Critical Step: Surface Prep

Pretreatment cleaning technologies and troubleshooting

BY MAX GEORGE

Plating processes can be difficult to maintain and control on a clean surface. Poorly preparing your parts for your finishing step will put you at a severe disadvantage for controlling the quality and consistency of your operation. Therefore, cleaning is the critical first step of any finishing process and overlooking it can come with costly consequences.

Good cleaning works in two ways: it removes all foreign matter from the surface of the metal part and it maintains the surface of the part. If we do not effectively remove contaminants like drawing compounds, lubricants, and rust preventives, these can act as a barrier on the metal surface and cause your plated metal to blister or peel. Also, if the cleaner is not appropriate for the substrate being cleaned, the cleaner can degrade or erode the metal surface that can make the surface inert.

Alkaline cleaners will be used in the majority of your pretreatment processes to remove organic soils from your metal that make up your most common metalworking fluids. They do this with a variety of ingredients, with the most important being alkaline builders. Sodium or potassium hydroxide are the most alkaline of the builders and function to saponify fats and oils while neutralising any acidic soils.

Other alkaline builders include carbonates, phosphates and silicates. Silicates are particularly important when cleaning nonferrous parts as these serve to inhibit attack of the base metal. Most cleaners also contain surfactants which are organic materials whose molecules have both a water-soluble portion and an oil soluble portion. Surfactants lift the oil from the part being cleaned and hold it either in solution or cause it to split out and move to the surface of the cleaning bath. Sequestering agents and chelators are also often included. These ingredients work to tie up metal ions like calcium, iron, and magnesium that are commonly found in water and can interfere with the detergency of the cleaner.

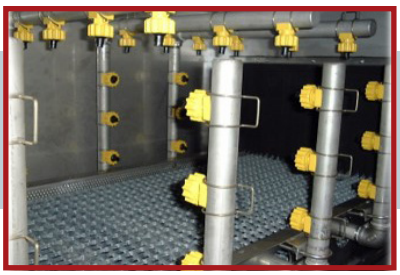
In most plating processes, the first step will be an alkaline cleaner. One method of application is spray cleaning, where the parts are hung or placed on a conveyor and sprayed with a heated cleaning chemistry. The spray produces an impingement action when used in combination with the chemistry and heat can quickly prepare your part for plating.

A more common method is immersion cleaning. This is a cleaning process where the bulk of the work is done by the chemistry of the cleaner and heat. This process is often used

Air Agitation

Electro Cleaning Operation

Plating Line Setup



Spray Washer

when parts are smaller with complex geometries where spray cannot clean all areas equally and it generally has greater heat, concentration, and contact time than a spray cleaning process.

The second step is usually an electrocleaner. Electrocleaning is used to remove soils that could not be removed in the alkaline cleaning step. These are often inorganic in nature and may include metallic fines, polishing compound abrasives, carbon and other alloying elements. Even when the electrocleaner doesn't completely remove the remaining soils, it conditions them for easier removal in the subsequent step. This cleaning process uses an electrical current and specially formulated cleaners. The parts are electrically connected and either oxygen or hydrogen is generated at the part depending on whether the part is connected to positive or negative current. This gas generation provides a scrubbing effect to supplement the heat and chemical cleaning action.

Electrocleaning is followed by an acid pickling step. The acid is used to remove scale and oxides and neutralize alkaline residues to result in a clean, active plateable surface. A variety of acids can be used ranging from strong mineral acids to mild mineral acids, organic acids or acid salts. Acid choice depends on the substrate as well as the severity of the soil. For steel substrates, hydrochloric acid is commonly used. Additives and proprietary acid blends are available offering acid inhibitors, fluoride activators, and/or surfactants for improved rinsing and providing mist suppression.

Immersion Cleaning Tank

Cleaning aluminum alloys prior to plating requires different pretreatment steps compared to steel and other alloys. This is due to aluminum's high affinity for oxygen. A typical cycle consists of a non-etch alkaline cleaner, alkaline or acid etch, deoxidizer and zincate (immersion zinc plate). Depending on the alloy of aluminum, the etch step may be omitted. There are a range of chemicals and proprietary blends available for the deoxidizer which also depend on the alloy being processed. Often a double zincate cycle is used where the first zincate coating is removed in a nitric acid solution and a second, thinner zincate coating is applied. One of the challenges in particular for job shops that process a wide variety of aluminum alloys is being able to alter their process as needed for proper pretreatment.

When thinking about your cleaning stage, there are some elements that you can control and toggle as needed. The acronym "WATCH" stands for Water, Action, Time, Chemical, and Heat. The lower the conductivity of your water the better as some of the ions and contaminants in harder water can interfere with the cleaning process. Action refers to how the chemistry is being applied on parts i.e. what is the pressure of your sprays or flow over the parts in an immersion application. Time, Chemical, and Heat are all factors where your change in one area can affect the parameters needed in another. If you are short on cycle times, you may need to increase the heat or the concentration of your chemistry. If you are running a higher concentration, maybe you can run at a lower temperature or for less time. If temperature is your limiting factor, you may need to increase concentration or temperature.

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Many cleaning chemistries have been used for decades per the old mantra "if it isn't broke, don't fix it," but increasing pressures from environmental bodies and customer preferences seem to be dictating some changes. Sustainability is no longer a differentiator but is becoming a demand of many platers. Low temperature cleaners are being developed and trialed to help reduce a plater's footprint and spending. Nonylphenols that were once a standard of cleaning chemistries are being more aggressively regulated and their phase out of formulations is being accelerated. Platers are also experiencing staffing shortages and are requesting fully formulated products where in the past, they may have wanted to split out some of the commodities as tank side additives to save cost.

Properly preparing your parts is key for any quality plating operation. Trying to cut corners or save a few dollars could prove to be very costly in part failures and defects. Take time to work with your chemical supplier to find a solution that works for your line, your parts, and you. ■

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