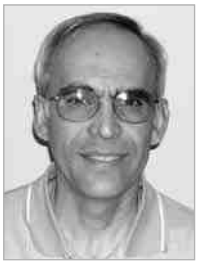

Phosphate Coatings: Some Basic yet Pertinent Facts

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Just like most metal finishing processes and treatments, phosphate coatings were developed to help protect the basis metal from corrosion. They also improve the adhesion of subsequent top coatings and enhance the performance characteristics of finished parts. The following goods, for either industrial or consumer application, rely heavily on phosphate coatings. Containers, instruments, automotive, aerospace, toys, window frames, metal furniture, water heaters, tools, toys, computer frames and electronic equipment are just some of these. It seems one cannot miss daily contact with something that has been phosphated.

Phosphate coatings have long been acknowledged for exceptional paint and powder coat bonding ability. In metal working, phosphated metals exhibit improved bending, forming and extruding properties. The improvements can be summed up as wear resistance, lubricity, adhesion of organic coatings and rust proofing. Crystalline phosphates absorb oils, thereby improving the corrosion resistance of processed coils and parts such as nuts and bolts. Iron, manganese and zinc phosphates are typically used in for most practical applications.

Metal surfaces such as steel, iron, zinc and aluminum are most commonly phosphated. In a specialized chemical reaction, the metal part surface is converted to a metal phosphate surface. The species formed in the iron phosphate process is an amorphous coating, whereas a crystalline coating forms in the manganese and zinc phosphate.

Iron phosphate

Iron phosphate may be applied to the surface in an immersion or spray application. Parts must first be cleaned to remove surface oils, grease and shop dirt. This may be accomplished in a separate cleaning step or in a combination cleaning and phosphate in a single process tank or station. Most iron phosphate coatings serve as a base prior to application of an organic coating, such as paint or powder coat. Typical coating weights of 25 to 75 (+) milligrams/ft^2 can be obtained. These coatings may be a deep blue to a light golden blue in color. Since these coatings are amorphous, they are less absorbent than the crystalline coatings. That is why iron phosphates are normally just a prepaint treatment. They are simpler to apply, show less sludging and operate at lower temperatures than manganese and zinc phosphates.

Zinc phosphate

Zinc phosphate may be applied as an immersion or spray. Five or up to seven stage units may comprise a zinc phosphate line. Process solutions provide very little cleaning ability. Therefore, a soak or spray cleaner should precede the zinc phosphate. Zinc phosphates provide the best corrosion protection of the types described. In addition, they are very good for cold forming, extruding, drawing and bending wire, and of course paint bonding. Zinc phosphate crystals may range in coating weight from 500 to 3,000 milligrams/ft^2. Because they are absorbent, the crystals hold drawing compounds and lubricants on the surface. This gives treated parts exceptional characteristics with regards to drawing and extrusion operations. The lower coating weights of 500 to 750 milligrams/ft^2 provide an excellent base for adhesion of paints. The heavy zinc phosphate coatings are typically 1,000 to 3,000 milligrams/ft^2. This range supports the absorption and retention of rust preventatives, lubricants, oils and waxes.

Manganese phosphate

Manganese phosphate is applied in an immersion process. It comprises the heaviest range of coating weights for the three processes discussed - 1,000 to 4,000 milligrams/ft^2. The structure is coarse and quite crystallized. This permits the crystals to retain more rust preventative oils and lubricants. Mild steel alloys are treated to improve wear resistance and provide exceptional lubrication. Gears, bearings and internal engine parts so coated improve break-in and prevent galling.

The table on the next page lists some applications of phosphate coating systems.

Phosphate crystals typically bind directly to the basis metal. This affords the coating exceptional abrasive resistance. That is why metals are zinc phosphated before cold forming and extruding. The heavier zinc phosphate coatings actually form crystalline bonds, to one another, within the total layer. This results in an overall looser bond, likely to be lifted or readily distorted in some mechanical operation. Iron phosphates are normally applied as undercoats for paint and powder. This provides excellent resistance to distortion and other phenomena such as chipping and abrasion.

Phosphated parts exhibit significant corrosion protection as per ASTM B-117 salt spray. It is not surprising, therefore, that phosphated panels that have been painted or powder coated may improve salt spray resistance ten times versus the same panels without the underlying phosphate coating.

The cost of corrosion to industry in general readily exceeds $125 million annually. All aspects of surface preparation and ultimate metal finishing are focused on preventing or minimizing corrosion. In a sense that is why our contributions, as a whole, are so important. Phosphating of metals is one important branch in this effort. *P&SF*

Applications of Phosphate Coating Systems

Phosphate	Basis metal	Requirement	Application
Zinc	Steel	Paint adhesion	Immersion or spray
Zinc	Steel	Rust proof	Immersion or spray
Zinc	Steel	Oil retention	Immersion or spray
Zinc	Steel	Cold forming	Immersion or spray
Zinc	Zinc	Paint adhesion	Immersion or spray
Zinc	Aluminum	Paint adhesion	Immersion or spray
Zinc	Steel	Oil retention	Immersion
Zinc	Steel	Rust proof	Immersion
Iron	Steel	Paint adhesion	Immersion or spray
Iron	Aluminum	Paint adhesion	Immersion or spray
Manganese	Steel	Wear resistance	Immersion

Typical phosphate bath operating parameters		
Phosphate type	**Operating temperature**	**Application time**
Iron	110-140°F (43-60°C)	1-5 min
Zinc	170-195°F (77-91°C)	15-30 min
Manganese	190-210°F (88-99°C)	10-20 min