CUI CORROSION

Joshua Fontenot

Advanced Corrosion Technologies & Training
Corrosion Under Insulation or Fireproofing

Per API 571 it is defined as corrosion of piping, pressure vessels and structural components resulting from water trapped under insulation or fireproofing.

Affected materials are carbon steel, low alloy steels, 300 series SS and duplex stainless steel.

It affects piping and equipment operating between
  10 degrees F and 350 degrees F for carbon & low alloy steels
  140 degrees F and 400 degrees F for austenitic & duplex stainless steels
What is CUI? (cont’d)

Some critical factors:
- Corrosion rates increase with increasing metal temperature up to the point water evaporates quickly most severe between 212 degrees F & 350 degrees F
- Poor design of insulation allowing water to be trapped
- Condensing steams, Intermittent services, insulations containing chlorides

Appearance of Damage:
- Carbon and low alloy steels are subject to localized pitting
- 300 series SS and duplex SS are subject to Stress Corrosion Cracking & localized pitting if chlorides are present
Corrosion-under-Insulation (CUIF), if left to its own devices, can and does cause serious and sometimes catastrophic consequences with piping systems and related components and equipment. CUI is difficult to detect and can be expensive to mitigate. National Association of Corrosion Engineers (NACE) data indicates that corrosion costs in the U.S. exceed approximately $1 trillion annually.

Between 40% and 60% of piping maintenance costs are related to CUI.

For piping systems most leaks occur due to CUI rather than process related factors on pipe less than 4-inches in diameter.

Major costs associated with CUI include:
- Removal and replacement of insulation and jacketing on corroded items & non-corroded
- Scaffolding to access piping and vessels
- Inspection costs associated with detection of CUI
- Costs of unplanned outages caused by failures

How can you reduce the costs associated with CUI?
The key is detection strategies implemented in an manner that increases detectability while reducing cost.
How to Detect and Monitor CUI using a comprehensive inspection program
Advantages when performing a CUI Inspection Program:

- Repeatable Inspection Data
- Inspection of Piping, Pressure Vessels and Storage Tanks
- Correlation between RBI, Visual, Bracelet Probe, EMAT Guided wave, Neutron Backscatter, Opencvision and X-Ray for greater corrosion detection accuracy.
- Inspect at concern areas or 100%
- Unparalleled Corrosion Detection
- Remove insulation at only areas with corrosion
- Nearly eliminate scaffolding and insulation removal costs
- Mitigate unplanned outages due to leaks
- Increase safety while lower impact to people and environment
**CUI INSPECTION PROGRAM OVERVIEW**

**Step 1** Acquire inspection history and Perform a Risk Based inspection for Corrosion Under Insulation/Fireproofing to determine scope of work and order of approach. API 571 can be used for determining material and temperature ranges or more stringent temperatures can be used. When determining actual temperatures of pipe and equipment a calibrated contact temperature probe is recommended. This will ensure critical areas of concern aren’t missed like dead legs and intermittent services. All data should be documented in a approved format with both hard and electronic files.
**CUI Inspection Overview**

**Step 2)** Perform API visual inspection designed to identify the potential for Corrosion Under Insulation/Fireproofing. This should be documented in a way that is uniform and approved by responsible party to eliminate interpretation of reports.
Step 3) Perform Moisture survey designed to identify trapped moisture in Insulation/Fireproofing. This should be documented in a way that is uniform and approved by responsible party to eliminate interpretation of reports. Also mark on isometric drawing & on test piece in field.
Neutron Backscatter

Neutron backscatter operates by emitting neutrons into the equipment being tested. The higher energy neutrons are moderated by collision with hydrogen atoms in trapped moisture within the insulation/(fireproofing). These moderated neutrons are then counted. Wet insulation will produce a higher count per unit of time than dry insulation.
Step 4) Review API visual inspection and moisture findings and create follow up inspection list. This should include areas found to have trapped moisture in insulation/fireproofing & suspect areas from visual inspection. This list should be given to the most applicable NDE technique to evaluate areas further.

Recommended Methods Include:
- Bracelet Probe
- Open Vision
- RT – Xray
- Strip and Perform Visual
- EMAT AXUS-Pitch Catch
OpenVision

OpenVision™ LT-NDT is a lightweight portable x-ray system for hand-held inspection. It includes a highly sensitive x-ray imager and battery-operated 70kV x-ray tube designed for portable field operation. This unit’s 4” x 6” imaging area and real-time video allows the operator to quickly scan a range of specimen and pipe sizes. Moving the x-ray source provides a 3D perspective, and moving closer or farther from the specimen allows for increased detail resolution or field of view.
Bracelet Probe

The technology is a revolutionary electromagnetic NDE inspection technique to screen and locate corrosion/wall loss in pipes, vessels and tanks without removing coating, fireproofing and/or insulation. Works for Detection of isolated & general corrosion/thinning

Benefits:

- Flexibility of one probe for many applications
- Condition assessment with or without insulation and/or fireproofing removal
- Rapid Scanning
- Up to 100% coverage
- Encoded mapping of results
EMAT AXUS-Pitch Catch

The EMAT (Electromagnetic Acoustic Transduction) AXUS technology is a high frequency ultrasonic pitch catch NDE technique to screen and locate corrosion/wall loss in pipes, vessels and tanks. The ultrasonic lamb wave travels down the length of pipe and reflects back to receiver when the ultrasonic energy encounters any change in thickness. Works for Detection of isolated & general corrosion/thinning down to 10% of the wall thickness. Due to the no contact EMAT high frequency technique used it works well on rough and very hot surfaces up to 1000 degrees f.
**CUI INSPECTION OVERVIEW**

**Step 5)** Review follow up NDE to determine if corrosion is present. Areas found not to have corrosion should have a recommendation to repair what was considered suspect to eliminate corrosion in future. Areas found to have corrosion should be inspected using either RT profiles or Stripping of insulation to visually inspect, pit gauge & UT to determine extent of damage. From these findings a repair or replace plan can be generated.
Conclusion

- Be Proactive with your approach
- Plan your work and work your plan
- Use personnel with experience in CUI inspections and the NDE tools used
- Use best NDE for the situation no one tool can solve all your problems