Finishers' Think Tank

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Electroless Nickel: Problems & Corrective Action

Electroless nickel (EN) has been and continues to be in popular demand for a variety of engineering, aerospace, automotive, medical, military and similar related finishes. Problems related to this process have been along "for the ride." It is important to understand these problems, probable sources and corrective action. These unwanted deposit conditions might include roughness, pitting, edge skip and premature corrosion. Let us review some of these problems.

Metallic contamination

Metals not part of the process may be introduced into the EN solution, by drag-in of previous activation acid, attack on zincated aluminum surfaces or an excess of proprietary EN additives (such as stabilizers and catalysts). Metals such as cadmium and lead (especially before RoHS) reduce the plating rate. Catalysts may destabilize the solution, resulting in decomposition. Plating on plastics (POP) which use precious metal catalysts are a likely source. Rinsing and, if possible, avoiding use of plating equipment for POP and going directly into EN is recommended. Zincated aluminum parts should first undergo an EN strike (mildly alkaline bath) that sufficiently seals the zincate coating. Use of RoHS compliant EN is additionally preferred to avoid the detrimental stabilizing effects of cadmium and lead. In general, metallic contamination can be very critical to the EN bath. As little as 1 - 5 ppm of specific metals (cadmium, lead, bismuth, chromium, copper and tin), 15 ppm zinc and 75 ppm iron, can make the difference to a properly operating EN bath.

Organic contamination

Fine deposit pitting is a typical indication of organic contamination. This is normally a problem associated with incomplete surface preparation, likely poor soak or solvent cleaning. Oils and grease effectively "spot out" on the surface, especially after acid activation, forming a barrier to deposition of EN. To a lesser degree improperly cured stop off or lubricants dripping from operating equipment, can also be a problem. It is usually optimum per production demands and time constraints, to replace the EN bath. At the same time, correction of the identified problem needs to be accomplished.

Nitrates

Only a few ppm of nitrates can significantly affect the EN deposit. Problems occur, such as, streaks, discoloration, slow or no deposition. The main cause is poor rinsing after a nitric acid containing desmut or zincate strip. Accurate test papers can be used to confirm nitrates in the EN bath. Correction is either replace the EN bath or (but in both cases) improve rinsing between acid desmut and the EN bath.

Chlorides

This contaminant affects the desired corrosion protection of the applied EN deposit. This occurs as chlorides increase deposit porosity. The main culprit is poor rinsing of a previous hydrochloric acid or pickle. Either improve rinsing or eliminate chlorides in the acid. In fact, etching or pitting of stainless steel EN tanks may also occur.

Orthophosphite

This is one problem that is inevitable. It occurs as an oxidation reaction occurring with the hypophosphite reduction of nickel. The analysis of orthophosphite can be tracked as the EN bath ages. Four grams of orthophosphite is formed for every gram of nickel that is reduced. Usually a concentration of 100 - 150 g/L of orthophosphite significantly affects the desired corrosion protection and the appearance of the EN deposit. A turbid or milky appearing solution also indicates high orthophosphite. In fact, this solution color may also occur with high pH, or low complexer.

In addition to these just discussed contaminants, similar adverse conditions affect the EN bath performance.

The EN bath

Low deposition rates can be the result of low nickel, hypophosphite, pH and/or bath temperature. Other operating factors include a bath that is over-stabilized, low bath loading (surface area per bath volume) and excessive solution agitation.

No deposition in a newly prepared EN bath can be the result of low bath analysis, pH, temperature or that copper and brass parts are not catalytic.

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nickel plating. Four to five oz/gal sulfamic acid or dilute phosphoric acid and using a short immersion time should be used to minimize hydrogen embrittlement of the basis metal. Even weak sulfamic acid has good deoxidizing ability (activation power).

3. Don't use rolled depolarized anodes, or any insoluble anodes. The intrinsic stress increases rapidly.

4. Don't ignore the stress, particularly if internal anodes are required such that sulfur depolarized anodes cannot be used. Be aware of the increase in compressive stress of the deposit.

5. Don't allow particles from anode bags to get into the solution. Agitation can sometimes cause particles to come over the top of the anode bag. ***P&SF***

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Pitting can also be corrected with proper filtration, and using bags rated for 1 micron. Tanks, pumps, liners and piping should also be approved for EN application.

Rough deposits can be the result of poor filtration, low solution agitation and shelf roughness (adjust the rack orientation of parts). Chemical sources are low bath stabilizer, rather large volume additions and high bath pH. Localized solution overheating is corrected by improving solution movement and circulation. Excessive work load per bath volume should be adjusted to the recommended range.

Porous deposits can arise from suspended particles in solution, organic contaminants, porous base metal and an aged EN bath (high in orthophosphite).

Non-uniform deposits can be the result of out-of-range EN bath operating parameters and insufficient surface preparation.

Deposit blisters can arise from poor surface preparation, an over-stabilized EN bath or dragging contaminated rinses into the EN bath. ***P&SF***

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