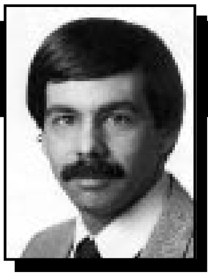

Finishers' Think Tank

Marty Borruso • 26 Flagship Circle • Staten Island, NY 10309
Phone 1-500/FINISH1

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.

Barrel Plating Small Parts

Q. We currently deposit decorative bright nickel and chromium onto brass and copper components. We would also like to finish our small parts with a barrel-plating technique. Is there a way in which we can process small parts in a barrel to resemble the components we currently plate on a rack process system?

A. As far as I have seen in the field, there have been no successful applications of chromium from a standard chromic acid plating solution to yield an acceptable deposit onto parts in a barrel on a production basis. There are, however, alternatives if your application is indeed purely decorative, and if the specifications you have to reach are not too severe.

In the past, bulk processing procedures have been emulated using basket plating techniques. The first time I saw this was in a plating shop in Manhattan in the early '60s. They had been performing the same jobs since World War I, and were successful in their application.

There have also been reports of successful application of trivalent chromium solutions over bright nickel in barrels, although I haven't seen any facilities actually performing that task. I have, however, seen samples from the major purveyors of trivalent chromium systems, and contacting them may yield you some benefits.

Several chromium substitutes that have entered the market, such as nickel-tungsten and cobalt-tin alloys, have been reported to offer some corrosion resistance with a similar color to chromium—these may be adaptable to your application. Because these solutions are early in their development, much investigation must be made before commitment to specifying such a system.

A good group to contact for reference is the U.S. EPA, which has funded several studies on chromium replacement technologies. The Office of Research and Development in Cincinnati is enlightened in its approach to the new regulations and environmental specifications. The establishment of manufacturing centers should also help the industry to make such decisions, and also should help aid in industrial pollution prevention programs.

For more information on whom to contact at EPA, please call or write my office.

Zinc Alloy Deposits

Q. We deposit a zinc-nickel alloy in a barrel plating operation and are having problems with color variations when chromating. How can we reduce that effect?

A. Zinc alloy deposits offer unique properties, with an opportunity to attain special effects that can provide different corrosion-resistant properties than can be found in either metal when deposited individually. Zinc-nickel alloys have shown superior corrosion resistance for some applications, and are in ever greater demand. To understand how to fix the problem, however, you must first understand how the alloy deposit is created.

Metals in alloy baths deposit at different rates depending upon several factors, which influence the deposition potentials of the various metals and create different alloy compositions from the same solution. To achieve a uniform alloy it is important that you bring closer together the deposition potentials of the zinc and nickel constituents. To accomplish uniform alloys, complexers, relative concentrations, metals ratios, temperatures and agitation factors are used to equilibrate the alloy structure. The concentrations of the materials in the plating bath are important because, at different levels of materials, the alloy will deposit differently. Most of the new alloy deposits depend on the operation of the plating baths at relatively low metal concentrations. At low concentrations, most metals behave similarly and the effects of the deposition potential differences are minimized.

The relative concentration of the materials is also a factor, because mass effect of the component concentrations can influence the alloy. If you increase the concentration of nickel, for instance, although not linear, the nickel concentration in the deposit will probably increase, relative to the zinc in the alloy.

Other parameters that have an influence on the alloy composition are current density and, consequently, voltage of operation. An increase in voltage will generally increase the nickel composition of the deposit. Temperature is also a consideration, because as the temperature of the plating solution increases, it tends to affect the way in which materials deposit from the process. Higher temperatures change the efficiencies of the metals, which will affect the alloy.

A final area to investigate when attempting to correct an alloy distribution problem is the agitation of the plating solution. Generally, individual metals react differently because of the agitation of the solution, and materials will plate out at different rates. In a barrel, therefore, a significant factor in the alloy distributions is the rotational speed of the barrel, as well as the current density of application.

Color variation of chromated alloy-plated parts depends on the distribution—the chromate response will react accordingly. A reduction in alloy distribution must be made to reduce the color variation. We are, therefore, focusing on *function* over *form* on zinc alloy-plated components, because the color and uniformity of the chromated coating of alloy-plated components will never emulate the chromates on zinc plate because of the influence of the alloyed materials. Once this is accepted, the job will be more achievable.

Heat-treating Electroless Nickel

Q. We plate electroless nickel and yield a deposit that gives a high degree of hardness, but sometimes gives mixed results when heat-treated. What particular factors are most important when deciding on heat-treating electroless nickel solutions to produce a consistently hard deposit?

A. This is an interesting question, and the following information concerning these issues is from an article by Dr. Martin Bayes of Shipley Corp.

The physical characteristics of an electroless nickel deposit are intimately associated with the composition of the deposit. As a result, there must be a qualification of the general process systems currently available.

A high-phosphorus electroless nickel bath yields phosphorus concentrations in the deposit of more than 10 percent; a medium-phosphorus system yields around 7 percent; and a mid-low bath yields about 5 percent. A true low-phosphorus bath is below 3 percent. The properties of these systems depend on both the phosphorus content of the deposit and the chemistry, as well as the rate of deposit of those systems to cause the characteristic phosphorus content.

Tests were carried out to determine the relationships. It was concluded that the as-plated hardness of electroless nickel increases with decreasing phosphorus content, ranging from 500 HK_{100} to 700 HK_{100} for commercially available systems. The maximum heat-treated hardness for electroless nickel also demonstrated a similar relationship to the phosphorus content. A point to consider, however, is that the time low-phosphorus deposits take to reach the maximum hardness becomes progressively shorter as the phosphorus content is reduced, but conversely, low-phosphorus deposits rapidly lose hardness beyond the peak value when treated at 400 °C or more. Deposits containing less than 4 percent phosphorus, for example, show maximum hardness at times of 30 min or less when heat-treated at temperatures of 400 °C or above. Heat-treating temperatures of 340–375 °C for times between one and two hr seem to cause hardness without the risk of loss of hardness.

There are additional variables that are controllable in an electroless nickel process system. Because of the differences in the general deposit chemical and physical characteristics, the plating solution parameters, the consistency in operation and the basic chemical formulation of the plating solution, customized heat-treating regimens must be addressed. Modifications to what heretofore has been normal heat-treatment practice may need to be changed to yield the desired results. When you have a choice of proprietary plating solutions available, you can have both positive and negative effects. As far as hardness and phosphorus are concerned, less may be more, but that must be tempered with the proper testing and controls.

For a reprint of Dr. Bayes' detailed article, please contact my office.

❖❖❖

Shop Talk From Marty ...

Pollution Prevention—Contingent Liability: Regulatory Inspections, Compliance, Sedatives, Antidepressants & Antacids

Contingent liabilities are associated with liabilities that result from waste and waste management. Because pollution prevention programs are targeted at reducing or eliminating materials from being discharged from a facility by default, they reduce the effect of contingent liabilities.

Those liabilities may or may not be quantified in direct costs of operation, but they may be embedded in the approach to the problems of discharging materials to the environment. Is my equipment working properly? Am I having an excursion? Should I take on that other job? What happens when we increase production? These and other decisions are based on that ephemeral quality of contingent liability.

Insurance costs and the ability of actually getting insurance that addresses environmental issues are concerns for a company's contingent liability position. Keep in mind that the Securities and Exchange Commission requires that public companies disclose and reasonably quantify probable set-asides to cover these potential costs. Liability estimates, therefore, have serious implications for the economic flexibility of a firm. Can we spend capital for new or better equipment, or do we have to reserve those funds to cover contingent liabilities that may or may not occur in the future?

As we enter into the next century, the contingencies presented by our operations will play even greater roles in how we view our companies and our investments—and how actuaries view our insurance. Unfortunately, those employing pollution prevention in their plants are the trailblazers, and will be viewed in association with those who don't employ those techniques to eliminate discharges and retain their process systems for use and reuse.

To truly incorporate pollution prevention decisions in our operations, we must validate the results and the impact they have on our costs of operation. Pollution prevention is a concept that must be addressed and embraced, and its results and benefits publicized. The employment of pollution prevention techniques, if handled properly, will affect how our industry will grow and prosper. As we travel the road of development, it will become more and more obvious how pollution prevention will affect operational costs. ❏