Some Production Plating Problems & How They Were Solved—Part 3

By Dr. Samuel Heiman
Updated by Dr. James H. Lindsay, AESF Fellow

Tecnical Editor's note: *By the time of publication of the third part of this question-and-answer series, Dr. Heiman's efforts were becoming increasingly popular, as evidenced by his opening remarks:*

Your editor wishes to thank those who have contributed signed or anonymous stories to this department. I should be glad to receive more of these case histories which may be in story form or in filled-out questionnaire form. Examples of both types are given in this column.

If any reader can produce or gather a sufficient number of stories to fill an issue, he would be welcome to serve as a guest editor of this department for that issue. [And that would be no less appropriate in this year, 2003—JHL.] There is certainly no dearth of material; it is a matter of overcoming the inertia of gathering or writing up the material, which almost everyone in production has.

Discussion is invited on any case history published. Remember, however, that the writer often did just the minimum to solve his immediate problem … no more, no less. He was usually not trying to prove any specific thesis or make an exhaustive study of the subject.

Based on an original article from the "Plating Topics" series [*Plating*, **53**, 110 (January 1966)]

1. Chromium Plating: Poor Adhesion—The Case of the Curly Chromium

For weeks we had been successfully chromium plating small experimental molybdenum parts with a proprietary crack-free deposit. A shipment of larger, but similarly shaped, parts was received. A large audience of engineers and managers was present as the first batch came from the tank. Instead of a smooth silky white deposit, our startled eyes beheld plate that was cracked and peeling away in curls.

The chromium solution was analyzed, superheated and stirred to insure solution of sufficient catalyst. More cracks and curls. We systematically started through the cleaning line; the abrasive in the vapor blaster was changed … no change. The electrocleaner was changed … still bad plate. New electropolish solution installed … no luck. Clean acid dip made … no help. All temperatures were carefully checked and controlled. The rinses after the acid dips were cold, pumped directly from deep wells and kept running to prevent sulfate drag-in to the chromium tank. The rinse temperature was a steady 14°C (58°F).

Finally, because everything else had been tried, we heated the final rinse before chromium plating. It worked! The new parts, though only twice the area, were about eight times the mass of the smaller part. The long dwell in the 14°C rinse lowered the temperature of the parts, causing a local chilling of the chromium solution, resulting in an initial cracked deposit with poor adhesion. As the deposit thickened, tension increased, ending in curly chromium.

Contributed by Sagittarius

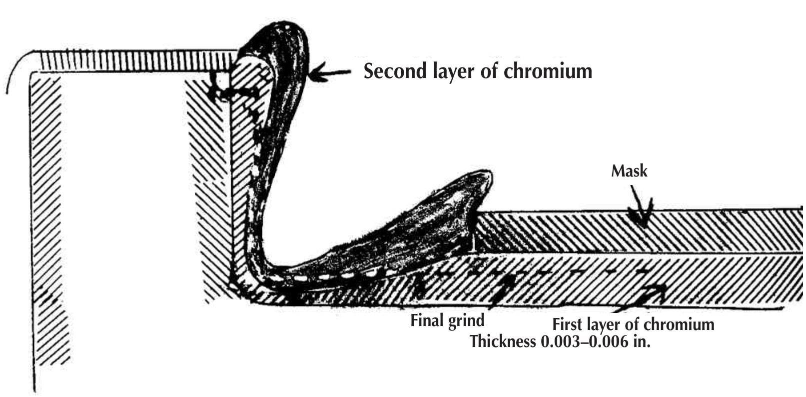

Fig. 1—The problem was to deposit enough chromium in the fillet radius for grinding.

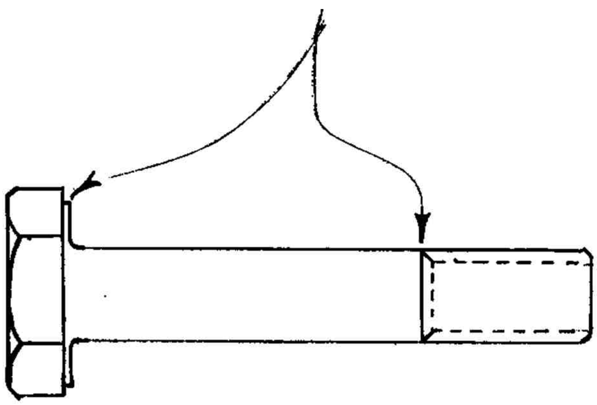

Fig. 2—An additional 24 hours of plating deposited enough chromium in the fillet radius for grinding.

Note: *Sagittarius is the nom de plume of a well-known electrochemical engineer and prominent Society member who, as you see, has a flair for good detective story writing. Sagittarius, being the name of a constellation in the southern skies that looks like an archer, is a particularly apt choice to represent a trouble-shooter. Incidentally, when all else fails, maybe one should not only read the instructions but also consult the stars!*

S. J. Heiman

2. Chromium Plating of Hex Head Bolts

The problem was to plate a minimum of 0.25 mm (10 mil) of chromium on the shank, underhead, and fillet radius of a 0.95 cm (0.375 in.) diameter by 7.00 cm (2.75 in.) long bolt. See Fig. 1. After plating, the chromium was ground to a final thickness of 76 to 152 microns (3 to 6 mil).

There was no problem getting the required chromium on the shank and underhead. The problem was getting it into the fillet radius. What was happening was that the shank and the underhead circumference were acting as thieves and diverting the current away from the fillet radius. Neither variations in the operating conditions nor the use of conforming anodes helped alleviate the condition.

The problem was solved by plating the shank, fillet and underhead until the shank had the required 0.25 mm (10 mil) of chromium. The shank was then masked off to within 6.35 mm (0.25 in.) of the head. The parts were then activated and plated for an additional 24 hours to get sufficient chromium into the fillet radius for grinding. See Fig. 2. Both the dimensional tolerances of the bolt and the required 76 to 152 microns (3 to 6 mil) of chromium were achieved after grinding.

Contributed by John J. Laurilliard, Standard Pressed Steel Co. Jenkintown, PA (1966).

3. Phosphating—Removal of Sludge & Scale From Phosphating Machine

Problem:

To clean iron phosphate sludge and scale from cleaning stages (lines, nozzles, heating surface, etc.) of a five-stage, strip phosphatizing machine without corrosive effect.

Former Method:

Flush tank, remove all nozzles, circulate from two to eight carboys of inhibited acid per 600 gallons of water, 54 to 60°C (130 to 140°F), 15 to 30 minutes, rinse and neutralize.

Solution:

Flush tank and system thoroughly, open nozzles, use an alkaline deruster at 30 g/L (4 oz/gal), 70 to 76°C (160 to 170°F), circulate one hour, dump and rinse.

Results:

The alkaline deruster is judged to be more than twice as effective as a one to seven acid boil-out in removing phosphate buildup without the corrosive and hazardous characteristics of acid cleaning. Stainless surfaces are bright and clean. Steel surfaces are clean. Some rust color, converted iron hydroxide, was evident out of the spray zone, but was not objectionable.

Comments:

A weekly cleanout of this machine is necessary. Increased use of inhibited muriatic (hydrochloric) acid resulted in corrosion to stainless nozzles, mild steel pipe and cast iron pump impellers. The alkaline deruster is safe on the equipment, permitting its use by unskilled help with no control. There is less material to handle and store. Neutralization is not required. Cost per cleanout was one-third less in this instance than with a 1 to 6 acid solution.

4. Clear Chromate Conversion Coating On Zinc Plate

A manufacturer of various types of zinc-plated hardware installed a new automatic rack machine much larger than his old one. He was immediately plagued by small mountains of rejects. The zinc-plated parts, which were given a proprietary bright chromate conversion coating, came off the machine with unsightly hues of iridescence still visible on them. Variations in the pH, temperature, bright dip concentration and caustic soda leach dip concentration were made-to no avail. The cycle was as follows:

- Zinc plate
- Rinse #1
- Rinse #2
- Nitric acid dip
- Chromate bright dip
- Rinse with air agitation and spray #1
- Rinse with air agitation and spray #2
- Rinse with air agitation and spray #3
- Caustic soda leach dip
- Rinse with air agitation and spray #4
- Rinse (hot)
- Dry

It was decided to try having only one rinse following the chromate bright dip. Thus, the leach dip was moved two stations back in the line, while the cycle following the leach dip remained as before. After this adjustment, acceptable work was turned out.

The conclusion was that the excessive rinsing between the chromate dip and the leach took so much time that the conversion coating "set" and the color was not entirely leached out. The moral of this story is: If your present machine has a cycle which results in good quality production work, don't change the cycle without adequate evaluation of the consequences!

Contributed by George McDowell
Allied Research Products, Inc. Baltimore, Md.

5. Premature Corrosion Under Salt Spray Test Of Chromate-Treated Aluminum

A customer continually submitted 2024-T3 aluminum panels for salt spray test under the MIL-C-5541 specification. These consistently failed the 168-hour salt spray test, resulting in overall white corrosion as well as a pit-type of breakdown. After thoroughly checking out the customer's operating procedure, it was found that the chromate tank had been installed with a brass or bronze valve at the outlet. This was found when the valve itself finally leaked because of the dissolving action of the acid chromate solution. The valve was replaced with a stainless steel valve and it was determined that the premature breakdown of the 2024-T3 aluminum arose from the accumulation of copper from the dissolved valve in the chromating solution, which in turn contaminated the deposited chromate film.

Contributed by C. W. Ostrander
Allied Resedrch Products, Inc. Baltimore, Md.

6. Shop Maintenance - Cleaning Floors

Problem:

To clean cement and hardwood floors. Soils encountered consisted of several years' accumulation of hardened oil and grease about 0.25 to 0.5 in. thick [Yuck! – JHL].

Former Method:

Scrape floor by hand using scraping tool. This method proved to be very time-consuming.

Solution:

Using an emulsion cleaner undiluted and pouring on the floor over this heavy grease and oil proved to be the answer. The emulsion cleaner was allowed to soak on the floor overnight and then everything scraped up very easily. It now takes about one-eighth the time in man-hours to scrape up the soil using an emulsion cleaner.

Results:

Very clean floors. The very tough spots on the cement floors were allowed to soak up to 16 hours. Hardwood block was easy to clean. I would not suggest an emulsion cleaner be used on regular wood floors. *P&SF*

Technical Editor's note: *The preceding article is based on material compiled and contributed by Dr. Samuel Heiman, as part of the "Plating Topics" series that ran in this journal. It deals with everyday production plating problems in the mid-1960s, many of which are still encountered in the opening years of the 21st century. Much has changed ... but not that much. The reader may benefit both from the information here and the historical perspective as well. In some cases here, words were altered for context.*