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965 ACID SULFATE CADMIUM PLATING PROCESS

INTRODUCTION:

The Accu-Labs 965 acid sulfate cadmium plating process is suitable for both rack and barrel operations. Some sintered iron parts have been successfully plated in rack installation. The Accu-Labs 965 process is based on cadmium sulfate salt and sulfuric acid as the maintenance acid. The chemistry of the Accu-Labs 965 process is maintained merely by controlling the amount of "free" sulfuric acid and the area of the cadmium metal anodes. The brightener additive system consists of entirely water soluble non-toxic organic compounds. The use of Accu-Labs 965-B and 965-C is very cost effective for barrel as well as rack plating operations.

SOLUTION COMPOSITION:

<u>Constituents Rack</u>	<u>Concentration</u>	<u>Optimum</u>
Cadmium, as metal	3.0-5.0 oz/gal 22.5-37.5 g/l	5.0 oz/gal
Sulfuric Acid (1.84 sp.gr.), free	90-190 mls/gal 6-12 oz/gal 24-50 ml/l 45-92 g/l	4-5% by volume
Accu-Labs 965-B	1.5-2.5 by volume	2.0% by volume
Accu-Labs 965-C	1.5-2.5% by volume	2.0% by volume
Accu-Labs 965-W	For maintenance not makeup	
<u>Barrel</u>		
Cadmium as metal	4.0-8.0 oz/gal 30.0-60.0 g/liter	
Sulfuric Acid (1.84 sp.gr.) free	90-190 mls/gal 6-12 oz/gal 24-50 ml/liter 45-92 g/liter	
Accu-Labs 965-B	1.0-2.0% by volume	
Accu-Labs 965-C	1.5-2.5% by volume	
Accu-Labs 965-W	For maintenance not makeup	

Note: A prepared concentrated electrolyte, Accu-Labs 965-E, is available to facilitate the preparation of the plating solution. This method allows the preparation of the solution in the plating tank, eliminating the need for a mixing tank with exhaust system, and the mechanical mixer.

- Fill the tank with cold water to half the final volume. Add the required amount of Accu-Labs 965-E.
- Add the required amount of Accu-Labs 965-B and 965-C, respectively, and add cold water to final volume.

OPERATING CONDITIONS:

	<u>Range</u>
Temperature*	70-80°F
Average Cathode Current Density	15-50 Amps/Ft ² 1.6-5.4 Amps/dm ²
Average Anode Current Density	30-75 Amps/Ft ² 3.2-8.1 Amps/dm ²
Voltage, as required	6-8 Volts DC

*Temperature above the high limit tends to dull the deposit and encourages the co-deposition of impurities which cause darkening of the deposit at very low cathode current densities.

FUNCTION OF ADDITIVES:

- Accu-Labs 965-B is the main brightener additive and is added as required to maintain brightness and to improve cathode current efficiency.
- Accu-Labs 965-C is added to the plating electrolyte less frequently. It functions as a carrier additive, enhances the grain refinement, and improves the low, as well as the high, current density range of the deposit.
- Accu-Labs 965-C acts as a purifier also, and combats impurities that may be present in the freshly prepared electrolyte which cause loss of coverage and dullness at low current densities.
- Accu-Labs 965-W is used as a surfactant to minimize the harmful effect of impurities that build up during operation and produce gray deposits at low current densities.

MAINTENANCE AND CONTROL

- Metal and free sulfuric acid should be determined by analysis and maintained within a predetermined range. Experience has shown that the cadmium metal content will build if the cadmium anodes are left in the electrolyte during idle periods.
- The recommended use of single 2 ½" diameter titanium anode baskets allows better anode area distribution as opposed to the use of rectangular anode baskets. The rectangular anode basket concentrates too much area for a limited anode rod space distribution.
- To prevent the rise of metal content during idle periods, it is best to remove the anode baskets from the plating solution. If possible, the plating solution could be pumped into a storage tank, pumping out only enough solution to expose the cadmium ball anodes.

- Accu-Labs 965-B and 965-C additives are very stable over extremely long idle periods. Each has a plating rate consumption of 20,000 – 30,000 ampere-hours per gallon. In case of problem, Hull Cell tests should be performed to determine the amount of a particular additive required to produce a fine grained mat to lustrous deposit. The analysis of the solution should be checked before performing the Hull Cell tests.
- Muriatic acid (Hydrochloric acid) is NOT recommended for pickling due to the fact that chloride ions will contaminate the bath and will tend to produce dull, rough deposits. Hydrochloric acid can be used for pickling if there are sufficient water rinse steps before the plating step. The use of warm sulfuric acid pickling solution has performed very satisfactorily for both heat-treated and mild steel parts.

SOLUTION PREPARATION

Equipment

Either the lined plating tank, or any other lined tank, or a tank constructed of fiberglass or polypropylene is recommended. It is also mandatory that the mixing tank is fitted with a mechanical mixer, and is properly equipped with an exhaust or ventilation system. The use of stainless steel tanks should be avoided.

Note: 18.3 ounces of cadmium oxide is equivalent to 16 ounces of cadmium metal. 100 pounds of cadmium oxide requires 70 lbs of 66° be´ sulfuric acid to be dissolved. The “free” sulfuric acid is over and above this quantity. Initially, the electrolyte should be made so that the “free” acid is equivalent to 3.5% by volume in cases of a barrel installation and 4.0% by volume for a rack installation.

The reaction of sulfuric acid with water and cadmium oxide generates a tremendous amount of heat causing mist and spray due to the kinetic energy of the liberated hydrogen gas bubbles. Refer to the method of solution preparation which follows.

To prepare 100 gallons of electrolyte

	<u>Rack Type</u>	<u>Barrel Type</u>
Cadmium Oxide	28.5 lbs	37.5 lbs
Sulfuric Acid	22.5 lbs or 1.5 gal (1.84 Sp. Gr.)	29.7 lbs or 2 gal (1.84 Sp. Gr.)

The above quantities of sulfuric acid are only sufficient to dissolve the cadmium oxide salts. An additional amount in each instance is required to meet the “free” acid content. For the rack type solution an extra four (4) gallons is required. For the barrel type solution, an extra three and one-half (3 ½) gallons is required.

The procedure is as follows:

1. Add 50 gallons of cold water to the mixing tank and turn on the exhaust system and the mechanical mixer.
2. Add the required amount of cadmium oxide in small amounts, making sure that the salt is thoroughly dispersed by the mechanical mixing (cadmium oxide is insoluble in water).
3. In small increments, slowly add the required amount of sulfuric acid, making sure that the dissolving action is complete for the amount of acid added, before making the next addition.
4. When all of the cadmium is dissolved, add the required amount of sulfuric acid to the desired “free” acid percent by volume desired.
5. Allow the solution to cool and add water to final volume. Analyze the solution and make adjustments of ingredients as required.
6. Add two (2) gallons each of Accu-Labs 965-B and 965-C, respectively.

EQUIPMENT:

Plating Tanks:

Plain steel tanks lined with Koroseal or equivalent material are required. Tanks fabricated from plastic material such as polypropylene, fiberglass, etc., are permissible for use.

Cooling Equipment

Heat exchangers or cooling coils constructed of titanium, type 316 stainless steel, graphite, PTFE or similar material can be used.

Slab or cast cadmium anodes are recommended. However, to minimize drastic variation in anode area, a problem inherent with the slab or cast anodes, titanium baskets constructed of perforated sheet (2 1/2" in diameter) should be used to contain cadmium ball anodes.

Rectangular anode baskets are not to be used as a replacement for the recommended 2 1/2" diameter round anode type.

The anodes must be properly bagged to avoid roughness. Anode bag material can be polypropylene or Dynel.

Filtration

Although continuous filtration is not necessary, filtration is desired and the filtration equipment should be constructed of chemically inert material. Piping should be constructed of PVC or CPVC.

ADVANTAGES OF THE ACCU-LABS 965 PROCESS:

- No solvents or chelating agents are needed to produce bright deposits.
- The process is very simple and easy to control.
- The process is versatile, since it can be used both for barrel and rack type plating systems.
- Bright deposits are obtained direct from the plating electrolyte.
- The deposits are very receptive to all types of post treatment, such as bright and iridescent (or olive drab) chromate types.
- The process presents no problem in waste effluent treatment. A simple neutralization of the drag-out effluent with caustic soda and sodium carbonate (soda ash) produces a precipitate of cadmium carbonate. The cadmium carbonate which is insoluble can be filtered and washed then solubilized with the plating electrolyte.

Temperature Control

Often neglected, this is very important in the control of the Accu-Labs 965 process. For the most consistent results, the temperature should be maintained within 75 degree F. +/- 5 degrees. Since considerable heat is evolved during the electro-deposition process, the Accu-Labs 965 electrolyte will require cooling.

The cooling load determination and selection of type of equipment will depend upon the D.C. power source in volts time amperes. Each installation will have to be evaluated before selecting the proper type of cooling method.

HANDLING: Always wear proper personal protective gear when using this and other chemicals; read MSDS prior to use.

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