# *Plating & Surface Finishing* Retrospective

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*Based on an original article from the early "Finishers Think Tank" series*
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## Reject: chromate on zinc

**Q:** We received an order from a customer marked "Plate zinc, chromate bright luster finish." We had always plated a blue-bright finish on their parts and assumed they wanted the same on this order. The shipment was rejected because it was blue bright and was expected to be near the color of nickel/chromium. I've never heard of the term they used, have you?

**A:** As you know, most zinc plating is specified by government spec, class, type, hardware or commercial plate with or without a specific chromate. Since we spoke and found the problem to be a matter of wording, and since the product was bright, had sufficient zinc plate and a blue chromate without any iridescence, the only answer would be to ask your customer for a sample to match. Is he talking about a chromate and leach or perhaps chromate and a blue dye? Has any reader heard of the term to which the inquirer has referred? If so, would you please share your information with us?

## Electroforming with nickel

**Q:** We are planning to electroform using nickel sulfamate (2000 gal). The tank has dual compartments and the electrolytic purification (EP) or "dummy" section is 20 × 40 in. We plan to use one anode and one cathode bar with a 316 stainless-steel corrugated sheet approximately 12 in. wide and 36 in. deep. Titanium baskets (2.5 × 6 × 36 in.) using round anodes containing a small amount of sulfur will be placed in the EP section. Deposition will be carried out at 3.0 A/ft$^2$ (0.33 A/dm$^2$). Can you foresee any problems?

**A:** Nickel sulfamate can give you the lowest internal stress of all nickel baths without using any addition agents, but metallic impurities still may present a problem if allowed to build up. Pitting, poor adhesion and brittle deposits may result.

On your setup, I would use plain steel corrugated sheet because it will be coated with nickel relatively quickly and should provide for better adhesion. For good agitation, which is necessary to preclude anode polarization, I would use the filter in the tank to discharge into your EP section, and then overflow back to the main tank. I would also go to a current density of 5.0 A/ft$^2$ (0.54 A/dm$^2$) so that the recessed areas in your cathode would receive about 3.0 A/ft$^2$. Too low a current would give little if any plate in recessed areas.

Care must also be taken to make sure that any rough deposit isn't washed off and returned to the electroforming tank. Roughness could develop. Occasionally turning the current up to the deposition range for a couple of minutes will cover the burnt and rough deposit with a fresh layer of nickel so it can't slough off. Two anodes, one on each side, would also keep the current density of your corrugated dummy sheet equal.

## Hobby problems with copper

**Q:** I have two questions regarding the plating of nonconductors. One, as a hobby, I copper plate in a sulfuric acid bath. Even with agitation, low voltage and a chemical preventative, I still get "treeing" and spots with no copper deposit at all. What else should I be doing? Two, is there a safe, low-cost, small-scale method of depositing electroless copper?

**A:** There are several good books on plating for people doing it only as a hobby. One of the better ones is *Electroplating and Electroforming for Artists and Craftsmen*, by L. Newman and J. Newman (Crown Publishers Inc., New York, NY, 1979).

The first of your problems may be the chemical balance of the bath. This should be checked first, in conjunction with chemicals to prevent treeing. Several proprietary products are available and their names will be sent to you. Spots with no electrodeposit could be the result of incomplete coverage with the conductive coating or perhaps the process you are using is incorrect for the application or simply not properly applied.

Was the work clean before plating? Was there "really" sufficient agitation in the bath? If the only areas that failed to cover are deep recesses, then the covering power of your electrolytic bath may be less than it should be. A longer plating time may help. Again, you may not be applying the deposit correctly after you have made the part conductive. For example, you may be using too high a voltage the first two or three minutes in the electrolytic bath.

Any electroless copper bath is safe if proper precautions are used, in spite of the bath being poisonous. Enclosed are some formulas for electroless copper that are homemade, but work. They lack the sophistication (stability) of the proprietary baths and perhaps plating speed, but are inexpensive to make up.

*[Such a Q & A would be exceedingly rare today – Ed.}*

## Plating on silicon

**Q:** Do you have any knowledge of plating nickel and/or rhodium on silicon? Where can I get some process information?

**A:** One source of information is the *Electroplating Engineering Handbook*, by A.K. Graham (Van Nostrand-Reinhold Co., New York, NY). [A later 4th edition, *Graham's Electroplating Engineering Handbook*, by L.J. Durney, was published in 1984.] The book lists two cycles. The first suggests the following: degrease; etch in 44 vol% nitric acid (70%), 18 vol% hydrofluoric acid (48%) with a balance of water; provide another etch in concentrated hydrofluoric acid (48%) for 10 sec; and electroless nickel plate in an alkaline bath. Note that rinses should be used between each step.

The second cycle consists of soaking for 1 min in a fluoride/citrate nickel bath, and then applying current to deposit the metal. At the conclusion of each of these cycles, the part is covered with a conductive coating and can be plated with anything over it.

## High reject rate?

**Q:** We manufacture and finish decorative trim for the appliance industry. For quite some time now, we have had a problem with vendor-defective raw materials. The majority of these defects are undetectable until after the finishing process. This presents quite a problem because, at that point in the production cycle, we have approximately 95% of our cost in the goods. Does the AES maintain industry figures as they pertain to reject percentages after the finishing process? I'd like to find out if our reject rate is excessive.

**A:** The AES does not record the kind of figures you are seeking. However, *P&SF*'s Technical Editor Bill Safranek [in 1982] has some interesting comments, as follows:

"The problem you describe appears similar to that facing the International Lead-Zinc Research Organization (ILZRO) about 1966 when several users of zinc die castings asked the organization to research ways and means of detecting flaws in castings before an investment was made in finishing, the cost of which is typically greater than that of fabricating the die casting. During the course of the research project, it was determined that casting defects consistently outnumbered plating defects by a wide margin. However, the proportions varied from plant to plant.

"After many potential inspection procedures were explored in some depth, it was evident that the most cost-effective method was visual - provided the lighting level was enhanced. The enclosed copy of Chapter 4 from *Finishing and Electroplating Die Cast and Wrought Zinc* [by William H. Safranek, American Zinc Institute, 1973] details the degree of enhancement. Another source cited quantitative data on the number of castings rejected at inspection points before and after plating. Visual detection with improved lighting again was very effective for ferreting our many defective castings before plating.

"After the paper was presented, the company began a program aimed at improving the quality of their castings. Subsequent reports showed that when lighting was enhanced, the result was a considerable improvement in quality when casting practice was upgraded to eliminate defects.

"Perhaps good lighting for inspection can be looked upon as the nail in the nursery rhyme that was responsible for the loss of the shoe, the horse and ultimately the kingdom. Poor lighting is a business risk!"

## Mirror anodized finish

**Q:** I would like to anodize a product to produce a mirror-like finish with the fewest possible steps. What would you suggest as a possible cycle?

**A:** I was happy to learn during our discussion that the parts are hand sized. This should be better because the flat area is relatively small. Buffing with a suitable wheel and compound should give a mirror-like finish. A short (but adequate) cycle of cleaning, desmutting and, finally, bright dipping before anodizing would be best. Ultrapure and special alloys of aluminum are available to provide the best possible finish, so this should be taken into account during the selection process.

## Black finishes

**Q:** With all the energy research going on in the area of black coatings, what wou1d be the best-black chromium or nickel-to use over steel for a decorative finish?

**A:** Both processes are of the electrolytic variety. The nickel process usually consists of a nickel-zinc or nickel-tin alloy applied at low current density. Therefore, you get a thin deposit. The black chromium is a mixture of chromium and oxides and is applied at high current density, but at low deposit efficiency. The biggest problem with black chromium may be in the current-density range because the low-current areas may not cover, and the result is "nickel show."

A simple and less expensive process would be the black caustic type. It can be used directly on steel without current because it is a chemical and not an electrolytic process. Surface preparation would still have to be done in all cases, and, depending on the corrosion protection desired, a clear epoxy lacquer might be needed as a final finish. There are several proprietary compounds to blacken steel directly.

## Copper anodes

**Q:** In our small shop, we refinish all types of items mainly with copper, brass or bronze, and buff or blacken. In order to save on anodes, would it be possible to use the same anode for all three baths if rinsing were done in between?

**A:** The logical choice would be OFHC copper anodes, either in slab form or in pieces in a steel basket, because all the baths you have are cyanide based and contain copper. The slabs should result in better rinsing than with baskets, but, to keep the same alloy color in brass and bronze, the zinc and tin would have to be added as salts to replace those lost during deposition. This also would require a little analytical work.

## Activating Kovar

**Q:** What, in your opinion, is the best method of activating small Kovar parts in a barrel operation prior to nickel sulfamate plating?

**A:** That would depend on the condition of the parts. But, since the alloy contains 29% nickel, 17% cobalt, 0.2 to 0.3% manganese and approximately 53% iron, it should be treated about like stainless steel or nickel. The usual shop soils should be removed with an alkaline cleaner, keeping the reverse-current time to a minimum.

Rinse, activate anodically in a Woods nickel strike at room temperature for 2 min at 30 A/ft$^2$ (3.0 A/dm$^2$), then reverse polarity to make it cathodic at about 30 A/ft$^2$ for approximately 6 min. Rinsing is required if sulfamate nickel is to be plated, and live entry should be used.

Some success has been reported using the Woods nickel strike without the anodic treatment. Proprietary chemicals also are available to activate nickel-containing alloys. In a barrel operation, the current density for activating should be as high as possible and perhaps longer than that indicated above. A bright dip before plating in 74% glacial acetic acid, 24.5% nitric acid and 1.5% hydrochloric acid should brighten the material between cleaning and plating but is optional.

Others have reported successfully using anodic then cathodic cleaning in lieu of the Woods nickel, but the strike process is surefire.

## Drying blind holes

**Q:** We zinc plate manifold blocks about 1 in. (2.54 cm) × 1 in × 3 in. (7.62 cm) that have blind holes. After plating and rinsing, we use a spin dryer and then allow the parts to dry further by just exposing them to ambient air. Despite this type of drying, not all the solution comes out of the part. The result is that residual chemicals remain in the holes and we get staining and corrosion in those areas. What suggestions do you have?

**A.** Blind holes have always been a problem for metal finishers. Ultrasonic treatment would remove the entrapped solution but since you have a high-volume, low-cost item, that may be an expensive route. You might try alternating hot- and cold-rinses if feasible.

Longer rinse times in conjunction with a wetting agent in the solution may also help. Another avenue might be to heat the part in near-boiling water and then use a heated spin dryer. If you could get the temperature of the metal near the boiling point of water, the trapped solution should dry, leaving behind only dry salts, which will not bleed out.

*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.* **P&SF**