Metal Finishing: Electroplating P2

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Reduce Electroplating Costs

- Slow down
- Counter-current rinsing
- “Static” rinse
- Racking to reduce dragout
- Restrict water flow
- Drain boards
- Check bath chemistry
- Fogging/Spraying/Air
- Ion exchangers
- Electrolytic/Electrowinning
Pollutant Reduction & Water Conservation Methods

- Reducing pollutant loading in rinsing & washing operations
- Improving rinse efficiency
- Extending bath life
- Close-looping technologies
- P2 for boilers & cooling towers
- Other water conservation techniques
Water Use

Rinsing Process

To understand the rinsing process:
- Measure dragout volume
- Measure rinse water volume
- Measure rinsing effectiveness

To modify the rinsing process:
- Reduce the dragout
- Improve rinsing efficiency
- Reduce water use
Dragout = Waste = $$$

- "Dragout reduction is one of the most important **low tech methods** to reduce pollutant loading to waste water!"
- Keep plating solutions in the tanks where they belong!
- Return to the tanks as much escaping liquid as possible!
- Use the least amount of rinse water required for good rinsing!
Dragout Reduction Techniques
For Any Parts Washing, Preparation or Plating Operations
(Percent Shops Using Technique)

☐ Still rinse (61%)
☐ Increase drip time (60%)
☐ Increase extraction time (38%)
☐ Decrease viscosity (32%)

☐ Improve rack orientation (51%)
☐ Lower bath conc. (34%)
☐ Captive spray rinsing (19%)
☐ Drain boards (56%)
Dragout Management

- **Recycle Method (Return to process)**
  - Atmospheric Evaporation
  - Ion Exchange
  - Electrolytic

- **Recycle Method (Non-Return methods)**
  - Electrolytic Recovery
  - Solution/Sludge Recovery with Off-Site Management
  - Waste Exchanges
The Common Rinsing Fallacy

The only way to improve washing & rinsing is to use higher flow rates.

Rinsing = Water

- Suitable water is costly!
- Water can cause difficulties!
- Used water represents a disposal problem!
Establishing Cleanliness Baselines

- Defining Cleanliness Needs
- Rinse Water Bath Conductivity
- Water Break-Free Test (organic soils)
- White Towel Test (inorganic soils)
- Tape Pull Test (inorganic soils)
- UV Detection
- Photo Acoustical Technology (PAT)
## Water Conservation Through Improved Rinsing Efficiency

(Percent Shops Using Technique)

<table>
<thead>
<tr>
<th>Technique</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counter current rinsing</td>
<td>68%</td>
</tr>
<tr>
<td>Reactive rinsing &amp; water reuse</td>
<td>23%</td>
</tr>
<tr>
<td>Turn off valves when not in use</td>
<td>66%</td>
</tr>
<tr>
<td>Air agitated rinsing</td>
<td>58%</td>
</tr>
<tr>
<td>Flow restrictors</td>
<td>70%</td>
</tr>
<tr>
<td>Conductivity controls</td>
<td>16%</td>
</tr>
</tbody>
</table>
## Conductivity Flow Control

### Typical Rinsing Criteria

<table>
<thead>
<tr>
<th>Type of Rinse</th>
<th>mg/L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Following Cleaner/Acid</td>
<td>400-1000</td>
</tr>
<tr>
<td>Following Function Plating</td>
<td>100-700</td>
</tr>
<tr>
<td>Following Bright Plating</td>
<td>5-40</td>
</tr>
</tbody>
</table>
Efficient Spray Rinsing Techniques

- 1/8 to 1/4 water usage as a dip operation
- Fog rinsing above heated process tanks
- Spray impact: flow, pattern, nozzle, distance, pressure & atomization
- Nozzle problems: flow rate, spray pattern, spray drop size, spray impact & alignment
Extending Bath Life
(Percent Shops Using Technique)

- Filtration
- Removing dropped parts (78%)
- Removing anodes when bath is idle (24%)
- Oil skimming, absorbing
- Chemical analysis (92%)
- Statistical process control
- Chemical treatment
Process Bath Filtration

**Types**
- Cartridges
- Disk
- Bag
- In-tank
- External
- Reusable
- Disposable
- Carbon / Ion exchange

**Benefits**
- Removes particles down to 1 micron
- Extends bath life 2-4x
- Improves quality
- Offers quick payback
- Provides agitation
Membrane Applications

- Degreasing oils concentration
- Coolant emulsion concentration
- Latex concentration
- Paint pigment recovery
- Laundry water reuse

- Pharmaceutical purification
- Dye recovery
- Caustic/acid recovery
- Wine clarification
- Brine recovery
- Alkaline cleaner recycling
Phosphatizing Processes

- Treats Mainly Steel and Iron Substrate
  - To impart Corrosion Resistance and Promote Adhesion of Finishes (i.e. Paint, Laquer, etc.)
- Provides a Coating of Insoluble Metal-Phosphate Crystals to Substrate
- Applies an Iron, Zinc, Manganese, Chromium Phosphate Solution to Substrate
- Iron and Zinc Phosphate – Most Common Types of Phosphating
Possible Modifications to Existing Phosphatizing System

- Reuse DI Water and other Water to Enhance the Quality of Cleaning
- Cascade the Rinses Where Overflow Volumes are the Greatest (i.e. > than 5 gpm)
- Use Overflow from Post Stages to Heated Tanks (Greatest Loss of Water due to Evaporation)
- Add a Prerinse Stage Before Cleaner Stage to Loosen and Remove Soils and Reuse Water from Cleaner Stage to Prerinse Stage
P2 in the Phosphatizing Process

- Reduce Chemical Use
  - Analyze and Control the Solution’s Temperature, Chemical Concentration, and pH level in each Step
- Recirculate Phosphate Solution
- Use Ultrafiltration to Maintain Baths or a Continuous Recirculation System Through A Clarifier to Reduce Amount of Sludge Generated
P2 in the Phosphatizing Process

- Reduce Water Use
- Counter Flow Water to Rinse Tanks
- Analyze Incoming City Water—Possibly High Amounts of Total Dissolved Solids (TDS)
- Determine Control Set Points
- Treat and Condition Water—De-Ionized (DI) or Reverse Osmosis (RO) Water
Other P2 Opportunities

- Reduce Carryover (Dragout)
  - Design System for Minimal Dragout
    (Includes Adequate Drip Time, Angle Parts, and Drain Zones Between Stages)

- Control Water Flow
  - Install Flow Meters
  - Install Flow Restrictors
  - Do Not Use Ball Valves (Only On and Off Option)
Other P2 Opportunities

- Maintain Automated Systems (i.e. Speed, Chemical Additions, etc.)-High Frequency of Bath Solution Turnover Is A Good Indicator of It Not Being Maintained!
- Clean and Properly Position Spray Nozzles
- Train Employees
- Conduct Daily Inspection of System
Plating/Painting Facility Reuse of Wastewater

- Installed Wastewater Reuse System in July 2001
- Installed Piping to Recycle Treated Water back to Non Critical Rinsing (NCR) Stages of Plating Lines
- Installed Solenoid Valves at NCR Stages
Plating/Painting Facility Reuse of Wastewater

- Use About 35 Million Gallons of Water Per Year for All Facility Operations
- Currently Reusing About 10% Treated Wastewater
- Expect to Increase the Amount of Water Reuse as the System Develops
Closed-Looped Phosphatizing

B & W Metal Fabricators, Inc.

- 6 tank metal surface preparation
- Counterflow rinses with conductivity control
- Evaporation tanks
- 96% reduction in water, 50% reduction in bath chemicals
- Less than two year payback
Closed-Looped Phosphatizing Line

- Alkaline Cleaner
- Rinse
- Phosphate Bath
- Rinse
- Rinse
- Sealer

Make-up

Estimated dump 2/yr

Estimated Dump 1/yr

Tap Water

No Dump
Closed-Looped Aqueous Degreasing

*Common System Changes*

- 2 to 3 stages counterflow cascade rinses
- Microfiltration recycling (ceramic membranes)
- Higher cleaner temperature (160-175 F)
- Use of DI water for rinse feed
- Quick payback
Other Process Water Conservation Measures

- Reuse of once through, non-contact cooling water for next process bath or for pre-heat
- Reuse of oil/water separator filtrate for mop water or paint booth water curtains
- Water flow timers, flow restrictors, water use inventories, and operator training
Water-Borne Paint Cleanup Management

- Wetting agents to assist paint line flushing / water evaporated - no solvents used
- First line flush-out saved as reducer for next paint batch
- Water & solvent flushes kept separate for reuse & P2/waste minimization
Efficient Washing Techniques

- Low Volume - High Pressure Nozzle
- Air Assisted Nozzle
- Conduct “Dry Cleanup” First
- Proper Equipment, Technique & Training
Boiler Water BMPs

- Chemical metering systems
- Biocide selection
- Improved blowdown techniques (total dissolved solid $\geq 2000$ ppm)
- Temperature optimization
- Fuel & Air mixture controls
Cooling Tower Water Management

- Chemical metering systems
- Alternative bacteria control systems (elimination of chromium)
- Drift reduction
- Efficient water distribution systems
Restroom Water Conservation

- Install aerators, spring loaded valves, or timers on all faucets
- Reduce toilet water use by installing tank displacement devices or water-saving diaphragms
- Install low-flow toilets (1.6 gallons per flush)
- Repair leaking toilets, faucets, & showers
Landscaping & Outdoor Water Use

口 Water in early morning or evening when wind and evaporation are lowest
口 Wait 10-14 days before watering after heavy rain
口 Raise mower blades to 2 1/2 to 3 1/2 inches in summer so grass retains more moisture
口 Consider drip irrigation vs. overhead sprinklers
口 Sweep - never hose - sidewalks, docks, parking lots
Surface Preparation And Coating Links

- Pollution Prevention Guide for Surface Coating Removal
  http://www.tnrcc.state.tx.us/exec/oppr/p2_info/coatings_removal.html

- Pollution Prevention for Wastewaters TIPS: Pollution Prevention Guide for Surface Coating Operations
  http://www.twua.org/p2/Tips/Coatings.html

- Minnesota Technical Assistance Program
  http://www.mntap.umn.edu/

- University of Illinois’ Waste Management Research Center
  http://www.wmrc.uiuc.edu/manuals/coatings/backgr.htm#Coatings
MI DEQ & RETAP Pollution Prevention (P2) Training

Next Steps: “Dee-fusion” of Electroplating P2 Technologies

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