ACRYMAX TECHNICAL ARTICLE

ATA-101 Protective Coatings: Types & Mechanisms for Corrosion Control

Introduction

Corrosion is a destructive force that costs the US economy over $275 billion per year. Effective corrosion control methods are critically important in preventing deterioration of infrastructure with the resultant benefits to the overall economy. Protective coatings account for nearly 90 percent of the average annual dollars spent on corrosion control measures and serve a crucial role at preventing corrosion.[1]

Types of Protective Coatings

There are two main types of protective coatings that help with corrosion control: Metallic and Organic. Metallic coatings include processes such as galvanization and are durable but somewhat limited in their overall applications. Organic coatings are more versatile, making them more frequently used, and include coatings such as acrylics, alkyds, urethanes, etc.

Coating Mechanisms for Corrosion Control

There are three types of mechanisms for corrosion control that coatings regularly use: Barrier, Sacrificial, and Inhibitive.

Barrier coatings provide a physical barrier between a metal and the environment, thereby isolating the metal from water, salts and other corrosive agents that are necessary for corrosion to occur. Barrier properties are mainly due to the resin system chosen; however, they can be improved by using platy or lamellar pigments such as talc or micaceous iron oxide and by applying multiple coats.[2]

Sacrificial coatings incorporate particles of metal having a more active corrosion potential than the substrate metal to be protected. Zinc pigments are widely used in the formulation of coating systems designed to protect steel because zinc is more active electrochemically than iron. This means the zinc metal is preferentially oxidized over the iron, and corrosion of the iron does not occur. Zinc-rich primers for the protection of steel are an industrial coatings standard.[2]

Inhibitive coatings incorporate active corrosion inhibiting compounds that effectively interfere or inhibit corrosion processes through a chemical action or effect. Certain types of compounds, such as phosphates, molybdates or chromates, will release corrosion inhibiting anions when in contact with water. These anions may effectively inhibit corrosion by forming adherent mixed oxide films over the anodic or cathodic corrosion sites. Other compounds may also effectively absorb corrosion stimulating materials, such as sulfate and ammonium ions, or exchange them for less aggressive ions, including hydroxide or calcium ions.[2]

Summary

The thermodynamic drive of corrosion is impossible to completely control; however, protective coatings offer unique solutions to the challenges corrosion presents. One coating may incorporate several of the mechanisms described in this article to help with control corrosion.

A high-performance corrosion control coating system will generally not consist of only one type of coating. It will incorporate different types of coatings in functional layers to provide the best overall protection. Substrate specific surface preparation may also be required.[3]

Periodic inspection and maintenance of a protective coating system that has been applied to a specific structure will greatly extend its service life. This will make the structure much less susceptible to destructive corrosion attack.

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[1] "Cost of Corrosion" <http://www.corrosioncost.com>.

[2] M. Jay Austin. "Inorganic Anti-Corrosive Pigments." Paint and Coating Testing Manuel. 14th Ed. pp. 239-251

[3] Society of Protective Coating: Coating System Definition. <http://www.sspc.org>.