**HP CADMIUM BRIGHTENER**

Cyanide Cadmium Plating Process

**HP CADMIUM BRIGHTENER** produces a fine grained bright deposits over a wide current density range, and is suitable for both rack and barrel applications.

**HP CADMIUM BRIGHTENER** can be varied to meet individual requirements using a single highly stable liquid addition agent.

**HP CADMIUM BRIGHTENER** produces deposits that are anodic to copper, brass, and steel, protecting these metals electrochemically, not depending on continuity of coatings as most other electrodeposited metallic coatings.

**HP CADMIUM BRIGHTENER** offers deposits that are low in electrical contact resistance, have self-lubricating qualities, ease of soldering, lack of bulky corrosion products, high resistance to salt corrosion, retention of luster, and the ability to plate on cast and malleable iron surfaces at low current densities.

**EQUIPMENT:**

- **Tanks:** Plain steel tanks are commonly used. PVC or Koroseal® are acceptable if needed.

- **Anodes:** High purity cadmium anodes.

- **Anode Baskets:** Steel anode baskets are acceptable.

- **Anode Bags:** Nylon or polypropylene bags are optional.

- **Filtration:** Use a 10 – 25 micron filter cartridge packed with non-cellulose filter aid. Filtration speed can be 1 to 2 tank turnovers per hour optional, continuous filtration is not essential.

- **Agitation:** Not absolutely necessary but can use solution or mechanical agitation.

- **Temperature:** Must be maintained within recommended range. Steel heating and cooling coils are required.

- **Ventilation:** Recommended. For worker safety and environmental reasons.
OPERATING INSTRUCTIONS:

**Rack Bath**
- **Cadmium Metal**
  - Range: 2.5-4.0 oz/gal (19 – 30 g/l)
  - Optimum: 3.0 oz/gal (22.5 g/l)
- **Total Sodium Cyanide**
  - Range: 15-20 oz/gal (112.5-150 g/l)
  - Optimum: 16.26 oz/gal (122 g/l)
- **Total Caustic Soda**
  - Range: 2.0-3.5 oz/gal (15-26 g/l)
  - Optimum: 2.6 oz/gal (19.5 g/l)
- **HP CADMIUM BRIGHTENER**
  - Range: 0.8 – 1.2 % v/v
  - Optimum: 1.0 % v/v

**Barrel Bath**
- **Cadmium Metal**
  - Range: 1.9-3.0 oz/gal (14 – 22.5 g/l)
  - Optimum: 2.4 oz/gal (18 g/l)
- **Total Sodium Cyanide**
  - Range: 15 – 20 oz/gal (112.5-150 g/l)
  - Optimum: 16.25 oz/gal (122 g/l)
- **Total Caustic Soda**
  - Range: 1.5 – 3.0 oz/gal (11 – 22.5 g/l)
  - Optimum: 2.0 oz/gal (15 g/l)
- **HP CADMIUM BRIGHTENER**
  - Range: 0.8 – 1.2% v/v
  - Optimum: 1.0 % v/v

OPERATING PARAMETERS:

For barrel and rack operations

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Range</th>
<th>Optimum</th>
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</thead>
<tbody>
<tr>
<td><strong>Temperature</strong></td>
<td>75 – 95°F</td>
<td>80°F</td>
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<tr>
<td><strong>Current Density</strong></td>
<td>5 – 50 ASF Rack</td>
<td>25 ASF Rack</td>
</tr>
<tr>
<td></td>
<td>5 – 10 ASF Barrel</td>
<td>7 ASF Barrel</td>
</tr>
<tr>
<td><strong>Anode Current Density</strong></td>
<td>15-30 ASF</td>
<td></td>
</tr>
<tr>
<td><strong>Voltage</strong></td>
<td>9 – 15 volts</td>
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</table>

Because of the changes of brightness due to variations in cadmium metal, total sodium cyanide, and caustic soda, it is recommended that the **HP CADMIUM BRIGHTENER** be added in increments of 2 fl. oz/100 gal bath, followed by plating tests. Loss of brightness in the intermediate current densities is the first indication of low brightener concentrations. Excessive additions of brightener will cause high current density pitting and a narrow current density bright range.

For optimum performance, the cadmium metal, sodium cyanide, and sodium hydroxide concentrations should be analyzed and brought to operational level at least twice weekly.

The cadmium content varies with the items to be plated and is one of the factors that determines the maximum permissible current density. The cathode efficiency will vary with the metal content, i.e., low metal—low efficiency, high metal—high efficiency. The metal content should be maintained by anode corrosion as much as possible.

The sodium cyanide content provides solution conductivity and anode corrosion. When plating items with recesses, a high sodium cyanide content and low cadmium content will provide better throwing and covering power that will produce a thicker deposit in low current density areas.

In order for the cadmium content to be maintained at a normal value, it is absolutely necessary to maintain the total sodium cyanide content (which determines the ability of the bath to dissolve the anodes), and to have a correct anode area in the tank. The cyanide should always be added in the form of Sodium Cyanide. The Sodium Cyanide is dissolved in the bath by putting it into perforated steel baskets or cotton sacks suspended in the bath, or may be placed in the barrels in order to dissolve the salts in the solution.
If metal content has been allowed to drop below normal value, it must be raised quickly. Add 1.15 pounds of cadmium oxide for each pound of cadmium required. The Cadmium Oxide must be dissolved in a Sodium Cyanide solution that contains twice the weight of the Cadmium Oxide being dissolved. First dissolve the Sodium Cyanide in a clean tank, using about one quart of water for each pound of sodium cyanide. Next make a slurry of the cadmium oxide with water using about one quart of water for each three pounds of cadmium oxide used. Pour the slurry of cadmium oxide slowly, with vigorous stirring, into the solution of Sodium Cyanide. Use a little more water to rinse out all the rest of the Cadmium Oxide slurry. Continue stirring until practically all of the solids are dissolved.

Add this solution to the plating tank and stir the plating solution thoroughly. Dissolving cadmium oxide and sodium cyanide in the bath will increase the total caustic soda content by an amount equal to 0.7% of the concentration of Cadmium Oxide added.

The Caustic Soda content in most installations is maintained automatically by the difference in cathode and anode efficiencies. Drag-in of acids or low cadmium anode area may necessitate occasional small additions based on analysis in order to maintain a concentration of 2 – 3 oz/gal. When insoluble anodes are used, it may be necessary to operate with a caustic content of 3 – 4.5 oz/gal. to prevent a film from forming on the anodes that may settle on the items being plated, causing roughness.

**CONTAMINATION AND PURIFICATION:**

Positive steps must be taken to prevent the introduction of metallic impurities into the bath. Metallic impurities are removed gradually from plating solutions by drag-out and plating-out with the cadmium. Copper and some other metallic impurities may be removed by treatment with zinc dust. The addition of 1 pound of zinc dust per 100 gallons of plating bath in a treatment tank, followed by agitation for several hours and filtration, is frequently beneficial to remove copper contamination.

Sodium carbonate is formed unavoidably by decomposition of sodium cyanide. High solution temperature, polarized anodes, and the use of insoluble steel anodes all tend to accelerate the formation of sodium carbonate in the bath. When the sodium carbonate content reaches about 12 oz/gal, steps should be taken to remove the carbonates.

Hexavalent chromium contamination can be overcome by the addition of sodium hydrosulfite to the solution. 1/16 oz/gal (0.53 g/l) is ordinarily sufficient when slight blistering has been noticed. The addition should be well distributed throughout the bath. NOTE that the hydrosulfite should be dissolved in a water solution of caustic soda before it is added to the bath. In barrel operations it is beneficial to add a reducing sugar type purifier to the cleaner used in the cadmium line.

Oil and grease suspended in the bath may cause blotchy, white deposits to be produced. The treatment of the bath with 1-2 pounds of activated carbon per 100 gallons of plating bath in a treatment tank, followed by filtration generally removes all these contaminating substances. Brightener is removed also, and must be replaced.
SOLUTION CONTROL:

Chemicals and Reagent Required
Ammonium Chloride, Reagent grade
Ammonium Hydroxide, Reagent grade
Potassium Iodide solution, (100 g/l and 8 ml of ammonium hydroxide)
Barium Chloride solution, 100 g/l
DI water
Formaldehyde 37%
Formaldehyde solution, 5% (135 ml of 37% Formaldehyde, diluted to 1 L with DI water) Store in dark bottle.
Buffer solution (50 g Ammonium Chloride and 400 ml Ammonium Hydroxide in 1 L DI water.)
0.1M EDTA solution
0.1N Hydrochloric acid
Sodium Chloride, Reagent grade
Sodium Cyanide, Reagent grade
1.0N Sulfuric Acid
0.1N Silver Nitrate
Eriochrome Black T indicator (mix 0.2 g Eriochrome Black T with 100 g sodium chloride)
Thymol Blue Indicator (0.1 g per 250 ml DI water)
Methyl Purple Indicator
Sulfo-Orange Indicator

Equipment Required
300 ml Erlenmeyer flask
Whatman filter paper, #1
Analytical Balance
1 mL pipet
2 ml pipet
10 ml pipet
5 ml pipet
Red Litmus paper
Graduated cylinder
Filter flask
Funnel

CADMIUM
1. Pipette 2 ml of the plating solution into a 250 ml Erlenmeyer flask, add 50 ml of DI water.
2. Add 2-3 drops of Thymol Blue Indicator.
3. While swirling vigorously, add 1.0 N Sulfuric Acid dropwise to a faint yellow endpoint.
4. Add 10 ml of the Buffer solution.
5. Add approximately 0.2 – 0.3 grams of Eriochrome Black T indicator.
6. Add 15 ml of the Formaldehyde solution and titrate immediately with 0.1M EDTA solution from a reddish purple to a blue endpoint.

Calculations:
Cadmium (oz/gal) = mL 0.1 M EDTA x 0.75
Cadmium (g/L) = mL 0.1 M EDTA x 5.62
TOTAL SODIUM CYANIDE

1. Pipette 2 mL of the plating solution into a 250 mL Erlenmeyer flask.
2. Add 100 mL of DI water and 3 mL of the Potassium Iodide solution.
3. Titrate with 0.1N Silver Nitrate until a permanent faint yellow turbidity.

Calculations:
Total sodium Cyanide (oz/gal) = mL 0.1N Silver Nitrate x 0.653
Total sodium Cyanide (g/l) = mL 0.1N Silver Nitrate x 4.90

TOTAL CAUSTIC SODA

1. Pipette 10 mL of the plating solution into a 250 mL Erlenmeyer flask.
2. Add 1 gram Sodium Cyanide. Mix until the cyanide has dissolved, add 8 drops of Sulfo Orange Indicator.
3. In the hood, titrate with 1.0 N Sulfuric Acid, until a yellow with a slightly greenish tint endpoint.

Calculations:
Total Sodium Hydroxide (oz/gal) = mL 1.0 N Sulfuric Acid x 0.535
Total sodium Cyanide (g/l) = mL 1.0 N Sulfuric Acid x 4.02

SODIUM CARBONATE

1. Pipette 2 mL of the plating solution into a 300 ml Erlenmeyer flask.
2. Add 100 ml of DI water.
3. Heat to near boiling.
4. Add 5 mL Barium Chloride solution, mix, stopper the flask lightly and allow the precipitate to settle.
5. Add 1 mL of Barium Chloride solution. If an additional precipitate is formed, add another 5 ml of the Barium Chloride solution. Continue additions until no further precipitate forms.
6. Filter with Whatman #1 filter paper. Wash the Erlenmeyer flask with hot DI water and filter, check the rinse water with Litmus paper; continue rinsing and filtering until there is no color change in the Litmus paper.
7. Remove the filter paper and place it in the 300 ml Erlenmeyer flask that was previously rinsed.
8. Add 50 mL DI water and 5-6 drops of Methyl Purple indicator.
9. Titrate with 0.1N Hydrochloric Acid, until the precipitate is dissolved and the green color changes to gray, and then to a purple endpoint. Be sure that any barium carbonate precipitate adhering to the sides of the flask is brought into contact with the acid.

Calculations:
Sodium Carbonate (oz/gal) = mL 0.1N Hydrochloric Acid x 0.353
Sodium Carbonate (g/L) = mL 0.1N Hydrochloric Acid x 2.65
**STORAGE:**

**HP CADMIUM BRIGHTENER** should be stored in a dry area and container should be kept tightly closed.

**WASTE DISPOSAL:**

Wastes must be tested using methods described in 40 CFR Part 261. It is the generator’s responsibility to determine if the waste meets applicable definitions of hazardous wastes. Dispose of waste material according to Local, State, Federal, and Provincial Environmental Regulations.

When empty, containers may still be hazardous because of product residue. All labeled hazard precautions must be observed.

Consult MSDS for additional safety and waste treatment information.

**NON-WARRANTY:**

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