



Praktijklab voor Industrieel Praktijkonderzoek

Corrosie Onder Isolatie

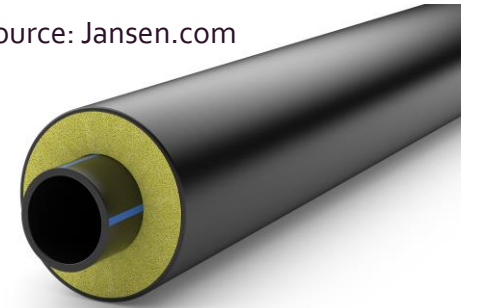
Sensoren, Corrosie Snelheden, Invloed process parameters, Coatings, Isolatie



Corrosion Under Insulation

SAFETY, COSTS, REPUTATION

Source: Jansen.com



CUI Failures: left, Petroplus (Src: BBC); right, Brae Alpha (Src: IMCA)

Development of a realistic CUI test environment

Develop and demonstrate CUI Management Solutions



Realistic CUI Test Environment for Sensors, Coatings and Insulation



Focus on

- Research into prevention, detection and repair of corrosion
- Accelerating the uptake of Corrosion Management innovations and improve our understanding thereof, while reducing financial and safety risks involved

Objectives towards CUI

- Reduce overall lifecycle cost associated with CUI
- Present clear insights and guidance on what combination of CUI Management solutions provides the most cost-effective approach for various situations

Activities on CUI

- Evaluation of different CUI management solutions in a realistic test environment
- Testing, demonstrating and understanding sensors and NII methods for CUI
- Comparative study of various CUI coating systems and development of a generally accepted method
- Investigate impact of insulation system design
- Investigate energy losses due to wet/degraded insulation

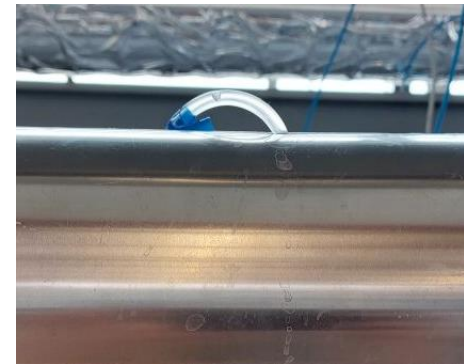
Realistic CUI Test Environment for Sensors, Coatings and Insulation

WHAT ARE WE DOING?



Testing rigs for CUI

- Plant trials are challenging to control and face safety & environmental issues
- Test rigs offer realistic environment, safe and controlled
- Test rigs managed by independent research institute can bridge the gap between innovation and implementation



Realistic CUI Test Environment for Sensors, Coatings and Insulation



Achieved

Provide system test for different company owners

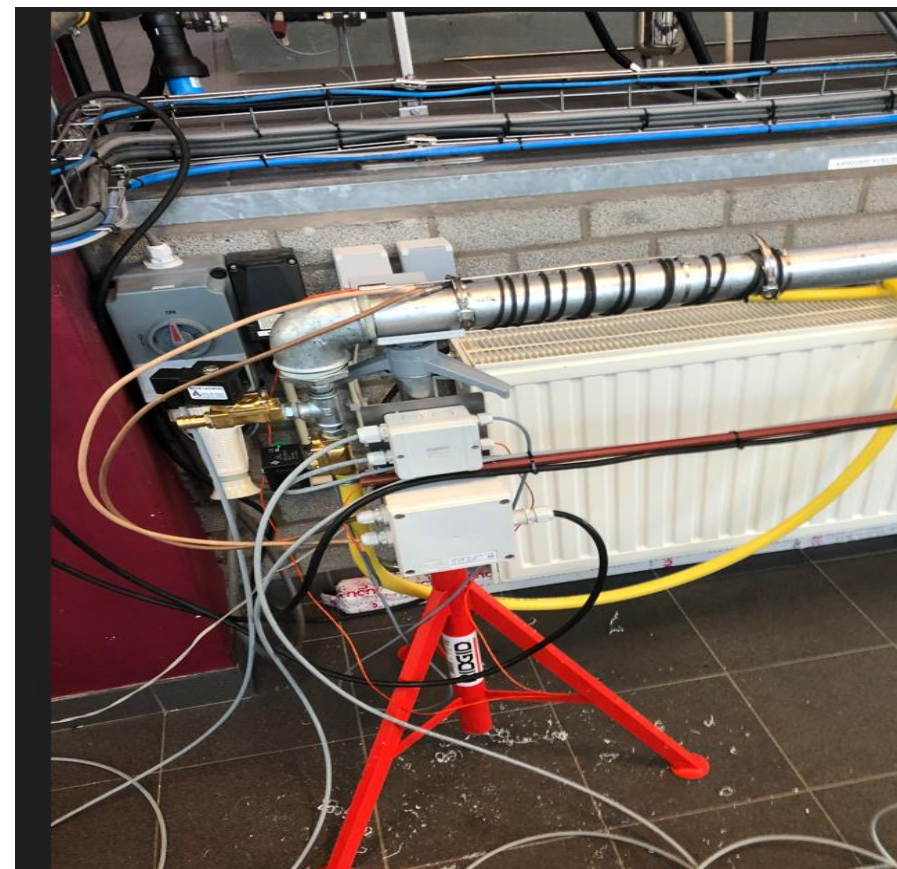
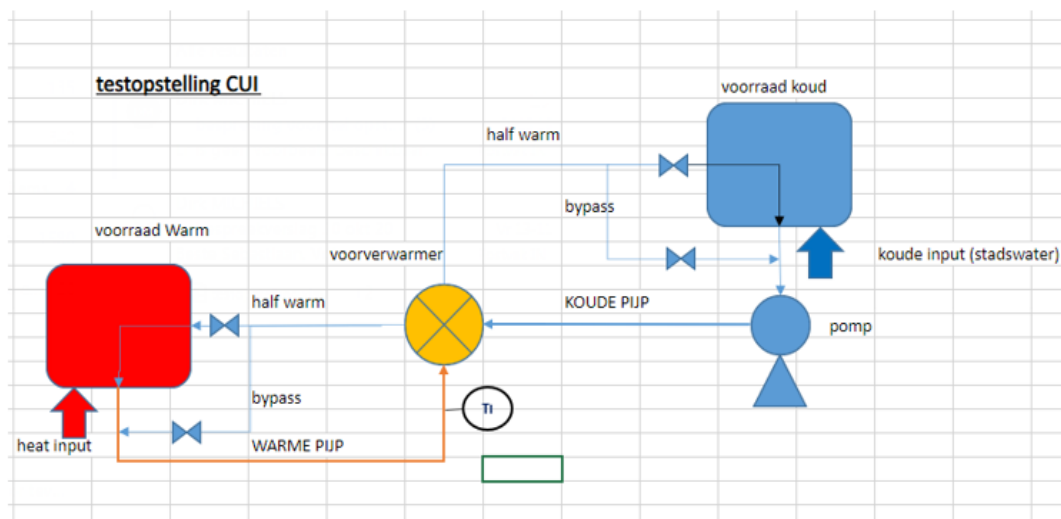
- Testing of measuring devices, sensors, insulation systems, etc.
- Sensor response times, detection thresholds, etc.
- Live measurements
- Impact of operating conditions on CUI



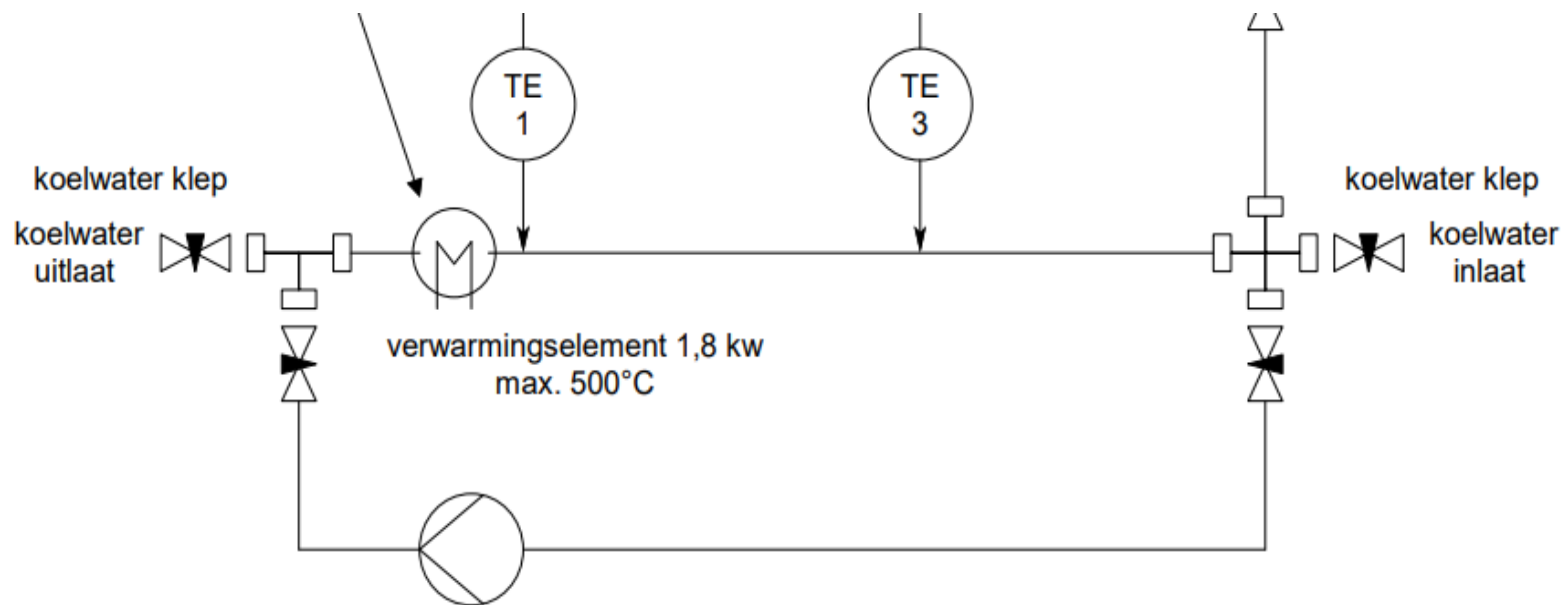
Result after 12 days (cyclic T, start with wet insulation)



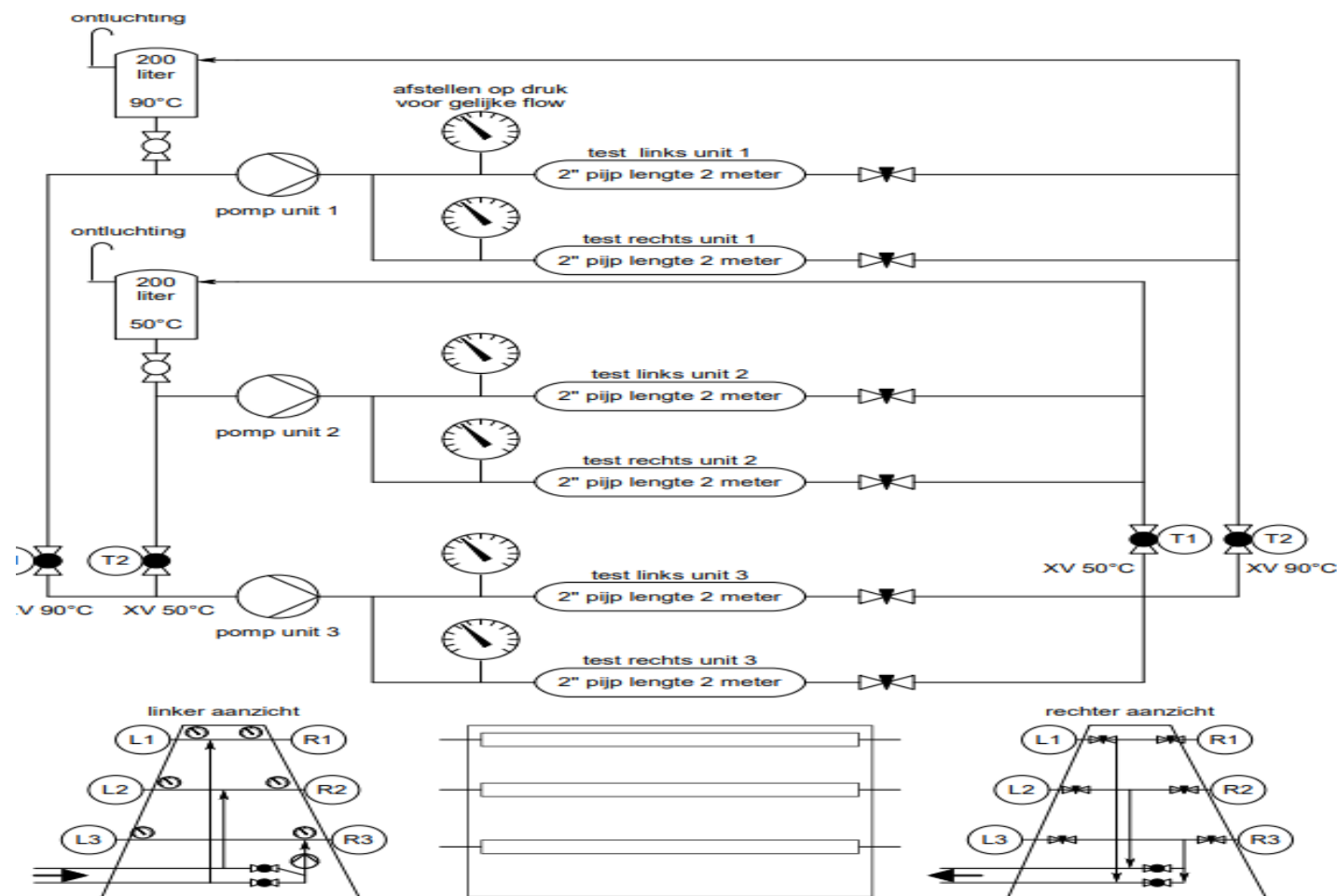
De bouw: diverse ideeën



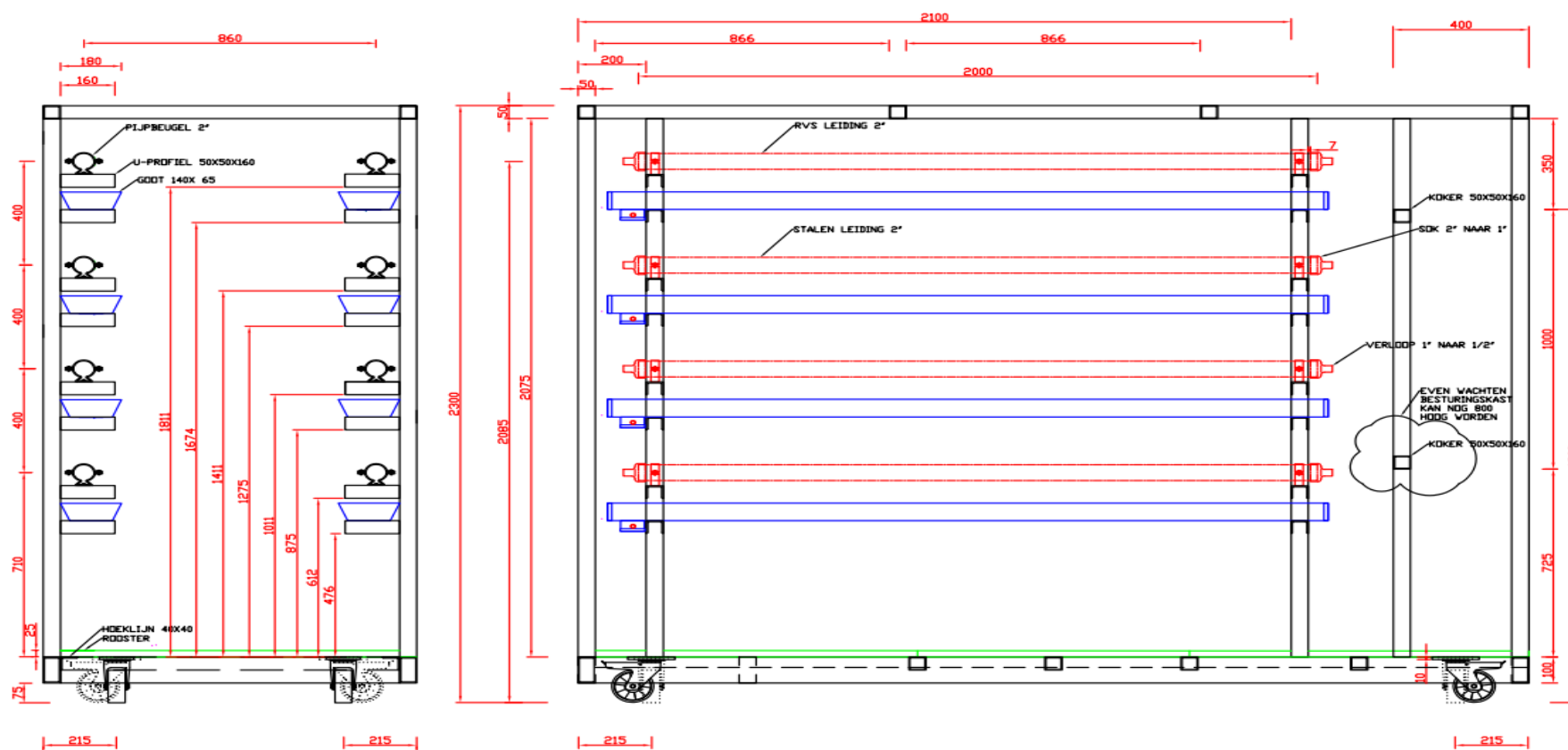
De bouw: diverse ideeën



Efficiënter, effectiever en duurzamer onderhoud.



Het idee op tekening



Studenten betrokken bij:

1. Bouw
2. Bediening
3. Aanpassingen
4. Experimenten



Efficiënter, effectiever en duurzamer onderhoud.



First results - Location of water retention



Effect of Temperature on Water repellent properties

12 days
80 ml/h
20°C
+ 120g



12 days
80 ml/h
82°C
+ 1500 g



Dry weight
approx. 1500 g

First results - Location of water retention

RT, 5ml/h, 4 weeks



82°C, 5ml/h, 4 weeks



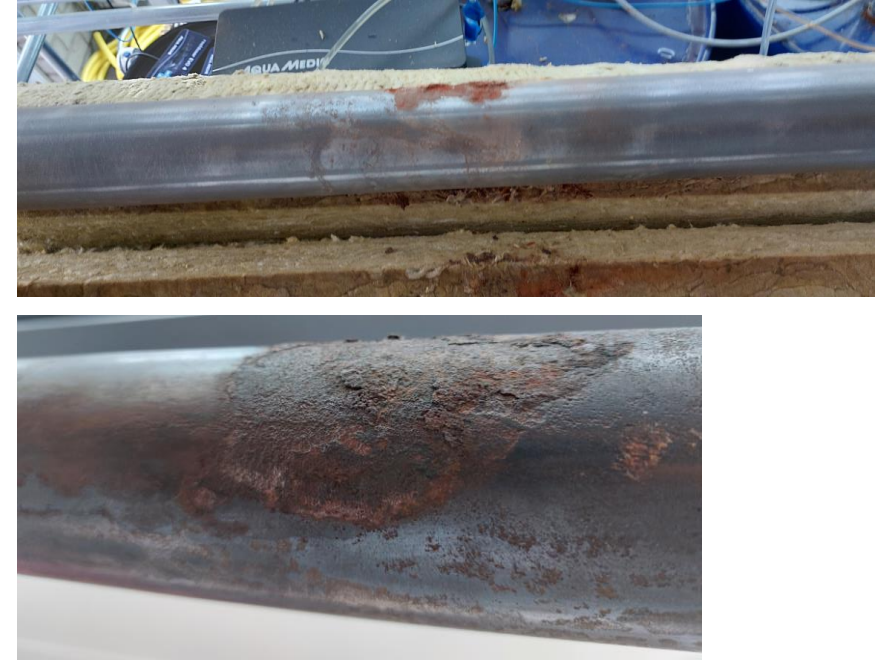
Take away: Small amounts of water have a more corrosive effect on cold pipes

Influence of temperature cycling

Cyclic (82/22°C), 5ml/h, 13 weeks

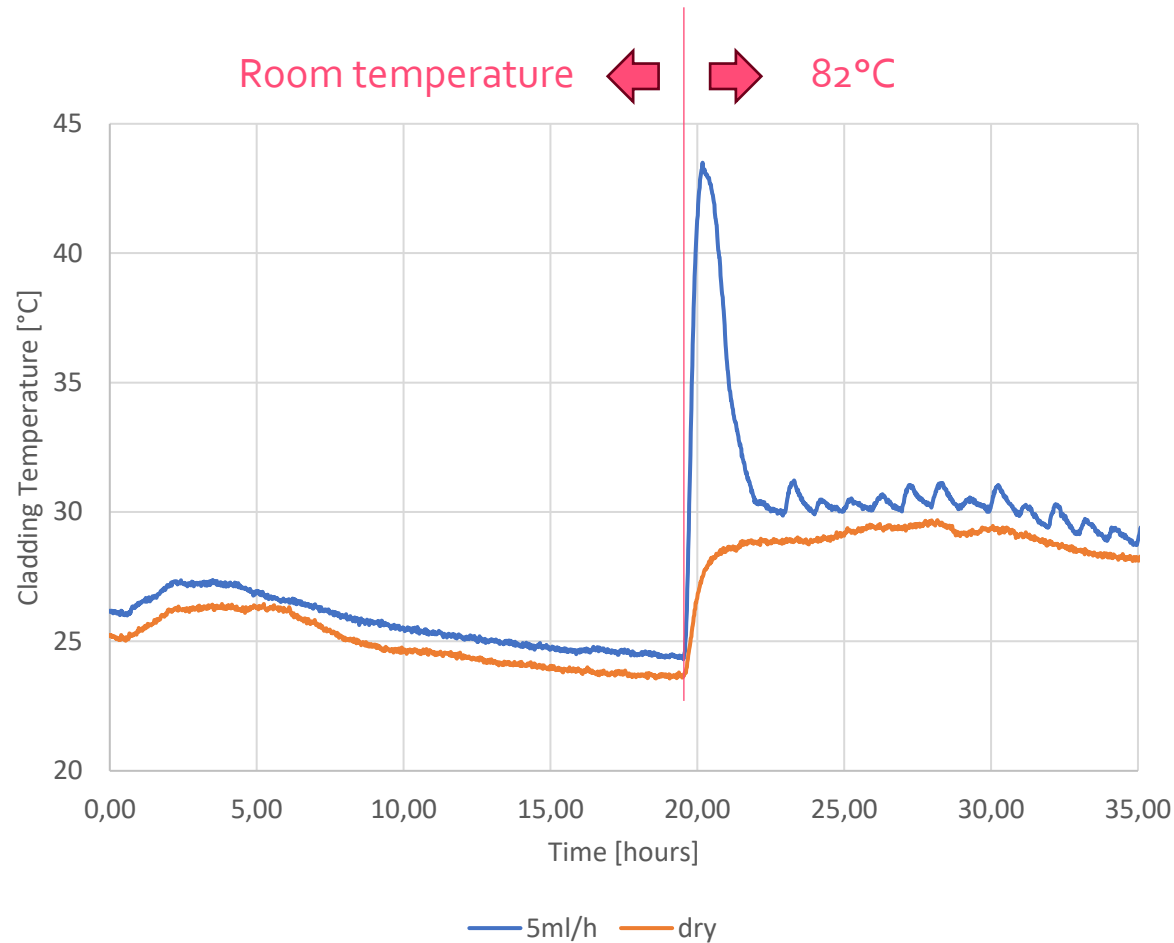


82°C, 5ml/h, 13 weeks



Take away: Cyclic temperature regime results in corrosion that is much more spread along the length of the pipe (further study of corrosion needed).

Water retention during cold cycling



- Frequent cycling may lead to aggressive CUI in case of a persistent water source
 - Period of very high moisture/humidity and high temperature
- Increased water retention with temperature cycling

Weight after 13 weeks	
Cyclic, 5ml/h	1935 g
Hot, 5ml/h	1655 g
Cyclic, 40 ml/h	2588 g
Hot, 40ml/h	2013 g
Average weight of dry insulation (st. dev.)	1638 g (± 98)

Influence of temperature cycling

Cyclic (82/22°C), 40ml/h, 13 weeks



82C°, 40ml/h, 13 weeks

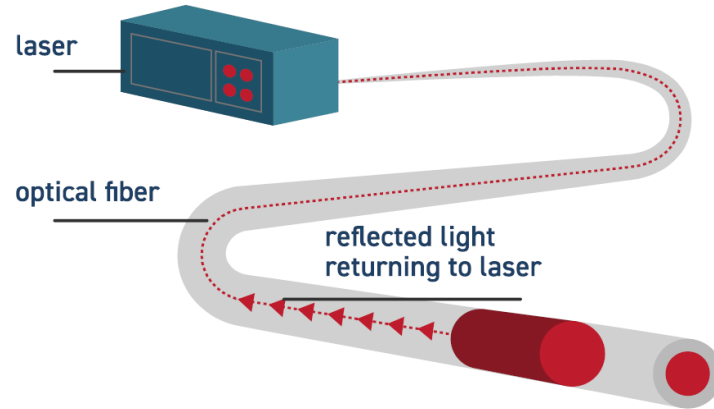


Take away:

At 40ml/h, hot pipe shows strong localised corrosion.
From visual observation, no immediate difference in
'depth' of corrosion.

Evaluation of CUI Sensors

EVALUATION AND TRAINING OF CUI MONITORING TECHNIQUES – FLUVES



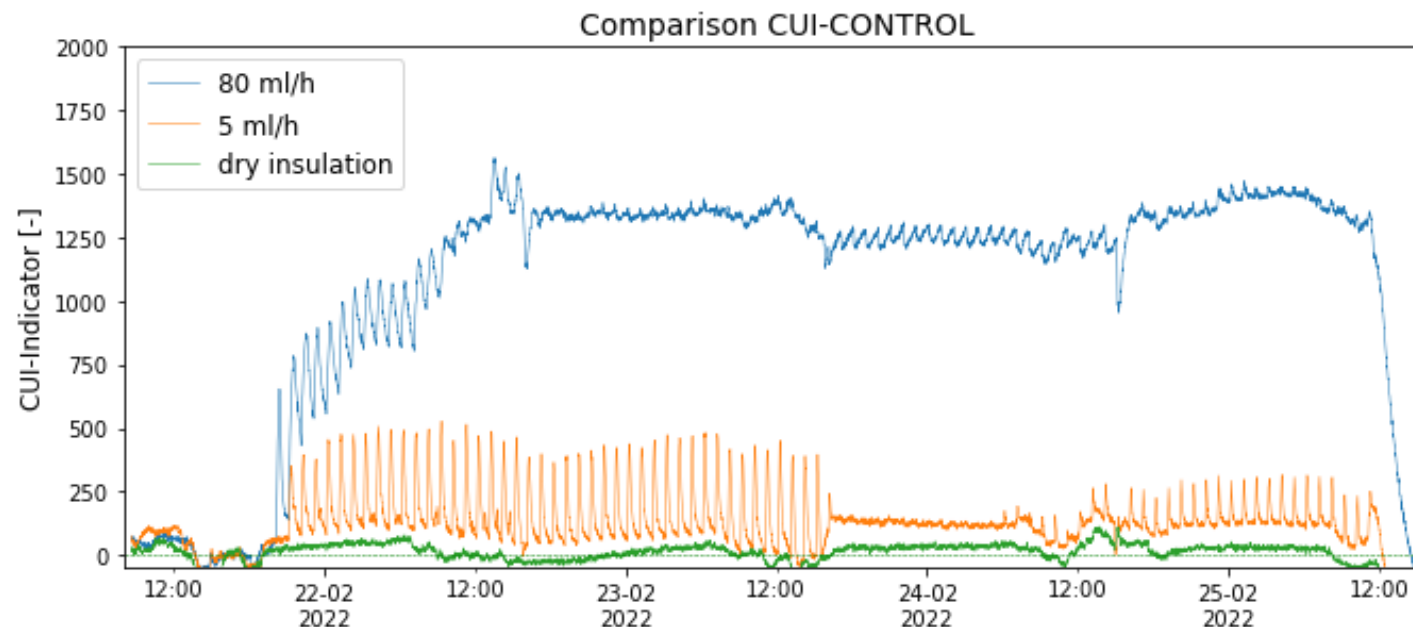
- Moisture monitoring using fibre optics, based on acoustic and temperature data
- Applied on the outside of the cladding



FLUVES

First results

EVALUATION AND TRAINING OF CUI MONITORING TECHNIQUES – FLUVES



- Differences between the pipes with 5ml and 80ml water injection per hour could clearly be detected
- Difference between dry pipe and pipe with 5ml per hour injection could clearly be detected.

FLUVES

Dry-out

82°C, 40ml/h, inspection after approx. 24h dry-out



Wet on the outside



Dry pipe



- If you want to use moisture in insulation as a input parameter in models, you may need to know where the moisture is. (Intended purpose of CUI Sensors...)
- What is 'dry' for one sensor may not be 'dry' for another one.
- Incorporation of sensor data in CUI Management programs.

Evaluation of CUI Sensors

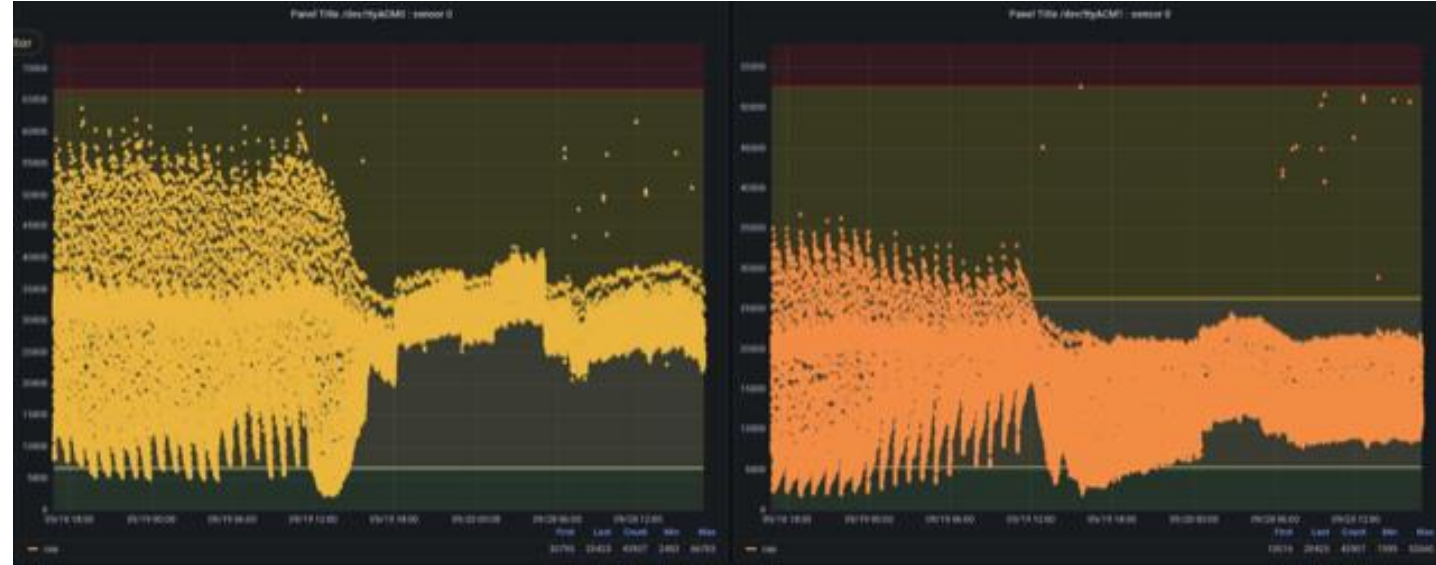
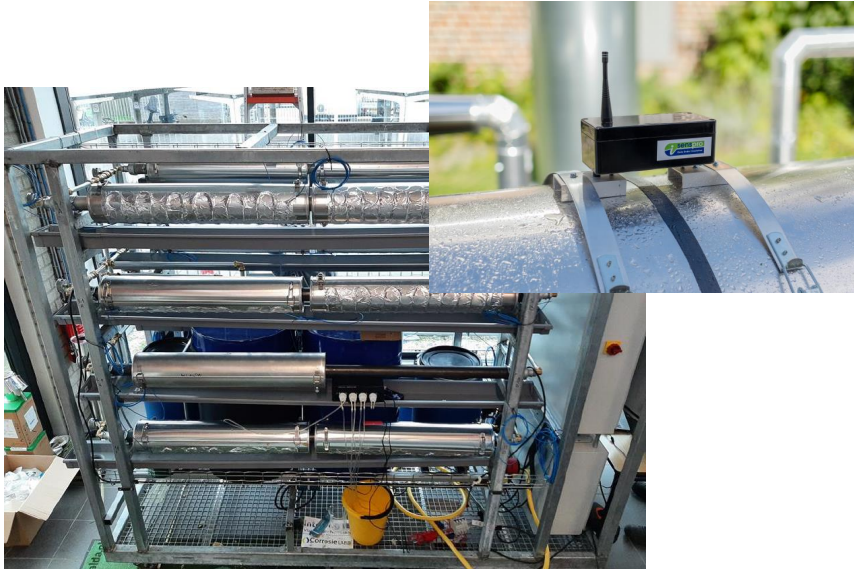
TEST AND DEVELOP CUI MONITORING TECHNIQUES - ISENSPRO

- Moisture monitoring
- Isenspro (electrical capacitive measurement)
- Stainless steel pipes
- Can the presence of ions be detected
- One pipe fresh water, other salt water



First results

TEST AND DEVELOP CUI MONITORING TECHNIQUES - ISENSPRO



- Water infiltration each hour is clearly detected.
- Wet and dry periods are clearly identified.
- Differences in signal due to salt concentration are being investigated.



Key take-aways



- Ambient temperature pipes are more susceptible to corrosion by small amounts of water ingress, hot pipes require larger amounts of water for CUI to take place
- Cyclic temperature regimes may indeed lead to an increase in corrosion rates.
- The ability for moisture retention and location of moisture in the system plays a key role.
- CUI Sensor technologies will play a key role in the future of CUI Management.
- For data driven CUI management, measured parameters need to be well understood.

Realistic CUI Test Environment for Sensors, Coatings and Insulation



Dec 2022

Phase 1

Phase 2

Durable industrial CUI
research program

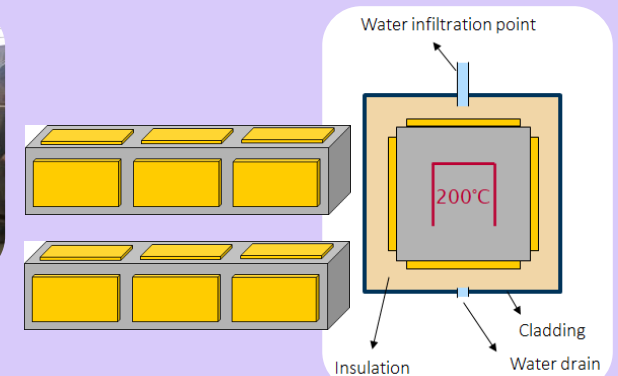
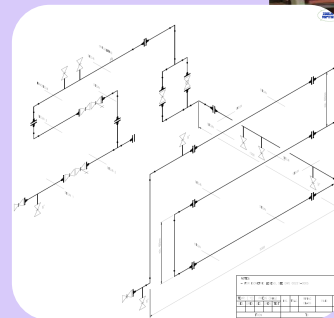
Interreg
Vlaanderen-Nederland

€400k, 2 year
learning trajectory




CUI-JIP

Financed by
the industry





The case of CUI is an example of what we can achieve.

We're looking forward to learn about other industrial cases where  **CorrosieLABS** can make a difference.

Let's talk!



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Coating specialist



Bart Teerlinck

Program lead



Let's talk!

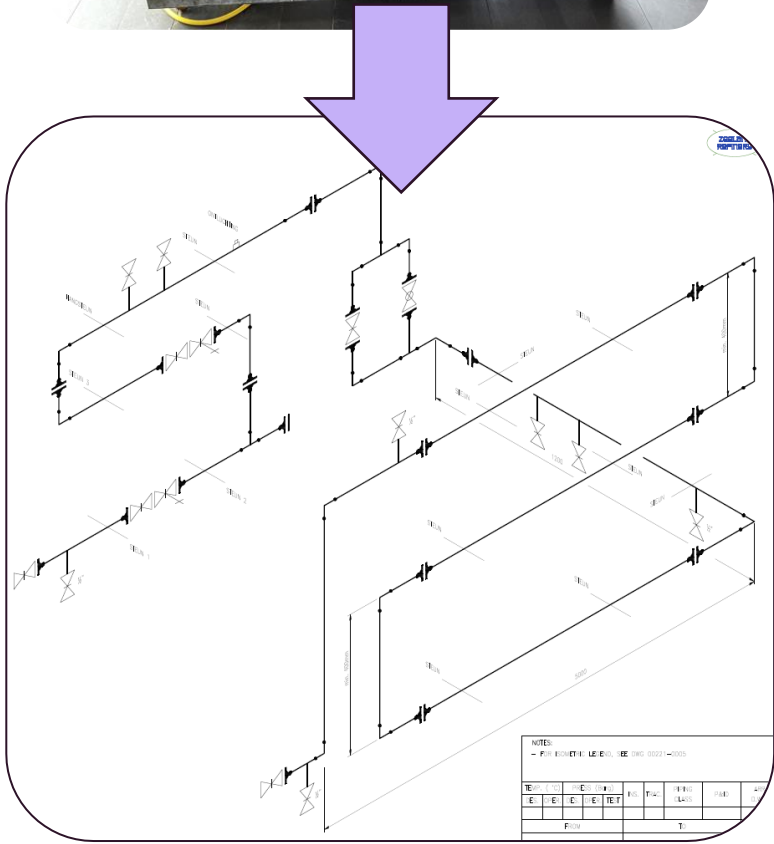
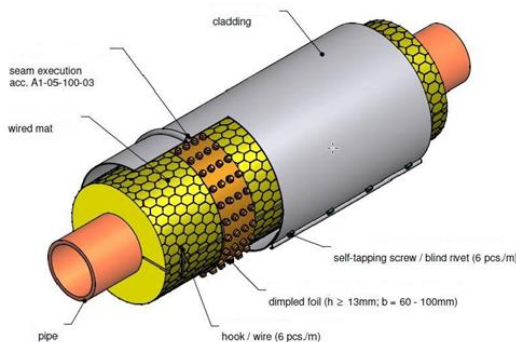
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sirris innovation
forward

 **Corrosion LABS**

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CUI JIP - Sensors



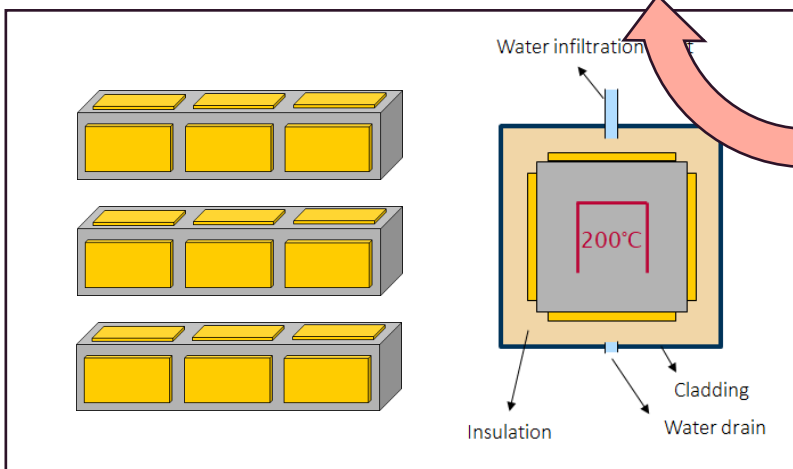
Source: Presentation, Rockwool, CUI Innovations, September 2017

CUI JIP - Coatings

Long duration
coating test (1.5 yrs)



Accelerated
coating test



In-field
measurements



Combined interpretation
to get insights about real-
field performance based
on accelerated testing.

A System Approach to CUI

