Making Direct Contact

A plastic anode basket can help improve plating performance . . .

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Imost everyone is familiar with the electrical contact problems associated with corrosion and salt build-up between a copper anode bar and a hanging-type of anode basket. This corrosion reduces current flow, thereby reducing plating thickness or extending plating time and reducing efficiency.

There are two mechanisms that reduce plating efficiency. The first is obvious. It is an increase in electrical resistance between the copper anode bar and basket hanger. This resistance reduces current flow and typically worsens as corrosion increases. In extreme cases, this resistance causes smoking or burning contacts between the anode bar and basket hanger.

The second mechanism is more subtle. I think most people have seen gouging, pitting or wearing on the copper anode bar where it contacts the anode basket hangers. Normally, pitting is not caused by resistance. Rather it's caused by electrical arcing resulting from intermittent electrical contact. In other words, the basket moves slightly during normal operation to break through the corrosion and make contact for a brief period of time with the copper anode bar. Then it rocks some more and contact is lost. The basket is switching off and on during the plating cycle. During the off cycle no plating takes place from that basket, even though the basket next to it is working. This effect causes damage in several ways:

• First, electrical power is wasted because the electricity is generating heat and smoke and vaporizing copper instead of plating.

• Second, the non-conducting bas-



1. ANODE BASKET design for consistent conductivity during plating

ket is absorbing zinc or is anodic for the off-cycle time. In extreme cases where the basket becomes permanently insulated, an anode basket is encased in metal, which should have been plated onto parts.

• Third, it means that the effective anode area is much lower than what it appears because of the baskets that are not connected.

These conductivity problems can be overcome by frequent cleaning with wire brushes or other means. However, electrical conductivity continues to decrease between cleaning, and frequent cleaning requires increased labor and downtime. There



DIRECT-CONNECTED plastic anode basket

are other problems associated with the hanging-style baskets.

Consider a basket with ball anodes in a zinc system. Assume none of the anode bar contact problems exists and the basket was just filled with new, shiny zinc balls. Each zinc ball touches the basket at one point (perhaps 18 - 24 points total), as well as each other. When the line is activated, electric current flows down into the basket and contacts each zinc ball individually. Zinc dissolves and moves toward the part to be plated.

Electrical current takes the easiest path to the part being plated, so only

those zinc balls facing the work dissolve and plate out. The other zinc balls just get dirty and/or oxidize over time. Eventually they are electrically insulated from the basket. Also, don't forget that titanium forms an oxide film on its surface that protects it from corrosion. Because the film is an electrical insulator, there must be enough force to "scratch through" the titanium oxide film as well as the zinc oxide film.

As time passes, all the balls touching the basket on the side opposite the work are electrically insulated from the basket side, so current flows from the zinc balls above or below it, assuming the contact points on these balls aren't too oxidized to conduct electricity.

This up-and-down conduction and possible insulation of some individual balls cause replating of zinc on the zinc balls, which effectively starts gluing balls together into a solid structure.

The sides of the balls facing the work are bright and shiny and are pushed into the titanium on the work side by the weight of the balls above them. This happens until the balls become so glued together that they can't push out to the active face. Don't forget that this has to continually happen to overcome the effect of zinc dissolving and shrinking away from the titanium, thereby losing electrical contact.

After a week or so, the zinc balls have more or less glued themselves together in a long mass and are probably touching the basket at only two places, the ball at the top of the basket and the ball at the bottom of the basket. The top contact has little pressure associated with it, probably not enough to break the oxide films. The bottom contact has a lot of pressure associated with it, the entire weight of all the zinc balls, but look at what else is in the bottom of the basket: mud, dirt and oxidized metal. The bottom ball has to push its way through all this insulation material to make contact.

The conductivity problems described above are usually attacked by beating on the basket with a hammer to obtain some temporary electrical conductivity. The basket design itself provides a poor electrical contact system. The electrical current gets past the anode bar to the anode basket hook contact, flows down the entire length of the titanium basket, and back up through partially oxidized zinc balls and out into the work.

So how do you eliminate these problems? You build a new type of anode basket. As an example, let's construct a simple ball-type anode basket. Start with a non-flattened expanded titanium grid plate about three-by-24 inches and weld a stub piece of titanium rod to the center. Connect a length of insulated copper wire to the titanium rod by means of a special submersible insulated connection.

Then fabricate a special open-mesh plastic sock with an open top and a flat, V-shaped closed bottom. The titanium grid plate is inserted into the sock and the sock is suspended above the plating tank with the grid plate under the solution level and the wire running outside the plating tank to the electrical bus. The wire is connected to the bus through a fusible link that operates as a safety device. Anodes are added to the sock in such a way to orient the titanium guide plate between the anode metal and the work to be plated. (Fig. 1.)

The wire is directed from the copper bus outside the plating tank to the center of the titanium grid plate, eliminating any electrical connection above the plating tank. This also eliminates cleaning the connection, hot spots, electrical connection resistance, intermittent contacts, electrical burning, and pitting. This also allows a much higher current-carrying capacity.

As anode metal (zinc balls) is added to the basket, the additional weight stretches the plastic sock, wedging the balls into the titanium grid. The sharp edges of the non-flattened titanium easily cut through any oxide or dirt accumulation, assuring good contact. As the anode metal dissolves and its size decreases, it continuously drops lower into the plastic "V" notch, where it is still pushed into the grid plate to assure good contact.

In this system all of the anode metal is 100 pct in electrical contact 100 pct of the time. This improves the total plating system because electrical efficiency is improved, providing more current per station. This higher current provides faster plating time and/or high plating thickness. The electrical efficiency is essentially constant and doesn't deteriorate between anode bar cleanings, so plating thickness is more uniform.

The anode-to-cathode ratio is reduced. The old anode basket systems operated at a ratio of around 2:1. The theoretical is 1:1. These baskets operate at about 0.8:1. This lower ratio allows the plater to reduce the number of anode baskets per station without increasing the dissolved metal contact of the bath. Conversely, in applications that require higher metal concentration, conversion will increase the metal content. A side effect of the conversion to plastic baskets is the elimination of metal falling into the tank because of titanium deterioration.

An example of an actual installation includes one plater with a sixstation acid zinc barrel line. This shop had 26 ball-type anode baskets per station. They pulled an average of 485 amps per barrel. After conversion, six direct contact plastic baskets per station provided an average of 550 amps per station. **PF**

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