Some Production Plating Problems & How They Were Solved—Part 18

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These stories were collected and edited by Walter H. Wade, of IBM, in Endicott, New York:

1. Identifying aluminum alloys

a. Distinguishing aluminum from magnesium

Magnesium is more active than aluminum. If these are the only two metals in question, add a drop of 1 to 2% silver nitrate solution [$AgNO_3$) to a clean spot on the metal. If the metal is magnesium, the spot of contact will turn black. Aluminum gives no reaction.

b. Estimation of approximate copper content of Aluminum

A 50% potassium hydroxide (KOH) solution attacks aluminum and its copper alloys. The copper residues from this reaction are black. The extent of darkness of an area tested can serve as a guide to the copper content.

Add 50% KOH to about one square inch of sample. After about 60 sec, wash off the KOH solution. If the spot tested on the material is shiny, the sample contains little or no copper (less than 0.2%). Alloy 1100 is an example of such a material. If the spot tested is just slightly dirty in appearance, the sample contains a small amount of copper, about 0.3%, as typified by alloy 6061. If the spot tested turns black, the material is a high copper-aluminum alloy such as alloy 2024, which contains 3.8 to 4.9% copper.

2. Anodizing thickness and racking problems

In anodizing, an unusually long time was required to get the desired thickness on all parts. Some similar parts being anodized together required much more time than others for equivalent anodizing. Parts were strung on aluminum hooks on titanium racks. A 10V drop was found to exist between the cathode bar and the titanium rack. It was also found that gassing or agitation floated some parts enough to break contact. The remedy was to use aluminum racks and to anchor the parts.

3. Wintry chromium conditions

During the severe cold weather in January 1968 (-29°C; -20°F), milky chromium was electroplated from a bath that appeared to be in good working condition. The temperature of the tap water rinse prior to the chromium was 4°C (40°F) because of the unusually cold weather. The normal temperature of tap water is 16 to 21°C (60 to 70°F). The tap water rinse was warmed to 16°C (60°F) and the problem disappeared.

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4. Liquid concentrate versus dry copper cyanide additions

The addition and relative insolubility of cuprous cyanide (CuCN) to the alkali cyanide copper bath presented a difficult problem particularly where production schedules were heavy and excessive downtime could not be tolerated. Copper cyanide is insoluble in cold and hot water, but soluble in ammoniacal solutions and solutions where complexation occurs, *e.g.*, in solutions of considerable excess cyanide (CN^-), either as KCN or NaCN. In most Rochelle, high efficiency and proprietary baths, the excess cyanide is only slightly greater than that required for CuCN complex formation:

$$CuCN + NaCN \rightarrow NaCu(CN)_2$$
$$NaCu(CN)_2 + NaCN \rightarrow Na_2Cu(CN)_3.$$

Solubility is further inhibited by the saturation level of the solution.

Therefore, supplementary additions of CuCN in correcting bath chemistry were not immediately effective. As a consequence, the line was shut down at the expense of subsequent operations (nickel and chromium) until the bath was corrected to the satisfaction of the plating control laboratory. In addition, finely divided particles of insoluble CuCN suspended in solution would settle on the work, causing roughness.

To remedy this problem, a concentrated solution of $Na_2Cu(CN)_3$ was formulated with copper (Cu^+) at approximately 75 g/L (10 oz/gal) and free (CN^-) preferably lower than 4 g/L (0.5 oz/gal). This, when added to the bath, provided immediate correction, allowing the process engineer to continue his troubleshooting procedure or allowing immediate continued production. This problem was extremely critical on the automated line equipment. In addition solution maintenance reported handling of the reserve concentrate much more desirable and efficient in contrast to weighing a dusty, toxic, CuCN powder for each addition.

5. Roughness problem in cyanide copper.

A high rejection rate was encountered in plating from a copper cyanide bath. Roughness was the primary problem.

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Materials included a large quantity of zinc die castings, but steel parts were similarly affected. Fairly hard tap water was being used to make up and replenish the bath.

In an attempt to correct the problem, a soluble hydroxide was added and the solution was heated to 71°C (160°F) to precipitate the insoluble hydroxides and salts. These insoluble particles settled on the substrate and only aggravated the roughness problem. Filtering the solution was tried but the reaction of the highly alkaline material with carbon dioxide from the air and the geometry of the tank made it impossible to remove sufficient particles from the bath to remedy the problem. The bath was dumped, the tank cleaned and the solution remade using DI (deionized) water for both make-up and bath replenishment. The problem disappeared.

In a prolonged study of the DI water bath, it was also noted that the bath required less KOH because it was being used more efficiently.

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6. Poor adhesion of an overcoat on copper

Copper was electrocleaned in alkaline silicate, rinsed, acid dipped, rinsed and overcoated. The electrocleaner was found to be too hot. The dragout dried on the part before entering the rinse tank. It was not removed by the subsequent rinse or acid dip and rinsing. Soluble silicate can be easily converted to insoluble silicates and silica. The remedy was to decrease the temperature of the electrocleaner.

The same problem in the production of magnetic drums resulted in the coatings having noise spikes caused by granules of SiO_2 under the magnetic coating. In all cases when an alkaline silicate was used, the concentration, temperature and rinsing procedure must be adjusted to give a clean product to eliminate silicate residues, or use a non-silicated cleaner.

7. Control of pitting in sulfamate nickel

In using a nickel sulfamate bath, the efficiency decreased and longer and longer times were required to obtain the standard thickness required. Spotty pitting was observed. Mechanical agitation was being used. The bath was found to contain anode debris.

The bath was put under constant filtration, and the flow rate was adjusted to give a good movement of liquid. The mechanical agitation was eliminated. The anodes were bagged in very closely knit bags. Plating was satisfactory for some time, then pitting started again. This was eliminated with an addition of boric acid. It was advantageous to use a simple wire hoop to evaluate the surface tension of the solution and to make additions of boric acid based on judgment from this test. Plating results have been excellent.

The edited preceding article is based on material first compiled and contributed by Dr. Samuel Heiman, as part of the "Plating Topics" series that ran in this journal. It dealt with everyday production plating problems in the late 1960s, many of which are still encountered in the opening years of the 21st century. Much has changed ... but not that much. The reader may benefit both from the information here and the historical perspective as well. For many, it is fascinating to see the analysis required to troubleshoot problems that might be second nature today. In some cases here, words were altered for context.