Tools and Techniques for Optimizing Metal Finishing Process/Environmental

*MA Metal Finishing Forum*

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Overview

- Integrated Process/Environmental Planning/Design
- Water and Chemical Recovery and Reuse
- Software Tools for Improved Decisionmaking and Implementation
- Life Cycle Information Management
- Life Cycle Project Improvement
- Supply Chain Impacts
PROCESS/ENVIRONMENTAL PROJECTS
Maximum project cost control is gained through effective early planning and engineering.
Project Value is Maximized Through Systematic Planning and Implementation

- Plan for adequate and flexible systems that meet current needs & can be easily modified to meet anticipated contingent/future scenarios
- Design efficient systems that maximize product quality and yield and minimize waste
- Implement useful information systems and documentation
- Meet/exceed goals
- Avoid constraints
WATER AND CHEMICAL RECOVERY AND REUSE
Water and Chemical Recovery and Reuse

Drivers

- Reduce wastes
- Reduce solution contaminants and constituent variations -- improve quality and performance of process solutions and rinse waters
- Reduce chemical and water use

Constraints

- Buildup of undesirable contaminants
- Incremental systems that will not be properly operated and maintained
Metal Finishing Process Water Flow Schematic

- **Process Bath**
  - **Drag-in**
  - **Batch Discharge to Waste Treatment**
  - **Make-up Chemistry**

- **Rinse Tank 1**
  - **Drag-out**
  - **Make-up Water**
  - **Continuous Discharge to Waste Treatment**

- **Rinse Tank 2**
  - **Drag-out**
  - **Make-up Water**
  - **Continuous Discharge to Waste Treatment**
Process Solution Maintenance and Rinse Water Recycling

Drag-in

Process Bath

Maintenance

Impurities
Purified Chemicals

Rinse Tank 1

Purification

Chemicals/Water Separation System

Chemicals/Water
Recycle System

Purified Rinse Water (Low TDS)

Drag-out

Drag-out

Drag-out

Rinse Tank 2

Make-Up Water

Purified Water
A Balance of Integrated Pollution Prevention and Pollution Control Provides Lowest Life Cycle Cost
SOFTWARE TOOLS FOR PROCESS/ENVIRONMENTAL IMPROVEMENT
Navy Demonstrated Success with Off-the-Shelf Anodizing Process Controls
Computerized Process Recipes, Monitoring, Control, and Verification Reports Improve Processing
## Process Cost Report Itemizes Nine Cost Categories for Each Process

### Annual Costs

<table>
<thead>
<tr>
<th>Processes in Lines</th>
<th>D&amp;B</th>
<th>Mt/Cool</th>
<th>Vaco</th>
<th>Water</th>
<th>Rectifier</th>
<th>Efficient</th>
<th>OnSite Trt</th>
<th>Sludge</th>
<th>Disposal</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 - 1. Soak Clean/Alkaline Etch (1)</td>
<td>$10,878</td>
<td>$1,588</td>
<td>$922</td>
<td>$90</td>
<td>$45</td>
<td>$224</td>
<td>$5,164</td>
<td>0</td>
<td>$18,910</td>
<td></td>
</tr>
<tr>
<td>#1 - 2. Deoxidize (3)</td>
<td>$8,646</td>
<td>$476</td>
<td>$461</td>
<td>$359</td>
<td>$0</td>
<td>$344</td>
<td>$28,689</td>
<td>$4,347</td>
<td>0</td>
<td>$41,144</td>
</tr>
<tr>
<td>#1 - 3. Sulfuric/Hard Anodize (13)</td>
<td>$14,202</td>
<td>$0</td>
<td>$922</td>
<td>$447</td>
<td>$27,600</td>
<td>$440</td>
<td>$2,201</td>
<td>$514</td>
<td>0</td>
<td>$46,326</td>
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<tr>
<td>#1 - 4. Black Dye (14)</td>
<td>$23,444</td>
<td>$965</td>
<td>$461</td>
<td>$783</td>
<td>$0</td>
<td>$755</td>
<td>$5,033</td>
<td>$377</td>
<td>0</td>
<td>$31,817</td>
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<tr>
<td>#1 - 5. Red Dye (15)</td>
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<td>$965</td>
<td>$461</td>
<td>$904</td>
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<td>$908</td>
<td>$6,056</td>
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<td>#1 - 6. Gold Dye (16)</td>
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<td>$777</td>
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<td>$757</td>
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<td>$785</td>
<td>0</td>
<td>$31,771</td>
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<tr>
<td>#1 - 7. Anodize Seal (17)</td>
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<td>$5,520</td>
<td>$184</td>
<td>$218</td>
<td>$0</td>
<td>$53</td>
<td>$3,135</td>
<td>$441</td>
<td>0</td>
<td>$113,743</td>
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<td>#2 - 1. Alkaline Clean (18)</td>
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<td>$1,276</td>
<td>$864</td>
<td>$122</td>
<td>$0</td>
<td>$97</td>
<td>$484</td>
<td>$411</td>
<td>0</td>
<td>$11,734</td>
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<tr>
<td>#2 - 2. Acid Etch (19)</td>
<td>$42,400</td>
<td>$0</td>
<td>$864</td>
<td>$143</td>
<td>$0</td>
<td>$149</td>
<td>$744</td>
<td>$0</td>
<td>0</td>
<td>$44,299</td>
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<tr>
<td>#2 - 3. Nickel Strike (20)</td>
<td>$25,234</td>
<td>$0</td>
<td>$864</td>
<td>$217</td>
<td>$480</td>
<td>$204</td>
<td>$1,022</td>
<td>$3,757</td>
<td>0</td>
<td>$31,779</td>
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<tr>
<td>#2 - 4. Electroless Nickel (21)</td>
<td>$239,400</td>
<td>$9,019</td>
<td>$346</td>
<td>$355</td>
<td>$0</td>
<td>$80</td>
<td>$395</td>
<td>$3,880</td>
<td>0</td>
<td>$235,655</td>
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<tr>
<td>#2 - 5. Ni Plate, Sulfamate (22)</td>
<td>$51,396</td>
<td>$5,898</td>
<td>$1,728</td>
<td>$296</td>
<td>$1,800</td>
<td>$126</td>
<td>$632</td>
<td>$12,213</td>
<td>0</td>
<td>$74,029</td>
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<tr>
<td>#3 - 1. Alkaline Clean (23)</td>
<td>$14,349</td>
<td>$1,618</td>
<td>$1,123</td>
<td>$750</td>
<td>$0</td>
<td>$718</td>
<td>$3,589</td>
<td>$530</td>
<td>0</td>
<td>$22,677</td>
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<td>#3 - 2. Chrome Etch (C305) (24)</td>
<td>$28,939</td>
<td>$1,680</td>
<td>$1,123</td>
<td>$1,042</td>
<td>$0</td>
<td>$984</td>
<td>$82,014</td>
<td>$10,407</td>
<td>0</td>
<td>$126,210</td>
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<tr>
<td>#3 - 3. Chrome Plate (C407) (25)</td>
<td>$35,329</td>
<td>$2,716</td>
<td>$2,346</td>
<td>$758</td>
<td>$166,500</td>
<td>$664</td>
<td>$55,296</td>
<td>$21,031</td>
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<td>$284,541</td>
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</table>
Modeling Production Ranges Produces Ranges for Flows, Energy, Material Use, and Annual Costs
Process Model Data Can be Exported to Tankline Spreadsheets
Chemical Usage Export to MS EXCEL Provides Basis for Chemical Consumption and Inventory

<table>
<thead>
<tr>
<th>Chemical/Material</th>
<th>Ordered</th>
<th>Quantity Received</th>
<th>Unit</th>
<th>Initial Fill and Use</th>
<th>Monthly Usage Estimate</th>
<th>Annual Usage</th>
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<tbody>
<tr>
<td>Activated Carbon</td>
<td>500</td>
<td>500</td>
<td>lb</td>
<td>150</td>
<td>106</td>
<td>1200</td>
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<tr>
<td>Ammonium Nitrate</td>
<td>2000</td>
<td>2000</td>
<td>lb</td>
<td>849</td>
<td>163</td>
<td>1957</td>
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<tr>
<td>Anionic Polymer</td>
<td>110</td>
<td>110</td>
<td>gal</td>
<td>10</td>
<td>13</td>
<td>189</td>
</tr>
<tr>
<td>Barrett Additive A</td>
<td>100</td>
<td>100</td>
<td>lb</td>
<td>0</td>
<td>11</td>
<td>127</td>
</tr>
<tr>
<td>Barrett SN</td>
<td>2200</td>
<td>2200</td>
<td>gal</td>
<td>2200</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Barrett SNAC</td>
<td>200</td>
<td>200</td>
<td>lb</td>
<td>0</td>
<td>8</td>
<td>96</td>
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<tr>
<td>Barrett SNAP AM</td>
<td>8</td>
<td>8</td>
<td>gal</td>
<td>0</td>
<td>8.7</td>
<td>104</td>
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<tr>
<td>Barrett SNR-24</td>
<td>495</td>
<td>495</td>
<td>gal</td>
<td>0</td>
<td>177</td>
<td>2126</td>
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<tr>
<td>Boric Acid</td>
<td>600</td>
<td>600</td>
<td>lb</td>
<td>344</td>
<td>171</td>
<td>2057</td>
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<tr>
<td>Brush Plate</td>
<td>1</td>
<td>Lot</td>
<td>brush plate</td>
<td>0</td>
<td>177</td>
<td>2126</td>
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<tr>
<td>Cad. Concentrate</td>
<td>2000</td>
<td>2013</td>
<td>lb</td>
<td>1000</td>
<td>16</td>
<td>193</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Chemical/Material</th>
<th>Quantity After Initial Fill</th>
<th>Months Left</th>
<th>Order Lead (mo)</th>
<th>Contingent Quantity</th>
<th>Minimum Inventory</th>
<th>Months to Min Inventory</th>
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</thead>
<tbody>
<tr>
<td>Activated Carbon</td>
<td>350</td>
<td>3.5</td>
<td>3</td>
<td>50</td>
<td>350</td>
<td>0.00</td>
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<tr>
<td>Ammonium Nitrate</td>
<td>1151</td>
<td>7.1</td>
<td>3</td>
<td>849</td>
<td>1338</td>
<td>(1.2)</td>
</tr>
<tr>
<td>Anionic Polymer</td>
<td>100</td>
<td>7.6</td>
<td>3</td>
<td>0</td>
<td>39</td>
<td>4.6</td>
</tr>
<tr>
<td>Barrett Additive A</td>
<td>100</td>
<td>9.5</td>
<td>3</td>
<td>0</td>
<td>32</td>
<td>6.5</td>
</tr>
<tr>
<td>Barrett SN</td>
<td>0</td>
<td>NA</td>
<td>3</td>
<td>1100</td>
<td>1100</td>
<td>0.00</td>
</tr>
<tr>
<td>Barrett SNAC</td>
<td>200</td>
<td>25</td>
<td>3</td>
<td>0</td>
<td>24</td>
<td>(22)</td>
</tr>
<tr>
<td>Barrett SNAP AM</td>
<td>8</td>
<td>0.92</td>
<td>3</td>
<td>0</td>
<td>28</td>
<td>(0.1)</td>
</tr>
<tr>
<td>Barrett SNR-24</td>
<td>495</td>
<td>2.8</td>
<td>3</td>
<td>0</td>
<td>532</td>
<td>(0.21)</td>
</tr>
<tr>
<td>Boric Acid</td>
<td>25</td>
<td>1.5</td>
<td>3</td>
<td>138</td>
<td>652</td>
<td>(0.8)</td>
</tr>
</tbody>
</table>
Use of Data Management Software Provides Automatic Trend Plotting and Statistical Calculations
Linking Photos and Documents Into Data Software Enhances Value of Information
Data Management System Software Implements
Selected Automatic Responses to Data Results
LIFE CYCLE INFORMATION MANAGEMENT
Planning Provides Awareness of Data Generation Over Project Life Cycle

- **Planning**: 1 year
- **Design**: 18 months
- **Construction**: 2 years
- **Facility Management**: 20 years

DATA
A Data Warehouse Enhances Project Lifecycle Information Management and Use
Early Data Input Maximizes Data Utility

Planning
Data Warehouse Delivers Benefits Over the Entire Lifecycle

Startup
Commissioning
O&M

Planning

Construction

Design
Access Vast Range of Data On Fixed PC or Laptop, Tablet or Pocket PC

- Design Files
- Software Input/output
- Intranet
- O&M Manual
- O&M Logs, Notes
Benefits of State of the Art Project Data Systems

- Data is more accessible and reliable
- Accurate, reusable information for project lifecycle
- Improve project understanding and communications
- Reduces cost and accelerates project delivery time
- Lower risk for changes, conflicts, errors and omissions
- Increased staff productivity due to easier access & availability of data
- Improved record-keeping and cross-referencing
Integrated Process Planning and Information Tools Produces Excellent Benefits

- Establish requirements, goals, constraints
- Understand impacts of production ranges on process systems and support systems
- Plan efficient life cycle information management systems
- Maximize opportunity to incorporate productive, efficient, lean, profitable systems
- Initiate effective life cycle implementation and mechanisms for continuous improvement
- Improve project delivery approach, information sharing, efficiency, ability to control project, and ability to integrate beneficial technique and technology
Supply Chain Considerations

Motivation

- Respond to Requirements
- Opportunity for Improvement

Impacts

- Efficiency
- Quality
- Profitability