## Finishers' Think Tank



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Have a problem on the finishing line? Please send your question to "Finishers' Think Tank," 12644 Research Pkwy., Orlando, FL 32826-3298; or e-mail to journal@aesf.org.

Hydrogen Embrittlement

I am having a problem with hydrogen embrittlement of fasteners that are deposited with cadmium and baked. We use a lowembrittling formulation for our process—what else can we do to correct this situation?

It has been demonstrated that Α. detrimental hydrogen embrittlement may result from a cadmium cyanide plating process, and that it is a function of cathode efficiency, which controls the introduction of hydrogen to the surface of the part. The structure of the coating controls the rate of removal of the hydrogen during postplate baking and high-temperature treatments. Optimization of the cadmium plating process minimizes the hydrogen embrittlement of the surface. Recent specifications call for the non-inclusion of organic or metallic brightener components in the plating process, in order to maximize the cathodic efficiency of the solution and leave a surface that can be easily relieved of hydrogen. Brighteners tend to suppress the ability of the surface to lose hydrogen because of tight crystal structure formation. In addition, you must keep the bath free from contaminants, especially nickel and other heavy metals that can adversely affect the efficiency of the process.

A brightener-free cadmium cyanide plating solution will deposit a surface structure that will allow for the removal of hydrogen from the surface and decrease the effects of embrittlement. Another area to watch is the carbonate concentration of the plating solution. Carbonate concentrations of > 4 oz/gal will drastically reduce the efficiency of the plating solution and will increase the propensity of the bath to cause embrittlement. A dedicated line to produce the cadmium-plated parts is essential to eliminate some of the contamination problems associated with the process.

To keep the plating solution at peak performance, I recommend regular use of a notched tensile strength sample to monitor the potential embrittlement of your system, particularly when the processed components are critical. When calculating the applied current density of the operation, also keep in mind that barrel plating is a combination of high and low current densities, depending on the position of the part within the load, and not merely an average of the current applied to the load. How the parts behave in the barrel, as well as the load size, is important in determining the applied current. Experimentation to determine the proper load size is also important in optimizing the process.

## Depositing EN on Copper Alloys **What cycles should be** followed to deposit electroless nickel onto copper-based alloys?

A Electroless nickel (EN) is also called autocatalytic nickel. Nickel is deposited by a chemically driven reaction that happens only if there is a catalyzed surface on the part to be plated. Metals that are not catalytic to EN include lead and copper alloys, among others. Because copper and most copper alloys do not have a catalytic surface for EN, they must first be coated with a material that is catalytic, or that will cause the surface to become catalytic. This is normally accomplished by making the parts cathodic in the EN bath using a stainless steel or nickel anode, which will cause the electrolytic reduction of nickel onto the surface. Because the electrolytic nickel coating is catalytic to the chemical reduction reaction, plating will continue, catalyzed by the nickel-coated surface.

Another method used is to sensitize the surface of the copper part with a material-such as palladium chloride in a solution of hydrochloric acidthat will cause the chemical reduction of the nickel at the surface. This will cause the reduction of nickel onto the surface of the part, allowing further deposition by the autocatalytic EN process. This method is widely used in manufacturing printed circuit boards, where deposition is targeted only on areas coated with copper, and not on the plastic associated with the boards. Because the copper is infinitely more sensitive to activation by palladium than the plastic, this method works well.

In recent years, palladium activation of copper has become more common. Because the quality of the resulting EN coatings is better, adhesion is improved and the deposit is more uniform with a better grain structure. The activators also allow plating over poor coverage areas, such as 90-degree angles, and over solders and areas affected by solder flux. A downside of using activators is, if they are carried over to the plating bath, they can cause spontaneous degeneration of the solution. Consideration must be given, therefore, to the cycle and to the number of rinses used between the process tanks.

## Cadmium Processing

Q. We are processing hardened steel landing gear components in cadmium and are experiencing some blistering in certain areas of the parts. The copper contamination level is >250 ppm the specification for the cad process does not include a concentration for copper. Can this be our problem?

A During our conversation, you described the Herculean effort you take in preparing the parts and limiting the preplate causes of embrittlement. Just the use of cadmium demonstrates that the components you are processing are very important to the end-user, as well as to your company. As such, it is very important to apply what I call a "flying ethic" when processing life-critical components.

Although I don't think that the copper concentration is a contributor to the blistering, it still doesn't belong in the process. The inclusion of copper will cause overall differences in the functionality of the deposit. The complex of copper cyanide is much more stable than that of the cadmium cyanide and should not allow inclusion in the deposit, except in certain current densities and under certain conditions where copper can truly change the characteristics of the coating. You must first find the reason for the copper contamination and correct it, then remove and replace the solution, and monitor the situation closely.

You also described operation of the solution at a carbonate level of up to 16 oz/gal. This is a major problem. The cadmium bath efficiency is dramatically affected by carbonate concentrations. A 4 oz/gal maximum of carbonate is recommended in this type of operation for optimum efficiency.

The blistering is probably associated with defects in your preparation process, and most likely with the blasting techniques used. Check the areas that are being manually prepared vs. those that are automatically blasted. The process and the blasting media must be controlled or your problems will persist. **PESF**  You'll leave your heart—but not your wallet—in San Francisco, where an expensive meal isn't that pricey. It is always a special pleasure to travel to the Bay Area, and I like to eat like a local, not a tourist. Having a relative's establishment on the wharf doesn't hurt ... so when you're in town, visit Borruso's and mention my name!

Exquisite elegance awaits you at the top of the list in the Ritz-Carlton Dining Room in the legendary worldclass hotel—a great place to stay and to eat. Enjoy New French cuisine at this wonderful place for dinner meetings or special events.

No trip to the area is complete without an oriental meal or two from downtown's elegant, top-rated Tommy Toy's to the "embarrassingly inexpensive" House of Nanking in Chinatown, there are lots of choices.

Another favorite Bay Area meal is seafood. As if the breathtaking view alone is not enough, the food at Roy's At Pebble Beach, along the legendary 17 Mile Drive, is well worth the effort. No car? No problem! Those who have their hearts set on seafood at Fisherman's Wharf can head for A. Sabella's. Also in town, the appropriately named Aqua is described as a "Mecca for seafood lovers" even if "your jaw may drop when you get the bill."

I still enjoy a good cigar, and cigar aficionados are increasingly welcome in Bay Area eateries. Supper clubs such as downtown's Essex and BIX in North Beach cater to cigar smokers, and many restaurants provide special bars or sealed rooms where you can puff away without offending anyone. Smokers at JT's Bistro, for example, can head upstairs to the Stellar Cigar Society Room.

When in wine country ... more and more good vintages can be found locally, thanks to the increasing number of neighborhood wine bars. Hayes and Vine in the Civic Center lets you enjoy good vintages late into the night. In Cole Valley, Eos promises an "expansive" wine list while waiting to enjoy its Cal-Asian cuisine. (\*)

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