tives, including quaternary amines, pyridine, substituted sugars and non-ionic surfactants will affect both brightness and crystal structure. The use of tartrates and citrates will help prevent anode polarization and permit the use of higher current densities.

Post Treatments

As versatile as the brass deposit itself is, there are many more post treatments that may be applied. These treatments produce a range of final finishes from bright brass to colored effects. Regardless of the final finish desired, a post treatment step will be required because of the brass deposit's soft characteristics and affinity to tarnish easily. In the case of bright brass finishes, an anti-tarnish step is required. This is usually accomplished by applying a thin film by dipping the part in either a weak chromic acid or benzotriazole solution. This will produce a temporary protective coating, which will prevent tarnishing and discoloration until a subsequent lacquer can be applied.

Coloration of the brass deposit through a controlled oxidation process is commonly called "antique finishing." The purpose of this is to create a finish that resembles the natural aging process of the brass. Of course, due to refinements in the oxidation processes, the "aged" look has given way to a rich, deep tone that has become very popular in the furniture industry. The antiquing process has evolved from a difficultto-control, luck-intensive art form into a consistent science. Originally, the brass was oxidized by dipping into a solution

containing ammonia, sulfide, carbonate, hydroxide or chlorates. This produced in consistent color, because the dipping solutions were very aggressive and control was nearly impossible. Later, a combination process using calcium polysulfide followed by sulfuric acid helped stabilize the color, but solution control is still a bit of an art. Most antique finishes today come from dip solutions containing selenous acid, molybdenum and copper. These solutions produce very uniform color, and variables in the process are limited to time, concentration and temperature. The color produced from these dipping solutions can range from a light brown to a near black. Following the antique dipping process, the parts generally will then go through either a brushing or highlighting step and relieve the parts of excess oxidation. This produces the rich, deep "antique look." As with the bright finishes, antique brass must receive a coat of lacquer to hold color and resist abrasion.

Health Impact

Due to the corrosion properties of brass, it is not recommended for food service applications. There are no other restrictions known for brass plating.

Care must be taken in the handling of copper, zinc and sodium cyanides in the preparation of brass plating solutions. Since cyanide can enter the body by inhalation, digestion and absorption, ventilation is required, as well as protective clothing during handling. Face shields, gloves, aprons, boots and respirators are strongly recommended. The threshold limit value (TLV) for cyanide is 5 mg/m³.

Environmental Status

Treatment requirements for brass plating operations can be fairly extensive. Wastewaters must first be chlorinated for the removal of cyanide. Once cyanide destruction is complete, high pH precipitation of copper and zinc metals into a hydroxide sludge is generally the practice. New standards adopted by EPA require a lime stabilization of this F006 classified waste to meet TCLP requirements for land disposal. Recycling of plating wastes is becoming a more viable alternative as new technology provides improved reclaiming processes.

Current EPA wastewater effluent standards for existing metal finishing sources discharging to a Publicly Owned Treatment Works (POTW) for copper are 3.38 mg/L for a single day and 2.07 mg/L monthly average. For zinc, the standards are 2.61 mg/L per day and 1.48 mg/L monthly average. For cyanide, 1.20 mg/L daily and 0.65 mg/L monthly. Many municipalities have more stringent requirements. You should contact state or local authorities to determine the appropriate standards for your area.

Trends

Brass electroplate continues to be the deposit of choice in the hardware and lighting industries. Alternatives to conventional cyanide brass plating solutions are an ongoing search. Some non-cyanide plating processes are being marketed but have received little acceptance. Electrolytically applied dyes and resins (E-coating) are potential substitutes. Although this is a relatively new technology, the finish is gaining some acceptance. At the present time, however, cost concerns, inability to adapt the process to bulk operations, and the fact that the finish cannot be oxidized or antiqued reduce its versatility, and therefore, will reduce its applications in the field.