Finishers' Think Tank

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The Past: Alive & Well in the Future

It's the second month of a new year. Every day brings new challenges. Do problems, opportunities and corrective actions cease? Of course not. We all have, over the years, accumulated a "card file" of practical experiences that enrich our understanding of various finishing processes and improve our troubleshooting techniques. Many times, we invest quality time to see problems through and to confirm preventive measures. No one gets bored in the metal finishing industry. There are too many processes, controls, cycles and parameters for us to monitor, thereby making this an exciting contributor to our nation's gross national product. I am certain our international readers feel the same about contributing to their nation's economy.

Reflecting back, like many of you, I have many interesting, odd, comical and/or unique situations indelibly stamped in my mind. What follows are some items that might be of interest to share. Let's start with problems associated with the soak cleaner—likely the first process tank in most operations—and then progress down the line.

Soak Cleaning

- Oils and grease are no longer being removed. It is a new bath makeup, with the same product and presumably the same soils being cleaned off the parts. The electrocleaner was also made up new. The problem? The electrocleaner was used to charge both tanks!
- Aluminum parts processed in a standard, satisfactorily proven, barrel acid-tin plating cycle. Suddenly, blisters rule! Walked the line, analyzed all tanks, dumped soak, etch, desmut, zincate—all to no avail. The problem was found to be raw aluminum stock being shipped in with wax sheets wrapped around the coil. Stored outdoors in the sun, the wax softened, eventually hardening as a tenacious film on the aluminum coil.
- A metal stamper routinely contracted a few platers to finish its parts. Suddenly, none of the shops could clean the parts. Rejects and cost overruns caused the stamper to conduct a check. It was found that the purchasing department had switched from the usual water-soluble oil to a chlorinated paraffin. Each plater used a caustic-based soak cleaner. The solution jelled the chlorinated paraffin, setting it up on the surface, rather than removing it. The problem was easily corrected by returning to the water-soluble oil.
- This soak cleaner reached a point of insufficiently cleaning parts on a daily basis. Coincidentally, parts could not longer be immersed to the required depth because of sludge accumulation. The fact was, this five-year-old, daily-used process bath was indeed "shot." The new makeup was perceived to be good for another five years.
- Hot is good—hotter is better! With approximately 25 percent of daily production time left, bright nickel-plated parts exhibited a white haze. From the beginning of the daily shift until then, nickel-plated parts were fine. After a few days, the problem was found to be a sticking solenoid valve that controlled the steam inlet to heat the bath. The warm soak cleaner (120° F) was steadily heating up, until (at 190° F) a dry-on film formed, coinciding with an excessively hot soak cleaner.
- Nickel-plated brass screws were rejected because of insufficient plating in the threads. Inspecting the raw parts confirmed copious oil loading in the threads. The current cleaner was not removing this oil. Switching to a different chemical type, based on pre-screening, provided satisfactory cleaning and the required nickel plating coverage.
- Steel parts were zinc-plated, revealing sporadic, mottled, etched patterns. The problem was caused by the cleaner not removing a grease. Passing down the line, this grease coated localized spots, causing a "grease etch" in these small areas.
- Plated zinc die castings were blistering. The blisters peeled back, right off the base metal. Examination of the raw parts revealed pitted areas and cold shots. These surface defects were worsened because the soak cleaner contained caustic that was etching the surface and enlarging the pits. Process solutions and rinses would become trapped in these voids, gradually bleeding out, resulting in the plating blisters. Replacing the cleaner with a proper, caustic-free blend greatly reduced occurrence of the blisters. Corrections made to the casting operation and buffing further reduced blisters to almost zero.

Electrocleaning

- The process bath, having reached its useful service life, was dumped for a fresh change of "old reliable." Apparently, however, the new bath was on strike, as evidenced by the strange lack of conductivity and appearance of water breaks. The problem was the result of a handling mistake, where the soak cleaner was inadvertently used in the electrocleaner makeup!
- Steel parts exiting the electrocleaner had a brown film that was more prevalent, along with base metal etching, in the high current density. The bath was under-concentrated, or specifically too low in caustic. With insufficient reserve caustic, the brown iron hydroxide film that formed on the surface during reverse current treatment was not being dissolved. Lack of conductivity resulted in the high-current-density burn.
- A barrel line was programmed to transfer parts from the soak cleaner via rinse to acid, then rinse prior to the electrocleaner, then proceed with the activation and plating. Plated parts had what seemed to be corrosive pits. By carefully studying the line, it was found that drag-in of the muriatic acid solution into the electrocleaner was the culprit. Specifically, the chloride was anodically oxidizing, forming chlorine gas bubbles on the parts, resulting in small corrosive pits. The problem was solved by improving the rinse quality between acid and electrocleaner and switching to a specially inhibited electrocleaner that was more tolerant to chloride.
- Lightning strikes twice! Rack-processed steel parts were found to have corrosive pits. It was caused by drag-in of the muriatic acid (our old nemesis, chloride) into the second electroclean in this double-cleaning cycle. Appropriate corrections were made.
- "All of a sudden" nickel/chrome-plated parts exhibited periodic blistering. This was apparently an ongoing problem, and the condition was traced to the electrocleaner. With every pass of the racks, chrome was anodically stripped off the rack tips. The buildup of hexavalent chromium was passivating the steel. Coincidentally, the electrocleaner solution color was turning progressively yellow and the usual thin foam blanket was nonexistent. These conditions were also related to the presence of hexavalent chromium. The addition of a sugar-type reducing agent corrected the problem without need to dump the electrocleaner. The complex sugar oxidizes to a charcoal grit, while the hex chrome is reduced to trivalent chrome. This species forms the insoluble hydroxide in solution. Blisters stop, solution color turns greenish and foam returns. "Sweeten" that electrocleaner.
- Zinc die castings exited the electrocleaner with white corro-

sive patches. The wrong electrocleaner formula was being used. Switching to a moderate caustic blend containing approximately 1:1 ratio of caustic to silicate eliminated this problem. Silicates are excellent inhibitors in electrocleaning, especially to protect sensitive metals from "overcleaning."

- Brass parts were de-zincified, resulting in pink patches. Changing to a properly formulated electrocleaner with correct reserve alkalinity, inhibitor and buffer eliminated the problem.
- Process tank dumped, serviced, cleaned and recharged. After a few days' running, parts were noted to be smutty and becoming progressively filmed. When the acid couldn't properly desmut the parts, the line was stopped and troubleshooting began. The culprits were reversed electrical connections. During this time, the soil buildup in solution increased as the electrocleaner bath aged. This coincided with the cathodic treatment that plated the smuts onto the surface of parts. Bus connections were corrected and the problem vanished.

Acid Activation

- A batch of nickel-plated wire goods had to be reprocessed because of plating rejects. The parts were cycled around the machine a second time. Normally, the installation would treat the parts in a cathodic acid, followed by acid immersion, then re-plate successfully with nickel. This time, only peelers ruled! Someone failed to catch these parts as having been lacquered after nickel. Lacquer was stripped and the cycle repeated with no problems.
- The muriatic acid bath was effective at a couple of accounts, but just did not provide a reasonable service life to justify expense of dumping acid waste treatment. The common problem was immersion copper from hooks and flight bars on steel, causing post-plate hazing and blisters. The common solution was adding an inhibitor to prevent the redox deposition of copper on the steel.
- Stainless steel wire parts that were alkaline zinc-plated exhibited blister patches and dullness. The surface preparation cycle consisted of: soak, double electro and double muriatic acid, Woods nickel strike, then alkaline zinc plate. The base metal had surface cracks from the extrusion process. Muriatic acid penetrated these cracks and fissures, raising smuts. Changing to a sulfuric acid and fluoride acid solution reduced base metal attack, avoiding smutting and leaving the surface clean for the Woods strike activation. Zinc plating was fine. The cracks and fissures, although present, were not as obvious.
- Zinc die-cast parts were smutty after acid dip, resulting in a hazy and somewhat rough copper strike deposit. The one-percent sulfuric acid dip was replaced with a working solution consisting of seven-percent sulfuric acid with one oz/gal of ammonium bifluoride. This left the parts

active and smut-free. Some castings contain varying amounts of other metals, such as copper and lead. The fluoride is an effective desmutter.

- One set of brass stampings nickel-plated just fine, but another set did so with blisters. Checking the assay of metal used in each part revealed the easy-to-plate parts had 0.25-percent lead in the alloy. The tough parts had three-percent lead. The muriatic acid dip resulted in sufficient, insoluble lead chloride forming on the surface of the tough parts, resulting in the blisters. Changing to a sulfuric acid-plus-fluoride blend corrected this problem. Fluoride dissolves the lead smuts.
- A plater routinely desmutted aluminum series 380 castings in a universal triacid (50% nitric acid, 25% sulfuric acid, 25% water, 8 oz/gal ammonium bifluoride). Without warning, the same parts were being shipped to the plater, but they were made of series 413 casting. Plating blisters ensued until the triacid strength of ammonium bifluoride was doubled. (Facts revealed that series 380 contains 7–9% silicon vs. 11–13% silicon in series 413.) It took that much more ammonium bifluoride to dissolve the silicon dioxide smut!
- 1100-series aluminum parts were effectively desmutted in a 50-percent nitric acid dip. The problem arose when the alloy was changed to 2027. The acid was changed to a combination nitric acid, iron salts and fluoride to desmut the surface. This is another example of matching the desmut solution chemistry to the alloy designation or casting being processed. Know your part alloy designation or assay.
- An esteemed chemistry professor substituted conventional mineral acids with perchloric acid whenever he deemed it fit to do so. Dr. X's famous line: "Perchloric acid: Nothing does it better." One day there was an explosion in his lab. A few windows were cracked and the door to his lab was partially off its hinge. Someone taped a note on the door that read, "Perchloric acid: Nothing does it better!"

New plating lines generate unique teething and mechanical problems. The most common one I have encountered is reversing the busing from rectifier to plating tank. One brand-new, automatic, computer-controlled line wouldn't plate worth a darn for this reason.

Next month, we'll reminisce about additional troubleshooting items.

Trivia

- In the 1980s, decorative trivalent chromium made large inroads from a process first introduced 25 years earlier.
- Chloride zinc, introduced in 1941, exhibits better efficiency but less covering power than its high-pH relative.
- Mass finishing is a surface finishing giant first used several thousand years ago. Refinements keep it at peak performance. P&SF