Finisher's Think Tank

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Help with Plating Problems—Keep it Easy

For me, one of the best examples of how good it is to be in the metal finishing business is the open exchange with other associates. Specifically, I refer to so many hard working people sharing their experience to help and enlighten others. Cooperation and a willingness to help are the key driving forces. How many times have you asked for help in some form and received a "ten-fold" response? Whatever the subject matter or involvement, I assume the assistance has been most helpful, enlightening, and just on target. How many times have you reciprocated? Everyone must have selected experiences of help received or given that are special, satisfying, or a source of great appreciation. Reflecting on past experiences, the benefits of quality assistance probably continue in future endeavors, and are passed on to others. In this way, a price or cost savings cannot be accurately measured, because it never ends! Chance encounters, specific inquiries, advice, and coordinated efforts typically guide us as help is on the way. There are many avenues for help to travel expeditiously and effectively. These include word of mouth, references, other finishers and suppliers, professional meetings (three societies soon to be one), literature, Web sites, technical symposiums. Help, in many forms, offered by lots of knowledgeable and experienced people, is there for the asking. How many better deals can you get? How many better deals can you expect? The following recent example is one that occurs many times daily.

A Problem Occurs

A hard chrome plater was experiencing deposit cracking, with poor adhesion. He ran through specific checks of the associated process tanks. These included pre-plate surface conditioning—grinding, cleaning, acid activation and reverse etch. Mechanical checks focused on buss connections and the rectification. Certain parameters appeared to be fine, while others were uncertain. In developing a response with troubleshooting direction, focus and interpretation, I contacted an old friend, who clarified and magnified certain points of importance. Our reply, without the benefit of actually being on-site witnesses, drew on our combined experience, based on the information supplied. In our best effort, this was an example of help on the way.

Identifying a Problem

The cracking certainly indicates adhesion problems. First, because these are specialized, high performance parts, check with the manufacturer. They may already have in place certain process specifications or cycles for hard chrome plating, or appropriate re-work of worn components. Does the adhesion problem go down to base metal? A simple wet test would determine this case. After peeling back the chrome deposit, wet the exposed surface with an acidified copper sulfate solution. By redox potential, copper will immersion deposit on the iron, but not on chromium. On site, the easiest and relatively cheapest corrective action would be to replace the acid pickle bath. This, especially because the concentration of less than 100 ppm of copper, might form immersion copper on the substrate, contributing to poor adhesion. Reverse cleaning, frequently used in the particular application, should be confirmed as actually occurring, with exit in the anodic condition. If the parts exit cathodic, then dissolved metals would plate on as a smutty film. This might not be sufficiently dissolved in the acid, thereby leading to another source of poor chrome adhesion.

Shot peening may not affect adhesion, but is necessary to impart a compressive stress on the surface to counteract the potential for microcracking. Everything wears down, including the shot. If broken or not periodically changed, sub-par shot can result in nodules or pits. However, adhesion is not usually the situation. The potential for hydrogen embrittlement should be acknowledged. Appropriately, oven baking before plating should eliminate any adverse condition caused by hydrogen embrittlement.

If the parts are clean and active, ready for chrome, then the problem would be occurring in the plating bath. The bond between chromium and the base metal is stronger than chrome itself. Chemically, the chrome bath should be operated at the high end of the preferred ratio (chromic acid to sulfate). More detailed would be keeping the sulfate at the minimum for the specification. Plating thickness should be as close to final thickness as possible. Post plate grinding should be gentle, about two microns per pass, always maintaining good water cooling.

Current interruption will be detrimental to good adhesion. Check for loose contacts and any hot spots. AC ripple should also be checked. It is critical to perform this test using an oscilloscope. Electrical problems can be a real demon, especially in chrome plating.

We have separately listed potential problems in surface preparation and plating. Hopefully, the plater has sufficient information to focus his energy directly on the problem and initiate effective corrective action.

Dummying is Good; Can be Better

Barrel platers of brass and zinc parts can be faced with quite a problem in the nickel plating. Not to overlook surface prepara-

tion and the copper strike, but lets just spend a few moments on the nickel end. Obviously, the major problem of a dark gray, streaked deposit is the lurking culprit. The contributing factors are always the same, including parts dropping out of the barrel, poor coverage in the copper strike, and not enough dummy purification. The combination brass/zinc magnet has not yet been discovered, and may not ever be. Therefore a little careful attention and diligent maintenance will greatly minimize zinc & copper contamination in the nickel bath.

Equipment. Specifically the barrels. Check for structural integrity. Any warping, cracking, or loose sections? Are the danglers in serviceable condition (*e.g.*, clean not overly thick contacts, good, uniform insulated arms and tight contact). Are the barrel perforations clean and unplugged? Make sure the perforations are of sufficient size to prevent parts from falling through them.

Parts. Examine them to be sure they will not nest or interlock while rotating in the barrel. Determine if the inclusion of slugs or shot will be helpful. Check for and confirm there is a sufficient loading of parts in the barrel. Surface preparation is very important. Be sure the parts are clean and active, optimized for the plating steps.

Nickel bath. The wet analysis should meet the specifications for the plating requirement. For example, 8–10 oz/gal nickel chloride, 30-40 oz/gal nickel sulfate, pH range of 4.0–4.5. Add a standard carrier (saccharin type) or zinc tolerant version. Incorporate a wetting agent. It will help to emulsify organic contaminants and enhance distribution of brightener additives in the bath. Purifiers can be very helpful addition agents. They should, however, only be added as recommended for routine maintenance to eliminate dark recesses. If metallic contamination becomes a problem during high demand production periods, the purifier can maintain a good deposit until dummy purification is initiated. Purifiers are excellent products. But, their application should be focused as a service additive, not a magic bullet for extreme metallic contamination. Lastly, there is no better maintenance than to check for and remove dropped parts! Look at the line rinse tanks. If you see accumulated parts on the bottom, it's a safe bet the same buildup of parts will be on the bottom of the nickel tank.

Dummy purification. This is the best way to keep the bath clean and greatly minimize metallic contamination levels. It is also rather simple to conduct and economical. The best way to proceed is to select a suitable steel sheet that has been pleated into uniform corrugations or expanded metal. The importance is to maximize the low current density area. Clean, activate, and nickel plate to sufficiently cover the surface. Then lower the current density to plate at $2A/ft^2$ (for copper) or $5A/ft^2$ (for zinc). Better yet, dummy at $2–5A/ft^2$, to more efficiently plate out both metal contaminants. How long? Just periodically check the inner corrugations of the dummy. Keep dummying as long as the deposit color is gray. A continuous "white" deposit of nickel insures the bath is sufficiently purified to meet general production plating demands. Dummying by these parameters consumes little nickel and power. That is why routine dummying is a good practice. The dummy sheet is relatively cheap. Recycle or replace it to keep the surface area in prime condition.

Following are some practical considerations for scheduling:

- Dummy the bath when not planned for production runs.
- Dummy before the day or shift commences.
- Dummy the night preceding the beginning of the work week.
- Consider the full time benefits of dummying. This can be readily accomplished in existing tanks or when planning new installations. After the nickel bath passes through the filter, have it discharged into a dummy cell that channels the solution back to the plating tank. If space is a constraint, insert a corrugated sheet into a nickel tank dead zone and dummy. In this example, dummying occurs continuously while the bath is in operation. The double benefit is carbon filtration and dummy purification. ***P&SF***

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