Sulfamate Nickel Ammonium Removal Equipment  
(S.N.A.R.E.)

Sulfamate Nickel plating is used in many industries and applications. In some plating applications, conditions occur within the plating bath which causes the chemistry to breakdown. The main breakdown is of the Sulfamate ion which decomposes into Ammonium. A high concentration of Ammonium, approximately 500-1000 ppm, causes excessive pitting in the plated nickel deposit. Traditionally, at this point the Sulfamate Nickel bath is waste treated and made up new. Zero Discharge Technologies has developed a system which can selectively remove the Ammonium with only a minor loss of the plating bath chemicals. This leads to the extension of the bath’s life indefinitely.

The Sulfamate Nickel Ammonium Removal Equipment (S.N.A.R.E.) uses hybrid Electrodialysis technology to remove Ammonium from Sulfamate Nickel plating baths. Electrodialysis is the induction of an electric potential across a membrane stack to cause the migration of dissolved ions across ion-exchange membranes. This results in the transport of Ammonium from the plating solution into an Ammonium Sulfate solution which is contained in a holding tank on the S.N.A.R.E.

The ion-exchange membranes used in the S.N.A.R.E. have an affinity for single charged cations (Ammonium). These membranes have been prepared, using a proprietary process, so that they will only allow the transport of a minute quantity of divalent cations (Nickel). Therefore, the loss of Nickel from the plating bath is minimized.

Test data accumulated at Poly-Plating, Inc., an FAA licensed repair facility, shows that the yearly cost savings of $59,625.99 The payback is realized in months. These costs only take into account the costs of plating chemicals. If waste treatment costs were taken into account, cost savings would increase even further.
Recovery Procedure:

**Step 1:** The Sulfamate Nickel (SN) is allowed to cool to room temperature and the Boric Acid is allowed to precipitate out. This can be done in the plating tank if an extended down time will not cause production delays or, this can be done in a separate, designated tank.

**Step 2:** The Sulfamate Nickel solution is decanted and filtered into another tank for processing. This is done to ensure that no undissolved Boric Acid is with the liquid. A simple method of doing this is to use an elevated, conical-bottomed tank in Step 1 and installing a valve and filter bag assembly beneath it. The solution flows by gravity through the filter bag and can be pumped into a designated recovery tank adjacent to the SNARE. The Boric Acid collected in the filter bag can later be dissolved back into the SN plating bath.

Once the solution is in the recovery tank, 10% by volume of Deionized water is added to the SN solution. This is to ensure that no boric acid will precipitate during the recovery process.

**Step 3:** The Ammonium concentration in the SN solution is determined. This value is then used to determine the amount of time required to lower the Ammonium Concentration to its optimum level. Each SNARE is sized for each individual application so that there is ample time to perform all of these steps.

**Step 4:** Recovery is begun by turning on 3 pumps on the SNARE and the setting the flow rates out of these pumps (SN pump, waste solution pump, & electrode wash solution pump). Once the flow rates are set, the constant current rectifier located on the SNARE is turned on the amperage is set.

**Step 5:** The SNARE is operated until the Ammonium concentration reaches 25-50 ppm. The SNARE is designed to operate unattended until the recovery process is complete.

**Step 6:** At the end of the processing time, the SN solution is analyzed for pH, Nickel, Boric Acid, Chloride Additive, and Wetter Concentration. The SN solution is pumped back to the plating tank and any required chemical additions are made. The Sulfamate Nickel plating bath is now operational.

**Typical Replenishment Schedule**

- **5% by vol** - 24 opg SN Nickel Replenisher
- **0.3 opg** - Boric Acid
- **0.4 opg** - Nickel Chloride
SNARE
(Sulfamate Nickel Ammonium Removal Equipment)

Analysis of a field installation at an FAA-Licensed overhaul & repair facility.

Performance Data (500-gallon SN tank)

<table>
<thead>
<tr>
<th>Component</th>
<th>Before Recovery</th>
<th>After Recovery</th>
<th>Change</th>
<th>Percent Removal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonium (ppm)</td>
<td>1029</td>
<td>59.4</td>
<td>970</td>
<td>94.2%</td>
</tr>
<tr>
<td>Nickel (opg)</td>
<td>11.8</td>
<td>10.7</td>
<td>1.1</td>
<td>9.3%</td>
</tr>
<tr>
<td>Boric Acid (opg)</td>
<td>4.8</td>
<td>4.5</td>
<td>0.3</td>
<td>6.3%</td>
</tr>
<tr>
<td>Cl Add. (opg)</td>
<td>0.762</td>
<td>0.414</td>
<td>0.348</td>
<td>45.7%</td>
</tr>
</tbody>
</table>

Performance
- >90% Ammonium Removed
- <10% Nickel Loss
- >80% Waste Volume Reduction

Chemical Savings (500-gallon SN tank)

<table>
<thead>
<tr>
<th>Component</th>
<th>Units</th>
<th>Cost/Unit</th>
<th>Quantity Traditional</th>
<th>Cost Traditional</th>
<th>Quantity Snare</th>
<th>Cost Snare</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel (@24 opg)</td>
<td>gals</td>
<td>$86.84</td>
<td>250</td>
<td>$21,710.00</td>
<td>23</td>
<td>$1997.32</td>
<td>$19,712.68</td>
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<tr>
<td>Boric Acid (opg)</td>
<td>lbs</td>
<td>$0.71</td>
<td>197</td>
<td>$139.87</td>
<td>9.375</td>
<td>$6.67</td>
<td>$133.20</td>
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<tr>
<td>Chloride Additive</td>
<td>lbs</td>
<td>$3.57</td>
<td>18.75</td>
<td>$66.94</td>
<td>10.5</td>
<td>$37.49</td>
<td>$29.45</td>
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<tr>
<td>Totals</td>
<td></td>
<td></td>
<td></td>
<td>$21,916.81</td>
<td></td>
<td>$2041.48</td>
<td>$19,875.33</td>
</tr>
</tbody>
</table>

BENEFITS
- >90% Chemical Cost Savings
- >80% Waste Disposal Savings
- >85% Decrease in Total Operating Costs
- “Purified” since 1992 with no "New" Makeups
- Deposit conforms to all ASTM & mil. Specs.
- Payback in less than 1 year