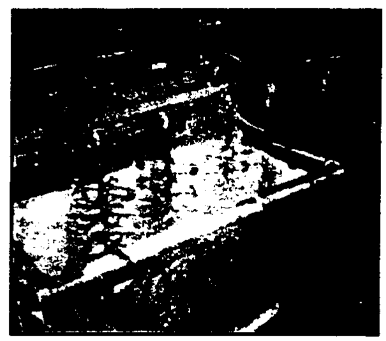
POLLUTION PREVENTION THROUGH PROCESS CONTROL



APRIL 22, 1998

WORKSHOP 3

ENVIRONMENTAL TRAINING WORKSHOP FOR METAL FINISHERS

SPONSORED BY:

U.S. EPA

SURFACE TECHNOLOGY ASSOCIATION

PRESENTED BY: TETRA TECH EM INC.

Pollution Prevention Through Process Control

Workshop 3

April 22, 1998

Unit 1
Introduction

EPA/STA Pollution Prevention Technical Assistance Project

- Training
  - Workshop Series (series of 6)
  - Operator Training Series (given multiple times)
- Mini-Assessments
  - 5 facilities already selected
  - 5 more will be selected in May (Apply Now!)

Training -- Workshop Series

Workshop Title	Date and Time
Industrial Wastewater Discharge Compliance	✓February 26
Operator Training	✓March 12
Hazardous Waste Compliance	✓March 25
Pollution Prevention Through Process Control	Today
Air Regulations and Compliance	June 10, 4-8 pm
Pollution Prevention Technologies	July 22, 4-8 pm
Enviro. Mgmt. System Approaches to P2	August 12, 4-8 pm
Operator Training	3 more available

Course Objectives

- Understanding similarity between process efficiency and pollution prevention
- Discuss process monitoring and assessment techniques
- Learn successful applications of pollution prevention techniques
- Identify opportunities for involvement in future EPA/STA P2 project activities

Agenda

- Pollution Prevention and Process Efficiency
- Process Bath Monitoring and Maintenance
- Measuring and Controlling Dragout
- Optimizing Rinising Operations

Wrap Up

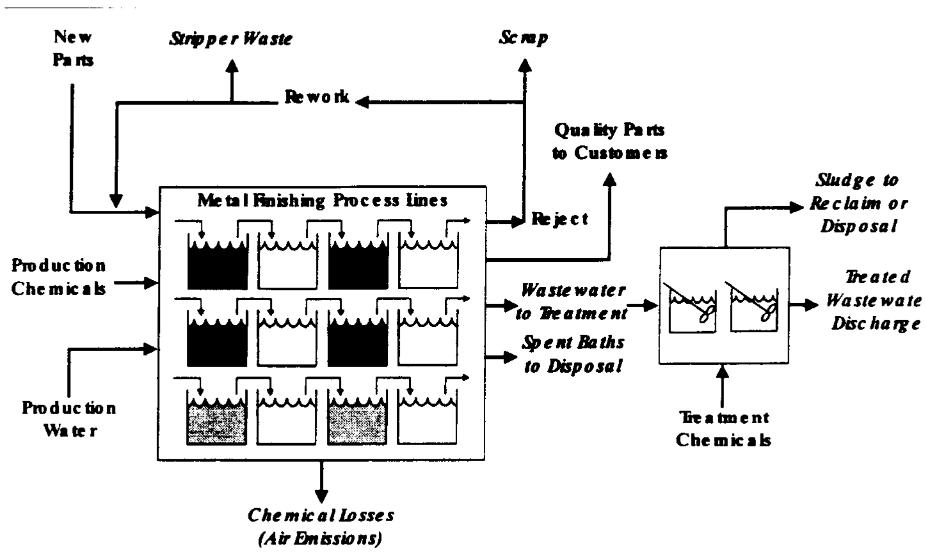
Unit 2
Pollution Prevention and Process Efficiency

How Birds See the World Slide

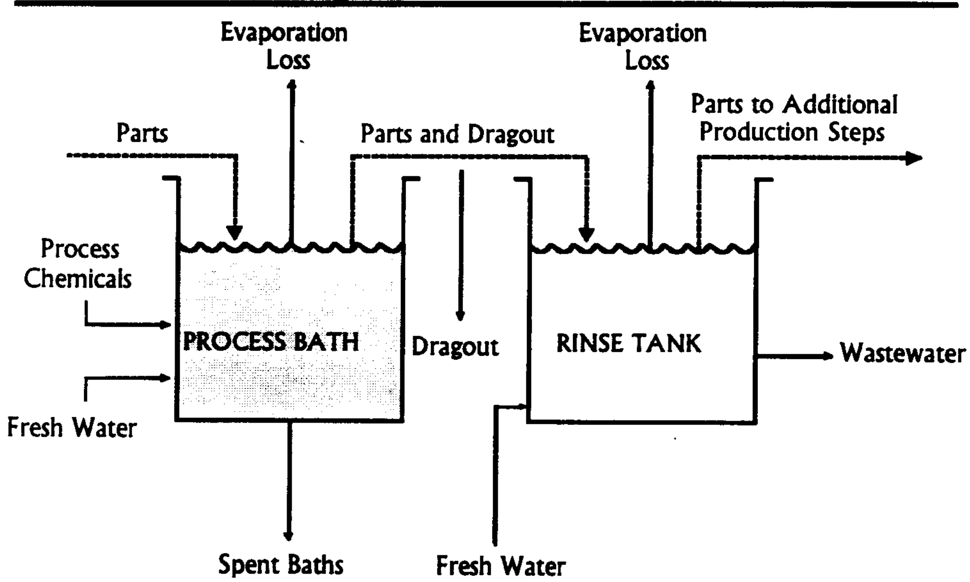
Looking at Environmental Management from a different perspective!!

A Tool for Competitiveness!

Facility-Wide Material Flows

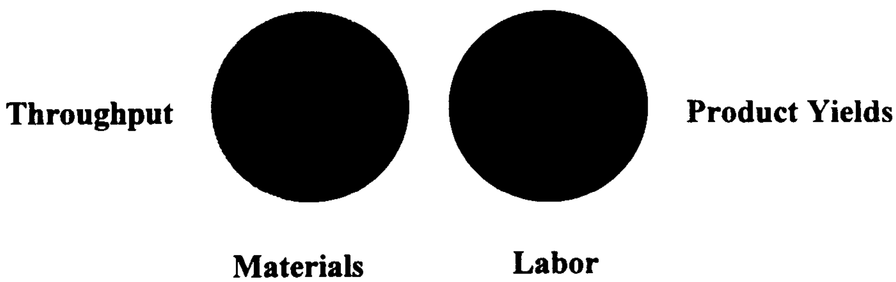


Process Specific Material Flows



P2 Perspectives

Process Efficiency and Pollution Prevention



Production and Quality Considerations

- Production rate (i.e., throughput)
- Chemical balance and process bath purity
- Drying and oxidation concerns
- Rinse quality and effectiveness
- Other considerations?

Process Efficiency and P2 Considerations

- Do you know the impacts of your current operating conditions on material use and waste generation?
- How much are current operating practices costing you in time, materials, disposal costs?

P2 Principles for Metal Finishing

1 Use the least toxic/easiest to manage process chemistries

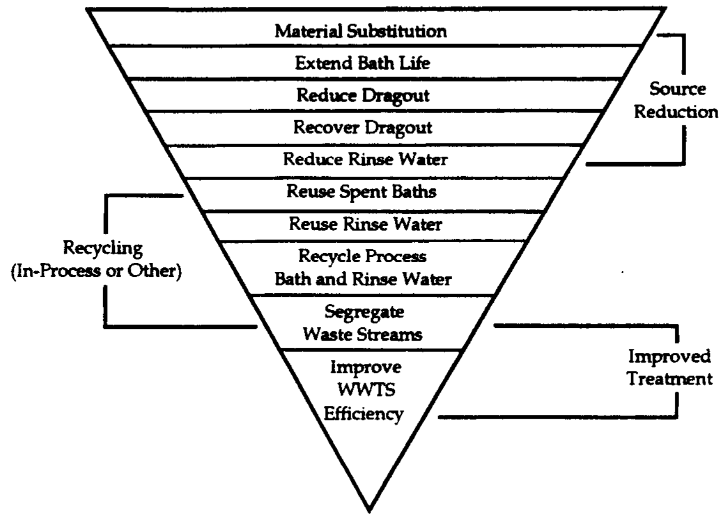
2 Extract the most life (use) out of process chemistries

3 Keep process chemistry solutions where they belong: in the tanks

4 Return as much escaping solution (dragout) as possible to the tanks

5 Use the least amount of rinse water required for good rinsing

Hierarchy of P2 and Waste Management Strategies for Metal Finishing

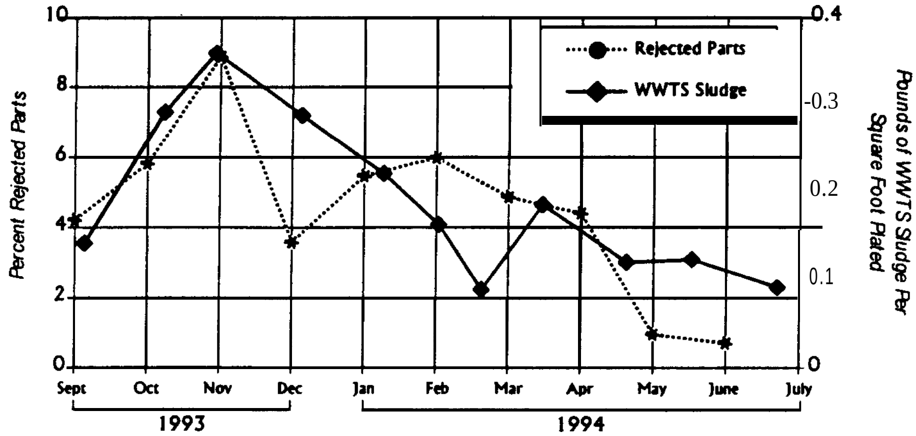


Production Quality is P2: Example

- Rejects and rework triple the waste
- Raw materials and waste for initial plating
- Initial plating stripped and discarded
- Raw materials and waste to replate

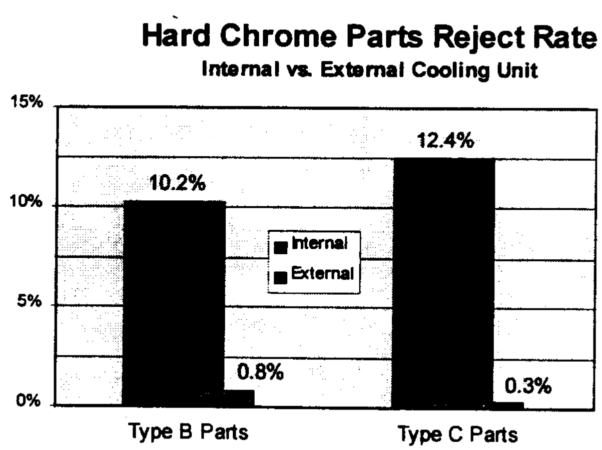
Case Study

Rejects and WWTS Sludge Generation



P2 Case Study

Decreased Reject Rates



P2 Case Study

Decreased Reject Rates (continued)

- 10% reduction Cr^{+6}
- 90% reduction in sludge generation
- Reduced stripper solution (not quantified)
- 50% increase in production capacity due to technology change and reject reduction

Case Study

Develop Chemical Add Controls, Procedures

- P2 Options: SPCs for baths, worker training, bath quality addition and change out schedules
- Implementation costs: Laboratory, personnel labor, training time
- Results:
  - Alkaline and electrocleaner chemicals: 15,000 pounds per year
  - Chemical purchases: $9,000 per year
  - Sludge reduction: not quantified

Case Study
Dragout Tanks

- P2 Option: Install dragout tank following zinc cyanide bath
- Implementation Costs: about $1,500 for hoist controller reprograming and tank installation
- Results:
  - Chemical recovery: 1,900 pounds zinc and 7,700 pounds sodium cyanide per year
  - chemical purchase savings: $8,800 per year

Case Study
Rinse Water Efficiency

- P2 options: plumbing improvement, flow restrictors, counter-current rinses
- Implementation costs: materials and labor $19,500
- Results
  - Water/wastewater reductions: 3.6 million gpy
  - Water use savings: $6,500 per year
  - WWTS costs, sludge disposal to be reduced 20 to 30 percent (not quantified)

Case Study
P2 Can Minimize Wastewater Treatment

- P2 Options: adjust hoists, install spray rinses, use stagnant and counter-current rinses, use flow controls
- Implementation costs: not quantified
- Results:
  - WWTS expansion reduced from 207 gpm to 117 gpm
  - Saved floor space to be used for chemical storage: 1,744 sq. ft.
  - WWTS construction reduced by $63,000

P2 Implementation

- Emphasis on measurement and monitoring: production, chemical additions, process parameters
- Input from staff: maintain measurement systems, feedback on implementability
- Trial and error approach: extending bath life, dragout reduction, reduced water flows
- Understand and control processes prior to pursuing technologies
- Continuous improvement philosophy

Unit 3
Process Bath Monitoring and Maintenance

NAMF Survey Results on Bath Maintenance

- 70% to 80% of respondents claim
  - dedicated personnel for bath additions
  - routine bath monitoring techniques
  - bath addition and change logs
  - production related bath dump schedules

Bath Degradation

- Depletion of bath chemicals (dragout)
- Imbalance of bath chemistry
- Buildup of contaminants (dragin)

Spent Bath Costs

- Process chemical use
- Treatment chemical use
- Waste handling and treatment operation labor
- Sludge (or other residual) disposal

Bath Treatment and Disposal

1. Batch treated on site
2. Bleed into an on-site WWTS
3. Containerize and ship off site

➪*Options 1 and 2 create sludge!*

➪*Option 3 is expensive!*

Bath Life Extension Techniques

- Schedule bath changes based on production or bath conditions
- Reduce dragin contamination
- Improve bath purity
- Maintain bath within control parameters
- Use a bath additive, or "enhancer"
- Reduce dragout

P2 Case Study
Bath Dumps Based on Production

- P2 Option: adjust bath dump schedule from calendar basis to production basis (square feet) for cleaners and static rinses
- Implementation Costs: labor for testing and tracking production
  - Doubled the life of process baths
  - Material purchases and waste disposal costs not quantified

Process Solution Dump Schedule

Bath[a]	*Dump Schedule by Time (Late 1991)*	*Dump Schedule by Production*[b] *(February 1994)*	*Annual Process Bath Savings*
Cleaner No. 1	Every 2 weeks	Every 300,000 sq ft	17,000 gal
Cleaner No. 2	Every 2 weeks	Every 400,000 sq ft	19,000 gal
Electrocleaner	Every 2 weeks	Every 500,000 sq ft	21,000 gal
Muriatic Acid	Weekly	Every 100,000 sq ft	26,000 gal

[a] Bath volume = 1,000 gallons.
[b] Typical production = 10,000 sq ft/day.

Case Study Bath Life Extension

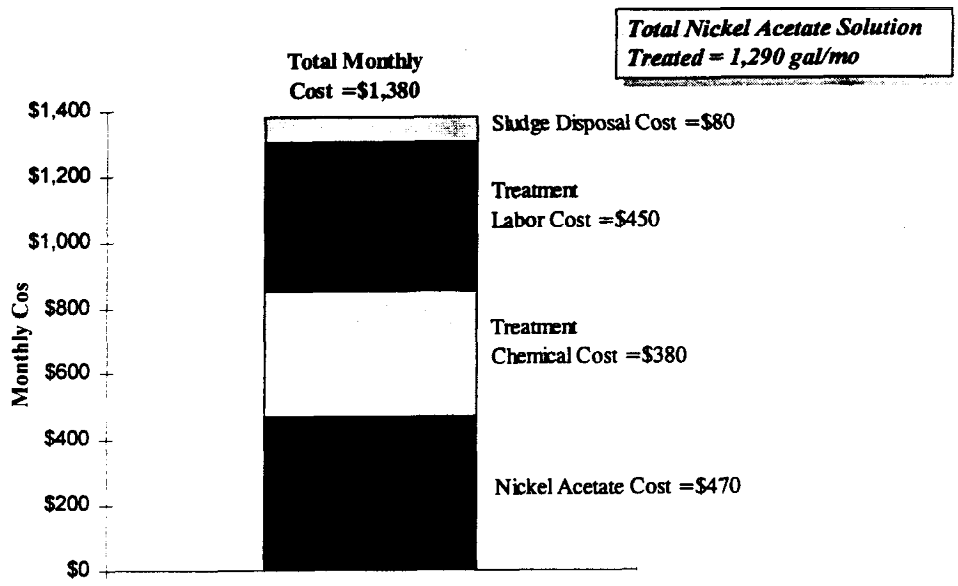
Facility Description

- Processes aluminum parts for aerospace and industrial customers
- Performs sulfuric acid anodizing and chromate conversion (them-film)
- Uses a manually-operated hoist
- 23 employees, two shifts per day

Nickel Acetate Seal Bath

- Operate single, 560-gallon nickel acetate seal
- Follows dye operation (primarily black dye)
- Final process on anodizing line
- Use Anoseal 1000
- Dumped when smut forms on parts
- Historically dumped 2.3 times per month on average

Nickel Acetate Bath Monthly Cost



P2 Assessment Findings

- Causes of bath dumps
  - Inadequate process monitoring and control
  - Dragin from preceding process operations
- Strategy
  - Maintain process bath control
  - Decrease bath contamination
  - Use a bath additive

Implementation Plan

- Understand baseline conditions
- Phase I: Process bath control and bath additive use
- Phase II: Filtration system, DI water, and black dye spray system

Nickel Acetate Seal Process Bath Control

Parameter	Target Range	Measurement Frequency	Measurement Method
Temperature	155 to 165 °F	Daily	Meter
pH	5.8 to 6.0	Daily	Meter
Concentration	1.5 to 2.5%	Every 2 Days	Titration

Use of Bath Additive

- Introduce chemical agents to boost bath performance
- Novaseal Enhancer
  - Contains wetting and dispersing agents
  - Improve seal quality
  - Prevents smut formation
  - Minimizes water spotting

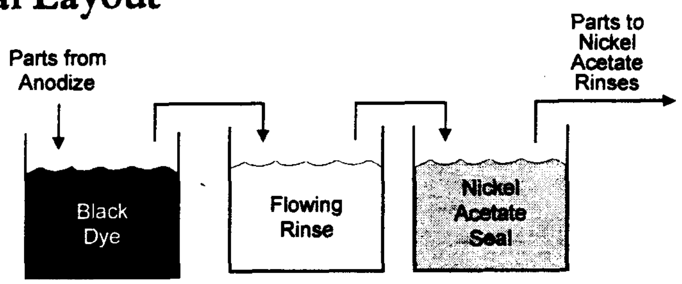
Bath Additive Costs

- Added an average of 1.3 gallons of enhancer per week
- Enhancer unit cost = $23/gal
- Overall costs
  - Enhancer = $30/week
  - Labor = $25/week

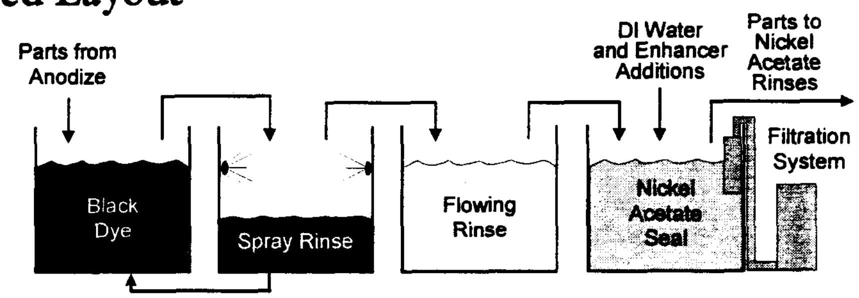
Decrease Bath Contamination

- Installed continuous filtration system
- Used DI water for new bath makeups
- Added a spray rinse to preceding black dye operations

Original Layout



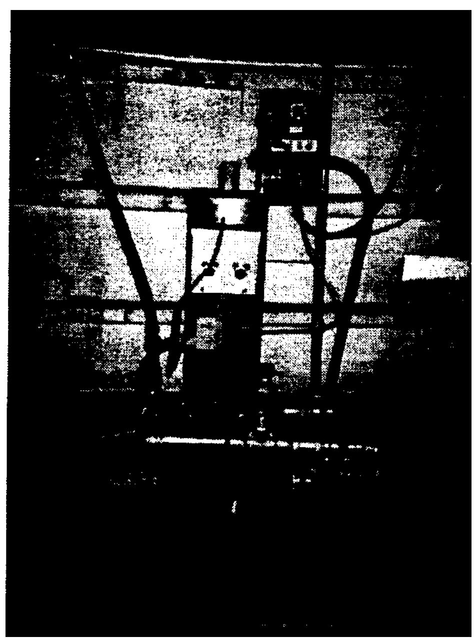
Modified Layout



Continuous Filtration System

- Removes suspended solids
- Maintains uniform bath temperature and concentration (by mixing)
- Design features
  - Holds six cartridge filters
  - 20 micron filters, replaced once a week
  - Centrifugal pump
  - Pressure-sensitive, automatic shutoff switch

Nickel Acetate Bath Filtration System



Filtration System Costs

Capital Costs		O&M Costs
Housing	$1,100	Labor = $25/week
Filters (6)	$59	Filters = $59/week
Pump	$870	
Pressure switch	$115	
Motor starter	$101	
Hose and fittings	$258	
Installation labor	$300	
Total capital	$2,803	

DI Water for Bath Makeups

- Originally used city water for bath makeups
- Minimizes introduction of compounds
- Purchased from Pure Rain Technologies
- 420 gallons of DI water used for each new bath
- Also use DI as makeup for evaporative losses
- System and installation = $403

Spray Rinse System

- Design features
  - Recessed nozzles
  - Check valves to maintain water pressure
  - Activated by a foot pedal
- Benefits
  - Reduced black dye dragin into nickel acetate seal
  - Black dye recovery and reuse in bath
  - Reduced flow rate on spray rinse

Spray System Costs

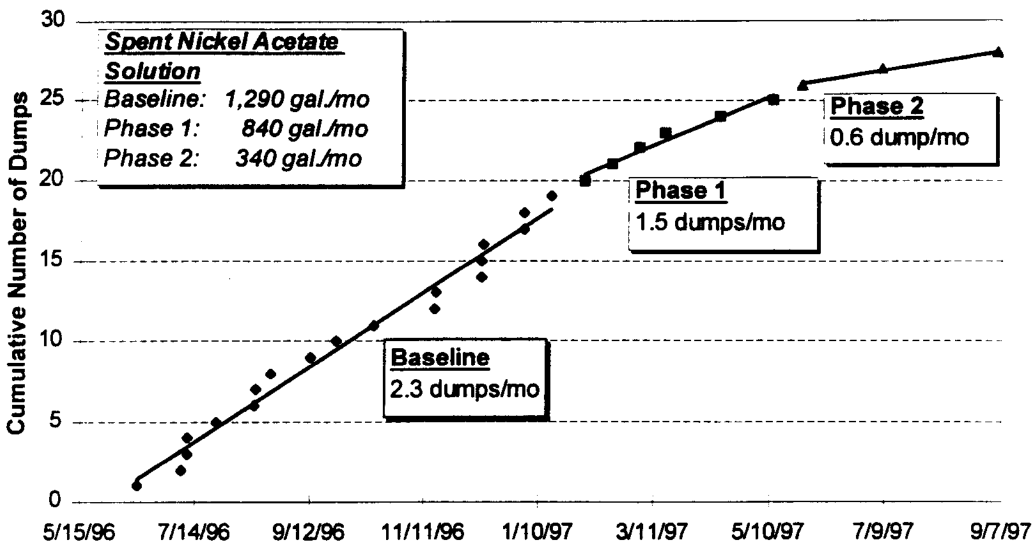
Capital Costs	
Tank liner*	$911
Nozzles (30)	$225
Check valves (6)	$17
Piping	$112
Pressure reducer	$46
Foot valve	$133
Installation labor	$1.200
Total	$2,644

O&M Costs

Labor = $50/week

* = Tank liner was used to reinforce an old plastic tank and is not representative of typical spray system costs

Nickel Acetate Bath Dump Frequency and Volume



Bath Life Extension Results

- 74 percent decrease in spent nickel acetate solution generation
- Decrease of 56 pounds per year of nickel released to the environment
- Net cost savings of $12,130 per year
- May realize additional cost savings through black dye recovery (up to $150 per month)

Bath Life Extension Results

	Per Month		Annual
	Before	After	Savings
Nickel Acetate Chemicals	26 gal	6.8 gal	$4,140
Treatment Chemicals	$380	$100	$3,360
Treatment Labor	9 hours	2.4 hours	$3,960
Sludge Generated	150 lb	39 lb	$670

* Spray rinse savings for black dye recovery not included; typically 30% to 50 %

Annual Savings = $12,130/yr*
Capital Cost = $5,850
Annual O&M Cost = $9,828
Payback Period = 1.5 yr

Unit 4
Measuring and Controlling Dragout

Dragout Impacts

- Increased plating chemical use
- Increased rinse water use or decreased rinse quality
- Increased dragin into next bath
- Decreased product quality

Dragout Impacts (continued)

- Increased wastewater generation
- Increased WWTS treatment chemicals use
- Increased WWTS filter cake generation
- Increased metal concentration in the WWTS discharge

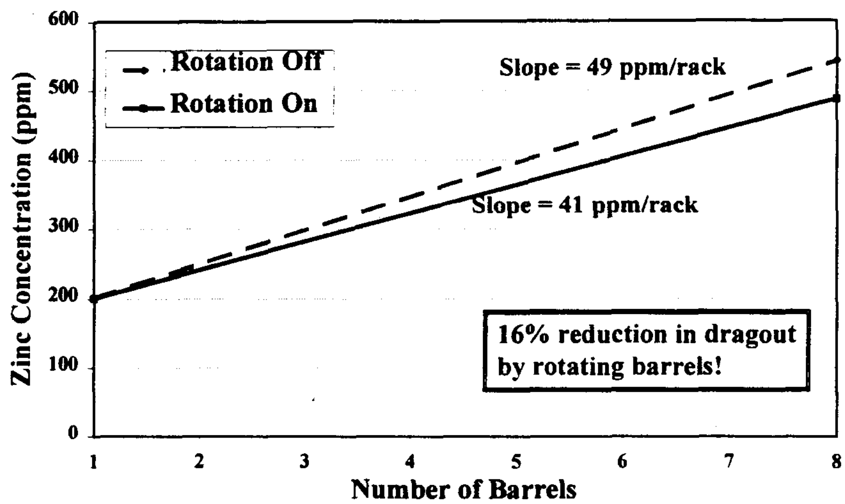
Dragout Reduction: Bath Conditions

- Operating concentration
- Temperature
- SPC

Dragout Reduction: Rack and Barrel

- Rack design
- Rack maintenance
- Part geometry
- Part overlap and angle
- Barrel rotation
- Barrel hole peening

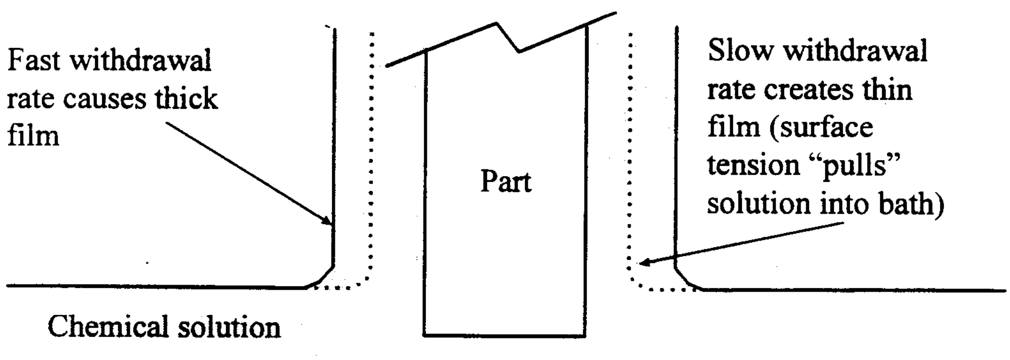
Dragout Impact of Barrel Rotation



Dragout Reduction: Worker Practices/Operations

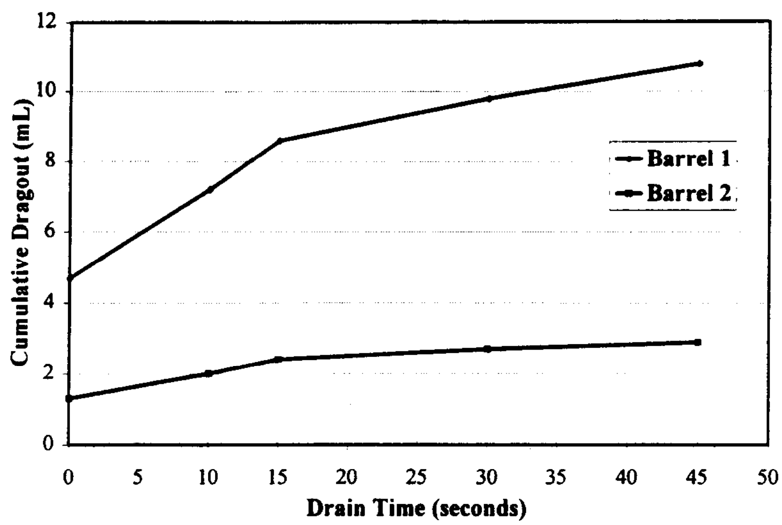
- Withdrawal rate
- Drainage time (↑ by 5 seconds will ↓ dragout by 30%)
- Production cycle times must be considered

Impacts of Withdrawal Rate on Dragout

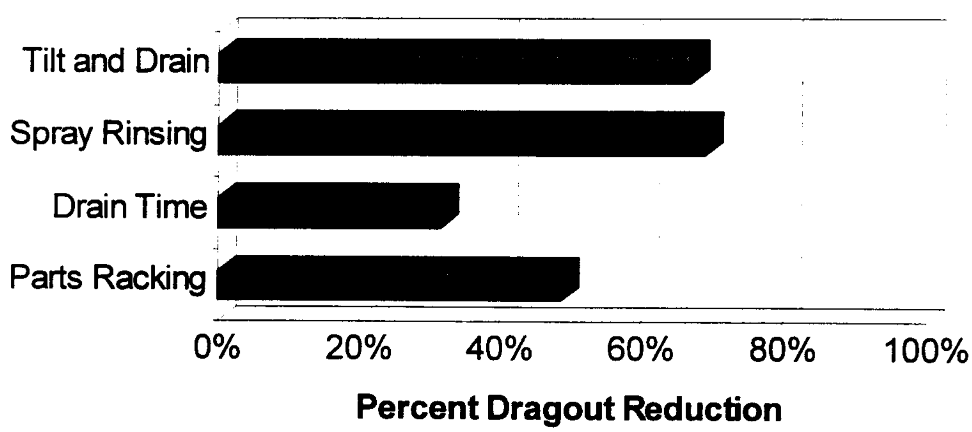


*Other conditions that impact thickness of solution are temperature and bath concentration.

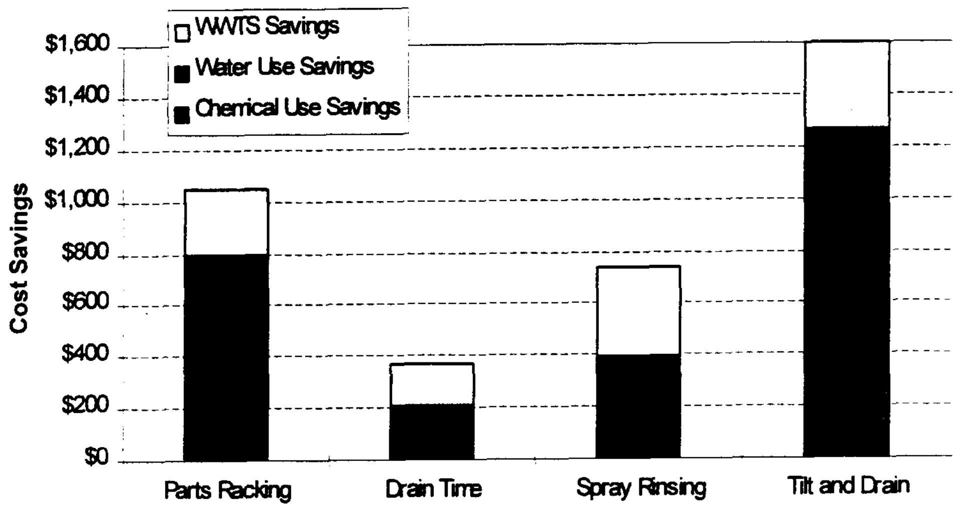
Dragout Volume vs. Drain Time



Average Dragout Reduction



Average Cost Savings for Dragout Reduction Techniques

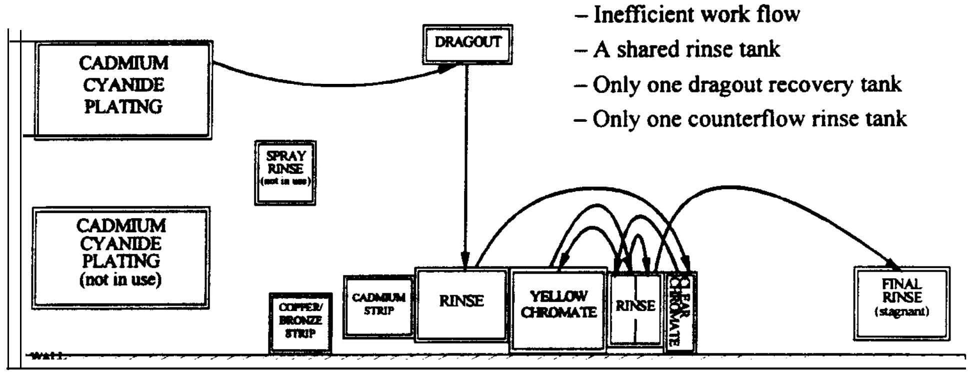


P2 Case Study
Modify Tank Layout

- Tank spacing and drain boards
- Tank sequence
- Dragout tanks (with or without sprays)
- Spray rinses

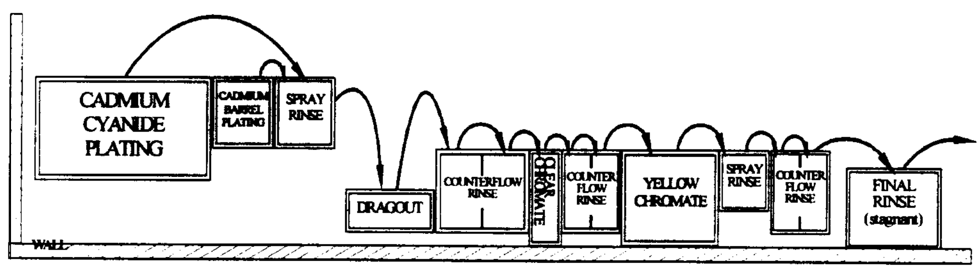
Tank Layout - Before

Features:
- Large gaps between tanks
- Inefficient work flow
- A shared rinse tank
- Only one dragout recovery tank
- Only one counterflow rinse tank



Tank Layout - After

Features:
(1) spray rinses
(2) dragout tanks,
(3) counter-current rinses
(4) straight process flow



Phase I Results

- Recovery and direct reuse of process solution dragout (50% reduction)
- Reduced rinse water flow (50% reduction)
- Improved rinsing
- More efficient work flow
- Lower concentration of metals in WWTS discharge

Tank Layout Modification Results

	Before Modification	After Modification	Cost Savings
Cadmium Cyanide Dragout	18 gal/mo	9 gal/mo*	$400/yr
Chromate Conversion Dragout	123 gal/mo	62 gal/mo*	$180/yr
Rinse Water	31,700 gal/mo	15,800 gal/mo	$360/yr
Sewer Fee	31,700 gal/mo	15,800 gal/mo	$1,400/yr
WWTS Chemicals		Not Quantified	
WWTS Filter Cake	200 lbs/mo	100lbs/mo*	$240/yr

Total Cost Savings = $2,620/year

Total Cost = $4,520

Payback Period = 1.73 years

*Estimated from *Perfect Rinsing* results

Dragout Monitoring Methods

- Direct measurement (dragout volume drained from parts)
- Metal concentration/conductivity in rinse tanks
- Wastewater contaminant concentration (dragout discharged to sewer)

➡ For job shop and varying conditions, monitoring period may be longer to collect data representing average conditions

Direct Volume Measurement

(1) Dip racked parts in bath (or water) and remove dragout over dishpan

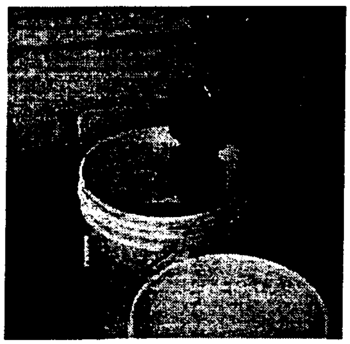
(2) Repeat for 10 racks

(3) Determine volume of accumulated dragout

(4) Dragout/rack = (Total volume)(# of racks)

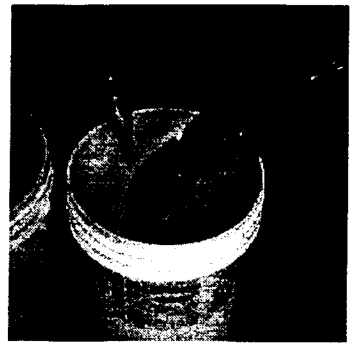
➡ Limits: Only quantifies solution drained from parts

Effects of Parts Racking on Dragout



Horizontal

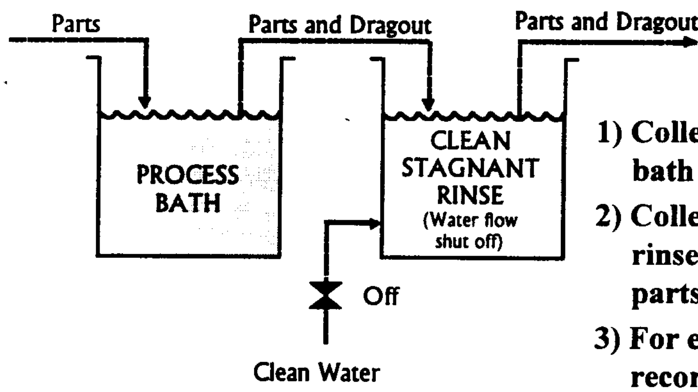
Vertical



Removing Dragout

Proper racking reduced dragout by 90% for these parts!!!

Measuring Concentration to Calculate Dragout



1) **Collect sample from process bath**
2) **Collect sample from stagnant rinse before and during parts plating**
3) **For each sample collected, record the number of parts plated**
4) **Analyze all samples collected for the primary metal in the process solution**

Calculating Dragout

1) Graph metal concentration on the y-axis (vertical) versus number of racks or barrels rinsed on the x-axis (horizontal)

2) Perform a linear regression or draw a best fit line. The slope of this line represents the increase in concentration per rack or barrel

Calculating Dragout (continued)

3) Calculate dragout: $V_d = (\Delta C)(V_r)/C_p$

where:

V_d = dragout volume (L/rack)

ΔC = increase in rinse water metal concentration per rack or barrel (mg/L/rack)

V_r = rinse tank volume (L)

C_p = concentration of metal in process tank (mg/L)

Calculation Example: Cadmium Dragout

ΔC = Cadmium increase in rinse water
= 2.5 mg/L/rack

V_r = Volume of rinse water = 352 L

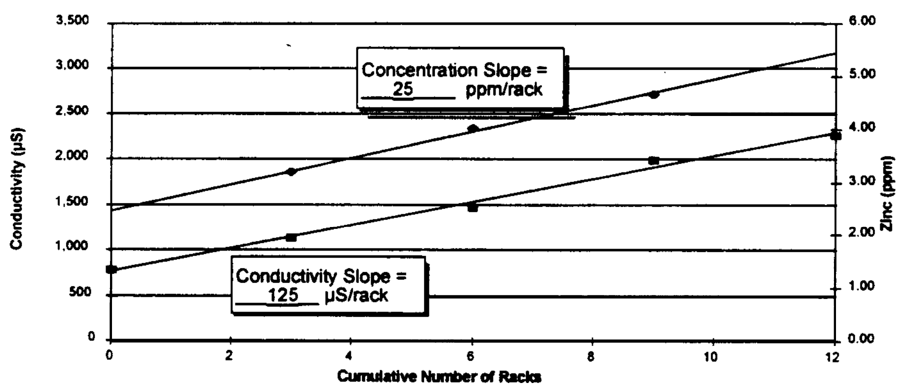
C_p = Cadmium in plating solution = 26,500 mg/L

V_d = Dragout volume (L/rack)
$= (\Delta C)(V_r)/C_p$
= (2.5 mg/L/rack)(352 L)/(26,500 mg/L)
= 0.033 L/rack
= 33 mL/rack

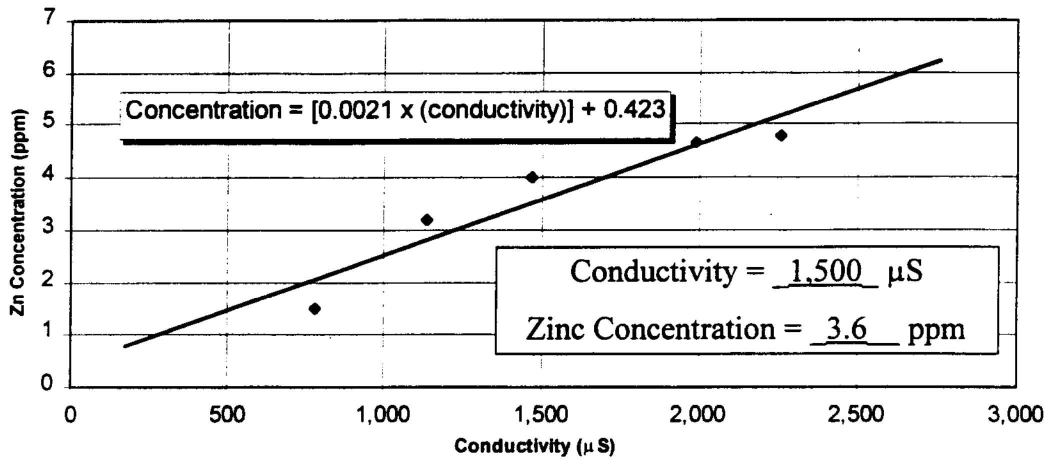
Using Conductivity to Measure Dragout

- Conductivity can be used as an indicator for process chemical concentration in rinse water
- Conductivity = a solution's ability to conduct electrical current
- Conductivity is an easy, inexpensive way to collect real-time data on rinse water quality
- Relationship is bath- and chemical-specific

Zinc Concentration and Conductivity vs. Cumulative Number of Racks



Zinc Calibration Curve



Using Dragout Measurements

- Estimate costs of dragout for particular parts
- Make cost/benefit decisions
  - Lower dragout vs. slower withdrawal rates
  - Lower dragout vs. longer hang time
  - Worker training
  - Incentive programs
  - WWTS
  - Recovery technologies
- Benchmarking

Dragout Reduction Case Study

Spray Systems

Spray Rinse Use

39% of shops use spray rinses
according to a 1995 NAMF survey

Facility Description

- Customer base: plumbing hardware and miscellaneous small jobs
- Metal stamping
- Decorative chrome and nickel plating
- 23 employees
- 40-year-old facility

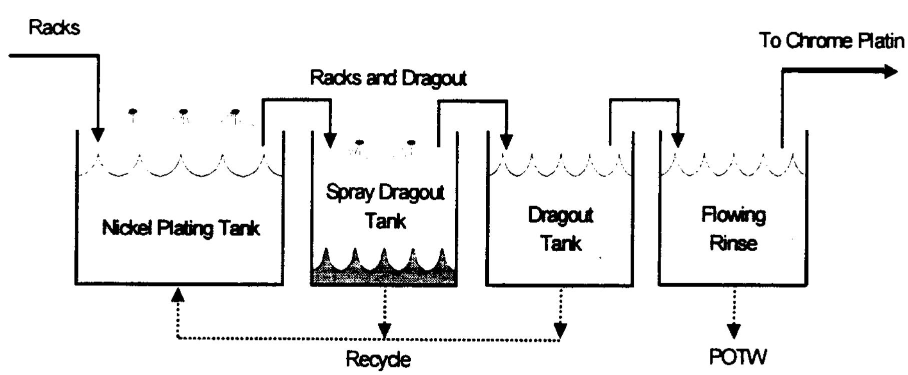
Motivation for Pursuing P2

- Competitive market: high volume, low profit margin
- Process control and efficiency
- Cost of raw materials and waste
- Compliance with wastewater limits
- Company TQM program
- Maintain good relationship with POTW

Spray Systems Demonstration

- Purpose: Implement spray rinses to reduce and recover dragout
- Approach:
  - Design and install spray systems
  - Measure and compare increase in conductivity in the rinse tank
  - Generate calibration curves
  - Calculate actual decrease in dragout volume

Nickel Plating Tank Layout



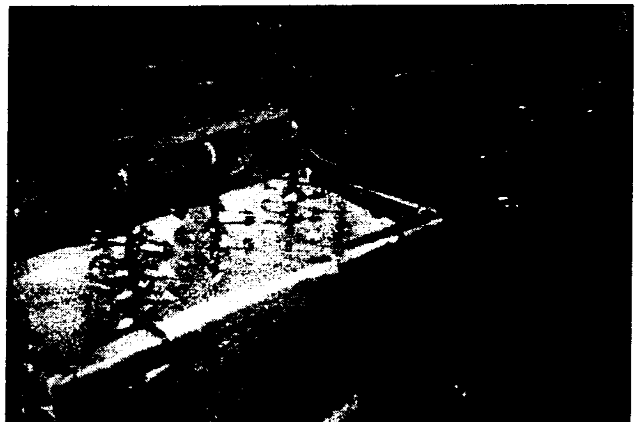
Spray Rinses Over Nickel Plating Tanks

- Nozzles
  - Hydraulic
  - Flat pattern
  - 84° angle
  - 0.5 gpm/nozzle at 40 psi
- Configuration
  - 6 nozzles per tank (3 nozzles per long side)
  - Installed 2 inches above process solution
  - Activated by switch and timer
  - Total flow = 4 gpm for 3 seconds

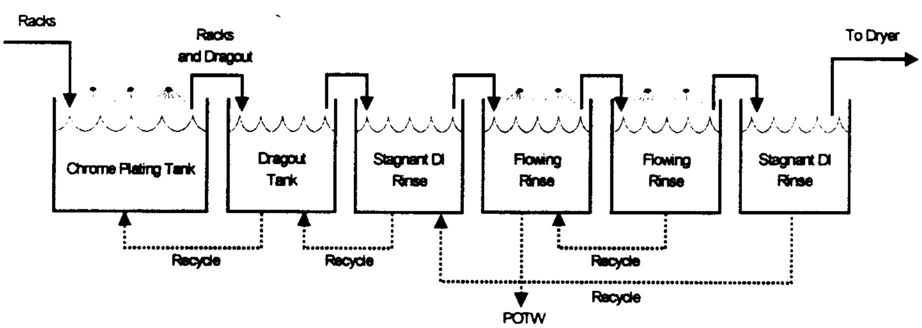
Spray Rinses In Dragout Tanks

- Nozzles
  - Air atomizing
  - Flat pattern
  - 84° angle
  - 0.29 gpm/nozzle at 40 psi
- Configuration
  - 8 nozzles per tank
  - Nozzles installed below tank lip level
  - Back-side nozzles several inches higher to spray at more of a downward angle
  - Total flow = 2.3 gpm for 5 seconds

Spray Rinse In Dragout Tanks



Chrome Plating Tank Layout

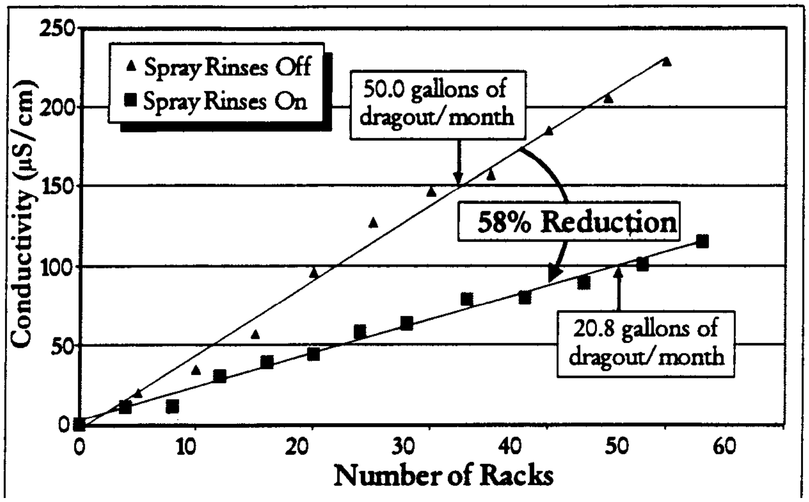


Spray Rinses Over Chrome Plating Tank

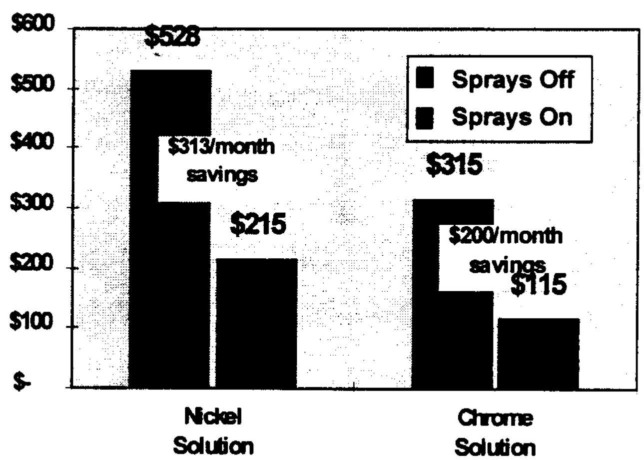
- Misting nozzles (0.04 gpm/nozzle)
- Configuration
  - Six nozzles evenly spaced along length of tank
  - One nozzle for each rack
- Location
  - Above chrome plating tank
  - In front of and slightly below vibrating hang bar
- Timer activated by placing rack on vibrating hang bar
- Stratification in plating tank
- Work environment improvement

Spray Rinses Over Chrome Plating Tank

Sprays Reduce Nickel Dragout by 58%



Monthly Savings from Dragout Reduction



Spray Rinse Results

	Without Sprays	**With Sprays**	**Monthly Savings**
Nickel Solution Dragout	50.0 gal/mo	20.8 gal/mo	$313
Chrome Solution Dragout	63.1 gal/mo	23.0 gal/mo	$200
Rinse Water*	380,000 gal/mo	152,600 gal/mo	$185

Total Cost Savings = $8,376/year
Total Cost = $4,890
Payback Period = 0.6 year

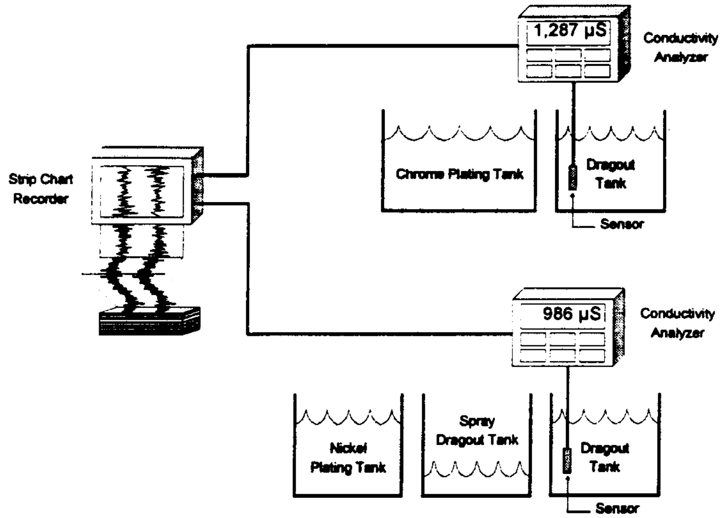
*Estimated based on dragout reduction

The Next Step: Phase II

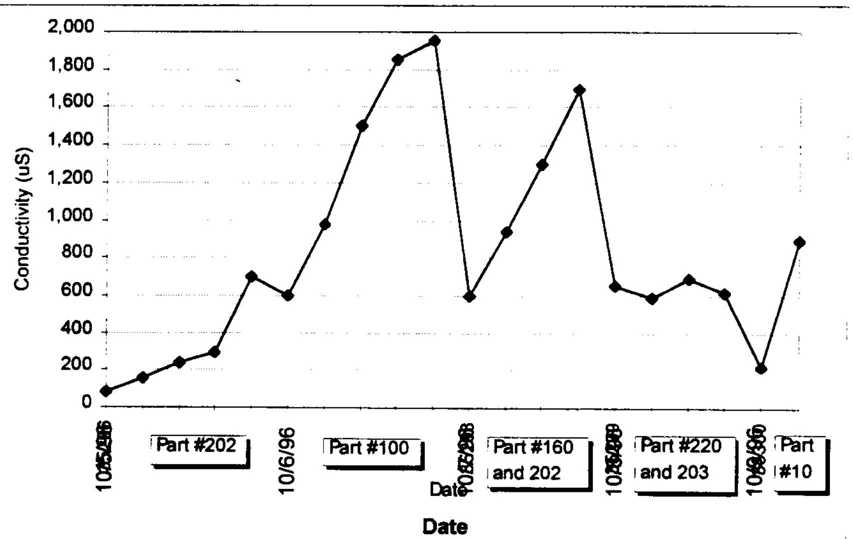
- Reduce rinse water use on flowing rinses while maintaining nickel and chrome discharge levels below POTW limits

- Train workers and continuously monitor dragout as part of company TQM program

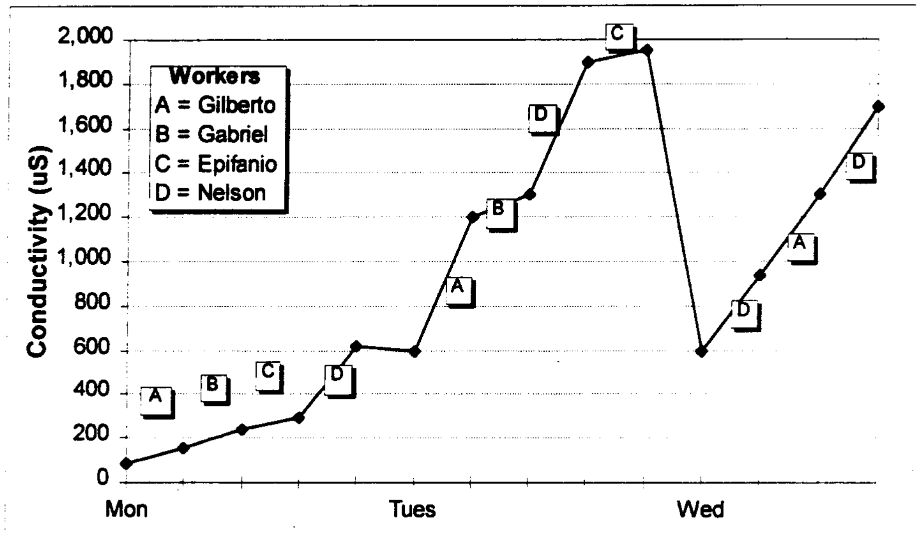
Conductivity Monitoring System



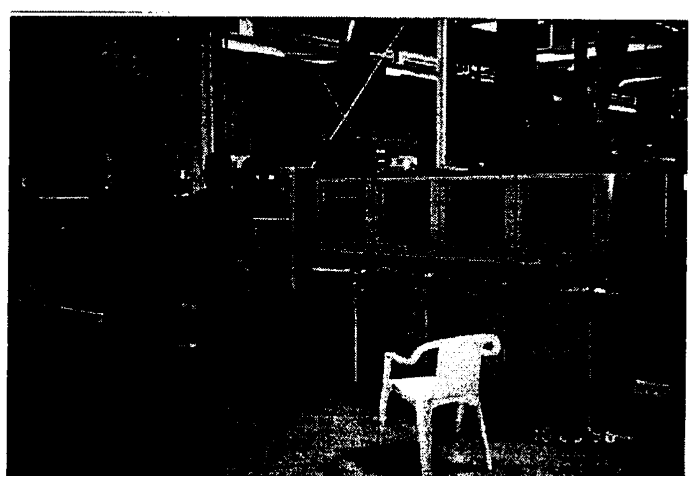
Using Conductivity to Identify High Dragout Parts



Using Conductivity to Identify High Dragout Practices



Keep It Simple



Keep It Simple

Unit 5
Optimizing Rinse Operations

Rinsing Perspectives

- *Quality Perspective:* Removing chemicals (dragout) from parts between process operations is critical
- *Financial Perspective.*- Reject and rework is costly; wastewater treatment is also expensive
- *Environmental Perspective.** Water is a scarce and valuable resource and dirty rinse water is a major hazardous waste stream

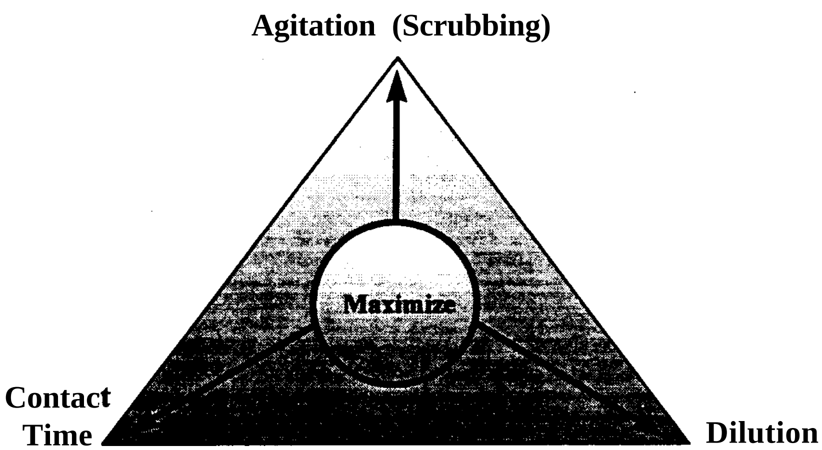
Rinse Water Quality

- Rinsing is a process that can and should be monitored
- Affects finish quality and dragin to "downstream" tanks
- Conductivity can be used as a quality indicator
  - Set flow rates
  - System design

Impacts of Poor Rinse Quality

- Increase dragin of contaminants into next bath
- Create impurities on parts surface
- Reduce visual appearance

Maximizing Rinse Efficiency



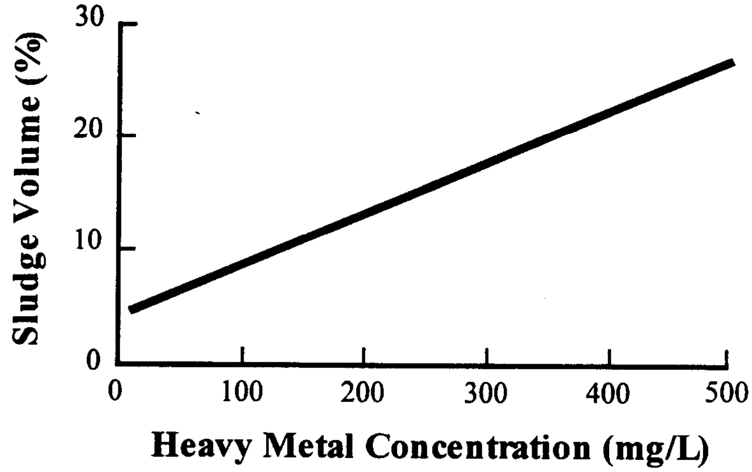
Rinsing Concepts

- Turbulent flow around part (scrubbing)
- Adequate contact time between the part and the rinse water
- Adequate dilution so that dragout from rinse tank does not affect subsequent operation

Benefits of Rinse Water Use Reduction

- Lower water bills and sewer fees
- Wastewater treatment impacts
  - Lower treatment chemical costs
  - Higher retention time
  - Less O&M requirements
- Decreased sludge generation

Wastewater Concentration and Sludge Volume



Volume of sludge per volume of wastewater treated after 1 hour settling.

Reducing Sludge Generation by Reducing Rinse Water Use

- Case A
  - wastewater volume = 1,000 gal
  - heavy metals concentration = 100 mg/L
  - sludge generated = 90 gal
- Case B
  - wastewater volume = 500 gal
  - heavy metals concentration = 200 mg/L
  - sludge generated = 65 gal

Total Cost of Water Use

	Unit Cost
Water purchase (Northern Cal.)	$1.00 to $2.60 per 1,000 gal
Wastewater sewer fee (Northern Cal.)	**$0.70** to $3.50 per 1,000 gal
WWTS chemical and labor costs	$12.00 per 1,000 gal
Total (not including sludge disposal cost)	**$15.90 per 1,000 gal**
Sludge disposal	$.25 to $.50 per pound

Water Use Reduction Savings

Before: 400,000 gal/mo After: 300,000 gal/mo

	Monthly Cost		Monthly
	Before	After	Savings
Water purchase	$600	$450	$150
Sewer fee	$300	$230	$70
WWTS O&M	$4,800	$3,600	$1,200
Sludge disposal	$1,900	$1,700	$200

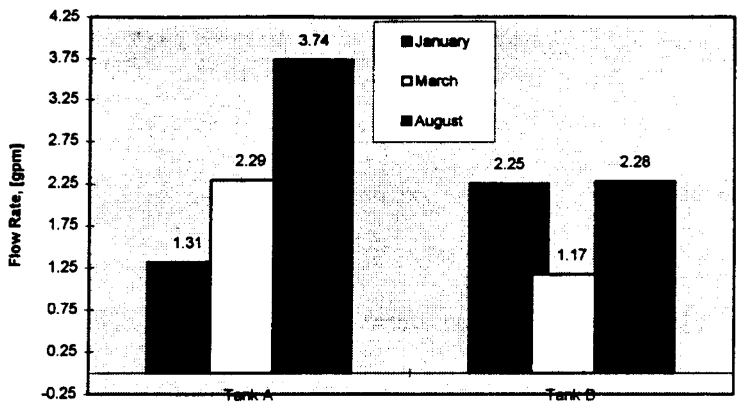
Total Savings = $1,620/mo

Measurement and Monitoring Techniques

- Water use
  - Production area
  - Rinse system flow tanks
  - Wastewater flow tanks
- Rinse quality
- Normalize water use by production
- Production monitoring parameters
  - Labor hours
  - Number of parts plated
  - Surface area of parts plated
  - Amp-hours

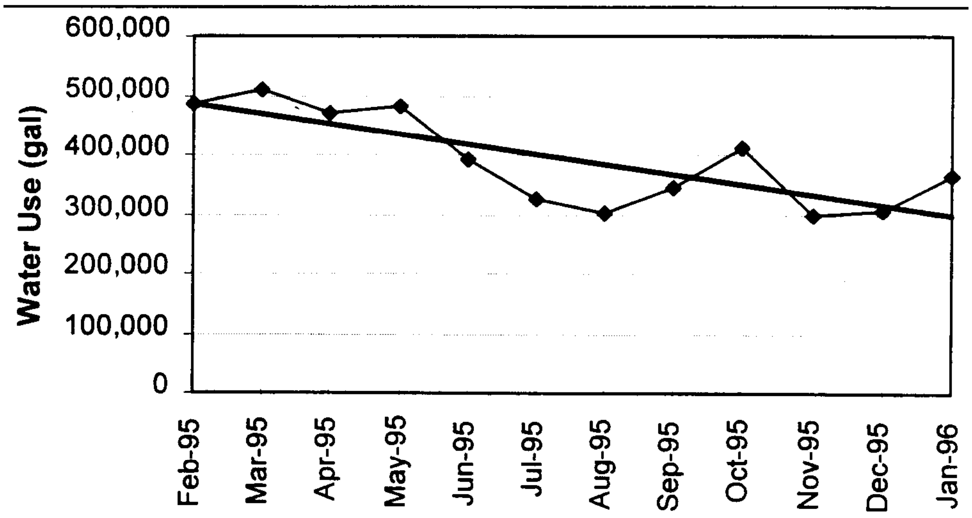
Uncontrolled Flow

Variations in Rinse Tank Flow Rate

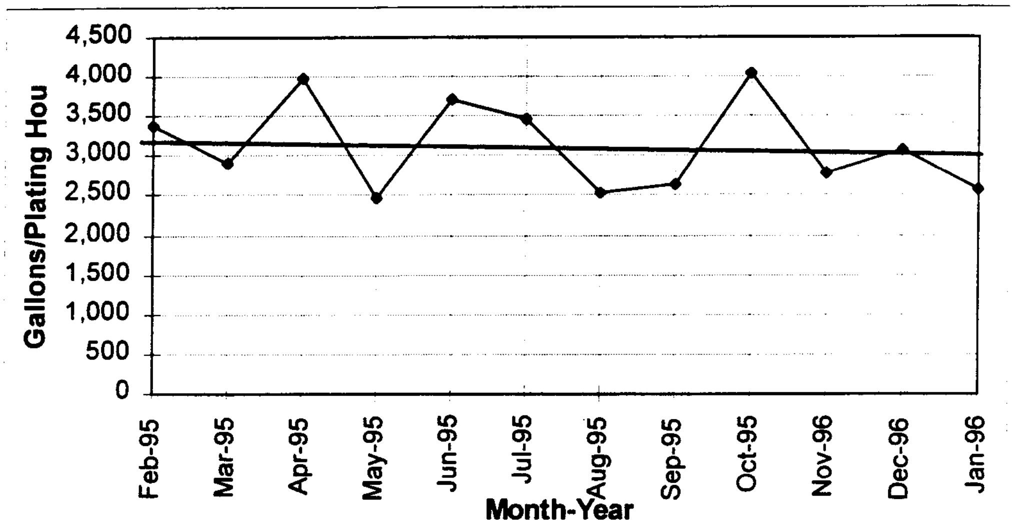


***Variations in flow not production-related**

Water Use



Water Use Per Plating Hour



Case Study: Conductivity Control Systems

Facility Descriptions

- Sports, plumbing, automotive hardware
- Specializes in electroplating zinc die-cast parts
  - Also electroplates steel and brass parts
- Hand Operated Rack Line
  - Brass, copper, nickel, chrome
- Manually-Operated Barrel Hoist Line
  - Copper
- 60 employees

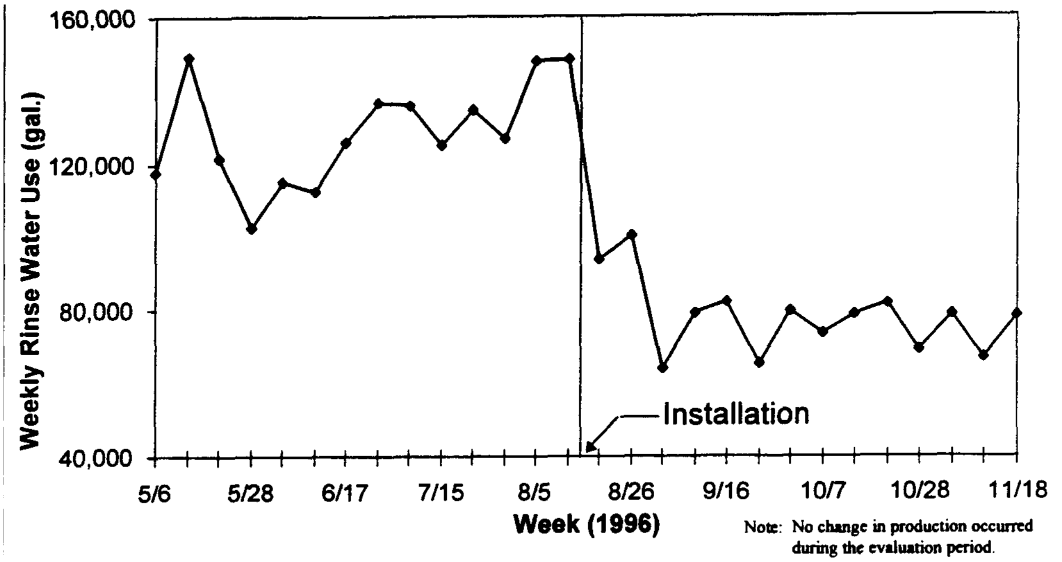
Conductivity Control System Demonstration

- Purpose: Implement conductivity control systems to reduce rinse water use
- Approach:
  - Measure current conditions
  - Evaluate new, innovative sensors
  - Worker involvement
  - Monitor system performance

Facility Operating Costs (Baseline)

	Monthly Rate	Monthly Cost
Rinse Water Use	520,000 gal	$640
Wastewater Discharge	520,000 gal	$260
WWTS Operation	520,000 gal	$5,800
Sludge Generation	2.6 tons	$1.400
Total =		**$8,100**

Rinse Water Use



Conductivity Control System Results

	Per Month		Monthly
	Before	After	Savings
Rinse Water Use	**516,000 gal**	**296,000 gal**	**$280**
Wastewater Discharge	**516,000 gal**	**296,000 gal**	**$110**
WWTS Chemical Use	**$4,000**	**$3,200**	**$800**
WWTS Sludge		**Not Quantified**	

Total Cost for Nine Systems = $14,500
Total Cost Savings = $14,300/yr
Payback Period = < 1.0 year

Techniques that Improve Rinse Efficiency

- Agitation
  - Rackmotion
  - Forced air and/or forced water
  - sprays
  - Double dipping
  - Addition of vigorous agitation can allow 1 gpm flow reduction in many applications
- Flow Controls and Water Quality
  - Flow restricters
  - Conductivity control systems
  - Use warm or hot water, if possible
  - Tap water vs. deionized water

Techniques that Improve Rinse Efficiency (continued)

- Tank Design
  - Size (not bigger than necessary)
  - Locate inlets and outlets to maximize mixing and eliminate short-circuiting
- Tank Layout
  - Multiple tanks better than single rinse tank
  - Countercurrent rinses are extremely efficient (90% reduction compared to a single flowing rinse) but most shops do not accommodate the larger “footprint”

NAMF Survey Results on Rinse System Design

- 58% to 70% of respondents claim use of:
  - Manual control of rinse water flow rates (66%)
  - Flow restrictors (70%)
  - Countercurrent rinse system designs (68%)
  - Rinse tank agitation (58%)
- Less than 40% of respondents claim use of:
  - pH or conductivity controls (16%)
  - Flow meters to measure water use (12%)
  - Reactive rinsing techniques (25%)
  - Spray rinses (39%)

1991 PF Survey Results on Counterflow Rinsing

Reported water reduction from a 2-stage counterflow rinse compared to single stage rinse based on survey of 250 metal finishing facilities

Percent Water Reduction	Percent of Facility Responses
25%	12%
50%	25%
75%	19%
90%	15%
99%	3%

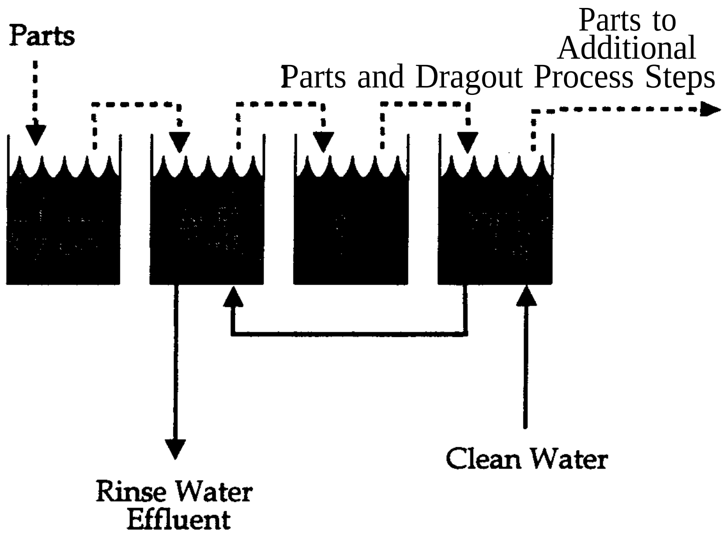
Rinse Water Flow Rates Required to Maintain Same Final Rinse Concentration

Type of Rinse	Single	Series		Counter-flow	
No. of Rinses	1	2	3	2	3
Rinse Water Flow Rate (gpm)	10.0	0.61	0.27	0.31	0.1

Rinse Water Reuse

- Effluent from critical rinse is used as influent to noncritical rinse
- Effluent from acid rinse reused as influent to alkaline rinse

Rinse Water Reuse



Perfect Rinsing Software

- *Perfect Rinsing* is a tool that can be used to:
  - Evaluate the relationship between dragout, rinse system design and rinse water flow rates
  - Identify source reduction opportunities
    - Process chemical recovery
    - Rinse water reduction
    - Reduction in total metals discharge
    - Improved rinsing

Inputs into ***Perfect Rinsing*** Software

- Process bath metal concentration (parts per million)
- Process bath evaporation rate (gallons per hours)
- Process solution dragout rate (gallons per hour)
- Rinse tank configuration
- Rinse water flow rates (gallons per hour)

Outputs from ***Perfect Rinsing*** Software

- Total rinse water flow rate (gallons per hour)
- Total metal discharge rate (ounces per hour)
- Metal concentration in each rinse tank (parts per million)
- Metal concentration in the combined rinse water discharge (parts per million)

Unit 6
Wrap Up

Environmental Management - Costly?

"Old"	Environmental improvement is costly and, therefore, must be mandated
"New"	P2 can be a win-win for the environment and a company's bottom line

Environmental Management - Technology Fix?

"Old"	People create pollution problems, technology and equipment will solve them
"New"	Technology and equipment are only as good as the people who operate and maintain them

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Environmental Management - Overhead Burden?

"Old"	Meeting minimum compliance requirements is a sound business strategy
"New"	Integrating environmental management into the entire business operations creates a competitive edge

Environmental Management - Regulatory Compliance Issue?

"Old" Sound environmental strategies involve helping companies address compliance requirements

"New" Regulations are a guide, and compliance may be a driver, but business excellence is the objective

Strategy for P2 Success

- Quantify the-true (total) cost of waste generation
- Process measurement, monitoring, and control
  - necessary to evaluate efficiency
  - without measurement (data), change is unlikely
- Focus on/in the processes!
- Timing and facility conditions play a role!

EPA/STA Pollution Prevention Technical Assistance Project

- Training
  - P2 and Compliance Workshop Series (series of 6)
  - Operator Training (given multiple times)
- Mini-Assessments
  - 5 facilities already selected
  - 5 more will be selected later this spring (Apply Now!)

Training -- Workshop Series

Workshop Title	Date and Time
Industrial Wastewater Discharge Compliance	✓February 26
Operator Training	✓March 12
Hazardous Waste Compliance	✓March 25
Pollution Prevention Through Process Control	✓Today
Air Regulations and Compliance	June 10, 4-8 pm
Pollution Prevention Technologies	July 22, 4-8 pm
Enviro. Mgmt. System Approaches to P2	August 12, 4-8 pm
Operator Training	3 more available

Operator Training Workshops

A "hands on" workshop for platers and anodizers:

- First training successfully conducted at Gold Seal Plating on March 12, 1998
- Conducted multiple times at different locations
- Looking for host sites for future workshops in Central Valley or South Bay
- At least one workshop will be in Spanish

Mini-Assessments

FREE technical assistance to motivated facilities to help them select and implement cost-effective Pollution Prevention "fixes"

Mini-Assessment Objectives

Objectives:

1. Collect and review data on material use, waste generation, and operating costs
2. Establish metrics to assess existing process operations and costs
3. Identify proven P2 projects to improve operating conditions
4. Implement selected P2 projects and monitor impact

Mini-Assessments (continued)

Activities:

- Facility Selection
- Mini-Assessments
- P2 Options Development
- P2 Options Implementation

Mini-Assessments (continued)

5 companies already selected

- Swift Plating, Santa Clara
- AMEX Plating, Santa Clara
- Valley Chrome Plating, Clovis
- Industrial Plating, San Carlos
- E-D Coat, Oakland

5 more to be selected in late spring

Sign up for a no obligation visit! !