

Independent study into sensors and coating solutions for the management of corrosion under insulation (CUI)



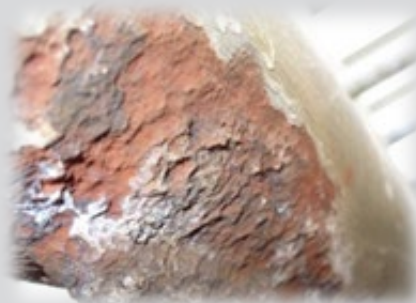
**JOINT INDUSTRY
PROJECT OUTLINE**

PROP304031

Summary

Corrosion Under Insulation (CUI) continues to present a major challenge across a range of process industries. We have no proven economic way to eliminate it by design and plant operators inherit the challenge of preventing failures. Sensor technologies and the use of protective coatings have been proposed to industry as possible solutions to the management of CUI. Information regarding the performance of these technologies often reside with the manufacturers and little or no independent studies have been carried out. Industry consensus is that more work is needed to improve our understanding of these technologies in order to implement them in the most effective way.

This project will investigate sensor and coating solutions for the management of CUI. It will focus on testing and comparing a range of CUI sensors and also to look at the performance of coating systems used for the protection from CUI. Furthermore, the knowledge gained from this work will help to define risk-based CUI models based on the data obtained and how best to analyse this to make informed decisions on the management of CUI.



Introduction

CUI presents unique challenges. Prediction of where and when CUI failures will occur is limited. Typically, a small percentage of the equipment prone areas are affected by severe CUI (Watt et al 2019). For highly critical equipment the occurrence of one failure can have severe safety and indirect financial consequences. Confident failure prevention requires high coverage, high reliability inspection at conservative intervals and is resource intensive because there are no cheap inspection options. Sooner or later many plants face the challenge of embarking on costly inspection campaigns, whether planned or triggered by unexpected severe CUI findings or failures.

Recent developments has seen a range of CUI sensors being offered as solutions to the detection and monitoring CUI. The use of these are proposed to reduce or eliminate the need for intensive inspection. However, since these technologies are still relatively new, there is little or no data on the comparison of their performance and limitations of use.

Information and data on the use of well-established technologies like coating for protection for CUI often reside with the manufacturers. The end user often has to rely on the coating manufacturers for guidance on selection for their plant conditions. This is especially the case for novel and new coatings system, where little or no data is available outside of the manufacturers.

In both cases, there is a need for an independent study to generate performance data for industry. This project proposes to address this and will enable the information gained to develop risk-based CUI models to assist in the management of CUI.



Project Concept

TWI, proposes to investigate sensor and coatings solutions for the management of CUI based on the following:

1. To investigate and compare the performance of a range of CUI sensors using a CUI simulation test facility.
2. Focussed laboratory testing to improve understanding of coating performance limits.
3. Development of a database from information gained from the performance testing sensors and coatings which can be used for prediction modelling



Objective

To carry out an independent investigation into sensors and coatings solutions for the management of CUI.

Key dates

- UK launch planned of January 26 2022 via teleconferencing.

Benefits

- Improved understanding of sensing and coating technologies that help to manage CUI.
- Independent assessment
- Generate data for CUI prediction models
- Resource, personnel, equipment and cost savings from more effective implementation
- Relevant for both new and older plants.

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Approach

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Two testing facilities will be built to test coatings and CUI sensors. The facilities will be based on standard test methods to simulate CUI conditions. A market search and liaison with manufacturers of CUI sensors and coatings have already started, in order to make sure that their products can be fully tested within the current plan. Regular communication with them for the duration of the project will be established, so that their systems are used as intended. The results from the tests at TWI's facilities will assist plant operators or asset management bodies decide which sensing and coating technology is the right one for their needs by:

- Providing an overview of the CUI sensing technologies currently available in the market.
- Performance of coatings in simulated CUI conditions
- Fully disclosing gathered data and commenting on them from an independent point of view.
- Reporting of findings of the test programme.

Technologies to be evaluated

The following types of sensors to be evaluated in the programme will include the following (*):

- Moisture/humidity sensors
- Long range corrosion detection sensors
- Passive magnetometry corrosion sensors
- Coating degradation sensors

(*) This list of technologies is based on manufacturers who have expressed an interest in participating in this proposed project.

Task 1 Performance testing and benchmarking of CUI monitoring systems

Although there is a significant amount of literature available regarding technologies that can detect or quantify CUI damage, there is no direct comparison of their performance. In addition, manufacturers usually carry out testing of their own systems, without necessarily comparing against other devices or disclosing all results.

Since commercially available products differ in their intended implementation – monitoring or inspection – the benchmarking process will only focus on monitoring as other studies for inspection of CUI has already been carried out (e.g. Burch 2020). Monitoring devices will be installed, as per manufacturer's instructions, on a simulated test loop which will run for period of time under simulated conditions known to cause CUI.

During the test, NDT sensors will be used to monitor for indication of corrosion from the internal surface to provide a comparison to any responses shown in the monitoring tools. Further analysis will be carried out at the end of the testing period, when the insulation will be removed and sections that show visual evidence of corrosion will be inspected using phased-array ultrasonic testing (PAUT). This will be compared with baseline scans of the pipes taken prior to testing. A report on the comparison of data from all devices against the NDT inspection reports will then be compiled.

Task 2 Coating performance testing

Coating life is not a fixed constant and varies with CUI environment severity as well as quality. The limitations of quality applied coatings is little explored. TWI has a long history of experience in the testing of thermal-sprayed aluminium (TSA) coatings. Unlike organic coatings, TSA is better suited to extrapolation of laboratory testing results to the field. TSA is commonly specified as the preferred coating under insulation. Recent TWI work funded by a major oil and gas company suggests that testing under simulated CUI conditions can expand our knowledge about where TSA can achieve long life and where life is limited. This may help to explain different experiences in the marine offshore and petrochemical industries. This task will include benchmarking with a current state-of-the-art coating used to mitigate CUI.

Task 3 Development of CUI database from testing data

Testing in the flow-loop Task 1 will provide data on the initiation and propagation of CUI in a simulated environment. In addition, tests of coating systems in Task 2 will also provide data on the CUI protection performance. This combined data set will be used to develop database of test results with a view that these will be used develop CUI prediction models for the management of CUI.

Detailed scope of work and schedule

The project scope depends on levels of interest in the three tasks outlined above. The proposed work programme will be discussed at a launch meeting planned in January 2022. Potential sponsors are encouraged to comment on the activities described in this outline, and indicate any specific requirements regarding project content. Potential sponsors not able to attend the meetings in person are asked to forward email comments to the Project Leader.

Following the meetings, a detailed technical proposal will be prepared describing the planned scope of work and price.

References

- Burch F, HOIS/OGTC Guidelines for in-situ inspection of corrosion under insulation (CUI), HOIS-G-023 Issue 1, March 2020.
- Watt C, Lee, C-M, Paterson S, Jopen A; "Using industry data to compare performance of different risk-based methods for the management of corrosion under insulation", Paper 226986, Eurocorr 2019 Conference, Seville, Spain, Sept 2019.

Further Information

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For further information on how a Joint Industry Project (JIP) runs please visit:

<https://www.twi-global.com/what-we-do/research-and-technology/current-research-programmes/joint-industry-projects#/>