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Use Common Sense to Avoid Flash Rust Problems

I was recently reminded that I have spent more than 40 years working to free surfaces from soils so that they could be finished by painting or plating. This prompted me to remember the many times that I answered emergency calls to help others eliminate rusty flash conditions that occurred on surfaces before, during, or after the preparation process. Flash rust can occur anywhere and anytime on a metal surface that is not handled and processed in the correct way.

Phosphate Conversion Prepares the Surface For Finishing

The fundamental chemistry of the phosphating process first cleans the surface to remove soils, such as oils, dirt, lubricants and light oxides; making the surface more acceptable for finishing.

The phenomenon of flash rust has received much attention in process application. There is very little on the subject, however, in my technical literature file.

Let's review some causes of flash rusting in the process of iron phosphating. Flash rusting, or oxidation conditions that interfere with surface finishing, still creep in daily.

The formation of flash rusting can really discourage metal finishers who are using iron phosphate for pretreating metal before painting or powder coating. Often, flash rust will occur suddenly and unpredictably, making it difficult to find and eliminate. It is, however, a condition that can be understood, and controls can be established to minimize or eliminate the cause. I have often used a simple color description to help operators look for signs of a proper conversion coating to anticipate and avoid flash rust.

The chemical composition of a phosphate bath will vary, depending on the supplier and the system being used. A three-stage system, or a multiple-stage system (five or more stages), can react the same when controls of the chemistry are not properly maintained. Because most phosphate conversion formulas are basically composed of phosphoric acid—plus accelerators, wetting agents, surfactants and other additives—it is important to know how to control concentrations, pH, temperature, etc., in the bath. The purpose is to clean, etch and deposit by conversion of the etched metal, to provide a complex ferric iron phosphate content. The chemist has already developed a specific ratio of ferrous and ferric iron, both in the bath and on the work.

The ratio of ferric to ferrous iron is related to the amount of ferrous iron dissolved during the phosphate conversion. Different baths will produce varying amounts of ferrous and ferric iron, because the amount of iron dissolved is a function of contact time, temperature, pH, concentration and surface activity of the metal or oxides on the surface. The mechanism of the phosphating reaction and the formation of oxidation (corrosion) are closely related.They can be in competition with each other.

The first step in creating a phosphate conversion is the dissolution of metallic iron. This puts ferrous iron in the solution that reacts with the phosphate ions and oxygen to provide the conversion. This is necessary to provide the conversion caused by the reaction with the accelerators. All of this helps to form the ferric iron part of the phosphate conversion.

As the reaction takes place, the normal tendency is for the pH to rise toward the neutral range. If phosphoric acid is added to lower the pH, it could create a condition that can cause flash rusting until the bath stabilizes. It is best to routinely add pH adjustments in small amounts—not in slug additions. The titration of neutralizing the acidic content of the solution does not distinguish between the phosphoric acid and the iron phosphate concentration of ferrous and ferric iron, so the pH may even indicate that the bath is correct and in good working order. Monitoring the bath should be done in a way that allows for small additions that will not cause drastic changes in pH or acid concentrations, unless the ferrous and ferric iron contents are being monitored according to supplier recommendations.

Check the Color

Remember, there are some color rules that give an indication of phosphate conversion conditions:

- Light gray color usually means a minimum phosphate conversion.
- Blue-gray may mean a light conversion.
- Blue-purple may mean a good conversion.
- Purple-gold means a heavy oxidized phosphate with a potential for flash rust.

Have test panels run for the full range of colors involved with the metals being processed and identify the corrosion protection, with and without paint, to obtain the desired quality. Then, use that information and monitor the solution color to help maintain the correct process. It's just a matter of developing the knowledge for a particular process and using it to make sure quality work is produced.

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