P&SF Retrospective

Originally contributed by Ronald Kornosky
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Springfield test

Q: ***We have been asked to apply a manganese phosphate coating on ferrous components. One of the quality-control tests mentioned in the relevant in-house specification is the "Springfield Immersion Test." I would appreciate any information you have on this. Also, how does it relate to the usual salt-spray test?***

A: The Springfield Immersion Test is used primarily to check the corrosion protection of a heavy zinc or manganese phosphate coating before any oil or drawing lubricants are applied. Thomas Myroup of Oakite Products, Berkeley Heights, NJ, says the test is spelled out in a military specification, DODP 16232 [manganese phosphate type m, z]. It is an accelerated immersion test using parts or panels for 10 min in 2 wt% sodium chloride dissolved in freshly boiled deionized water. The pH is kept at 6.8 to 7.0 and the bath temperature at 149 ± 3°F (65.0 ± 1.7°C). Aeration of the bath to adsorb CO_2 is required.

The Springfield test apparently can be used in some cases, with military approval, as a substitute for salt spray. Advantages, according to Mr. Myroup, may be that (1) it's faster (10 min vs. 1.5 to 24 hr for salt spray) and (2) the equipment is less expensive.

Chromium mist

Q: ***How can I check a hexavalent chromium bath for mist? Also is venting a must?***

A: One simple test method employs a standard vacuum pump with a known ft^3/min displacement to pull air from any area through a slightly acidic water solution utilizing a gas dispersion tube. The chromium concentration can be checked and calculated to give a reading of chromic acid per ft^3.

The maximum allowable concentration for 8 hr of exposure to chromic acid and chromates as CrO_3 is 0.1 mg/m^3 of air. This has been set by the American Conference of Government Industrial Hygienists. They also publish data for ventilation required in ft^3/min, based on ft^2 of tank surface. These figures vary depending on whether or not the tank has a hood, an enclosed hood or a canopy. Most state departments of health also have this information available, as well as guidance on appropriate test methods.

Venting requirements can be reduced using fume suppressants. Companies supplying products for chromium plating offer mist suppressants either pre-mixed or as a separate additive. The fume controller actually lowers the surface tension of the solution so that very small bubbles of gas are evolved and a controlled foam blanket is kept on the solution/air interface. The gas bubbles therefore are restrained from flying off the surface as a mist.

Poor adhesion on circuits

Q: ***We make flexible printed circuits and our material is processed roll to roll. We find that when we pattern plate and solder plate we often have adhesion problems with our dry-film resist. There is much bending of the web over the 10"-diameter rollers. Our material is electroless plated and then electrolytically flashed with copper sulfate before the photoresist is applied. Scrubbing is often difficult due to the thin materials and web distortion. What can we do to improve adhesion of the resist?***

A: Dr. Alan Poskanzer of Morton Thiokol Inc., Tustin, CA, reports that obtaining good dry-film adhesion over an unscrubbed or unetched electrolytic copper surface "is a near impossibility." Those who operate such a process do so either with lifting problems or no margin for safety. The surface topography is simply too smooth and the grain structure of the electrolytic copper is too tight.

There are three alternatives, according to Dr. Poskanzer. The simplest and most reliable is to use scrubbing. Pumice scrubbing is best, he says, but is not popular because pumice machines tend to be "self-destructive." Scotch-Brite* scrubbing is next and "brushlon" scrubbing is least effective but still desirable.

** Product of 3M Co., Minneapolis, MN.*

Dr. Poskanzer continues, "If scrubbing is not possible, then a chemical etch may be used. Any of the common etching compositions such as ammonium or sodium persulfate may be used. Peroxide/sulfuric acid etchants may be employed, too. The persulfates leave more of a matte finish than do the peroxide/sulfurics. In any case, etching should be done under mild conditions so as to remove only a small amount of copper (about 15 to 20 μ-in.). This will be less costly. The etching step should be followed with a sulfuric acid post-dip to remove oxides and then immersion in a suitable anti-tarnishing agent before thorough drying prior to rolling up the flexible board materials. This way, they will be matte and well preserved before dry-film lamination.

"The third alternative," he says, "is simply to do away with the electrolytic strike and put the dry film right on top of the electroless copper. For this, a good reliable, heavy-deposition electroless copper is needed. Dry film will almost always adhere exceptionally well to the electroless copper surface because the surface is inherently matte and the grain structure more open. The electroless copper should also be treated with an anti-tarnishing agent and thoroughly dried prior to rolling and laminating."

Silver-lead alloy

Q: ***We have a request to plate a bearing surface with silver-lead alloy and can't find a bath to do it. Any recommendations?***

A: Chapter 8 in the book *Silver in Industry*, edited by Lawrence Addicks, Reinhold Publishing Co. (1940), gives information on plating a silver/3 to 4% lead alloy for bearings. The alloy can be electrodeposited from 22 g/L potassium cyanide, 30 g/L silver cyanide, 47 g/L potassium tartrate, 0.5 g/L potassium hydroxide and 4 g/L basic lead acetate - $Pb(C_2H_3O_2)_2 \cdot 2Pb(OH)_2$ - at 77 to 86°F (25 to 30°C), a cathode current density of 5 to 15 A/ft^2 (0.5 to 1.5 A/dm^2), and an anode current density of 5 to 7.2 A/ft^2 (0.5 to 0.72 A/dm^2).

Reports Dr. Charles Faust, finishing consultant in Columbus, OH, "To make up the bath, the silver cyanide should be dissolved in a solution of the potassium cyanide. The lead salt should be dissolved in a solution containing the potassium tartrate and the potassium hydroxide. When the solutions are clear, they can be mixed together to form the plating bath.

"The alloy plate is smooth at 29.5 mil (750 μm) or more in thickness and contains 3.3 to 3.5% lead, balance silver. The anodes are 96.2% silver/3.8% lead and are made by casting in a warm, graphite mold in order to provide suitable grain size and uniformity. The anode efficiency of nearly 100% is slightly greater than that of the cathode.

"As deposited," summarizes Dr. Faust, "the hardness of the alloy plate is about 126 Vickers (diamond-point indicator with 1-kg load). If annealed for about 1 hr at 550°F (288°C), the hardness is lowered to about 46 to 60." *P&SF*

The edited preceding article is based on material compiled by Mr. Ronald Kornosky, then of Hager Hinge Co., in Montgomery, AL, as part of the Finishers Think Tank series, which began its long run in this journal 26 years ago. It dealt with everyday production plating problems, many of which are still encountered in the opening years of the 21st century. As we have often said, 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.