Some Production Plating Problems & How They Were Solved—Part 12

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Through the years, the Udylite Customer Service Laboratory has been confronted with production plating problems of every conceivable nature. These problems have run the gamut from peeling, pitting and poor adhesion, to clouds, roughness and poor chromium coverage. You name it and we've seen it.

We are indebted to Mr. Edwin Hoover, Director of Field Service Engineers, and the staff of the Udylite Customer Service Laboratory for a small cross-section of the many problems encountered.

1. A sign of the times: Nickel shortage

Problems with chromium coverage over bright nickel were being encountered in a certain hoist line installation. The problem was peculiar in that the chromium coverage problem was confined only to the racks at one end of the work bar. The lead anodes and temperature of the chromium solution were checked and barium carbonate was added to the chromium solution with only a minor improvement in chromium coverage.

Attention was then turned to the bright nickel tank and the culprit was uncovered. The titanium anode baskets at one end of the nickel tank were low in nickel chips. The insufficient anode area in this part of the nickel tank resulted in low current densities, thin nickel deposits and hence, dummying out of metallic impurities on the work. This produced an inferior nickel deposit. The result was poor chromium coverage.

2. Poor cleaning produces blisters

An installation plating copper, nickel and chromium on brass castings encountered a severe problem with small blisters over the entire part. The plating solutions were checked and found to be in a satisfactory condition. The cleaning cycle was then examined and the following conditions were noted:

1. Low temperature in the soak cleaner.
2. Low temperature in the electrocleaner.
3. Insufficient current in the electrocleaner. The current density was only 0.22 to 0.43 A/dm^2 (2.0 to 4.0 amp/ft^2). The electrical connections around the electrocleaner tank were heavily covered with corrosion products. The resultant high resistance caused the electrocleaner to be really nothing more than a soak cleaner.
4. Low temperature in the acid dip.

The following corrections were made:

1. Temperatures in the soak cleaner and electrocleaner were raised from 60°C (140°F) to 82-88°C (180-190°F).
2. All electrical connections on the cleaning line were taken apart and thoroughly cleaned.
3. Temperature of the acid dip was increased from 15 to 38°C (60 to 100°F).

The corrective steps outlined above corrected the blistering problem.

3. Falling pH in a bright nickel solution

The operator had observed a constant, gradual decline of pH in his bright nickel tank during a day's production. The pH of the solution was adjusted in the morning, with nickel carbonate in the filter, to a value of 4.0, but by mid-afternoon, the pH decreased to 3.7. (The rinse tank prior to the nickel tank was not acidified.) The operator had purchased some titanium baskets, and in addition to the falling pH, he had noted that since their installation, he was not able to draw as much current as he did before the baskets were installed.

Insufficient anode area was pointed out as being the probable cause for both reduction in current and the falling pH. The anode current density was calculated to be as high at 17.2 A/dm^2 (160 amp/ft^2), based on the open face of the anode basket. Oxygen was being liberated at the anode, resulting in an increase in hydrogen ion concentration accounting for the decrease in pH. The following modifications were recommended:

1. The use of longer and additional anode baskets to increase anode area. .
2. The use of sulfur-depolarized (SD) nickel rather than pure electrolytic nickel.
3. Changing of anode bags and cleaning of anode baskets every six weeks.

Step 3 resulted in the greatest immediate effect because of improved solution transfer through the anode bag. Iron deposits had clogged the anode bag restricting solution transfer, and changing anode bags more frequently solved the problem.

4. Plating problems do not always originate in the plating solution

Many plating problems, such as pitting and roughness, may not be the fault of the plating solution or the plater.

Based on an original article from the "Plating Topics" series [*Plating*, **54**, 838 (July 1967)]

In the following cases the guilty party was the polisher, diecaster or molder. We are indebted to John Burghart, Udylite Customer Service Laboratory, for the excellent photomicrographs.

Figure A—
Pitting was encountered in a triple nickel deposit on steel wheel rims. As usual, the nickel solutions (and in this case there were three solutions) were suspect. The nickel solutions were checked and given a clean bill of health. Cross-sectional examination through a typical pit clearly showed that the pitting resulted from a void in the basis metal. Improvement in the polishing operation solved the pitting problem.

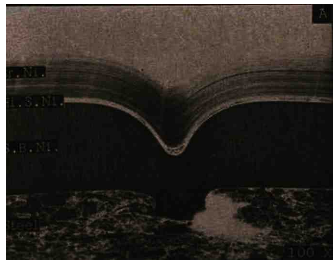
Fig. A

Figure B—
Roughness and pitting were encountered on zinc die castings plated with copper, semi-bright and bright nickel. After the plating solutions were checked and found to be trouble-free, attention was turned to the die casting itself. The photo illustrates formation of a roughness nodule over gross porosity in the zinc die casting. Figure C (next) clearly shows that gross porosity in the die casting was also responsible for the pitting in the plated deposit. Changes in casting techniques resulted in a sound casting and the roughness and pitting problems were solved.


Fig. B

Figure C—
Gross roughness was encountered in the Bi/Nickel plating of steel automobile bumpers. The filtering procedure, anode bags and the nickel solutions were checked without finding the answer to the problem. Microscopic examination of a cross-section through a roughness nodule showed a steel sliver remaining on the surface after polishing (Fig. D, next). The nickel deposit had built up around the sliver and produced a rough nodule. Sisal buffing after polishing solved the roughness problem.

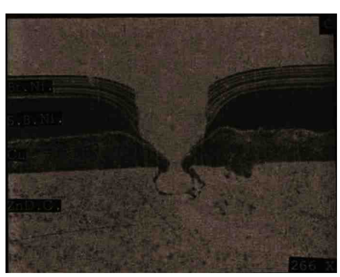
Fig. C

Figs. D&E—
Gross roughness was encountered in the bright acid copper-bright nickel plating of ABS plastics. The roughness could be observed on the parts after acid copper plating, so "clearly" the acid copper solution was to blame. Increased filtration and bagging of the copper anodes did not solve the problem, so attention was directed to the plastic part. Figure E clearly shows that plastic debris clinging to the surface of the plastic part was the culprit. Changing the molding technique solved this "roughness" problem.

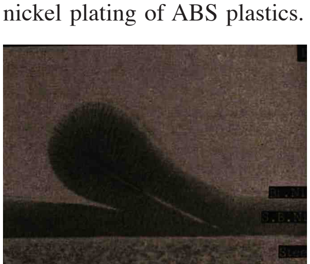
Fig. D

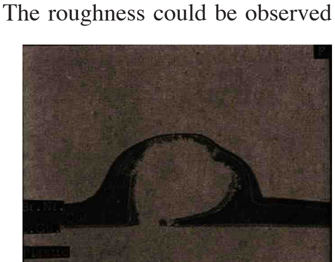
Fig. E

5. Change in drawing compound causes roughness

After six months of successful operation, an installation which was nickel plating tubular steel parts [5-cm (2 in.) ID, 43 cm (17 in.) long] encountered severe roughness. It was first suggested that the cause of the trouble was iron contamination in the nickel solution. Simultaneously, using field expedients and chemical analysis, it was proved that this was not the case. In the hope of gaining further insight into the nature of the problem, the following steps were taken:

1. Pre-cleaning of parts in trichloroethylene (*in 1967*).
2. Running ordinary parts through the cycle and skipping various stations.
3. Replacing the complete cleaning cycle with fresh solutions.
4. Treating, filtering, and dummying the bright nickel for a period of about four hours.

None of these steps helped, but Step 2 indicated that the final acid dip and the nickel strike had contributed to the roughness.

The acid dip was changed and the filter on the nickel strike was positioned so that the solution was picked up from the sump and returned to the plating tank, rather than picking up from the overflow and returning to the plating tank. After about two hours of filtering, no more roughness was encountered.

Based on this information, a thorough investigation of the operation was made. Shortly before the beginning of the trouble, a shipment of the wrong type of drawing compound had been received and had gone into use unnoticed. The cleaners were unable to cope with this new compound, resulting in a bleedout of grease from the inside of the tubes. This grease was accompanied by a great deal of iron fines which accumulated in the acid dip and low pH nickel strike and caused the roughness.

6. The old gal needs a new dress!

A technical service representative was requested by a customer to look over his plating operation. His problem consisted of being unable to draw as much current through his nickel plating solution as he should have. This required slowing down the machine. A loss of production was the inevitable consequence. After checking the rectifier and electrical connections, it was found that the anode bag was the trouble. By putting on a new bag, one titanium basket drew 80A (tong meter check) as compared to 20A with the old bag.

***Technical Editor's note**: The edited preceding article [Plating, **54**, 838 (July 1967)] is based on material compiled and contributed by Donald R. Millage, as part of the "Plating Topics" series that ran in this journal. This particular article was one of the rare occasions in the series that was not contributed by Dr. Samuel Heimann. It dealt with everyday production plating problems, 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. 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.*