Stephen F. Rudy, CEF
Enequist Chemical Co.
100 Varick Avenue
Brooklyn, NY 11237
718/497-1200
E-mail: sfrudy@aol.com

Is It Soup Yet? On the Track of Perfect Surface Finishing

Every time we process parts, tackle a new job, or run different finishing cycles, important decisions are made. Our choice of path or progression is certainly very important. The most critical selections we make are related to three very important operating parameters: time, concentration, and temperature. Getting these right shouldn't become a shell game or three card monte. Believe it or not, there is a very critical law related to our profession that for some reason many try to circumvent, stretch, or violate. How we make our selections, set operating parameters, and follow the cycle will ultimately affect the completion. Taking this to the next step—how we do the job—has a direct bearing on properties of the finish. Major considerations include corrosion protection, wear resistance, lubricity, and desired aesthetic qualities. Let us review a checklist that should be helpful for any finishing project.

Inspection

Parts should be carefully examined for any unsuspected surprises. Things to look for may cover an interesting range of possibilities. Burrs and surface damage, such as cracks and pits, should be noted. Perhaps mass finishing, electropolishing, manual polishing, or chemical immersion treatment may correct or sufficiently reduce such defects. There is also the chance that surface damage may not be economically or feasibly corrected by any selected treatment. In this case, the parts should be rejected outright, defects highlighted, and appropriate corrections made in the manufacturing process.

The Process Cycle

Select the correct or most appropriate cycle for the job or project. It's important to understand the requirements, both in regard to finish and post finish. The continued development of effective processes gives us choices for the type of treatments and finishes we select. Bright nickel and chrome versus copper strike, bright copper, duplex nickel, and chrome are examples of two different cycles. Each provides specific protection along with aesthetic qualities. Chloride zinc versus alkaline zinc offer different deposit covering ranges and brightness/leveling. Alloy plating with chromates helps to achieve excellent corrosion protection. Sulfamate nickel is not intended for a bright finish, but it provides important deposit ductility characteristics. Electroless nickel affords deposit hardness. Hard chrome can be used to refurbish worn parts by building deposit thickness, along with the accompanying hardness. Aluminum requires a special surface preparation cycle and surface treatments prior to electrolytic or electroless plating. These are some examples of process cycles and selections, based on targeted finishing requirements.

Operating Parameters

Each process bath or surface treatment has associated with it a specific range of effective operating parameters. These are time, temperature, and concentration. In a cleaning tank, they are very important. Optimizing each parameter affords the best cleaning results. Arriving at the best settings or levels largely depends on experimentation, running smaller test loads, and evaluating the results. This is not as cumbersome, tedious, or highly technical, as it may sound. Cleaning systems, by and large, encompass and optimize the best operating parameters, as per their specific design and development. There are many cleaning processes, such as aqueous, semi aqueous, biologically active, and solvent. Vendors can help select the right processes and optimize these parameters. Experience is also an excellent resource for selecting and setting the known operating parameters. Each plating system includes specific conditions for their best performance and response. Concentrations of salts and proprietary additives with recommended ranges make up the specific bath profile. Operating temperature along with appropriate current densities have been previously tested and tuned for best response and effect of metals deposition. Post dips such as chromates work best when set and kept at recommended operating parameters.

For any process of choice, the development or selections of time, temperature, and concentration need not be a chore. There are many resources for tested and true settings, once the processes have been selected. There is no way to push a cycle towards successful completion if the cleaners are at half strength or 20 degrees below temperature. Half-strength plating baths maintained at the wrong temperature or current density will not provide the desired finish. To get it right, set it right and keep it right. In a similar way, a cook wouldn't prepare soup diluted with too much water, or with the wrong amounts of spices.

Let's spend some time reviewing a most critical part of the finishing industry that is constantly beleaguered.

Faraday's Law

How many times have we encountered instances where this law is violated in some form. Either knowingly or unintentionally. Or perhaps circumvented in the hope that a cheaper, faster result can be obtained. Let us first confirm how Faraday's Law affects us. Simply stated, during electrolysis, the number of electrons liberated at the anode by negative ions is equal to the number of positive ions taken up or deposited at the cathode. Faraday's Law can be expressed in two parts. In one, the mass of a material liberated during electrolysis is proportional to the amount of electricity passed. The quantity of electricity is a coulomb. A flow of 1 amp for 1 second equals 1 coulomb.

$$(\text{Amps}) \times (\text{Seconds}) = \text{Coulombs}.$$

By doubling the current, the quantity of electrons in transit is doubled. Therefore, the number of ions (positive and negative) reacting at the charged electrodes is doubled, thereby doubling the masses of substances. The masses of substances liberated are proportional to current and time, or the quantity of electricity. The other part of Faraday's Law states that different substances liberated by the same value of electricity are proportional to their atomic masses divided by the valence of their ions. If a material forms singly charged ions, the value of electricity carried in a known number of particles is half that quantity carried by the same number of doubly charged ions. This can be broken down to state that the Faraday Constant, which is 96,500 coulomb/mole, is the amount of electricity required to liberate a mole of monovalent ions.

Our industry acknowledges the importance of Faraday's Law. Plating processes include specific guidelines with respect to current densities relative to rates of deposition for various metals. We must recognize that operating parameters include optimized equipment, chemistries, temperature, and current. Furthermore, handbooks and bulletins abound describing specific rates of deposition for metals at given current densities. Simply put, there is no other way to plate, but with the correct settings and maintenance. Anything else will not work. Faraday's Law is unbreakable. It doesn't even bend. *P&SF*