Detecting Corrosion Under Insulation

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- Industrial Insulation
- Problems and Solutions

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Detecting CUI: Corrosion under insulation (CUI) is one of the main threats to safety and performance that high-temperature industrial facilities face. Should corrosion cause a high-pressure or high-temperature pipe system fail, the effects could be catastrophic for both the plant and the surrounding communities. However, since the corrosion occurs beneath the insulation, the presence of corrosion is not outwardly apparent. If it is allowed to go unchecked, the pipes can crack, buckle or even rupture. In order to prevent CUI, regular system maintenance and inspection are necessary. There are a variety of detection methods available that utilize different scientific approaches to detect corrosion. This offers a solution for just about every application. However, each method has unique benefits and drawbacks that maintenance crews need to be aware of in order to select the right method for the unique needs of the system. We’ve outlined a few of the methods used to detect corrosion, as well as their benefits and drawbacks.

Visual Detection: This is, by far, the most accurate way to check for corrosion on the outer diameter of the pipe. However, performing a complete inspection (not merely spot inspections using ports or plugs) is also the most expensive and labor/time intensive. Once the insulation has been removed, it typically can’t be reapplied and usually must be replaced. All of these factors tend to make visual inspection one of the less common methods of corrosion detection.

X-Ray: Just like x-rays for humans, these use radiation to get a real-time image of the outer diameter of the pipe. There are three different x-ray detection methods: Real-Time Radiography (RTR), Computed Radiography (CR), Digital Detector Array (DDA). Each method uses a slightly different technique to capture the image – namely, film (RTR), plate (CR), and digital (DDA). The benefit of using an x-ray detection method is that the insulation does not have to be removed in order to do the screening – inspectors simply place the machine on both sides of the pipe, and capture an x-ray image. Pipe maintenance crews can then determine whether or not there is any corrosion on the outer diameter of the pipe by examining the image for any change in the outer diameter profile. The downside to x-rays is that they can be used only on smaller structures because the x-ray apparatus needs to have access to both sides of the pipe to be effective. Additionally, x-rays are a hazardous form of ionizing radiation. Fortunately, with the guarding equipment used in the existing x-ray technology and the strict safety procedures that are in place to help keep workers safe, the likelihood of radiation exposure is minimized.

Neutron Backscatter: This method doesn’t actually interact with the pipe, but rather it tests for wet insulation. Because of this, the neutron backscatter is used to detect the potential for corrosion rather than corrosion itself. While it does make it easier to access elevated or hard-to-reach areas, it can also generate false positives because the presence of moisture does not always indicate the presence of corrosion and likewise. For example, if the system is insulated with Thermo-12® Gold, a calcium silicate insulation that is manufactured with XOX™, a corrosion inhibitor, the insulation can still help protect the system from corrosion even once it has become wet. When water enters a system that has been insulated with Thermo-12 Gold, it activates corrosion inhibitors in the insulation that neutralize corrosive ions and create a passivation layer on the pipe surface. Sproule WR-1200® expanded perlite with XOX has the same protective properties. As a result, even though the insulation might prove to be wet via information from the Neutron Backscatter, the risk for corrosion could be minimal depending on the type of insulating material used.

Ultrasonic Thickness (UT) Measurement: UT measures the local thickness of a solid based on an ultrasound wave’s flight time. It requires part of the insulation to be removed in the form of plugs so that the apparatus can have direct contact with the surface of the pipe. Additionally, it captures only the conditions of a localized area, and can actually miss corrosion that isn’t occurring in the location that is being monitored. Cutting plugs in the insulation also poses an increased risk for CUI, as the plugs must be properly recovered in order to maintain system integrity. That said, UT measurements trend to have a high-level of accuracy, and can handle a variety of wall thicknesses as well as different coatings and linings without diminishing in accuracy (as long as the machine has been properly calibrated for the material). Another form of ultrasonic testing is Guided Wave testing. This type of testing is able to scan longer sections of pipe, but it still requires cutting plugs, and it is unable to measure the exact percentage of corrosion.

Pulse Eddy Current (PEC): The PEC electromagnetic method tests for corrosion by using an electrical current to detect pipe-wall thickness. While this isn’t good for isolated pitting on the pipe surface, it averages the pipe wall thickness over a relatively large area. This can help maintenance crews better understand the overall state of the pipe, but it fails to tell them exactly which sections of pipe are problematic. For this reason, the PEC method is typically used as a screening tool to diagnose areas that may be at risk for CUI, rather than as a means to target the location of CUI directly. Since PEC doesn’t require direct contact with the testing surface, it is one of the few non-invasive methods that is accurate even through linings, jacketing, and insulation; however, it can only be used on carbon steel and low-alloy steel.

Dog Corrosion Detection: While this isn’t a mainstream method yet, recent studies have taken to using dogs to sniff out CUI. Researchers explored this option after seeing the TSA and the police successfully employ dogs to find drugs, explosives, and people. While the science is still young, initial research results look promising. The dogs are allowed to scent air that has been sucked through the drain plugs in the insulation. Incredibly, the results in the double blind study showed that the dogs’ sensitivity of the detection of field samples was 92% and the selectivity was 93%. While this concept is still in the exploration stages, it may be a viable alternative to some of the more invasive corrosion detection methods that can cause damage to the insulation or put the system at risk of water ingress. Given that no method for detecting CUI is 100%
accurate, system designers and maintenance crews need to make sure that they proactively and strategically address CUI before it becomes a problem. This starts by designing systems with insulation that can withstand water ingress without putting the pipe surface at risk. Insulations that contain corrosion inhibitors, like Sproule WR-1200 and Thermo-12 Gold with XOX, can be a tactical step toward this goal. Following a defensive system design with maintenance and inspections that are thorough and regular helps significantly reduce the risk for severely damaging pipe corrosion. To learn more about CUI, click here. Resources:

- http://www.eddyfi.com/ndt/surface-inspection/corrosion-under-insulation-7-inspection-methods-you-must-know-about/

All Other Multimedia:
- Detecting-CUI-150x113.png (18.57 KB)

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