PN-ABY-161

PULP AND PAPER U.S. STUDY TOUR

(Volume 2 of 2)

APPENDIX B
Participant Reports

United States
October 24 - November 5, 1993

Prepared for:

US - ASIA ENVIRONMENTAL PARTNERSHIP

WEC

WORLD ENVIRONMENT CENTER

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SECTION I

EXECUTIVE SUMMARY

The waste minimization assesment focused on the finding of practices and techniques that can reduce waste, and worker health and safety in metal finishing industry. We visited ten industries around San Francisco & Los Angeles, USA., including metal finishing shops, waste equipment manufacturer, aircraft repair, and presentation from metal finishing laboratory. This visiting was coordinated by World Environment Centre (WEC), cooperation with USAID & United States-Asia Environmental Partnership.

By meeting & visiting, we know that all metal finishing facilities have done waste minimization and take care of health and safety. The waste minimization is reported that can reduce cost and improves quality of environment. Unfortunetely, we didn't find document that including tracking and economic evaluation of waste minimization program completely.

Sometimes, waste minimization can be done very simple, and low/no cost. The metal finishing industries in Indonesia can choose what they can do according to their condition. Industrial managements should have begun to do waste minimization, because by waste minimization they can reduce cost, at all once, their industry becomes a 'good' guy for public and government.

SECTION II

INTRODUCTION

Study tour for six Indonesian representatives (two from government and four from industry) during two weeks in December 1993, was coordinated by World Environment Centre (WEC), through a cooperative agreement with the United States-Asia Environmental Partnership and the United States Agency for International Development in Indonesia.

The objective of the U.S. study tour is to provide the participants with an intensive overview of technologies and management practices implement in metal finishing industry in the United States which enhance waste minimization and improve worker health and safety. The study tour provides the Indonesian participants and U.S. counterparts with an unique opportunity to exchange experiences. Upon return to Indonesia, the study tour participants will conduct a second waste minimization workshop to share their experiences gained in the United States.

The U.S. study tour has held during December 5 - 18, 1993, with Indonesian participants:

1. Widya Wicaksana - Yayasan Mandiri
2. Herry Hamdani - Environmental Impact Management Agency
3. B. Situngkir - Department of Industry
4. Suryanur Syafe'i - PT Padi Komponen
5. Dadang Sudrajat - PT Superex Raya
6. Jaya Agung Prastowo - PT YKK Indonesia Zipper Co Ltd

The agenda during visited California, U.S. is

<u>Monday, 12/6/1993</u>

- Metal Surfaces Inc. (plating shop has many kind of plating bath solution).

<u>Tuesday, 12/7/1993</u>

- Electrolizing Inc.(specialist for hard chrom plating).

Thusday, 12/9/1993

- Presentation by Lawrence Livermore National Laboratory on waste reduction.

Friday, 12/10/1993

- Discussion with Jim Miille regarding waste minimization in the Bay Area.
- Wastewater Treatment Systems Inc. (manufacturer of waste treatment equipment)

Monday, 12/13/1993

- Read-Rite (manufacturer of disk read heads, has good waste water treatment system).
- Aceteron Corporation (plating shop has done good waste minimization).

Tuesday, 12/14/1993

- Schlage Lock (large barrel plating of door fixtures).
- Santa Clara Plating (plating shop has done considerable waste minimization, and lay-out designated).

Wednesday, 12/15/1993

- United Airlines (large aircraft repair)
- New United Motors

Thusday, 12/16/1993

- City of San Jose Water Pollution Control (city sewer control agency with big facility).

SECTION III

FINDINGS

Waste Minimization

The importance of waste minimization is save money, because it will use less chemical, less water bill, and less waste generate. Moreever, by waste minimization your facility becomes a "good" guy for public and government.

A great amount of providings to reduce waste are:

1. Reducing rinse water usage: use spray, counter flow rinse, and flow control.
2. Material reuse & recovery: use drag out tank, ion exchange, reverse osmose, electrowinning, and electrodialysis.
3. Extend the life of bath: use skimmer to float off oil, use purer chemical.
4. Source control: good operating practice, training for worker, good house keeping.
5. Technology modification: chemical substitution, use barrel designated.

We visited metal finishing shops in U.S. which enhance waste minimization as listed below:

A. Aceteron

1. Location

Aceteron is located at 851 Shasta Street, Redwood City, California 94063.

2. Site Description

Aceteron serves plating for electronics, semiconductor, microwave, optics, laser, medical, aerospace, diskdrive, defense, and another commercials. With over 50 technicians & engineers and serves 12,000 sq.ft facility, Aceteron has been developing waste minimization. I'm very impressed, Aceteron is not a big company but able to serve plating with high technology, and has quality

control laboratory and inspection completely.

3. Person visited and tittle

   Patrick Burt, President of Aceteron Corporation.

   Jim Miille, President of CSI (as guide).

4. Meeting attendees and summary

   Aceteron is good plating shop for sample. Almost all of the aspect of waste minimization and health & safety have been done completely. This indicates that Patrick Burt gives attention to the environmental.

Minimization Initiatives

There are some of the Aceteron's providing to waste minimization:

1. Installation double counterflow rinses

   Almost all processes are completed by double counter flow rinses. The first tank is dirty tank, and the other is clean tank. In the clean tank involves conductivity controller that can regulate rinse water flow automatically.

2. Use spray rinses over process/rinse tank

   Spray rinses use much of air and little of water. The work piece after is processed, then lift slowly, and cleaned by spray over the tank.

3. Good agitation

   Aceteron use agitation in process and rinse water too. The rinsing tank is agitated mechanically to increase rinsing efficiency. It's done by air agitation and water circulated by filtration system.

4. Use skimmer to float off oil

   Skimmer is used to float off oil in cleaner tank, so it will clean oil on the surface cleaner solution and prevent oil go to next tank.

5. Segregation of rinse water

The successfull of waste water treatment system is begun from separation of the certain waste stream. Never mix waste become one stream, especially cyanide and chrom bearing.

6. Substitute with less pollution

Many ways to reduce pollution, It means, reduce waste too. Aceteron use non cyanide soak cleaner. It's proven by colorless in acid after soak cleaner.

Another ways, to clean parts, Aceteron worker wipes parts one by one by solvent degreaser. It reduces vapor degreaser drastically.

7. Indoctrination and training of employees

Aceteron has fixed schedule to train employees.

8. Use in-tank filtration system

Another key aspect of Aceteron's waste minimization program is the use of in-tank filter. The in-tank system eliminates leaks and spills because it uses no hoses, clamps, seals, and another out-tank apparatus.

After Aceteron did waste minimization program, it's reported can reduce water usage almost 85 %.

B. Metal Surfaces Inc.

Metal Surfaces Inc. (MSI) is located at 6060 Shull Street Bell Garden California. MSI has many kinds of plating bath solutions with 45,000 sq.ft of precision plating. The plating type is most of rack, and a little barrel.

Sam Bell (President), and Bruce F Nielsen (Plant Engineer) explained that they had done waste minimization with plate out (electrowinning) to recover Ag, Cu, Sn, & Pb), use ion exchange, vaccum evaporation after tin-lead solution rinse, housekeeping, racking, drip schedule, and use spray rinses.

MSI has good thinking of segregation of waste. It's indicated that MSI can send sludge waste to copper smelter facility to recover copper metal. Waste of vapor degreaser is sent to another facility that's will be treated.
From waste minimization program is reported that waste water treatment cost is 10 % (including chemicals, labor and sludge treatment) from total cost.

C. Electrolizing Inc.

Electrolizing Inc. is located at 1947 Hopper Ave., Los Angeles, California, specialists for hard chrom plating. Hard chrom plating use hexavalent chrom that's suspected as carcinogen. Unfortunetely, some specification of product (metal wear part, tolls, gauge, and mold) should be plated by hexavalent chrom. Substitution with another solution is rejected cause the reason of properties product, as Susan B. Grant (General Manager) said.

The waste minimization is doing including drag out tank, use spray rinse water, and electrowinning to recycle chrom.

D. Lawrence Livermore National Laboratory (LLNL)

Jack W. Dini (Section Leader) and Chris Steffani from LLNL, visited us to give presentation of waste minimization. LLNL is using all three generation catagories of waste reduction :

1. Good housekeeping practices, inventory control, and minor changes in operating practices.
2. Current technology and material substitution e.g.:

- Substitution of zinc-nickel alloy for cadmium plating
- Elimination of hexavalent chromium plating and vapor degreasing.

3. Significant technological advances in process synthesis and engineering.

They reported that by the waste reduction program they save money $ 500,000/year and 3 Millon gallons of water/year. I was impressed that they offered substitution of process plating, especially for pyrophosphate copper substitutes cyanide copper. They also offered electroless nickel to substitute hexavalent chromium, and membrane technology to recyecle acid rinse waste.

E. Read-Rite

Read-Rite produces plating by high technology. Not all people are permitted to see the process plating. We focused in waste water treatment system. Read Rite also uses high technology for waste treatment. The stream are segregated in three: acid, high pH, and reagent waste. To precipitate, Read-Rite uses DTC and caustic soda. DTC (di-thio-carbamates) is added to adjust pH, and forming sulfides out of metals that failed to form hydroxide.

Read-Rite uses polypropylene membrane to filter waste water treated upon water 98.7% recycled. All processes are computerized, and building construction is very good.

F. Santa Clara Plating Co. Inc.

Santa Clara plating was estabilished in 1976, located at 1773 Grant Street, Santa Clara, California is managed by Thomas L. Coss (President). Thomas has thought about waste minimization. He built plating shop with good flooring, clean, and consider waste minimization. He uses in-tank filter system, spray rinses, and sets tray in bottom of loading car to prevent spills to the ground.

To success of waste minimization program, He traines, educates, and presses dicipline to his employees.

G. Schlage Lock

The biggest plating shop that use barrel plating is Schlage Lock. The product is door fixtures. Schlage Lock has many kinds of plating bath: copper, nickel, zinc, brass plating there're all non cyanide. I'm very surprised that Schlage Lock has non cyanide brass plating solution. Upon now, It's difficult to find non cyanide brass plating in the market.

Schlage Lock has done waste minimization with keeping process (non cyanide solution is more difficult to control than cyanide solution), mechanical design, and use three counter flow rinses. The success of this program is indicated by reducing water usage approximately 30 %.

H. United Airlines

We visited United Airlines in Maintenance Operation Centre (MOC). The major responsibility of the MOC is the repair, overhaul, and modification of airplanes, engines, and component parts. In the plating department, parts of engine will be strip, inspected (another dept.), and replate.

The method of waste minimization in United Airlines is done by reactives tank and recycle water treated upon 85 %. In reactives tank is added chemical that will destruct waste in rinse water tank, and than water rinse is filtered in sand filter that will be reused. The chemical added should be kept in certain concentration. Example, for cyanide destruct rinse tank, the added chlor is not much than 1,000 ppm. If too much, parts that coated copper will be oxidized. Chlor is strong oxidizer.

Safety and Health issues

United States has standard for safety and health. It's regulated by OSHA. All metal finishing shops have safety equipment such as goggles, mask, shower, etc.

Santa Clara plating has new plating lay-out. It's very nice by considering of health & safety including good flooring, ventilation, placement of chemical complete with labelling and separation of chemical. Almost all of the facilities use shower

that can be reached within 10 seconds after accident happened.

The climate in the U.S. is dry relatively. So, to store flamable solvent, tanks are connected to the ground to prevent spark from electrostatic. They store chemical with dikes to prevent leaks or spills of chemicals to the ground.

For certain reason, They use poison solution plating like Cadmium, and hexavalent chrom, but they do by the most safety manner such as use hoist and good ventilation.

SECTION IV

CONCLUTIONS & RECOMENDATIONS

IV.1. Conclutions

By environmental regulations and considering of cost, all metal finishing industries that we have visited do waste minimization program. The program is done by modification equipment, add apparatus, and training of their employees. Each facility identified waste minimization as necessary and based on condition it's facility. So, the efforts of waste minimization are different. Waste minimization is proven reduce cost.

Safety and health condition in U.S. that we've visited is good. They have tried to do with the most safety & health manner as possible.

IV.2. Recomendations

In Indonesia, for past years, water is unvalueable. But, now, we can feel that water is valueable. So, sooner-later, Indonesian industries shloud do waste minimization, involves metal finishing industries.

Priority

Many ways to do waste minimization. The first priority is no/low cost, because sometimes waste minimization is very simple and inexpensive without addition of equipment. Each facility should identify what kind they can do base on a kind of product, plating type, and other condition. The best manner, I think, is to do plating process perfectly, if we produce bad parts, buyer will reject it. So, the parts become scraps. It means we produce waste, spent of cost and time. The other way, the waste minimization can be done by good house keeping. This method is no cost/low cost and simple to do.

The general ways to do waste minimization are:

A. Reducing rinse water

The most of waste water in metal finishing facility comes from rinse water. More rinse water that is used, the larger waste water treatment system will be, that means more cost, more difficult it will be to obtain consistent compliance with regulations and more chemicals & sludge it will generate.

Rinse water reduction involves rinsing the work pieces in the most efficient manner, thereby use volume of rinse water as little as possible.

1. Install automatic flow controls.
   An automatic flow control involves conductivity probes. Probes sensor will send signal to controller that will open valve to flow water as needed. Conductivity controller probes are very sensitive to contamination by floating oil. These probes can be coated with oil, and the risks, water flows unaccurately. Use skimmer to float off oil.
2. Install multiple rinses tank.
   Counter flow rinses are wonderful for reducing water consumption. Compare by using 1 tank we need 7,500 liter/hour but using 2 counter flow tanks we only need 61.24 liter/hour for same result. Unfortunetely, It's difficult to use counter flow rinses after acidic solution that attack coating, such as chromating process.
3. Use spray rinses
   Spray rinses are essentially useless for process that operate at temperature below 100 °F, and parts are plated in rack. For barrel plating, we should use barrel designated.

B. Drag-out reduction

The efficiency of many technique of drag out reduction will function with the geometry of parts, processed, operator technique, racking method, transfer times, drain time, and numerous of the variable.

Drag-out reduction can be done by:

1. Withdrawn work pieces at slower rate. The optimum time must be calculated, based on the worst case of drag out.
2. Rotate barrel over the process tank if possible. If it cannot, use drag out tank (the empty tank). The schedule must be adherent.
3. Train worker to allow for optimum drain times.

C. Recycling

Recycling is use, re-use, or reclamation of waste after it is generated. Examples of recycling opportunities include:

1. Return drag-out from drag out tank to the process tank. In Indonesia, the climate condition is relatively warm. Everyday much water is evaporated. By return drag out is the good opportunity.
2. Use evaporator, electrowinning, reverse osmose, and ion exchange to recycle rinse water. Make sure that water quality is good with total dissolved solid (TDS) not high. If TDS too high, your solution will be accumulated by dissolved solid.

- Using atmospheric evaporator is bad decision in Indonesia, even it's cheap, because Indonesia has high relatives humidity. For another case, by using atmospheric evaporator will increase carbonate content. Vaccum evaporator is expensive both energy and maintenance.
- Electrowinning is applied of the system after cyanide zinc plating, and cyanide copper plating.
- Ion exchange is good for application recycling. Ion exchange also can be used to remove specific ion from rinse water after the rinse tank.
- Membrane is in reverse osmose or electrodialysis. Before using membrane, think about water quality. Membrane will be foulded it if water contain manganese, calcium, carbonate, and other fouling materials. Ask to supplier for information completely.

D. Extend the life processing solution

The method to extend life bath solution is good advice, if your solution is contaminated and you should make new solution, your old solution will be wasted. Try to extend life your plating bath by:

1. Use purer chemical
2. Use filtration
   Filter will make your solution clean, but filters are big potential of waste. Filters should be placed in side the process tank. If they cannot, they should be inside containment trays. Use in tank filtration system with reusable filter media. Conventional filter cartridges go to land fill - they are solid waste.
3. Avoid to contaminated by work as clean as possible.
4. Be sure to replenish solution with the right chemical.

E. Chemical substitution

The incentive for chemical substitution containing non pollution material has only been present in recent years with advent of pollution control regulations. A good advice before making a decision to substitute, the following questions should be asked to the chemical supplier:

Are substitutes available and practical ?
Can the chemical be supplied to Indonesia routinely ?
Will substitution create another problems ?
Who else is using this process ?
How long has this process in the market ?

The possibility of chemical substitution that we can do is substitution non cyanide solution : zinc plating, brass plating (like in Schlage Lock), cleaner (Aceteron), copper strike (LLNL). Unfortunetely, YKK uses zinc die casting as base material. Most of non cyanide solutions are unsuitable for zinc die casting. The solution will generate problems in pre-plate process. The facility should be ready to install pre-plate line. By using non

cyanide will be greater sensitivity to impurities, and is more difficult to control.

Safety and Health Issues

Many pollution prevention practices are low/no cost, low risk alternatives. Most of the approaches do not require a great of sophisticated technology, and can be relatively inexpensive. Management commitment is the key in this program. Effective management initiatives should foster employee awareness of participation in.

Indonesia doesn't has specific regulation for metal finishing health and safety. So, It's important, each facility makes guidence because in metal finishing industry has potential hazard, chemical's carcinogen, and poison.

The beginning of safety and health program is done by training to the employees. Most of accidents are caused by carelessness, and lack of knowledge. The training includes how operators do safety, prevention disaster, using protection equipment, and first aid.

The other important aspect is management should has good knowledge of material handling. It's including good storing of chemical in warehouse, and labelling. Good storing includes separation of certain chemical to prevent disaster.

APPENDICES

APPENDIX – 1	Agenda, and Corporation & Agency visited
APPENDIX – 2	Photographs
APPENDIX – 3	Curriculum Vitae
APPENDIX – 4	List of Document Received

Appendix – 1 Agenda, and Corporation & Agency visited

No.	Date	Corporation & Agency	Person met	Remarks
1	December 5, 1993	-	-	Arrive in Los Angeles
2	December 6, 1993	Metal Surfaces Inc. 6060 Shull Street, Bell Garden California 90201 tel. (213) 773-4050 fax. (213) 773-4055	Bruce F. Nielsen (Plant Engineer) Sam Bell (President)	
3	December 7, 1993	Electrolizing Inc. 1947 Hooper Avenue, Los Angeles, CA 90011 tel. (213) 749-7876 fax. (213) 749-9880	Susan B. Grant (General Manager) Jack Morgan (Plant Manager)	
4	December 8, 1993	-	-	Travel to San Francisco
5	December 9, 1993	Lawrence Livermore National Laboratory (LLNL) Po Box 308, L-332, Livermore California 94551 tel. (510) 422-8342 fax. (510) 422-1290	Jack W. Dini (Section Leader) Chris Steffani	
6	December 10, 1993	Chemical Solutions Inc.(CSI) 400 Main Street, Suite 203 Pleasanton , CA 94566 tel. (510) 426-1816 fax. (510) 426-1889	Jim Miille (President)	
		Wastewater Treatment System Inc 1235 Elko Drive Sunnyvale, CA 94089 tel. (408) 541-8600 frax. (408) 541-8615	Glen C. Neustedter (President) John B. Strandberg, P.E (Sr. Chemical Eng.)	
7	December 11, 1993	-	-	Free day
8	December 12, 1993	-	-	Free day
9	December 13, 1993	Read Rite c.q. Epoc 3065 N. Sunnyside Fresno, CA 93727 tel. (209) 291-8144 fax. (209) 291-4926	Mark Rothweiler (Operations/Field service)	
		Aceteron Corporation 851 Shasta Street, Redwood City California 94063 tel. (415) 369-5217 fax. (415) 364-9748	Patrick Burt (President)	

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10	December 14, 1993	Schlage Lock	Jim	
		Santa Clara Plating Co. Inc. 1773 Grant Street Santa Clara, CA 95050 tel. (408) 729-9315 fax. (408) 748-0987	Thomas L. Coss (President)	
11	December 15, 1993	United Airlines Bldg. 49-SFO Fl San Francisco Int'l Airport Calif. 94128-3800 tel. (415) 634-4576 fax. (415) 634-4551	Steven F. Sulgit (Facilities-and Engineering)	
		New United Motor		
12	December 16, 1993	City of San Jose Water Pollution Control 700 Los Esteros Road, San Jose, CA 95134 tel. (408) 945-5300 fax. (408) 945-5442	Alex Ekster P.E., Ph.D. (Sanitary Engineer)	
13	December 17, 1993	-	-	Organize report
14	December 18, 1993	-	-	Depart from San Francisco

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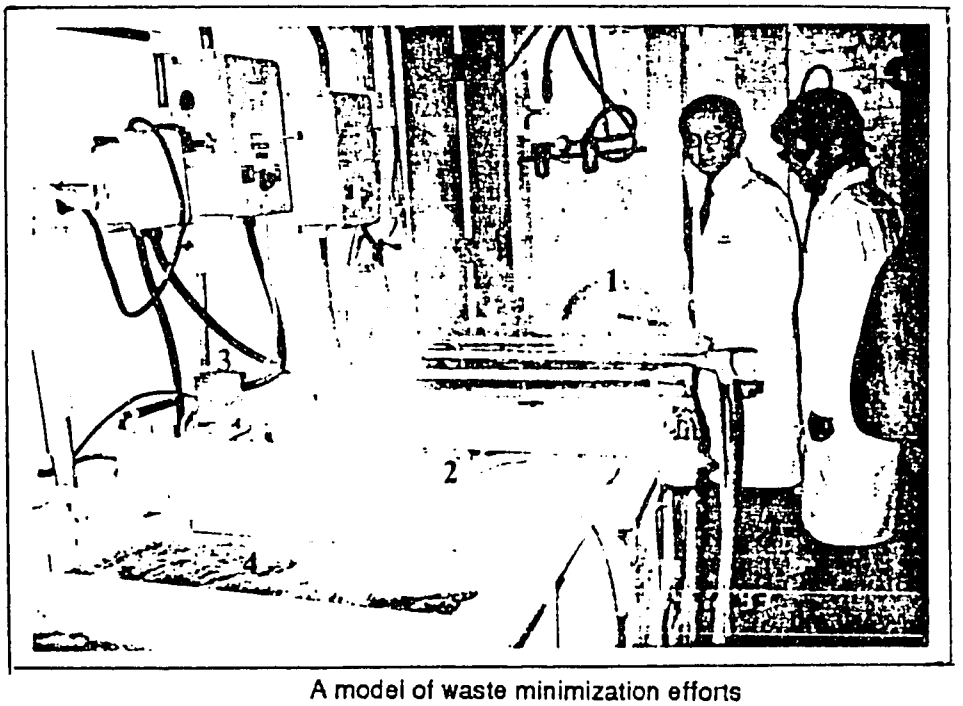
Appendix – 2 Photographs



A model of waste minimization efforts

Legend: 1. Skimmer

2. Spray rinse

3. In tank filter

4. Air agitation

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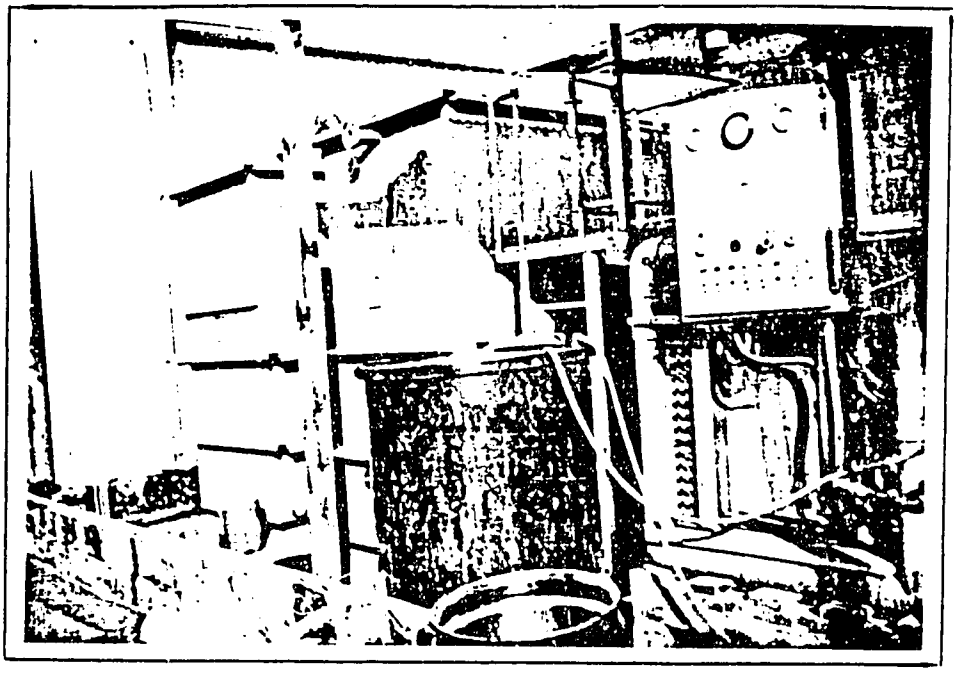

Vaccum evaporator to recycle rinse water

Reusable filter cartridges

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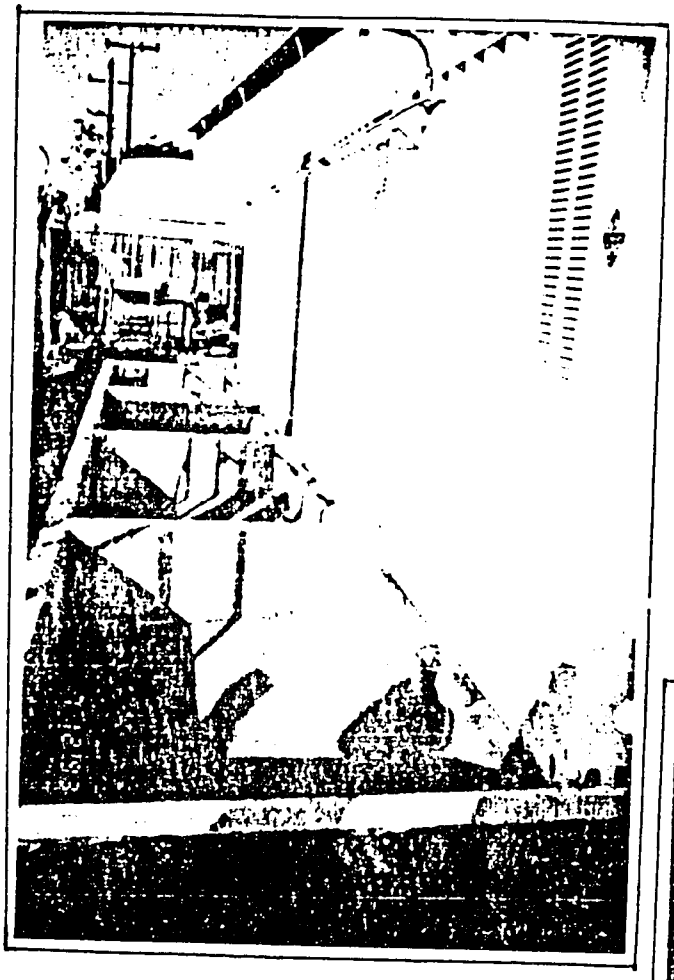
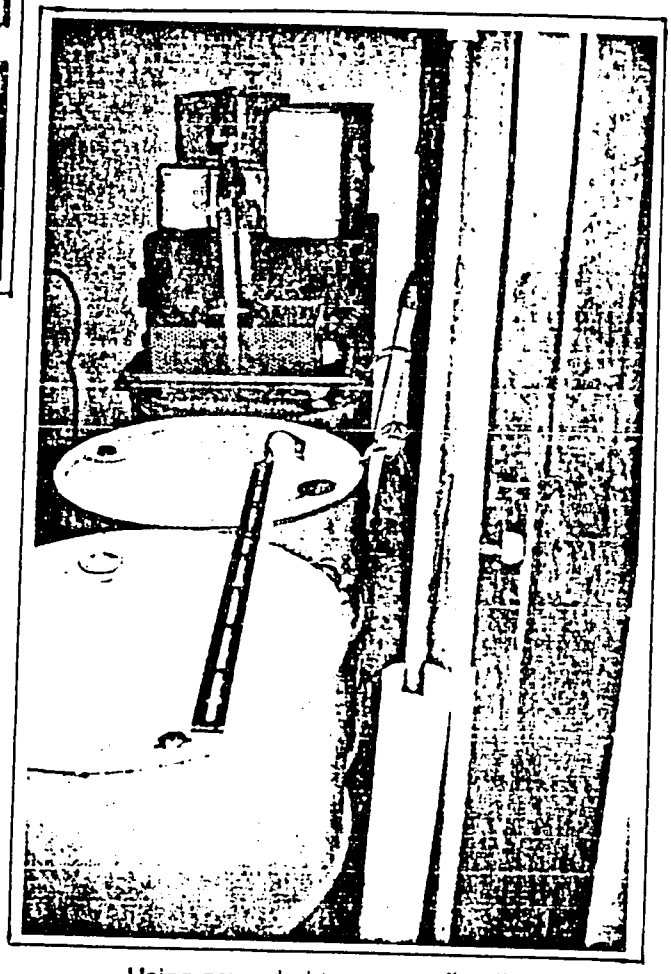


Using dikes to prevent leaks and spills



Using grounded to prevent fire disaster

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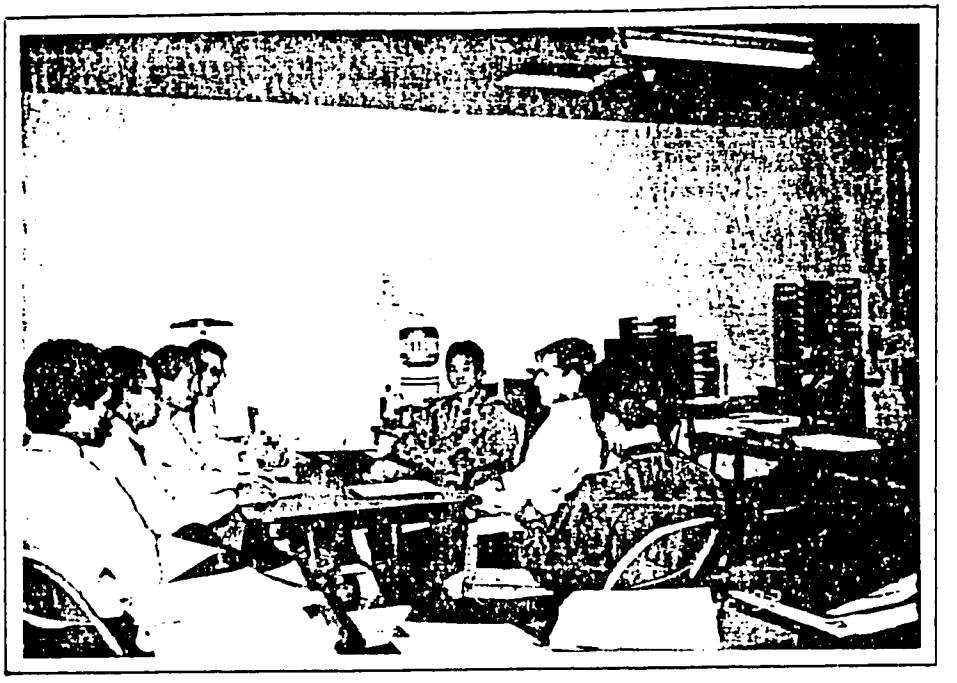

Meeting with Jim Miille regarding waste minimization

Indonesian study tour participants

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Appendix-3 **CURRICULUM VITAE**

Name:	Jaya Agung Prastowo
Address:	
Date of Birth:	
Place of Birth:	
Nationality:	Indonesian
Marital Status:	Single
Health:	Good
Skills:	Waste water treatment of dyeing and electroplating Metal surface finishing; polishing, electroplating and coating

Work Experience:

4/91 - Present	Joined YKK Indonesia Zipper Co., Ltd.: Electroplating Department: Polishing, processing, and waste water treatment

Education:

1984 - 1990	Chemical Engineering, Gadjah Mada University Jogyakarta
1981 - 1984	Senior High School: SMA de Britto, Jogyakarta
1978 - 1981	Junior High School: SMPN Purwodadi, Purworajo
1972 - 1978	Elementary School: SDN Purwodadi Purworejo

Training:

10/93	Workshop; Waste Minimization in the Metal Finishing Industry, World Environment Center (WEC), Jakarta
4/93	Short training: Waste water treatment technology, Yayasan Mulia Dharma, Bogor
8/92 - 10/92	On the job training: "Metal surface finishing", YKK Kurobe-shi, Toyama-ken, Japan

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Appendix - 4 List of Document Received

1. J.W. Dini and C.P. Steffani, "Electroplating Waste Minimization at Lawrence Livermore National Laboratory", April 1992.

2. V.J. Shannon, " Aceteron and Waste Minimization", Finishers' Management.

3. P. Burt, "Incentives for Waste Minimization in the Metal Finishing Industry", Finishers' Management, November/December 1990.

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Electroplating Waste Minimization at Lawrence Livermore National Laboratory

J. W. Dini and C. P. Steffani

This paper was prepared for submittal to the
Spectrum '92, The Nuclear and Hazardous Waste
Management International Topical Meeting
Boise, Idaho
August 23-27, 1992

April 1992

Lawrence Livermore National Laboratory

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ELECTROPLATING WASTE MINIMIZATION AT LAWRENCE LIVERMORE NATIONAL LABORATORY

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ABSTRACT

This paper describes efforts on waste minimization in the electroplating facility at Lawrence Livermore National Laboratory (LLNL). Issues that are covered include: elimination of cadmium plating, copper cyanide plating, hexavalent chromium plating and vapor degreasing, segregation of cyanide solutions, changing rinsing practices, recycling of rinse water, changing cleaning of aluminum parts and rejuvenation of gold plating solutions. Discussion is also presented on other issues currently being worked and these include: combining electroplating and physical vapor deposition, elimination of all cyanide plating processes, and recycling of electroless nickel and spent acid solutions.

INTRODUCTION

The purpose of this paper is to describe what we've done in our plating operation at Lawrence Livermore National Laboratory (LLNL) to minimize waste and conserve resources. Our facility, which is 6000 sq. ft. including a small lab and machining area, is used principally for prototype parts and very little effort that would be considered production in the normal sense of the word. The shop provides a viable, one-of-a-kind on-site service to all LLNL programs. Our services are used when fabrication activity requires levels of expertise, technology, equipment, process development, hazardous processes, security or scheduling that is not typically available elsewhere. Operations include processes such as electroplating, electroless plating, anodizing, cleaning, etching, electroforming and chemical milling.

INITIATIVES ALREADY COMPLETED

A number of initiatives undertaken within the past years have noticeably reduced our waste streams and also reduced costs for disposal. They include: 1-elimination of cadmium plating, 2-segregating cyanide solutions, 3-elimination of copper cyanide plating, 4-elimination of hexavalent chromium plating, 5-elimination of vapor degreasing, 6-changing rinsing practices, 7-recycling of rinse water, 8-changing cleaning of aluminum parts, and 9-rejuvenating gold plating solutions.

1. Elimination of Cadmium Plating

We eliminated cadmium plating from our facility in the late 1970's. Efforts one of us (Dini) was involved with in those days revealed the viability of substituting zinc-nickel deposits for cadmium.[1-3] After 500 hours of salt fog exposure, heavy red rust was evident on 2.5 µm thick cadmium plated steel panels while no rust appeared on zinc-nickel plated panels.[1,2] Similarly, excellent protection was obtained in salt fog tests with Zn-Ni coatings as thin as 15 µm on U-0.75 Ti alloy.[3] These days, Zn-Ni coatings are being evaluated in more detail within the DOE weapons complex with the goal of eliminating all cadmium plating operations from the production agencies.

2. Segregation of Cyanide Solutions

All solutions containing cyanide are now located in a separate room and all plating and rinsing associated with these solutions is also confined to this room. By doing this, we avoid having to categorize all wastes from the shop as cyanide containing and this helps to

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noticeably minimize costs. For example, disposal costs for our wastes containing cyanides are approximately $12/gallon compared to $4/gallon for non-cyanide containing wastes.[4] Each cyanide solution has its own rinse tank which is also used to maintain level control in its neighboring plating solution thereby avoiding having to dispose of rinse water contaminated with cyanide.

3. Elimination of Copper Cyanide Plating

Our principal use for copper cyanide plating was as an intermediate step in plating on aluminum. The reason for this is that excellent adhesion is obtained if aluminum is given a copper strike after zincating; in fact, the adhesion is considerably superior to that obtained when the copper strike is omitted.[5,6] With removal of all cyanide solutions from the main area of the shop as already discussed, this created processing difficulties for parts requiring copper cyanide striking. Recently, Johnson, et. al.,[7] used ring shear data to further show the viability of substituting copper pyrophosphate for copper cyanide when plating on a variety of aluminum alloys (Table 1). We've supplemented these data with ring shear results for 1018 steel and cast iron (Table 2) further showing the excellent results obtainable with the copper pyrophosphate strike. After a six month evaluation on the shop floor, we eliminated the cyanide solution and at this point in time have been exclusively using the copper pyrophosphate strike for over one year with quite satisfactory results.

Table 1

Comparison of Ring Shear for Cyanide and Copper Pyrophosphate Strikes for Preparing Aluminum Alloys for Plating

Alloy	Shear Strength (A,B) (MPa) Cyanide Copper	Pyrophosphate Copper (C)
1100-F	79	77
2024-T4	288	273
6061-T6	217	222
7075-T6	285	374

A. These data are from Reference 7.

B. The zincate solution time was 30 seconds. The copper strikes were overplated with nickel in a nickel sulfamate solution. All reported values are the average of 5 samples.

C. The formulation of the copper pyrophosphate solution included copper (7.5 to 11 g/l), P_2O_7/Cu (20/1 to 25/1). Operating conditions were: temperature (25 to 30C), pH (8.5 to 9.2) and current density (10ASF).

Table 2

Ring Shear Data for Use of a Copper Pyrophosphate Strike for Plating on 1018 Steel and Cast Iron

Alloy	Shear Strength (c) (MPa)	Location of Failure
1018 steel (a)	325	Thick acid copper deposit
Cast iron (b)	124	Substrate cast iron

a. The cleaning/activating cycle included: electrocleaning, pickling in 25% HCl for 2 minutes, copper pyrophosphate striking at 10 asf for 5 minutes, then plating 0.10 inch thick acid copper in a proprietary solution.

b. The cleaning/activating cycle included: cleaning, pickling in 25% HCl for 10 seconds, copper pyrophosphate striking at 10 asf for 5 minutes, then plating 0.10 inch thick acid copper in a proprietary solution.

c. Reported values are the average of five test samples.

4. Elimination of Hexavalent Chromium Plating

January 1, 1989 was the date for compliance with Regulation 11, Rule 8 of the Bay Area Air Quality Management District which specified control requirements for plating operations emitting hexavalent chromium.[8] This regulation is directed at controlling emissions of hexavalent chromium to the atmosphere from hard chromium plating, decorative chromium plating and chromic acid anodizing. We estimated that it was going to cost us about $25,000 to demonstrate that we were in compliance with this regulation and that costs would continue to mount in future years just to provide the analytical results to show continued compliance. Since our chromium plating customers were very few, we decided it was time to quit chromium plating at our site. Therefore, as part of our waste minimization program, two chromic acid plating solutions (about 300 gallons each) were decommissioned effective January 1, 1989. Customers with requirements for chromium plating have since been referred to shops in the Bay Area.

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5. Elimination of Vapor Degreasing

In May, 1990 we eliminated a large vapor degreaser from our plating shop. This unit utilized about 700 gallons of perchlorethylene per year and also created waste that had to be disposed of via our hazardous waste management group. We've replaced degreasing with a variety of cleaning processes including: soak and electrolytic cleaning, ultrasonic cleaning, and also with a water pressure cleaning system that recycles the water so waste is kept to a minimum. We've experienced no difficulty in cleaning parts since the degreaser has been removed from our facility and this was confirmed by a number of other installations at the recent 13th AESF/EPA Conference.[9]

6. Rejuvenating Gold Plating Solutions

Gold plating solutions, like many other solutions used for electrodeposition, have the capability of providing good coatings for many years. For example, the solution we use at LLNL has not been replaced in over 12 years. Recently, due to some contamination and dilution problems encountered with our solution we had to decide whether or not to replace it. We were able to salvage the solution by adding a trace amount of lead (0.02 g/l). This restored the current density range over which fine-grained, acceptable deposits were obtained and did not affect the mechanical properties of the deposits. In fact, it allowed us to double the plating current density while providing smoother deposits than were previously obtained (Figure 1).

Data presented by Reinheimer[10] and shown in Figure 2 help to explain the effect of small additions of lead on a phosphate-based gold plating solution. The figure is a polarization plot (cathode potential vs time) for a deposit produced in a phosphate solution at 30 A/m². In a fresh solution, bright uniform yellow coatings were obtained. The cathode potential increased from a nucleation value around -900 mV to a final value around -700 mV. This final stabilized value took about 25 minutes to reach. After about three turnovers of gold, the deposit was coarse and dark. Appearance was quite similar to that of deposits produced in solutions deliberately contaminated with copper or nickel. Nucleation then commenced at a cathode potential less than -900 mV and remained essentially constant. Addition of only 0.5 ppm lead resulted in a noticeable modification of the curve and produced bright yellow coatings. Nucleation occurred at a potential around -900 mV. However, it rapidly (in about three minutes) stabilized to a value of about -680 mV. These data show that the trace addition of lead serves as a depolarizing agent during plating, i. e., plating occurs at potentials positive to those at which cathode deposition would begin without the additive.[11-13] Reinheimer[10] reported n change in the curve even after 50 turnovers of gold, no in the good appearance of the deposit as long as the lea was present in the solution.

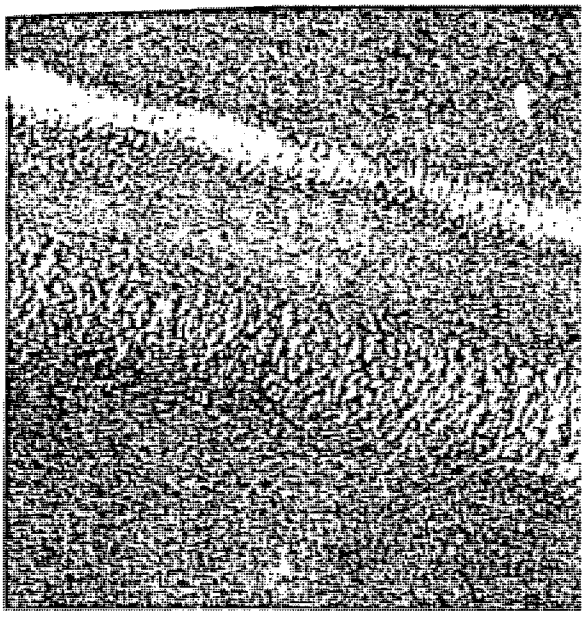

Figure 1 - Macrographs of gold (0.30 inch thick) pla on a thin tube. Top part was plated at 6ASF after lea oxide addition, bottom part was plated at 3ASF befo lead oxide addition.

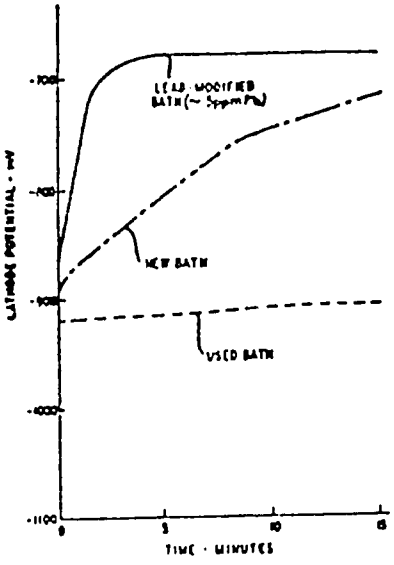

Figure 2 - Polarization curves for a phosphate-base gold plating solution at 30 A/m² (Ref. 10)

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7. . Changing Rinsing Practices

Prior to 1989, rinsing practices in plating consisted of first rinsing parts over the floor grating (this solution was then sent for disposal as waste), followed by rinsing in a running water rinse tank and finally rinsing in a running DI water tank. This practice generated an average of 40,000 gallons/year of non-sewerable waste. In addition, the water rinse tanks were in continuous operation for an average of 10 hours/day. This water was passed through a system that monitored for pH and total dissolved solids (TDS).

In 1989 rinsing methods were modified to reduce both the volume of the collected waste water and the concentration of hazardous materials in the water. The wet floor rinse to the central sump was discontinued and the "first" rinse was now performed over the plating tank.

In June, 1990 we converted the continuous flow rinse tanks into spray stations. These stations consisted of an empty tank and a hand held, trigger operated spray rinse nozzle, located directly adjacent to each chemical/plating tank. This provided both a first rinse over the tank (greatly reducing dragout) and a second rinse in the empty tank. Several large DI still rinse tanks were retained to prevent any drag-in to the plating processes. At this stage we no longer discharged to the sanitary sewer. As a result of these changes in rinsing practices we are saving over 2.5 million gallons of water per year.

8. Recycling of Rinse Water

This system, which is closed loop, allows for the recycling of rinse water from all tanks within the main area of the shop excluding the cyanide line. The process involves cold vaporization, which is distillization employing a vacuum. Waste liquid is placed in a boiler unit and the side walls are heated to 90 to 100°F. A vacuum is applied and as a result the wastewater boils at approximately room temperature. The water vapor travels to a condensor and forms clean product water. Any contaminant remains in the boiler, eventually formir g a slurry when the concentration reaches a certain level. Reductions of up to 99% can be obtained with this process.

Each of five waste streams are segregated by separate drain lines, holding tanks, dirty water tanks and evaporator chambers. Concentrated waste from each of five discrete dirty water rinse tanks is periodically pumped into separate drums for analysis and disposition through LLNL's Hazardous Waste Management Division. The recycled water from this operation is purer than water that is received in the shop from the city (Table 3).

9. Cleaning of Aluminum Parts

Past practice in the plating facility when cleaning aluminum parts was to utilize an alkaline etch followed by an acid desmutt in a nitric/hydrofluoric solution and finally by an immersion in 30% nitric acid to remove a copper film that sometimes was left on parts after extended use. The process worked very well but was hazardous because of the strong acids and waste extensive due to the formation of insoluble aluminum fluoride. Additionally, the solution had a finite life span, requiring replacement on a quarterly basis. The insoluble material had to be removed from the wall of the tank when new solutions were formulated and this was very labor intensive.

Substitution of a commercially available ferric sulfate material for the acids allowed us to reduce the desmutting operation to just one tank while improving the quality of the process. In addition, the hazards associated with working with the concentrated acids were eliminated. Another significant benefit was the elimination of the insoluble aluminum fluoride from precipitating on the tanks walls and the subsequent labor required to remove, package and dispose of it as hazardous waste. After two years of operation we have not had to replace the solution which we control on an addition basis per operator analysis. Savings on this operation are around $4000 per year.

Table 3

Plating Shop Water Analysis (1/92)

	DI	City	Recycled
CN	nd	nd	nd
Cr	nd	nd	nd
Cu	nd	.16	.08
Ni	nd	nd	nd
Si	nd	nd	nd
Zn	nd	.09	.01
TDS	nd	35	5
pH	7.0		6.0

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10. Miscellaneous

Some other initiatives have also been undertaken besides the items already discussed. These include: 1-dropping the temperature of solutions during off-hours, 2-product return, 3-precious metal recovery, and 4-reducing the volume of silver cyanide plating solutions.

During off-hours and week ends all solutions are dropped to a temperature of 100°F. This saves on electricity, reduces evaporation and is a good safety step since it further reduces the chance for any solution level to drop below the active level of in-tank heating elements, thus eliminating potential fire hazards.

Within the past year we cleaned all our storage areas and realized that we had some products such as chromic acid and aluminum plating chemicals, to mention a few, that we were not going to use. The suppliers of these chemicals accepted them back since we had not opened the containers and this was a much more prudent way of removing these products from our facility than having to dispose of them as hazardous waste.

We recover precious metals for our materials management group at LLNL from plated parts, scrap chips, old solutions, etc. Over the past four years this has resulted in savings of over $100,000.

Recently, we reduced the size of two silver cyanide plating solutions from 250 to 160 gallons, a 36% reduction. This was done to help minimize the amount of cyanide in the shop and silver plating solutions are the largest contributors to this issue.

ON-GOING AND FUTURE PLANS

1. Combining Electroplating and Physical Vapor Deposition (PVD)

Combining the technologies of electroplating and vacuum deposition offers a number of potential advantages and these are reviewed in References 14-17. One of the possible benefits is a reduction in the creation of hazardous waste. For example, the combined processes can be used to coat non-metallics and obviate the need for an electroless copper line.[18] A second example is the coating of substrates that are difficult-to-coat with adherent deposits. With this approach, metals such as titanium, tungsten and molybdenum can be coated with adherent deposits without having to resort to use of concentrated acid pickling, etching and/or high temperature heating to provide acceptable adhesion. With the combined processes, parts are first sputter cleaned in a vacuum chamber and then ion plated with a thin film (6 μm) of copper without breaking vacuum. This coating can the serve as the base for subsequent thick, adherent electrodeposits. We've used this process to coat molybdenum parts as large as 1.3 m in diameter and besides providing better adhesion than could be obtained with wet processes this technique also avoide creation of large volumes of highly concentrated acidic wastes.[19]

2. Elimination of Cyanide

We would like to eliminate all cyanide processes from the plating facility. As mentioned earlier, we eliminated cadmium cyanide plating and substituted copper pyrophosphate plating for copper cyanide plating. However, we still utilize cyanide processes for gold and silver plating. There is a commercially available process for depositing gold from sulfite solution and we plan on evaluating this. In regards to silver, a non-cyanide plating process is also available, however, it is not suitable for deposits thicker than about 1 mil. Since many of our requirements are for deposits much thicker than 1 mil, the replacement of cyanide in this situation is clearly a most challenging task.

3. Recycling of Electroless Nickel and Spent Acid Solutions

Commercial processes are now available for recycling of electroless nickel solutions and also for recyling spent acids. We are currently evaluating some of these processes to determine if they might further help in our waste minimization efforts.

SUMMARY

Steps that were taken to minimize waste and conserve resources in our metal finishing facility are discussed in this paper. The program, which encompasses employee awareness, common sense, and existing technology has been quite effective. Future plans which include elimination of all cyanide plating and recycling of electroless nickel and spent acid solutions are also covered.

This work was performed under the auspices of the U. S. Department of Energy by Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48.

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Introduction

The purpose of this paper is to provide an update on what we've accomplished and have planned in our plating operation at Lawrence Livermore National Laboratory (LLNL) in the area of waste minimization. Our efforts have included issues other than waste minimization and, therefore, fall under the wider umbrella entitled pollution prevention or environmentally conscious electroplating. Previous efforts on this activity can be found in references 1 and 2. Approximately one year has passed since our last report on pollution prevention and since this topic remains a high-effort activity much more has been accomplished.

Our efforts to date fall under the first two generation categories of waste reduction. Good housekeeping practices, inventory control, and minor changes in operating practices (first generation) resulted in an impressive amount of waste reduction. In the second generation of waste reduction, current technology, separation technologies, and material substitutions were used to reduce emission and wastes. The third generation of improvements requires significant technological advances in process synthesis and engineering. We are presently starting some projects in this third generation phase and these will be discussed at the end of this paper.

Initiatives Already Completed

A variety of initiatives have been previously completed and are described in detail in earlier reports (1,2). Therefore, only a brief review of these will be presented here.

- Elimination of cadmium plating- Zinc-nickel deposits are a suitable substitute for our applications. Salt fog tests (500 hours) have revealed heavy red rust on 2.5 um thick cadmium plated steel panels while no rust appeared on zinc-nickel plated panels.

- Segregating cyanide solutions- By locating all solutions containing cyanide in a separate room we avoid having to categorize all wastes from the facility as cyanide containing and this noticeably minimizes disposal costs. For example, disposal costs for our wastes containing cyanides are approximately $12/gallon compared to $4/gallon for non-cyanide containing wastes.

- Substitution for copper cyanide plating- We've replaced copper cyanide plating with a copper pyrophosphate process. The substitution has been in operation for over two years and works quite well. Ring shear adhesion tests for a variety of aluminum alloys (3), 1018 steel and cast iron have revealed results as good as those obtained with the copper cyanide process (Table 1).

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- Elimination of hexavalent chromium plating- New Bay Area Air Quality Managment District regulations on emissions from hexavalent chromium went into effect in January 1989. We estimated that it was going to cost about $25,000 to demonstrate that we were in compliance with these regulations and that costs would continue to mount in future years just to provide the analytical results to show continued compliance. After analyzing our customer base for chromium plating and discovering how small it was we eliminated chromium plating from our facility.

- Elimination of vapor degreasing- Vapor degreasing was replaced with a variety of aqueous cleaning processes including soak and electrolytic cleaning, ultrasonic cleaning and also with a water pressure cleaning system that recycles the water so waste is kept to a minimum. We've experienced no difficulty in cleaning parts since the degreaser was removed from our facility and this was confirmed by a recent literature review of quantitative results from a variety of researchers who reported that aqueous systems provide equal, if not better cleaning, than vapor degreasing (4).

- Changing rinsing practices-A variety of changes in rinsing practices have been made. These include: performing the first rinse over the plating tank, converting continuous flow rinses into spray stations, and utilizing hand held, trigger operated spray rinse nozzles. As a result of these changes in rinsing practices we are saving over 3 million gallons of water per year.

- Recycling of rinse water- A commercial system which utilizes cold vaporization (distillation in a vacuum, references 5 and 6) allows for the recycling of rinse water from all tanks within the main area of the shop excluding the cyanide line. Therefore, we no longer send any water to the sewer system. At this point after 1-1/2 years of operation we have recycled 80,000 gallons of water through the system and created only 500 gallons of waste. Because of our accomplishments with our revised rinsing practices and water recycling, the, City of Livermore nominated us for an award from the California Water Pollution Control Association. On April 23 1993, LLNL's plating facility received a Certificate of Merit for Outstanding Achievement in recognition of continuing efforts in the wastewater field.

The recycled water from this system is purer in metallic ion content than the water we receive from the City of Livermore as shown in Table 2 for analyses performed in January 1992 and January 1993. However, with time, anion content of the recycled water increases as shown in Table 3. Our next step is the installation of an ion exchange unit to remove these anions before the water is returned to the shop

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- Cleaning of aluminum parts- Substitution of a commercially available ferric sulfate material for a two step process that included an acid desmutt in a nitric/hydrofluoric acid solution and an immersion 30% nitric acid allowed us to reduce the desmutting operation to just one tank while improving the quality of the process. The hazards associated with working with the concentrated acids were eliminated, an insoluble aluminum fluoride film formed with the acid process is no longer an issue, and the new solution lasts much longer.

- Rejuvenating gold plating solutions- Acid gold-cyanide solutions can be rejuvenated by the addition of small amounts of lead (0.02 g/l) which restore the current density range over which fine-grained, acceptable deposits can be obtained (7-9) This lead addition does not affect the mechanical properties and allows us to double the plating current density while providing smoother deposits than were previously obtained.

- Combining the technologies of electroplating and physical vapor deposition. This is an on-going activity that offers a number of potential advantages that are reviewed in references 10-14. A key benefit is a reduction in the amount of hazardous waste that is created. For example, the combined processes can be used to coat non-metallics and obviate the need for an electroless copper line (14). A second example is the coating of substrates that are difficult-to-coat with adherent deposits. With this approach, metals such as molybdenum, tungsten and titanium can be coated with adherent deposits without having to resort to use of concentrated acid pickling, etching and/or high temperature heating to provide acceptable adhesion. References 12 and 13 provide details for molybdenum and tungsten.

- Miscellaneous-Other initiatives that have been completed include: reducing the temperature of solutions during off-hours, product return, precious metal recovery and reducing the volume of silver cyanide solutions.

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Replacement of cyanide bearing conversion coatings

As mentioned early in this paper, we took special care to segregate cyanide containing solutions from other processes in the facility. However, although we saw levels of cyanide drop significantly in rinse water, the levels did not reach zero. We looked at all of our traditional non-cyanide processes and found that the chromate conversion coating solution used for aluminum parts contained small amounts of cyanide as potassium ferricyanide. By checking with a number of vendors we found a replacement for this process that contained no cyanide. Since the changeover we have noticed that castings require a slightly different pre-treatment and most parts require a slightly longer immersion time. Other than this, the process is producing parts of the same quality and appearance as before.

Recycling of acids

We recently purchased a commercial unit which utilizes diffusion dialysis technology for recycling of acids. Spent solutions of nitric, sulfuric, and hydrochloric have been recycled using this system and efficiency of recovery has been about 80%. as shown in Table III. Cost of this unit was less than $10,000 keeping in the range we consider affordable for most small plating installations.

Energy conservation project

The electroplating facility uses large amounts of electrical power for process solution heating, space heating, and exhaust ventilation. By reducing thermostat settings and air flow during off-shift hours, electrical savings on the order of 1.6 million kwh as well as natural gas savings of 30K therms are projected as savings. We are now in the construction phase of this project which we estimate will save approximately $100,00 per year.

Ion exchange

An ion exchange unit has been obtained from another group at LLNL and this will be installed on the water recycle unit. This will even further purify the water from the recycle unit so that this water can be used for activities other than just rinse stations.

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Summary

The plating shop at LLNL is a nonproduction-oriented metal finishing facility that places heavy emphasis on utilizing environmentally conscious manufacturing principles. Key focus items have included; minimizing hazardous wastes, minimization of rinse water usage, material and process substitutions and recycling technology. With all these changes we are saving over $500,000 per year, have a safer, cleaner facility, and have not reduced quality of parts processed through the operation.

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Acteron & Waste Minimization

by V. J. Shannon
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With trend-setting anti-pollution legislation, water and landfill shortages, and a strong environmental consciousness, northern California tends to spawn ecologically minded businesses. And for Acteron Corporation, Redwood City, CA, that spells waste minimization.

Acteron is a 13-year-old firm specializing in highly reflective plating for infrared optical components used in the industrial and medical fields, electroless nickel on high-reliability electronic components, precious metals plating for electrical contacts and microwave applications, functional hard anodizing, and more. The company processes materials such as difficult-to-plate metals, non-metallics, plastics, silicon and glass. With over 50 technicians and engineers, Acteron has even developed proprietary processes employing ultrasound and pulse plating. Its customer base includes some of the most

Acteron President Patrick Burt (right) and Steve Cazel, Plating Manager, examine blanket-like reusable filter media.

prominent names in electronics and over 10 prime defense contractors. It has an inspection department that meets the requirements of MIL-I-45208A and lab resources that feature AA analysis, specific ion testing, and a zero-defects QC program in accordance with MIL-Q-9858A.

Patrick Burt, president of the 12,000-square-foot facility, is an avid proponent of waste minimization. In fact, he is chairman of the National Association of Metal Finishers (NAMF) Waste Minimization Committee, whose mission, in part, is "to research, study, and promote waste reduction, minimization, recycling or reclaim techniques to the surface finishing industry, regulators, and legislators." *(Editor's note: See article on waste minimization in November/-December issue of FM by Patrick Burt).*

Minimization Initiatives

To illustrate the results of an aggressive waste minimization program, consider this. Just seven years ago, Acteron moved from Belmont after acquiring and expanding a four-man shop in Redwood City. Despite a company that now has approximately 12 times the personnel and sales of that four-man operation Acteron actually consumes *less than one-third the water and has nearly 90 percent less heavy metals in its effluent.* Here are some of the initiatives that have contributed to these impressive figures:

- Installation of double and triple counterflow rinses.
- Use of spray rinses over select process and rinse tanks.
- Adoption of conductivity sensors to regulate water condition and flow.
- Segregation of rinsewaters.
- Substitution of less-polluting processes (e.g., acid copper to replace cyanide copper, and periodic reverse-current cleaning to replace cyanide-containing cleaners).
- Elimination of vapor degreasing by using a system of dual soak cleaners with ultrasonic enhancement.
- Use of more dilute formulations such as those for acid pickling.
- Thorough indoctrination and training of employees to stress how they can make a positive contribution to the environment. For example, all personnel are taught the importance of extending drip-times over rinse tanks.

In-Tank Filtration Systems

Another key aspect of Acteron's waste minimization program is the use of in-tank filter systems in tanks as small as 10 gallons and as large as a few hundred gallons. As Plating Manager Steve Cazel says, "On any plating tank, but particularly on precious metal tanks, external plumbing for filtration is a concern for us. Housings can crack. Hoses and clamps get weak. And even if you recover spilled solution from a secondary containment area, chances are it would be too contaminated to recycle because of the dirt and debris involved. So it's a great benefit to keep all of the

Filter changes on in-tank system are achieved easily and quickly using hand-tightening thumbscrews.

filtration equipment in the tank. Even though the in-tank system takes up some tank space, we feel it is minimal and that the advantages are far in our favor."

The in-tank system eliminates leaks and spills because it uses no hoses, clamps, seals, chambers or, for that matter, any out-of-tank apparatus. The filter(s) is attached to the pump body and totally immersed in the solution to be filtered. The pump body is secured to the tank lip with an adjustable bracket. Solution is continuously drawn by vacuum through the filter cartridge(s), after which it travels approximately 3" before being expelled through a discharge port on the pump body. Solution never leaves the tank.

Importantly, the force of this discharged solution produces a clean, oil-free source of robust agitation that

suspends particles for quick-capture filtration, thus keeping the tank bottom free of contaminating solids buildup. Frequently, the agitation provided as a natural byproduct of in-tank filtration is sufficient to replace mechanical or air agitation systems. As Mr. Burt explains, "Airborne contaminants — some organic, some inorganic — are a concern for our technology." By removing those particles quickly, before they dissolve in solution, we reduce the need for carbon treatment, dummying, peroxide treatments, or, in the worst case, bath dumps."

Using the same basic principles of operation but different models and sizes to produce from 1 to 3,000 gallons/hour of filtered solution, in-tank systems find application in tanks as small as a half-gallon and as large as thousands of gallons. For high-volume baths, two or more in-tank units are used on a single tank. Ease of use is another asset. Conventional filter systems often require tools and significant time and labor for filter changes. But the uncomplicated design of the in-tank system enables rapid filter changes using hand-tightening thumbscrews rather than tools. Because the systems are portable, cleanable, and consume no floor space, they can also be used to filter multiple tanks where continuous filtration is not required.

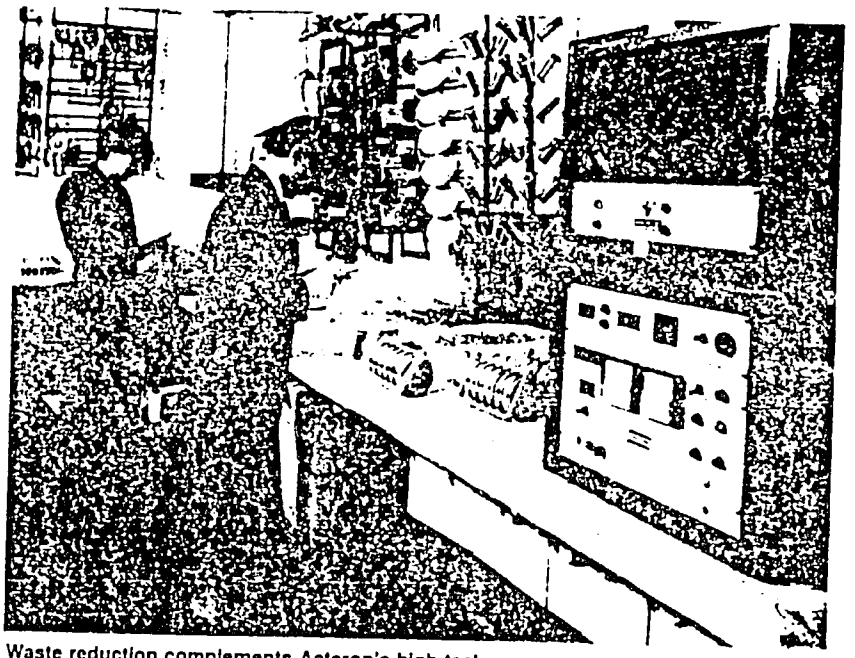
Prior to using the in-tank systems, Acteron did not filter preparatory solutions such as those in its aluminum finishing lines. In the case of nitric acid and mixed organic acids, for instance, that meant frequent dumps, frequent neutralization, frequent and liberal use of neutralization chemicals, and frequent acid purchases. Now Acteron continuously filters those pre-dips ... and with just rewards. As Cazel says, "High-solution-turnover filtration gives us more confidence in all of our solutions. It reduces rejects and adds life to the baths. So we're purchasing less acid and utilizing less neutralization chemicals for waste treatment."

Reusable Filter Media

Another important element of Acteron's waste minimization program is a reusable filter media. Before converting to this material, the company routinely accumulated a 55-gallon barrel of spent disposable filters every 90 days. But in nearly a year of using the blanket-like reusable media, not a single drum of the spent filter material has been generated, according to Cazel.

"Conventional filter cartridges go to landfill — they're solid waste — and we're committed to reducing waste," he said. "Plus, with disposables, there is the cost of an expendable product to consider. The reusable material has been real cost effective for us. We have yet to find a plating system that we weren't able to upgrade by using the in-tank filter system and reusable cartridge."

Clean filter operation is predicated on good filter maintenance, and Acteron has trained a crew whose sole job it is to properly maintain tanks, filters, and accessories on a regularly scheduled basis. That includes cleaning the reusable filters by draping them over a 3/8-inch-thick polypropylene perforated sheet, then pressure spraying with deionized water over an appropriate rinse tank.



Waste reduction complements Acteron's high-tech processes such as pulse plating to obtain particle and pore-free nickel finishes on disc drive components.

Patrick Burt and Acteron have such a high profile in the area of waste minimization that they participate in local, regional, national, and even international programs on the subject. For instance, on a goodwill NAMF tour to Czechoslovakia, Mr. Burt shared waste minimization technology with that nation's environmental and industrial ministries. And, recently, Acteron participated in the making of a film on waste minimization produced by the State of California Department of Health Services. In that film it is no accident that they discuss the in-tank filter system with reusable filter media. It is but one of many tools and techniques available to operate an ecologically responsible business in these environmentally conscious times.

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Incentives For Waste Minimization In The Metal Finishing Industry

by Patrick Burt, President, Acteron Corporation. Chairman, Waste Minimization Committee, N.A.M.F.

Waste minimization is a unique direction among environmental control measures. Over the past ten years environmental regulations have caused the metal finishing industry to become the most heavily regulated small business classification in the United States. Virtually all of these regulations have reduced the profitability and the viability of these small businesses which are so vital to American manufacturing. The costs and difficulty of meeting these regulations has resulted in the closure of 25% of the plating firms in the United States over the past ten years. However, waste minimization can significantly reduce the costs of environmental controls while being the most environmentally sound approach to manufacturing.

Incentives for waste minimization can be characterized in three primary categories:

- *Economic Benefits*
- *Regulatory Conformance*
- *Environmental Achievement*

Economic Benefits

The cost of waste handling and waste disposal is already a major operating expense for metal finishing operations. These costs continue to escalate each year. Reducing the amount of waste generated reduces operating costs in several ways and can actually improve the profitability of metal finishers. Waste minimization options which a company rejected previously may now be economically viable. In many cases there is a rapid return on investment. If all of the direct and indirect benefits of waste minimization are identified and considered, the economic benefits of waste minimization can be substantial.

With increasing regulatory costs and decreasing landfill capacity the costs associated with hazardous waste disposal will increase at a far greater rate than most other business expenses. Companies which don't act now to minimize waste generation will be seriously impacted by rapidly escalating costs and may find themselves at a competitive disadvantage. Eventually they may be overwhelmed by the regulatory burdens associated with waste treatment and disposal.

The NAMF has identified a "Triad of Waste Minimization" which includes *source reduction, on site recycling* and *off site recycling* as three necessary and complimentary methods of achieving waste minimization for our industry.

Many waste minimization alternatives are very inexpensive low technology *source reduction* options which provide immediate cost savings. For example, spray rinsing and full dripping over tanks to recapture and re-use process solutions are among the least costly and most advantageous waste minimization options available.

Many of these incentives are indirect and therefore frequently overlooked or under appreciated. However, these simple source reduction methods can be utilized to varying degrees in virtually all facilities and they are relatively inexpensive to implement.

Once the waste volume has been significantly reduced by using simple source reduction options, then the more costly advanced technology *on site recycling* approaches can be implemented with reduced equipment and operating costs due to the reduced volume of waste to be recycled.

Regulatory Conformance

Conformance to stringent environmental regulations has become the foremost concern of metal finishing firms. Waste Minimization can ease the difficulty of meeting many of these mandates. In addition, federal, state and local regulations are requiring that businesses which generate hazardous waste must reduce the amount and/or toxicity of their wastes. These new waste minimization regulations will not allow manufacturers to complacently accept the higher costs of waste handling and disposal. The 1984 Resource Conservation Recovery Act renewal first addressed this issue on the federal level. Every hazardous waste manifest contains a statement which the generator must sign certifying that the generator has a waste minimization program in place and that progress reviews of the program are done periodically.

Many state and local governments have adopted or will adopt comprehensive waste minimization mandates. California and Massachusetts are among the states which have already enacted far reaching laws which require source reduction and process substitution changes.

Some Regional Water Quality Control Boards are requiring that Public Owned Treatment Works (POTW's) reduce their mass discharge volumes. To achieve this, many POTW's will continue to reduce the allowable contamination levels or water volume from industrial dischargers. Source reduction and recycling technologies are emerging as the most effective means of meeting these more stringent discharge standards.

Environmental Achievement

A strong waste minimization program is the most effective way for a manufacturer to minimize the environmental detriments of metal finishing, while continuing to provide the frequently underappreciated environmental benefits of metal finishing. These benefits include product corrosion prevention and wear resistance which prevent the product itself from becoming a waste. By minimizing waste beyond the statutory requirements, the company improves its good standing in its community and its standing with the agencies responsible for administering environmental regulations.

Through waste minimization metal finishers can continue to provide vital societal and environmental benefits while minimizing the detriments which were historically associated with these processes.

Barriers To Waste Minimization And Their Cures

Having recognized the many values and incentives of waste minimization there remain certain technical or regulatory impediments to waste minimization which need to be addressed.

Process Baths Conducive to Solution Recapture

As was noted, effective recapture of chemical process solutions for re-use is probably the most cost effective and environmentally preferred method of waste minimization. However, in practice the liquid volume being returned to the process solution must be no greater than the evaporative loss occurring in the process tank.

Over the last twenty years proprietary chemical manufacturers have responded to customer and government requests for energy conservation by providing new process solutions which operate at low or ambient temperatures. However, these low temperature solutions minimize solution recapture opportunities because of their reduced evaporation. Consequently, there is now a need for process solution manufacturers to provide two sets of operating parameters, one option at warm temperatures for waste minimization and the other at lower temperatures for energy conservation. In addition to their evaporation advantage, warmer solu-

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tions rinse more freely and can operate at lower chemical concentrations thereby further reducing drag out waste. The energy consumption detriments of warmer solutions may be mitigated by use of environmentally sound heating methods such as process heat re-use and solar heating. Metal finishers need to notify chemical manufacturers of their desire for low waste generating process solutions.

Solution Purification

As drag out wastes are reduced, an increasing proportion of metal finishing wastes come from concentrated process solutions which are gradually contaminated through normal use. The generation of these waste solutions can actually be accelerated due to solution recapture by preventing traditional drag out of contaminants which occurs with the normal drag out of process solutions. Consequently, the importance of solution purification has become increasingly critical to achieving waste minimization. Unfortunately, purification tends to be process and contaminant specific so that no single simple method can meet this requirement.

Technical research in the metal finishing field needs to place extensive focus on solution purification technologies. In addition, existing knowledge on methods of solution purification needs to be compiled and provided to all industry members by pollution prevention agencies as well as technical and trade associations.

Shortage of Educational Materials

Recently there has been a surge in waste minimization research and education. This information needs to become widely available to even the smallest and least sophisticated firms in the metal finishing trade. Audit manuals, educational films, training courses and technical papers are all needed and valuable waste minimization tools.

Legislative Cures

Many impediments to waste minimization currently exist within the U.S. regulatory framework. These impediments include the difficulties that off-site recycling firms have in obtaining and maintaining treatment permits. In addition, there lacks a consistent regulatory framework which identifies recycling as inherently preferable to treatment and disposal and which adequately assists and promotes recycling. Some prospective state and federal regulations would actually cause in-house recycling to be more burdensome than waste treatment.

Waste Minimization = Increased Profits
Economic Benefits of Water Minimization
Dripping and Spraying Over Tanks

EFFECT		*COST BENEFIT*
QUALITY CONTROL		
1) Greater Solution Stability	=	Improved Quality Control
2) Less Frequent Solution Analysis	=	Lower Quality Control Labor
3) Less Chemical Usage	=	Lower Chemical Cost and Less Labor for Chemical Additions
4) Less Chemical Storage due to Fewer Additions Needed	=	Lower Inventory and Less Storage Area
5) Cleaner Rinses	=	Better Product Quality
REDUCED COSTS OF WASTE TREATMENT		
6) Less Water Usage	=	Lower Water Bills
7) Less Sewer Water Discharge	=	Lower Sewer Bills
8) Less Waste Treatment Chemical Usage	=	Lower Material Usage and Less Chemical Storage
9) Better Wastewater Treatment Quality	=	Due to Longer Settling Time
10) Less Sludge Generation	=	Less Wastewater Treatment Labor
11) Less Sludge Cake Generation	=	Lower Cost for Disposal, Drums, & Hauling, Documentation & Liability
IMPROVED CONFORMANCE TO ENVIRONMENTAL REGULATIONS		
12) Sewer Water Volume Reduction	=	Potential Reduction of Limits on Specific Heavy Metals (based on under 10,000 gallons per day)
13) Comply with Effluent Standards & Waste Minimization Regulations	=	Achieve Good Company Standing in your community & stay in business
14) Less Waste Volume	=	Reduced Waste Fees, Taxes & Permits. Better Quality of Conformance to Waste Storage & Documentation

Provided by: NAMF Waste Minimization Committee 10/90

Tax credit incentives for waste minimization or recycling equipment would provide the financial assistance which would allow many firms to switch from their existing investment in waste treatment equipment toward new waste minimization technologies. These financial incentives could be either state or federal. However, the best chances for enactment of tax incentives exists on the state level.

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INDUSTRIAL WASTE MINIMIZATION ASSESSMENT STUDY TOUR
INDINESIAN PULP AND PAPER INDUSTRY

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Reported by
IYAN SUWARGANA

THE ENVIRONMENTAL IMPACT MANAGEMENT AGENCY
(BAPEDAL)
JAKARTA - INDONESIA
1993

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I. EXECUTIVE SUMMARY

On October 27th - November 5th,1993, Iyan Suwargana from The Environmental Impact Management Agency (BAPEDAL), Jakarta, Indonesia, joined with the industrial waste minimization assessment study tour participants to visit some Industrial Organization and Association in Pulp and Paper in The United States which is especially involved in the technology of waste water treatment and its management. This program was implemented on October 24 th - November 5th, 1993. Its a follow up of "Lokakarya Minimisasi Limbah Industri Pada Industri Pulp dan Kertas" which was held in Hotel Indonesia Jakarta, in July 1993 by World Environment Center (WEC) and supported by United States Agency for International Development (USAID) and BAPEDAL.

Participants in the study tour were : Mrs. Hendayani T.A M.Sc, Institute Research and Development of Cellulose under Industrial Ministry, Bandung, Widya Tjahyana L, PT. Pakerin, Mojokerto, Mr. Warih Supriady, PT. Surabaya Agung Industri Pulp dan kertas, Gresik, Mr. Darono Wikanaji, PT. Kertas Leces (Persero), Probolinggo, Mr. Zulkifli Lubis, PT. Indah Kiat Pulp and Paper, Bengkalis, Riau, and Mr. Charles J.H Hong, Deputy Project Manager WEC, New York.

The main purpose of this visit is to know implementation waste minimization program on pulp and paper industri in The United States. In addition, its to enable us to learn and absorb the experience of some pulp and paper mill as well as to learn how to handle the problem, to broaden our knowledge that concerns the technology of pulp and paper, and waste water treatment. The result of the finding is expected to be applied through out Indonesia.

In addition, the aim of this program included visiting several research organization which support waste minimization program in the US like National Council of the Paper Industry for Air and Stream Improvement (NCASI).

The place to be visited :

- Friday, October 29th, 1993.
  Union Camp Corporation, Fine Paper division Eastover, South Caroline meet with Mr. Wesley A. Foy Technical Control Manager, Mr. James P. Witkowski, Environmental Engineering Manager and Mr. Dough R. Lazar, Senior Application Engineer.

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- Tuesday, November 02nd, 1993.
  Weyerhaeuser, Pulp Division, Oglethrope, Georgia meet with Mr. Russell K. Stevenson, Plant Environmental Manager and Mr. Frank D. Wohhrley, Environmental Project Engineer.

- Wednesday, November 03rd, 1993.
  Visited at World Environment Center, New York.

- Thursday, November 04th, 1993.
  NCASI, Madison Avenue, New York meet with Mr. DR. Isaiah Gellman, President.

II. INTRODUCTION.

Generally the environmental management system of pulp and paper industri in US, in this case Union Camp Corporation and Weyerhaeuser Company include modern processing and environmental control technologies which should provide the foundation for long-term, highly-effective, environmental performance.

Major strengths of the both industries were the capabilities to achieve the environmental target and a management that looks to the future and is commitment is demonstrated in their support for installing state-of-the-art processing and environmental control technology in the mill. Most opportunity areas relate to the development of management systems to facilitate making the right operating decisions.

The existence of an organization such as National Council of the Paper Industry for Air and Stream Inprovement (NCASI) is very helpful to the government and industri in making a new decision by giving information and acting as a third person.

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III. FINDING

III.1. UNION CAMP, FINE PAPER DIVISION, EASTOVER, SOUTH CAROLINA.

Description of Mill

Union camp Pulp and Paper Division is located in Eastover, 30 Miles of Columbia, South carolina with a 4000 acre Construction area, and 150 acre for it's mill, with 860 employees which it separated in to four shift.
Business purpose : manufacture fine white paper for use in the communications industri, (i.e., copier paper, envelopes, bisiness forms, offset printing, reading materials and writing supplies, and bleached market pulp.

The total production is about 1800 tons per day. of this, approximately 1500 tons per day is converted to fine paper and 300 tons per day to bleached pulp.

The mill use river water for the production and need 1400 gallons fresh water for one ton product.

The mill has two paper machines and one pulp machine.
Paper machine I

Start up in August, 1994 the equipment is from voith duofomer twin wire paper machine, with a capacity of 600 ton per day producing fine paper 46-55 basis weight (gsm).

Paper machine II

Star up in July, 1991 producing fine paper 35-46 gsm the equipment is from beloit bel baie III paper machine with capacity this machine 660 ton per day.

Pulp machine

Star up in April, 1991 the equipment is from valmet-ahlstrom wet end, with capacity 500 ton per day, this machine in able to produce two kind of pulp i.e. soft wood and hard wood. The pulp mill uses trees as raw material. The chipping process goes to two continuous digester for dilignification process then to bleaching process.

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Description of Environmental Issues

- Water / Effluent Treatment.

The mill contains a state-of-the art spill prevention system to reduce in-mill losses. This is followed by a large and complex effluent treatment system.
To minimize the amount taken from the Wateree River, the same water is uses up to 22 times throughout the paper making process prior to being released. Mill controls and an extensive treatment system ensure that water color, temperature, dissolved oxigen, solids content and oxigen demand levels more than meet required environmental standards.
Effluent treatment is meant to reduce organic matter as BOD, solids content (TSS), color, also pH. There are two kind of first treatment system; sanitary treatment and primary clarifier treatment. The result of both treatment is sent to the mixing box for secondary treatment.

Clarifier (primary treatment)

Effluent from wood yard, paper mill, pulp mill, recovery plant, evaporator etc through the pipe filtered in the bar screen going to primary clarifier no I. The sludge is carried to the dewatering process, this system can remove 95 % of solid waste.

Mixing box

Treated water from clarifier no. I and no. II are mixed with effluent from bleach plant and sanitary treatment in mix box from the mixing box, treated water goes to ABS through splitter box.

Aerated Stabilization Basin (Secondary treatment)

Effluent treatment for ASB splitter box separate in 2 series, one goes to ABS I and ABS II. Both of them had the same capacity. Each ASB equipped with 9 electrical aerator of 75 horsepower for mixing and aerating, treated water in ASB need 6 days time. Treated water from ASB I goes to ASB no. 3 and ASB II goes to ASB no.4.

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- Effluent Holding Pond

From the secondary treatment, the treated water is stored in the effluent holding pond which finally lead to the river through diffuser. This treated water has 10 ppm BOD, and so is the TSS.

- Oxygen Bleaching

The mill use this paper-whitening method because it uses less water and minimizes contaminants that are by-products of other pulp bleaching processes.

- Air Pollution Control

The mill's air quality system significantly reduce odor associated with paper mill. Odorous gases are collected and incinerated, preventing them from escaping into the atmosphere. Their system operates at an impressive 99,9 % effeciency. In the prpcess of production, this mill also produce gas such as particulate, SO_2, NO_x, Cl_2 which can pollute the air and this gas produce by the recovery furnace, power boiler, bleach plant etc. To control this pollution the mill uses precipitator, incinerator. Therefore low sulfur fuel preferable for power boiler.

- SolidWaste

The main resource of solid waste is primary clarifier as sludge, power boiler as a fly ash, recausticizing grits and pulp mill produce reject knot. Almost all solid waste are sent to landfill of the mill.

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III.2. WEYERHAEUSER PAPER Co., OGLETHROPE, GEORGIA.

Description of Mill

Weyerhaeuser Paper Co. is located in Oglethrope, Georgia founded in 1971. All the product of this mill is for the pulp market and producing 750 ton pulp per day. The first time to produce 1 ton pulp this mill consume 17,000 gallon fresh water, but now consumption is reduced to 10,000 gallon per ton product.

In the paper making process include chips yard, digesting, bleaching process, stoc preparatidn and dryer.

Description of Environmental Issues

- Water / Waste Water Treatment

Primary treatment

Waste water from the mill flow in to canal with a bar screen going to a primary clarifier, with 1,75 million gallon treated water, it has 3 hour resistant time. In this clarifier there is also pH adjustment. Solid waste produced goes to screw press for dewatering and remove this solid waste to the landfill. The clarifier able to remove BOD and COD up to 90 %. If something happen in this waste water instalation the mill has prepare on emergency spill basin placed before the bar screen.

Secondary treatment

Treated water from the primary clarifier goes to first lagoon, of 23 acre it has 15 million gallon, with 12 aerator. Treated water in the first lagoon goes to the second one covering 22 acres with 6 aerators, it has resistant time for 9 days.

Stabilization Pond

In order to make treated water to become cleaner, from the second lagoon it goes to the stabilization pond, this pond equipped with 1 aerator covering 25 acres and treated water has 10 days resistant time. Beside that, the instalation has a holding pond with 660 million gallon capacity, which function for keeping treated water from the stabilization pond.

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This treated water need 24 days resistant time as long it is treated; before treatment in this instalation the in-let effluent has 500 ppm BOD. After treatment, the out let is expected to only 35 ppm BOD.

- Bleaching Process

In the bleaching process a good pulp need caustic soda and oxygen to be pumped to the top tower (to get a good mixture) then going to the diffusion washer stage. Then ClO_2, H_2SO_4, Na_2CO_3 is added to the pulp and pump to the D2 tower (for washing with white water).

Finally the pulp are kept in high density storage. This mill has two high density storage which each of them has the capacity of 210 ADMT.

- Recovery Chemical

Black liquor from the pulping process goes to the evaporator, collected in the "process condensate tank", it is then washed in post oxygen washer and stored in the "cylinder mould filtrate tank", solid of which is 1 %, this tank has a capacity of 750 million gallon. From this 1 % solid of black liquor it is concentrated to 40 % solid, this need to be sent to the first stage filtrate tank. The next is to go to the extraction tank and filtered.

Result of above process is collected in flash tank, from then on black liquor increased their concentration up to 67 % to be stored in two tank, each has a capacity of 130 million gallon. The next process is in the recovery boiler, green liquor is produced from the recovery boiler going to the clarifier. From the clarifier its goes thru to the slacker where caustizer process take place the next process of it produces white liquor. The white liquor is ready for use in the digester and oxygen reactor.

- Air Pollution Control

This mill in the air pollution control include for weak gas and strong gas.
For the weak gas : using incinerator to reduce pollution. The source of pollution is from power hose, pulping vessel passed to moisture separation finally sent to smell dissolving tank vent and to recovery boiler.

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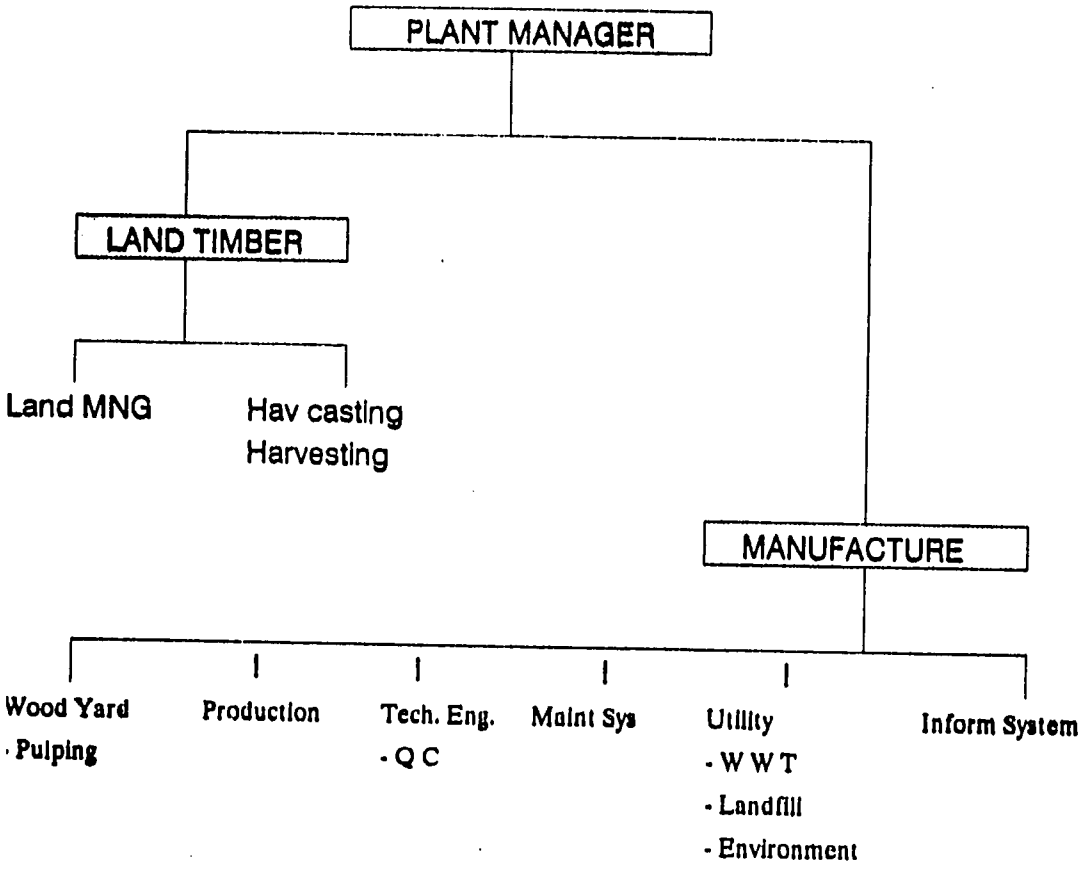
For the strong gas : gas from the evaporator area and from pulping unit are passed toliquid ring compressor goes to "moisture separator" finally separated to stack, power boiler and to calciner.

- Solid Waste
  Solid waste from this mill are sent to the landfill, for example solid waste from chipping process, waste from boiler i.e. ash.

Description of Organization



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IV. CONCLUSIONS AND RECOMMENDATIONS.

This program is very helpful to the participant in implement waste minimization program on pulp and paper industri in Indonesia. It is will be more effective if enough time is given to the participant to know more about the detail of pulp and paper technology in order be able to apply it in practice, it will be helpful that the participant is given the change to take part or get involved in the pulp and paper making process.

IV.1. RELATIONSHIPS BETWEEN GOVERNMENT AND INDUSTRY

The existence of an organization such as National Council of the Paper Industry for Air and Stream Inprovement (NCASI) is very helpful for industri to make agreements with the goverment in deciding some new regulations by giving information. In doing so, the organization help the industry which face some difficult in processing waste water or pollution and make some improvement to increase the quality with limited impact to environment. In this matter, indeed the U.S government has a good relationship with industry.

This organization is indeed needed in Indonesia to help the industry and the goverment.

IV.1. UNION CAMP, FINE PAPER DIVISION, EASTOVER, SOUTH CAROLINA.

The processes that are used in the Union Camp plant use large quantities of chemicals that produce some environmental concerns.

Potential cost savings and waste minimization are realized with the addition of Union Camp's Eastover II. Eastover II is highly automated and features many new technology advances to control cross direction moisture and basis weight profiles. Mill controls and an extensive treatment system ensure that water color, temperature, dissolved oxigen, solids content and oxigen demand levels more than meet required environmental standards. At the Eastover II use paper-whitening method because it uses less water and minimizes contaminants that are by-products of other pulp bleaching processes.

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In the bleaching process, chlorine dioxide is used. But it will be tried for possible elimination or reduction with use another alternative i.e. Ozone.

For delignification, Oxygen is used. It is a highly efficient process in which oxygen are using to break-down and remove lignin.

This mill have instalations for waste water treatment, including primary and secondary treatment with lagoon and the mill is completely furnished with equipment needed to preserve clean and healthy surrounding and have good instalations for waste water treatment.

IV.2. WEYERHAEUSER PAPER Co., OGLETHROPE, GEORGIA.

The mill have chemical analysis conducted systematically on the waste water to determine potential problems and possible solutions.

In the delignification process the mill uses 100 % oxygen, furnished with recovery plant, evaporator, recovery boiler to reduce air pollution. And for the bleaching process still using chlorine and chlorine dioxide at the comparison of 70 % chlorine dioxide and 30 % chlorine.

The use of clorine dioxide can be decreased but efecting the brightness of the pulp produced, therefore untul now researches are still being conducted to replace it.

Effluent treatment is meant to reduce organic matter as BOD, solids content (TSS), color, also pH. There are two kind of first treatment system; sanitary treatment and primary clarifier treatment. The result of both treatment is sent to the mixing box for secondary treatment.

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V. APPENDICES

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APPENDIX A

FIGURES AND POTHOGRAPHS

Participants and Pacility Personel at Union Camp Plant.

The Union Camp Plant

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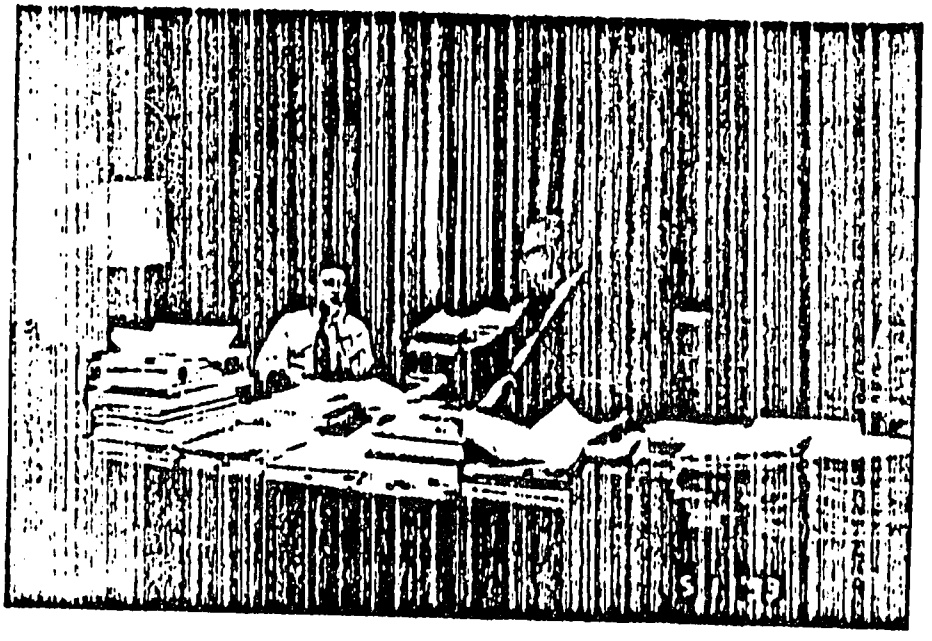

DR. Isaiah Gellman and Charles Jong Hwa Hong in a discussion.

Participants and Pacility Personel at Weyerhaeuser Paper Co.

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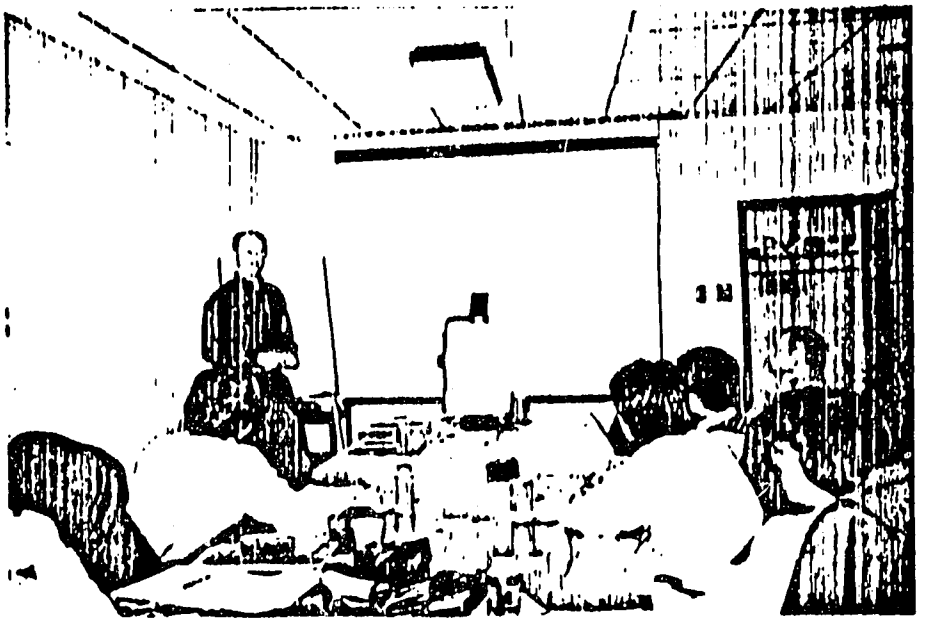

Frank D. Wohrley, Environmental Project Engineer from the Industry explaining his experience at Weyerhaeuser Paper Co.

The Weyerhaeuser Plant

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APPENDIX B

ITINERARY :

- Friday, October 29th, 1993.
  Union Camp Corporation, Fine Paper division Eastover, South Caroline meet with Mr. Wesley A. Foy Technical Control Manager, Mr. James P. Witkowski, Environmental Engineering Manager and Mr. Dough R. Lazar, Senior Application Engineer.

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- Wednesday, November 03rd, 1993.
  Visited at World Environment Center, New York.

- Thursday, November 04th, 1993.
  Visited at NCASI, Madison Avenue, New York meet with Mr. DR. Isaiah Gellman, President.

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APPENDIX C

BUSINESS CARDS :

DR. ISAIAH GELLMAN
PRESIDENT
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WEC World Environment Center

CHARLES JONG HWA HONG
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ncasi technical bulletin

NATIONAL COUNCIL OF THE PAPER INDUSTRY FOR AIR AND STREAM IMPROVEMENT, INC., 260 MADISON AVENUE, NEW YORK, N.Y. 10016

RESPONSE OF SELECTED PULP AND PAPER INDUSTRY SOLID WASTES TO THE RCRA TOXICITY CHARACTERISTIC LEACHING PROCEDURE (TCLP)

TECHNICAL BULLETIN NO. 587

MAY 1990

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May 7, 1990

Technical Bulletin No. 587

RESPONSE OF SELECTED PULP AND PAPER INDUSTRY SOLID WASTES TO THE RCRA TOXICITY CHARACTERISTIC LEACHING PROCEDURE (TCLP)

Since its inception, NCASI has devoted a considerable portion of its investigative program to characterizing the industry's wastes and emissions. Included in this activity has been a continuing program to characterize (a) the industry's solid wastes and (b) the potential environmental significance of the industry's solid waste management practices. An important element of this research has been the examination of the responses of industry wastes to test methods used to identify those wastes which, under the Resource Conservation and Recovery Act (RCRA), must be handled as hazardous wastes.

On March 29, 1990, EPA promulgated a new method for identifying hazardous wastes under RCRA's Toxicity Characteristic. This new Toxicity Characteristic Leaching Procedure (TCLP) is different from the previous Extraction Procedure primarily in that (a) a number of organic chemicals have been added to the Toxicity Characteristic, and (b) the testing methods have been modified to allow testing for these chemicals.

This technical bulletin contains the results of a research program designed to characterize the response of paper industry wastes to the TCLP. NCASI used the TCLP to examine twenty-five paper industry solid wastes collected at fifteen mills in seven different production categories. The solid wastes collected were (a)primary and combined wastewater treatment sludges, (b) various boiler ashes, and (c) causticizing wastes. None of the wastes exceeded or even approached the promulgated regulatory levels. Consequently, none of the wastes tested would be considered RCRA hazardous wastes under the Toxicity Characteristic rule promulgated on March 29, 1990.

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Intralaboratory repeatability of the TCLP was found to be about 7 percent relative standard deviation for volatile compounds and 17 percent for semivolatiles.

This technical bulletin was written by Jay Unwin, Regional Manager of NCASI's Central-Lakes States Regional Center. The required sample collection, by laboratory extraction work was done under the direction of Steven Norton, Research Assistant at the Central-Lake States Regional Center. Chemical analyses were performed at NCASI's West Coast Regional Center by Carol Standley under the direction of Gerald Dodo, Project Chemist and Larry LaFleur, Organic Chemical Analytical Program Manager.

Your questions or comments on this technical bulletin are welcome and should be directed to Jay Unwin, Central-Lake States Regional Manager, Western Michigan University, Kalamazoo, MI 49008-3844. [phone (616) 387-5128]

Very truly yours,

Isaiah Gellman
President

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RESPONSE OF SELECTED PULP AND PAPER INDUSTRY SOLID WASTES TO THE RCRA TOXICITY CHARACTERISTIC LEACHING PROCEDURE (TCLP)

TECHNICAL BULLETIN NO. 587
APRIL 1990

ABSTRACT: Twenty-five pulp industry solid wastes and leachates were collected from fifteen different mills representing seven different production subcategories. The solid wastes collected were primary and combined wastewater treatment sludges, various boiler ashes, and causticizing wastes. Each of these wastes was subjected to the RCRA Toxicity Characteristic Leaching Procedure (TCLP). The extracts were analyzed for selected organic compounds, both semivolatile and volatile, for which regulatory levels have either been proposed or promulgated.

No extract or leachate concentration exceeded any currently promulgated regulatory level. Most concentrations were less than one percent of the regulatory level. None exceeded twenty percent of the level.

Intralaboratory repeatability of the TCLP was found to be about 7 percent relative standard deviation for volatile compounds and 17 percent for semivolatiles.

KEYWORDS: RCRA, TCLP, toxicity characteristic, extraction, leachate, solid waste, hazardous waste

RELATED NCASI PUBLICATIONS:

"Response of Selected Paper Industry Sludges to Alternate Solid Waste Toxic Extraction Procedures," NCASI Stream Improvement Technical Bulletin No. 311 (May 1978).

"Nature and Environmental Behavior of Manufacturing-Derived Solid Wastes of Pulp and Paper Origin," NCASI Stream Improvement Technical Bulletin No. 319 (January 1979).

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RESPONSE OF SELECTED PULP AND PAPER INDUSTRY SOLID WASTES TO THE RCRA TOXICITY CHARACTERISTIC LEACHING PROCEDURE (TCLP)

I INTRODUCTION

Until recently, an integral part of the hazardous waste regulations has been the EP (extraction procedure) toxicity test method used to characterize a solid waste with regard to the RCRA toxicity characteristic. A solid waste that exhibited the characteristic of "EP toxicity" was declared a hazardous waste. Prior to the publication of final hazardous waste regulations on May 19, 1980, NCASI had investigated the EP and a number of other proposed alternative extraction procedures with regard to the likely response selected forest industry solid wastes would exhibit (1,2).

The list of analytes for the EP contains only a few organic compounds, primarily pesticides. In November of 1984, Congress passed the Hazardous and Solid Waste Amendments. Among other things, these amendments directed EPA to promulgate a new toxicity characteristic which would bring into the hazardous waste management system those wastes that were posing a potential threat due to their organic constituents. This required expanding the list of analytes and, if volatile organics were to be included, revision of the extraction procedure itself.

In April of 1985 EPA officially unveiled a new extraction procedure, the Toxicity Characteristic Leaching Procedure or TCLP, and declared its intention to replace the EP with the TCLP. On June 13, 1986 EPA published a proposal to change the existing hazardous waste rules to replace the EP test with the TCLP and to expand the number of chemicals to be analyzed in extracts from fourteen to fifty-two (3,4). The proposed additions were all organic compounds, both volatile and semivolatile.

On March 29, 1990, EPA published final rules (5) establishing regulatory levels for 39 compounds in TCLP extracts. It is noteworthy that many of the final regulatory levels are much higher than they were in the proposal. Thirteen of the proposed compounds were left out of the final rule due to "technical difficulties" in establishing appropriate regulatory levels for them.

Shortly after publication of the proposed rule, NCASI carried out preliminary experiments to help determine whether further studies of the TCLP as applied to industry solid wastes were warranted. By early 1987 it was clear that further work was justified.

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The design and results of the study that constituted that further work are presented in this technical bulletin.

A. Objectives

The primary objective of the study was to gain insight into the response that common types of industry solid wastes might exhibit when subjected to the TCLP. Secondary objectives were to examine (a) the ability of the TCLP to predict the composition of industry leachates, (b) the intralaboratory precision obtainable, and (c) the practical aspects of applying the procedure to typical industry solid wastes.

B. Scope

This study is not an exhaustive investigation of the response of industry solid wastes to the TCLP. Rather, it is intended as a screening study to give an indication of the kinds of results generally to be expected. Attempts have been made to examine waste materials from a broad range of production categories, but it is inevitable that wastes from some other facilities will yield results which fall outside of the range found in this study.

It would be imprudent for anyone to base decisions about the character of their own wastes solely on the information presented here. Either TCLP test results from the particular waste or other waste-specific information should be consulted before making any final decisions as to the character of any particular waste.

II REVIEW OF SELECTED LITERATURE

Although the following disucssion does not constitute a thorough review of the literature available on the TCLP, it does provide an overview of the kinds of studies that have been published.

A. Method Development

The TCLP was developed at the Oak Ridge National Laboratory under an EPA contract. Francis and Maskarinec (6) present the details of that development. It was a two-phase study. In the first phase, four different industrial wastes were leached with municipal solid waste leachate generated in field-scale lysimeters. The resulting solution was assumed to represent leachate that would result from co-disposal of municipal solid waste and each of the industrial wastes. Thirty-four different extraction procedures were then applied to the four industrial wastes. The artificial extracts thus obtained were compared to the previously obtained leachate-based extracts in order to examine the ability of the extraction procedures to reproduce

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"natural" leachates from codisposed industrial and municipal wastes. Two candidate methods were chosen: one was based on carbonic acid and the other was based on acetic acid.

The second phase of the study was similar to the first phase. Seven additional industrial wastes were examined using only the two candidate extraction procedures.

Statistical analysis of data from the eleven industrial wastes (none of which was of pulp and paper industry origin) lead to the conclusion that the acetic acid extraction most closely reproduced the leachate-based extracts. Thus, the TCLP is an acetic acid extraction procedure.

B. Method Evaluation

Taylor et al. (7) report on an EPA sponsored interlaboratory study of the method. Twenty-three laboratories participated in the study which concentrated on the metals and semivolatile compounds. Relative standard deviation (RSD) for the metals varied between 20 and 129 percent. For the semivolatile organic compounds the RSD varied between 24 and 156 percent. In preliminary results for volatile organic compounds the RSD varied between 17 and 152 percent. Recoveries of spiked compounds were generally "acceptable" within the definition of that term in the study. There was no statistical evidence of different results from the different laboratories. The authors conclude that "the TCLP can be applied consistently by a diverse group of organizations." No pulp and paper industry wastes were examined in this study.

An interlaboratory study (8) sponsored by a coalition of six trade associations involved six laboratories and 21 different wastes (none of pulp and paper industry origin). The study was designed to compare the TCLP and the EP, and also to estimate precision and reliability of the TCLP. It was found that the RSD for both the EP and the TCLP were similar (between 10 and 100 percent depending upon the waste type and parameter measured). The RSD for four volatile organics was between 24 and 78 percent. TCLP extract concentrations of metals were slightly higher than in EP extracts. Interlaboratory variability was found to be 1 to 20 times higher than intralaboratory variability for a variety of metals. It was noted that contaminants could carry over from one extraction to another when using the zero headspace extractor (ZHE) for volatiles.

Another interlaboratory study and a related review of a wider data base (9,10) compared the TCLP and the EP to evaluate the likely impact of the TCLP on the utility industry. The studies looked primarily at metals. The ratio of the TCLP metal concentration to the EP metal concentration was between 0.8 and 1.2 in 60 percent of the comparisons. The ratio was below 2 in 85 percent of the comparisons. The TCLP was found to have better

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reproducibility than the EP. The TCLP was judged easier to conduct and also less expensive than the EP.

Bricka et al. (11) conducted a study to compare the results of the TCLP with those of the EP. Two heavy metal synthetic wastes and a perchloroethylene still bottom waste were examined. Twelve volatile organic compounds were added to each waste type. The two heavy metal wastes were solidified/stabilized. The extracts were analyzed for a variety of metals and the twelve volatile organics. The results indicated that the two tests gave similar results for metals when TCLP extraction fluid 2 is used, but that the results differ when TCLP extraction fluid 1 is used (See p. 7 for discussion of extraction fluids.). The ratio of TCLP extract metal concentration to EP extract metal concentration varied from about 0.2 to more than 400, though it was generally under 5. The TCLP/EP ratio for volatile organics ranged between about 0.5 and 5 with most values below 2. Concentrations for six of the volatile organic compounds were significantly higher in the TCLP extract, but they were essentially equal or lower for the remaining volatile compounds. This result is particularly surprising since the EP incorporates no particular procedures to capture volatiles, while the TCLP incorporates elaborate and expensive features for that purpose. This study also indicated problems with contaminant carryover from the zero headspace extractor.

III MATERIALS AND METHODS

A. Solid Wastes

In order to accomplish the primary objective of the study, it was necessary to examine a broad range of solid wastes commonly generated in the pulp and paper industry and to collect such wastes from mills in every major production category. Table 1 summarizes the wastes and production categories from which samples of solid wastes and leachates were obtained.

A total of twenty-five solid wastes were subjected to the TCLP. Detailed descriptions of each waste, the mill at which it was collected and the analytical results are presented in Appendix A.

B. Sample Collection and Handling

Appendix B lists the sources for all equipment and supplies used for sample collection, handling, and extraction.

(1) Sample Containers - All sample containers used in this study were commercially precleaned glass vessels of various sizes and types with Teflon-lined caps. These were also occasionally used as transfer vessels. Any other transfer vessels or implements

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TABLE 1 SOLID WASTES EXAMINED

PROD. CATEGORY	NUMBER OF MILLS	PRIMARY SLUDGE	COMBINED SLUDGE	ASH	LIME MUD	DREGS	ALL WASTES
Bl. Kraft	7	2	6	4	3	1	16
UB Kraft	1		1			1	2
Semi-chem.	1	1					1
Sulfite	1		1				1
NI Fine	1		1				1
Deink Fine	2		2				2
Groundwood	1		1				1
WP Board	1	1					1
Totals	15	4	12	4	3	2	25

(spatulas, spoons) were detergent-washed and triple-rinsed with deionized water prior to each use.

(2) Solid Wastes - All solid wastes were collected as grab samples from as near the point of generation as possible. Sludges were collected immediately after dewatering. Ashes were taken from the ash collection device on the boiler. Causticizing wastes were collected at the point where they were ready for disposal.

Solid wastes were collected in wide-mouth brown glass quart bottles. No distinction was made between samples to be extracted for volatile organics and those to be extracted for semivolatiles. The sampling personnel wore latex surgical gloves.

Sample bottles were filled quickly and packed as full as possible, though it was usually not possible to exclude all headspace. Where possible, the sample was made up of small portions from throughout the mass at hand. For example, small portions were collected from along a mat of dewatered sludge or from various points in a pile. Samples from piles were taken from below the surface of the pile. Care was taken at all times to minimize exposure of the sample to the atmosphere and any sources of contamination.

All solid waste samples were stored on ice packs in insulated containers immediately after collection. Upon receipt in the laboratory (usually within 24 hours of collection), samples were transferred to refrigerated storage facilities. Wastes were usually extracted for volatiles within 72 hours of the time of collection. Extractions for semivolatiles were usually completed within 96 hours of sample collection.

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C. Extraction Procedure

The details of the TCLP as proposed at the time this research was carried out are given in Appendix C. The procedure as applied in this investigation conformed as closely to the proposed method as possible. The TCLP method promulgated on March 29, 1990 does not differ in any important respects (for these wastes) from that used in this study. Appendix B lists sources for equipment and supplies used in carrying out the extraction procedure.

(1) General - The TCLP is really two extraction procedures: one is for generation of extracts to be analyzed only for volatile organic compounds (VOC's) and the other is for generation of extracts to be analyzed for any other substances (semivolatile organics and metals). The major differences between the two kinds of extraction are the design of the extraction vessel and the mass of solid waste which is extracted.

The basic approach is to place a measured mass of solid waste (after initial filtration to remove and collect free liquid) in an extraction vessel with an acetic acid extraction fluid such that the liquid to solids mass ratio is 20:1.

The vessel is then agitated by turning end over end at about 30 rpm for 18 hours. At the end of that time the extraction fluid is separated from the solids remaining, combined with any liquid collected initially, and subjected to analysis.

(2) Extraction Vessels and Agitator - For extraction of semivolatile constituents the extraction vessel used was a 2.5-liter, wide-mouth (40 mm), screw capped glass bottle. The solid waste sample sizes for the semivolatiles extractions in this study were all within one percent of the target mass given in the procedure of 100 grams.

Extractions for volatile organic compounds were carried out in a specially designed "zero headspace extractor," or ZHE, which is intended to allow retention of volatile organic compounds in the extract during and after the extraction process. A schematic diagram of the ZHE is shown in Appendix C. Because of practical limitations on the size of the ZHE, the maximum mass of solids that can be extracted in it is 25 grams. By using a high capacity, high precision electronic balance, it was possible to adjust all solid waste masses to within 0.1 percent of the target mass of 25.0 grams.

The agitator was designed to accept either the glass vessels or ZHE's in any of six collars and rotate them end for end at approximately 30 rpm.

(3) Extraction Fluids - The proposed procedure specifies two different extraction fluids. Extraction fluid 1 is used for wastes of normal alkalinity (as determined in a screening procedure). Extraction fluid 2 is a stronger acid solution for use with highly alkaline wastes. The majority of the solid wastes

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examined in this study were extracted with the weaker acid extraction fluid. Comments in Appendix A indicate for which wastes extraction fluid 2 was used.

Extraction fluids were prepared on the day they were used. They were stored in covered glass reservoirs for the short time until they were used. Water used to make all extraction fluids was obtained from apparatus guaranteed to produce ASTM Type 1 water. The volume of fluid added to the extraction vessel was adjusted, based on the previously measured mass of the solid waste sample added to the vessel, to maintain exactly a 20:1 liquid to solids ratio.

(4) TCLP Extracts - Following extractions for semivolatile components, the contents of the glass extraction vessel were transferred to a pressure filtration unit from which the extract was expressed into a 5-pint glass bottle. The entire volume of extract that could be expressed was combined therein with any fluid that had been expressed from the solids during the initial filtration. The resulting mixture was transferred directly to 500-milliliter brown glass bottles and adjusted to pH 2 with 6M sulfuric acid before shipment to the analytical laboratory.

Extracts for volatile components were expressed directly (without atmospheric exposure) into Tedlar bags into which fluid from initial filtration of the waste had previously been expressed. Because of the design of the discharge valve on the bags, it was usually not possible to exclude all headspace from the bags. Typically, a small bubble remained after the bags had been filled. The bags containing the extract were stored under refrigeration until (within a few hours) the extract could be expressed from the bag into 20- milliliter, septum-lined screw cap vials for shipment to the analytical laboratory. Vials were filled by attaching a short Teflon tube to the bag discharge valve, extending the tube to the bottom of the vial and following the liquid surface from the bottom of the vial until it was overfilled. Vials were sealed without headspace. Tedlar bags were discarded after one use.

All extracts and blanks were shipped overnight to the analytical laboratory on ice packs in insulated containers.

(5) Miscellaneous - Pressure filtration operations other than those carried out inside the zero headspace extraction vessel were performed under "pre-purified" grade nitrogen gas in a stainless steel and Teflon pressure filtration apparatus. Filter media used for all pressure filtrations were the borosilicate glass fiber type obtained from the manufacturer suggested in the proposed method. Quantitative transfer of extraction fluid into the zero headspace extraction vessel under pressure was accomplished using a metering pump with stainless steel and Teflon wetted surfaces. Measurements of pH and temperature were

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accomplished using a digital electronic pH meter with a glass electrode and a laboratory mercury thermometer.

Mass measurement was somewhat of a problem because the proposed method requires use of a balance accurate to ±0.01 grams. Some measurements must be made on the mass of solid waste as it resides within the zero headspace extraction vessel which has a mass of about 7200 grams. Therefore, to obtain the required accuracy, mass was measured with the only top-loading balance available on the market at the time that could provide the required accuracy in the range of 7200 grams.

(6) Quality Assurance Procedures - Because one objective of the investigation was to examine the response of wastes to the TCLP as it would normally be applied, every attempt was made to conform to the QA/QC guidelines published in the proposed method. Extraction method blanks were performed on extraction vessels on or before their tenth use, as specified in the proposed procedure. These blanks were conducted exactly like a normal extraction except that no solid waste was added to the extraction vessel. Extraction blanks for the semivolatiles (glass) vessels sometimes were not filtered in order to provide a check on the extraction vessel itself instead of the extraction vessel and the pressure filtration unit together. After noting that extracts from certain solid wastes were at pH 11 or higher, it was decided that one method blank should be run with a water solution adjusted to a pH of 12 with sodium hydroxide. This blank was run in a ZHE chosen at random. Extraction fluid blanks were collected from every batch of extraction fluid.

Each extraction (except method blanks) was performed in triplicate. That is, every solid waste collected was subjected to three extractions for volatiles and three extractions for semivolatiles. These replicate extractions were performed on aliquots of a single solid waste sample. Replicate solid waste sampling was not done.

Triplicate extractions were done, in part, to assist in defining the intralaboratory precision of the method and in part to ensure the method was being applied in a consistent manner to all samples. At least one replicate was analyzed for each waste. The analytical laboratory chose at random about 10 percent of the wastes for which to perform analyses on all three replicates.

Extraction vessels were disassembled after each use and cleaned according to the manufacturer's instructions which called for thorough cleaning with water and detergent, tap water rinse, triple deionized water rinse, and air drying.

After cleaning, zero headspace extractors were reassembled, pressurized to 50 psi, and inspected after one hour. If any pressure loss was detected, all o-rings were replaced.

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Extractors were not used until their gas-tight integrity had been ensured in this way.

D. Extract and Leachate Analysis

(1) Compounds Analyzed - Tables 2 and 3 list the compounds analyzed in the TCLP extracts, leachates, and blanks. No metals were included in this study because earlier studies (1,2) had indicated that EP extracts of these wastes would contain metal concentrations far below the regulatory levels and a review of the literature indicated that any increase caused by use of the TCLP would be unlikely to cause those limits to be approached.

TABLE 2 TCLP STUDY VOLATILE ORGANIC ANALYTES

(All concentrations expressed as ppb)

	LOQ	REGULATORY LEVEL
Chloroform	10	6,000
Carbon Tetrachloride	20	500
1,2-Dichloroethane	20	500
1,1,1-Trichloroethane	20	-
1,1,2-Trichloroethane	20	-
1,1,1,2-Tetrachloroethane	100	-
1,1,2,2-Tetrachloroethane	20	-
1,1-Dichloroethylene	20	700
Trichloroethylene	20	500
Chlorobenzene	20	100,000
Benzene	20	500
Methyl ethyl ketone	100	200,000
Toluene	20	-

TABLE 3 TCLP STUDY SEMI-VOLATILE ORGANIC ANALYTES

(All concentrations expressed as ppb)

	LOQ	REGULATORY LEVEL
Phenol	1.5	-
o-Cresol	1.4	200,000
m-Cresol	1.6	200,000
p-Cresol	3.1	200,000
2,4,5-Trichlorophenol	2.1	400,000
2,4,6-Trichlorophenol	1.6	2,000
2,3,4,6-Tetrachlorophenol	1.4	-
Pentachlorophenol	2.2	100,000

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Because all the matrices analyzed were very similar, analytical limits of quantitation (LOQ) for each compound were the same for all analyses. The LOQ for each compound is listed in the table.

Regulatory levels listed are those promulgated in the final rule (6). Compounds for which no regulatory levels are given are those which were proposed for inclusion on the list of analytes but which were not included in the final rule.

(2) Analytical Methods - All the volatile organic compounds, with the exception of methyl ethyl ketone, were analyzed by EPA Method SW846-8240 (12). Methyl ethyl ketone was analyzed by EPA Method 1624 Rev. B (13). Both these methods are based on purge and trap followed by gas chromatography and mass spectrometer detection (GC-MS). Method 1624, which is published by EPA's Office of Water, further incorporates isotopic dilution into the method for quantitation.

The chlorinated phenols were analyzed by NCASI Method CP 85.01 published elsewhere (14)

Phenol and the cresols were analyzed using a screening level procedure. In this procedure, 2-ethyl phenol and 4-isopropyl phenol were added to the samples as internal standards. The samples were then buffered to a pH of 9.9. Pentafluorobenzoyl chloride and hexane were added and the pentafluorobenzoyl esters of the phenols were formed in situ and were concurrently extracted. These extracts were then washed to remove interferences and/or unreacted pentafluorobenzoyl chloride and then they were analyzed by capillary chromatography using a 30 M DB-5 column and electron capture detection. Quantitation was based upon the internal standard technique using calibration standards prepared by in situ derivitization exactly as was done for samples.

This procedure was highly sensitive and convenient for screening for the presence of the analytes. However, the procedure was more prone to false positives due to interferences that elute at the retention times of the analytes. Where analytes were detected, an additional aliquot of the sample was analyzed using a modification of EPA Method 1625 Rev. B (15), with phenol and p-cresol quantitated using the isotopic dilution procedure and all other analytes by the internal standard procedure.

IV RESULTS AND DISCUSSION

A. Extract Analyses

The results from analyses of TCLP extracts are summarized in Tables 4 through 10 below. These tables are summaries which do

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not present individual results from each waste. The tables are arranged by waste type. All concentrations are reported in parts per billion (ppb). Individual results, organized by mill, are reported in Appendix A.

Since all limits of quantitation are quite low and far below the EPA regulatory levels, compounds which were not present at concentrations greater than or equal to the LOQ are reported throughout this technical bulletin as not detected, ND.

Many of the analytes were not detected in any of the extracts or leachates. Results are reported only for those compounds that were detected in one or more of the extracts covered by the particular table. Median values reported were calculated assuming that compounds not detected were present at the limit of quantitation. Since this was probably not always true, median values are probably overstated in some instances. Therefore, medians which were calculated using any ND values are presented as being less than or equal to the calculated median.

Similarly, some individual results are reported as the mean of the analyses of three replicate extracts. In some instances, the analyte was detected in one or two of the extracts, but not in the others. Mean values are calculated from such data assuming that compounds not detected were present at the limit of quantitation, and they are reported as less than or equal to the calculated mean.

(1) Sludges - Table 4 presents a summary of results for primary sludges extracts. None of the values reported exceeds or even approaches the regulatory level.

Table 5 presents a summary of results for combined sludges. The compounds detected in the combined sludge extracts are the same as for the primary sludge extracts with the addition of methyl ethyl ketone for two of the sludges. Again, none of the concentrations approaches the regulatory levels. However, the levels seem to be slightly higher for the combined sludges than the primary sludges.

Because combined sludges were collected from most of the production categories, it is possible to break down the results by production category. This is done in Table 6. (See page 13.) The most noteworthy aspect of this table is the number of ND's. This is even more noticeable in the individual results in Appendix A. As might be expected, the bleaching subcategories show the presence of chlorinated organics, albeit at concentrations far below the regulatory levels. The only compounds detected in extracts from the other subcategories are phenolics.

(2) Leachates - Table 7 summarizes the analytical results for leachates. These leachates were not filtered prior to

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TABLE 4 ANALYSES OF TCLP EXTRACTS FROM PRIMARY SLUDGES

Number of samples extracted = 4
(All concentrations expressed as ppb)

ANALYTE	NUMBER ≥LOQ	LOWEST	HIGHEST	MEDIAN
Chloroform	2	ND	60.6*	≤10
2,4,6-Trichlorophenol	1	ND	2.0	≤1.6
Phenol	4	32.8	119	40.4
o-Cresol	1	ND	≤1.5*	≤1.4
p-Cresol	2	ND	5.2	≤3.7

* average of three replicate extractions

TABLE 5 ANALYSES OF TCLP EXTRACTS FROM COMBINED SLUDGES

Number of samples extracted = 12
(All concentrations expressed as ppb)

ANALYTE	NUMBER ≥ LOQ	LOWEST	HIGHEST	MEDIAN
Chloroform	7	ND	287*	≤23.2
Methyl ethyl ketone	2	ND	415*	≤100
2,4,6-Trichlorophenol	4	ND	23.0*	≤1.6
Phenol	12	7.4	139*	26
o-Cresol	1	ND	≤3.8*	≤1.4
p-Cresol	5	ND	6.4*	≤3.1

* Average of three replicate extractions

TABLE 7 ANALYSES OF LEACHATES

Number of samples = 6
(All concentrations expressed as ppb)

ANALYTE	NUMBER ≥ LOQ	LOWEST	HIGHEST	MEDIAN
Methyl ethyl ketone	3	ND	1521	≤240
Toluene	2	ND	271.6	≤20
2,4,5-Trichlorophenol	1	ND	29.8	≤2.1
2,4,6-Trichlorophenol	1	ND	13.4	≤1.6
Phenol	6	21.1	32200	87.9
o-Cresol	4	ND	360	≤14.6
m-Cresol	3	ND	290	≤2.0
p-Cresol	5	ND	9240	≤521

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TABLE 6 COMBINED SLUDGE TCLP EXTRACT ANALYSES BY PRODUCTION CATEGORY

(All concentrations expressed as ppb)

ANALYTE	BLEACHED KRAFT (6) NBR ≥LOQ	Low	High	Med.	UB KRAFT (1)	SULFITE (1)	NI FINE (1)	DEINK (2)	GRWOOD (1)
Chloroform	5	ND	163	≤46.1	ND	114.3	ND	ND, 287*	ND
Methyl ethyl ketone	2	ND	415*	≤100	ND	ND	ND	ND, ND	ND
2,4,6-Tri-chlorophenol	1	ND	6.9*	≤1.6	ND	14.6*	ND	11.8, 23.0*	ND
Phenol	6	7.4	139*	41.7	9.1*	ND	18.1	8.6, 24.3	37.2
o-Cresol	2	ND	≤3.8*	≤1.4	ND	ND	ND	ND, ND	ND
p-Cresol	3	ND	6.3	≤3.1	6.4*	ND	ND	ND, ND	ND

* Average from three replicate extractions

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analysis, so they are not, strictly speaking, TCLP extracts. However, most leachates were quite low in suspended solids so these results can be taken as indicative of what might be expected from leachates.

None of the detected compounds exceeds any of the present regulatory levels. However, the highest phenol concentration observed was above the originally proposed (but not promulgated) regulatory level of 14.4 mg/L. All of the other leachates examined had phenol concentrations that were much lower.

TCLP extracts are intended to represent the leachate that would be generated in a particular scenario of codisposal of the sludge with municipal waste. The primary purpose for collecting leachate samples in this research was to allow comparison of actual leachates with the hypothetical leachates generated from the same solid waste. This comparison is presented in Table 8. For purposes of clarity, in those instances where a compound was detected in neither the sludge extract nor the leachate, no results are reported.

Aside from the large number of instances in which compounds were detected in neither the extract nor the leachate, there is little apparent similarity in composition between the TCLP extracts and the actual leachates generated in the sludge landfills. For example, chloroform was detected in several extracts, but not in a single leachate. Toluene was detected in two of the leachates, but in neither of the corresponding extracts. Based on these data, the TCLP would appear to be a poor predictor of the quality of leachates from sludge landfills of the type examined in this study.

(3) Causticizing Wastes - Analytical results for extracts from lime mud and green liquor dregs are presented in Table 9. Since there were so few determinations above the limit of quantitation, individual results are presented rather than the ranges and medians presented in the previous tables.

(4) Ash - Analytical results for extracts from ash samples are presented in Table 10. Since there were so few determinations above the limit of quantitation, individual results are presented.

B. Practical Aspects of the TCLP

Overall, the TCLP is more convenient to run than the EP. This is primarily because pH adjustment is not required with the TCLP and because the shorter extraction time coordinates with normal working hours.

The major difficulty encountered was with breakage of the glass extraction vessels (one exploded rather violently). Regular venting of the vessels during extractions did not always

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TABLE 8 COMPARISON OF SLUDGE TCLP EXTRACT AND LANDFILL LEACHATE ANALYSES

(All concentrations expressed as ppb)

ANALYTE	MILL A		MILL B		MILL C		MILL D		MILL E		MILL F	
	Sludge	Leach.	Sludge	Leach.	Sludge	Leach.	Sludge	Leach.	Sludge	Leach.	Sludge	Leach
Chloroform	163.2	ND	20.3	ND	39.9	ND	48.5*	ND			114.3	ND
Methyl ethyl ketone	ND	ND	ND	380.3	357.3	ND	415.3*	ND	93.1*	2617	ND	1521
Toluene	ND	ND	ND	153.3					ND	271.6		
2,4,5-Tri-chlorophenol											ND	29.8
2,4,6-Tri-chlorophenol							6.9*	ND			14.6*	13.4
Phenol	56.4	34.1	10.2	254	72.3*	21.1	139*	25.8	26.9	150	59.0	3220
o-Cresol			ND	221	≤3.8*	ND			ND	26.5	ND	360
m-Cresol			ND	290					ND	65.2		
p-Cresol	ND	63.2	ND	979	≤4.2*	ND	3.5*	17.6	6.3	2600	ND	9240

*Average from three replicate extractions

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TABLE 9 ANALYSES OF TCLP EXTRACTS FROM LIME MUD AND DREGS

Number of samples extracted = 3 lime mud, 2 dregs
(All concentrations expressed as ppb)

ANALYTE	LIME MUD	DREGS
Phenol	5.6, 5.5, 35.5*	3.2, 9.5

* Average of three replicate extractions

TABLE 10 ANALYSES TCLP EXTRACTS FROM ASH

Number of samples extracted = 4
(All concentrations expressed as ppb)

ANALYTE	
Phenol	2.7, 18.7*, 21.9, 29.2

* Average of three replicate extractions

prevent breakage. Precautions should be taken to prevent damage or injuries in the event one of these vessels should break.

The only other significant problem was occasional blowout of the filter within the ZHE. The guidance given in the procedure for managing this problem is of little help because it requires that the failure be anticipated. Other than this problem, the particular ZHE's used worked quite well for the wastes examined.

Finally, it was troubling that headspace could not always be excluded during sampling or during handling of extracts. Sample collection and handling procedures need improvement in this regard.

It is noteworthy that there was no apparent difficulty with contaminant carryover in the ZHE's. None of the ZHE extraction blanks indicated this was a problem, and there is no apparent bias in the data that would point to contaminant carryover.

C. Intralaboratory Precision

Intralaboratory precision is, as evaluated in this study, a measure of both the repeatability of the extraction procedure and the analytical methods used. This study was not designed to allow the separate evaluation of the two sources of variability. Both will always be present, so it is appropriate to evaluate the

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overall results without separating out the component variabilities.

A potential source of variability present in this study that may not be typical is the effect of extract shipment to the analytical laboratory. Contract or in-house laboratories may have extraction and analytical facilities housed together. It is also possible, despite efforts to minimize the effect, that in the research environment in which this study was conducted, the procedures and practices which make up the method were better thought-out and executed than they would be in a "production" mode of operation. These factors conspire to make the evaluation of intralaboratory precision in this study difficult to extrapolate to what may be obtained under different conditions. The evaluation presented here should be considered only as an example of what might be obtained under roughly similar conditions.

Evaluation of the intralaboratory precision is done by examining the results of those extractions in which all three replicates were extracted. Analytical results below the limit of quantitation (ND) are not included in evaluation of precision because there is no valid way to estimate the variability of such measurements. Censoring of the data set in this way probably biases the estimate of precision, but neither the direction nor the magnitude of such bias can be determined without knowledge of the variance structure of the ND measurements.

Of 1662 individual determinations of compound concentrations in solid waste extracts in this study, 979 (about 59 percent) were done on replicate extracts. Of the 979 replicate analyses obtained, however, 895 were from analyses in which one or more of the triplicates was "ND". Of the 84 analyses for which complete data were obtained, 21 analyses (7 sets of triplicates) were from 2 different volatile compounds and 63 analyses (21 sets of triplicates) were from 13 different semivolatile compounds. The 21 volatiles analyses were performed on 6 different extracts. The 63 semivolatiles analyses were performed on 10 different extracts. Thus, judgements of intralaboratory precision in this study are based 6 and 10 different extractions for volatile and semivolatile extraction procedures, respectively. Appendix D summarizes the data used to compute intralaboratory precision.

Table 11 summarizes the intralaboratory precision for each of the extraction procedures. Precision is presented as the relative standard deviation (RSD) expressed as a percent. RSD is the ratio of the standard deviation to the mean.

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TABLE 11 INTRALABORATORY PRECISION

PROCEDURE	NUMBER OF ANALYSES	NUMBER OF COMPOUNDS	NUMBER OF EXTRACTS	PRECISION AS %RSD
Volatiles	21	2	6	7.0
Semivolatiles	63	13	10	17.3

V SUMMARY AND CONCLUSIONS

This technical bulletin presents the design and results of a screening study to examine the response of pulp and paper industry solid wastes to the Toxicity Characteristic Leaching Procedure, TCLP. Twenty-five wastes, including six leachates, from eight different production categories were examined.

The major finding is that none of the extracts or leachates contained levels of substances even approaching currently promulgated regulatory levels that would cause them to be considered hazardous due to the toxicity characteristic. Most concentrations were less than one percent of the regulatory level. For the solid waste extracts, the closest approach to a regulatory level was for chloroform in a combined sludge extract which reached 4.7 percent of the regulatory level. For the leachates, the closest approach was for p-cresol which reached 4.6 percent of the regulatory level.

It was found that extracts and leachates from production categories involving bleaching tended to contain trace amounts of chlorinated organic compounds whereas those from the other production categories contained primarily traces of phenolic compounds. Concentrations in secondary sludge extracts appeared to be slightly higher than in extracts from primary sludges.

It was found that TCLP extracts were poor predictors of the quality of sludge landfill leachates examined in this study.

The method was found to be reasonably easy to conduct. The only significant problem encountered was with breakage of the glass extraction vessels.

The intralaboratory precision, expressed as relative standard deviation, for volatile organic compounds in extracts was 7.0 percent. For semivolatile compounds the RSD was 17.3 percent.

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EASTOVER

EASTOVER MILL FACT SHEET

UNION CAMP CORPORATION
FINE PAPER DIVISION
EASTOVER, SOUTH CAROLINA

EO I PAPER MACHINE

- Medium Weight Fine Paper (46-55 Basis Weight)
- Design Rate: 600 TPD
- Phase II Rebuild Design Rate: 800 TPD
- Equipment:

  Voith Duofomer Twin Wire Paper Machine

  372 Inches Wide

  3000 FPM Maximum Speed
- Start-Up: 8/84

EO II PAPER MACHINE

- Light Weight Fine Paper (35-46 Basis Weight)
- Design Rate: 660 TPD
- Equipment:

  Beloit Bel Baie III Paper Machine

  372 Inches Wide

  4400 FPM Maximum Speed
- Start-Up: 7/91

PULP MACHINE

- Bleached Kraft Pulp

  Softwood Pulp - EASTOCELL
  Hardwood Pulp
- Design Rate: 500 TPD
- Equipment:

  Valmet-Ahlstrom Wet End

  192 Inches Wide

  215 FPM Maximum Speed

  Flakt Compact Dryer

  Lamb Cutter Layboy and Bale Line
- Start-Up: 4/91

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SVH (7/1/91)

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UNION CAMP CORPORATION
ENVIRONMENTAL, HEALTH, SAFETY AND FORESTRY PRINCIPLES

TO MAKE ENVIRONMENTAL, HEALTH, AND SAFETY CONSIDERATIONS PRIORITIES IN OPERATING EXISTING FACILITIES, AS WELL AS IN PLANNING NEW OPERATIONS.

TO RECOGNIZE ENVIRONMENTAL, HEALTH, AND SAFETY EFFECTS OF PRODUCT MANUFACTURE, DISTRIBUTION, USE, AND DISPOSAL.

TO MONITOR ENVIRONMENTAL, HEALTH, AND SAFETY PERFORMANCE AND TO REPORT REGULARLY ON THESE MATTERS TO THE BOARD OF DIRECTORS.

TO TRAIN EMPLOYEES AND TO PROMOTE AWARENESS AND ACCOUNTABILITY ON THESE MATTERS.

TO IMPROVE PERFORMANCE THROUGH SUPPORT OF RESEARCH AND DEVELOPMENT.

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ENVIRONMENTAL, HEALTH, SAFETY, AND FORESTRY (CONT)

- TO COMMUNICATE WITH EMPLOYEES, CUSTOMERS, SUPPLIERS, THE COMMUNITY, PUBLIC OFFICIALS, AND SHAREHOLDERS.

- TO PARTICIPATE CONSTRUCTIVELY IN THE DEVELOPMENT OF PUBLIC POLICIES.

- TO CONTINUE TO PURSUE ENERGY CONSERVATION.

- TO PRACTICE A LAND STEWARDSHIP ETHIC THAT RECOGNIZES THE IMPORTANCE OF SOIL CONSERVATION, AIR AND WATER QUALITY, WILDLIFE AND FISH HABITAT, AND AESTHETICS.

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THE ROAD TO SUCCESS

- Well Prepared Applications
- Productive Dialogue with DHEC
- Valuable Public Input
- Commitment to Permit Limits
- Honor Those Commitments
- Open & Ongoing Communications with Neighbors
- Proven Environmental Record

DEVELOP AND MAINTAIN A

HIGH ENVIRONMENTAL ETHIC

EFFLUENT TREATMENT

REGULATED POLLUTANTS

- ORGANIC MATTER (BOD)
- SOLIDS (TSS)
- NUTRIENTS
- COLOR x

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IN PLANT CONTROLS

SEGREGATED SEWERS

- PROCESS (SOLIDS)
- BLEACH PLANT (ACID)

SPILL CONTROL

- OIL STORAGE DIKING
- PAVING + CURBING
- SPILL RECOVERY

SYSTEM PERFORMANCE

BODs

PROCESS SEWER → CLARIFIER →
40,000 #/DAY 75 %

BLEACH PLANT SEWER →
40,000 #/DAY

→ ASB'S
95 %

= 2500 #/DAY FINAL EFFLUENT

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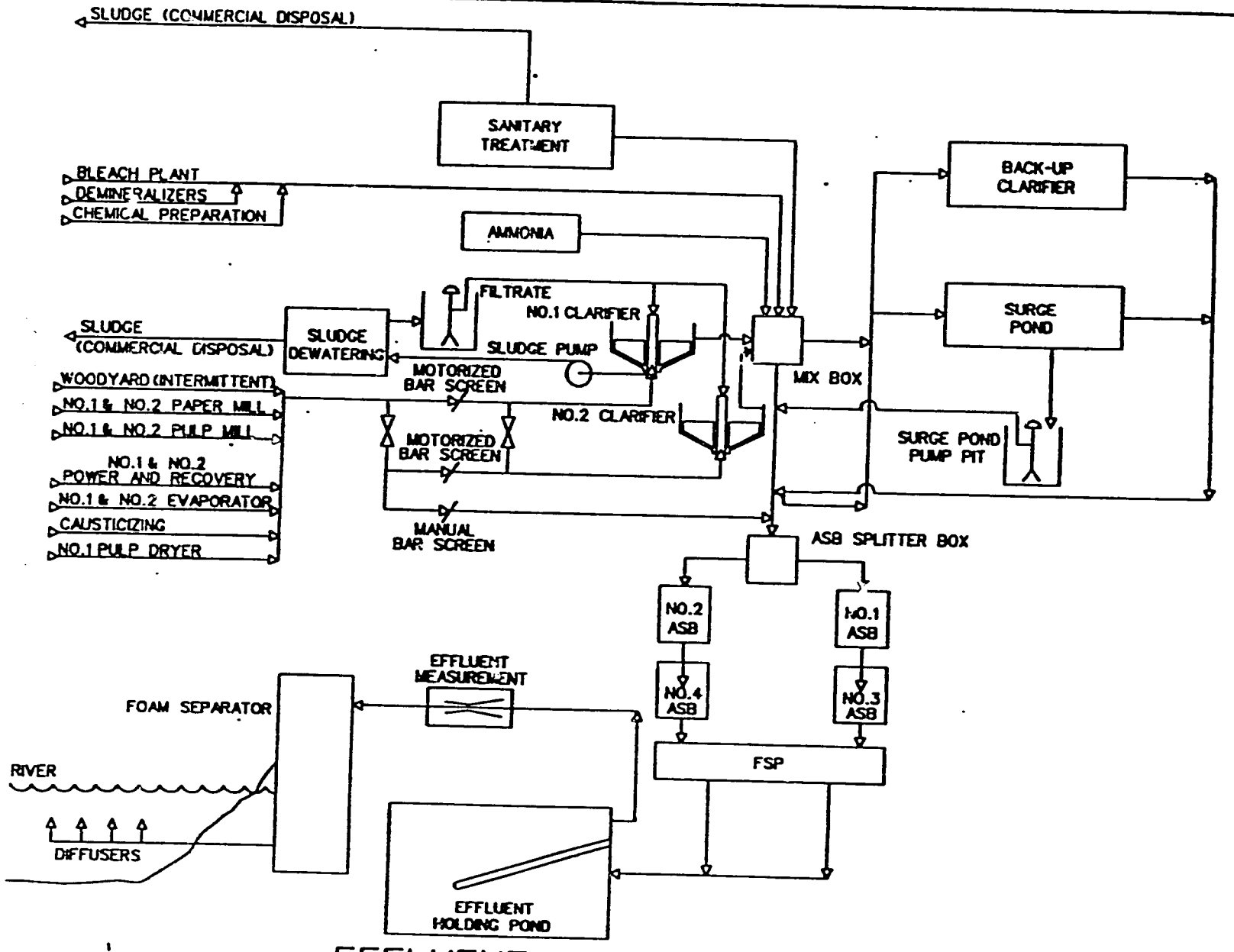

EFFLUENT TREATMENT SYSTEM

FIGURE VI - 1

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AIR POLLUTION CONTROL

REGULATED POLLUTANTS

- PARTICULATE
- SULFUR DIOXIDE
- NITROGEN OXIDES
- TOTAL REDUCED SULFUR
- "AIR TOXICS"

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Pollutant	Source	Control
• Particulate	• Recovery Furnace	• Precipitator
	• Power Boiler	"
	• Lime Kiln	"
• SO_2	• Power Boiler	• Low Sulfur Fuel
	• NCG Incinerator	• Scrubber
• NO_x	• Power Boiler	• Burner Design
• TRS	• Pulp Mill	• Incineration
• Chlorine	• Bleach Plant	• Scrubber

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PRECIPITATOR DESIGN

EXAMPLE: NO. 1 POWER BOILER

COMB. FUEL: COAL, OIL, BARK

500×10^6 BTU / HR

200,000 ACFM @ 350°F

DESIGN

- DUAL CHAMBER
- 4 MECHANICAL, 4 ELECTRICAL FIELDS / SIDE
- 120,000 SQ. FT. COLLECTION AREA

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PRECIPITATOR DESIGN

EXAMPLE: NO. 1 RECOVERY FURNACE

2.4×10^6 #/DAY BLS

300,000 ACFM @ 390°F

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DESIGN

- DUAL CHAMBER
- 4 MECHANICAL, 8 ELECTRICAL FIELDS / SIDE
- 150,000 SQ. FT COLLECTION AREA

SCRUBBER APPLICATIONS

SOURCE	POLLUTANT	TYPE
• BLEACH PLANT	CHLORINE	PACKED COLUMN
• NCG INCINERATOR	SO_2	"
• LIME KILN	PARTICULATE	VENTURI
• SMELT DISSOLVING TANK	PARTICULATE & TRS	DYNAMIC FAN

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ODOROUS GAS
NON-CONDENSIBLE (NCG) GAS
TOTAL REDUCED SULFUR (TRS) GAS

- Hydrogen Sulfide H_2S
- Methyl Mercaptan CH_3SH
- Dimethyl Sulfide $(CH_3)_2S$
- Dimethyl Disulfide $(CH_3)_2S_2$

Major Combustible Components

- Turpentine
- Methanol

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EASTOVER MILL ODOR CONTROL SYSTEM

DESIGN CRITERIA

- Safety
- Comply with All Regulations
- Minimize Off-Site Odor
- SO_2 Emission Reduction
- Sulfur Recovery
- Anticipate Future Requirements

SOURCES

Chip Bins

Steaming Vessels

Flash Tanks

Blow Tanks

Brown Stock Washers

Filtrate Tanks

Knotters

Knot Conveyors

Evaporator Condensers

Black Liquor Tanks

Foul Condensate Tanks

Salt Cake Mix Tanks

Foam Tanks

Soap Tanks

Acid Wash Tanks

Lime Mud Pressure Filters

White Liquor Pressure Filters

Rejects System

Turpentine Tanks

Stripper Off Gas

CHARACTERISTICS OF SOURCES

1. Above or Below Explosive Limits?

2. High or Low Volume?

- Below LEL —> Dilute System
- Above UEL —> Concentrated System
- Treat / Redesign Other Sources

INCINERATION DEVICES

- Stand Alone Incinerators
- Power Boilers
- Lime Kilns / Calciners
- Recovery Furnaces
- Flares

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PRIME MOVERS

- Steam Eductors
- Centrifugal Fans
- Liquid Ring Compressors

DILUTE NCG SYSTEM

Design Basis:
System < 25% LEL, No Individual Source Can Be > 50% LEL

Sources	Prime Mover	Incineration Device
Chip Bin *	Fan With Spare	No. 1 Power Boiler
Blow Tank *		or
Brown Stock Washers		No. 2 Power Boiler
Black Liquor Foam Tanks		
Knotters / Conveyors		
Foul Condensate Tanks		
Pressure Filters		
Miscellaneous Sources		

Total 20,000 ACFM

CONCENTRATED NCG SYSTEM

Design Basis:
All Sources Must be > UEL, Maintain High Velocities

Sources	Prime Mover	Incineration Device
Steaming Vessel *	Steam Eductor	Stand-Alone Incinerator With SO_2 Scrubber
Flash Tanks *		or
Evaporator Condensers		No. 2 Power Boiler (Back-Up)
Stripper Feed Tank		
Turpentine Tanks		
Total 800 ACFM		

STRIPPER OFF GAS

Design Basis:
BOD and TRS Removal, Provide Commercial Grade Liquid Fuel

Sources	Prime Mover	Disposition
Stripping Columns	System Pressure	Rectification Column or Stand-Alone Incinerator (Back-Up)

"SWEAT THE DETAILS"

- Materials of Construction
- Condensate Removal
- Flame Arresters
- Rupture Discs
- Vent Locations
- Electrical Grounding
- LEL Meter
- Explosion Suppression System
- Ambient Monitors
- Control System Interlocks

SOLID WASTE

MAJOR STREAMS

- PRIMARY CLARIFIER SLUDGE
- POWER BOILER FLY ASH
- RECAUSTICIZING GRITS & DREGS
- PULP MILL KNOTS & REJECTS

HAZARDOUS WASTE

CLASSIFICATION

LISTED

- PURE
- UNUSED
- FUNCTION
- APPLICATION

pages of specific chemical

CHARACTERISTIC

- CORROSIVITY aqueous 2 > pH > 12.5
- REACTIVITY sulfide bearing
- IGNITABILITY flashpoint < 140°F
- TOXICITY TCLP

nitrogen
infectious

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HAZ. WASTE MANAGEMENT

GENERATOR RESPONSIBILIM

- GENERATION
- TRANSPORTATION
- STORAGE
- TREATMENT
- DISPOSAL

} MANIFEST SYSTEM

[illegible] Emergency Response [illegible] for [illegible]
[illegible]

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POTENTIAL WATER & EFFLUENT BENEFITS

Using OZED Bleaching

Estimated Values for a Typical Plant

	CEDED	O(CD)ED	OZED
Bleach plant Water Use	**47.5**	**15.8 ***	**13.7 ***
Bleach Plant Effluent	**55.4**	**14.2**	**7.5**

M^3/A.D.Metric Ton

* Some water is recycle therefore savings may vary

OUTLINE
C-Free™ TALK FOR INDONESIAN VISITORS
to EASTOVER MILL OCTOBER 29th

I. UNION CAMP BLEACHING DEVELOPMENT
- MOTIVATING FACTORS AND TECHNOLOGY ADVANCEMENT
- BLEACH PLANT CLOSURE
- BLEACHING SEQUENCE DEVELOPED
- BLEACH PLANT CONTRIBUTION TO EFFLUENT

II. FULL SCALE COMMERCIAL OPERATION
- FRANKLIN START-UP EXPERIENCE
- FIBER QUALITY PERFORMANCE
- OPERATING EFFECTIVENESS

III. ENVIRONMENTAL ANALYSIS
- POTENTIAL EFFLUENT LOAD REDUCTIONS
- ACTUAL MILL PERFORMANCE AT FRANKLIN
- PROJECTED PERFORMANCE ON OTHER SPECIES
- ENVIRONMENTAL IMPACT OF C-Free™

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C-Free™ PULP DEVELOPMENT

UNION CAMP - ENVIRONMENTAL AWARENESS

FRANKLIN MILL - SMALL LOW-FLOW RIVER

EASTOVER MILL - GREENFIELD MILL STANDARDS

DEMONSTRATED DEVELOPMENT EFFORTS

MANY YEARS OF INTENSE BLEACHING RESEARCH

AMONG FIRST COUNTER CURRENT BLEACHING IN USA

ONE OF FIRST USING O2 BLEACHING WITH RECYCLE

HIGH CONSISTENCY O2BLEACHING FOR MAXIMUM CLOSURE

$4.5MM+ PILOT PLANT INVESTMENT AND
CONTINUING COMMITMENT ($1.5MM EXPANSION)

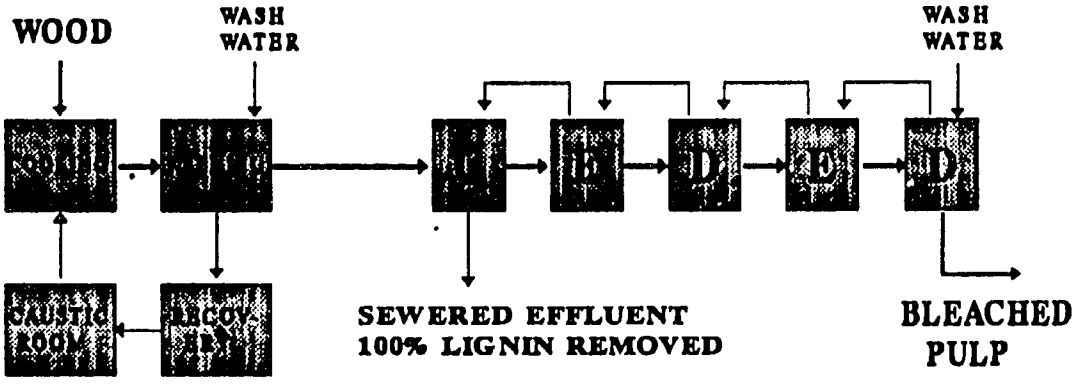
FULL SCALE REACTOR SIMULATION AND PROCESS MODELING

$100MM FULL SCALE 1000 TPD OZONE BLEACH PLANT

ESTABLISHED UNION CAMP TECHNOLOGY

MARKETING ARRANGEMENT WITH SUNDS DEFIBRATOR

Conventional CEDED



PROBLEMS: HIGH WATER USE AND SEWER FLOW

ALL BLEACHED CHEMICALS AND ORGANICS MUST BE SEWERED
HIGH BOD, COD AND COLOR

USE OF CHLORINE PRODUCES CHLORINATED ORGANICS
DIOXIN, TOCl, AOX AND CHLOROFORM

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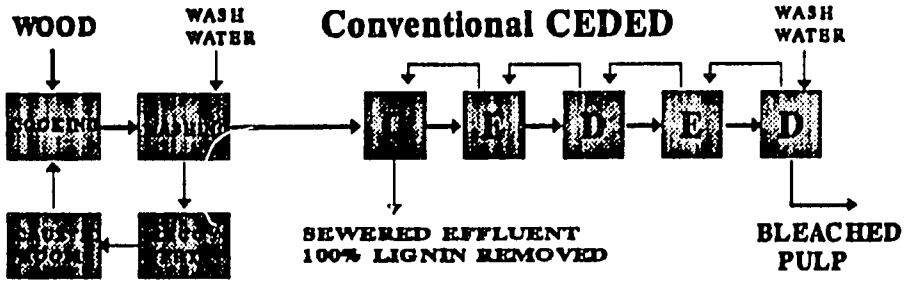
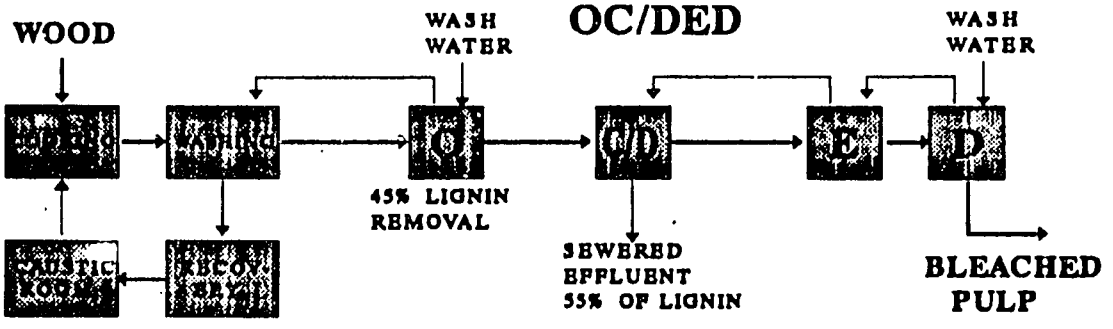
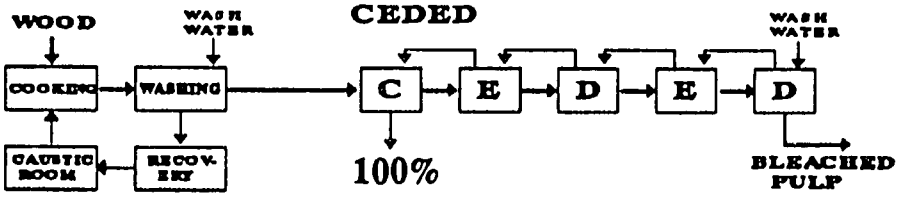
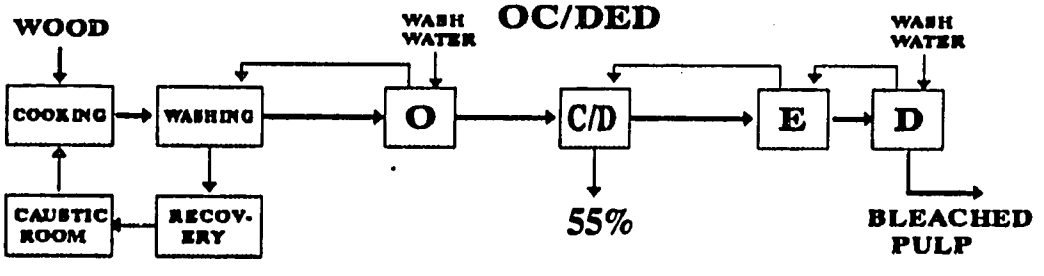


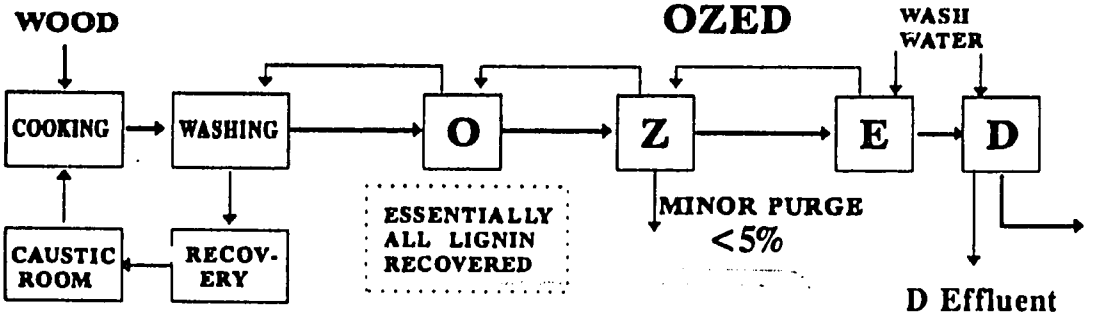


PROBLEMS: STILL A HIGH PERCENTAGE OF ORGANICS AND BLEACHING CHEMICALS SENT TO THE SEWER WITH HIGH BOD, AND COLOR.

CHLORINE STILL USED; SIZABLE AMOUNTS OF CHLORINATED ORGANICS PRODUCED.







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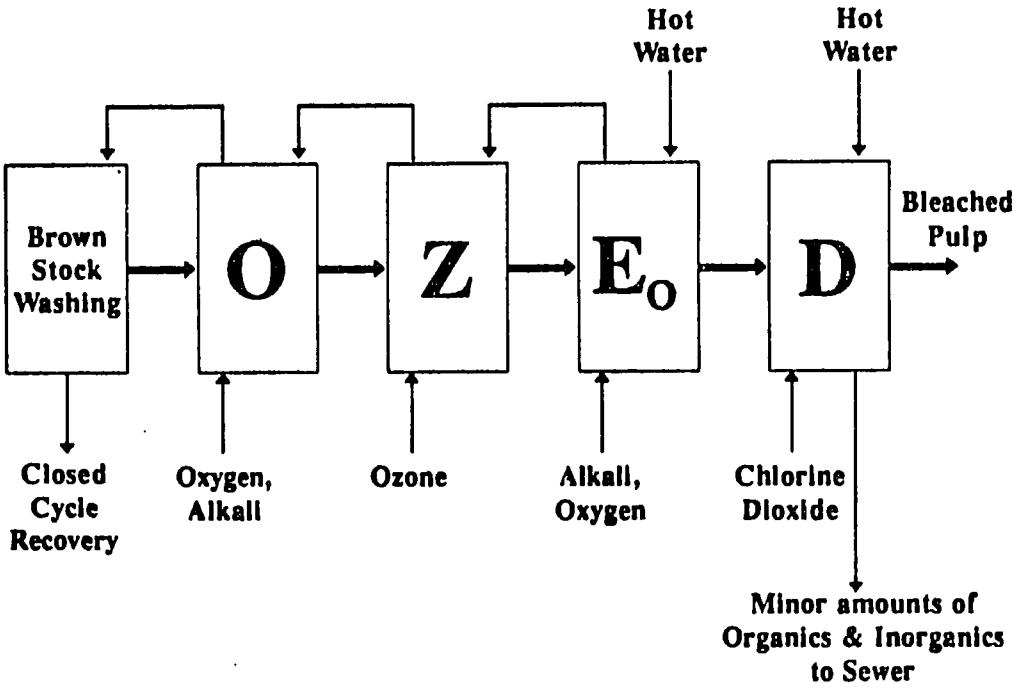
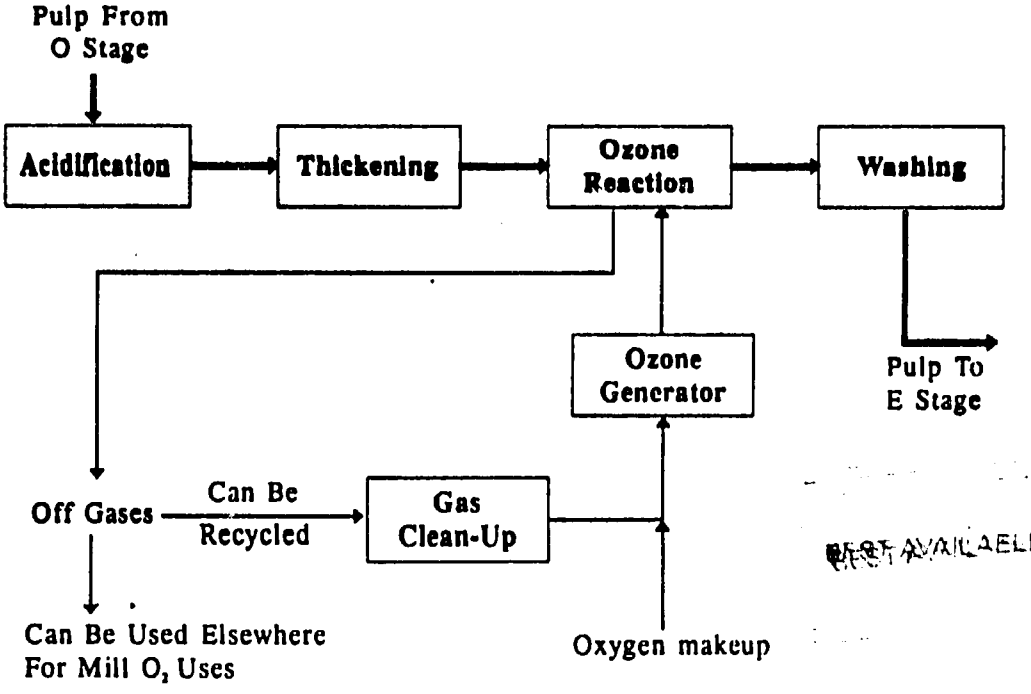
OZ(EO)D Bleaching



OZONE TREATMENT STEP



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BLEACHING COST REDUCTIONS FOR VARIOUS WOODS

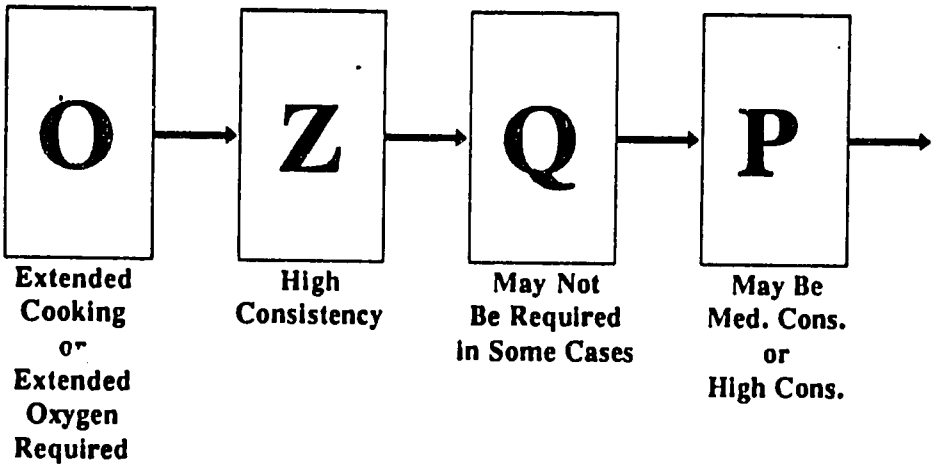
C-Free™ Compared with Conventional Bleaching

90 G.E. BRIGHTNESS PULP

	Percent reduction at Average U.S. Material Costs		
	Normal C/D Substitution	100% D/C Substitution	Comparison Sequence
Birch	42%	47%	OC/DED
Southern HD	20%	52%	CEDED
Eucalyptus	16%	46%	CEDED
Hemlock/Fir Mix	38%	61%	CEDED
Spruce/Pine Mix	35%	52%	OC/DED

OZQP (TCF) Bleaching
Totally Chlorine Compound Free

For Easy to Bleach Pulps - Market Brightness & Strength Possible



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OZONE
START-UP EXPERIENCES

FRANKLIN F-LINE
- STARTED UP ON OZONE — SEPTEMBER 19,1992

Z STAGE PERFORMANCE
- SELECTIVITY & EFFICIENCY — AS EXPECTED
- BLEACHING UNIFORMITY — EXCELLENT
- SYSTEM OPERATION — MINOR PROBLEMS ONLY

GAS SYSTEM PERFORMANCE
- STARTED UP ON OZONE — SEPTEMBER 19, 1992
- SAFETY PERFORMANCE — EXCELLENT
- OZONE PRODUCTION — EXCELLENT
- GAS RECYCLE SYSTEM — MINOR "NEW SYSTEM" ITEMS

EFFLUENT RECOVERY
- SMALL Z STAGE PURGE FOR CALCIUM

OZONE STAGE PERFORMANCE

	Ozone Application		Brightness % ISO		Viscosity dm^3/kg		Selectivity
	Kg/ADT Applied	Percent Consumed	In	Out	In	Out	$\frac{\Delta \text{Brightness}}{\Delta \text{ Viscosity}}$
Expected	6.8	90-95	39	53	705	590	0.12
Current Operation	7.6	95+	36	51	706	600	0.14

OZ(EO)D
BLEACH CHEMICAL SAVINGS

	Reduction vs CEDED
Typical	26%
Optimized	35%

FRANKLIN MILL

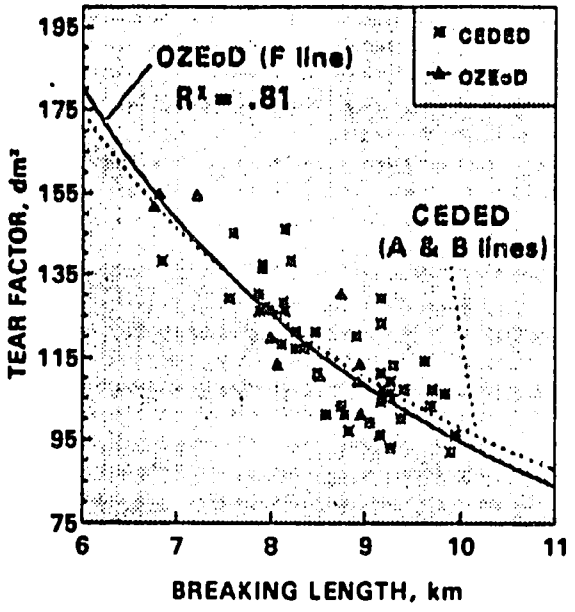
1992 OPERATING CONDITIONS

Effect of F-Line OZEoD Pine

FOR ALL SIX PAPER MACHINES	Gross Production Tons/Day	1st Grade Production Tons/Day	Sheet Breaks Number/Day	Machine Downtime min./day
Baseline Jan-July A&B Bleach Lines	2045	1806	13.1	18.3
Oct-Dec F-Line as OZEoD	2057	1822	12.3	15.6

TEAR vs TENSILE

Franklin Southern Pine



PFI BEATING DATA

BLEACH PLANT CONTRIBUTION
to
MILL EFFLUENT TREATMENT PROBLEMS

As a Percent of Total Mill	Normal Mill	With Rest of Mill as Closed as Possible
EFFLUENT FLOW	50%	65%
EFFLUENT BOD_5	35%	45%
EFFLUENT COLOR	60%	85%
CHLORINATED ORGANICS	85%	85%

PERCENT REDUCTION IN EFFLUENT
Using OZED Bleaching
90 G.E. BRIGHTNESS PULP

	Compared to Reference Sequence	COLOR	BOD	TOX	COD
Birch	ODEDED	88%	76%	71%	58%
Southern HD	CEDED	99%	88%	98%	91%
Southern HD	O(D$_{ll}$C)ED	96%	78%	97%	90%
Eucalyptus	CEDED	98%	87%	97%	88%
Spruce/Pine	O(D$_{ll}$C)EDED	98%	---	97%	85%
Hemlock/D. Fir	CEDED	96%	91%	84%	92%
Southern Pine	CEDED	99%	88%	99%	91%
Southern Pine	O(D$_{ll}$C)ED	96%	69%	98%	73%

POTENTIAL BENEFITS
CHLORINATED ORGANICS
Southern PINE Kraft to 82 ISO

	CEDED	OC/DED	OZED
on PULP TOX (kg/ADMT)	0.28	0.13	0.04
in BLEACH PLANT EFFLUENT TOX (kg/ADMT)	6.5	3.0	0.08 [a]
CHLOROFORM GENERATION total (kg/ADMT)	0.18	0.08	0.002

a. Level depends on the amount of chlorine in the chlorine dioxide used

POTENTIAL BENEFITS

BLEACH PLANT ORGANICS

Southern PINE Kraft to 82 ISO

	CEDED	OC/DED	OZED
BOD_5 (kg/ADMT)	16	6.5	2
COD (kg/ADMT)	65.5	22.5	6
COLOR (kg/ADMT)	185	41.5	1.5

RESULTS ON EFFLUENT PRODUCED FROM COMMERCIAL OZ(EO)D PLANT

	CEDED	OC/DED	Predicted OZED	INITIAL MEASURED F-LINE
BOD_5 (kg/ADMT)	16	6.5	2	1.8
COD (kg/ADMT)	65.5	22.5	6	5.6
COLOR (kg/ADMT)	185	41.5	1.5	0.9
TOX (kg/ADMT)	6.5	3.0	0.075	0.14
AOX	--	--	--	N.D.(<1-5ppb)
Chloroform	0.18	0.08	0.003	0.00017

C-Free ENVIRONMENTAL IMPACTS

- ESSENTIALLY ELIMINATES **DIOXIN**
- ELIMINATES MOST OF THE TOTAL CHLORINATED ORGANIC **CHLOROFORM, TOX and AOX**
- ALMOST ELIMINATES **COLOR** IN BLEACH PLANT EFFLUENT
- OFFERS LARGE **BOD** REDUCTIONS IN EFFLUENT TREATMENT
- USES LESS **WATER** AND PRODUCES LESS **EFFLUENT**

"Business success can and must march in step with a safe and pleasing environment."

— Jack Creighton
President

Weyerhaeuser Company
ENVIRONMENTAL POLICY

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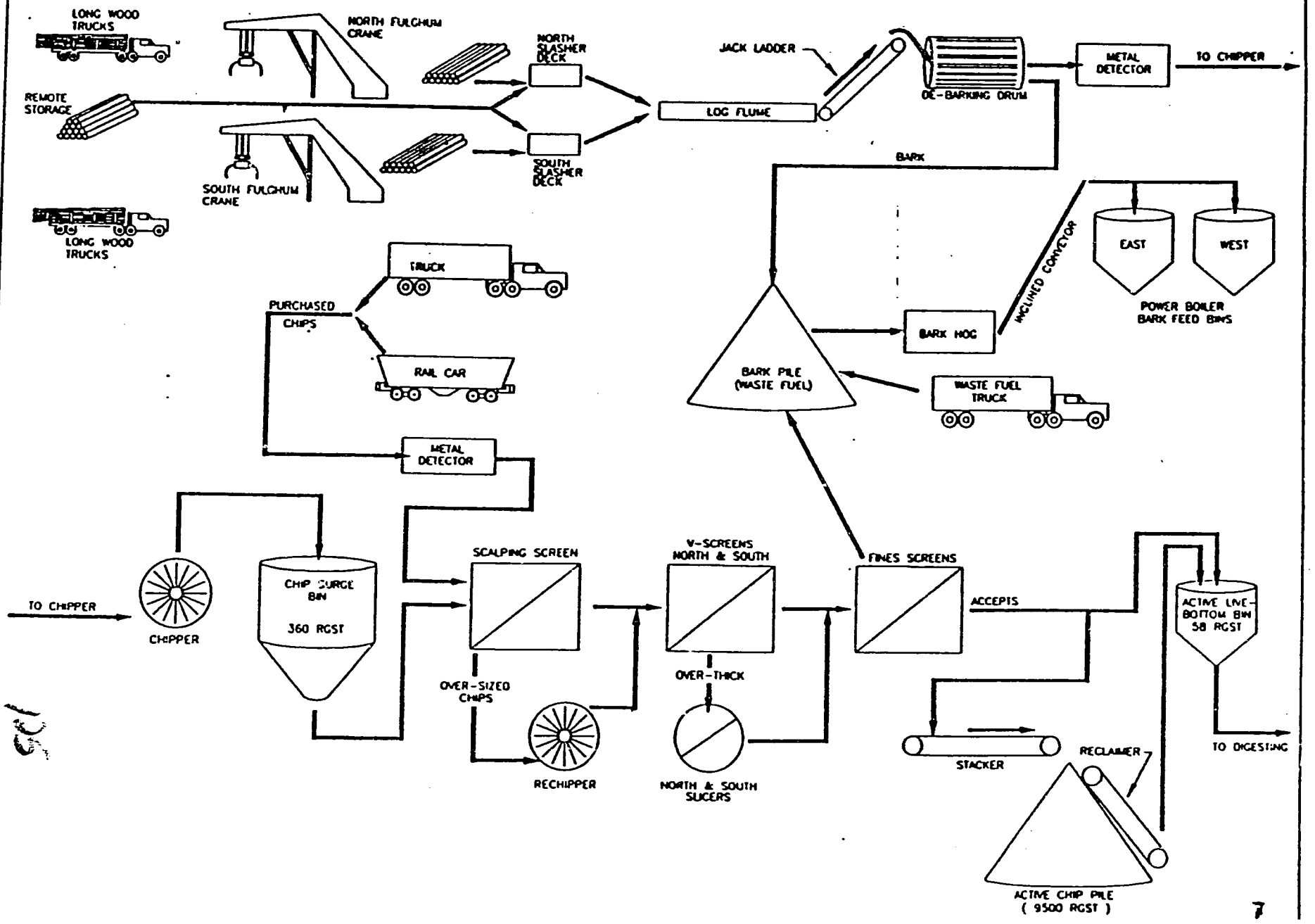
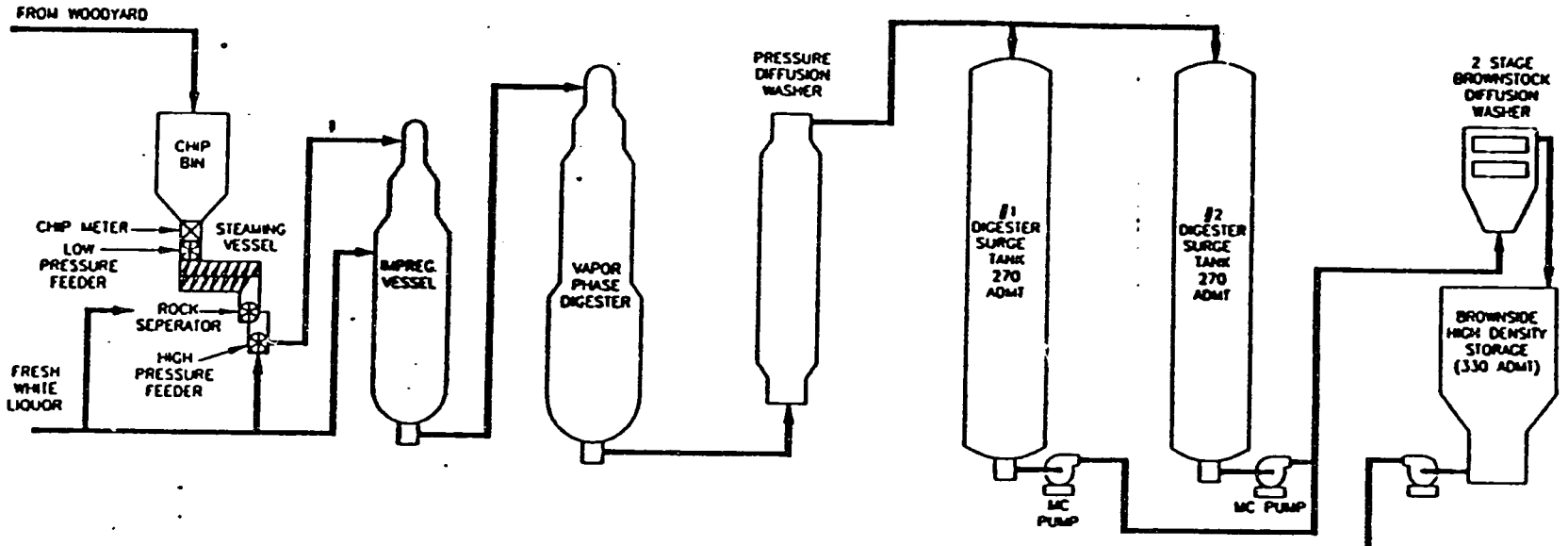
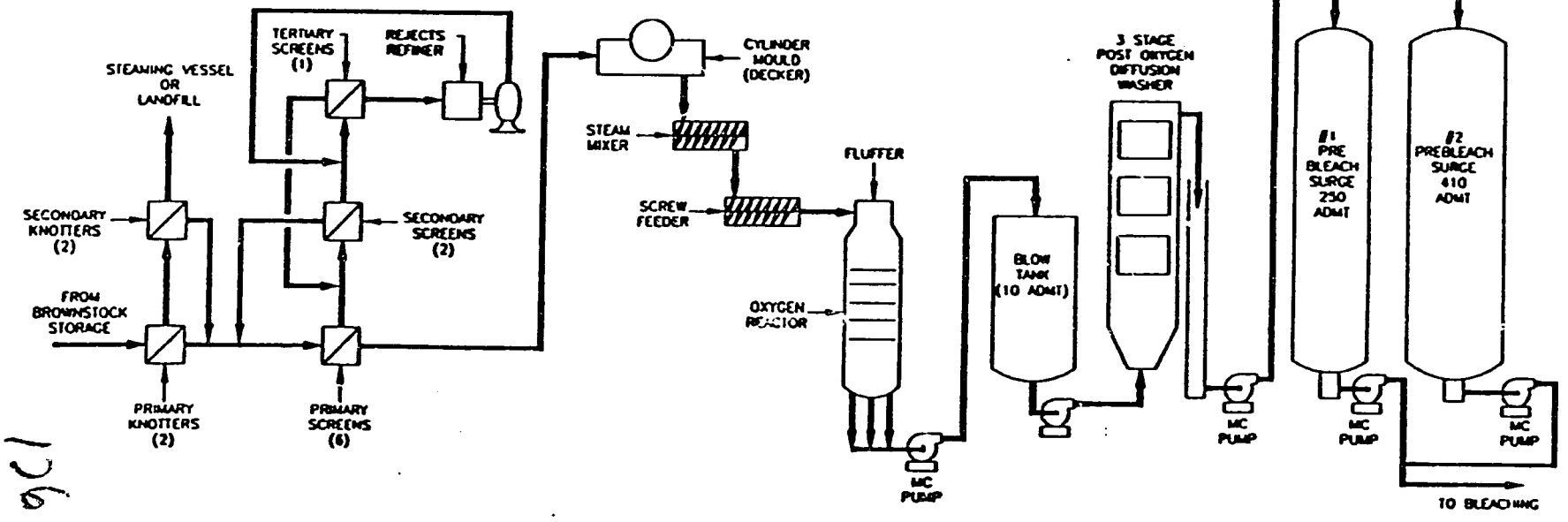
WOODYARD


LONG WOOD TRUCKS
REMOTE STORAGE
NORTH FULCHUM CRANE
SOUTH FULCHUM CRANE
NORTH SLASHER DECK
SOUTH SLASHER DECK
LOG FLUME
JACK LADDER
DE-BARKING DRUM
METAL DETECTOR
TO CHIPPER
BARK
INCLINED CONVEYOR
EAST
WEST
POWER BOILER BARK FEED BINS
BARK HOG
BARK PILE (WASTE FUEL)
WASTE FUEL TRUCK
TRUCK
PURCHASED CHIPS
RAIL CAR
METAL DETECTOR
TO CHIPPER
CHIPPER
CHIP SURGE BIN
360 RGST
SCALPING SCREEN
OVER-SIZED CHIPS
RECHIPPER
V-SCREENS NORTH & SOUTH
OVER-THICK
NORTH & SOUTH SLICERS
FINES SCREENS
ACCEPTS
STACKER
RECLAIMER
ACTIVE CHIP PILE (9500 RGST)
ACTIVE LIVE-BOTTOM BIN 58 RGST
TO DIGESTING

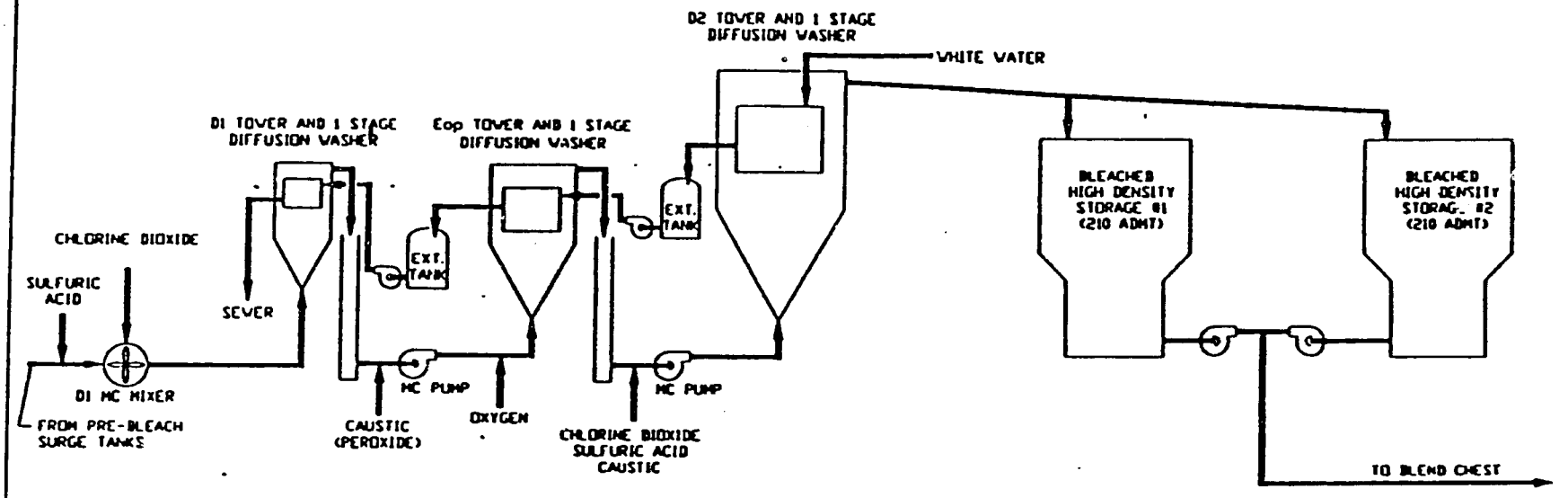
DIGESTING



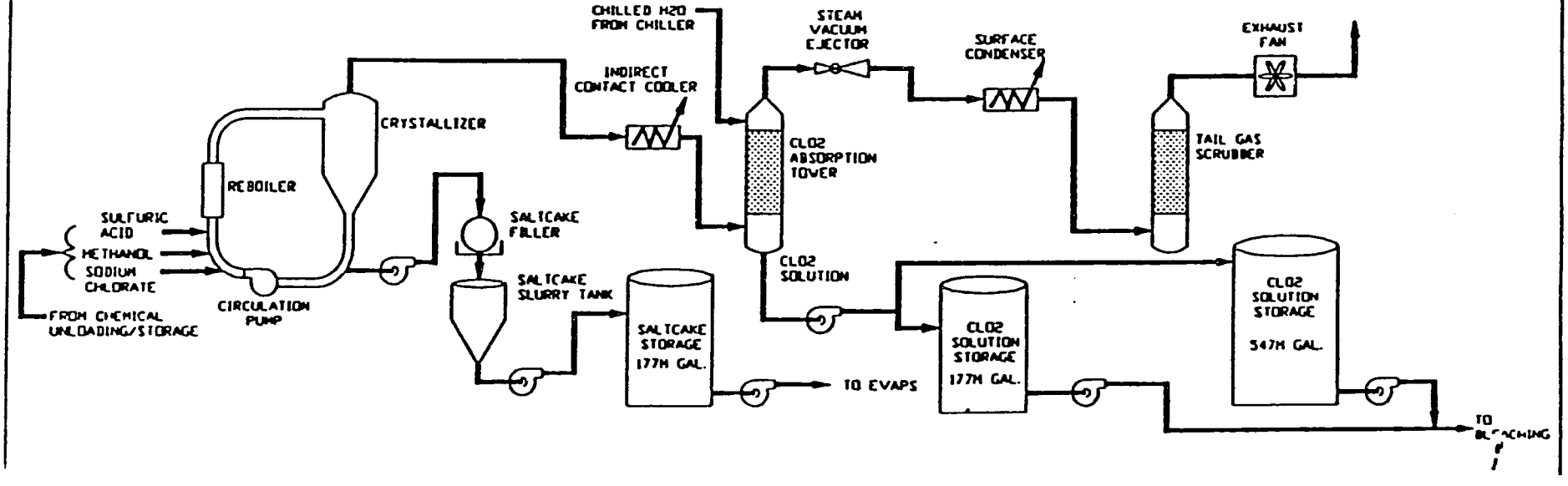
SCREENING/OXYGEN



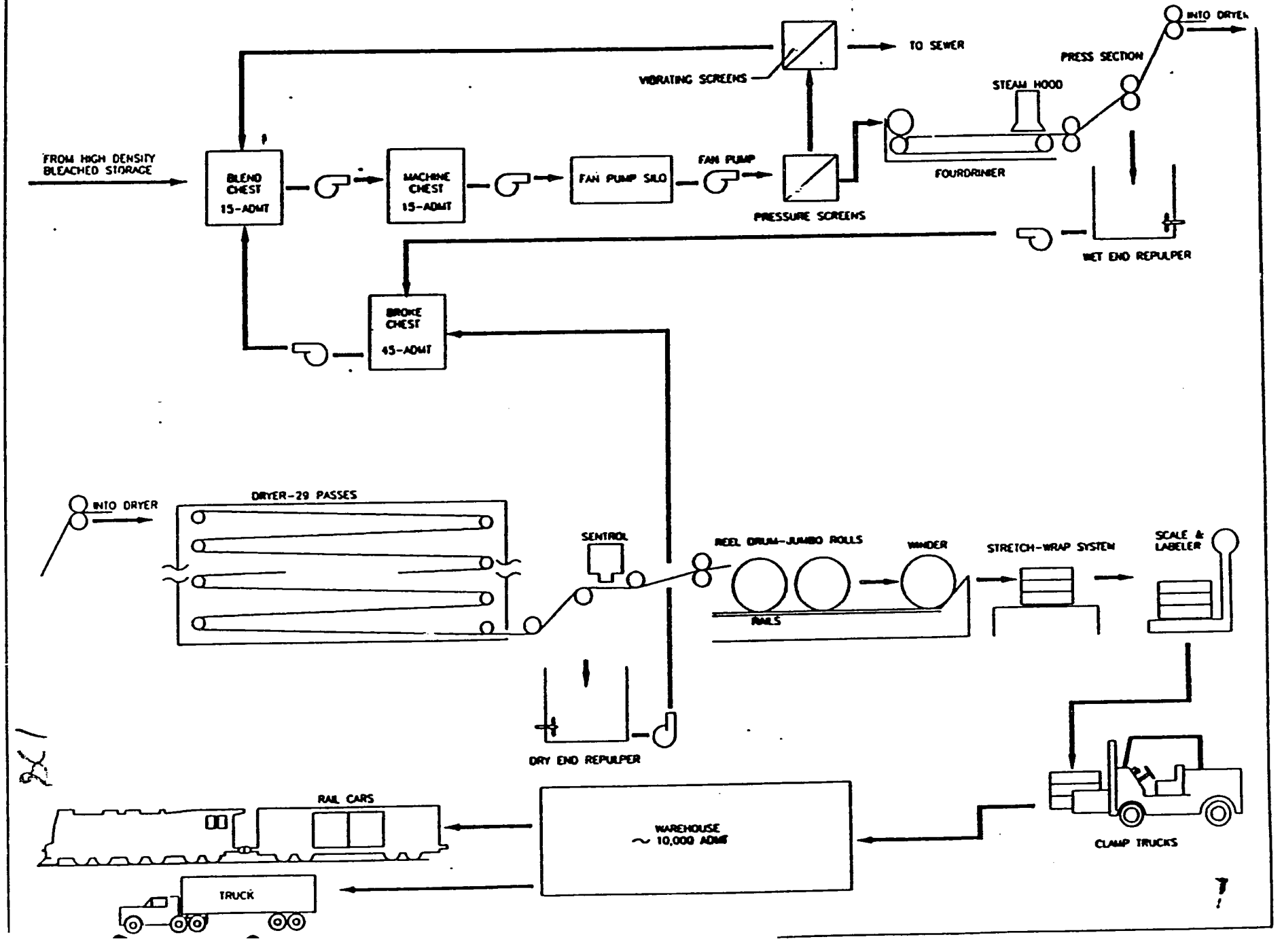
BLEACHING



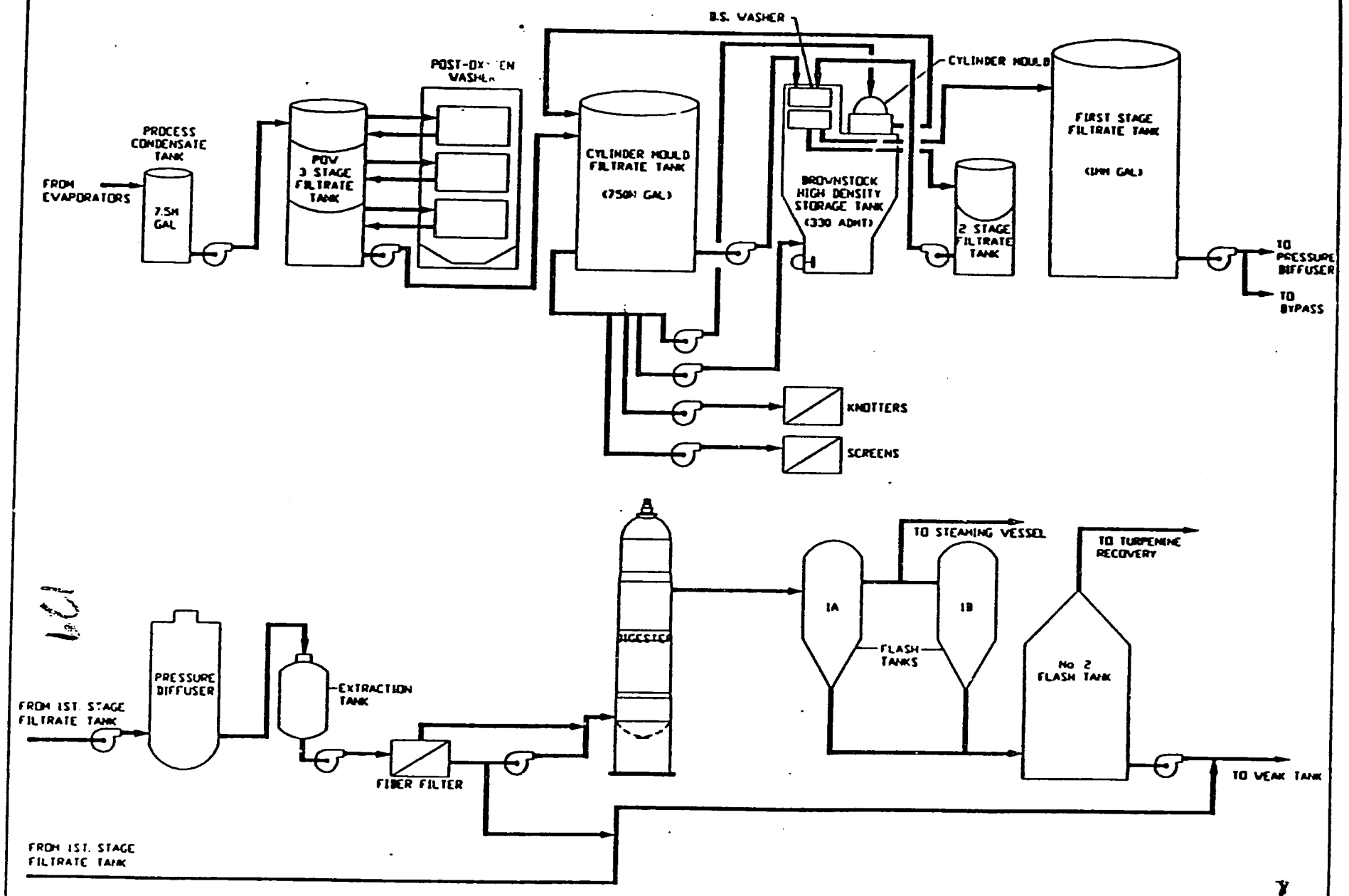
R-8 CHEMICAL GENERATOR



STOCK PREPARATION/DRYER

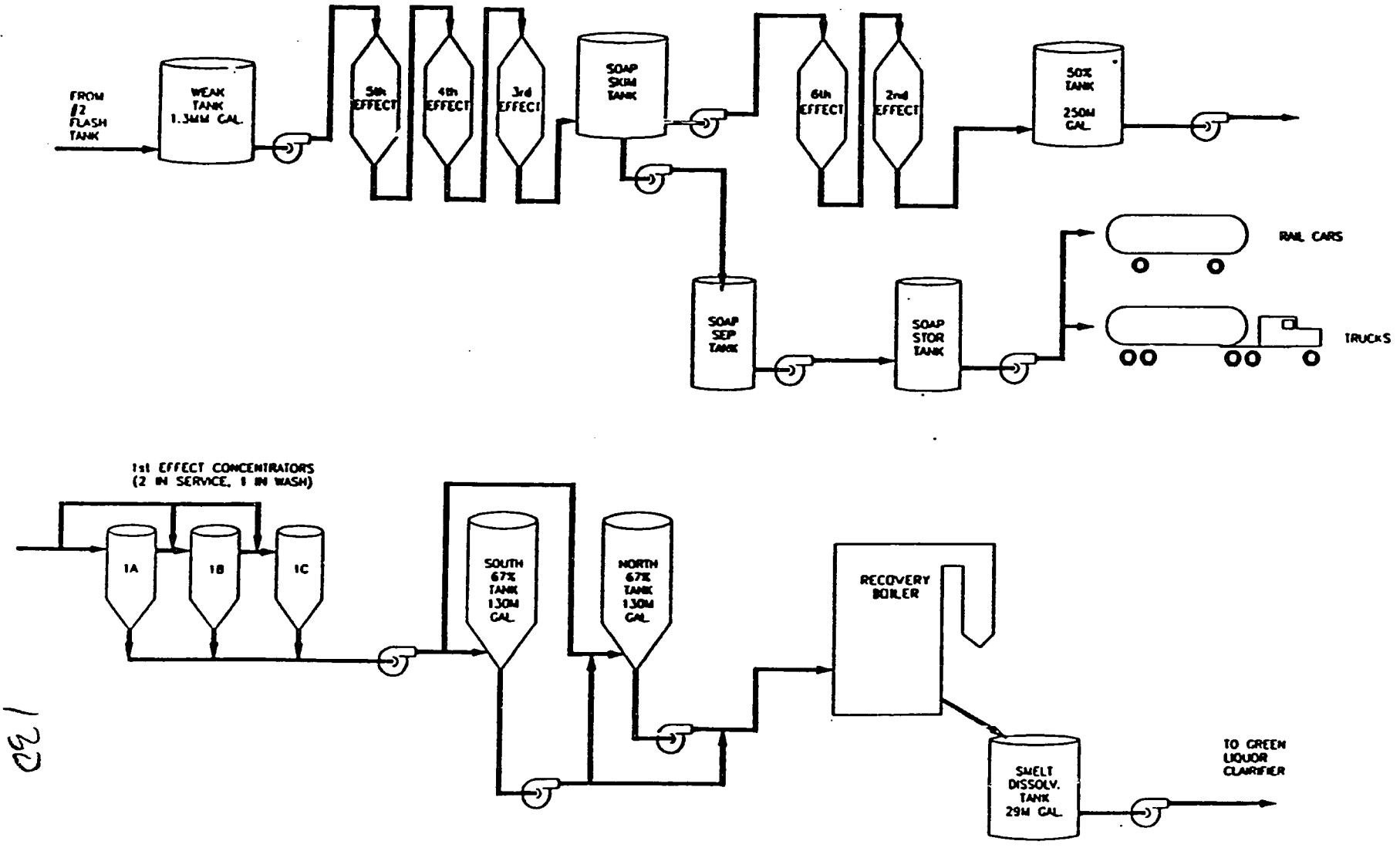


PULPING FILTRATE LOOP



CHEMICAL RECOVERY, BLACK SIDE

EVAPORATION/RECOVERY



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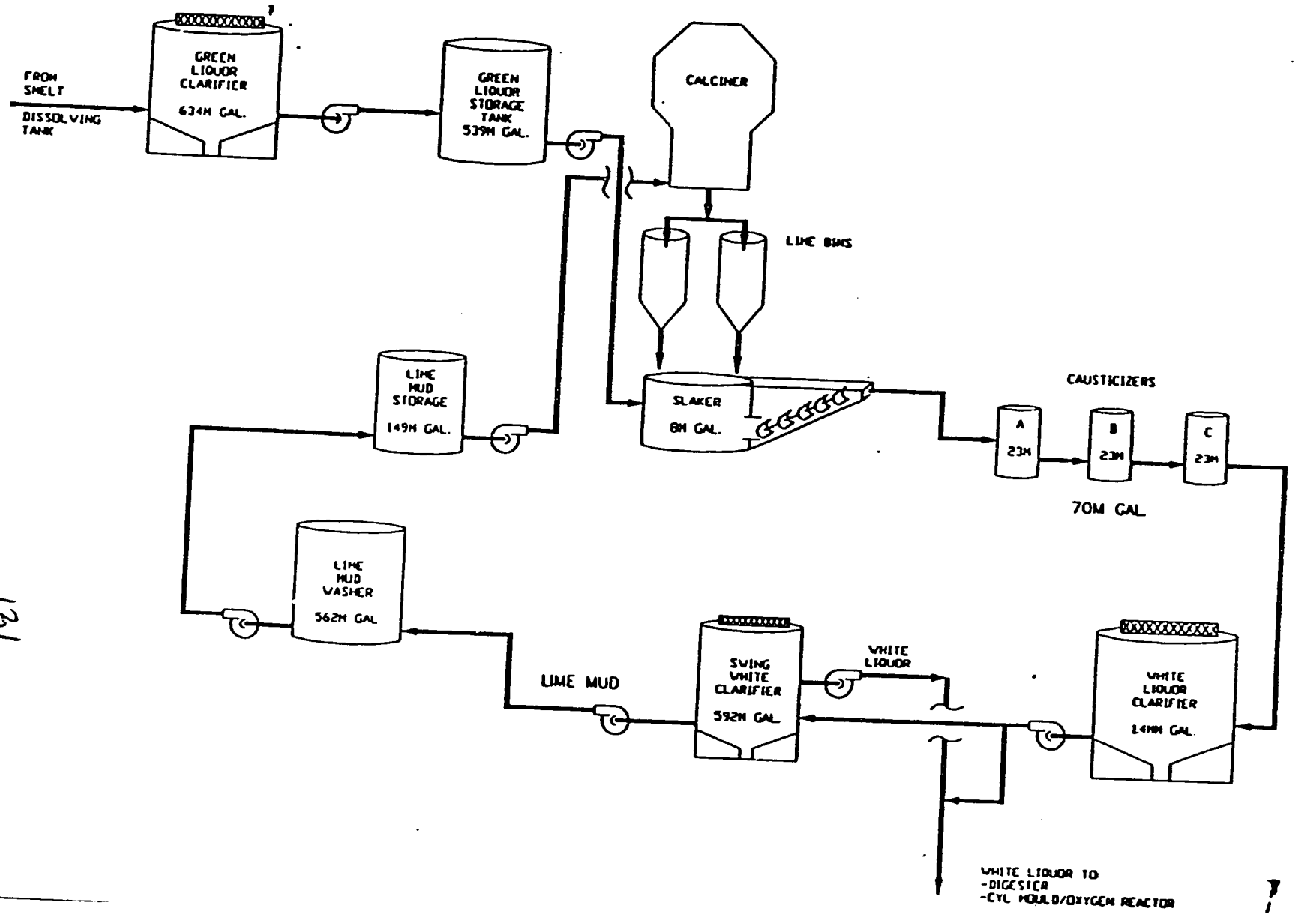
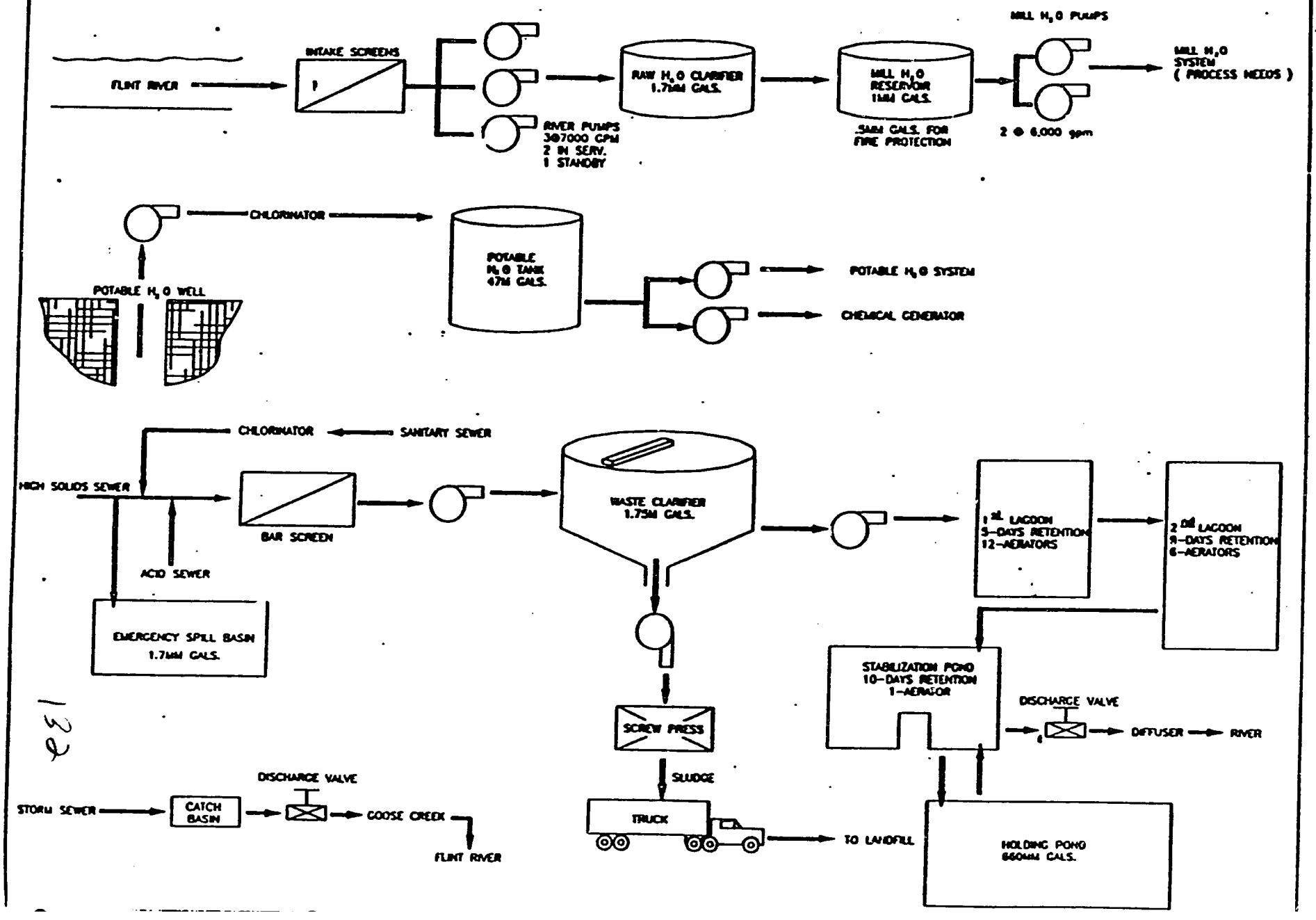
CHEMICAL RECOVERY, GREEN & WHITE SIDE

CAUSTICIZING

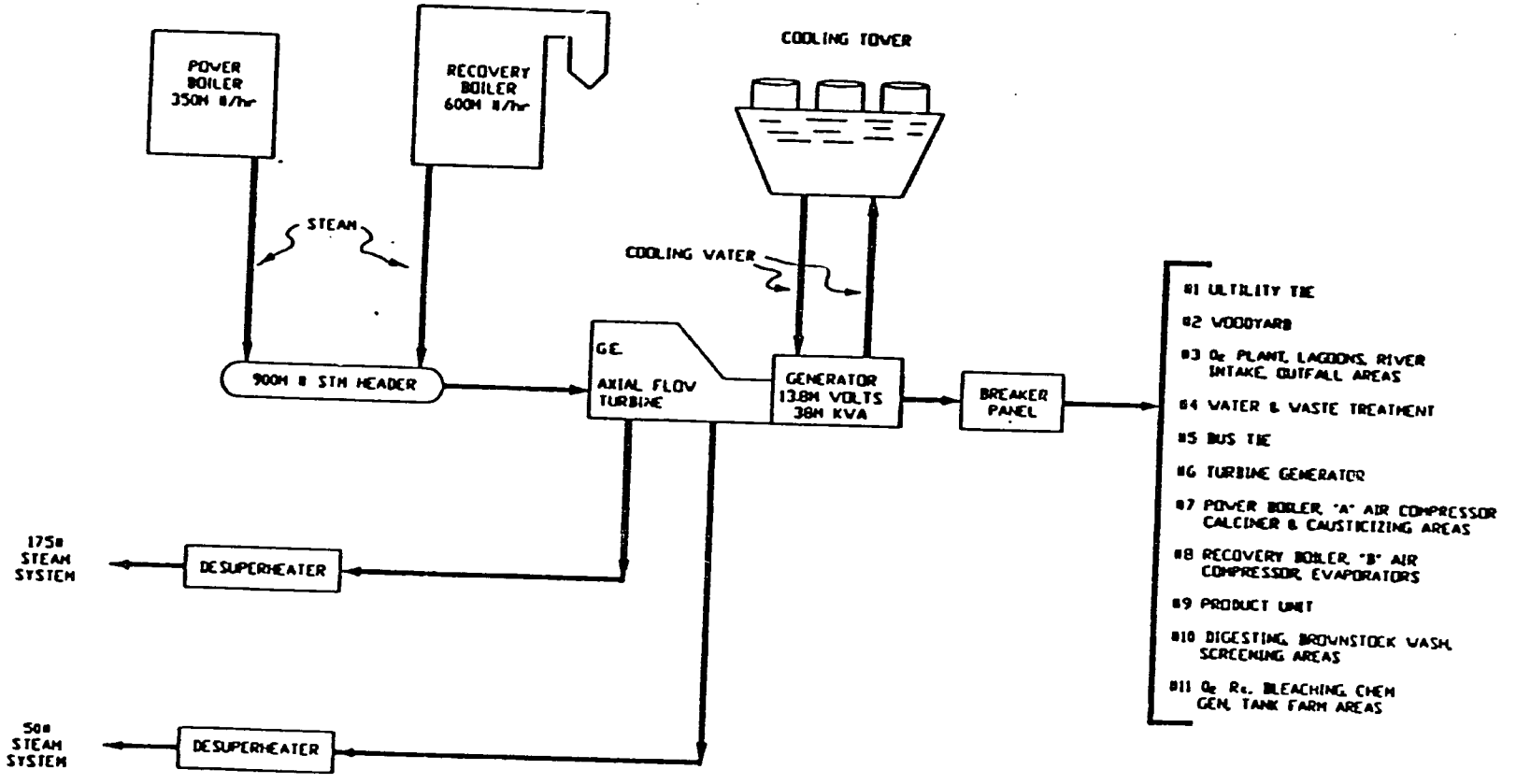


WASTE & WATER TREATMENT

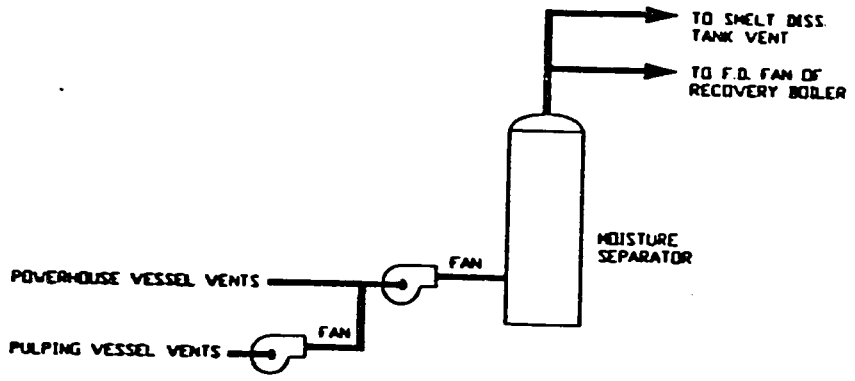


TURBINE GENERATOR STEAM/POWER FLOW

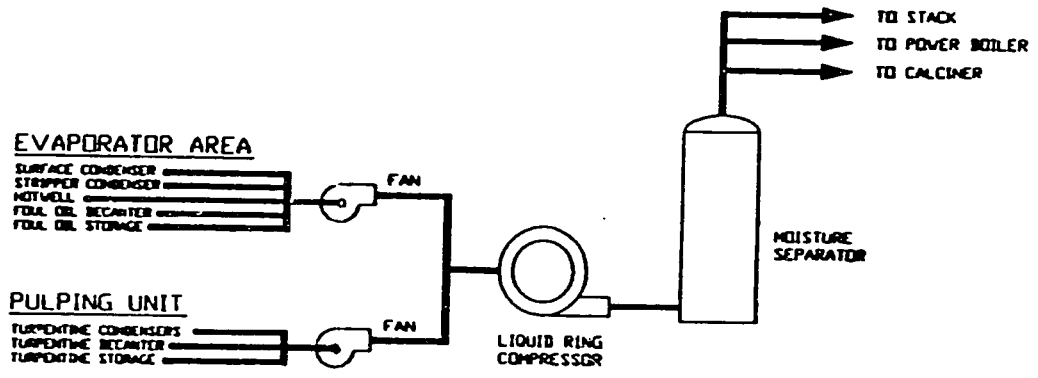
POWER SYSTEM



WEAK GAS INCINERATION



STRONG GAS INCINERATION



APPENDIX E

CURRICULUM VITAE

BIOGRAPHICAL SKETCH OF IYAN SUWARGANA

Institution	:	The Environmental Impact Management Agency (BAPEDAL)
Current Position	:	Staff of Directorate for Hazardous Waste Management
Education	:	Bandung Institute of Technology, Chemistry Department, Bandung.

Work Experience

November 1992-present Staff Chemist :
Hazardous Waste Management Directorate,
The Environmental Impact Management Agency
(BAPEDAL)

Responsible for :

- Development of technical guidelines for Emergency Response System and Hazardous Waste Management. Activities include working with industry and other government department to develop the programs.
- Development of technical guidelines for Prior Informed Consent Prosedure (PIC) and implementation of the Amended London Guidelines.

CURRICULUM VITAE

N a m e : HENDAYANI TEGUH ADISESHA (Mrs)

Date of Birth :

Nationality : Indonesian

Marital Status & Dependents : Maried + 3

Education :

S2., Chemistry, Post Graduate Study, Bandung Institute Of Technology, 1982

S1., Chemical Engineering, Bandung Institute of Technology 1964

Work Experience :

1985-now

Institute for research and Development of Cellulose Industries, Bandung.
Post :
Head of Derivatives and Pollution Division

Responsibility :
- Directing and coordinating in house, national as well as international research activities and research cooperation in cellulose derivatives and pollution fields
- Coordinating and doing technical cooperation with pulp and paper industries, especially in waste water treatment plant design
- Participating central and Provincial Environmental protection Activities

1980-1985 Institute for Research and Development of Cellulose Industries

Post :
Head of Quality Control and Normalization Section

Responsibility :
- Coordinating and doing preparation of draft for Indonesia Industrial Standard
- Coordinating testing and quality control activities

1968-1980 Cellulose Research Institute, Bandung

Post :
Chief of Rayon Laboratory.

Responsibility :
- Coordinating and doing research in viscose rayon processing and other cellulose derivatives.

Professional Association :

Indonesian Engeneers Association (PII)
Indonesian Chemical Associayion (HKI).
International Association on Water Quality

Bandung, 8 September 1993

Hendayani Teguh Adisesha (Mrs)

Head of Cellulose Derivatives and Pollution Division

PT KERTAS LECES (PERSERO)
LECES, PROBOLINGGO 67202
JAWA - TIMUR, INDONESIA
Telegram : KERTAS LECES Phone : (62)-0335-21893, 21894, 21896. Fax : (62)-0335-21628 Tlx : 31388, 31048 LETJES IA

BIODATA

CANDIDATE FOR TRAIN THE TRAINER TRAINING IN U.S.

NAME	:	IR. DARONO WIKANAJI
BIRTH DATE	:	24 MAY 1962
NATIONALITY	:	INDONESIAN
RELIGION	:	MOSLEM
EDUCATION/TRAINING	:	* GRADUATE FROM GAJAH MADA UNIVERSITY CHEMICALS ENGINEERING DEPT. IN 1989 * PULP & PAPER TECHNOLOGY SEMINAR AT INSTITUTE FOR RESEARCH AND DEVELOPMENT OF CELLULOSE INDUSTRIES, BANDUNG, IN 1991 * ENVIRONMENTAL MANAGEMENT BY NETWORK INSTITUTE TECHNOLOGY, IN 1992 * ENGLISH LANGUAGE COURSES, IN 1992
WORK EXPERIENCE	:	HIRED BY PT KERTAS LECES IN JULY 1990 AS EFFLUENT TP SECTION HEAD UP TO NOW.

U - 087

P.T. INDAH KIAT PULP & PAPER CORP

Head Office : Jakarta
Tel : (021) 3104647, 3104405
Tlx : 61507 IKPP IA
Fax : 3104582, 3104583

Branch Office : Pekanbaru
(0761) 21627, 32047
56121 IKPP PK-BARU
(0761) 33662

Mill Site : Perawang
(0761) 38998 (Hunting Syste
.....
(0761) 33080

PAGE : 01 OF 01	DATE : 24/09/93		
TO : WORLD ENVIRONMENT CENTER INDONESIA OFFICE		RECEIVED 24 SEP 1993 Ans'd.....	
ATTN : Drs.R.H.M.WIRADIPUTRA			
FAX NO. : 21-511195	REF NO. : JT/3/251		

THANK YOU FOR YOUR CALLING.
IN ORDER TO COMPLETE THE APPLICATION OF TRAIN-THE-TRAINEE PROGRAM, OUR CANDIDATE CURICULUM VITAE IS STATED BELOW

NAME : ZULKIFLI LUBIS
DATE OF BIRTH : AUGUST 24, 1964
EDUCATION : MECHANICAL ENGINEER
ALUMNI OF NORTH SUMATERA UNIVERSITY 1989

WORKING EXPIRIENCE:
JANUARY 03, 1991 - OCTOBER 20, 1991
STAFF OF WATER TREATMENT SECTION
PT INDAH KIAT PULP & PAPER CORPORATION PERAWANG RIAU
OCTOBER 20, 1993 - JUNE 30, 1992
STAFF OF ENVIRONMENT PROTECTION SECTION
PT INDAH KIAT PULP & PAPER CORPORATION PERAWANG RIAU
JULY 01, 1992 TILL PRESENT
VICE CHIEF OF ENVIRONMENT PROTECTION SECTION
PT INDAH KIAT PULP & PAPER CORPORATION PERAWANG

TRAINING AND SEMINAR:
FEBRUARY 10 - 13, 1992
POLLUTION CONTROL MANAGEMENT - BANDUNG
DECEMBER 21, 1992
ENVIRONMENTAL SEMINAR - PEKANBARU

THANK YOU,
WITH BEST WISHES,

PETER YOKSAN
FAX: 0761-38080

CC:
MR EDDIE E-TAK SHAW
EXECUTIVE VICE PRESIDENT
PT INDAH KIAT PULP & PAPER CORP. JAKARTA

B I O D A T A

N a m e	WIDYA TJAHYANA LAUWANGSA
A g e	39 years
S t a t u s	Married
A d d r e s s	Wisma Tropodo AL-21 Waru - Sidoarjo

EDUCATION & TRAINING

1979	-	Graduated from "AKADEMI TEKNIK RAJASA" majoring in Mechanical Engineering
Nov.1975 [3 months]	-	COCHRAN Boiler service & commissioning at GUTHRIE SINGAPORE.
1979 [1 year]	-	Job training for Coating Colour Preparation from DAISHOWA ENGINEERING - JAPAN at PT PAKERIN
July 1983	-	Introduction to paper industry instrumentation
January 1988	-	High quality Compressed Air Seminar from ATLAS COPC
June 1988	-	Steam Engineering & Energy Conservation from SPIRAX SARCO
June 1989	-	Technological Development on Fabrication of Stainless Steel. A Seminar by ESAB.
Febr. 1991	-	Leadership training from the Management Consultant 'PRANIDYA'
Sept. 1991	-	Energy Conservation in the Industrial Sector from the Indonesia Dept. of Industry [K.M.I. - WORLD ENERGY COUNCIL].
Nov. 1991	-	Bearing [A Seminar by S.K.F]
Febr. 1992	-	Design on Anaerobic Industrial Waste Water Treatment - a Seminar by I.T.S. (The Institute Technology of Surabaya.
Feb. 1993	-	Mechanical Design Consideration and some problems in the process plants. A Seminar by The High Pressure Gas Safety Institute of Japan "KHK"

EXPERIENCES :

1975 - 1977	-	at PT OMETRACO Engineering Division as Commissioning and Service Engineer for COCHRAN BOILER in Indonesia Scope of jobs are : Erection, Commissioning, Service and Overhaul of steam boiler.
1977 - now	-	at PT PAKERIN

JOB POSITION AT PT PAKERIN

1977 - 1979	-	as Boiler & Water Treatment SECTION HEAD.
1979 - 1983	-	as Boiler & Water Treatment SECTION HEAD plus Coating Colour Preparation SUPERVISOR.
1983 - 1987	-	as Vice Chief Engineer
1988 - now	-	as Mechanical Chief Engineer

SCOPE OF JOB AT PT PAKERIN

1977	-	Boiler & Water treatment erection, steam piping. Design, erection and trial run of PM I
1979	-	Coating Color Preparation training from DAISHOWA
1981	-	Boiler & Water treatment, steam piping design and erection of PM II
1983	-	Boiler and steam piping erection for PM III
1988	-	Erection of Co-Generation plant from SHIN NIPPON JAPAN
1989	-	Member of the team for Effluent Treatment Plant design, fabrication and erection.
Feb 1991	-	To survey Paper Machine & Stock Preparation Equipment at Smorgon - Melbourne (second hand machine)
Feb 1992	-	To survey Effluent Treatment equipments in India, at TNPL Pulp & Paper Mill, SESHASAYE Pulp & Paper Mill, Madras Refinery, New Delhi Municipal Effluent Treatment Plant, HINDUSTAN DORR OLIVER - Bombay

PT. SURABAYA AGUNG INDUSTRI PULP & KERTAS
PAPER & BOARD MANUFACTURING

BIODATA

CANDIDATE FOR TRAIN THE TRAINER TRAINING IN U.S.

Name	: Drs. Warih Supriadi
Birth Date	: November, 22nd 1966
Nasionality	: Indonesian
Health	: Exellent
Education	:
1985 - 1990	Chemistry Dept. Faculty Math and Natural Science Airlangga University, Surabaya.
1992	Course Supervisory Management in LMS Surabaya
Work Experience	:
1991 - Present	Quality Controle Dept. PT. Surabaya Agung Industri Pulp & Kertas.

World Environment Center

BADAN PENGENDALIAN DAMPAK LINGKUNGAN

JAKARTA

STUDY TOUR REPORT
FROM
UNITED STATE METAL FINISHING FACILITIES

BY
DADANG SUDRADJAT

DECEMBER 06 – 18 , 1993

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CONTENTS

I EXECUTIVE SUMMARY

II INTRODUCTION

III FINDING
- A. Overview of Facility
- B. Details of the Focused Activity
  - a. Waste Minimization
  - b. Safety and Health
  - c. Waste Treatment

IV CONCLUSIONS AND RECOMMENDATIONS

V APPENDICES
- Appendix A : Corporations and Agencies visited
- Appendix B : Figure and Photographs
- Appendix C : Bussines Cards of Persons Contacted
- Appendix D : Document Received
- Appendix E : Curriculum Vitae

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I. EXECUTIVE SUMMARY

This study tour is directed to finding of the environmental management implemented on several the metal finishing facility at United State with focuses about waste minimization, safety & health, and wastewater treatment practices.

Waste minimization practices have been done by technology options as made of counterflow rinses instalation, substitution of less polluting proces, reuse and recycling practice, good housekeeping, instalation of the works safety & health equipments, good chemical storage, and good wastewater treatment practices.

Corporations and Agencies that were visited including Metal Finishing Ass. of Southern California, Metal Finisher, Material Fabrication Division of The Lawrance Livermore National Laboratory, Environmental Consulting, and Industrial Wastewater Treatment Industry.

In many cases, many waste minimization with low technology has applicated at United State with options of technology include source reduction, on site recycling, and off site recycling which provide immediate cost saving.

For the future action, we should be improved and make evaluate of source which could possible to implement of minimization.

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II. INTRODUCTION

This below will describing about the implementation or experience of study tour from the metal finishing industries at United State (Los Angeles and San Francisco).

This study tour has implemented onto coorporation BAPEDAL (Environmental Impact Management Agency) with USAID (United State Agency for International Development) where WEC (World Environment Centre) as implementer which has started from 6-18 December 1993. The WEC contributes to sustainable development worldwide by strengthening industrial environmental, health and safety management practices. The objective of U.S. study tour is to obtain the technologies and management practices implemented in the United State which enhance waste minimization and improve worker health and safety.

The study tour participate are six person (two from government and four from industry), where each one of participate are as follow :

1. Ir. Herry Hamdani, Staff of Directorate for Hazardous Waste Management, BAPEDAL.
2. Ir. Berani Situngkir, Section Head of The Pollution Control, Ministry ofIndustry Directorate General of Multivarious Industry.
3. Ir. Dadang Sudradjat, Head of Quality Control, P.T. Superex Raya - Aluminum Extrusions.
4. Ir. Widya Wicaksana, Project Manager, Institute for Small Scale Industry Development.
5. Ir. Jaya Agung Prastowo, Notion Division, P.T. YKK Indonesia Zipper Co. Ltd.
6. Suryanur Syafei, Chief of Quality Control, Padi Komponen - Stamping & Electro Plating Shops.

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In the study tour activities followed by Mr. Charles Jong Hwa Hong as Deputy Project Manager and Mr. Jim Miille as President of Chemical Solution, Inc. The metal finishing facilities that were visited are as follow :

- December 06, 1993 : Metal Surface Inc.
- December 07, 1993 : Electrolizing Inc.
- December 09, 1993 : Presentation from Lawrence Livermore National Laboratory.
- December 10, 1993 : Wastewater Treatment System Inc.
- December 13, 1993 : Read - Rite wastewater treatment facility. Acteron Corporation.
- December 14, 1993 : Schlage Lock. Santa Clara Plating Co. Inc.
- December 15, 1993 : United Airlines. New United Motor.
- December 16, 1993 : Water Pollution Control Plant.

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III. FINDING

A. Overview of facility

Generally, the metal finishing facilities visited has moved on electro plating shop, except the water pollution control plant. Appendix A are explained several corporations and agencies that were visited.

The plating shop contains the following metal finishing processes:
- Nickel plating
- Tin plating
- Tin Lead plating
- Chrome plating
- Gold plating
- Rhodium plating
- Anodizing (Sulfuric process)
- Copper plating.

The water pollution control plant is facility that was treated water from city or industry which the following process:
- solid removal,
- solid separation,
- first clarification (20% metal removed),
- second clarification,
- add. oxidizer (control BOD/COD),
- removal ammonia,
- filtering,
- backwash,
- clorination.

The visiting also has the following additional activity related to support the environmental management programs :
- The presentation from the Lawrence Livermore National Laboratory/Material Fabrication Division.
- Environmental consulter.
- Industrial Wastewater Treatment Industry.
- Vendor of The Wastewater Treatment Equipments.

The facility has constructed the wastewater treatment plant that utilizes hexavalent chromium reduction, cyanide oxidation, neutralization/presipitation, flocculation, clarification, pH adjusment in discharge, and filtration to remove solid from the combined wastewater of all of the metal finishing operations.

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B. Details of The Focused Activity

This study tour only focused on observation of the environmental management practices including :
- Waste minimization,
- Health & safety,
- Waste treatment.

a. Waste Minimization

Many waste minimization with low technology more applicated at United State. Technology option include source reduction, on site recycling, and off site recycling which provide immediate cost saving. The way of waste minimization practices at the metal finishing facilities that were visited has found are as follow :

1. Instalation of drip tray to prevent liquid discharge.
2. Spray rinses
   Purpose of spray is to rinse racked parts as the leave any rinse station or as they emerge from the plating or processing tank. Advantage of spraying system are the rinse tank is free from dragout, and this will conserve water.
3. Counterflow rinsing sistem
   This system purpose to conserve water. By increasing from one to two rinse, a water saving is realized. The otherhand, this system could reducing the flow of water lessens the load on waste treatment system and makes dragout recovery for more economical and practical.
4. Good housekeeping practices
5. Recycling of plate solution with use evaporator
   Evaporation eliminates water and leaves all the plating chemical (and tap water impurities) in the process tank.
6. Recycling of acids with utilizes diffusion dialysis technology for recycling of acid. Spent solution of nitric, sulfuric, and hydrochloric have been recycled using this system and efficiency of recovery has been about 80%.
7. Recycling of rinsewater
   The water recycling unit that obtained are cold vaporation and ion exchange systems.
   - Cold vaporation
   Cold vaporation is distillization employing vacuum. Waste liquid is placed in a boiler unit and the side walls are heated to go to 100 F. A vacuum is applied and as a result the wasetewater boils at approximately room temperatur. The water vapor travels to a condensor and forms clean product

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water. Any contaminant remains in the boiler, eventually forming a slurry when the concentration reaches a certain level. Reduction of up to 99% can be obtained with this process. The recycled water from this operation is purer than water is received in the shop from the city.

- Ion Exchange

Ion exchange is as applied to water treatment is the removal of essentially all inorganic salts. Ion exchanger are materials that can excharge one ion for another, hold it temporaly, and release it to a regenerant solution.

8. Elimination of vapor degreasing

Vapor degreasing was replaced with a variety of aqueous cleaning processes including soak and electrolytic cleaning, ultrasonic cleaning and also with water pressure cleaning system that the recycles the water so waste is kept to a minimize.

9. Segregation of cyanide solutions

All solution containing cyanide are located in a separate room and all plating and rinsing associated with these solution is also confined to this room. By doing this, helps to minimize costs.

b. Safety and Health

More has implemented the system of safety & health practices as follow :

- Has instalated the fume srubber systems
- Wearing of work safety & health equipments
- Labelling system at the solution tanks
- Good chemical storage.

c. Waste Treatment

In observation to the pollution prevention just focused, to the wastewater treatment where the processed system as follow :

- segregation type of wastewater,
- reduction process on wastewater which has content of hexavalent chromium,
- oxidation process on wastewater which has content of cyanide,
- good mixed and agitation systems on flocculation process,
- adjusment of pH,
- control of BOD, COD, heavy metal content, etc., according with standarded limit.

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IV. CONCLUSIONS & RECOMMENDATIONS

A. CONCLUSIONS

1. Waste minimization practice more implemented at the United State metal finishing facilities.
2. Waste minimization is direction among environmental control measures, and can characterized in three advantage catagories:

   - Economic Benefit
   By reducing the amount of waste generated reduces operating cost in several ways and can actually improve the profitability.

   - Regulatory Conformance
   Source reduction and recycling technologies are emerging as the most effective means of meeting these more stringent discharge standards.

   - Environmental Achievement
   A strong waste minimization programs is the most effective way for a manufacturer to minimize the environmental detriments of metal finishing, while continuing to provide the frequently under appreciated enviromental benefits of metal finishing.

B. RECOMMENDATIONS

For the future action, we should be improved and make evaluate as follow :

1. Evaluate sources which could possible to implement of minimization.
2. Making plan of a system which would applicated or modified on process, for example :
   - Recycling system on plate solution or pre-treatment solution with use evaporator system or the other system.
   - Changing rinsing practices to reduce both the volume of the collected waste water and the concentration of hazardous material in the water, example: application of spray rinse system, etc.
   - The ferfect treatment on the treatment of waste that would become the industrial disposal.
3. Use deionized water on the process solutions and rinse solution to minimize problems in the process.

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4. Use the filtering system so that good quality or solution will be kept clear.
5. Train employee about knowledge of management of the minimization, safety & health, and waste treatment practices.

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APPENDIX A

CORPORATIONS AND AGENCIES VISITED

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Co & Agency Names	Facilities	Persons Visited and Title
-Smith,Bucklin & Ass.Inc 5000 Van Nuys Boulv Suite 300 Sherman Oaks, CA 91403 USA	Metal Finishing Association of Southern California	Mark A.Hanson, CAE Manager Los Angeles Office
-Metal Surface Inc. 6060 Shull St.Bell Gardens CA 90201 - 0521	Nickel, Gold, Tin, Tin Lead Platings	Sam Bell President, Bruce F. Nielson, Plant Engineer
-Electroplating 1947 Hooper Ave Los Angeles, CA 90011	Chrome Plating Specialist	Susan B. Grant, General Manager, Jack Morgan, Plant Manager
-Lawrence Livermore National Laboratory PO.BOX 808, L - 332 Livermore, CA 94551.	Material Fabrication Division	Jack W. Dini, Section Leader
-Chemical Solution, Inc 400 Main Street, Suite 203 Pleasanton, CA 94566	Environmental Consulting	Jim Millie, President
-Wastewater Treatment System Inc 1239 Elko Drive Sunnyvale, CA 94089	Industrial Wastewater Treatment Industry	Glen C. Meistauter, President
-Lead-Rite 2065 N. Sunnyside Fresno, CA 93727	Wastewater Treatment Facility	Mark Buhwaller, Operations / Field Services
-Process Scientific,Inc 460 Saratoga Ave.Suite 213 San Jose, CA 95129	Vendor of Wastewater Treatment Equipments	Jim Elliott, Marketing Manager
-Acteron Corporation 651 Shasta Street Redwood City, CA 94063	Gold, Nickel, Rhodium platings and Anodizing	Patrick Burt, President
-Santa Clara Plating Co.Inc. 1773 Grant Street Santa Clara, CA 95050 - 3914	Copper & Nickel Platings, Anodizing	Thomas L.Coss, President
-United Airlines Bldg.47 - SFOAL San Francisco Int'l Airport San Francisco, CA 94128-3000	Maintenance Operations Center & Wastewater Treatment Facility	Steven F.Sulgit, Facilities and Eng.
-Water Pollution Control Plant 700 Los Esteros Rd. San Jose, CA 95134	Wastewater Treatment & Control Facility	Alex Elster P.E. Ph.D. Sanitary Engineer
New United Motor Fremont, Ca	Wastewater Treament Facility	

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APPENDIX B

FIGURE AND PHOTOGRAPHS

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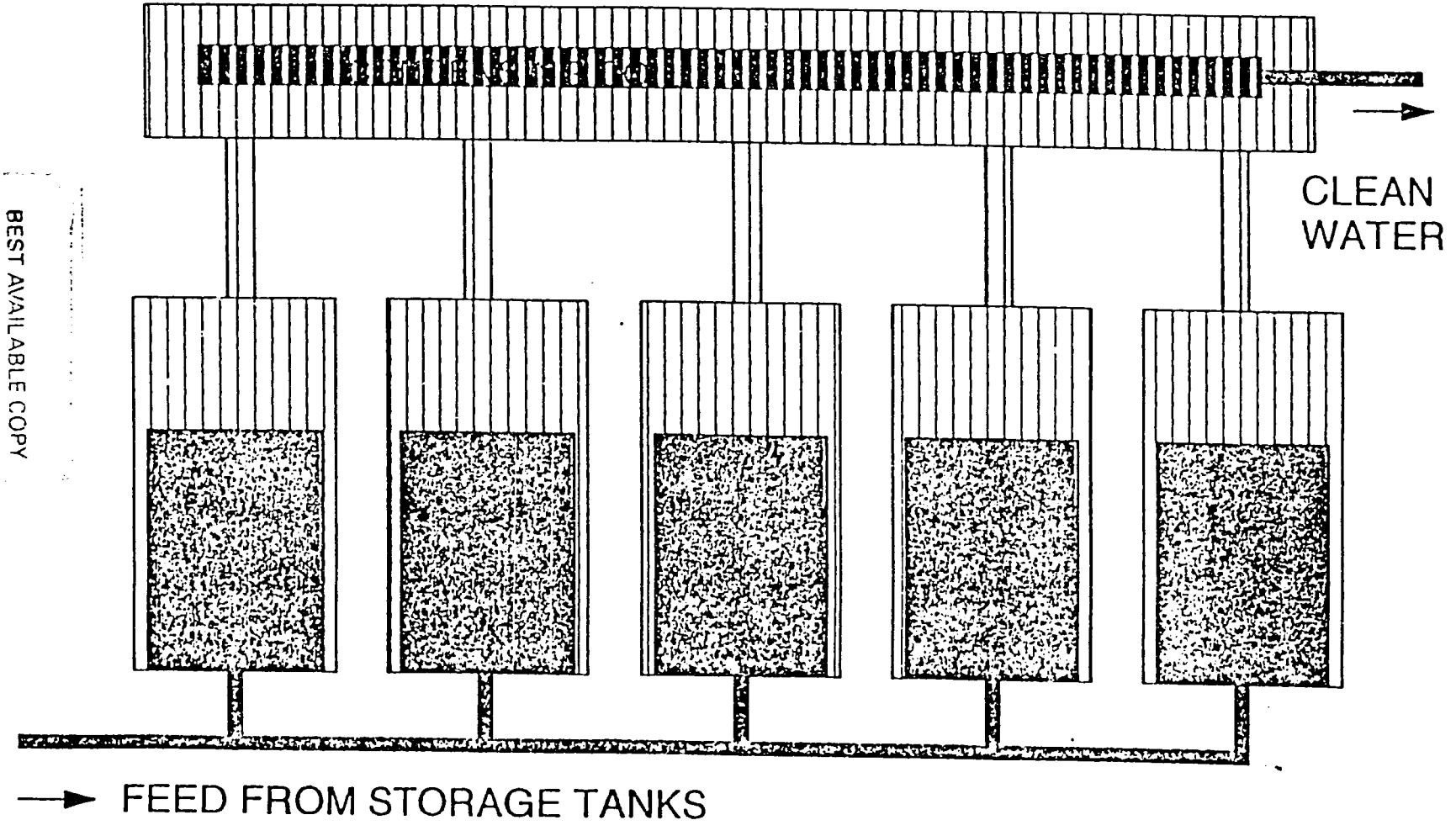
RINSE WATER DISTILLATION



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DISTILLATION RESULTS

Typical feed rate = 25 gallons /hr
@ 30 PPM average metal content, pH 2 - 9.5

Typical water return rate = 25 gallons /hr
@ <1 PPM average metal content, pH 6.5 - 7.5
Typical concentrate @ 9000 PPM

Cost per gallon recovered = $.03

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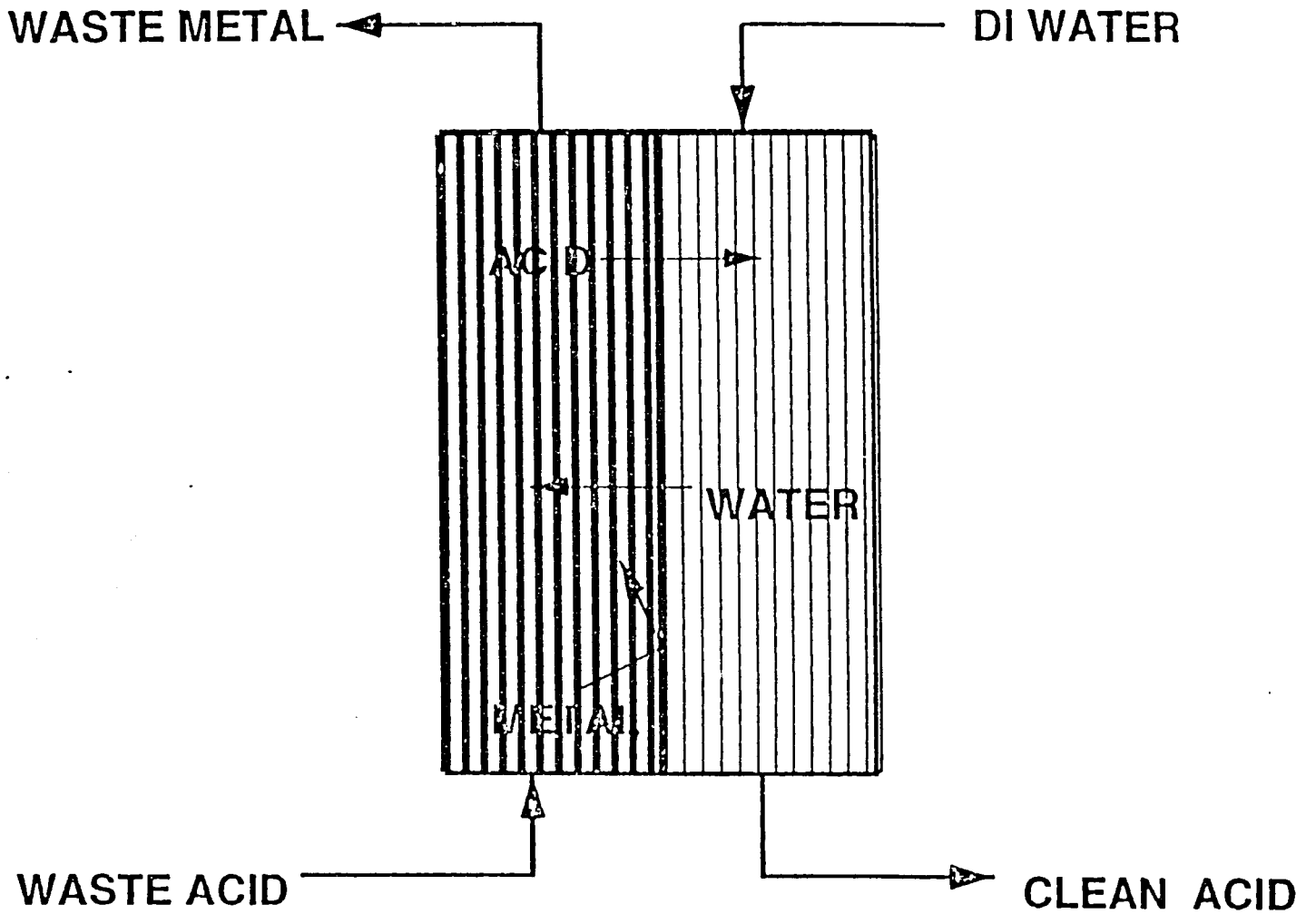
ACID DIALYSIS EQUIPMENT



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ACID RECYCLING EQUIPMENT

10 GPD Dialysis cell

- 50 pair stack of polymer membranes
- 2 impulse pumps and tubing
- supply and storage tanks

Feed

- DI water
- Metal Bearing acid

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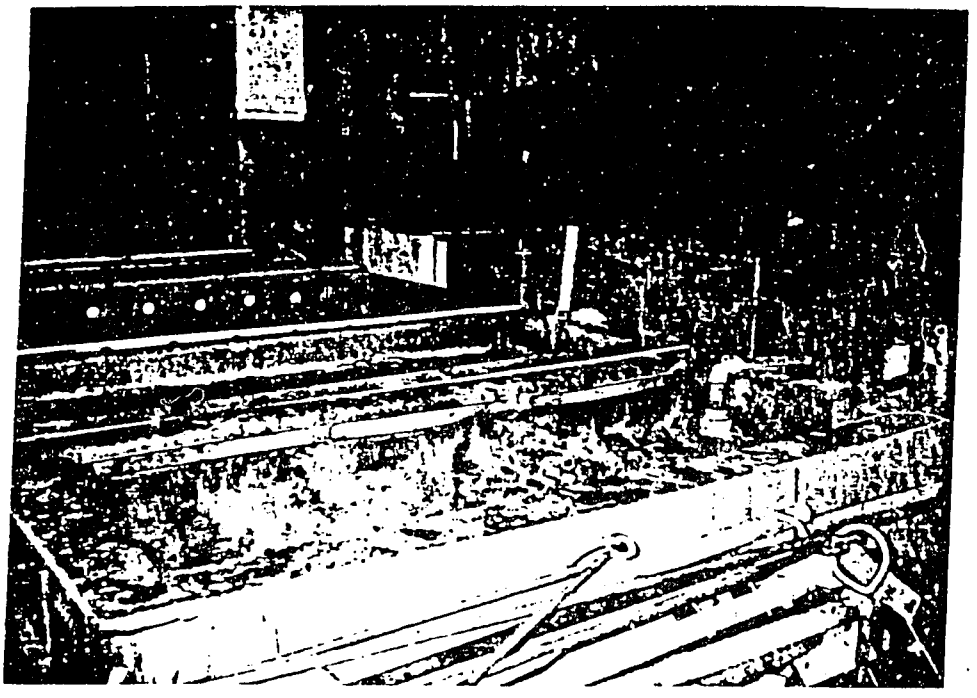
ACID DIALYSIS RESULTS

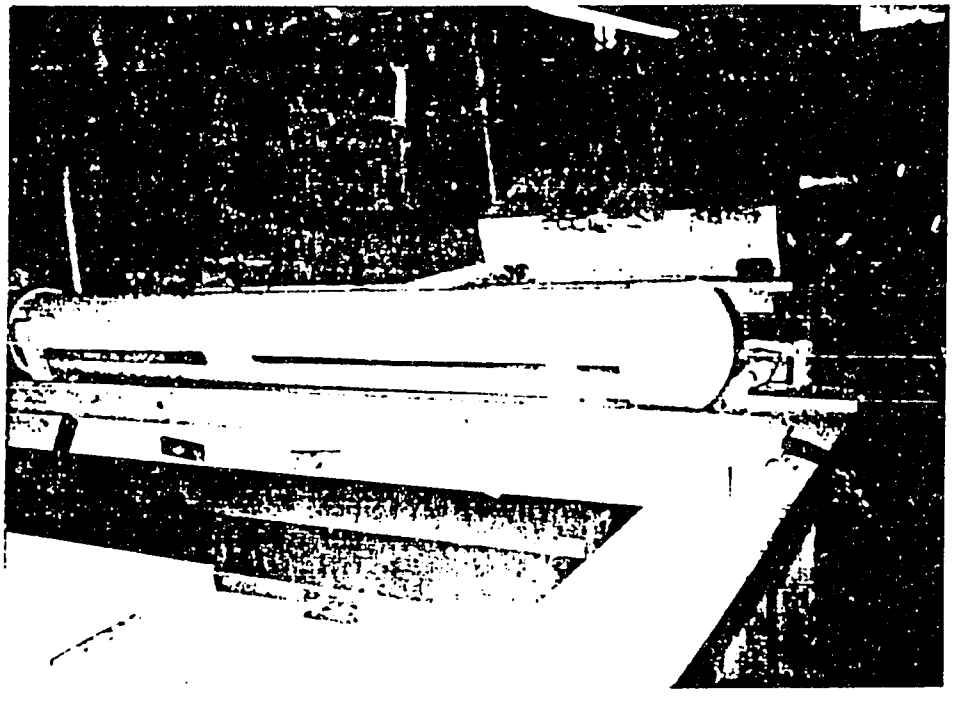
<u>Test 1</u>

(start)	(finish)
4.9 Normal Nitric Acid	3.9 Normal Nitric Acid (79.5%)
60 gm/l copper metal	7.2 gm/l copper metal (88%)

<u>Test 2</u>

(start)	(finish)
9.4 Normal Muriatic Acid	7.1 Normal Muriatic Acid (75.5%)
10 gm/l copper metal	1.1 gm/l copper metal (89%)
14 gm/l iron metal	3.1 gm/l iron metal (77.8%)





Instalation of fume scrubber to depuration gases
from the treatment tanks producing harmful fumes.
(Metal surface Inc, Bell Gardens & Acteron Co Redwrod City,CA)

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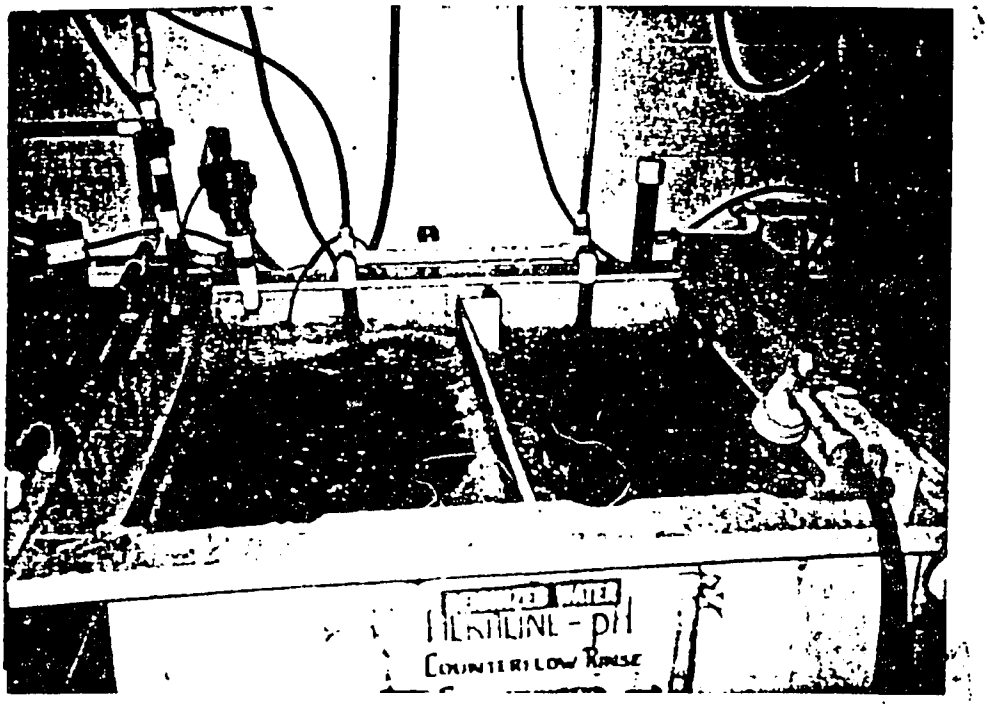

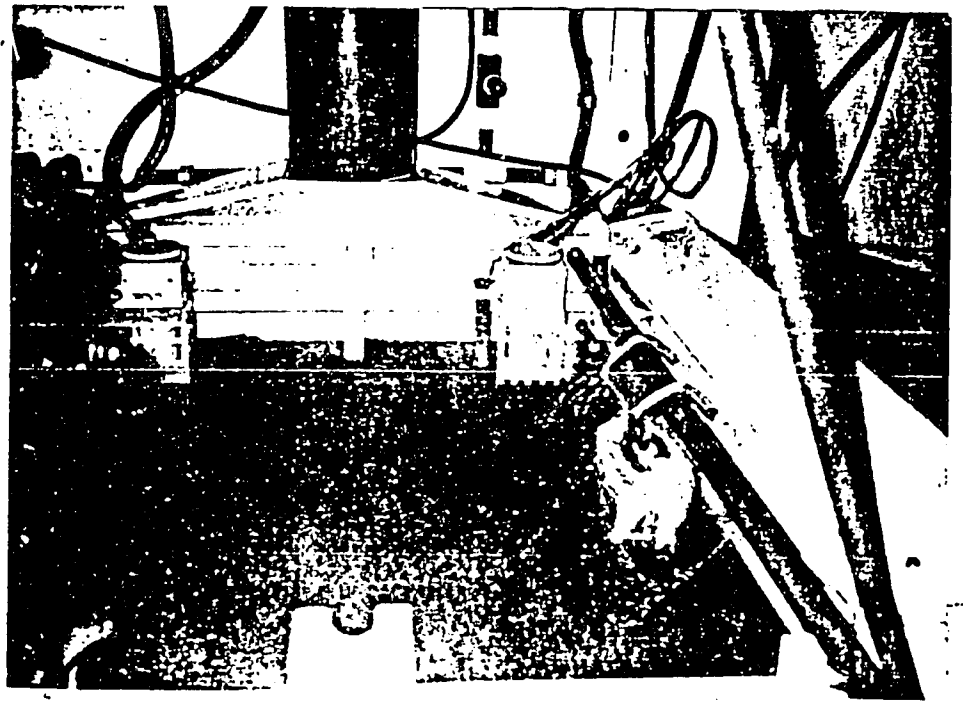

Rinsing practice with counterflow rinse system
that has completed with driptray and spray rinse
(Acteron Co, Redwood city, CA)

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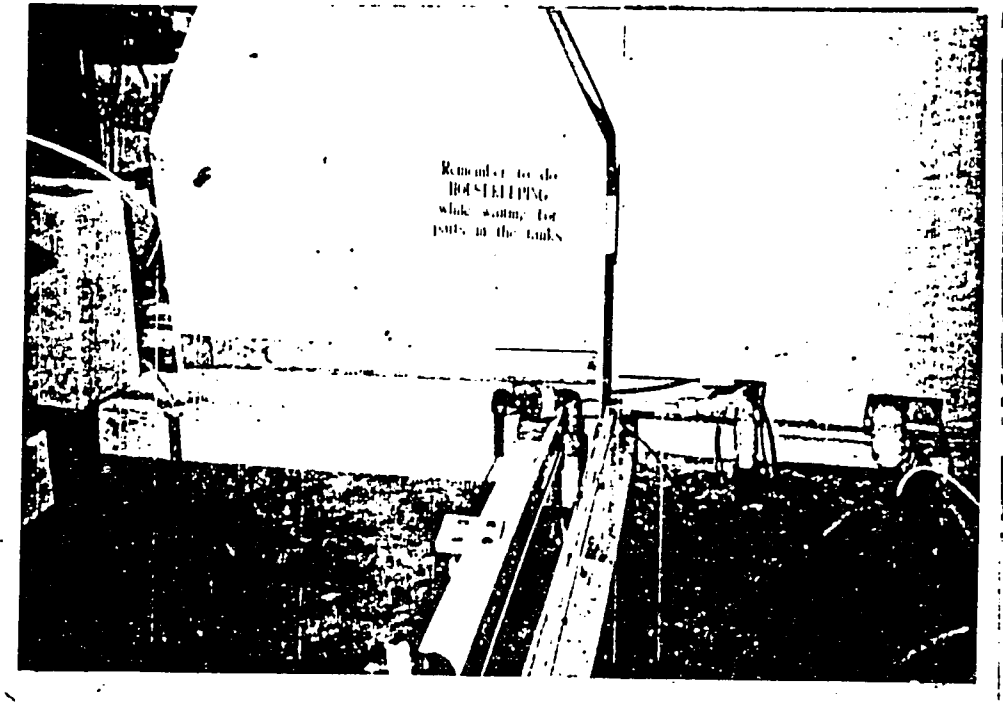

Good Housekeeping Practice
No Chemical solution goes out to the floor
(Acteron Co, Redwood city, CA)

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Jack Morgan, Plant Manager of Electrolizing Inc.
does explaining about recycling of plating solution
(Electrolizing Inc, Los Angeles, CA)

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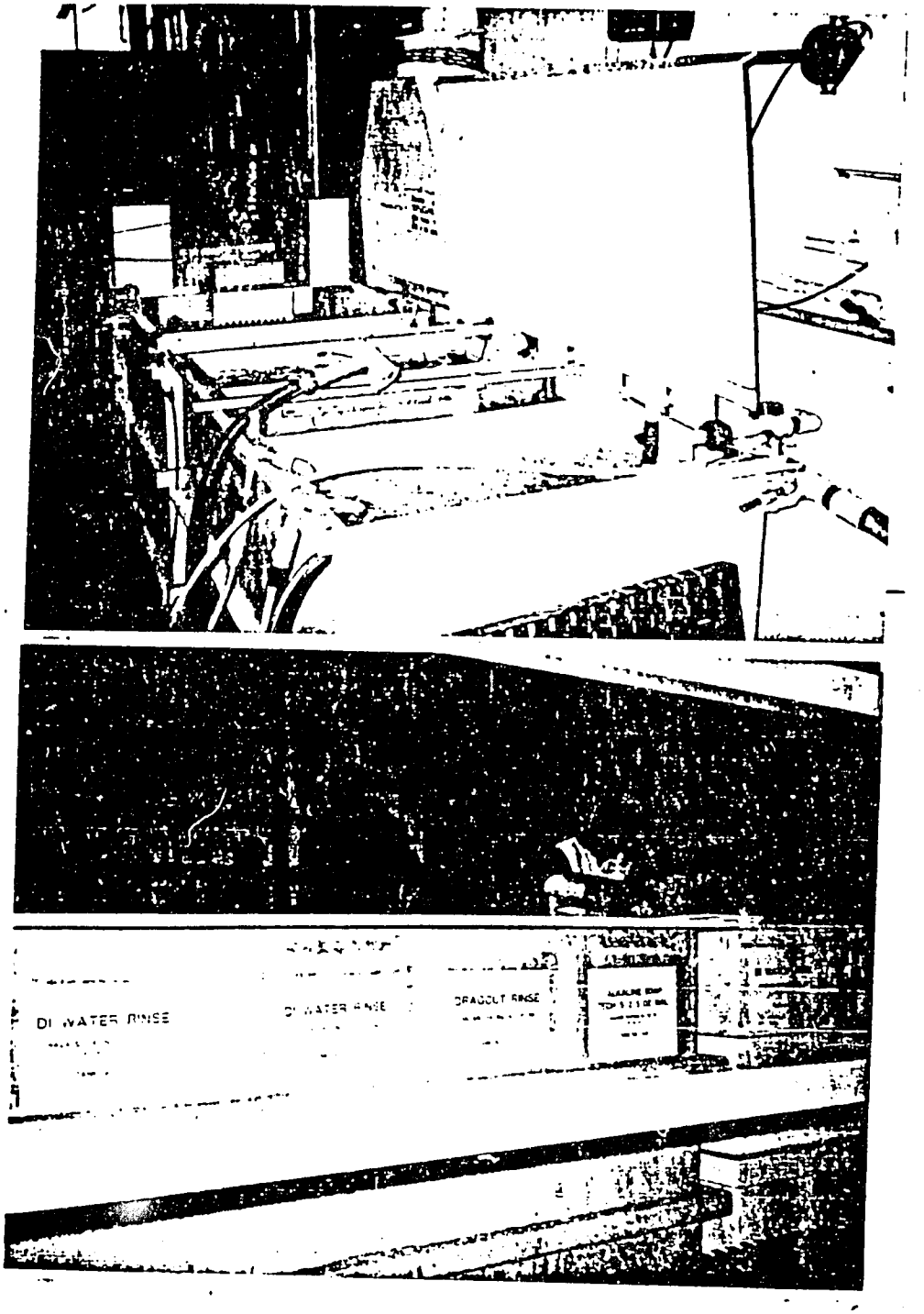

Deionized water more used in rinsing process practice
(Acteron Co, & Santa Clara Plating Co. Inc)

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Discussion with Jim. Mille (President of CSI Inc.)
He's describing about techniques of waste minimization
(Acteron Co & CSI office)

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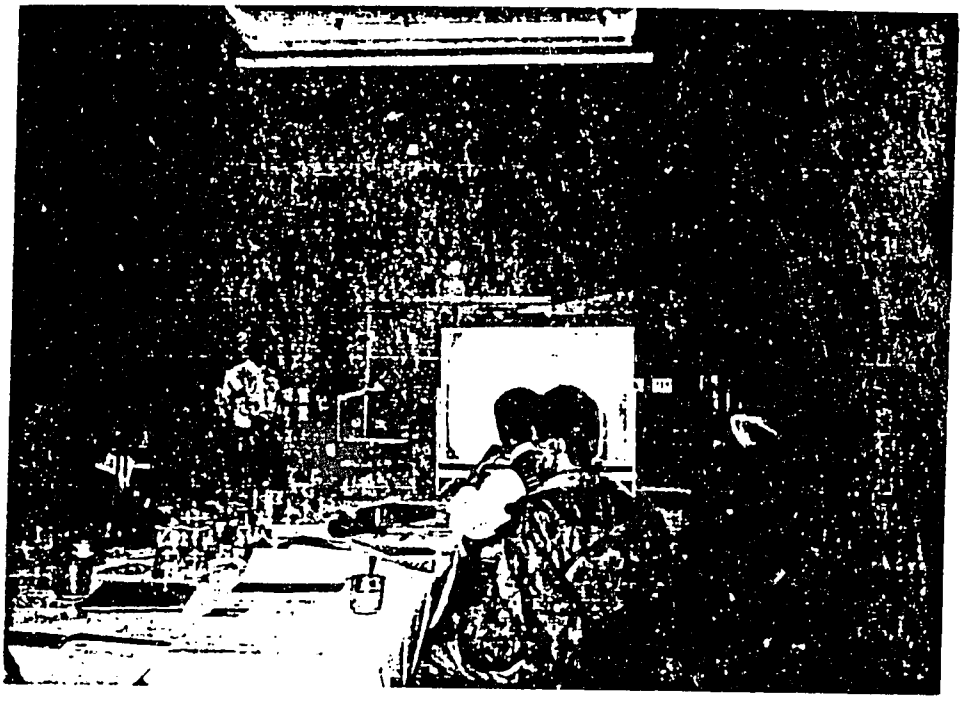

Chris Steffani, Staff of LLNL does describing efforts on waste minimization in LLNL electroplating facility

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Employee always wear work equipment
while is doing the job
(Santa Clara Plating Co. Inc)

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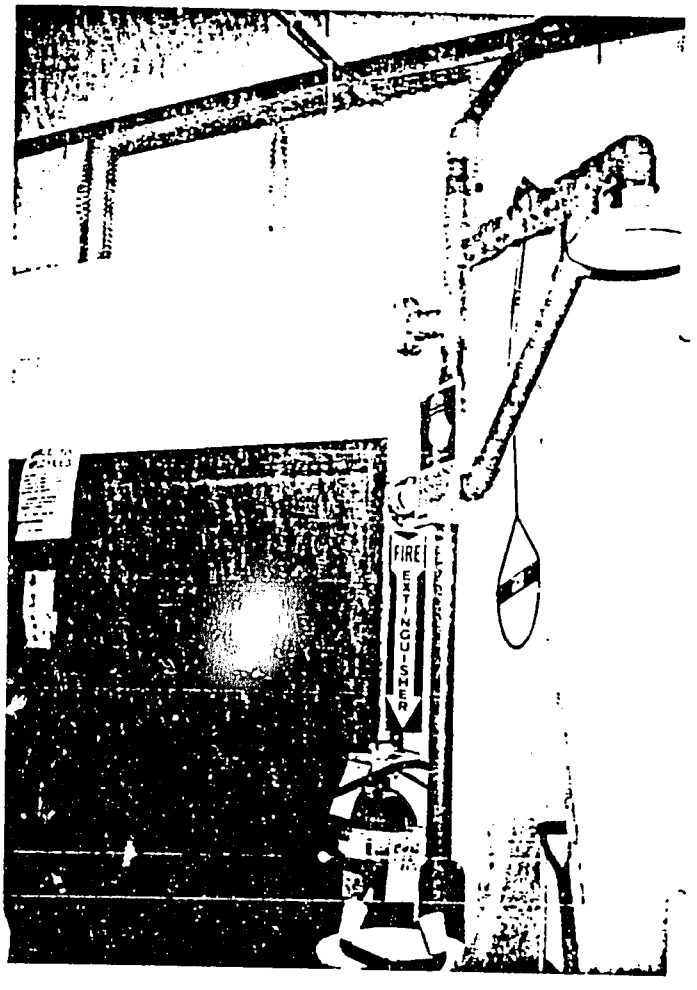

Emergency shower & eyewash
(Acteron Co.)

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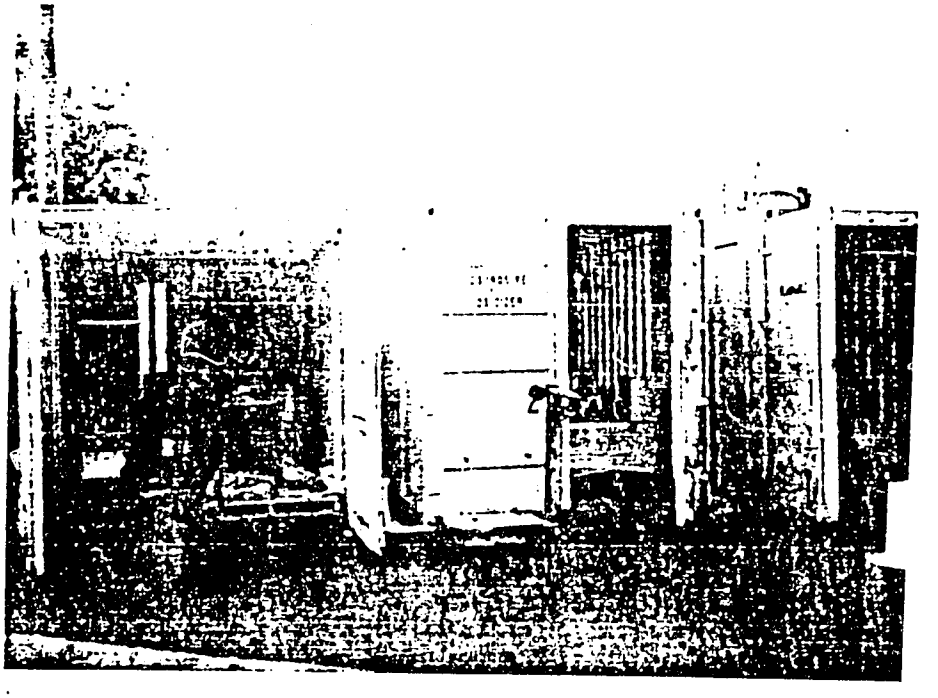

Separation system of incoparible materials
(Metal surface Inc, Bell Gardens, CA)

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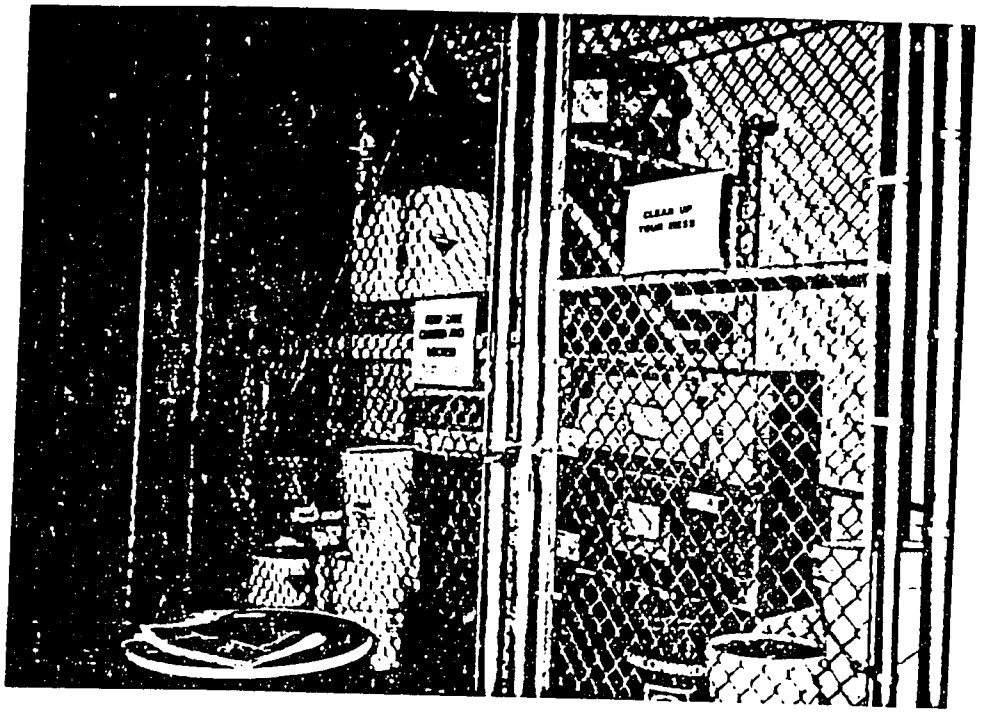

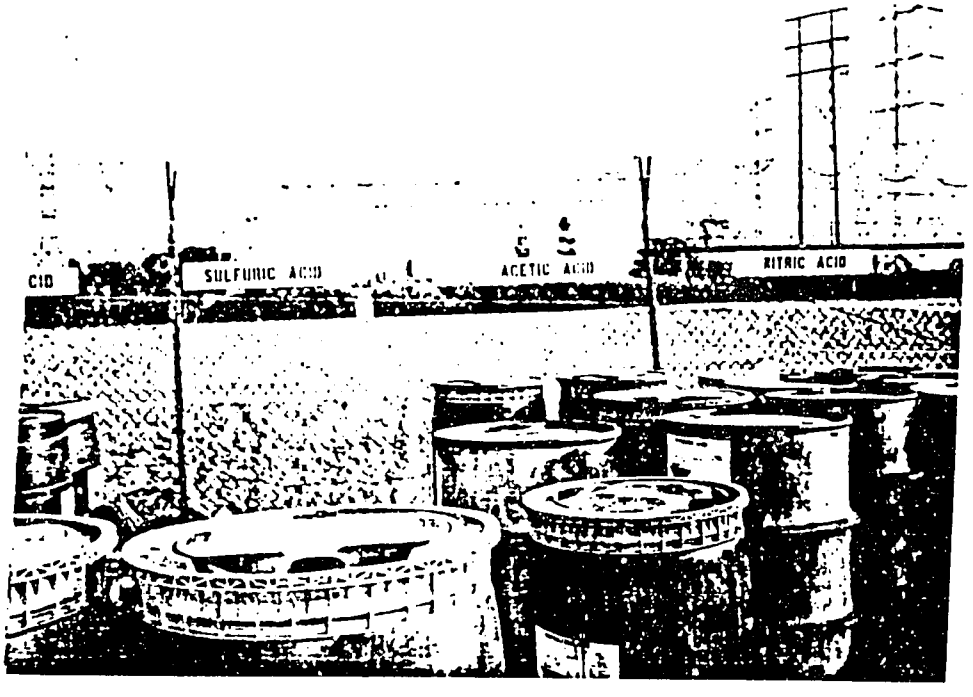

Labelling practice more applicated in chemical storage system
(Metal surface Inc. & Santa Clara Plating Co. Inc.)

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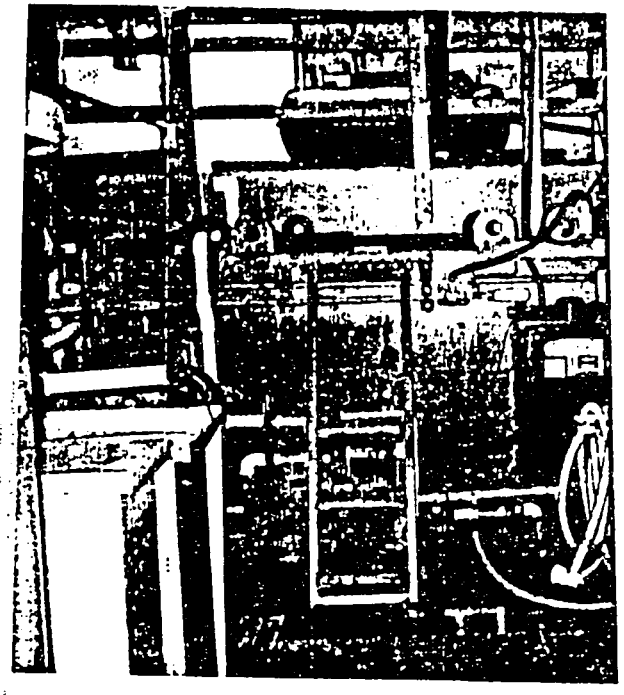

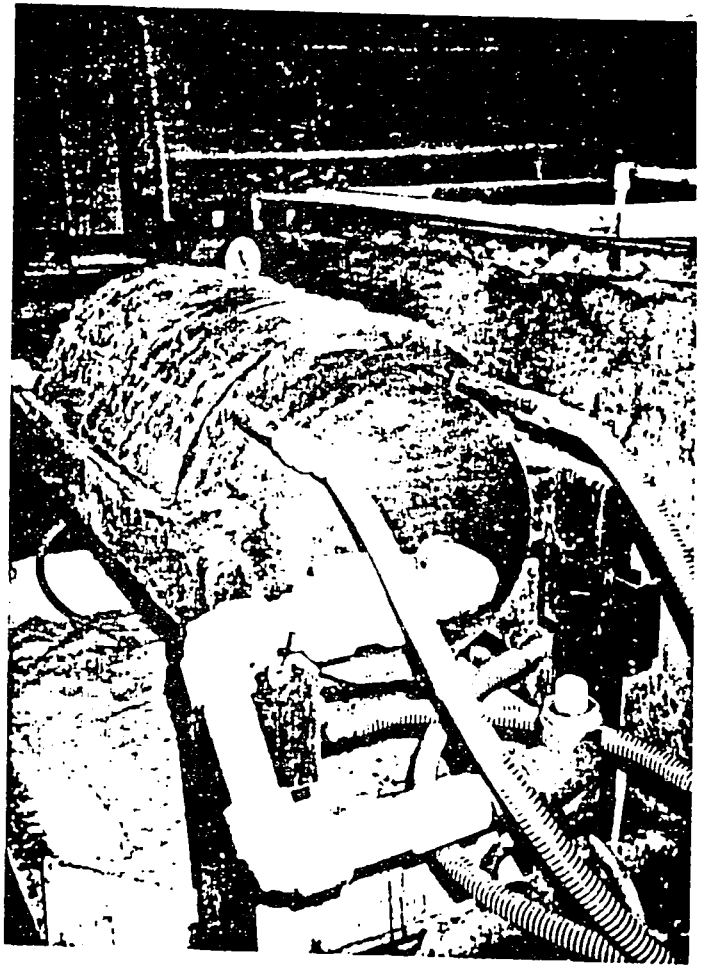

Acteron's wastewater treatment equipment

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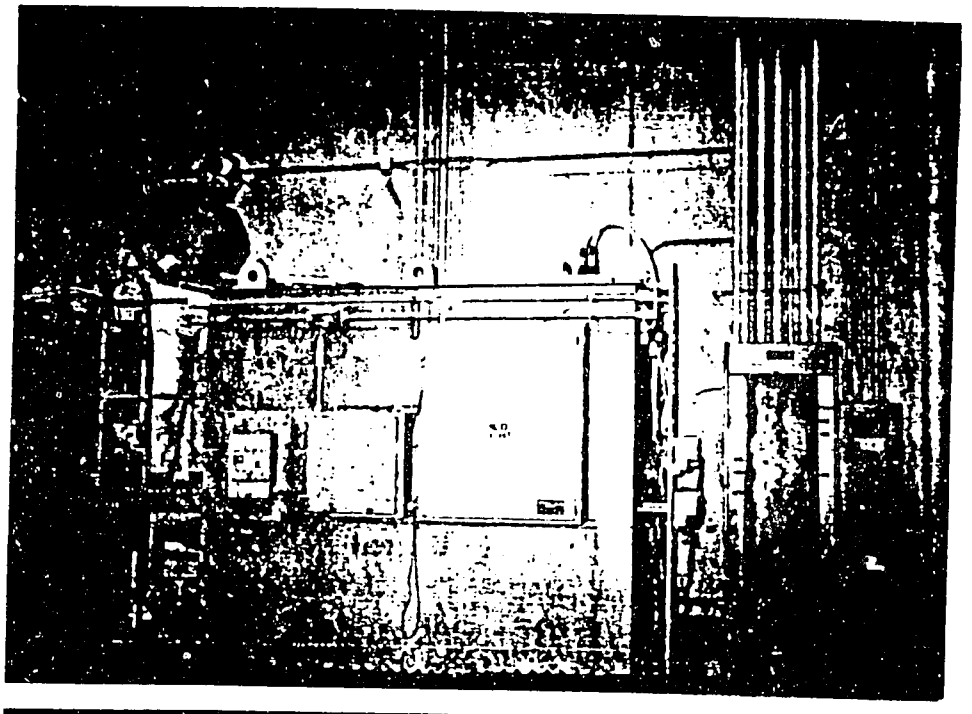

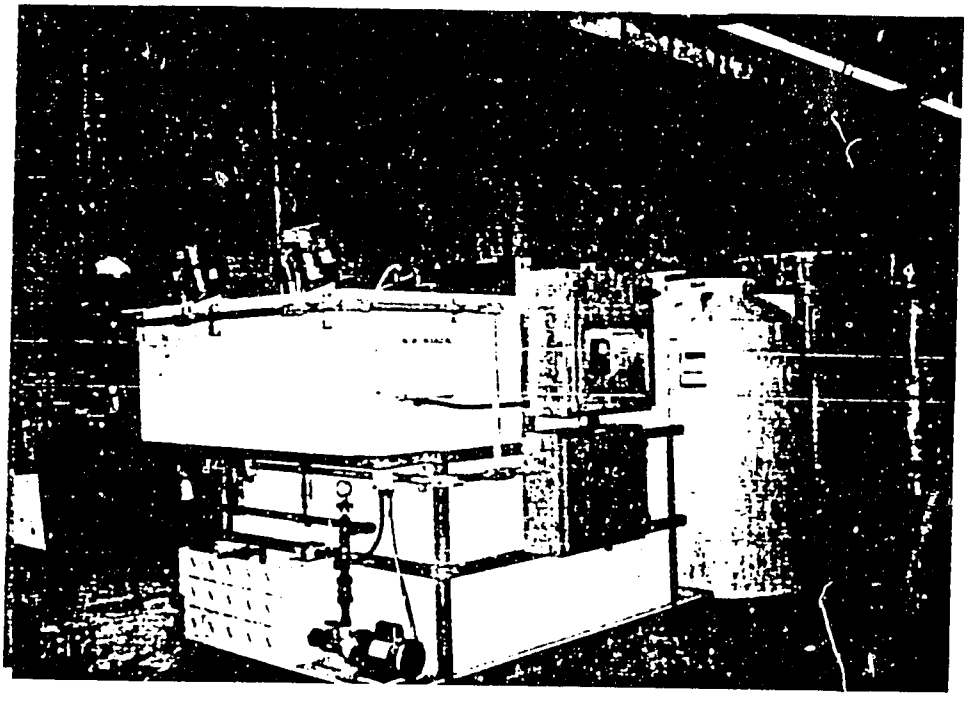

Glen C. Neustedter, President of WTS Inc. does explaining work system on the equipments of wastewater treatment at WTS facility.

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APPENDIX C

BUSINESS CARDS OF PERSONS CONTACTED

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PRESIDENT

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(714) 521-4112
(213) 773-4055

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Manager
Los Angeles Office

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818/995-7335
818/995-0857 (Fax)

Chicago Washington, D.C. Los Angeles Brussels

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DEPUTY PROJECT MANAGER

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NEW YORK, N.Y. 10016

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TLX 261200 ENVIRONENT
FAX (212) 683-5033

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ENVIRONMENTAL CONSULTING

JIM MIILLE
PRESIDENT

Helping Industry Meet Its Environmental Goals

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Fax: (510) 426-1889

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Inc.

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LOS ANGELES, CALIF 90011
(213) 749-7876

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dense chrome plating specialists

7019 CORPUS CHRISTI
HOUSTON, TEXAS 77020
(713) 678-8412

Susan B. Grant
General Manager

Electrolizing

Dense Chrome Plating Specialists

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Tel 213 749 7876
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epoc

Mark Rothweiler
Operations/Field Services

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Fax: (209) 291-4926

UNITED AIRLINES

Steven F. Sulgit
Facilities and Eng.
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FAX (415) 634-4551

United Airlines
Bldg. 49 - SFOFL
San Francisco Int'l Airport
San Francisco, CA 94128 3800

Glen C. Neustedter
President

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WASTEWATER TREATMENT SYSTEMS INC

Wastewater Treatment Systems Inc.
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FAX: (408) 541-8615

Part of the Thames Water Plc Group

(415) 369-5217
EXT. 14

Patrick Burt
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FAX: (415) 364-9748

OPTIMIZE PLANNING AND ANODIZING

University of California
Lawrence Livermore National Laboratory

Jack W. Dini
Section Leader
Materials Fabrication Division

P.O. Box 808, L-332
Livermore, CA 94551

(510) 422-8342
FAX (510) 422-1290

psi

Jim Elliott
Marketing Manager

process scientific, inc.

510/820-7583
824 MATADERA CIRCLE • DANVILLE • CA 94526
408/241-1533 • FAX 408/241-2118
960 SARATOGA AVE • SUITE 213 • SAN JOSE • CA 95129

Thomas L. Coss
President

(408) 727-9315 ext. 21
FAX: (408) 748-0987

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PLATING CO. INC.

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Santa Clara, CA
95050-3984

(408) 945-5300
FAX (408) 945-5442

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SANITARY ENGINEER

CITY OF SAN JOSE
WATER POLLUTION CONTROL
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Glen C. Neustedter
President

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Wastewater Treatment Systems Inc.
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Sunnyvale, California 94089
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Thames Water

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ENVIRONMENTAL IMPACT
MANAGEMENT AGENCY

Herry Hamdani
Staff of Directorate for Hazardous waste Management

Badan Pengendalian Dampak Lingkungan

Artbaloka Building 11 th floor
Jl Jend. Sudirman No. 2 Jakarta
Phone : (62-21) 5703419 ext. 209
Fax : (62-21) 5703365, 5702547

MINISTRY OF INDUSTRY
DIRECTORATE GENERAL OF MULTIVARI
OUS INDUSTRY

IR. BERANI SITUNGKIR

SECTION HEAD OF THE POLLUTION CONTROL

OFFICE :
14TH FLOOR MINISTRY OF INDUSTRY DIRECTORATE OF
ELECTRICAL EQUIPMENT AND METAL INDUSTRY
JL. GATOT SUBROTO KAV. 52-53 JAKATA 12950 INDONESIA
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Fax 21 365649
Telex 45507 Djabes IA

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Jl Pembangunan Balucepe
km 23 Tangerang
Telp 5523170 5523231
Fax (021) 552317

Ir. WIDYA WICAKSANA
Project Manager

PROBENGKEL
Proyek Pengembangan Bengkel
Promotion of SME S

YAYASAN MANDIRI

LEMBAGA PENGEMBANGAN INDUSTRI KECIL
INSTITUTE FOR SMALL SCALE INDUSTRI DEVELOPMENT

Office . Jl Dedenuk 32 Bandung 40133. Tlp (022) 7[illegible] 1506[illegible]

PADI
KOMPONEN

Suryanur Syafe'i
Chief Quality Control

Factory Office 3rd Floor • Jl. H.R. Rasuna Said Blok X - 1, Kav. 03, Jakarta 12950, Indonesia • ☎ (021) 5721068 • Fax (021) 5203581 • Telex 48122 GODEL IA

STAMPING & ELECTRO PLATING SHOPS

YKK

PT. YKK INDONESIA ZIPPER CO., LTD
NOTION DIVISION

Dr. Jaya Agung Prastowo

Factory :
Jl. Raya Jakarta - Bogor Km. 29
Cimanggis - Bogor.
Telp. (021) 8710641, 8711386-88
Fax. 8710962

Head Office :
Jl. R.P. Soeroso No. 7 Jakarta
Telp. 331708 (7 Lines)
Fax. 3106751, 3107109
Telex. 61465 YKK JKT.

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APPENDIX D

DOCUMENT RECEIVED

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World Environment Center 419 Park Avenue South Suite 1800 New York, NY 10016
Tel: (212) 683-4700 Telex: 261290 Envirocent FAX: (212) 683-5

MISSION

The World Environment Center contributes to sustainable development worldwide by strengthening industrial and urban environmental, health and safety policy and practices.

To achieve this mission, the Center:

Maintains an independent and non-advocacy position.

- Seeks to integrate environment, economics, energy and education.
- Establishes and promotes partnerships among industry, government and non-governmental organizations.
- Serves as a bridge for the exchange of information and expertise among industry, government and non-governmental organizations.
- Provides training and technical cooperation programs staffed by volunteer and other experts from industry, government, academia, non-governmental organizations and the general public.
- Encourages corporate environmental leadership and responsibility worldwide by providing international public recognition for outstanding accomplishments.

HISTORY

The World Environment Center is a not-for-profit, non-advocacy environmental organization. Although independent since 1981, WEC was founded in 1974 with seed funding from the United Nations Environment Programme. Today the Center is funded by industry, government, international organizations, corporate or private foundations and private citizens.

Initially, WEC published the bi-weekly World Environment Report and a number of environmental information directories. In 1977, the Center made a conscious decision to draw industry into the environmental policy dialogue with the creation of its International Environment Forum (see IEF).

In 1981, WEC held the first of four major conferences on the links between the environment and development, drawing representatives from industry, government, non-governmental and international organizations, academia and the media from countries around the world.

In 1982, after earlier pilot activities, WEC launched an industry and government supported pro bono environmental technology transfer program, the International Environment and Development Service (see IEDS).

In 1985, the first WEC Gold Medal for International Corporate Environmental Achievement was presented.

World Environment Center
Industrial Waste Minimization Assessment Program
Indonesian Metal Finishing Industry

United States Study Tour - December 1993

The World Environment Center (WEC), through a cooperative agreement with the United States-Asia Environmental Partnership and the United States Agency for International Development in Indonesia, is supporting sustainable development by strengthening industrial and urban environmental, health and safety management policy and practices in Indonesia. WEC is demonstrating, through cooperation of U.S. technical experts, the environmental and economic benefits resulting from no/low cost waste minimization techniques in the metal finishing industry.

Waste minimization assessments have been conducted at eight Indonesian metal finishing facilities over the past two years. The waste minimization assessments focused on the identification of no/low cost practices and techniques that can reduce the discharge of pollutants and improve worker health and safety. Upon completion of the assessments, a technical waste minimization workshop was held in Jakarta for approximately 40 industry, government and non-government managers and design engineers. The workshop summarized assessment observations, presented Indonesian waste minimization success stories, and provided the exchange of waste minimization experience from Indonesian industries to other Indonesian industries.

WEC is currently coordinating a U.S. study tour for six Indonesian representatives (two from government and four from industry) during December 6-18, 1993. The objective of the U.S. study tour is to provide the participants with an intensive overview of technologies and management practices implemented in the U.S. which enhance waste minimization and improve worker health and safety. The study tour provides the Indonesian participants and U.S. counterparts with a unique opportunity to exchange experiences with respect to environmental, health and safety management and provides a basis for continued interaction and international cooperation regarding the metal finishing industry's response to heightened environmental standards and regulations.

Participating host facilities will provide a walk through facility tour and brief the Indonesian representatives on issues regarding waste water treatment and management, solid waste management and disposal, and measures taken to ensure worker health and safety. Upon return to Indonesia, the study tour participants will conduct a second waste minimization workshop to share their experiences gained in the United States.

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World Environment Center 419 Park Avenue South Suite 1800 New York, NY 10016
Tel: (212) 683-4700 Telex: 261290 Envirocent FAX: (212) 68

WEC WASTE MINIMIZATION PROJECTS INDONESIA: 1992-PRESENT

1992:

May: Waste minimization assessment of three metal finishing plants, followed by a one-day workshop/seminar on waste minimization. Two WEC-sponsored U.S. experts visited the facilities.

June: Waste minimization assessment at two pulp and paper facilities. This assessment involved observation of the current waste minimization/pollution control activities and facility operation. Two WEC-sponsored U.S. experts visited the facilities.

August: Workshop in Los Angeles, California to develop a comparative city case study on mobile sources of air pollution, in preparation for "Megacities" conference, 1993, Jakarta.

October-November: Second round of waste minimization assessment for the Pulp and Paper industry. One facility was visited by a WEC-sponsored U.S. expert.

December: Waste minimization assessments of 5 textile plants in Bandung, Indonesia followed by a one-day workshop/discussion to review audit results with plant managers. Two WEC-sponsored U.S. experts participated in the waste minimization assessments.

1993

February: WEC sponsored the "Megacities on the Pacific Rim and the Burden of Air Pollution" conference in Jakarta, Indonesia. This conference and working session addressed air quality concerns of eight major urban centers in the Pacific Rim. Topics included: Stationary sources; Mobile sources; Health and economic concerns; Institutional and regulatory frameworks.

April: Third round of waste minimization assessments for the Pulp and Paper industry. Four Indonesian Pulp and Paper facilities were visited by three WEC-sponsored U.S. experts.

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June: Second round of waste minimization assessments at metal finishing facilities. Eight facilities were visited by two WEC-sponsored U.S. experts.

July: Pulp and Paper Workshop:

This workshop was specifically designed to follow the pulp and paper plant waste minimization assessments conducted during the past year, by the three experts who performed those assessments. The workshop addressed industry-wide needs identified during the assessments. These needs included improved sampling and analysis of waste streams, knowledge of raw material used, and knowledge of manufacturing/waste minimization principles and assessment practices. Workshop participants will be selected for further intensive training with the agreement that they serve as waste minimization trainers for the Pulp and Paper industry.

October: Metal Finishing Workshop:

This workshop was designed to follow up waste minimization assessments in the Metal Finishing industry sector conducted during the past year. The workshop addressed: Environmental management programs and waste minimization principles and assessment practices in the following areas: Electroplating, wastewater treatment, principles of rinsing, cyanide (chemical) safety and control, recycling and recovery, process modification.

October: Two week Pulp and Paper Study Tour of medium sized pulp and paper facilities in the United States.

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ENVIRONMENTAL POLICY STATEMENT
Metal Finishing Association of Southern California

The Metal Finishing Association of Southern California (MFASC) supports the uniform enforcement of all current Local, State and Federal environmental laws. We strongly believe that protection of the environment is, and must continue to be, a primary objective of our Association and its members.

We will vigorously support all equitable and reasonable regulations designed to achieve that goal and we condemn those who would purposely evade those regulations.

Waste, both toxic and otherwise, is a natural by-product of our industrial society in general and of our industry in particular. This waste generation is not by design; it is not what we would wish; it is merely the natural result of the processes of an industry doing its best to meet the demands of the marketplace in this very complex and sophisticated world.

Therefore, rather than dwelling on the negative aspects of what has gone before, we intend to try to encourage a spirit of cooperation. Cooperation between the generators of waste, the public, which benefits from the end-products of the processes causing the waste and the various governmental agencies and authorities charged with the responsibility of protecting the public and the environment.

In order to be successful, however, this cooperative effort must be supported by a responsible and objective media. We urge their examination and participation and will respectfully point out that outright advocacy and sensationalism only obscure the issues and retard rather than promote resolution.

In its efforts to attain these goals, the MFASC will attempt to initiate and maintain an ongoing dialogue to communicate its point of view on relevant issues to the public, to government and to the media. These issues may be of an informative nature, or they may involve technical considerations, but in all cases they will be pertinent to our concerns of managing wastes in a safe, economical and efficient manner.

As a part of this policy and as a part of MFASC's service to its members, we will attempt to keep them as up-to-date as possible on the issues of the times, on current regulations and on methods and technologies to meet those regulations. We are mindful that if we, as a society, are to be successful in protecting ourselves and our environment, we must, as a primary goal, seek the development of alternative methods to the disposal of toxic wastes by land filling. One such method, which we strongly support, is centralized facilities that can take in, treat, recycle, recover or destroy waste from industry.

Metal Finishing Association of Southern California
5000 Van Nuys Boulevard, Suite 400
Sherman Oaks, California 91403
(818) 995-7338

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METAL FINISHING ASSOCIATION OF SOUTHERN CALIFORNIA INC.

STATEMENT OF POLICY

The members of the Metal Finishing Association of Southern California wish to remind you of the established practices of the metal finishing industry in processing your materials.

In order to avoid misunderstandings, we are setting forth below conditions under which your material will be accepted by us for processing:

1. Whenever we are given material with detailed instructions as to treatment, our responsibility shall end with the carrying out of those instructions. Type of material, tolerances and specifications for processing shall be declared in writing prior to our processing.

2. Our liability for any cause is limited to the cost of direct labor and material of the product directly damaged by our processing or three times our processing charges on such material, whichever is the lesser. Charges for our services are based on this Policy limiting our liability.

3. Liability greater than that outlined in paragraph (2) above will be assumed by us only when so agreed in writing by us. In such event a higher charge may be made for our services.

4. Parts, materials, etc. as processed by us shall be presumed to be accepted as satisfactory by you if we are not notified of damages, shortages or other discrepancies within ten working days of your receipt of the same.

   Rejected parts must be returned to us for rework. Further processing or assembly of rejected parts, materials, etc., by you or any other party shall constitute a waiver of any liability on our part.

5. Where operations or processes performed by us are in the nature of "salvaging" parts or material, the work is accepted on a "best effort" basis and no liability shall attach to us unless previously agreed upon in writing prior to processing the job.

6. In the event that results of metal finishing operations are unsatisfactory due to metal imperfection, changes in grade or composition of materials, manufacturing and/or fabrication imperfections, usages for which the plating or other finishing operation was not reasonably designed, and similar variables over which we have no control, the customer would be required to pay the contracted amount for the finishing operation performed.

We trust you will agree with us that the conditions above set forth are realistic and reasonable and that acceptance of the material for processing subject to such conditions will permit us to continue to provide quality metal finishing at an economic price.

5000 Van Nuys Boulevard, Suite 300 • Sherman Oaks, California 91403 • (818) 995-7338

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PROGRAMS

International Environment Forum (IEF)

The IEF is a group of 60 major multinational manufacturing corporations based in eight countries and engaged in nine industrial sectors with operations on six continents. The IEF meets quarterly for off-the-record discussions of environmental, health, safety and resource management issues with senior policy-makers from around the world.

WEC offers the IEF proprietary programs, including the Country Profile Program which, through reports produced by and for IEF companies, supplies detailed information on environmental, health and safety requirements in over 20 countries worldwide.

WEC offers workshops that promote the inter-sectoral exchange of information and experience in such subjects as corporate international environmental management, environmental auditing, waste minimization, total product life-cycle analysis and waste remediation practices. Additionally, WEC coordinates the joint development of training programs to provide IEF companies cost-effective, culturally-relevant solutions to the steadily increasing need to transfer skills, technology and information to operations worldwide.

International Environment and Development Service (IEDS)

Using volunteers and other experts, contributed services and materials from industry, government, academia and non-governmental organizations, IEDS provides pro bono assistance worldwide to enhance industrial and urban environmental, health and safety management policy and practices. To accomplish this, IEDS conducts:

- institutional and factory assessments;
- technology cooperation and training workshops; and
- study tours and on-the-job internships for environmentalists and government and industry officials.

Travel and management costs are funded primarily through cooperative agreements with the U.S. Agency for International Development. Other funding comes from industry, the U.S. Environmental Protection Agency, the World Bank and private citizens. More than 250 activities have provided opportunity to work with or training for 700 professionals from 28 countries.

WEC Gold Medal for International Corporate Environmental Achievement

The WEC Gold Medal honors multinational corporations having outstanding, sustained and well-implemented, worldwide environmental policies. It may be awarded annually by an independent international jury of distinguished environmentalists from academia, government, non-governmental organizations and the medal-winning company of the previous year. Past recipients of the WEC Gold Medal are Xerox Corporation (1993), The Procter & Gamble Company (1992), Rohm and Haas Company (1991), IBM Corporation (1990), The Dow Chemical Company (1989), The British Petroleum Co. p.l.c. (1988), E.I. du Pont de Nemours & Co. (1987), Exxon Corporation (1986) and 3M (1985).

Rev. 7/27/93

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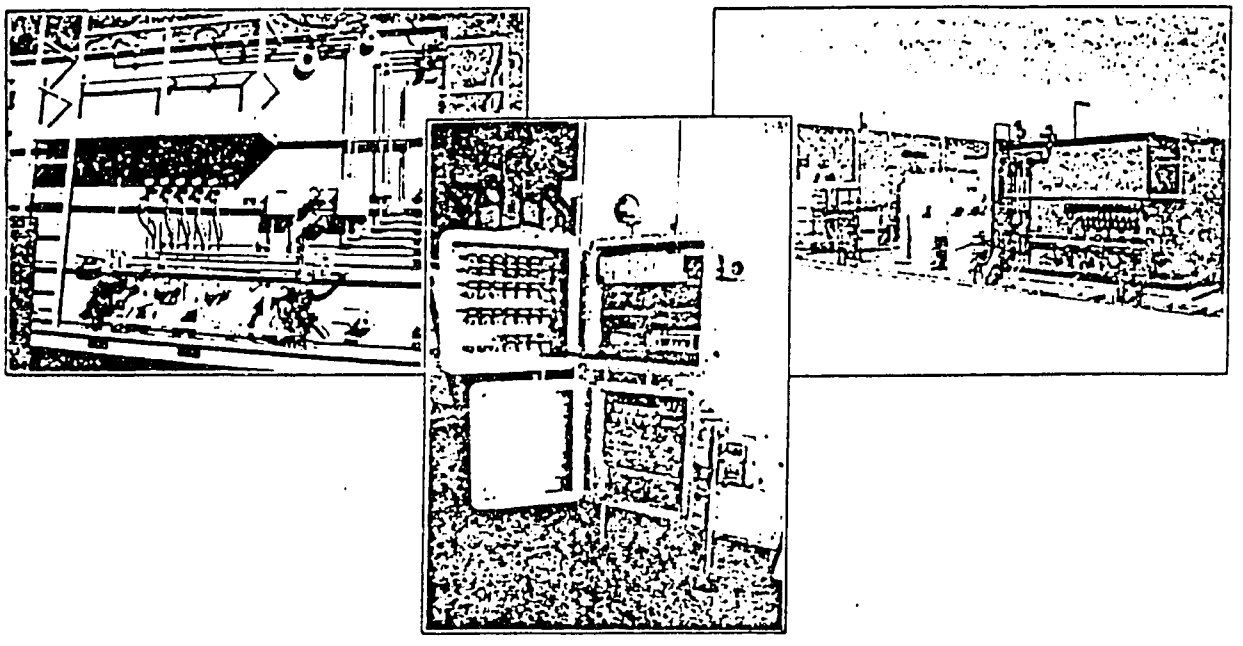

WTS
WASTEWATER TREATMENT SYSTEMS INC

COMPANY PROFILE

INTRODUCTION

Wastewater Treatment Systems, Inc., (WTS) was founded in April 1985. With more than fifteen years of experience in the industrial wastewater treatment industry,the founders brought together considerable knowledge and technical capabilities in the chemical, mechanical, instrumentation, and process design fields of industrial wastewater treatment. This knowledge and these capabilities, combined with years of proven achievement in providing successful wastewater treatment system installations, have made WTS an industry leader.

WTS was founded with the objective of providing high quality equipment combined with unsurpassed professional engineering services and support. This objective was to be fulfilled through the development of standard, packaged equipment used for treatment of a wide variety of industrial waste effluents. In addition, these products and installations would be supported by the formation of a diversified staff of engineers and field support personel. These individuals are the key to maintaining a high quality product furnished with the required support and service to ensure successful installation of WTS products.

WTS is a member of the Thames Water Plc Group, an international supplier of water, process fluids, and wastewater treatment. From the smallest industrial user to the largest utility, Thames Water companies provide a complete package of products and services. WTS's prominence in the industrial wastewater treatment industry is ensured by their integration with Thames Water Plc. This gives WTS the financial strength of the Thames Water balance sheet, as well as Thames Water's experience as a major supplier of wastewater products and services, and utility operations.

Today, WTS has achieved and maintained its founding objective. This is confirmed by the diverse line of high quality, standard products now offered by WTS, and by its many successful installations located throughout the world.

WTS SERVICES

Field Support:

WTS understands successful system performance relies on effective field installation, commissioning and ongoing service. WTS maintains an independent staff of field engineers and technicians capable of providing the following support functions:

- Project Management
- Turnkey Installation
- Ongoing Maintenance
- Troubleshooting
- System Commissioning
- Performance Testing
- System Operation
- Emergency Repair

Commitment to Field Operations is a key factor to the success WTS has achieved in the industry today. WTS continues to offer and works to provide unequaled Field Support to its installed customer base.

Engineering

WTS supports its manufactured products and installations by maintaining an engineering staff encompassing the following disciplines:

- Mechanical Engineering
- Chemical Engineering
- Civil Engineering
- Electrical Engineering
- Manufacturing Engineering
- Environmental Engineering

WTS has developed this group of engineers to ensure quality design of its manufactured products and competent support for its equipment installations. This level of engineering expertise is a mandatory element for successfully supporting today's evolving industrial wastewater treatment requirements.

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WTS PRODUCTS

Packaged Systems:

WTS offers the finest in packaged industrial waste-water treatment systems. These system designs are primarily based upon proven, conventional treatment technologies enhanced by specialized process engineering and state-of-the-art automation. The packaged units are installed as stand-alone systems, or easily incorporated into more complex, specially engineered systems. Typical treatment applications for the packaged plants are:

- Heavy Metals Removal
- pH Neutralization
- Cyanide Destruction
- Arsenic Removal
- Waste Evaporation
- Aqueous Cleaning Effluent Treatment & Recycle
- Fluoride Removal
- VOC Removal
- BOD/COD Reduction
- Oil/Grease Reduction
- Water Recycle
- Semi-Aqueous Cleaning Effluent Treatment & Recycle

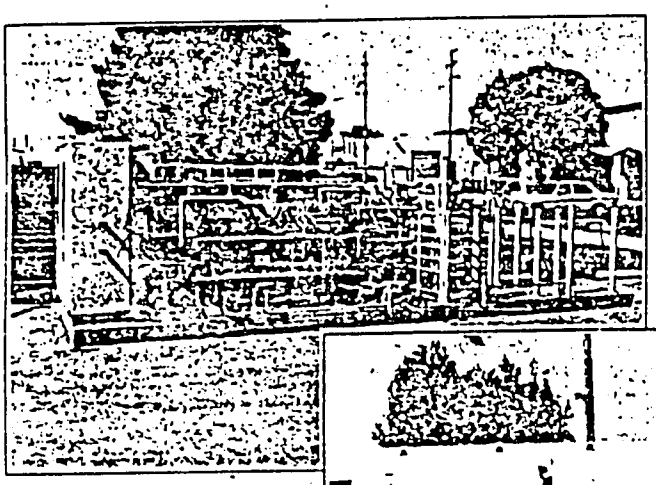
The packaged systems can treat waste streams containing concentrated and dilute levels of contamination. Standard systems are based upon continuous flow and batch treatment processes. The systems are offered with all peripheral devices necessary to provide a complete, functional wastewater treatment system.

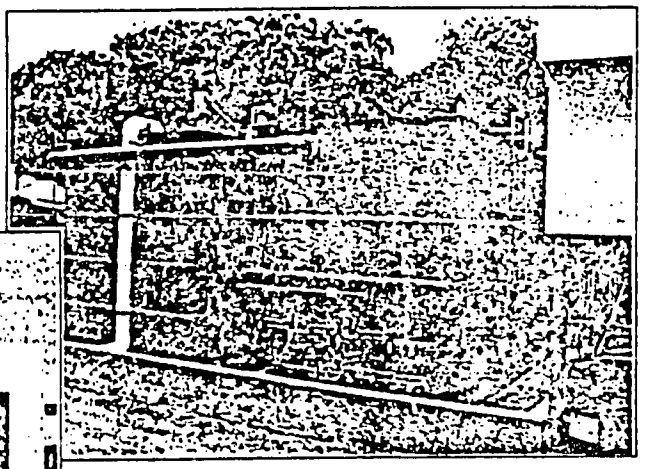
Engineered Systems:

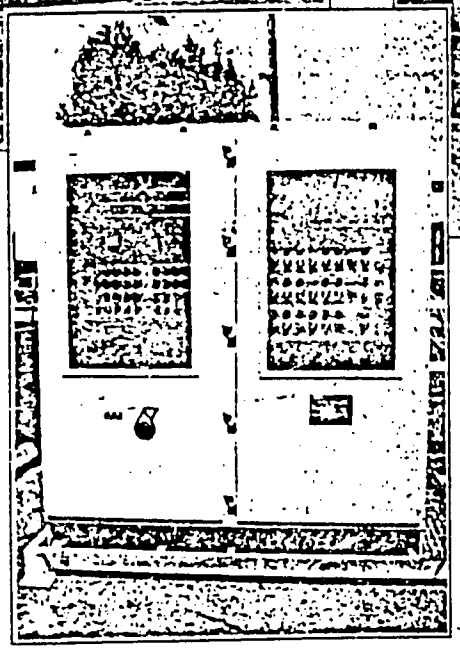
WTS provides detailed design, and manufacture of specialized equipment for custom engineered wastewater treatment projects. This capability, together with our standard packaged systems, allows WTS to provide high quality equipment to meet the many diversified needs of industrial wastewater treatment. Treatment equipment for non-standard, engineered applications includes systems such as the following:

- Ammonia Treatment
- Phenol Treatment
- Tanker Truck Wash Effluent Treatment
- Sodium Azide Treatment
- Landfill Leachate Treatment
- Laundry Effluent Treatment/Recycle
- Vehicle Cleaning Effluent Treatment
- Zero Discharge
- Existing System Rebuilds/Upgrades
- TDS Controls

These non-standard, engineered systems typically incorporate the same state-of-the-art automation included with WTS packaged products. These systems are also offered with all peripheral devices and WTS service necessary to provide a complete functional wastewater treatment system.







WTS
WASTEWATER TREATMENT SYSTEMS INC.

Wastewater Treatment Systems Inc.
1235 Elko Drive
Sunnyvale, California 94089
Telephone: (408) 541-8600
FAX: (408) 541-8615

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The Treatment of Laundry Effluent:

ANOTHER WASTEWATER

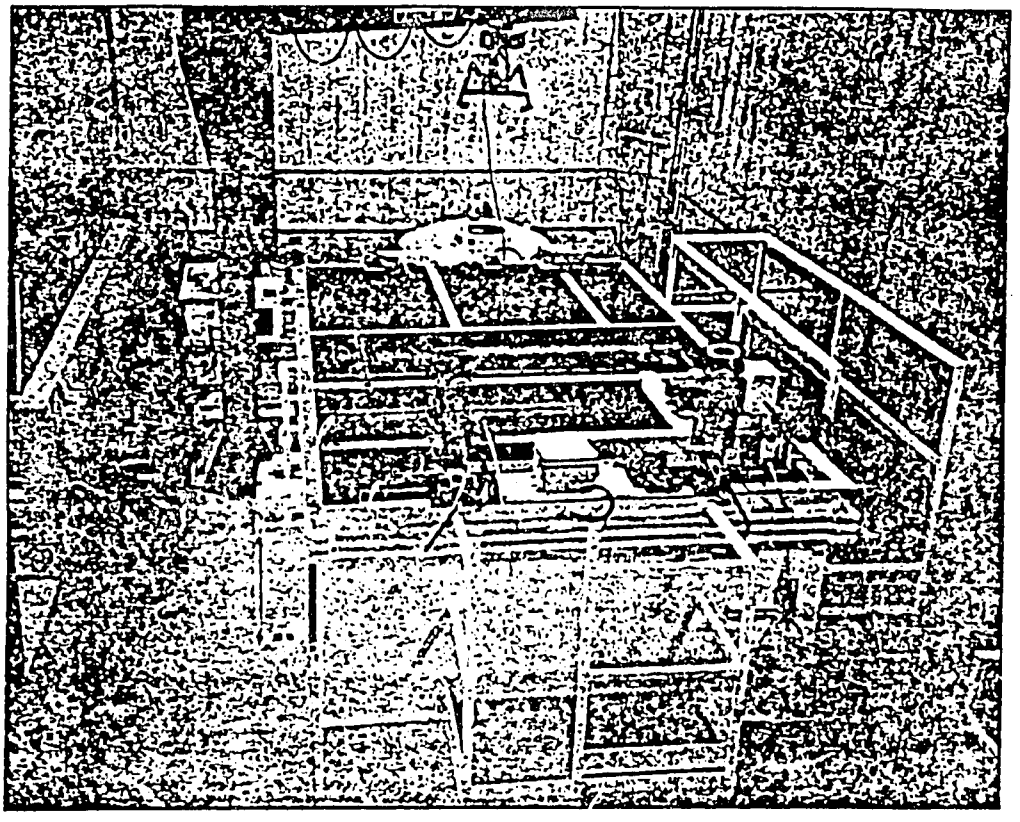
WTS

WASTEWATER TREATMENT SYSTEMS INC.

part of the Thames Plc Group

LOCATION:
Tullahoma, Tennessee
U.S.A.

CLIENT
Mid-South Uniform Service, In



* **SCOPE OF SUPPLY:**
Process design, manufacture, delivery, and commissioning of all the mechanical, electrical, instrumentation and control equipment required for pre-treatment of the laundry's effluent.

* **PROJECT DATE:**
System commissioned in November 1992.

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THE PROBLEM:
In November of 1992, Mid-South Laundry, of Tullahoma, Tennessee, car to WTS with the following water treatment problem:

Local receiver guidelines required that they reduce the level of the contaminants from their wastewater outflow:

- Oils and Grease
- Heavy Metals
- Suspended Solids
- Residual Organics
- Detergents

An economy-conscious company, Mid-South needed a solution that wou both satisfy these environmental regulations, and be economically feasib WTS went to work on the problem, supplying conventional chemic physical treatment methodology with an eye to efficiency, performan and economy throughout.

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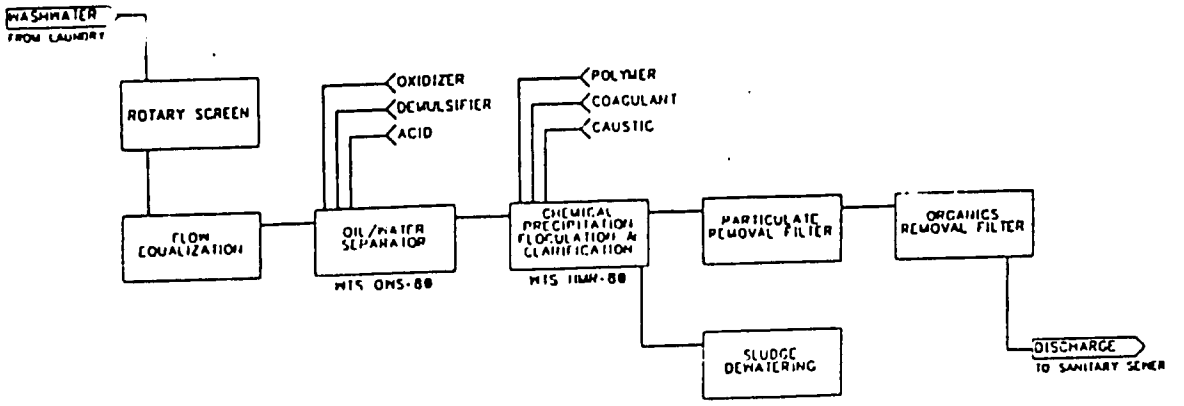

MID-SOUTH LAUNDRY EFFLUENT TREATMENT PROCESS DIAGRAM

THE SOLUTION:

WTS designed a multi-phase treatment system, based upon usin standard WTS products. The first step - to remove large fibrous solids fro the effluent - required installing a rotary screen. Beyond the scree Mid-South installed a flow equalization tank, a necessity in laundries whic have highly variable levels of effluent contamination.

Next, the effluent is pumped into a WTS OWS-75 gravity type oil/wat separator, which uses lamella style inclined tubes to enhance th separation process. Chemical pretreatment also takes place at this stage the process to demulsify the oils and grease.

Beyond the oil/water separator, the effluent moves to the WTS HMR- chemical precipitation/clarification system for removal of the remainin contaminates. This system provides chemical conditioning and pH adju ment for effective precipitation of heavy metals and residual oils a grease. The precipitate is then flocculated using anionic polymer, a removed from the effluent using a lamella style clarifier.

At this point, the effluent leaving the HMR-75 is typically in complian with environmental requirements, and with no indication of color. T following treatment steps are precautionary, and typically come into p only when very heavily soiled laundry is being washed.

The effluent leaving the HMR-75 is pumped through, a multi-media filter remove any residual suspended solids, and a subsequent activat carbon filter to remove residual organics. Finally, the effluent is discharg into the sanitary sewer, meeting the pre-treatment requirements esta lished by the receiving authority.

SYSTEM CAPACITY:	
Maximum Throughput	70,000GPD
Maximum Flow Rate	75 GPM
Oil/Grease Loading	2000 ppm
Suspended Solids Loading	1000 ppm
Heavy Metals Loading	30 ppm

EFFLUENT QUALITY:	
Oil/Grease	Less than 10 ppm
Zinc	Less than 1 ppm
Cadmium	Less than 0.1 ppm
Lead	Less than 0.4 ppm
Total Chrome	Less than 1.0 ppm
Suspended Solids	Less than 1.0 ppm
Water Clarity	No color / tint visible

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WASTEWATER TREATMENT SYSTEMS INC.
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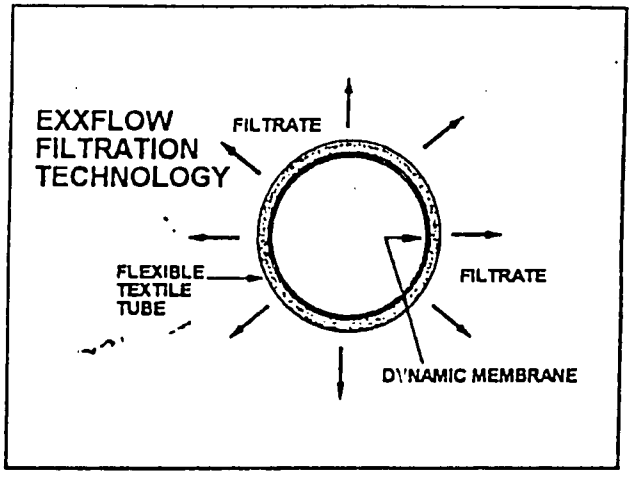
part of the Thames Water Plc Group

EXXFLOW™ CROSSFLOW MICROFILTRATION

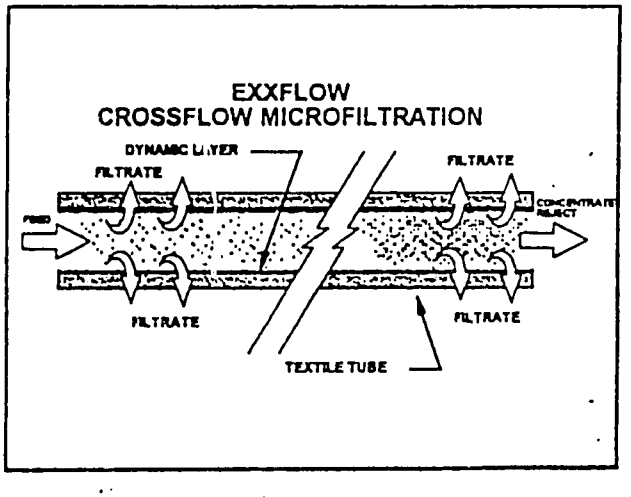
The *EXXFLOW* crossflow microfiltration process occurs in an array of permeable textile tubes. Manifolds are cast onto each end of the cloth filter to form modules which are connected to a pump for liquid inlet and to a back pressure valve at outlet. Upon introducing liquid flow into the tubes and regulating outlet pressure, suspended and colloidal matter in the liquid to be treated forms a thin film cake layer on the internal surface of each tube. This layer is called a "dynamic membrane" for its membrane-like characteristics. Other terms used are "filter layer" and "pre-coat layer". Should the quantity of suspended matter in the feed liquid be insufficient to form a filter layer, a small amount of filter aid compound is added to the initial feed. Filter layers or membranes of widely different characteristics can be produced by using different treatment chemicals.



To become treated product liquid, or **permeate**, the feed water filters radially through the membrane layer and out of the textile tube walls for collection at the base of each filter module. The debris removed from the liquid becomes concentrated and is swept out of the tubes with the remaining liquid which is called **reject concentrate.**

It is from the longitudinal or "crossflow" passage of the feed liquid along the filter cloth tubes that the process derives its name.

EXXFLOW crossflow microfiltration plants are of modular construction employing a number of manifolded filter modules. Modules are connected together either in parallel or in series with each other.



Ease of cleaning is an important feature of *EXXFLOW* crossflow microfiltration, distinguishing it from standard membrane microfiltration. In most cases, cleaning is simply a matter of momentarily stopping the feed resulting in tube collapse which causes the thin cake or membrane material to be dislodged and flushed out with the reject flow. In other applications, chemical cleaning in place is used.

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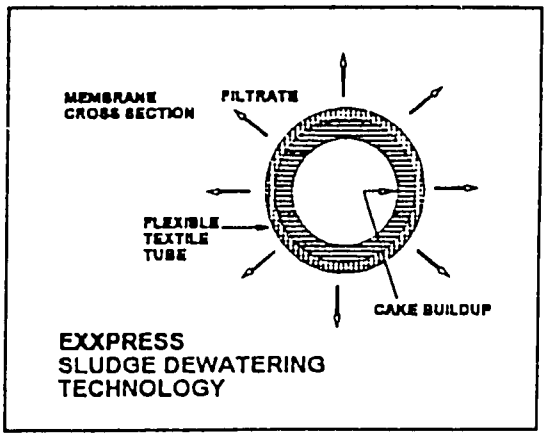
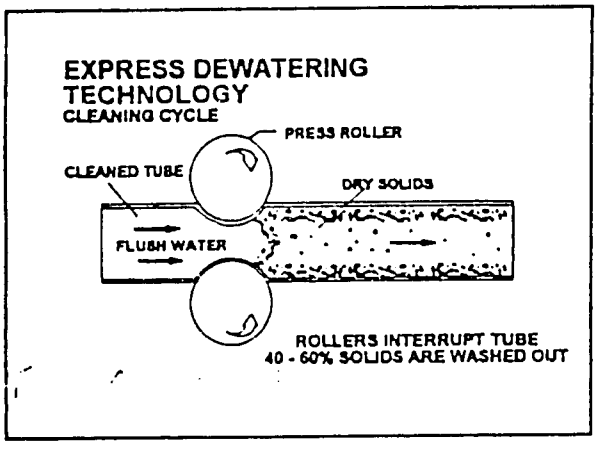
960 SARATOGA AVENUE • SUITE 213 • SAN JOSE • CALIFORNIA 95129 • 408/241-1533 • FAX 408/241-2118

EXXPRESS™ AUTOMATIC TUBULAR FILTER PRESS

Wastewaters, or dilute slurries containing concentrations of 2 to 20% solids or more can be dewatered if pumped into filter modules operating with all tubes in parallel in the dead end mode. This mode is achieved by closing the outlet valves at the reject end of the module. The slurry forms a cake layer on the internal walls of the tubes. Its associated water permeates through the cake layer and escapes as filtrate on the outside of the tubes. The dewatering cycle is complete when the cake layer reaches a controlled thickness. The solids discharge cycle then commences by opening the outlet valves and traversing the module with rollers. The venturi formed by the rollers creates a high velocity with the incoming water and flushes the solids down the tubes and onto a dewatering screen.



EXXPRESS
SLUDGE DEWATERING
TECHNOLOGY



Compared to conventional dewatering devices, including centrifuges, plate and frame filter presses, vacuum and belt presses, the *(EXXPRESS)* has the following advantages:

Lower installed capital cost

Use of the same filter cloth as *EXXFLOW*

No chemical additions are required

Low operating pressures are used resulting in lower cost of operation

EXXPRESS is self cleaning and automatic

Sludge from water treatment processes and industrial sludges including toxic and hazardous materials

EXXPRESS produces superior quality filtrate

NOTE: "EXXFLOW AND "EXXPRESS" ARE LICENSED TRADE NAMES OF EPOC WATER, INC.

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The *EXXFLOW* core technology is based upon the highly specialized woven textile tubular array and its post weaving treatment as well as on the formation and maintenance of dynamic layers, or membranes, and cleaning techniques.

A uniformly high quality permeate is achieved with the EXXFLOW crossflow microfiltration process. Removal of virtually all suspended solids down to about 0.1 micron has been demonstrated in countless laboratory and field trials. Other experimental work indicates that *EXXFLOW* can be developed to produce a low pressure process to reject high molecular weight dissolved solids.

The process has many advantages over conventional treatment process:

Most liquids are treatable without the addition of filter aid chemicals

Specialized membranes can be formed to produce the desired quality of treated liquid by using standard chemistry.

EXXFLOW is a low pressure process (20 - 35 psi) with a low crossflow velocity (3 - 6 fps)

The single stage treatment produces a treated liquid having no suspended solids greater than approximately 0.10 micron.

Cleaning of the filter cloth is easily accomplished

Water recovery is very high: Usually greater than 97%

Coagulation, settlement, clarification and filtration occur in the same process - usually without the need expensive of polymers or coagulant additives

Liquids of wide pH range, from strongly acidic to strongly alkaline, can be processed at temperatures up to 90°C

Extensive civil works and structures are not required

Operation is simple either manually or in the automatic mode

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APPENDIX E

CURRICULUM VITAE

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CURRICULUM VITAE

N a m e	: Dadang Sudradjat
Place/Date of Birth	: Majalengka/October 16, 1964
Sex	: Male
Addres	: Perum. Harapan Kita Jl. Teratai 27 Blok A1 Karawaci - Tangerang
Work Experience : 1990 - Present	P.T. SUPEREX RAYA Head of Quality Control
Education : 1989	Metallurgical Engineer, Sekolah Tinggi Teknologi Industri Bandung
1980 - 1983	Sr. High School Sekolah Menengah Atas PGRI I Majalengka
1976 - 1980	Yr. High School Sekolah Menengah Pertama Majalengka
1970 - 1976	Elementary School Sekolah Dasar Majalengka

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WORLD ENVIRONMENT CENTER

INDUSTRIAL WASTE MINIMIZATION PROJECT
INDONESIAN ELECTROPLATING INDUSTRY

UNITED STATES STUDY TOUR REPORT

BERANI SITUNGKIR

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JANUARI 1994

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EXECUTIVE SUMMARY

The World Environment Center (WEC) in cooperation with United States Agency for International Development (USAID) has launced waste minimization technique for metal finishing industry in Indonesia. The present two weeks study tour to the metal finishing ficilities in United States, as Follow up Workshop Waste Minimization October 1993 in Jakarta.

The waste minimization assessment focused on the identification of no cost/low cost practices and techniques that can reduce the discarge of pollutants an improve worker health and safety. Upon return to Indonesia the study tour participants will conduct a second waste minimization work shop to share our experiences gained in the United States.

Activities during study tour include plant visit and seminar/presentation as follow :

1. Surface Metal Inc.
2. Electrolizing.
3. Seminar/presentation.
4. Waste water Treatment System.
5. Read Rite Corporation.
6. Acteron Corporation.
7. Schlage Lock.
8. Santa Clara Plating.
9. United Air Lines.
10. New United Motors.
11. City of San Jose California Water Pollution Control.

Some major finding during this study tour are as follows :

A. Waste minimization technologies which have been put in practice are
   - Installation of double and triple rinses counter flow rinses.
   - Use of spray rinses over select process and rinse tanks.
   - Adoption of conductivity sensors to regulate water condition and flow.

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- Membran filter system.

B. Health and Safety Equipment

- Safety glasses
- Goggles
- Respirators
- Showers
- Face shields
- Protective gogles
- Eye Wash stations
- Boots

C. Waste water Treatment.

- Phisic and chemical treatment, is used in waste water treatment industrial plant.
- No chemical treatment is used in waste water pollution control plant city sewer. The treatment consist, solid separation, clasification, aerated, removal ammonia filtering, and clorination.

D. Air emision from plating tank to catch by exhaust pipe scrubber.

To futher improve the environment and economic performance of the metal finishing industry in Indonesia, the following activities are recommended :

1. A short day seminar for the top executives or the mills owners in which the Economical benefits of waste minimization are clearly demonstrated.
2. In view of the present situation of the metal finishing industry in Indonesia, the most effective low cost/no cost practices that can reduce the discharge of pollutant and provide economic incentives is less chemical usage cleaner rinses, and reduced cost of waste treatment. Work shop detailing in this topics and demonstration project would be very helpful.
3. In recent time the awareness of environment and regulation in Indonesia is still weak. Government should strenght the regulation's implementation and give penalties to companies that do not pay attention in environment and health and safety in workplace.
4. Incentive should be given for companies/industries that have implemented waste minimization program and also free tariff duty for equipment that support the program.

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WORLD ENVIRONMENT CENTER

INDUSTRIAL WASTE MINIMIZATION ASSESSMENT PROGRAM

INDONESIA METAL FINISHING INDUSTRY

UNITED STATES STUDY TOUR REPORT

Ir. Berani Situngkir

Directorate General for Multivarious of Industry

Ministry of Industri

I. INTRODUCTION

The World Environment Center, through a cooperative agreement with The United States-Asia Environmental Partnership and The United States Agency for international development (USAID) in Indonesia, is supporting sustainable development by strengthening industrial and urban environmental, health and safety management policy and practices in Indonesia.
WEC is demonstrating, through, cooperation of US technical experts, the environmental and economic benefits resulting from no cost/low cost waste minimization techniques in the metal finishing industry.

Waste minimization assessment have been conducted at eight Indonesian metal finishing facilities over the past two years. The waste minimization assessments focused on the identification of no cost/low cost practices and techniques that can reduces the discharge of pollutans and improve workers health and safety.

Upon completion of the assessment, a technical waste minimization workshop for the metal finishing industry was held in Jakarta for approximately 40 industry, goverment and non-goverment manager and design engineers. The workshop summarized assessment observation, presented Indonesia waste minimization success stories, and provided the exchange of waste minimization experience to other metal finishing industries.

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WEC is currently coordinating a US study tour for six Indonesia representatives (two from goverment and four from industry) during December 6-18, 1993.

Coordinator and Participants Study Tour :

- Tour Coordinator : Charles Jong Hwa Hong
  Deputy Project Manager WEC
- Participants :
  1. Ir. B. Situngkir : Directorate General for Multivarious of Industry, Ministry of Industry.
  2. Ir. Dadang Sudrajat : PT. Superax Raya
  3. Ir. Harry Handani : Environmental Impact Management Agency
  4. Ir. Jaya Agung P. : PT. YKK Indonesia Zipper Co. Ltd. Notion Division
  5. Suryanur Syafe'i : PT. Patolipu Dinamika Komponen
  6. Ir. Widya Wicaksana : PT. Probengkel

Activities during study tour include plant visit and seminar as follow ;

Company	Plant Visited
- Metal Surface Inc.	December 6, 1993
- Electrolizing	December 7, 1993
- Presentation by LLNL	December 9, 1993
- Waste Water Treatment Systems Inc.	December 10, 1993
- Read Rite Ind. & Acteron Corp.	December 13, 1993
- Schlage Lock Ind. & Santa Clara Plating	December 14, 1993
- United Air Lines and New Unitd Motor	December 15, 1993
- City of San Jose California Water Pollution Control	December 16, 1993

The objective an intensive overview of technologies and management practices implement in the US which enhance waste minimization and improve worker health and safety. Upon return to Indonesia the study tour participants will conduct a second minimization workshop to share their experiences gained in the United States.

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II. Findings.

II-1. Metal Surface Inc.

- Established

  This Company Established 1954.

- Location/Adress

  6060 Shull Street Bell Gardens

  California 90201.

  Phone : (310) 9271331, (231) 7734050

  Fax. : (231) 7734055

- Person Visited and Title

  - Sam Bell (President)
  - Bruce F. Nielsen (Plant Engineer)

- Kind of Plating

  Workpiece that plate are components such as : electronics, air craft, auto mobile components, according to job order.

  Type of Plating are Done :

  - Electroless Gold + Nickel
  - Chromium Plating
  - Copper Plating
  - Sn Plating
  - Cadmium Plating

  Chemical material used that mixed with cyanide for the kind of electrolisis gold, cadmium and copper plating.

- Process Operation

  - Rack System Plating

- Waste Treatment System

  The flow process has done as follow :

  - Segregation type of rinse water
  - Reduction Hexavalent Chromium, Cr^{6+} ---> Cr^{3+}
  - Oxidation of Cyanide
  - Precipitation/Flocculation
  - Clarification
  - Final pH Adjusment
  - Recycling water, used to process

  Sludge to happen within clarification tank

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pressed and then done dryer.

Sludge disposal, send to mining and give charge US.$. 158/Tone.

- Waste Minimization

  Waste minimization techniques has done as follow

  - Ion exchange
  - Electro winning
  - Vacuum evaporator
  - Spray rince
  - Drip shield
  - Drip Time
  - House keeping
  - Line Operation
  - Water Conservation
  - Material handling

- Air Emisions

  Gas or mist, out from tank plating to catch by exhaust pipe scrubber.

- Safety and Health

  To keept wacth safety and health, workers to completed safety equipment (see figure 3).

II-2. Electrolizing Inc.

- Established

  This company established 1944

- Location/Adress

  1847 Hooper Avenue, Los Angeles
  California 90011.
  Phone : (213) 7497876

- Person Visit and Title

  - Susan B. Grant (General Manager)
  - Jack Morgen (Plant Manager)

- Kinds of Plating

  Raw material that are plated are component such as automobile, air craft, etc.

  This company done electroplating special hard platng.

- Process Operations

  - Rack system plating

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- Manual operation

- Waste treatment system
  - Kind of waste contain are Chromium and Acid, etc.
  - Flow process has done as follow :
    Chromium Reduction ---> precipitation ---> flocculation ---> claritication ---> pH Adjustement ---> recycling water.
  - Sludge ---> filter press ---> cake dryer.
  - Sludge disposal seded to mining and give US.$ 1,200/Tone.

- Waste Minimization
  Waste minimization technic has done are ;
  - Electro winning
  - Spray ringe
  - Recycling water

- Safety and Health
  - Weak attention, employees do not use safety equipment such as cloth protection, masker, etc.

- Air Emision
  Protection the employees from gas/mist chemical, plating tank, covered and to connect by valve exhaust scrubber to out side (see figure ... 4).

II-3. Presentation Laurence Livermore National Laboratory (LLNL)

Title : Environmental Conscious Electr..plating at LLNL.

Presentation by : J.W. Dini
C.P. Steffni
University of California

Location : Sheraton Fisherman Wharf Hotel
2500 Mason Street
Sanfrancisco
California 94133.

Material presented : Presentation to give three generation categories of waste reduction to support environmental management program as follow ;

1. Good house keeping practices,inventory,control and

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minor changes in operating practices.

2. Current technology and material substitution .
3. Significant technological advance in process synthesis and engineering.

Complete material can see Appendices E.

II.4. Waste Water Treatment System Inc.

- Established

  This company established 1985

- Location

  125 Elko Prive

  Sunnyvale - California 94089

  Phone : (408) 5418600

  Fax. : (408) 5418615

- Person Visited and Title

  Glen C. Neustedter (Precident)

  John B. Strandberg P.E (Sr. Cmemical Eng.

- Visit Result
  - This plant to produce several kinds waste treatment package portable such as indicated (see Appendices E).
  - The kinds of product are, agree use to small industry electro plating.

II-5. Read Rite Inc.

- Location/Address

  3065 N-Sunnyside

  Presno-CA-93727

  Phone : (209) 291811

  Fax. : (209) 2914926

- Kind of Production

  Manufactures disk read heads

- Kinds of Plating
  - Nickel Plating
  - Copper plating (non Cyanide)
- Waste Minimization, Safety Health

  No datas because can not to see in plant, but we were only visited waste treatment plant.

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- Waste Treatment

  This company has membrane treatment system. Operation system can see at brosur (see Appendics E). This equipment very good,can to reduce rinse water Ni, Cu 14 Mg/l to become output 0,05 Mg/l (Ni, Cu) and result of water can used to operation 99%.

II-6. Acteron Corporation

- Location/Address

  851 Shasta Street
  Redwood City CA 94063
  Phone : (415) 3695217
  Fax. : (415) 3649743

- Person Visited

  Patrick Burt (Precident)

- Kind of Plating/Coating

  Work peace that are plated are components of electronics, semiconductor, microwave, optics, laser, medical,aerospace, disk drice, defense, commercial, according to job order.

- Type of Plating are done
  - Nickel plating
  - Gold plating
  - Rhodium plating
  - Silver plating
  - Hard anodize

- Process Operation
  - Rack System
  - Manual operations

- Waste Minimization

  To reduce rince water, this company has done as follow :
  - Instalation at double and triple counter flow rinses.
  - Use of spray rinses over select process and rinse tanks.
  - Adoption of conductivity sensor to regulate water condition and flow.

- Segregation of rinse waters.
- Substitution of less polluting processes.
- Elimination of vapor degreasing by using a system of dual soak cleaners with ultrasonic enhancement.
- Use more delute formulation such as those for Acid pikling.
- Indoctrination and training employees to stress, how they can make a positive controbution to the environment.

  To do the waste minimization technology above, this company can to reduce water used as follow.

  Before to do waste minimization, water that used 10.000 GPD to become 1.500 GLP has done waste minimization.

  Equipment about waste minimization (can see Figure 5).

- Waste Water Treatment

  This plant has been used someone water treatment production of the waste water treatment system inc.

  Treatment process consist segeregation water rinses, oxidation Cn, Clasification, neutralization and filter press sludge.

- Safety and Health

  In the room workers, employees are completed safety and health equipment (see Figure 6).

- Air Emision

  This plant has constructed the exhaust pipe schubber to catch air emision from tank plating (see Figure 7).

II-7. Schlage Lock Inc.

- Production and Kind Plating

  This company be in motion manufacturing part at lock and lock. Kind of plating has done Zink plating and non Cyanide Copper Plating.

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Plating processed has done by barrel system and operated automatic.

- Waste Minimization
  - To reduce hazardous, the company used chemical less hazardous.
- Safety and Health

  Worker room very clean, and employees are completed safety and health equipment.
- Air Emision

  To catch mist/gas exist from plating has constructed exhaust pipe srubber.
- Waste Treatment

  Rinses water, processes in waste water treatment with to do flocculation, sedimentation, neutralization and filter press sluoge.

II-8. Santa Clara Plating Co. Inc.

- Location/Address

  1773 Grand Street Santa Clara, CA 95050-3984

  Phone : (408) 7299315

  Fax. : (408) 7480987
- Person Visited and Title

  Thomas L. Cruss (Precident)
- Kind of Plating
  - Nickel Plating
  - Non Cyanide Copper
  - Anodazing

  Waste minimization, safety health WTS, and air emision, very good.

  Some as Acteron Corporation, see Figure 8.

II-9. United Airlines

- Location/Address

  Bldg 49 SFOFL

  Sanfrancisco Int'l Airport

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Phone : (415) 6344576

Fax. : (415) 6344551

- Person Visited and Title

  Steven F. Sulgit (Facilities and Eng.)

- Activities Company

  This company very big shop electroplating, to support maintenance, opertions, center in to do repair, overhaul and modification airline. Kind of plating are Chromium plating, Cadmium plating, Nickel plating, Silver plating.

  - Waste Water Treatment, Safety and Health, and Air Emision Protection, very good ... see Appendics E.

II-10. New United Motor Manufacturing Inc.

- Plant Activities

  This company to produce, Toyota Corolla sedan and Toyota Hilux Truck, joint venture by General Motor Corporation and Toyota Motor Corporation.

- Located in Fremont, California

  The company has incorporated Toyota's production concept and management philosophies and established the goal of building the highest quality vehicles posible at the most competitive price.

- Kind of Plating

  This company not to do plating but only painting shop.

  Waste or rinses water exite this plant contain degreasing rinses and phospating rinses.

- Waste Water Treatment (WTS)

  Waste exites from room phospating streamed to Waste Water Treatment (WTS) .

  The result of water from WTS comeback use again in process.

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II-11. City of San Jose California Water Pollution Control

- Location/Address

  City of San Jose
  Water Pollution Control
  700 Los Esteros, San Jose CA 95134.
  Phone : (408) 9455300
  Fax. : (408) 9455442

- Person Visited and Title

  Alex Ekster P.E, PhD (Sanitary Engineer)

- Waste Water Treatment

  City of San Jose California Water Pollution Control is center of city sewer treatment. Kind of waste treatment is organic disposal. The treatment no chemical use, but it done biological process.

  Flow process has done as follow :

  Solid removal ---> solid separation ---> first clarification (20% metal removed) ---> scond clarification ---> aeration ---> removal Ammonia ---> filtering ---> clorination ---> water result dumped to sea.

  Result water from Treatment Plant discarded to sea.

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III. Conclusion and Recommendation

III-1. Conclusion

During this study tour, some important finding are as follows :

a. World Environment Center (WEC)

WEC has launched very good technology transfer program on introducing waste minimization practices through out the world. Indonesia can benefit much from this program in to development industry and environment achievement.

b. Waste Minimization

- Waste minimization had been done successfully in United States because of goverment suggestion and company honestly to obey the regulation.
- Waste minimization technology, that be executed successfuly simple technology (dragout/dgarin, spray rinse, drip time, drip sheild) and medium/ hight techology (ion exchange, electro winning, vacuum evaporator, membrane system) can to reduce waste 50-80% and saving cost.
- Execution of waste minimization, will giving incentive to the industrialist :
  - Economics benefits
  - Regulatory conformance
  - Environmental achievement

c. Safety and Health

- Industrial attention about safety and health is very hight, it is shown when employees and guest in field has to wear safety equipment and in plant (room plating) completed eye wash station and shower.
- At works space almost there is no smelt at chemical, because it is equipped with ventilation and exhaust of air mision.

d. Waste Water Treatment (WTS)

All industries that we visit do waste water treatment with physic and chemical system.

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Waste that is treated is rinse water and then this clean water from WTS, is used again for processing.

Sludge in the clasification is pressed and then it is dry before sending to other campany for processing.

The company which own sludge to pay US.$. 158/Ton-US.$. 1.200/Ton.

III-2. Recommendation

From the knowledge obtained during the study tour in observation situation and development electro plating industries in United States. To futher improve the environment and economic performance of the metal finishing industry in Indonesia, the following activities are recommended :

1. A short day seminar for the top executives or the mills owners in which the Economical benefits of waste minimization are clearly demonstrated.
2. In view of the present situation of the metal finishing industry in Indonesia,the most effective low cost/no cost practices that can reduce the discharge of pollutant and provide economic incentives is less chemical usage cleaner rinses, and reduced cost of waste treatment. Work shop detailing in this topics and demonstration project would be very helpful.
3. In recent time the awareness of environment and regulation in Indonesia is still weak.
   Government should strenght the regulation's implementation and give penalties to companies that do not pay attention in environment and health and safety in workplace.
4. Incentive should be given for companies/industries that have implemented waste minimization program and also free tariff duty for equipment that support the program.

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APPENDICES A :

Figures and Photographs

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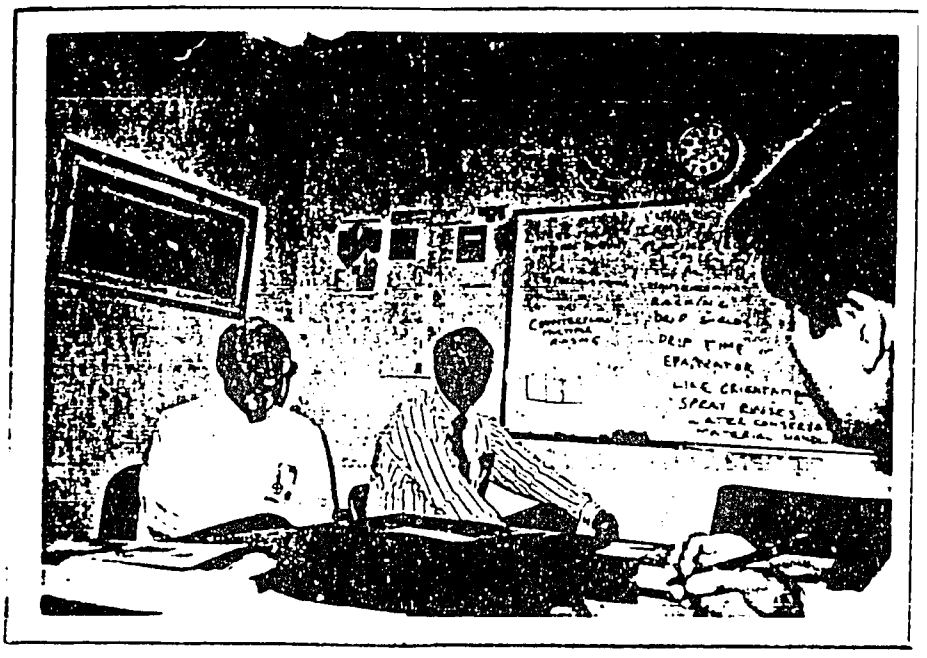

Discussion at Surface metal Inc

Storage Chemical at Surface metal Inc

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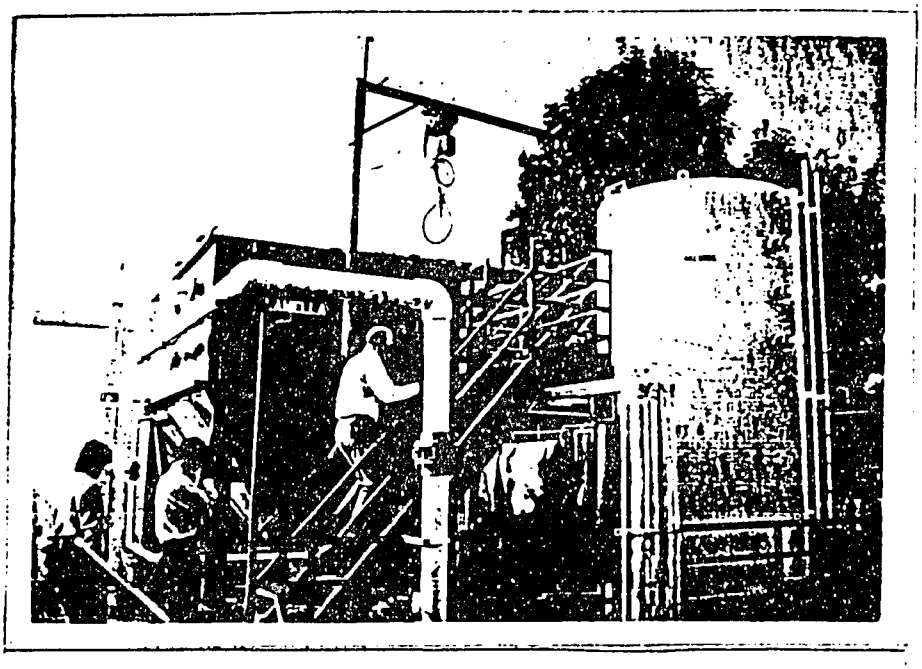
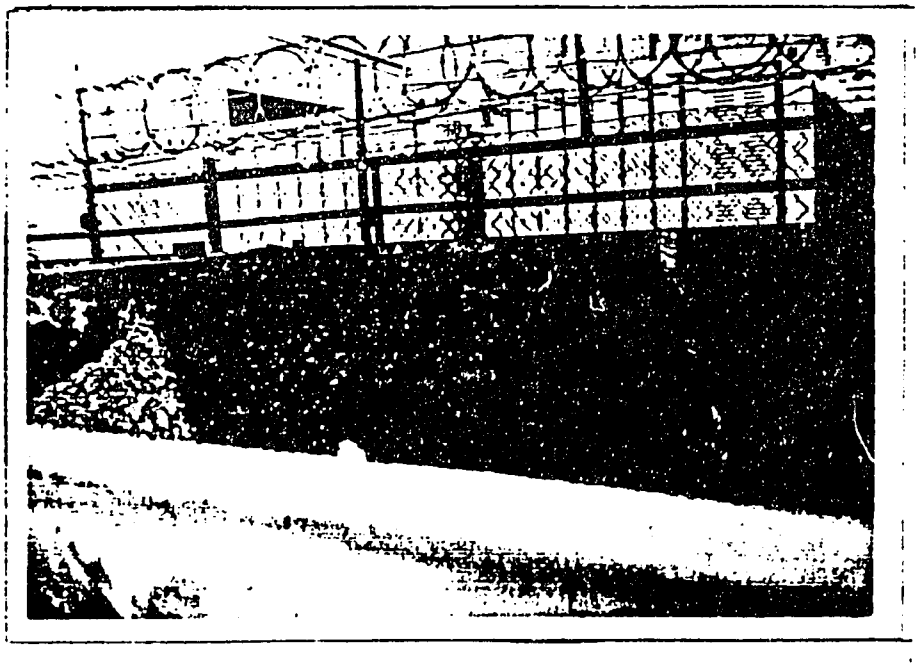


Waste water Treatment Plant at Surface metal Inc



Sludge from Surface metal Inc

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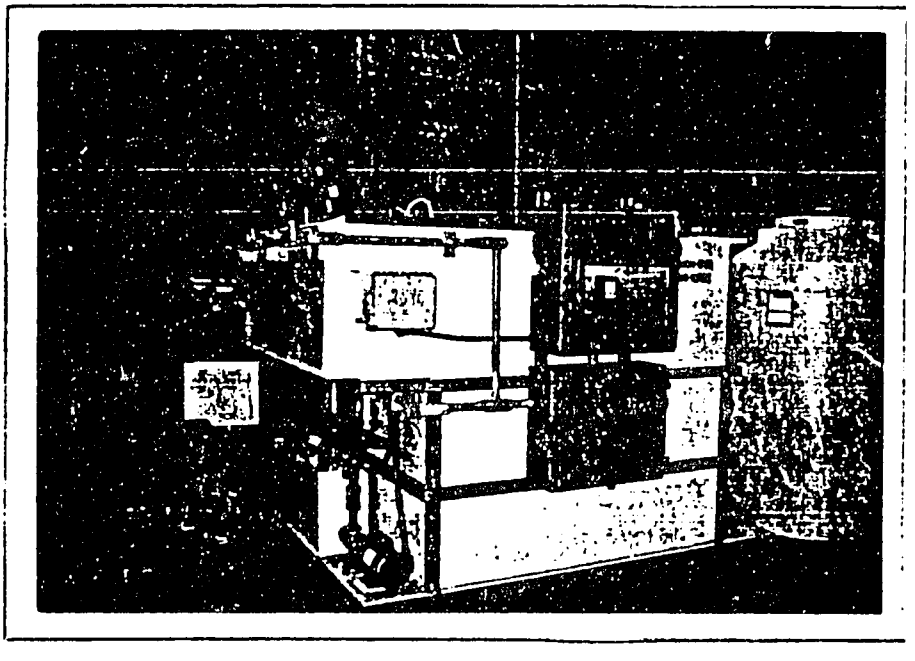
Discusion at Wastwater Treatment Systime Inc



Waste water Treatment, Product. WTS Inc

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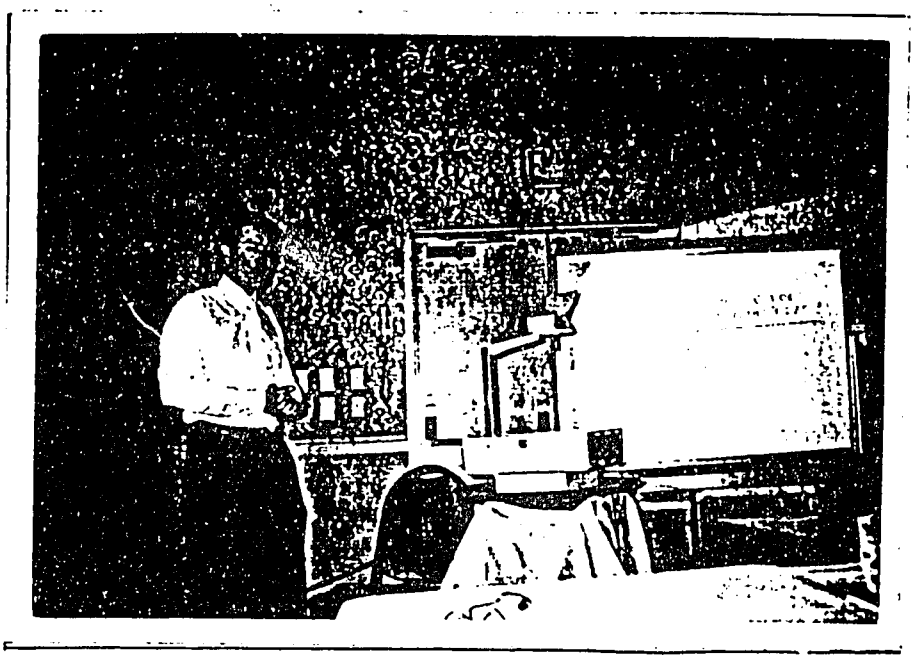

Presentation by LLNL at

Discussion with Jim Mille

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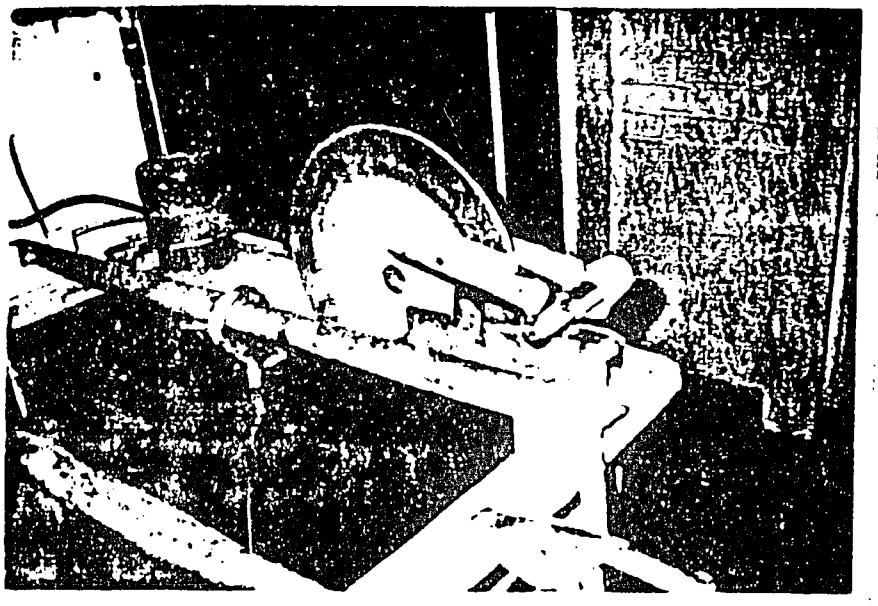
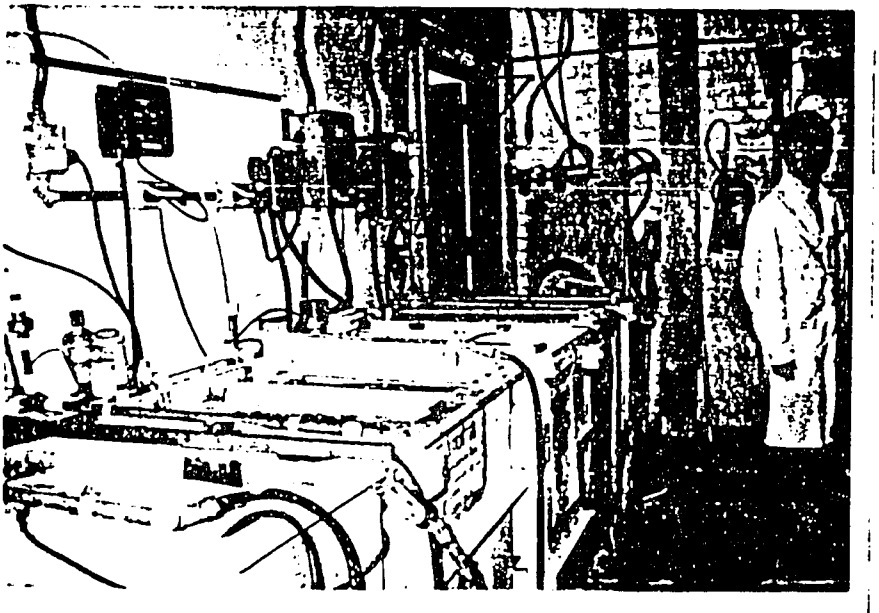


Oil Catcher at Acteron Corporation



Multiple Rinse, Spray Rince, Counter flow
at Acteron Corporation

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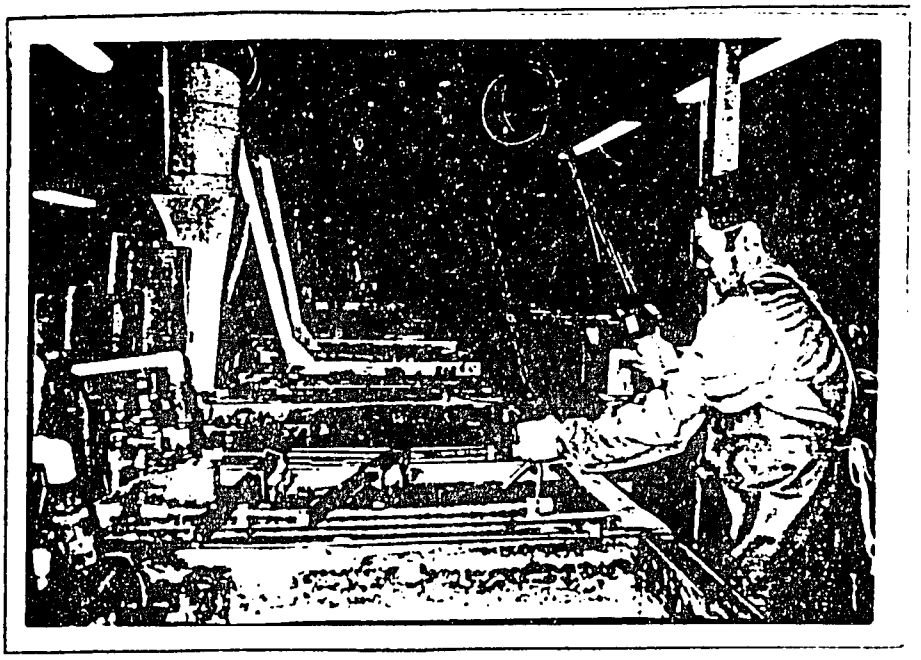
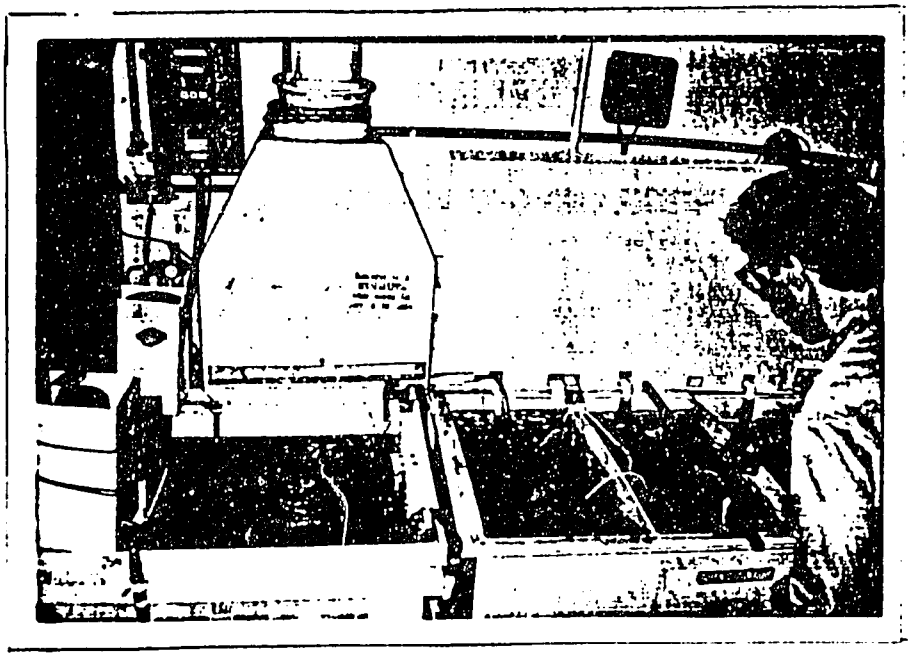


Line Operation at Acteron Corporation



Exhaust Pipa Scrubber at Acteron Corporation

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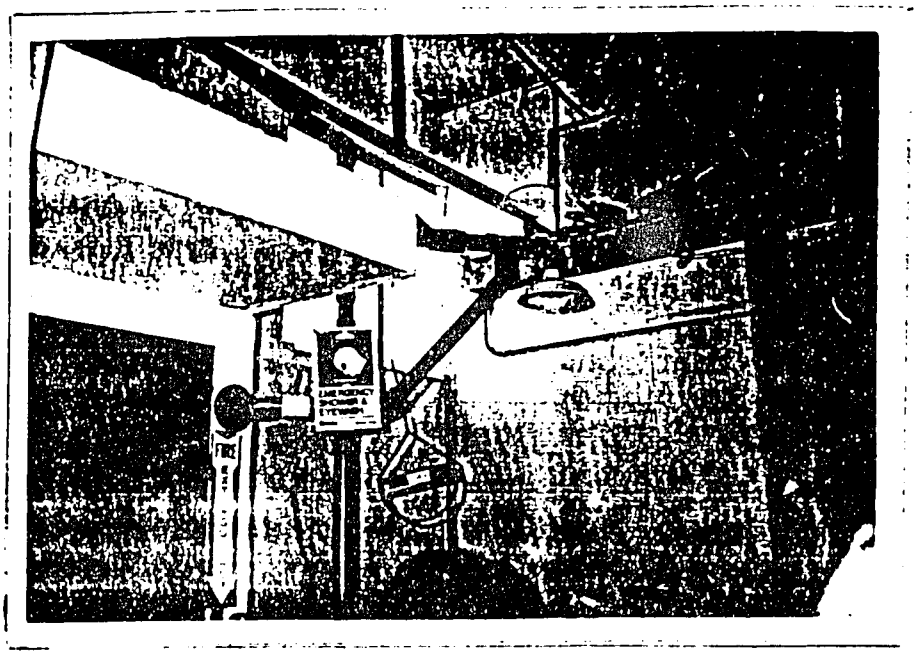
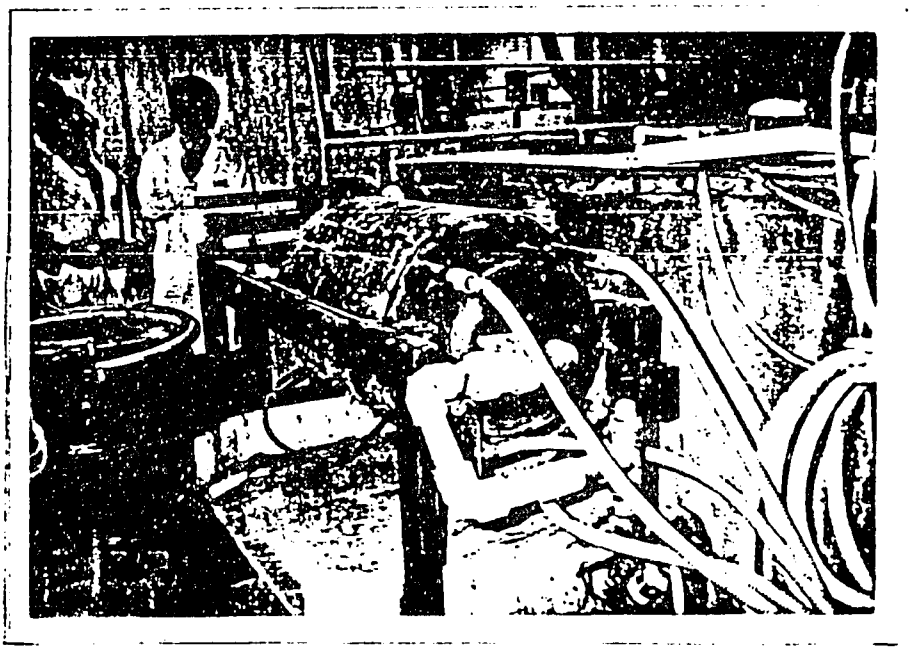


Emergency Shower & Eye wash at Acteron Corporation



Filter Press of Sludge at Acteron Corporation

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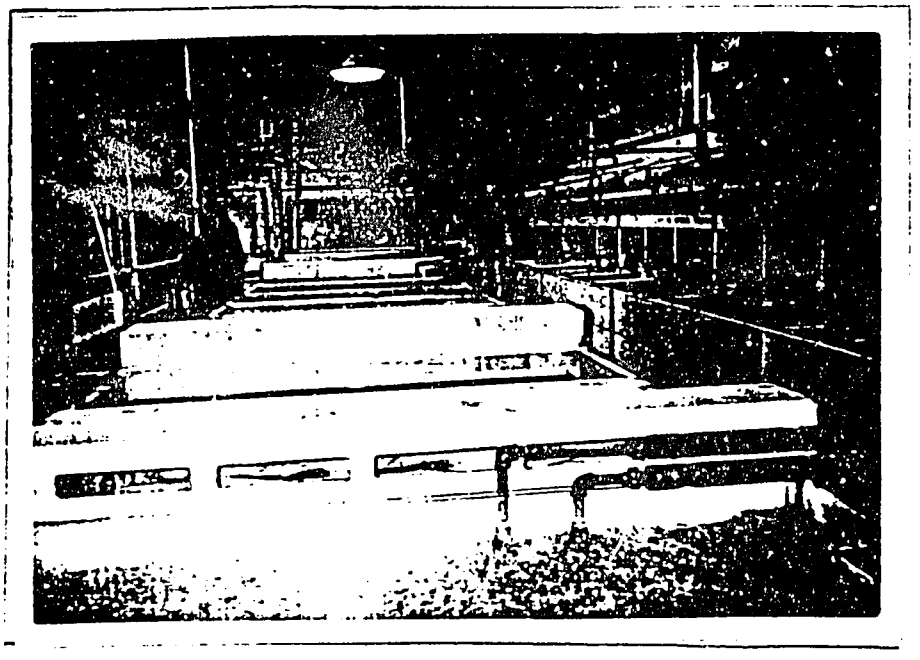
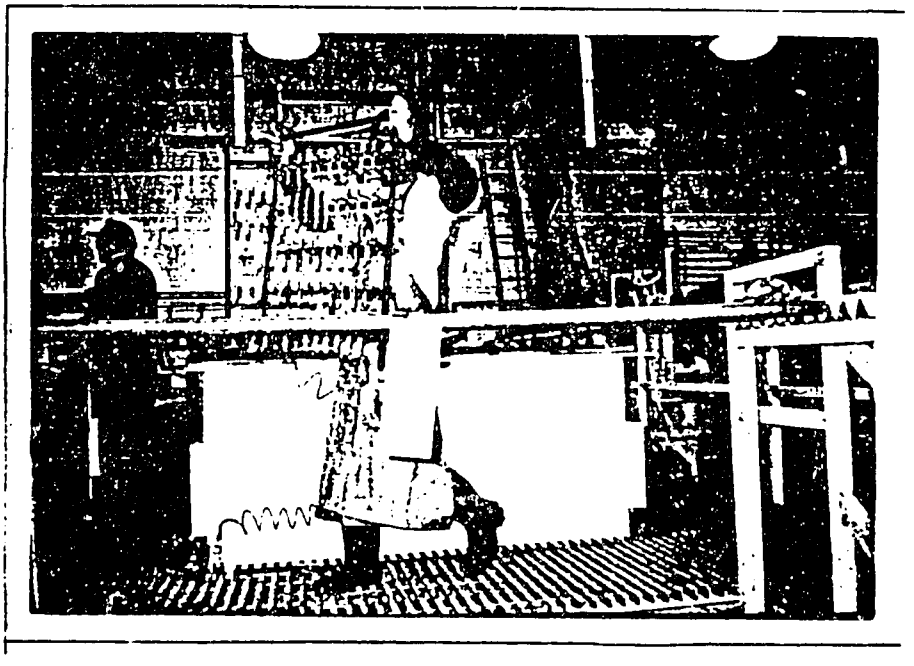


Line Operation at Santa Clara Plating



Rack Systim at Santa Clara Plating

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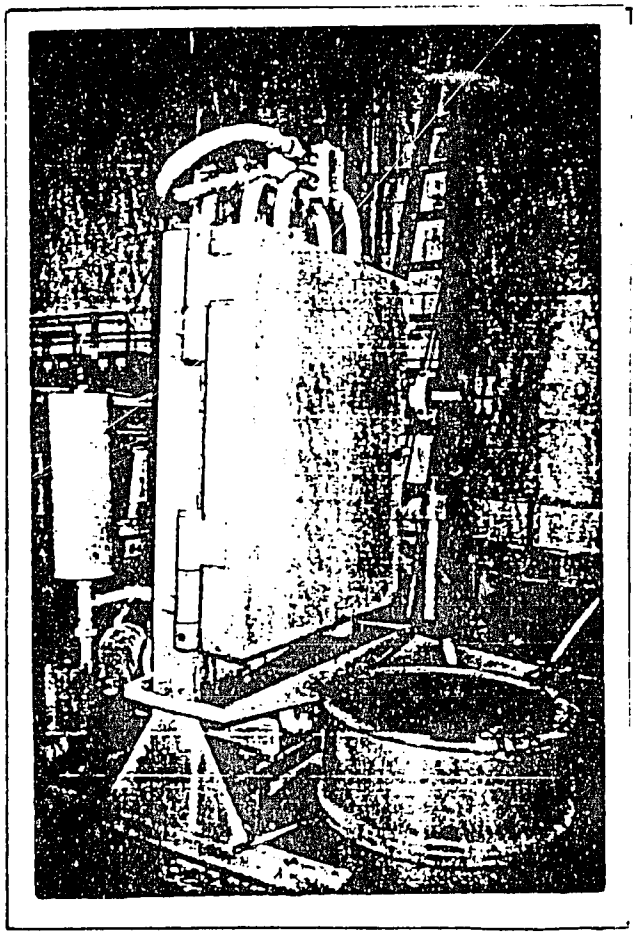

Filter Press Sludge at
Santa Clara Plating

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Dryer Work Place by air at
Santa Clara Plating

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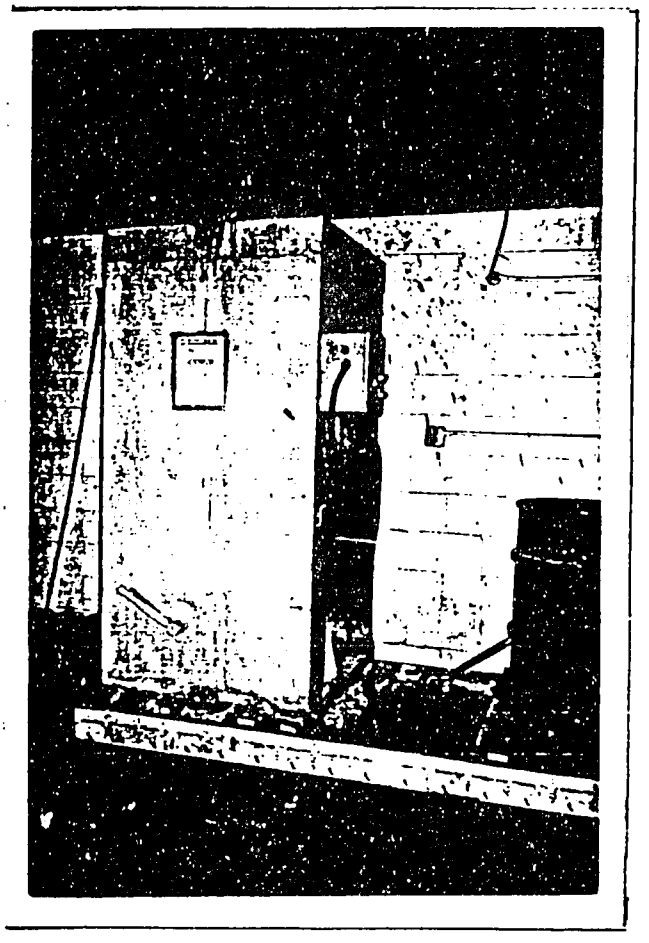

Dryer Sludge at Santa Clara Plating

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APPENDICES B :

List The Date, Facility Visited and Location

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AGENDA FOR US STUDY TOUR
INDONESIA DELEGATED

Monday, December 6, 1993

* Metal Surface Inc.
  6060 Shull Street Bell Gardens, Los Angeles
  California 90201.

Tuesday, December 7, 1993

* Electrolizing Inc.
  1847 Hooper Avenue, Los Angeles
  California 90011.

Wednesday, December 8, 1993

* Travel from Los Angeles to Sanfransisco.

Thursday, December 9, 1993

* Presentation [illegible]
  Sheraton Fisherman Warf Hotel
  2500 Mason Street, Sanfransisco
  California 94133.

Friday, December 10, 1993

* Discussion by Jim Mille
* Waste Water Treatment System Inc.
  1235 Elko Drive
  Sonnyvale, California.

Saturday & Sunday, December 11,12, 1993

* Sanfransisco

Monday, December 13, 1993

* Read Rite
  3065 N. Sunningside
  Fresno, CA. 93727.
* Acteron Corporation
  851 Shasta Street
  Redwood City, CA. 94063.

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Tuesday, December 14, 1993

* Schlage Lock Inc.
* Santa Clara Plating Inc.
  1773 Grana Street,
  Santa Clara, CA. 95050-3484.

Wednesday, December 15, 1993

* United Airlines
  Bldg 49 SFOL
  Sanfransisco Int'l Airport
  Sanfransisco CA. 94128-3800.
* New United Motor
  Eremont, California.

Thursday, December 16, 1993

* City of San Jose
  Water Pollution Control
  700 Los Angeles Road, San Jose
  CA. 95134.

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APPENDICES C :

Person & Organization Visited

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PERSON & ORGANIZATION VISITED

NO.	ORGANIZATION	PERSONS MEET
1.	Metal Surface Inc. 6060 Shull Street Bell Gardens Los Angeles, California 90201. Phone : (310) 9271331. (231) 7734050. Fax. : (213) 7734055.	* Sam Bell (Precident) * Bruce F. Nielsen (Plant Ebgineer)
2.	Electrolizing Inc. 1947 Hooper Avenue LA, California 90011. Phone : (213) 71197876. Fax. : (213) 7499890.	* Susan B. Grant (General Manager) * Jack Morgan (Plant Manager)
3.	Lawrence Livermore National Laboratory (LLNL). University California PO Box 808 L 332 Livermore CA. 94551. Phone : (510) 4228342. Fax. : (510) 4221290.	* Jack W. Dini (Section Leader Material Fabrication Division
4.	Waste Water Treatment System Inc. 1235 Elko Drive Sunnyvale California 94089. Phone : (408) 5418600. Fax. : (408) 5418615.	* Glent C. Neustedter (Precident) * John B. Trandberg PE (Sr. Chemical Engineer)

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NO.	ORGANIZATION	PERSONS MEET
5.	Read Rite Inc. 3065-N Sunny Side Fresno CA. 93727. Phone : (209) 2918144. Fax. : (209) 2914926.	* Mark Rothweiler (Operation/Field Services)
6.	Acteron Corporation 851 Shasta Street Redwood City CA. 94063. Phone : (415) 3695217. Fax. : (415) 3649748.	* Patrick Burt (Precident)
7.	Schlage Lock Inc.	-
8.	Santa Clara Plating Co. Inc. 1773 Grand Street, Santa Clara CA. 95050. Phone : (408) 7299315. Fax. : (408) 7480987.	* Thomas L. Cross (Precident)
9.	United Airlines Bldg 49 SFOFL Sanfransisco Int'l Airport. Phone : (415) 6344576. Fax. : (415) 6344551.	* Steven F. Sulgit (Facilities and Engineer)
10.	New United Motor Manufacturing Inc. Fremont, California.	-
11.	City of San Jose California Water Pollution Control 700 Los Esteros, San Jose CA. 951134.	* Alex Ekster PE, PhD (Sanitary Engineer)

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APPENDICES D :

Business Cards Contacted

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WEC World Environment Center

CHARLES JONG HWA HONG
DEPUTY PROJECT MANAGER

WORLD ENVIRONMENT CENTER
410 PARK AVENUE SOUTH
SUITE 1800
NEW YORK, N.Y. 10016

(212) 683-4700
TLX 261210 ENVIRONENT
FAX (212) 683-5063

CHEMICAL SOLUTIONS, INC.
ENVIRONMENTAL CONSULTING

JIM MIILLE
PRESIDENT

Helping Industry Meet Its Environmental Goals

400 Main Street, Suite 203
Pleasanton, CA 94566

Tel: (510) 426-1816
Fax: (510) 426-1889

University of California
Lawrence Livermore National Laboratory

Jack W. Dini
Section Leader
Materials Fabrication Division

P.O. Box 808, L-332
Livermore, CA 94551

(510) 422-8342
FAX (510) 422-1290

SMITH, BUCKLIN & ASSOCIATES, INC.

MARK A. HANSON, CAE
Manager
Los Angeles Office

5000 Van Nuys Boulevard
Suite 300
Sherman Oaks, CA 91403 USA
818/995-7,338
818/995-4878 (Fax)

Chicago Washington, D.C. Los Angeles Brussels

Glen C. Neustedter
President

WTS WASTEWATER TREATMENT SYSTEMS INC.

Wastewater Treatment Systems Inc.
1235 Elko Drive
Sunnyvale, California 94089
Telephone: (408) 541-8600
FAX: (408) 541-8615

Part of the Thames Water Plc Group

METAL SURFACES, INC.

6060 SHULL STREET BELL GARDENS, CA 90201-0521
(310) 927-1331 (714) 521-4112
(213) 773-4050 FAX (213) 773-4055

BRUCE F. NIELSEN
PLANT ENGINEER

45,000 SQUARE FEET OF PRECISION PLATING

John B. Strandberg, P.E.
Sr. Chemical Engineer

WTS WASTEWATER TREATMENT SYSTEMS INC.

Wastewater Treatment Systems Inc.
1235 Elko Drive
Sunnyvale, California 94089
Telephone: (408) 541-8600
FAX: (408) 541-8615

Part of the Thames Water Plc Group

SAM BELL
PRESIDENT

METAL SURFACES, INC.
6060 SHULL ST., P.O. BOX 2160
BELL GARDENS, CALIFORNIA 90201-0521

(310) 927-1331
(213) 773-4050
(714) 521-4112
(213) 773-4055

NEW UNITED MOTOR MANUFACTURING

Thomas W. Sinclair
Environmental Engineer
Environmental Affairs/Legal

45500 Fremont Boulevard
Fremont, CA 94538 U.S.A.
(510) 498-5797
FAX (510) 770-4160

Electrolizing Inc.

JACK MORGAN
PLANT MANAGER

dense chrome plating specialists

1947 HOOPER AVENUE

7019 CORPUS CHRISTI

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UNITED AIRLINES

Steven F. Sulgit
Facilities and Eng.
(415) 634-4576
FAX (415) 634-4551

United Airlines
Bldg. 49 - SFOFL
San Francisco Int'l Airport
San Francisco, CA 94128-3800

Thomas L. Coss
President

(408) 727-9315 ext. 21
FAX: (408) 748-0987

SANTA CLARA PLATING CO. INC

1773 Grant Stree
Santa Clara, CA
95050-398

(408) 945-5300
FAX (408) 945-5442

ALEX EKSTER P.E., Ph.D.
SANITARY ENGINEER

CITY OF SAN JOSE
WATER POLLUTION CONTROL
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epoc

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Project Manager

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APPENDICES E :

List of Documents Received

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Environmentally Conscious Electroplating at LLNL

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Chris Steffani
Jack Dini

Lawrence Livermore National Laboratory
Livermore, CA 94550

December 9, 1993

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We Are Using All Three Generation Categories of Waste Reduction

1- Good housekeeping practices, inventory control, and minor changes in operating practices

2- Current technology and material substitutions

3- Significant technological advances in process synthesis and engineering

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We Are Saving Over $500,000/Year and 3 Million Gallons of Water/Year

- Substitution of zinc-nickel for cadmium plating
- Segregating cyanide solutions
- Elimination of hexavalent chromium plating
- Elimination of vapor degreasing
- Changing rinsing practices
- New pickle for aluminum parts
- Recycling of rinse water

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Bldg. 322 Floor Plan

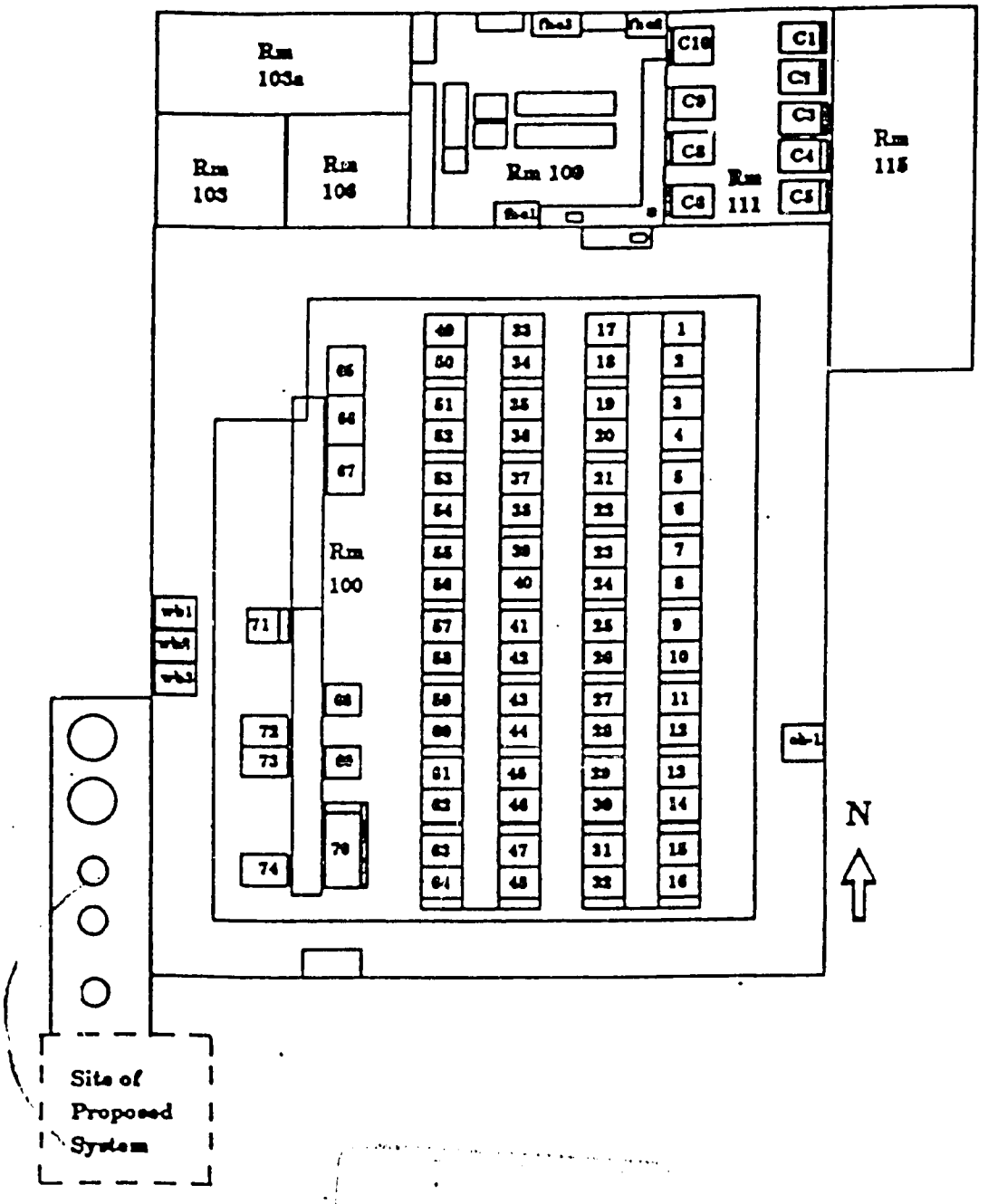

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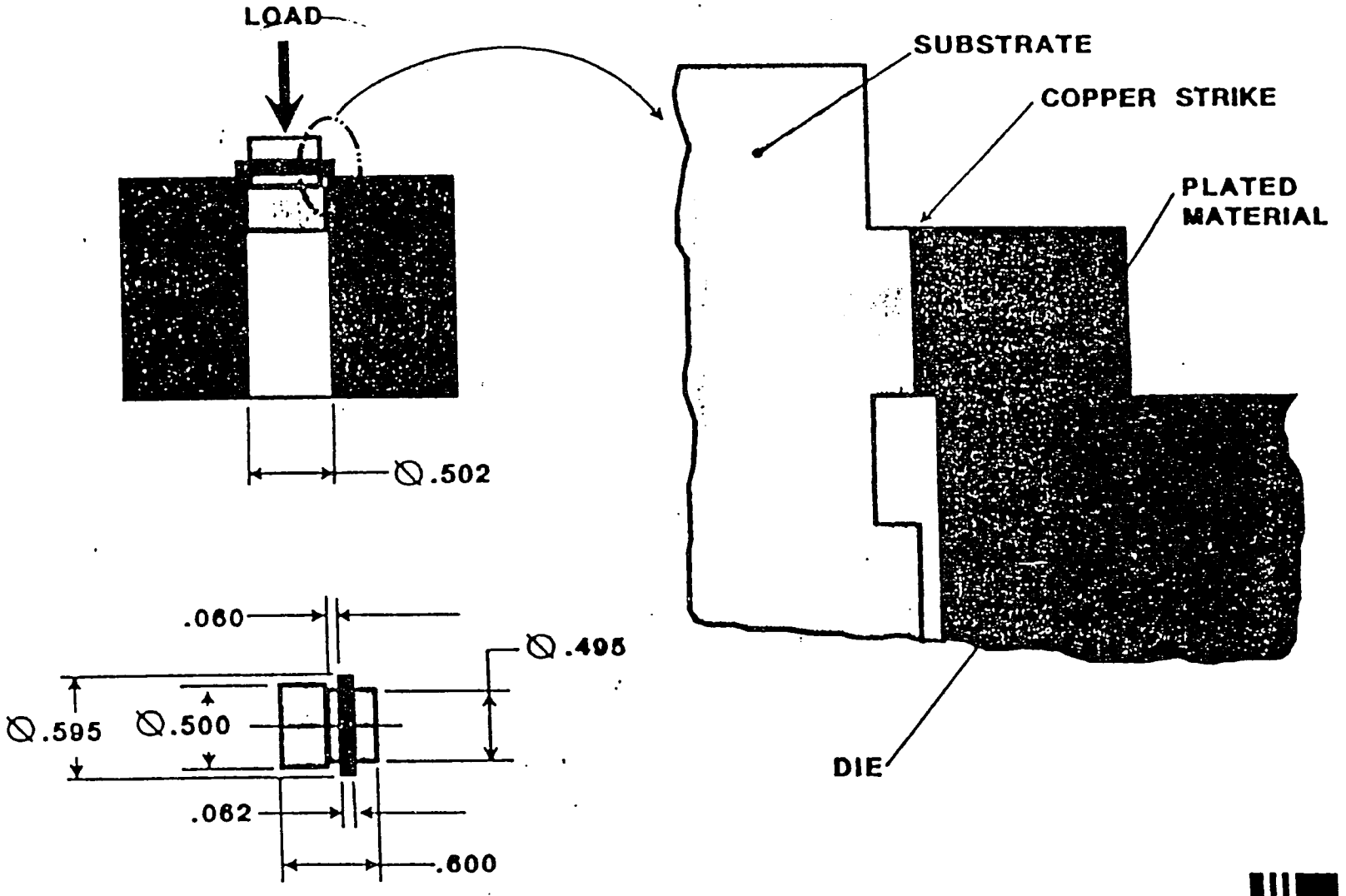
Figure 1. Plan View of Plating Shop



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Comparison of Ring Shear for Cyanide and Copper Pyrophosphate Strikes for Preparing Aluminum Alloys for Plating

Alloy	Shear Strength (A,B) (MPa) Cyanide Copper	Pyrophosphate Copper (C)
1100-F	79	77
2024-T4	288	273
6061-T6	217	222
7075-T6	285	374

A. These data are from Reference 7.

B. The zincate solution time was 30 seconds. The copper strikes were overplated with nickel in a nickel sulfamate solution. All reported values are the average of 5 samples.

C. The formulation of the copper pyrophosphate solution included copper (7.5 to 11 g/l), P_2O_7/Cu (20/1 to 25/1). Operating conditions were: temperature (25 to 30C), pH (8.5 to 9.2) and current density (10ASF).

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Solvent vapor degreasing has been an integral part of electroplating operations

- It has been around for many years.
- It is nearly universally applicable to organic soils on metal substrates.
- The cleaning speed is quite fast.

- IT PERFORMS THREE IMPORTANT FUNCTIONS, CLEANING, RINSING AND DRYING.

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Pratt & Whitney's results showed that ultrasonic agitation was more important than the choice of cleaner

FACTOR	IMPACT ON CLEANING (%)
? Agitation (ultrasonic)	45
Cleaner	12
Cleaner concentration	6
Soil loading	3
Time	3
Temperature	3
Noise (unexplained by experiment)	28

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Use of ultrasonics in aqueous cleaners has proven to be quite effective

- Pratt & Whitney has been able to remove all but two perchloroethylene degreasers, remove over 50% of the total degreasers used in 1988 and reduce toxic air emissions by 50%.

- Martin Marietta (Y-12) has used ultrasonic cleaning with aqueous detergent in place of vapor degreasing since 1985.

- Western Electric, Kansas City uses a mixture of aliphatic esters with the aid of ultrasonics for removing machining oils encountered in producing circuit board backplane pins.

- APS Materials in Dayton uses a terpene based cleaner with ultrasonics instead of TCA for cleaning metal parts prior to plasma coating.

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Why is agitation so important?

- Aqueous cleaners involve concentrations of only 1-4% by volume while solvent degreasers use 100% concentrations.

- Because of this, 80-90% of the cleaning done by aqueous cleaners is effected by mechanical action while the remaining portion is by chemical action.

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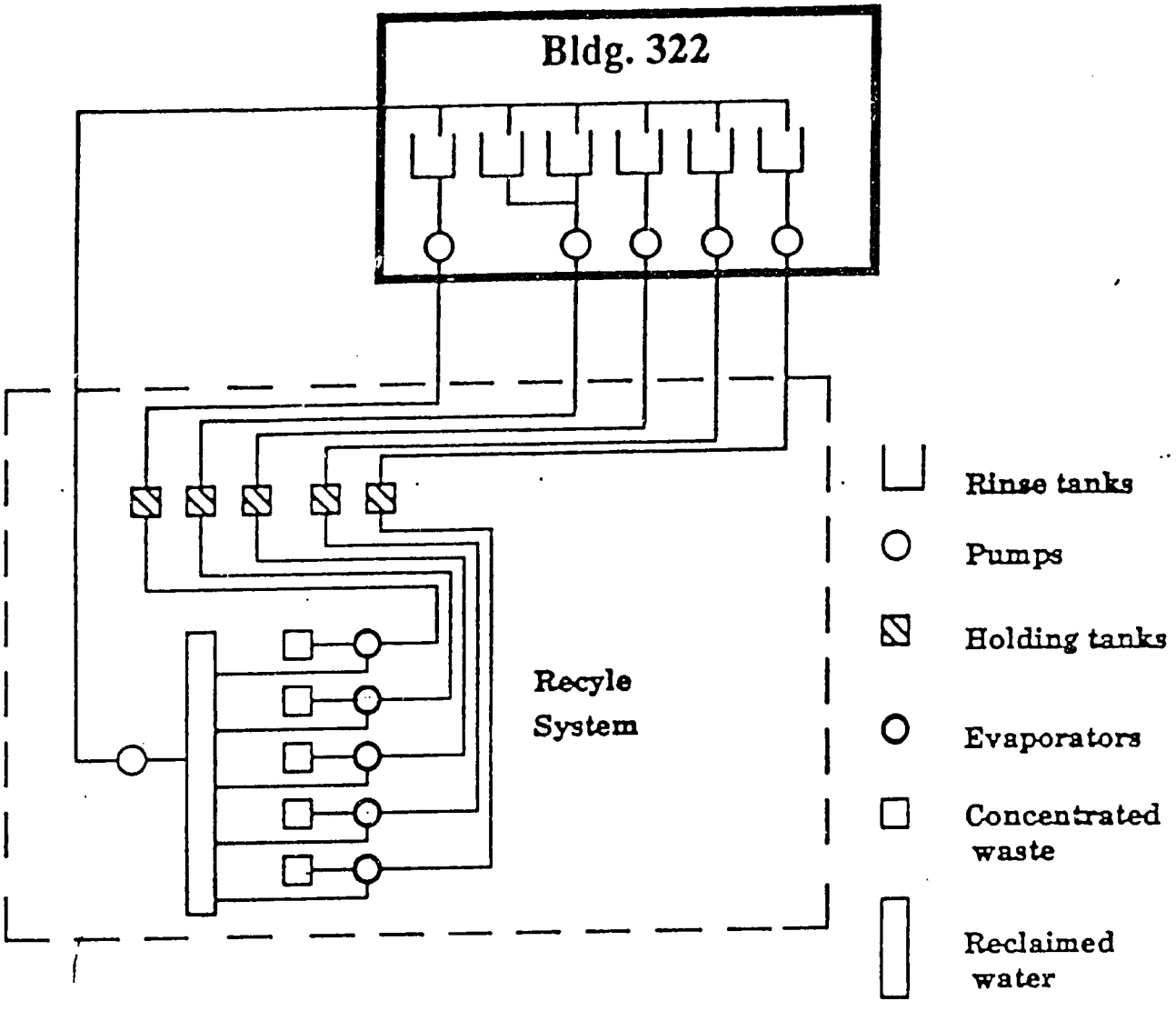

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Rinse Water Recycling Has Been Quite Effective

- We've recycled about 80,000 gallons of rinse water and returned all but 200 gallons back to the processing lines.
- The recycled water is purer than the water we receive from the city of Livermore.
- We no longer discharge any water to the sewer system.

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Recent Generation 1 and 2 Activities

- Substituting oxalic acid for sulfuric acid for hard anodizing of Al
- Extending the life of electroless nickel solutions
- Recycling of acid solutions
- Use of ion exchange on the recycled water
- Energy conservation project

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Metal Finishing Energy Conservation Project

- The metal finishing facility used large amounts of electrical power for process solution heating, space heating, and exhaust ventilation

- By reducing thermostat settings and air flow during off-shift hours, electrical savings on the order of 1.6 million kwh can be achieved, as well as natural gas savings of 30,000 therms.

- Savings that will result from this are over $100,000 per year.

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Summary

- Our efforts in environmentally conscious electroplating save LLNL over $500,000/year and 3 million gallons of water/year.
- The facility is now much cleaner and safer than it used to be.
- Product quality has not been compromised by the changes.
- We are now involved in a number of generation 3 (new technology activities.

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WASTE MINIMIZATION TECHNIQUES

- Processing methods
- Equipment
- Results
- Future work

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PROCESSING METHODS

- Rinse water distillation
- Acid recycling
- Electrowinning
- Electroless nickel recycling

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ACID RECYCLING EQUIPMENT

10 GPD Dialysis cell

- 50 pair stack of polymer membranes
- 2 impulse pumps and tubing
- supply and storage tanks

Feed

- DI water
- Metal Bearing acid

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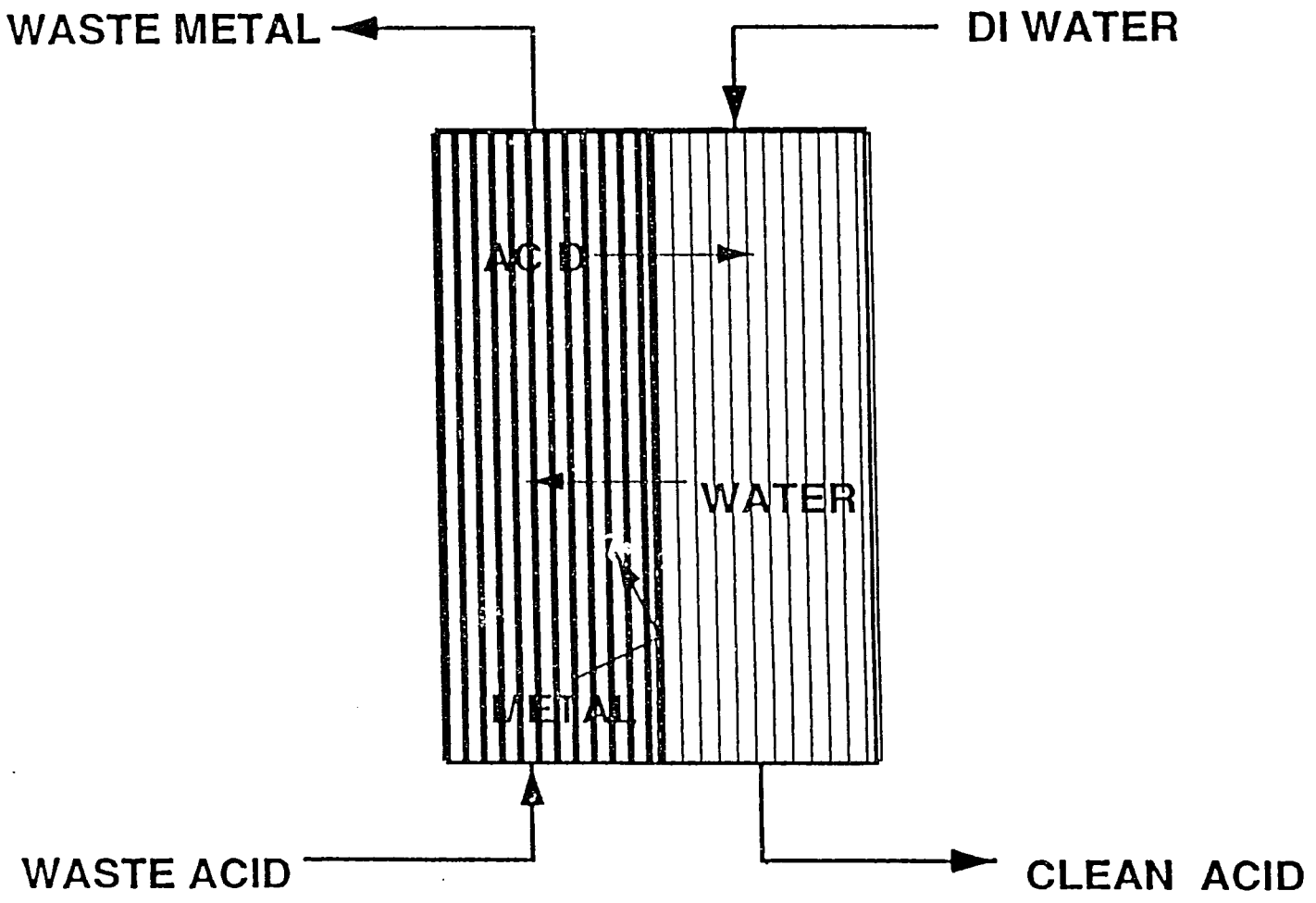
ACID DIALYSIS EQUIPMENT



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ACID DIALYSIS RESULTS

<u>Test 1</u>

(start)	(finish)
4.9 Normal Nitric Acid	3.9 Normal Nitric Acid (79.5%)
60 gm/l copper metal	7.2 gm/l copper metal (88%)

<u>Test 2</u>

(start)	(finish)
9.4 Normal Muriatic Acid	7.1 Normal Muriatic Acid (75.5%)
10 gm/l copper metal	1.1 gm/l copper metal (89%)
14 gm/l iron metal	3.1 gm/l iron metal (77.8%)

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RECYCLING POSSIBILITIES

- Acid recycling from spent solutions
  Nitric, Sulfuric, Muriatic (greater than 5 Normal)

- Water recycling from aqueous waste
  pH >2, metal concentration < 500 mg/l, non rad

- Precious metal recycling
  solid or mixed coated base metals, liquids

- Metal stripping and salvage
  sputter chambers, broken taps, chemical machining

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RINSE WATER DISTILLATION EQUIPMENT

- "COLD VAPORIZATION" System (700 GPD)
- Dragout rinse tanks (minimizes flow)
- Separate plumbing for clean and dirty water
- Holding tanks for storage

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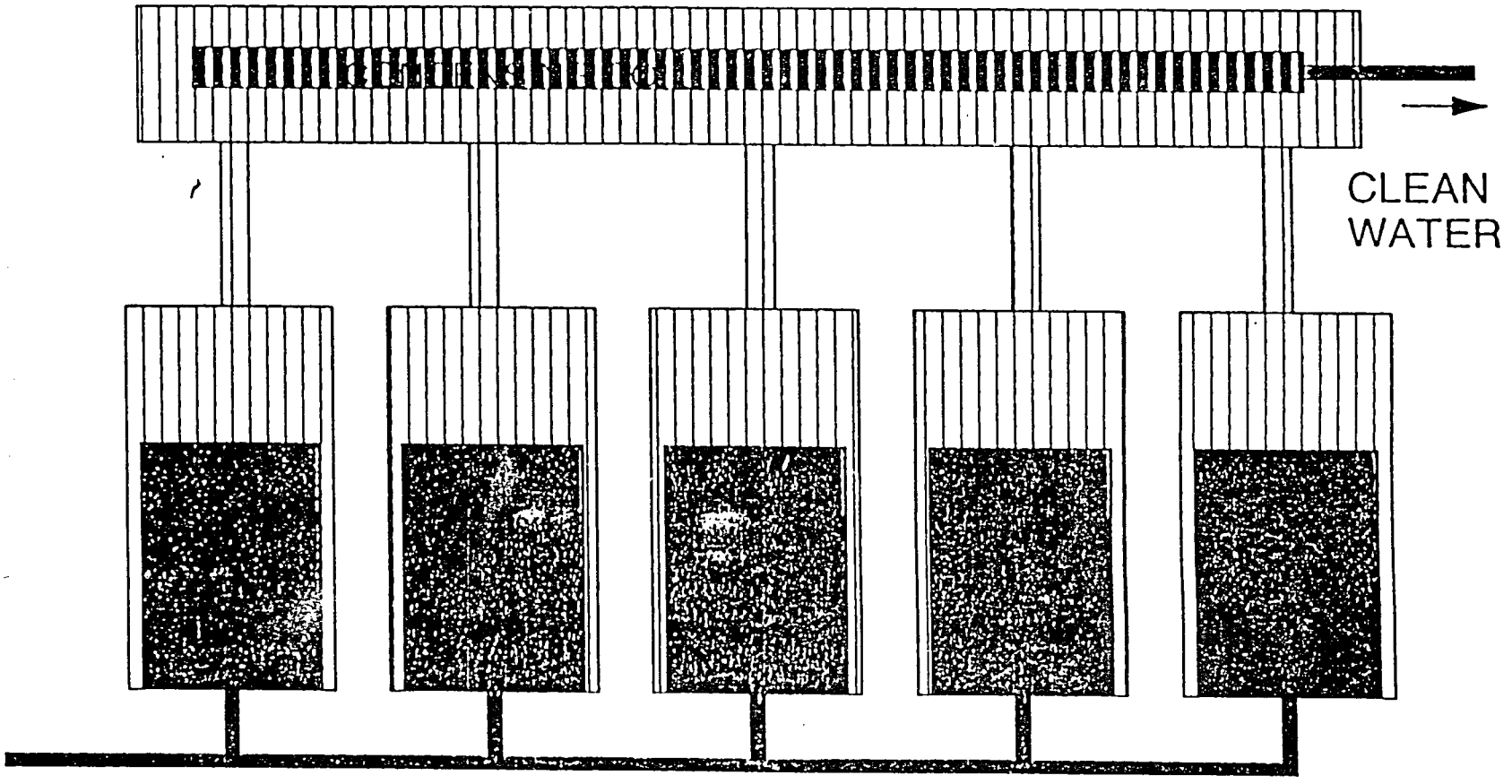
RINSE WATER DISTILLATION



→ FEED FROM STORAGE TANKS

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DISTILLATION RESULTS

Typical feed rate = 25 gallons /hr
@ 30 PPM average metal content, pH 2 - 9.5

Typical water return rate = 25 gallons /hr
@ <1 PPM average metal content, pH 6.5 - 7.5
Typical concentrate @ 9000 PPM

Cost per gallon recovered = $.03

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CPS:

ELECTROWINNING

- Electrolytic recovery cell
- Multiple cathode areas
- Separation and recovery of common streams
- Low cost, low maintenance

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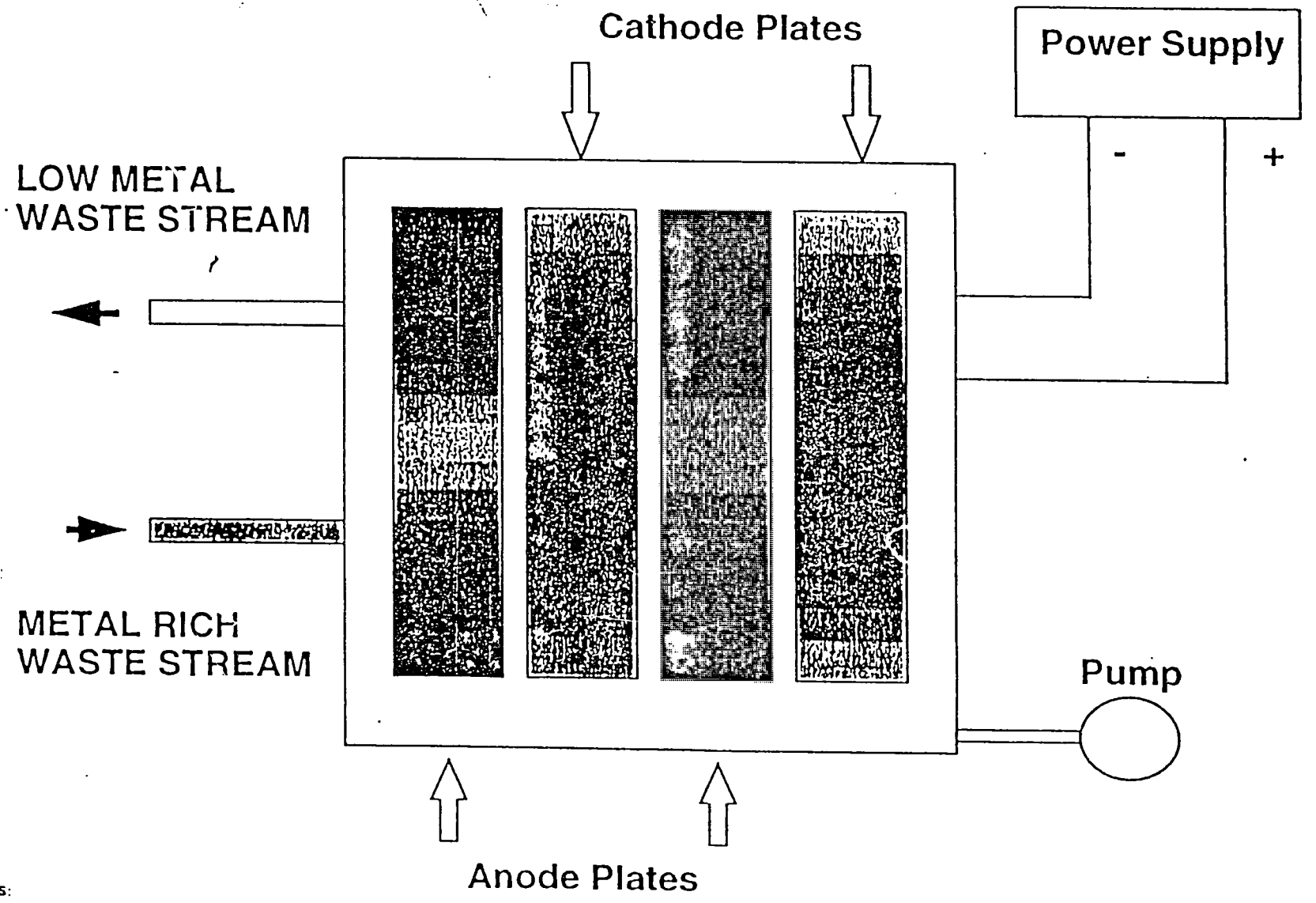
ELECTROWINNING EQUIPMENT



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CPS:

ELECTROWINNING RESULTS

TEST 1

BEFORE	AFTER
Copper metal = 310 gm/l Sulfuric acid = 40 gm/l	Copper metal = 12 gm/l Sulfuric acid = 44 gm/l

TEST 2

Copper metal = 100 gm/l Nickel metal = 200 gm/l Zinc metal = 20 gm/l	Copper metal = 15 gm/l Nickel metal = 9.5 gm/l Zinc metal = 2.5 gm/l

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ELECTROLESS NICKEL RECYCLING

- Reduce chemical purchases
- Reduce waste disposal
- Provide more consistent product
- > 100 metal turnovers

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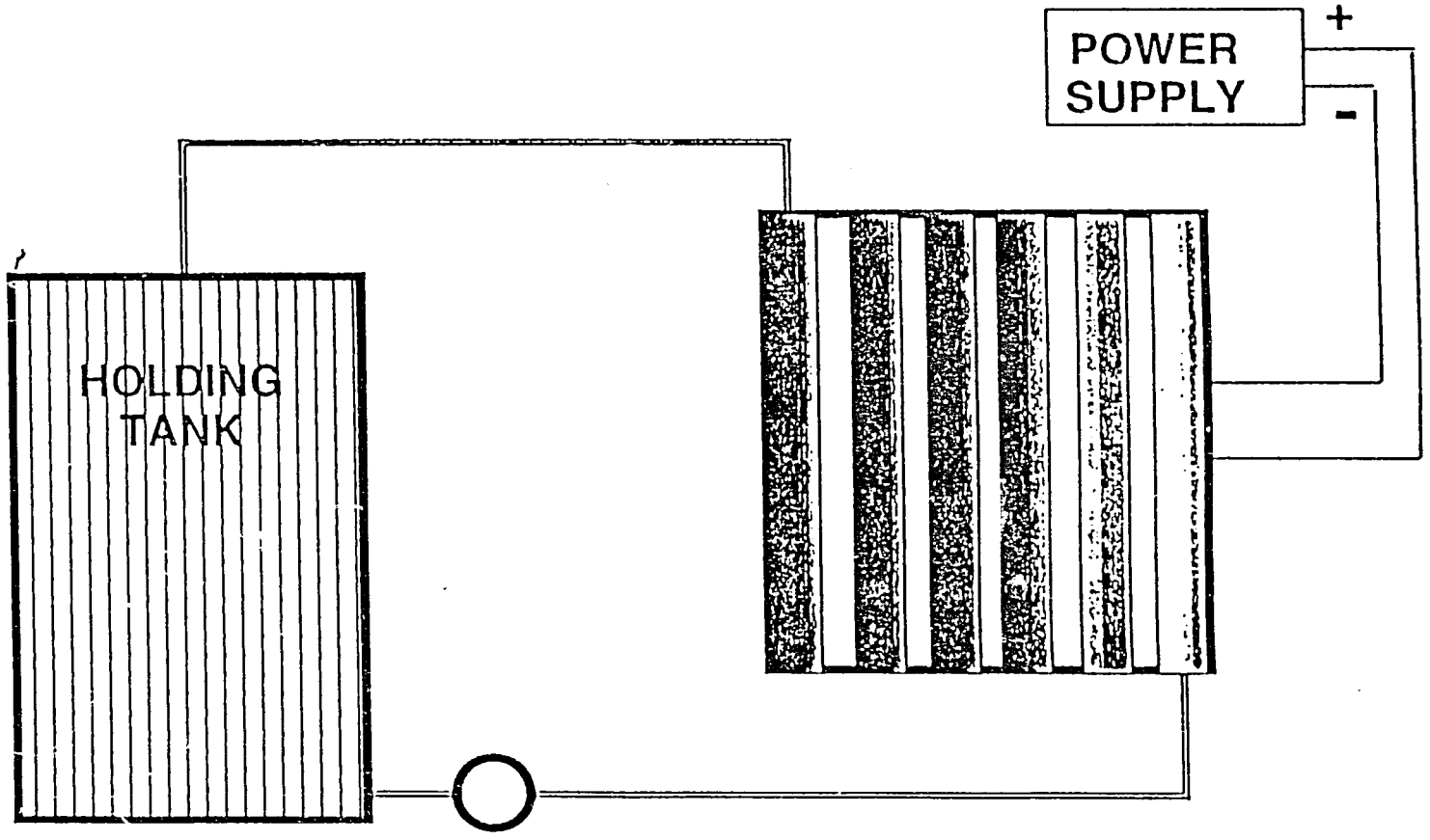
ELECTROLESS NICKEL EQUIPMENT



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ELECTROLESS RECYCLING RESULTS

Testing still underway

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CPS:

FUTURE WORK

- Continue to operate efficiently
- Experiment with new technologies
- Work with outside industry
- "Zero in" on ZERO WASTE PRODUCTION

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CPS:

Incentives For Waste Minimization In The Metal Finishing Industry

by Patrick Burt, President, Acteron Corporation. Chairman, Waste Minimization Committee, N.A.M.F.

Waste minimization is a unique direction among environmental control measures. Over the past ten years environmental regulations have caused the metal finishing industry to become the most heavily regulated small business classification in the United States. Virtually all of these regulations have reduced the profitability and the viability of these small businesses which are so vital to American manufacturing. The costs and difficulty of meeting these regulations has resulted in the closure of 25% of the plating firms in the United States over the past ten years. However, waste minimization can significantly reduce the costs of environmental controls while being the most environmentally sound approach to manufacturing.

Incentives for waste minimization can be characterized in three primary categories:

- *Economic Benefits*
- *Regulatory Conformance*
- *Environmental Achievement*

Economic Benefits

The cost of waste handling and waste disposal is already a major operating expense for metal finishing operations. These costs continue to escalate each year. Reducing the amount of waste generated reduces operating costs in several ways and can actually improve the profitability of metal finishers. Waste minimization options which a company rejected previously may now be economically viable. In many cases there is a rapid return on investment. If all of the direct and indirect benefits of waste minimization are identified and considered, the economic benefits of waste minimization can be substantial.

With increasing regulatory costs and decreasing landfill capacity the costs associated with hazardous waste disposal will increase at a far greater rate than most other business expenses. Companies which don't act now to minimize waste generation will be seriously impacted by rapidly escalating costs and may find themselves at a competitive disadvantage. Eventually they may be overwhelmed by the regulatory burdens associated with waste treatment and disposal.

The NAMF has identified a "Triad of Waste Minimization" which includes *source reduction, on site recycling* and *off site recycling* as three necessary and complimentary methods of achieving waste minimization for our industry.

Many waste minimization alternatives are very inexpensive low technology *source reduction* options which provide immediate cost savings. For example, spray rinsing and full dripping over tanks to recapture and re-use process solutions are among the least costly and most advantageous waste minimization options available.

Many of these incentives are indirect and therefore frequently overlooked or under appreciated. However, these simple source reduction methods can be utilized to varying degrees in virtually all facilities and they are relatively inexpensive to implement.

Once the waste volume has been significantly reduced by using simple source reduction options, then the more costly advanced technology *on site recycling* approaches can be implemented with reduced equipment and operating costs due to the reduced volume of waste to be recycled.

Regulatory Conformance

Conformance to stringent environmental regulations has become the foremost concern of metal finishing firms. Waste Minimization can ease the difficulty of meeting many of these mandates. In addition, federal, state and local regulations are requiring that businesses which generate hazardous waste must reduce the amount and/or toxicity of their wastes. These new waste minimization regulations will not allow manufacturers to complacently accept the higher costs of waste handling and disposal. The 1984 Resource Conservation Recovery Act renewal first addressed this issue on the federal level. Every hazardous waste manifest contains a statement which the generator must sign certifying that the generator has a waste minimization program in place and that progress reviews of the program are done periodically.

Many state and local governments have adopted or will adopt comprehensive waste minimization mandates. California and Massachusetts are among the states which have already enacted far reaching laws which require source reduction and process substitution changes.

Some Regional Water Quality Control Boards are requiring that Public Owned Treatment Works (POTW's) reduce their mass discharge volumes. To achieve this, many POTW's will continue to reduce the allowable contamination levels or water volume from industrial dischargers. Source reduction and recycling technologies are emerging as the most effective means of meeting these more stringent discharge standards.

Environmental Achievement

A strong waste minimization program is the most effective way for a manufacturer to minimize the environmental detriments of metal finishing, while continuing to provide the frequently under-appreciated environmental benefits of metal finishing. These benefits include product corrosion prevention and wear resistance which prevent the product itself from becoming a waste. By minimizing waste beyond the statutory requirements, the company improves its good standing in its community and its standing with the agencies responsible for administering environmental regulations.

Through waste minimization metal finishers can continue to provide vital societal and environmental benefits while minimizing the detriments which were historically associated with these processes.

Barriers To Waste Minimization And Their Cures

Having recognized the many values and incentives of waste minimization there remain certain technical or regulatory impediments to waste minimization which need to be addressed.

Process Baths Conducive to Solution Recapture

As was noted, effective recapture of chemical process solutions for re-use is probably the most cost effective and environmentally preferred method of waste minimization. However, in practice the liquid volume being returned to the process solution must be no greater than the evaporative loss occurring in the process tank.

Over the last twenty years proprietary chemical manufacturers have responded to customer and government requests for energy conservation by providing new process solutions which operate at low or ambient temperatures. However, these low temperature solutions minimize solution recapture opportunities because of their reduced evaporation. Consequently, there is now a need for process solution manufacturers to provide two sets of operating parameters, one option at warm temperatures for waste minimization and the other at lower temperatures for energy conservation. In addition to their evaporation advantage, warmer solu-

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tions rinse more freely and can operate at lower chemical concentrations thereby further reducing drag out waste. The energy consumption detriments of warmer solutions may be mitigated by use of environmentally sound heating methods such as process heat re-use and solar heating. Metal finishers need to notify chemical manufacturers of their desire for low waste generating process solutions.

Solution Purification

As drag out wastes are reduced, an increasing proportion of metal finishing wastes come from concentrated process solutions which are gradually contaminated through normal use. The generation of these waste solutions can actually be accelerated due to solution recapture by preventing traditional drag out of contaminants which occurs with the normal drag out of process solutions. Consequently, the importance of solution purification has become increasingly critical to achieving waste minimization. Unfortunately, purification tends to be process and contaminant specific so that no single simple method can meet this requirement.

Technical research in the metal finishing field needs to place extensive focus on solution purification technologies. In addition, existing knowledge on methods of solution purification needs to be compiled and provided to all industry members by pollution prevention agencies as well as technical and trade associations.

Shortage of Educational Materials

Recently there has been a surge in waste minimization research and education. This information needs to become widely available to even the smallest and least sophisticated firms in the metal finishing trade. Audit manuals, educational films, training courses and technical papers are all needed and valuable waste minimization tools.

Legislative Cures

Many impediments to waste minimization currently exist within the U.S. regulatory framework. These impediments include the difficulties that off-site recycling firms have in obtaining and maintaining treatment permits. In addition, there lacks a consistent regulatory framework which identifies recycling as inherently preferable to treatment and disposal and which adequately assists and promotes recycling. Some prospective state and federal regulations would actually cause in-house recycling to be more burdensome than waste treatment.

Waste Minimization = Increased Profits
Economic Benefits of Water Minimization
Dripping and Spraying Over Tanks

EFFECT		*COST BENEFIT*
QUALITY CONTROL		
1) Greater Solution Stability	=	Improved Quality Control
2) Less Frequent Solution Analysis	=	Lower Quality Control Labor
3) Less Chemical Usage	=	Lower Chemical Cost and Less Labor for Chemical Additions
4) Less Chemical Storage due to Fewer Additions Needed	=	Lower Inventory and Less Storage Area
5) Cleaner Rinses	=	Better Product Quality
REDUCED COSTS OF WASTE TREATMENT		
6) Less Water Usage	=	Lower Water Bills
7) Less Sewer Water Discharge	=	Lower Sewer Bills
8) Less Waste Treatment Chemical Usage	=	Lower Material Usage and Less Chemical Storage
9) Better Wastewater Treatment Quality	=	Due to Longer Settling Time
10) Less Sludge Generation	=	Less Wastewater Treatment Labor
11) Less Sludge Cake Generation	=	Lower Cost for Disposal, Drums, & Hauling, Documentation & Liability
IMPROVED CONFORMANCE TO ENVIRONMENTAL REGULATIONS		
12) Sewer Water Volume Reduction	=	Potential Reduction of Limits on Specific Heavy Metals (based on under 10,000 gallons per day)
13) Comply with Effluent Standards & Waste Minimization Regulations	=	Achieve Good Company Standing in your community & stay in business
14) Less Waste Volume	=	Reduced Waste Fees, Taxes & Permits. Better Quality of Conformance to Waste Storage & Documentation

Provided by: NAMF Waste Minimization Committee 10/90

Tax credit incentives for waste minimization or recycling equipment would provide the financial assistance which would allow many firms to switch from their existing investment in waste treatment equipment toward new waste minimization technologies. These financial incentives could be either state or federal. However, the best chances for enactment of tax incentives exists on the state level.

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Acteron & Waste Minimization

by V. J. Shannon
FLO KING Filter Systems
Longwood, Florida

With trend-setting anti-pollution legislation, water and landfill shortages, and a strong environmental consciousness, northern California tends to spawn ecologically minded businesses. And for Acteron Corporation, Redwood City, CA, that spells waste minimization.

Acteron is a 13-year-old firm specializing in highly reflective plating for infrared optical components used in the industrial and medical fields, electroless nickel on high-reliability electronic components, precious metals plating for electrical contacts and microwave applications, functional hard anodizing, and more. The company processes materials such as difficult-to-plate metals, non-metallics, plastics, silicon and glass. With over 50 technicians and engineers, Acteron has even developed proprietary processes employing ultrasound and pulse plating. Its customer base includes some of the most

Acteron President Patrick Burt (right) and Steve Cazel, Plating Manager, examine blanket-like reusable filter media.

prominent names in electronics and over 10 prime defense contractors. It has an inspection department that meets the requirements of MIL-I-45208A and lab resources that feature AA analysis, specific ion testing, and a zero-defects QC program in accordance with MIL-Q-9858A.

Patrick Burt, president of the 12,000-square-foot facility, is an avid proponent of waste minimization. In fact, he is chairman of the National Association of Metal Finishers (NAMF) Waste Minimization Committee, whose mission, in part, is "to research, study, and promote waste reduction, minimization, recycling or reclaim techniques to the surface finishing industry, regulators, and legislators." *(Editor's note: See article on waste minimization in November/-December issue of FM by Patrick Burt).*

Minimization Initiatives

To illustrate the results of an aggressive waste minimization program, consider this. Just seven years ago, Acteron moved from Belmont after acquiring and expanding a four-man shop in Redwood City. Despite a company that now has approximately 12 times the personnel and sales of that four-man operation, Acteron actually consumes *less than one-third the water and has nearly 90 percent less heavy metals in its effluent.* Here are some of the initiatives that have contributed to these impressive figures:

- Installation of double and triple counterflow rinses.
- Use of spray rinses over select process and rinse tanks.
- Adoption of conductivity sensors to regulate water condition and flow.
- Segregation of rinsewaters.
- Substitution of less-polluting processes (e.g., acid copper to replace cyanide copper, and periodic reverse-current cleaning to replace cyanide-containing cleaners).
- Elimination of vapor degreasing by using a system of dual soak cleaners with ultrasonic enhancement.
- Use of more dilute formulations such as those for acid pickling.
- Thorough indoctrination and training of employees to stress how they can make a positive contribution to the environment. For example, all personnel are taught the importance of extending drip-times over rinse tanks.

In-Tank Filtration Systems

Another key aspect of Acteron's waste minimization program is the use of in-tank filter systems in tanks as small as 10 gallons and as large as a few hundred gallons. As Plating Manager Steve Cazel says, "On any plating tank, but particularly on precious metal tanks, external plumbing for filtration is a concern for us. Housings can crack. Hoses and clamps get weak. And even if you recover spilled solution from a secondary containment area, chances are it would be too contaminated to recycle because of the dirt and debris involved. So it's a great benefit to keep all of the

Filter changes on in-tank system are achieved easily and quickly using hand-tightening thumbscrews.

filtration equipment in the tank. Even though the in-tank system takes up some tank space, we feel it is minimal and that the advantages are far in our favor."

The in-tank system eliminates leaks and spills because it uses no hoses, clamps, seals, chambers or, for that matter, any out-of-tank apparatus. The filter(s) is attached to the pump body and totally immersed in the solution to be filtered. The pump body is secured to the tank lip with an adjustable bracket. Solution is continuously drawn by vacuum through the filter cartridge(s), after which it travels approximately 3" before being expelled through a discharge port on the pump body. Solution never leaves the tank.

Importantly, the force of this discharged solution produces a clean, oil-free source of robust agitation that

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suspends particles for quick-capture filtration, thus keeping the tank bottom free of contaminating solids buildup. Frequently, the agitation provided as a natural byproduct of in-tank filtration is sufficient to replace mechanical or air agitation systems. As Mr. Burt explains, "Airborne contaminants — some organic, some inorganic — are a concern for our technology." By removing those particles quickly, before they dissolve in solution, we reduce the need for carbon treatment, dummying, peroxide treatments, or, in the worst case, bath dumps."

Using the same basic principles of operation but different models and sizes to produce from 1 to 3,000 gallons/hour of filtered solution, in-tank systems find application in tanks as small as a half-gallon and as large as thousands of gallons. For high-volume baths, two or more in-tank units are used on a single tank. Ease of use is another asset. Conventional filter systems often require tools and significant time and labor for filter changes. But the uncomplicated design of the in-tank system enables rapid filter changes using hand-tightening thumbscrews rather than tools. Because the systems are portable, cleanable, and consume no floor space, they can also be used to filter multiple tanks where continuous filtration is not required.

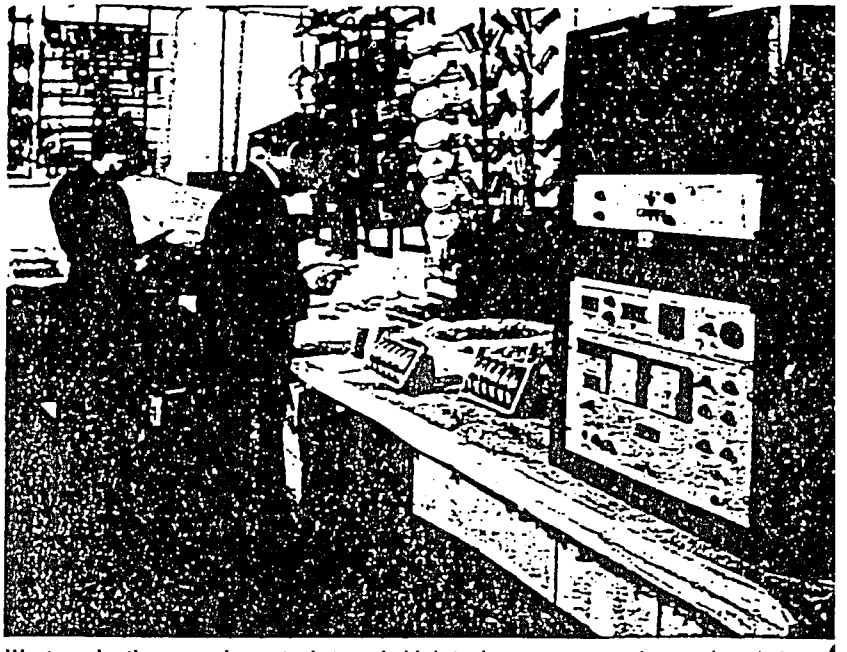
Prior to using the in-tank systems, Acteron did not filter preparatory solutions such as those in its aluminum finishing lines. In the case of nitric acid and mixed organic acids, for instance, that meant frequent dumps, frequent neutralization, frequent and liberal use of neutralization chemicals, and frequent acid purchases. Now Acteron continuously filters those pre-dips ... and with just rewards. As Cazel says, "High-solution-turnover filtration gives us more confidence in all of our solutions. It reduces rejects and adds life to the baths. So we're purchasing less acid and utilizing less neutralization chemicals for waste treatment."

Reusable Filter Media

Another important element of Acteron's waste minimization program is a reusable filter media. Before converting to this material, the company routinely accumulated a 55-gallon barrel of spent disposable filters every 90 days. But in nearly a year of using the blanket-like reusable media, not a single drum of the spent filter material has been generated, according to Cazel.

"Conventional filter cartridges go to landfill — they're solid waste — and we're committed to reducing waste," he said. "Plus, with disposables, there is the cost of an expendable product to consider. The reusable material has been real cost effective for us. We have yet to find a plating system that we weren't able to upgrade by using the in-tank filter system and reusable cartridge."

Clean filter operation is predicated on good filter maintenance, and Acteron has trained a crew whose sole job it is to properly maintain tanks, filters, and accessories on a regularly scheduled basis. That includes cleaning the reusable filters by draping them over a 3/8-inch-thick polypropylene perforated sheet, then pressure spraying with deionized water over an appropriate rinse tank.



Waste reduction complements Acteron's high-tech processes such as pulse plating to obtain particle and pore-free nickel finishes on disc drive components.

Patrick Burt and Acteron have such a high profile in the area of waste minimization that they participate in local, regional, national, and even international programs on the subject. For instance, on a goodwill NAMF tour to Czechoslovakia, Mr. Burt shared waste minimization technology with that nation's environmental and industrial ministries. And, recently, Acteron participated in the making of a film on waste minimization produced by the State of California Department of Health Services. In that film it is no accident that they discuss the in-tank filter system with reusable filter media. It is but one of many tools and techniques available to operate an ecologically responsible business in these environmentally conscious times.

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UNITED AIRLINES

WASTE TREATMENT FLOW CHART

ACID WASTE TREATMENT SYSTEM

FROM THE CHROME BATHS & TANKS ON THE WEST SIDE OF THE PLATE SHOP, DRAG OUT FROM THE BATHS, WASH DOWN AROUND THE TANKS, CONDENSATE FROM THE DEGREASER & STEAM LINES + (IRREGULAR LEAKS) FLOW INTO THE TUNNEL DRAINS LEADING TO THE ACID SUMP AND SCRUBBERS.

NOTE: ACID BATHS THAT ARE BEING DUMPED AND TREATED, GET PUMPED DIRECTLY INTO TANK # 402 OR 403.

WASTE FROM THE DRAINS RUN DOWN THE TUNNEL NORTH TO SOUTH BELOW THE PLATE SHOP AND COLLECTS IN THE ACID SUMP.

FROM ACID SUMP, WASTE IS AUTOMATICALLY PUMPED INTO TANK 402 OR 403 FOR TREATMENT.

ADD SODIUM BISULFITE TO KILL CHROME IN TANKS 402 OR 403. AFTER CHROME IS NEUTRALIZED, ADD CAUSTIC TO ADJUST pH 6.5-7.0.

WASTE IS THEN PUMPED INTO PRECIPITATION TANK 1 OR 4 WHERE LIME IS ADDED TO RAISE pH TO 10.0-12.0 AND POLYMER IS USED AS A FLOCKING AGENT TO COAGULATE HEAVY METALS AND DROP THEM TO THE BOTTOM OF THE TANK.

ALKALINE WASTE TREATMENT SYSTEM

FROM THE PLATING BATHS & TANKS THROUGHOUT THE MIDDLE & EAST SIDE OF THE PLATE SHOP ON THE WET LINES (SURFACE TREAT, NICKEL, SILVER, METAL SPRAY STRIP, NICKEL STRIP & CADMIUM LINES.) DRAG OUT FROM THE BATHS, WASH DOWN AROUND THE TANKS, CONDENSATE FROM THE DEGREASER & STEAM LINES + (IRREGULAR LEAKS) FLOW INTO THE TUNNEL DRAINS LEADING TO THE ALKALINE SUMP AND BLOWERS.

NOTE: CYANIDE BATHS THAT ARE BEING DUMPED AND TREATED, GET PUMPED DIRECTLY INTO THE DESTRUCT TANKS # 400 AND/OR 401. THE BATH UNDERGOES ELECTROCHEMICAL OXIDATION TO BRING IT DOWN TO 1 OUNCE PER GALLON OR LESS. THEN THE WASTE IS PUMPED INTO TANK 404 OR 405.

WASTE FROM THE DRAINS RUN DOWN THE TUNNEL FROM THE NORTHEAST CORNER OF THE PLATE SHOP THEN NORTH TO SOUTH AND COLLECTS IN THE ALKALI SUMP.

FROM ALKALI SUMP, WASTE IS AUTOMATICALLY PUMPED INTO TANK 404 OR 405.

OXIDIZE CYANIDE BY ADJUSTING THE pH BETWEEN 11.5 TO 12.8, WHILE CLORINATING TANK 404 AND/OR 405. BRING CYANIDE BELOW 10.0 PPM

PUMP TO PRECIPITATION TANK 2 OR 3 AND ADD SODIUM HYDROSULFITE TO KILL CHLORINE AND RESIDUAL CHROME. AFTER THESE TWO CHEMICALS TEST NEUTRAL, ADD LIME TO ADHERE TO HEAVY METALS AND ADD POLYMER TO COAGULATE THESE HEAVY METALS

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ALLOW TO SETTLE FOR 24 HOURS

NOTE: DESTRUCT (COMPLEX CYANIDES) IS PUMPED DIRECTLY TO THE BAKER TANK (OSV)

DRAIN SUPERNATANT LIQUID INTO pH ADJUSTMENT TANK 1-4

SPOT CHECK FOR CHROME

ADJUST pH TO 6.5-7.0

PUMP INTO INDUSTRIAL DRAIN

PUMP SUPERNATANT SLUDGE INTO FILTER PRESS SLUDGE TANK # ___

PRESS LIQUIDS OUT AND TRANSFER TO HOLDING TANKS # ___ OR # ___

DRAIN HOLDING TANK # ___ OR # ___ INTO pH ADJUSTMENT TANK
ADJUST pH (USUALLY HIGH) NEUTRAL IS 6.5-7.0

PUMP INTO INDUSTRIAL DRAIN

FILTERED SLUDGE GOES INTO (OSV) DUMPSTER FOR HAULING

* CORRECTION: SURFACE TREAT LINE SHOULD BE INCLUDED UNDER ACID-WASTE SYSTEM.
* All CONDENSATE FROM DEGREASER UNITS GO TO ACID WASTE SYSTEM.

M.A.
4/30/92

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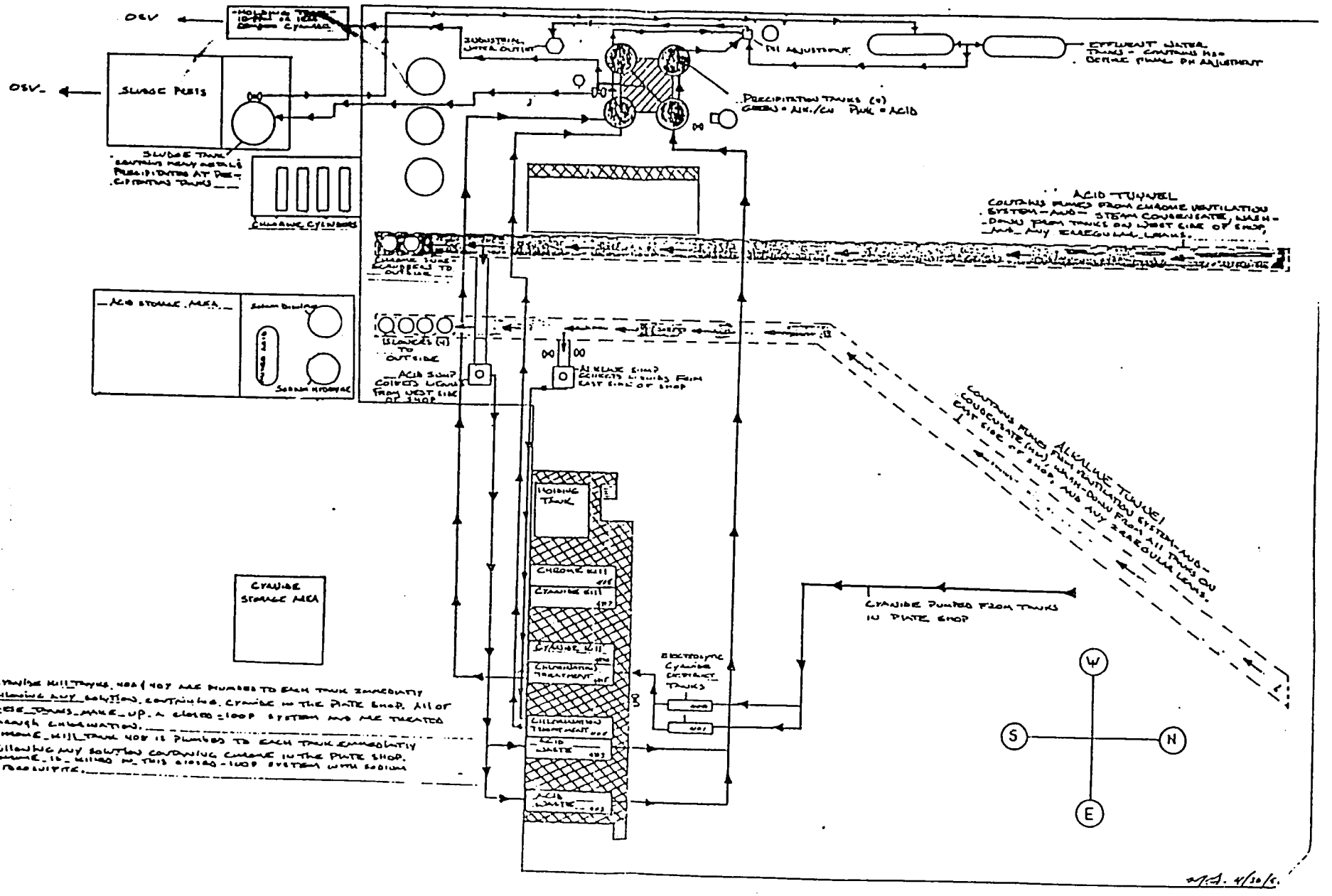

NOTE: 1. CYANIDE MILL TANKS, 406 & 407 ARE NUMBERED TO EACH TANK IMMEDIATELY FOLLOWING ANY SOLUTION CONTAINING CYANIDE IN THE PLATE SHOP. ALL OF THESE TANKS MAKE UP A CLOSED LOOP SYSTEM AND ARE TREATED THROUGH CHLORINATION.

CHROME MILL TANK 408 IS PLUMBED TO EACH TANK IMMEDIATELY FOLLOWING ANY SOLUTION CONTAINING CHROME IN THE PLATE SHOP. CHROME IS MILLED IN THIS CLOSED-LOOP SYSTEM WITH SODIUM METABISULFITE.

M.A. 4/30/5.

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WTS PRODUCTS

Packaged Systems:

WTS offers the finest in packaged industrial waste-water treatment systems. These system designs are primarily based upon proven, conventional treatment technologies enhanced by specialized process engineering and state-of-the-art automation. The packaged units are installed as stand-alone systems, or easily incorporated into more complex, specially engineered systems. Typical treatment applications for the packaged plants are:

- Heavy Metals Removal
- pH Neutralization
- Cyanide Destruction
- Arsenic Removal
- Waste Evaporation
- Aqueous Cleaning Effluent Treatment & Recycle
- Fluoride Removal
- VOC Removal
- BOD/COD Reduction
- Oil/Grease Reduction
- Water Recycle
- Semi-Aqueous Cleaning Effluent Treatment & Recycle

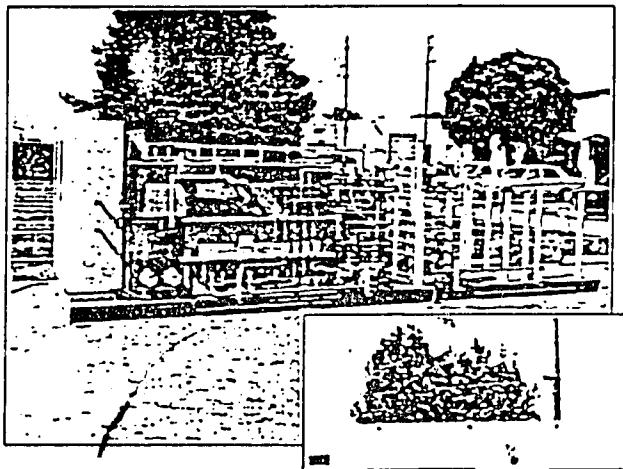
The packaged systems can treat waste streams containing concentrated and dilute levels of contamination. Standard systems are based upon continuous flow and batch treatment processes. The systems are offered with all peripheral devices necessary to provide a complete, functional wastewater treatment system.

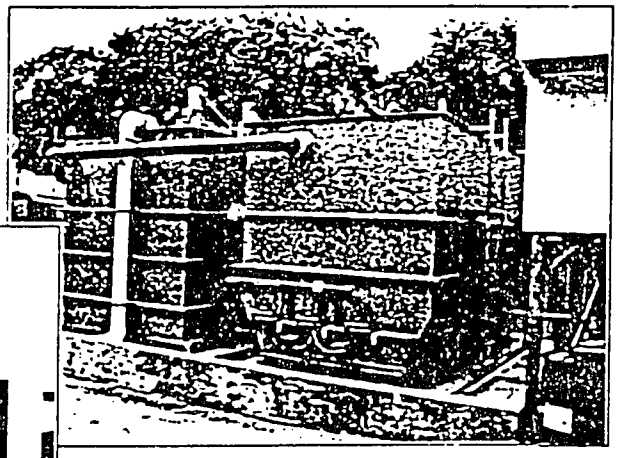
Engineered Systems:

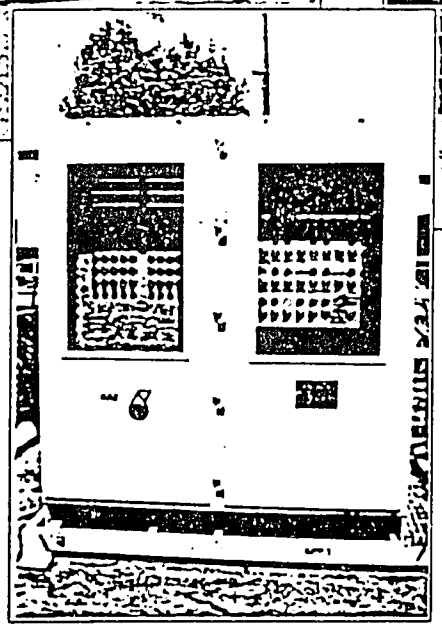
WTS provides detailed design, and manufacture of specialized equipment for custom engineered wastewater treatment projects. This capability, together with our standard packaged systems, allows WTS to provide high quality equipment to meet the many diversified needs of industrial wastewater treatment. Treatment equipment for non-standard, engineered applications includes systems such as the following:

- Ammonia Treatment
- Phenol Treatment
- Tanker Truck Wash Effluent Treatment
- Sodium Azide Treatment
- Landfill Leachate Treatment
- Laundry Effluent Treatment/Recycle
- Vehicle Cleaning Effluent Treatment
- Zero Discharge
- Existing System Rebuilds/Upgrades
- TDS Controls

These non-standard, engineered systems typically incorporate the same state-of-the-art automation included with WTS packaged products. These systems are also offered with all peripheral devices and WTS service necessary to provide a complete functional wastewater treatment system.







WTS
WASTEWATER TREATMENT SYSTEMS INC.

Wastewater Treatment Systems Inc.
1235 Elko Drive
Sunnyvale, California 94089
Telephone: (408) 541-8600
FAX: (408) 541-8615

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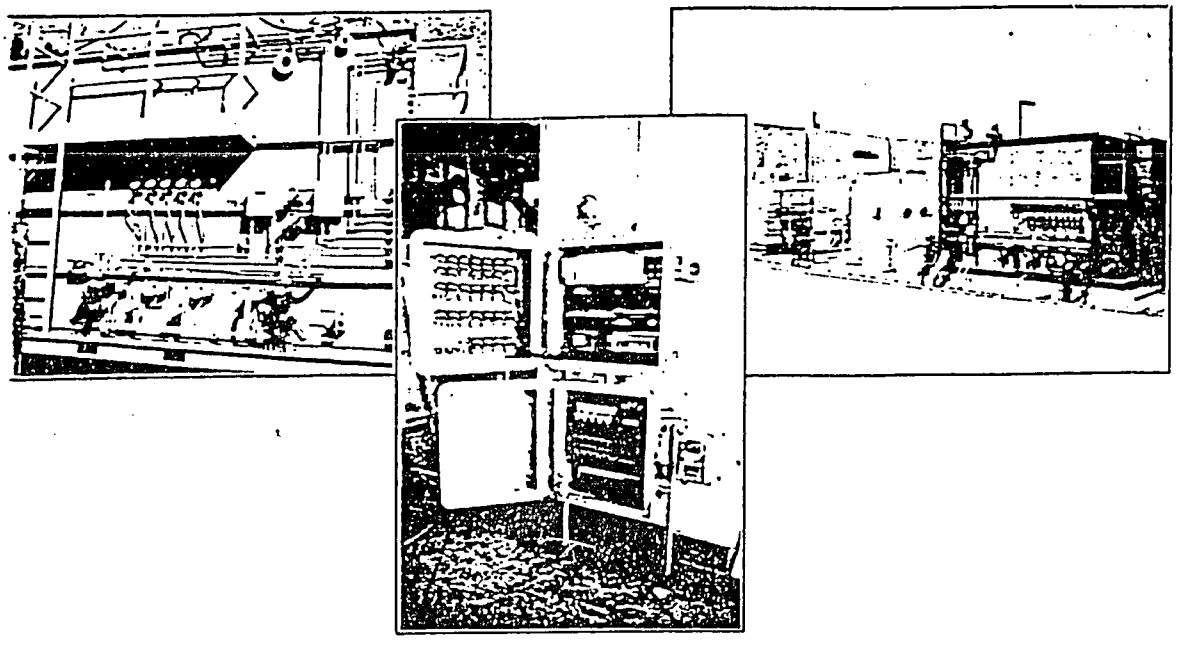


WTS
WASTEWATER TREATMENT SYSTEMS INC.

COMPANY PROFILE

INTRODUCTION

Wastewater Treatment Systems, Inc., (WTS) was founded in April 1985. With more than fifteen years of experience in the industrial wastewater treatment industry,the founders brought together considerable knowledge and technical capabilities in the chemical, mechanical, instrumentation, and process design fields of industrial wastewater treatment. This knowledge and these capabilities, combined with years of proven achievement in providing successful wastewater treatment system installations, have made WTS an industry leader.

WTS was founded with the objective of providing high quality equipment combined with unsurpassed professional engineering services and support. This objective was to be fulfilled through the development of standard, packaged equipment used for treatment of a wide variety of industrial waste effluents. In addition, these products and installations would be supported by the formation of a diversified staff of engineers and field support personel. These individuals are the key to maintaining a high quality product furnished with the required support and service to ensure successful installation of WTS products.

WTS is a member of the Thames Water Plc Group, an international supplier of water, process fluids, and wastewater treatment. From the smallest industrial user to the largest utility, Thames Water companies provide a complete package of products and services. WTS's prominence in the industrial wastewater treatment industry is ensured by their integration with Thames Water Plc. This gives WTS the financial strength of the Thames Water balance sheet, as well as Thames Water's experience as a major supplier of wastewater products and services, and utility operations.

Today, WTS has achieved and maintained its founding objective. This is confirmed by the diverse line of high quality, standard products now offered by WTS, and by its many successful installations located throughout the world.

WTS SERVICES

Field Support:

WTS understands successful system performance relies on effective field installation, commissioning and ongoing service. WTS maintains an independent staff of field engineers and technicians capable of providing the following support functions:

- Project Management
- Turnkey Installation
- Ongoing Maintenance
- Troubleshooting
- System Commissioning
- Performance Testing
- System Operation
- Emergency Repair

Commitment to Field Operations is a key factor to the success WTS has achieved in the industry today. WTS continues to offer and works to provide unequaled Field Support to its installed customer base.

Engineering

WTS supports its manufactured products and installations by maintaining an engineering staff encompassing the following disciplines:

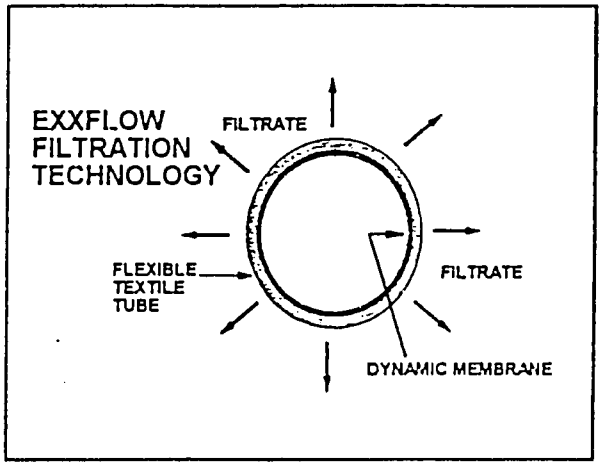
- Mechanical Engineering
- Chemical Engineering
- Civil Engineering
- Electrical Engineering
- Manufacturing Engineering
- Environmental Engineering

WTS has developed this group of engineers to ensure quality design of its manufactured products and competent support for its equipment installations. This level of engineering expertise is a mandatory element for successfully supporting today's evolving industrial wastewater treatment requirements.

psi

EXXFLOW™ CROSSFLOW MICROFILTRATION

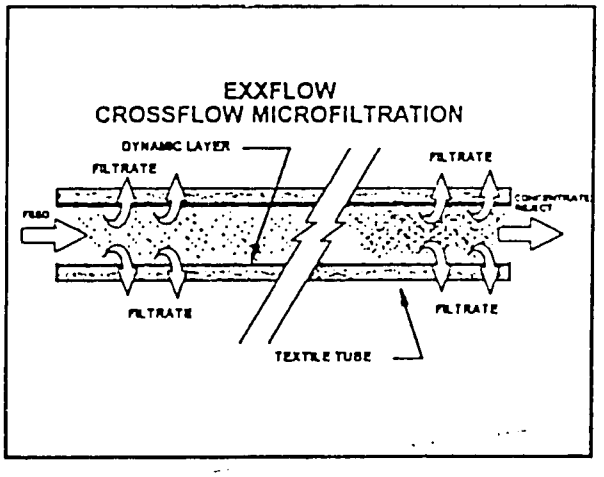
The *EXXFLOW* crossflow microfiltration process occurs in an array of permeable textile tubes. Manifolds are cast onto each end of the cloth filter to form modules which are connected to a pump for liquid inlet and to a back pressure valve at outlet. Upon introducing liquid flow into the tubes and regulating outlet pressure, suspended and colloidal matter in the liquid to be treated forms a thin film cake layer on the internal surface of each tube. This layer is called a "dynamic membrane" for its membrane-like characteristics. Other terms used are "filter layer" and "pre-coat layer". Should the quantity of suspended matter in the feed liquid be insufficient to form a filter layer, a small amount of filter aid compound is added to the initial feed. Filter layers or membranes of widely different characteristics can be produced by using different treatment chemicals.



To become treated product liquid, or permeate, the feed water filters radially through the membrane layer and out of the textile tube walls for collection at the base of each filter module. The debris removed from the liquid becomes concentrated and is swept out of the tubes with the remaining liquid which is called reject concentrate.

It is from the longitudinal or "crossflow" passage of the feed liquid along the filter cloth tubes that the process derives its name.

EXXFLOW crossflow microfiltration plants are of modular construction employing a number of manifolded filter modules. Modules are connected together either in parallel or in series with each other.



Ease of cleaning is an important feature of *EXXFLOW* crossflow microfiltration, distinguishing it from standard membrane microfiltration. In most cases, cleaning is simply a matter of momentarily stopping the feed resulting in tube collapse which causes the thin cake or membrane material to be dislodged and flushed out with the reject flow. In other applications, chemical cleaning in place is used.

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process scientific, inc.
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The *EXXFLOW* core technology is based upon the highly specialized woven textile tubular array and its post weaving treatment as well as on the formation and maintenance of dynamic layers, or membranes, and cleaning techniques.

A uniformly high quality permeate is achieved with the EXXFLOW crossflow microfiltration process. Removal of virtually all suspended solids down to about 0.1 micron has been demonstrated in countless laboratory and field trials. Other experimental work indicates that *EXXFLOW* can be developed to produce a low pressure process to reject high molecular weight dissolved solids.

The process has many advantages over conventional treatment process:

Most liquids are treatable without the addition of filter aid chemicals

Specialized membranes can be formed to produce the desired quality of treated liquid by using standard chemistry.

EXXFLOW is a low pressure process (20 - 35 psi) with a low crossflow velocity (3 - 6 fps)

The single stage treatment produces a treated liquid having no suspended solids greater than approximately 0.10 micron.

Cleaning of the filter cloth is easily accomplished

Water recovery is very high: Usually greater than 97%

Coagulation, settlement, clarification and filtration occur in the same process - usually without the need expensive of polymers or coagulant additives

Liquids of wide pH range, from strongly acidic to strongly alkaline, can be processed at temperatures up to 90°C

Extensive civil works and structures are not required

Operation is simple either manually or in the automatic mode

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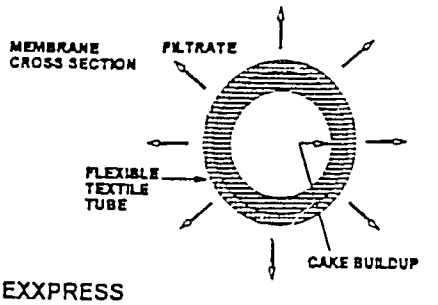
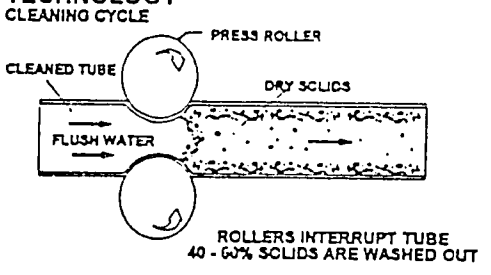
EXXPRESS™ AUTOMATIC TUBULAR FILTER PRESS

Wastewaters, or dilute slurries containing concentrations of 2 to 20% solids or more can be dewatered if pumped into filter modules operating with all tubes in parallel in the dead end mode. This mode is achieved by closing the outlet valves at the reject end of the module. The slurry forms a cake layer on the internal walls of the tubes. Its associated water permeates through the cake layer and escapes as filtrate on the outside of the tubes. The dewatering cycle is complete when the cake layer reaches a controlled thickness. The solids discharge cycle then commences by opening the outlet valves and traversing the module with rollers. The venturi formed by the rollers creates a high velocity with the incoming water and flushes the solids down the tubes and onto a dewatering screen.



EXXPRESS SLUDGE DEWATERING TECHNOLOGY



Compared to conventional dewatering devices, including centrifuges, plate and frame filter presses, vacuum and belt presses, the (*EXXPRESS*) has the following advantages:

- Lower installed capital cost
- Use of the same filter cloth as *EXXFLOW*
- No chemical additions are required
- Low operating pressures are used resulting in lower cost of operation
- *EXXPRESS* is self cleaning and automatic
- Sludge from water treatment processes and industrial sludges including toxic and hazardous materials
- *EXXPRESS* produces superior quality filtrate

NOTE: "EXXFLOW AND "EXXPRESS" ARE LICENSED TRADE NAMES OF EPOC WATER, INC.

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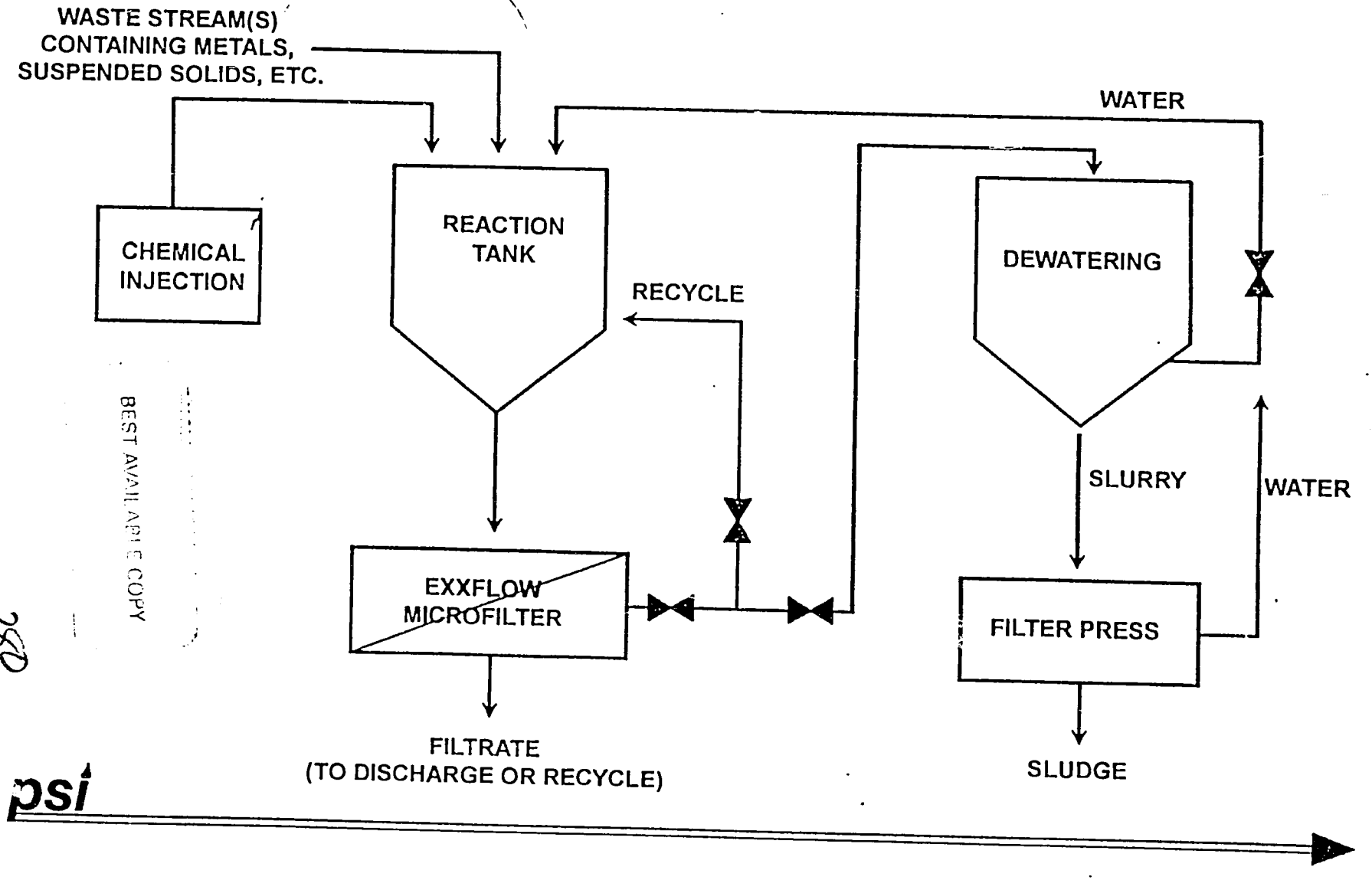
11/17/93

TYPICAL FLOW DIAGRAM
HEAVY METAL AND SUSPENDED SOLIDS REMOVAL



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APPLICATION REPORT

Industrial Wastewater Recycle

REPORT # 9002

CLIENT: Commercial Aluminum Cookware - Toledo, Ohio

DATE INSTALLED: July 1990

PROBLEM STATEMENT

Water is used to remove machine oil, kerosene and dirt from aluminum cookware prior to a deionized rinse in preparation for hard anodizing. The wash/rinse system produced a wastewater containing up to 150 mg/l of oil & grease. The local sewage regulations required the oil & grease and kerosene concentrations to be below 5 mg/l.

SOLUTION

After detailed investigation by the consulting engineer, the recommended treatment process was microfiltration/ultrafiltration. Exxflow microfiltration was chosen because it treated the washwater to recycle quality at an economical cost. The Exxflow microfilter, using an inert powdered adsorbent, removes the kerosene and oil & grease contaminants. The microfiltrate, which meets not only discharge standards but also recycle quality water, is reused as washwater in the parts washer.

The adsorbent solids, after concentration by the Exxflow microfilter, are dewatered by the Exxpress tubular filter press. Overall, the treatment system provides over 99% water reuse and produces a filter cake of 30-40% w/w solids.

The 40 gpm system returned its total cost within the first 3 months of operation, compared to off-site disposal.

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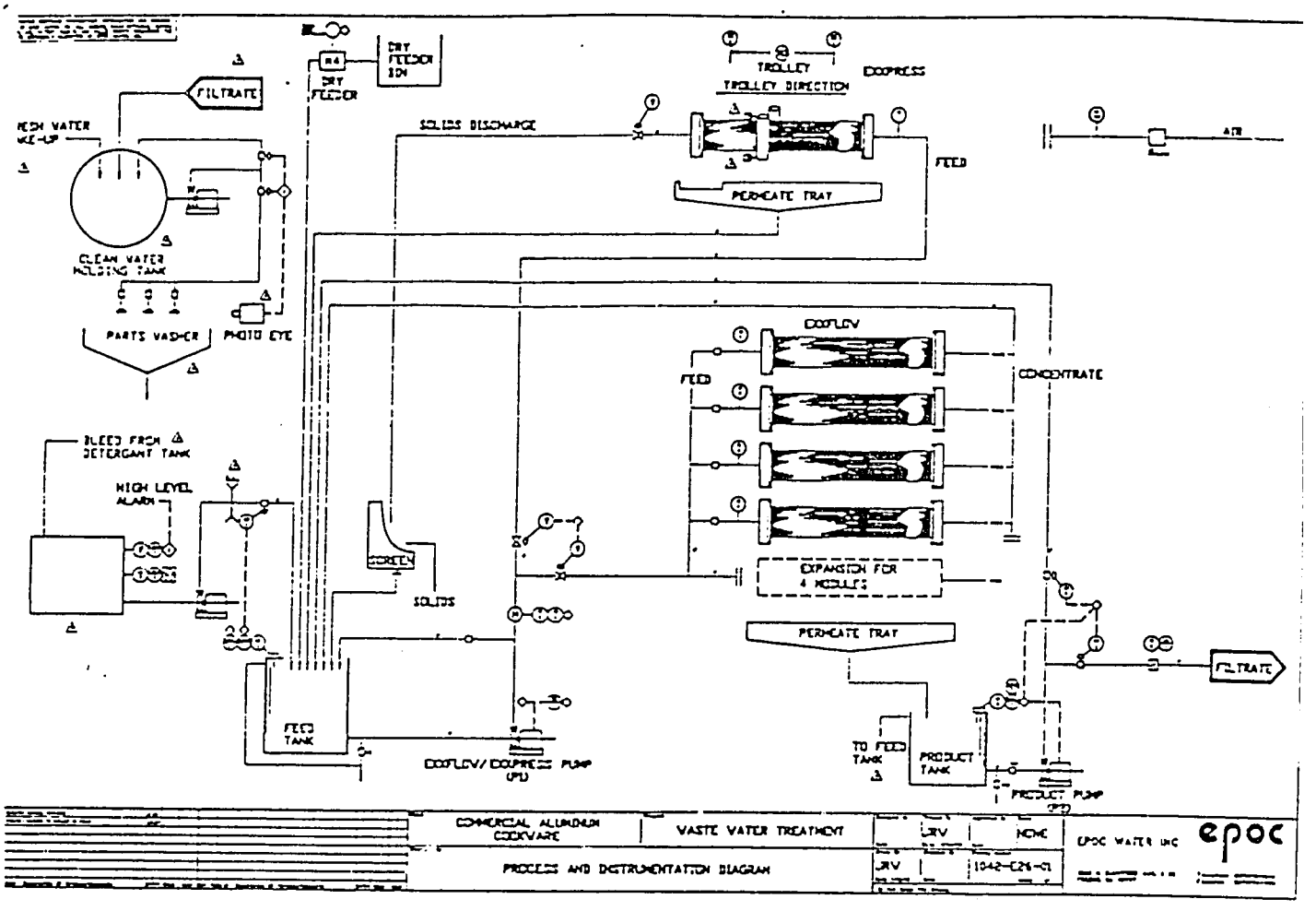
PROCESS



RESULTS

	RAW FEED	FILTRATE
Oil & Grease/Kerosene	Up to 150 mg/l	<5 mg/l
Metal Fines	10 - 50 mg/l	ND
Exxpress Filter Press Cake	>30% solids w/w	

Design Capacity: 40 gpm

Payback: Less than 3 months vs. disposal

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APPENDICES F :

Curriculum Vitae

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CURRICULUM VITAE

Name:	B. Situngkir
Date of Birth:	
Mailing Address:	Jl. Gatot Subroto Kav. 52-53, Jakarta
Home Address:	
Nationality:	Indonesia
Sex/Marital Status:	Male/Married

Work Experience:

July 4, 1984 - Present	The Chief of the Section of the Industrial Relation and Pollution Control, Directorat of the Electrical Equipment and Metal Industry. Electrical Equipment and Metal Industry, Department of Industry

Training/Seminar:

October 4, 1993	The Ozone Layer Protection and ODS phase out Jakarta State Ministry for the Environment of the Republic of Indonesia and Japan Environmental Agency - Japan Environmental Sanitation Center (JEA - JESC)
August 24-27, 1993	Sectoral workshop for preparation of Indonesia Country Programme for the ODS phase out under the Montreal Protocol, Jakarta State Ministry for the Environment and United Nations Development Programme (UNDP)
April 21 - May 2, 1992	Basic Course of the Environment Analysis University of Indonesia and Indonesia Environmental Impact Management Agency (BAPEDAL)

Education:

1980	University of North Sumatera Medan

WORLD ENVIRONMENT CENTER

INDUSTRIAL WASTE MINIMIZATION ASSESSMENT

INDONESIA METAL FINISHING INDUSTRY

UNITED STATES STUDY TOUR REPORT

Widya Wicaksana

January, 1994

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3.2. Electrolizing Inc.
3.3. Wastewater Treatment Syatems Inc.
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3.7. United Airlines Maintenance Operations Center
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3.10. Lawerence Livermore National Laboratory
3.11. Chemical Sollution Inc.

IV. CONCLUSIONS and RECOMMENDATIONS

V. APPENDICES

I. EXCECUTIVE SUMMARY

The World Environment Center (WEC), through a cooperative agreement with the United States-Asia Environmental Partnership (US-AEP) and United States Agency for International Development in Indonesia (US-AID), is supporting sustainable development by strengthening industrial and urban environmental, health and safety management policy and practices in several of sector industry with waste minimization program. One of sector of industries is metal finishing & electroplating industry.

The hole program consisf of waste minimization assessment at the facilities, training and workshop, and study tour for Indonesian representative (goverment & industry). The purpose of those activities are to identify no/low cost practices and techniques that can reduce the discharge of pollutans and improve worker health and safety.

Especially for the U.S. study tour the objective is to provide the participant with an intensive overview information of technologies and management practices implemented in the U.S. metal finishing industries.

The study tour group has visited 10 waste treatment facilities (small, medium and big industry) and attended 2 discusscion meeting with expert form research institute (Lawerence Livermore National Laboratory, Univ. of California) and from environmental consulting company (Chemical Solutions Inc.).

Some major findings and conclucions during this tour :

- United States Goverment has strong regulation of waste disposal from industry, which industries should followed
- Waste treatment aspect has became one of the important competitiveness factor in business, also in metal finishing sector, because the customers don't want to make deal with company which bad reputation in environment issue
- Waste treatment does not mean need high cost and complicated technology, it can be with moderate investment, low operation cost (7-10 % from total cost production) and with simple systems
- Waste minimization techniques start at the first step of plating process and follow process, not only at the end process
- Work safety has high attention from management of company, almost in every company has safety equipment and safety handling procedure, and also the worker involved and participated in safety management through regular meeting and periodic safety training

To further improve waste treatment of metal finishing industry in Indonesia, the recommendetion follow-up are :

- Conduct seminar for excecutive (top management) with topics the economical and future benefits of waste minimization
- Develop and build information network consist of person, institution, coperation, univercity and others people who have interest in waste treatment management and technology
- Goverment agency (Bapedal) should make more strong implementation of environment impact regulation
- Develop local capabillity for knowledge and technology of waste minimization through intensive and focused training
- Goverment agency (Bapedal) should give insentive systems for the company which have good waste management

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II. INTRODUCTION

This study tour, one of the activities of Industrial Waste Minimization Assessment Program, was conducted by World Environment Center (WEC). The program supported through cooperation between the United States - Asia Environmental Partnership (US-AEP) and the United Agency for International Development (US-AID) in Indonesia.

The Industrial Waste Minimization Assessment program consist of :
- factory waste minimization assessment
- workshops/seminar waste minimization
- U.S. study tour

in several sector of industries, and this tour for metal finishing industry.

The objective of the U.S. study tour is to provide the participants with an intensive overview information of technologies and management practices implemented in the U.S. to enhance waste minimization and improve worker health and safety in metal finishing industry through observation and discusstion. In this tour the participants would take opportunity to exchange experiences with U.S. counterparts directly in basis environmental, health and safety issue and to build interaction, relation and international cooperation regarding the metal finishing industry's response to heigtened environmental standard and regulations.

Funding this tour provided by the United States Agency for International Development (USAID) through a cooperative agreement with WEC.

The experiences gained during the study tour will be disseminated to other Indonesia metal finishing industries and Indonesia goverment officials through second workshop of waste minimization in Indonesia next year. Hopefully, the next workshop will be more effective based on field observation and information from this tour.

Detailed description of this tour :

Date	: December 5-17, 1993
Tour coordinator	: Charles Jong Hwa Hong - Deputy Project Manager, WEC
Participants	:
1. Berani Situngkir	- Section Head of the Pollution Control, Ministry of Industry, Directorate General Multivarious Industry
2. Widya Wicaksana	- Project Manager of Small Scale Metal Industry Development, Institute for Small ScaleIndustry Development,Mandiri Found.
3. Herry Hamdani	- Staff of Directorate for Hazardous Waste Management, Environmental Impact Mangement Agency
4. Dadang Sudradjat	- Head of Quality Control Section, PT. Superex Raya (allumunium extrutions)

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5. Agung Prastowo - Staff Electroplating Departement,
PT. YKK Indonesia Zipper CO.,Ltd

6. Suryanur Syafe'i - Chief Quality Control,
PT. PADI Komponen (electronic component manufacturer)

The Schedule of tour :

1. Dec. 6, 1993 Metal Surface Inc., Los Angeles, California 90201-0521
Persons met : SAM BELL (President)
Bruce F. Nielsen (Plant Engineer)
Mark A. Hanson (Excecutive Dir. MFASC)

2. Dec. 7, 1993 Electrolizing Inc., Los Angeles, California 90011
Persons met : SUSAN B. GRANT (General Manager)
Jack Morgan (Plant Manager)

3. Dec. 9, 1993 Lawerence Livermore National Laboratory, Univ. of California
Persons met : JACK W. DINI
(Section Leader Material Fabrication Division)
Christ Steffani (Staff)

4. Dec. 10, 1993 Wastewater Treatment Systems Inc., Sunnyvale, California 94089
Persons met : GLEN C. NEUSTEDTER (President)
John B. Strandberg (Sr. Chemical Engineer)

5. Dec. 13, 1993 Read Rite Inc., 3065 N. Sunnyside, California
Persons met : MARK ROTHWEILER (Operations)
Jim Elliott (Marketing Mag. Process Scientific Inc)

6. Dec. 13, 1993 Acteron Corporation
851 Shasta Street, Redwood City, CA 94063
Persons met : PATRICK BURT (President)

7. Dec. 14, 1993 Schlage Lock Co.,San Francisco
Person met : JIM COLLINS (Plating Departement)

8. Dec. 14, 1993 Santa Clara Plating Co.Inc.
1773 Grant Street, Santa Clara, CA 95050-3984
Person met : THOMAS L. COSS (President)

9. Dec. 15, 1993 United Airlines, San Francisco Int'l Airport, CA 94128-3800
Persons met : STEVEN F. SULGIT (Facilities & Eng.)
Alexander Klauss (Electroplating Manager)

10. Dec. 15, 1993 New United Motors Manufacturing Inc.
Fremont, California

11. Dec. 16, 1993 Chemical Solutions Inc.
400 Main Street, Suite 203, Pleasanton, CA 94566
Person met : JIM MILLE (President)

12. Dec. 16, 1993 San Jose Water Pollution Control Plant
700 Los Esteros Road, San Jose, CA 95134
Person met : ALEX EKSTER, Ph.D. (Sanitary Engineer)

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III. FINDINGS

3.1. Metal Surface Inc.

Description of the facilities :

Location	: Los Angeles, Southern California
Established	: 1954
Products/services	: Metal finishing processes, espesially precision plating for Aircraft, Electronics and Aerospace parts, like gold plating, nickel plating, copper plating, silver plating etc.
Company size	: 140 employees (2 shift)

Production plant :

This company has completed production process facillities and equipment, like laboratorium for testing and controlling quality plating and quality plating solution, special material storage, work and safety equipment and waste treatment facility, special room for high precision plating. Lay out for plating process of this company is not very good, but lay out of plant is good. They used rack plating system in plating process and made special area (room) for gold plating.

Plating process generated three kind waste water, every waste water contain nickel, cyanide and copper which should handle with special treatment process.

Waste Treatment System facility :

They started use waste water treatment at 1987 with total investment US$ 1.5 million. Capacity of waste treatment is 40,000 gallon water perday and produce 200 pon sludge perday. For sludge they should pay US$ 158 perton to mining company to recycle heavy metal from sludge. Operating cost of waste treatment relatively low, it's only 7 % from total production cost.

The waste treatment system in this company used chemical precipitation/clarification system, it's common method used almost in every metal finishing industry. The waste treatment system relatively big size and looks complicated system, waste treatment facility used area about 400 m2. They integrated treatment for 3 difference waste solution and operated waste treatment from special control room. See Appendics for process diagram.

To minimize waste from processing line they have some technique as follows :

- Material handling (chemical material and produst to plating)
- Housekeeping (cleanliness at processing area)
- Racking and Line orientation (flow process)
- Drip shields and drip time (design tank process and rinsing tank)
- Spray rinsing
- Ion exchange
- Electrowining (optimation chemical solution)

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The important and specifics finding in this company is how they handle dangerous material. First, they split the dangerous material and use special container and then put the container at chemical storage area to reduce risk.

Work safety aspect :

They approached work safety with completed safety equipment, used special area and storage for hazardous material and improve skill and increse awareness worker with safety aspect through meeting and training.

3.2. Electrolizing Inc.

Description of the facilities :

Established	: 1944
Products/services	: Spesialist in metal coating process that uniformly deposits a dense, hard, high chromium plating, non-magnetic alloy on the surface of the basis metal. The coating has a Rockwell C hardness value of 67-72 and it's applied with deposit thickness ranging from 0.000025" to 0.0006".
Company size	: 40 employees

Production plant :

Electrolizing is a small scale metal finishing industry with old facilities (building, processing equipment), but they have specifics product/services that is hard and high chromium plating for special part. The facilities and equipment which this company have is not well organize and maintance. Also they do not have complete laboratorium for testing and controlling quality. Lay out for plating process is not very good, cleanliness of workshop for some area is poor. For coating process they used rack plating system. The process generated only one kind waste water. that's chrome which should handle with special treatment process. This company has small and appropiate waste water treatment system.

Waste Treatment System facility :

The waste treatment system in this company is very small with capacity only about 3000 gallon water perday and produce 20 pon sludge perday For sludge they should pay US$ 1200 perton to mining company to recycle heavy metal of sludge. Operating cost of waste treatment relatively low, it's only 7-10 % from total production cost.

The waste treatment used area only 40 m2 without special area, only small area in the corner of workshop. The waste treatment system used precipitation techniques with out complex design. also equipment of waste treatment made with functional approach, they used simple and appropiate part and equipment. It can reduce and minimize investment cost for waste treatment.

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The important and specifics finding in this company is how the small scale industry like Electrolizing aware about environment aspect and try answer the problem regarding their capability. It's mean responsibility for environment problem is not depend on the size of industry or factory, but for everyone who generated waste.

This is vey surprise and make future perspective because in Indonesia there are many small industry which in future could be generated some environment problem.

To minimize waste from processing line they have some technique as follows :
- spray rinsing
- electrowining
- recycling water

Work safety aspect :
For cleanliness and safety work Electrolizing need some improving in every aspect like ; lay-out, safety equipment, awareness of worker and also special program for worker concerning safety aspect like training or regular meeting. The discipline of worker to use safety equipment like glasses, face shield, etc is still need attention.

3.3. Wastewater Treatment Systems Inc.

Description of the facilities :

Established	: 1985
Products/services	: WTS Inc. offers the finest in packaged industrial wastewater treatment systems, especially for small and medium waste treatment equipment. (for detailed see appendics)

Detailed Product/services :
WTS Inc. is a member of the Thames Water Plc Group, an international supplier of water, process fluids, and wastewater treatment. WTS Inc. specialized in manufacturing packaged industrial waste water treatment systems. These systems designs are primarily based upon proven, conventional treatment technologies enhanced by specialized process engineering. The packaged units are installed as stand-alone systems, or easily incorporated into more complex or specially engineering systems.

WTS Inc. provides detailed design, and manufacture of specialized equipment for custom engineered wastewater treatment project. And support field installation, commissioning and ongoing service through project management, turnkey installation, ongoing maintenance, troubleshooting, system commissioning, performance test, system operation and emergency repair.

WTS Inc. has strong supported team for design and engineering aspect by special staff with engineering background.

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Typical treatment applications for packaged plants are :
- Heavy metal removal
- pH neutralization
- Cyanide destruction
- Arsenic removal
- Waste evaporation, etc.

The packaged systems can treat waste streams containing concentrated and dilute levels of contamination. Standard systems are based on continuous flow and batch treatment processes.

The important and specifics findings in WTS Inc. that's simple, packaged and practice systems for waste water treatment. This is very interesting because many people still think that is waste treatment always need systems with big size, expensive and complex.

3.4. Read Rite Inc.

Description of the facilities :

Read Rite Inc. is one of high tech. factories in Silicon Valley which produce computer component like floopy disk, hard disk, disk drive with nickel plating for finishing product. In this company we can't see inside the factory, it's very closed and secret, we only see waste treatment facility outside of the plant.

This factory has nickel plating unit to support production for finishing. This plating unit generated waste water contains nickel particle.

Waste Treatment System facility :

This company has new waste water treatment facility installed at september 1993 with total investment US$ 800,000. Capacity of the WTS is 300 gallon per minute. Design of waste treatment system of this company supported by Process Scientific Inc. (PSI) and used new method (technology) to separate liquid and solid waste, it's called membrane technology. (for detailed see appendics)

This method used membrane filter made from permeable textile tubes, trade name of the technology is EXXFLOW crossflow microfiltration. EXXFLOW crossflow microfiltration plants are of modular contruction employing a number of manifolded filter modules.

The EXXFLOW technology is based on the highly specialized woven textile turbular array and its post weaving treatment as well as on the formation and maintenance of dynamic layers or membrane, and cleaning techniques. This method has some advantages compare with conventional method.

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The EXXFLOW crossflow microfiltration has many advantages over conventional treatment process :

- most liquids are treatable without the addition of filter aid chemical
- low pressure process (20-35 psi) and low crossflow velocity (3-6 fps)
- water recovery is very high, usually greater than 97 %
- coagulation, settlement, clarification and filtration occur in the same process (usually without expensive polymers or coagulant additives)
- operation is simple either anually or in the automatic mode
- cleaning of the filter cloth is easily accomplished
- extensive civil works and structures are not required

The PSI Inc also has new filter press techniques, its called EXXPRESS automatic turbular filter press. This techniques used filter modules operating with all tubes in parallel in the dead end mode. This mode is achieved by closing the outlet valces at the reject end of the module. (see appendics for detail).

The EXXPRESS techniques has advantages :

- lower installed cost
- no chemical additions are required
- low operating pressure
- self cleaning and automatis
- use the same filter cloth as EXXFLOW
- produces superior quality filtrate

3.5. Acteron Corporation

Description of the facilities :

Products/services : Metal finishing processes, spesializing in highly reflective plating for infrared optical component, electroless nickel on electronics component, special plating for microwave applications, hard anodizing etc. They have advanced plating techniques to answer customer satifaction.

Production plant :

Acteron has very good plant almost in every aspect, lay out process is very efficient even the space is limited, supporting aspect like laboratorium, quality control, and research development have high priority from management level.

Acteron has developed many unique processes for special plating like for rhodium coating its eliminates problems of ductility, stress cracking, and porosity.
They have strong R & D staff for developed specific techniques to answer problem in quality and for special plating.

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Another products from R & D division are :
- OptiGold plating,
- OptiCarriers plating,
- OptiNickel, etc.

Every product has specifics plating performance.

Waste Treatment System (WTS) facility :

The waste treatment system used precipitation technique. Acteron has installed small packaged heavy metal precipitation system (HMR) from WTS Inc. with capacity 5 gallon per minute. The prize of this type is US$ 45,000 included installment, training and supervision, the installation need only 40 m2.

The important and specifics finding in this company is how they minimize waste water from proceesing line. Before they implemented minimization techniques, Acteron consume much water perday almost 10 thousands gallon for one day. After implemented some minimization techniques they can reduce water consumtion only 1500 gallon perday. That's why they used small waste treatment system, only 5 gallon per minute. They try to recylce and recovery water for rinsing to make more efficient.

To minimize waste water from processing line they used some techniques in flow rinsing and rinsing technique, these are :
- counterflow rinses technique
- spray rinses technique
- drag-in drag-out rinses

The idea of counterflow and drag-in drag-out technique is to separate clean water rinse and dirty water clean and try to minimize water consuming in rinsing.

They also used ion exchange cylinders to remove metals and cyanide from rinse water, and then we can re-use rinse water. All these techniques are low cost, simple and easy for implementing. (for detailed see diagram process in appendics)

Result of these minimization techniques is plating process produce few waste water to go to waste treatment system. It's mean we can reduce invesment cost for waste treatment system, we only need small waste treatment facility with easy and simple operation and of course with cheap prize.

Work safety aspect :

They approached work safety with completed safety equipment (safety glasses, boots, goggles, face shield, eye wash stations, showers, fire extinguishers, hard hat, safety shoes). Used special area and storage for hazardous material and improve skill and increse awarness worker with safety aspect through regular worker meeting and worker training. The workers have good discipline used safety equipment.

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3.6. Santa Clara Plating Co. Inc.

Description of the facilities :

Santa Clara Plating Co. is medium scale metal finishing, it's not have special plating service. This Company has very good building with well organized workshop, and has good lay out of plant. Mostly customers come from computer factory to plate casing and components of computer.

Production plant :

This company has completed production process facillities and equipment, like laboratorium for testing and controlling quality plating and quality plating solution, special material storage, work and safety equipment and waste treatment facility. They used rack plating system in plating process. Plating process generated three kind waste water, every waste water contain nickel, cyanide and copper which should handle with special treatment process.

Waste Treatment System facility :

Santa Clara used precipitation technology to handle waste water from plating process. Operating cost of waste treatment 8-10 % from total production cost. The waste treatment of this company relatively simple and not too big, it's used area about 50 m2. This company only need small waste treatment because it's implemented some techniques to reduce waste water from processing.

To minimize waste from processing line they have some technique as follows :

- counterflow rinses technique
- spray rinses technique
- drag-in drag-out rinses
- use ion exchange

Work safety and cleanliness aspect :

Santa Clara has good work safety aspect with completed safety equipment (safety glasses, boots, goggles, face shield, eye wash stations, showers, fire extinguishers, hard hat, safety shoes), used special area and storage for hazardous material. Also improving skill and increasing awarness worker through regular meeting and training.

This plant is very clean, they reach this condition through some activities as :

- product handling, after processing
- lay out process tank and rinses tank
- setting flow worker in processing line

The important and specific findings in this facility are :

- well planned and organized facilities
- clean plant

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3.7. United Airlines Maintenance Operations Center

Description of the facilities :

United Airlines maintenance center opened in 1948. The Maintenance Operations Center (MOC) is technological pacesetter in the airline industry. This facility is one of the largest facilities of its kind, supporting United's Airlines maintenance mission throughout the world. The major responsibility of the MOC is repair, overhaul and modification of airplanes, engines and component parts.

Electroplating Production division :

As maintenance center which has job to repair and overhaul of airplanes, MOC need plating section for finishing component parts airplanes. The plating unit used rack plating system for chrome plating and nickel plating. They started treat waste directly from rinse tank with reactive rinse tank system. It's looked simple system to recovery dirty rinse water.

Waste Treatment System facility :

The MOC of United Airlines simplified waste treatment system with used rective rinse tank to remove heavy metal before go to waste treatment facility. It's make few waste water with low concentration of heavy metal, and also waste treatment looked simple. Of course this system reduce a lot cost for investment and operation of waste treatment system.

In the reactive rinse tank with chemical reaction they caught heavy metal before waste water go to treatment. From this tank waste water pumped into chrome kill tanks or cyanide kill tanks neutralized pH and coagulated heavy metal with polymer and drop to the bottom of the tank. Overflow from these tanks after recondition with added chemical solution back to reactive rinse tank.

Using reactive rinse tanks make waste treatment more simple system and looked waste treatment easy. We don't need complex waste treatment system, the important thing is function of the system.

Waste treatement from elctroplating division is part of United Airlines Water Treatmment System. From waste treatment in electroplating division the water pumped into United Airlines Water Treatment mixed with rain water, washing water etc.

Work safety aspect :

United Airlines has systimatics approached for work safet, first completed safety equipment, second used special area and storage for hazardous material, third improve skill and increse awarness worker with safety aspect through regular meeting (every week) to discuss every thing concerning work safety in every section and also through work safety traning.

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3.8. New United Motors Manufacturing Inc.

Description of the facilities :

The New United Motors Manufacturing Inc. is the joint venture formed by General Motors Corporation and Toyota Motor Corporation. Located in Fremont, California, the company has incorporated Toyota's production concepts and management and established the goal of building highest quality vihicles at the most competitive price.

The company started in 1983 produced Toyota Corolla sedans, Toyota Hilux pickup trucks and Chevrolet Nova sedans. This company is big industry.

This company applied two important concepts from japan management style these are Kaizen and Jidoka. Kaizen means the continuous pursuit of improvement in every facet of the company. The Kaizen principle encourages team members to contribute their ideas to helping make company more productive and safer operation. Jidoka is quality principle. With this principle, company strives to guarantee quality in manufacturing process itself.

Production plant :

The production process in this company are :

- Stamping process used hydraulic press machines, ranging from 400 to 2,300 tons
- Welding and bolting divisions are responsible for welding and bolting together component parts of vihicles, they used automatically welding by welding robots and automatic welding machines.
- Painting process
- Assembling line installed over 3,400 separate components and parts in each car, also checking and inspections.

This company don't have electroplating unit, so they don't have heavy metal waste water.

Waste Treatment System facility :

This factory has waste water treatment only for water from painting process and washing section. There's no waste water contain heavy metal solid. The techniques of the waste treatment here is have big different with the waste treatment of metal finishing factory. There is no specific reaction to treatment waste water.

The waste treatment facility used more for remove micro particles from waste water at painting process or at washing line

Work safety aspect :

Work safety aspect in this company also has different with metal finishing process, the stress of safety work more in mechanical aspect not chemical.

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3.9. San Jose Water Pollution Control Plant

Description of the facilities :

This facility is local goverment plant to control waste water from San Jose area before go to San Francisco bay through the river. This plant has capacity 150 million gallons water per day, at the present time they only process 100-110 millin gallons per day.

In this plant the processed only to removal particles from water and then sterilized water from bactery, they don't have facility for removal heavy metal from water. In this waste treatment, after removed particles from the water, they used biology process.

3.10. Lawerence Livermore National Laboratory

Description of the Institute :

This laboratorium is part of Univercity of California with specialized in research and development. Electroplating is one of activities in this laboratorium developed for plating process technology and also for waste treatment techniques. This laboratorium is one of the best institute in this field in United States.

Presentation :

The representatives of Lawerence Livermore National Laboratory in discussion with tour group are Mr. Jack Dini and Chris Steffani at Sheraton Hotel at The Fisherman Wharf.

They presented environmentally conscious electroplating at their laboratory, especially waste reduction program. The focus intention at this laboratory are minimizing hazardous wastes, mminimization of rinse water usage, material and process substitutions and recycling technology. With all these program they can saving over US$ 500,000 per year, have a safer, cleaner facility, and have not reduced quality of parts processed through the operation. For detail information see appendics.

3.11. Chemical Sollution Inc.

Description of the corporation :

This corporation is specialized consultant for environmental issue, developed system with minimum waste and low cost, developed and improved plating process, developed waste treatment techniques. In our meeting we discussed a lot about minimization technique at plating process as follow :

- drag-in drag-out technique
- counterflow rinses
- spary rinses
- reactive rinses

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IV. CONCLUCIONS AND RECOMMMENDATIONS

4.1. Conclucions

Some major findings and conclucions during this tour :

- United States Goverment has strong regulation of waste disposal from industry, which industries should followed. They have two regulations, one is from United States Environmental Protection Agency this regulation for all area in U.S. Second, every states has their specific regulation only for their area

- Waste treatment aspect has became one of the important competitiveness factor in business, also in metal finishing sector, because the customers don't want to make deal with company which bad reputation in environment issue

- Waste treatment does not mean need high cost and complicated technology, it can be with moderate investment, low operation cost (7-10 % from total cost production) and with simple systems

- Waste minimization techniques start at the first step of plating process and follow process, not only at the end process. Some minimization techniques are :
  - drag-in drag out rinses technique
  - counterflow rinses technique
  - reactive rinses tank technique
  - spray rinse technique

  and also for material handling, lay out process unit, flow worker at process unit

- Work safety has high attention from management of company, almost in every company has safety equipment and safety handling procedure, and also the worker involved and participated in safety management through regular meeting and periodic safety training

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4.2. Recommendation

To further improve waste treatment of metal finishing industry in Indonesia, the recommendetion follow-up are :

- Conduct seminar for excecutive (top management) with topics the economical and future benefits of waste minimization
- Develop and build information network consist of person, institution, coperation, univercity and others people who have interest in waste treatment management and technology
- Goverment agency (Bapedal) should make more strong implementation of environment impact regulation
- Develop local capabillity for knowledge and technology of waste minimization through intensive and focused training
- Goverment agency (Bapedal) should give insentive systems for the company which have good waste management

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V. APPENDICES

A. Figures and Photographs

B. List the date, facility visited, persons and organizations contacted

C. Business Cards of perons contacted

D. List of Documents recieved

E. Curriculum Vitae

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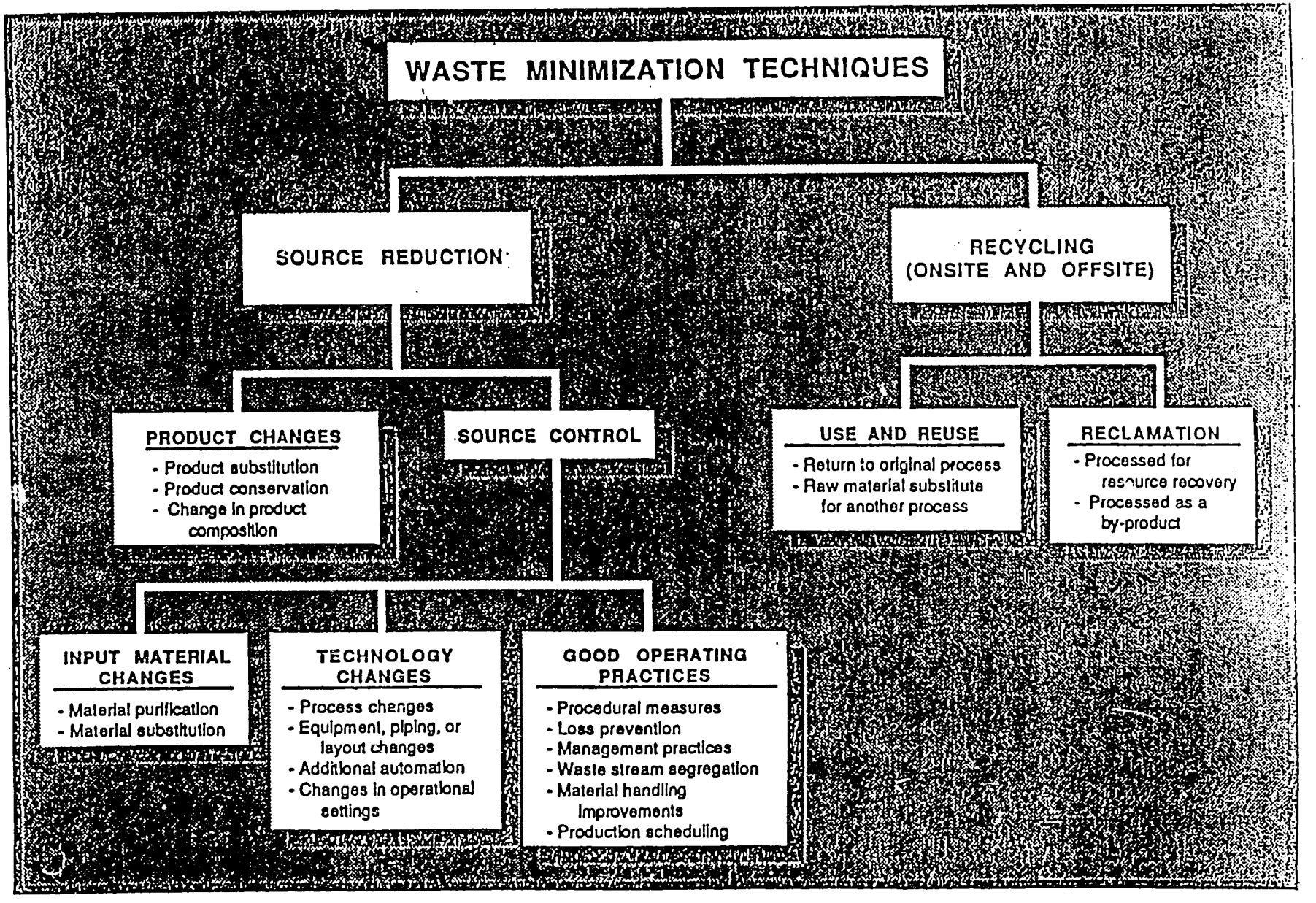
Appendices A :

Figures and Photographs



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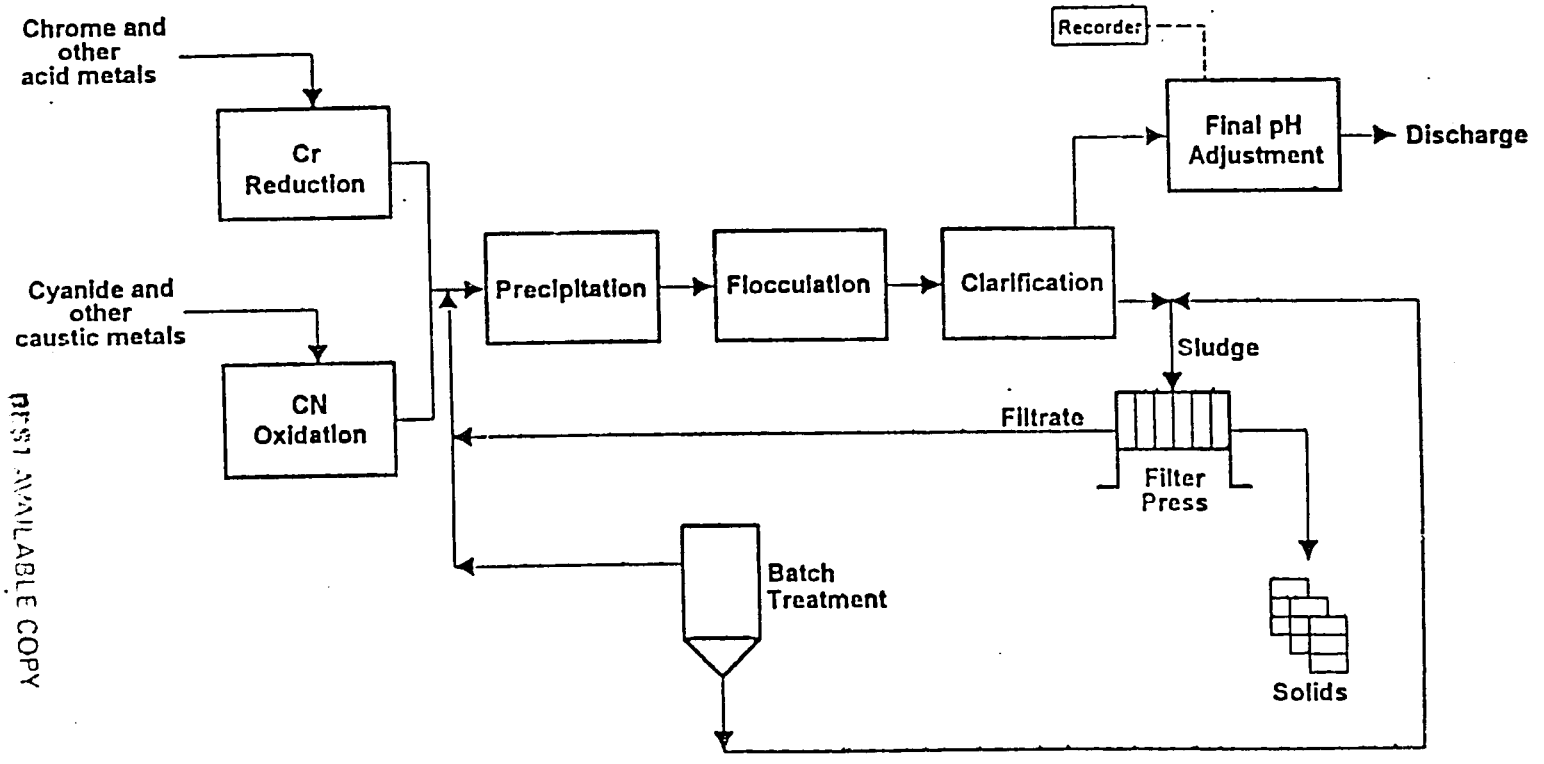
BASIC PRINCIPLE
WASTE WATER TREATMENT
for ELECTROPLATING



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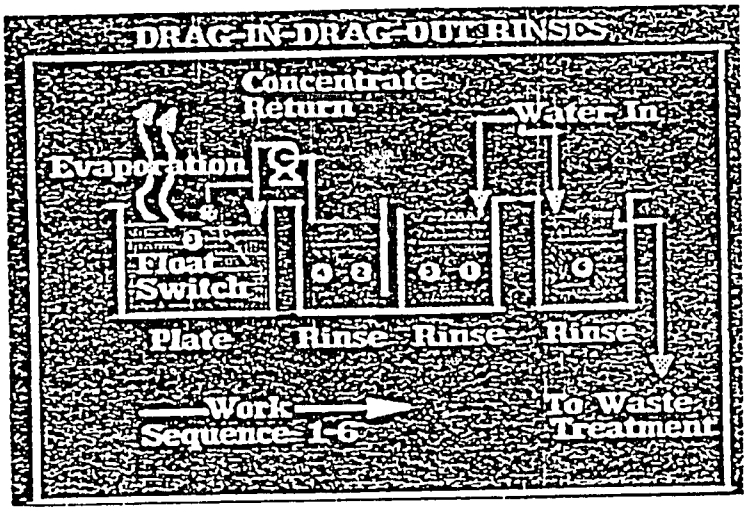

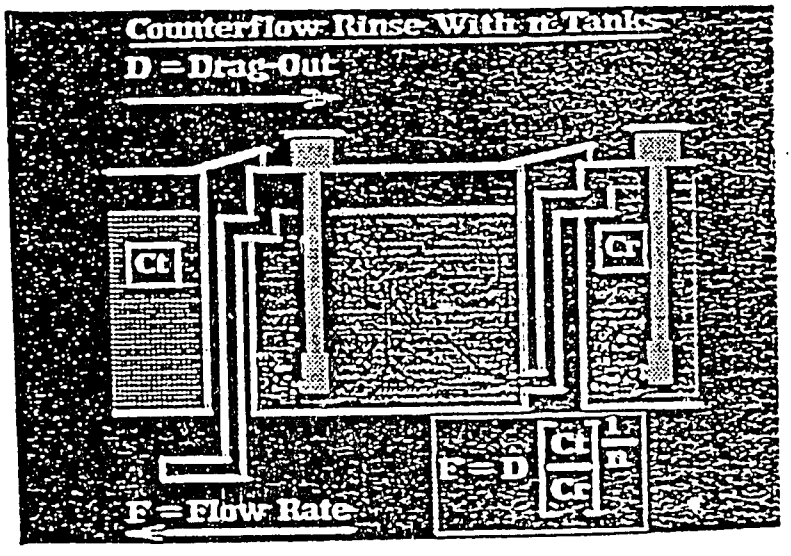

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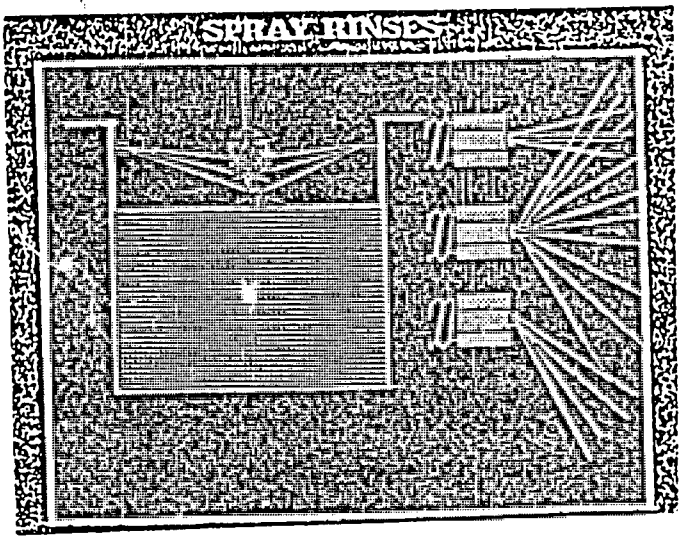

Flow Process at United Airlines

WASTE TREATMENT FLOW CHART

ACID WASTE TREATMENT SYSTEM

FROM THE CHROME BATHS & TANKS ON THE WEST SIDE OF THE PLATE SHOP, DRAG OUT FROM THE BATHS, WASH DOWN AROUND THE TANKS, CONDENSATE FROM THE DEGREASER & STEAM LINES + (IRREGULAR LEAKS) FLOW INTO THE TUNNEL DRAINS LEADING TO THE ACID SUMP AND SCRUBBERS.

NOTE: ACID BATHS THAT ARE BEING DUMPED AND TREATED, GET PUMPED DIRECTLY INTO TANK # 402 OR 403.

WASTE FROM THE DRAINS RUN DOWN THE TUNNEL NORTH TO SOUTH BELOW THE PLATE SHOP AND COLLECTS IN THE ACID SUMP.

FROM ACID SUMP, WASTE IS AUTOMATICALLY PUMPED INTO TANK 402 OR 403 FOR TREATMENT.

ADD SODIUM BISULFITE TO KILL CHROME IN TANKS 402 OR 403. AFTER CHROME IS NEUTRALIZED, ADD CAUSTIC TO ADJUST pH 6.5-7.0.

WASTE IS THEN PUMPED INTO PRECIPITATION TANK 1 OR 4 WHERE LIME IS ADDED TO RAISE pH TO 10.0-12.0 AND POLYMER IS USED AS A FLOCKING AGENT TO COAGULATE HEAVY METALS AND DROP THEM TO THE BOTTOM OF THE TANK.

ALKALINE WASTE TREATMENT SYSTEM

FROM THE PLATING BATHS & TANKS THROUGHOUT THE MIDDLE & EAST SIDE OF THE PLATE SHOP ON THE WET LINES (SURFACE TREAT, NICKEL, SILVER, METAL SPRAY STRIP, NICKEL STRIP & CADMIUM LINES.) DRAG OUT FROM THE BATHS, WASH DOWN AROUND THE TANKS, CONDENSATE FROM THE DEGREASER & STEAM LINES + (IRREGULAR LEAKS) FLOW INTO THE TUNNEL DRAINS LEADING TO THE ALKALINE SUMP AND BLOWERS.

NOTE: CYANIDE BATHS THAT ARE BEING DUMPED AND TREATED, GET PUMPED DIRECTLY INTO THE DESTRUCT TANKS # 400 AND/OR 401. THE BATH UNDERGOES ELECTROCHEMICAL OXIDATION TO BRING IT DOWN TO 1 OUNCE PER GALLON OR LESS. THEN THE WASTE IS PUMPED INTO TANK 404 OR 405.

WASTE FROM THE DRAINS RUN DOWN THE TUNNEL FROM THE NORTHEAST CORNER OF THE PLATE SHOP THEN NORTH TO SOUTH AND COLLECTS IN THE ALKALI SUMP.

FROM ALKALI SUMP, WASTE IS AUTOMATICALLY PUMPED INTO TANK 404 OR 405.

OXIDIZE CYANIDE BY ADJUSTING THE pH BETWEEN 11.5 TO 12.8, WHILE CLORINATING TANK 404 AND/OR 405. BRING CYANIDE BELOW 10.0 PPM

PUMP TO PRECIPITATION TANK 2 OR 3 AND ADD SODIUM HYDROSULFITE TO KILL CHLORINE AND RESIDUAL CHROME. AFTER THESE TWO CHEMICALS TEST NEUTRAL, ADD LIME TO ADHERE TO HEAVY METALS AND ADD POLYMER TO COAGULATE THESE HEAVY METALS AND DROP THEM TO THE BOTTOM OF TANK.

ALLOW TO SETTLE FOR 24 HOURS

NOTE: DESTRUCT (COMPLEX CYANIDES) IS PUMPED DIRECTLY TO THE BAKER TANK (OSV)

DRAIN SUPERNATANT LIQUID INTO pH ADJUSTMENT TANK 1-4

SPOT CHECK FOR CHROME

ADJUST pH TO 6.5-7.0

PUMP INTO INDUSTRIAL DRAIN

PUMP SUPERNATANT SLUDGE INTO FILTER PRESS SLUDGE TANK # ___

PRESS LIQUIDS OUT AND TRANSFER TO HOLDING TANKS # ___ OR # ___

DRAIN HOLDING TANK # ___ OR # ___ INTO pH ADJUSTMENT TANK ADJUST pH (USUALLY HIGH) NEUTRAL IS 6.5-7.0

PUMP INTO INDUSTRIAL DRAIN

FILTERED SLUDGE GOES INTO (OSV) DUMPSTER FOR HAULING

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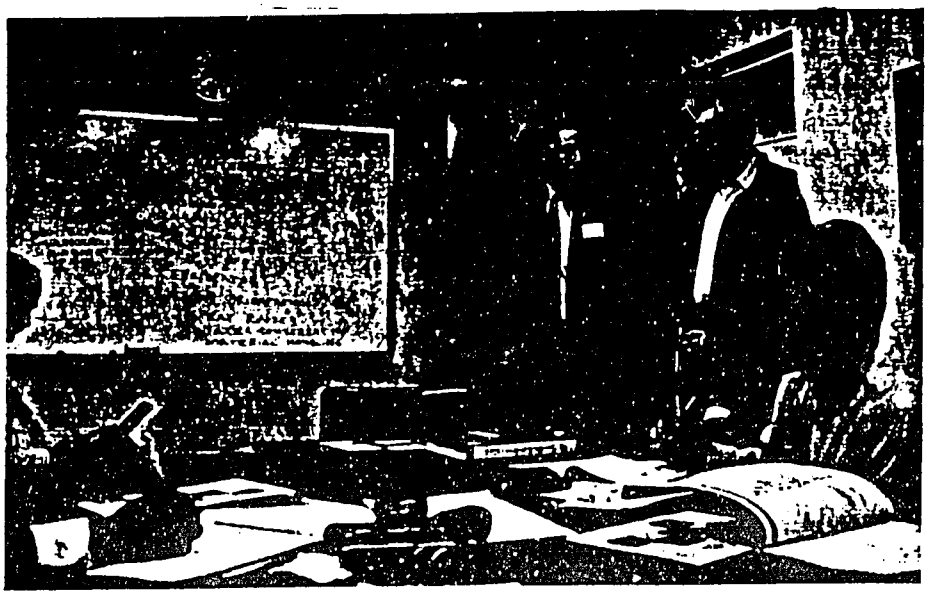
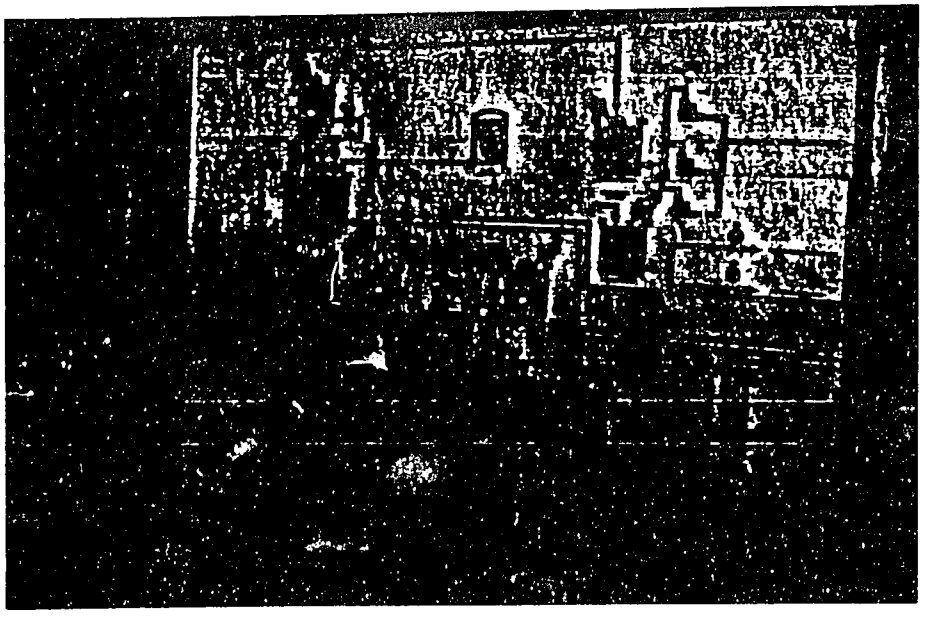
Metal Surface Inc.





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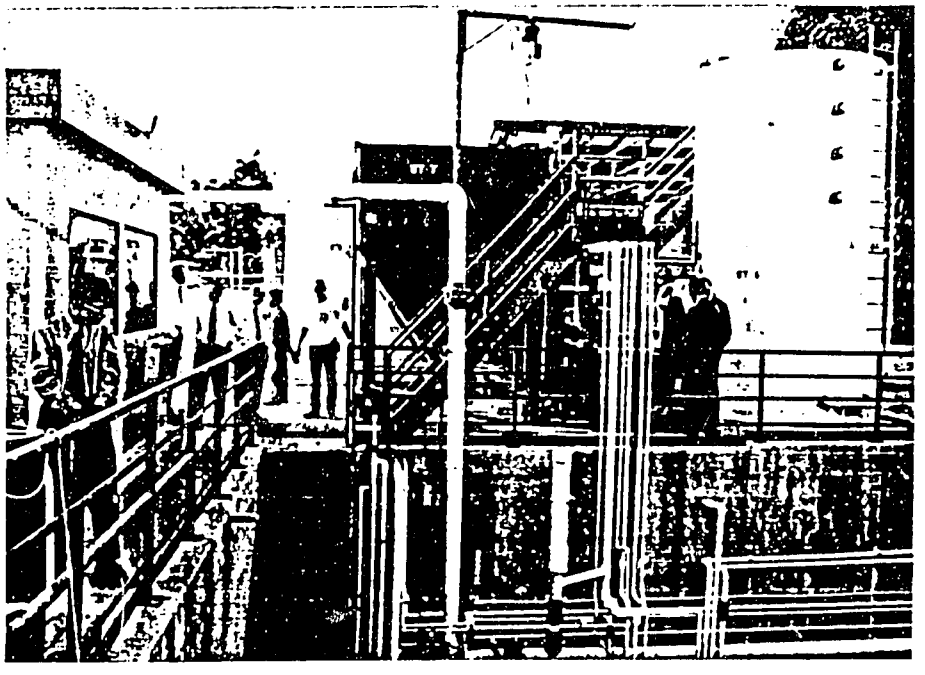
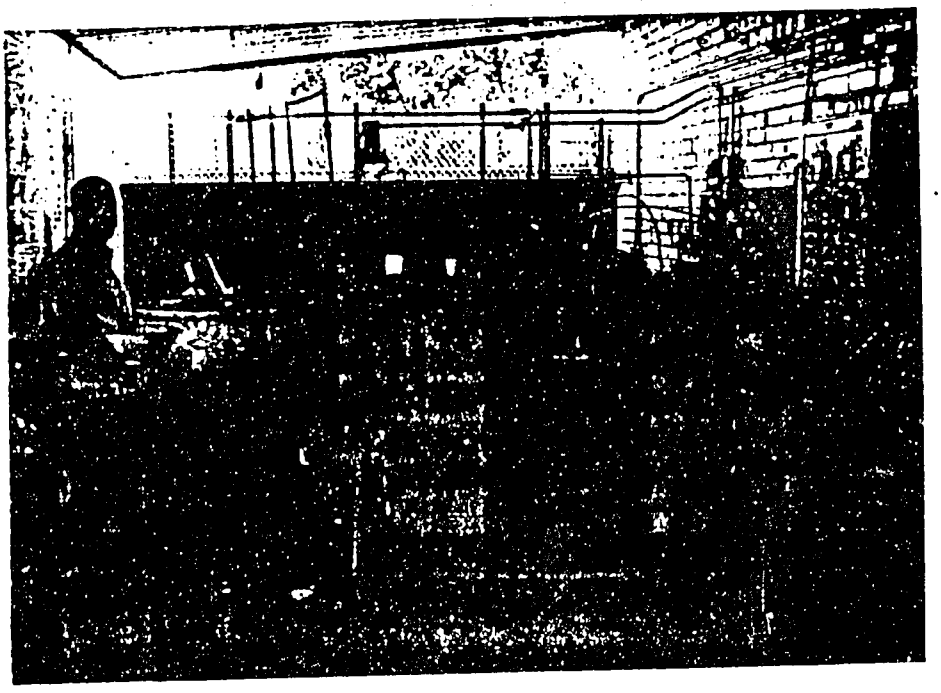


Electrolizing Inc.



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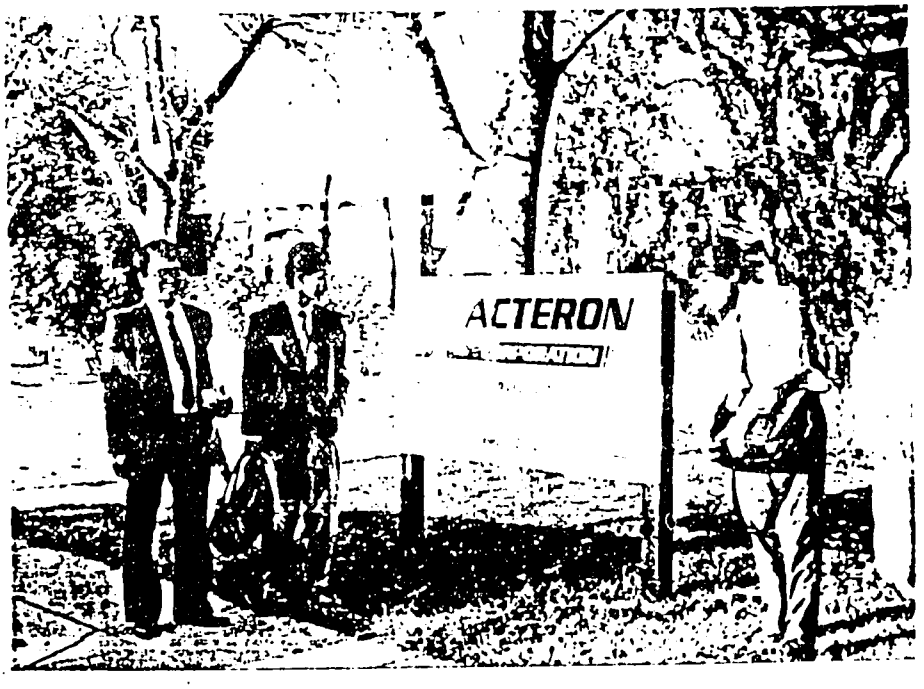
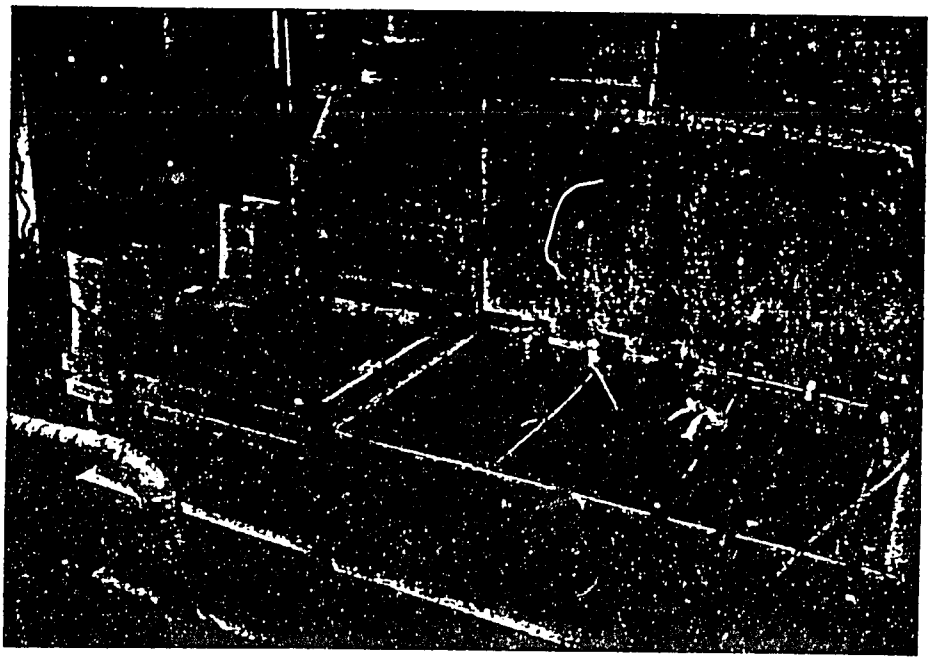
Acteron Corp.





Counter Flow rinses at Acteron

Spray rinses at Acteron

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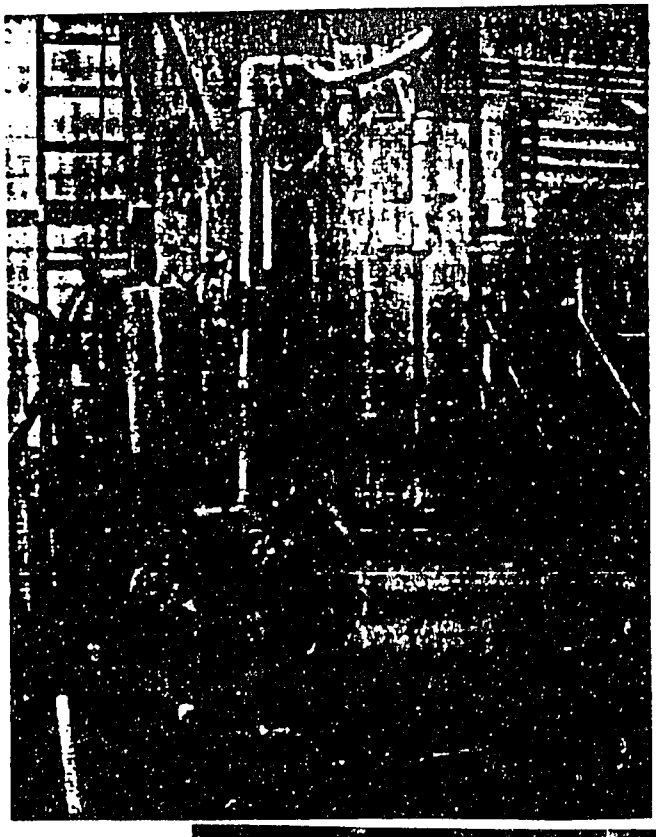
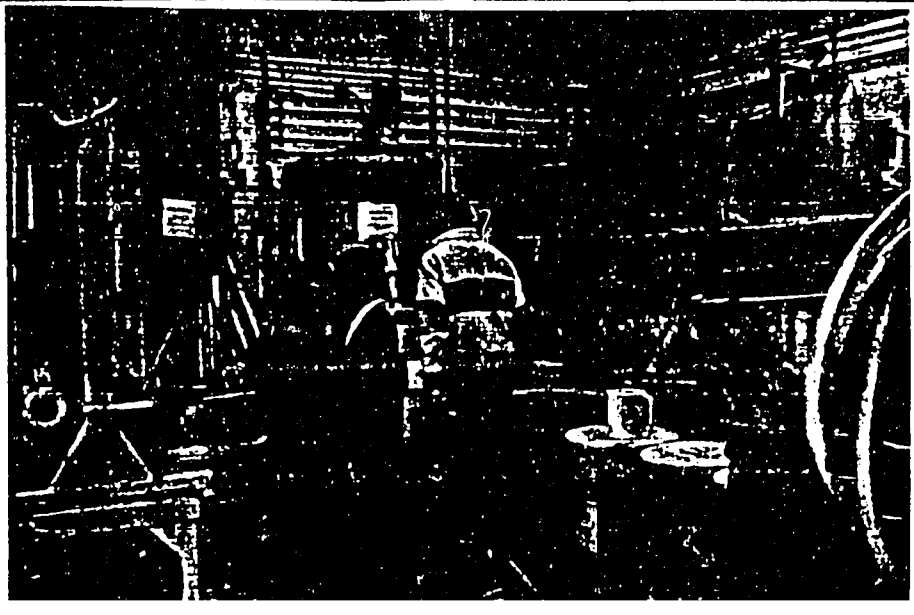
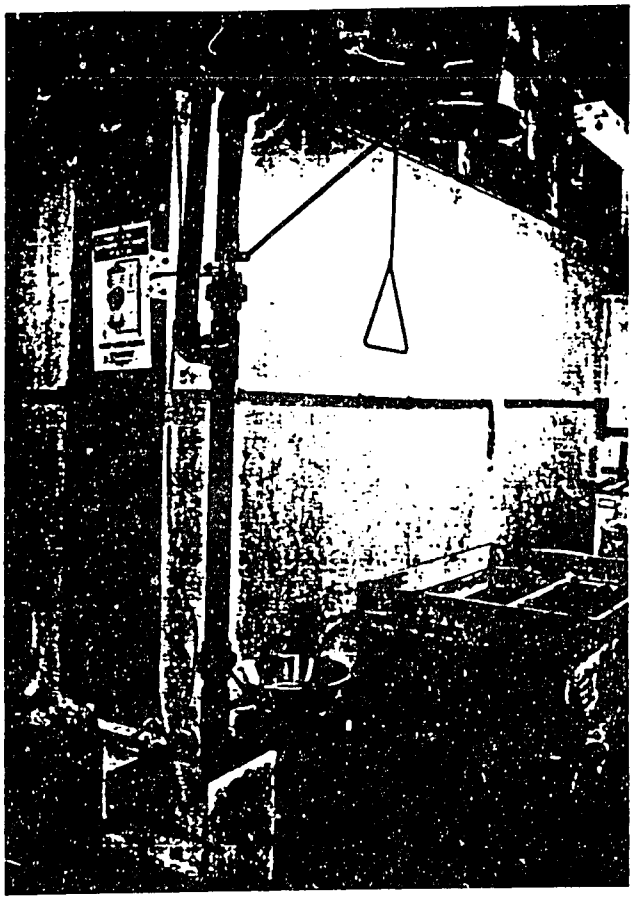
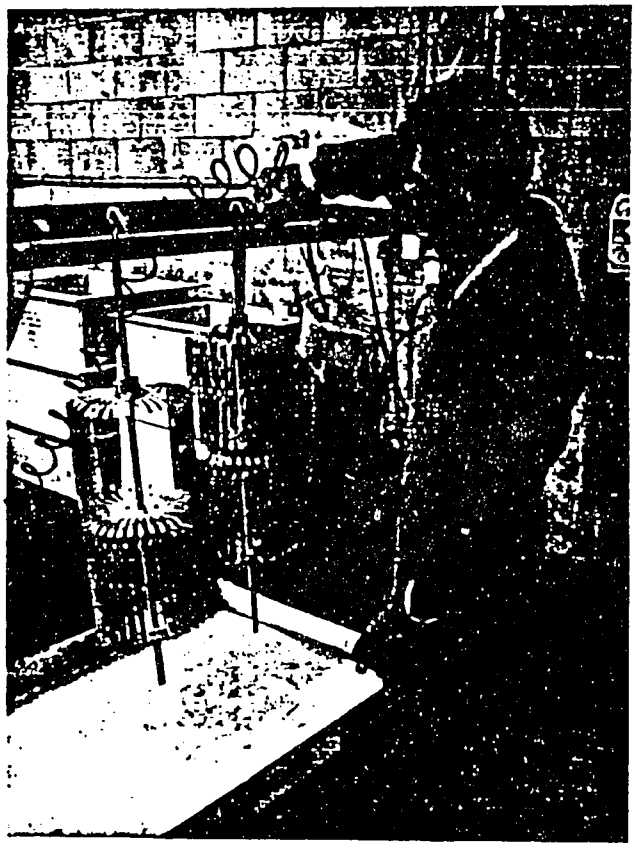






Worker Safety



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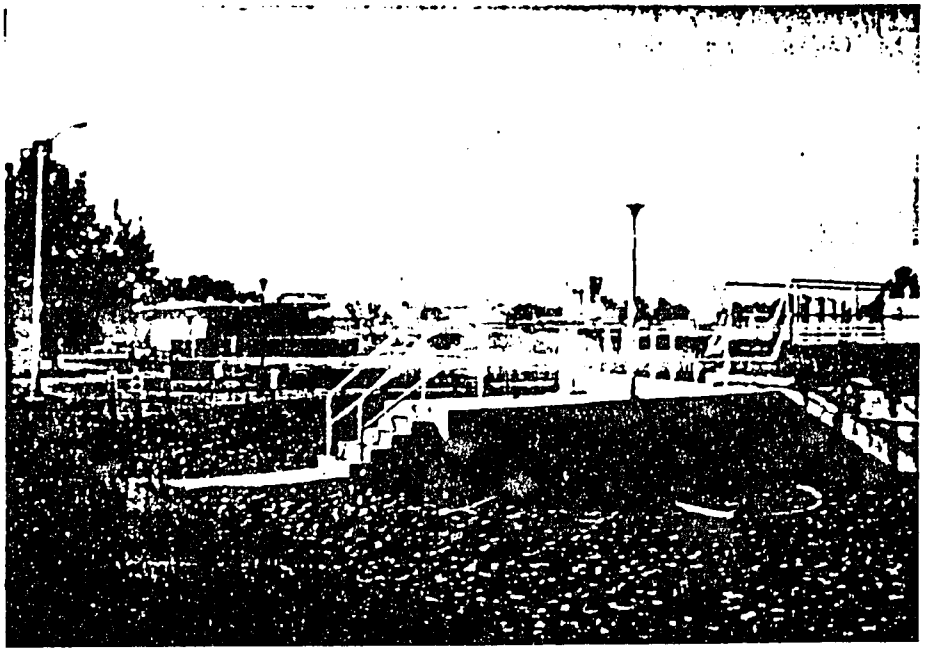
San Jose Woter Pollution Control Plant



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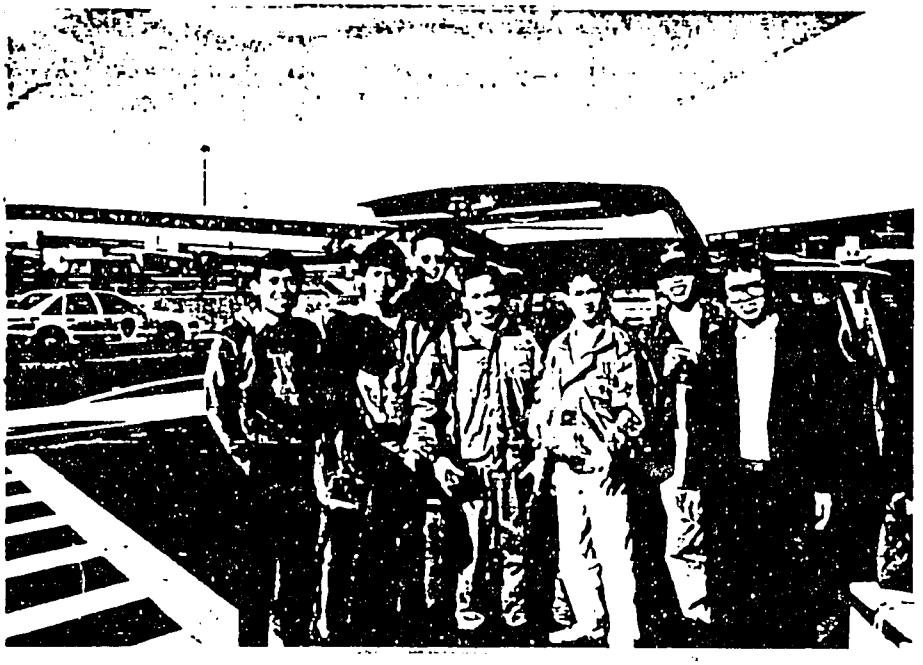
Discussion at Chemical Solutions Inc.

Tour's Group



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Appendices B :

List the date, facility visited, person & organizations contacted

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List the date, facility visited, persons & organizations contacted :

1. Dec. 6, 1993	Metal Surface Inc. 6060 Shull St., Po.Box 2160, Bell Garden, California 90201-0521 Persons met : SAM BELL (President) Bruce F. Nielsen (Plant Engineer) Mark A. Hanson (Excecutive Dir. MFASC)
2. Dec. 7, 1993	Electrolizing Inc. 1947 Hooper Avenue, Los Angeles, California 90011 Persons met : SUSAN B. GRANT (General Manager) Jack Morgan (Plant Manager)
3. Dec. 9, 1993	Lawerence Livermore National Laboratory, Univ. of California Po.Box 808, L-332, Livermore, CA 94551 Persons met : JACK W. DINI (Section Leader Material Fabrication Division) Christ Steffani (Staff)
4. Dec. 10, 1993	Wastewater Treatment Systems Inc. 1235 Elko Drive, Sunnyvale, California 94089 Persons met : GLEN C. NEUSTEDTER (President) John B. Strandberg (Sr. Chemical Engineer)
5. Dec. 13, 1993	Read Rite Inc., 3065 N. Sunnyside, California Persons met : MARK ROTHWEILER (Operations) Jim Elliott (Marketing Mag. Process Scientific Inc)
6. Dec. 13, 1993	Acteron Corporation 851 Shasta Street, Redwood City, CA 94063 Persons met : PATRICK BURT (President)
7. Dec. 14, 1993	Schlage Lock Co.,San Francisco Person met : JIM COLLINS (Plating Departement)
8. Dec. 14, 1993	Santa Clara Plating Co.Inc. 1773 Grant Street, Santa Clara, CA 95050-3984 Person met : THOMAS L. COSS (President)
9. Dec. 15, 1993	United Airlines Bldg. 49 - SFOFL, San Francisco Int'l Airport, CA 94128-3800 Persons met : STEVEN F. SULGIT (Facilities & Eng.) Alexander Klauss (Electroplating Manager)
10. Dec. 15, 1993	New United Motors Manufacturing Inc. Fremont, California
11. Dec. 16, 1993	Chemical Solutions Inc. 400 Main Street, Suite 203, Pleasanton, CA 94566 Person met : JIM MILLE (President)
12. Dec. 16, 1993	San Jose Water Pollution Control Plant 700 Los Esteros Road, San Jose, CA 95134 Person met : ALEX EKSTER, Ph.D. (Sanitary Engineer)

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Appendices C :

Business Cards of Persons contacte

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SMITH, BUCKLIN & ASSOCIATES, INC.

MARK A. HANSON, CAE
Manager
Los Angeles Office

Sixty-Eight Van Nuys Boulevard
Suite 300
Sherman Oaks, CA 91403 USA
818-815-7338
818-815-0878 (Fax)

Chicago · Washington, D.C. · Los Angeles · Brussels

METAL SURFACES, INC.

6060 SHULL STREET BELL GARDENS, CA 90201-0521
(310) 927-1331 (714) 521-4112
(213) 773-4050 FAX (213) 773-4055

BRUCE F. NIELSEN
PLANT ENGINEER

Electrolizing Inc.

JACK MORGAN
PLANT MANAGER

dense chrome plating specialists

1947 HOOPER AVENUE
LOS ANGELES CALIF 90011
(213) 749-7876

7019 CORPUS CHRISTI
HOUSTON TEXAS 77020
(713) 678-8412

SAM BELL
PRESIDENT

METAL SURFACES, INC
6060 SHULL ST. P.O. BOX 2160
BELL GARDENS, CALIFORNIA 90201-0521

(310) 927-1331
(213) 773-4050
(714) 521-4112
(213) 773-4055

Susan B. Grant
General Manager

Electrolizing

1947 Hooper Avenue
Los Angeles
California 90011

Dense Chrome Plating Specialists

Tel 213 749-7876
Fax 213 749-9880

University of California
Lawrence Livermore National Laboratory

Jack W. Dini
Section Leader
Materials Fabrication Division

P.O. Box 808 L-332
Livermore, CA 94551

(510) 422-8342
FAX (510) 422-1290

CSI CHEMICAL SOLUTIONS, INC.
ENVIRONMENTAL CONSULTING

JIM MIILLE
PRESIDENT

Helping Industry Meet Its Environmental Goals

400 Main Street, Suite 203
Pleasanton, CA 94566

Tel. (510) 426-1816
Fax: (510) 426-1889

Glen C. Neustedter
President

WTS
WASTEWATER TREATMENT SYSTEMS INC

Wastewater Treatment Systems Inc.
1235 Elko Drive
Sunnyvale, California 94089
Telephone (408) 541-8600
FAX (408) 541-8615

BEST AVAILABLE COPY

WEC World Environment Center

CHARLES JONG HWA HONG
DEPUTY PROJECT MANAGER

WORLD ENVIRONMENT CENTER
419 PARK AVENUE SOUTH
SUITE 1800
NEW YORK, N.Y. 10016

(212) 683-4700
TLX 261290 ENVIRONNY
FAX (212) 683-5053

MINISTRY OF INDUSTRY
DIRECTORATE GENERAL OF MULTIVARIOUS INDUSTRY

IR. BERANI SITUNGKIR

SECTION HEAD OF THE POLLUTION CONTROL

OFFICE :
14TH FLOOR MINISTRY OF INDUSTRY DIRECTORATE OF ELECTRICAL EQUIPMENT AND METAL INDUSTRY
JL. GATOT SUBROTO KAV. 52-53 JAKATA 12950 INDONESIA
PHONE (021) 5253526

Ir. WIDYA WICAKSANA
Project Manager

PROBENGKEL
Proyek Pengembangan Ben
Promotion of SME S

YAYASAN MANDIRI

LEMBAGA PENGEMBANGAN INDUSTRI KECIL
INSTITUTE FOR SMALL SCALE INDUSTRI DEVELOPMENT

Office Jl Dewanu 32 Bandung 40133 Tlp 022 [illegible] 20061

ENVIRONMENTAL IMPACT
MANAGEMENT AGENCY

Hérry Hamdani
Staff of Directorate for Hazardous waste Management

Badan Pengendalian Dampak Lingkungan

Arthaloka Building 11 th floor
JL Jend. Sudirman No. 2 Jakarta
Phone : (62-21) 5703419 ext. 209
Fax : (62-21) 5703365, 5702547

P.T. SUPEREX RAYA
ALUMINIUM EXTRUSIONS

IR. DADANG SUDRADJAT
Head Of QC

Office
Jl Suryopranoto No 28
Jakarta (10130)
Telp 373368 (5 Lines)
Fax 21 365649
Telex 45507 Djabes IA

Factory
Jl Pembangunan Batuce
Km 23 Tangerang
Telp 5523170 552323
Fax (021) 5523170

Y·K·K

P.T. YKK INDONESIA ZIPPER CO., LTD
NOTION DIVISION

Factory :
Jl. Raya Jakarta - Bogor Km 29
Cimanggis - Bogor.
Telp. (021) 8710641, 8711385-88
Fax. 8710962

Head Office :
Jl. R.P. Soeroso No 7 Jakarta
Telp. 331708 (7 Lines)
Fax. 3106751, 3107109
Telex. 61465 YKK JKT

PADI
INDONESIA

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psi

Jim Elliott
Marketing Manager

process scientific, inc.

510/820-7583
824 MATADERA CIRCLE • DANVILLE • CA 94526
408/241-1533 • FAX 408/241-2118
960 SARATOGA AVE • SUITE 213 • SAN JOSE • CA 95129

epoc

Mark Rothweiler
Operations/Field Services

(415) 369-5217
EXT. 14

Patrick Burt
PRESIDENT

3065 N. Sunnyside
Fresno, CA 93727

Tel: (209) 291-8144
Fax: (209) 291-4926

ACTERON CORPORATION

851 Shasta Street, Redwood City, CA 94063
FAX: (415) 364-9748

OPTIMUM PLATING AND ANODIZING

UNITED AIRLINES

Thomas L. Coss
President

(408) 727-9315 ext. 21
FAX. (408) 748-0987

SANTA CLARA
PLATING CO. INC.

1773 Grant Street
Santa Clara, CA
95050-3984

Steven F. Sulgit
Facilities and Eng.
(415) 634-4576
FAX (415) 634-4551

United Airlines
Bldg. 49 - SFOFL
San Francisco Int'l Airport
San Francisco, CA 94128-3800

(408) 945-5300
FAX (408) 945-5442

ALEX EKSTER P.E., Ph.D.
SANITARY ENGINEER

CITY OF SAN JOSE
WATER POLLUTION CONTROL
700 LOS ESTEROS ROAD, SAN JOSE, CA 95134

John B. Strandberg, P.E.
Sr. Chemical Engineer

WTS
WASTEWATER TREATMENT SYSTEMS INC.

Wastewater Treatment Systems Inc.
1235 Elko Drive
Sunnyvale, California 94089
Telephone. (408) 541-8600
FAX. (408) 541-8615

Part of the Thames Water Plc Group

Thames Water

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Appendices D :

List of Documents Received

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Jakarta, 18 November 1993

Kepada Yth,
Saudara Ir. Widya Wicaksana
PT. Pro Bangkel
Jl. Raya Dederuk 32
Bandung 40133.

Dengan hormat,

Seperti dimaklumi, Saudara telah ditunjuk oleh Pimpinan Saudara, untuk mengikuti program Study Tour untuk sektor industri Metal Finishing/Electroplating, dalam rangka program minimisasi limbah industri yang diselenggarakan atas kerja sama USAID-Indonesia Mission dengan BAPEDAL, melalui WEC sebagai unsur pelaksananya.

Program Study Tour ini diselenggarakan di Amerika Serikat dalam kurun waktu dua minggu dari tanggal 5 Desember 1993 hingga tanggal 18 Desember 1993.
Biaya perjalanan sejak berangkat dari Jakarta (tanggal 4 Desember 1993), dan biaya penginapan/hotel selama kurun waktu program hingga kembali di Jakarta, sepenuhnya ditanggung oleh WEC, sedangkan untuk biaya se-hari hari (makan dan sebagainya) akan diberikan allowance sesuai yang diatur oleh prosedur USAID. Persiapan yang perlu ditempuh oleh peserta program ini hanya persiapan passport yang harus mempunyai masa berlaku minimum 6 bulan sejak tanggal 18 Desember 1993, visa untuk Amerika Serikat, dan biaya fiskal pada waktu berangkat di airport Jakarta.

Jadwal sementara untuk program Study Tour ini adalah sebagai sebagai berikut :

4 Desember 1993	Berangkat dari Jakarta ;
5 Desember 1993	Tiba di Los Angeles, USA mengunjungi fasilitas industri Metal Finishing di sekitar L.A.
8 Desember 1993	Dari Los Angeles menuju S'Francisco, mengunjungi beberapa industri Metal Finishing di kawasan California.
18 Desember 1993	Meninggalkan S'Francisco, kembali ke Jakarta.

Demikianlah hal-hal yang perlu disampaikan untuk dimaklumi, dan acara-acara yang lebih rinci akan kami informasikan menjelang pemberangkatan.

Hormat kami,

World Environment Center
Indonesia Office,

Drs. R.H.M. Wiradiputra
Direktur.

c.c. : Pimpinan Yayasan Mandiri

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World Environment Center
Industrial Waste Minimization Assessment Program
Indonesian Metal Finishing Industry

United States Study Tour - December, 1993

The World Environment Center (WEC), through a cooperative agreement with the United States-Asia Environmental Partnership and the United States Agency for International Development in Indonesia, is supporting sustainable development by strengthening industrial and urban environmental, health and safety management policy and practices in Indonesia. WEC is demonstrating, through cooperation of U.S. technical experts, the environmental and economic benefits resulting from no/low cost waste minimization techniques in the metal finishing industry.

Waste minimization assessments have been conducted at eight Indonesian metal finishing facilities over the past two years. The waste minimization assessments focused on the identification of no/low cost practices and techniques that can reduce the discharge of pollutants and improve worker health and safety. Upon completion of the assessments, a technical waste minimization workshop was held in Jakarta for approximately 40 industry, government and non-government managers and design engineers. The workshop summarized assessment observations, presented Indonesian waste minimization success stories, and provided the exchange of waste minimization experience from Indonesian industries to other Indonesian industries.

WEC is currently coordinating a U.S. study tour for six Indonesian representatives (two from government and four from industry) during December 6-18, 1993. The objective of the U.S. study tour is to provide the participants with an intensive overview of technologies and management practices implemented in the U.S. which enhance waste minimization and improve worker health and safety. The study tour provides the Indonesian participants and U.S. counterparts with a unique opportunity to exchange experiences with respect to environmental, health and safety management and provides a basis for continued interaction and international cooperation regarding the metal finishing industry's response to heightened environmental standards and regulations.

Participating host facilities will provide a walk through facility tour and brief the Indonesian representatives on issues regarding waste water treatment and management, solid waste management and disposal, and measures taken to ensure worker health and safety. Upon return to Indonesia, the study tour participants will conduct a second waste minimization workshop to share their experiences gained in the United States.

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World Environment Center 419 Park Avenue South Suite 1800 New York, NY 10016 USA
Tel: (212) 683-4700 Telex: 261290 Envirocent FAX: (212) 683-5053

MISSION

The World Environment Center contributes to sustainable development worldwide by strengthening industrial and urban environmental, health and safety policy and practices.

To achieve this mission, the Center:

Maintains an independent and non-advocacy position.

- Seeks to integrate environment, economics, energy and education.
- Establishes and promotes partnerships among industry, government and non-governmental organizations.
- Serves as a bridge for the exchange of information and expertise among industry, government and non-governmental organizations.
- Provides training and technical cooperation programs staffed by volunteer and other experts from industry, government, academia, non-governmental organizations and the general public.
- Encourages corporate environmental leadership and responsibility worldwide by providing international public recognition for outstanding accomplishments.

HISTORY

The World Environment Center is a not-for-profit, non-advocacy environmental organization. Although independent since 1981, WEC was founded in 1974 with seed funding from the United Nations Environment Programme. Today the Center is funded by industry, government, international organizations, corporate or private foundations and private citizens.

Initially, WEC published the bi-weekly World Environment Report and a number of environmental information directories. In 1977, the Center made a conscious decision to draw industry into the environmental policy dialogue with the creation of its International Environment Forum (see IEF).

In 1981, WEC held the first of four major conferences on the links between the environment and development, drawing representatives from industry, government, non-governmental and international organizations, academia and the media from countries around the world.

In 1982, after earlier pilot activities, WEC launched an industry and government supported pro bono environmental technology transfer program, the International Environment and Development Service (see IEDS).

In 1985, the first WEC Gold Medal for International Corporate Environmental Achievement was presented.

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PROGRAMS

International Environment Forum (IEF)

The IEF is a group of 60 major multinational manufacturing corporations based in eight countries and engaged in nine industrial sectors with operations on six continents. The IEF meets quarterly for off-the-record discussions of environmental, health, safety and resource management issues with senior policy-makers from around the world.

WEC offers the IEF proprietary programs, including the Country Profile Program which, through reports produced by and for IEF companies, supplies detailed information on environmental, health and safety requirements in over 20 countries worldwide.

WEC offers workshops that promote the inter-sectoral exchange of information and experience in such subjects as corporate international environmental management, environmental auditing, waste minimization, total product life-cycle analysis and waste remediation practices. Additionally, WEC coordinates the joint development of training programs to provide IEF companies cost-effective, culturally-relevant solutions to the steadily increasing need to transfer skills, technology and information to operations worldwide.

International Environment and Development Service (IEDS)

Using volunteers and other experts, contributed services and materials from industry, government, academia and non-governmental organizations, IEDS provides pro bono assistance worldwide to enhance industrial and urban environmental, health and safety management policy and practices. To accomplish this, IEDS conducts:

- institutional and factory assessments;
- technology cooperation and training workshops; and
- study tours and on-the-job internships for environmentalists and government and industry officials.

Travel and management costs are funded primarily through cooperative agreements with the U.S. Agency for International Development. Other funding comes from industry, the U.S. Environmental Protection Agency, the World Bank and private citizens. More than 250 activities have provided opportunity to work with or training for 700 professionals from 28 countries.

WEC Gold Medal for International Corporate Environmental Achievement

The WEC Gold Medal honors multinational corporations having outstanding, sustained and well-implemented, worldwide environmental policies. It may be awarded annually by an independent international jury of distinguished environmentalists from academia, government, non-governmental organizations and the medal-winning company of the previous year. Past recipients of the WEC Gold Medal are Xerox Corporation (1993), The Procter & Gamble Company (1992), Rohm and Haas Company (1991), IBM Corporation (1990), The Dow Chemical Company (1989), The British Petroleum Co. p.l.c. (1988), E.I. du Pont de Nemours & Co. (1987), Exxon Corporation (1986) and 3M (1985).

Rev. 7/27/93

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World Environment Center 419 Park Avenue South Suite 1800 New York, NY 10016 USA
Tel: (212) 683-4700 Telex: 261290 Envirocent FAX: (212) 683-5053

WEC WASTE MINIMIZATION PROJECTS INDONESIA: 1992-PRESENT

1992:

May: Waste minimization assessment of three metal finishing plants, followed by a one-day workshop/seminar on waste minimization. Two WEC-sponsored U.S. experts visited the facilities.

June: Waste minimization assessment at two pulp and paper facilities. This assessment involved observation of the current waste minimization/pollution control activities and facility operation. Two WEC-sponsored U.S. experts visited the facilities.

August: Workshop in Los Angeles, California to develop a comparative city case study on mobile sources of air pollution, in preparation for "Megacities" conference, 1993, Jakarta.

October-November: Second round of waste minimization assessment for the Pulp and Paper industry. One facility was visited by a WEC-sponsored U.S. expert.

December: Waste minimization assessments of 5 textile plants in Bandung, Indonesia followed by a one-day workshop/discussion to review audit results with plant managers. Two WEC-sponsored U.S. experts participated in the waste minimization assessments.

1993

February: WEC sponsored the "Megacities on the Pacific Rim and the Burden of Air Pollution" conference in Jakarta, Indonesia. This conference and working session addressed air quality concerns of eight major urban centers in the Pacific Rim. Topics included: Stationary sources; Mobile sources; Health and economic concerns; Institutional and regulatory frameworks.

April: Third round of waste minimization assessments for the Pulp and Paper industry. Four Indonesian Pulp and Paper facilities were visited by three WEC-sponsored U.S. experts.

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June: Second round of waste minimization assessments at metal finishing facilities. Eight facilities were visited by two WEC-sponsored U.S. experts.

July: Pulp and Paper Workshop:

This workshop was specifically designed to follow the pulp and paper plant waste minimization assessments conducted during the past year, by the three experts who performed those assessments. The workshop addressed industry-wide needs identified during the assessments. These needs included improved sampling and analysis of waste streams, knowledge of raw material used, and knowledge of manufacturing/waste minimization principles and assessment practices. Workshop participants will be selected for further intensive training with the agreement that they serve as waste minimization trainers for the Pulp and Paper industry.

October: Metal Finishing Workshop:

This workshop was designed to follow up waste minimization assessments in the Metal Finishing industry sector conducted during the past year. The workshop addressed: Environmental management programs and waste minimization principles and assessment practices in the following areas: Electroplating, wastewater treatment, principles of rinsing, cyanide (chemical) safety and control, recycling and recovery, process modification.

October: Two week Pulp and Paper Study Tour of medium sized pulp and paper facilities in the United States.

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ENVIRONMENTAL POLICY STATEMENT
Metal Finishing Association of Southern California

The Metal Finishing Association of Southern California (MFASC) supports the uniform enforcement of all current Local, State and Federal environmental laws. We strongly believe that protection of the environment is, and must continue to be, a primary objective of our Association and its members.

We will vigorously support all equitable and reasonable regulations designed to achieve that goal and we condemn those who would purposely evade those regulations.

Waste, both toxic and otherwise, is a natural by-product of our industrial society in general and of our industry in particular. This waste generation is not by design; it is not what we would wish; it is merely the natural result of the processes of an industry doing its best to meet the demands of the marketplace in this very complex and sophisticated world.

Therefore, rather than dwelling on the negative aspects of what has gone before, we intend to try to encourage a spirit of cooperation. Cooperation between the generators of waste, the public, which benefits from the end-products of the processes causing the waste and the various governmental agencies and authorities charged with the responsibility of protecting the public and the environment.

In order to be successful, however, this cooperative effort must be supported by a responsible and objective media. We urge their examination and participation and will respectfully point out that outright advocacy and sensationalism only obscure the issues and retard rather than promote resolution.

In its efforts to attain these goals, the MFASC will attempt to initiate and maintain an ongoing dialogue to communicate its point of view on relevant issues to the public, to government and to the media. These issues may be of an informative nature, or they may involve technical considerations, but in all cases they will be pertinent to our concerns of managing wastes in a safe, economical and efficient manner.

As a part of this policy and as a part of MFASC's service to its members, we will attempt to keep them as up-to-date as possible on the issues of the times, on current regulations and on methods and technologies to meet those regulations. We are mindful that if we, as a society, are to be successful in protecting ourselves and our environment, we must, as a primary goal, seek the development of alternative methods to the disposal of toxic wastes by land filling. One such method, which we strongly support, is centralized facilities that can take in, treat, recycle, recover or destroy waste from industry.

Metal Finishing Association of Southern California
5000 Van Nuys Boulevard, Suite 400
Sherman Oaks, California 91403
(818) 995-7338

BEST AVAILABLE COPY

METAL FINISHING ASSOCIATION OF SOUTHERN CALIFORNIA INC.

STATEMENT OF POLICY

The members of the Metal Finishing Association of Southern California wish to remind you of the established practices of the metal finishing industry in processing your materials.

In order to avoid misunderstandings, we are setting forth below conditions under which your material will be accepted by us for processing:

1. Whenever we are given material with detailed instructions as to treatment, our responsibility shall end with the carrying out of those instructions. Type of material, tolerances and specifications for processing shall be declared in writing prior to our processing.

2. Our liability for any cause is limited to the cost of direct labor and material of the product directly damaged by our processing or three times our processing charges on such material, whichever is the lesser. Charges for our services are based on this Policy limiting our liability.

3. Liability greater than that outlined in paragraph (2) above will be assumed by us only when so agreed in writing by us. In such event a higher charge may be made for our services.

4. Parts, materials, etc. as processed by us shall be presumed to be accepted as satisfactory by you if we are not notified of damages, shortages or other discrepancies within ten working days of your receipt of the same.

   Rejected parts must be returned to us for rework. Further processing or assembly of rejected parts, materials, etc., by you or any other party shall constitute a waiver of any liability on our part.

5. Where operations or processes performed by us are in the nature of "salvaging" parts or material, the work is accepted on a "best effort" basis and no liability shall attach to us unless previously agreed upon in writing prior to processing the job.

6. In the event that results of metal finishing operations are unsatisfactory due to metal imperfection, changes in grade or composition of materials, manufacturing and/or fabrication imperfections, usages for which the plating or other finishing operation was not reasonably designed, and similar variables over which we have no control, the customer would be required to pay the contracted amount for the finishing operation performed.

We trust you will agree with us that the conditions above set forth are realistic and reasonable and that acceptance of the material for processing subject to such conditions will permit us to continue to provide quality metal finishing at an economic price.

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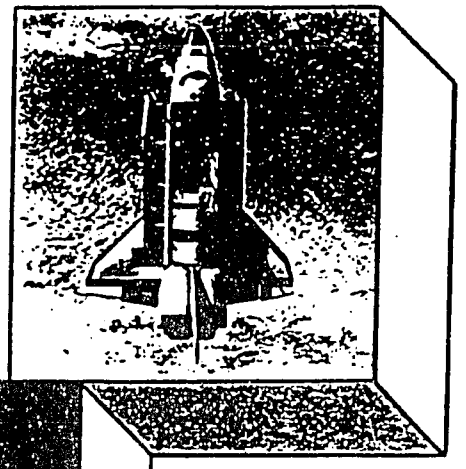
5000 Van Nuys Boulevard, Suite 300 • Sherman Oaks, California 91403 • (818) 995-7338

METAL SURFACES, INC.



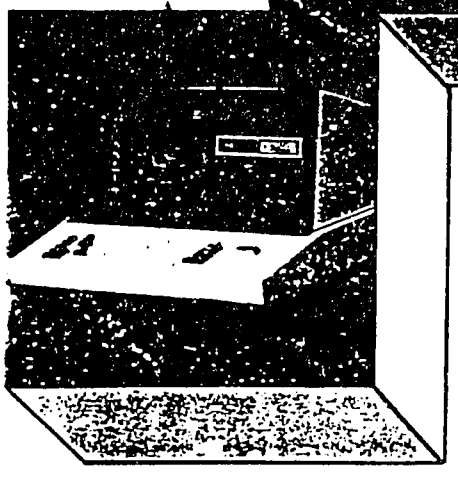
24k Gold
23k Gold
Electroless Gold
Silver
Rhodium
Platinum
Indium
Electroless Palladium

"WHEN PRECISION PLATING COUNTS"

Metal Finishing Processes Offered

Tin
Solder Plate
Lead
Cadmium
Electro-Polish
Black Chrome
Copper (Various types)
Passivate

Electroless Nickel
Electroless Nickel
(Non-Magnetic)
Nickel Cad Diffuse
Sulfamate Nickel
Nickel Tin
Hard Anodize



45,000 Square Feet OF PRECISION PLATING ON TITANIUM, ALUMINUM, BERYLLIUM, TUNGSTEN AND NON-CONDUCTORS. SELECTIVE AND CONTINUOUS PLATING OF NICKEL, GOLD, TIN AND SOLDERPLATE.

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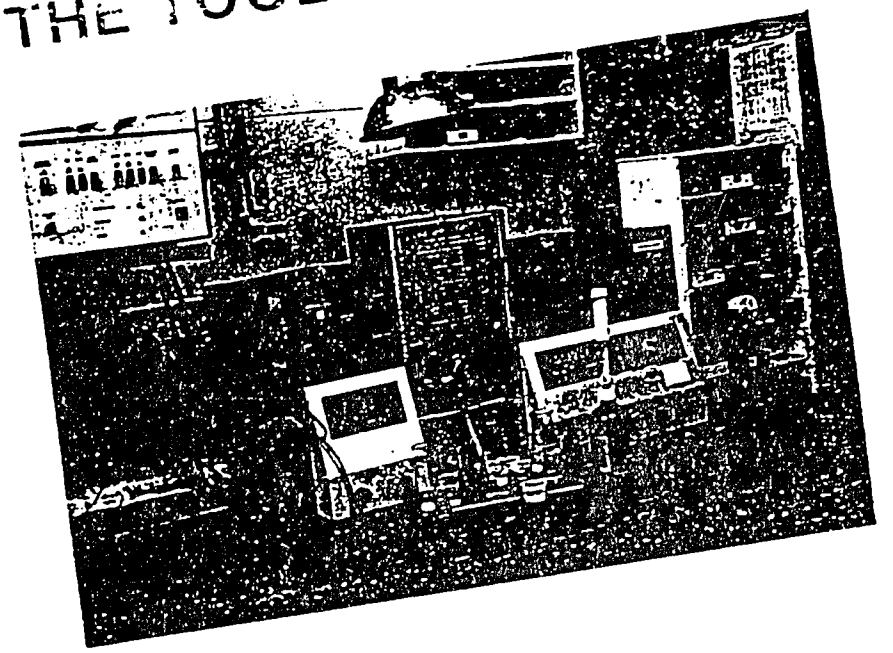
6060 Shull Street, Bell Gardens, CA 90201

(213) 927-1331 --- (714) 521-4112

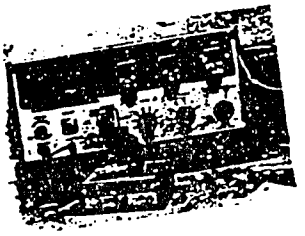
THE TOOLS OF QUALITY



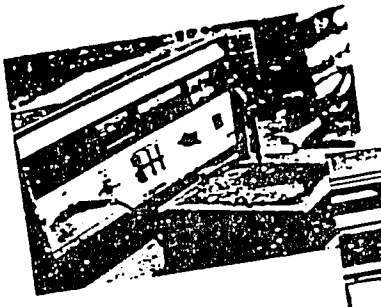
Quality is the keynote of success in any plating business. We support this philosophy in its fullest.

Francis Odell
President, MSI

INSPECTION UNDER MAGNIFICATION.



MICRODERM THICKNESS CHECKER.



BETASCOPE THICKNESS CHECKER.

MICRO SECTIONING AND VIDEO SCREEN.

SEIKO X-RAY THICKNESS ANALYZER.

PERMASCOPE THICKNESS CHECKING OF COPPER

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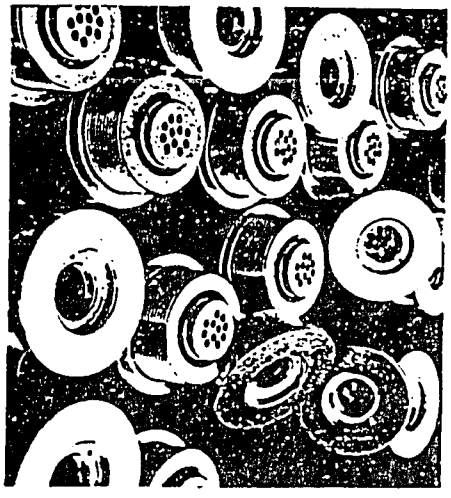
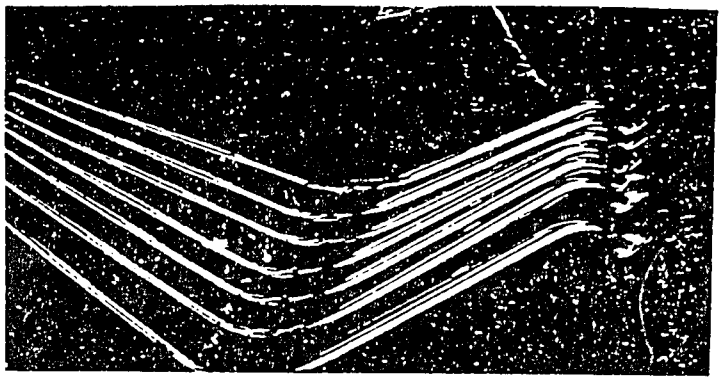
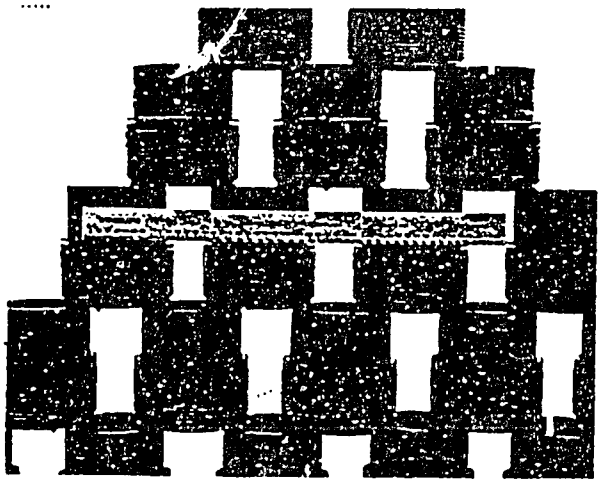


ELECTROLESS NICKEL AND SILVER PLATED BERYLLIUM.

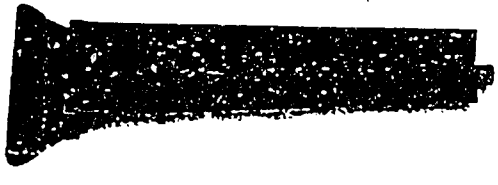


ELECTROPOLISHING FOR BRIGHT FINISH AND SUPER PASSIVATION.

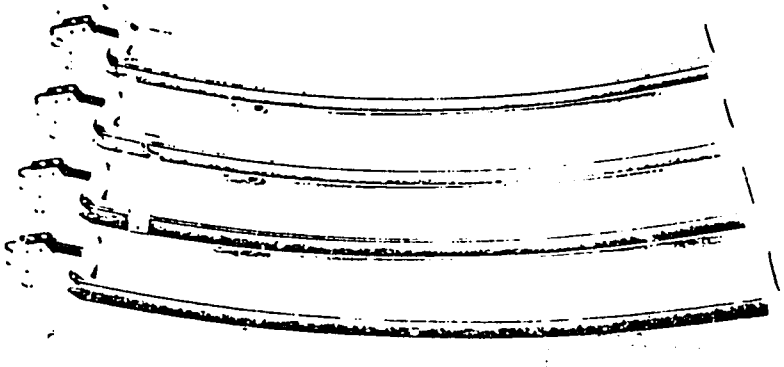


ALUMINUM CONNECTOR SHELLS.
NICKEL/CADMIUM PLATED TO MEET
500 HOUR SALT SPRAY REQUIREMENTS.

ENGINEERING PLATING BECOMES AN INTEGRAL FUNCTION OF THE PART



NICKEL/CADMIUM DIFFUSED
TURBINE BLADES FOR
AIRCRAFT AND PUBLIC UTILITIES.



FLAP TRACKS PRECISION ELECTROLESS
NICKEL PLATED FOR WEAR
AND CORROSION RESISTANCE.

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Electrolizing... the proven process that assures longer life, greater reliability.

Since its inception in 1944, the Electrolizing process has been proven in countless applications throughout industry as the single most effective coating available to improve the performance of metal wear parts, tools, gauges and molds.

Electrolizing assures optimum resistance to wear and corrosion of metallic surfaces. It offers maximum resistance to abrasion, erosion, adhesive wear, scuffing or galling, scoring, seizing, cavitational and corrosive wear, and fretting of sliding or rolling metallic surfaces.

In the demanding aerospace industry, where reliability is the most critical design consideration, Electrolizing has been used extensively and with outstanding success because of its remarkable wear resistance...extremely low coefficient of friction...excellent anti-seizure characteristics...and superior resistance to corrosion.

Among its newest applications—the nuclear, data processing and computer industries—Electrolizing has been used repeatedly to prevent galling of soft metals and to prolong the durability of stainless steel threaded parts in nuclear reactor components...and to assure longer life for printers, cutters, drives, perforators, memory storage and retrieval systems.

What Electrolizing is...

Electrolizing is a coating process that uniformly deposits a dense, hard, high-chromium, nonmagnetic alloy on the surface of the basis metal. As deposited, this coating has a Rockwell C hardness value of 67-72. It is applied with the deposit thickness ranging from .000025" to .0006" with tolerances held from ±.00001" to ±.0001" (depending on the precision and quality requirements).

Electrolizing...the key to greater reliability

Essentially, Electrolizing extends the life and improves the performance of ferrous and non-ferrous metal wear parts, cutting tools, molds, dies and gauges. It improves efficiency, lengthens service life, increases lubricity, permits the use of similar or like materials as opposing bearing surfaces, eliminates galling and enhances sealing capabilities.

For you, this adds up to the vital consideration: greater reliability.

In hardness—a primary factor in longer wear—Electrolizing ranks slightly below diamond on the Moh hardness scale: 9.0 as compared to 10.0. (Nickel, for example, rates a hardness of only 3.5 on the same scale.)

Combined with this hardness is denseness with a low coefficient of friction. Frictional force is a main cause of wear. Reducing it increases the life of wear parts, greatly resists abrasion and prevents interlocking of mating surfaces. **(See following table, "Kinetic Friction Coefficients.")**

The coefficient of friction of the Electrolized deposit is of the general order of .10 (Electrolized steel sliding on steel), and it has been tested to as low as .001 (Electrolized stainless steel sliding on the same treated metal at 50 fpm, 60 psi).

s of photographs representing some of the
tries utilizing the Electrolizing process.

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What Electrolizing will do...

It will increase the life of wear parts by 200% to 1000%.

It will solve problems not overcome by conventional surface treatments. It will coat total or partial surfaces, even sharp edges and complex shapes. It can be applied to all ferrous and many non-ferrous metals, including copper, brass, beryllium copper, aluminum and titanium, but is not recommended for use on lead, beryllium, columbium or magnesium.

Inside diameters can be Electrolized, with concentricity and roundness tolerances maintained, provided the diameters are .187" or larger. Slots, grooves, serrations, splines and threads are uniformly coated if depths are not greater than their widths. In corners, uniformity will fall in the areas below where a .187" ball will contact.

Generally, maximum dimensions which can be Electrolized are: length—10 feet; diameter—40 inches; and weight—approximately 1,500 pounds. Special arrangements can be made to accommodate larger sizes.

Any area, section or segment of a part can be coated, and most geometric shapes can be processed, including blind holes and intricate configurations—in virtually any application ranging from cryogenic to high temperature. As a rule, a range of -452°F. to +1150°F. ambient (1600°F. inert environment) will not impair the properties of Electrolizing, depending on how long the part is subjected to a given temperature.

Electrolizing meets and exceeds the requirements of applicable military and government agency specifications for chromium coatings.

How Electrolizing saves money...

Electrolized parts last 2 to 10 times longer than untreated parts—which is only one of the savings you realize from this unique process.

It solves friction, seizure and corrosion problems for you. In short, Electrolized parts perform better...longer...more reliably. With that kind of performance and service from wear parts, tools and gauges, the dollar savings are highly significant in terms of time labor and replacement costs.

An instance of the savings possible is the Electrolizing of carburized ball screw assemblies for wing flaps, stabilizers and other controls in the aviation industry. Corrosion-resistant steel assemblies are four to five times more costly.

Specific savings will vary, of course, depending on the nature of the application, but Electrolizing is not an expensive process. It falls within a practical cost range for all recommended applications.

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/hat Electrolizing vill not do . . .

It does not affect the mechanical properties of the metal being treated. Because the maximum temperature the material being treated reaches during the process is less than 120°F., there is no warpage or distortion of wear parts, tools or gauges being coated—and it is practically impossible for Electrolizing to damage or ruin a part.

No grinding, lapping or honing is required after treatment for size control because of the stringent control of thickness tolerances involved. Light afterlapping or polishing may be done to improve the RHR (or RMS) finish and/or the light band flatness.

The coating will not separate from the basis metal by peeling, chipping or flaking.

Electrolizing will not change the microinch finish value of the basis metal down to approximately 6 RHR (or RMS) and will not cause nodulation on corners or edges. Radiused or chamfered edges and corners are recommended and functionally should be provided.

It is important to note that Electrolizing does not take the place of heat treating. Any thermal heat treatment required should be done before Electrolizing.

Applications throughout industry

Electrolizing is ideal wherever wear, friction, galling and corrosion are problems. Some typical applications of the process are pictured in this brochure and include examples from the aerospace, aviation, nuclear energy, armament, photography, computer and transportation industries.

These are typical shapes we have Electrolized...either partial or total surfaces.

There is no single Electrolizing solution to every wear, friction and corrosion problem. Before we can recommend the right Electrolizing coating for your application, we must consider the basis metal used...the type and amount of friction or abrasion involved during operation...the hardness required...the speeds at which parts operate...the type and degree of corrosion encountered.

How your part, tool or gauge should be Electrolized for long-lasting, reliable performance can be determined only after our engineers have evaluated your problem.

We'll treat test parts for you free to prove the benefits of Electrolizing.

For a solution to your particular situation, contact us. Please send a description of the problem with a drawing indicating the critical areas, and preferably one or more sample parts. We will Electrolize the parts and return them to you for testing. Cutting tools, dies, fixtures and molds are not included in this offer.

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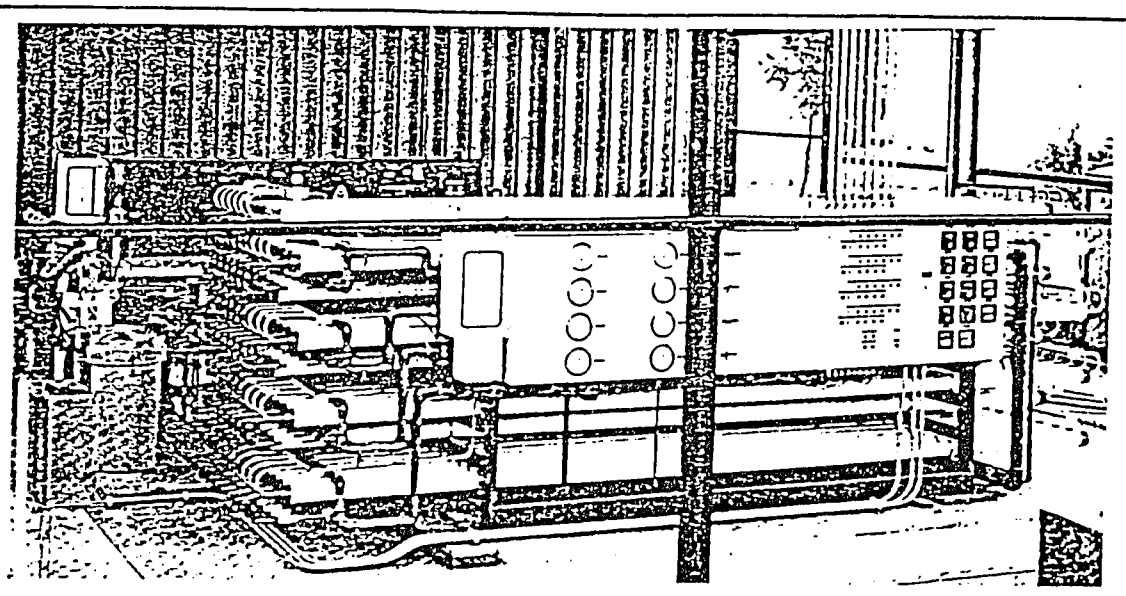
PSI



Process Scientific, Inc. specializes in the design, manufacture, application and service of high technology water treatment systems. Using the most advanced techniques and materials, PSI has earned a reputation for quality and reliability. Since it was established in 1982, PSI has followed a course of commitment, serving clients' continually changing needs through development and application of state-of-the-art technology. PSI has excelled in applications ranging from ultrapure to wastewater treatment and has successfully solved all types of feedwater contamination problems.

TOTAL SYSTEMS CONCEPT

Process design is a complex interrelation of science and technology. Design and implementation are vital factors on which the sucess of any plant depends. From evaluation of the feedwater through final purity specifications, PSI builds systems that meet the requirements and regulations of any ultrapure or other high technology water treatment application. With a philosophy of total systems responsibility, PSI is committed to providing the best equipment and technical support services. For all of your water purification needs, PSI provides superior system engineering the first time...every time.

SPECIALTY PRODUCTS AND EQUIPMENT

Management of high technology water treatment systems is becoming more complex. New challenges in this changing industry require specialty equipment and products. PSI's ongoing research and development efforts focus on solutions to these challenges.

PILOT SYSTEMS AND ENGINEERING

Well planned and executed pilot projects can assure the optimum in design and operation, thus providing maximum economic return. PSI has packaged pilot plants specially designed for generating accurate data over a large range of conditions and parameters. RoTRACK provides monitoring of all performance and operational parameters.

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RoTRACK

PSI developed RoTRACK (Reverse Osmosis TRACKing) to meet the need for more accurate and complete management information. RoTRACK is an automatic data acquisition and management system. Each component of a high technology water treatment system must function as an integral part of a more complex system. RoTRACK provides the crucial function of real time monitoring and the mechanism for evaluating both specific components and overall system performance. Long and short term trend analysis provided by RoTRACK is vital to proper system management. RoTRACK systems can be customized or expanded to incorporate other water treatment system components.

RoTRACK

ɔTRACK puts you back in control of your Water Purification operations.

New advanced, computerized Reverse Osmosis tracking and management system can pay for itself in a few weeks.

oting away from a Membrane Crash

iding one membrane "crash" will pay for the RoTRACK em many times over. A load of Reverse Osmosis membranes a medium-sized industrial water purification system can cost ar's salary. RoTRACK can help avoid premature membrane acement due to operating accidents.

ca Blues

ou are a Production Superintendent. breakthrough of silica . anics or other impurities into your process can literally ruin day. These impurities can do major damage to processes as electronic rinsing lines. electrophoretic paint lines. and rmaceuticals. RoTRACK can give you advanced warning of npending disaster and often gives you time to correct the lem before it starts to cost you real money in the production

partial Judge with the Memory of an Elephant

n more important. RoTRACK locks away critical facts of the re mode into the computer hard disk drive. This allows you oroughly analyze all the facts about ultrapure water equipment ure so that you can avoid future occurrences. Complete facts means enhanced accountability. We have found that this s to keep operators on their toes.

ndard components means quick, local fixes

TRACK is an advanced computer system designed around the compatible personal computer. The system collects operating from a reverse osmosis plant. such as pressure. flow. ductivity. temperature. and pH and sends it to a central signal cessing box. These data are then processed using standard. he-shelf personal computer hardware. Standard modular gn lowers the initial cost of the system as well as operating ts.

User friendly, debugged program

The heart of the system is the menu-driven. user-friendly RoTRACK program. This program has been perfected and enhanced through field use in operating water purification plants since 1986. This program gives the user the option to monitor the functioning of the purification unit in real time or to generate graphs. charts. reports.

Good Communicator

Some advanced RO plants have phone alarms which "beep" the supervisor in case of shutdown. In some cases this may be too late. With RoTRACK by using his home computer through a standard MODEM. the supervisor can poll the RoTRACK system from the leisure of his home and detect any water purification system changes before they become problems. We can also perform this supervisory function for you if you prefer.

Flexibility

The RoTRACK system can be easily modified for your application to keep track and warn you of critical events which can affect you particular process. We can add extra sensors. such as dual silica probes. process temperature monitors. DI conductivity breakthrough detectors... whatever you need to make RoTRACK work for you.

Proven Design

RoTRACK is already improving the operations and saving money at Yates/Square D (New Jersey) and Xerox (New York). The latest application involves both the monitoring and control of six units at the Trabuco Canyon Developement (Orange County).

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rocess scientific, inc.

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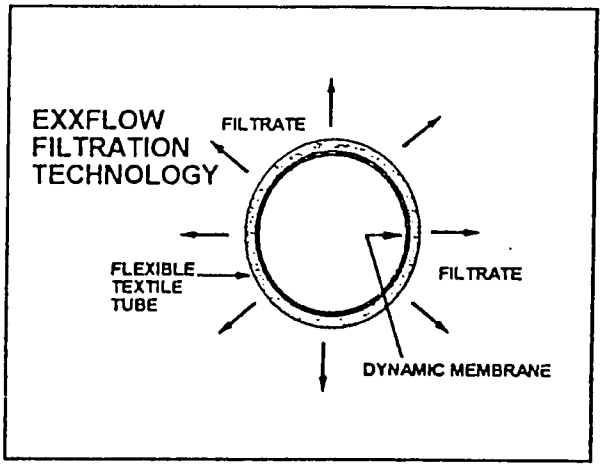
EXXFLOW™ CROSSFLOW MICROFILTRATION

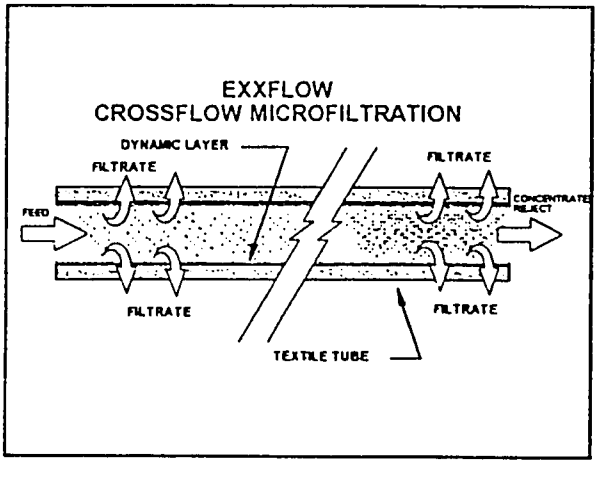
The *EXXFLOW* crossflow microfiltration process occurs in an array of permeable textile tubes. Manifolds are cast onto each end of the cloth filter to form modules which are connected to a pump for liquid inlet and to a back pressure valve at outlet. Upon introducing liquid flow into the tubes and regulating outlet pressure, suspended and colloidal matter in the liquid to be treated forms a thin film cake layer on the internal surface of each tube. This layer is called a "dynamic membrane" for its membrane-like characteristics. Other terms used are "filter layer" and "pre-coat layer". Should the quantity of suspended matter in the feed liquid be insufficient to form a filter layer, a small amount of filter aid compound is added to the initial feed. Filter layers or membranes of widely different characteristics can be produced by using different treatment chemicals.



To become treated product liquid, or **permeate**, the feed water filters radially through the membrane layer and out of the textile tube walls for collection at the base of each filter module. The debris removed from the liquid becomes concentrated and is swept out of the tubes with the remaining liquid which is called **reject concentrate.**

It is from the longitudinal or "crossflow" passage of the feed liquid along the filter cloth tubes that the process derives its name.

EXXFLOW crossflow microfiltration plants are of modular construction employing a number of manifolded filter modules. Modules are connected together either in parallel or in series with each other.



Ease of cleaning is an important feature of *EXXFLOW* crossflow microfiltration, distinguishing it from standard membrane microfiltration. In most cases, cleaning is simply a matter of momentarily stopping the feed resulting in tube collapse which causes the thin cake or membrane material to be dislodged and flushed out with the reject flow. In other applications, chemical cleaning in place is used.

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The *EXXFLOW* core technology is based upon the highly specialized woven textile tubular array and its post weaving treatment as well as on the formation and maintenance of dynamic layers, or membranes, and cleaning techniques.

A uniformly high quality permeate is achieved with the EXXFLOW crossflow microfiltration process. Removal of virtually all suspended solids down to about 0.1 micron has been demonstrated in countless laboratory and field trials. Other experimental work indicates that *EXXFLOW* can be developed to produce a low pressure process to reject high molecular weight dissolved solids.

The process has many advantages over conventional treatment process:

Most liquids are treatable without the addition of filter aid chemicals

Specialized membranes can be formed to produce the desired quality of treated liquid by using standard chemistry.

EXXFLOW is a low pressure process (20 - 35 psi) with a low crossflow velocity (3 - 6 fps)

The single stage treatment produces a treated liquid having no suspended solids greater than approximately 0.10 micron.

Cleaning of the filter cloth is easily accomplished

Water recovery is very high: Usually greater than 97%

Coagulation, settlement, clarification and filtration occur in the same process - usually without the need expensive of polymers or coagulant additives

Liquids of wide pH range, from strongly acidic to strongly alkaline, can be processed at temperatures up to 90°C

Extensive civil works and structures are not required

Operation is simple either manually or in the automatic mode

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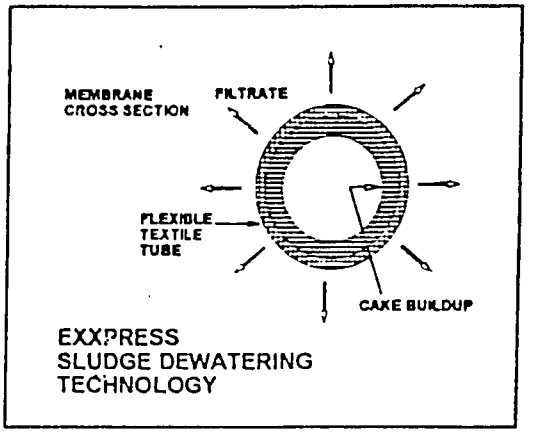
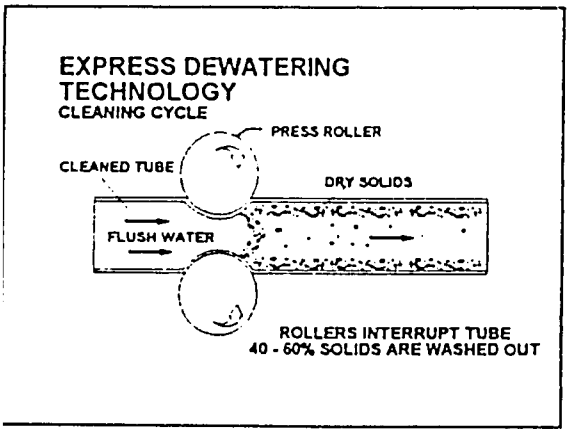
EXXPRESS™ AUTOMATIC TUBULAR FILTER PRESS

Wastewaters, or dilute slurries containing concentrations of 2 to 20% solids or more can be dewatered if pumped into filter modules operating with all tubes in parallel in the dead end mode. This mode is achieved by closing the outlet valves at the reject end of the module. The slurry forms a cake layer on the internal walls of the tubes. Its associated water permeates through the cake layer and escapes as filtrate on the outside of the tubes. The dewatering cycle is complete when the cake layer reaches a controlled thickness. The solids discharge cycle then commences by opening the outlet valves and traversing the module with rollers. The venturi formed by the rollers creates a high velocity with the incoming water and flushes the solids down the tubes and onto a dewatering screen.





Compared to conventional dewatering devices, including centrifuges, plate and frame filter presses, vacuum and belt presses, the *(EXXPRESS)* has the following advantages:

Lower installed capital cost

Use of the same filter cloth as *EXXFLOW*

No chemical additions are required

Low operating pressures are used resulting in lower cost of operation

EXXPRESS is self cleaning and automatic

Sludge from water treatment processes and industrial sludges including toxic and hazardous materials

EXXPRESS produces superior quality filtrate

NOTE: "EXXFLOW AND "EXXPRESS" ARE LICENSED TRADE NAMES OF EPOC WATER, INC.

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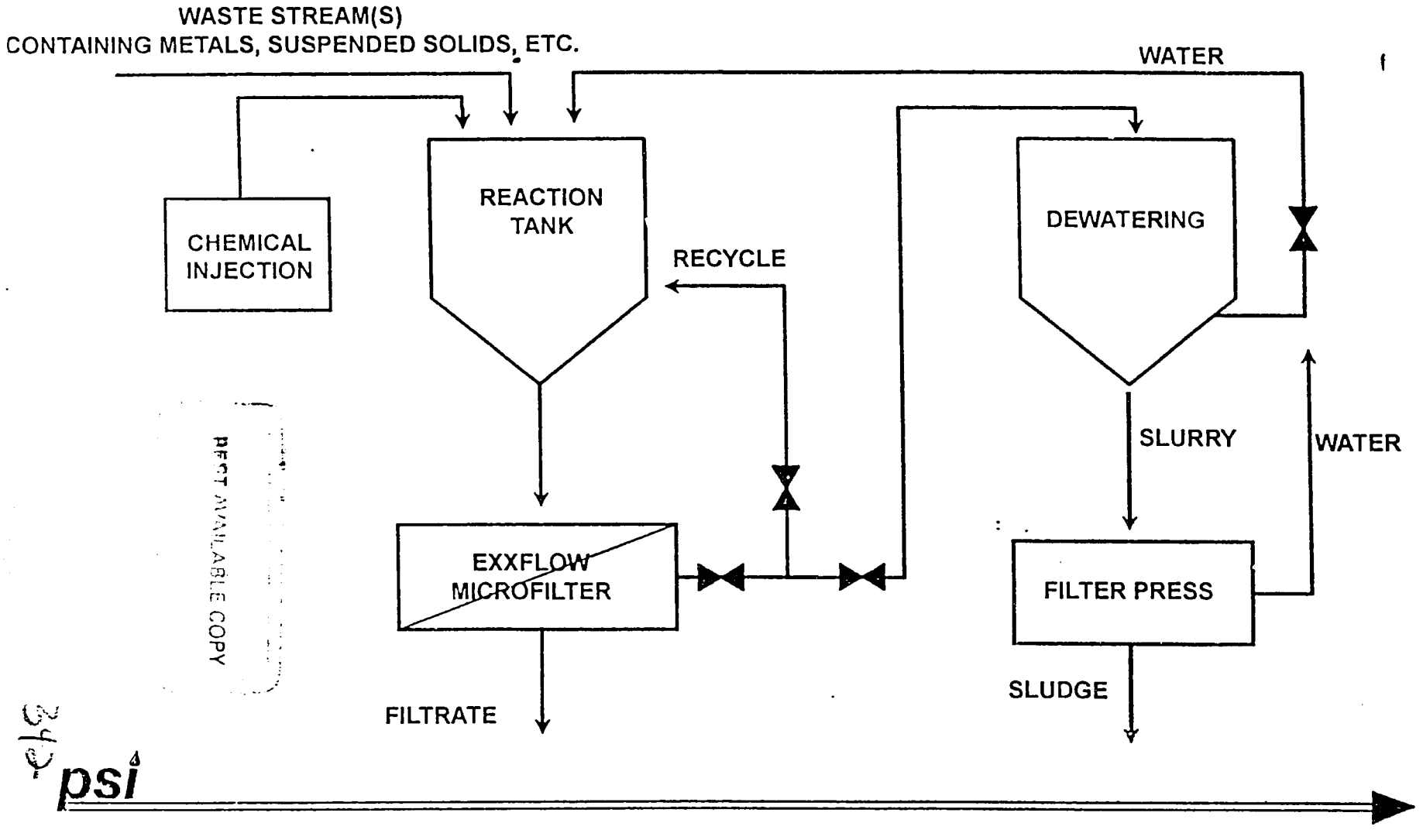
process scientific, inc.
11/17/93

TYPICAL FLOW DIAGRAM
HEAVY METAL AND SUSPENDED SOLIDS REMOVAL



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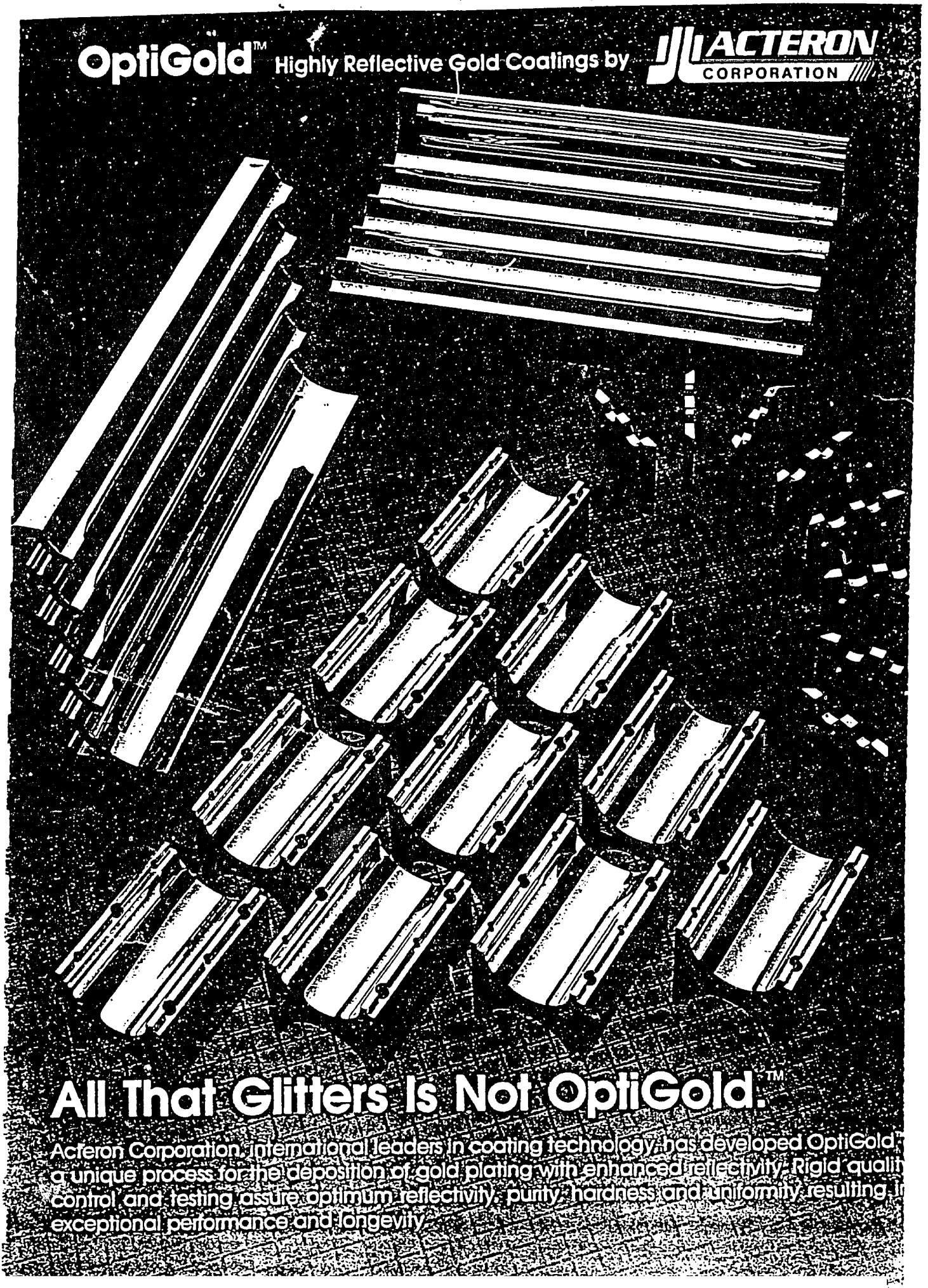

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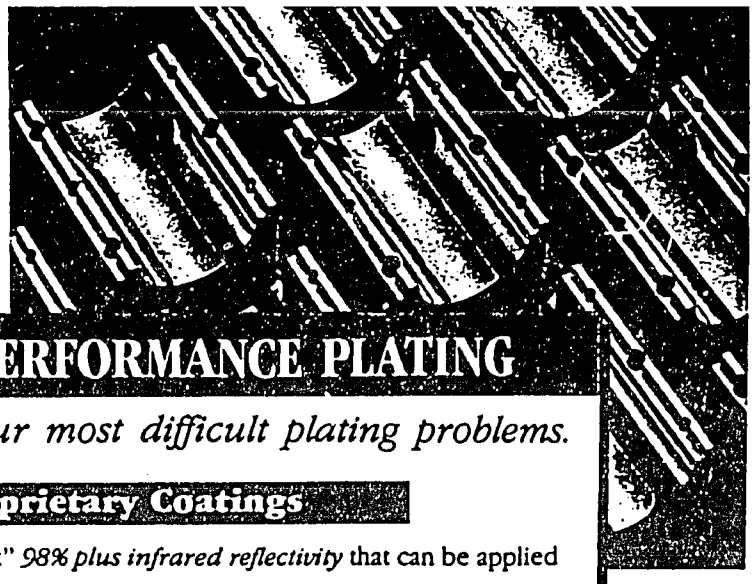

OPTIMUM PERFORMANCE PLATING

Acteron solves your most difficult plating problems.

Proprietary Coatings

OptiGold™ "State-of-the Art" *98% plus infrared reflectivity* that can be applied directly to stainless steel.

OptiNickel™ a breakthrough coating providing optimum corrosion resistance, lubricity and *wear properties equivalent to hard chromium.* It is virtually defect free for diamond turning and has been optically lapped to 1 angstrom RMS.

OptiRhodium™ ultrahard, reflective, ductile, and extremely corrosion resistant.

OptiAnodize™ customized properties for your application. Enhanced dielectric strength, hardness, thickness and emissivity.

Special Processes

OptiBond™ our unique activation processes provide maximum adhesion without etching of the base materials.

DIFFICULT TO PLATE METALS - all aluminum alloys and castings; kovar, invar, monel, stainless steels; titanium, nitinol, beryllium, molybdenum, tungsten, thermkon; mixed metal assemblies; rare earth magnets.

NON-METALS - ceramic, plastic, glass, silicon carbide and virtually all materials.

OTHER SERVICES - precision masking, brush plating, ultrasonics, pulse plating, bead-blast, electropolish of aluminum. Part fabrication, Autocad, optical polish, lapping.

Exact Plating to Specifications

- **SOFT GOLD** - 99.9%+ pure, for die attachment and wire bonding.
- **HARD GOLD** - alloyed for wear resistance and low contact resistance.
- **SILVER** - high purity and conductivity.
- **HARD ANODIZE** - extreme hardness, dielectrics, corrosion resistance, and crack free.
- **RHODIUM** - extreme wear and protection.
- **ELECTROLESS NICKEL** - high phosphorous, non-magnetic, food approved. For soldering, brazing, welding, machining and electroforming.
- **SULFAMATE NICKEL** - low stress, and ductile.

Advanced Quality Control

Our Complete Inspection Department performs to Mil-I-45208A including X-Ray Fluorescence and backscatter thickness testing, spectral reflectance, computerized coordinate measurement-SPC and various tests for particular plating properties.

Acteron's Quality Control Lab to Mil-Q-9858A, and ISO 9000. Atomic absorption, specific ion testing, complete chemical laboratory and corrosion testing.

rkets Served:

- Electronics
- Semiconductor
- Microwave
- Optics
- Laser
- Medical
- Aerospace
- Disc Drive
- Defense
- Commercial

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(415) 369-5217

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improving life and
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ACTERON CORPORATION

851 Shasta Street
Redwood City, California 94063
Telephone (415) 369-5217
Fax (415) 364-9748

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OptiGold™

ACTERON CORPORATION
851 Shasta Street • Redwood City, California 94063
(415) 369-5217
Fax: (415) 364-9748

Highly Reflective Gold Coatings for Optical and Thermal Reflectivity

Acteron has developed unique processes for the deposition of optically reflective gold coatings. These deposits are exceptionally **hard, pure, uniform** and **thermally stable.** The **OptiGold™** layer can be applied over an Acteron developed, multi-layer **OptiNickel™** process or directly to our **OptiAlloy™** stainless steel for optimum corrosion resistance, reflectance and uniformity.

Why Is OptiGold™ The Best Choice In Reflector Coatings?

◆ Optimum Reflectivity

OptiGold™ utilizes proprietary processes to achieve 98% plus infrared reflectivity.

◆ Purity and Uniformity

OptiGold™ is a highly pure (99.9%) and exceptionally fine-grained hard gold deposit which is free of organic polymers present in other hard gold deposits.

◆ Exceptional Longevity

The combination of hardness, purity and non-porosity provide an exceptionally durable coating which can be applied over our extremely corrosion-resistant OptiNickel™ undercoating. OptiNickel™ is a proprietary multi-layer nickel process utilizing ultrasound, innovative chemistries and modulated electrocurrent to achieve a uniquely pore-free diamond turnable and corrosion-resistant coating.

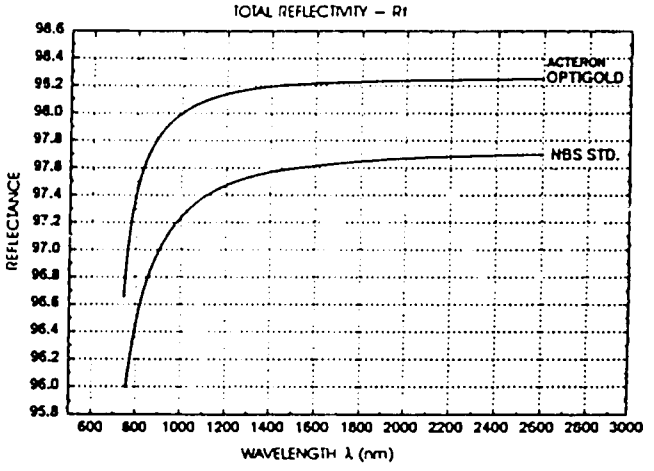
◆ Highest Reliability

Exceptional purity and uniformity are combined with the Acteron *"zero defect"* quality control system to provide the highest reliability available anywhere.

APPLICATIONS

- **Lasers** – "State-of-the-art" reflector coatings for new and refurbished yag laser cavities. OptiGold™ can be applied directly to stainless steel for use in water cooled systems providing enhanced corrosion resistance and power output.
- **Infrared Reflectors** – OptiGold™ is the ideal coating for epitaxial reactors, rapid thermal processing systems and many other heat shielding or directing applications.
- **Optics** – Spectral or diffused OptiGold™ is preferred internationally for its durability, reflectivity and precise quality control.

GOLD REFLECTIVITY



SUBSTRATES

OptiGold™ can be aplied to virtually **all metallic and many non-metallic substrates** through the use of Acteron's proprietary OptiBond™ processes which achieve exceptional coating adhesion **without surface etching.**

FABRICATION

We provide complete optical components fabricated to print. In-house services include coordinate measurement; profilometer testing; optical lapping and polishing. Other services include diamond turning machining; CNC and conventional machining; surface diffusion.

ACTERON QUALITY ASSURANCE

Reflectance measurement is supplied by **Beckman DK2A Spectrophotometer** with an integrating sphere for measurement of total spectral reflectivity. NBS traceable reflectance measurements are provided for spectral and diffused surfaces.

OptiNickel™ "A Major Breakthrough"

ACTERON CORPORATION

851 Shasta Street • Redwood City, CA 94063 • (415) 369-5217

Multilayer Electroless Nickel Coatings for Optimum Performance

Acteron Corporation has developed a series of unique, pore-free coatings utilizing state-of-the-art enhancements, including ultrasound and pulse plating to solve the most critical applications. These coatings include an optional protective chromate overcoat for selected applications.

Why OptiNickel™?

Ultra Corrosion Protection – Over 1000 hours salt spray resistance. Strongly resistant to chemical environments.

Economical – Lower coating thickness required to obtain specified corrosion resistance. The lower thickness allows easier tolerancing of threads and critical dimensions which reduces machining and plating costs.

Extreme Hardness – Heat treatable up to Rockwell C68 and wear resistance equivalent to hard chromium.

Pore-free – And particle-free, for high-end disc drives and optical surfaces.

Excellent Uniformity– And consistency of deposit.

Other Attributes – For soldering, brazing, welding. Food approved, excellent lubricity for mold release, exceptional ductility.

SPECIAL SUBSTRATES

Opti-Bond™ – A unique process which provides maximum adhesion without chemical etch of the substrate.

Difficult to Plate Metals – All aluminum alloys and castings; invar, kovar, monel, stainless steels; titanium, nitinol, beryllium, molybdenum, thermkon, tungsten; mixed metal assemblies and rare earth magnets.

OptiNickel™ on Non-Metallics – We are able to plate complex geometries on virtually any material including ceramics, plastics, glass and silicon.

APPLICATIONS

Disc Drives – Non-magnetic, particle-free, pore-free, and exceeding 168 hours of humidity testing – even on porous ductile iron or aluminum castings.

Precision Diamond Turning – Precise control of phosphorous content, hardness and process variables to achieve a deposit free of inclusions, pits or protrusions. OptiNickel™ has outstanding lubricity which creates uniform chip formation and extends tool life. When applied over OptiBond™ process, OptiNickel™ actually *improves* the surface RMS.

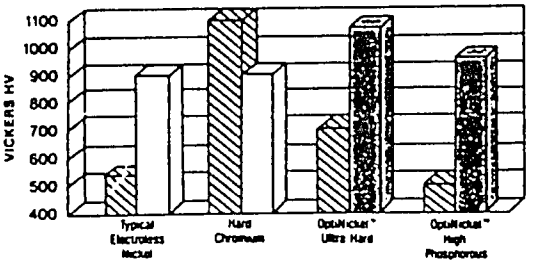
Optics Applications – A highly corrosion resistant undercoat prior to Acteron's exclusive OptiGold™ or OptiRhodium™ highly reflective coatings. OptiNickel's™ pore-free surface is PDT machinable and can be optically polished to 1 *angstrom* RMS.

Corrosion Resistant Applications

Wear and Abrasion Resistant Surfaces – Lubrous and heat treatable to Rockwell C68.

Electronic Applications – Solderable and aluminum wire bondable. Best diffusion barrier undercoating for precious metal plating.

COMPARISON OF DEPOSIT HARDNESS



As Plated
Heat-treated at 750°F for 1 hour

ACTERON'S RIGID QUALITY ASSURANCE SYSTEM

OptiNickel™ – exceptionally consistent and defect free due to our on-line automated process controls. Corrosion resistance and coating property studies are available on request.

Complete Quality Control Laboratory
- atomic absorption analysis
- specific ion testing
- complete chemical laboratory
- full engineering staff for process and analytical control
- on-line electronic thickness testing

Complete Plating Inspection Dept.
- x-ray fluorescense
- beta backscatter thickness testing
- coulometric thickness testing
- coordinate measurement - SPC
- thermal testing up to 1200°F

Our quality assurance and quality control systems are the key to our exceptional product uniformity and repeatability. In addition we are the preferred source for many of the leading high technology manufacturers in the United States.

We welcome you to visit and inspect our modern facility and become familiar with our advanced quality, production and environmental control system.

Please contact our technical staff for consultation on your specific applications.

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Specialists in Microwave Plating

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Microwave Plating

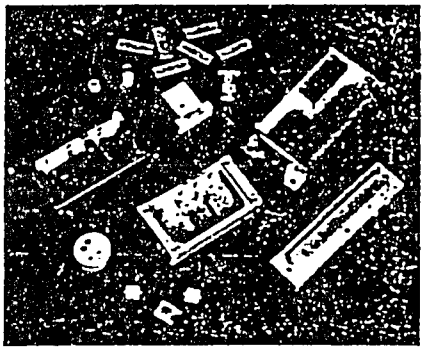
Acteron leads the way in precision electroplating to military and commercial specifications. We are nationally recognized for exceptional quality control and coating performance that is essential to the microwave and telecommunication fields. Acteron meets and surpasses military and commercial specifications.

Housings, Enclosures and Cases

- High purity hard or soft gold over low stress sulfamate nickel or highly corrosion resistant electroless nickel.
- High purity (99.9%) "high Q" and "low loss" silver without organic brighteners. Will meet the resistivity of high Q filters.
- Selective gold or silver in feedthrough holes.
  Electroless nickel coatings that can be soldered and laser welded.

Carriers To Print

- High purity (99.9%+) and soft (90 Knoop maximum) gold plating for optimum die attachment and wire bonding.
- Low stress sulfamate nickel or electroless nickel underplate. We provide the finest reliability nickel underplated carriers. They are able to withstand hot plate thermal shock at 430°C for up to 30 minutes without discoloration, blisters, pits or other defects.



Process Innovations

- Non etch material preparation processes.
- High bond coating adhesion.
- Exceptional plating thickness and dimensional control.
- Excellent uniformity of deposit.
- Plating on almost all materials — metallics and non-metallics.

- *Connectors, Isolator Circuits, Diodes, Electroformed Components*
- *Fabrication Technologies*

Acteron utilizes leading edge technology and quality control to produce cost effective carriers conforming to exacting standards for flatness, dimensions, surface finish and all critical coating characteristics.

Fabrication technologies include: chemical milling (up to .030" thk.), stamping, machining, lapping, heat treating, laser fabricating and scribing. Quality conformance is insured by in-house coordinate measurement and profilometer testing. Quality system conformant to Mil-Q-9858A and Mil-I-45208A.

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Ask us for additional information and test reports on these processes. (415) 369-5217

Acteron & Waste Minimization

by V. J. Shannon
FLO KING Filter Systems
Longwood, Florida

With trend-setting anti-pollution legislation, water and landfill shortages, and a strong environmental consciousness, northern California tends to spawn ecologically minded businesses. And for Acteron Corporation, Redwood City, CA, that spells waste minimization.

Acteron is a 13-year-old firm specializing in highly reflective plating for infrared optical components used in the industrial and medical fields, electroless nickel on high-reliability electronic components, precious metals plating for electrical contacts and microwave applications, functional hard anodizing, and more. The company processes materials such as difficult-to-plate metals, non-metallics, plastics, silicon and glass. With over 50 technicians and engineers, Acteron has even developed proprietary processes employing ultrasound and pulse plating. Its customer base includes some of the most

Acteron President Patrick Burt (right) and Steve Cazel, Plating Manager, examine blanket-like reusable filter media.

prominent names in electronics and over 10 prime defense contractors. It has an inspection department that meets the requirements of MIL-I-45208A and lab resources that feature AA analysis, specific ion testing, and a zero-defects QC program in accordance with MIL-Q-9858A.

Patrick Burt, president of the 12,000-square-foot facility, is an avid proponent of waste minimization. In fact, he is chairman of the National Association of Metal Finishers (NAMF) Waste Minimization Committee, whose mission, in part, is "to research, study, and promote waste reduction, minimization, recycling or reclaim techniques to the surface finishing industry, regulators, and legislators." *(Editor's note: See article on waste minimization in November/-December issue of FM by Patrick Burt).*

Minimization Initiatives

To illustrate the results of an aggressive waste minimization program, consider this. Just seven years ago, Acteron moved from Belmont after acquiring and expanding a four-man shop in Redwood City. Despite a company that now has approximately 12 times the personnel and sales of that four-man operation, Acteron actually consumes *less than one-third the water and has nearly 90 percent less heavy metals in its effluent.* Here are some of the initiatives that have contributed to these impressive figures:

- Installation of double and triple counterflow rinses.
- Use of spray rinses over select process and rinse tanks.
- Adoption of conductivity sensors to regulate water condition and flow.
- Segregation of rinsewaters.
- Substitution of less-polluting processes (e.g., acid copper to replace cyanide copper, and periodic reverse-current cleaning to replace cyanide-containing cleaners).
- Elimination of vapor degreasing by using a system of dual soak cleaners with ultrasonic enhancement.
- Use of more dilute formulations such as those for acid pickling.
- Thorough indoctrination and training of employees to stress how they can make a positive contribution to the environment. For example, all personnel are taught the importance of extending drip-times over rinse tanks.

In-Tank Filtration Systems

Another key aspect of Acteron's waste minimization program is the use of in-tank filter systems in tanks as small as 10 gallons and as large as a few hundred gallons. As Plating Manager Steve Cazel says, "On any plating tank, but particularly on precious metal tanks, external plumbing for filtration is a concern for us. Housings can crack. Hoses and clamps get weak. And even if you recover spilled solution from a secondary containment area, chances are it would be too contaminated to recycle because of the dirt and debris involved. So it's a great benefit to keep all of the

Filter changes on in-tank system are achieved easily and quickly using hand-tightening thumbscrews.

filtration equipment in the tank. Even though the in-tank system takes up some tank space, we feel it is minimal and that the advantages are far in our favor."

The in-tank system eliminates leaks and spills because it uses no hoses, clamps, seals, chambers or, for that matter, any out-of-tank apparatus. The filter(s) is attached to the pump body and totally immersed in the solution to be filtered. The pump body is secured to the tank lip with an adjustable bracket. Solution is continuously drawn by vacuum through the filter cartridge(s), after which it travels approximately 3" before being expelled through a discharge port on the pump body. Solution never leaves the tank.

Importantly, the force of this discharged solution produces a clean, oil-free source of robust agitation that

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suspends particles for quick-capture filtration, thus keeping the tank bottom free of contaminating solids buildup. Frequently, the agitation provided as a natural byproduct of in-tank filtration is sufficient to replace mechanical or air agitation systems. As Mr. Burt explains, "Airborne contaminants — some organic, some inorganic — are a concern for our technology." By removing those particles quickly, before they dissolve in solution, we reduce the need for carbon treatment, dummying, peroxide treatments, or, in the worst case, bath dumps."

Using the same basic principles of operation but different models and sizes to produce from 1 to 3,000 gallons/hour of filtered solution, in-tank systems find application in tanks as small as a half-gallon and as large as thousands of gallons. For high-volume baths, two or more in-tank units are used on a single tank. Ease of use is another asset. Conventional filter systems often require tools and significant time and labor for filter changes. But the uncomplicated design of the in-tank system enables rapid filter changes using hand-tightening thumbscrews rather than tools. Because the systems are portable, cleanable, and consume no floor space, they can also be used to filter multiple tanks where continuous filtration is not required.

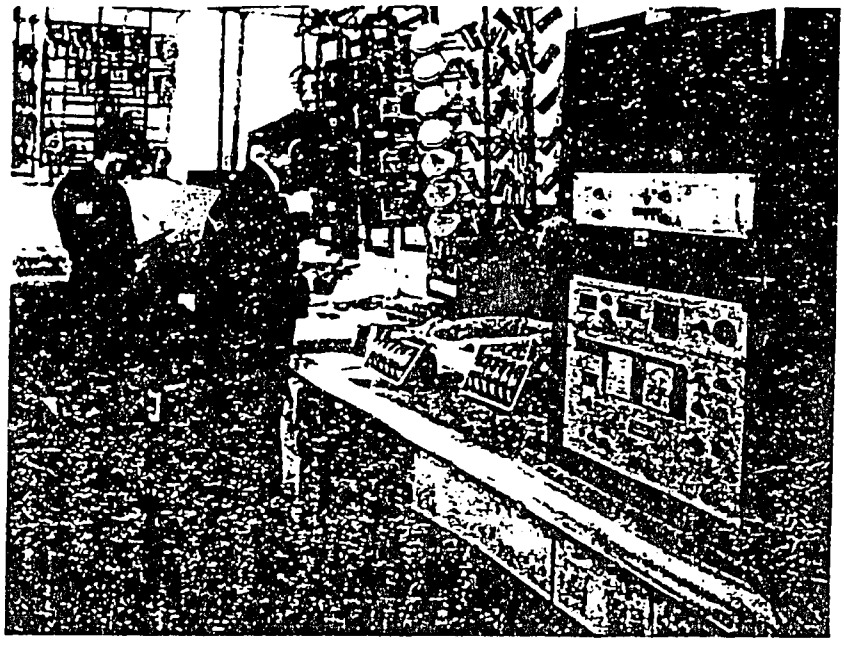
Prior to using the in-tank systems, Acteron did not filter preparatory solutions such as those in its aluminum finishing lines. In the case of nitric acid and mixed organic acids, for instance, that meant frequent dumps, frequent neutralization, frequent and liberal use of neutralization chemicals, and frequent acid purchases. Now Acteron continuously filters those pre-dips ... and with just rewards. As Cazel says, "High-solution-turnover filtration gives us more confidence in all of our solutions. It reduces rejects and adds life to the baths. So we're purchasing less acid and utilizing less neutralization chemicals for waste treatment."

Reusable Filter Media

Another important element of Acteron's waste minimization program is a reusable filter media. Before converting to this material, the company routinely accumulated a 55-gallon barrel of spent disposable filters every 90 days. But in nearly a year of using the blanket-like reusable media, not a single drum of the spent filter material has been generated, according to Cazel.

"Conventional filter cartridges go to landfill — they're solid waste — and we're committed to reducing waste," he said. "Plus, with disposables, there is the cost of an expendable product to consider. The reusable material has been real cost effective for us. We have yet to find a plating system that we weren't able to upgrade by using the in-tank filter system and reusable cartridge."

Clean filter operation is predicated on good filter maintenance, and Acteron has trained a crew whose sole job it is to properly maintain tanks, filters, and accessories on a regularly scheduled basis. That includes cleaning the reusable filters by draping them over a 3/8-inch-thick polypropylene perforated sheet, then pressure spraying with deionized water over an appropriate rinse tank.



Waste reduction complements Acteron's high-tech processes such as pulse plating to obtain particle and pore-free nickel finishes on disc drive components.

Patrick Burt and Acteron have such a high profile in the area of waste minimization that they participate in local, regional, national, and even international programs on the subject. For instance, on a goodwill NAMF tour to Czechoslovakia, Mr. Burt shared waste minimization technology with that nation's environmental and industrial ministries. And, recently, Acteron participated in the making of a film on waste minimization produced by the State of California Department of Health Services. In that film it is no accident that they discuss the in-tank filter system with reusable filter media. It is but one of many tools and techniques available to operate an ecologically responsible business in these environmentally conscious times. t

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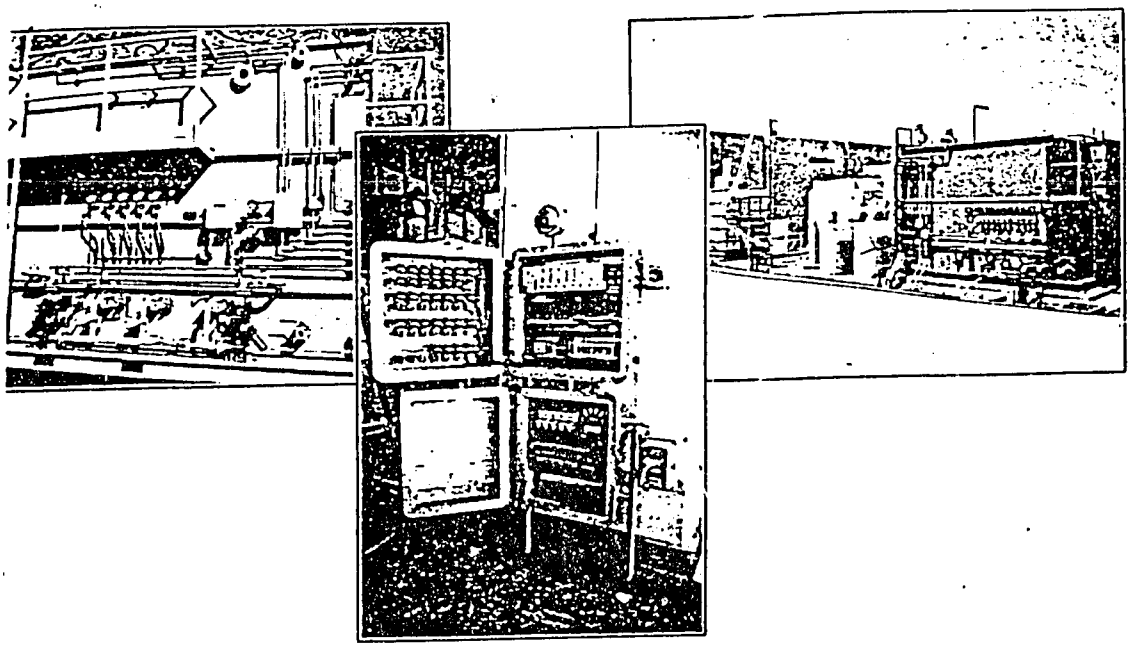

WTS
WASTEWATER TREATMENT SYSTEMS INC.

COMPANY PROFILE

INTRODUCTION

Wastewater Treatment Systems, Inc., (WTS) was founded in April 1985. With more than fifteen years of experience in the industrial wastewater treatment industry,the founders brought together considerable knowledge and technical capabilities in the chemical, mechanical, instrumentation, and process design fields of industrial wastewater treatment. This knowledge and these capabilities, combined with years of proven achievement in providing successful wastewater treatment system installations, have made WTS an industry leader.

WTS was founded with the objective of providing high quality equipment combined with unsurpassed professional engineering services and support. This objective was to be fulfilled through the development of standard, packaged equipment used for treatment of a wide variety of industrial waste effluents. In addition, these products and installations would be supported by the formation of a diversified staff of engineers and field support personel. These individuals are the key to maintaining a high quality product furnished with the required support and service to ensure successful installation of WTS products.

WTS is a member of the Thames Water Plc Group, an international supplier of water, process fluids, and wastewater treatment. From the smallest industrial user to the largest utility, Thames Water companies provide a complete package of products and services. WTS's prominence in the industrial wastewater treatment industry is ensured by their integration with Thames Water Plc. This gives WTS the financial strength of the Thames Water balance sheet, as well as Thames Water's experience as a major supplier of wastewater products and services, and utility operations.

Today, WTS has achieved and maintained its founding objective. This is confirmed by the diverse line of high quality, standard products now offered by WTS, and by its many successful installations located throughout the world.

WTS SERVICES

Field Support:

WTS understands successful system performance relies on effective field installation, commissioning and ongoing service. WTS maintains an independent staff of field engineers and technicians capable of providing the following support functions:

- Project Management
- Turnkey Installation
- Ongoing Maintenance
- Troubleshooting
- System Commissioning
- Performance Testing
- System Operation
- Emergency Repair

Commitment to Field Operations is a key factor to the success WTS has achieved in the industry today. WTS continues to offer and works to provide unequaled Field Support to its installed customer base.

Engineering

WTS supports its manufactured products and installations by maintaining an engineering staff encompassing the following disciplines:

- Mechanical Engineering
- Chemical Engineering
- Civil Engineering
- Electrical Engineering
- Manufacturing Engineering
- Environmental Engineering

WTS has developed this group of engineers to ensure quality design of its manufactured products and competent support for its equipment installations. This level of engineering expertise is a mandatory element for successfully supporting today's evolving industrial wastewater treatment requirements.

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WTS PRODUCTS

Packaged Systems:

WTS offers the finest in packaged industrial waste-water treatment systems. These system designs are primarily based upon proven, conventional treatment technologies enhanced by specialized process engineering and state-of-the-art automation. The packaged units are installed as stand-alone systems, or easily incorporated into more complex, specially engineered systems. Typical treatment applications for the packaged plants are:

- Heavy Metals Removal
- pH Neutralization
- Cyanide Destruction
- Arsenic Removal
- Waste Evaporation
- Aqueous Cleaning Effluent Treatment & Recycle
- Fluoride Removal
- VOC Removal
- BOD/COD Reduction
- Oil/Grease Reduction
- Water Recycle
- Semi-Aqueous Cleaning Effluent Treatment & Recycle

The packaged systems can treat waste streams containing concentrated and dilute levels of contamination. Standard systems are based upon continuous flow and batch treatment processes. The systems are offered with all peripheral devices necessary to provide a complete, functional wastewater treatment system.

Engineered Systems:

WTS provides detailed design, and manufacture of specialized equipment for custom engineered wastewater treatment projects. This capability, together with our standard packaged systems, allows WTS to provide high quality equipment to meet the many diversified needs of industrial wastewater treatment. Treatment equipment for non-standard, engineered applications includes systems such as the following:

- Ammonia Treatment
- Phenol Treatment
- Tanker Truck Wash Effluent Treatment
- Sodium Azide Treatment
- Landfill Leachate Treatment
- Laundry Effluent Treatment/Recycle
- Vehicle Cleaning Effluent Treatment
- Zero Discharge
- Existing System Rebuilds/Upgrades
- TDS Controls

These non-standard, engineered systems typically incorporate the same state-of-the-art automation included with WTS packaged products. These systems are also offered with all peripheral devices and WTS service necessary to provide a complete functional wastewater treatment system.

WTS
WASTEWATER TREATMENT SYSTEMS INC.

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WTS
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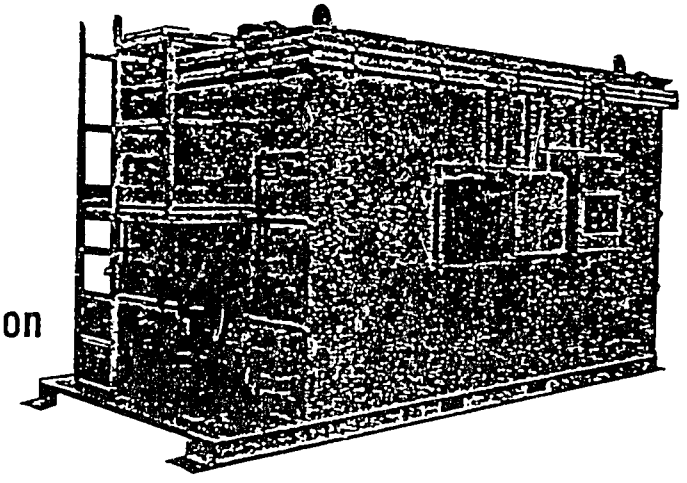
HMR

Packaged Chemical Precipitation/Clarification System



General

The HMR is designed to provide a standard product used for precipitation and clarification of regulated contaminants from industrial wastewaters. This product services a wide range of field proven applications, and offers a compact design unsurpassed in the industry. The HMR is commonly used as a stand-alone treatment system, and is also easily incorporated into custom designed effluent treatment systems.

Features

- Compact Design
- PLC Controlled
- High Quality Design
- Continuous Flow
- Easy Operation
- Process Guarantee
- Factory Assembled

Description

The HMR is a skid-mounted, factory-assembled unit incorporating separate chambers to perform the following treatment processes.

- Chemical Pretreatment/Precipitation
- Pre-clarification pH Adjustment
- Precipitate Flocculation
- Precipitate Clarification
- Sludge Thickening
- Effluent Clear Well

The HMR and all system peripheral equipment are automated to the greatest practical degree utilizing a WTS programmable Process Control Unit. This Control Unit unifies the equipment with the treatment process and is field proven to increase system reliability and reduce operator involvement. The HMR is typically supplied with all necessary peripheral equipment such as:

- Sludge Processing Equipment
- Effluent Filtration Equipment
- Reagent Holding Tanks
- Lift Station(s)

This equipment is supplied to provide a complete, functional system that meets the user's needs.

Application

The HMR is a continuous flow system configured to meet many diversified needs. The unit is field proven in the following applications:

- Heavy Metal Removal
- Arsenic Removal
- Fluoride Removal
- Residual Oil/ Grease Removal
- Suspended Solids Removal
- Iron Removal

The HMR has been successfully utilized in industries such as the following:

- Electronic /Semi-conductor
- Printed Circuit Board Manufacturing
- Metal Finishing/Plating
- Industrial Laundries
- Landfill Leachate
- Groundwater Remediation
- Petro Chemical

These applications clearly demonstrate the versatility of the WTS HMR.

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Service

WTS offers the following comprehensive services with each order:

Engineering Support

- Process Design
- As Built Documentation
- Installation Documentation
- Operation/Maintenance Manual
- Lab Studies
- Pilot Studies

Field Support

- Equipment Installation
- Turnkey Facility Construction
- Start-up and Testing
- Operator Training
- Ongoing Service
- Emergency Repair

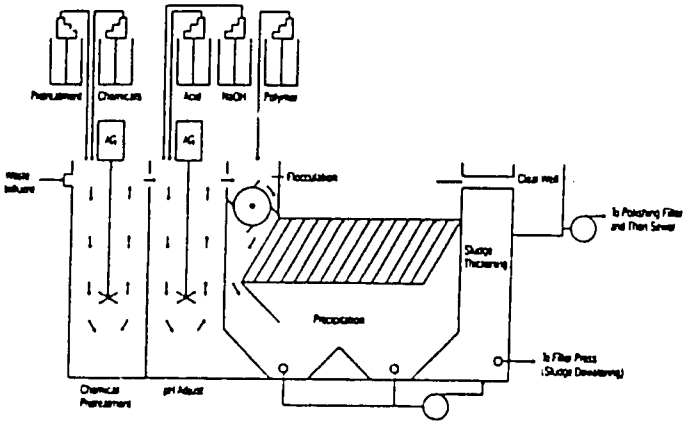
Equipment Service

WTS offers continuous service and maintenance contracts. This is part of our commitment to provide customers with dependable wastewater treatment.

Warranty

All system components are warranted for one year after receipt of the equipment. WTS also guarantees that the process will meet applicable pretreatment limits establish at the time of order placement. (See full warranty and guarantee statement)

Heavy Metal Precipitation System



Sizing/Construction

The HMR is a rugged design with chemical resistant interior and exterior coatings. The units are offered in the following various sizes based upon flow rate and solids loading:

Unit	Capacity	Dimensions (HxWxL)	Construction
HMR 2	2 GPM	5'6" x 4'0" x 8'0"	Steel Reinforced Polypropylene
HMR 5	5 GPM	5'6" x 6'8" x 9'0"	Steel Reinforced Polypropylene
HMR 10	10 GPM	7'0" x 6'0" x 12'6"	Steel Reinforced Polypropylene
HMR 20	20 GPM	8'0" x 6'0" x 13'0"	Steel Epoxy Lined
HMR 30	30 GPM	8'0" x 6'0" x 16'0"	Steel Epoxy Lined
HMR 50	50 GPM	9'0" x 9'0" x 17'6"	Steel Epoxy Lined
HMR 70	70 GPM	11'0" x 9'0" x 18'0"	Steel Epoxy Lined
HMR 100	100 GPM	11'0" x 9'0" x 25'0"	Steel Epoxy Lined
HMR 150	150 GPM	11'0" x 9'0" x 30'0"	Steel Epoxy Lined

Contact WTS Factory for sizing and construction details for larger units.

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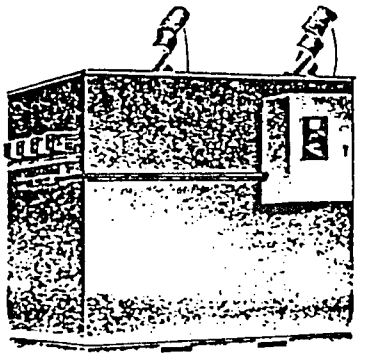
pH Neutralization System (NS)



Features

- Continuous Flow
- Compact Design (saves space)
- Automatic Proportional Control
- Final pH Recording
- Field Proven Design
- Process Guarantee

General

The NS is a compact, factory-assembled unit designed for automatic pH neutralization. This continuous flow-through system offers proportional control of the neutralizing chemicals, and is fully automated through the utilization of our PLC-based control package.

Warranty

All system components are warranted for one year after receipt of the equipment. WTS also guarantees that the process will meet EPA and local receiver pretreatment limits that are in effect at the time of order. (See full warranty and guarantee statement)

Sizing/Construction

Single Chamber Model Number	Capacity	Material	Appox. Size
NS5-1	5gpm	Polyethylene	2'D x 4'H
NS10-1	10gpm	Polyethylene	3'D x 4'H
NS15-1	15gpm	Polyethylene	4'D x 4'H
NS20-1	20gpm	Polyethylene	4.5'D x 4'H
NS30-1	30gpm	Polyethylene	5'D x 5'H
NS50-1	50gpm	Polyethylene	4'D x 9'H
NS70-1	70gpm	Polyethylene	5'D x 8'H
NS100-1	100gpm	Polyethylene	5'D x 11'H

Dual Chamber Model Number	Capacity	Material	Appox. Size
NS5-2	5gpm	Polypropylene	2.5' x 4.5' x 3'H
NS10-2	10gpm	Polypropylene	3.5' x 4.5' x 3.5'H
NS15-2	15gpm	Polypropylene	3.5' x 6.5' x 3.5'H
NS20-2	20gpm	Polypropylene	4.5' x 6.5' x 3.5'H
NS30-2	30gpm	Polypropylene	4.5' x 6.5' x 4.5'H
NS50-2	50gpm	Polypropylene	4.5' x 8.5' x 5.5'H
NS70-2	70gpm	Polypropylene	4.5' x 10.5' x 6.5'H

Three Chamber Model Number	Capacity	Material	Appox. Size
NS5-3	5gpm	Polypropylene	2.5' x 5.5' x 3'H
NS10-3	10gpm	Polypropylene	3.5' x 6.5' x 3.5'H
NS15-3	15gpm	Polypropylene	4.5' x 6.5' x 3.5'H
NS20-3	20gpm	Polypropylene	4.5' x 6.5' x 4.5'H
NS30-3	30gpm	Polypropylene	4.5' x 8.5' x 4.5'H
NS50-3	50gpm	Polypropylene	4.5' x 10.5' x 6.5'H
NS70-3	70gpm	Polypropylene	4.5' x 10.5' x 8.5'H

* Contact WTS Factory or Local Representative for sizing and construction for larger systems.

Service

WTS offers the following services with each order:

Engineering Support
- Site Layout Drawing
- System P & ID
- Operations Manual

On-Site Support
- Final Interconnects
- Start-up and Testing
- Operator Training

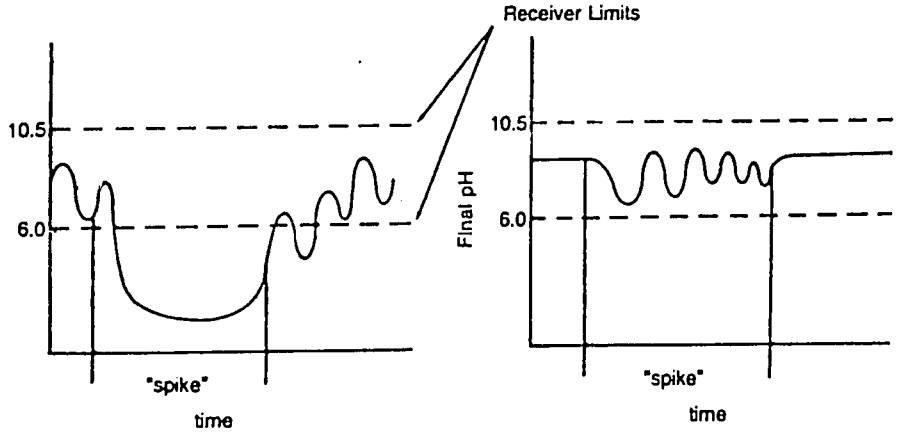
On-going Support
WTS Offer continuous service and maintenance contracts. This is part of our assurance that your unit will preform effectively over its useful life.

Log/Linear pH Control System

FIGURE 1

A) pH control obtained using conventional neutralization system.

B) pH control obtained using the WTS LOG/LINEAR pH CONTROLLER.



Many conventional pH neutralization systems fail to meet local receiver discharge limits due to occasional acid and/or caustic spikes. WTS has developed the LOG/LINEAR pH Control System specifically to maintain satisfactory pH levels at all times. This includes periodic acid/caustic dumps which many conventional systems are incapable of handling. (See Figure 1) The LOG/LINEAR Controller is standard equipment on all WTS Neutralization Systems and is offered as a retrofit package for existing systems. The compact design and economical cost make the LOG/LINEAR Controller an ideal upgrade for existing systems that have trouble meeting receiver pH limits.

The LOG/LINEAR Controller provides logarithmic proportional control over chemical addition for pH neutralization. The Controller takes a 4 to 20 MA signal from a conventional pH transmitter and processes through an analog input of the system's Programmable Logic Controller (PLC). The PLC utilizes WTS-developed control algorithms and makes proportional chemical additions based upon the pH signal being received. The PLC also identifies and alarms high and low pH conditions in each reaction chamber and for the final effluent. The Controller is equipped with a final pH recorder and individual panel meters for pH indication in each adjustment reactor. The Controller also contains all necessary components needed to provide manual and automatic control over the treatment process.

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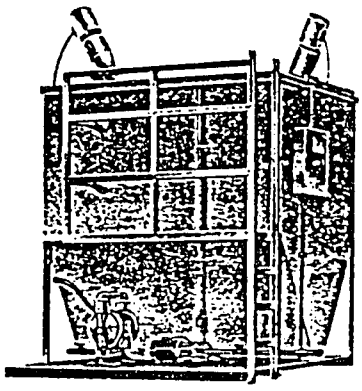
Batch Master



Features

- Compact Design
- Versatile
- PLC Controlled
- Easy to Operate
- Economical

General

Eliminates the rising cost and liability of hauling wet process wastewater with the WTS BATCH MASTER. The BATCH MASTER offers users with low daily volumes of process wastewater, an effective solution to this problem. The BATCH MASTER, equipped with state-of-the-art process controls, efficiently treats several different types of contaminated process water on an "as needed" basis. It is an ideal alternative for users unable to justify a large, continuous flow system.

Description

The BATCH MASTER is a skid mounted, factory assembled batch treatment system consisting of:

- Process treatment chamber(s)
- Chemical feed equipment
- Programmable process controller
- Optional components (based upon individual customer requirements)
  - Filter press
  - Transfer pump(s)
  - Polishing filter — Filtration equipment
  - Storage tank
  - Lift station(s)

The process treatment chamber(s) and skid are combined into a compact, rugged design. All the system components are ready for operation when the unit is delivered. The BATCH MASTER and all system peripherals are operated by a single programmable controller. This centralized approach provides an extremely reliable system that is easy to operate.

Application

The BATCH MASTER is an automatic batch treatment system that can be configured to treat waste effluents such as:

- Hydrofluoric Acid
- Heavy Metals
- Cyanide
- Acids
- Caustics
- Arsenic
- Iron
- Suspended Solids

The WTS BATCH MASTER system finds its greatest application with users generating less than 40,000 gallons of process wastewater per month. The system can also be applied when process wastewater is too concentrated for effective treatment on a continuous flow basis. The BATCH MASTER offers an economical alternative to hauling liquid wastes.

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Incentives For Waste Minimization In The Metal Finishing Industry

by Patrick Burt, President,
Acteron Corporation.
Chairman, Waste
Minimization
Committee, N.A.M.F.

Waste minimization is a unique direction among environmental control measures. Over the past ten years environmental regulations have caused the metal finishing industry to become the most heavily regulated small business classification in the United States. Virtually all of these regulations have reduced the profitability and the viability of these small businesses which are so vital to American manufacturing. The costs and difficulty of meeting these regulations has resulted in the closure of 25% of the plating firms in the United States over the past ten years. However, waste minimization can significantly reduce the costs of environmental controls while being the most environmentally sound approach to manufacturing.

Incentives for waste minimization can be characterized in three primary categories:

- *Economic Benefits*
- *Regulatory Conformance*
- *Environmental Achievement*

Economic Benefits

The cost of waste handling and waste disposal is already a major operating expense for metal finishing operations. These costs continue to escalate each year. Reducing the amount of waste generated reduces operating costs in several ways and can actually improve the profitability of metal finishers. Waste minimization options which a company rejected previously may now be economically viable. In many cases there is a rapid return on investment. If all of the direct and indirect benefits of waste minimization are identified and considered, the economic benefits of waste minimization can be substantial. With increasing regulatory costs and decreasing landfill capacity the costs associated with hazardous waste disposal increase at a far greater rate than other business expenses. Companies which don't act now to minimize waste generation will be seriously impacted by rapidly escalating costs and find themselves at a competitive disadvantage. Eventually they may be overwhelmed by the regulatory burdens associated with waste treatment and disposal.

NAMF has identified a "Triad of Waste Minimization" which includes *source reduction, on site recycling* and *off site recycling* as three necessary and complementary methods of achieving waste minimization for our industry.

Many waste minimization alternatives are very inexpensive low technology *source reduction* options which provide immediate cost savings. For example, spray rinsing and full dripping over tanks to recapture and re-use process solutions are among the least costly and most advantageous waste minimization options available.

Many of these incentives are indirect and therefore frequently overlooked or under appreciated. However, these simple source reduction methods can be utilized to varying degrees in virtually all facilities and they are relatively inexpensive to implement.

Once the waste volume has been significantly reduced by using simple source reduction options, then the more costly advanced technology *on site recycling* approaches can be implemented with reduced equipment and operating costs due to the reduced volume of waste to be recycled.

Regulatory Conformance

Conformance to stringent environmental regulations has become the foremost concern of metal finishing firms. Waste Minimization can ease the difficulty of meeting many of these mandates. In addition, federal, state and local regulations are requiring that businesses which generate hazardous waste must reduce the amount and/or toxicity of their wastes. These new waste minimization regulations will not allow manufacturers to complacently accept the higher costs of waste handling and disposal. The 1984 Resource Conservation Recovery Act renewal first addressed this issue on the federal level. Every hazardous waste manifest contains a statement which the generator must sign certifying that the generator has a waste minimization program in place and that progress reviews of the program are done periodically.

Many state and local governments have adopted or will adopt comprehensive waste minimization mandates. California and Massachusetts are among the states which have already enacted far reaching laws which require source reduction and process substitution changes.

Some Regional Water Quality Control Boards are requiring that Public Owned Treatment Works (POTW's) reduce their mass discharge volumes. To achieve this, many POTW's will continue to reduce the allowable contamination levels or water volume from industrial dischargers. Source reduction and recycling technologies are emerging as the most effective means of meeting these more stringent discharge standards.

Environmental Achievement

A strong waste minimization program is the most effective way for a manufacturer to minimize the environmental detriments of metal finishing, while continuing to provide the frequently under-appreciated environmental benefits of metal finishing. These benefits include product corrosion prevention and wear resistance which prevent the product itself from becoming a waste. By minimizing waste beyond the statutory requirements, the company improves its good standing in its community and its standing with the agencies responsible for administering environmental regulations.

Through waste minimization metal finishers can continue to provide vital societal and environmental benefits while minimizing the detriments which were historically associated with these processes.

Barriers To Waste Minimization And Their Cures

Having recognized the many values and incentives of waste minimization there remain certain technical or regulatory impediments to waste minimization which need to be addressed.

Process Baths Conducive to Solution Recapture

As was noted, effective recapture of chemical process solutions for re-use is probably the most cost effective and environmentally preferred method of waste minimization. However, in practice the liquid volume being returned to the process solution must be no greater than the evaporative loss occurring in the process tank.

Over the last twenty years proprietary chemical manufacturers have responded to customer and government requests for energy conservation by providing new process solutions which operate at low or ambient temperatures. However, these low temperature solutions minimize solution recapture opportunities because of their reduced evaporation. Consequently, there is now a need for process solution manufacturers to provide two sets of operating parameters, one option at warm temperatures for waste minimization and the other at lower temperatures for energy conservation. In addition to their evaporation advantage, warmer solu-

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tions rinse more freely and can operate at lower chemical concentrations thereby further reducing drag out waste. The energy consumption detriments of warmer solutions may be mitigated by use of environmentally sound heating methods such as process heat re-use and solar heating. Metal finishers need to notify chemical manufacturers of their desire for low waste generating process solutions.

Solution Purification

As drag out wastes are reduced, an increasing proportion of metal finishing wastes come from concentrated process solutions which are gradually contaminated through normal use. The generation of these waste solutions can actually be accelerated due to solution recapture by preventing traditional drag out of contaminants which occurs with the normal drag out of process solutions. Consequently, the importance of solution purification has become increasingly critical to achieving waste minimization. Unfortunately, purification tends to be process and contaminant specific so that no single simple method can meet this requirement.

Technical research in the metal finishing field needs to place extensive focus on solution purification technologies. In addition, existing knowledge on methods of solution purification needs to be compiled and provided to all industry members by pollution prevention agencies as well as technical and trade associations.

Shortage of Educational Materials

Recently there has been a surge in waste minimization research and education. This information needs to become widely available to even the smallest and least sophisticated firms in the metal finishing trade. Audit manuals, educational films, training courses and technical papers are all needed and valuable waste minimization tools.

Legislative Cures

Many impediments to waste minimization currently exist within the U.S. regulatory framework. These impediments include the difficulties that off-site recycling firms have in obtaining and maintaining treatment permits. In addition, there lacks a consistent regulatory framework which identifies recycling as inherently preferable to treatment and disposal and which adequately assists and promotes recycling. Some prospective state and federal regulations would actually cause in-house recycling to be more burdensome than waste treatment.

Waste Minimization = Increased Profits
Economic Benefits of Water Minimization
Dripping and Spraying Over Tanks

EFFECT		*COST BENEFIT*
QUALITY CONTROL		
1) Greater Solution Stability	=	Improved Quality Control
2) Less Frequent Solution Analysis	=	Lower Quality Control Labor
3) Less Chemical Usage	=	Lower Chemical Cost and Less Labor for Chemical Additions
4) Less Chemical Storage due to Fewer Additions Needed	=	Lower Inventory and Less Storage Area
5) Cleaner Rinses	=	Better Product Quality
REDUCED COSTS OF WASTE TREATMENT		
6) Less Water Usage	=	Lower Water Bills
7) Less Sewer Water Discharge	=	Lower Sewer Bills
8) Less Waste Treatment Chemical Usage	=	Lower Material Usage and Less Chemical Storage
9) Better Wastewater Treatment Quality	=	Due to Longer Settling Time
10) Less Sludge Generation	=	Less Wastewater Treatment Labor
11) Less Sludge Cake Generation	=	Lower Cost for Disposal, Drums, & Hauling, Documentation & Liability
IMPROVED CONFORMANCE TO ENVIRONMENTAL REGULATIONS		
12) Sewer Water Volume Reduction	=	Potential Reduction of Limits on Specific Heavy Metals (based on under 10,000 gallons per day)
13) Comply with Effluent Standards & Waste Minimization Regulations	=	Achieve Good Company Standing in your community & stay in business
14) Less Waste Volume	=	Reduced Waste Fees, Taxes & Permits. Better Quality of Conformance to Waste Storage & Documentation

Provided by: NAMF Waste Minimization Committee 10/90

Tax credit incentives for waste minimization or recycling equipment would provide the financial assistance which would allow many firms to switch from their existing investment in waste treatment equipment toward new waste minimization technologies. These financial incentives could be either state or federal. However, the best chances for enactment of tax incentives exists on the state level.

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Introduction

The purpose of this paper is to provide an update on what we've accomplished and have planned in our plating operation at Lawrence Livermore National Laboratory (LLNL) in the area of waste minimization. Our efforts have included issues other than waste minimization and, therefore, fall under the wider umbrella entitled pollution prevention or environmentally conscious electroplating. Previous efforts on this activity can be found in references 1 and 2. Approximately one year has passed since our last report on pollution prevention and since this topic remains a high-effort activity much more has been accomplished.

Our efforts to date fall under the first two generation categories of waste reduction. Good housekeeping practices, inventory control, and minor changes in operating practices (first generation) resulted in an impressive amount of waste reduction. In the second generation of waste reduction, current technology, separation technologies, and material substitutions were used to reduce emission and wastes. The third generation of improvements requires significant technological advances in process synthesis and engineering. We are presently starting some projects in this third generation phase and these will be discussed at the end of this paper.

Initiatives Already Completed

A variety of initiatives have been previously completed and are described in detail in earlier reports (1,2). Therefore, only a brief review of these will be presented here.

- Elimination of cadmium plating- Zinc-nickel deposits are a suitable substitute for our applications. Salt fog tests (500 hours) have revealed heavy red rust on 2.5 um thick cadmium plated steel panels while no rust appeared on zinc-nickel plated panels.

- Segregating cyanide solutions- By locating all solutions containing cyanide in a separate room we avoid having to categorize all wastes from the facility as cyanide containing and this noticeably minimizes disposal costs. For example, disposal costs for our wastes containing cyanides are approximately $12/gallon compared to $4/gallon for non-cyanide containing wastes.

- Substitution for copper cyanide plating- We've replaced copper cyanide plating with a copper pyrophosphate process. The substitution has been in operation for over two years and works quite well. Ring shear adhesion tests for a variety of aluminum alloys (3), 1018 steel and cast iron have revealed results as good as those obtained with the copper cyanide process (Table 1).

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- Elimination of hexavalent chromium plating- New Bay Area Air Quality Managment District regulations on emissions from hexavalent chromium went into effect in January 1989. We estimated that it was going to cost about $25,000 to demonstrate that we were in compliance with these regulations and that costs would continue to mount in future years just to provide the analytical results to show continued compliance. After analyzing our customer base for chromium plating and discovering how small it was we eliminated chromium plating from our facility.

- Elimination of vapor degreasing- Vapor degreasing was replaced with a variety of aqueous cleaning processes including soak and electrolytic cleaning, ultrasonic cleaning and also with a water pressure cleaning system that recycles the water so waste is kept to a minimum. We've experienced no difficulty in cleaning parts since the degreaser was removed from our facility and this was confirmed by a recent literature review of quantitative results from a variety of researchers who reported that aqueous systems provide equal, if not better cleaning, than vapor degreasing (4).

- Changing rinsing practices-A variety of changes in rinsing practices have been made. These include: performing the first rinse over the plating tank, converting continuous flow rinses into spray stations, and utilizing hand held, trigger operated spray rinse nozzles. As a result of these changes in rinsing practices we are saving over 3 million gallons of water per year.

- Recycling of rinse water- A commercial system which utilizes cold vaporization (distillation in a vacuum, references 5 and 6) allows for the recycling of rinse water from all tanks within the main area of the shop excluding the cyanide line. Therefore, we no longer send any water to the sewer system. At this point after 1-1/2 years of operation we have recycled 80,000 gallons of water through the system and created only 500 gallons of waste. Because of our accomplishments with our revised rinsing practices and water recycling, the, City of Livermore nominated us for an award from the California Water Pollution Control Association. On April 23 1993, LLNL's plating facility received a Certificate of Merit for Outstanding Achievement in recognition of continuing efforts in the wastewater field.

  The recycled water from this system is purer in metallic ion content than the water we receive from the City of Livermore as shown in Table 2 for analyses performed in January 1992 and January 1993. However, with time, anion content of the recycled water increases as shown in Table 3. Our next step is the installation of an ion exchange unit to remove these anions before the water is returned to the shop

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- Cleaning of aluminum parts- Substitution of a commercially available ferric sulfate material for a two step process that included an acid desmutt in a nitric/hydrofluoric acid solution and an immersion 30% nitric acid allowed us to reduce the desmutting operation to just one tank while improving the quality of the process. The hazards associated with working with the concentrated acids were eliminated, an insoluble aluminum fluoride film formed with the acid process is no longer an issue, and the new solution lasts much longer.

- Rejuvenating gold plating solutions- Acid gold-cyanide solutions can be rejuvenated by the addition of small amounts of lead (0.02 g/l) which restore the current density range over which fine-grained, acceptable deposits can be obtained (7-9) This lead addition does not affect the mechanical properties and allows us to double the plating current density while providing smoother deposits than were previously obtained.

- Combining the technologies of electroplating and physical vapor deposition. This is an on-going activity that offers a number of potential advantages that are reviewed in references 10-14. A key benefit is a reduction in the amount of hazardous waste that is created. For example, the combined processes can be used to coat non-metallics and obviate the need for an electroless copper line (14). A second example is the coating of substrates that are difficult-to-coat with adherent deposits. With this approach, metals such as molybdenum, tungsten and titanium can be coated with adherent deposits without having to resort to use of concentrated acid pickling, etching and/or high temperature heating to provide acceptable adhesion. References 12 and 13 provide details for molybdenum and tungsten.

- Miscellaneous-Other initiatives that have been completed include: reducing the temperature of solutions during off-hours, product return, precious metal recovery and reducing the volume of silver cyanide solutions.

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Replacement of cyanide bearing conversion coatings

As mentioned early in this paper, we took special care to segregate cyanide containing solutions from other processes in the facility. However, although we saw levels of cyanide drop significantly in rinse water, the levels did not reach zero. We looked at all of our traditional non-cyanide processes and found that the chromate conversion coating solution used for aluminum parts contained small amounts of cyanide as potassium ferricyanide. By checking with a number of vendors we found a replacement for this process that contained no cyanide. Since the changeover we have noticed that castings require a slightly different pre-treatment and most parts require a slightly longer immersion time. Other than this, the process is producing parts of the same quality and appearance as before.

Recycling of acids

We recently purchased a commercial unit which utilizes diffusion dialysis technology for recycling of acids. Spent solutions of nitric, sulfuric, and hydrochloric have been recycled using this system and efficiency of recovery has been about 80%. as shown in Table III. Cost of this unit was less than $10,000 keeping in the range we consider affordable for most small plating installations.

Energy conservation project

The electroplating facility uses large amounts of electrical power for process solution heating, space heating, and exhaust ventilation. By reducing thermostat settings and air flow during off-shift hours, electrical savings on the order of 1.6 million kwh as well as natural gas savings of 30K therms are projected as savings. We are now in the construction phase of this project which we estimate will save approximately $100,00 per year.

Ion exchange

An ion exchange unit has been obtained from another group at LLNL and this will be installed on the water recycle unit. This will even further purify the water from the recycle unit so that this water can be used for activities other than just rinse stations.

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Summary

The plating shop at LLNL is a nonproduction-oriented metal finishing facility that places heavy emphasis on utilizing environmentally conscious manufacturing principles. Key focus items have included; minimizing hazardous wastes, minimization of rinse water usage, material and process substitutions and recycling technology. With all these changes we are saving over $500,000 per year, have a safer, cleaner facility, and have not reduced quality of parts processed through the operation.

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Environmentally Conscious Electroplating at LLNL

Chris Steffani
Jack Dini

Lawrence Livermore National Laboratory
Livermore, CA 94550

December 9, 1993

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We Are Using All Three Generation Categories of Waste Reduction

1- Good housekeeping practices, inventory control, and minor changes in operating practices

2- Current technology and material substitutions

3- Significant technological advances in process synthesis and engineering

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We Are Saving Over $500,000/Year and 3 Million Gallons of Water/Year

- Substitution of zinc-nickel for cadmium plating
- Segregating cyanide solutions
- Elimination of hexavalent chromium plating
- Elimination of vapor degreasing
- Changing rinsing practices
- New pickle for aluminum parts
- Recycling of rinse water

Solvent vapor degreasing has been an integral part of electroplating operations

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- It has been around for many years.
- It is nearly universally applicable to organic soils on metal substrates.
- The cleaning speed is quite fast.

- IT PERFORMS THREE IMPORTANT FUNCTIONS, CLEANING, RINSING AND DRYING.

Use of ultrasonics in aqueous cleaners has proven to be quite effective

- Pratt & Whitney has been able to remove all but two perchloroethylene degreasers, remove over 50% of the total degreasers used in 1988 and reduce toxic air emissions by 50%.

- Martin Marietta (Y-12) has used ultrasonic cleaning with aqueous detergent in place of vapor degreasing since 1985.

- Western Electric, Kansas City uses a mixture of aliphatic esters with the aid of ultrasonics for removing machining oils encountered in producing circuit board backplane pins.

- APS Materials in Dayton uses a terpene based cleaner with ultrasonics instead of TCA for cleaning metal parts prior to plasma coating.

Rinse Water Recycling Has Been Quite Effective

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- We've recycled about 80,000 gallons of rinse water and returned all but 200 gallons back to the processing lines.
- The recycled water is purer than the water we receive from the city of Livermore.
- We no longer discharge any water to the sewer system.

Recent Generation 1 and 2 Activities

- Substituting oxalic acid for sulfuric acid for hard anodizing of Al
- Extending the life of electroless nickel solutions
- Recycling of acid solutions
- Use of ion exchange on the recycled water
- Energy conservation project

Metal Finishing Energy Conservation Project

- The metal finishing facility used large amounts of electrical power for process solution heating, space heating, and exhaust ventilation.

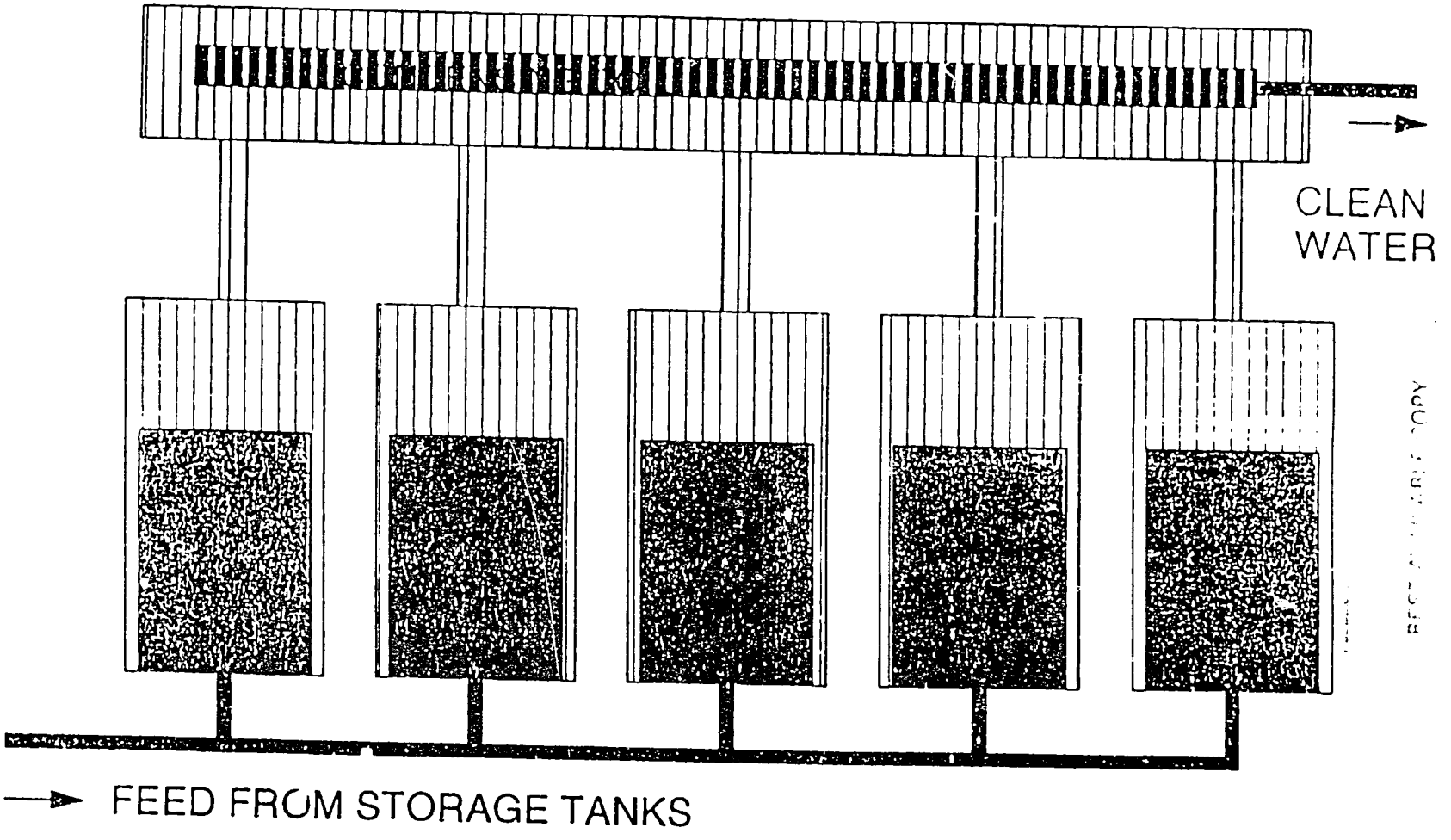
- By reducing thermostat settings and air flow during off-shift hours, electrical savings on the order of 1.6 million kwh can be achieved, as well as natural gas savings of 30,000 therms.

- Savings that will result from this are over $100,000 per year.

PROCESSING METHODS

- Rinse water distillation
- Acid recycling
- Electrowinning
- Electroless nickel recycling

RINSE WATER DISTILLATION



CPS:

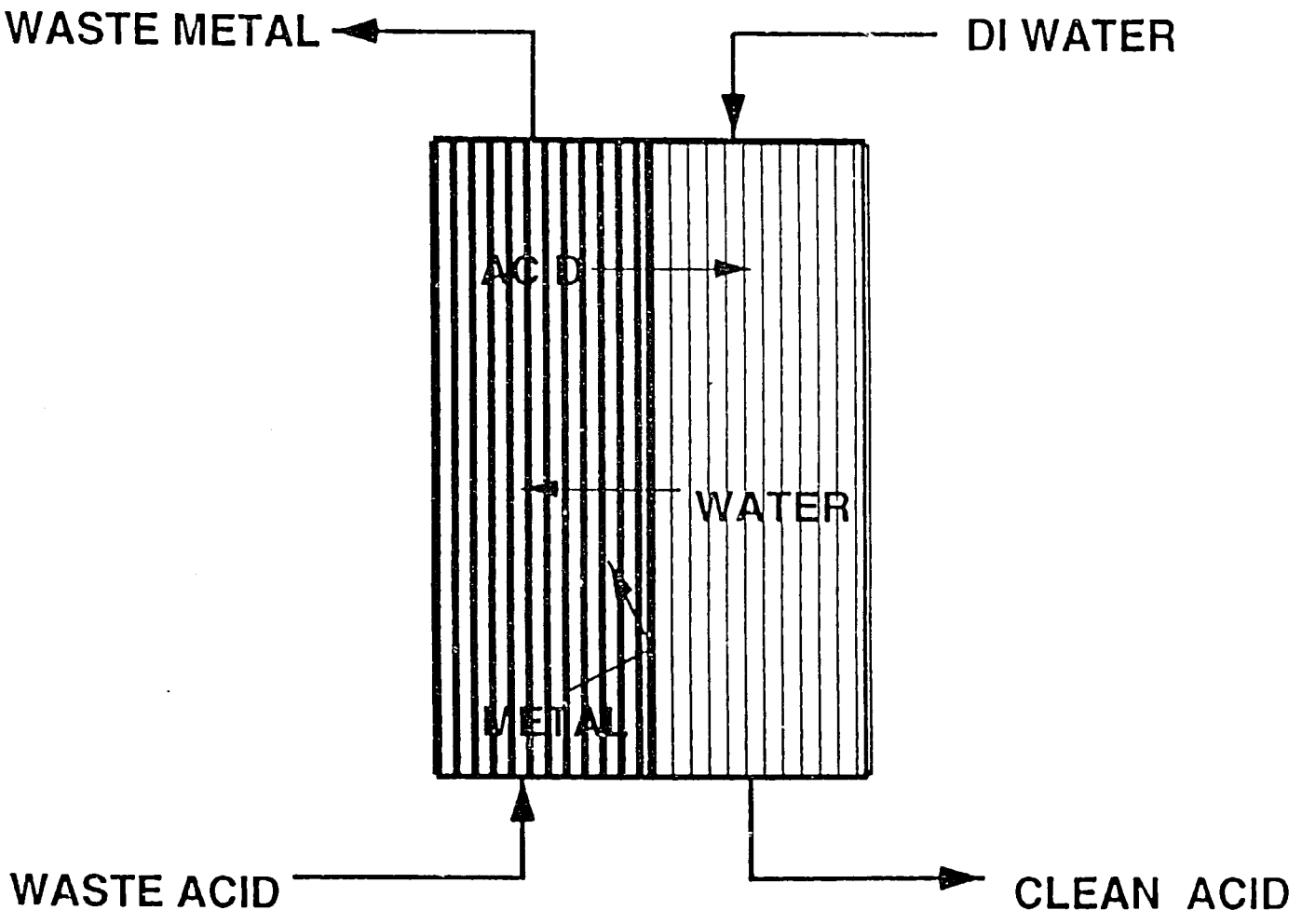
DISTILLATION RESULTS

Typical feed rate = 25 gallons /hr
@ 30 PPM average metal content, pH 2 - 9.5

Typical water return rate = 25 gallons /hr
@ <1 PPM average metal content, pH 6.5 - 7.5
Typical concentrate @ 9000 PPM

Cost per gallon recovered = $.03

ACID DIALYSIS EQUIPMENT



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ACID DIALYSIS RESULTS

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Test 1

(start)	(finish)
4.9 Normal Nitric Acid	3.9 Normal Nitric Acid (79.5%)
60 gm/l copper metal	7.2 gm/l copper metal (88%)

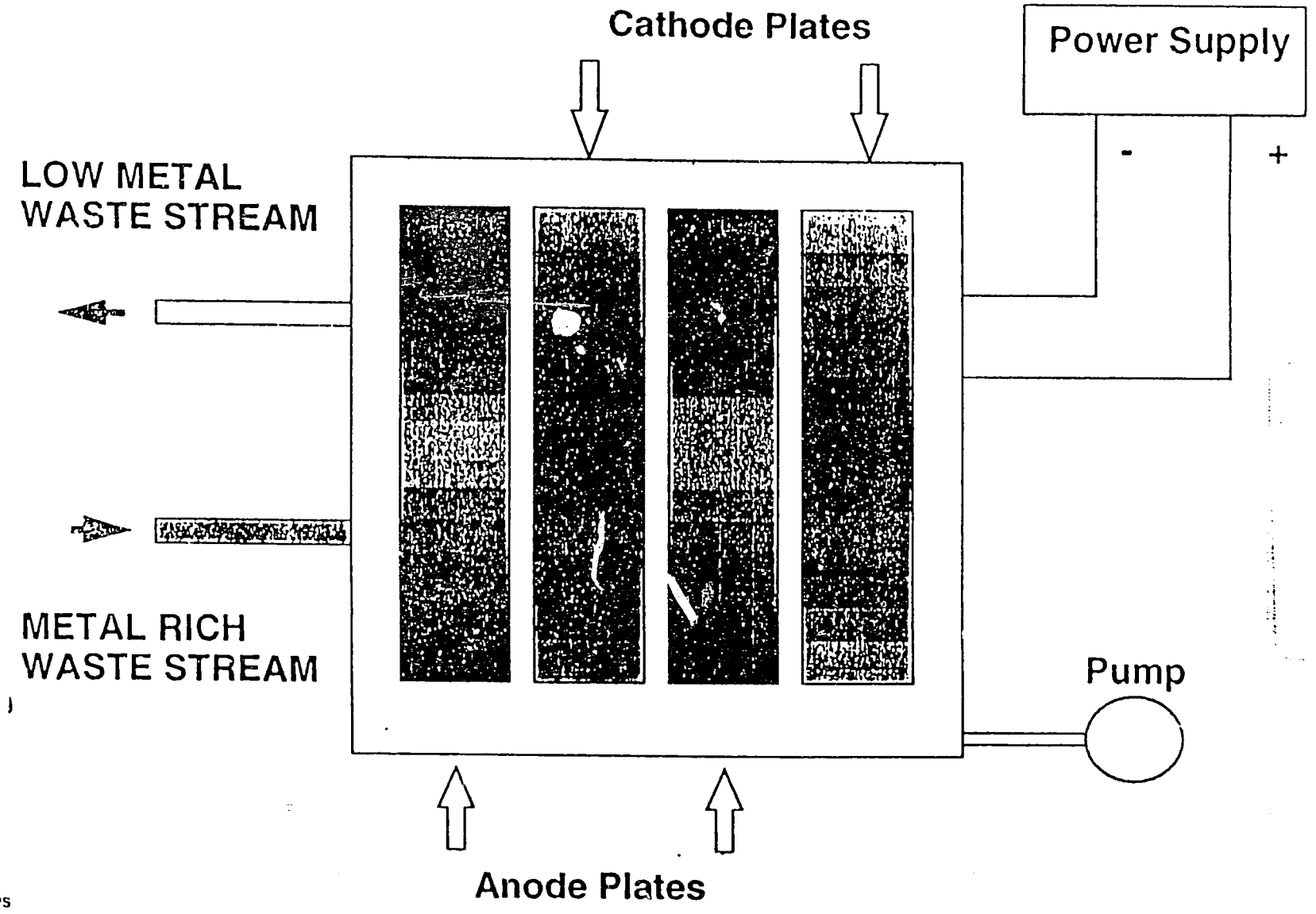
Test 2

(start)	(finish)
9.4 Normal Muriatic Acid	7.1 Normal Muriatic Acid (75.5%)
10 gm/l copper metal	1.1 gm/l copper metal (89%)
14 gm/l iron metal	3.1 gm/l iron metal (77.8%)

ELECTROWINNING

- Electrolytic recovery cell
- Multiple cathode areas
- Separation and recovery of common streams
- Low cost, low maintenance

ELECTROWINNING EQUIPMENT



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ELECTROWINNING RESULTS

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	BEFORE	AFTER
TEST 1	Copper metal = 310 gm/l Sulfuric acid = 40 gm/l	Copper metal = 12 gm/l Sulfuric acid = 44 gm/l
TEST 2	Copper metal = 100 gm/l Nickel metal = 200 gm/l Zinc metal = 20 gm/l	Copper metal = 15 gm/l Nickel metal = 9.5 gm/l Zinc metal = 2.5 gm/l

ELECTROLESS NICKEL RECYCLING

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- Reduce chemical purchases
- Reduce waste disposal
- Provide more consistent product
- > 100 metal turnovers

Appendices E :

Curriculum Vitae

CURRICULUM VITAE

Name:	Suryanurdian Syafei
Address:	
Age:	
Place of Birth:	
Nationality:	Indonesia
Martial Status:	Single
Language:	English (fair in spoken and written)

Work Experience:

1992 - Present	PT Padi Komponen, Bekasi Electronic Component Manufacturer Assistant to the Head of Laboratory
1990 - 1992	PT Sukma Beta Sempurna, Bekasi Electronic Manufacturer, producing printed circuit board Process Engineer In addition to the R&D job, responsibilities included controlling chemical condition in plating area, etching and some materials. Also responsible for evaluating the process and doing the trouble shooting during the process
1989 - 1990	PT Rudy Soetadi, Bekasi Cosmetic Manufacturer Lab/Research & Development Staff Responsible for checking raw material visually, chemically and microbiologically

Education:

1985- 1989	Academy of Analytical Chemistry Graduated and awarded Diploma Degree

CURRICULUM VITAE

Name:	Jaya Agung Prastowo
Address:	
Date of Birth:	
Place of Birth:	
Nationality:	Indonesian
Marital Status:	Single
Health:	Good
Skills:	Waste water treatment of dyeing and electroplating Metal surface finishing; polishing, electroplating and coating

Work Experience:

4/91 - Present	Joined YKK Indonesia Zipper Co., Ltd.: Electroplating Department: Polishing, processing, and waste water treatment

Education:

1984 - 1990	Chemical Engineering, Gadjah Mada University Jogyakarta
1981 - 1984	Senior High School: SMA de Britto, Jogyakarta
1978 - 1981	Junior High School: SMPN Purwodadi, Purworajo
1972 - 1978	Elementary School: SDN Purwodadi Purworejo

Training:

10/93	Workshop; Waste Minimization in the Metal Finishing Industry, World Environment Center (WEC), Jakarta
4/93	Short training: Waste water treatment technology, Yayasan Mulia Dharma, Bogor
8/92 - 10/92	On the job training: "Metal surface finishing", YKK Kurobe-shi, Toyama-ken, Japan

CURRICULUM VITAE

Name:	Ir. Dadang Sudrajat
Place/Date of Birth:	
Sex:	Male
Religion:	Islam
Address:	Perur. Rsab Harapan Kita Blok A1
	Jalan Teratai No. 27
	Karawaoi - Tangerang

Work Experience:

1990 - Present	P.T. Superex Raya
	Head of Quality Control

Education:

1989	Metallurgical Engineer, Sekolah Tinggi Teknologi Industri Bandung (STTIB)
1982 - 1983	Sr. High School Sekolah Mendngah Atas (SMA) PGRI I Majalengka
1979 - 1980	Yr. High School Sekolah Mendngah Pertama (SMP) Kadipaten Majalengka
1976	Elementary School Sekolah Dasar (SD) Cideres II Majalengka

CURRICULUM VITAE

Name:	B. Situngkir
Date of Birth:	
Mailing Address:	Jl. Gatot Subroto Kav. 52-53, Jakarta
Home Address:	
Nationality:	Indonesia
Sex/Marital Status:	Male/Married

Work Experience:

July 4, 1984 - Present	The Chief of the Section of the Industrial Relation and Pollution Control, Directorat of the Electrical Equipment and Metal Industry. Electrical Equipment and Metal Industry, Department of Industry

Training/Seminar:

October 4, 1993	The Ozone Layer Protection and ODS phase out Jakarta State Ministry for the Environment of the Republic of Indonesia and Japan Environmental Agency - Japan Environmental Sanitation Center (JEA - JESC)
August 24-27, 1993	Sectoral workshop for preparation of Indonesia Country Programme for the ODS phase out under the Montreal Protocol, Jakarta State Ministry for the Environment and United Nations Development Programme (UNDP)
April 21 - May 2, 1992	Basic Course of the Environment Analysis University of Indonesia and Indonesia Environmental Impact Management Agency (BAPEDAL)

Education:

1980	University of North Sumatera Medan

CURRICULUM VITAE

Name:	Harry Hamdani
Address:	
Date of Birth:	
Place of Birth:	
Sex:	Male
Nationality:	Indonesian
Marital Status:	Single
Health:	Good

Work Experience:

November 1992 - present	Staff for: Hazardous Waste Management Directorate, The Environmental Impact Management Agency (BAPEDAL) Responsible for: Development of Waste Minimization and Waste Exchange Programs in Indonesia

Training:

1993	Use Photogrammetry and Integration Methods into GIS Madras, India (4 weeks)
1993	Environmental Impact Assessment (AMDAL), UI Jakarta (2 weeks)
1992	Hazardous Waste Management, Bandung (2 weeks)

Education:

1984 - 1992	Bandung Institute of Technology, Biology Department, Bandung
1981 - 1984	SMA Negeri Majalengka, Majalengka
1977 - 1981	SMP Negeri Kadipaten, Kadipaten
1972 - 1977	SD Negeri IV Kadipaten
Hobby:	Table Tennis, Jogging
Reference:	Robert E. Byers, EMB/ BAPEDAL

CURRICULUM VITAE

Name:	Ir. Widya Wicaksana
Place/Date of birth:	
Address:	

Education:

1990	Institute Technology Bandung (ITB) Dept. of Engineering Physics
Institution:	Development Project for Small Scale Metal Industry "Probengkel" Mandiri Foundation, Bandung

Training:

November, 1992	Small Business Consultancy Training, Manila
1992	Staff at Rural Electricity Microhidro Project, Mandiri Foundation GTZ, Bandung
August 1991	Short course on Manufacturing Productivity, PII & PMS-ITB,
January - October 1990	Research on Combustibility of Heat Insulating material, Center of Housing Research/Development, Dept. of Public Works, Bandung
1990	Development Consultant for Metal Industry Probengkel, Mandiri Foundation-Swisscontact, Bandung
July - August, 1988	Work Training at Fertilizer Industry PT. Pupuk Iskandar Muda (Maintenance) Lhokseumawe

WORLD ENVIRONMENT CENTER

INDUSTRIAL WASTE MINIMIZATION PROJECT
INDONESIAN METAL FINISHING

UNITED STATES STUDY TOUR REPORT

SURYANURDIAN SYAFE'I

JANUARY, 1994

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EXECUTIVE SUMMARY

The World Environment Center in coorporation with United States Agency for international Development has launced waste minimization technique for metal finishing industry in Indonesia. The present two weeks study tour to the metal finisning facilities in United States.

The waste minimization assessment focused on the identification of no/low cost practices and techniques that can reduce the discharge of pollutants an improve worker health and safety. Upon return to Indonesia the study tour participation will conduct a second waste minimization work shop to share our experiences gained in the United States.

The Study Tour was conducted at :

1. Surface Metal Inc
2. Electrolizing
3. Waste Water Treatment System
4. Read Rite
5. Acteron Coorporation
6. Schlage Lock
7. Santa Clara Plating
8. United Air Lines
9. New United Motors
10. San Jose/Santa Clara Water Pollution Control Plant.

Some major finding during this study tour are as follows :

A. *Waste minimization technologies which have been put in practice are :*

- Instalation of double and triple rinses couter flow rinses
- Use of spray rinses over select process and rinse tanks
- Adoption of conductivity sensors to regulate water condition and flow.
- Membran filter system
- Recycling water system

B. *Healt and Safety Equipment*

- Safety glasses
- Gogles
- Respirators
- Shower
- Face shield
- Protective gogles
- Eye Wash station
- Boots

C. The World Environment Center contributes to sustainable development worldwide by strengthening industrial and urban environmental, health and safety policy and practices.

D. Lawrence Livermore National Laboratory benefited much research for metal finishing.

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WORLD ENVIRONMENT CENTER

INDUSTRIAL WASTE MINIMIZATION ASSESSMENT PROGRRAM INDONESIA METAL FINISHING INDUSTRY

UNITED STATES STUDY TOUR REPORT

Suryanudian Syafe'i

PT. PADI Komponen

I. INTRODUCTION

The World Environment Center, through a coorperative agreement with the United States - Asia Environmental Partnership and the United States Agency for International Development (USAID) in Indonesia, is supporting sustainable development by strengthening industrial and urban environmental, health and safety management policy and practices in Indonesia.
W E C is demonstrating, through coorporation of U.S. technical experts, the environmental and economic benefits resulting from no/low cost waste minimization techniques in the metal finishing industry.

Waste minimization assessment have been conducted at eight Indonesian metal finishing facilities over the past two years.
The waste minimization assessment focused on the identification of no/low cost practices and techniques that can reduces the discharge of pollutans and improve worker healt and safety.

Upon completion of the assessment atechnical waste minimization workshop was held in Jakarta for approximately 40 industry, goverment and non-goverment manager and design engineers. The workshop summarized assessment observation, presented Indonesia waste minimization success stories, and provided the exchange of waste minimization experience form Indonesia industries to other Indonesian industries.

W E C is currently coordinating a U.S. study tour for six Indonesian representatives (two from goverment and four from industry) during December 6 - 18, 1993. The objective of the U.S. study tour is to provide the participants with an intensive overview of technologies and management practices implement in the U.S. which enchance waste minimization and improve worker health and safety. Upon return to Indonesia the study tour participants will conduct a second minimization [illegible] States.

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II. DETAILED DESCRIPTION OF THE STUDY TOUR

Date : December 5 - 18, 1993

Tour Coordinator : Charles Jong Hwa Hong - Deputy Project Manager, WEC.

Participants :

1. Ir. B. Situngkir : Ministry of Industry Directorate General of Multivari ous industry.
2. Ir. Dadang S : P.T. Superex Raya
3. Ir. Harry Hamdani : Environmental Impact Management Agency (BAPEDAL)
4. Ir. Jaya Agung P : P.T. YKK Indonesia Zipper Co, Ltd Notion Division.
5. Suryanur Syafe'i : P.T. Patolipu Dinamika Komponen
6. Ir. Widya W : P.T. Brobengkel.

The sponsor ship reference is attached in appendix 1.

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CORPORATION AND AGENCY VISITED

NO	DATE	CORPORATION AGENCY
01.	December 06, 1993	*Metal Surface Inc* 6060 shull ST PO Box 2160 Bell Gardens, California 90201-0521 Phone (714) 521-4112 Fax (213) 773-4055
02.	December 07, 1993	*Electrolizing Inc* 1947 Hooper Avenue Los Angeles, California 90011 Phone : (213) 749-7876
03.	December 10, 1993	*Waste Water Treatment System* 1233 Elko Drive Sunny Valve California 94089 Phone : (408) 541-8600 Fax : (408) 541-8615
05.	December 13, 1993	*Acteron corporation* 851 Shasta Street Redwood City CA 94063 Phone : (415) 369-5217
06.	December 14, 1993	*Schlage Lock* San fransisco C A L I F O R N I A
07.	December 14, 1993	*Santa Clara Plating* 1173 Grant Street Santa Clara California 95050 - 3984
08.	December 15, 1994	*United Airlines* Bldg 49 SFOFL San Francisco Int'l Airport San Francisco, CA 94128-3800 Phone : (415) 634-4576 Fax : (415) 634-4551
09.	December 15, 1993	*New United Motors* 45500 Fremont Boulevard Fremont, CA 94538 USA Phone : (510) 498-[illegible]797 Fax : (510) 770-4150
10.	December 16, 1993	*Santa Clara Water Pollution* 700 Los Esteros Road San Jose, CA 95134

The Agenda of the visit Could be found in Appendix 2.

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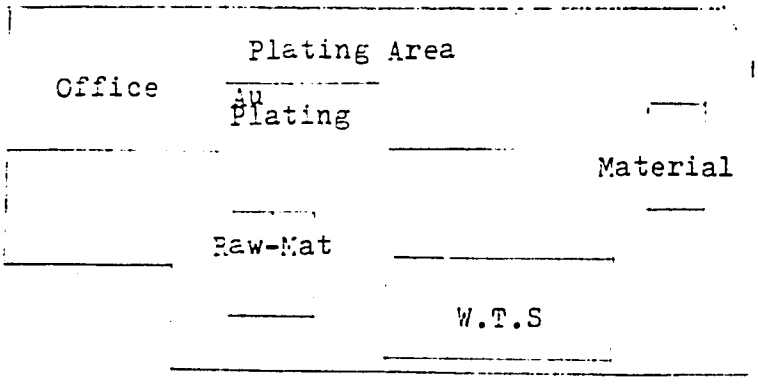
III. FINDING

III. 1. *METAL SUSFACE INC*

1.1 Location



A c r e a g e	:	0.5 - 0.7 Ha
Building Area	:	0.3 - 0.5 Ha
W T S Area	:	100 - 500 M2
Address	:	6060 Shull Street, Bell Gardens, California 90201.

1.2 Site description

Metal Surface Incorporated was founded in 1954

* Product :
  - Electroless Nickel and plated beryllium
  - Alumunium Connector Shells
  - Mi/Cd Diffused Turbine Blades for Air Craft
  - Silver Plated Gear
  - Precision Plated Plastic for industry

  Etc

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1.3 Person Visited and Title

a. San Bell
President

b. Bruce F. Nielsen
Plant Engineers

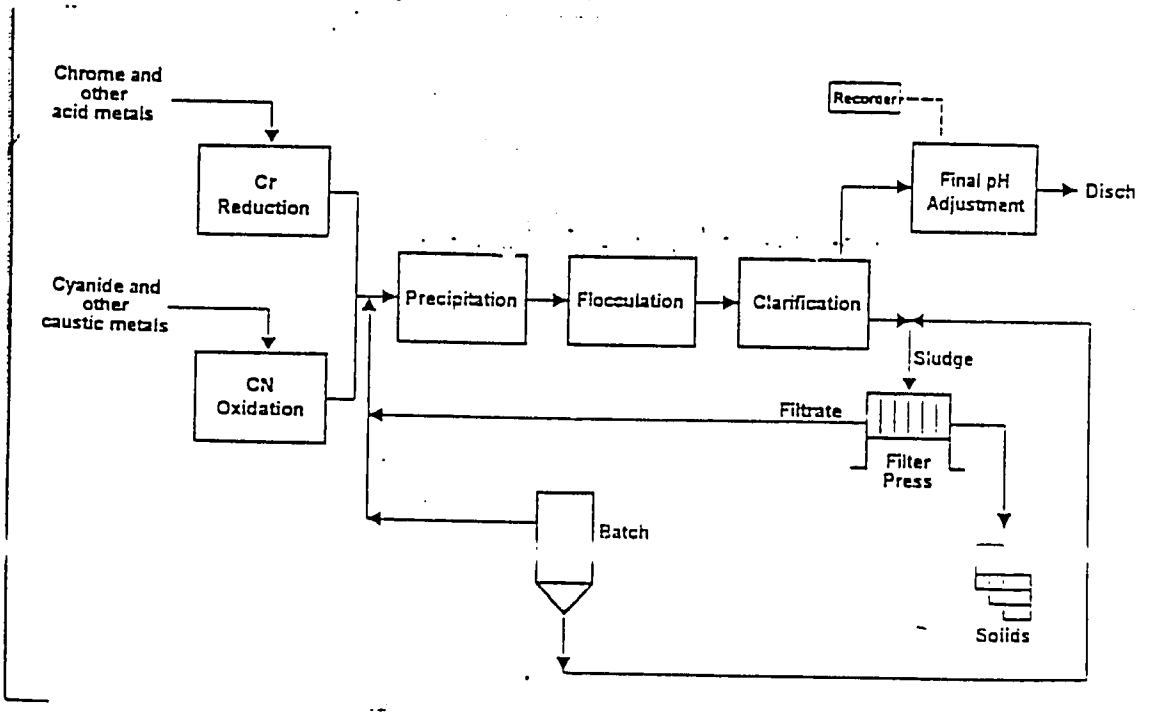
1.4 Meeting attendance/note summary.
The meeting took place on Dec 6th 1993 at 3.00 until 4.30 pm

a. Kinds of plating which were done are :
24 K Gold
23 K Gold
Electroless Gold
Electroless Nickel
Copper plating
Sn plating
Sn / Pb plating]

Chemical material that mixed with cyanide is for the kind of Electrolisis Gold and Copper plating.

b. The Waste is produced in the form of :
- Ni
- Cu
- Sn
- Pb
- Cyanide

The waste is processed by processing system like :



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That system has been applied since 1987.

The above mentioned waste in solid form is dried in room temperature condition, and then taken into a plastic bag, after that we do recycle once more in other place (Landfill) so the waste become not dangerous.
The Waste which is processed by the relevant factory must pay $ 153/ton, but cost operation of W T S is 7 - 10% of cost production.

The limitation which still permited is:

Mi :	4.1	ppm	Cr :	7.0	ppm
Cu :	4.5	ppm	Pb :	0.6	ppm

To decrease the waste exite to WWT so minimization technic that is done are :

- Ion Exchange

  This technic is binding technic of element which contains cation and anion in water. To bind anion and cation in this process we use a resin, some times will be saturated. To reactive this resin by doing regeneration process using is acid and alkalin.
  The product of this process is for binding anion and cation to total value of disolve solid will be lower.

- E l e c t r o w i n n i n g

  This technic is pulling metal element in the water with using electricity. The purpose of this process is to lower the value T.D.S.

- E v a p o r a t o r

  The one of evaporatored technic is with using vacuum system, in this case undesire the material will evaporate, usually in form of water which the residu will be come more consentrate and can usage again.

- House keeping

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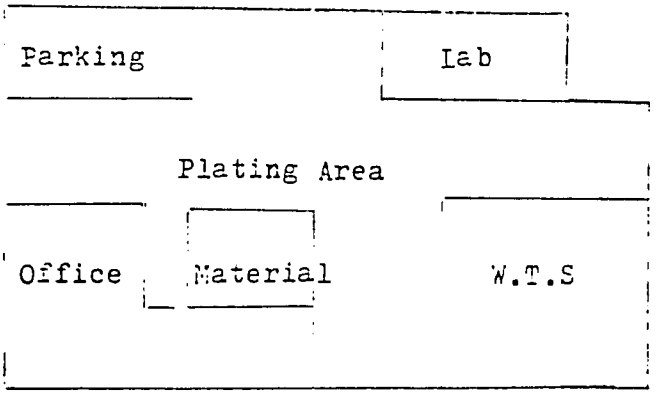
- Racking
- Drip shield
- Drip time
- Material handling

2. *ELECTROLIZING*

2.1 Location



Acreage	:	1.500 - 2.000 M2
Building	:	1.300 - 1.700 M2
WTS area	:	50 - 75 M2
Address	:	1947 Hooper Avenue Los Angeles, California - 90011.

2.2 Site description

- Established 1944.
- Product :
  - Magnetic Actractor
  - Ball stud 17 - 4 ph
  - Rod end beasing balls
  - Magnetic head assy
  - Helicopter piston rodend
  - Shalf, powder turbine
  - Cores
  - Guide rails 82" - 92"
- Electrolizing special hard chrom

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2.3 Persons Visited and title

a. Susan B Grant
General Manager

b. Jack Morgan
Plant Manager

2.4 Meeting attendance/note summary

On Dec 7th, 1993 at 1.00 - 1.40 pm.
The meeting took place in the room but not special, only explanation about electrolizing process, especially hard chrom plating and waste water treatment process in the field. This is a short time meeting.
Factory condition is rather small with 30 - 40 employees.

In plating process the solution is in heat condition and toavoid the stem of chemical material to employee which is doing his job so the tank during the processing is in close condition, but the stem which out during the process will through a condensator process so it will be melt again and can be used any more.

One of the unic at this factory is to heat chemical material usually by using liquid pressure gas in each tank.

In the process of WWT chrom waste which is out from the process will be reduced before from Hexavalent to trivalent by using sodium meta bisulfit then chrom trivalent will be precipitated by coustic soda at PH 9 - 10. Then the sediment is mixed with polimer so that causes coagulation reaction

$$Cr + NaH\ SO3 + H2\ SO4 \text{ ---> } Cr^{3+} + NaH\ SO4 + H2O$$

$$Cr^{3+} + Na\ OH \text{ ---> } Cr\ (OH)3\downarrow + Na2\ SO4.$$

After that, sediment and solution are separated by filter press, then the sludge is dried at room temperature and put into the plastic bag and become ready for sending to landfill with cost $ 1.200/ton.

Minimization technic that is used are

- Electrowining
- Spray rinse and
- Condensator

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The house keeping in this factory was impressed not good because there is technical material is falled on the floor mixed with water besides there is much solution in the spill way.

The interesting one is although this is a small factory but it has good waste facility.

3. *LAWRENCE LIVERMORE NATIONAL LABORATORY (LLNL) PRESEN TATION.*

Presentation was serve by :

a. Chriss Steffani
b. Jack W. Dini
   Section Leader
   Material Fabrication Division

Place : Sheraton Fisherrmans
Wharf,Hotel San Francisco
2500 Mason Street
San Francisco, California 94133

Date : December, 9 1993

Time : 10.00 - 11.30 am

Materi: Environmentally Concius
Electroplating att LLNL

The details can be seen Appendix 3

4. *READ RITE*

4.1 Plant Site : Cannot detected (bigger)

Addres : 3065 N Sunny Side Fresno
California 93727

4.2 <u>Site description</u>

- Start New Waste Water Treatment on September 11, 1993
- Manufacture : Disk Computer
- Membran Filter System at WTS

4.3 <u>Person Visited and Title</u>

Operations / field services (EPOC)

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b. Jim Elliott
Marketing Manager
Process Scientific Inc

4.4 Meeting attendance/note summary

Date December 13th 1993, at 11.00 - 12.30 am in this meeting visiting was done at the place of WTS process WTS was done in WTS area. WTS facility in this place was very good because of controlling by computer system.
The using of this facility was started on September 11th, 1993. So it is a new equipment. In this place the waste that is treated in the form of copper metal and nickel, come from Cv and Ni plating.

The treatment process of Cu and Ni at the first step is precipitation way in alkalin condition.
The remnant Cv and Ni which have not had precipitated yet, is very little and existence is super supernatant solution. It will be filtesed by a filter membrance in the system bellow :

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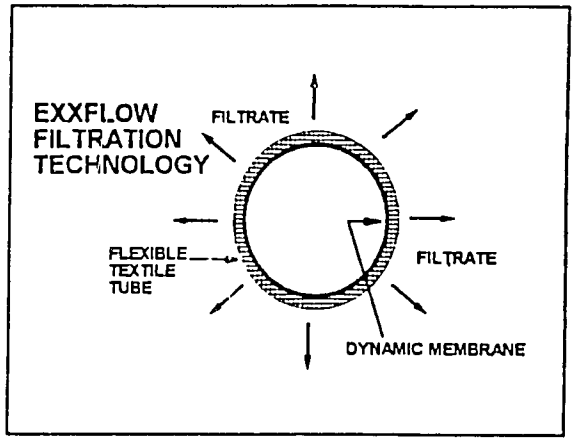
EXXFLOW™: CROSSFLOW MICROFILTRATION

The *EXXFLOW* crossflow microfiltration process occurs in an array of permeable textile tubes. Manifolds are cast onto each end of the cloth filter to form modules which are connected to a pump for liquid inlet and to a back pressure valve at outlet. Upon introducing liquid flow into the tubes and regulating outlet pressure, suspended and colloidal matter in the liquid to be treated forms a thin film cake layer on the internal surface of each tube. This layer is called a "dynamic membrane" for its membrane-like characteristics. Other terms used are "filter layer" and "pre-coat layer". Should the quantity of suspended matter in the feed liquid be insufficient to form a filter layer, a small amount of filter aid compound is added to the initial feed. Filter layers or membranes of widely different characteristics can be produced by using different treatment chemicals.

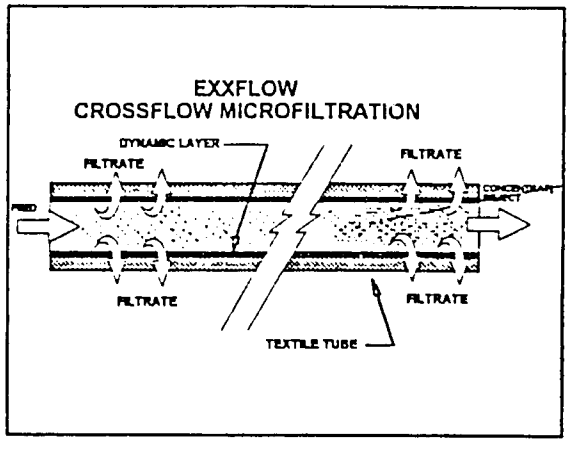


To become treated product liquid, or **permeate**, the feed water filters radially through the membrane layer and out of the textile tube walls for collection at the base of each filter module. The debris removed from the liquid becomes concentrated and is swept out of the tubes with the remaining liquid which is called **reject concentrate.**

It is from the longitudinal or "crossflow" passage of the feed liquid along the filter cloth tubes that the process derives its name.

EXXFLOW crossflow microfiltration plants are of modular construction employing a number of manifolded filter modules. Modules are connected together either in parallel or in series with each other.

Ease of cleaning is an important feature of *EXXFLOW* crossflow microfiltration, distinguishing it from standard membrane microfiltration. In most cases, cleaning is simply a matter of momentarily stopping the feed resulting in tube collapse which causes the thin cake or membrane material to be dislodged and flushed out with the reject flow. In other applications, chemical cleaning in place is used.



process scientific, inc.

960 SARATOGA AVENUE • SUITE 213 • SAN JOSE • CALIFORNIA 95129 • 408/241-1533 • FAX 408/241-2118

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The *EXXFLOW* core technology is based upon the highly specialized woven textile tubular array and its post weaving treatment as well as on the formation and maintenance of dynamic layers, or membranes, and cleaning techniques.

A uniformly high quality permeate is achieved with the EXXFLOW crossflow microfiltration process. Removal of virtually all suspended solids down to about 0.1 micron has been demonstrated in countless laboratory and field trials. Other experimental work indicates that *EXXFLOW* can be developed to produce a low pressure process to reject high molecular weight dissolved solids.

The process has many advantages over conventional treatment process:

Most liquids are treatable without the addition of filter aid chemicals

Specialized membranes can be formed to produce the desired quality of treated liquid by using standard chemistry.

EXXFLOW is a low pressure process (20 - 35 psi) with a low crossflow velocity (3 - 6 fps)

The single stage treatment produces a treated liquid having no suspended solids greater than approximately 0.10 micron.

Cleaning of the filter cloth is easily accomplished

Water recovery is very high: Usually greater than 97%

Coagulation, settlement, clarification and filtration occur in the same process - usually without the need expensive of polymers or coagulant additives

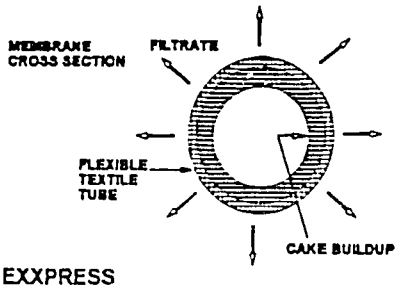
Liquids of wide pH range, from strongly acidic to strongly alkaline, can be processed at temperatures up to 90°C

Extensive civil works and structures are not required

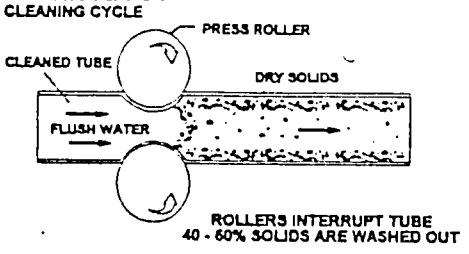
Operation is simple either manually or in the automatic mode

EXXPRESS™ AUTOMATIC TUBULAR FILTER PRESS

Wastewaters, or dilute slurries containing concentrations of 2 to 20% solids or more can be dewatered if pumped into filter modules operating with all tubes in parallel in the dead end mode. This mode is achieved by closing the outlet valves at the reject end of the module. The slurry forms a cake layer on the internal walls of the tubes. Its associated water permeates through the cake layer and escapes as filtrate on the outside of the tubes. The dewatering cycle is complete when the cake layer reaches a controlled thickness. The solids discharge cycle then commences by opening the outlet valves and traversing the module with rollers. The venturi formed by the rollers creates a high velocity with the incoming water and flushes the solids down the tubes and onto a dewatering screen.



EXXPRESS SLUDGE DEWATERING TECHNOLOGY



Compared to conventional dewatering devices, including centrifuges, plate and frame filter presses, vacuum and belt presses, the *(EXXPRESS)* has the following advantages:

Lower installed capital cost

Use of the same filter cloth as *EXXFLOW*

No chemical additions are required

Low operating pressures are used resulting in lower cost of operation

EXXPRESS is self cleaning and automatic

Sludge from water treatment processes and industrial sludges including toxic and hazardous materials

EXXPRESS produces superior quality filtrate

NOTE: "EXXFLOW AND "EXXPRESS" ARE LICENSED TRADE NAMES OF EPOC WATER, INC.

This system is a new technology which has it is suitable for work processing of disk computer which demands very good quality of water.
The data that can be given are contains of Cv and Ni before using membrance filter is 14 ppm and after using membrance filter is 0.05 ppm.
The final product of waste processing is water and used again in processing or for washing the floor and other equipments.
The cost of this facility is *q* $ 800.000 or Rp. 1.6 milyar.
It is necessary to known that taking picture is not allowed in this factory.

5. *W.T.S Inc*

5.1 Location

Adress : 1235 Elko Drive
Sunny Vale, California 94089

5.2 Site description

WTS was founded in April in April 1985
Manufacture : WWT equipment

5.3 Person Visited and Title

a. Glen C Neus Tedter
President.

b. John B. Standberg
Sr. Chemical Engineer.

5.4 Meeting attendance/note summary company.

COMPANY PROFILE INTRODUCTION

Waste water Treatment System Inc., (WTS) was founded in April 1985. With more than fifteen years of experience in the industrial wastewater treatment industry, the founders brought together considerable knowledge and technical capabilities in the chemical, mechanical, instrumentation and process design fields of industrial wastewater treatment. This knowledge and these capabilitties, combined with years of proven achievement in providing succesfull wastewater treatment system installation, have made WTS an industry leader.

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WTS was founded with the objective of providing high quality equipment combined with unsurpassed profesional engineering service and support. This objective was to be filfilled through the development of standard, package equipment used for treatment of a wide variety of industrial waste effluents. In addition, these product and installation would be supported by the farmation of a diversified staff of engineers and field support personel. These individuals are the key to maintaining a high quality product furnished with the required support and service to ensure succesful instalation of WTS product.

WTS PRODUCTS

PACKAGED SYSTEM :

WTS offers the finest in packaged industrial waste-water treatment system. These system designs are primarily based upon proven, conventional treatment technologies enchanced by specialized process engineering and state-of-the-art automation. The package units are installed as stand-alone systems, or easily incorporated into more complex, specially engineered systems. Typical treatment application for the packaged plants are :

- Heavy Metals Removal
- Flouride Removal
- pH Neutralization
- VOC Removal
- Cyanide Destruction
- BOD/COD Reduction
- Oil/Grease Reduction
- Arsenic Removal
- Waste evaporution
- Water Recycle
- Aqueous Cleaning Effluent Treatment & Recycle
- Semi Aqueous Effluent Treatment & Recycle

The packaged system can treat waste streams containing concentrated and dilute levels of contamination. Standard system are based upon continuous flow and batch treatment processed. The systems are offered with all peripheral devices necessary to provide a complete, functional wastewater treatment system.

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ENGINEERED SYSTEM :

WTS provides detailed design, and manufacture of specialized equipment for custom engineered wastewater treatment projects. This capability, together with our standard packaged systems, allows WTS to provide high quality equipment to meet the many diversified needs of industrial wastewater treatment. Treatment equipment for non-standard, engineered applications includes systems such as the following :

- Ammonia Treatment
- Phenol Treatment
- Tanker Truck Wash Effluent Treatment
- Sodium Azide Tretment
- Landfill Leachate Treatment
- Laundry Effluent Treatment/ recycle
- Vecicle Cleaning Effluent Treatment
- Zero Discharge
- Existing System Rebuilds/Upgrades
- TDS Controls

These non-standard, engineered system typically incorporate the same state-of-the-art automation included with WTS packaged products. These systems are also offered with all peripheral devices and WTS service necessary to provide a complete functional wastewater treatment system.

The kinds of product are appendix 4.

6. *ACTERON CORPORATION*

6.1 Location

Acreage	:	+ 2.000 - 3.000 m2
Buliding	:	+ 2.000 - 3.000 m2
W T S	:	+ (50 - 75) m2
Address	:	851 Shasta Street Red Wood City California 94063

6.2 Site description

[illegible] International Leaders in coating technology, has developed Opti Gold a unique process for the deposition of Gold

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plating with enhanced reflectivity, pority, hardness an uniformity resulting in exceptional performance and longevity.

Market Served :

Electronic, Semiconductor, Microwave, Optics, Laser, Medical Aerospace, disk Drive, Defense, Commercial.

Exact plating to specification :

- Soft Gold
- Hard Gold
- Hard Anodize
- Rhodium
- Electroless Ni
- Sulfamat Ni

6.4 Meeting attendance/note summary

In this place an interisting thing to study is the minimization technic in form of chemical material or water using.
Before this technic was applied, using of wate is 10.000 gal/day, and after this technic was applied water using reduce until 1.500 gal/day or reduce 85%, and this is a very good performance.

MINIMIZATION INITIATIVES

To illustrate the results of an aggressive waste minimization program, consider this. Just seven years ago, Acteron moved from Belmont after acquiring and expanding a four-man shop in Redwood City. Despite a company that now has approximately 12 times the personnel and sales of that four-man operation, Acteron actually consumes *less than one third the water and has nearly 90 percent less heavy metals in its effluents.* Here are some of the initiatives that have contributed to these impressive figures :

- Instalation of double and triple counter flow rinses.

- Adoption of conductivity sensors to regula te water condition and flow.

- Segregation of rinsewaters.

- Substitution of less polluting processes (e.g., acid copper to replace cyanide copper, and periodic reverse current cleaning to replace cyanide containing cleaners).

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- Elimination of vapor degreasing by using the system of dual soak cleaners with ultrasonic enchancement.

- Use of more dilute formulations such as those for acid pickling.

- Thorough indoctrination and training of employees to stress how they can make a positive contribution to the environment. For example, all personnel are taught the importance of extending drip-times over rinse tanks.

7. *SCHLAGE LOCK*

7.1 Location.

Address : San Francisco - California.

7.2 Site description

This factory makes door fixture which has a very good quality. The raw material of door fixture is steel which is plated by zinc and brass.
Plating technic which is used is automatic Barrel Plating.

7.3 Person Visited

7.4 Meeting attendance/not summary date Dec 14th, 1993, on 11.00 - 11.40 am. The purpose of this visiting is to watch the minimization of plating Barrel and WTS process.
The waste that is treated are waste of Zn and brass (Cu + Zn) which comes from plating of Zn and Brass and it doesn't contain cyanide (Alkalin non cyanide).
The sludge product after filter press was dried especially with liquid pressure gas.
Dried sludge was taken into a special place and ready to be sent to landfill.

The interesting thing in this factory is first at plating process of chemical material, which is used before is contain cyanide but now has been changed with non-cyanide, solution. The [illegible] and the treatment process does not use special

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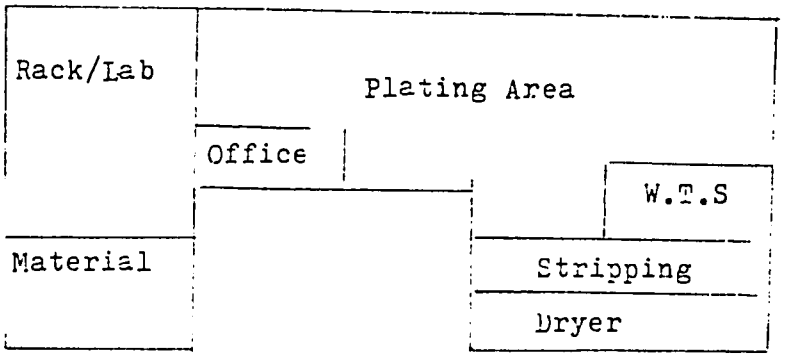
process for separating cyanide.

The second interesting thing is the sludge that is produced to speed up drying especially doing by Liquid Pressure Gas.
The healthand safety condition in this factory are quite well.

8. *Santa Clara Plating*

8.1 Location:



Acreage : (0.4 - 0.6) Ha

Building : (0.3 - 0.5) Ha

W T S : (50 - 75) m2

Address : 1773 Grant Street, Santa Clara
California 95050 3984

8.2 Site description :

Product : Part Computer

Plating :
- Copper
- Nickel
- Aodizing

8.3 Person visited

Thomas L. Coss
President

8.4 Meeting attendance/note summary.

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Date : December 14th, 1993 on 02.00 - 03.30 pm on this meeting, the interesting thing to be studied are the problems of health, safety and minimization techniq.

The facilities of health and safety in form of:

- Safety Glasses
- Goggles
- Respirators
- B o o t s
- Face shields
- Protective gloves

All the things above have been used by the employees when they worked, beside that, they also have :
- S h o w e r
- Eye wash stations
- Fire Exting fishers

And were completed by a good ventilation/ exhaut, so will reduce the influence of chemical material to employees.

The condition of house keeping is very good, it can be seen from environmental condition of working which is very clean and supported by a cart that is used to move on goods that is having done in wet condition to other place especially the goods which will be on stripping. For standard material especially chemical material were arrange on a multi storied rack neatly.

The minimization technic that is applied in form of :
- Spray rinse
- Drip time
- House keeping
- Counterflow rinsing

But on waste processing the waste which is treated are Cu and Ni. The product of solid waste which is gotten is inform of sludge must be dried in a oven before take into a plastic bag and ready to be sent to landfill.

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9. *United Airlines*

9.1 Location

Address : Bldg 49 SFOFL
Sanfrancisco Int'l Airport
Sanfrancisco
California, CA 94128 - 3800.

9.2 Site description

Maintenance Operations Center

In 1948, united Airlines opened its Sab Francisco maintenance base. The Maintenance Operation Center (MOC) is a technological pacesetter in the airline industry. It is one of the largest facilities of its kind, supporting United's maintenance mission throughout the world.
The major responsibility of the MOC is the repair, overhoul and modification of airplanes, engines and component parts. The largest concentration of United's employees work at the MOC.
Located on 144-acres at the San Francisco International Airpor, the sprawling complex includes over three million square feet of floor space.

9.3 Person visited

Steven F. Sulgit
Facilities Ang Eng.

9.4 Meeting attendance/note summary

Date : Dec 15th, 1993 at 11.00 -12.30 am.
This visiting was guided to see the location of reactive rinsing on plating process and WWT systems are reactive rinsing was applied to rinsing process for cyanide and chrom. Reactive rinsing is rinsing solution which have been added a chemical material which will react with the chemical material that is brought on the process before.
For example rinsing cyanide used active substance NaOCL so will cause a reaction between cyanide and NaOCL with the reaction bellow :

$$CNO + NaOCL + H2O \longrightarrow CO2 + N2 + NaCL + OH$$

The product of the reaction above with chance of CL2 and OH will be gotten a sedimentation on the WWT tank, that sedimentation was separated

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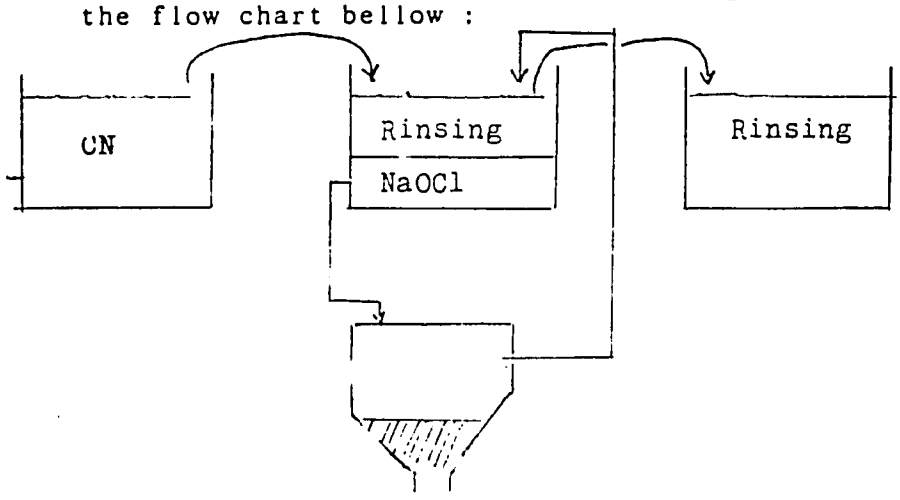
and the supernatan solution can use again ,like the flow chart bellow :

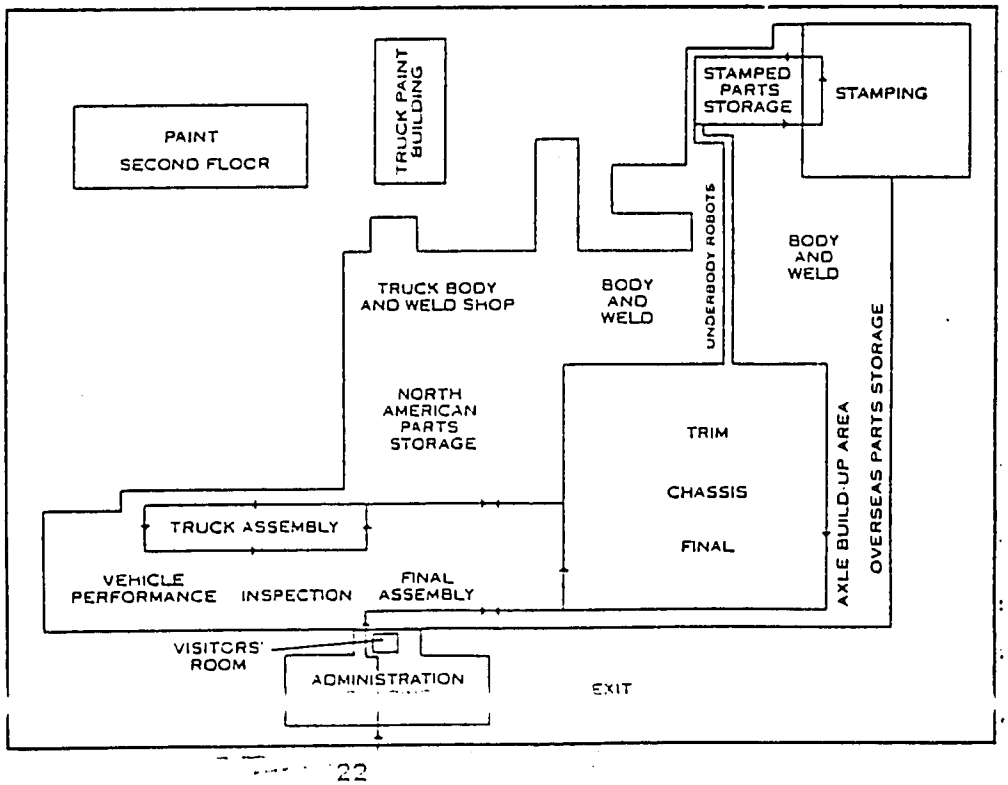


With this methode, the WWT tank can be reduced. But reactive rinsing for chrom uses chemical S2 Os . And the flow process is the same as above for details it is applied on waste treatment on flow chart at appendix 5.

. *New United Motor Manufacturing Inc*

10.1 Location

Plan site



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Address : 45500 Fremont Boulevard
Fremont, California 94538
U.S.A

10.2 Site description

New United Motor Manufacturing Inc (NUMMI) established 1983 and it is the joint venture formed by General Motors Corporation and Toyota Motor Corporation.
Located in fremont, California, the company has incorporated Toyota's production concepts and management philosophies and established the goal of building the highest quality vehicles possible at the most competitive price.
New United Motor Manufacturing Inc produced it first car, a Chevrolet Nova in December 1984. The company is currently producing Geo Prizms for the Chevrolet Motor Division of General Motors and Toyota Corrola sedans and Hilux Pick up trucks for Toyota.

10.3 Person visited

Thomas W. Sinclair
Environmental Engineer

10.4 Meeting attendance

Building Quality Vehicles ...

Over 1.000 vehicles are in the production process at NUMMI's 3.7 million-square-foot plant at one time. Their vehicles remain in the system for about 18 hours as they travel through the body and weld, Paint, and Assembly areas.

Stamping

The Car and truck building process begins in the Stamping plant. The 180.000 square foot Stamping facility, the largest on the West Coast, includes 26 presses, ranging from 400 to 2,300 tons. Each day, over 542,000 pounds of steel are used to produce over 60 separate auto parts, including roofs, fenders and doors, as well as 11 parts for truck cabs.
NUMMI uses two sided galvanized steel to make our vehicles more corrosion and rust resistant.

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Body and Weld

Both the car and truck body and weld shops are responsible for welding and bolting together the car and truck panels which form car shell and truck cabs. Over 96 percent of the 3,800 weld each car body receives and over 98 percent of the 1,488 welds each truck cab receives are performed automatically by welding robots and automatic welding machines. NUMMI utilizes over 300 robots for jobs that are tedious or hazardous to team members.

Paints

Both the car shells and truck cabs are cleaned, given a rust inhibiting undercoat of "elpo," and primed. Sealers are also applied to the seams and joints of the body shells to make them water and sound proof. Then, each car and truck is painted and baked in a 300 degree oven for 28 minutes before being transferred to the Assembly shop.
NUMMI's truck beds are assembled and painted at a company called TABC Inc. In ling Beach and trucked to NUMMI daily.

Assembly/Inspection

In the Assembly operation, cars wind their way along 1.3 miles of conveyors, and trucks along roughly a half mile of confeyor. During the car assembly process, over 3,400 separate components and parts are installed in each car, and over 2,100 in each truck. In the final phase of Assembly, numerous inspections are performed on both vehicles to ensure their.

11. *SANTA CLARA WATER POLLUTION CONTROL*

11.1 Location

Address : 700 Los Esteros Road San Jose California 95134.

11.2 Site description

Plant (City Sewer Control Agency).

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- This company will process the exile water/ dirty water to be the drink water.

11.3 Person visited

Alex Exster P.E, Phd
Sanitary Engineer

11.4 Meeting attendance/note summary

Date Dec 16th, 1993 at 02.00 - 03.00 pm
The purpose of this visiting is to see the processing of exile water/dirty water to be drink water.
The substance, that can be treated here is orgnic substance like waste, smell substances (amonia) etc. So that on this process there is the secunder treatment with biological process.
Water capacity that is produced is 160 million gallon/day. In principal, the flow process of water treatment will be explained bellow :

Waste cleaning
↓
Precipitation process
↓
Aeration process
↓
Biological process
↓
Sand Filter
↓
Chloronization
↓
Drink water

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12. *DISCUSSION ON A CHEMICAL*

Solution by Jim Mille

Place : Chemical Solution, Inc
400 Main Street, suite 203
Pleasanton, CA 94566.

Date : December 16, 1993

Time : 10.00 - 12.00 am

12.1 Meeting attendance/note summary

In this discussion Mr. Jimmile put recover on the visiting to the factory before with meeting materials :

a. Reactive rinsing
b. Counter flow rinsing
c. Spray rinsing
d. Drag out rinsing
e. Airemission criteria

In the begining he explained about regulation. The E.P.A started in California at 1974 California is a special place cause in other place like Iowa, Montana, Nebraska and up North of America doesn't have many regulation doesn't have a lot of people but in California there are many regulations and people. California has special regulations. Before E.P.A program was made, in this case E.P.A is the top of regulation but the regulation of California was studied too in E.P.A.

There were four the waste characteristies :

1. Ignibility / Flammability
   Example : Solvents

2. Corosifity
   Example : Sulfurid acid, hydrochloric acid, chromic acid.

3. Reactifity
   Example : picric acid, Oxidizer, Reducer

4. Toxictity
   Example : Cyanide solutions
   Almost every solution that contains metals.

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To analize those waste we can use two methods

1. Total Threshold Limit Concentration (TTLC)

2. Soliable Threshold Limit Consentration (STLC)
   Example : 20 ppm Nickle

He also said that the systems which can be used are :

- Counter flow rinsing
- Drug Out rinsing
- Spray rinsing
- Reactive rinsing

In General if we use the methodes above so will reduce process cost, recycle water so must be support by using DI Water because the contain of T.D.S is small so will be reduced the sludge product.

Document meeting with Jim Mille, see Appendix 6.

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IV. CONCLUSION AND RECOMENDATION

1. Conclusion

During this study tour some important finding are as follows:

1. WEC has launched very good technology transfer program on introducing waste minimization practices through out the world.

A. Regulation

2. The E.P.A in California has Consequency to apply the regulations of environmental problems/waste exile. If there is offense it can be solve by law sanction according to the regulations.

3. In California the metalfinishing factory has a high concious to the environment.

B. Minimization

4. The success of minimization in the factory actually depends on the filosofy of Company and management comitment to solve environmental problems.

5. Actuating If waste minimize program actualy depends on
   - Kind of Industries
   - Kind of Process
   - Technology
   - Industrial Capacity
   - Condition
   - etc

6. The provit of waste minimize application are :
   - The waste load can be reduced
   - The cost of waste can be reduced
   - To increase the competitive power of product

7. Pollution prevention or waste minimization, can be classified in two ways
   - Source reduction
   - Reuse, Recycle and Recovery of waste

8. Minimization technics are :
   - House keeping
   - Intallation of double and triple counter flow rinses
   - Use of spray rinses over select process and rinse tanks
   - Adoption of conductivity sensors to regulate water condition and flow
   - Segregation of rinse waters

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- Substitution of less polluting process
- Thorough indoctrination and training of employees to stress how they can make a positive contribution to the environment.

C. Health and Safety

9. Emergency response/safety equipment:
   - Safety glasses
   - Goggles
   - Face Shields
   - Respirations
   - Showers
   - Safety Shoes
   - Fire extinguishers
   - Eye wash stations
   - Protective Gloves

D. Land Fill

10. Land fill is a final part in Environmental processing according to "Cradle to Grave" princile

2. Recomendation

A. Regulation

1. The Government must apply or give sanction to the factory which doesn't do conservation of environment consequently

2. Each Factory especially metal finishing must has the real conscious about environment and must has pressure from the customer

3. Giving guidence and propagate the cleaning technology to people especially in Business world, include the things are as follows :
   - Waste minimization
   - Re use
   - Recycle
   - Recovery and
   - Save material and energy.

B. Health and Safety

4. Every metalfinishing factory must have the equipments like :
   - Safety glasses
   - Goggles
   - Face Shields
   - Respirations
   - Protective Gloves
   - Eye wash Stations
   - Showers

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- Safety Shoes
- Fire extinguishers

C. Minimization

5. Minimization technic that can be applied are as follows :
   - House keeping
   - Installation of double and triple Counter flow rinses
   - Use of spray rinses over select process and rinse tanks.
   - Segregation of rinse waters
   - Substitution of less polluting process
   - Thorough indoctrination and training of employees to stress how they can make a positive contribution to the environment.

D. Land Fill
   Indonesia must have land fill area to put the waste.

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A P P E N D I E C E S

Appendix 01. - Sponsorship reference

Appendix 02. - Agenda of the visit

Appendix 03. - Document receive from Lawrence Livermore National Labaratory (LLNL)

Appendix 04. - The kinds of product W.T.S

Appendix 05. - Waste Treatment flow chart United Air Lines.

Appendix 06. - Document meeting with Jim Mille

Appendix 07. - Document receive from W.E.C

07 a. - Document receive from Acteron

Appendix 08. - I t i n e r a n y

Appendix 09. - Photographs

Appendix 10. - Curricullum Vitae

Appendix 11. - Bussiness Card

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Appendix O1 : Sponsorship Reference

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World Environment Center 419 Park Avenue South Suite 1800 New York, NY 10016 USA
Tel: (212) 683-1700 Telex: 261290 Envirocent FAX: (212) 683-5052

LETTER OF AGREEMENT

BETWEEN: **The World Environment Center, Inc.**
419 Park Avenue South, Suite #1800
New York, NY 10016
(hereafter referred to as WEC)

AND: Suryanurdian Syafei
PT. Padi Komponen Corporation

(hereafter referred to as Study Tour participant)

1. This Agreement is entered into pursuant to the International Environment and Development Service (IEDS) program.

2. The Study Tour participant will participate in all activities described in Annex A.

3. This Agreement covers the Study Tour participant's participation in this program from December 6, 1993 to December 18, 1993. These dates are estimates, and WEC may find it necessary to postpone or cancel the assignment and/or to shorten or extend its duration, and in such event WEC will not, except as specifically provided herein, incur any obligation or expense, nor shall WEC be liable for any consequential damages.

4. WEC will provide a per diem allowance to cover meals, taxis, and other necessary expenses in the United States in accordance with the terms and conditions of Annex B.

5. Study Tour participant shall submit a Report within thirty (30) days of the completion of the Study Tour in accordance with the trip report instructions contained in Annex C.

6. This Agreement does not create an agency or employment relationship between Study Tour participant and WEC, and Study Tour participant has no authority to bind WEC to any obligations of any kind whatsoever. Study Tour participant shall be considered an independent contractor and not an employee or agent of the WEC for any purpose whatsoever.

7. Study Tour participant acknowledges the rigors and potential dangers of international and domestic air or other travel, and agrees to hold WEC harmless from any claims, damages or other harm incurred by or befalling the Study Tour participant arising out of or related to travel or other activities associated with this Project.

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8. United States Agency for International Development (USAID) regulations require all subgrantees to specifically commit themselves to refrain from lobbying, i.e., the use of USAID funds for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress.

9. If circumstances arise in-country to curtail the specified time period of the mission, the Study Tour participant will contact WEC immediately. If its necessary to cancel the mission before the planned termination date, the balance of the advanced per diem allowance must be returned to WEC.

10. This Agreement may be amended only in writing, which may include an exchange of letters.

11. This Agreement is composed of two pages and Annexes A, B, and C.

Signed this _____ day of _____, 19___.

For WEC,

Antony G. Marcil
Antony G. Marcil
President & CEO

Date: Nov. 19, 1993

~~The Study Tour participant,~~

Suryanudian Syafi
(Name & Title)

Date: Nov, 24, 1993

Contract #:4447
Project #:LA94ID6181

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Appendix 2 : Agenda of the Visit

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AGENDA

Thursday, 12/9/93

- Discussion at SFO Hotel by Jim regarding Waste Minimization in the Bay Area and the Agenda
- Presentation by Lawrence Livermore National Laboratory on Waste Minimization

Friday, 12/10/93

- Wastewater Treatment Systems (manufacturer of treatment equipment)

Monday, 12/13/93

- Read-Rite (manufactures disk read heads, has membrane treatment system)
- Acteron Corporation (plating shop that has done considerable waste minimization)

Tuesday, 12/14/93

- Schlage Lock (large barrel plating of door fixtures)
- Santa Clara Plating (plating shop that has done considerable waste minimization)

Wednesday, 12/15/93

- United Airlines (large aircraft rebuild center, many plating lines and large waste treatment)
- New United Motors (GM/Toyota plant, overall waste minimization)

Thursday, 12/16/93

- McClellan Air Force Base (many plating lines and involved waste treatment)
- San Jose/Santa Clara Water Pollution Control Plant (city sewer control agency)

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Appendix 03 : Document Receive from Lawrence Livermore National Laboratory (LLNL)

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Environmentally Conscious Electroplating at LLNL

Chris Steffani
Jack Dini

Lawrence Livermore National Laboratory
Livermore, CA 94550

December 9, 1993

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We Are Using All Three Generation Categories of Waste Reduction

1- Good housekeeping practices, inventory control, and minor changes in operating practices

2- Current technology and material substitutions

3- Significant technological advances in process synthesis and engineering

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We Are Saving Over $500,000/Year and 3 Million Gallons of Water/Year

- Substitution of zinc-nickel for cadmium plating
- Segregating cyanide solutions
- Elimination of hexavalent chromium plating
- Elimination of vapor degreasing
- Changing rinsing practices
- New pickle for aluminum parts
- Recycling of rinse water

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Bldg. 322 Floor Plan

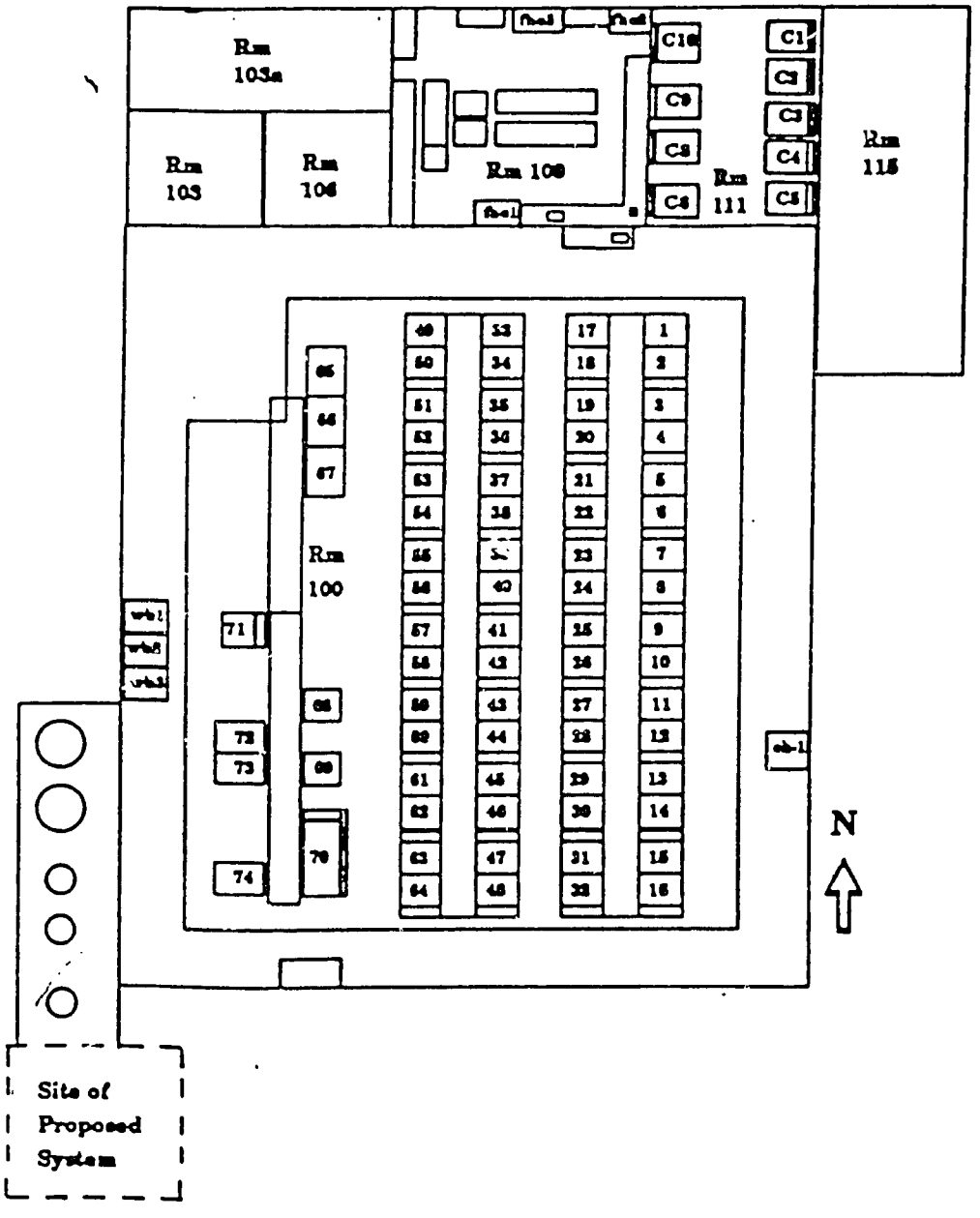

Figure 1. Plan View of Plating Shop

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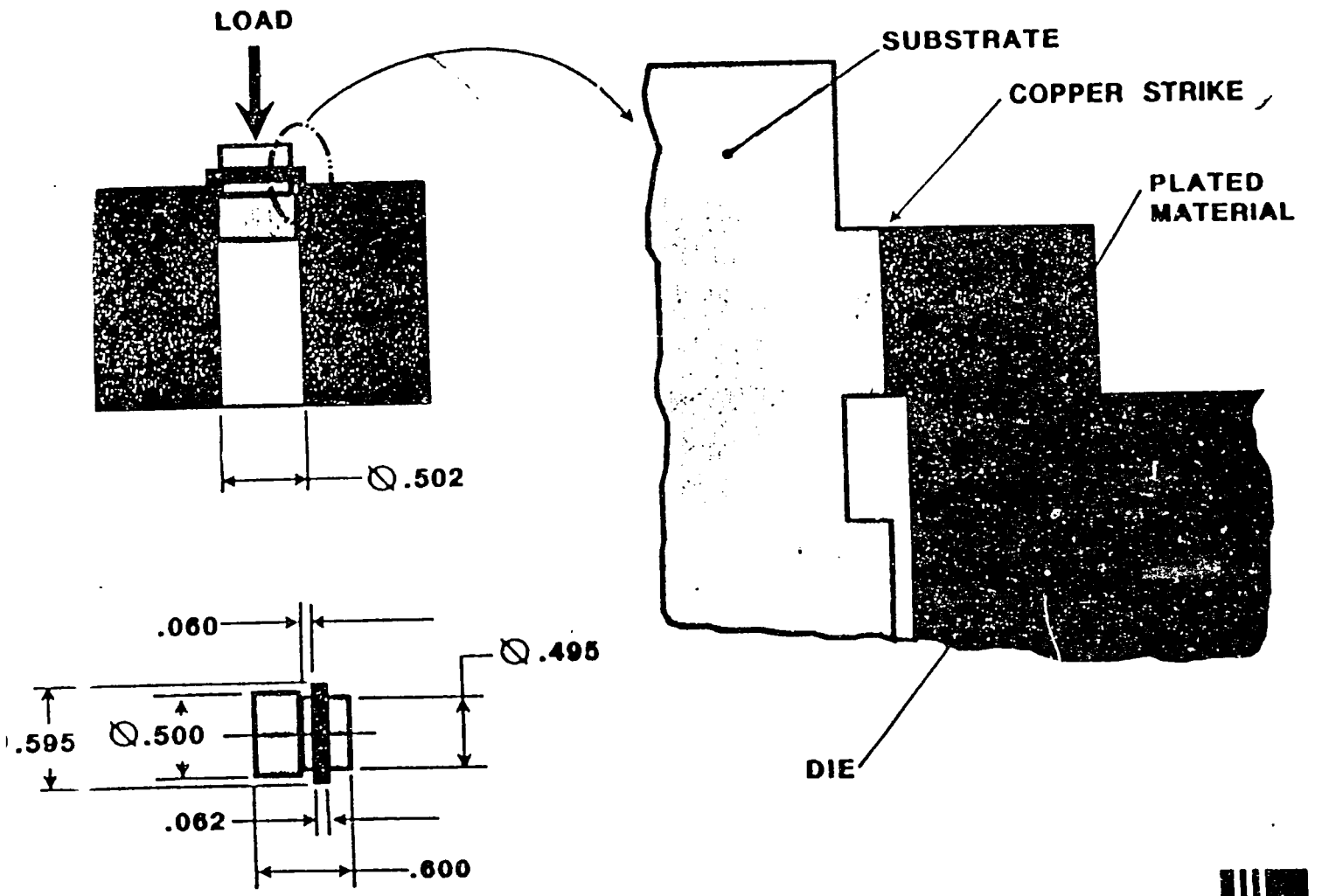

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Comparison of Ring Shear for Cyanide and Copper Pyrophosphate Strikes for Preparing Aluminum Alloys for Plating

Alloy	Shear Strength (A,B) (MPa) Cyanide Copper	Pyrophosphate Copper (C)
1100-F	79	77
2024-T4	288	273
6061-T6	217	222
7075-T6	285	374

A. These data are from Reference 7.

B. The zincate solution time was 30 seconds. The copper strikes were overplated with nickel in a nickel sulfamate solution. All reported values are the average of 5 samples.

C. The formulation of the copper pyrophosphate solution included copper (7.5 to 11 g/l), P_2O_7/Cu (20/1 to 25/1). Operating conditions were: temperature (25 to 30C), pH (8.5 to 9.2) and current density (10ASF).

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Solvent vapor degreasing has been an integral part of electroplating operations

- It has been around for many years.
- It is nearly universally applicable to organic soils on metal substrates.
- The cleaning speed is quite fast.

- IT PERFORMS THREE IMPORTANT FUNCTIONS, CLEANING, RINSING AND DRYING.

Pratt & Whitney's results showed that ultrasonic agitation was more important than the choice of clear er

FACTOR	IMPACT ON CLEANIN G (%)
Agitation (ultrasonic)	45
Cleaner	12
Cleaner concentration	6
Soil loading	3
Time	3
Temperature	3
Noise (unexplained by experiment)	28

Use of ultrasonics in aqueous cleaners has proven to be quite effective

- Pratt & Whitney has been able to remove all but two perchloroethylene degreasers, remove over 50% of the total degreasers used in 1988 and reduce toxic air emissions by 50%.

- Martin Marietta (Y-12) has used ultrasonic cleaning with aqueous detergent in place of vapor degreasing since 1985.

- Western Electric, Kansas City uses a mixture of aliphatic esters with the aid of ultrasonics for removing machining oils encountered in producing circuit board backplane pins.

- APS Materials in Dayton uses a terpene based cleaner with ultrasonics instead of TCA for cleaning metal parts prior to plasma coating.

Why is agitation so important?

- Aqueous cleaners involve concentrations of only 1-4% by volume while solvent degreasers use 100% concentrations.

- Because of this, 80-90% of the cleaning done by aqueous cleaners is effected by mechanical action while the remaining portion is by chemical action.

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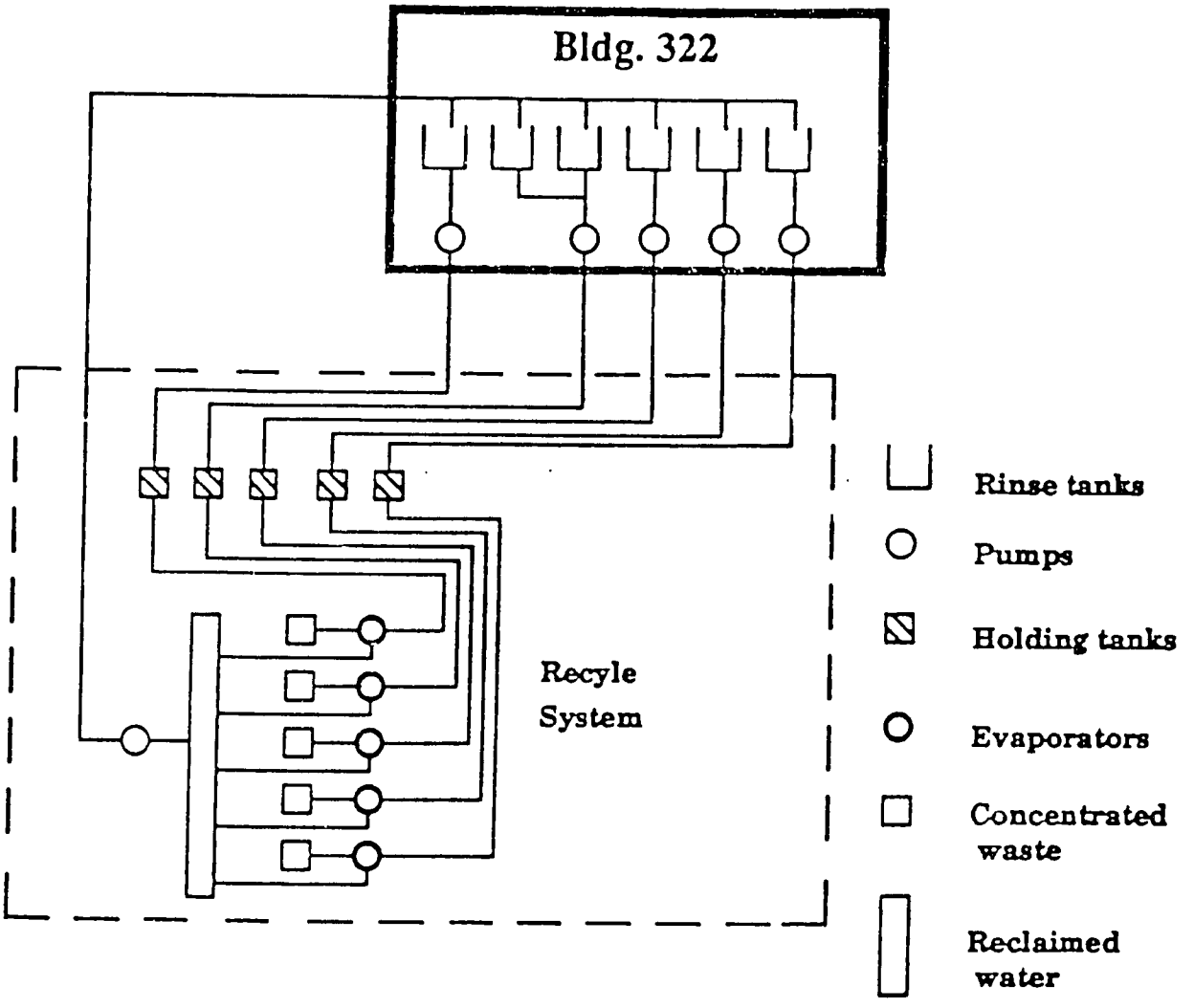


Rinse Water Recycling Has Been Quite Effective

- We've recycled about 80,000 gallons of rinse water and returned all but 200 gallons back to the processing lines.
- The recycled water is purer than the water we receive from the city of Livermore.
- We no longer discharge any water to the sewer system.

Recent Generation 1 and 2 Activities

- Substituting oxalic acid for sulfuric acid for hard anodizing of Al
- Extending the life of electroless nickel solutions
- Recycling of acid solutions
- Use of ion exchange on the recycled water
- Energy conservation project

Metal Finishing Energy Conservation Project

- The metal finishing facility used large amounts of electrical power for process solution heating, space heating, and exhaust ventilation.

- By reducing thermostat settings and air flow during off-shift hours, electrical savings on the order of 1.6 million kwh can be achieved, as well as natural gas savings of 30,000 therms.

- Savings that will result from this are over $100,000 per year.

Summary

- Our efforts in environmentally conscious electroplating save LL NL over $500,000/year and 3 million gallons of water/year.

- The facility is now much cleaner and safer than it used to be.

- Product quality has not been compromised by the changes.

- We are now involved in a number of generation 3 (new technology activities.

WASTE MINIMIZATION TECHNIQUES

- Processing methods
- Equipment
- Results
- Future work

PROCESSING METHODS

- Rinse water distillation
- Acid recycling
- Electrowinning
- Electroless nickel recycling

ACID RECYCLING EQUIPMENT

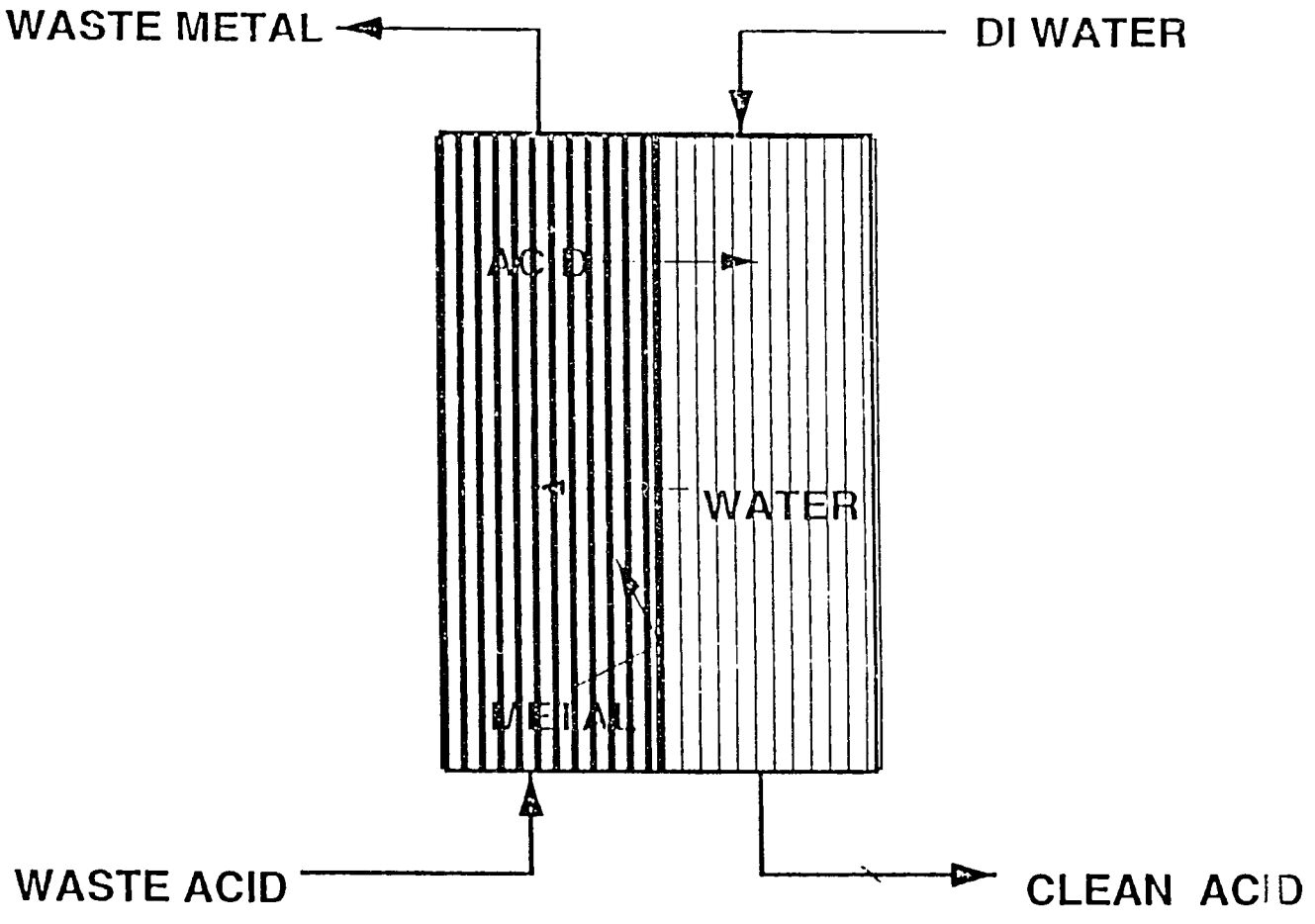
10 GPD Dialysis cell

- 50 pair stack of polymer membranes
- 2 impulse pumps and tubing
- supply and storage tanks

Feed

- DI water
- Metal Bearing acid

ACID DIALYSIS EQUIPMENT



ACID DIALYSIS RESULTS

Test 1

(start)	(finish)
4.9 Normal Nitric Acid	3.9 Normal Nitric Acid (79.5%)
60 gm/l copper metal	7.2 gm/l copper metal (88%)

Test 2

(start)	(finish)
9.4 Normal Muriatic Acid	7.1 Normal Muriatic Acid (75.5%)
10 gm/l copper metal	1.1 gm/l copper metal (89%)
14 gm/l iron metal	3.1 gm/l iron metal (77.8%)

RECYCLING POSSIBILITIES

- Acid recycling from spent solutions
  Nitric, Sulfuric, Muriatic (greater than 5 Normal)

- Water recycling from aqueous waste
  pH >2, metal concentration < 500 mg/l, non rad

- Precious metal recycling
  solid or mixed coated base metals, liquids

- Metal stripping and salvage
  sputter chambers, broken taps, chemical machining

RINSE WATER DISTILLATION EQUIPMENT

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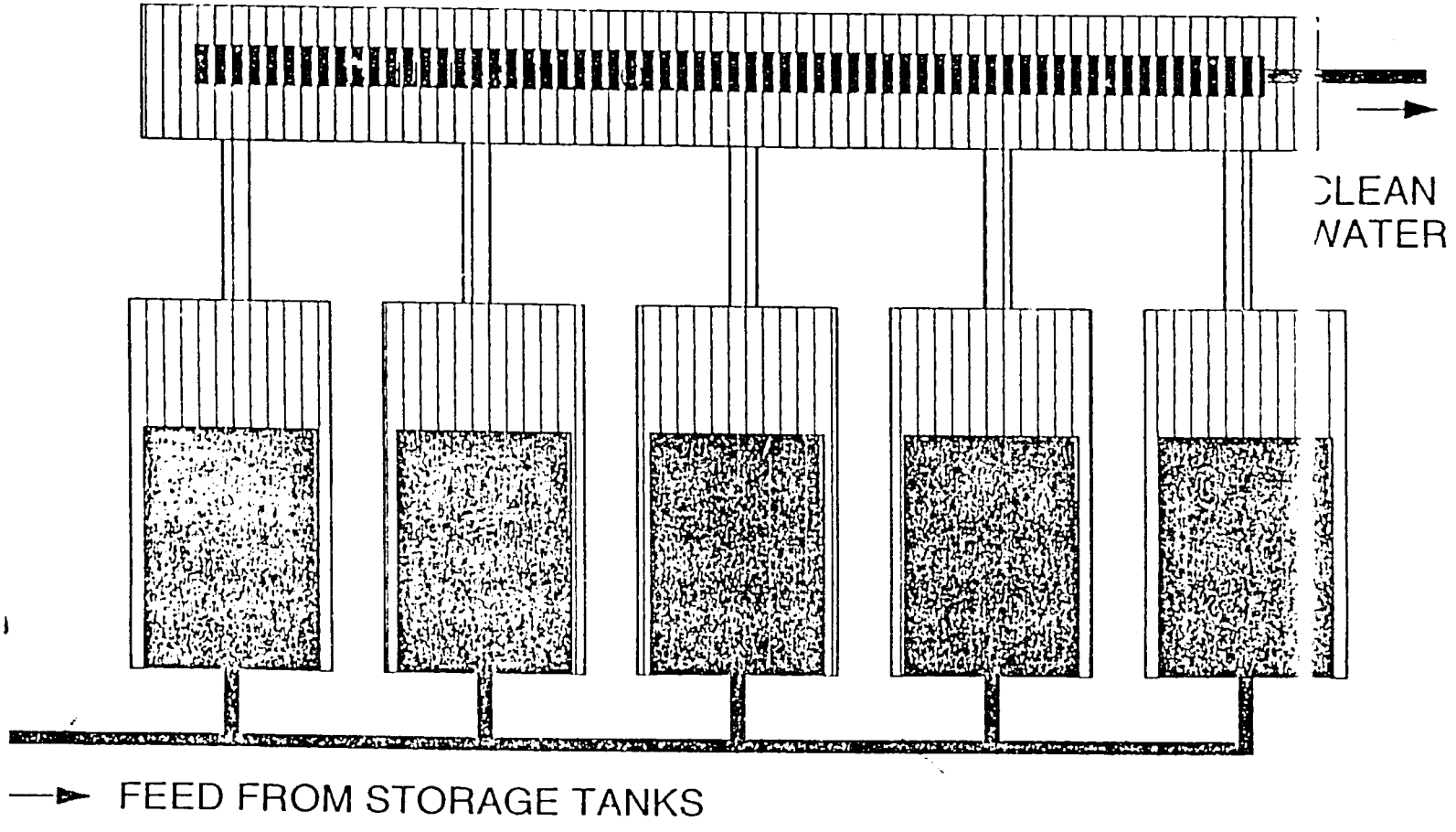
- "COLD VAPORIZATION" System (700 GPD)
- Dragout rinse tanks (minimizes flow)
- Separate plumbing for clean and dirty water
- Holding tanks for storage

RINSE WATER DISTILLATION



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DISTILLATION RESULTS

Typical feed rate = 25 gallons /hr
@ 30 PPM average metal content, pH 2 - 9.5

Typical water return rate = 25 gallons /hr
@ <1 PPM average metal content, pH 6.5 - 7.5
Typical concentrate @ 9000 PPM

Cost per gallon recovered = $.03

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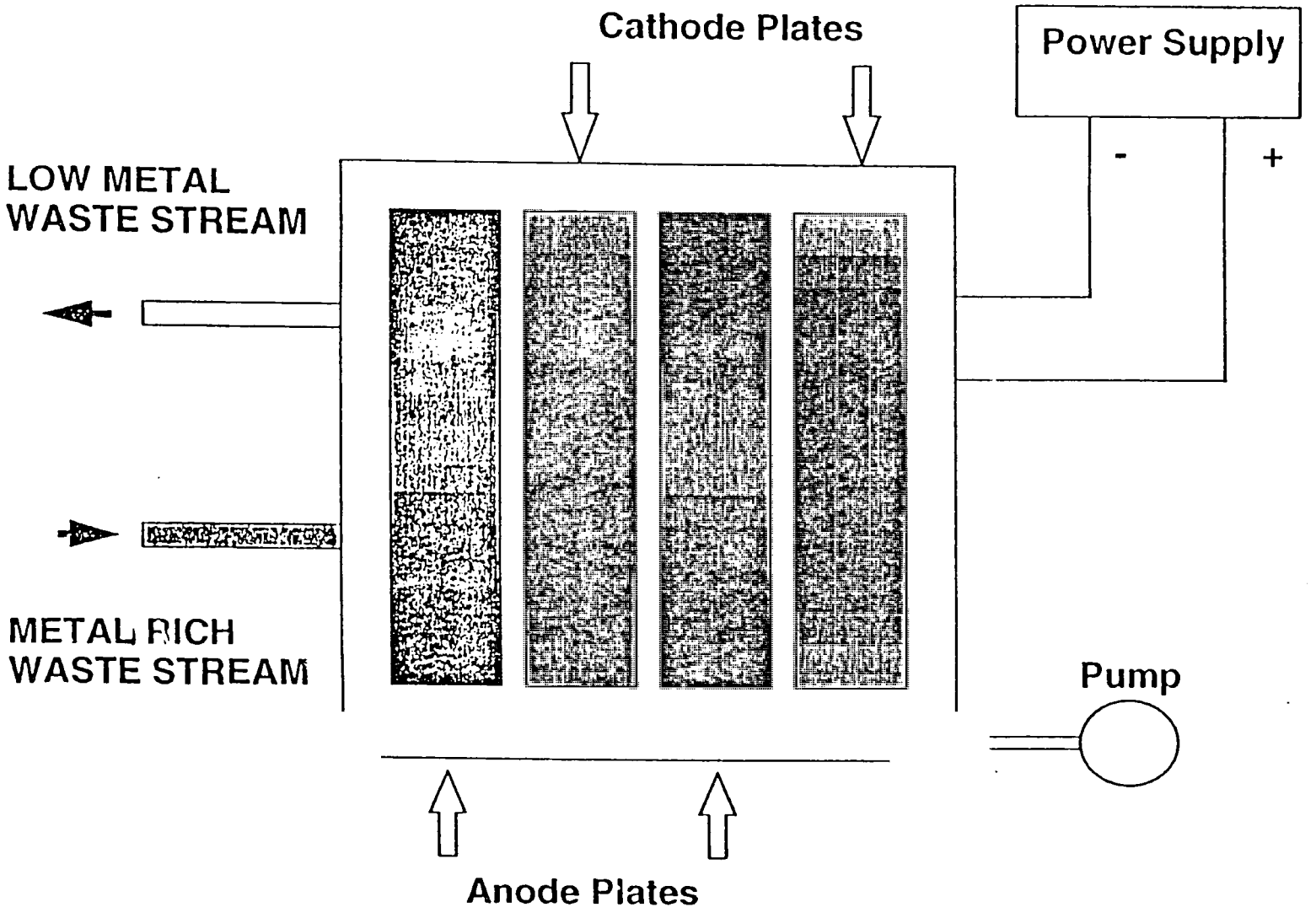
ELECTROWINNING

- Electrolytic recovery cell
- Multiple cathode areas
- Separation and recovery of common streams
- Low cost, low maintenance

ELECTROWINNING EQUIPMENT



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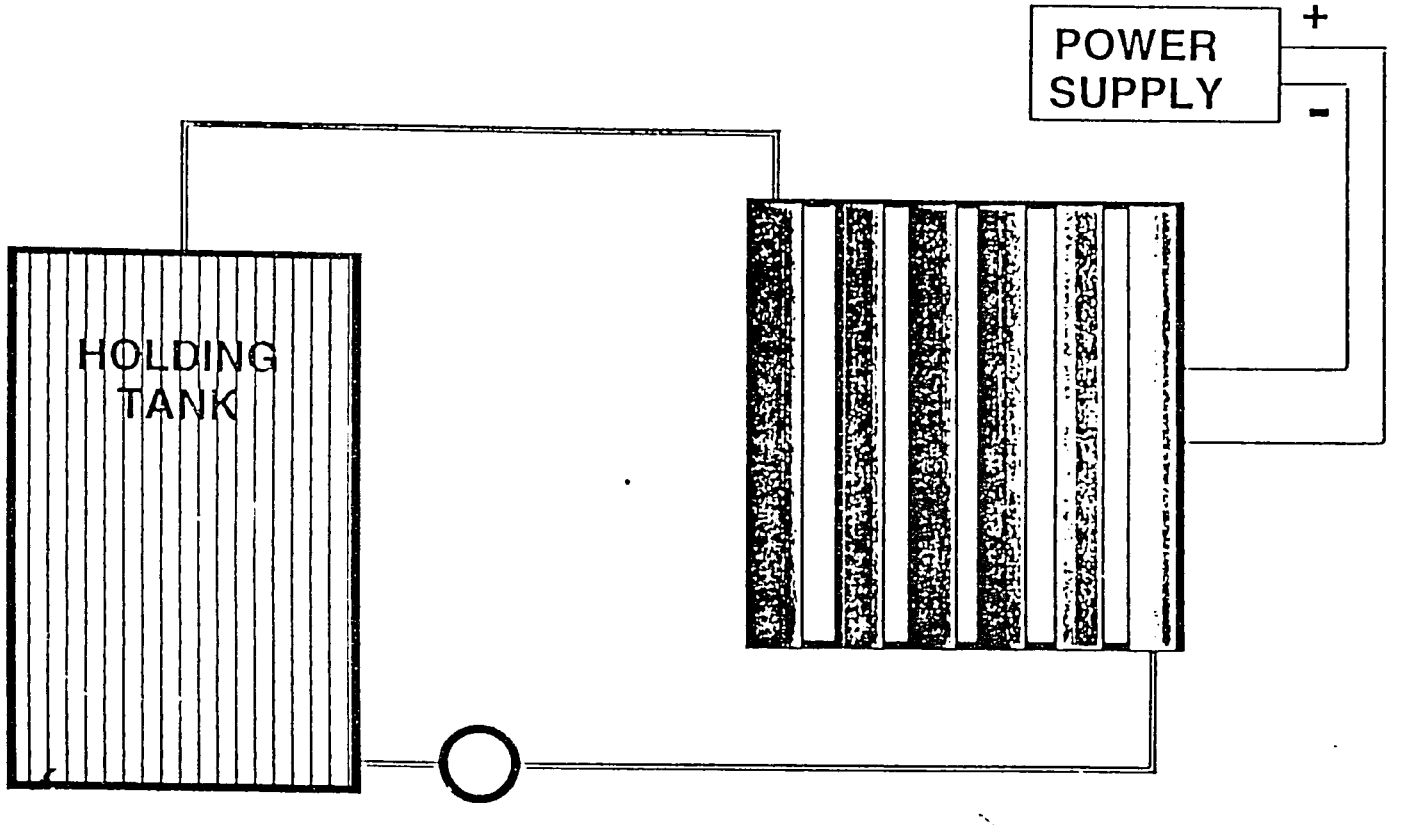
ELECTROWINNING RESULTS

	BEFORE	AFTER
TEST 1	Copper metal = 310 gm/l Sulfuric acid = 40 gm/l	Copper metal = 12 gm/l Sulfuric acid = 44 gm/l
TEST 2	Copper metal = 100 gm/l Nickel metal = 200 gm/l Zinc metal = 20 gm/l	Copper metal = 15 gm/l Nickel metal = 9.5 gm/l Zinc metal = 2.5 gm/l

ELECTROLESS NICKEL RECYCLING

- Reduce chemical purchases
- Reduce waste disposal
- Provide more consistent product
- > 100 metal turnovers

ELECTROLESS NICKEL EQUIPMENT



ELECTROLESS RECYCLING RESULTS

Testing still underway

FUTURE WORK

- Continue to operate efficiently
- Experiment with new technologies
- Work with outside industry
- "Zero in" on ZERO WASTE PRODUCTION

Appendix C4 : The Kinds of Product W.T.S Inc

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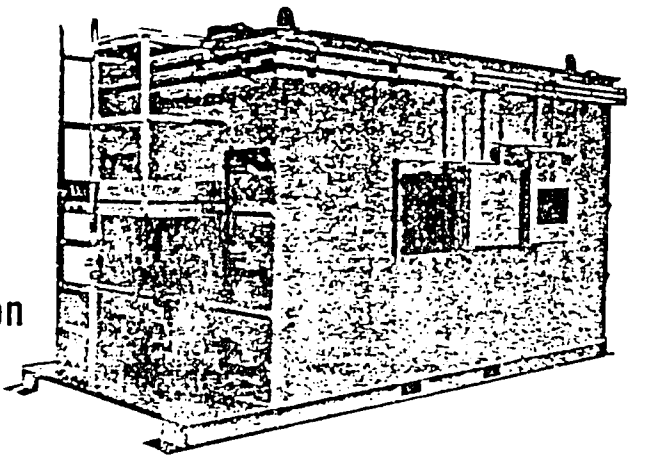
WTS
WASTEWATER TREATMENT SYSTEMS INC.

HMR

Packaged Chemical Precipitation/Clarification System



General

The HMR is designed to provide a standard product used for precipitation and clarification of regulated contaminants from industrial wastewaters. This product services a wide range of field proven applications, and offers a compact design unsurpassed in the industry. The HMR is commonly used as a stand-alone treatment system, and is also easily incorporated into custom designed effluent treatment systems.

Features

- Compact Design
- PLC Controlled
- High Quality Design
- Continuous Flow
- Easy Operation
- Process Guarantee
- Factory Assembled

Description

The HMR is a skid-mounted, factory-assembled unit incorporating separate chambers to perform the following treatment processes.

- Chemical Pretreatment/Precipitation
- Pre-clarification pH Adjustment
- Precipitate Flocculation
- Precipitate Clarification
- Sludge Thickening
- Effluent Clear Well

The HMR and all system perioneral equipment are automated to the greatest practical degree utilizing a WTS programmable Process Control Unit. This Control Unit unifies the equipment with the treatment process and is field proven to increase system reliability and reduce operator involvement. The HMR is typically supplied with all necessary peripheral equipment such as:

- Sludge Processing Equipment
- Effluent Filtration Equipment
- Reagent Holding Tanks
- Lift Station(s)

This equipment is supplied to provide a complete, functional system that meets the user's needs.

Application

The HMR is a continuous flow system configured to meet many diversified needs. The unit is field proven in the following applications:

- Heavy Metal Removal
- Arsenic Removal
- Fluoride Removal
- Residual Oil/ Grease Removal
- Suspended Solids Removal
- Iron Removal

The HMR has been successfully utilized in industries such as the following:

- Electronic /Semi-conductor
- Printed Circuit Board Manufacturing
- Metal Finishing/Plating
- Industrial Laundries
- Landfill Leachate
- Groundwater Remediation
- Petro Chemical

These applications clearly demonstrate the versatility of the WTS HMR.

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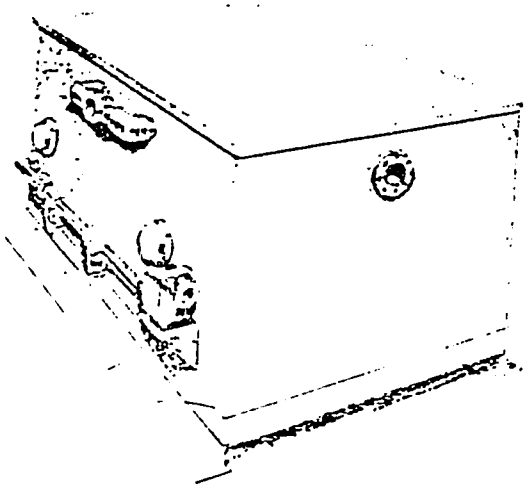
Oil/Water Separation System (OWS)



Features

- Factory Assembled for Easy Installation
- Skid Mounted for Portability
- Adjustable Pipe Oil Skimmer
- Coalescing Settling Media requires Less Settling Area than API Separator
- Solids Settling Chamber
- All Corrosion Resistant

OWS Options

- Complete Electrical Control Packages
- Electric Heating Systems
- Level & Temperature Sensors
- Pumping Systems: Air or Electric
  - Influent
  - Effluent
  - Sludge
- Demulsifying Systems
- Oily Waste Storage Tanks
- Oleophilic Polishing Filter Systems
- Construction Materials
  - Polypropylene standard
  - FRP
  - Carbon Steel, Epoxy Coated

General

The WTS OWS is a precisely engineered, compact factory assembled unit designed to separate hydrocarbons and oils from wastewater streams. The OWS can reduce oil content from up to 1000 mg/ltr to below 20 mg/ltr, The OWS ships fully assembled to simplify installatio

In operation, flow through the OWS first enters a settling chamber where settlable solids fall to the bottom for occasional removal. The waste stream then enters the coalescing separation chamber. Liquid passes through a series of oleophilic coalescing tubes. These tubes provide laminar flow and attract small oil globules which coalesce with other globules, increase in size and buoyancy, then break away and ris to the top. Surface oils drain through a pipe skimmer into a collection tank. Effluent flows by gravity to drain.

In addition to the base unit, WTS offers options to provide the end use a fully functional unit purchased from a single source.

Applications

- Groundwater Remediation
- Auto/Truck Washdown Treatment
- Machine Coolant/Tramp Oil Treatment
- Metal Finishing
- Petroleum Waste Treatment

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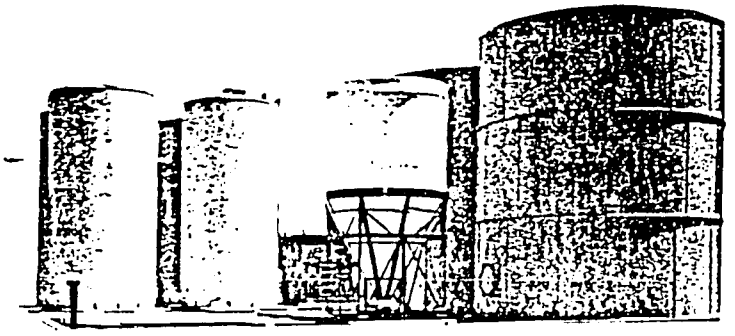
WTS
WASTEWATER TREATMENT SYSTEMS INC

UBR

BIO-TREATMENT SYSTEMS FOR INDUSTRIAL WASTEWATERS



General

WTS offers comprehensive capability for the treatment of high BOD/COD and organic waste effluents generated by many industrial operations. The WTS UBR is a patented fixed film biological reactor that aerobically digests organic waste reducing BOD/COD loading and/or regulated organic constituents to acceptable discharge levels.

Using advanced microbe technology and bio-oxidation concepts, the UBR offers a compact, space saving system that treats many aggressive effluents in an efficient, safe, and odor free environment.

Features

- Compact Design
- PLC Controlled
- High Quality Design
- Continuous Flow
- Shock Resistant
- Guaranteed Process

Benefits

- Space Saving Design
- Low Operator Interface
- Low Microbe Replacement Cost
- Low Sludge Output
- Fast Startup Period

Description

The UBR is a flooded, packed vessel combining fixed film and suspended growth reactor kinetics. The inherent shock resistance and biological efficiency of this type of system, in conjunction with specialized microbe cultures, provide an ideal environment for biological oxidation of a wide range of organic wastewaters.

The UBR utilizes nutrient and microbe feed equipment in conjunction with a patented pre-acclimation unit, which combined allow the bacteria to attain their growth phase before entering the Bio-Reactor. Use of this equipment reduces operating costs and yields a stronger, more resilient biomass in the Bio-Reactor.

The UBR is typically supplied with all ancillary equipment required to provide a complete, functional biological treatment system. This includes equipment that may be used for the following:

- pH Control
- Flow Equalization
- Solids Clarification
- Sludge Digestion
- Sludge Dewatering
- Metals Removal
- Filtration
- Residual Organic Removal

The UBR treatment system, including all ancillary equipment, is automated to the greatest practical degree utilizing a WTS Programmable Process Control Unit. This control unit unifies the

and is field proven to increase system reliability and reduce operator intervention.

Application

The UBR is typically applied for basic BOD/COD reduction, however it is also applied for removal of organics such as dissolved oils, phenols and BTX. The following list represents typical industrial users of the UBR technology:

- Beverage Bottlers
- Meat Packers
- Die Casters
- Food Packaging Plants
- Groundwater Remediators
- Landfills (Leachate)
- Dairies
- Pharmaceutical Manufactures
- Chemical Plants
- Refineries

This host of industrial users, as well as others, present many diversified applications for the UBR biological treatment process. Many of these requirements are very straight forward and lend themselves to standard system sizing formulas. Others are more difficult to size. Therefore, WTS offers laboratory and pilot plant testing when it is necessary to prove treatment feasibility and/or actual sizing criteria. Please consult WTS or it's local representative for additional applications information or to inquire on our laboratory and pilot plant testing services.

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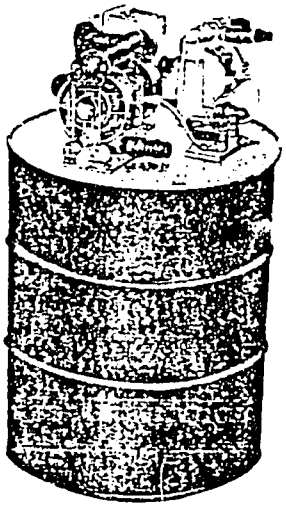
WASTEWATER TREATMENT SYSTEMS INC

Sludge Barrel

Economical Low-Volume Sludge Dewatering System



Features

- Automatic
- Compact
- Easy to maintain
- Economical

Benefits

- Reduced sludge disposal costs
- Save space
- Low cost

Description

The SLUDGE BARREL provides the user with an economical alternative to a filter press in situations where a small volume of sludge is being generated (under ½ cubic foot per day). Its automatic decant cycle means you can use it for days without any operator intervention. Because of its unique, simple design, it acts as a filter for the decant water as well as a sludge dewatering device.

The unit comes as a single barrel or dual barrel design for higher volume users.

Application

The unit is ideal for:

- Laboratory generators of precipitates
- Small flow platers (2 GPM or less)
- Small flow circuit board shops (2 GPM or less)
- Water/paint separation
- Solids removal from water

The unit comes complete with:

- Barrel
- Polypropylene bag
- Bag retainer
- Level sensor system
- Decant system and pump
- Inflow pump
- Pump control

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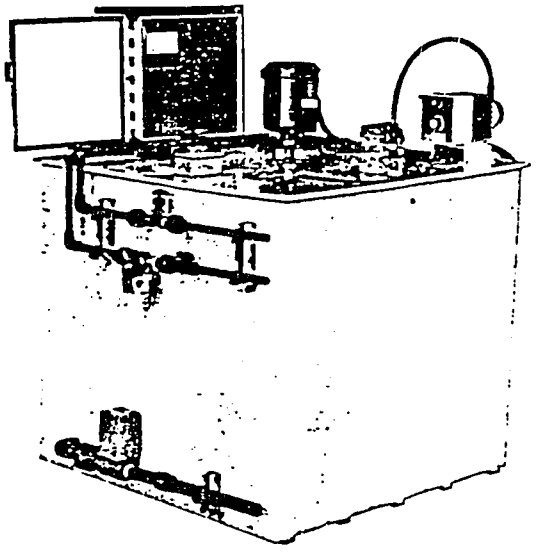
WTS
WASTEWATER TREATMENT SYSTEMS INC

Mini Batch Neutralizer



Features

- Fully or Semi automatic operation
- Programmable
- Double Contained
- Compact
- Economical

Benefits

- Provides Local Treatment
- Prevents Hauling Concentrated Solutions
- Low Cost

General

The Mini Batch Neutralizer provides an economical means for treating small amounts of acid/alkaline solutions. The systems can be configured to treat both diluted and concentrated wastes. Automation is derived using a WTS Programmable Control System, and is programmed to meet your specifications.

Applications

The Mini Batch Neutralizers can be configured as continuous or single batch treatments systems. The units are used for neutralizing diluted or concentrated acid or alkaline solutions.

Mini Batch Neutralizers are ideally suited for use: in laboratories, by low volume wastewater generators, and by users having concentrated solutions hauled away. They are an effective pretreatment mechanism prior to discharge into an existing treatment system. The units also provide an economical alternative to installing long runs of double contained piping.

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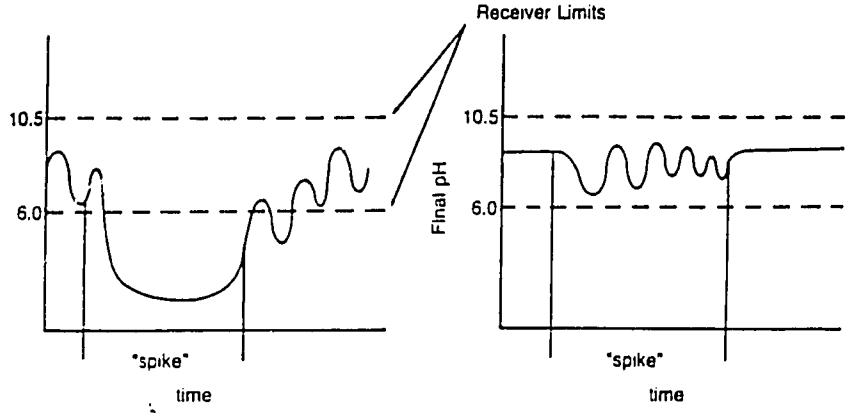
Log/Linear pH Control System

FIGURE 1

A) pH control obtained using conventional neutralization system.

B) pH control obtained using the WTS LOG/LINEAR pH CONTROLLER.



Many conventional pH neutralization systems fail to meet local receiver discharge limits due to occasional acid and/or caustic spikes. WTS has developed the LOG/LINEAR pH Control System specifically to maintain satisfactory pH levels at all times. This includes periodic acid/caustic dumps which many conventional systems are incapable of handling. (See Figure 1) The LOG/LINEAR Controller is standard equipment on all WTS Neutralization Systems and is offered as a retrofit package for existing systems. The compact design and economical cost make the LOG/LINEAR Controller an ideal upgrade for existing systems that have trouble meeting receiver pH limits.

The LOG/LINEAR Controller provides logarithmic proportional control over chemical addition for pH neutralization. The Controller takes a 4 to 20 MA signal from a conventional pH transmitter and processes through an analog input of the system's Programmable Logic Controller (PLC). The PLC utilizes WTS-developed control algorithms and makes proportional chemical additions based upon the pH signal being received. The PLC also identifies and alarms high and low pH conditions in each reaction chamber and for the final effluent. The Controller is equipped with a final pH recorder and individual panel meters for pH indication in each adjustment reactor. The Controller also contains all necessary components needed to provide manual and automatic control over the treatment process.

WTS
WASTEWATER TREATMENT SYSTEMS INC.

Wastewater Treatment Systems Inc.
1235 Elko Drive

Telephone: (408) 541-8600
FAX: (408) 541-8615

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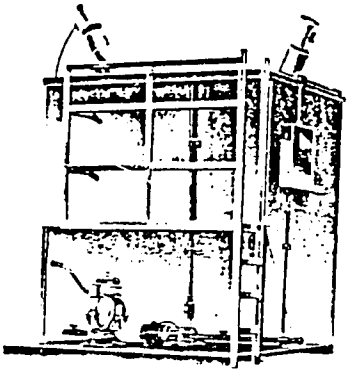
WASTEWATER TREATMENT SYSTEMS INC

Batch Master



Features

- Compact Design
- Versatile
- PLC Controlled
- Easy to Operate
- Economical

General

Eliminates the rising cost and liability of hauling wet process wastewater with the WTS BATCH MASTER. The BATCH MASTER offers users with low daily volumes of process wastewater, an effective solution to this problem. The BATCH MASTER, equipped with state-of-the-art process controls, efficiently treats several different types of contaminated process water on an "as needed" basis. It is an ideal alternative for users unable to justify a large, continuous flow system.

Description

The BATCH MASTER is a skid mounted, factory assembled batch treatment system consisting of:

- Process treatment chamber(s)
- Chemical feed equipment
- Programmable process controller
- Optional components (based upon individual customer requirements)
  - Filter press
  - Transfer pump(s)
  - Polishing filter — Filtration equipment
  - Storage tank
  - Lift station(s)

The process treatment chamber(s) and skid are combined into a compact, rugged design. All the system components are ready for operation when the unit is delivered. The BATCH MASTER and all system peripherals are operated by a single programmable controller. This centralized approach provides an extremely reliable system that is easy to operate.

Application

The BATCH MASTER is an automatic batch treatment system that can be configured to treat waste effluents such as:

- Hydrofluoric Acid
- Heavy Metals
- Cyanide
- Acids
- Caustics
- Arsenic
- Iron
- Suspended Solids

The WTS BATCH MASTER system finds its greatest application with users generating less than 40,000 gallons of process wastewater per month. The system can also be applied when process wastewater is too concentrated for effective treatment on a continuous flow basis. The BATCH MASTER offers an economical alternative to hauling liquid wastes.

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The Treatment of Laundry Effluent:

ANOTHER WASTEWATER SOLUTION

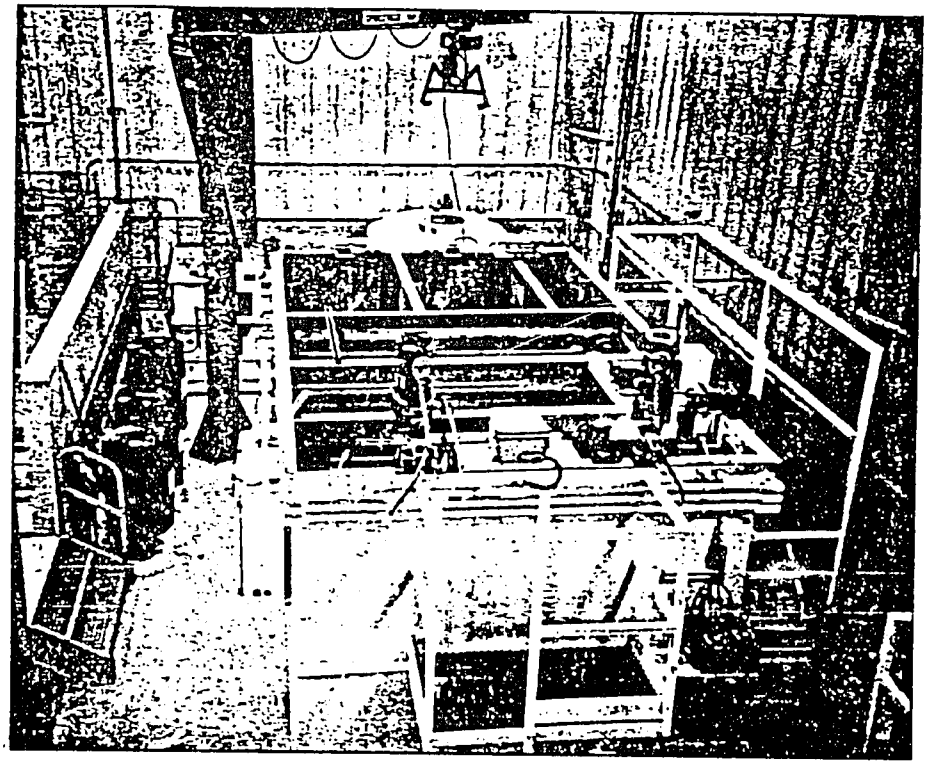
WTS

WASTEWATER TREATMENT SYSTEMS INC.

part of the Thames Plc Group

LOCATION:
Tullahoma, Tennessee
U.S.A.

CLIENT:
Mid-South Uniform Service, Inc.



SCOPE OF SUPPLY
Process design, manufacture, delivery, and commissioning of all the mechanical, electrical, instrumentation and control equipment required for pre-treatment of the laundry's effluent.

PROJECT DATE:
System commissioned in November 1992.

THE PROBLEM:
In November of 1992, Mid-South Laundry, of Tullahoma, Tennessee, came to WTS with the following water treatment problem:

- Local receiver guidelines required that they reduce the level of these contaminants from their wastewater outflow:

- Oils and Grease
- Heavy Metals
- Suspended Solids
- Residual Organics
- Detergents

An economy-conscious company, Mid-South needed a solution that would both satisfy these environmental regulations, and be economically feasible. WTS went to work on the problem, supplying conventional chemical/physical treatment methodology with an eye to efficiency, performance and economy throughout.

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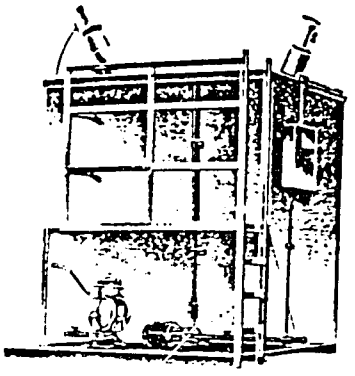
WTS
WASTEWATER TREATMENT SYSTEMS INC

Batch Master



Features

- Compact Design
- Versatile
- PLC Controlled
- Easy to Operate
- Economical

General

Eliminates the rising cost and liability of hauling wet process wasterwater with the WTS BATCH MASTER. The BATCH MASTER offers users with low daily volumes of process wastewater, an effective solution to this problem. The BATCH MASTER, equipped with state-of-the-art process controls, efficiently treats several different types of contaminated process water on an "as needed" basis. It is an ideal alternative for users unable to justify a large, continuous flow system.

Description

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- Process treatment chamber(s)
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  - Lift station(s)

The process treatment chamber(s) and skid are combined into a compact, rugged design. All the system components are ready for operation when the unit is delivered. The BATCH MASTER and all system peripherals are operated by a single programmable controller. This centralized approach provides [illegible] that is easy to operate.

Application

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Appendix 05 : Waste Treatment Flow Chart United Airlines

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WASTE TREATMENT FLOW CHART

ACID WASTE TREATMENT SYSTEM

FROM THE CHROME BATHS & TANKS ON THE WEST SIDE OF THE PLATE SHOP, DRAG OUT FROM THE BATHS, WASH DOWN AROUND THE TANKS, CONDENSATE FROM THE DEGREASER & STEAM LINES + (IRREGULAR LEAKS) FLOW INTO THE TUNNEL DRAINS LEADING TO THE ACID SUMP AND SCRUBBERS.

NOTE: ACID BATHS THAT ARE BEING DUMPED AND TREATED, GET PUMPED DIRECTLY INTO TANK # 402 OR 403.

WASTE FROM THE DRAINS RUN DOWN THE TUNNEL NORTH TO SOUTH BELOW THE PLATE SHOP AND COLLECTS IN THE ACID SUMP.

FROM ACID SUMP, WASTE IS AUTOMATICALLY PUMPED INTO TANK 402 OR 403 FOR TREATMENT.

ADD SODIUM BISULFITE TO KILL CHROME IN TANKS 402 OR 403. AFTER CHROME IS NEUTRALIZED, ADD CAUSTIC TO ADJUST pH 6.5-7.0.

WASTE IS THEN PUMPED INTO PRECIPITATION TANK 1 OR 4 WHERE LIME IS ADDED TO RAISE pH TO 10.0-12.0 AND POLYMER IS USED AS A FLOCKING AGENT TO COAGULATE HEAVY METALS AND DROP THEM TO THE BOTTOM OF THE TANK.

ALKALINE WASTE TREATMENT SYSTEM

FROM THE PLATING BATHS & TANKS THROUGHOUT THE MIDDLE & EAST SIDE OF THE PLATE SHOP ON THE WET LINES (SURFACE TREAT, NICKEL, SILVER, METAL SPRAY STRIP, NICKEL STRIP & CADMIUM LINES.) DRAG OUT FROM THE BATHS, WASH DOWN AROUND THE TANKS, CONDENSATE FROM THE DEGREASER & STEAM LINES + (IRREGULAR LEAKS) FLOW INTO THE TUNNEL DRAINS LEADING TO THE ALKALINE SUMP AND BLOWERS.

NOTE: CYANIDE BATHS THAT ARE BEING DUMPED AND TREATED, GET PUMPED DIRECTLY INTO THE DESTRUCT TANKS # 400 AND/OR 401. THE BATH UNDER GOES ELECTROCHEMICAL OXIDATION TO BRING IT DOWN TO 1 OUNCE PER GALLON OR LESS. THEN THE WASTE IS PUMPED INTO TANK 404 OR 405.

WASTE FROM THE DRAINS RUN DOWN THE TUNNEL FROM THE NORTHEAST CORNER OF THE PLATE SHOP THEN NORTH TO SOUTH AND COLLECTS IN THE ALKALI SUMP.

FROM ALKALI SUMP, WASTE IS AUTOMATICALLY PUMPED INTO TANK 404 OR 405.

OXIDIZE CYANIDE BY ADJUSTING THE pH [illegible] TO 2.8, WHILE CHLORINATING TANK 404 AND/OR 405. [illegible] CYAN DE BELOW 10.0 PPM

PUMP TO PRECIPITATION TANK 2 OR 3 AND ADD SODIUM HYDROSULFITE TO KILL CHLORINE AND RESIDUAL CHROME. AFTER THESE TWO CHEMICALS TEST [illegible] HEAVY METALS AND ADD POLYMER TO COAGULATE THESE HEAVY METALS AND DROP THEM TO THE BOTTOM OF

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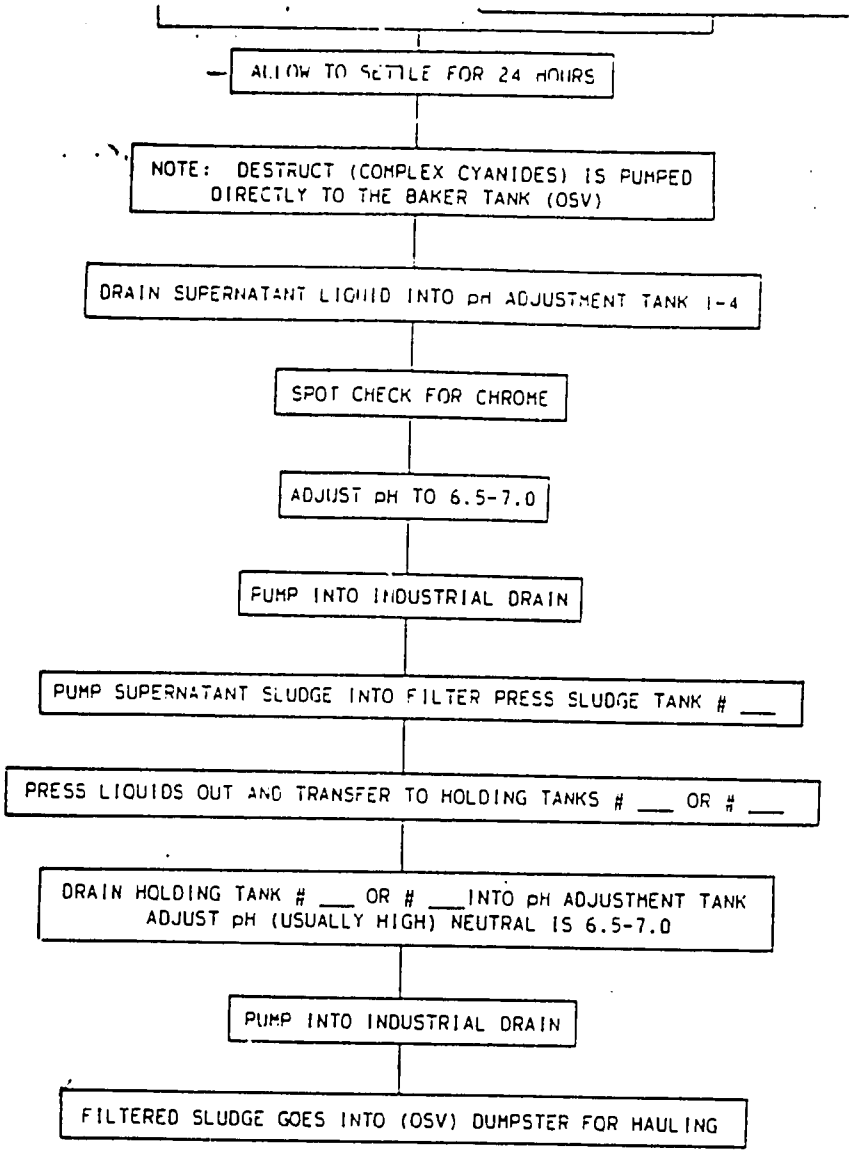

+ CORRECTION - SURFACE TREAT LINE SHOULD BE INCLUDED UNDER ACID-WASTE SYSTEM.
* ALL COMBUSTATE FROM DEGREASER UNITS GO TO ACID-WASTE SYSTEM.

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Appendix C6 : Document Meeting With Jim Mille

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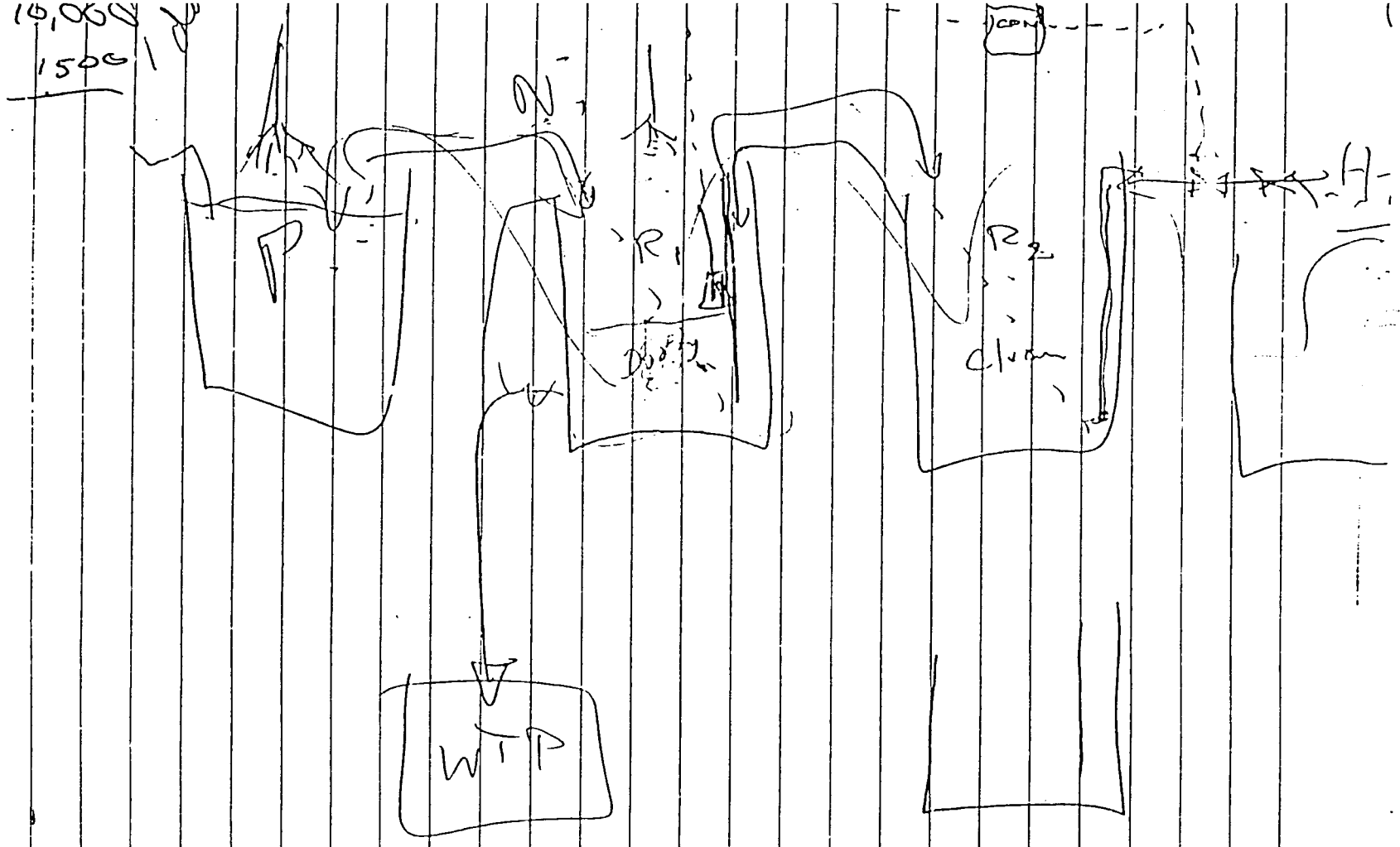

Counter flow rinsing.

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Reactive Rinse bath systems

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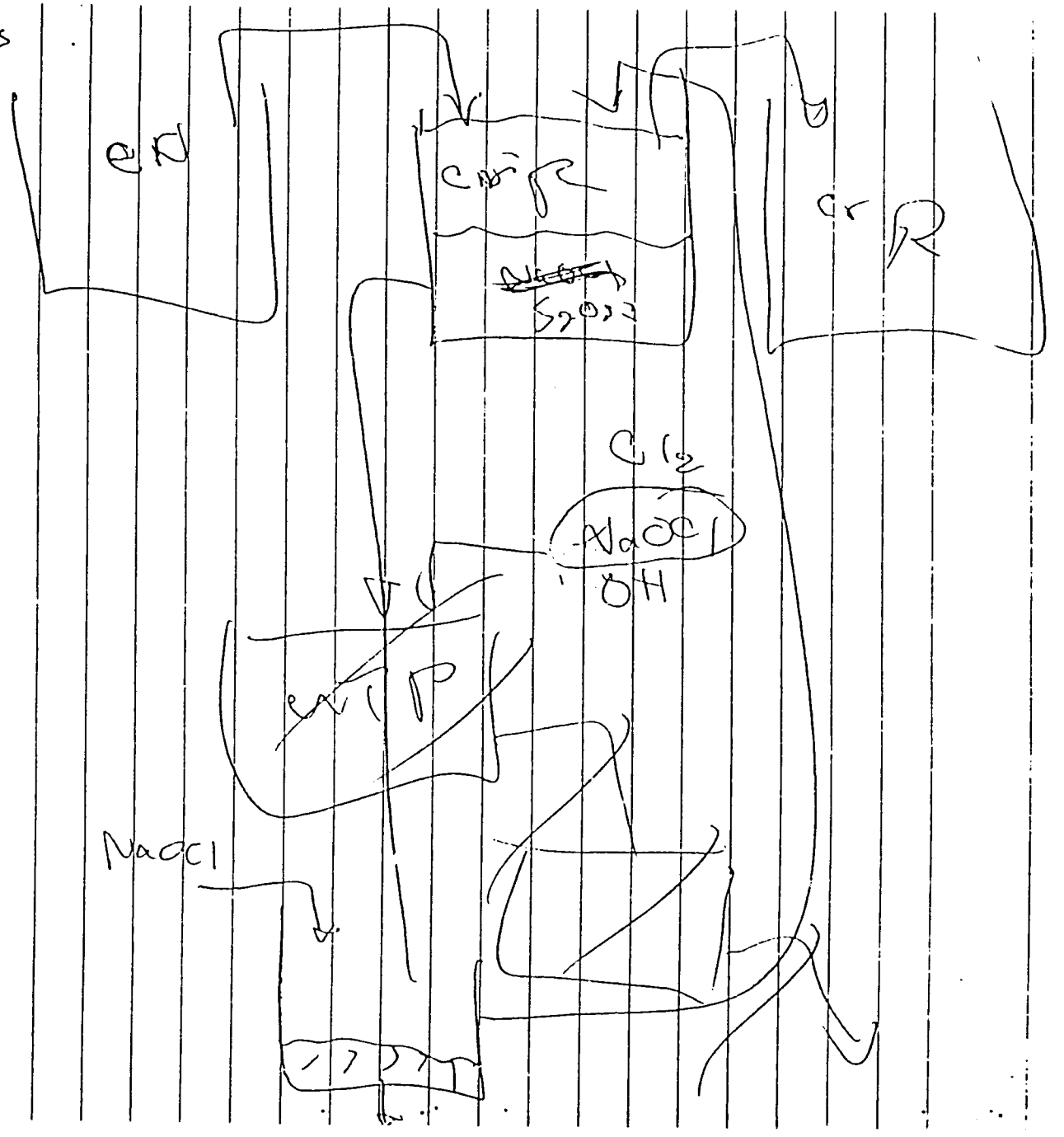

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array in
array onto systems.

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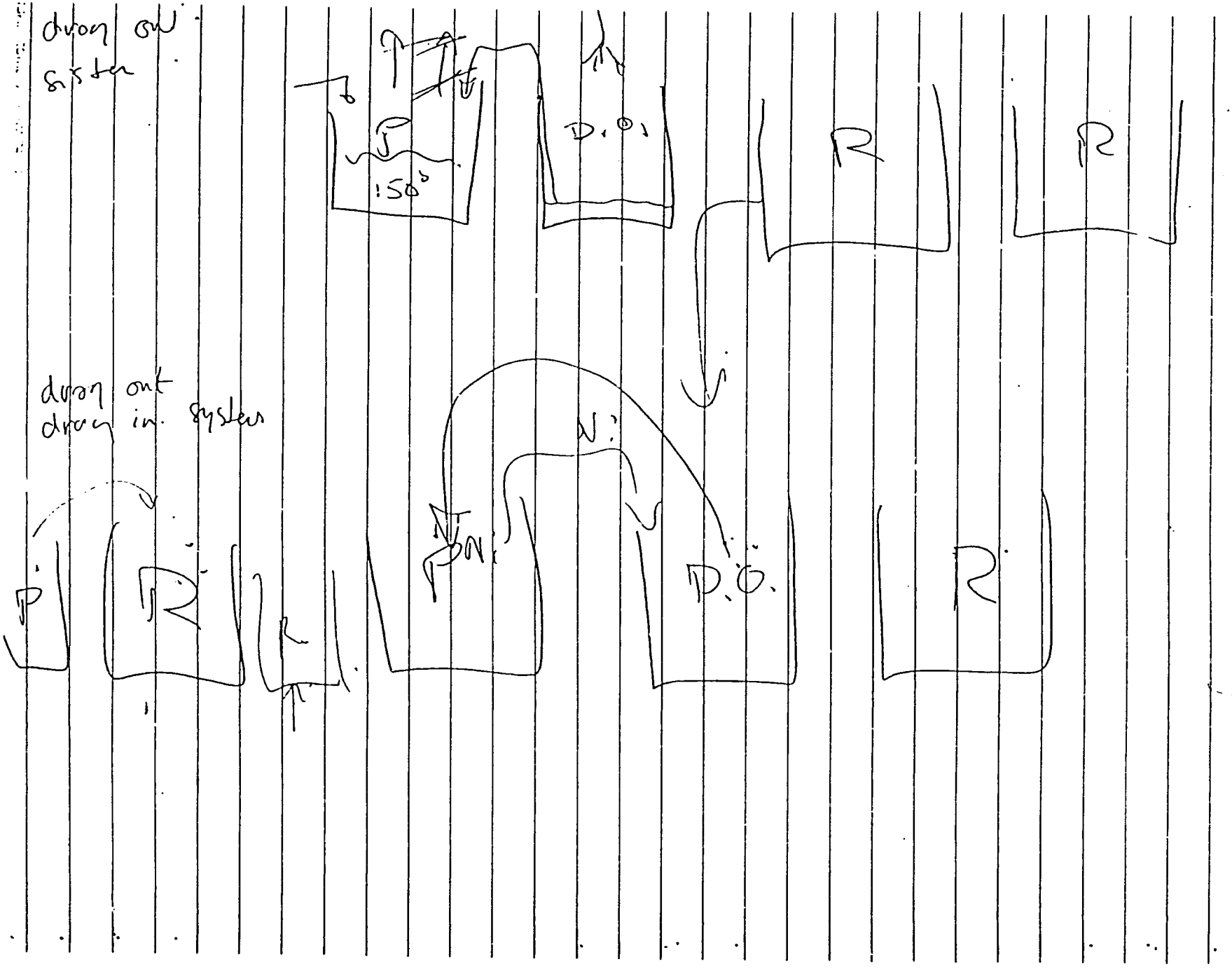

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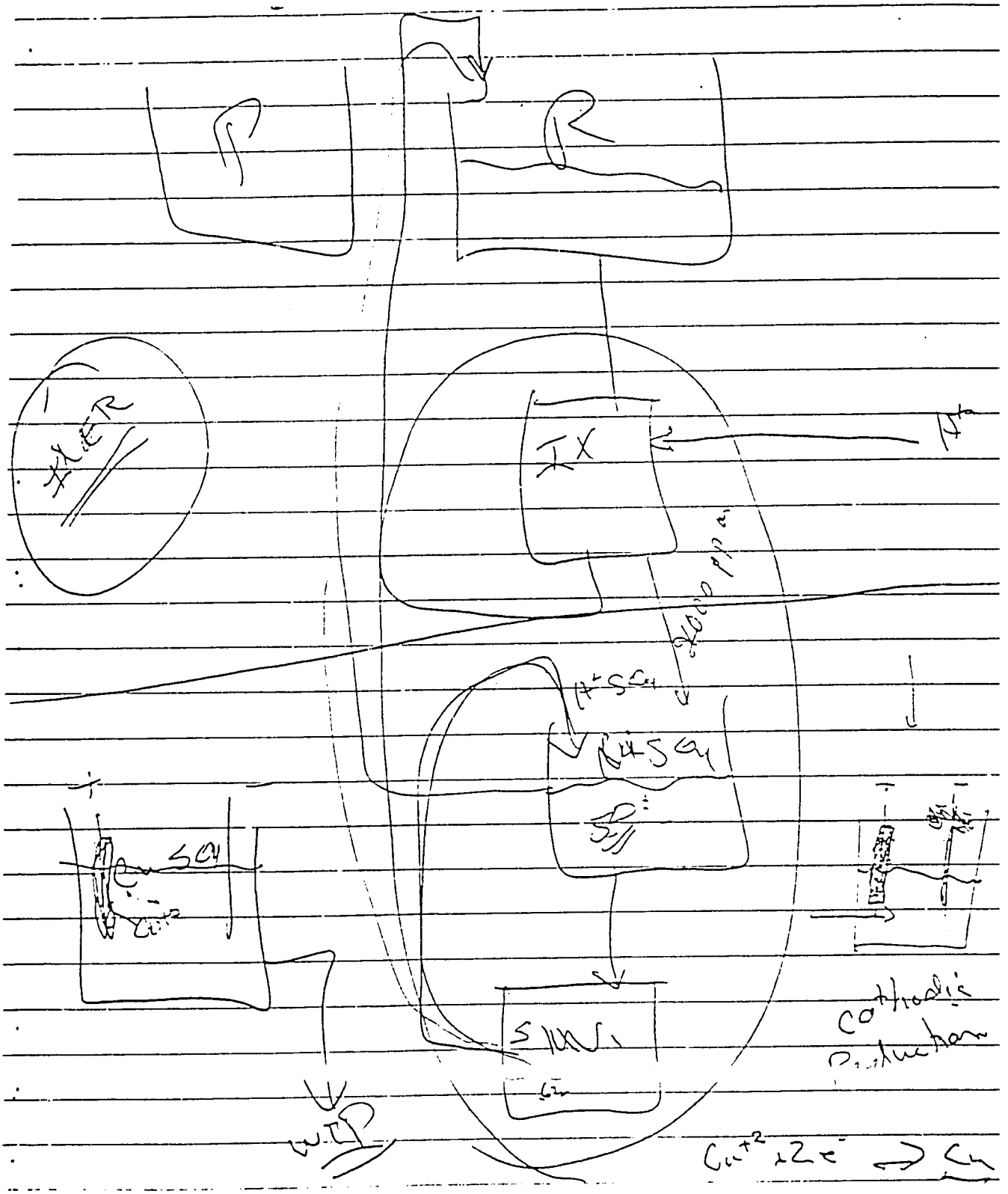
Electro Winning



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Appendix C7 : Document Receive From W.E.C.

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World Environment Center
Industrial Waste Minimization Assessment Program
Indonesian Metal Finishing Industry

United States Study Tour - December, 1993

The World Environment Center (WEC), through a cooperative agreement with the United States-Asia Environmental Partnership and the United States Agency for International Development in Indonesia, is supporting sustainable development by strengthening industrial and urban environmental, health and safety management policy and practices in Indonesia. WEC is demonstrating, through cooperation of U.S. technical experts, the environmental and economic benefits resulting from no/low cost waste minimization techniques in the metal finishing industry.

Waste minimization assessments have been conducted at eight Indonesian metal finishing facilities over the past two years. The waste minimization assessments focused on the identification of no/low cost practices and techniques that can reduce the discharge of pollutants and improve worker health and safety. Upon completion of the assessments, a technical waste minimization workshop was held in Jakarta for approximately 40 industry, government and non-government managers and design engineers. The workshop summarized assessment observations, presented Indonesian waste minimization success stories, and provided the exchange of waste minimization experience from Indonesian industries to other Indonesian industries.

WEC is currently coordinating a U.S. study tour for six Indonesian representatives (two from government and four from industry) during December 6-18, 1993. The objective of the U.S. study tour is to provide the participants with an intensive overview of technologies and management practices implemented in the U.S. which enhance waste minimization and improve worker health and safety. The study tour provides the Indonesian participants and U.S. counterparts with a unique opportunity to exchange experiences with respect to environmental, health and safety management and provides a basis for continued interaction and international cooperation regarding the metal finishing industry's response to heigntened environmental standards and regulations.

Participating host facilities will provide a walk through facility tour and brief the Indonesian representatives on issues regarding waste water treatment and management, solid waste management and disposal, and measures to [illegible] worker health and safety. Upon return to Indonesia, the study tour participants will conduct a second waste minimization workshop to share their experiences gained in the United States.

World Environment Center 419 Park Avenue South Suite 1800 New York, NY 10016
Tel. 212) 683-4700 Telex 261290 Envirocent FAX (212) 683-

WEC WASTE MINIMIZATION PROJECTS INDONESIA: 1992-PRESENT

1992:

May: Waste minimization assessment of three metal finishing plants, followed by a one-day workshop/seminar on waste minimization. Two WEC-sponsored U.S. experts visited the facilities.

June: Waste minimization assessment at two pulp and paper facilities. This assessment involved observation of the current waste minimization/pollution control activities and facility operation. Two WEC-sponsored U.S. experts visited the facilities.

August: Workshop in Los Angeles, California to develop a comparative city case study on mobile sources of air pollution, in preparation for "Megacities" conference, 1993, Jakarta.

October-November: Second round of waste minimization assessment for the Pulp and Paper industry. One facility was visited by a WEC-sponsored U.S. expert.

December: Waste minimization assessments of 5 textile plants in Bandung, Indonesia followed by a one-day workshop/discussion to review audit results with plant managers. Two WEC-sponsored U.S. experts participated in the waste minimization assessments.

1993

February: WEC sponsored the "Megacities on the Pacific Rim and the Burden of Air Pollution" conference in Jakarta, Indonesia. This conference and working session addressed air quality concerns of eight major urban centers in the Pacific Rim. Topics included: Stationary sources; Mobile sources; Health and economic concerns; Institutional and regulatory frameworks.

April: Third round of waste minimization assessments for the Pulp and Paper industry. Four Indonesian Pulp and Paper facilities were visited by three WEC-sponsored U.S. experts.

June: Second round of waste minimization assessments at metal finishing facilities. Eight facilities were visited by two WEC-sponsored U.S. experts.

July: Pulp and Paper Workshop:

This workshop was specifically designed to follow the pulp and paper plant waste minimization assessments conducted during the past year, by the three experts who performed those assessments. The workshop addressed industry-wide needs identified during the assessments. These needs included improved sampling and analysis of waste streams, knowledge of raw material used, and knowledge of manufacturing/waste minimization principles and assessment practices. Workshop participants will be selected for further intensive training with the agreement that they serve as waste minimization trainers for the Pulp and Paper industry.

October: Metal Finishing Workshop:

This workshop was designed to follow up waste minimization assessments in the Metal Finishing industry sector conducted during the past year. The workshop addressed: Environmental management programs and waste minimization principles and assessment practices in the following areas: Electroplating, wastewater treatment, principles of rinsing, cyanide (chemical) safety and control, recycling and recovery, process modification.

October: Two week Pulp and Paper Study Tour of medium sized pulp and paper facilities in the United States.

World Environment Center 419 Park Avenue South Suite 1800 New York, NY 10016 USA
Tel: (212) 683-4700 Telex: 261290 Envirocent FAX: (212) 683-5053

MISSION

The World Environment Center contributes to sustainable development worldwide by strengthening industrial and urban environmental, health and safety policy and practices.

To achieve this mission, the Center:

Maintains an independent and non-advocacy position.

- Seeks to integrate environment, economics, energy and education.
- Establishes and promotes partnerships among industry, government and non-governmental organizations.
- Serves as a bridge for the exchange of information and expertise among industry, government and non-governmental organizations.
- Provides training and technical cooperation programs staffed by volunteer and other experts from industry, government, academia, non-governmental organizations and the general public.
- Encourages corporate environmental leadership and responsibility worldwide by providing international public recognition for outstanding accomplishments.

HISTORY

The World Environment Center is a not-for-profit, non-advocacy environmental organization. Although independent since 1981, WEC was founded in 1974 with seed funding from the United Nations Environment Programme. Today the Center is funded by industry, government, international organizations, corporate or private foundations and private citizens.

Initially, WEC published the bi-weekly World Environment Report and a number of environmental information directories. In 1977, the Center made a conscious decision to draw industry into the environmental policy dialogue with the creation of its International Environment Forum (see IEF).

In 1981, WEC held the first of four major conferences on the links between the environment and development, drawing representatives from industry, government, non-governmental and international organizations, academia and the media from countries around the world.

In 1982, after earlier pilot activities, WEC launched an industry and government supported pro bono environmental technology transfer program, the International Environment and Development Service (see IEDS).

In 1985, the first WEC Gold Medal for International [illegible] presented.

PROGRAMS

International Environment Forum (IEF)

The IEF is a group of 60 major multinational manufacturing corporations based in eight countries and engaged in nine industrial sectors with operations on six continents. The IEF meets quarterly for off-the-record discussions of environmental, health, safety and resource management issues with senior policy-makers from around the world.

WEC offers the IEF proprietary programs, including the Country Profile Program which, through reports produced by and for IEF companies, supplies detailed information on environmental, health and safety requirements in over 20 countries worldwide.

WEC offers workshops that promote the inter-sectoral exchange of information and experience in such subjects as corporate international environmental management, environmental auditing, waste minimization, total product life-cycle analysis and waste remediation practices. Additionally, WEC coordinates the joint development of training programs to provide IEF companies cost-effective, culturally-relevant solutions to the steadily increasing need to transfer skills, technology and information to operations worldwide.

International Environment and Development Service (IEDS)

Using volunteers and other experts, contributed services and materials from industry, government, academia and non-governmental organizations, IEDS provides pro bono assistance worldwide to enhance industrial and urban environmental, health and safety management policy and practices. To accomplish this, IEDS conducts:

- institutional and factory assessments;
- technology cooperation and training workshops; and
- study tours and on-the-job internships for environmentalists and government and industry officials.

Travel and management costs are funded primarily through cooperative agreements with the U.S. Agency for International Development. Other funding comes from industry, the U.S. Environmental Protection Agency, the World Bank and private citizens. More than 250 activities have provided opportunity to work with or training for 700 professionals from 28 countries.

WEC Gold Medal for International Corporate Environmental Achievement

The WEC Gold Medal honors multinational corporations having outstanding, sustained and well-implemented, worldwide environmental policies. It may be awarded annually by an independent international jury of distinguished environmentalists from academia, government, non-governmental organizations and the medal-winning company of the previous year. Past recipients of the WEC Gold Medal are Xerox Corporation (1993), The Procter & Gamble Company (1992). [illegible] The Dow Chemical Company (1989), The British Petroleum Co. p.l.c. (1988), E.I. du Pont de Nemours & Co. (1987), Exxon Corporation (1986) and 3M (1985).

Rev. 7/27/9[illegible]

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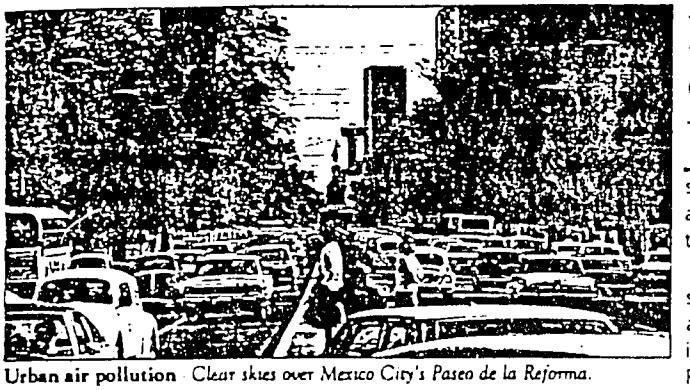
WEC NETWORK NEWS

PUBLISHED BY WORLD ENVIRONMENT CENTER VOLUME 12, NUMBER 1, WINTER 1993



Urban air pollution - *Clear skies over Mexico City's Paseo de la Reforma.*

Europe's ecological disaster can be repeated, Megacities session told

Jakarta – The environmental disaster that is Eastern and Central Europe can easily be repeated, the United States ambassador warned a conference here on air pollution.

"We have all heard about industrial pollution in Eastern European cities, I can tell you from personal observation, over 25 years of service in that region, that the environmental disaster there is worse than you can imagine," Robert Barry, U.S. Ambassador to Indonesia, told the February session of Megacities of the Pacific Rim and

continued on page 6

Emerging economies face choice, environment or development

Jakarta – Less developed countries are increasingly finding themselves caught on the sharp horns of a dilemma as they work to expand their economies.

Dr. Emil Salim, Indonesia's Minister of the State for Environment and Population, speaking to the closing session of Megacities on the Pacific Rim and the Burden of Air Pollution, said policy makers face deciding between badly needed economic development and ecosystems stretched to their limits.

The minister remarked that the realization that bumping up against the environmental carrying capacity is creating significant constraints, comes at an unfortunate time for less developed countries. Populations have shifted from rural to urban areas and urban populations are growing faster while rural population growth declines.

As an example of environmental demands, Dr. Salim outlined an informal survey he made of his Indonesian cabinet colleagues. The survey asked each minister to estimate future departmental land-use requirements. Responses added up to 256 million hectares.

He said the survey results, even though informal, clearly indicated land-use planning cannot be left to individual sectors and land users must be prepared to compromise on their requirements.

Dr. Salim said he reached his conclusions when he realized total land requirements were 63 million hectares more than Indonesia's 193 million hectare land mass.

As less developed countries progress, the minister urged policy-

continued on page

Replacement of 'Evil Empire' arduous, daunting task minister says

The vilified "Evil Empire" may be gone but cobbling together a workable replacement is proving to be an arduous and daunting task.

Oleg Kolbasov, the Russian Federation's Vice Minister of Ecology and Natural Resources, told the 63rd International Environment Forum (IEF) meeting in New York in October, current confusion over jurisdictions is rooted in the different types of entities which make up the federation.

Some 88 members constitute the Russian Federation. Of that membership, 20 areas are republics with their own constitutions, legislation and governments. By contrast approximately 50 areas, referred to [illegible]

government.

Professor Kolbasov told the IEF five organizations influence environmental legislation at the federal level. The Ministries of Environmental Protection and Natural Resources, Public Health and Atomic Energy deal with environmental issues along with two committees, the State Committees on Emergencies and Rehabilitation.

At the regional level 17 agencies are responsible for environmental regulation in addition to a number of local agencies. "Fortunately, recent reforms have resulted in some reduction in the number of organizations," he said.

With 20 republics holding a substantial degree of autonomy, Prof. Kolbasov commented on the need for careful management of relations between the central government and the republics. Environment and natural resources are currently the subject of treaties between the federal and republican governments. Agreements cover other areas such as transportation, industrial development, and railways.

Consolidating organizations and implementing new policies is a slow process prolonged by vested interests resisting change, according to Professor Nicholas Robinson, Director of the Pace University School of Law's Center for Environmental Legal Studies and Vice Chairman of World Environment Center.

Oleg Kolbasov - *Russian Federation's Vice Minister of Ecology and Natural*

Participating as a member of a discussion panel with Prof. Kolbasov, Prof. Robinson noted Russian public opinion shows concern about the environment. "Western companies interested in investing in Russia must show, by example, their concern," he added.

A complicating element facing western companies is they are being asked to accept responsibility for clean up of past contamination. James Hildrew, Mobil Corporation's Manager of Environmental Affairs, the second member of the discussion panel, noted companies are prepared to offer technical resources to correct problems but should not be asked to shoulder undefined burdens in pre-existing conditions.

During discussions, Prof. Kolbasov said that while foreign investors will not be held responsible on a blanket basis, each situation will be looked at case by case.

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Corporate group reorganized
Veras promoted, new director named

The Corporate Programs group of World Environment Center (WEC) has been reorganized. As a result Senior Vice President, James Veras, has been promoted to executive vice president and a new director of corporate programs has been appointed.

Effective February 1, Ramon Alfonso took over responsibilities as director of WEC's corporate programs including the International Environment Forum (IEF) and the WEC Gold Medal for International Corporate Environmental Achievement.

Mr. Alfonso joined WEC after a variety of management positions with Combustion Engineering and United Technologies. He founded and became president of the Alliance for International Environmental Studies. The alliance, in partnership with Yale and Universidad Lasalle, was involved in training of industrial environmental managers in Latin America.

While at United Technologies, Mr. Alfonso participated in programs of the Center. He was United Technologies' senior representative to the IEF and was a major contributor to and supporter of WEC's Country Profile Program.

WEC's President, Antony Marcil, on announcing Mr. Veras' promotion, said it reflects a restructuring of and new challenges for senior management at the Center.

For the last eight years Mr. Veras has been involved in all aspects of the Center's management but mainly responsible for relations with corporate participants in WEC's International Environment Forum and the annual WEC Gold Medal program. Under Mr. Veras IEF participation doubled from 30 companies to 60 firms in 1991.

The new title formally recognizes Mr. Veras' participation in strategic planning and development of the Center's long-term goals and his role in day-to-day management. He will continue to work with companies of and activities involving the IEF including development of Forum meetings outside of the United States.

Following his graduation from the Massachusetts Institute of Technology, Mr. Veras spent 33 years with a number of multinational companies before beginning his own consulting practice which eventually lead to his role at World Environment Center. ▲

Prague, Jakarta new WEC office sites

World Environment Center (WEC) added emphasis to its worldliness with the addition of two new offices.

Facilities in Prague, in the Czech Republic, were opened in the fall of 1992 operating with three part-time staff members. Ludmila Hofmanova manages the office as country coordinator. Jim Scherer is serving as advisor to the Czech Federal Committee, and the Ministries for the Environment, Industry and Privatization. Radomir Matyas is a WEC Senior Fellow who will coordinate activities.

Former PT Goodyear employee, Harry Wiradiputra, was appointed January 1 to head WEC's new office in Jakarta, Indonesia. Mr. Wiradiputra assumed his position in time to be involved in the February Megacities conference.

Staff in the Prague office will be responsible for activities in Eastern and Central Europe. The Jakarta office, space for which is being acquired, will oversee a number of WEC activities in Indonesia including [illegible] and Prevention program.

WEC currently operates with headquarters in New York and offices in Washington, DC; Mexico City, Mexico; and Bangkok, Thailand. ▲

Berlin IEF - *Former USEPA Administrator William Reilly makes a point at a n conference while his German counterpart, Klaus Töpfer, listens.*

EPA's carrot & stick work better than command & control

Berlin – Much remains to be done before major environmental goals are accomplished, but steps necessary to reach the objectives have been established, the outgoing Administrator of the United States Environmental Protection Agency (EPA) told a meeting here of the International Environment Forum (IEF).

"We may not yet have fully realized our most important environmental and economic goals, but I think the path we need to take is well marked," William Reilly, who left the EPA in January, 1993 said at the December meeting.

The 1992 environment conference in Rio de Janiero established the political "linkage" between economic growth and environmental protection, Mr. Reilly remarked. "Linkages between the economy and the environment, accepted as philosophical truth in many political and business circles, are still difficult to forge in practice."

Mr. Reilly criticized what he called, "command and control as standard U.S. government operating procedure" admitting it had improved environmental quality in the United States.

"But over time it's become apparent that environmental policy based on prescriptive 'command and control' has many drawbacks. [illegible] when the sources of pollution are small and dispersed, when individual – as opposed to corpora – behavior is involved."

In the last four years EPA has i posed more fines, penalties and months of jail time for violators o environmental law than in the agency's previous 18 years combined. "But we are adding a new tool, a carrot that complements t big stick of enforcement."

He said government, by defini the best pollution controls for an dustry, "creates a disincentive for technological advancement."

Community right-to-know requirements, law since 1986, have produced an unexpected result. requiring business to report the quantity of some 200 toxic chem cals released into air, water and land, corporate executives have been informed of the waste from their own facilities, the result of ficient use of process chemicals, vents and energy.

"It gave corporate executives strong economic incentive to fin ways to reduce waste and liabilit save money and . . . improve the image and build public confiden he said.

Subsequently, EPA was able get reductions in pollution levels asking. Mr. Reilly added reducti were achieved, "not just becaus we asked, but because corporat increasingly realize that it's in th [illegible] tion." Other voluntary efforts h achieved "similar results", he sai

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Conventional wisdom is wrong - environment must come first

Berlin – Current conventional wisdom is wrong - environmental issues in Eastern Europe and the Third World cannot take second place to economic development without "serious consequences," Prof. Dr. Klaus Töpfer, the German

Klaus Töpfer - German Minister for the Environment, Nature Conservation and Nuclear Safety.

federal Minister for the Environment, Nature Conservation and Nuclear Safety; told the 64th meeting of the International Environment Forum (IEF).

Prof. Töpfer speaking to the December meeting, IEF's first ever session in Europe, said ". . . we are often confronted with the theory that, because of their (Eastern European and Third World countries) economic situation, these countries are not in a position to take account of the environment. According to this theory . . . it is only on the basis of a certain level of economic prosperity that environmental protection can be financed."

"I believe this is a fallacy which could have serious consequences for these countries, not only from an ecological, but also from an economic point of view," the minister warned.

Prof. Töpfer told the IEF session the environment must be viewed as any other capital asset and treated by corporations in the same way a company looks after its other capital stock. "By taking . . . depreciation into consideration a company sets the basis for maintenance of its activities in the long term. The same is true of our environmental capital."

The minister cited examples from a recent German study which examined the scale of costs of environmental abuse:

- emission-related building damage - 1.8 to 3.2 billion Deutsche Marks per year ($1.13 to $2 billion dollars US);
- cost to provision of safe drinking - 1.7 billion Deutsche Marks ($1 billion dollars US); and
- soil pollution cost - 22 to 60 billion Deutsche Marks ($13.8 billion to $37.8 billion dollars US).

"There can be no doubt preventative environmental protection is cheaper than subsequent clean-up," the minister said adding, "environmental protection must not be put off . . . it must be ensured that this (economic) growth is environmentally compatible and thus can be maintained in the long-term."

In addition to delivering the keynote address to the session, Prof. Töpfer was also its host as a result of his 1991 invitation to the IEF to meet in Germany. The gathering was a series of opportunities. Not only was it an occasion for IEF companies to meet and hear from the German minister, it was also an event for European company officials to be exposed to IEF and to hear from a leading American regulator, William Reilly, the outgoing Administrator of the United States Environmental Protection Agency.

Commenting on environmental policy, the minister noted effective policy requires involvement by both government and the private sector. He was critical of the former Eastern European governments saying, "the socialist command economy" failed to provide even a minimum level of regulation.

However, the free market economy is not "automatically environmentally compatible," he added.

The objective of government environmental policy "must be to gear the social market economy towards" ecological needs.

Government policies which set a "clear framework" of law and in-

"There can be no doubt preventative environmental protection is cheaper than subsequent clean-up"

tegrate environmental and business concerns, will trigger "the superiority of market mechanisms" generating corporate "interest" in protecting the environment.

"In order for an ecological market economy to function, cooperation is required between the state and trade and industry." The minister added, "however, it is, in the final analysis, the state which bears ultimate responsibility for environment policy and thus must ensure the measures that are necessary are implemented even if they meet with opposition from trade and industry."

The countries of Central and Eastern Europe have "dramatic ecological legacies" which they cannot overcome on their own. Similarly, countries of the Third World have equal need for assistance from the industrialized countries.

"These (developing) countries also have a moral right to aid since it is beyond doubt that many global environmental problems have been caused by the industrialized countries."

Continued from page 2

EPA's carrot & stick

Mr. Reilly called on multinational companies to "embrace the revolution of volunteerism," saying to do so will help governments address pressing global environmental issues with the least burden on industry and society.

"You should be committed to go beyond compliance, whatever compliance means in a host country. It is up to you to foster technological innovation, continuous improvement, he told the group of corporate officials.

Government actions on ecological pledges will be dictated by political philosophy and their state of economic development. Regardless of those actions, "voluntary actions by multinational corporations will be crucial to . . . overall success," he stated.

IEF in Berlin sets new records

December's 64th meeting of the International Environment Forum (IEF) in Berlin, Germany set a number of IEF firsts.

World Environment Center's (WEC) Executive Vice President, James Veras, responsible for the IEF, reported the Forum's meeting in Berlin was the first IEF session held outside of North America.

A second milestone for the IEF came from its speakers. For the first time, an IEF audience heard from two senior environment ministers at the same session. Prof. Dr. Klaus Töpfer, the German federal Minister for Environment, Nature Conservation and Nuclear Safety; and his outgoing American counterpart, William Reilly, the then Administrator of the U.S. Environmental Protection Agency (EPA), both addressed the meeting.

With two high quality speakers, it was not unusual that the forum should have its largest audience, the third accomplishment for the Berlin meeting.

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New program offers training to appreciate other cultures

Did Iraq and the coalition forces of Desert Storm go to war because of cultural misunderstanding?

That's the conclusion the Saudia Arabian Ambassador to the United States came to as the air war began over Iraq on January 17, 1990. Prince Bandar bin Sultan, who's views were reported by Bob Woodward in his book *The Commanders* Simon and Schuster 1991), is said o have been involved in negotiaions between Iraq, the United itates and Saudia Arabia following raq's invasion of Kuwait.

The mass destruction of war nay be an extreme example, but it ; the worst possible result when eople from different cultures fail o understand each other because f their differences.

Responding to the increasing lobalization of business, and the esulting higher potential for misnderstanding, World Environment enter (WEC) is now offering a proram to expose international busiess to the need for sensitivity in ansitions between cultures.

.The program, "Training for lobal Diversity: Understanding the uman Factor," was offered during a compressed, one-day session in New York last October.

Intercultural training program - *Consultant William Moss makes a point during the first intercultural training program. WEC's Director of Training, Peter Beckschi, is seated at left.*

William Moss, a consultant with extensive experience in intercultural training, and Peter Beckschi, WEC's Director of Training, lead the session for 20 representatives from companies participating in the International Environment Forum (IEF).

"Lack of cultural, human sensitivity is one of the most potent barriers to the flow of information," Mr. Beckschi said.

To overcome that lack of sensitivity the seminar examines a five dimensional "model." Mr. Moss said this model is used by a number of multinational firms, such as Royal Dutch Shell and British Petroleum, to define cultural differences.

Among the areas covered are the way a culture creates authority structures, the role of personal identity and integration with groups, and tasks and relationships.

The objective of the program, according to Mr. Beckschi, is to give participants a working "mental model" of how different cultures operate. As a result, there should be less anxiety for people who must work across cultures and greater comprehension of information passed between cultures.

"At the urging of a number of companies, WEC began looking at this area in the context of transferring information on and as well as awareness of environmental, health and safety issues to other cultures," Mr. Beckschi remarked.

Following the October seminar WEC was approached by companies to offer the program to employees. One in-house session has been contracted and Mr. Beckschi said another seminar, open to IEF companies, will take place May 13 and 14 in New York City.

Seating at seminars is limited. Additional information is available from Mr. Beckschi at WEC. ▲

Ten IEF companies mark 10 years

1992 marked a decade of paraipation for ten companies of the ternational Environment Forum :F).

A cornerstone of World Environent Center (WEC), the Forum, curntly a group of some 60 multinanal manufacturing companies, eets several times each year for f-the-record discussions on enonmental, health, safety and iource management issues with nior policy-makers from around e world.

At an October 14, 1992 dinner Chairman and Vice President of ied-Signal, Inc., Edward Callahan, d Professor Nicholas Robinson, e Chairman of the WEC Board of ectors, presented plaques recog-ing corporate participation and ressing appreciation for conued support.

Companies recognized were: Minerals, The Dow Chemical Company, Englehard Corporation, Exxon Corporation, IBM Corporation, Mobil Oil Corporation, Occidental Petroleum Corporation, 3M Corporation, Unocal Corporation, and Westvaco Corporation.

IEF senior representatives - *Company representatives receiving plaques marking ten years of participation are (left to right) Ernie Rosenberg of Occidental Petroleum, Robert Dostal of Dow Chemical, David Benforado of 3M, John Kelly of Exxon International, James Hildrew of Mobil Oil, Rita Ewing of BHP Minerals and IEF Chairman Edward Callahan of Allied-Signal.*

Employees of the ten firms have contributed countless volunteer hours to the Center as a whole and the International Environment and Development Service (IEDS) in particular. IEDS is a technical cooperation program providing professional development and sharing of environmental expertise around the world.

Organizations eligible to participate in the IEF are multinational manufacturing or processing companies with production facilities in more than one country and a desire to contribute to global sustainable development by strengthening industrial and urban environmental, health and safety policies and practices. ▲

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Time away from government refreshes, revitalizes, gives perspective

'n the continual struggle to main-
-tain contact with customers, it is
nportant for an organization,
ublic or private, to keep employees
urrent en their clients' perspectives.

Many large organizations en-
ourage employees to work outside
f the institution for a period then
eturn bringing a new, refreshed in-
ght. Through the Intergovernmen-
al Personnel Act the United States
overnment enables its employees
o take fixed-term positions with
ther governments and non-
overnmental organizations. For
he employee, it is an opportunity
o develop new skills, learn how dif-
erent organizations function and
eturn with a new perspective.

World Environment Center
WEC) has benefitted from this pro-
ram. Robert Hardaker, now a
enior fellow in WEC's Washington
ffice, came to WEC having been
ne of the original employees of
he Environmental Protection Agen-
y (EPA). In an interview with **Net-
vork News**, Mr. Hardaker talked
bout his government career, its
hallenges and the satisfaction of
is job at WEC.

Network News: What did you
ope to accomplish by participating
n this exchange?

Mr. Hardaker: In mid-1991, I
ame to a personal conclusion I
eeded to spend some time outside
f EPA, to reinvent myself. There
vere a few things I wanted to ac-
omplish. I felt I needed to get
ack in the environment, working
n real, on-the-ground issues. In
articular I wanted to work on inter-
ational environmental issues and
o look at approaches to govern-
nent/industry cooperation. I also
vanted to see whether I could have
more effective and more satisfy-
ng impact on problems from out-
ide of the bureaucracy.

NN: How does that relate to your
PA job, your perspective at EPA.?

Mr. Hardaker: I like to think I have
vorked in a variety of programs in
hefederal environmental
ureaucracy looking for better ways
o deliver government services,
[illegible]
f the stakeholders and building
state and local environmental
management capacity.

NN: Do you think that influenced
your desire to look outside of
government?

Mr. Hardaker: In some ways, yes.
If you are familiar with TQM (total
quality management) you know a
keystone of TQM is identification
with your customer. That's impor-
tant for government too because it
is easy for government employees,
after a time, to come to believe
their client is government. It's not.

NN: Do you know why you felt
that need to see the world from the
other side of the fence, as it were?

"If you really are intent on having a perceptible impact, if you really crave it, WEC is the place."

Mr. Hardaker: I've been working
in government for 20 years. I real-
ized I needed to get out with my
real clients and see the government
from their perspective. To me the
experience will clearly help me to
do my job better.

NN: What arrangements lead to
your coming to WEC?

Mr. Hardaker: For all intents and
purposes, I'm on loan to WEC from
the EPA. Once I decided I wanted
to work outside of the EPA I
received approval from the deputy
administrator for two-years service.
An agreement between WEC and
the agency provides me with a
secure position at the agency and a
job at WEC. The agreement be-
tween the two also includes a
negotiated arrangement on pay-
ment of my government salary and
benefits.

NN: You have been here at WEC
for a little over a year. Have you
come to any conclusion about your
experience at the Center?

Mr. Hardaker: It has been incredib-
ly satisfying.

If you are really intent on having a
perceptible impact, if you really
[illegible]
course, the environmental problems
in these countries (where WEC
works) are enormous, but pretty
much whatever you do has an im-
pact. You can see it in the faces of
the people with whom we work. I
feel that I'm having a real effect.

Now I may have been in a really ad-
vantageous position from the start
because it was an extraordinary
coincidence that I met (WEC Presi-
dent) Tony Marcil just as the Mexico
program was about to begin.

At EPA I did a lot of work shaping
programs and initiatives. With the
Mexico program I have had the
chance to develop the program con-
cept then actually working on its im-
plementation.

NN: What will you take back to
EPA, both personally and profes-
sionally, from your experience?

Mr. Hardaker: Well, first of all, I'll
take back a feeling of renewal,
revitalization. Second, I'll also take
back a sense of the environmental
challenges out there, challenges
that people and organizations, like
WEC, are doing something about.

Third, and perhaps most important,
I'll return with a sense of how and
what EPA can and should do to
work more effectively with industry
and nongovernmental organiza-
tions, like WEC, to accomplish our
shared environmental goals.

NN: As a manager in government,
what would you say to a staff mem-
ber or colleague who asked about
the wisdom of and the experience
from this kind of activity?

Mr. Hardaker: I would, without
question, recommend the ex-
perience particularly if it was with
an organization like WEC.

NN: You transferred from a large
organization into a much smaller
one, how does it feel?

Mr. Hardaker: It has been a
definite challenge shifting from a
large government system to a small
have also moved from doing a lot
of talking about problems to doing
a lot about them.

Working on the Mexico project has
the additional demand of moving
from thinking in terms of U.S. cul-
ture and problems to thinking
about those of Latin America.

NN: Are there other aspects to
your service with WEC that give
you satisfaction?

Mr. Hardaker: As you know, we
work primarily with volunteers, ex-
perts in their professional fields.
They give us their expertise, on an
uncompensated basis, for a period
of about two weeks.

So far, it has been a truly wonder-
ful, growing experience that, as we
often hear from the volunteers,
gives back way more than it takes!

NN: How did you come to be work-
ing at WEC?

Mr. Hardaker: Bill Reilly, (then) the
EPA's administrator, has been very
interested in international environ-
mental and trade-related issues and
I was working in his office on a
range of international environ-
mental problems.

My first boss in Washington and
long-time mentor, Bert Printz, is the
person largely responsible for my
being with WEC today. He con-
nected me with Tony Marcil and we
both agreed WEC was the right
place.

NN: What career background did
you bring to WEC?

Mr. Hardaker: I have over 20
years of experience in the environ-
mental field starting with the
Department of the Interior's Federal
Water Quality Administration in
Chicago. Most of my career has
been spent in Washington with a
strong emphasis on managing
domestic water quality programs.

I have worked on a number of chal-
lenging programs including develop-
ment of the new National Pollutant
Discharge Elimination System and
development of an innovative oper-
ations and maintenance training and
technical assistance program for
waste water treatment facilities.

Just prior to coming to WEC, I
[illegible]
administrator's Office of Coopera-
tive Environmental Management. ▲

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Joint Megacities initiatives to continue

Jakarta – Eight of the world's megacities, home for over 75 million people, have agreed to continue a series of joint initiatives to address problems of urban air pollution.

Delegations representing the cities agreed, at the concluding session of Megacities on the Pacific Rim and the Burden of Air Pollution, to establish a permanent steering committee of city representatives to work on common air quality issues.

Over the next two to five years the cities will attempt to address existing problems and transfer and implement new air pollution technology and techniques. The role of the steering committee will be to support various national initiatives by providing facilities for exchange of information between participating cities.

Organization of the permanent steering committee began immediately following the February Megacities meeting here.

Among the projects the cities will undertake are harmonization of ambient air quality standards, emission monitoring and coordination of air pollution programs within the region and exchange of information on existing technology and techniques.

Each of the eight cities participating in the Megacities meetings will appoint a representative to the steering committee. World Environment Center (WEC), one of the meeting organizers, will provide support services to the steering committee. WEC will also assist the cities by aiding the steering committee in identifying projects, organizing timelines, and project monitoring and evaluation.

Participating in the four days of Megacities meetings and the new committee are representatives of the cities of Bangkok, Jakarta, Kuala Lumpur, Los Angeles, Manila, Mexico City, Singapore, and Taipei. The meeting's examination of the stipulated principal emissions source, mobile source, was aided by the release of a two volume report prepared at California's South Coast Air Quality Management District in the summer of 1992.

Megacities was organized by WEC with assistance from the Mansfield Center for Pacific Affairs. ▲

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Problem urban growth unstoppable

makers to focus on four principal areas: resource management, waste management, human resource management and rehabilitation and enrichment of the prevailing environment.

Once those factors have been controlled, the focus can then be shifted to economic progress through development of those elements.

Four days of Megacities meetings in February were attended by 90 people from the cities of Bangkok, Jakarta, Kuala Lumpur, Los Angeles, Manila, Mexico City, Singapore, and Taipei.

Failing to address the problems of the world's megacities, such as population, risks damaging the ecology and the economic stability of the cities themselves, Indonesia's assistant minister for population and [illegible] opening session.

Among the problems facing urban areas in developing countries, yet remaining unaddressed by society, are traffic congestion, backlogs of services and facilities and resource depletion. The assistant minister said those problems are often interrelated and not limited by local, regional or international boundaries.

"To remain unchallenged (these environmental problems) will lead to various population and environmental constraints so that . . . ecologically sound and sustainable development itself will be at risk," Dr. R.E. Soeriaatmadja, Assistant Minister of State for Population and Environment, said.

To date, the world's megacities have failed to adequately address a number of issues, urban air pollution among them, he added.

Laying the statistical groundwork for his minister's remarks, Dr. Soeriaatmadja noted the global urban population has grown from under 300 million people in 1950 to over 1.3 billion people in 1992.

If the urbanization trend continues over the 1990s, the world's urban population will reach two billion people. "No country in the world, especially in the developing countries, . . . is able to restrain, successfully, the urban population growth," Dr. Soeriaatmadja added.

To support themselves, the megacities must improve their productivity and quality of urban environment will be key to accomplishing that goal. The assistant minister remarked that an improved environment will result in "better income generating activities" producing "higher productivity of human resources" in urban areas.

Future development of the megacities will be a fine balancing act. Improved productivity and environmental quality may add to problems confronting the cities by increasing their desirability and generating increased migration from rural areas.

Solutions to the problems of one of the megacities may lie in the experiences of another. In some cases, the assistant minister said, one city's failures may turn out to be another city's solution because of the diversity in conditions between the cities. ▲

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Pollution transnational problem

the Burden of Air Pollution.

"Cities there (Eastern Europe) are an environmental nightmare and I fear the mistakes made in Eastern Europe will be repeated elsewhere," Ambassador Barry warned conference participants including over 60 representatives from eight major cities of the Pacific Rim.

He said the Megacities meeting represents an important landmark, "(it) reflects the realization that none of us can afford to pursue economic growth blindly, relegating environmental protection to secondary importance."

"Pollution is a transnational problem . . . we are all in this together," he added.

Speaking at the opening of the four-day Megacities symposium, the ambassador told city representatives environmental awareness is no longer a "luxury." Traditional economic growth and resource utilization policies have "seriously degraded" the earth's productive capacity. "We must use resources more wisely than in the past."

"Clearly, I do not mean to suggest that we must cease all industrialization or economic development. That is obviously impossible and undesirable. But I do mean that sustainable economic growth policies must become the norm, with social and environmental needs factored into planning."

Commenting on American technical and regulatory initiatives, the ambassador said progress has been made, "but more needs to be done." In particular he cited the need for American companies to transfer, to countries with air pollution needs, improved environmental protection technology.

"The U.S. is committed to working, as a partner, with Indonesia and with other countries in the region to promote sustainable economic growth," Ambassador Barry said. He told city representatives the United States does not have all the answers. It does have considerable experience with environmental technologies that can be "helpful."

Four days of Megacities meetings were attended by representatives of the cities of Bangkok, Jakarta, Kuala Lumpur, Los Angeles, Manila, Mexico City, Singapore, and Taipei. The meetings, following up sessions held in the summer of 1992, heard a series of technical reports and concluded by organizing information sharing and action programs to address urban air pollution.

Megacities was organized by World Environment Center (WEC) with assistance from the Mansfield Center for Pacific Affairs. The United States Agency for International Development, the United States/Asia Environmental Partnership and the Environmental Protection Agency provided substantial funding for the event with additional financing from Taiwan and WEC. ▲

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Waste minimization demonstration

East Europeans show pollution prevention can be profitable investme

If you made a one-time investment of $5,000 and earned a return of $90,000 a year following the first year and for every year thereafter, would you consider it a worth-while investment?

That is a conservative estimate of economic returns to be earned by a Polish industrial facility participating in a waste minimization demonstration project run by World Environment Center (WEC). The early months of WEC's program, funded by the United States Agency for International Development (USAID), shows the potential for even larger financial returns at other project sites.

Establishing a value for the positive environmental impact of the program is not as easy as calculating the economic benefits but the results are equally profound, according to Romuald Michalek, WEC's Vice President for Central and Eastern Europe's Region I.

Improvements at this Polish plant should see air emissions of organic carbons alone drop by about 10 metric tonnes per year.

Teams from WEC's International Environment and Development Service (IEDS) are running a series of demonstration projects at targeted industrial plants in Central and Eastern Europe. The main objective is to transfer technology and techniques to build local pollution reduction capabilities and show economic benefits from the use of low-cost and no-cost waste minimization techniques.

"$5,000 invested in waste reduction earns a return of $90,000 a year . . ."

eligible to participate in the project," Mr. Michalek said. "Facilities must meet five criteria."

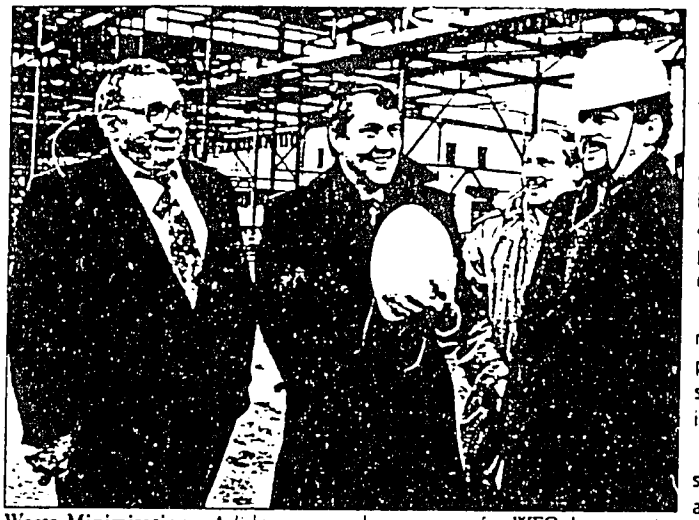
First, and perhaps most important, plant management must be interested in and committed to the project. As an indication of commitment company executives must sign a participation agreement. "There is no question about it, top plant management must be committed to the project," remarked Tom McGrath, WEC's Vice President for Central and Eastern Europe's Region II.

Second, the facility must have serious pollution problems and opportunities for waste minimization.

Third, the company must be in an industrial category important to the host country. With the condition of economies in the region, an early focus on key economic sectors is important to the countries, Mr. Michalek said.

Fourth, the plant must be economically viable. If the enterprise has not been privatized, it should be a candidate for government divestiture.

The fifth, and key criteria, is the site, when feasible, must be within Danube River. USAID, The World Bank and other organizations are involved in programs to improve the quality of the Danube.



Waste Minimization - *A lighter moment during a tour of a WEC demonstration project. U.S. Ambassador to Poland, Thomas Simons, (center) and U.S. Consul General in Poznan, Christian Kennedy (right) were briefed by Jerzey Ossouski, General Director of Organika-Zachem, (left) and WEC officials at company facilities in Bydgoszcz, Poland.*

sumed means lower quantities of waste. For the plant, the diminished waste stream means reduced environmental liabilities and improved opportunities for relationships with western companies.

The old centrally planned economies of Europe curbed plant reinvestment in favor of directing profits to large, national undertakings. Projects important to local management were given lower priority.

Minimizing waste should occur at source, Mr. Michalek said. To take advantage of economic and environmental benefits, local management needs to be in a position to decide priorities and make choices.

A typical WEC waste minimiza-

three people: an independent consultant, an expert and a WEC staff member. The team works with management and staff, both at and

a way

"One of the things we are tryir to do is work ourselves out of a job," Mr. McGrath said. WEC teams assist with establishment of plant-wide waste minimization cor mittee structure and provide training programs to educate plant sta and management, local independent consultants as well as rep resentatives of other area plants.

Depending on the project, time may be divided between plant process matters and training of staff and management in waste m imization activities.

"We are working to promote th spread of waste-free technology and techniques throughout the region like the ripples created whei you drop a stone in a pool of water," Mr. McGrath commented. To avoid reinventing the wheel, teams also aid in seeking out case studies and other sources of information useful to project participant

"We are working to promote the spread of waste-free technology . . . like the ripples created when you drop a stone in a pool . . ."

The waste minimization project, a first for WEC, was conceived and designed by WEC staff working closely with both Washington-based and field staff of USAID. By demonstrating the economic benefit of waste reduction at source, the old state-owned companies develop their own motivation to achieve the ultimate goal of waste-free industrial processes. ▲

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WEC Gold Medal

Call for nominations

The World Environment Center (WEC) is now accepting nominations for the tenth WEC Gold Medal for International Corporate Environmental Achievement.

Awarded annually, the WEC Gold Medal recognizes industry's contribution to international environmental management.

To be eligible, a corporation must have substantial international operations with an outstanding, sustained and well-implemented environmental policy. Submissions are evaluated by an international jury of distinguished, independent, multi-disciplinary, multinational experts from industry, academia, government and non-governmental organizations. The jury assessment of the submissions seeks a corporate policy demonstrating positive environmental practices, clear examples of that policy and leadership in the international environmental field.

Industry, organizations, governments, associations, institutions and individuals may submit nominations. Self-nominations are also accepted. The submission deadline is August 2, 1993 with the jury announcing its decision in December. The medal presentation takes place at ceremonies in Washington, D.C. in the spring of 1994.

Xerox Corporation will receive the 1993 WEC Gold Medal at Washington ceremonies on April 30. Previous recipients include The Procter & Gamble Company, Rohm and Haas Company, IBM Corporation, The Dow Chemical Company, The British Petroleum Company, E.I. du Pont de Nemours & Co., Exxon Corporation and 3M Corporation.

Additional information is available from the Center. ▲

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Russians seek money & clean technology

"Russia encourages foreign investment but is seeking experienced investment, investment that brings with it high and clean technologies."

The vice minister added, "Russia encourages foreign investment but is seeking experienced investment, investment that brings with it high and clean technologies."

Established in 1991, the Ministry of Environment and Natural Resources plays a key role in the regulatory process. The Law of the Russian Federation on Protection of the Natural Environment is the main regulatory statute setting policy for resource development and economic activities ranging from existing industry to agriculture and use of water, forests, and other biological resources.

Prof. Kolbasov noted new federal laws have been passed setting standards for air, soil, drinking water and food. Others are being developed based largely on current European Community standards. ▲

NETWORK NEWS is published by the World Environment Center (WEC), an independent, not-for-profit, non-advocacy organization. Founded in 1974, WEC contributes to sustainable development worldwide by strengthening industrial and urban environmental, health and safety policy and practices. Through three complementary programs, WEC serves as a bridge for the exchange of information and expertise among industry, government, and non-governmental organizations.

WEC receives funding, in-kind resources from industry, government, national and international agencies, foundations and private citizens. Volunteer expert services are the hallmark of the Center's programs.

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WEC IEDS REVIEW

PUBLISHED BY WORLD ENVIRONME[illegible] CENTER

VOLUME 3, NUMBER 1, SPRING 19[illegible]

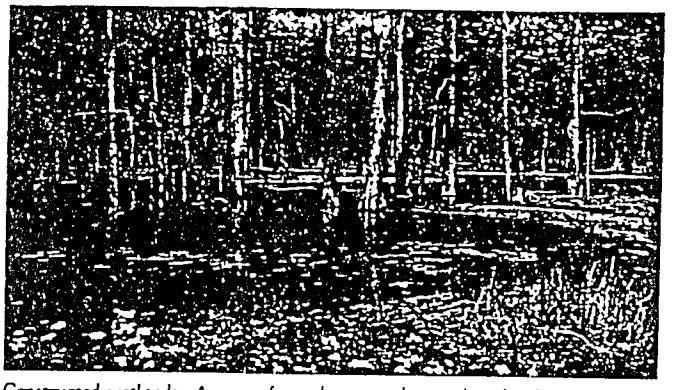
Constructed wetlands

Mother Nature's good idea finding new role in wastewater treatment

Marsh, swamp, bog; call it what you will but unfortunately, the area between water and dry land has long been considered wasted. Any value in this terrain has been for conversion to other uses.

These tracts are now being looked at from a different perspective, as a natural resource that can be used, with few changes, to benefit the community. A substantial new value may come from recognizing what these areas, now referred to as wetlands, really are — giant biological filters.

Statistics clearly show the extent of wetland conversion. It is estimated the United States originally had 215 million acres of this marginal land. About half of that total, some 116 million acres, has since been transformed to other uses, mostly agriculture. Preservation by private organizations, such as Ducks [illegible] limited, or governments has been oriented to conservation of water-[illegible] habitat.



Constructed wetlands – A series of open lagoons and areas planted with native wetland plants are used to create an environment resembling this natural swampland

Using natural or man-made wetlands for waste-water treatment has many advantages. Conventional methods are energy intensive with facilities using large volumes of electrical and mechanical power as well as chemical and biochemical techniques.

By contrast, wetlands use solar power, photosynthesis, to take up and assimilate pollutants. They even produce beneficial by-products including nutrition for bacteria, fungi and other micro-organisms that assimilate and metabolize pollutants and as food and cover for animals who frequent them.

Lisa Raudelunas, the World Environment Center's Project Manager for Asia, says knowledge of wetlands,

See Wetlands on page 2

Program addresses cement dust major Near East air problem

Cement. It is the main construction material in the Near East as it is in many parts of the world. In the Near East it is also one of the largest sources of air pollution, particularly around Cairo.

Past efforts to address cement dust problems did not seem to reach expectations. However, in recent years the region's industry has shown renewed interest and begun to take steps to address the issue.

To assist in that process the World Environment Center, through the volunteer technical experts of its International Environment and Development Service, undertook a number of environmental assessments at Egyptian cement plants. IEDS receives funding from the United States Agency for International Development.

According to George Lombardo, the Center's project manager for the Near East, the assessments, conducted independently of each other, identified many common problems.

The assessments also identified "phenomenal...unbelievable" economic benefits for dust reduction, remarked Jim Parsons of the environmental consulting firm Apco Services, who conducted several technical assessments.

Mr. Parsons tries to resist overstating the [illegible] consequence but notes [illegible] have found many tons of [illegible]ished cement being vented from manufacturing facilities. He said he joke[illegible] with an Egyptian company official saying, "if you will give us the product we will capture [illegible] year, we will [illegible] and maintain [illegible] of [illegible] dust collect[illegible] system."

While the Egyptian industry shares [illegible] there are [illegible] of potential solutions. Mr. Lombardo remarked that [illegible] Egyptian industry [illegible] environmental, health and safety field. Since the nation's cement industry has high visibility, it presents a platform from which to introduce other environmen-

See Cement Dust on page 2

Success of Polish program outlined for Vice President Gore

Warsaw—When the boss is in town, you want to make sure everything goes well and he or she leaves with a favorable impression. That was the challenge that faced staff of the United States embassy in Warsaw, Poland when Vice President Al Gore visited earlier this spring.

The main purpose of the short visit was to commemorate the [illegible] in the Warsaw ghetto. Time was available to meet with [illegible] embassy staff organized [illegible] a number of government [illegible] nongovernment environmental groups. The next task was to find a business person who could speak to the challenge of commerce and the environment.

Staff at the United States Agency for International Development's Warsaw office called on Tom Pluta at the World Environment Center's International Environment and Development Service.

Mr. Pluta said he knew just the right person: Roman Kasperczyk, coordinator of waste minimization at Organika-Zachem in Bydgoszcz. The chemical company is on the leading edge of commercial and environmental issues in Poland. While Zachem could be considered part of Poland's environmental, health and safety problems it is also playing a major role identifying issues and finding effective solutions.

It took some convincing but Mr. Pluta persuaded his Polish contact to make a five minute presentation on behalf of the nation's business community.

"Poland and other countries in Central and Eastern Europe face severe environmental problems the [illegible] emphasized development at all cost," Mr. Kasperczyk told Mr. Gore.

Managers of Polish companies are now confronted by the need for environmental sensitivity while operating in new, competitive regional and global markets, he said.

See VP Applauds on page 2

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VP applauds USAID/WEC efforts

"Meeting the environmental challenge is a considerable task we must undertake because the management and staff at our company...are citizens of the town of Bydgoszcz as well. Each day, with our neighbors, we see, smell and feel the waste materials generated by our plant."

Mr. Kasperczyk described the origins of the company's waste minimization program and its growth to the point at which the company needed experience beyond its capabilities.

"We are fortunate to have been able to continue our initiatives by accessing new expertise. With the assistance (of USAID and WEC) we have been able to draw upon North American experts to advise us on current low-cost and no-cost technology and techniques.

"...waste minimization has a comprehensive impact. Our environment is cleaner. Our company benefits, making it more competitive, because we have become that much more efficient producing more products using less raw material and less energy." Mr. Kasperczyk went on to tell Mr. Gore that his company intended to "build on our accomplishments and spread to our countrymen the knowledge we have gained."

Mr. Kasperczyk told the vice president the program, when fully implemented, has the potential to save Organika-Zachem some $2 million (U.S.) per year as well as realize significant reductions in plant waste emissions.

In his remarks, Vice President Gore complimented Mr. Kasperczyk on his presentation and was delighted to learn about USAID's involvement in the successful undertaking.

The Organika-Zachem program is a joint, one-year demonstration with WEC. The objective is to demonstrate measurable environmental and economic benefits resulting from low-cost/no-cost waste minimization at selected sites and subsequently introduce these practices to other industries.

The company's waste minimization program, discussed in more detail in "East Europeans show pollution prevention can be profitable investment" (*Network News*, Vol. 12, No. 1; Winter, 1993; pg. 7), is continuing. ▲

continued from page 1

WEC & UN focus on cement dust

tal, health and safety concepts for the industry and other industrial sectors.

WEC formulated a plan to pursue dust reduction through a program with an Egyptian company serving as a model. In planning the program Mr. Lombardo found the Vienna-based United Nations Industrial Development Organization (UNIDO) was working on an event for senior cement plant management.

A decision was made to supplement the UNIDO presentation by a session for plant operational staff. According to Mr. Lombardo, WEC focused on plant engineers because, "you can get it (dust reduction) done, but you need to empower local plant personnel."

Representatives of state-owned and private cement companies, government and private consulting firms attended the two sessions in March. USAID funding allowed WEC to bring cement officials from Tunisia, Morocco and Jordan to Cairo for both events.

As a result, the Suez Cement Company, a semi-private Cairo corporation, expressed interest in the project committing itself to improving its own dust control techniques and transferring that knowledge. WEC is now working with Suez Cement, government and private industry to establish a model facility. Mr. Lombardo said having others participate in the program makes solutions more readily accepted throughout the industry.

Cement dust – Volunteer expert, Jim Parsons, makes notes during a dusty tour of a Egyptian cement plant.

WEC will be conducting other related activities in the Near East, and other areas of the world, with volunteer experts. ▲

continued from page 1

Wetlands prove useful after all
Thai projects test applicability

as an environmental technology, has matured. The current state of the technology owes a great deal to work by the Tennessee Valley Authority (TVA), the electric utility founded during the depression to provide power in the southeastern United States.

WEC, along with a TVA-based organization, has begun working with the concept of constructed wetlands for effluent treatment in Thailand. Ms. Raudelunas says the kingdom's inland waters are becoming increasingly polluted with urban and industrial contaminants. For a country which lives along its waterways, their deterioration motivates the government.

Through TVA's work, constructed wetlands have "proven an effective technique" for waste water treatment in the southern United States. Ms. Raudelunas says the technology has yet to be proven in tropical climates such as those of Southeast Asia.

Thailand has a number of attributes which make it a particularly good candidate for this technology. The Center, with funding from the United States Agency for International Development, is serving as a bridge between wetland technology and areas in need. So far, WEC has assessed a number of municipal and industrial sites as possible candidates for constructed wetland wastewater treatment pilot projects.

Ms. Raudelunas says the Center is tapping into TVA's wetlands expertise through Bicentennial Volunteers Incorporated (BVI), an organization of retired TVA employees.

Once locations have been chosen, BVI staff will prepare designs for wetland treatment sites. Planning and construction involves more than the apparent haphazard approach favored by Mother Nature. "It's relatively simple, they can do it on a napkin," Ms. Raudelunas says of designing a wetland area. She adds the more complicated aspect of the project is choosing proper vegetation.

Constructed wetland elements, referred to as cells, contain sections of marsh, planted with native vegetation, and open lagoons. Designers attempt to "optimize what's there," Ms. Raudelunas says, when planning a cell. Where necessary, the site, sometimes as large as 25 acres, is graded and compacted to prevent effluent leaks into the natural water table.

While cells may be planned on a napkin, the biological design of systems depends on balancing a number of factors such as type and quantity of nutrient to be removed, land available, and overall intent of the project.

Contaminated water circulates between cell elements based on the amount and type of pollutant. Once the circulation process is complete, with contaminates either settling or being drawn out of the effluent, the clean water is released into the natural water system.

Wetland vegetation – As wastewater travels through wetland cells, effluent materials either settle out or are drawn out by vegetation or bacteria.

Wetlands technology is currently focused on biological waste, however, a U.S. researcher has found water vegetation that appears to be capable of dealing with toxic wastes. WEC's projects in Thailand will be focused on municipal and industrial wastewater and will "ideally" be carrying out tertiary treatment of effluent, according to Ms. Raudelunas.

The TVA, headquartered in Knoxville, Tennessee, operates hydroelectric dams and other power generation facilities in and around the state of Tennessee. Ms. Raudelunas says the authority may well be one of the world's leading experts in this area after having conducted considerable research on constructed wetlands. ▲

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WEC offers wide range of training programs for and by Mexicans

MEXICO CITY

The office is playing a key role in an aggressive industry and government program to improve Mexico's environment.

A staff of ten Mexicans is managing training and other programs which both directly and indirectly address the country's environmental issues. In Ciudad Juarez, WEC continues to make progress with industry and government to develop an industrial and municipal sewage treatment facility. As *WEC Network News* reported ("Partnership builds plants"; Network News, Vol.11, No.2), millions of gallons of raw industrial and municipal wastes flow through open ditches in and around the border community.

Arrangements have been concluded to finance construction of two waste handling facilities and completion of an enclosed sewer system. The project is an example with strong potential for application in other communities.

Discussions are now taking place with the United States Agency for International Development and the InterAmerican Development Bank to extend this concept to other areas.

Among the indirect environmental, health and safety initiatives is a comprehensive, skill-building series of nine-week training courses offered around Mexico to raise abilities of the country's consultants. The 270-hour course, run in four Mexican centers so far, utilizes 46 Mexican professionals to deliver material in Spanish. At the conclusion of the program the consultants are tested with those passing receiving Mexican government certification.

Four seminars have been offered since August, 1992 attended by 130 professionals. Not everyone passes the rigorous course although the attrition rate in the first two seminars is relatively low. (Two seminars were in operation in Guadalajara and Tijuana as *IEDS Review* went to press.)

Other educational programs have addressed emergency response and prevention, environmental risk assessment, air quality monitoring, and plant waste minimization.

In its second year of operation th office will offer training seminars to government and industry in some te subject areas ranging from auditing monitoring to energy recovery.

The office has been leading a pil project to develop the Technology Transfer Clearinghouse. Users are ab to obtain information from commercial and government data bases, tecr nical experts, and product and servic vendors. Material is available in a number of formats including on-line access, read-only compact disks and reference books.

The experience from this pilot prc gram will be used to structure similar systems for WEC's offices in other areas of the world. ▲

Newest office implementing waste & accident prevention programs

JAKARTA

Established in January, 1993 WEC's three-member office is currently focusing on waste minimization, accident prevention and emergency response activities.

As part of April activities surrounding awarding of the ninth WEC Gold Medal for International Corporate Environmental Achievement, directors from the Center's foreign offices were in Washington D.C. to provide updates on their activities. These are highlights of their reports.

Waste Minimization

This project has two objectives: first, to strengthen private sector capabilities to minimize discharge of pollutants while maintaining, or even enhancing, economic efficiency. This objective can be met through an approach which introduces improved housekeeping, maintenance and operating procedures. New or modified process technology is also important.

The second objective involves working with industry and government to promote development and enforcement of more effective waste minimization and pollution prevention policies and regulations.

WEC currently operates a number of successful waste minimization programs in Central and Eastern Europe. Lessons learned there provide a good starting point from which to examine Indonesia's particular needs. The initial focus is on the pulp and paper, textile and metal finishing industries.

Projects begin with an assessment conducted by industry experts recruited in the United States. With the knowledge gained, industry-specific workshops are organized to upgrade local knowledge of waste minimization.

American companies play an important role in WEC Indonesia's projects by volunteering technical experts to conduct assessments and by hosting Indonesian visitors at company facilities in the U.S. These visits provide opportunities to discuss waste minimization and general environmental, health and safety issues with industry experts.

To buttress these efforts, WEC is implementing complementary technical cooperation activities supporting these new approaches as they are adapted and implemented in Indonesia.

Accident Prevention and Emergency Response Planning

Oedoyo Oesman has been appointed project manager for the Local Accident Management and Prevention Program. He will work with local and regional authorities, industry, communities, medical and other sectors at selected locations to develop industria disaster preparedness strategies.

Megacities and Air Pollution

In February WEC Indonesia played a central role in "Megacities on the Pacifi Rim and the Burden of Air Pollution", conference of eight major Pacific Rim urban areas. Participants identified an ranked leading problems. A number of bilateral exchanges were set up and all agreed to develop further technology cooperation and information sharing projects on urban air pollution WEC Indonesia, along with other WEC offices, will continue to play a role in maintaining what turned out to be a most productive dialogue.

Support

The Jakarta office was established with the generous assistance of the United States Agency for International Development with whom the Center has worked for many years. Over the next three years the office will work closely with USAID's Jakarta staff while pursuing a goal of becoming self-supporting. ▲

USAID-funded programs address growing Thai interest

BANGKOK

November, 1992 marked a year of operation for WEC in Thailand. During that time the Center's activities have grown considerably. Funding for WEC Thailand's activities comes largely from the United States Agency for International Development. Those resources have allowed the office to begin a number of projects.

- [illegible] training programs have been conducted with the services of experts from 24 companies and agencies in the United States. Well over 500 Thais participated in those sessions.
- In excess of 22 man-months of experts' services have been provide to Thai industry and government.
- A group of 15 Thai volunteer indus- [illegible] serve as technical resources for other Thai companies.

Among the initiatives undertaken by the office are:

- introduction of constructed wetlands waste-water treatment techniques, (This is covered in more detail in "Mother Nature's good idea finding [illegible] treatment" on page one of this edition).
- working with the Federation of Thai Industries' Chemical Industry Club to review and adopt a code of conduct based on the "Responsible Care Program" developed by the

See Thai programs on page 4

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Thai programs

J.S. Chemical Manufacturers Asso-iation, and

- development of an emergency pre-paredness and response program with ompanies in the Bang Poo Industrial tate.

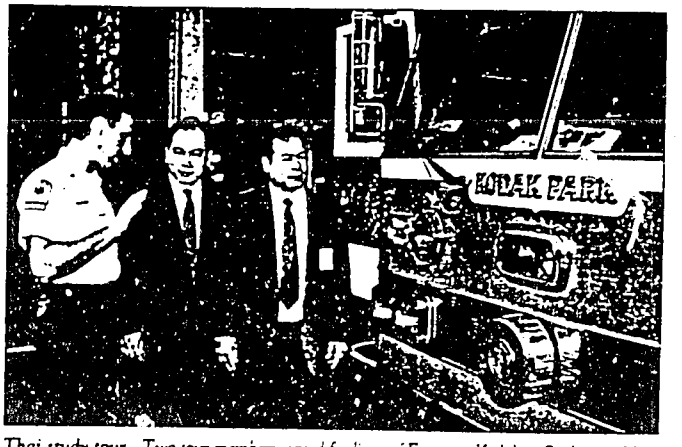
General awareness of the impor-ance of environmental, health and afety issues is growing in Thailand omplementing the timing of WEC's JSAID-funded initiatives. That change n attitude is reflected in a number of jovernment actions. Three major pieces of environmental legislation have under-jone revision. The National Environ-nent Board, a policy making agency, as been elevated to ministry level and hree new environmental management lepartments have been created.

The recently initiated program to ntroduce constructed wetlands technol-ogy to Thailand is an innovative venture addressing an environmental situation, but also in the way it is funded.

As a core element of the U.S. hailand Environmental Partnership, he project will foster application of J.S. experience and technology to Thai environmental challenges. The wet-ands concept has been discussed with officials of the Ministry of Interior and other government agencies and several ites have been selected for develop-nent as pilot projects.

While WEC Thailand currently relies on support from the United States government, the office is continuing o build its links with government and ndustry and intends, with support rom Thai business, to become locally upported. ▲

Kodak, Xerox cooperate in skill building program for Thailand



Thai study tour – Two tour members visited facilities of Eastman Kodak in Rochester, New York. A Kodak emergency medical technician (left), briefs Bancha Surachaidunthavin (center), plant manager of Pacific Plastics of Thailand, and Chalermchai Chaikittiporn, (right) Chairman of the Department of Occupational Health at Thailand's Mahidol University, on fire apparatus at the Kodak Park fire station.

Rochester, New York—Two major American companies recently joined forces to participate in a program to enhance the environmental, health and safety skills of industry and government in Thailand.

Eastman Kodak Company and Xerox Corporation jointly hosted two Thai professionals as part of a fourteen day study tour. Funded by the United States Agency for International Development the Thais met with environmental, health and safety officials at Kodak and Xerox facilities here.

Chalermchai Chaikittiporn, Chairman of the Department of Occupational Health at Thailand's Mahidol University, and Bancha Surachaidunthavin, plant manager of Pacific Plastics of Thailand, met Kodak officials for one week and Xerox representatives during their second week here.

The project began in 1992 with a Bangkok workshop on occupational health and safety. Attended by representatives of Thai industry, government and academia, it was the first step in building Thai knowledge in the field.

Worker health and safety is of growing importance in the world's developing countries, such as Thailand. However, implementing health and safety initiatives is easier said than done. Along with USAID, the World Environment Center has launched this program to assist in the enhancing of Thai capabilities.

Some 35 management officials participated in the workshop and selected eight of their peers for intensive training in the United States. The first of four teams visited the United States in the fall of 1992 follow by two teams in the spring of 1993. The remaining team will visit in August.

"Study tours are an opportunity to see real life implementation of these policies," according to Lisa Raudelunas, the WEC Project Manager for Asia. "Through networking in the United States our desire is that these experts develop contacts here that allow them to serve as an information resource (in Thailand) through the life of that project."

With the importance of the study tours WEC personnel were careful to select companies with developed environmental, health and safety programs. Kodak, a participant in the WEC's International Environment Forum, agreed to join the program and offered to recruit Xerox, a company which was not familiar with WEC until it was awarded the 1993 WEC Gold Medal for International Corporate Environmental Achievement.

Richard Poduska, Director of Environmental Affairs for Eastman Kodak's Imaging Group, and Tom Roberts, Corporate Manger of Industrial Hygiene and Ergonomics for Xerox were instrumental in organizing the visits.

Once back in Thailand the groups will begin preparing for the project's third phase. Ms. Raudelunas said Dr. Chaikittiporn and Mr. Surachaidunthavin, along with six others, were selected for the visits and will present a series of workshops beginning this fall to train other Thais in safety, health and environmental policies, strategies, worker and corporate programs, and implementation and monitoring. ▲

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Founded in 1974, WEC contributes to sustainable development worldwide by strengthening industrial and urban environmental, health and safety policies and practices. Through three major programs, WEC serves as a bridge for the exchange of information and expertise among industry, government, and non-government organizations. Volunteer expert services are the hallmark of the Center's programs.

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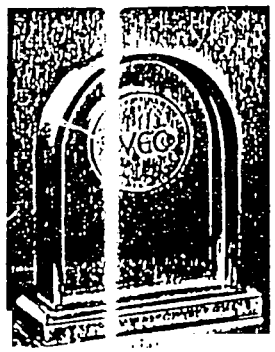
International Environ ent Forum (IEF)

Since 1977, the IEF ha offered industry executives the opportunity to meet enior policy makers from around the world for of ne record discussions on environmental and res rce management issues. Today, 59 multinationa orporations, based in eight countries and engage n ten industrial sectors, participate in the IEF. Thro gh IEF quarterly meetings, an international netwo of government and industry contacts is maintai d. The IEF also offers workshops and countr profiles for the benefit of the participating corporatio s.

WEC Gold Medal for ternational Corporate Environmental Achie ement

The WEC Gold Medal presented to a multinational company that ha an outstanding, sustained and well implemented orldwide environmental policy. Every year sinc 1985, an independent international jury of environ entalists from government, academia and industry as selected the recipient of the WEC Gold Medal. ublic recognition of corporate environmen l initiatives stimulates global environmental adership and draws attention to the potenti benefits of an environmentally sound corporate p licy.

Recipients of the WEC old Medal are The Procter & Gamble Company (92), Rohm and Haas Company (1991), IBM Cor ration (1990), The Dow Chemical Company (1 9), The BP Group (1988), E.I. du Pont de Nemo s & Company (1987), Exxon Corporation (19 5) and 3M (1985).



International Environment Forum

These companies participate in the IEF, a program of the World Environment Center.

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ALCAN ALUMINIUM LIMITED
ALLIED SIGNAL, INC.
AMP INCORPORATED
ASEA BROWN BOVERI INC.
AT&T
BASF CORPORATION
THE BFGOODRICH COMPANY
BHP-UTAH INTERNATIONAL INC.
THE BLACK & DECKER CORPORATION
BORDEN, INC.
BRISTOL-MYERS SQUIBB COMPANY
THE BRITISH PETROLEUM CO. p.l.c.
COLGATE-PALMOLIVE COMPANY
COMPAQ COMPUTER CORPORATION
DIGITAL EQUIPMENT CORPORATION
THE DOW CHEMICAL COMPANY
EASTMAN KODAK COMPANY
E.I. DU PONT DE NEMOURS & COMPANY
SOCIÉTÉ NATIONALE ELF AQUITAINE
ENGELHARD CORPORATION
EXXON CORPORATION
FLETCHER CHALLENGE CANADA LIMITED
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TEXACO INC
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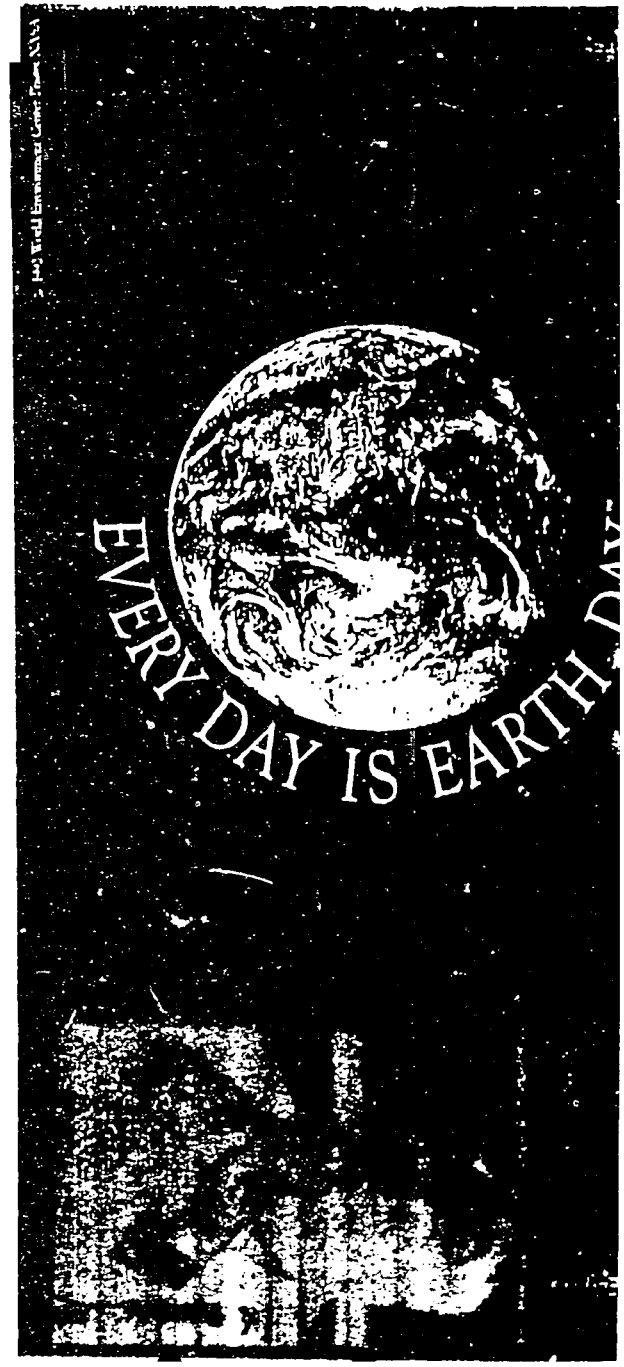
UNOCAL CORPORATION
W.R. GRACE & CO
WARNER LAMBERT COMPANY
WESTINGHOUSE ELECTRIC CORPORATION
WESTVACO CORPORATION
WHIRLPOOL CORPORATION

WEC™



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Every day is Earth Day at the World Environment Center (WEC), an independent, non-advocacy organization contributing to sustainable development by strengthening industrial and urban environmental, health and safety policy and practices worldwide.

WEC makes every day Earth Day as it seeks to integrate the four E's - *Environment, Economics, Energy* and *Education* - in practical solutions to globally recurrent issues.

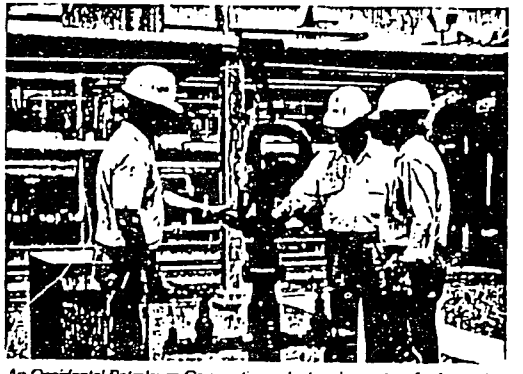
To accomplish this, WEC establishes and promotes partnerships and acts as a bridge linking industry and government and non-governmental organizations (NGOs) around the world. The enthusiastic participation of volunteer experts from industry, government, academia and NGOs has been the cornerstone of WEC's success.

Two complementary programs - the International Environment and Development Service and the International Environment Forum - respond to the growing demand for environmental expertise by offering opportunities for sharing technical information between the private and public sectors. The WEC Gold Medal for International Corporate Environmental Achievement recognizes corporate leadership above and beyond regulatory requirements or common practices.

Founded in 1974, WEC's headquarters are located in New York City with additional offices in Prague, Czechoslovakia; Mexico City, Mexico; Bangkok, Thailand; and Washington, DC, U.S.A.

> The Earth Summit's goal of forging a new "Earth Ethic" is epitomized by the World Environment Center's global vision. The Center, an outstanding environmental leader, builds partnerships around the world for environmentally sound, sustainable development.
>
> Maurice F. Strong, Secretary-General
> United Nations Conference on
> Environment and Development,
> Earth Summit

A volunteer expert from Fletcher Challenge Canada Ltd. and a host-country engineer at a pulp and paper plant in Akdeniz, Turkey.



An Occidental Petroleum Corporation volunteer inspects a fire boss at a petroleum facility in Dhurnal, Pakistan.

Pfizer Inc volunteers at the Polfa pharmaceutical plant in Grodzisk, Poland on the 100th IEDS mission.

International Environmen t and Development Service (I DS)

Thanks to over 275 envir mental, health and safety volunteer experts, I: DS has provided pro bono services in 32 cour les.

Since its first project in 19 , IEDS has demonstrated to companies, org izations and governmental agencies that eco mic benefits are deriv from environmentally sou f management.

Over 180 projects involvi 700 host-country professionals have been c mpleted including activities such as:

- Industrial environmen reviews at national, sectoral and individu plant levels;
- support for the streng ening of environmenta Institutions and the dr ling of environmental laws and regulations;
- organization or suppo of workshops, training programs and confer ces; and
- study tours and on-th job internships for officials from industry d government.

Travel and management sts were initially funde through cooperative agre ments with the US Agency for International D velopment. Additional funding has come from in stry, the US Environmental Protection Agency Environment Canada, the World Bank and priva citizens. Close workin relationships with NGOs a d other organizations augment WEC's multidisc linary approach.

> The World Environm l Center's continuing commitm t to the worldwide exchange of informat n on environmental issues plays an impo nt part in ensuring a clean and healthy f ure for our fragile planet.
>
> George Bush
> President of the Unit States of America

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Appendix 07 a : Document Receive from Acteron

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Acteron & Waste Minimization

by V. J. Shannon
FLO KING Filter Systems
Longwood, Florida

With trend-setting anti-pollution legislation, water and landfill shortages, and a strong environmental consciousness, northern California tends to spawn ecologically minded businesses. And for Acteron Corporation, Redwood City, CA, that spells waste minimization.

Acteron is a 13-year-old firm specializing in highly reflective plating for infrared optical components used in the industrial and medical fields, electroless nickel on high-reliability electronic components, precious metals plating for electrical contacts and microwave applications, functional hard anodizing, and more. The company processes materials such as difficult-to-plate metals, non-metallics, plastics, silicon and glass. With over 50 technicians and engineers, Acteron has even developed proprietary processes employing ultrasound and pulse plating. Its customer base includes some of the most

Acteron President Patrick Burt (right) and Steve Cazel, Plating Manager, examine blanket-like reusable filter media.

prominent names in electronics and over 10 prime defense contractors. It has an inspection department that meets the requirements of MIL-I-45208A and lab resources that feature AA analysis, QC program in accordance with MIL-Q-9858A.

Patrick Burt, president of the 12,000-square-foot facility, is an avid proponent of waste minimization. In fact, he is chairman of the National Association of Metal Finishers (NAMF) Waste Minimization Committee, whose mission, in part, is "to research, study, and promote waste reduction, minimization, recycling or reclaim techniques to the surface finishing industry, regulators, and legislators." *(Editor's note: See article on waste minimization in November/-December issue of FM by Patrick Burt).*

Minimization Initiatives

To illustrate the results of an aggressive waste minimization program, consider this. Just seven years ago, Acteron moved from Belmont after acquiring and expanding a four-man shop in Redwood City. Despite a company that now has approximately 12 times the personnel and sales of that four-man operation, Acteron actually consumes *less than one-third the water and has nearly 90 percent less heavy metals in its effluent.* Here are some of the initiatives that have contributed to these impressive figures:

- Installation of double and triple counterflow rinses.
- Use of spray rinses over select process and rinse tanks.
- Adoption of conductivity sensors to regulate water condition and flow.
- Segregation of rinsewaters.
- Substitution of less-polluting processes (e.g., acid copper to replace cyanide copper, and periodic reverse-current cleaning to replace cyanide-containing cleaners).
- Elimination of vapor degreasing by using a system of dual soak cleaners with ultrasonic enhancement.
- Use of more dilute formulations such as those for acid pickling.
- Thorough indoctrination and training of employees to stress how they can make a positive contribution to the environment. For example, all personnel are taught the importance of extending drip-time [illegible] er rinse tanks.

In-Tank Filtration Systems

Another key aspect of Acteron's waste minimization program is the use of in-tank filter systems in tanks as small as [illegible] gallons. As Plating Manager Steve Cazel says, "On any plating tank, but particularly on precious metal tanks, external plumbing for filtration is a concern for us. Housings can crack. Hoses and clamps get weak. And even if you recover spilled solution from a secondary containment area, chances are it would be too contaminated to recycle because of the dirt and debris involved. So it's a great benefit to keep all of the

Filter changes on in-tank system are achieved easily and quickly using hand-tightening thumbscrews.

filtration equipment in the tank. Even though the in-tank system takes up some tank space, we feel it is minimal and that the advantages are far in our favor."

The in-tank system eliminates leaks and spills because it uses no hoses, clamps, seals, chambers or, for that matter, any out-of-tank apparatus. The filter(s) is attached to the pump body and totally immersed in the solution to be filtered. The pump body is secured to the tank lip with an adjustable bracket. Solution is continuously drawn by vacuum through the filter cartridge(s), after which it travels approximately 3" before being expelled through a discharge port on the pump body. Solution never leaves the tank.

Importantly, the force of this discharged solution produces a clean, oil-

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suspends particles for quick-capture filtration, thus keeping the tank bottom free of contaminating solids buildup. Frequently, the agitation provided as a natural byproduct of in-tank filtration is sufficient to replace mechanical or air agitation systems. As Mr. Burt explains, "Airborne contaminants — some organic, some inorganic — are a concern for our technology." By removing those particles quickly, before they dissolve in solution, we reduce the need for carbon treatment, dummying, peroxide treatments, or, in the worst case, bath dumps."

Using the same basic principles of operation but different models and sizes to produce from 1 to 3,000 gallons/hour of filtered solution, in-tank systems find application in tanks as small as a half-gallon and as large as thousands of gallons. For high-volume baths, two or more in-tank units are used on a single tank. Ease of use is another asset. Conventional filter systems often require tools and significant time and labor for filter changes. But the uncomplicated design of the in-tank system enables rapid filter changes using hand-tightening thumbscrews rather than tools. Because the systems are portable, cleanable, and consume no floor space, they can also be used to filter multiple tanks where continuous filtration is not required.

Prior to using the in-tank systems, Acteron did not filter preparatory solutions such as those in its aluminum finishing lines. In the case of nitric acid and mixed organic acids, for instance, that meant frequent dumps, frequent neutralization, frequent and liberal use of neutralization chemicals, and frequent acid purchases. Now Acteron continuously filters those pre-dips ... and with just rewards. As Cazel says, "High-solution-turnover filtration gives us more confidence in all of our solutions. It reduces rejects and adds life to the baths. So we're purchasing less acid and utilizing less neutralization chemicals for waste treatment."

Reusable Filter Media

Another important element of Acteron's waste minimization program is a reusable filter media. Before converting to this material, the company routinely accumulated a 55-gallon barrel of spent disposable filters every 90 days. But in nearly a year of using the blanket-like reusable media, not a single drum of the spent filter material has been generated, according to Cazel.

"Conventional filter cartridges go to landfill — they're solid waste — and we're committed to reducing waste," he said. "Plus, with disposables, there is the cost of an expendable product to consider. The reusable material has been real cost effective for us. We have yet to find a plating system that we weren't able to upgrade by using the in-tank filter system and reusable cartridge."

Clean filter operation is predicated on good filter maintenance, and Acteron has trained a crew whose sole job it is to properly maintain tanks, filters, and accessories on a regularly scheduled basis. That includes cleaning the reusable filters by draping them over a 3/8-inch-thick polypropylene perforated sheet, then pressure spraying with deionized water over an appropriate rinse tank.

Waste reduction complements Acteron's high-tech processes such as pulse plating to obtain particle and pore-free nickel finishes on disc drive components.

Patrick Burt and Acteron have such a high profile in the area of waste minimization that they participate in local, regional, national, and even international programs on the subject. For instance, on a goodwill NAMF tour to Czechoslovakia, Mr. Burt shared waste minimization technology with that nation's environmental and industrial ministries. And, recently, Acteron participated in the making of a film on waste minimization produced by the State of California Department of Health Services. In that film it is no accident that they discuss the in-tank filter system with reusable filter media. It is but one of many tools and techniques available to operate an ecologically responsible business in these environmentally conscious times.

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Reprinted from FINISHERS' MANAGEMENT

Incentives For Waste Minimization In The Metal Finishing Industry

by Patrick Burt, President,
Acteron Corporation.
Chairman, Waste
Minimization
Committee, N.A.M.F.

Waste minimization is a unique direction among environmental control measures. Over the past ten years environmental regulations have caused the metal finishing industry to become the most heavily regulated small business classification in the United States. Virtually all of these regulations have reduced the profitability and the viability of these small businesses which are so vital to American manufacturing. The costs and difficulty of meeting these regulations has resulted in the closure of 25% of the plating firms in the United States over the past ten years. However, waste minimization can significantly reduce the costs of environmental controls while being the most environmentally sound approach to manufacturing.

Incentives for waste minimization can be characterized in three primary categories:

- *Economic Benefits*
- *Regulatory Conformance*
- *Environmental Achievement*

Economic Benefits

The cost of waste handling and waste disposal is already a major operating expense for metal finishing operations. These costs continue to escalate each year. Reducing the amount of waste generated reduces operating costs in several ways and can actually improve the profitability of metal finishers. Waste minimization options which a company rejected previously may now be economically viable. In many cases there is a rapid return on investment. If all of the direct and indirect benefits of waste minimization are identified and considered, the economic benefits of waste minimization can be substantial.

With increasing regulatory costs and decreasing landfill capacity the costs associated with hazardous waste disposal will increase at a far greater rate than most other business expenses. Companies which don't act now to minimize waste generation will be seriously impacted by rapidly escalating costs and may find themselves at a competitive disadvantage. Eventually they may be overwhelmed by the regulatory burdens associated with waste treatment and disposal.

Waste Minimization' which includes *source reduction, on site recycling* and *off site recycling* as three necessary and complimentary methods of achieving waste minimization for our industry.

Many waste minimization alternatives are very inexpensive low technology *source reduction* options which provide immediate cost savings. For example, spray rinsing and full dripping over tanks to recapture and re-use process solutions are among the least costly and most advantageous waste minimization options available.

Many of these incentives are indirect and therefore frequently overlooked or under appreciated. However, these simple source reduction methods can be utilized to varying degrees in virtually all facilities and they are relatively inexpensive to implement.

Once the waste volume has been significantly reduced by using simple source reduction options, then the more costly advanced technology *on site recycling* approaches can be implemented with reduced equipment and operating costs due to the reduced volume of waste to be recycled.

Regulatory Conformance

Conformance to stringent environmental regulations has become the foremost concern of metal finishing firms. Waste Minimization can ease the difficulty of meeting many of these mandates. In addition, federal, state and local regulations are requiring that businesses which generate hazardous waste must reduce the amount and/or toxicity of their wastes. These new waste minimization regulations will not allow manufacturers to complacently accept the higher costs of waste handling and disposal. The 1984 Resource Conservation Recovery Act renewal first addressed this issue on the federal level. Every hazardous waste manifest contains a statement which the generator must sign certifying that the generator has a waste minimization program in place and that progress reviews of the program are done periodically.

Many state and local governments have adopted or will adopt comprehensive waste minimization mandates. California and Massachusetts are among the states which have already enacted far reaching laws which require source reduction and process substitution changes.

Some Regional Water Quality Control Boards are requiring that Public Owned Treatment Works (POTW's) reduce their mass discharge volumes. To achieve this, many POTW's will continue to reduce the allowable contamination levels or water volume from industrial dischargers. Source reduction and recycling technologies are emerging as the most effective means of meeting these more stringent discharge standards.

Environmental Achievement

A strong waste minimization program is the most effective way for a manufacturer to minimize the environmental detriments of metal finishing, while continuing to provide the frequently underappreciated environmental benefits of metal finishing. These benefits include product corrosion prevention and wear resistance which prevent the product itself from becoming a waste. By minimizing waste beyond the statutory requirements, the company improves its good standing in its community and its standing with the agencies responsible for administering environmental regulations.

Through waste minimization metal finishers can continue to provide vital societal and environmental benefits while minimizing the detriments which were historically associated with these processes.

Barriers To Waste Minimization And Their Cures

Having recognized the many values and incentives of waste minimization there remain certain technical or regulatory impediments to waste minimization which need to be addressed.

Process Baths Conducive to Solution Recapture

As was noted, effective recapture of chemical process solutions for re-use is probably the most cost effective and environmentally preferred method of waste minimization. However, in practice the liquid volume being returned to the process solution must be no greater than the evaporative loss occurring in the process tank.

Over the last twenty years proprietary chemical manufacturers have responded to customer and government requests for energy conservation by providing new process solutions which operate at low or ambient temperatures. However, these low temperature solutions minimize solution recapture opportunities because of their reduced evaporation. Consequently, there is now a need for process solution manufacturers to provide two sets of operating parameters, one option at warm temperatures for waste minimization and the other at lower temperatures for energy conservation. In addition to their evaporation advantage, warmer solu-

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tions rinse more freely and can operate at lower chemical concentrations thereby further reducing drag out waste. The energy consumption detriments of warmer solutions may be mitigated by use of environmentally sound heating methods such as process heat re-use and solar heating. Metal finishers need to notify chemical manufacturers of their desire for low waste generating process solutions.

Solution Purification

As drag out wastes are reduced, an increasing proportion of metal finishing wastes come from concentrated process solutions which are gradually contaminated through normal use. The generation of these waste solutions can actually be accelerated due to solution recapture by preventing traditional drag out of contaminants which occurs with the normal drag out of process solutions. Consequently, the importance of solution purification has become increasingly [illegible] to achieving waste minimization. Unfortunately, purification tends to be process and contaminant specific [illegible] simple method can [illegible] equipment.

Technical research in the metal finishing [illegible] on solution [illegible] In addition, existing knowledge on methods of solution purification needs to be [illegible] industry members, pollution prevention agencies as well as technical and trade associations.

Shortage of Educational Materials

Recently there has been a surge in waste minimization research and education. This information needs to become widely available to even the smallest and least sophisticated firms in the metal finishing trade. Audit manuals, educational films, training courses and technical papers are all needed and valuable waste minimization tools.

Legislative Cures

Many impediments to waste minimization currently exist within the U.S. regulatory framework. These impediments include the difficulties that off-site recycling firms have in obtaining and maintaining treatment permits. In addition, there lacks a consistent regulatory framework which identifies recycling as inherently preferable to treatment and disposal and which adequately assists [illegible] tive state and federal regulations would actually cause in-house recycling to be more burdensome than waste treatment.

Waste Minimization = Increased Profits
Economic Benefits of Water Minimization
Dripping and Spraying Over Tanks

EFFECT		*COST BENEFIT*
QUALITY CONTROL		
1) Greater Solution Stability	=	Improved Quality Control
2) Less Frequent Solution Analysis	=	Lower Quality Control Labor
3) Less Chemical Usage	=	Lower Chemical Cost and Less Labor for Chemical Additions
4) Less Chemical Storage due to Fewer Additions Needed	=	Lower Inventory and Less Storage Area
5) Cleaner Rinses	=	Better Product Quality
REDUCED COSTS OF WASTE TREATMENT		
6) Less Water Usage	=	Lower Water Bills
7) Less Sewer Water Discharge	=	Lower Sewer Bills
8) Less Waste Treatment Chemical Usage	=	Lower Material Usage and Less Chemical Storage
9) Better Wastewater Treatment Quality	=	Due to Longer Settling Time
10) Less Sludge Generation	=	Less Wastewater Treatment Labor
11) Less Sludge Cake Generation	=	Lower Cost for Disposal, Drums, & Hauling, Documentation & Liability
IMPROVED CONFORMANCE TO ENVIRONMENTAL REGULATIONS		
12) Sewer Water Volume Reduction	=	Potential Reduction of Limits on Specific Heavy Metals (based on under 10,000 gallons per day)
13) Comply with Effluent Standards & Waste Minimization Regulations	=	Achieve Good Company Standing in your community & stay in business
14) Less Waste Volume	=	Reduced Waste Fees, Taxes & Permits. Better Quality of Conformance to Waste Storage & Documentation

Provided by: NAMF Waste Minimization Committee 10/90

Tax credit incentives for waste minimization or recycling equipment would provide the financial assistance which would allow many firms to switch from their existing investment in waste treatment equipment toward new waste minimization technologies. These financial incentives could be either state or federal. However, the best chances for enactment of tax incentives exists on the state level.

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Appendix C8 : Itinerany

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CORPORATION AND AGENCY VISITED

NO	DATE	CORPORATION AGENCY
01.	December 06, 1993	*Metal Surface Inc* 6060 shull ST PO Box 2160 Bell Gardens, California 90201-0521 Phone (714) 521-4112 Fax (213) 773-4055
02.	December 07, 1993	*Electrolizing Inc* 1947 Hooper Avenue Los Angeles, California 90011 Phone : (213) 749-7876
03.	December 10, 1993	*Waste Water Treatment System* 1235 Elko Drive Sunny Valve California 94089 Phone : (408) 541-8600 Fax : (408) 541-8615
05.	December 13, 1993	*Acteron corporation* 851 Shasta Street Redwood City CA 94063 Phone : (415) 369-5217
06.	December 14, 1993	*Schlage Lock* San fransisco C A L I F O R N I A
07.	December 14, 1993	*Santa Clara Plating* 1173 Grant Street Santa Clara California 95050 - 3984
08.	December 15, 1994	*United Airlines* Bldg 49 SFOFL San Francisco Int'l Airport San Francisco, CA 94128-3800 Phone : (415) 634-4576 Fax : (415) 634-4551
09.	December 15, 1993	*New United Motors* 45500 Fremont Boulevard Fremont, CA 94538 USA Phone : (510) 498-5797 Fax : (510) 770-4160
10.	December 16, 1993	*Santa Clara Water Pollution* 700 Los Esteros Road San Jose, CA 95134

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Appendix C9 : Photograps

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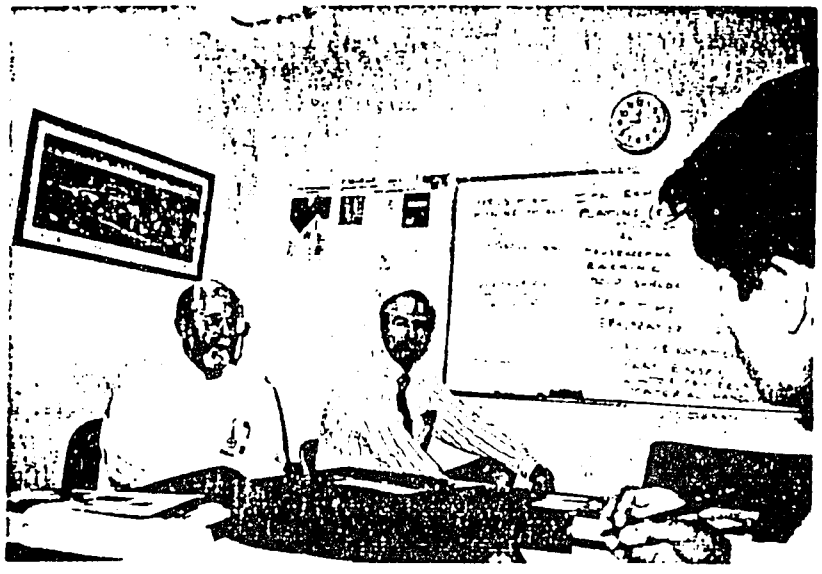
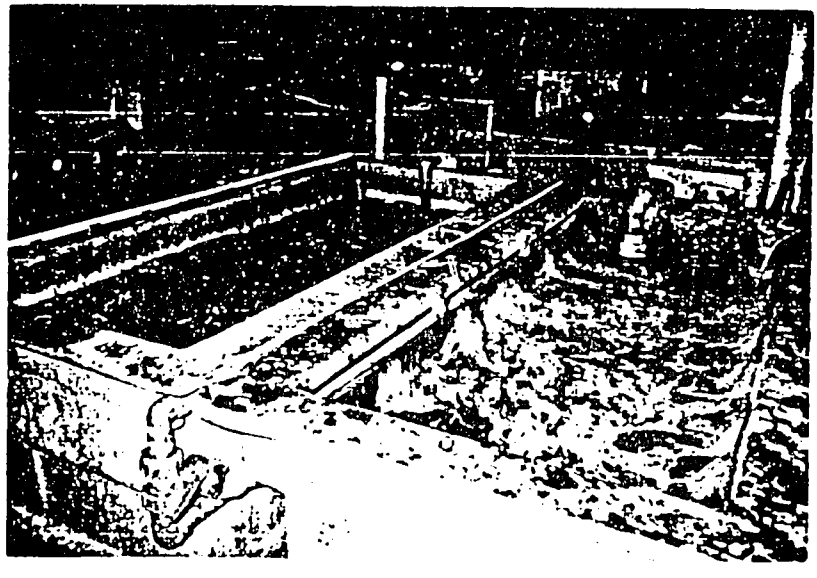


Pht 1. Meeting With Sam Bell and Bruce F.Nielsen in Metal Surface Inc



Pht 2. Plating Area in Metal Surface Inc

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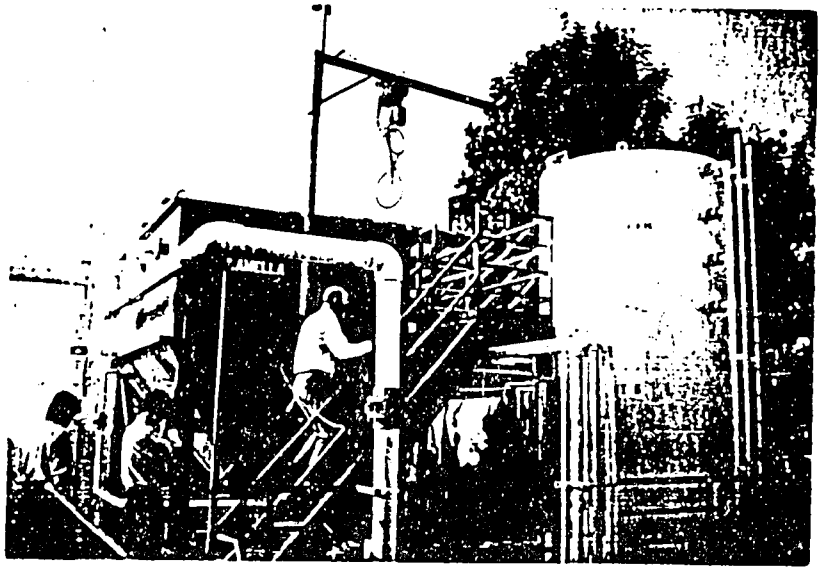
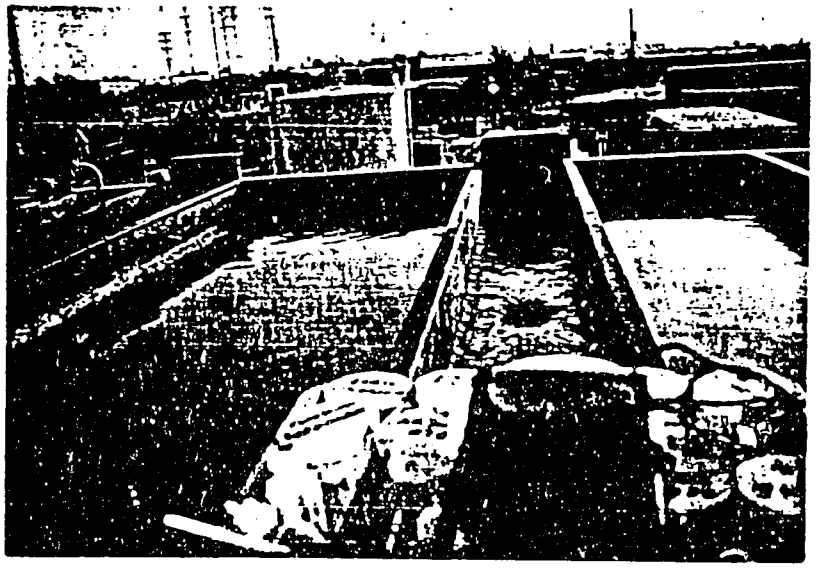


Pht 3. Facilities W.W.T in Metal Surface Inc



Pht 4. The Water Very Clean at Lamela Step Process In Metal Surface Inc.

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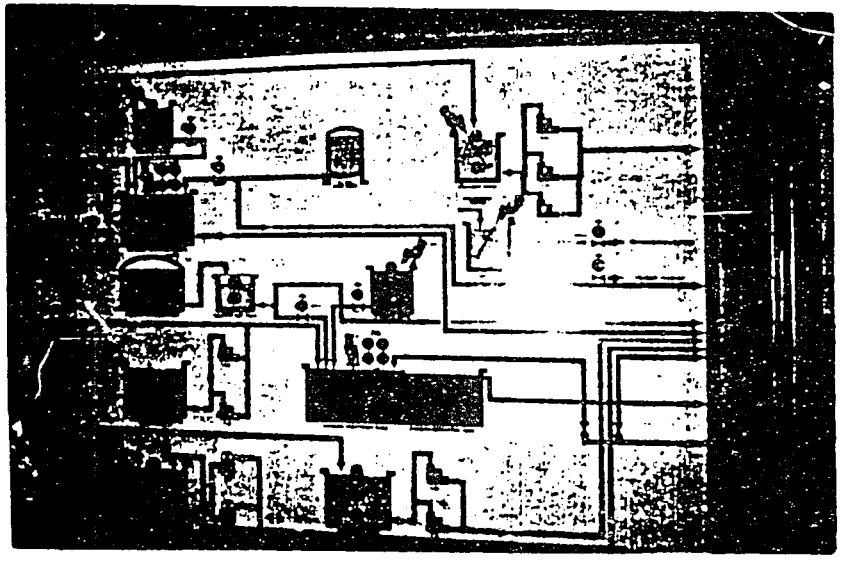

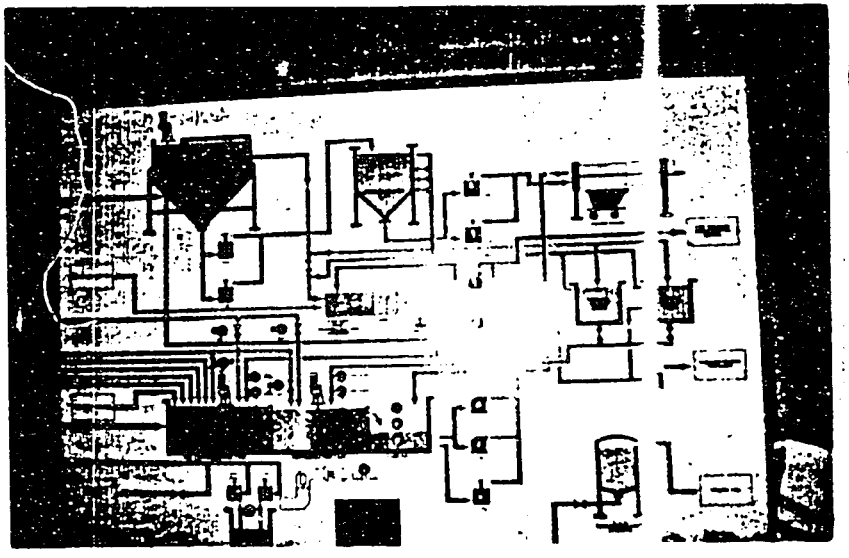

Pht 5.Flow Process Waste Water Treatment in Metal Surface Inc

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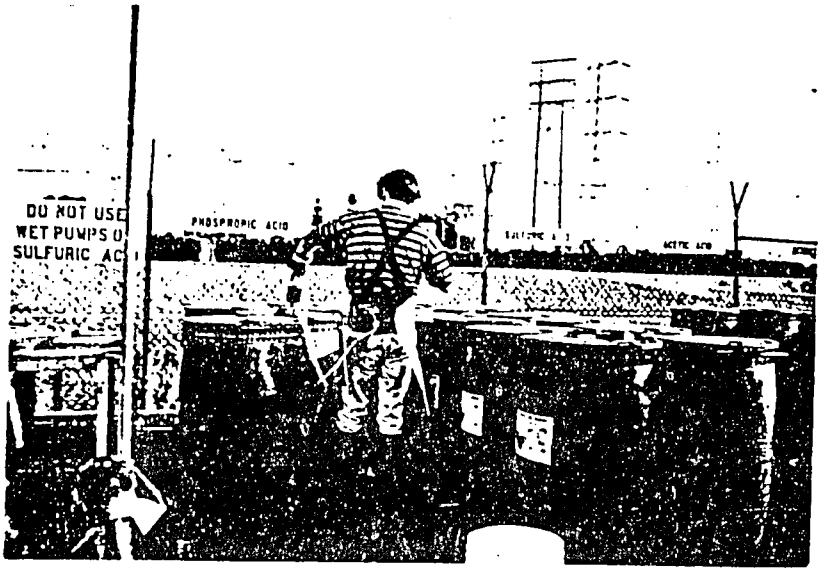
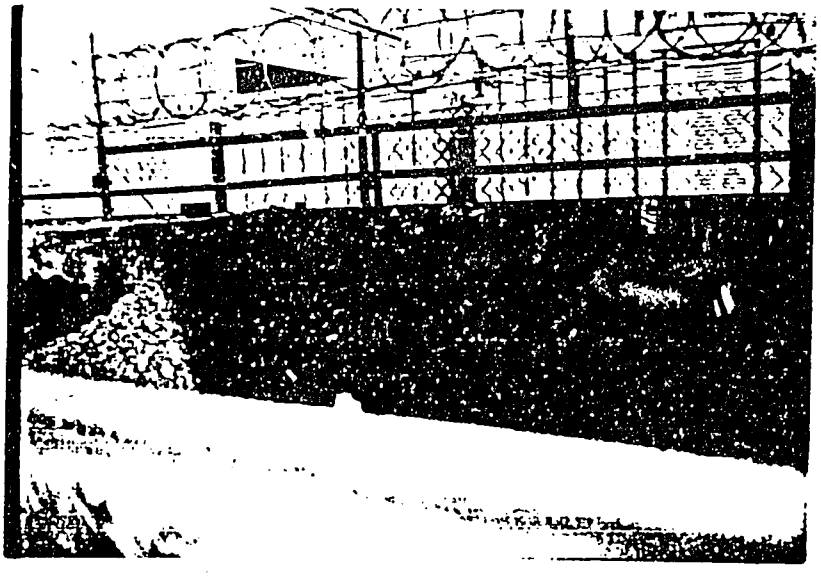


Pht 6.Safety Equipment He Has used for taken Chemical Solution in Metal Surface Inc.



Pht 7; Sludge in Metal Surface Inc

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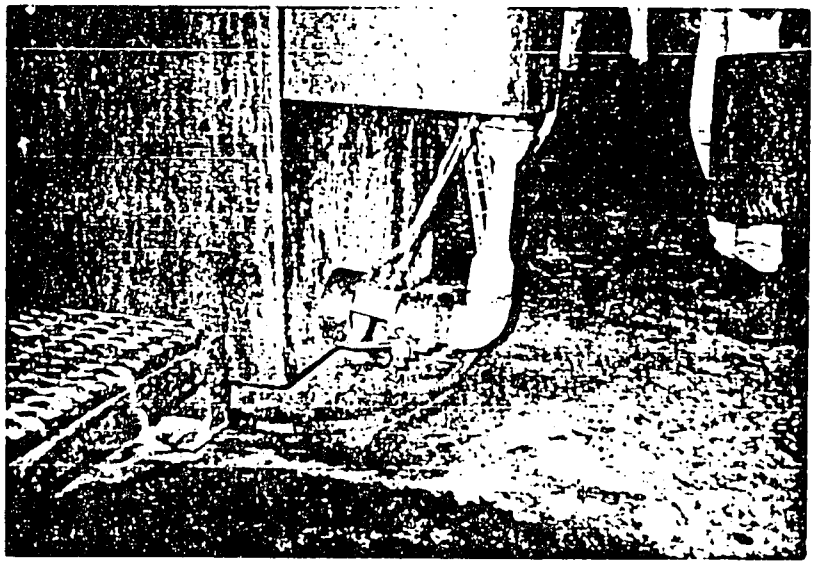
Pht 8.Jack Morgan and Susan, in Electrolizing Inc



Pht 9. Heater with I. P. C. in Electrolizing

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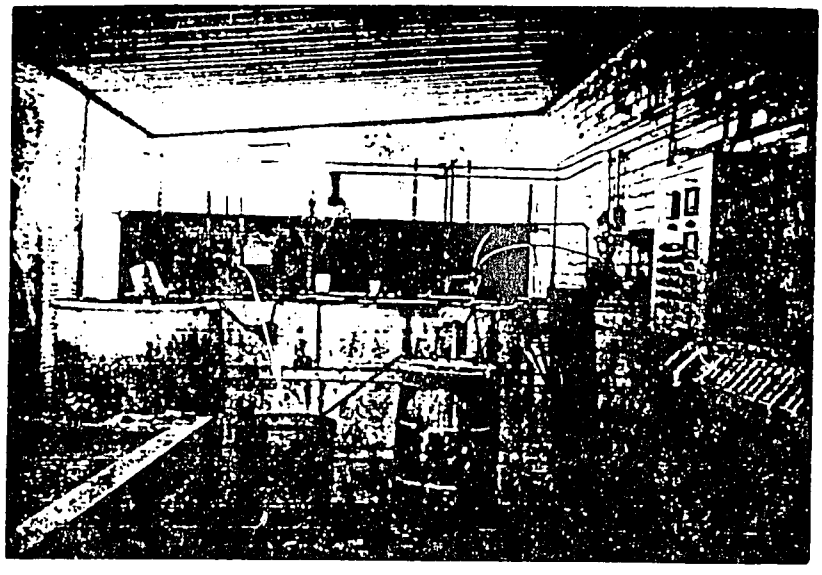
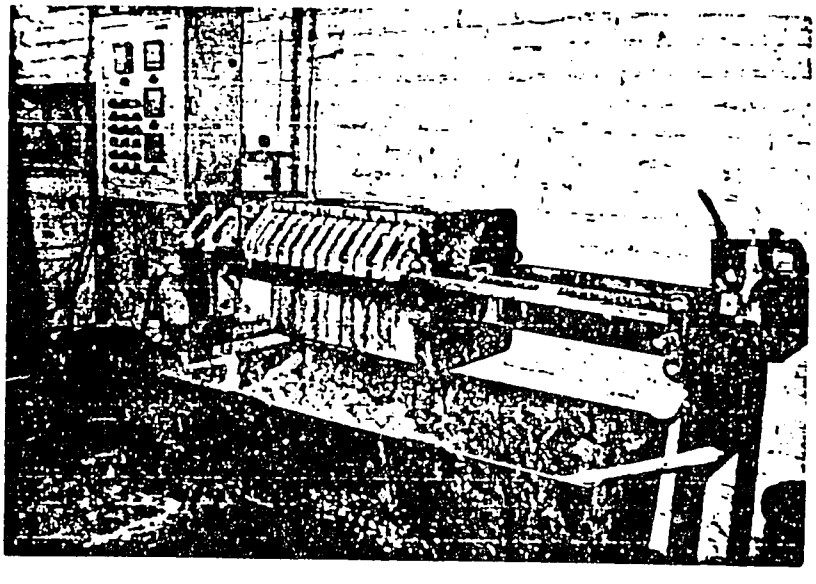


Pht 10. Facilities Waste Water Treatment
in Electrolizing Inc



Pht 11. Filter Press, in Electrolizing

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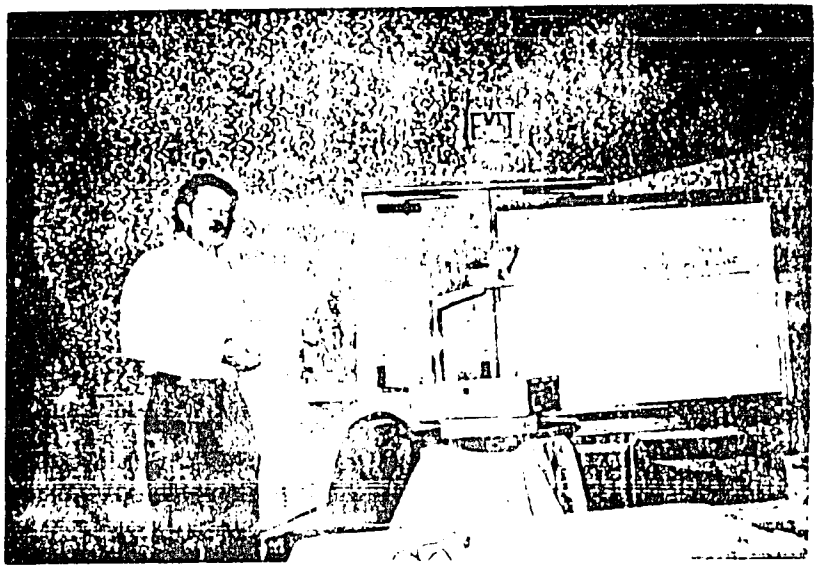
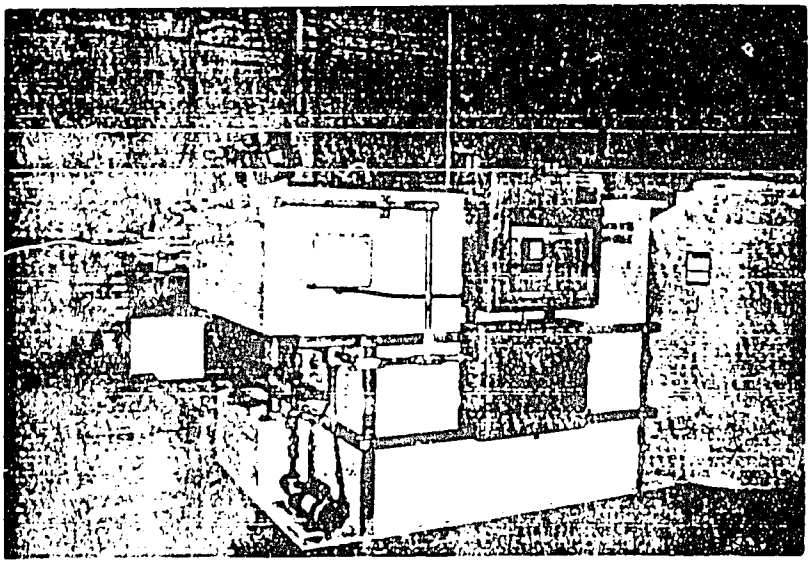


Pht 12. Presentation by Lawrence Livermore National Laboratory(LLNL)



Pht 13. W.T.S. Equipment(Type OWS-5,Capacity 5GPM) in W.T.S. Inc

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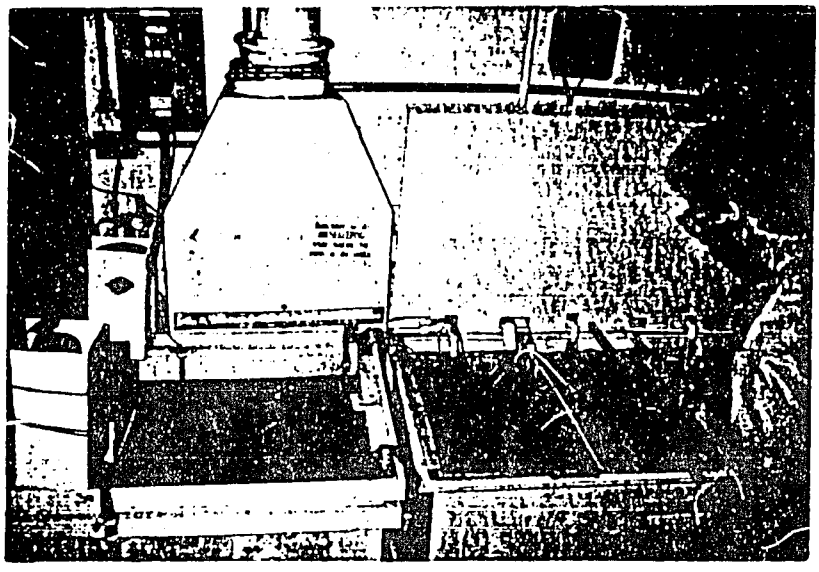
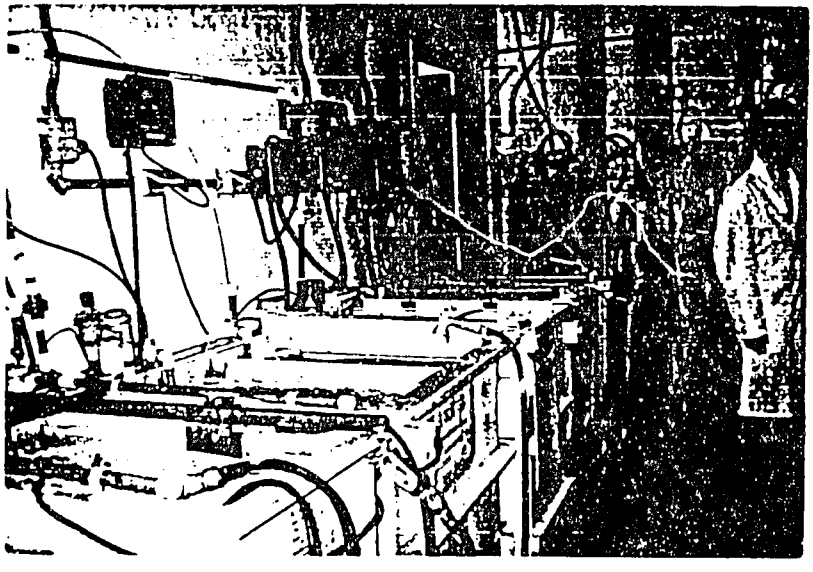


Pht 14. Conductivity Meter System in Acteron Corporation



Pht 15. Spray Rinse/Counter Flow System in Acteron Corporation

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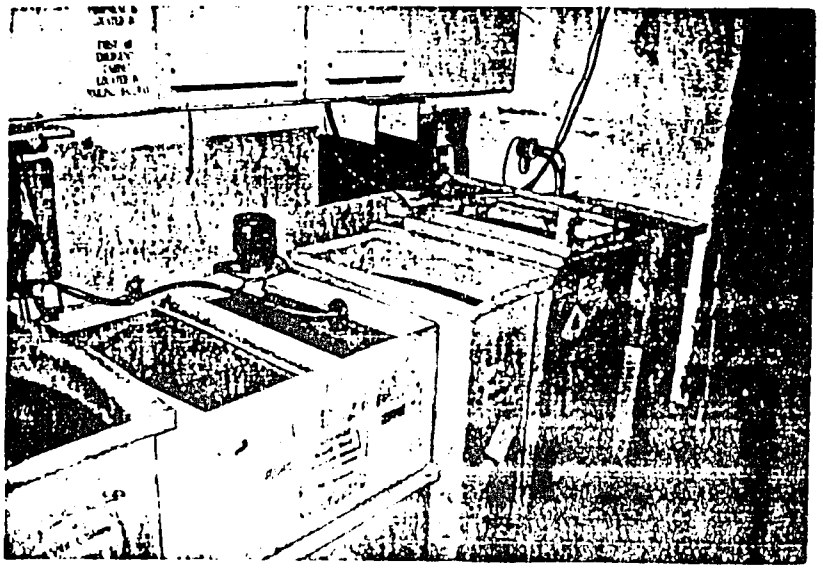
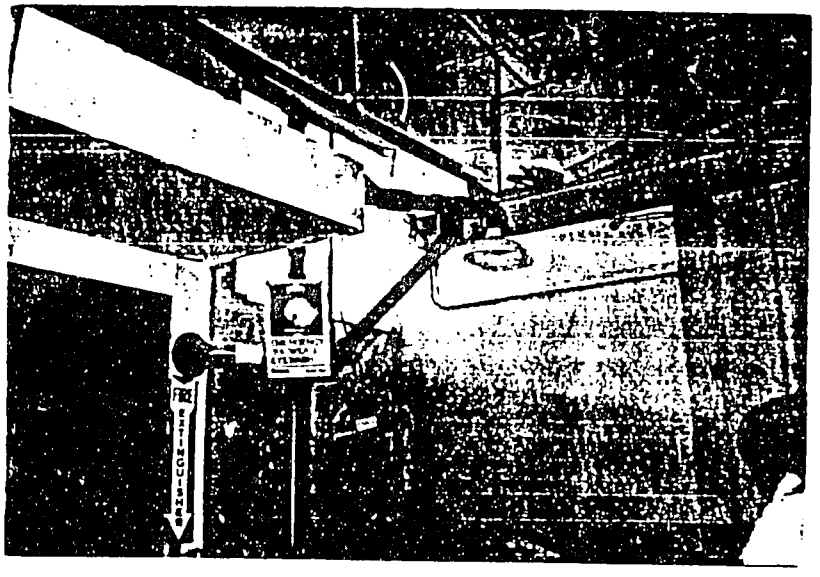


Pht 16. Drag Out Tank Gold,in Acteron Corporation



Pht 17. Shower/Eyewash Station,in Acteron Corporation

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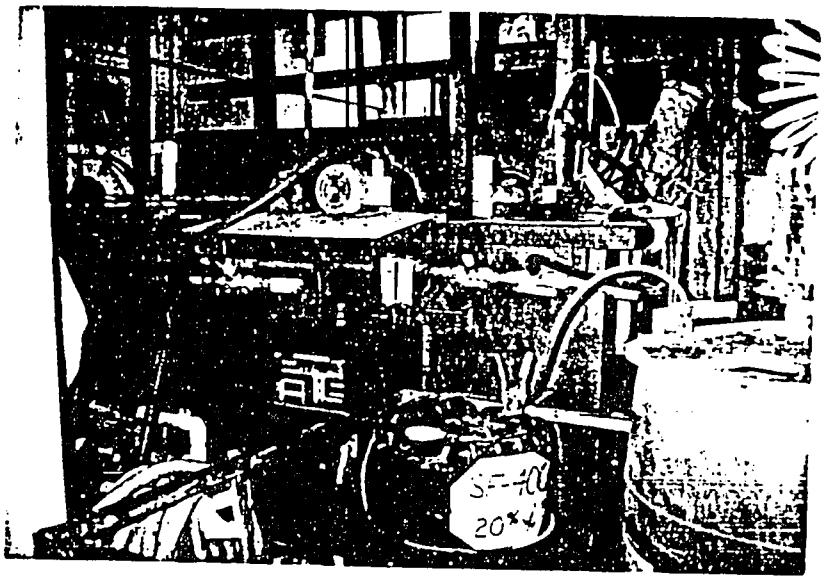
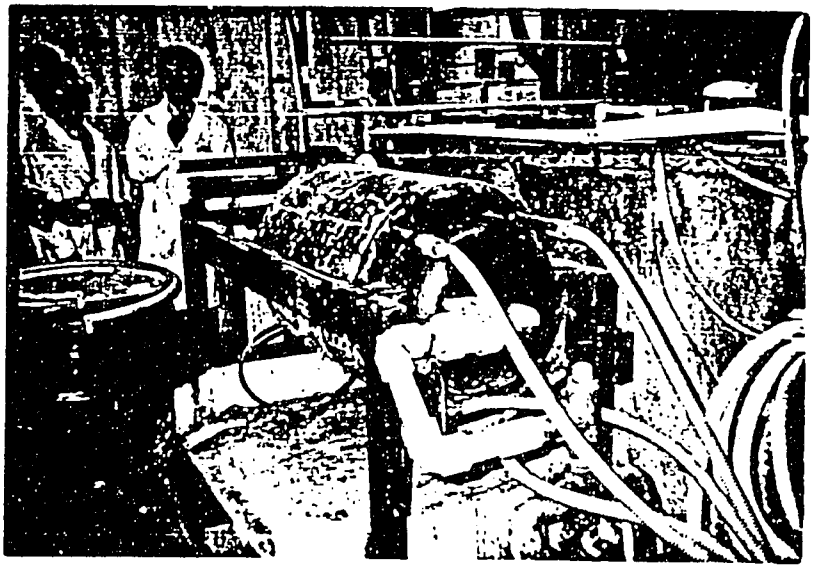


Pht 18. Facilities W.W.T.,in Acteron Corporation



Pht 19. Filter Press,in Acteron Corporation

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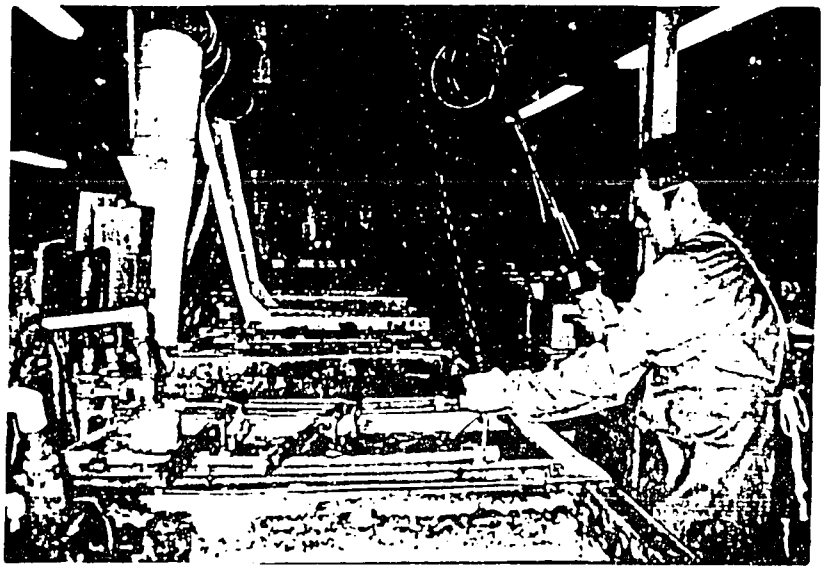
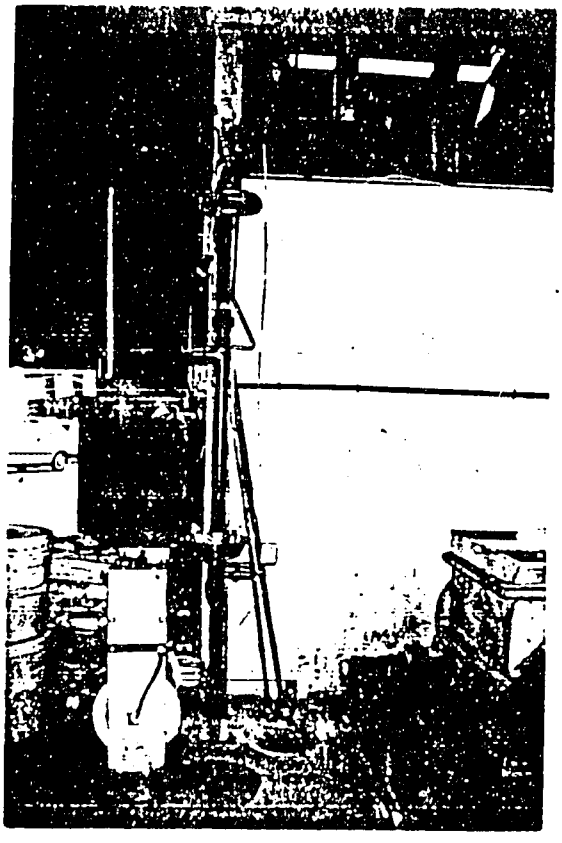


Pht 20. Electro Plating area, in Santa Clara Plating



Pht 21. Shower/Eyewash Station, in Santa Clara Plating

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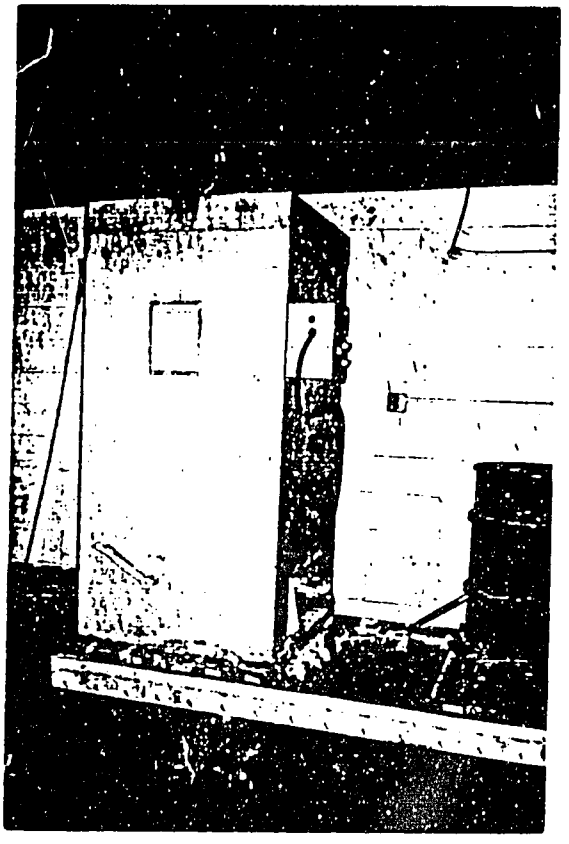
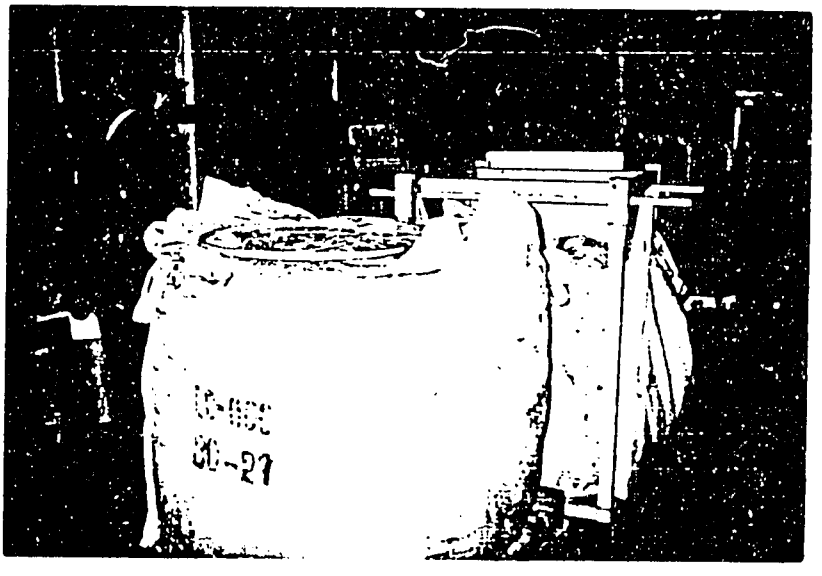


Pht 22. Oven Dryer,in Santa Clara Plating



Pht 23. Dried Sludge Put in to Plastic Bag

in Santa Clara Plating

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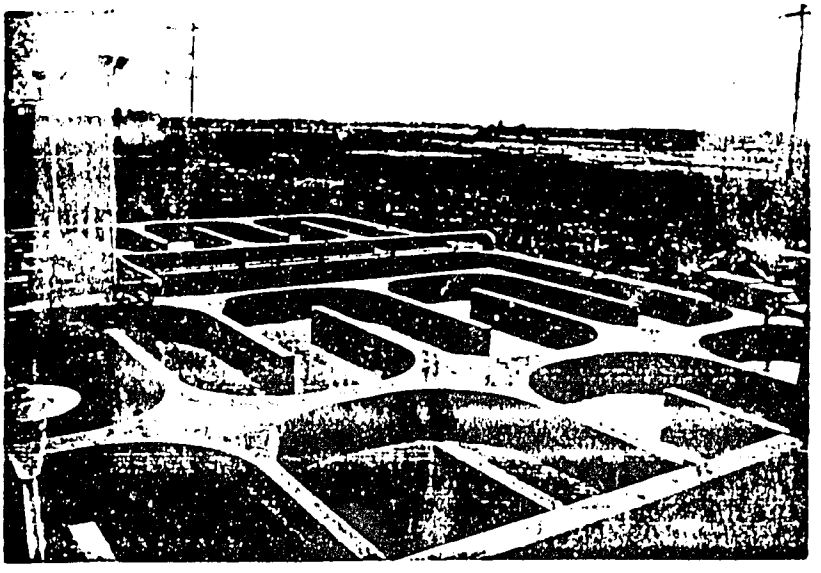

Pht 24. Process Chloronization,in Santa Clara
water Pollution Control

Pht 25. Meeting with Jim Mille,in Chemical
Solution Inc

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Appendix 10 : Curricullum Vitae

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CURRICULUM VITAE

Name:	Suryanurdian Syafei
Address:	
Age:	
Place of Birth:	
Nationality:	Indonesia
Martial Status:	Single
Language:	English (fair in spoken and written)

Work Experience:

1992 - Present	PT Paci Komponen, Bekasi Electronic Component Manufacturer Assistant to the Head of Laboratory
1990 - 1992	PT Sukma Beta Sempurna, Bekasi Electronic Manufacturer, producing printed circuit board Process Engineer In addition to the R&D job, responsibilities included controlling chemical condition in plating area, etching and some materials. Also responsible for evaluating the process and doing the trouble shooting during the process
1989 - 1990	PT Rudy Soetadi, Bekasi Cosmetic Manufacturer Lab/Research & Development Staff Responsible for checking raw material visually, chemically and microbiologically

Education:

1985- 1989	Academy of Analytical Chemistry Graduated and awarded Diploma Degree

Appendix 11 : Bussiness Card Participant

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Appendix 11 : Bussiness Card Person Visited

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PRESIDENT

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psi

Jim Elliott
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WORLD ENVIRONMENT CENTER

INDUSTRIAL WASTE MINIMIZATION PROJECT
INDONESIAN PULP AND PAPER INDUSTRY

UNITED STATES STUDY TOUR REPORT

Hendayani T. Adisesha

DECEMBER, 1993

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EXECUTIVE SUMMARY

The World Environment Center in cooperation with the United States Agency for International Development has launced waste minimization project for pulp and paper industry in Indonesia. The present two-week study tour to the pulp and paper facilities in the United States is one of the activities included in the program.

The objectives are to provide intensive training in waste minimization program and practices. The experience gained during the study tour will be disseminated to other Indonesian pulp and paper industries in a workshop.

The study tour was conducted at

1) Willamette Industrial Inc.
   Marlboro Mill
2) Sonoco Product Company
3) Union Camp Corporation
   Eastover Mill
4) Weyerhaeuzer
   Flint River Operation
5) World Environment Center Inc.
   Headquarter
6) National Council of the Paper Industry for Air and Stream Improvement
   Gainsville Branch and New York Headquarter

To further improve the environment and economic performance of pulp and paper industry in Indonesia, the following activities are recommended:

1) Hold a one day seminar for top executives in which the economical and environmental benefits of waste minimization is introduced

2) In view of the present situation of pulp and paper mills in Indonesia, the most effective low cost/no cost practices that can reduce the discharge of pollutant and provide economic incentives is water conservation. Workshops detailing in this topics and demonstration project would be very helpful.

3) In order to have better understanding of the existing pulp and paper mill conditions, especially in the generation of pollutants, pollution and possible waste minimization practice loads, strengthening in the following fields are needed:

   - Develop Indonesian pulp and paper technology information center
   - Develop mill auditing skill and air emission measurement know-how.
   - Develop joint practical research activities supported by existing mills

Some major findings during this study tour are as folows:

- Waste minimization technologies which have been put into practice are:

  - Oxygen delignification before bleaching process
  - Substitution of chlorine with chlorine dioxide in bleaching process
  - Water recycling and reused in the entire mill

- Spill prevention and accidental discharge hold up by having surge pond, back up clarifier, sludge pond, holding pond etc
- Soda pulping process recovery system using a lime kiln as recovery furnace
- Odorous gas handling by burning in power boiler or incinerator
- No chemical treatment is used in waste water treatment plant. Usually the treatment consists of separation of suspended solids and biological treatment by very big aerated lagoons. All basins and lagoon are lined only by clays

- WEC has launched a very good technogy transfer program on introducing waste minimization practices throughout the world

- US pulp and paper mills have benefited much by the research done by NCASI

WORLD ENVIRONMENT CENTER

INDUSTRIAL WASTE MINIMIZATION PROJECT
INDONESIAN PULP AND PAPER INDUSTRY

UNITED STATES STUDY TOUR REPORT

Hendayani T. Adisesha

INSTITUTE FOR RESEARCH AND DEVELOPMENT OF CELLULOSE INDUSTRY

I. INTRODUCTION

The World Environment Center (WEC), through a cooperative agreement with the United States Agency for International Development (USAID) in Indonesia is supporting sustainable development by strengthening environmental management policy and practices in several sector of industries through waste minimization programme, one of which is in the pulp and paper industry.

The waste minimization programme consists of :
1. Factory assessments
2. Technology cooperation and training workshops
3. Study tours and workshops

Waste minimization assessments have been conducted at four Indonesian pulp and paper facilities over the past fourteen months. The assessment focussed on the identification of low cost/no cost practices and techniques that can reduce the discharge of pollutants and provide economic incentives.

Upon completion of the assessments a technical waste minimization workshop for the pulp and paper industry was held in Jakarta, July 1993, for 40 industries, government and non government managers and design engineers. The workshop summarized assessment observations and presented Indonesian waste minimization experience to other pulp and paper industries.

This report is a two-week study tour report to the pulp and paper facilities in the United States. The tour was coordinated by WEC. The objectives is to provide intensive training in waste minimization programs and practices in the pulp and paper industry in US and upon return to Indonesia, the study tour participants will conduct a waste minimization workshop for the Indonesian pulp and paper industry detailing their experiences in the U.S. and in Indonesia.

II. DETAILED DESCRIPTION OF THE STUDY TOUR

Date : October 23 - November 3, 1993
Tour coordinator : Charles Jong Hwa Hong - Deputy Project Manager, WEC

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Participants.

1. Ir. Widya Tjahyana Lauwangsa - PT. Pakerin
2. Ir. Darono Wikanaji - PT. Kertas Leces
3. Ir. Iyan Suwargana - Environmental Impact Management Agency
4. Ir. Warih Suprindi - PT. Surabaya Agung Kertas
5. Ir. Zulkifli Lubis - PT. Indah Kiat
6. Ir. Hendayani T. Adisesha - Institute for Research and Development of Cellulose Industry

The sponsorship reference is attached in Appendix 1.

Corporation and agency visited

No.	Date	Corporation/Agency	Persons met
1.	October 25, 1993	National Council of the Paper Industry for Air and Stream Improvement (NCASI) 3434 SW 24th Avenue, Gainesville Florida - 32607 Phone: 904 377 4708 x 224 Fax. : 904 371 6557	Ashok Jain Regional Manager
2.	October 27, 1993	Willamette Industries Inc. Marlboro Mill, P.O. Box 673 Bennetteville, South Carolina Phone: 803 479 0200 Fax. : 803 479 0608	W.Martin Barfield Techn. Services Manager Grag Fullenwider
3.	October 28, 1993	Sonoco Product Company Hartsville, South Corolina	Philip Wichard Chemical Recovery and Waste Water Manager
4.	October 29, 1993	Union Camp Corporation P.O. Box B, Eastover, South Carolina Phone: 803 353 7700 Fax. : 803 353 7981	Wesley A. Foy Techn. Control Manager Doug R. Lazar Senior Application Eng James P.Wilkowski Env. Eng. Manager
5.	November 2, 1993	Weyerhaeuser Flint River Operation P.O. Box 238, Oglethorpe, Georgia Phone: 912 472 2527 Fax. : 912 472 5508	Russell K Stevensson Plant Env. Manager Frank D. Wohrley Env. Project Engineer
6.	November 3, 1993	World Environment Center 419 Park Avenue, South Suite 1800 New York, NY. 10016 Phone: (212) 683-4700 Fax. : (212) 682-5053	Romnald Michalek Vice President Techn. Programs
7.	November 4, 1993	National Council of the Paper Industry for Air and Stream Improvement 260 Medison Avenue, Suite 1105 New York, NY. 10016 Phone: (212) 532 9000 Fax. : (212) 779 2829	Dr. Isaiah Gellman President

The agenda of the visit could be found in Appendix 2

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III. FINDINGS

III.1. Willamette Industries Inc., Marlboro Paper Mill, Bennettsville

Established	: 1990
Products	: Uncoated alkaline printing and writing paper 650 tons daily
Plant site	: 1,800 acres
Raw material	: - Hardwood and softwood chips from harvest operation and milling leftovers from Willamette's plywood plant and other wood product firms - Whole trees from pulpwood thinning from timberlands
Fiberline	: - 6 digesters each can hold 88 tons of chips - Hardwood and softwood cooked separately with kraft process, cooking time 11 hrs - No blowing process, he pulp mixture is pumped out of the digester (produce fiber strength 15% higher) - Oxygen delignification (extended cooking process) to remove more lignin prior to bleaching process - 3 stages bleaching process (C/D,E,D) 30% ClO_2 in hardwood, 50% ClO_2 in softwood
Chemical Recovery	: - Low odor recovery boiler
Other Steam sources	: - 1 Hogged fuel boiler - 1 Package boiler for back-up in cold weather, use natural gas
Calcium Carbonate manufacture	: a small on-site company bubles the carbon dioxide released from the lime kiln through lime
Environmental Control	: Based on 840 tons per day pulp - Lift station 15 MGD - Primary Clarifier 2,5 MG, Ø 195 ft, depth 9 ft, surface load 500 gpd/sqft, retention time 4 hrs, removal efficiency 90% settleable solids, 10% BOD

- Screw press
  50% solid content, 17 dry tons/day sludge (operate at 35 dry tons/day)

- Sludge lagoon
  one acre (in case screw press fails)

- Surge basin
  3 acres x 15 ft, cap. 14,7 million gallons (in case of hydraulic overloads, later pumps back to primary clarifier or aerated stabilization basin. The content can also overflow to a polishing pond)

- Spill basin
  The same as surge basin (use in case of high strength waste water flow. Gravity flow to the lift station or aerated stabilization basin can also be used as an alternate clarifier during primary clarifier maintenance period)

- Aerated stabilization basin no.1
  Lined with 24 inches of compacted native clay 2,000 ft long, 400 ft wide, 15 ft depth, cap. 90 million gallons. 6 days retention time, organic loading rate 1.3 lb BOD/day/1,000 cubic ft

- Aerated stabilization basin no.2
  The same as ASB no. 1, operated in series with ASB no.1, 13 aerators, (9 in ASB no.1 and 4 in ASB no.2) 75 hp each. DO = 0-1 ppm, 0.4 lbs biological solid/lb of BOD removal

- Polishing pond no.1
  Line with 12 inches of native clay, 30 acres x 15 ft depth, cap. 293 million gallons has 175 hp aerator near outlet (normal operation filled to a depth of 4 ft or less)

- 2 diffusion header
  To discharge treated waste water to the river

- 1 Domestic lagoon
  Lined with 12 inches native clay a single lagoon divided into two cells by a curtain, first cell 100,000 gallons with a 3 hp aerator. Second cell 75,000 gallons with 1 hp aerator, removal rate 90% for BOD and TSS.
  The treated waste water is disinfected with chlorine tablets to reduce fecal coliform count to less than 1,000 per 100 ml before flowing to ASB no.1

- Solid waste
  The clarifier sludge is dewatered in a screw press,

no polyelectrolyte is needed. The sludge which has 50% solid content is burned in hogged fuel boiler. Solids collected on bar screen and skimmed material from clarifier go to Marlboro County landfill. Dewatered sludge at 50% solid content is burned in the hog fuel boiler, sludge from the sludge lagoon can be air-dried and removed to on-site Willamette Landfill

Diagram of effluent system can be seen in Appendix 3.

Sectional waste water flow rate

Browstock	: 1.270 MGD
Bleach plant	: 0.840 MGD + 1.58 MGD
Chemical recovery	: 0.922 MGD
Utilities	: 0.543 MGD
Wet lap/Paper making	: 8.500 MGD

The above figures are achivied by recirculating the white water to bleach plant, condensate from chemical recovery to brown stock washing. warm water from every section is recycled back from reuse.

Air emmission

- 2 scrubber system in bleach plant one with white liquor, the other with caustic solution
- Gas emission goes to tray type steam stipper clean condensate goes to pulp washer

Management

- 250 personnel in total , 4 shifts
- Organizational structure

Plant manager

Paper line	Fiber line	Recovery & Utilities	Manufacturing Services
- Stock Preparation - Finish Product - Shipping	- Wood yard - Pulping - Bleaching	- Recovery boiler - Evaporator - Lime kiln - Water treatment	- Engineering - Test service - Special management

- The operator in every unit also do maintenance job of the machineries in their unit. Only special maintenance job is taken care by manufacturing services

- There were no conflict between production unit and end of pipe treatment unit mainly because the mill has a good design to prevent operation up-set

- The mill should let the EPA knows of the situation when they exceed the pollution regulation, like for instances when a scrubber is being repaired. Severe punishment can be put on them if they knowingly and willfully polute the environment.

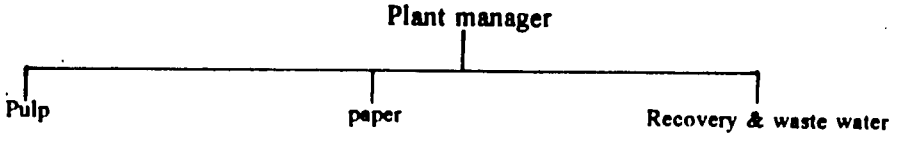
III.2. Sonoco Product Company

Established	: 1900
Product	: Corrugated medium 500 ton/day Paper cone, paper core Grocery sack, Paper can } 500 ton/day
Raw material	: Old corrugated carton and hardwood for corrugating medium. OCC + Old newsprint for other products.
Pulping	: Batch digester (340 ton pulp/day) Cooking liquor: 10% NaOH + 90% Na_2CO_3 or 100% Na_2CO_3, 250 lb Na_2CO_3/ton pulp at 7% moisture content. Using 150 lb stream to produce 305°F cooking temperature. Yield 81 %.
Paper machines	: 1 Fourdinier for corrugated medium, 7 cylinder machines each with 5-7 vats for other products.
Chemical recovery	: (see process flow diagram in Appendix 4.) 3 stages evaporators to concentrate the cooking liquor from 8% to 40% solids content, 2 stages evaporators to further increase the solid content to 50%. The hot thick cooking liquor is burned in a Bartlett Snow lime kiln which is 100 ft long and 10 ft in diameter. The sodium carbonate formed drops into a dissolving tank which contain water. The gas from lime kiln goes to waste heat boiler to produce steam which together with power plant steam is used for black liquor evaporation. From waste heat boiler the gas goes through gas cooler, venturi scrubber and demister absorber before being released to the air.
Waste water treatment plant	: (for process flow diagram see Appendix 5.) For the whole 1000 ton/day production the local water consumption is 3.5- 4.0 MGD. The uncontact cooling water which is 2-3 MGD is discharge directly to the Black Creek. The waste water treatment plant consists of : - 1 anaerobic lagoon 24,300,000 gallons capacity. 5 days retention time

covered with plastic. The gas is burned (3 flare)
- 1 aerated lagoon
  40,000,000 gallons capacity, 4 aerators 100 hp each. 14-16 aerators 50 hp each, 10 days retention time
- 2 settling basin
  Capacity not known

Solid Waste : Ways of disposal
- Burn in waste boiler for OCC reject sludge
- Incinerator/gasifier for waste water treatment sludge
- Land fill (lined with high density polyethylene) for other solid wastes

Management : Organizational structure



III.3. Union Camp Corporation, Fine Paper Division, Eastover, South Carolina

Established : in 1984 on 4,400 acres land at Eastover

Product :
- Medium weight fine paper (46-55 basis weight) phase I 600 TPD, phase II rebuilt to 800 TPD
- Light weight fine paper (35-46 basis weight) 660 TPD (1991)
- Market bleached kraft pulp softwood pulp and hardwood pulp 500 TPD (1991)

Pulping : 2 Continuous Kamyr digesters

Pulp drying : Fourdriniers Valmet-Ahlstrom wet end 192 inches wide. 215 FPM max speed, Flakt compact dryer, Lamb cutter layboy and Bale line.

Bleaching : Oxygen bleaching, OC/DED at Union Camp Franklin Plant, only the oldest of three bleaching lines still uses chlorine. The second oldest uses an oxygen bleaching process and the newest work with ozone. Data on comparisons of the benefits of oxygen bleaching and ozon bleaching are given. Some important figures are as follows (more can be seen in Appendix 6.)

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Chlorinated Organics Content

	CEDED	OC/DED	OZED	Franklin line
On pulp TDX (kg/ADMT)	0.28	0.13	0.04	-
In bleach plant effluent TOX (kg/ADMT)	6.50	3.00	0.08[a)]	0.14
Chloroform generation Total (kg/ADMT)	0.18	0.08	0.002	0.00017
BOD (kg/ADMT)	16.00	6.50	2.00	1.8
COD (kg/ADMT)	65.50	22.50	6.00	5.6
Color (kg/ADMT)	185.00	41.50	1.50	0.9
AOX				< 1-5 ppb

a) level depends on the amount of chlorine in chlorine dioxide used

Paper machine : - EO I : Voith Duoformer Twin Wire
372 inches wide
3,000 FPM max. speed

- EO II : Beloit Bel Bail II
372 inches wide
4,400 FPM max. speed

Odor control system : The non-condensible odorous gas which consists of hydrogen sulfide (H_2S), methyl mercaptan CH_3SH, dimethyl sulfide $(CH_3)_2S$ and dimethyl disulfide $(CH_3)_2S_2$ is treated in two different system, i.e., dilute system and concentrated system

The sources in dilute system (<25% explosive limits) are:

- Chip bin
- Blow tank
- Brown stock washers
- Black liquor foam tanks
- Knotters / conveyors
- Foul condensat tanks
- Pressure filters
- Miscellaneous sources

The gas which amount to 200,00 ACFM is transported by fan to power boiler for incineration.

Lower volume (800 ACFM) of concentrated non-condensible gas originated from:

- Steam vessel
- Flash tank
- Evaporator condensers
- Stripper feed tank
- Turpentine tank

The gas is transported by stream eductor and burned in stand-alone incenerator with scrubber or power

boiler as back up. The stripper off gas is sent to rectification column or incinerator as back-up.

Air Pollution Control : The regulated pollutant. The source and ways to control the pollution are as follows:

Pollutant	Sources	Control
Particulate	- Recovery furnace - Power boiler - Lime kiln	- Precipitator - Precipitator - Precipitator
SO_2	- Power boiler - NCG incinerator	- Low sulfur fuel - Scrubber
NOX	- Power boiler	- Burner design
TRS	- Pulp mill	- Incinerator
Chlorine	- Bleach plant	- Scrubber

Effluent treatment (see Appendix 7.)

The in-plant measures taken are sewers segregation between process and bleach plant effluent and spill control by oil storage diking, paving, curbing and spill recovery.

Effluent from woodyard, pulp mill, paper mill, evaporator, power and recovery, cauticizing and pulp dryer flows through bar screen to clarifier. At mix box the effluents from bleach plant, demineralizer and chemical preparation comes in to be mixed with effluent come out of the clarifier (25 MGD in total). Through splitter box, the mixed effluent is diverted to two flows. Each flow goes through 2 aerator stabilization basins which has 9 aerators of 75 hp each and a retention time of 7 days each. Further treatment is in final sedimentation pond. The effluent treatment system has a holding pond of 30 days capacity and a foam separator (100 ft drop) before discharging the effluent through diffusers to the river.

To ensure that regulation can be met at all time the facilities are also equipped with back up clarifier and surge pond.

Solid waste : The solid waste which consists of primary clarifiers sludge is dewatered by belt presser. Power boiler fly ash, recausticizing grits and dregs and pulp mill knots and reject are dumped for landfill in an area which has been lined with clays. The leachate goes to treatment plant.

Management	: - Union camp has more staffs, operates in a team concept and emphasizes in-house training and employee involvement - Union camp takes a pro-active approach to environmental issues. They develop chlorine free bleaching technology and installed it at the Franklin Mill - 1,60% of total sale is used for research and development 200 employees involve in research and development work.

III.4. Weyerhaeuser Company

Flint River Operation, Ogglethorpe

Established	: 1978/79
Product	: Bleached softwood kraft paper grade and dissolving market pulps 930 tons per day
Raw material	: Softwood whole tree log, chips
Log yard	: - log yard water recycle - rechipper for over-sized chip - bark and fines for waste fuel
Pulping	: Impregnation vessel; Kamyr 3 stages vapor phase continuous digester; oxygen deliqnification. Pressure diffusion washer after digester; 2-stage brown stock diffusion washer; 3-stage post oxygen diffusion washer; closed screening room.
Bleaching	: 100% ClO_2 , D_1-E_0-D_2 stages using white water
Pulp drying	: Fourdriniers: 1240 inches trim , 29 -pass dryer
Chemical recovery	: 6 - effect evaporators, turpentine and soap recovery.
Water sources	: 10 MGD from Flint River, 0,8 MGD ground water
Effluent treatment plant	: Cap. ± 12 MGD Pulping and bleaching effluent are mixed before bar screen llthen enter waste clarifier. Further treatments are in :

1st lagoon	- 5 days retention time 9 aerators 75 hp each
2nd lagoon	- 9 days retention time 6 aerators 75 hp.
Stabilization pond	- 10 days retention time 1 aerator
Holding pond	- 660 MMG capacity

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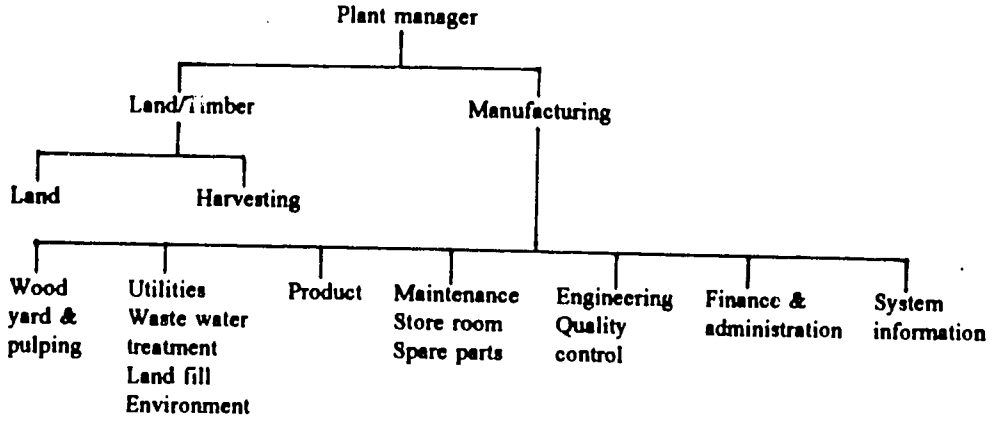
Emergency spill basin - located before bar screen, cap. 1.7 MMG. Water and waste water initial cost (1979-82) US$ 13.500.000 (excluding land cost). Operating and maintenance cost of water and waste water US$ 1.998.000 in 1992 (± 5% of pulp price).

Management : Mill structural organization



Flow diagram of the process can be seen in Appendix 8

III.5. National Council of The Paper Industry for Air and Stream Improvement Inc. (NCASI)

The visits were done to NCASI Gainsville and NCASI headquarter in New York. NCASI was founded in 1943 by the pulp and paper companies in the United States to carry out environmental research for pulp and paper industries. At present the organization has 100 employees with a yearly budget of $ 100 million funded by 90% of pulp and paper member companies.

In total, NCASI has 4 study sites which are in New York, Washington, Boston and Gainsville. Each site has each own specialty. Like in Gainsville they concentrate on air emission. In Washington the impact on marine sp. In Boston modelling of surface water. Beside doing study on pulp and paper pollutant, the source and the environmental impact, NCASI also provide information on waste minimization technology studies through their Technical Bulletin series.

The NCASI in Gainsville has many sophisticated apparatus for air quality studies. Among other Atomic Absorption Spectrophotometer equipped with permeation tube system. HPLC with ion chromatography etc.

The discussion at Gainsville was on the subjects like special features in each mill which we were going to visited, especially on waste minimization practices, some US pollution control regulation and effluent treatment processes.

Discussion with Dr. Isaiah Gellman at NCASI headquarter in New York was among others concerning the possible for IRDCLI to have access to the publication made by NCASI and to distribute the information further to Indonesian pulp & paper mills. IRDCLI would write a request letter for that. The

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study tour participants have received a bulletin concerning current testing and index of NCASI technical bulletines and special report. Upon request, NCASI would supply some literatures and the delivery will be taken care by WEC.

The possibility of assisting Indonesia to set up a similar activities as done by NCASI was also discussed. Knowing the experiences and the benefits of doing cooperative study of identifying, understaning and responding to public health and environmental impact of pulp and paper mill operation would be very valuable for improving the environmental and economic performance of pulp and paper mill in Indonesia.

World Environment Center Inc.

The World Environment Center is a not for profit non-advocacy environmental organization. WEC was founded in 1974 with seed funding from the United Nations Environment Programme, Independent since 1981, today the center is funded by industry, government, international organization, corporate or private foundations and private citizens.

The objectives of WEC are:

- Demonstrate measurable environmental and economic benefits from no-cost or low-cost waste minimization activities.

- Train in-country engineers

- Introduce waste minimization practices throughout the industry.

The center has three major programs :

- The International Environment Forum (IEF)
  The IEF is a group of 61 major multinational manufacturing corporations which operate on six continent. Senior policymakers around the world met with IEF for off-the-record discussion of environmental, health, safety and recource management issues.

- The International Environment Development Services (IEDS)
  Using volunteers and experts from IEF and other industries, government, academica and non-government organizations. IEDS provides pro-bono assistance to developing countries throughout the world. The present study tour is one of their IEDS program.

- WEC gold medal for International Environmental achievement.
  Several past recipients of WEC gold medal are Xerox Corporation (1993), The Procter and Gamble Company (1992), Rohm and Hass Company (1991), IBM Cooperation (1990)

IV. CONCLUSIONS AND RECOMMENDATIONS

IV.1. Conclusions

During this study tour, some important findings are as follows:

- WEC has launched very good technology tranfer program on introducing waste minimization practices through out the world. Indonesia can benefit much from the pro-bono assistance given to developing countries.

- The existance of NCASI in the United States since 1943 has proved that joined research programs can be performed for the common benefits of pulp and paper indutries. The research topic cover identification of pollutants, understanding the source and the environmental impact and also waste minimization technology.

- The important feature of waste minimization technology which have been put into practise commercially in the mills visited are:

  - Oxygen delignification also known as extended cooking process. This process removes more lignin prior to bleaching process, so that more lignin can be used as energy in recovery boiler and less bleaching agent is needed. Consequently less pollutants enter the bleach effluent.

  - Substitution of chlorine by chlorine dioxide causes a reduction of about 60% BOD_5, 65% COD, 77 % Color and 54% TOX in kg/ADMT.

  - Water has been recycled to a level where consumption is around 60-90 per ton product in 2 integrated mill, 45 m^3 per ton in a pulp mill, and around 27 m^3 per ton product in an unbleached integrated paper mill.

  - Spill prevention is performed by having a good process and equipment design in the first place. Further measures are by paving, diking and curbing around spill prone area and by having a spill basin. The spillage is recycled back as much as possible in a small loop. If by any chance the spillage is not recycled back, the flow to the treatment plant is regulated so as not to up set the treatment plant.

- Chemical recovery

  The chemical recovery process in Sonoco Product Company is quite unique. The pulping process is soda process using sodium carbonate and small amount of sodium hydroxide. Evaporation is done in 5 stages evaporators to bring the black liquor to 50% solids content. The burning of black liquor is not in a recovery furnace, but in a lime kiln. The sodium carbonate formed drops into a dissolving tank.

- Effluent treatment plant

  An effluent treatment plant in the mills visited takes up quite a large space. The process is based on sedimentation without chemical addition, then follows by huge aerated lagoons. The retention time in the aerated basin is usually more than 10 days with lots of 75 hp surface aerators. After aeration basin, sedimentation pond is usually used for the separation of biological sludge. Because of the low flow of the river in summer time, only a small

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amount of effluent can be discharged to maintain the allowed quality difference between up-stream and down-stream river water, therefore a holding pond of 20-30 days or even a 60 day holding pond exists.

The multi layered measures to guard accidental discharges or in case of out of order situations are amazing. Starting from in-plant good design, spill control measures, spill recovery, and also surge ponds, spill ponds, back-up clarifiers, sludge pond and one mill even has deep ditch surrounded the plant site.

The effluent is discharged to the river by mean of diffuser which is extended to the centre of the river under the water. The use of diffuser is meant to disperse the effluent quicker. The BOD level of effluent is usually below 50 mg/l. The effluent is clear but the color is brownish black. All basins are lined with compacted clay from about 0.5 to 1 m thick, no concrete basin or stone lined basin are found. A concrete patch is put under every surface aerator to prevent erosion from fluid movement. The anaerobic basin in Sonoco is also lined with clay. The surface is covered wiht polyethylene sheet and the gas formed is burned in 3 flares.

- Solids waste handling
  Log yard solids waste which mainly consist of wood bark is commonly burned in hogged fuel boilers. 3 from 4 mills visited dewatered clarifier sludge in screw presses. 1 mill uses 2 belt presses. A screw press is a lot smaller in size than a belt press. Steam is needed to lubricate the press. The solid content of the sludge comes out of a screw press is around 50%, twice higher as that comes out of a belt press. The dried sludge (50%) can be burned as fuel. The sludge from belt press together with other in-plant solids wastes are usually dumped for landfill.

- Air emission
  The smelt around the relatively new pulp mills visited is very mild or even has no smelt. The dilute non-condensible odorous gases from blow tank, washer etc are burned in power boiler, while the concentrated ones from flash tank, evaporator etc are burned in incinerator or power boiler. For bleach plant and power boiler, steam stripper or scrubbers using white liquor caustic solution are used. Clear condensate is sent to pulp washer. For particulate matters, electric-precipitators are used.

- Management

  - Willamette has a very lean staffs. Union camp has more staffs, operate in a team concept and carries out a lot of R & D works.

  - In most case, the operators in the mills are trained to do also maintenance jobs. Only special repairations are done by technical staffs.

  - The management for waste water treatment is placed under the utilities. No conflict of interest occurs between production unit and waste treatment unit mainly because the process and equipment design are good and the environmental awareness of all mill personnel are high.

- In USA, EPA has developed self monitoring system for pollution prevention. If in certain circumstances like equipment failure, the mill should surpass the environmental regulation, the situation should be reported immediately to EPA. EPA would check the case and monitor the progress of counter measures. Heavy charges will be put to the executives of the mill who knowingly and willfully polute the environment.

IV.2. Recommendations

From the knowledge obtained during the study tour concerning the WEC program, the NCASI activities and the development of pulp and paper industries in the USA, to further improve the environmental and economic performance of pulp and paper mills in Indonesia from the present situation, the following needs are identified :

1) A short one day seminar for the top executives or the mills owners in which the economical benefits of waste minimization are clearly demonstrated.

2) In view of the fact that most of the pulp and paper industries in Indonesia still consume quite a high amount of water, it would have a more immediate impact if the waste minimization program would emphasize on water conservation. US pulp and paper mills and also NCASI have already a lot of experiences in this field. A workshop discussing detailed techniques, and equipments about water concervation preferably with case studies would be very helpfull. It would be more convincing if some demonstration projects could also be implemented.

3) Lately Indonesia is experiencing a fast progress in pulp and paper industries. To support sustainable development and to implement environmental policies, a better understanding of the existing condition in relation with generation of pollutants, pollution loads (liquid, solid and air) possible waste minimization practice, existing end of pipe treatment and air pollution abatement is essential. In order to obtain this data which is very important for mill management and also for the Environmental Impact Management Agency (Bapedal), strengthening in setting up the following activities is necessary.

   - Indonesian pulp and paper technology information center — Institute for Research and Development of Cellulose Industry (IRDCLI) in Bandung has had some collections already, and IRDCLI has regular contact with all mills through *"Berita Selulosa"* periodical.

   - Develop joint practical research activities for the common benefits of existing mills. The present need is not in conducting basic or very scientific research activities, but more for assessment of mill conditions to supply data for mill management and regulatory agency to make good decisions.

   - Develop mill auditing skill and the ability for air emisi analysis like air flow measurement, the analysis of total reduced sulfur, non-condensible odorous gas component, AOX etc.

ACKNOWLEDGEMENT

The writer would like to express her appreciation to WEC and Bapedal for coordinating the study tour and to USAID for funding this activity.

APPENDICES

Appendix 1 - Sponsorship reference

Appendix 2 - Agenda of the visit

Appendix 3 - Diagram of effluent system in Willamette

Appendix 4 - Chemical Recovery Plant
Flow diagram of Sonoco Product Company

Appendix 5 - Waste Water Treatment Plant of Sonoco Product Company

Appendix 6 - The benefits of oxygen and ozon bleaching

Appendix 7 - Union Camp effluent treatment system

Appendix 8 - Process flow diagram Weyerhauezer

Appendix 9 - Photographs

Appendix 1 - Sponsorship reference

World Environment Center
Indonesia Office

Jl. H.R. Rasuna Said Kav. 11 - 14 Jakarta 12940 - Indonesia
Phone : 511120 Fax : 511195

Kepada Yth.
Pimpinan Balai Penelitian dan
Pengembangan Industri Selulosa
u.p. Ibu Ir. Handayani M.S.
Jl. Raya Dayeuhkolot 132
Bandung - 40259

Fax : 022-502871

Jakarta, 7.9.1993

Dengan hormat,

Pertama-tama kami ingin menyampaikan, sekali lagi, terima kasih atas partisipasi aktif serta kontribusi dari B.B.S. pada waktu penyelenggaraan Lokakarya Minimisasi Limbah Industri Pulp/Kertas, di Jakarta pada achir bulan Juli y.l.

Selanjutnya perlu kami informasikan bahwa sebagai tindak lanjut dari Lokakarya tersebut, sesuai dengan paket program kerja W.E.C. dengan U.S.A.I.D., kami rencanakan untuk mengirim beberapa pejabat teknisi dari sektor Industri Kertas ke Amerika Serikat dalam rangka program "train-the-trainer" untuk kunjungan pelatihan selama dua minggu.

Pelatihan di Amerika Serikat ini diharapkan akan menghasilkan tenaga-tenaga terampil khususnya dalam prosedur "waste assessment" dari "waste audits", yang dapat memberikan penataran/penyuluhan kepada rekan-rekannya dikalangan Industri Kertas, sebagai "instructors" pada Lokakarya serupa, yang akan diselenggarakan pada awal tahun 1994, yang mudah-mudahan dapat kita laksanakan secara swadaya, tanpa tenaga-tenaga pakar asing, dalam bahasa Indonesia sepenuhnya.

BAPEDAL, Departemen Perindustrian dan USAID telah sepakat dengan kami bahwa peluang terbatas untuk mengirimkan "trainee" ke Amerika Serikat ini seyogianya diberikan secara prioritas kepada Industri-industri yang telah terbukti mendukung program minimisasi limbah di lokasinya masing-masing, disamping trainee dari Bapedal dan Balai Penelitian dan Pengembangan Industri Seluloca.

World Environment Center
Indonesia Office

Kuningan Plaza, South Tower 3 rd Fl Suite 304 A
Jl. H.R. Rasuna Said Kav. 11 - 14 Jakarta 12940 - Indonesia
Phone : 511120 Fax - 511195

Sesuai dengan hal tersebut diatas, dan sejalan pula dengan pengarahan Lembaga-lembaga tersebut diatas, maka kami mengharapkan agar Ibu bersedia untuk menyampaikan calon "trainee" dari jajaran teknisi B.B.S., serta dapat mengirimkan biodata dari calon tersebut kepada kami secepatnya.

Kami mengerti bahwa waktu persiapan untuk program ini sangat pendek, namun jadwal untuk pelatihan ini direncanakan untuk diselenggarkan pada awal bulan Oktober y.a.d.

Bilamana ada hal-hal yang palu penjelasan lebih lanjut, kami mohon untuk disampaikan kepada kami dengan segera.

Atas perhatian dan kerjasamanya, sekali lagi kami ucapkan terima kasih.

Hormat kami

Drs. R.H.M. Wiradiputra
WEC - Indonesia Office
Country Director

P.S.
Terlampir kami sampaikan "write-up" dari experts W.E.C. di USA, sebagai indicator dan patokan untuk pancalonan "trainee" tsb.

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Appendix 2 - Agenda of the visit

World Environment Center 419 Park Avenue South Suite 1800 New York, NY 10016
Tel (212) 683 4700 Telex 261290 Environcent FAX (212) 683

AGENDA FOR U.S. STUDY TOUR
INDONESIAN DELEGATES

Saturday, October 23, 1993

- Gainesville Fl
- CCH arrives
- Fairfield Inn Mariott Hotel
  6901 NW 4th Blvd.
  Gainsville, Fl 32606
  Tel: 904 332 6292
  Fax: 904 332 6292
  (same as tel - wait for them to switch over when faxing)

Sunday, October 24, 1993

- Gainesville, Fl
- Delegates arrive
- Fairfield Inn Mariott Hotel
  (same as above)

Monday, October 25, 1993

- Gainesville, FL
- Meeting at NCASI 9:00am
- Mr. Ashok Jain
  Regional Manager
  3434 SW 24th Avenue
  Gainesville, Fl 32607
  Tel: 904 377 4706 x 224.
  Fax: 904 371 6557
- Fairfield Inn Mariott Hotel

Tuesday, October 26, 1993

- Travel to
- Florence, SC
- Ramada Inn Hotel
  2036 West Lucas Street
  Florence, SC 29501
  Tel: 803 669 4241
  Fax: 803 665 8883

Wednesday, October 27, 1993

- Bennettesville, SC
- Meeting at Willamette Mill 9:00am
  Mr. James Myers
  Plant Manager
  P.O. Box 673
  Bennettsville, SC
  Tel: 803 479 0200
  Fax: 803 479 0608
- Ramada Inn Hotel

Thursday, October 28, 1993

- Travel to
- Columbia, SC
- Ramada Town House
  1615 Gervais Street
  Columbia, SC 29201
  Tel: 803 771 8711
  Fax: 803 252 9347

Friday, October 29, 1993

- Eastover, SC
- Meeting at Union Camp 9:00am
  Mr. Wes Foy
  Technical Control Manager
  P.O. Box B
  Eastover, SC 29044
  Tel: 803 353 7700
  Fax: 803 353 7961
- Ramada Town House

Saturday, October 30, 1993

- Travel to
- Atlanta, GA
- Embassy Suites Hotel
  3265 Peachtree Road, NE
  Atlanta, GA 30305
  Tel: 404 261 7733
  Fax: 404 262 0522

Sunday, October 31, 1993

- Atlanta, GA
- Free day
- Embassy Suites Hotel

Monday, November 1, 1993

- Travel to
- Perry, GA
- Comfort Inn Hotel
  1602 Sam Nunn Blvd
  Perry, GA 31069
  Tel: 912 987 7710
  Fax: 912 987 7710 (same as tel - wait for switch over)

Tuesday, November 2, 1993

- Oglethrope, GA
- Meeting at Weyerhauser 9:00am
  Mr. Russell Stevenson
  Plant Environmental Manager
  P.O. Box 238
  Oglethrope, GA 31068
  Tel: 912 472 2527
  Fax: 912 472 5508
- Comfort Inn Hotel

Wednesday, November 3, 1993

- Travel to
- Atlanta, GA/New York
- Roger Smith Hotel
  501 Lexington Avenue
  New York, NY 10017
  Tel: 212 755 1400
  Fax: 212 319 9130

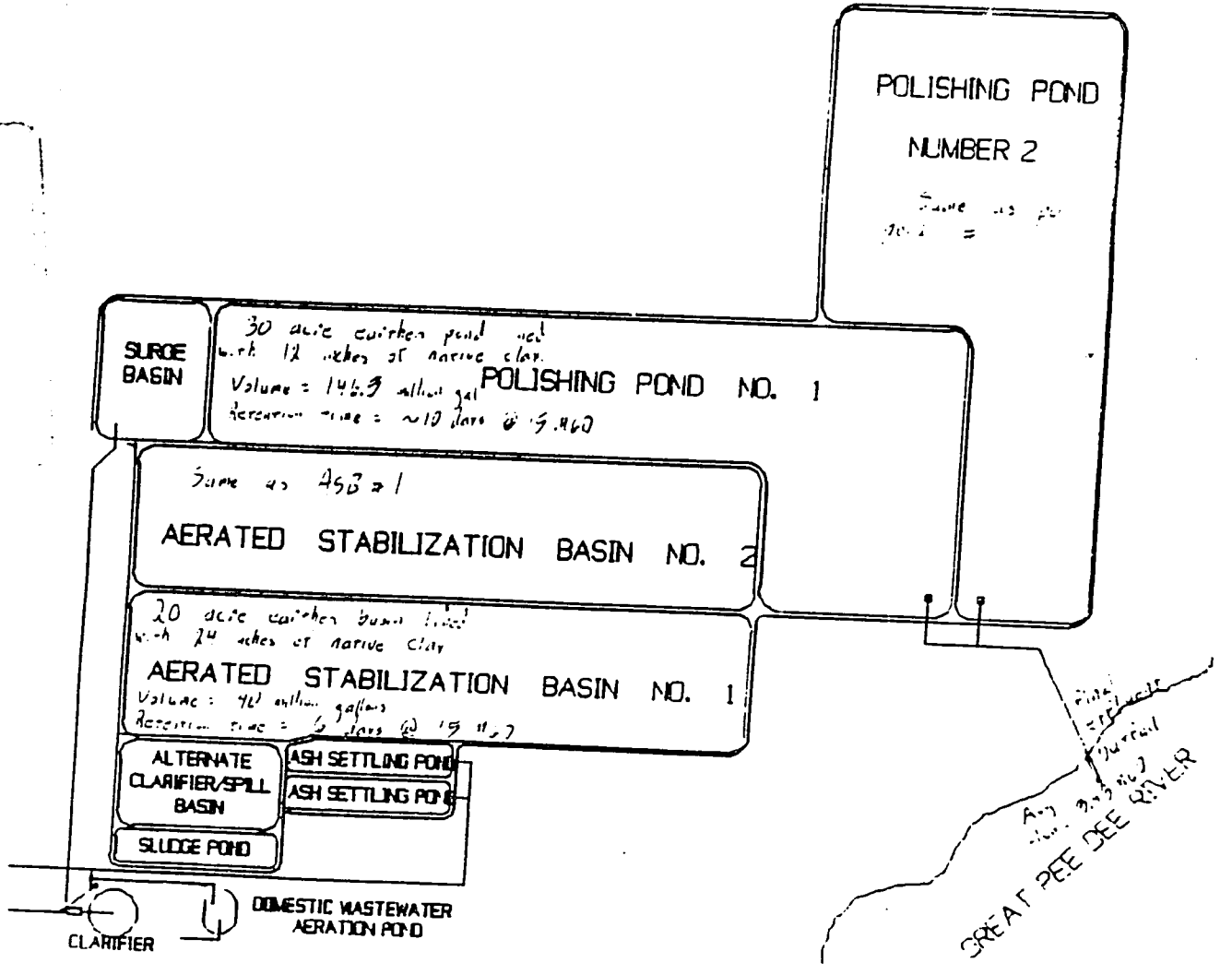
Thursday, November 4, 1993

- New York, NY
- Meeting at NCASI 9:00am
  Dr. Isaiah Gelman
  Vice President
  260 Madison Avenue, Suite 1105
  New York, NY 10016
  Tel: 212 532 9000
  Fax: 212 779 2849

Friday, November 5, 1993

- Delegation departs from New York, to Indonesia

Appendix 3. Diagram of effluent system in Willamette, Marlboro Paper Mill



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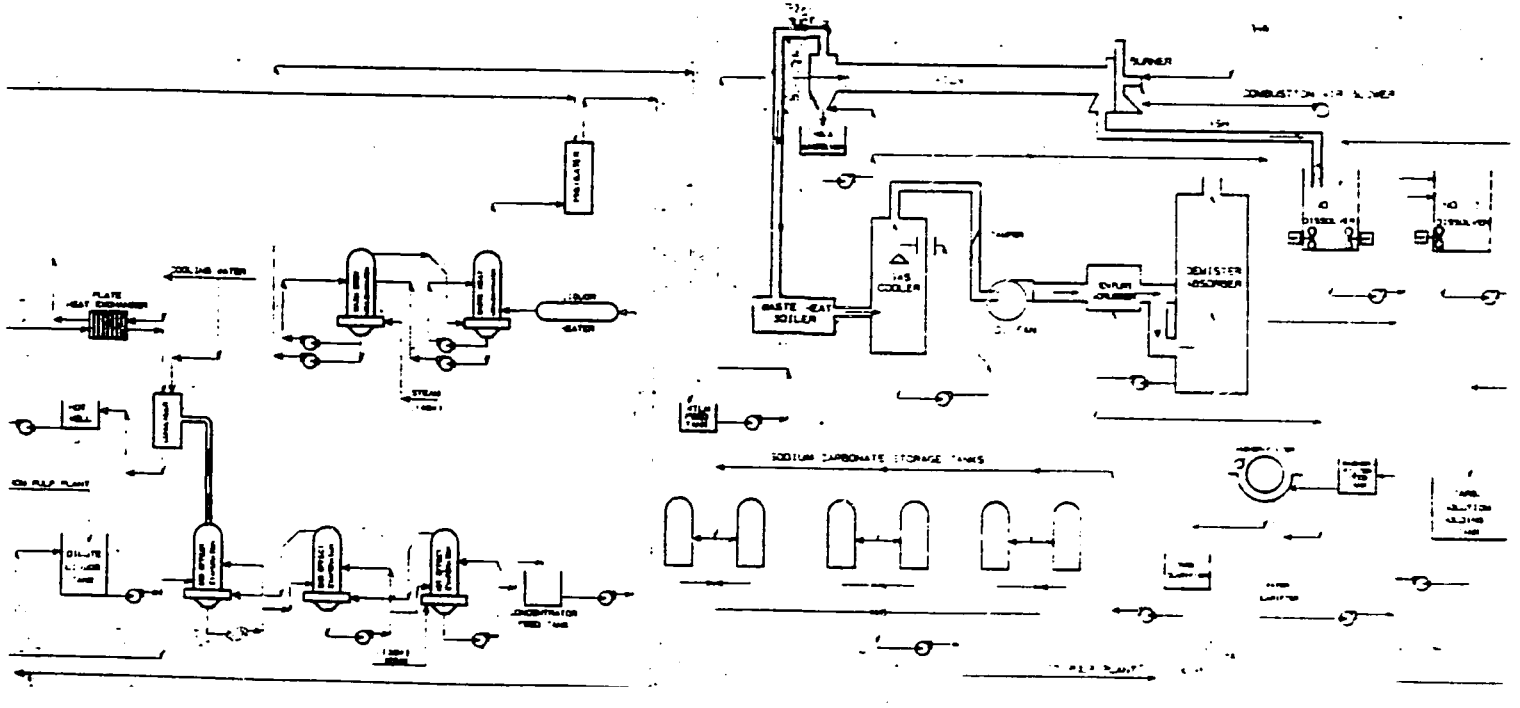
Appendix 4. Corrugating Division, Chemical Recovery Plant
Sonoco Product Company



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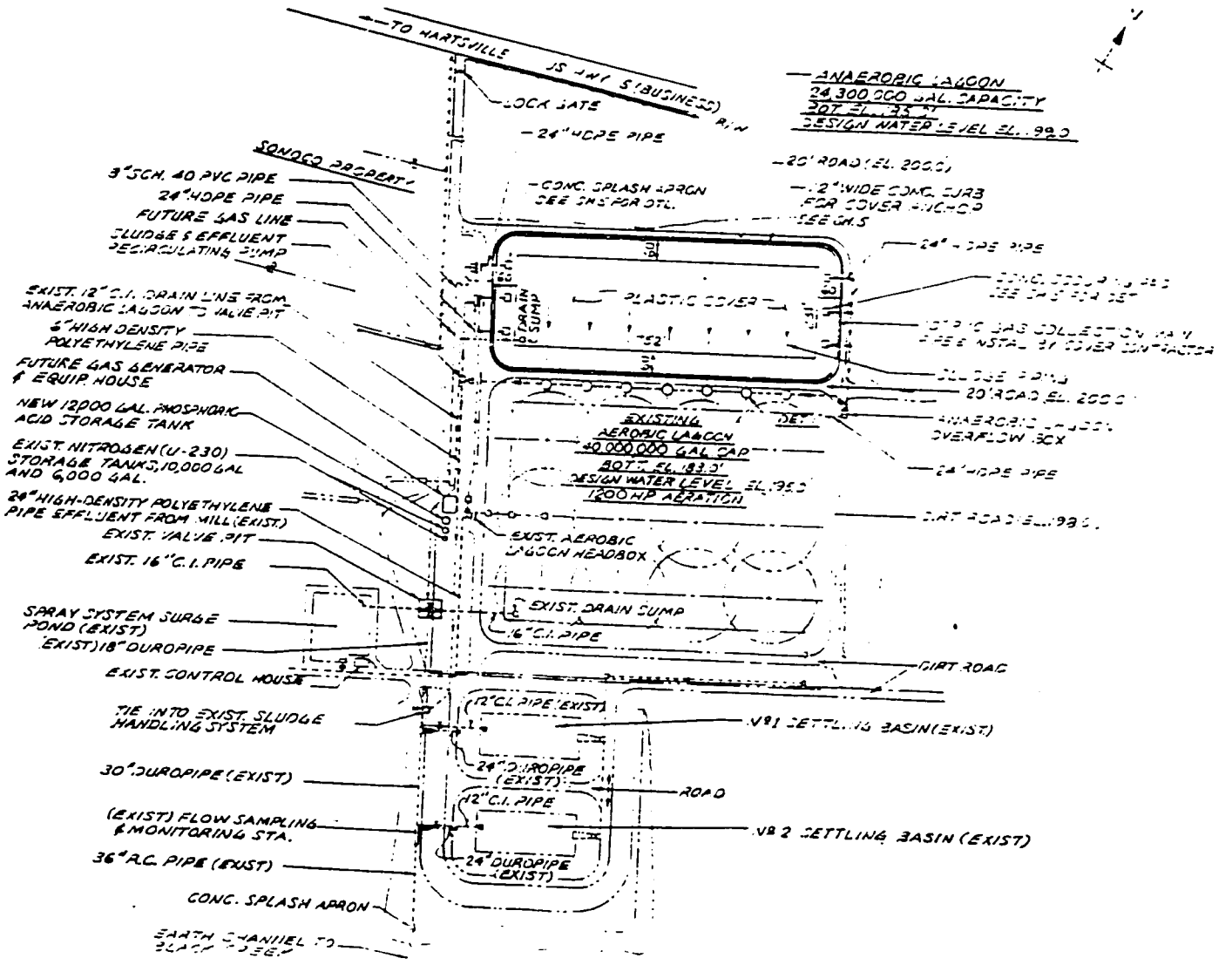
Appendix 5. Waste Water Treatment Plant
Sonoco Product Paper Mill



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PERCENT REDUCTION IN EFFLUENT
Using OZED Bleaching
90 G.E. BRIGHTNESS PULP

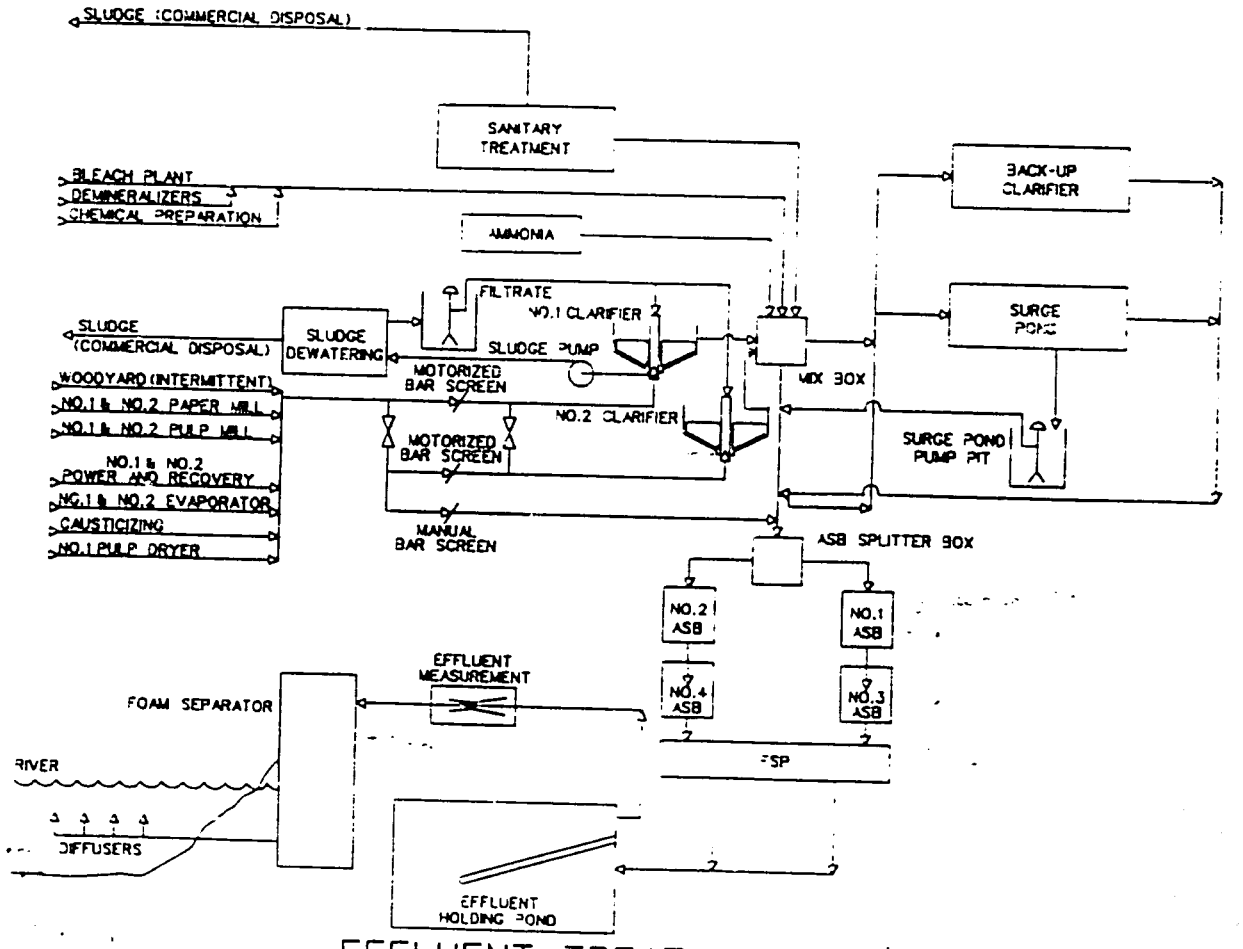
	Compared to Reference Sequence	COLOR	BOD	TOX	COD
Birch	ODEDED	88%	76%	71%	58%
Southern HD	CEDED	99%	88%	98%	91%
Southern HD	O(D$_{ll}$C)ED	96%	78%	97%	90%
Eucalyptus	CEDED	98%	87%	97%	88%
Spruce/Pine	O(D$_{ll}$C)EDED	98%	---	97%	85%
Hemlock/D. Fir	CEDED	96%	91%	84%	92%
Southern Pine	CEDED	99%	88%	99%	91%
Southern Pine	O(D$_{ll}$C)ED	96%	69%	98%	73%

POTENTIAL BENEFITS
CHLORINATED ORGANICS
Southern PINE Kraft to 82 ISO

	CEDED	OC/DED	OZED
on PULP			
TOX (kg/ADMT)	0.28	0.13	0.04
in BLEACH PLANT EFFLUENT			
TOX (kg/ADMT)	6.5	3.0	0.08 [a]
CHLOROFORM GENERATION			
total (kg/ADMT)	0.18	0.08	0.002

a. Level depends on the amount of chlorine in the chlorine dioxide used

Appendix 7. Union Camp Effluent Treatment System



EFFLUENT TREATMENT SYSTEM

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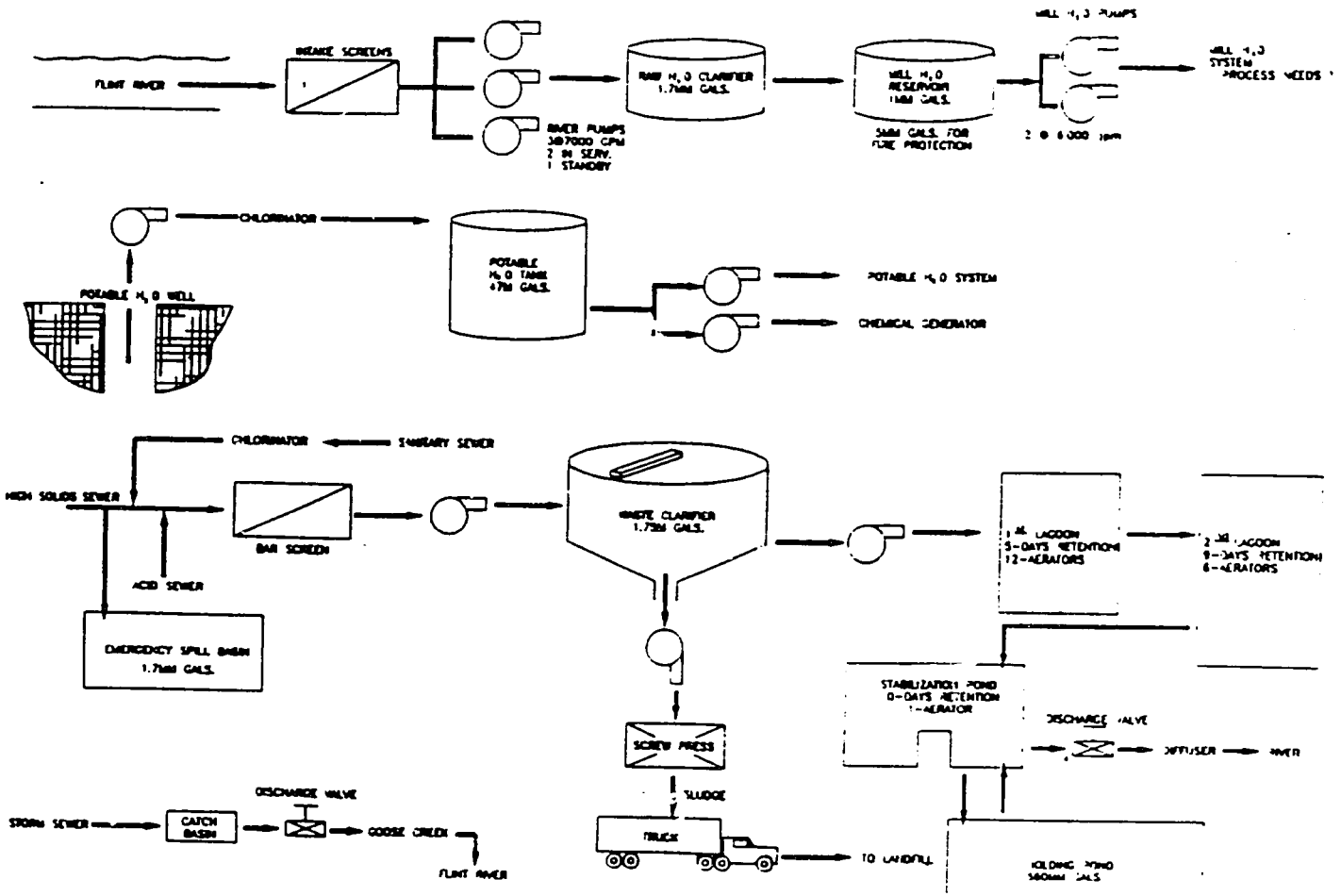
Appendix 8. Waste and Water Treatment
Weyerhaeuser Company, Flint River Operation



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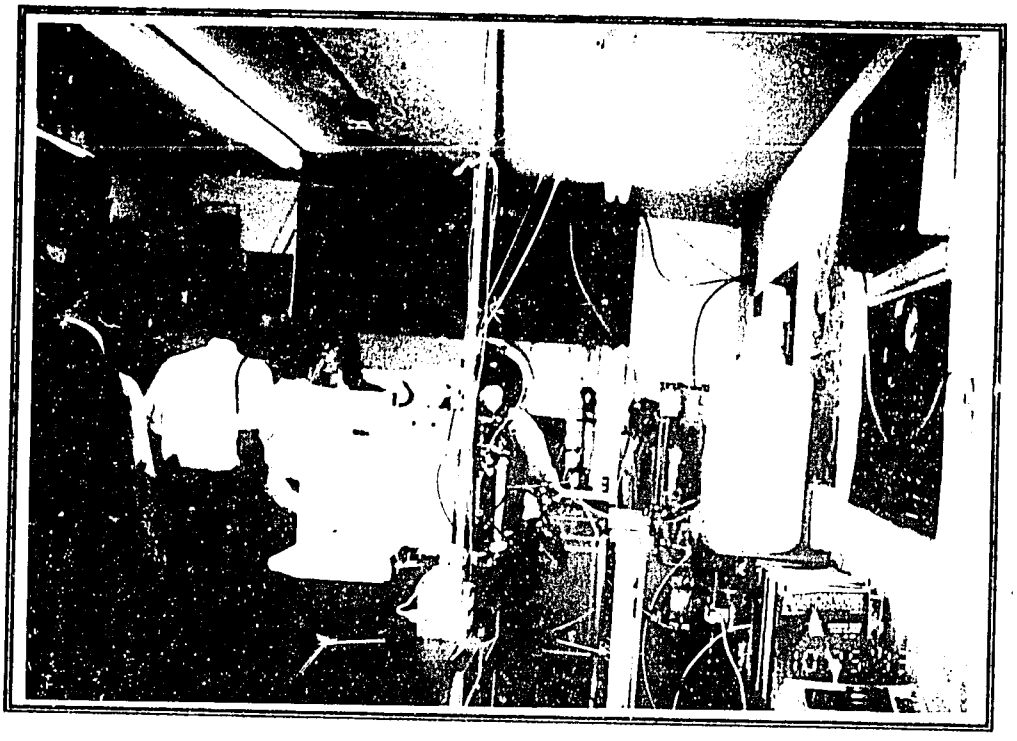
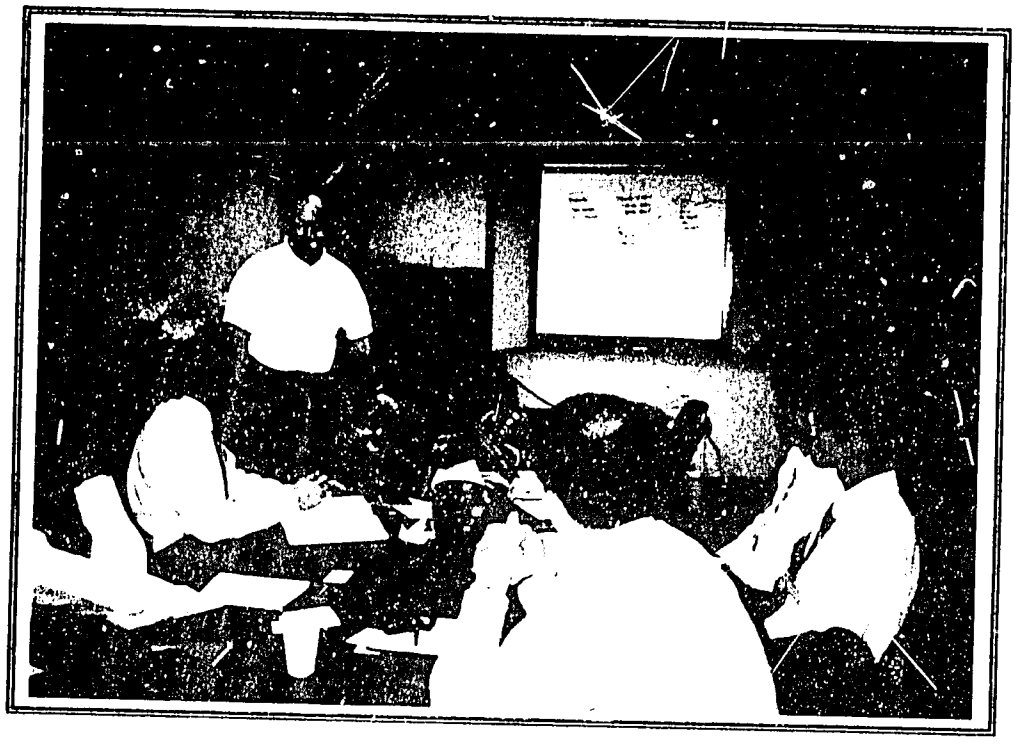
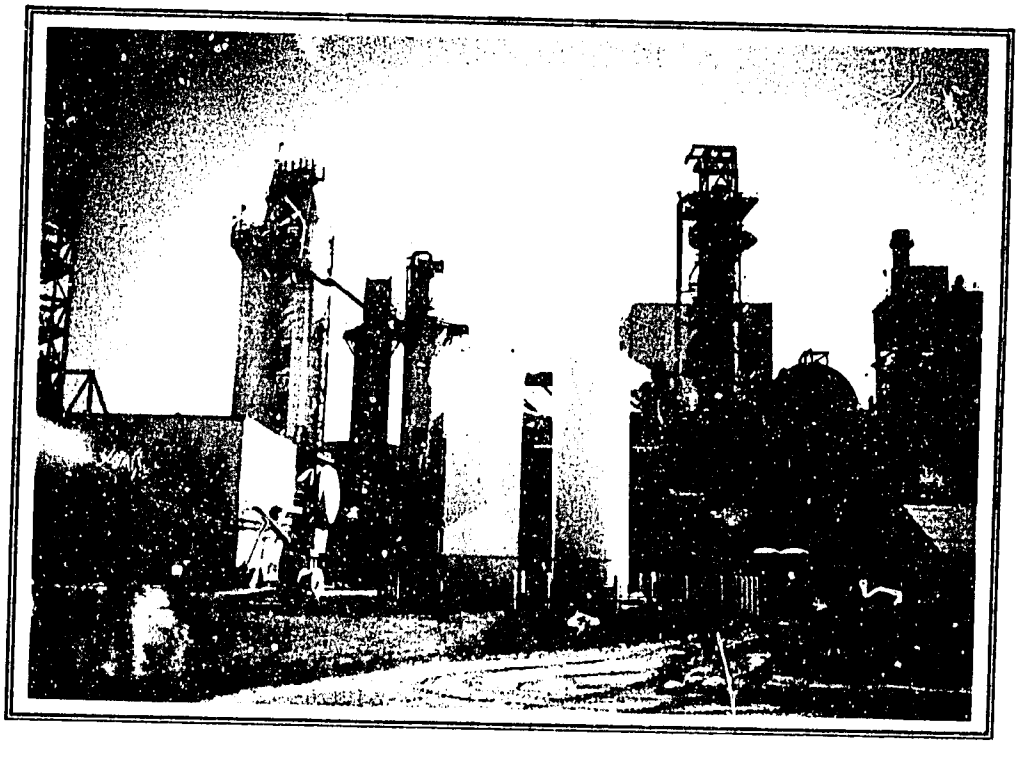


Laboratory Tour at NCASI Gainsville

Discussion at NCASI Gainsville



Discussion at Willamette Industries Inc., Marlboro Paper Mill



Bleaching Plant at Marlboro Paper Mill
Oxygen delignification tower at the back right side

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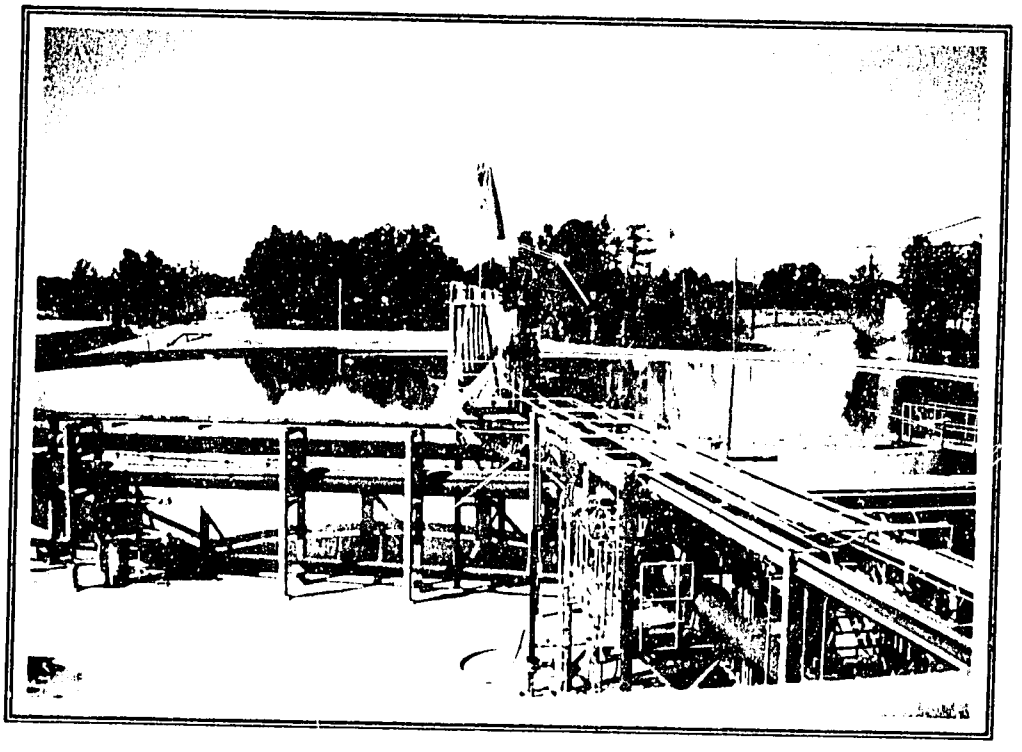
Influent at Marlboro Paper Mill



Clarifier at Marlboro Paper Mill

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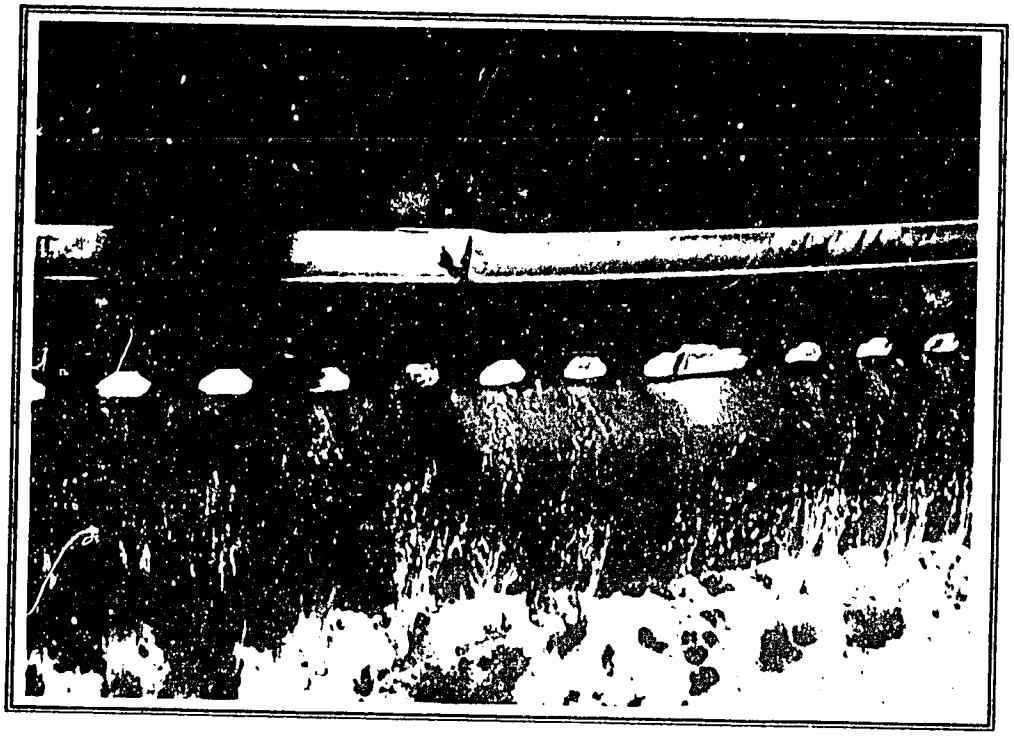
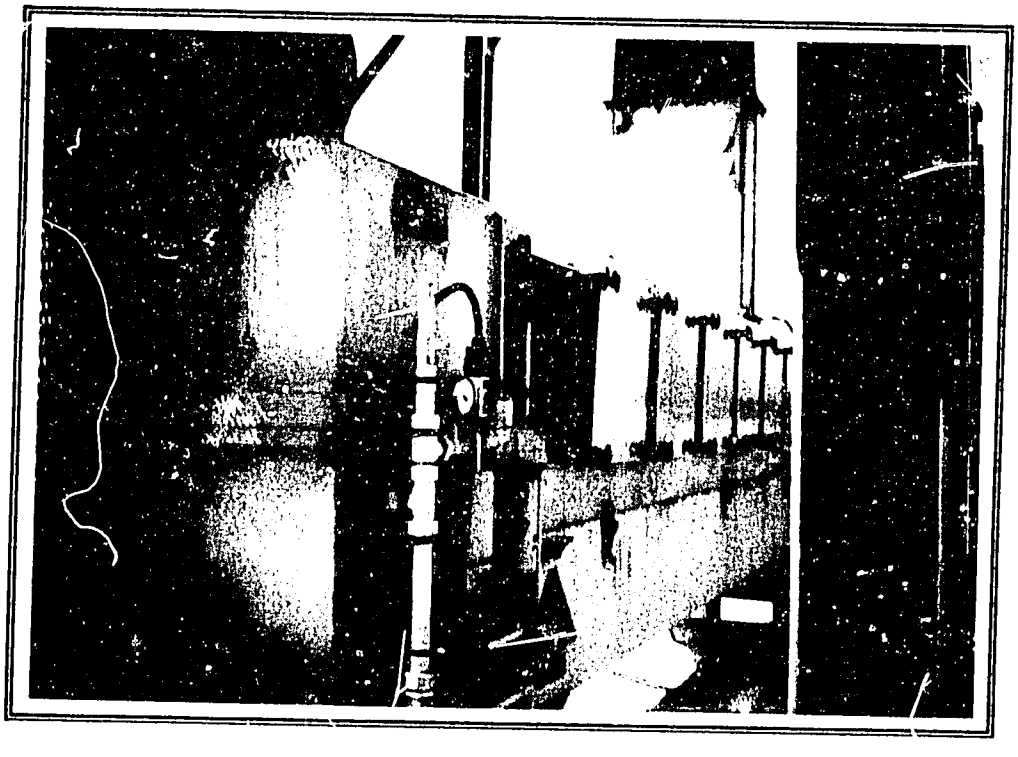
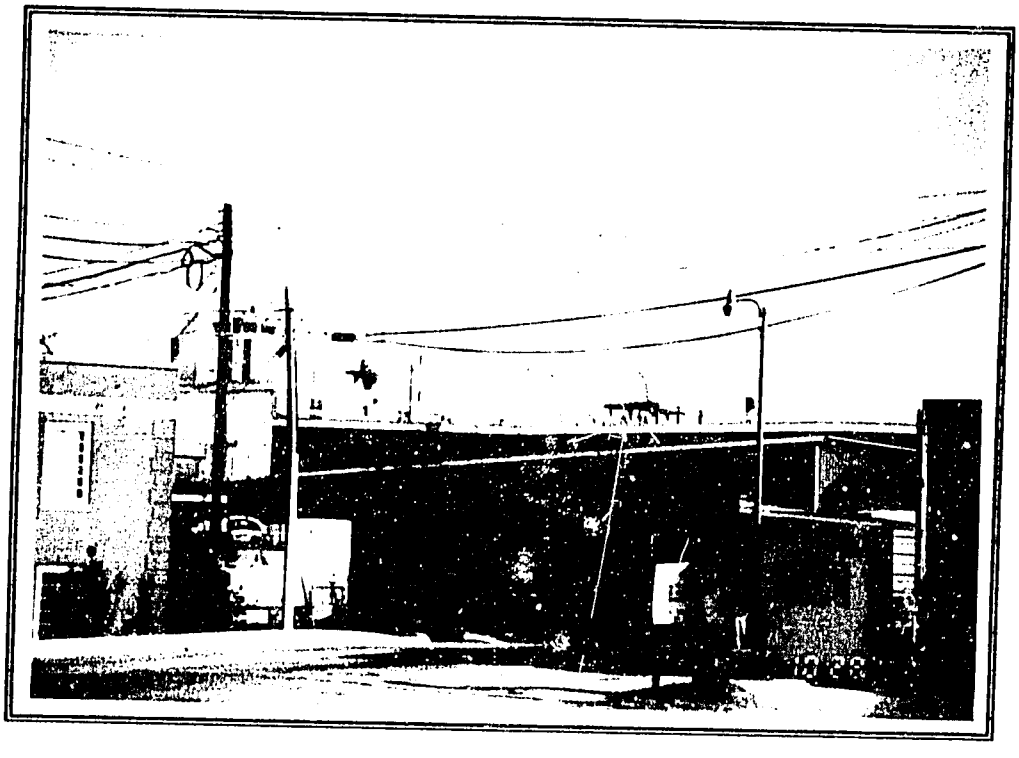


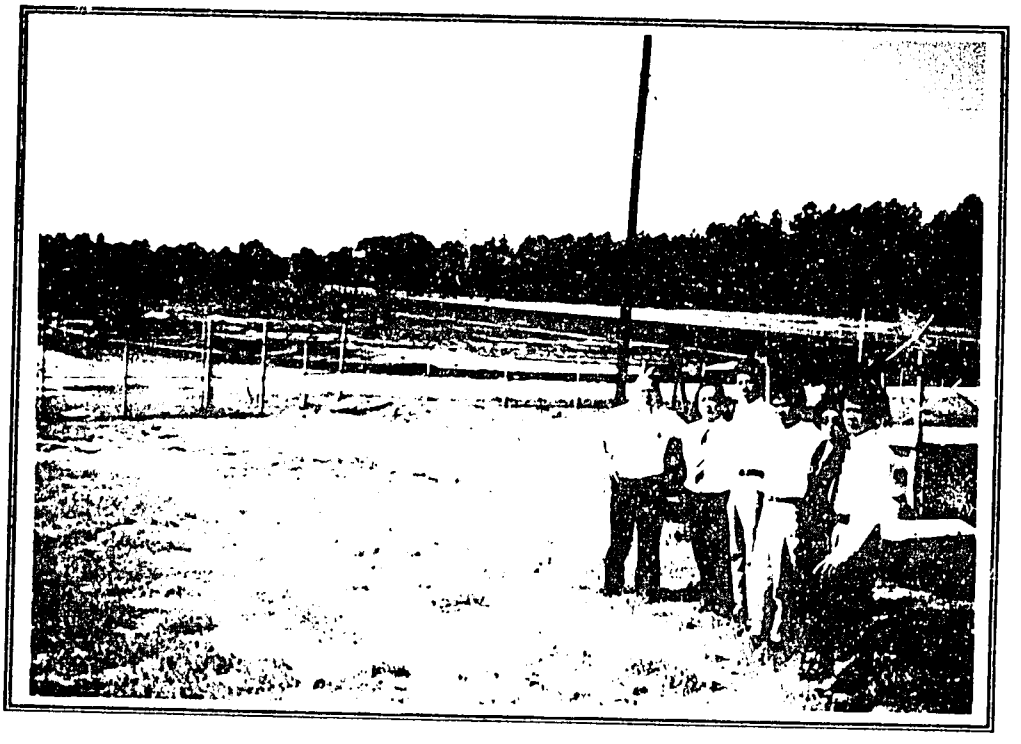
Clarifier overflow



A screw press for sludge dewatering at Marlboro Paper Mill 568

Treated waste water discharge through diffusion header
into the Great Pee Dee River





Anaerobic lagoon Sonoco Product Company

aerobic lagoon Sonoco Product Company

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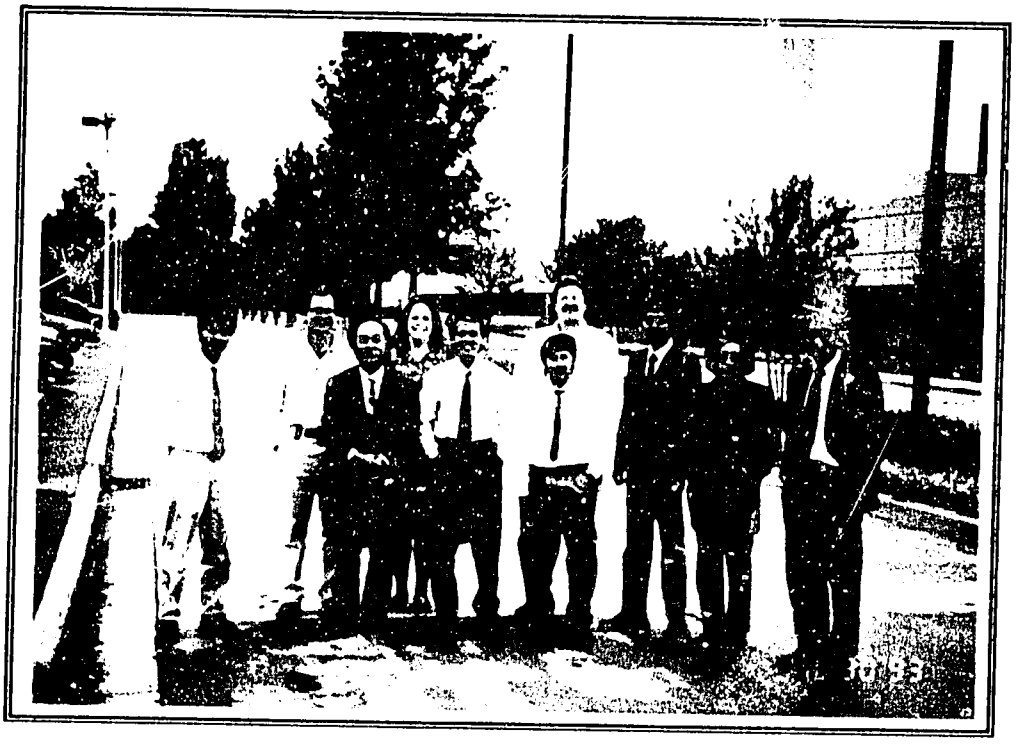
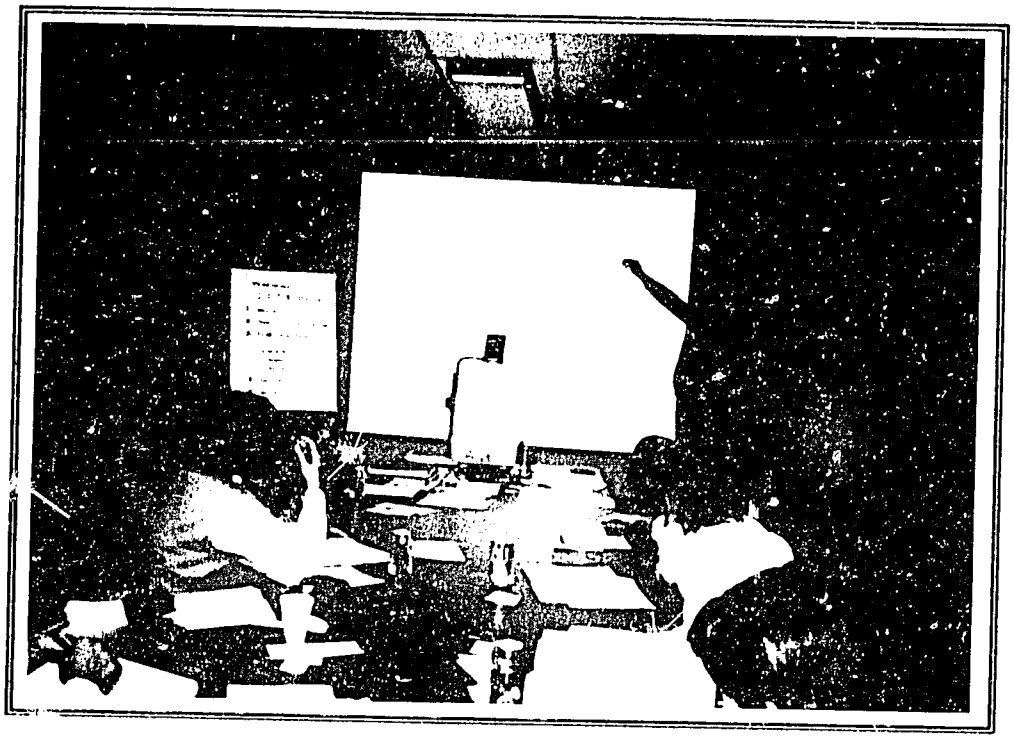
Union Camp Corporation Eastover Mill



The whole study tour participants and
Union Camp exceutives at Eastover Mill



Discussion at Weyerhaeuser Company Oglethorpe

Discussion at WEC, New York

Discussion at NCASI, New York

PN-ABU-161

PULP AND PAPER U.S. STUDY TOUR

(Volume 1 of 2)

SUMMARY REPORT

United States
October 24 - November 5, 1993

Prepared for:

US - ASIA ENVIRONMENTAL PARTNERSHIP

WEC

WORLD ENVIRONMENT CENTER

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DISCLAIMER

This project was sponsored b the U.S. Agency for International Development through WEC's Cooperative Agreement in support of the U.S.-Asia Environmental Partnership (US-AEP). The opinions expressed herein are the professional opinions of the authors and do not represent the official position of the Government of the United States or the World Environment Center.

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I. EXECUTIVE SUMMARY

During October 24 to November 5, 1993, representatives of the Indonesian Pulp and Paper Industry participated in an Environmental Business Exchange (EBE) of environmental management practices and technologies implemented in four U.S. pulp and paper mills. The participants represented four Indonesian pulp and paper mills and two governmental agencies. The group met with senior managers of U.S. facilities to discuss methods of waste minimization and environmental system/technology management. Particular focus was given to assessing the transferability of technologies and management practices applied to wastewater treatment, water use reduction, chemical recovery and waste reduction/recycling.

Funding for this project was provided through a Cooperative Agreement between the World Environment Center (WEC) and the United States-Asia Environmental Partnership (US-AEP) and the United States Agency for International Development/Jakarta (USAID/Jakarta).

This report summarizes technical reports submitted to WEC by the study tour participants. The individual study tour participant reports are attached as Appendix B.

Funding for this project was provided through a Cooperative Agreement between the World Environment Center (WEC) and the United States-Asia Environmental Partnership (US-AEP).

II. INTRODUCTION

In response to the recent developing and strengthening of environmental regulations in Indonesia, numerous organizations of Indonesia's private and public sectors have initiated efforts to enhance the ability of the pulp and paper industry to effectively meet both existing and emerging environmental standards/regulations. Close cooperation between the World Environment Center (WEC), the U.S. Government, the Indonesian Ministry of Industry (MOI), the Environmental Impact Management Agency (BAPEDAL) and private industry has allowed for the development of a comprehensive and integrated WEC Indonesian Waste Minimization Program. The EBE program, has effectively demonstrated that coordination and communication between regulatory agencies and industry can result in the development of cost effective initiatives for minimizing waste, enhancing production and efficiency, and improving worker safety and health.

Following up on two waste minimization assessments (1992) and one waste minimization workshop (1993) in Indonesia, a group of six Indonesians visited the United States to exchange information regarding current technologies and best management practices implemented in four pulp and paper mills. With the assistance of the National Council of the Paper Industry for Air and Stream Improvement (NCASI), WEC identified Willamette Industries, Inc's. Marlboro Paper Mill, Sonoco Paper Products, Hartsville, South Carolina Mill, Union Camp Corporation's Eastover, South Carolina Mill, and Weyerhaeuser Company's Oglethorpe, Georgia Mill to be U.S. Study Tour host facilities.

This report summarizes technical reports submitted by the participants. Please note that facility diagrams, presentation materials and photographs will not be presented in this report, as they, as well as individual's impressions can be found in Appendix B - Participant Reports.

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III. FACILITY AND MEETING SUMMARIES

National Council of the Paper Industry for Air and Stream Improvement, Inc. (NCASI)

On October 25, 1993, Mr. Ashok K. Jain, Regional Manager, Southern Region, NCASI, hosted the exchange participants to discuss the study tour itinerary and exchange information regarding the regulatory climate of the U.S. pulp and paper industry and measures taken by the industry to comply with existing and emerging environmental standards and regulations. NCASI, a private, non-governmental organization, was organized in 1943 through funding from the U.S. pulp and paper industry to help the industry respond to increasing regulatory and social pressure regarding environmental issues. NCASI continues to be industry funded, with membership consisting of 95% of all U.S. pulp and paper companies.

Mr. Jain explained that a major benefit of NCASI is that it allows industry to pool resources together for research and development for environmental technology and management advancement, saving individual paper companies the large capital investment and staff time necessary to balance increased production demand and more stringent environmental regulations.

The delegates showed much interest in NCASI activities, particularly with respect to the free flow of technical information between U.S. facilities. Despite the highly competitive nature of the pulp and paper market in the U.S. (and world-wide), the industry realized the cost effectiveness of designating one organization as a focal point for research and development of new technologies, particularly with respect to environmental control.

As a result of the participants' interest in chemical pulping operations and corrugated medium (card-board), a fourth facility (Sonoco Products Company, Hartsville, SC) was added to the itinerary.

Key Issues:

- Ms. Hendayani expressed interest in developing an organization similar to NCASI in Indonesia. Information collection and exchange is critical for the Indonesian industry to effectively meet environmental regulations, while keeping pace with the growing pulp and paper market.

- Benefits of having an industry funded organization such as NCASI in Indonesia are:

  - response to environmental controls can be immediate and not dependant on governmental approval of funding allocated towards environmental technology/management research and development

- implementation of advanced technology and management practices is more immediate, as it is based on needs and wants of the industry

- top management of facilities may be more easily informed of changes in the environmental regulatory climate, and can keep abreast of methods for keeping facilities in compliance

- The delegates requested additional information regarding NCASI and agreed to discuss future NCASI-Indonesia cooperation with Dr. Isaiah Gelman, President, in New York.

- Priority issues identified by the delegates for the Study Tour are as follows:

  - water use reduction/recycling and waste water treatment systems
  - surface water quality modeling
  - air pollution control technology and U.S. emissions standards
  - KRAFT emission standards
  - solid waste management, both on and off site disposal
  - improving facility management and increasing staff awareness of environmental issues
  - black liquor oxidation system design
  - U.S. hazardous waste regulation
  - total reduced sulphur (TRS)
  - sludge bulking - folic acid was suggested as a means of control

Willamette Industries, Inc. Marlboro Paper Mill, Bennettsville, SC.

On October 27, 1993, the delegation toured the Marlboro Paper Mill in South Carolina. Martin Barfield, Technical Services Manager, and Greg Fullenwider, Technical Specialist, met with the group to discuss specific waste minimization applications and management practices.

Commencing operations in 1990, the mill is the newest in the U.S. and implements state-of-the-art processes and environmental control technologies. The mill employs 200 people and operates 4 shifts a day (24 hrs./day). The Marlboro Mill is located on 1,800 acres and produces approximately 750 tons of bleached paper a day from virgin fiber. 60% of the fiber source is from hardwood chips and the remaining 40% comes from soft wood chips. Present water consumption is 9 million gallons/day and wastewater is discharged into the Great Pee Dee River located near the facility.

Because the mill was built from the ground up using the highest level technology available, there was a considerable investment in process and environmental control technology. The participants believed that many of the environmental control technologies implemented at Willamette would take some time to enter Indonesia, as it is not yet cost effective to do so. However, the mill did serve as a good example for future consideration.

As a state-of-the-art facility, the mill uses: extended oxygen delignificaiton, non direct contact furnace (NDC), high level steam strippers for removing TRS and methanol, electrostatic percipitators and wet scrubbers on all stacks, and implements a three stage bleaching process using chlorine and chlorine dioxide as bleaching agents. BOD discharge is currently 75% below Federal emissions standards.

The participants were very interested in the management structure of the mill, which is based on a participatory approach wherein employees are grouped into teams. There is a strong emphasis on cross training between operations and maintenance, all operators have basic maintenance training and all employees receive regular health and safety training sessions. This cross training and team building has allowed the Willamette mill to operate efficiently with less staff. Suggestions made by any employee are taken into consideration by senior management and staff is awarded for positive contributions.

Key Issues

- The tour focused on observing:
  - extended oxygen delignification
  - steam stripper configuration
  - non-direct contact furnace
  - management organization
  - spill control measures
  - digital monitoring system
  - secondary treatment facility and final discharge into stream (color)

- Water conservation at the Willamette mill was thought to be rather impressive.
  - brownstock consumption :1.270 MGD
  - bleach plant consumption :.84 MGD
    chemical recovery system :.92 MGD
  - utilities :.54 MGD
  - wet lab/paper production :8.5 MGD

- Wastewater treatment is not done by activated sludge (as it often is in Indonesia) but rather through a system of aerated lagoons.

- Sludge from the wastewater stream (50% solid) is burned in a hogged fuel boiler and solids collected are land filled. The mill is currently evaluating options for land application of sludge.

<u>Sonoco Products Company, Hartville, South Carolina</u>

The exchange participants visited Sonoco Products Company's Hartville Mill on October 28, 1993. This facility was added to the agenda due to it's rather unique chemical recovery system. The group was hosted by Mr. Philip Whichard, Chemical

Recover and Wastewater Manager.

The Sonoco mill was established in 1900 and has undergone much retrofitting and expansion as the facility grew in production output. The delegates were highly interested in learning about measures taken by the facility over the past 90 years to keep pace with increased production and more stringent environmental regulations. The mill produces almost exclusively corrugated medium (500 ton/day) for cardboard boxes and paper cans/cones (additional 500 tons/day). The raw material for the process is mainly recycled corrugated cartons and some virgin hardwood stock. The mill has a total of eight (8) paper machines; one Fourdinier machine for corrugated medium, and seven cylinder machines for other products. Total water consumption for the facility is 3.5 - 4.0 MGD, which calculates to approximately 3000 gallons of water per ton of product.

The wastewater treatment facility configuration consists of:

- anaerobic lagoon with 24,300,000 gal. capacity and holding time of 5 days.
- aerated lagoon with 40,000,000 gal. capacity, four 100 hp. aerators and sixteen 50 hp aerators.
- 2 settling basins - capacity unknown.

The highlight of the Sonoco facility was the method employed for treating wastewater from the washing process (black liquor) in the pulping line. In this system, black liquor from the pulping process is sent directly to the evaporator (three stage evaporator), where the liquor is condensed from 8% to 50% solid content. The liquor is then sent to a rotary kiln (lime) for incineration. The sodium carbonate produced then falls into a dissolving tank. Gas from the lime kiln goes to a waste heat boiler, producing steam. The steam from the waste heat boiler is combined with steam from the power plant to evaporate the black liquor (inside the waste heat boiler). The gas is then sent through a gas cooler, a venturi scrubber and de-mister absorber and is then released.

Key Issues

- The soda pulping process used at Sonoco was quite interesting to the delegation, as this process is used more extensively in Indonesia than in the U.S.

- The chemical recovery system employed at Sonoco is quite unique and has been designed by Sonoco engineers. This design has been considered by the group to be highly creative and highly cost effective (costs the mill 8 - 10% of the cost of a standard recovery boiler). The approximate savings by using the lime kiln system is 10 million dollars. All delegates have expressed interest in examining further the possibility of adopting the same system in Indonesia.

Union Camp, Eastover, South Carolina

On October 29, 1993 the delegation was hosted by Wesley A. Foy, Technical Control Manager, Doug R. Lazar, Senior Applications Engineer, and James P. Wilkowski, Environmental Engineer, of the Union Camp Eastover Mill. The mill was established in 1984 and manufactures fine white paper for use in the communications industry, (i.e., copier paper, envelopes, business forms, offset printing, reading materials and writing supplies). The facility also produces bleached market pulp. The facility employs 800 people and runs four work shifts/day. Water consumption is calculated to be approximately 1400 gallons for one ton/product.

The Eastover Mill pulps both hard and soft wood trees. The chipping process goes into two continuous digesters for delignification and is then bleached. For bleaching, chlorine dioxide, Ozone and oxygen are used.

Wastewater is treated by a primary clarifier, aerated stabilization basin (with a total of 18 75 hp aerators) and a effluent holding pond. Wastewater discharged into the local river is reported to have 10ppm BOD.

In-plant measures taken to reduce waste include segregating process and bleach plant effluent, and implementing effective spill control such as diking, paving, curbing, and spill recovery. In Indonesia, there in a strong need for enhanced spill control and the Eastover facility served as a good example of a state-of-the-art facility in this respect.

Of particular interest was Eastover's ozone bleaching system (information in Appendix section) and technology used in odor control, where the primary focus is given to controlling H_2S, CH_3SH, $(CH_3)_2S$, and $(CH_3)_2S_2$.

Key Issues

- The participants looked into the future applicability of various bleaching methods, primarily ozone bleaching, which has demonstrated high bleaching efficiency and less negative environmental impact.

- The Eastover facility has a very strong focus on Health and Safety and the participants were impressed by the detail given to safety matters.

Weyerhaeuser Company, Flint River Operation, Oglethorpe, GA

The final facility tour took place November 2, 1993 at Weyerhaeuser, Flint River. The delegates were greeted by Mr. Russell Stevenson, Plant Environmental Manager and Mr. Frank D. Wohrley, Environmental Project Engineer. The mill was established in 1978 and is an integrated facility which produces bleached softwood kraft paper for use primarily in the diaper industry.

Water consumption has been reduced from 17,000 gallons per ton of production to

10,000 gallons per ton of production. The bleaching process makes use of chlorine and chlorine dioxide. The use of molecular chlorine has been eliminated at the mill.

The effluent treatment system has a capacity of 12 MGD and consists of two aerated lagoons with a total of 18 75 hp aerators, a stabilization pond and a 660 MMG capacity holding pond.

Key Issues

- The delegation was highly interested in the amount of capital investment needed to develop an effective waste management system. It was demonstrated that the initial cost of the facility in 1979 was approximately $13,500,000, of which approximately $1,998,000 was invested in waste water and emissions control. The current spending necessary for the operation and maintenance of the wastewater treatment system is equal to approximately 5% of the pulp price.

- The Flint River mill mandates that all operations employees spend two hours/week in training sessions which focus on facility operations, environmental issues, health and safety issues. This strong emphasis on staff training and environment was well received by the Indonesian group.

World Environment Center, New York

A meeting was held at the World Environment Center on November 3, 1993 to discuss the Study Tour and identify potential future programs (discussed in the following section). Mr. Frank T. Wood, Vice President, Technical Programs, hosted the delegates.

National Council of the Pulp and Paper Industry for Air and Stream Improvement (NCASI), New York City

Dr. Isaiah Gelman, President of NCASI, greeted the delegation on November 04, 1993 to discuss the Study Tour and provide additional information. Dr. Gelman expressed interest in continuing cooperation with WEC and the Indonesian delegates. A copy of the current listing and index of NCASI technical bulletins and special reports was distributed to the group. NCASI also agreed to host future visits to additional facilities throughout the U.S. and will coordinate with WEC to examine future projects.

IV. STUDY TOUR SUMMARY AND RECOMMENDATIONS

Project Summary

Feedback regarding the 1993 U.S. Pulp and Paper Study Tour from the participants indicated that the program was overall successful. As Indonesia's pulp and paper industry expands (35 additional facilities are planned for the next three years) there will be increased need for technical assistance programs.

During the WEC meeting with the participants, there was strong emphasis from the group to continue the waste minimization program in Indonesia. Mrs. Hendayani T. Adisesha of the Institute for Research and Development of the Cellulose Industry, expressed interest, on behalf of the group, in submitting additional project proposals to WEC and USAID/Indonesia.

In terms of future study tours, it is recommended that all participants be screened for technical and language fluency before participation in WEC programs. Participants should submit detailed information regarding their specific goals and interests to WEC/Indonesia one month prior to a U.S. visit so that arrangements can be made with facilities that suit the needs and interests of the participants.

Waste Minimization and Technical Summary

- Oxygen delignification, the removal of lignin before the bleaching process, has proven benefits in reducing the amount of energy needed to fuel a recovery boiler system. The removed and captured lignin may be used as recovery boiler fuel and the decreased amount of lignin reduces the amount of bleaching agents needed, thus reducing the total amount of pollutants entering the bleach effluent.

- Chemical recovery systems, such as the one seen at Sonoco Products, can be designed and built so that a full recovery furnace system is not needed. The delegates all agreed that the Sonoco design is both cost effective and efficient in treating black liquor. One of the Indonesian companies that participated in the U.S. Study Tour has already contacted Sonoco to further discuss the transfer of this design.

- Substitution of chlorine, by chlorine dioxide in the bleaching process has yielded a reduction of BOD_5 equaling 60%, COD by 65%, Color by 77%. Ozone bleaching, although a relatively new technology in the U.S., was considered by the delegates to be an effective and "environmentally friendly" means of bleaching. This option is currently being considered for new facilities in Indonesia.

- Water recycling was implemented in all the facilities visited. This is a critical

area for waste minimization in the Indonesian pulp and paper industry. A follow up workshop or training session has been requested for this topic.

- Employee training programs, implemented in the U.S. facilities visited, have demonstrated that health and safety related accidents and chemical spills can be avoided through management commitment to training. There has been dramatic decreases of staff injuries and spills as a result of these programs.

- Tight control and incineration of TRS and non-condensable odorous gasses in the facilities visited has greatly reduced odor at the mills. The delegates commented that the odor was almost non-detectable at all of the facilities visited.

V. SUMMARY RECOMMENDATIONS FOR FUTURE PROJECTS

The following recommendations were made to WEC for future projects in the pulp and paper industry:

- One day seminar for senior Indonesian executives and mill owners outlining the economic and environmental benefits of waste minimization.

- Establish a waste minimization demonstration project at a selected facility in Indonesia to clearly demonstrate the cost effectiveness and environmental benefits of waste minimization.

- Conduct a two week seminar for facility engineers regarding specific techniques and technologies that enable effective water use reduction and recycling.

- Conduct training for environmental assessments and air emissions analysis.

APPENDICES

APPENDIX A

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