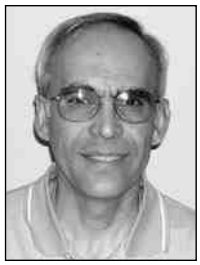
Stephen F. Rudy, CEF
Hubbard-Hall Inc.
563 South Leonard Street
Waterbury, CT 06708
E-mail: sfrudy@optonline.net



Phosphate Coatings: Some Basic Points

The applications of paints and powder coatings have become more pronounced over the years. In the 1990s, it was estimated that organic coatings had at the time replaced plated finishes by approximately 30%. A variety of parts that comprise products in consumer, automotive, aerospace, military and construction, abound, along with other end users. Organic coatings continue to be in demand and popularly applied. Let us review some basic facts and guidelines for the common types of phosphate coatings.

What it is

After surface preparation (cleaning), metal parts are immersed in, sprayed or brushed on with an acidic solution, especially blended to react with the basis metal. This reaction forms a product that is a modified metal phosphate species. This product can be referred to as a crystalline or amorphous material. The crystalline deposit that forms consists of insoluble salts that continually form on the metal part surface. Amorphous coatings are not crystalline, rather of a different formation. This deposit also forms on the metal parts surface. In both instances, there is a minor etching of the basis metal. The coating forms a tight bond to the metal surface. It is can be relatively thin, ranging from approx. 40 mg/ft^2 to upwards of 4,000 mg/ft^2, but uniform and dense. The coatings provide an excellent base for paints and powder coats, corrosion protection, accept lubricants and conditioners, enhance abrasion resistance, as well as accept waxes and rust preventative oils. Because of their nature, phosphate coatings are quite resistant to chipping and abrasion.

The main types of phosphate coatings are iron, zinc (light to heavy), and manganese. Light to moderate zinc phosphates are crystalline, developing a range of coating weights from 100 to 1,000 mg/ft^2. The coating tends to be smoother, as the weight per square foot decreases. These coatings provide the best corrosion protection versus the other phosphates. That is why they are ideal as a pretreatment before paints and powder coats. In addition they are excellent surface modifiers prior to cold forming. Having superior lubricant and drawing compound capacity, holding capacity makes them ideal for metal extruding and forming dies which last longer, due to reduced friction. This superior capillary action readily absorbs and retains the fluids mentioned.

Heavy zinc phosphate coatings normally range from 1,000 to 3,000 mg/ft^2 in thickness. These phosphate coatings are crystalline and dense, but more porous than the lighter coatings. The conditioned surface is coarser. Oils and waxes readily absorb into these crystalline structures. These heavier coatings are a build-up of crystal upon crystal. This mechanism of formation, a result of looser bonding, makes the coating more susceptible to physical failure. One fact that is common to zinc phosphate treatments is that proper cleaning to remove oils and grease beforehand is mandatory. Zinc phosphate solutions have no soil cleaning capacity in this regard.

Iron phosphate coatings are the lightest weight, ranging from 40 to above 80 mg/ft^2. These coatings are amorphous, not crystalline. Therefore, they are not absorbents for oils, lubricants and waxes. Rather, the iron phosphate coatings provide a corrosion protection underlayer and a bonding base for organic coatings. Unlike zinc phosphate solutions, combination cleaning and phosphating can be achieved in one process bath treatment. Compared to zinc phosphates, the iron phosphate process is more economical, both in chemical use and reduced energy requirements for heating. Additionally, analysis and process operating parameters are much easier with iron phosphates.

Manganese phosphates are typically the heavier ones, with a thickness range of 1,000 to 4,000 mg/ft^2. The crystalline structure is quite coarse. This improves the retention of rust preventative oils and lubricants. Subsequent corrosion protection is very good, along with minimizing galling of moving parts.

Applications

Zinc phosphate on steel can be applied for paint adhesion, adhesion of organic coatings, rust proofing, oil retention and cold forming. Aluminum and zinc surfaces (plated zinc) can also be treated for adhesion of organic coatings. Heavy zinc phosphate on steel is preferred for oil retention and rust preventatives.

Iron phosphate is applied to steel, zinc (plated zinc) and aluminum before application of organic coatings.

Manganese phosphate is typical on steel for improved wear resistance. ***P&SF***