SSPC 2018(Draft)

Temporary Coating for In Process or Storage Applications

Abstract

There is a tremendous need for the protection of assets during processing, shipment and storage. Critical spares must be readily available and easy to place into service with minimal impact to the operation of equipment. The proven technology of VCIs(Vapor Corrosion Inhibitors) has long been used to preserve many of these assets using traditional mechanisms such as papers and films. Newer advances have allowed the use of this VCI technology to be incorporated into temporary coatings which are designed to provide corrosion protection in extreme environments, yet still be easy to remove compared to the older traditional wax type coatings or permanent coatings. By incorporating the VCI technology into these temporary coatings, it allows the use of thinner film thicknesses and less reliance on a thick barrier to keep contaminants away from the surface[1,4].

Four Learning Objectives

1. **What is a VCI**

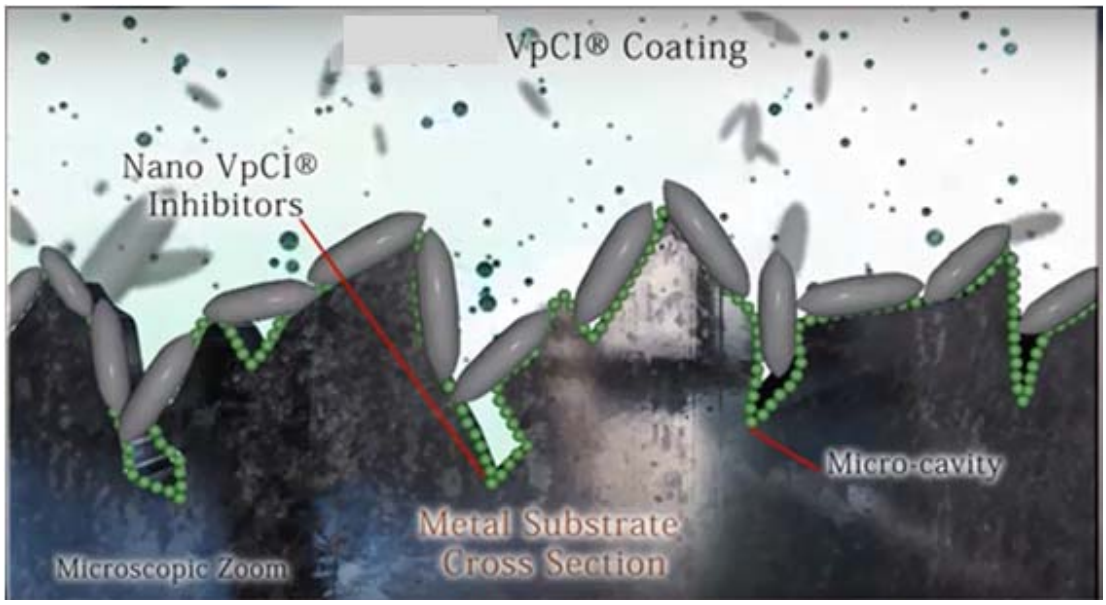
   VCI(Vapor Corrosion Inhibitor) is a corrosion inhibiting technology which consists of various organic and inorganic compounds which have an attraction to a metal surface. When properly formulated and compounded, this technology can be used in a multitude of carrier systems, such as coatings, which bring the inhibitors close to the metal substrate.

2. **How VCIs work in a coating**

   VCIs are formulated into a coating thru a complex development process which involves determining chemical compatibility of the VCIs with the other components of the coating such as the resin, solvents, pigments and other additives used for a variety of reasons. VCIs work by adsorbing onto the metal surface in a non-reactive attractive capacity, in other words, they are attracted to the metal through the particle charge[2].

3. **How VCIs compare to traditional inhibitors**

   VCIs compare with traditional inhibitor systems by using smaller particles as well as relying not only on contact inhibition but also vapor phase inhibition, providing more complete coverage and protection of the surface. This can be illustrated as follows:



The larger platelets are representative of traditional inhibitors which are unable to fill the micro-crevices, leaving gaps where corrosion can start and/or grow[3].

4. **What type of coating systems can use VCIs**

   VCIs can be used with most coating systems. There are many variations of VCIs and the key is to choose the correct VCI for the corresponding coating system by checking compatibility, effectiveness and processability.

5. **The environmental advantages of VCIs over traditional inhibitors**

   Traditional inhibitors containing heavy metals are becoming increasingly more regulated and often are no longer allowed to be used due to the negative impact they have on the environment and carcinogenic effects on workers exposed to them. The environmental advantages of using VCIs are that they are non-toxic, do not contain heavy metals, and have no adverse effect due to their low usage concentrations. VCIs have long been used in other products such as PE films, foams, powders and liquids to provide a vapor phase of corrosion protection without impacting the environment.

Experiments

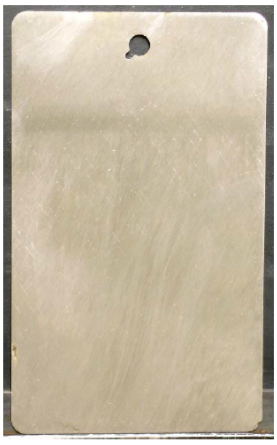
These studies examine the effectiveness of various types of corrosion inhibitors in solvent and waterborne removable coatings, based on salt fog results, (ASTM B117) and humidity results (ASTM D1748).

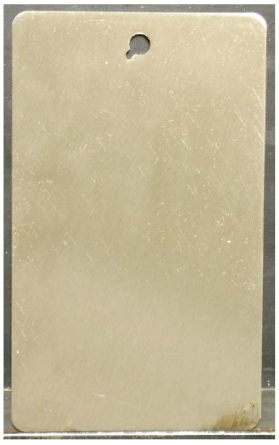
Each coating was applied on cold rolled steel (CRS) panels, (SAE 1010), or on actual parts provided by customers. Dry film thicknesses (DFTs) were according to mfg's recommendations.

Salt Spray Testing for competitive solventborne wax type coating with and without VCI inhibitors

ASTM B-117
pictures

ASTM B-117
pictures





350 Hours	50 Hours	400 Hours	> 400 Hours
Without VCI	Without VCI	With VCI	With VCI

Humidity Testing for competitive solventborne wax type coating without and with VCI inhibitors

ASTM D-1748
pictures

ASTM D-1748
pictures

3170 Hours	1100 Hours	>3170 Hours	> 3170 Hours
Without VCI	Without VCI	With VCI	With VCI

Salt Spray(ASTM B117) Testing for Various Systems(600 hrs)

A

Solventborne Coating without VCI

B

Solventborne Coating with VCI

C

Waterborne Coating with VCI

Self- Healing Effect of the VCI on the Scribe in Salt Spray Testing

VCI Coating compared to non-VCI Coating

Humidity Testing for solventborne wax type coating and waterborne wax type coating with VCI inhibitors(768 hours)

This testing shows that waterborne systems can compete with solventborne systems thru the use of VCI inhibitors. However, there are some distinct advantages of using a waterborne system which include:

- More Environmentally friendly
- Lower VOCs
- Easier cleanup

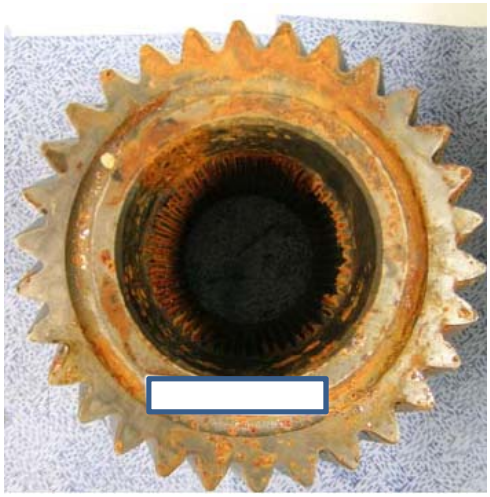
Examples of Other Technologies Using VCI Inhibitors

Engine Components Packaging in VCI film

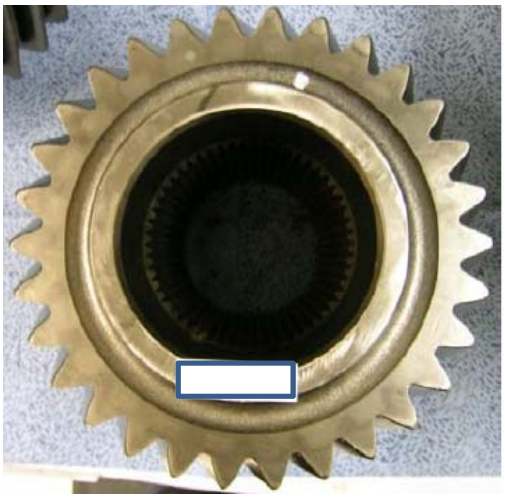
Film Using Inferior Inhibitors

Film Using VCI Inhibitors

Transmission Components in Preservative Oils



Preservative without Inhibitors



Preservative with VCI Inhibitors

Case History

PROBLEM

A manufacturer of large construction graders needed an effective alternative to prevent corrosion on their products. There were several disadvantages to the Heavy Wax Cosmoline type product they were using. First, it did not always work if the equipment was stored outdoors for extended periods of time before shipping. Secondly, it left a greasy and slippery film on the graders, which made it difficult to climb into them for moving and shipping. Finally, the product was hard to remove and had to be disposed of as hazardous waste.

APPLICATION

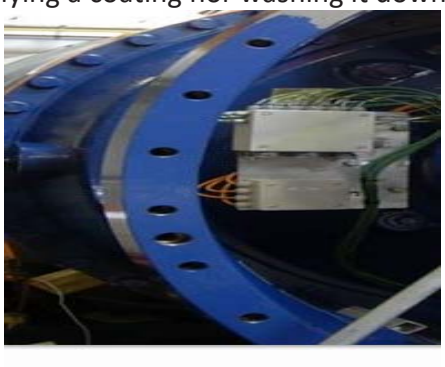
The manufacturer sprayed the VCI containing coating and solvent in a 3:1 ratio on the equipment, which resulted in dry coat thicknesses between 0.8 and 1 mil (20- 25microns). Then the machines were transported by rail to the seaports. A few of the graders were placed in containers, but the majority were left uncovered.

The VCI containing coating at 1mil (25 microns) outperformed the Cosmoline type coating at 3 mil (75 microns). The manufacturer also found VCI containing coating easier to spray, free of offensive odors and much easier to remove. After two years of export shipments they had experienced no corrosion problems when using the thinner film VCI containing coating.

Case History

PROBLEM

A manufacturer of industrial equipment was struggling with protecting critically machined surfaces from corrosion and damage during transport. Due to the nature of the equipment, they were not able to deal with spray applying a coating nor washing it down for removal.



APPLICATION

The manufacturer brush applied the waterborne VCI containing coating onto the equipment, which resulted in dry coat thicknesses between 2-10 mil (50- 250 microns). The equipment was transport to the final destination where the coating was removed by simply peeling it off.

Conclusion

With corrosion costs in the billions of dollars and making up as much as 3% of our GDP[5], there is a need in the market place, for environmentally friendly, low VOC, removable coatings that can be applied at a thin film thickness (1.0 mils) which provide excellent corrosion protection and yet can still be easily removed. Compared to permanent coatings where removal requires blasting or the use of heavy duty solvents, or thick heavy barrier type wax coatings which are difficult to remove and dispose of, many removable thin film coatings with VCI technology can be easily removed using an alkaline solution and high pressure water.

This paper shows, through research, that systems enhanced with VCI inhibitors can greatly improve the corrosion resistance of both solvent and waterborne coatings. In addition, waterborne coatings with VCI inhibitors can compete from a performance aspect with solventborne systems, while at the same time being more environmentally friendly, easier to cleanup and lower in VOCs.

Acknowledgements/References

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5. NACE, Cost of Corrosion Study(2002)