INTRODUCTION

Novalyte 421-D is a completely cyanide free system, utilizing only one liquid addition agent. It can be used in barrel and rack electroplating systems.

The Novalyte 421-D process utilizes an all-caustic sodium zincate electrolyte completely free of any cyanide bearing constituents. The addition agent was developed to improve the undesirable properties of this type of electrolyte. The use of the addition agent markedly improves the low current density throwing power of the electrolyte, resulting in a fine-grained, semi-bright to bright deposit at cathode current densities normally encountered in barrel plating applications. In the application to rack plating somewhat lower current densities than those utilized in cyanide type electrolytes have to be adopted. Zinc deposits obtained from the Novalyte 421-D process have excellent base-metal adhesion, good lustre, and ductility. These zinc deposits can be subsequently chromate treated, phosphated, or post-treated with organic type finishes.

SOLUTION COMPOSITION

<table>
<thead>
<tr>
<th>Constituent</th>
<th>Concentration</th>
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</thead>
<tbody>
<tr>
<td>Zinc Oxide</td>
<td>1.5 - 2.0 oz/gal</td>
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<tr>
<td>Sodium Hydroxide</td>
<td>10.0 - 14.0 oz/gal</td>
</tr>
<tr>
<td>Novalyte 421-D (Rack Plating)</td>
<td>0.75 - 1.25% by volume</td>
</tr>
<tr>
<td>(Barrel Plating)</td>
<td>0.5 - 1.0% by volume</td>
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OPERATING CONDITIONS

- Temperature: 60° - 90°F
- Average Current Density - Cathode: 2 - 40 ASF
- Average Current Density - Anode: 5 - 60 ASF
- Voltage: 6 - 12 Volts
- Anodes: Special High Grade 99% purity

SOLUTION PREPARATION

The electrolyte should be prepared in a clean storage tank or treatment tank equipped with a mechanical mixer. If such tanks are not available, the solution can be prepared in the thoroughly cleaned plating tank. It is again desirable to have some means of mechanical agitation.
Procedure*

Note: Agitation plays an important role in the proper preparation of aqueous solutions of zinc oxide and sodium hydroxide. For this reason, the use of agitation with wide impeller blades is desirable for the efficient dispersion and dissolution of the zinc oxide.

1. Fill the tank with water to one-third the final volume.

2. Carefully add the required amount of caustic soda to water and agitate until the material is in complete solution.

3. Prepare a water slurry of the required amount of zinc oxide using one gallon of water for each pound of zinc oxide. Complete wetting out of the zinc oxide must be effected before adding the slurry.

4. Carefully add the slurry of zinc oxide into the caustic solution, preferably into the vortex of the agitated solution. The solution will appear to be milky at this point but should not show evidence of agglomerated zinc oxide particles. With the agitator in operation, add the required amount of water to bring to final volume.

Note:
(a) Solution should be clear with a minimum of insolubles. The amount of sludge will vary depending upon the grade of zinc oxide and caustic soda used, as well as the quality of water.

(b) The grades of zinc oxide will vary in physical characteristics such as, particle size, shape, specific surface, bulk density and absorption. Grades of zinc oxide with small particle size (0.12 - 0.20 microns) and 99.5 - 99.9% purity (lead free) are recommended.

(c) It is normally not necessary to carbon treat or electrolyze the prepared solution prior to use.

(d) Allow the solution to cool down to the operating range before making addition of Novalyte 421-D.

(e) It is important to recognize that additions of caustic soda to the water during the preparation of the plating bath will cause the temperature to rise, and some caustic spray will evolve during this operation. For this reason, the solution operator must be adequately protected with suitable protective facilities, including eye goggles and gloves or gauntlets.

FUNCTION OF CONSTITUENTS

Zinc Oxide

The zinc oxide is used as the source of zinc ions during the preparation of the original bath. Thereafter, it is not generally required.

* See Appendage at the conclusion of this bulletin, for Method II.
Sodium Hydroxide

The caustic soda enables the zinc oxide to form zinc ions in aqueous solution and serves to increase the conductivity of the electrolyte. It also enables the zinc metal to produce zinc ions at the anode. It is extremely important to maintain the caustic soda content in the desired range to prevent anode sludging.

Novalyte 421-D

The deposit obtained from the zincate solution in the absence of any addition agents is dark and powdery. The addition of Novalyte 421-D brightener produces a smooth, uniform, adherent and brilliant deposit which has a slight yellow-brown cast on the surface. This cast can be removed either by a dilute nitric acid dip or by the application of a conventional acidified chromate solution. The deposit is smooth and reflective at all current densities below approximately 100 amperes per square foot, or 10 amperes per square decimeter, when the concentration of Novalyte 421-D in the plating solution is about 3/4 to 1.0% by volume.

Excessive amounts of Novalyte 421-D can cause darkening of deposit on bright chromating. When normal additions of the addition agents fail to produce the desired results, it is recommended to check the solution composition, cleaning cycle, and other factors rather than make unnecessary extraneous additions of the brightener.

Operation of the bath at the upper limits of the temperature range or higher, usually increases the consumption of this addition agent and may reduce the lustre of the deposit.

The Novalyte 421-D has good clarity and can be used with automatic dispensers. Stock solutions of the brightener can be made in any concentration by diluting with water. It is recommended that all additions of brightener be diluted with water before introducing into the plating bath.

SOLUTION OPERATION AND CONTROL

Zinc Metal Concentration

The operating range for the zinc metal concentration should be chosen for the given application after specific operational experience. Anode dissolution will generally maintain the metal content, again operational experience dictates the addition or removal of anode area. Drag-out characteristics have a marked effect on zinc metal content and should be considered in cases of decreasing zinc metal concentration.

Where the plating bath is idle for several days or more, it is recommended to remove the zinc anodes from the tank in order to prevent undue increase in zinc metal concentration.
Sodium Hydroxide

The operating range for the caustic soda concentration is 10-14 oz/gal. Lower concentration means lower conductivity of the plating solution and slower the attack of caustic on zinc anodes during idle time. The reverse is true at higher concentrations of caustic soda. Losses that occur in caustic soda content during bath operation and idle periods must be replenished upon analytical results to maintain the ratio selected. Adequate concentration of caustic soda in the bath should be maintained at all times to promote proper zinc anode corrosion and solution conductivity.

Cathode Current Density

Current density in barrel work is difficult to determine due to many factors such as surface finish of the parts, bulk density of the parts, tumbling characteristics, etc. An average current density of 7 to 8 ASF is considered normal, and the range can extend from 5 to 15 ASF.

The current density range in rack plating will depend on many factors. The major being the fact that the high current density range of Novalyte 421-D is much lower compared to conventional cyanide type baths. Hence, in rack application, the plating parameters must be selected accordingly.

Anode Current Density

The anode current density range varies from 5 to 60 ASF. Under normal operating conditions the anodes should have a smooth, electro-polished appearance. At low and very high current densities the anodes appear dark and unpolished. An anode current density of 20-30 ASF has been found to be more appropriate.

Temperature

The recommended range is 65°F - 95°F. The optimum operating temperature within this range should be selected after operational experience and maintained there for consistent results. The temperatures at the low end of the range lower the permissible high current densities. The temperatures in the high end permit higher current densities. The temperature is also dependent in the zinc metal concentration and the Sodium Hydroxide: Zinc ratio.

Voltage

A direct current source is recommended with voltage control over the upper two thirds of the output.

Anodes

Special high grade anodes of 99.99% purity are recommended. Ball anodes or segmented anodes are preferred. Rolled or cast anodes too length are normally not recommended due to greater difficulty in maintaining constant area. Steel or titanium containers can be used. However, titanium baskets are preferred.
EQUIPMENT

Tanks

Unlined tanks of steel may be used if electrically isolated. PVC type linings are highly recommended to prevent stray current problems.

Coils

Heating and cooling coils can be constructed of plain steel. Exchangers made of stainless steel, Karbate, Duriron and titanium are highly acceptable. Lead or copper equipment must be avoided.

Ventilation

No serious problems have been encountered in practice. However, if the plating bath is not maintained at its operating level some caustic spray could develop. Though this spray could be reduced considerably by using the Novalyte 421-W Wetting Agent, a suitable ventilation system is recommended for such abnormal situations.

Filtration

Filtration equipment should be constructed of plain iron. Brass, copper, or bronze fittings should be avoided in the circulation system.

CONTAMINANTS AND THEIR REMOVAL

Inorganic

The removal of inorganic impurities is necessary to maintain the quality of the deposit, especially where bright dipping or chromate treatments are used.

Low current density electrolysis will remove many of the metal contaminants which are soluble in the alkaline medium. Metals which do not form alkali-soluble ions are normally precipitated out and can be filtered out.

Organic

When a build up of organic contamination occurs due to ineffective removal of oils, greases, etc., during the cleaning operation, a periodic treatment with activated carbon is usually effective in removing such organic contamination.

CLEANING AND PREPARATION OF BASIS METALS

The cleaning and preparation of basis metals is any electro-deposition process is of paramount concern. Without chemically clean basis metal surfaces, it is very difficult to obtain deposits with good adhesion and ductility.

Low carbon steel surfaces, when properly prepared, can be plated normally without difficulty. On the other hand, high carbon steel surfaces with attendant oxide and heat-treatment scales, introduce problems unless properly cleaned. Carburized surfaces produced by any of the methods in
commercial use, as well as, nitrified surfaces, present the most difficult problems in the proper cleaning techniques to use. These surfaces pose the situation of both improperly pickled or over-pickled conditions in the acid treatment of the parts to be plated.

Automatic plating machines are usually not designed to include acid pickling stations with enough total immersion time capable of removing many of the scale conditions encountered with heat-treated parts. The use of proper inhibitors is highly recommended for both muriatic acid and sulfuric acid pickling solutions to minimize over-pickling of heavily scaled or rusted parts. Aldac K-3-P inhibitor has been developed for this purpose which does not require an anodic cleaning step following the rinse after pickling.

Zinc plating from all-zincate electrolytes utilizing the Novalyte 421-D system has shown to present no difficult problems other than those usually encountered in commercial operations. Gray iron and malleable iron are difficult to plate due to the amount, form, and distribution of graphite and other constituents.

**NON-WARRANTY**

Due to numerous factors affecting results, all Aldoa products are offered purchasers with no guarantee, expressed or implied, as to results obtained or to the effects derived from such use. Aldoa guarantees only as to formulated quality upon shipment from our plant.

**APPENDAGE**

**PREPARATION OF ELECTROLYTE- Method II**

1. Thoroughly clean the plating tank and fill it with water to one third the final volume.

2. Carefully add the required amount of caustic soda to water and agitate until the material is in complete solution.

3. Add sufficient amount of zinc balls in each anode basket and hang as many baskets as possible on anode and cathode bars, and even on the end walls of the tank, such that the zinc balls completely immerse in caustic solution. Sufficient amount of zinc balls will dissolve in 24 to 48 hours. Fill tank to just below the final volume with water. Fill baskets with zinc balls and hang them on the anode bars (remove all other baskets) such that the anode area is sufficient to give anode current density of 15 - 30 ASF. Add brightener and commence plating.