge from Area II is initially placed in covered lagoons; monitoring wells are installed. Twice a year the lagoon contents are pumped into tanker trucks and disposed of in an off-site hazardous landfill by contractor.

Batch dumps from the printed circuit board area are hauled by contractor. In the plating facility, they are dumped to treatment tanks and batch treated. The waste is then discharged to a settling lagoon.

Installation: Corpus Christi Army Depot (tenant of Naval Air Station)

Metal Plating and Finishing Processes:

Cadmium and chromium electroplating are a majority of the work done; other metals and surface treatment as requested.

Wastewater Volumes:

Volume from plating shop: 120,000 gpd

Total volume processed by IWTP: 185,000 gpd

Volume of cyanide-bearing wastewater: 10,000 gpd

Volume of chrome-bearing wastewater: 50,000 gpd

Discharge IWTP effluent to: Direct

Permit containing standards for that effluent issued by: EPA and State of TX

Discussion:

Cyanide oxidation and chrome reduction occur before wastes are piped to the Naval Air Station's IWTP. Caustic and acid wastewaters are neutralized as well.

Sludge is filter pressed prior to contractor disposal in a hazardous landfill.

Contaminated baths are pumped into tank trailers and disposed of off-site at approved chemical waste disposal facilities.

FY 85 MCA project will upgrade the IWTP to meet EPA BAT effluent standards.

Installation: Crane Army Ammunition Activity

Metal Plating and Finishing Processes:

Cadmium, zinc, bright dip, chromating, phosphating; some others when requested.

Wastewater Volumes:

Volume from plating shop: 44,000 gpd

Total volume processed by IWTP: 44,000 gpd

Volume of cyanide-bearing wastewater: 14,500 gpd

segregated

Volume of chrome-bearing wastewater: 7,200 gpd

Discharge IWTP effluent to: sanitary sewer and direct to stream

Permit containing standards for that effluent issued by: State of Indiana

Discussion:

40,000 gpd of treated wastewater is recycled to the plating shop for use in non-critical rinses.

Treatment includes cyanide oxidation, chromium reduction, chemical precipitation, filtration, chlorination, and discharge to the sanitary sewer.

Sludge is dewatered by pressure filtration and the sludge cake is hauled by contractor to a hazardous landfill.

Concentrated batch dumps are pumped to a holding tank and bled slowly into the treatment system.

Installation: Detroit Army Tank Plant

Metal Plating and Finishing Processes:

Surface treatment of metal parts prior to painting only.

Wastewater Volumes:

Volume from plating shop: 100,000 gpd

Total volume processed by IWTP: 100,000 gpd

Volume of cyanide-bearing wastewater: low level

Volume of chrome-bearing wastewater: flows are not segregated

Discharge IWTP effluent to: POTW

Permit containing standards for that effluent issued by: City of Warren, MI

Discussion:

Treatment includes pH adjustment, settling, and discharge to the sanitary sewer.

A new IWTP is being designed by the Corps of Engineers; target date for completion is December 1984.

Sludge underflow goes to a 8,000 gallon holding tank for contractor removal.

Concentrated baths are dumped in succession with rinse waters. The alkaline cleaner, for example, is dumped weekly and the chromic coat chemical conversion tank is to be dumped every two years.

Installation: Iowa AAP

Metal Plating and Finishing Processes:

Brass, chrome and occasional phosphatizing of shells; also metal cleaning.

Wastewater Volumes:

Volume from plating shop: 500-600 gpd for 2-3 months per year

Total volume processed by IWTP:

Volume of cyanide-bearing wastewater:

Volume of chrome-bearing wastewater:

Discharge IWTP effluent to:

Permit containing standards for that effluent issued by: State of Iowa

Discussion:

Standard pH adjustment treatment.

Sludge has been delisted and is land filled in an on-site sanitary landfill. Sampling wells are installed.

Installation: Lake City AAP

Metal Plating and Finishing Processes:

Chromium only

Wastewater Volumes:

Volume from plating shop: 100 gpd; additional metal-bearing wastewater is generated in metal drawing operation

Total volume processed by IWTP: 200,000 gpd

Volume of cyanide-bearing wastewater: not segregated

Volume of chrome-bearing wastewater: not segregated

Discharge IWTP effluent to: Direct to stream

Permit containing standards for that effluent issued by: State of Missouri

Discussion:

Treatment is by standard lime, acid, alum, and clarifier.

Solids are separated by an air flotation system. The sludge which comes from plating shop wastewater treatment has been delisted in the past. However, renegotiation of this delisted status is necessary due to the recent addition of a lead-bearing wastewater. Sludge is currently hauled by dump truck to several on-site hazardous lagoons. Lysimeters and monitoring wells are installed.

Batch dumps of electroplating solution are pumped to 55 gallon drums and transported to a licensed reclaimer.

Installation: Letterkenny Army Depot

Metal Plating and Finishing Processes: Chrome electroplating only

Wastewater Volumes:

Volume from plating shop: 5,000 gpd

Total volume processed by IWTP: 130,000 gpd

Volume of cyanide-bearing wastewater: none

Volume of chrome-bearing wastewater:

Discharge IWTP effluent to: direct to stream

Permit containing standards for that effluent issued by: State of PA

Discussion:

Treatment includes chrome reduction, neutralization, chemical precipitation, sedimentation, trickling filter, clarifier, and direct discharge of effluent to the stream.

Sludge from the plating shop is transferred to 55-gallon drums and hauled by contractor to an off-site hazardous landfill.

IWTP sludge is pumped into tankers and taken to an oil-and-grease landfill off-site. This sludge has been delisted.

Concentrated baths are pumped into 55 gallon drums and hauled by contractor.

Installation: Lone Star AAP

Metal Plating and Finishing Processes:

Chrome, etching, electroless chrome on steel.

Wastewater Volumes:

Volume from plating shop: 1,000 gpd

Total volume processed by IWTP: (see Red River AD)

Volume of cyanide-bearing wastewater: none

Volume of chrome-bearing wastewater: 1,000 gpd

Discharge IWTP effluent to: (see Red River AD)

Permit containing standards for that effluent issued by: EPA and State of TX

Discussion:

Plating shop pumps wastes into an 8,000 gallon holding tank. When filled, a tank truck transports the wastes to Red River AD for treatment.

Installation of a closed loop treatment and chrome recovery system has taken place. No operational data is available and no sludge has required disposal. Little to none is expected.

As of August 1982, Lone Star was in transition between systems.

Installation: Louisiana AAP

Metal Plating and Finishing Processes:

Area I: phosphating
Area II: anodizing and chromating

Wastewater Volumes:

Volume from plating shop: I: 2,000 gpd II: 6,000 gpd

Total volume processed by IWTP:

Volume of cyanide-bearing wastewater: none

Volume of chrome-bearing wastewater: all flows

Discharge IWTP effluent to: Direct to stream

Permit containing standards for that effluent issued by: EPA

Discussion:

Area I treats wastewater using the Lancy System; in Area II the Turner System is used.

Chrome-bearing wastewater is not segregated.

Sludge underflows from Area I are disposed of in an on-site lagoon. This lagoon will be filled and covered when its capacity is exhausted. Sludge from Area II is vacuum filtered, drummed and stored on-site. Negotiations are underway for off-site disposal by contractor. Approximately 40-50 drums are filled in a two-year period.

Installation: Materials and Mechanics Research Center

Metal Plating and Finishing Processes:

Cadmium and phosphating; other metals and finishing processes as requested.

Wastewater Volumes:

Volume from plating shop: under 1,000 gpd

Total volume processed by IWTP:

Volume of cyanide-bearing wastewater: under 500 gpd

Volume of chrome-bearing wastewater: insignificant

Discharge IWTP effluent to: Sanitary sewer, POTW

Permit containing standards for that effluent issued by: State of MA

Discussion:

Cyanides are to be replaced by non-cyanide plating solutions.

Treatment of rinse waters includes filtration, adsorption, ion exchange, and neutralization with discharge to the sanitary sewer.

Approximately one 55-gallon drum of sludge is generated each 2-3 month period. When filled, the drum is hauled away by Fort Devon personnel.

Batch dumps: 1)non-cyanide alkaline solutions to the sewer, 2)acids are neutralized and hauled off-site, and 3)solvents are hauled off-site.

Installation: New Cumberland Army Depot

Metal Plating and Finishing Processes:

Cadmium, chromium, copper, nickel, silver, anodizing, etching, chromating, immersion plating.

Wastewater Volumes:

Volume from plating shop: 2,500 gpd

Total volume processed by IWTP: 14,500 gpd

Volume of cyanide-bearing wastewater: 300 gpd
not segregated
Volume of chrome-bearing wastewater: 300 gpd

Discharge IWTP effluent to: direct to stream

Permit containing standards for that effluent issued by: State of PA

Discussion:

Plating wastes flow to an industrial waste holding tank. From there they are pumped as part of the influent to a domestic sewage treatment system. No special procedures are used to pretreat the plating shop wastewaters prior to being pumped to the sewage treatment plant. The treatment there includes screening, equalization, activated sludge, clarification, sand filters, and chlorination. Plating shop flows are said to constitue a minor portion of the influent to the NCAD Sewage Treatment Plant.

Sludge from the sewage treatment plant is incinerated by contractor.

Batch dumps are drummed for contractor disposal.

Installation: Red River Army Depot

Metal Plating and Finishing Processes:

Copper, nickel, chromium, cadmium, tin, anodizing, etching, chromating. Silver, gold, and zinc on request.

Wastewater Volumes:

Volume from plating shop: flows not metered

Total volume processed by IWTP: over 250,000 gpd. Flows not metered.

Volume of cyanide-bearing wastewater: none

Volume of chrome-bearing wastewater: flows not metered.

Discharge IWTP effluent to: Red River AD sanitary sewer and direct to stream

Permit containing standards for that effluent issued by: EPA and State of TX

Discussion:

Treatment includes grit removal, equalization, pH adjustment, flocculation, and chemical precipitation. Chrome streams are treated separately.

Sludge volume is reduced in a gravity thickener. Sludge drying beds are used for dewatering. Monitoring wells are installed. Sludge cake is than taken to an approved on-site hazardous landfill.

Concentrated wastes are bled into the system.

The new NPDES permit (1982) will allow direct discharge of IWTP effluent into the stream.

Installation: Redstone Arsenal

Metal Plating and Finishing Processes:

Copper, tin lead, nickel, gold, etching

Wastewater Volumes:

Volume from plating shop: 100 gpd

Total volume processed by IWTP: 100 gpd

Volume of cyanide-bearing wastewater: less than 10 gpd

Volume of chrome-bearing wastewater: none

Discharge IWTP effluent to:

Permit containing standards for that effluent issued by: State of Alabama

Discussion:

Batch dumps are containerized for turn-in to the Property Disposal Office.

Wastewaters from the plating shop go directly to the sanitary sewer without pretreatment. Periodic checks of the wastewater for precious metals are made.

Installation: Riverbank Army Ammunition Plant

Metal Plating and Finishing Processes:

Zinc phosphate coating only

Wastewater Volumes:

Volume from plating shop: 70,000 gpd

Total volume processed by IWTP: 150,000 gpd

Volume of cyanide-bearing wastewater: none

Volume of chrome-bearing wastewater: 1,000 gpd

Discharge IWTP effluent to: Settling ponds and direct to stream

Permit containing standards for that effluent issued by: State of CA

Discussion:

Treatment includes lime precipitation, clarification, pH control, with discharge to settling ponds.

Batch dumps flow directly to the IWTP, except cyanide and chromium baths. Cyanide and chromium-bearing wastewaters are separately pretreated and then discharged to main treatment.

Sludge from clarifier underflow is gravity thickened and hauled by contractor on a monthly basis to on-site hazardous lagoons. Leachate monitors are installed.

Current MCA modification program includes improvements in pH control and sludge dewatering.

Installation: Rock Island Arsenal

Metal Plating and Finishing Processes:

Chromium, cadmium, copper, nickel, black oxide, phosphating, and anodizing.

Wastewater Volumes:

Volume from plating shop: 45,000 gpd

Total volume processed by IWTP:

Volume of cyanide-bearing wastewater: none

Volume of chrome-bearing wastewater: flows not segregated

Discharge IWTP effluent to: RIA sanitary sewer, then to City of Rock Island sanitary sewer.

Permit containing standards for that effluent issued by: City of Rock Island

Discussion:

Treatment includes chromium reduction, pH adjustment, and clarification.

Sludge is filter pressed to approximately 35% solids, drummed, and contractor hauled.

Concentrated dumps are batch treated and neutralized prior to release to the IWTP.

Installation: Sacramento Army Depot

Metal Plating and Finishing Processes:

Cadmium, nickel, chromium, silver, gold, copper, tin, anodizing, etching, milling, chromating, phosphating, and printed circuits.

Wastewater Volumes:

Volume from plating shop: 35,000 gpd

Total volume processed by IWTP: 35,000 gpd

Volume of cyanide-bearing wastewater: 12,000 gpd

Volume of chrome-bearing wastewater: 1,000 gpd

Discharge IWTP effluent to: County sewers

Permit containing standards for that effluent issued by: EPA and county

Discussion:

Treatment includes cyanide destruction, chrome reduction, neutralization, and clarification.

Sludge is pumped into drums for landfill disposal off-site by contractor.

Batch tanks, when dumped, are drained to contract tanks.

Modifications due for completion August 1982 will include renovation of existing cyanide treatment system and three existing clarifiers, and installation of new chrome plating system.

Installation: Scranton Army Ammunition Plant

Metal Plating and Finishing Processes:

Chromating and phosphating. All work is also painted.

Wastewater Volumes:

Volume from plating shop: 11,000 gpd of which 2,000 gpd is recycled.

Total volume processed by IWTP: 11,000 gpd

Volume of cyanide-bearing wastewater: none

Volume of chrome-bearing wastewater: 11,000 gpd

Discharge IWTP effluent to: POTW

Permit containing standards for that effluent issued by: City

Discussion:

Lancy System is used weekly on baths.

Rinsewater treatment includes chromium reduction, pH adjustment, chemical precipitation, clarification, and discharge to sanitary sewer.

Sludge is gravity thickened and discharged to a holding tank for contractor removal to a sanitary landfill. The sludge has been delisted.

A project to upgrade instrumentation is planned with obligaticn date of September 1981.

Installation: Stratford Army Engine Plant

Metal Plating and Finishing Processes:

Copper, nickel, chrome, cadmium, steel passivate, phosphate, anodize, and HAE.

Wastewater Volumes:

Volume from plating shop: 65,000 gpd

Total volume processed by IWTP: 109,000 gpd

Volume of cyanide-bearing wastewater: 650 gpd

not segregated

Volume of chrome-bearing wastewater: 46,000 gpd

Discharge IWTP effluent to: Direct to river

Permit containing standards for that effluent issued by: EPA

Discussion:

Treatment includes pH adjustment, cyanide oxidation, chrome reduction, coagulant addition, upflow clarification, and discharge of the effluent to the river.

Sludge from the clarifier goes to the lagoon and on to sludge drying beds. Sludge is hauled by contractor.

Batch dumps are metered slowly into the treatment system.

Funding for redesign of the IWTP has been approved. An A&E firm has been retained. The existing system is 23 years old.

Installation: Tank-Automotive Command Research and Development Center

Metal Plating and Finishing Processes:

Non-production plating on miscellaneous parts for research and development projects as required.

Wastewater Volumes:

Volume from plating shop: 300 gpd when plating is operational

Total volume processed by IWTP:

Volume of cyanide-bearing wastewater:

Volume of chrome-bearing wastewater:

Discharge IWTP effluent to: POTW

Permit containing standards for that effluent issued by: State of Michigan

Discussion:

Wastewater is batch treated on an as-needed basis using methods appropriate to the wastewater composition.

Treatment is provided by the Detroit Army Tank Plant IWTP.

Installation: Tobyhanna Army Depot

Metal Plating and Finishing Processes:

Copper, nickel, chromium, cadmium, tin, silver, anodizing, etching, phosphating, and immersion coating.

Wastewater Volumes:

Volume from plating shop: 18,000 gpd

Total volume processed by IWTP:

Volume of cyanide-bearing wastewater: 4,000 gpd

Volume of chrome-bearing wastewater: 2,000 gpd

Discharge IWTP effluent to: TAD sanitary sewer and direct to stream.

Permit containing standards for that effluent issued by: State of PA

Discussion:

New IWTP is due to come on-line during the fall of 1982, using soluble sulfide precipitation of metals. New system will include cyanide oxidation, chromium reduction, neutralization, sulfide precipitation, clarification, filtration, and discharge to the sanitary sewer.

Sludge will be filter pressed and hauled by contractor.

Batch dumps to be containerized for contract disposal.

Installation: Watervliet Arsenal

Metal Plating and Finishing Processes:

Copper, nickel, chromium, cadmium, electropolishing, anodizing, phosphating, and etching.

Wastewater Volumes:

Volume from plating shop: 61,500 gpd

Total volume processed by IWTP: 70,000 gpd, including soluble oil wastes

Volume of cyanide-bearing wastewater: 200 gpd

Volume of chrome-bearing wastewater: 61,300 gpd

Discharge IWTP effluent to: Direct to river

Permit containing standards for that effluent issued by: EPA and State of NY (June 1982)

Discussion:

Acids, oils, and cyanides are separately treated prior to mixing at the IWTP, and chrome wastes are reduced. Treatment of the blending tank contents includes pH adjustment, alum and polyelectrolyte addition, clarification, neutralization, and discharge to the river.

Sludge is dewatered in sludge drying beds and hauled by contractor.

Concentrated baths may be batch treated or bled into the system.

Current expansion of the IWTP includes a second parallel chrome treatment process, addition of a 75,000 gallon holding tank and dual batch treatment tanks for cyanide-bearing wastewaters.

Plating shop personnel have been provided tours of the IWTP to encourage coordination between platers and treatment personnel.

Installation: White Sands Missile Range

Metal Plating and Finishing Processes:

Anodize only

Wastewater Volumes:

Volume from plating shop: 10 gpd

Total volume processed by IWTP:

Volume of cyanide-bearing wastewater: none

Volume of chrome-bearing wastewater: none

Discharge IWTP effluent to:

Permit containing standards for that effluent issued by: State of New Mexico

Discussion:

Anodizing waste solutions are disposed of at the WSMR Toxic Waste Disposal Facility in evaporation tanks. Sludge remaining after evaporation is containerized and land-filled on-site. The on-site hazardous landfill is EPA-registered.

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