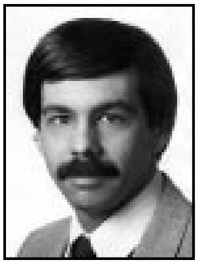
Finishers' Think Tank



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Have a problem on the finishing line? To send your question, use the convenient, postpaid form on our Readers' Service Card, or send a letter to: "Finishers' Think Tank," 12644 Research Pkwy., Orlando, FL 32826-3298.

Q. We zinc plate over Zamac 3 zinc diecast parts. When storing parts for six months or more, they tend to change color to an irregular deep blue. What causes this and how can we prevent it?

A. This problem can be directly related to diffusion. The zinc deposit will diffuse into the diecast component and cause a color change. The diffusion is slow and the problem is insidious, because it may occur long after the part is processed and delivered to the customer. The magnitude of the problem, therefore, may never be known.

Unfortunately, the only real solution is to use a barrier layer (usually a cyanide-based copper strike) on the parts prior to zinc plating. This column does not normally advocate the use of a cyanide solution, but in this case it is one of the only reliable, consistent process types that will provide the proper barrier.

To halt the diffusion, a minimum of 0.00025 in. of copper must be applied. This requirement tends to complicate what would have been a rather straightforward process of plating zinc on a zinc-based substrate.

Q. We process a mix of zinc diecast parts, as well as steel in copper-nickel and chromium. Our nickel tanks inadvertently become contaminated with zinc, causing the corrosion response and the quality of our parts to vary. What can we do to obtain consistent results?

A. In a system such as yours, the contamination level will vary because of the mix of parts, the configuration of those parts, and the operator attention given to removing fallen parts from the tanks.

Perfection is rarely achieved in any multi-sequenced process facility, but a steady-state condition can be attained by monitoring the contaminant levels, examining the quality of the process parts, and addressing a threshold level of contamination. Instead of using electrolysis to remove noticeable contamination in the tanks (as described in your letter), uninterrupted treatment of the process solution is recommended. A continuous off-line electrolysis system should be used that is large enough to handle the worse-case contamination, and it should run constantly to keep the process solutions at peak performance at all times. Batch treatments tend to be counterproductive because the systems must be shut down periodically. They also develop a significant sludge of waste materials that must be disposed of properly. Consistency is the key to maintaining quality.

Preventive maintenance procedures, such as raking the tanks and removing fallen parts, should be performed regularly, and purification techniques must be integrated and/or modified on an ongoing basis. Quality and cost-effectiveness can be improved by enforcing consistent operating techniques and increasing the percentage of time that the system is up and running, thereby adopting a "steady-state" operation concept.

Q. We have occasional adhesion problems when plating nickel on parts made from various base metals. The physical distance between the acid pickle and the nickel process is significant, so the parts are exposed to atmospheric conditions for several minutes prior to plating. What can we do?

A. Whether plating over copper, brass or a ferrous substrate with nickel, the surface should first be prepared by removing oxidation prior to nickel plating. A mild acid pre-dip with enough activity to remove flash rust and mild oxidation should be used, particularly with systems where a great deal of time passes between the preparation cycle and the plating operation.

Because pre-dips are either rinsed with a single rinse or not rinsed at all, the pre-dip solution should be amenable to drag-in to the nickel bath so that the acid does not contaminate the nickel. Pre-dips should be clean and uninhibited—good grades of mineral acids are recommended—and effective at room temperature. They should also be inexpensive because they must be replaced (or purified) often. This last station before the plating tank can be used to collect errant material and prevent it from entering the nickel bath. Some sample pre-dips for steel or iron parts include:

Direct plating of nickel over steel—To remove flash rust that will form on the surface of steel during pre-plate, use a simple formulation of 2 percent sulfuric acid. If the flash rust is excessive, include 1–2 percent hydrochloric acid.

Pre-dip with current—Woods nickel or modified Woods nickel can be used. The electrified Woods nickel will remove flash rust as a chloride and deposit a thin coating of an active nickel on the surface, which will increase adhesion and prevent drag-in of iron to the nickel bath.

Nickel over copper alloys—Whether plating over a copper substrate or over a copper deposit, an acid pre-dip should be used to remove any oxides that form. If the copper was plated from an alkaline bath, condition the surface by neutralizing, which leaves a slightly acidic film. Sulfuric acid at 1–2 percent is usually sufficient to activate and remove any slight surface oxidation prior to nickel plating. Chlorides are more soluble than sulfates, so a small addition of either sodium chloride or hydrochloric acid will help.

Because you are dissolving copper as copper, the oxide and the copper will exist in the ionic form, and the bath will need to be replaced often to prevent drag-in of copper. In addition, the copper in the pre-dip solution may immersion-deposit onto the surface of the parts if the concentration is allowed to get too high, so the solution must be changed often or purified by electrolysis.

Q. What can be done to prevent pH changes during the operation of a cyanide copper strike solution?

A. In alkaline cyanide plating solutions, it is imperative that there is a good distribution of both soluble and insoluble anodes—or no insoluble anodes at all. Insoluble anodes work at low efficiency, so tend to increase the pH of the process systems because of the evolution of hydroxide at the anode surface.

To correct the problem, use soluble anodes with a chemically well-controlled process system. It is important that the anodes do not develop a passivation film—a coating on the anode surface will also decrease the efficiency and the anodes will react much in the same way as insoluble anodes, and will increase the pH of the process system. As a rule, try to keep a fairly high concentration of tartrates in the plating solution to keep the anodes working at maximum efficiency, and to keep the conductivity high so that the solution can be run lean. If the correct configuration and ratio of anodes (2:1 anode-to-cathode) do not control the pH, try adding small amounts of sodium bicarbonate to drop the pH to acceptable levels.

Shop Talk from Marty ...
Watts Nickel Plating

This type of plating solution is probably the most common in North America. It is very versatile and is used in many industries and applications. Nickel deposited from Watts baths contributes to corrosion protection, and is used for decorative purposes because it provides a bright, leveled deposit on many substrates. The components of a Watts system vary in concentration depending on the application and yield differing results, but are generally within the following ranges:

Nickel sulfate—Used to provide nickel metal reserve in the plating bath. It is common, relatively inexpensive and does not cause as much stress to the deposit as other forms of nickel-bearing materials. Nickel sulfate is used in concentrations from 10–40 oz/gal.

Nickel chloride—Used in the Watts bath to help increase the anodic efficiency of the process system, so that organic materials are less likely to be oxidized at the anodes and form potentially harmful by-products. It allows for deposit of nickel in reasonably low-current-density areas, and allows operation of the Watts system at reasonably low temperatures, even with significant concentrations of contaminants in the plating bath. Nickel chloride is used in concentrations from 6–40 oz/gal, depending on the substrate and method of operation. When fuel costs are high, plating baths tend to be run at lower temperatures, so the nickel chloride concentration is kept at higher levels during these times.

Boric acid—Used in the Watts plating bath because of its action as a buffering agent and its reaction as a multi-hydric acid material. It provides a buffering action within the solution surface interface area of the catholyte film. Boric acid is used in concentrations from 5–7.5 oz/gal.

Other significant operating parameters of a Watts plating solution are:

- Current density: 15–60 A/ft^2
- Temperature: 120–150 °F
- pH: 3.8–4.5
- Total nickel (as nickel metal) concentration: 8–12 oz/gal

A Watts bath operating within these parameters should be reasonably successful. The most important factor, however, is to keep the bath clean and free from organic and metallic contaminants.

Most Watts formulations are operated with the inclusion of proprietary additives. Consultation with the suppliers of those additives is imperative to achieve appropriate results. Beware, however, of materials that are touted as purifiers or that allow you to operate at high levels of contamination. Purifiers usually sacrifice something in leveling or brightening of the deposit. The most effective and efficient method of dealing with contaminants is not to have them in the bath in the first place.

Air or mechanical agitation is also a very important element in a Watts nickel solution, because the catholyte film on the deposited surface tends to deplete with metals and the pH of the film changes rapidly, so the film must be replenished just as rapidly. Higher current densities are possible when the agitation is rapid and the solution interface changes at a high rate. Air agitation is the most common method employed by electroplaters, but solution sparging and mechanical movement of the parts are also commonly used in the industry. **P&SF**