Organic Compounds & Carbon Treatment

Many platers continue to ask: How should I test for organics? When should I carbon treat? Will I lose my brighteners? ...

By William J. Saas (from 2002 Flo King newsletter)

Not all organic compounds are detrimental to plating baths. Just as there is good and bad cholesterol, some organic compounds provide essential performance characteristics and others negatively affect performance. For example, certain organic materials are needed in bright nickel baths to ensure deposits are ductile, low stressed, and will accept topcoats of chrome. Similarly, other organic compounds are needed in copper, zinc, tin, and tin-lead baths to provide grain refinement, brightness and leveling, and to increase the maximum current density without burning. These beneficial compounds typically comprise the addition-agent systems that suppliers offer.

Examples of organic compounds that typically have a negative effect on plating are:

- Oil/grease/drawing compounds/ lubricants, etc.
- Buffing compounds.
- Cleaner and acid wetter drag-in.
- Masking agents.
- Incorrect additions to the bath.
- Additive breakdown products.

The first three of these contaminants generally enter the bath as a result of improper cleaning or rinsing. Likewise, masking agents can contaminate a bath if not compatible with the electrolyte or the operating conditions. For example, a temperature-sensitive masking agent may decompose in a hot solution.

Operator error while making normal additions can also create problems. For instance, adding excess secondary brightener to a bright nickel bath can cause brittleness, stressed deposits, or a lack of chrome coverage. Finally, many addition agents—if present in high enough concentrations—decompose upon normal electrolysis to form compounds that cause hazy or cloudy deposits.

Testing for Organics

All plating shops monitor the appearance of production parts. This serves as an effective—albeit indirect—means of determining the level of additives in the bath, as well as a test to determine if there is significant organic contamination present. If, for example, bright nickel-plated parts exhibit uniformly bright and haze-free, ductile deposits, and exhibit the proper degree of chrome coverage, it's reasonable to assume that the organic additives intentionally added to the bath are within their suggested operating range. It's also reasonable to assume that the concentration of organic compounds that might have a detrimental effect on plating performance is below a level at which they will cause problems on plated parts.

In addition to constantly scrutinizing production results, most well-run plating shops monitor overall performance using periodic small-scale tests in a Hull Cell or a Jiggle Cell. The latter is particularly effective for checking the overall performance of nickel baths. These tests are either run at the shop itself or in a supplier's lab. Panels run on a sample from a bath high in detrimental organics will generally exhibit some type of negative characteristic. In the case of nickel plating, depending on the type and degree of organic contamination, panels often show one or more of the following faults: brittle and/or stressed deposits, pitting, blistering, haze/clouds/discoloration, high-current-density burning, low-current-density dullness or darkness, and poor chrome coverage. (Measuring chrome coverage obviously requires running a second test where chrome is applied over a nickel-plated panel.)

Small-scale tests provide empirical results, as opposed to actual concentrations. Fortunately, almost all suppliers have developed special analytical procedures to measure the concentrations of the various additives they supply. Again, using nickel plating as the example, High-Pressure Liquid Chromatography (HPLC) is the most common such procedure. Furthermore, at least one supplier has developed a special HPLC procedure to track the buildup of detrimental organics in operating baths. This special long-scan screening test helps the plater by predicting when a batch carbon treatment may be needed to avoid production problems.

Magic of Carbon

Carbon removes organic compounds from plating baths by a chemical process known as *adsorption*. The carbon literally attracts the organics to its surface, where they attach themselves. Unfortunately, this reaction may reverse over time, meaning that the removed organics can detach from the carbon and re-enter the bath. One way to minimize the chances of this happening is to remove the carbon-treatment device from the bath after

Options: Flo King pump with carbon bag, canister or cartridge.

the specified contact time has been completed.

Carbon works its magic on all organic compounds to some degree. Thus, some beneficial organics, such as essential additives, are removed in the course of treatment to remove the bad organics. Fortunately, in most situations, the detrimental organics are removed faster and to a greater degree than the beneficial compounds.

The rate of removal and the degree to which various organics are removed depend on a variety of factors, including:

1. The solubility of the compound in the bath. The more soluble the compound, the harder it is to remove and the less that is removed during carbon treatment.

2. The polarity, or ability of the organic compound to bond with water molecules. The less polar the compound (i.e., the less likely it will bond with water molecules), the faster and more completely it's removed during carbon treatment.

3. The treatment temperature. Generally, carbon treatment at higher temperatures, say 150 to 160° F (66-71° C), is noticeably more effective than at lower temperatures.

4. The pH at which carbon treatment is done. As mentioned, some compounds are less soluble at lower pH, meaning they are more effectively removed at lower pH. Other organics are less soluble at higher pH, and are therefore most effectively removed at higher pH.

Shop Practices

Organic compounds are generally removed by either batch treatment or continuous carbon "polishing." **Flo King** in-tank systems are especially effective at maintaining low levels of detrimental organics. In fact, regular use of **Flo King** carbon cartridges, bags or canisters containing activated pelletized carbon is so effective, it typically reduces the frequency of and sometimes eliminates the need for batch treatment using powdered carbon.

In some instances, other contaminants are present in plating baths, along with the detrimental organics. Example: It is well known that iron tends to build up in chloride zinc baths and all types of nickel baths. In these cases, it is generally necessary to add an oxidizer, such as peroxide or permanganate, and raise the bath pH before carbon treatment.

There are also some organic compounds more effectively removed at low pH. This is especially true in the case of nickel baths, where treatment at pH 2.5 -2.7 often affords much more effective removal of detrimental organics than at normal or even elevated pH.

Shops that experience frequent buildup of detrimental organics should review their preventive maintenance programs and overall operating procedures. They should also work closely with their addition-agent supplier(s) to determine the source of the bad organics. If it is a buildup of electrolytic decomposition products, it's possible that the wrong type of addition-agent system is being used. In some instances where extremely high-quality plating is required, a specifically formulated addition-agent system should be used rather than a lower-performance "workhorse" variety that must be operated at unusually high brightener levels to achieve the desired performance.

If frequent carbon treatment is required due to drag-in, this might suggest improvements in rack maintenance. Cracked rack coatings almost invariably create aggravated drag-in situations. Likewise, many shops have gone to non-chelated cleaners to reduce potential waste-treatment difficulties. In some cases, especially where difficult-to-remove soils are present, the non-chelated cleaners do not provide clean parts, and contamination is dragged down the production line, eventually causing a buildup of detrimental organics.

No Single Answer

As one might suspect, there is no practical way to predict the ideal treatment that will hold true for all plating shops, or even for baths of a given type. This is because there are so many organics that can—and usually do—enter various types of plating baths. Think for a minute about the variety of soils that a typical jobshop encounters every month, or the variety of wetting agents in suppliers' cleaners and acid wetting systems. Think also about the variations in plating bath additives from one supplier to another, and remember that, in many cases, the main reason for a treatment is to remove some of the detrimental organics that form as a result of normal bath electrolysis.

Two final points. First, platers frequently ask, **"How much of the beneficial organics will I remove from my bath if I carbon treat?"** The answer is, there is no answer, only sweeping generalities, such as 10 to 20%. Remember, the more effective the treatment, the greater the degree to which *all* organic compounds are removed. Thus, to significantly remove the detrimental organics, it follows that some of the beneficial additives also will be removed. Fortunately, most suppliers have quick and reliable methods that will tell the plater how much material should be added back after treatment.

Finally, it's important to remember that the treatment conditions that provide the most effective removal of bad organics may not be the best to use every time that specific bath is treated. It's quite possible that the source of the detrimental organics will change over time. The major contaminant in one case may be buffing-compound residue in a nickel plating bath, but two months later, an excess of addition agent might be the reason for treatment.

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