Shop Talk

Some Production Plating Problems & How They Were Solved—Part 13

Contributed and edited by Dr. Samual Heiman, updated by Dr. James H. Lindsay, AESF Fellow

1. Parkinson's Laws

Dear Dr. Heiman:

For those who found interesting the reading of Chisholm's, Finagle's and Murphy's Laws, here is a contribution on a fourth authority, Parkinson.

Parkinson's First Law: Work expands so as to fill the time available for its completion.

Professor Parkinson illustrates this law by stating that officials make work for each other. "Officials want to multiply subordinates, not rivals." He found that "in any organization the number of subordinates multiplies at a predetermined annual rate regardless of the amount of work that the staff actually turns out. Statistical surveys show this increase to be between 5.17 and 6.56% a year even in those cases when the final output actually decreases."

Parkinson's Second Law: Expenditure rises to meet income.

"Individuals know this but its implications have not been grasped on the government scale. It is folly to believe that the more money a government receives, the better will be its services. Reduced revenue would bring about improvement, not decline in the public service. Individuals noticed that raises disappear. Whatever the revenue may be, there will always be compelling reasons to spend it."

Parkinson's Third Law: Expansion means complexity, and complexity, decay.

"The more complex, the sooner dead' applies especially to corporate structures. No enterprise can last forever but the process of decline and fall can be retarded."

Professor C. Northcote Parkinson had a long and distinguished career and had written 17 scholarly publications in the field of economics since 1934. He was Professor of History at the University of Malaya. He worked in the British War Office and the RAP during World War II, but his real contribution to our society started when he produced his laws. Each of them is developed in a volume complete with examples and case studies. They are delightful reading. The three books (Riverside Press, Cambridge) are: "Parkinson's Law" (1957), "The Law and the Profits" (1960), and "In-Laws and Outlaws" (1962).



His first book contains an additional important law:

Parkinson's Law of Triviality: The time spent on any item of the agenda will be in inverse proportion to the sum involved.

I have extended this law into the general relation shown in the above figure (solid line). Parkinson's examples A, B, and C are in good agreement. Note the limits:

- 1. Any item takes at least three minutes regardless of the amount (Parkinson says 2¹/₂).
- 2. Because large amounts are outside of the experience of the average person, dollar values above a half million are passed quickly. Does it really matter whether it is one million or one billion dollars? [*Hmmm. Even after four decades of inflation, those numbers still work.— JHL*]
- 3. No subject is allotted more than 1¼ hours of floor time, and
- 4. There is a reversal for trivial amounts but again, it takes at least three minutes. You will find this curve useful in pin-pointing the length of time needed for discussing money at your next business, association or club meeting.

Gunther Cohn Information Center on Metal Coatings and Plating Franklin Institute Research Laboratories Philadelphia, Pa.

Based on an original article from the "Plating Topics" series [*Plating*, **54**, 1049 (September 1967)]

2. Color anodizing: Poor dye work because of the decomposition of dye solutions

Dear Dr. Heiman:

I have encountered the above condition described by F. P. Stiller in the [June 2004] issue of this column. Decomposition may happen to the dyes of any of the major suppliers. Whenever a dye solution develops evidence of bacterial decomposition, I have been able to stop the decomposition, while maintaining production, by adding about 50 ppm sodium cyanide and adjusting the pH to the desired value. It has never been necessary to repeat the treatment. I have tried hexavalent chromate as a bactericide but it is not as effective as the cyanide.

Gerald E. Ward, Alumtreat, Inc., San Marino, CA

3. Silver plating: Accelerated test for tarnish-resistant coating

This work, which was done a number of years ago, taught me a lesson which has been valuable to me over the years, and may be valuable to others today. We were doing some exploratory work in tarnish-resistant coatings on silver and found that if an extremely thin coating of tin was applied over buffed silver plate, the appearance to the eye was still that of silver. A thicker tin deposit, however, would cause the surface to lose the pleasing appearance associated with bright silver.

These thin coatings of tin could be applied by immersion in a stannite-cyanide solution or galvanically in a stannite solution, prepared from stannous chloride and caustic, when in contact with iron. With a very thin coating over buffed silver there was no perceptible change in surface appearance. Over unbuffed silver, the surface became light grey.

Many silver-plated panels and pieces of silverware were treated in this manner and exposed to (hydrogen sulfide (H_2S) fumes at different times and of different concentrations in the laboratory. Invariably, the treated parts remained untarnished for 10 to 20 times longer than the untreated silver.

Friends immediately brought in silverware such as cream and sugar sets to be treated. This was done, and the friends were very pleased with the appearance. They took the pieces home and within a week or two I had lost some friends! While the surface on these treated parts would resist tarnishing when exposed to an air- H_2S atmosphere in the lab, the treated parts actually tarnished in a home atmosphere, especially in the kitchen, much faster than did the untreated parts.

There are a few possible explanations but no further work was done to explain this anomaly. The question arises whether in recent work on contact resistance in the electronic field, the use of tests involving H_2S will always lead to correct service condition prediction.

4. Chromate conversion coating on barrel zinc plate

A processor of small parts (bolts, nuts, screws, etc.) switched from an old oblique-barrel type of automatic to a brand new horizontal barrel machine. The cycle had been the same in both, approximately: zinc plate, rinse, rinse, rinse, olive drab chromate, rinse, rinse and dry, unload.

Trouble was encountered with the new machine from the beginning. The first two or three loads took on a good olive drab color; the work in subsequent barrels looked all mottled and "washed out."

The zinc plate thickness was found to be sufficient. Extending the time in the olive drab chromate solution did not help. Increasing its concentration helped only for two or three barrel loads, then the parts appeared as before. The manufacturer of the proprietary olive drab chromate suggested that the chromate dip was being contaminated by drag-in of alkali.

A pH determination was made of the solution dripping from the barrels as they descended into the chromate dip. It was found to be approximately 12.0, alkaline enough to cause the trouble.

A $\frac{1}{2}$ % nitric acid dip was substituted for the water rinse immediately preceding the chromate dip, and no further difficulty was encountered.

It was concluded that the three rinses after zinc plating were inadequate because the holes in the new barrels were too small to allow adequate passage of the rinse water through them, and so the nitric dip had to be used.

> George L. McDowell Allied Research Products, Inc., Baltimore, MD

5. Aluminum anodizing: Improved sealing

A great deal has been written on the subject of sealing of clear anodized aluminum and the last word has not been spoken. In general, three kinds of water are used today:

- 1. Tap water
- 2. Deionized water
- 3. Tap water plus additives

The seal bath used depends on the circumstances, such as the quality of the tap water available and the performance requirements such as corrosion resistance specifications.

I should like to describe two seals which are in use in my shop; one is a single seal and the other is a double seal. They belong to Category 3 above. They were developed in my circumstances for economy, improved corrosion resistance and the minimum amount of smut formation. The tap water which was used contains 50 to 75 ppm hardness and is low in chlorides. The seals are made up fresh once a week (one-shift operation).

1. Single Seal:	
Sodium acetate	
Acetic acid	3.0 fl. oz./1000 gal (0.023 mL/L)
Proprietary nonionic wetting agent.	
Phosphate (PO_4) 5.0 ppm, max	(23 g phosphoric acid, 85%/1000 gal)
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This seal is operated at:	
pH	
Temperature	
Time	

The acetates serve as a buffer, an intrinsic sealing aid, and help to neutralize acid residues in the pores of the anodic coating. The proprietary wetting agent may be obtained from a number of dye companies. It reduces smut. The phosphate also reduces smut. The concentration must be about 5.0 ppm. Higher concentrations, above 20 ppm, are harmful. If the anodized aluminum is to be painted, it should be given a final rinse in deionized water at 130-140°F (54-60°C).

2. Double Seal:

Tank No. 1:	
Sodium acetate	5.0 lb/1000 gal (0.6 g/L)
Acetic acid	15 fl. oz./1000 gal (0.11 mL/L)
Nickel acetate	0.27 oz/gal (2.0 g/L)
Proprietary nonionic wetting agent	1/32 oz/gal (0.023 g/L)
Phosphate (PO ₄) 5.0 ppm max (23	g phosphoric acid, 85%/1000 gal)

This seal is operated at:	
pH	5.1 to 5.4
Temperature	
Time	

Tank No.2:

Sodium acetate	5.0 lb/1000 gal (0.6 g/L)
Acetic acid	
Chromate	
Phosphate (PO ₄)	

This seal is operated at:

pH	5.5 to 6.0
Temperature	208° F (98°C)
Time	15 min

The double seal is more effective in minimizing smut and improving corrosion resistance than the single seal. The nickel acetate in Tank No. 1 contributes improved sealing of the pores.

The chromate in Tank No. 2 contributes its well-known corrosion inhibiting properties. At the same time, since its concentration is so low and sealing is already initiated, it does not impart any color to the clear anodize coating.

Using this double seal, I have found a 30 to 50% improvement in corrosion resistance, based on the Kape test [J.M. Kape, *Metal Industry*, Sept. 18, 1959.] over that which is obtained from the standard deionized water seal.

6. Bright nickel plating: Roughness

The problem was roughness which persisted over a period of several months. At first it was very slight but it gradually became worse. The plating bath was an air-agitated, bright nickel solution. Standard 1 in. square S-D nickel anodes were used in expanded metal titanium baskets which had ³/₄ in. openings. Ten oz. cotton duck bags, with 56-40 thread count were used, two bags on each basket.

Considerable attention was first paid to improving the filtering system, which formerly had been perfectly adequate to remove suspended material which could cause roughness. However, this did not solve the problem now. During this period, all hardened and broken bags were replaced as a matter of normal maintenance.

It finally became evident, since we had tried everything else, that solid particles of nickel sulfide must be getting through the bags that still looked good. So we again removed the solution, and replaced all the anode bags, including those still apparently in good condition, and filtered the solution back into the plating tank. Roughness was thereby eliminated.

When S-D nickel corrodes, a sludge of black nickel sulfide is formed and accumulates inside the basket. Evidently the nickel sulfide particles of anode sludge gradually penetrate and fill the space between the interwoven threads of the anode bag. Then, once the bag is hardened and then stretched, particles leave the bag and enter the solution more freely. It is now standard practice to change all S-D bags every six months. Since this practice was instituted, the roughness has not recurred.

> Irvin K. Hauseman Pottstown Plating Works, Inc. Pottstown, PA

7. Bright nickel plating: Cloud in low current density area

I was called in by the customer who was operating our bright nickel solution with the complaint that the low current density areas of the parts being plated had a haze or cloud.

The 500-gal solution was operated by a captive shop which had spared no expense to operate the solution properly. One would find no fault with fine equipment which included cathode rod agitation and continuous filtration, the clean environment, the general operation and the careful control and additions of the chemicals and brighteners.

Since a cloud in the low current density areas could be caused either by organics or metallics, we proceeded to carbon treat and dummy the bath. The carbon treatment had no beneficial effect at all. The dummying actually made the cloud worse! This narrowed down the possible causes but was more perplexing than ever.

At this point, since the bath was not behaving according to the book, we had no recourse but to stand by the operator and observe everything which was being done and examine every piece of equipment in the set-up. Several hours passed without a clue. Finally, we noticed a faint pink deposit on the anodes. This meant the presence of copper in the solution which deposited on the nickel anodes by immersion. This proved to be the turning point in the investigation.

Looking around for sources of copper, we noticed that one of the metal rollers of the cathode agitator had stuck and, on rubbing against the copper cathode rod, formed a powder which fell into the nickel solution. One could barely see this copper powder in the solution. because the efficient filtration system filtered it out and put the fine copper particles in the press where they continued to dissolve in the nickel solution!

Once this point was established, the remedy was quickly made and the solution dummied to remove the copper which caused the cloud.

In retrospect, I was amazed at how little copper in the solution was enough to cause so much trouble. This emphasizes the importance of keeping contamination out of bright nickel solutions as a major factor in getting high quality work. I wonder how many cathode rod agitators are not working properly today.

The edited 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 dealt with everyday production plating problems encountered during that period, 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.