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Abstract

Traditional zinc or chromate based corrosion inhibitors have been used in coatings to provide long term corrosion protection by providing a sacrificial effect on the substrate and effectively creating a layer of oxidation on the surface of the metal which prevents additional oxidation or corrosion from taking place. However, due to large particle sizes of the zinc or chromate, there are gaps and voids which exist between the particles and this is where micro-corrosion can occur and lead to coating failure. Increasing environmental regulations are also limiting the use of certain metals such as zincs and chromates and forcing the need for alternative technologies. Vapor Phase Corrosion Inhibitors can be used in coatings as an alternative or an addition to standard zinc based corrosion inhibitors. Vapor Phase Corrosion Inhibitors generally have an attractive environmental profile compared to the metal based particles. Vapor Phase Corrosion Inhibitors are very mobile and act on the nano size scale to complement the function of particle based inhibitors.

Overview

At a microscopic level, Figure A, illustrates the surface of a coated substrate with traditional zinc inhibitors. As illustrated, the large particle size of the zinc inhibitors allows gaps and voids to exist on the surface of the substrate.

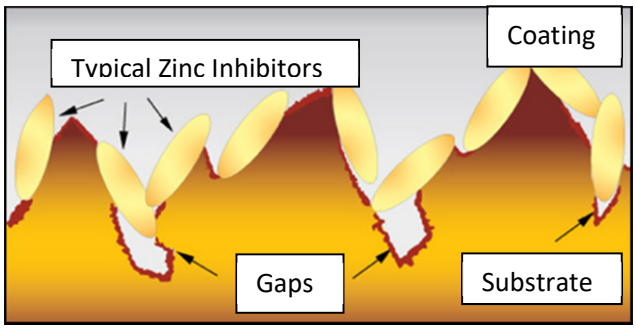

Figure A: Traditional Coating System w/Inhibitor

In Figure B, the same system as Figure A is shown with the addition of the Vapor Phase Corrosion Inhibitors. As illustrated, the Vapor Phase Corrosion Inhibitors due to their nano-molecular size, have the ability to coat the substrate and fill in between the gaps and voids that the larger particle zinc inhibitors are not able to fill.

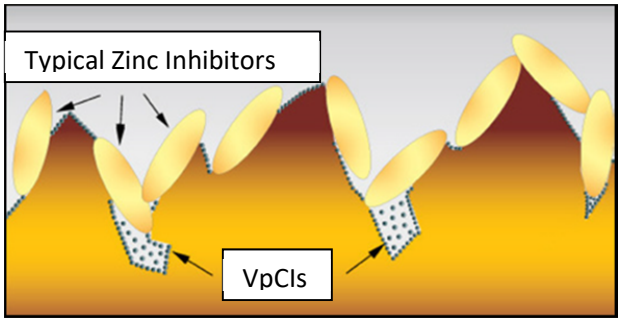

Figure B: Traditional Coating System w/Inhibitor & VPCIs

How It Works

The typical corrosion cell involves moisture working its way thru the coating down to the substrate and allowing the electrochemical process to start as illustrated in Figure C.

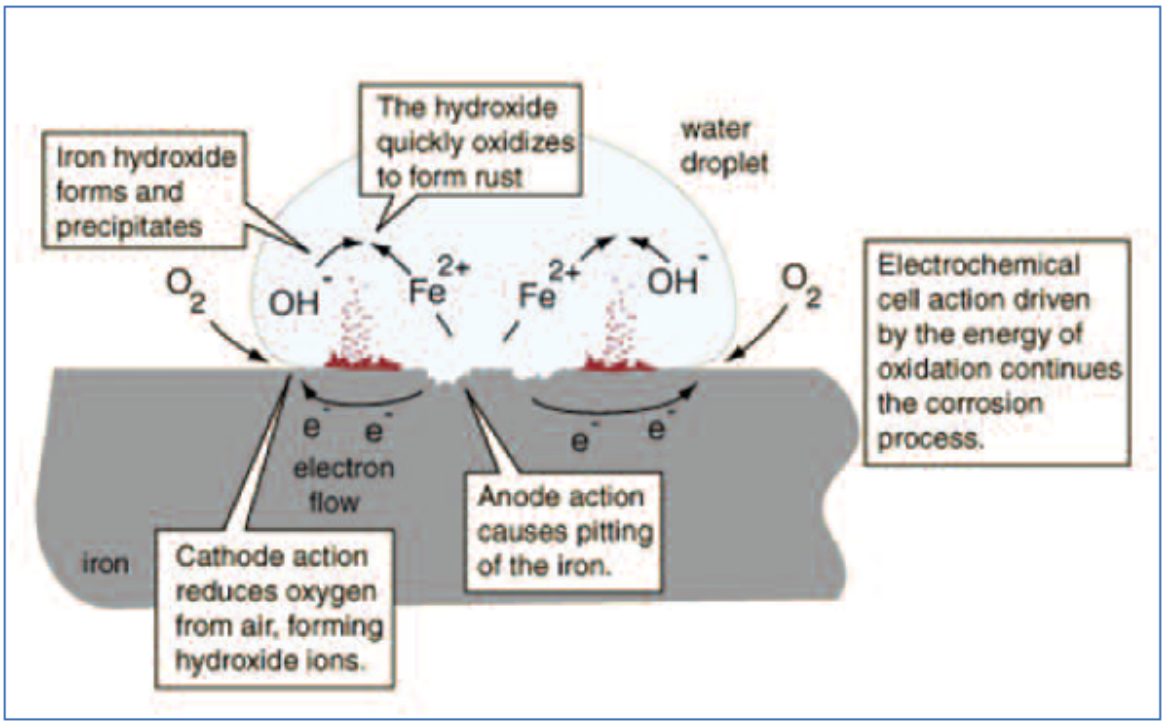

Figure C: Corrosion Process

Vapor Phase Corrosion Inhibitors are complex combination of various chemical compounds that have an affinity to metal. They travel thru the medium in which they are contained to reach the metal substrate and are adsorbed onto the surface of the substrate. Once they reach the surface of the substrate, they form a very thin protective layer on the surface of the substrate which prevents oxidation from occurring by effectively locking out the oxygen and preventing it from reaching the surface.

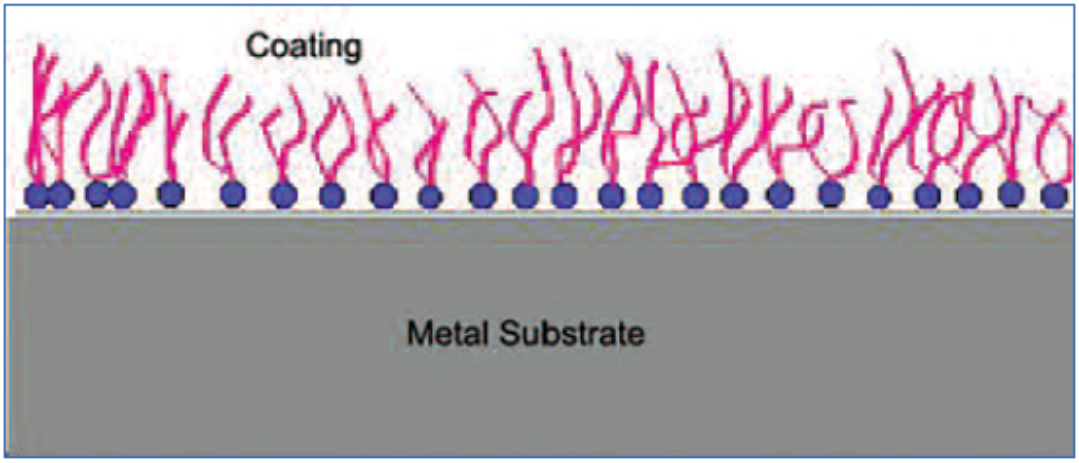

Figure D: Vapor Phase Corrosion Inhibitors attracted to the Metal Substrate

Examples of Coatings Using Vapor Phase Corrosion Inhibitors Technology

Figure E: Tested samples

Conclusion

Corrosion is a process of unintentional destruction of structural materials, caused by physical, chemical and biological agents. This is a spontaneous process that causes tremendous economic damage to economy.

According to some data, it was found that the annual cost of corrosion of metals, including measures to protect against corrosion in the highly industrialized countries amount to about 3% of their gross national income. This data is incomplete because they do not include secondary damage caused by corrosion such as accidents, threats to human health, production losses, serious environmental disasters, deterioration of cultural heritage and more. This demonstrates the great importance of quality corrosion protection.

Coatings are one of the corrosion protection technologies which may be used in combination with vapor phase corrosion inhibitors. By using vapor phase corrosion inhibitors, the effect of the coating is improved.

Vapor phase corrosion inhibitor technology operates at a nano particle level, which prevents corrosion in micro crevices and defects in the coating, and prevents the spread of corrosion beneath the coating.

Literature:

Boris A. Miksic, VpCI® Technology Handbook, Vol1

Boris A. Miksic, VpCI® Technology Handbook, Vol2