DECEMBER 2019

CORTEC Laboratories, Inc.

The LEADING Edge

Cortec® Laboratories Continues to be a Leader in ISO/IEC 17025 Accredited Testing Services

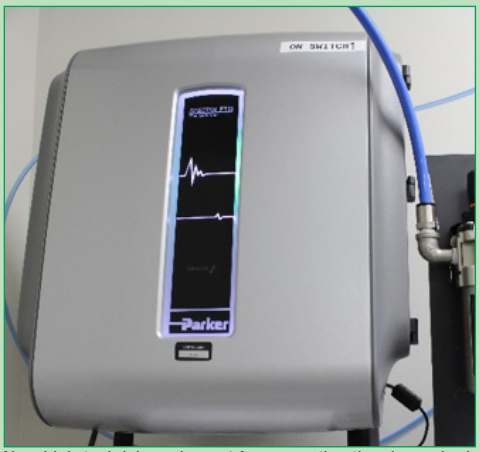
In 2010, Cortec® Laboratories set itself apart as an important industry leader by achieving ISO/IEC 17025 laboratory testing accreditation, a standard that is internationally recognized as a confirmation of competence and reliability in testing services.

This year was another milestone, as Cortec® Laboratories added to its scope of accreditation by becoming officially certified to perform NACE TM 0208-2018 VIA testing. This test is an important industry standard set forth by NACE International, a non-profit professional organization and self-proclaimed "Worldwide Corrosion Authority." The test examines the ability of corrosion inhibitors to protect metals in the vapor-phase when not in direct contact with the metal surface in an enclosed space.

NACE TM 0208-2018 VIA testing in action

Cortec® Laboratories continues to be accredited to perform ASTM G180 testing, another noteworthy test that is significant as the only "quick" ASTM evaluation tool for concrete admixtures used as corrosion inhibitors against chloride attack on steel reinforcement. Cortec® Laboratories stands out as the only laboratory in the industry that has this accreditation.

In July, Cortec® Laboratories was once again recertified for ISO/IEC 17025 accreditation, which covers a broad range of 19 tests including humidity, salt fog, immersion, electrochemical polarization, and other testing relevant to Cortec's expertise and customer needs for corrosion solutions. View the entire scope of accreditation here: https://www.corteclaboratories.com/wp-content/uploads/2019/10/Draft-17025-Cert-Supp-Page1..pdf



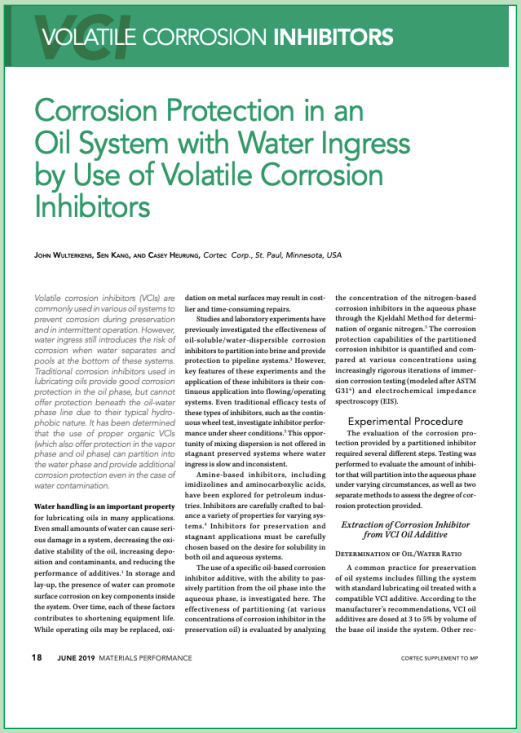
New high-tech lab equipment for generating the air required for ASTM G180 testing

ASTM G180 testing in action

Lab News

Laboratory Testing Forms Basis for Materials Performance Supplement Articles

Numerous tests are constantly in progress at Cortec® Laboratories. Some of these tests are performed specifically for customers, while other test results make their way into white papers presented at NACE International's annual CORROSION conference. This year, Cortec's June 2019 Supplement to Materials Performance magazine included several articles based on NACE CORROSION white papers, some of which in turn included research data from testing performed at Cortec® Laboratories. Below are links to two articles for further reading!



VCI VOLATILE CORROSION **INHIBITORS**

Corrosion Protection in an Oil System with Water Ingress by Use of Volatile Corrosion Inhibitors

John Wulterkens, Sen Kang, and Casey Heurung, Cortec Corp., St. Paul, Minnesota, USA

Volatile corrosion inhibitors (VCIs) are commonly used in various oil systems to prevent corrosion during preservation and in intermittent operation. However, water ingress still introduces the risk of corrosion when water separates and pools at the bottom of these systems. Traditional corrosion inhibitors used in lubricating oils provide good corrosion protection in the oil phase, but cannot offer protection beneath the oil-water phase line due to their typical hydrophobic nature. It has been determined that the use of proper organic VCIs (which also offer protection in the vapor phase and oil phase) can partition into the water phase and provide additional corrosion protection even in the case of water contamination.

Water handling is an important property for lubricating oils in many applications. Even small amounts of water can cause serious damage in a system, decreasing the oxidative stability of the oil, increasing deposition and contaminants, and reducing the performance of additives.[1] In storage and lay-up, the presence of water can promote surface corrosion on key components inside the system. Over time, each of these factors contributes to shortening equipment life. While operating oils may be replaced, oxidation on metal surfaces may result in costlier and time-consuming repairs.

Studies and laboratory experiments have previously investigated the effectiveness of oil-soluble/water-dispersible corrosion inhibitors to partition into brine and provide protection to pipeline systems.[2] However, key features of these experiments and the application of these inhibitors is their continuous application into flowing/operating systems. Even traditional efficacy tests of these types of inhibitors, such as the continuous wheel test, investigate inhibitor performance under sheer conditions.[3] This opportunity of mixing dispersion is not offered in stagnant preserved systems where water ingress is slow and inconsistent.

Amine-based inhibitors, including imidizolines and aminocarboxylic acids, have been explored for petroleum industries. Inhibitors are carefully crafted to balance a variety of properties for varying systems.[4] Inhibitors for preservation and stagnant applications must be carefully chosen based on the desire for solubility in both oil and aqueous systems.

The use of a specific oil-based corrosion inhibitor additive, with the ability to passively partition from the oil phase into the aqueous phase, is investigated here. The effectiveness of partitioning (at various concentrations of corrosion inhibitor in the preservation oil) is evaluated by analyzing the concentration of the nitrogen-based corrosion inhibitors in the aqueous phase through the Kjeldahl Method for determination of organic nitrogen.[5] The corrosion protection capabilities of the partitioned corrosion inhibitor is quantified and compared at various concentrations using increasingly rigorous iterations of immersion corrosion testing (modeled after ASTM G31[6]) and electrochemical impedance spectroscopy (EIS).

Experimental Procedure

The evaluation of the corrosion protection provided by a partitioned inhibitor required several different steps. Testing was performed to evaluate the amount of inhibitor that will partition into the aqueous phase under varying circumstances, as well as two separate methods to assess the degree of corrosion protection provided.

Extraction of Corrosion Inhibitor from VCI Oil Additive

Determination of Oil/Water Ratio

A common practice for preservation of oil systems includes filling the system with standard lubricating oil treated with a compatible VCI additive. According to the manufacturer's recommendations, VCI oil additives are dosed at 3 to 5% by volume of the base oil inside the system. Other rec-

"Corrosion Protection in an Oil System with Water Ingress by Use of Volatile Corrosion Inhibitors"

This article covers results of testing done to show how certain VCIs can provide corrosion protection in both the oil-phase and water-phase when water contamination occurs in oil systems.

"The Use of VCIs in Conjunction with or Replacement of Traditional Corrosion Inhibitors"

This article examines the use of various corrosion inhibitor combinations in designing protective coatings that replace or enhance older technology.

VCI VAPOR PHASE CORROSION **INHIBITORS**

The Use of VCIs in Conjunction with or Replacement of Traditional Corrosion Inhibitors

Markus Bieber, Cortec Corp., St. Paul, Minnesota, USA

The use of traditional corrosion inhibitors in paints and coatings continues to be challenged from both an environmental and performance aspect. End users are demanding better corrosion performance and in many formulations this cannot be achieved with traditional zinc or chromate-type inhibitors. The use of vapor corrosion inhibitors in coating formulations has shown that in many systems, they can replace the older technology or significantly improve the performance of the system by working in synergy with the existing inhibitors.

Vapor phase corrosion inhibitors (VCIs) are a corrosion inhibitor technology that is comprised of very small particles that are attracted to a metal substrate. Once the particles attach to the metal substrate through adsorption, they prevent a corrosion cell from forming. They come in various formulations that are dependent on the type of system they will be used in; for example, films, oils, coatings, cleaners, etc. There are also a variety of formulations that provide protection in ferrous, nonferrous, or multi-metal applications. Other variables include the amount of vapor phase compared to contact phase inhibitors.[1] VCIs are widely used throughout a broad range of industries and applications ranging from automotive to processing to preservation and have saved billions of dollars of corrosion-expenses.

VCIs as Alternative Corrosion Inhibitor Technologies

The use of VCIs as alternative corrosion inhibitor technologies in coatings is not a new concept. In the last few years, however, with the growing environmental pressures to reduce the use of traditional inhibitors containing heavy metals, they have gained in popularity.[2]

VCIs as a category are very broad and can be made up of thousands of combinations of raw materials that can have varying rates of effectiveness. Commonly used terms, such as amine carboxylates, cover a broad range of potential formulations. Depending on the formulation, they can vary in their functionality as far as contact vs. vapor phase inhibition. When choosing the right VCI package to formulate into a coating, it is critical to find not only the package that is compatible with the coatings carrier (solvent or water) but also the resin system.

Choosing the wrong inhibitor package can lead to a variety of issues in the coating itself, which include gelling, phase separation, and flocculation. Once these issues have been eliminated, the next stage is testing to determine at which level there is an improvement in the corrosion performance, which is typically done using the salt fog test standard (ASTM B117[3]).

Since VCI particles have a polar attraction to the metal substrate, this allows them to work in the coating without negatively impacting other components of the coating such as defoamers, wetting agents, leveling agents, etc. VCIs are typically added to the formulation in very small amounts by weight of the overall formula. The typical range is from 0.5% to 3%.

The particle size of the VCIs is very small in comparison to the traditionally used inhibitors (Figure 1). This allows the VCIs to migrate into the smaller voids more effectively.

Once the VCIs have adsorbed onto the surface of the metal, they provide an effective barrier that is hydrophobic and prevents moisture from getting through to the metal surface.

Consequently, this prevents the formation of a corrosion cell and renders the moisture ineffective.[4]

Experimental Procedure

These studies examine the effectiveness of various types of corrosion inhibitors in single-component, waterborne acrylic coatings, based on salt fog results (ASTM B117).

FIGURE 1 Microscopic surface view.

Important Cortec® Technical Paper Published in Materials Performance: "New Corrosion Inhibitor for Steam-Generating Boilers"

Another important Cortec® technical paper published in the November 2019 issue of Materials Performance shares an in-depth study on Cortec's VCI technology alternative to hydrazine. Hydrazine is a genotoxic carcinogen that has been used as an oxygen scavenger in steam-generating systems but is being recommended to be replaced by safer chemicals. This paper describes how VCIs were able to reduce corrosion rates in boiling water and a steam closed loop system. Contact Cortec® to learn more about the cutting edge VCI technology behind this study: https://www.corteclaboratories.com/contact-us/!

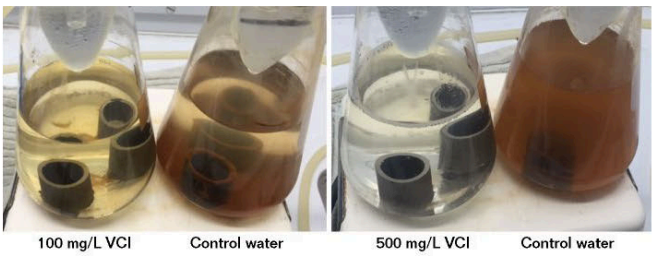


FIGURE 1 Corrosion behavior of the steel pipe samples in boiling water. Corrosion rate decreased to 1.36 mpy with 100 and 500 mg/L VCI addition (700 h).

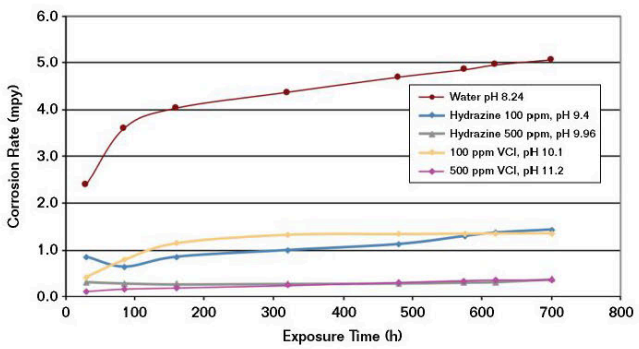


FIGURE 2 Corrosion behavior of steel pipes in hot water solution at 100 °C when exposed to control solution, 100 and 500 mg/kg VCI, and hydrazine.

Lab News

PRODUCT NEWS

Thanks to the hard work of R&D, Cortec® was recently able to release a new improved version of VpCI®-369, one of Cortec's most popular and effective products for corrosion protection. The improved VpCI®-369 has the same appearance as the previous version, but with the following added benefits:

- Provides improved corrosion protection
- Provides improved protection for galvanized steel and other non-ferrous metals
- Has a lower odor, making application in enclosed areas even easier
- Fully conforms with all REACH requirements

Learn more here: https://www.cortecvci.com/whats_new/announcements/VpCI-369-PR.pdf

This fall, Cortec® was also pleased to officially release EcoLine® Rail Curve Grease, Winter just in time for cold weather in the Northern Hemisphere. EcoLine® Rail Curve Grease, Winter can be used between 0 °F and 100 °F (-17 °C and 37 °C). The grease is designed to reduce friction and wheel and rail wear while using biobased, biodegradable material. EcoLine® Rail Curve Grease, Winter contains 80% USDA certified biobased content and offers better gauge face coefficient of friction than most petroleum-based grease.

Learn more here: https://www.cortecvci.com/whats_new/announcements/EcoLine-Rail-Curve-Grease-PR-09.pdf

Even earlier this year, Cortec® announced the successful reformulation of MCI® POWR 100 to meet the demands of an ever-changing regulatory landscape. MCI® POWR 100 is a powerful three-in-one concrete surface treatment for water repellency, oil/stain resistance, and corrosion protection. The product underwent multiple tests to demonstrate that it still delivered the required water, oil, and stain resistance characteristics, while performing competitively and sometimes superior to a traditional silane sealer in water and oil repellency traits.

Learn more here: https://www.cortecvci.com/whats_new/announcements/MCI_POWR_100_PR.pdf

Stay tuned for forthcoming news on other new and improved product offerings from Cortec® R&D!

CORTEC CORPORATION
Environmentally Safe VpCI®/MCI® Technologies

4119 White Bear Parkway, St. Paul, MN 55110 USA
Phone (651) 429-1100, Fax (651) 429-1122
Toll Free (800) 4-CORTEC, E-mail productinfo@cortecvci.com
www.corteclaboratories.com

Created: 12/2019