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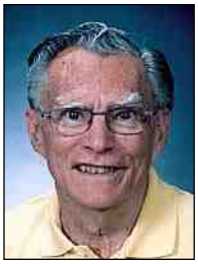

Do's and Don'ts of Sulfamate Nickel Plating

Why is sulfamate nickel plating used? The deposits are ductile, yet strong. The deposits have good thermal and electrical conductivity, favorable modulus of elasticity, low coefficient of expansion and the formula is simple. It does not cause hydrogen embrittlement per se. Embrittlement is often due to pretreatment, such as the use of hydrochloric acid or sulfuric acid. A mild sulfamic acid or mild phosphoric acid is suggested for a very short time when treating high strength steels. The sulfamate radical is very strong in activating steels. There is a sulfamate nickel strike formula that will activate some stainless alloys that are difficult to activate using a Woods strike.

Sulfamate nickel solutions can plate at very high current density using mild agitation. Over 100 A/ft^2 (10.8 A/dm^2) is possible. With moderate agitation, the deposition can be run up to 400 A/ft^2 (43 A/dm^2) With high agitation, 600 A/ft^2 (65 A/dm^2) or more is possible and with "hone plating," where an agitator is in contact with the deposit surface moving at relatively high speed, 6000 A/ft^2 (646 A/dm^2) is achievable. The plating rate is about a mil per minute.

Trace metals in the plating solution can influence some of the characteristics of the sulfamate nickel deposit. For example, a small amount of manganese (Mn) decreases stress and more important, manganese can inhibit sulfur migration to grain boundaries of the nickel deposit. Also, manganese in the deposit will stop cracking at weld sites by preventing sulfur from reaching weld areas. Sulfur is a common impurity in sulfamate nickel deposits. Sources of sulfur are carbon filters and overflow from anode baskets, because of the sulfur depolarized (SD) anodes required for sulfamate nickel. The particulate sulfur can co-deposit in the nickel. On heating of the deposit, sulfur migrates to grain boundaries.

Small amounts of magnesium have little or no influence on the physical characteristics of the nickel deposit. Small amounts of chromium, copper, zinc and cadmium change the properties of the nickel deposit drastically. Cobalt additions will harden the deposit and enhance the hard magnetics. Iron will also increase the deposit magnetic characteristics.

Sulfamate nickel deposits make a good base for bright nickel plating. It is used with diamond particles used in cutting tools. Sulfamate nickel deposits are useful for many different applications.

Do's

1. Do keep undesirable impurities out of the sulfamate plating solution. If impurities are indicated, remove them as soon as possible, using correct methods for purifying the sulfamate nickel plating solution.

2. Do take advantage of the high plating rate using high agitation.

3. Do use eductors properly placed to increase solution agitation, to aid in high speed plating.

4. Do test for metallic and organic impurities frequently and remove them as soon as possible to maintain the desirable deposit characteristics.

5. Do use a moderate solution temperature. High temperature can slowly hydrolyze the sulfamate resulting in ammonia. Ammonia is an undesirable impurity.

6. Do keep the pH at 4.0 to 4.4. At pH 4.0 or above iron is insoluble and can be picked up in the filter. A pH below 4.0 allows iron to stay in the solution causing adverse effects in the deposit. At pH 5.0 or above, hardness increases and ductility decreases due to the co-deposition of oxygen.

7. Do use sulfur depolarized (SD) anodes only. Any other anode will cause compressive stress in the deposit. Keep bags full of anode chips. Keep the top of anode bags above the SD nickel anode squares.

Don'ts

1. Don't overheat the plating solution. A temperature over 120°F (49°C) causes hydrolysis of the sulfamate-producing ammonia that has adverse effects on the deposit. Ammonia is difficult to remove.

2. Don't use mineral acids such as hydrochloric acid or sulfuric acid in preparation for sulfamate

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*

Finishers' Think Tank

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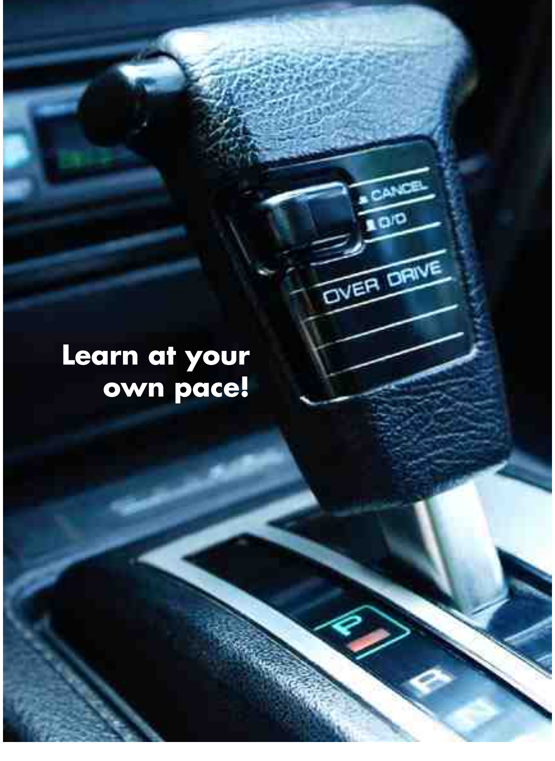
Pitting can also be corrected with proper filtration, and using bags rated for 1 micron. Tanks, pumps, liners and piping should also be approved for EN application.

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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