Finishers' Think Tank

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Plating EN on Cast Aluminum

Q. We are experiencing a blistering problem in plating electroless nickel (EN) on cast aluminum jig plate of unknown alloy—the parts blister in machined and cast areas. We are using the same cycle we have always used with little problem, but now are unable to meet production requirements. What are we missing?

A. A traditional cycle includes the use of alkaline etches on the aluminum parts being processed. It is often necessary to keep the cycle acidic or, at the most, mildly alkaline. Your current cycle is as follows:

- Soak clean in a non-etch cleaner
- Rinse
- Etch in a highly alkaline solution
- Rinse
- Deoxidize with 50 percent nitric acid, 20 percent sulfuric acid and 2 percent HF
- Rinse
- Zincate
- Rinse
- Electroless nickel plate
- Rinse

Some aluminum alloys are very sensitive to alkaline etches, particularly those for which the alloy of the substrate is unknown. These alloys are usually encountered in parts that are of little value, which have been fabricated without considering the fact that they must later be plated.

The best results will be achieved by keeping these alloys away from alkaline cleaners and etches before finishing with EN. The following cycle is recommended:

- Clean and degrease in a low-temperature, non-etch cleaner
- Rinse
- Etch in a 20-percent phosphoric, 3-percent HF etch at 110 °F

- Rinse
- Deoxidize in 50 percent nitric acid, 20 percent sulfuric acid, and 3 percent HF
- Rinse
- Zincate in a modified alloy zincate
- Rinse
- Electroless nickel plate

Keep in mind that the parts must be free from oil and grease, and that the EN must be kept at <75 ppm of zinc contamination. This may or may not be a problem, but I have found that cast alloys seem to contaminate EN solutions rather quickly. Cast aluminum is very porous, and the substrate surface characteristics can cause problems when rinsing the zincate film. I have found that, after the zincate, a rinse in sodium bicarbonate at a pH of ~8.7 is appropriate to cut the alkaline film on the cast surfaces. Double-zincating on this type of poor surface seems to complicate the processing, causing blistering and adhesion problems.

Chromium Conversion Coatings Over Zinc & Zinc Alloys

Q. All the focus on replacing hexavalent chromium conversion coatings seems to be on aluminum substrates. What efforts are being made to find conversion coatings over zinc or zinc alloy substrates?

A. The military and aerospace industries have been hard-hit by the chromium reduction requirements. For that reason, initial emphasis has been on processes for aluminum substrates. Similar collateral work, however, will develop for zinc substrates as replacement processes evolve.

One of the coincident properties of aluminum and other light, non-ferrous metals is the production of an oxide film over the surface that develops as the substrate is exposed to the atmosphere. Research work on aluminum will likely be based on handling that oxide surface, and the results may indeed be transferable to zinc and other materials.

For progress to continue in developing coatings on zinc and other light, non-ferrous metals, it must be recognized that conversion coatings may be acceptable for application over these substrates, and performance-based specifications must be met to satisfy the traditional industries that have required chromated conversion coatings on zinc.

Alternate Systems For Corrosion Resistance

Q. Are there replacements for copper, nickel, and hexavalent chromium that will give the same type of corrosion-resistant results?

A. Yes, there are coatings that will give as good, or better, results as the traditional copper-nickel-chromium system, depending on the application. They are, however, uncommon, so are somewhat unfamiliar and misunderstood. There are no major lines in industry running alternate systems that produce large quantities under controlled conditions. New technologies and applications are generally "trailblazing" efforts made by smaller companies in discreet market areas, on discreet products. The results, therefore, may not be acknowledged by larger markets, such as automotive or aerospace.

Alternative coatings affect platers in two major ways: Economically and environmentally. Hexavalent chromium operations present a problem to the environment because of air and water effluent. There is also a severe OSHA impact to those who come into personal contact with the operating process tanks. Hexavalent chromium, therefore, is problematic and costly, and there is a degree of difficulty and liability associated with the operation.

To expedite the move into alternative coatings, performance-based criteria should be used when writing specifications for products. This would allow alternative coatings to be considered on some of the more common applications, which would increase respectability of the processes, help establish a database, and allow platers to be more creative in their approach. Unfortunately, the safety and security of more common coatings, backed by a large database, make alternatives less attractive to major users in the industry. The downside potential in automotive applications, for example, will usually prohibit the use of a substitute.

There are several aspects that must be addressed by alternative coatings. First, the coatings must meet or significantly exceed current specifications for corrosion resistance. Second, the finish must be similar in appearance to nickel-chromium. (Although viscerally less important, the general public tends to equate quality with a bright chromium finish. Parts with alternate coatings must be able to "blend" with traditionally coated parts.)

Last, but certainly not least, a database must be established for candidate applications. Proponents of such new coatings naturally tend to minimize the downside and maximize the upside potential of their products. This must be balanced by straightforward database information.

In summary, there currently are systems and process sequences that can match the color and meet the corrosion-resistant requirements of standard coating processes. Acceptance of these products for use in common applications is arduous and complex, but imperative. In order to be competitive as an industry, we must make the effort to remove the liability of some of the more dangerous systems and replace them with more benign processes.

Decorative Nickel & Chromium On Steel Vehicle Rims

Q. We are plating decorative nickel and hexavalent chromium on steel, and are experiencing difficulties on motor vehicle rims. Can you supply detailed information for plating steel and aluminum rims?

A. Although this column is not the forum for this type of question, I would like to make some recommendations.

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