

The
High-Temperature
Corrosion Center

KME711

Combating superheater corrosion by new materials and testing procedures - Corrosion experiments in the waste fired CFB boiler P15 at Händelö



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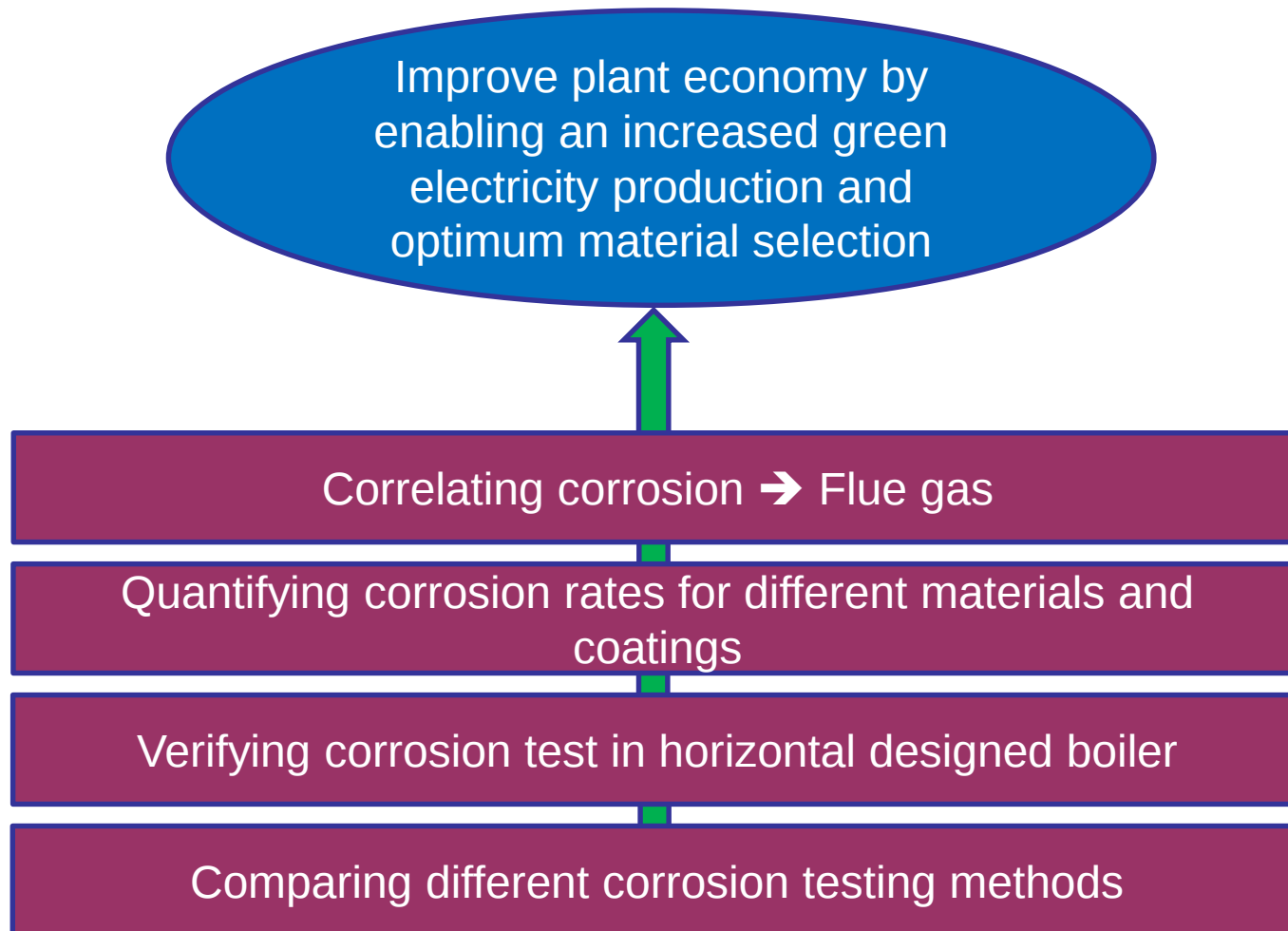


Matti Huhtakangas
Operational staff



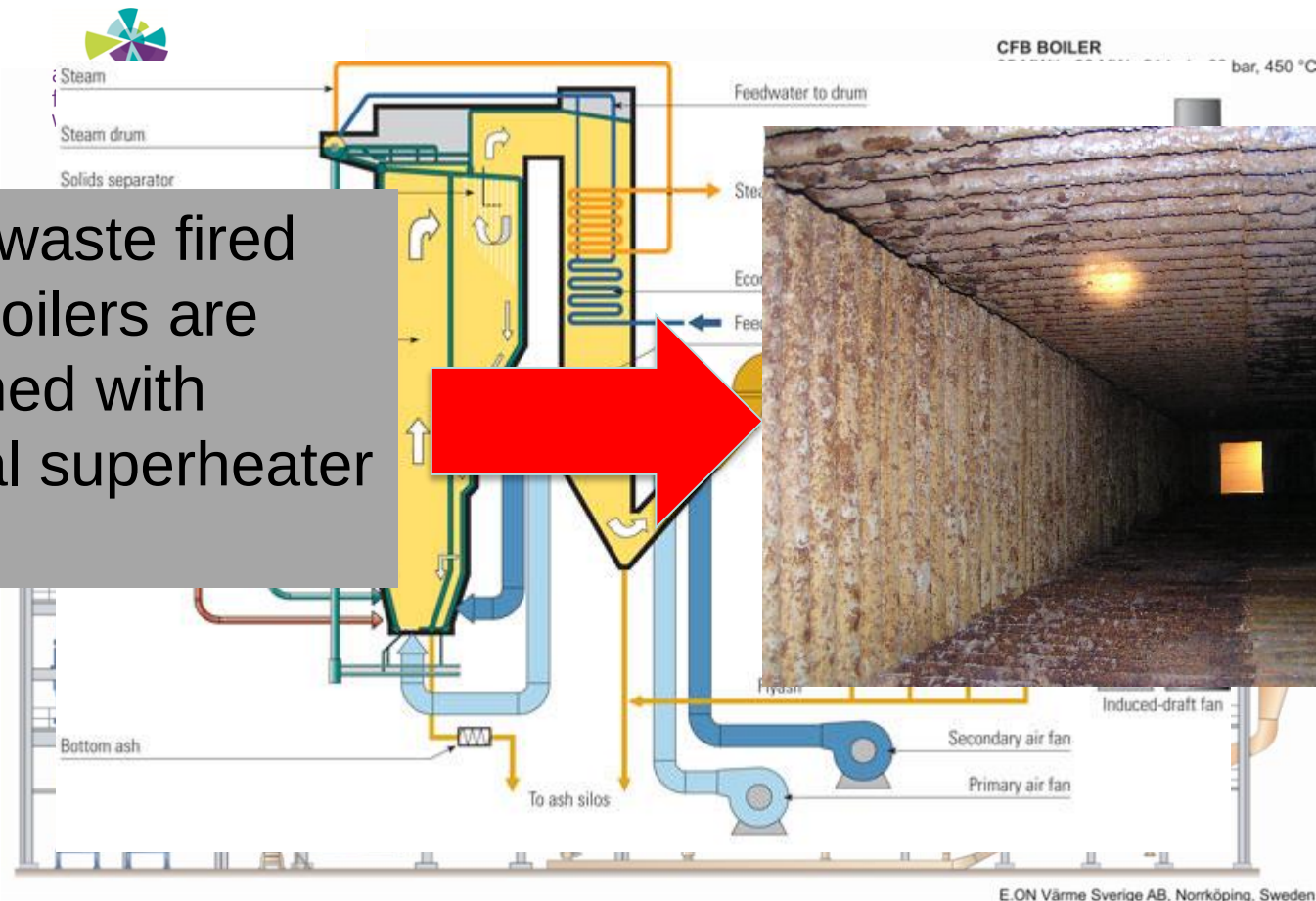
Edgardo Coda Zabetta, Jouni Mahanen, Kyösti Vänskä, Kari Peltola, Vesna Barisic

Goal of the Project



Background

Many waste fired CFB boilers are designed with vertical superheater bank



Project Plan

1 Investigate corrosion of the superheaters in a boiler with horizontal design using 3 different corrosion testing methods

2 How does the corrosivity of flue gas varies depending on its temperature and chemistry?

3 Test usability of FeCrAl alloys and coatings and comparison towards state-of-the-art SS and conventional SS and steels

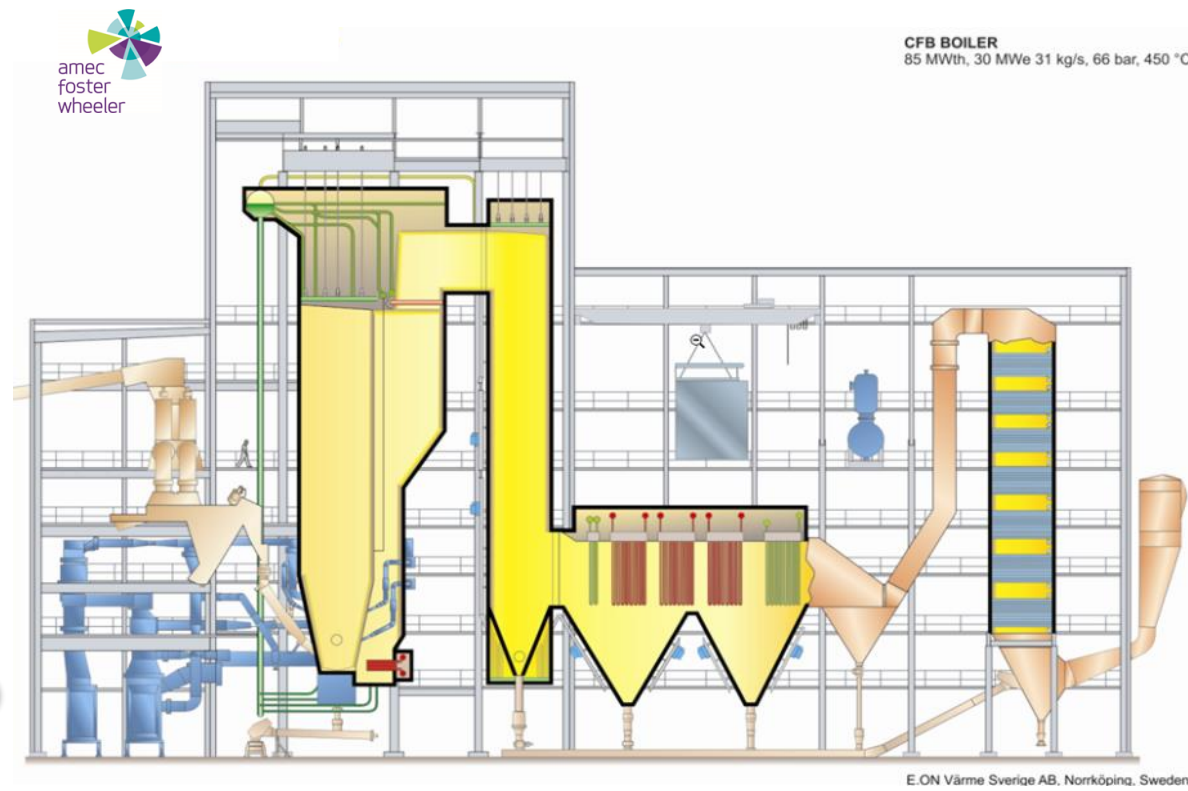
Investigate corrosion of the superheaters in a boiler with horizontal design using 3 different corrosion testing methods

Corrosion testing methods

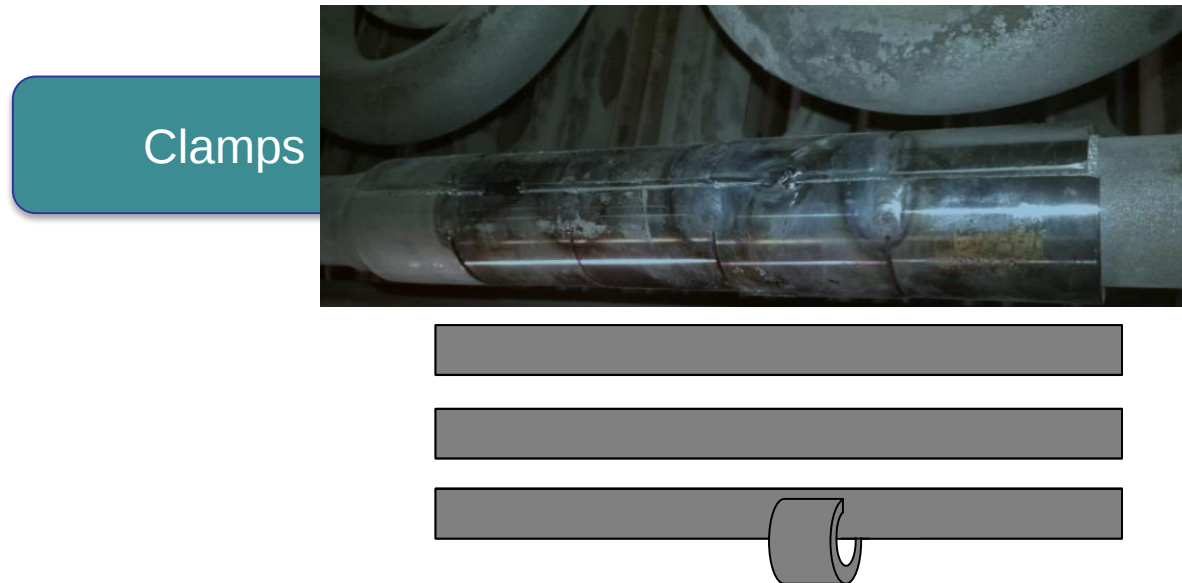
Probes

Coils/tubes

Clamps



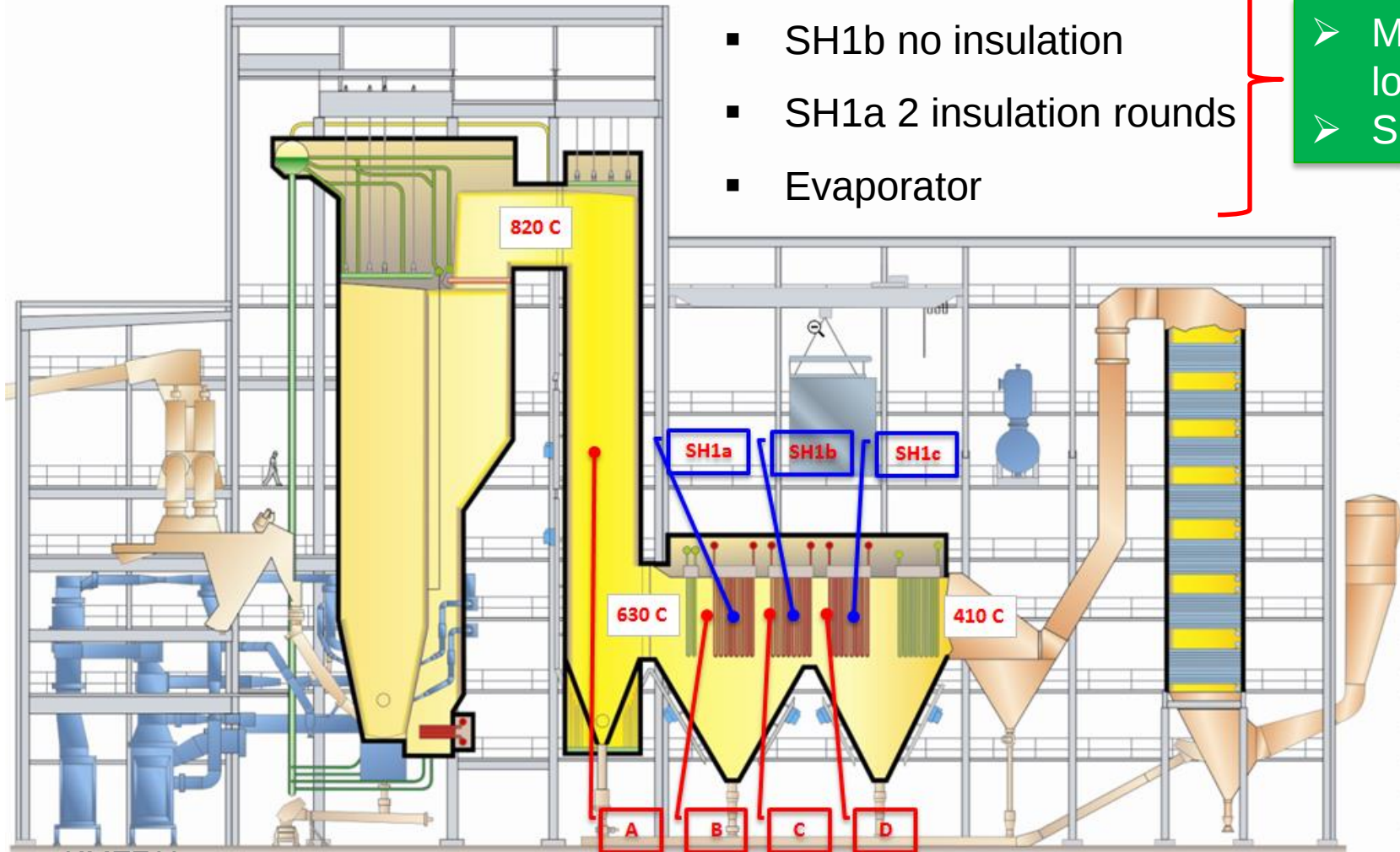
We aim to generate new knowledge of how corrosion testing is performed in an optimum way of lifetime prediction...



Clamps

- SH1a no insulation
- SH1b no insulation
- SH1a 2 insulation rounds
- Evaporator

➤ Material loss
➤ SEM/EDX

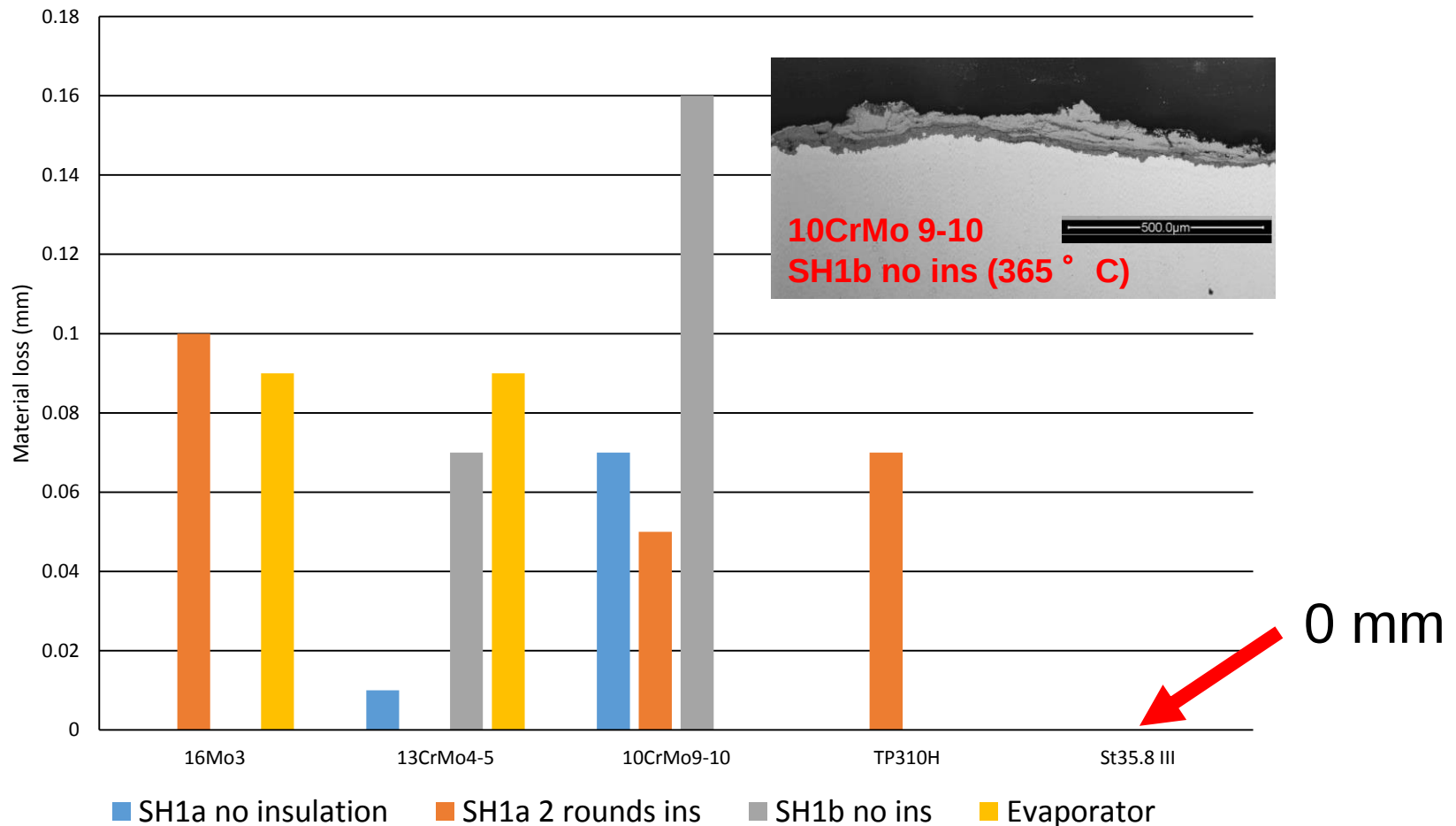


KME711

E.ON Värme Sverige AB, Norrköping, Sweden

Clamps: Material loss

Exposure time: 6400 h



We aim to generate new knowledge of how corrosion testing is performed in an optimum way of lifetime prediction...

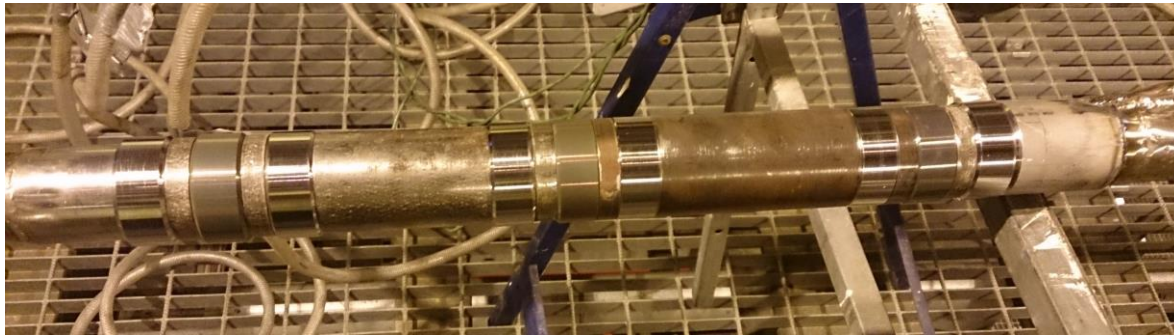
Technique developed by
Foster Wheeler

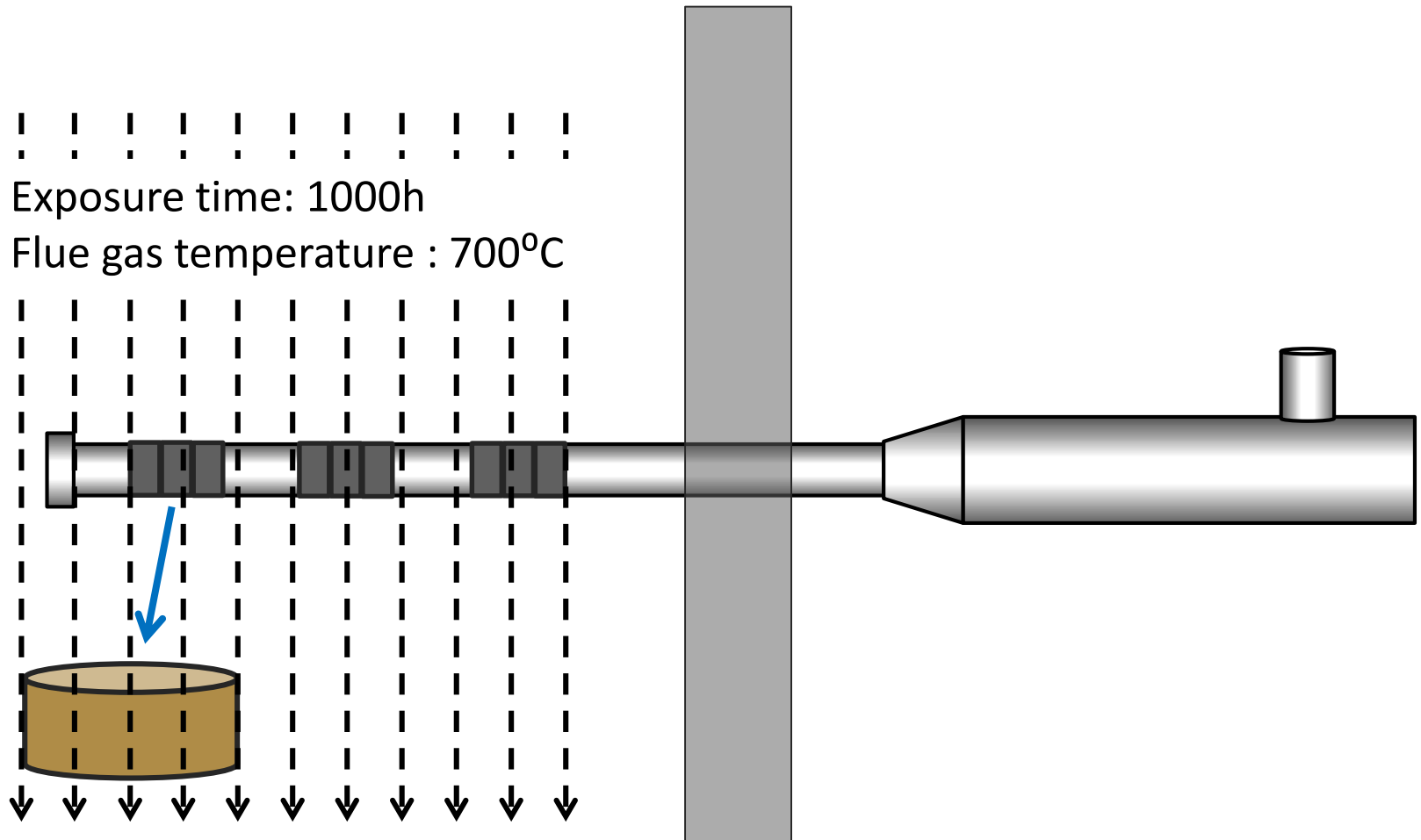
Clamps

Effect of startup
sequence

Start exposure with pre-
heated probes?

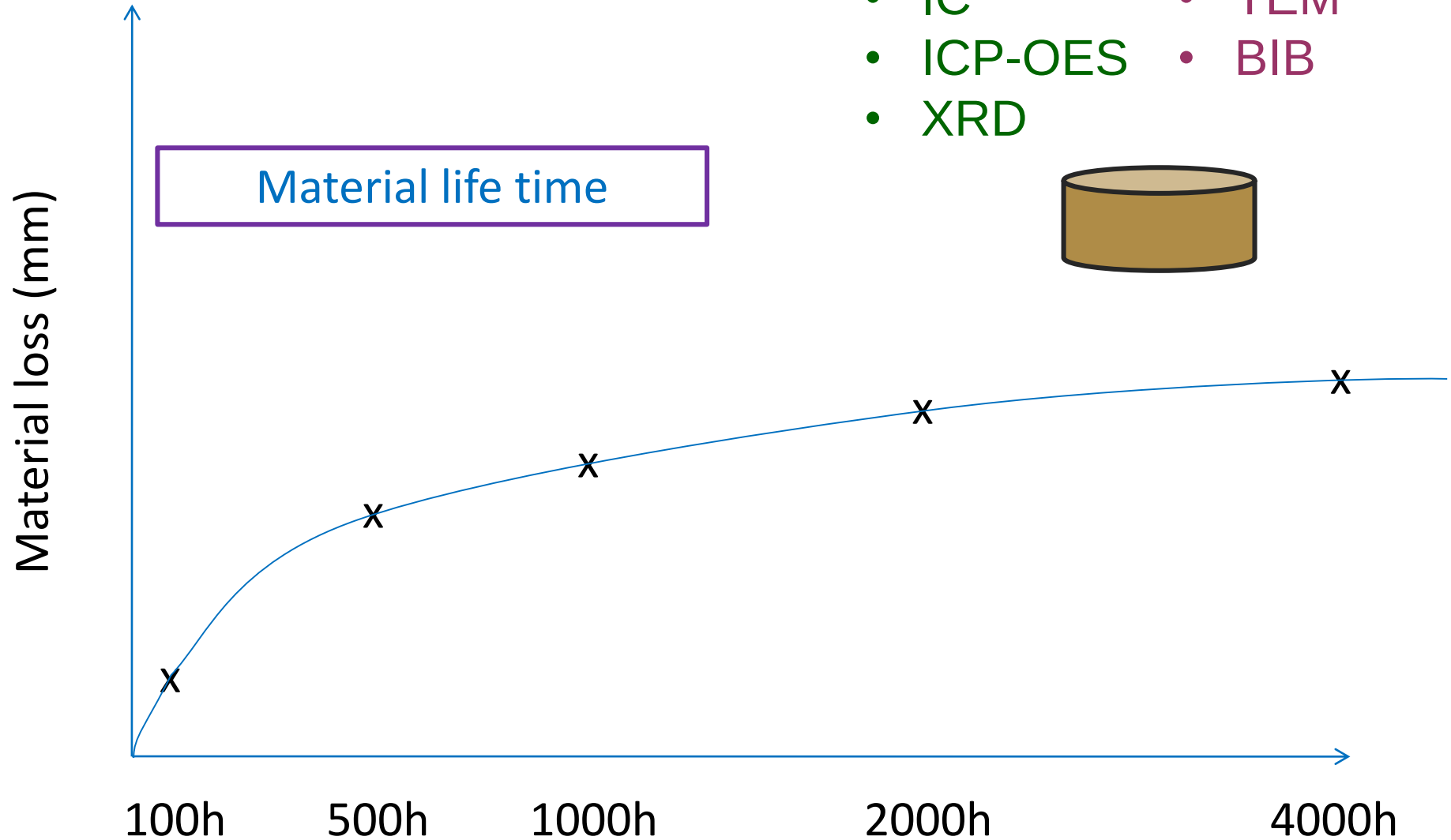
First exposures of the project performed in November 2014 by Chalmers and Foster Wheeler



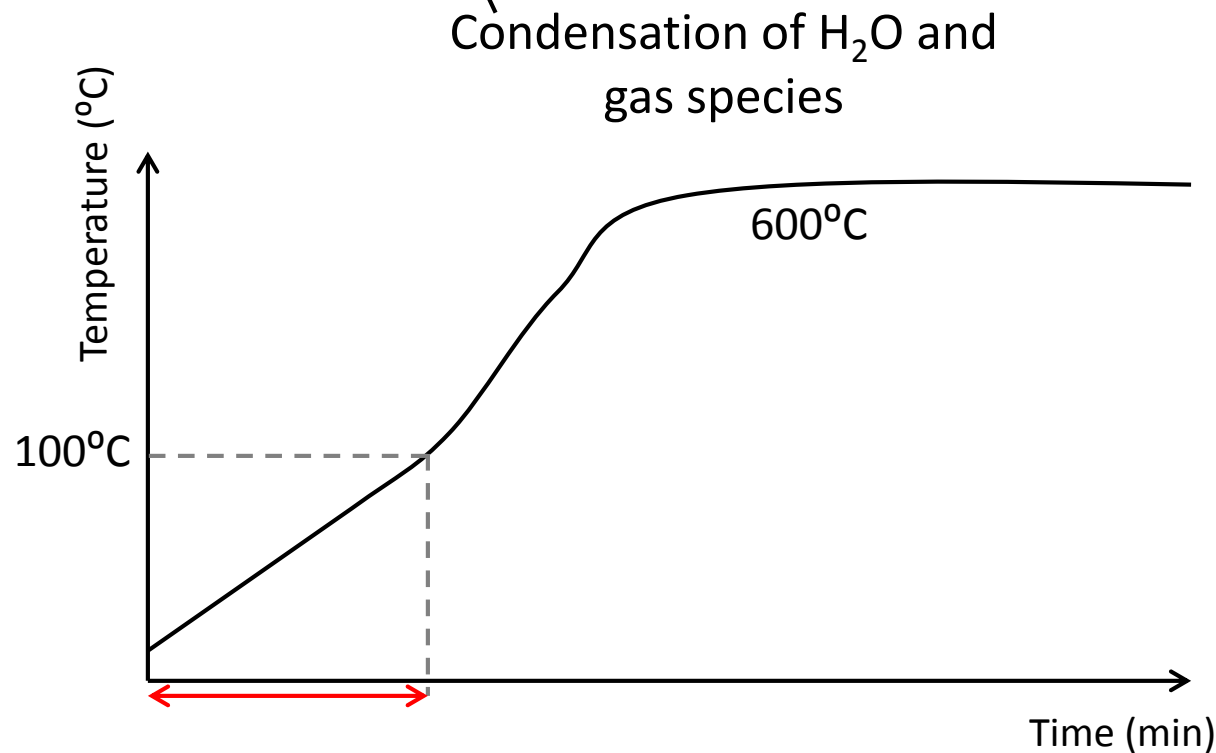


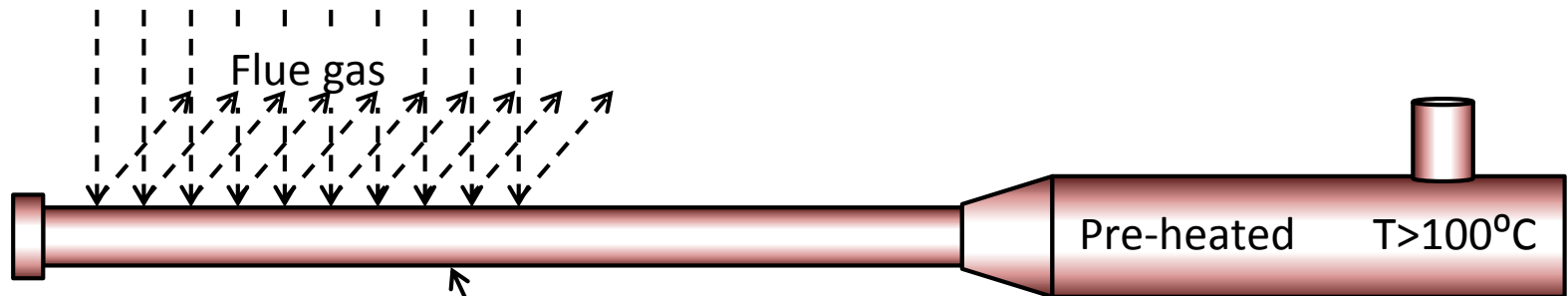
- SEM/EDX
- IC
- ICP-OES
- XRD
- EBSD
- TEM
- BIB

Material life time

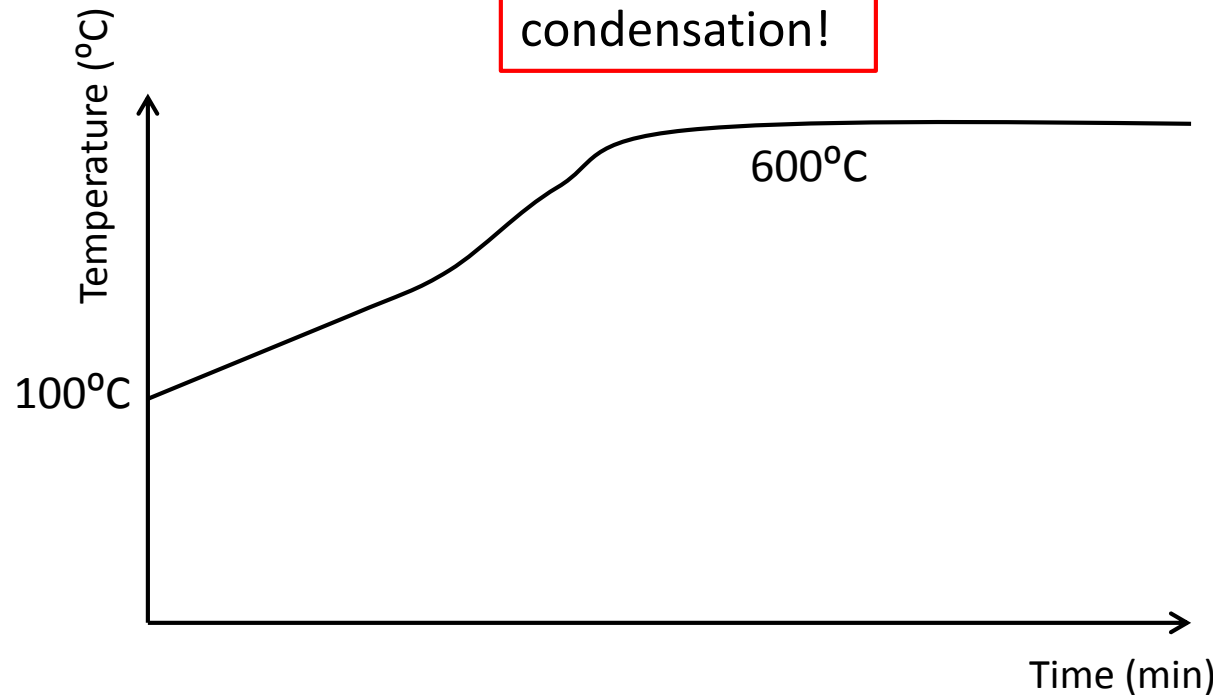


Effect of startup

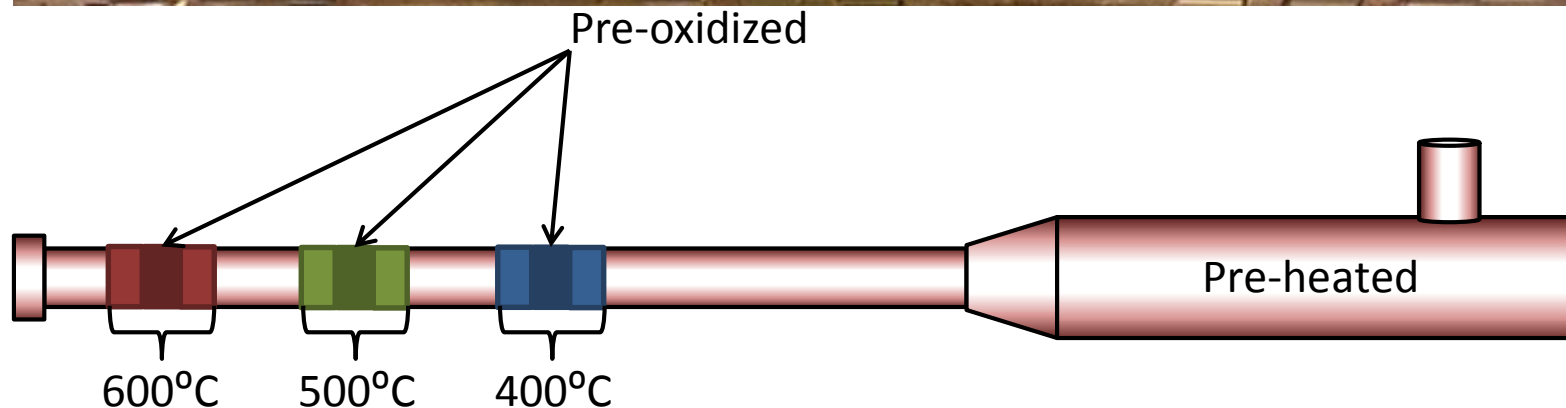
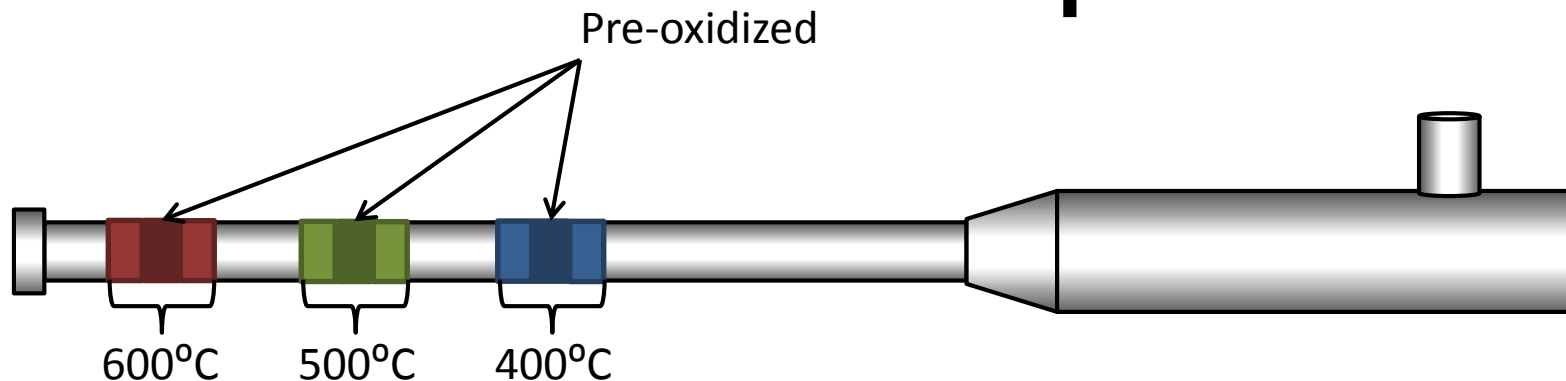




Trying to avoid
condensation!



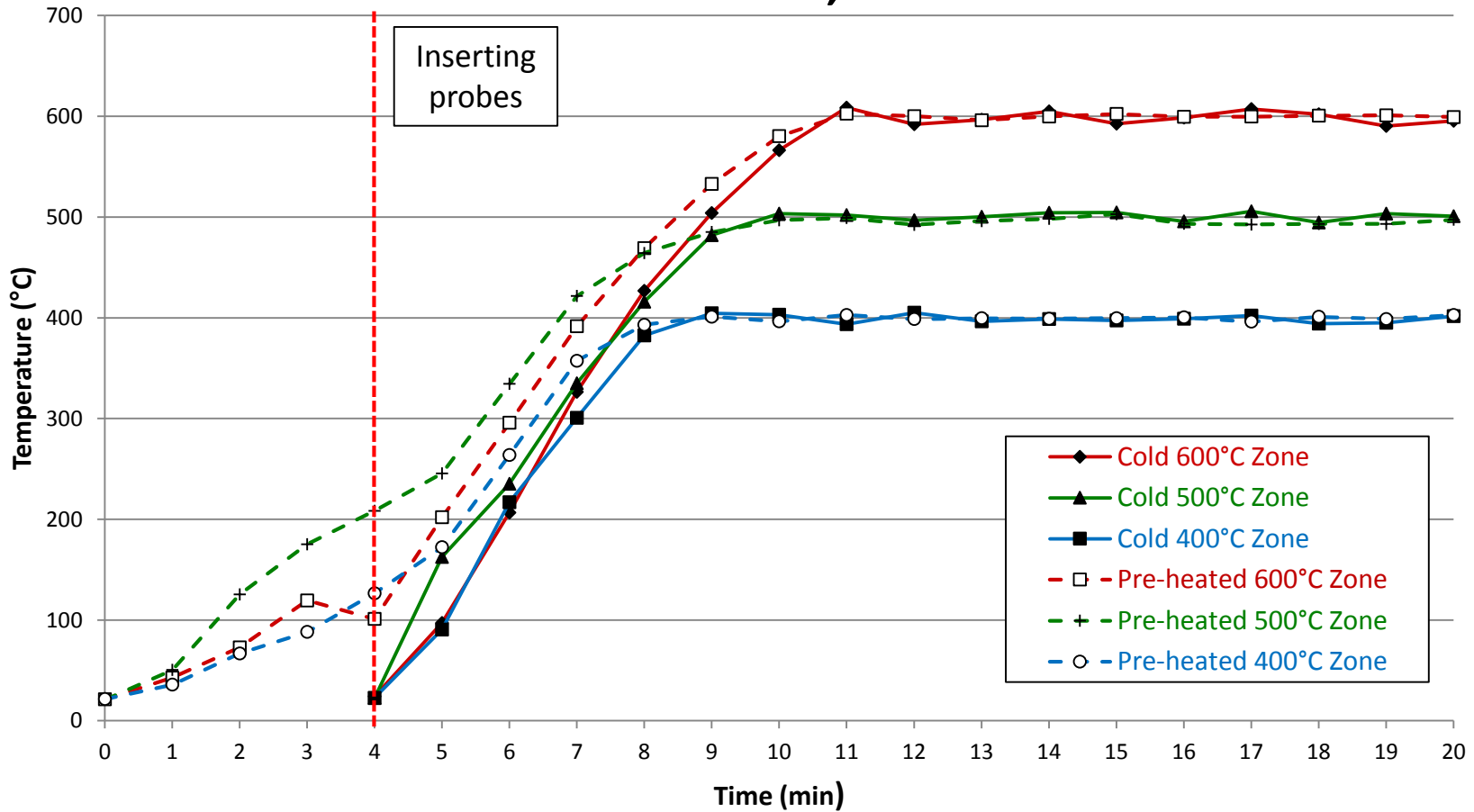
Probes setup



Sanicro 28

C	Si	Mn	P	S	Cr	Ni	Mo	Cu	N
0.014	0.42	1.77	0.016	0.0005	26.68	30.56	3.39	0.93	0.054

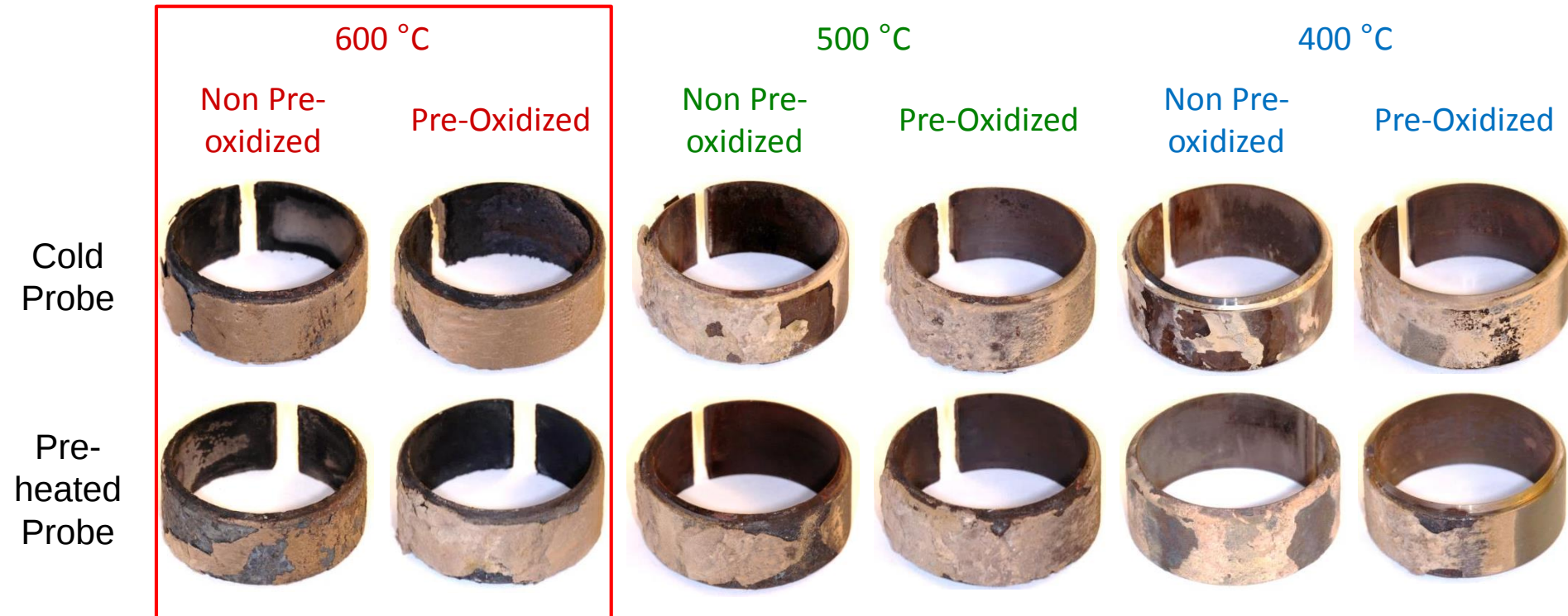
Initial temperature profiles Sanicro 28, 24h



Cold probe

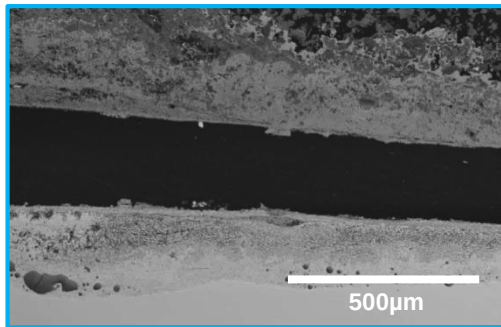
Pre-heated probe

Optical images of samples exposed for 24 h

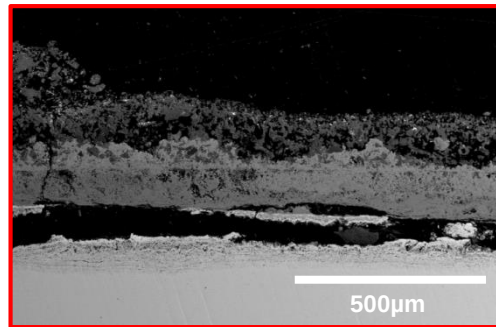


Effect of startup

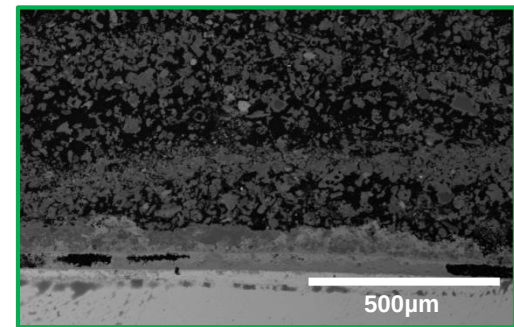
Samples exposed at 600°C, 24h



Cold probe



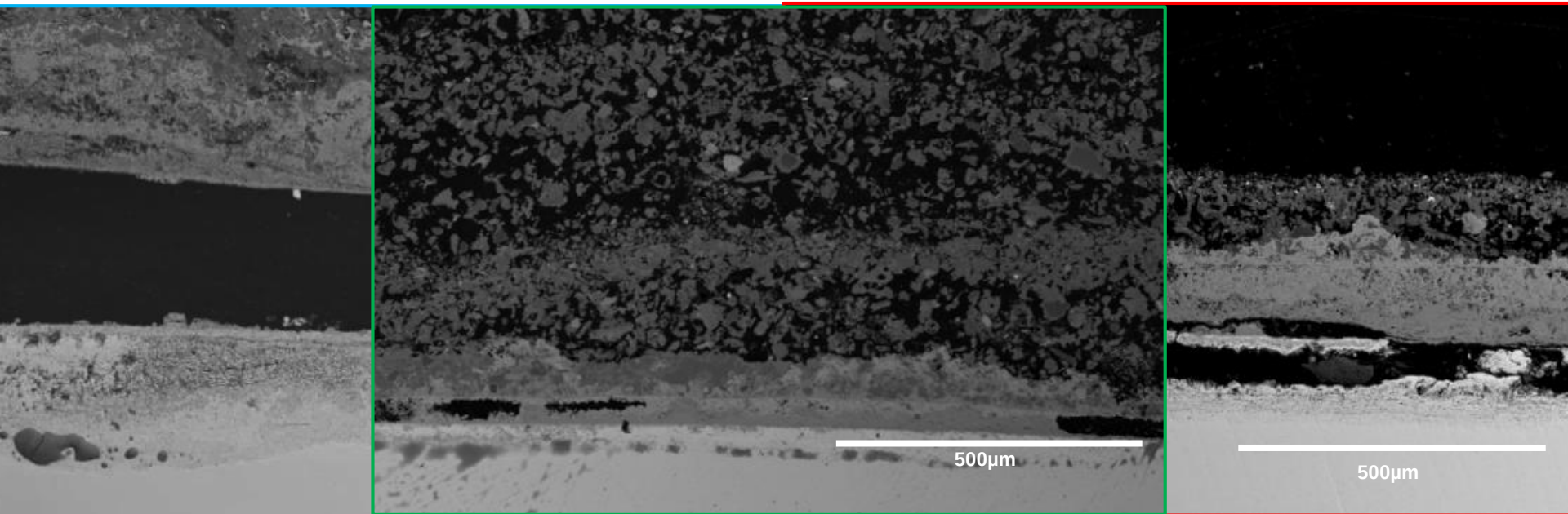
**Pre-heated
probe**



**Pre-heated probe +
Pre-oxidation**

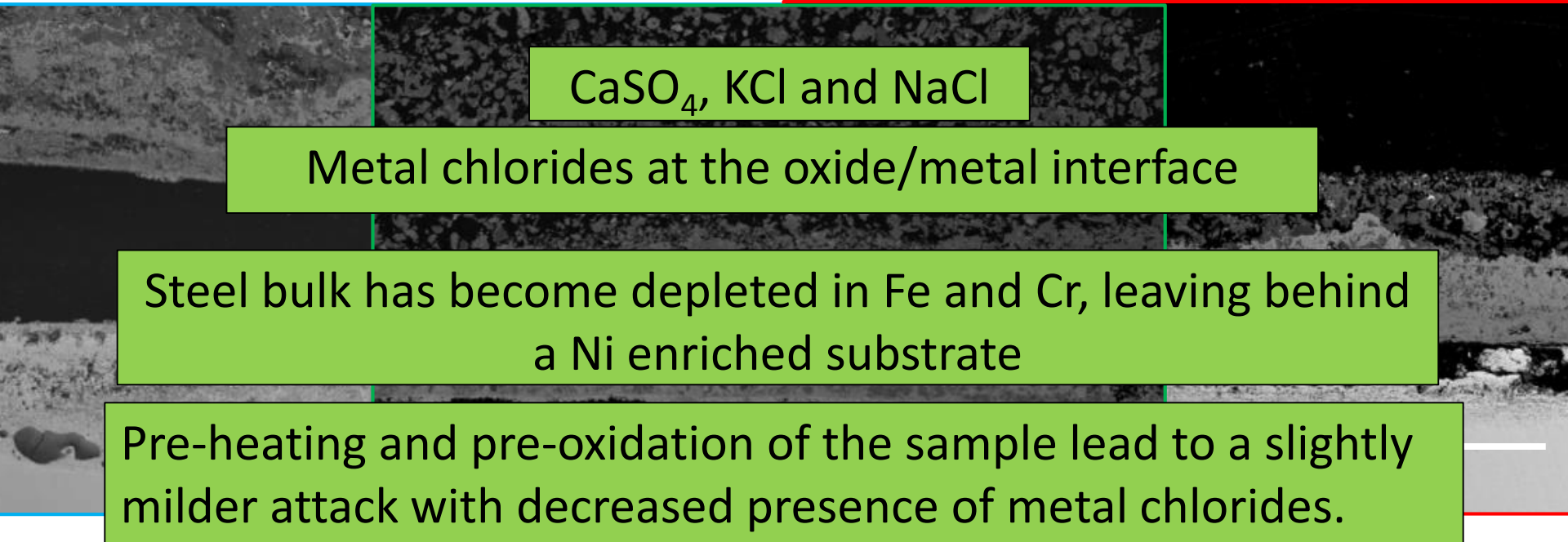
Effect of startup

Samples exposed at 600°C, 24h



Effect of startup

Samples exposed at 600°C, 24h



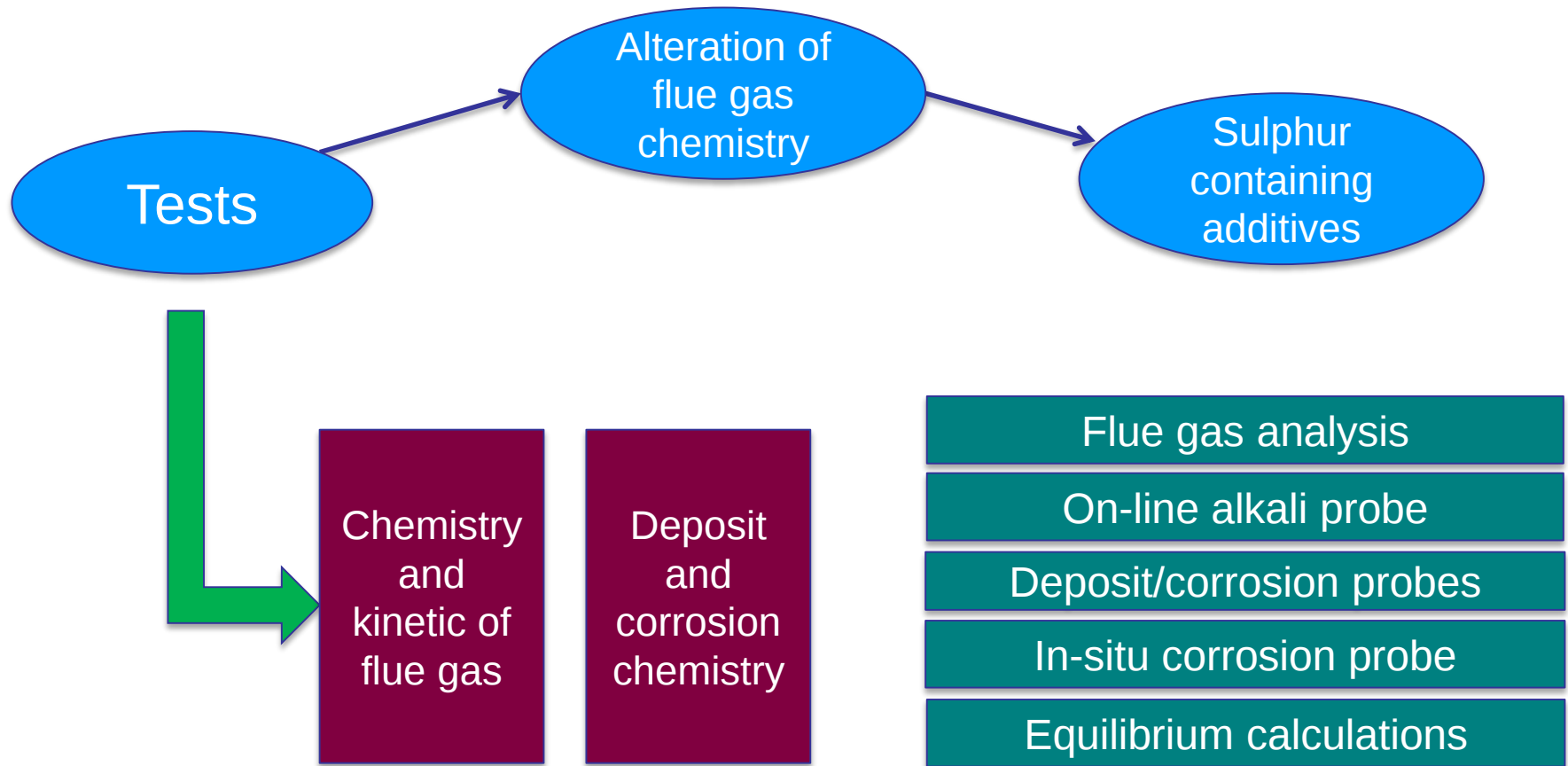
CaSO₄, KCl and NaCl

Metal chlorides at the oxide/metal interface

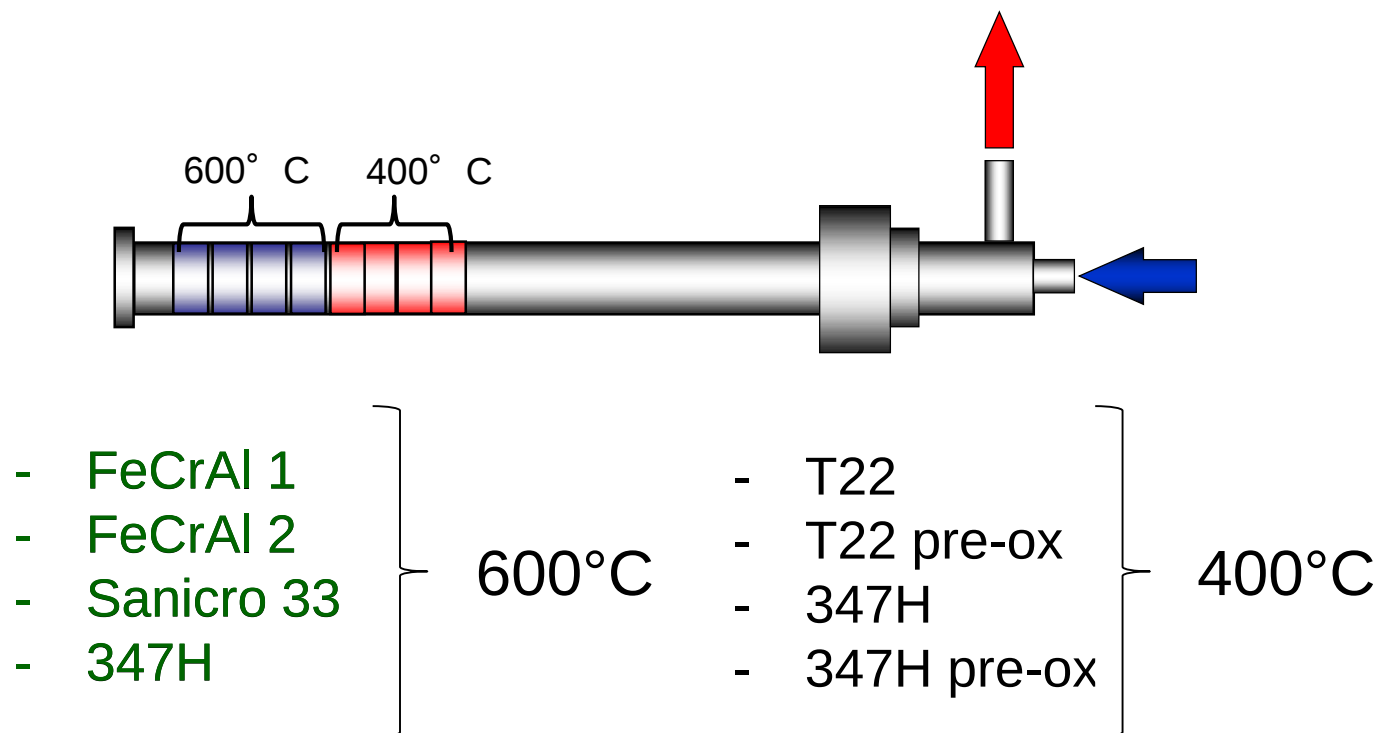
Steel bulk has become depleted in Fe and Cr, leaving behind a Ni enriched substrate

Pre-heating and pre-oxidation of the sample lead to a slightly milder attack with decreased presence of metal chlorides.

How does the corrosivity of flue gas varies depending on its temperature and chemistry?

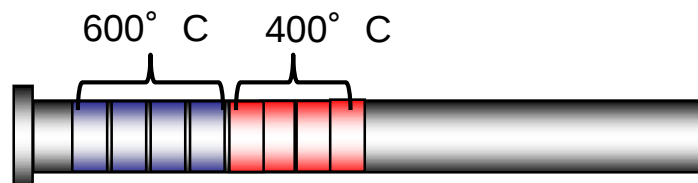


Upcoming boiler exposures (I)



1 week waste + 1 week sulphur additives

Upcoming boiler e



- FeCrAl 1
- FeCrAl 2
- Sanicro 33
- 347H

600°C

- T22
- T22 pre-ox
- 347H
- 347H pre-ox

400°C

24 h waste + 24 h sulphur aditives

Test usability of FeCrAl alloys and coatings and comparison towards state-of-the-art SS and conventional SS and steels

- ✓ FeCrAl-Alloys
- ✓ High performance stainless steels
- ✓ Coatings

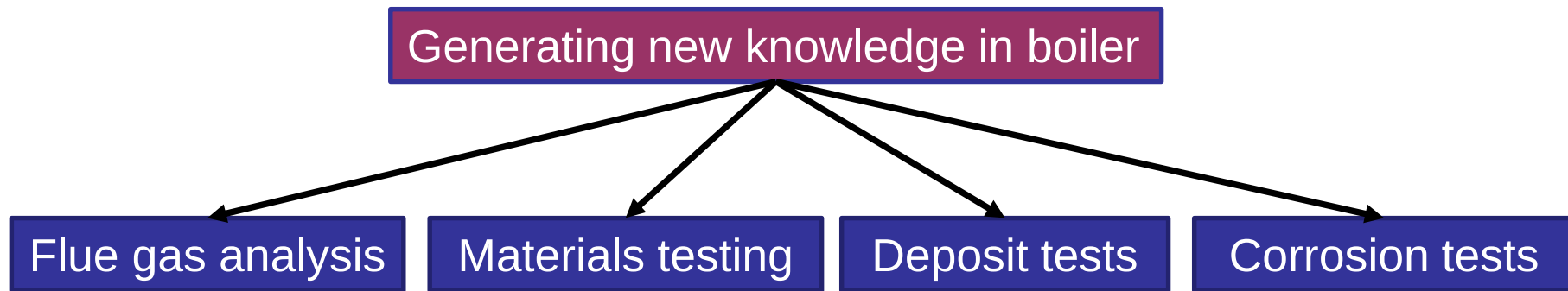


New coating
technology:
HVOF

Overall Goal of KME711

- Research strategy and correlation to KME goals

Improve plant economy by enabling an increased green electricity production and optimum material selection



KME goals:

- ✓ Verifying novel solutions in boiler design with respect towards corrosivity
- ✓ Increased steam parameters and thereby higher electrical efficiency
- ✓ Test improved material solutions – including alumina forming alloys and coatings