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NEWS ALERT

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New White Paper Presents "The Cortec® Solution" for Corrosion Under Insulation

Cortec® is pleased to present a new white paper addressing the perennial problem of corrosion under insulation (CUI). The paper introduces the troublesome, costly, and even dangerous problem that CUI poses to industries that use insulated piping. The main cause of CUI is water trapped between insulation and the pipe. This moisture incites corrosion that is difficult to detect and can result in dangerous leaks or explosions costing millions of dollars.

The white paper goes on to report various findings from testing performed by Dr. Behzad Bavarian at California State University, Northridge. Dr. Bavarian tested the capabilities of Cortec® VpCI®-619 to protect against CUI in corrosive conditions at different temperatures with a 200 ppm sodium chloride solution injected every 48 hours.

The pipe treated with VpCI®-619 remained protected at 176 °F (80 °C) after 240 hours of testing, while the control pipe had localized corrosion. CUI simulation tests of a treated pipe at 350 °F (177 °C) after 192 hours and four salt injections also showed no corrosion, and an inhibitor deposit was detected on the surface. A companion corrosion test showed the effectiveness of VpCI®-619 to protect a steel pipe segment tested in a 200 ppm chloride solution at boiling temperature and reduce corrosion by a factor of 15.

Dr. Bavarian concluded, "These results showed that an effective protective coating system under the insulation is critical and requires the inclusion of VpCI 619 to prolong the pipe integrity and lower inspection and maintenance cost."

To learn more about the Cortec® solution for CUI, please continue to read the full white paper.

Cortec® Corporation is the global leader in innovative, environmentally responsible VpCI® and MCI® corrosion control technologies for the Packaging, Metalworking, Construction, Electronics, Water Treatment, Oil & Gas, and other industries. Headquartered in St. Paul, Minnesota, Cortec® manufactures over 400 products distributed worldwide. ISO 9001, ISO 14001, and ISO 17025 Certified.

CORTEC CORPORATION
Environmentally Safe VpCI®/MCI® Technologies

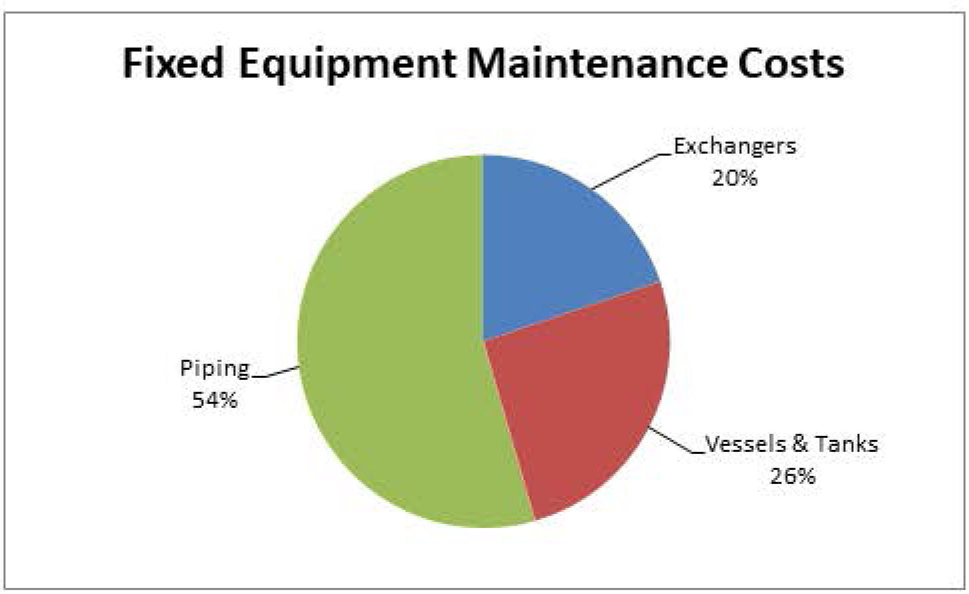
Overview

Corrosion Under Insulation (CUI) is a serious concern both in terms of monetary loss and danger to personnel safety. It is a top culprit for piping leaks and near misses and results in significant maintenance costs. It can mean the difference between a safely operating refinery or the depressurization of an entire hydrocarbon system at a gas plant. [1]

CUI is caused by water trapped between insulation and a metal surface. It may be due to leakage, condensation, rain, or other causes. CUI occurs mainly on carbon steel, but it also affects stainless steel (such as 18-8 grades and 300 series). CUI tends to be the most severe on equipment operating at temperatures of 120 to 200 °F (49 to 93 °C), but it can affect both carbon and stainless equipment operating at temperatures anywhere from 25 to 302 °F (-4 to 150 °C). [1, 2]

Based on Exxon data, 84% of CUI leaks happen on piping, 81% of which is less than 4 inches (10 cm) in Nominal Pipe Size (NPS). Pipe wall thickness appears to be a key factor in CUI failure, with failures of piping in the 16-20 year range occurring mainly on <4 inch (10 cm) NPS low Wall Thickness (WT) <Sch 40 wall piping, and failure in the over 25 year range occurring mainly on piping with >6 inch (15 cm) heavy WT >Sch 40 wall thickness. [1]

Temperature and containment sources influence the CUI rate, with wet insulation being the root cause of the problem. Maintenance costs are significant both in terms of materials and resources. Approximately 35 cents of every general maintenance dollar goes to costs for fixed equipment, such as vessels and piping. Of fixed equipment costs, about 55% is spent on piping (about 20 cents of every maintenance dollar), with CUI making up 40-60% of piping cost (or 10 cents of every maintenance dollar) (see chart below). [1]



One example of the cost impact of CUI occurred in 2006 when a leak in a 4 inch (10 cm) hydrocarbon line caused a massive fire at an aging Gulf Coast petrochemical facility. Half the unit was destroyed, and resulting costs reached $50 million dollars.[2] This demonstrates how dangerous and expensive a leak from CUI can be. Another example occurred in 2008 at a Dow Chemical Plant. Despite excellent maintenance, inspection, and safety records, aging materials suffered from CUI in a high condensation area. An 8 inch (20 cm) carbon steel hydrocarbon line sprang a pinhole leak that caused the piping to fail drastically as the operators worked on isolating and de-pressurizing the area. The force of the explosion buckled the pipe, fortunately causing it to seal itself and offset what could have been a terrible disaster. [3].

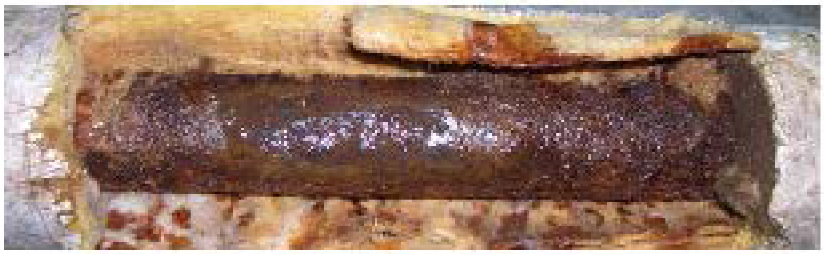
Corrosion on a pipe leads to pipe failure. It is even more difficult to detect when covered by insulation.

CUI remains a serious industry problem because it is not easily detectable and is frequently overlooked by maintenance. Too often management does not realize the importance of CUI prevention, so no proactive inspection plans are put in place. However, taking a proactive approach to CUI can save millions of dollars in future damages.

The Cortec® Solution

Testing performed at California State University, Northridge, and documented in reference [4] demonstrates that Cortec® VpCI®-619 is an effective means of controlling CUI in the temperature range of 170 °F (77 °C) to 350 °F (177 °C).

In this investigation, four API 5L X65 steel pipes were insulated with thermal insulator (fiberglass system) to determine the effective protection of a VpCI® corrosion inhibitor (VpCI®-619) against CUI. The specimens underwent isothermal and cyclic wet/dry test conditions at 170 °F (77 °C) and 350 °F (177 °C). Results demonstrated that VpCI®-619 could successfully reduce corrosion attack under insulation even in a chronic wet environment. After corrosion testing, chemical analysis of insulated samples exhibited the presence of a protective Mo-rich inhibition compound on pipe surfaces. In a companion test, corrosion rate dropped by a factor of 15 when VpCI®-619 was added to a 200 ppm salt solution during the testing of bare pipe segments at boiling temperature. The report states, "These results showed that an effective protective coating system under the insulation is critical and requires the inclusion of VpCI 619 to prolong the pipe integrity and lower inspection and maintenance cost." [4]



An example of the deteriorated condition of an existing pipe with CUI.

Pipe protected with VpCI®-619.

The test was performed in two parts. In the portion of the test that involved boiling a steel pipe segment in a 200 ppm chloride solution, one sample included VpCI®-619 and one did not. The corrosion rate of the control pipe (no VpCI®) was ~5.3 mpy, while the corrosion rate of the pipe boiled in the VpCI®-619/chloride solution was 0.36 mpy, 15 times less than the control.

The other part of the test involved insulated piping that was subjected to cyclic corrosion testing for 240 hours. The purpose was to see if VpCI®-619 inhibitor impregnated into the thermal insulation would protect the pipe. The insulation of the control pipe remained untreated. Both the control and treated sample were injected with a 200 ppm sodium chloride solution every 48 hours, and the samples were inspected every 5 days. After 240 hours, the untreated pipe showed localized corrosion, but the surface of the VpCI®-619 treated pipe remained well-protected. Consistent with inhibitor chemistry, a

Molybdenum rich protective film was detected on the surface of the VpCI®-619 protected pipe.

Insulated pipes after 240 hours of CUI condition testing at 176 °F (80 °C). Control sample insulation revealed localized corrosion and red rust. No corrosion attack was found on the sample treated with VpCI®-619.

After four cycles (192 hours) of salt injection and CUI tests at 350 °F (177 °C), VpCI®-619 coated pipe surfaces were discolored but not corroded. Discoloration was attributed to Mo-rich deposits of inhibitor compound.

References

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2. Anderson, Stephen A. "Out of Sight, Out of Mind?" *Hydrocarbon Engineering*. August 2010 <http://www.intertek.com/articles/2010-08-corrosion-under-insulation/>.
3. Sampaio, Renato, and Antônio Luiz M.V. Leite. "More Lesson Re-Learned from Corrosion Under Insulation." Accessed 13 Mar. 2018 <http://www.penderlo.com/doc/Dow_CUI.pdf>.
4. Bavarian, Dr. Behzad. "Protection Effectiveness of Vapor Corrosion Inhibitor VpCI 619 for Corrosion Under Insulation at Elevated Temperatures." California State University, Northridge, and Cortec Corporation. Feb. 2018 <https://www.cortecvci.com/Publications/Papers/CUI-report-on-VCI-619.pdf>.