P&SF Retrospective

Originally contributed by Ronald Kornosky
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Chromate resistivity

Q: ***What is the electrical resistivity of chromate coatings on zinc? Also, does resistivity increase or decrease with age?***

A: Generally, the resistance of a chromate coating is low, but may vary depending on purity, film thickness and the nature of the process. The *Electroplating Engineering Handbook* (edited by A.K. Graham and published by Van Nostrand Reinhold Co., New York) lists the following figures based on a 100-psi contact pressure: zinc plate, 20 to 50 microhm; zinc plate with clear chromate, 50 to 150; zinc plate with yellow chromate, 100 to 1000; zinc plate with olive drab chromate, 1000 to 2000. Because the chromate film is a complex, gel-like coating, I would expect that, as time goes on, dehydration would occur and the microhm resistance would decrease to some degree.

Explosive cyanide process

Q: We are barrel plating with a low-cyanide zinc bath and experiencing occasional explosions that sometimes break the barrels. Could you explain why this happens and tell us how to eliminate the problem?

A: Because cyanide baths are inefficient, hydrogen gas is evolved at the cathode (work being plated). As with cleaners, a spark will ignite the flammable mixture of gas on the solution surface, causing a pop. My best guess is that your barrels have extremely small perforations. As with many cyanide plating processes, these holes may almost be closed by grease, oil, etc. This could cause a high concentration of hydrogen to build up in the barrel. At this point, a spark may occur at the dangler when the barrel is lifted out of solution. To prevent this, keep the holes in the barrel open and/or make sure the solution level is above the barrel. Also, the dangler should always be free to hang down.

Paint adhesion tests

Q: ***When can a painted part be tested for coating adhesion? Can it be done right off the finishing line or should you wait 24 hours?***

A: Twenty-four hours is certainly a common curing period before testing adhesion. Nonetheless, each company usually writes its own testing procedure, though referee methods are often used, too. For example, ASTM D-3359 spells out adhesion to metallic substrates by the cut tape test. ASTM D-2197 discusses adhesion to smooth panel surfaces using the scrape and parallel groove adhesion tests. D-3359 doesn't give a time limit, but does suggest a mutual agreement between buyer and seller. This would seem reasonable, as the paint may be a waterborne, solvent based, solvent air-dry, powder coating, etc. D-2197 does call for a 48-hour conditioning period at 77°F (25°C) and 50% relative humidity before testing. ASTM D-3359 is a commonly used test because it can be done easily by the customer, on the job site or in the laboratory.

Basket destruction

Q: ***In just one year, our steel baskets containing copper chips in a cyanide copper bath have been destroyed. What's happening and why?***

A: The first thing to look for with a problem like this is solution analysis. It is a fact that cyanide can combine with steel (iron) to form iron ferrocyanides. There is some iron in almost any cyanide bath, even with lined tanks, because parts fall in the solution, etc. By analysis, the free cyanide should be kept up to operating limits. This should keep the copper anode polarization down. In a high-efficiency bath, Rochelle salts (sodium potassium tartrate) or a proprietary additive could be used to help anode corrosion. The free caustic, either caustic soda (NaOH) or caustic potash (KOH), helps keep the bath conductivity up.

In normal situations, plain steel tanks can be used for cyanide copper plating, using care to avoid dead electrical shorts. Some suppliers say that 5% of the anode area should be steel to avoid anode polarization. Is it possible that your "steel" anode baskets are actually made of stainless steel? You could use titanium baskets, but the cost is relatively high.

One other possible cause of the problem is reported by Bill Innes of MacDermid, Waterbury, CT. There could be chloride in the copper plating solution. Chloride may be oxidized to chlorine, which attacks iron. The oxidized iron is then complexed by CN to form $[Fe(CN)_6^{-4}]$.

Nickel for chromium

Q: ***I've been asked to plate horses' bits with electroless or electrodeposited nickel because the usual chromium deposits eventually fail, presumably due to the environment in the animals' mouths. What do you think?***

A: I would expect that most of the chromium failures you talk about are wear related, but it is difficult to answer your question without knowing the exact mechanism of failure. According to a representative of a major nickel supplier, "Bits plated with nickel plus chromium or nickel alone, or bits coated with electroless nickel, should not fail if coating thickness is adequate and adhesion is good. The solubilities of nickel and chromium have been measured in saliva, and the levels are well below those that would cause any health problems."

Personally, I have seen some stainless-steel bits that have really shown a lot of use. Because nickel and chromium are alloyed in some percentage in stainless steel and approved by the FDA for food contact, I feel the main potential problem would be with plating adhesion. P&SF

The edited preceding article is based on material compiled by Mr. Ronald Kornosky, then of Hager Hinge Co., in Montgomery, AL, as part of the Finishers Think Tank series, which began its long run in this journal 26 years ago. It dealt with everyday production plating problems, many of which are still encountered in the opening years of the 21st century. As we have often said, 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.