TECHNICALLY speaking

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Low-Temperature, Phosphate-Free Conversion Coatings

A cost-effective, high-performance, environmentally friendly alternative to iron phosphate.

Energy costs are a major concern for metal finishing operations and tie into environmental compliance issues. Wastewater treatment facilities in certain areas of the country are tightening phosphate and heavy metal discharge limits on metal finishers. To address these concerns, zirconium- and zirconium-vanadium- based inorganic conversion coatings have been developed. They focus on temperature reduction and phosphate discharge elimination while improving corrosion resistance.

Formulated to replace traditional iron phosphate, these products require very little to no heat to deposit an inorganic conversion coating. Conventional iron phosphate products, on the other hand, can require temperatures of 130°F to 160°F. Another benefit of this new technology is usage—a maximum of about 2% by volume is needed in the bath compared to approximately 2% to 4% by volume with conventional iron phosphates. Also, practical experience has shown that the usage of replenishing chemicals is reduced by at least 30%. Contact time is also reduced.

PERFORMANCE

These conversion coatings provide an amorphous surface in the nanometer (10–9m) range and require a short contact time of 15 to 30 seconds. Conventional iron phosphate coatings are usually in the micrometer (10–6m) range and require at least 45 to 60 seconds contact time. The coatings formed increase the surface area of the substrate, thereby enhancing paint adhesion, corrosion protection, and consequently salt-spray results. These inorganic conversion coatings do not require a post-treatment seal to achieve high-performance adhesion, under film corrosion and salt-spray resistance.

The corrosion-resistance performance of these inorganic conversion coatings is compared in Table I to conventional iron phosphate coatings (organic accelerator) with TGIC polyester and hybrid powder paint systems on cold-rolled steel and aluminum substrates.

As Table I indicates, the inorganic conversion coatings outperformed conventional iron phosphate coatings in under-film corrosion resistance.

In actual production on cold-rolled steel panels, this new type of inorganic conversion coating with a DI water rinse has been proven to outperform Bonderite 1000/P60 Chrome/DI rinse in corrosion resistance after 504 and 1,008 hours of neutral salt-spray exposure (ASTM B-117) as shown in Table II.

WASTE TREATMENT

These new technology coatings contain no regulated heavy metals and eliminate phosphate from the process bath. Sludge is also reduced to a minimum, while waste treat-

Table I: Comparison of Corrosion-Resistance Performance of Inorganic Conversion Coatings with Conventional Iron Phosphate Coatings

Paint System	Substrate	Inorganic conversion coating 2% conc., 80 °F bath, 30 seconds contact time	Conventional iron phosphate conversion coating 4% conc., 140 °F bath, 60 seconds contact time	Hours of neutral salt-spray exposure (ASTM B-117)
TGIC Polyester	Cold Rolled Steel	0.5 mm creepage from scribe	1.8 mm creepage from scribe	504
TGIC Polyester	Aluminum	0.2 mm creepage from scribe	1.0 mm creepage from scribe	1008
Hybrid	Cold Rolled Steel	2.0 mm creepage from scribe	4.3 mm creepage from scribe	504
Hybrid	Aluminum	0.4 mm creepage from scribe	2.2 mm creepage from scribe	1008

Test panels were prepared and tested according to ASTM B-117 and evaluated according to ASTM D-1654 Method 2. Ratings were taken of the average creepage failure from the scribe mark after a predetermined number of hours of exposure.

Table II: Comparison of Inorganic Conversion Coating with DI Water Rinse with Bonderite 1000/P60 Chrome/DI Rinse

Substrate	Creepage from Scribe After 504 Hours of Neutral Salt-Spray Exposure (ASTM B-117)	Creepage from Scribe After 1008 Hours of Neutral Salt-Spray Exposure (ASTM B-117)
CRS treated with Inorganic Conversion Coating and DI Water Rinse	0.5 mm	1.8 mm
Pre-Treated Bonderite 1000 / P60 Chrome / DI rinse	1.5 mm	2.8 mm

A TGIC Polyester paint, with an average thickness of 2.6 mils was used on all panels.

ment costs and other effluent issues are greatly diminished. Reduced sludge formation results in considerably lower maintenance costs since fewer bath dumps are needed and the incidence of plugged nozzles and other problems are reduced. Rinse water consumption is also reduced because of the lower amount of total dissolved solids present in these new coating baths. Lower total dissolved solids means less rinse water overflow is needed to maintain proper rinse integrity.

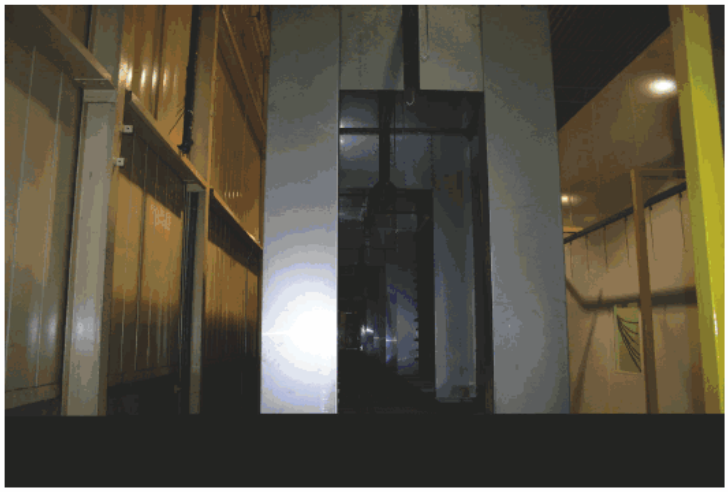

Figure 1: Stainless steel industrial spray washer.

BENEFITS

The benefits of these new types of conversion coatings are real and tangible. Energy consumption is reduced, the process is consistent and easy to control, while parts quality and performance are improved. The process produces much less sludge than conventional iron phosphates, and when the tanks need to be pumped out—about once a year—there is no need for a tanker truck to haul away the sludge as hazardous waste; all that is required is to neutralize the pH.

CONCLUSION

To summarize, these new products offer a cost-effective, high-performance and environmentally friendly alternative to traditional iron phosphates.

For more information on these new-technology inorganic conversion coatings, please contact EnviroServe Chemicals Inc. at(910) 892-1791, e-mail sales@enviroserveinc.com, or visit www.enviroservechemicals.com.