Ram Charan
PRODUCT DEVELOPMENT INFORMATION

VOLUME 1
ISSUE 8
DECEMBER 2011

"Eco-Friendly" Coatings Corrosion inhibitors (Zinc Chrome - Zinc Phosphate)

Human behavior has caused a great impact on the world; it has taken us time to understand the repercussions and the environmental accidents that have seriously compromised our own future. Chemical weapons, insecticides, fertilizers, industrial effluents, paints and organic solvents have damaged the health of the planet and its inhabitants to the point of contaminating even the most remote places.

In the eighties, due to several environmental scandals, different scientific publications, etc., prompted the need for a new environmentally friendly and transparent chemistry. Conventional coatings contain derived synthetic products from the petrochemical industry that can harm our health and the environment. The danger resides in the heavy metals such as lead, cadmium, mercury, etc., and in VOCs such as xylene, toluene, phenols and formaldehydes, which are emitted by paints and varnishes when applied, or while they dry.

The challenges currently faced by the coatings industry are not just to reduce cost and improve performance but also to fulfill strict legal requirements. In an American technical magazine the technical director of a major national paint company recently reported that his staff spends nearly 40% of its time reformulating their paint in order to meet increasingly stringent VOC regulation. Forty percent of his staff's time is a lot of time, and is robbing energy and efforts that could be devoted elsewhere, such as toward new developments.

The technical director was expressing a universal phenomenon in the paint industry. Large amounts of manpower are focused on correcting current formulations to new eco-green developments: replacing products containing hexavalent chromium or lead, among other heavy metals, and reducing or eliminating VOCs. This also avoids any undesired labelling that may be associated with toxicity in general.

In terms of corrosion inhibitors, some of the most effective and widely used anticorrosive pigments such as red lead (PbO_4), lead silica-chromate ($4\,(PbCrO_4 \bullet PbO) + 3\,(SiO_2 \bullet 4\,PbO)$), zinc chromate ($ZnCrO_4$), zinc tetraoxychromate ($ZnCrO_4 \bullet 4\,Zn(OH)_2$), and strontium chromate ($SrCrO_4$), have been and continue to be under heavy scrutiny due to the hazards posed to humans and the environment. Lead compounds are deemed toxic, zinc and strontium chromate are classified as carcinogenic and most recently, according to the EU Directive 004/73/CE, zinc phosphate has been determined to be a danger to the aquatic media.

In general, the latest global trend is to design coatings that comply with the environmental regulations that now exist. These "Eco-Friendly" or "Green" coating systems contain only non-toxic, non-reportable raw materials to ensure no hazard to humans and the environment. The industry has found it very difficult to obtain the same level of performance with the eco-friendly systems as compared to the non-compliant systems.

What is an Eco-Friendly Coating?

Coatings that meet the eco-friendly definition are high- or 100%-solids systems, powder coatings, UV- or EB-curing coatings, low/zero VOC, no heavy metal content, zinc-free or systems that contain no reportable compounds or ingredients in order to meet green label compliant status. Therefore, eco-friendly corrosion inhibitors should not contain heavy metals or non-reportable compounds, and be zinc-free in order to meet the green label compliant standard.

Ever since the use of chromates was restricted, we have been forced to use a variety of different non-toxic corrosion inhibitors specifically designed for a given substrate or resin type in an attempt to match the efficiency and versatility that chrome-based inhibitors offered. But now coatings formulators are demanding today's non-toxic inhibitors offer as much universal application in a wide range of binders and protective coatings as their toxic counterparts.

What is an Eco-Friendly Corrosion Inhibitor?

Zinc phosphate (Zn3(PO4)2 • X H2O) was the first and most widely used non-toxic inhibitor for replacing lead- and chrome-based inhibitors. Historically, standard zinc phosphate has demonstrated acceptable performance in real outdoor exposure, but less efficiency compared to chromates in marine environments and in accelerated weathering tests such as salt spray and cyclic corrosion (i.e., Prohesion). However its user-friendly, low cost, universal application, and good package stability in a variety of general-purpose industrial and protective coating applications, made zinc phosphate the most popular choice early on for replacing chrome- and lead-based inhibitors

Our goal was to develop met all the environmental demands required for green label compliant coatings but also provided a high level of cost-effective corrosion resistance, exhibited good correlation in accelerated and real-world environments, and offered universal application similar across a wide variety of resin systems and substrates equivalent to its zinc-based counterparts.

The following properties by using Zinc Phosphate against Chrome

- Universal application – water and solvent systems
- Improve early (accelerated testing) corrosion resistance
- Good correlation between accelerated testing and real world environments
- Good multi-substrate performance
- Application in thin-film (< 25µ d.f.t.) systems
- Good package stability

- Zinc phosphate coating is applied when increased corrosion resistance is required. Zinc phosphate withstands 240 hours of neutral salt test
- A wide range of coating weights may be obtained: from very thin fine crystal films to heavy deposits with weight up to 4 g/ft2 (40 g/m2)
- The coating color is gray of different tins from light to dark. Finer zinc phosphate crystals produce darker color Dark gray color is also characteristic for the high carbon steel substrates
- Zinc phosphate coatings may be applied by using immersion or spray technique
- Light and medium weight zinc coatings do not require substrate surface activation. The substrate surface should be acid activated prior to heavy coating deposition
- Zinc phosphate is used not only for non-coated Steels and cast irons but also for galvanized (zinc plated) steel parts
- Greater price stability vs. zinc chrome inhibitors

BENEFITS OF PHOSPHATE COATINGS

Corrosion Protection

Phosphate, followed by an appropriate post-treatment, provides added corrosion protection to the surface of the metal, prolonging service and increasing the shelf-life of stored parts.

Anti-Galling

The phosphate finish provides an anti-galling surface for mating parts that sacrifices the lubricating layer of phosphate during initial contact and abrasion, while a work-hardened surface is being formed.

Lubricity

The oil-based post-treatment available for phosphate not only provides added protection against corrosion, but also produces a lubricating film for smoother running of mating parts.

Reduced Light Glare

The phosphate finish also reduces glare and eye fatigue in optical applications or where bright light reflection is a concern.

Surface Preparation

The phosphate finish improves adhesion of parts prior to painting and lacquering processes.

Economical

Phosphate is a simple, cost effective means of providing mild corrosion protection and increasing the aesthetic value of parts. It is a much faster process that saves time and money over painting or other metal finishing processes.

TYPICAL SPECIFICATION OF ZINC PHOSPHATE BY TRANSPEK-SILOX

Transpek-Silox

PRODUCT SPECIFICATIONS

ZINC PHOSPHATE — CAS NO. [7779-90-0]

PHYSICAL FORM

Micronized Powder

CHEMICAL & PHYSICAL PROPERTIES

Parameters	Unit	Specification: Nominal value	Specification: Tolerance (±)	Test Method
01. Chemical Properties				
Zinc Content (as Zn)	%	50.0	2.0	ICP
PO4 Content (after calcinations - 1 hr at 600 degrees)	%	48.0	2.0	ICP
Oil Absorption (CM3/100 g)		27.0	5.0	ISO787/5
pH		6.5	1.0	ISO787/9
02. Physical Properties				
Average Particle size (microns)	M2/gm	4.5	Laser granular	
Bonded water content		15.7	1 hr at 600 gravimetric	
Sieve Residue (on 325 ASTM, 350 BSS, 45 micron)	%	0.05	Max.	ISO787/7

PACKAGING

25 Kg HDPE/Paper bags (Other packing available on request).

STORAGE

Keep it away from moisture. Store in a dry and well-ventilated place.

MAJOR APPLICATIONS

- ☐ Manufacture of Zinc Rich Paint Formulations.
- ☐ Manufacture of Fertilizers.

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