CUI Spotter

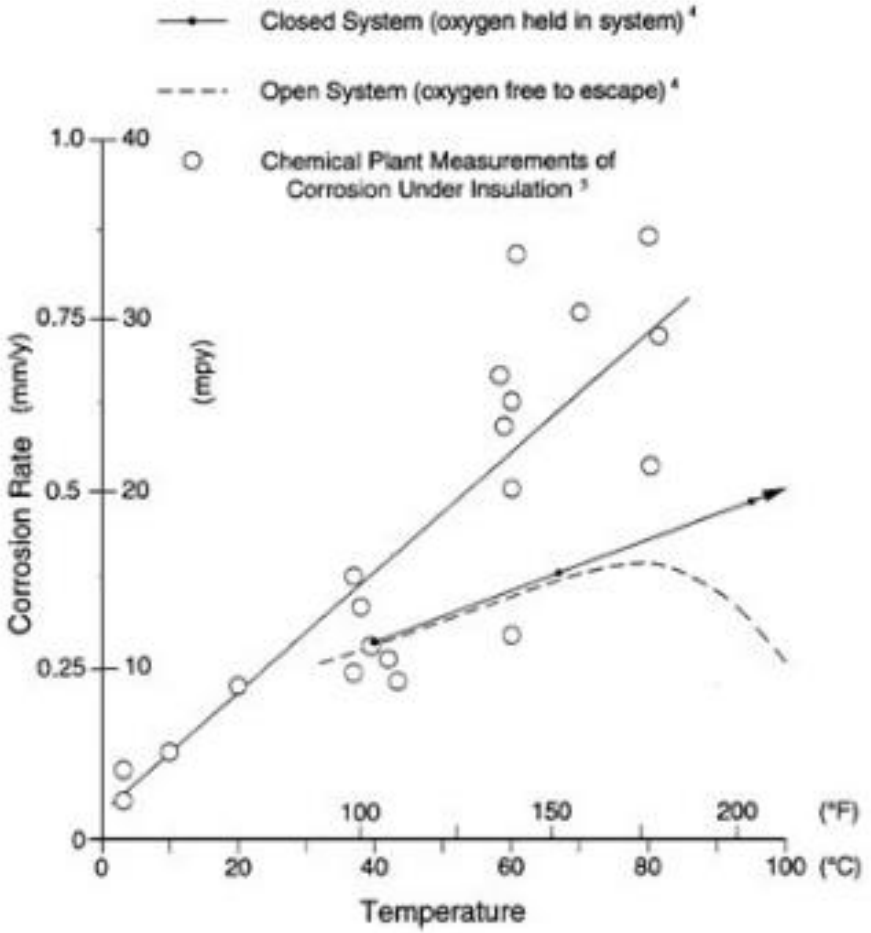
Visit the website

Detect Corrosion Under Insulation

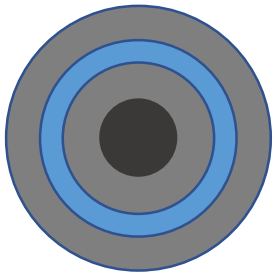
no batteries - no wireless network - no installed instruments

Emanuele Cardilli

Corrosion under insulation



CUI Spotter working principle

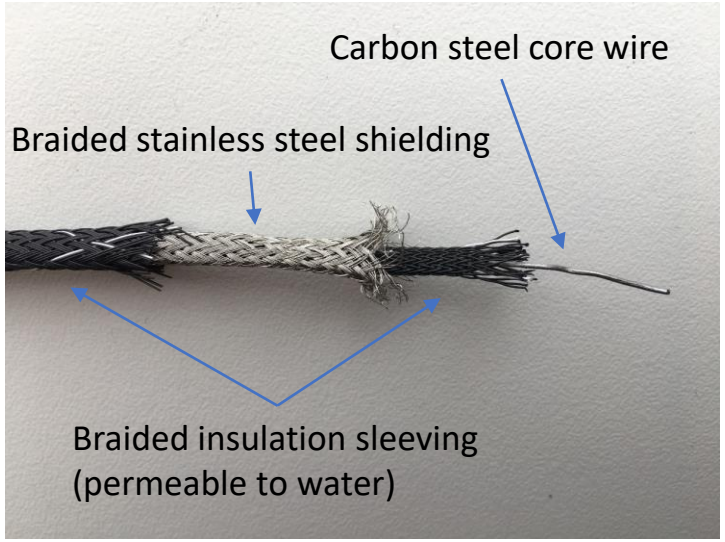


Cable cross section

Carbon steel core wire

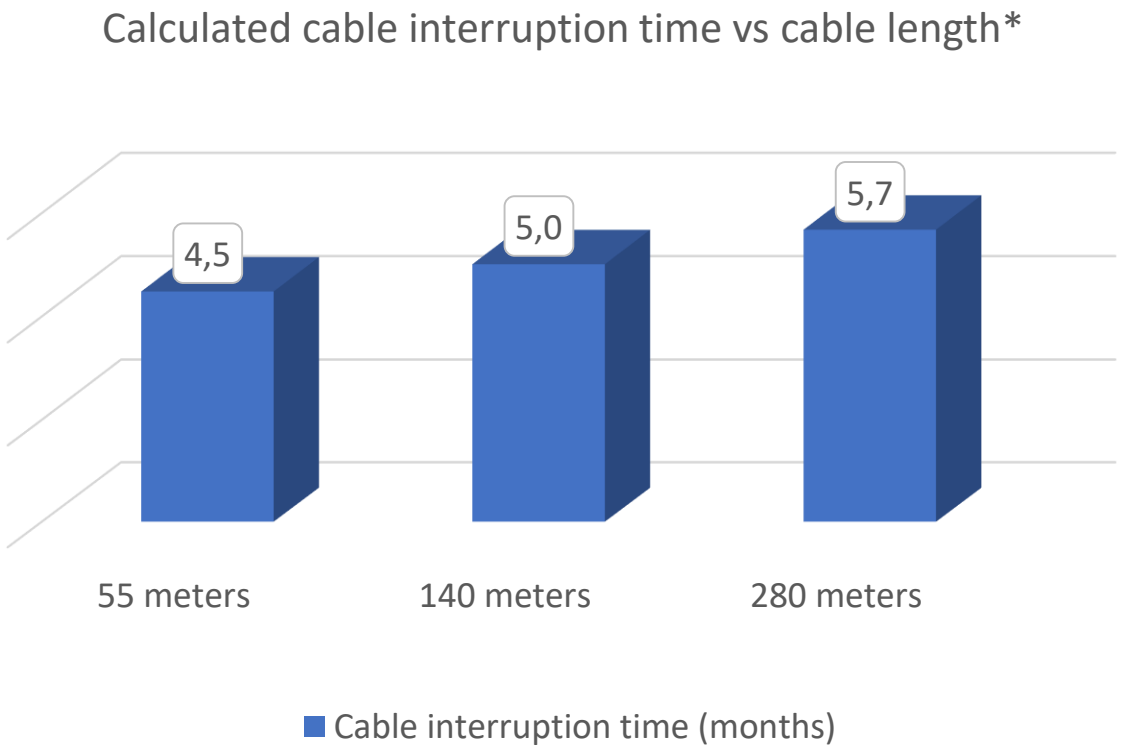
Permeable (braided) insulation sleeving

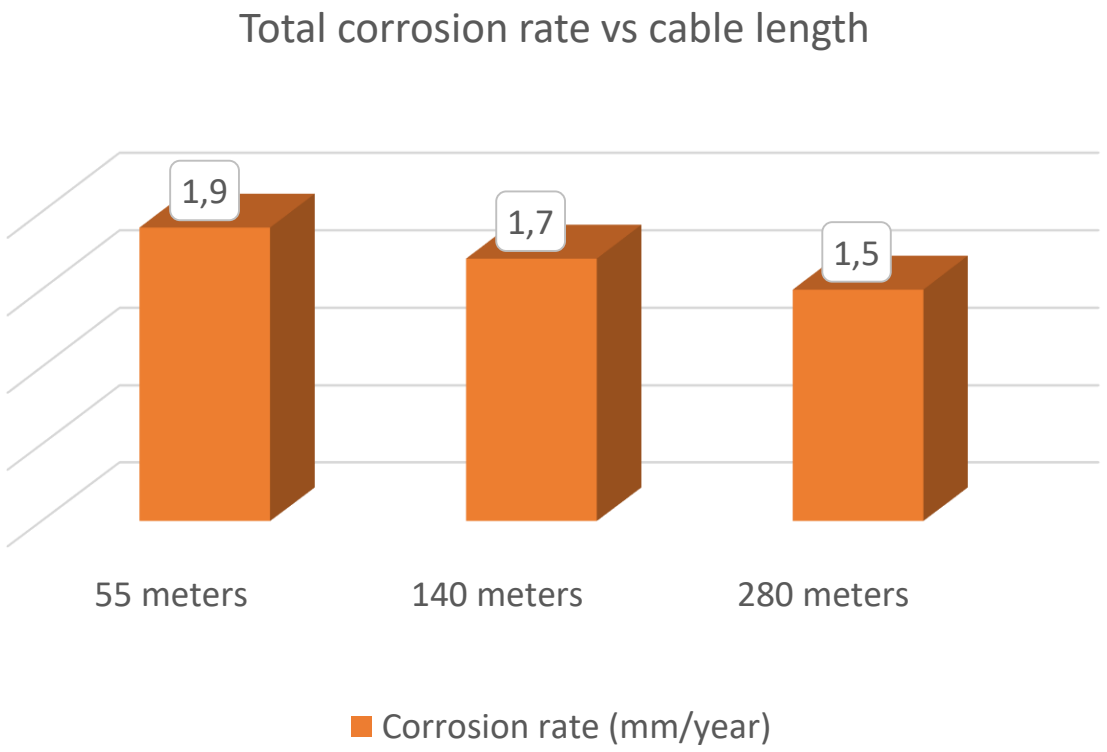
Braided stainless steel shielding



- Water permeates through the cable until it reaches the internal carbon steel core wire
- Carbon steel core and stainless-steel shielding connection at one end induces galvanic corrosion on the core carbon steel
- Core wire corrodes rapidily (5-6 months) until it brakes
- TDR can locate the position where the core wire is interrupted

Inner conductor corrosion rate at 80°C





* When considering a 0.7 mm carbon steel core wire as in the prototype tested

Sensor interrogation

A. Rough, by an ohmmeter to determine the present of corrosion but not the exact location.

B. Accurate, by a TDR to determine the exact location of CUI.

Checking for CUI

- One section of the sensor has two ends. One is used for interrogating the sensor. The second end is permanently short circuited.

- The presence of an interruption caused by CUI can be tested by using a normal multimeter.

Checking for CUI locations

- Time domain reflectometry (TDR)
- Pulse signal (voltage) sent through a conductor
- Pulse travel at known velocity in the conductor
- Conductor interruption reflects most of the pulse back
- Interruption position can be located. Exact distance from the measuring point (one of the cable ends)
- The sensor can be locally repaired and brought back into service.

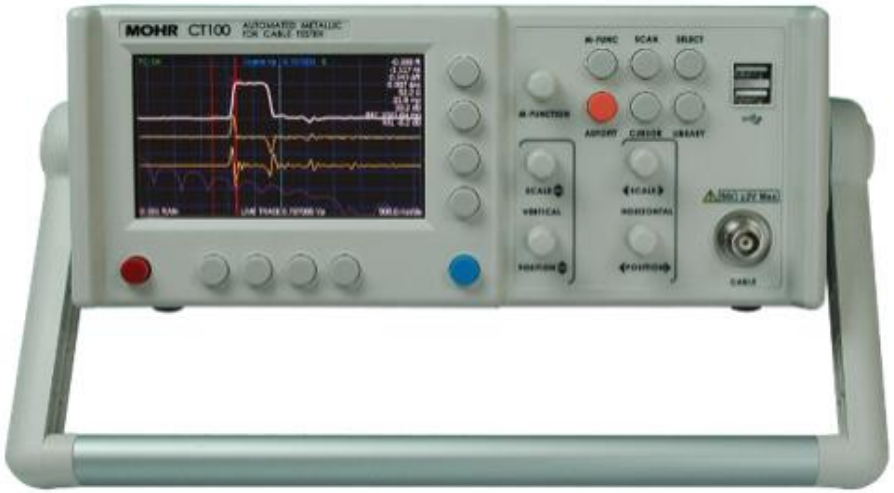
TDR tests

Tests were carried out by Heynen in Belgium with Mohr CT100

http://www.mohr-engineering.com/tdr-cable-tester-CT100.php\
https://www.heynen.com/meet-heynen/our-brands/mohr/

Sensor interruptionts can be detected with great precision, also
after eventual connectors used to repair the sensor or
to connect launch cables.

Mohr CT100/CT100B



Mohr CT100/CT100B is the
Industry's Highest Resolution Portable Time-Domain Reflectometers
It is a portable and battery-powered TDR

EMC: MIL-PRF-28800F. MIL-STD-461F RE102, CE102. IEC 61000
Shock/Vibration: MIL-PRF-28800F (Class 3)
Temperature/Humidity: MIL-PRF-28800F (Class 3)
Explosive Atm.: MIL-STD-810G 511.5 Procedure 1 (+55°C, 0-4600 m)

Installation at Tata Steel - July 2023

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Possible installation under tank chime protection

- The installation of tank chime liners makes UT NDT impossible
- CUI Spotter could be install to detect water permeation under the liner

Technical data standard sensor

Technical data

Diameter: 9 mm

Maximal length: 300 meters

Operating temperature: -70°C to 150°C continuous

Response time for 50 m sensor: 4-5 months*

Response time for 300 m sensor: 5-6 months*

**When considering a CUI environment potentially leading to 0.5mm/y corrosion rate on carbon steel. For faster response time consider BRPP-07.*

Material data - insulating braided sleeve (external and intermediate)

Melting point: + 225°C

Material: Polyester (PBT)

Colour: Black with white identification yarn

Flammability: UL94 V0, FMVSS302

Specification: UL, NF F16-101, DIN 5510-2

Other compliances: RoHS 2002/95/EC

Insulation sleeves for higher temperature

- CUI Spotter sensor can also be assembled using a Teflon insulator, thus increasing the max operating temperature up to 288°C

- For even higher temperature fiberglass sleeves could be used, thus increasing the max operating temperature up to 650°C

Conclusions

- CUI Spotter can be installed on any insulated lines, pipelines or single equipment
- CUI Spotter could be installed under a tank chime lining
- Max operating temperature up to 650°C
- Cable range around 300 meters
- No need of permanent instruments installed
- Robust measurement, easy data interpretation
- Allow detecting CUI within 6 months from water entering the insultation

Our view on being included in a effectiveness assessment

We interpreted the question this way:

> “is it realistic to be asked to prove CUI technologies on the long term using data from pilot installation?”
>
> or/and
>
> “would we agreed on the results of an effectiveness assessment based on a theoretical evaluation of the technique?”

Long term evaluation based on real installation data

- It would take decades to collect enough data with sufficient statistical relevance.
- It is not realistic and not advisable for companies to change their approach on CUI maintenance or inspections programs because of the installation of any of the techniques proposed on the market.
- All these techniques should be seen as an additional line of defence, thus eventually resulting in a reduced number of incidents and in a reduction of downtime costs.
- Although their installation would not directly result in a reduction of CUI scheduled maintenance costs, there is a good change their use will increase the plant reliability and safety.

Theoretical assessment

We are in favour of this approach if:

- The study considers the CUI monitoring systems in combination with different possible CUI maintenance strategies.

- If the combination CUI prevention strategy and type of sensor installed is evaluated in its totality, including installation costs, monitoring system maintenance costs and possible issues (see batteries replacement and monitor system reliability).

Examples

- For company that bases its CUI program on critical point inspections, it could be beneficial installing systems claiming claim the possibility of detecting CUI without removing the insulation. However, those systems are more expensive and they require some attention in the maintenance of the system itself.

- Instead, companies relying on preventive insulation revamping or willing to include a monitoring system in a new plant, could be attracted by systems like CUI Spotter. This system has in fact very low installation costs, almost no maintenance costs and it cannot fail (unless corrosion is CUI is taking place).

Discussion