TECH TIP

Evaluating the Importance of Proper Corrosion Inspections

Corrosion inspections and how they apply to certain processes. The release of flammable or toxic material could be attributed to many reasons, but one common mode of failure for incidents in today's industry is corrosion. That is why it is important to apply corrosion inspections to any piece of equipment that may be susceptible to any type of corroding or cracking.

However, it is important to not just conduct a visual inspection of the vessel, but rather to apply the correct and proper inspections to each type of process and material. If we take Eddy Current Testing as an example, this type of corrosion testing is not appropriate for carbon steel and low-alloy steel piping as the high permeability of this material makes it difficult for the Eddy Current probes to get a good reading on the piping. For carbon steel piping, using Wet Fluorescent Magnetic Testing would be a better option as the main disadvantage of using wet fluorescent magnetic testing is that the material must be ferromagnetic. For carbon steel piping this is not a problem, but for other materials such as aluminum, magnesium, and other stainless steels, this is an issue as these stainless steel materials are non-ferromagnetic. A type of corrosion testing that generally works on all kinds of materials is Ultrasonic Testing. Ultrasonic Testing uses sound waves, and as can be seen in **Figure 1,** once these sound waves hit another boundary such as the other end of the pipe or air in the pipe due to a crack in the piping, the sound wave will then bounce back. Based on the frequency of the sound waves, a diagram can be then created that will visually indicate any abnormalities in the piping. The main drawback to using Ultrasonic Testing is that its range is limited to small areas, so solely using this type of corrosion testing may prove too time consuming and inefficient for larger, complex units.

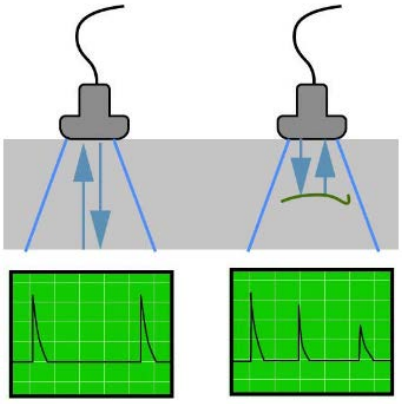

Figure 1: Ultrasonic Testing

What if proper corrosion inspections are not conducted? An incident took place in 2009 at the NDK Crystal facility in Illinois in which one person was killed and another was injured. The facility produced crystals for electronic devices by mixing a corrosive sodium hydroxide solution with raw quartz and silica. The idea behind the design of this vessel is that the iron from the walls of the vessel would react with the silica and sodium hydroxide solution to form a layer of acmite on the vessel walls which would theoretically protect the vessel from corrosion, however the acmite layer was never tested to see if it did mitigate the potential for corrosion. Because of the way the vessel was designed, the NDK team felt that corrosion inspections were not required on this vessel as they did not believe the vessel was susceptible to corrosion. However, this theory proved to be wrong as the vessel did in fact experience stress corrosion cracking which resulted in rupture of the vessel. Due to the rupture of the vessel, projectiles were sent outwards from the vessel which led to the fatality and injury.

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How to discuss corrosion in a PHA setting? Based on the background information given and the consequences discussed that could occur due to failure to identify corrosion, it is important to discuss corrosion inspections during a PHA to avoid any potential hazards that could occur from missing or improper inspections. During a PHA, on a node-by-node basis, corrosion mechanisms should be discussed on all types of equipment in the unit that may be susceptible to corrosion such as heat exchangers that may vulnerable to tube leaks or reactors that may be exposed to a case involving a high temperature hydrogen attack. In a PHA setting, first the consequences associated with corrosion must be discussed to gauge how hazardous of a consequence can occur without taking into consideration of any safeguards that may be available. This may be contamination or a release of hazardous chemicals. Once the consequences has been discussed, safeguards can begin to be credited such as what inspections are conducted on the vessel, inspection and replacement frequencies, and if the metallurgy has been confirmed adequate for service. If there are deficiencies identified, inspections for particular piping materials, process fluids, and corrosion types can be suggested. A PHA is a perfect setting for the team to discuss any overlying issues with corrosion inspections that may otherwise get overlooked.

Best practice is to have a corrosion inspector or some form of metallurgist involved in the PHA as these questions and concerns regarding corrosion are sometimes unfamiliar territory to the Process Engineer or to the Operators. This corrosion inspector can be in the PHA meeting for the whole duration of the PHA and can answer questions as the PHA goes from node to node. The other option is to collect any questions related to corrosion and at the end of the PHA once all the concerns have been gathered, the corrosion inspector can then come in and address these issues with the team. Both methods are effective. The main focus is that corrosion inspections should be discussed in some way in the PHA as this is a concern that can get overlooked and can lead to serious consequences if not addressed correctly.

Resources

1. (6) Corrosion Under Insulation: The 7 Inspection Methods You Must Know About | LinkedIn
2. CSB Releases Safety Video on 2009 Fatal Blast at NDK Crystal Animation Depicts Stress Corrosion Cracking; Vessels Were Not Inspected or Tested - General News - News | CSB
3. Magnetic Particle Examination (nationalboard.org)
4. Figure 1: Ultrasonic Testing (UT) - G.Cotter Enterprises (gcotter.com)

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