Phosphates - Metal Finishing

Phosphoric acid-based chemical polishes are used primarily to chemically polish (brighten) aluminum and aluminum alloys. These products, which can be tailored for a specific alloy, work in conjunction with nitric acid to smooth the surface of aluminum parts, giving a bright appearance.

Under normal conditions, aluminum parts, whether machined, stamped, or extruded, are first cleaned, typically in an alkaline or acid cleaner. These parts are then water rinsed prior to entering the phosphoric acid-based brightener solution. Nitric acid first reacts with the surface of the aluminum parts forming an aluminum oxide coating. Phosphoric acid is then added to attack this oxide coating forming aluminum phosphate, which congregates in microscopic recesses on the surface of the part. This action serves to protect the recessed areas from additional phosphoric acid attack. The highest peaks on the surface of the parts are eventually dissolved away by phosphoric acid; leveling the surface and yielding a part with a bright finish. This process is known in the metalworking industry as “bright-dipping” and is often followed by a final anodic- protection step using sulfuric acid.

Another application for phosphoric acid in the metal finishing industry is that of phosphatizing which protects steel with a phosphate coating. Phosphatizing is essentially the pickling of steel in phosphoric acid. The surface of steel is made up of numerous small anode and cathode sites. Phosphoric acid reacts with the steel at the anodes, liberating iron ions into the bath and generating hydrogen gas. An accelerator (oxidizing agent) is required to oxidize the iron and use up the hydrogen at the metal surface. This lowers the acid content, or pH, at the cathodic sites to the point at which iron phosphate naturally precipitates onto the steel surface. This process continues until all cathodic sites are coated. Iron phosphate formulations generally contain a combination of ferrous phosphate, ferric phosphate, and ferric oxide. Process operators typically use solutions that include phosphoric acid, an accelerator, and one or more surfactants. The surfactants help to wet the steel, enhancing adhesion of the phosphate coating. Phosphatizing helps prevent corrosion and prepares the metal surface for improved paint adhesion.