PRETREATMENT TECHNOLOGY

Nonpolluting replacement for chromate conversion coating and zinc phosphate in powder coating applications

David Ferguson *US EPA* **Bruce Monzyk** *Battelle*

This article summarizes a study about Picklex®, a proprietary formulation claimed to be an alternative to conventional metal surface pretreatments. EPA and Battelle researchers developed a laboratory program to compare the product with conventional metal pretreatment processes. This was done by using steel and aluminum panels and by measuring product coating properties, process operability, and costs. Researchers tested 41 combinations of substrates, degreasers, pretreatments, conversion coatings, and powder coatings to evaluate properties such as coating adhesion, bend, impact resistance, hardness, and corrosion resistance. The article gives results from an actual field study in a powder coating shop that validates the lab results. The study shows that panels pretreated with the product performed as well as panels pretreated with conventional solutions but that Picklex® offered a simpler, nonhazardous solution to conventional methods, particularly chromate conversion coating of aluminum and zinc phosphatizing of steel.

Most manufacturers would like to eliminate surface processing steps to reduce processing costs, waste production, and energy consumption. With these objectives in mind, a no-waste surface-finishing agent designed to provide a nearly one-step metal surface preparation operation offers a great benefit.

In this study, researchers evaluated Picklex®[1] as a metal pretreatment or pretreatment and conversion coating in finishing operations to find out if it could eliminate or reduce the amount of hazardous and toxic chemicals, which would be zinc phosphate for steel and chromate for aluminum. The goal was to accomplish equal or better performance properties with the product than with conventional methods, with economic benefit or without significant economic penalty. Researchers assumed the reduction in waste production would be accomplished through the elimination of processing steps that contained toxic wastes and consequently the waste stream volumes from these steps, especially processes involving ventilation of warm or gassing solutions. Researchers expected that these improvements would decrease production costs. The cost of the product itself would offset these savings somewhat. Researchers' specific objective was to evaluate product applications for powder coating finishes on aluminum and steel by conducting representative commercial field tests. The evaluation focused on technical performance and economics while validating the previous laboratory tests and environmental benefits.[2]

In this study, researchers used the product to provide metal surface cleaning, pickling, a conversion coating, and priming by using a process simply consisting of degreasing, a one-dip step (which could also be sprayed), one rinse, and then the final process. For powder coating field tests, oven drying occurred after the one-dip step. Because of the number of surface finishing operations, researchers assumed that the potential for sizable waste and cost reductions with the product would be significant. Therefore, the National Risk Management Research Laboratory (NRMRL)[3] of the US EPA contracted Battelle[4] to perform a joint assessment of the efficacy of the product in major polluting metal surface finishing operations. The major pollution comes from emission and waste disposal from zinc phosphate and chromate along with their rinse water, which can be significant depending on the amount of production. There is also some visible surface rust on steel parts, which in some cases is removed by acid treatment (which is used by some job shops and becomes a hazardous waste).

Field testing

Researchers used a commercial metal-surface-treatment vendor's equipment and personnel to evaluate field-produced components and panels similar to those used in Phase I of the testing. The researchers then evaluated these test components and panels after treatment and powder coating with the same coating performance test conducted in Phase I.

Researchers studied a focused field test with the product for powder coating applications on aluminum and steel. The tests involved 41 different combinations of sub-