New Materials and Oxygen Carrier Aided for improved competitiveness of FB plants using renewable fuels

e·on
SANDVIK
MH Engineering
stockholm exergi
KANTHAL®
Part of Sandvik Group
Sumitomo SHI FW
Energiforsk
AVANCEZ 1829
CHALMERS

Overall aim

The overall goal of the project is to **improve plant economy** of power plants and CHPs using renewable fuels and thereby increase the competitiveness towards fossil fuelled power plants and CHPs. This is done by **targeting two problem areas** in the (fluidized bed) boilers, namely **water wall corrosion** and **loop seal superheater corrosion/erosion.** The project will utilize a two-pronged approach towards decreasing the extent of the corrosion attack of the water walls and the loop seal superheaters in waste-fired CFB boilers:

(1) Improving the corrosion resistance of the materials used
(2) Mitigating the corrosive/erosive environment by changing the bed material or optimized design.

Project plan

The overall project goal, to **improve plant economy of power plants and CHPs using renewable fuels,** will be achieved by generating new knowledge and industrial experience about the following topics:

- **Decrease the overall cost** of water walls and/or loop seal superheaters by enabling new materials and/or by mitigating the corrosive environment by changing the bed material or optimized design. The overall cost may be decreased either by improving the material life time or by decreasing the material cost.

- **Increase the knowledge** of what type of material degradation mechanisms as well as environmental parameters are at play in loop seal superheaters.

- Investigate the performance of **newly developed steels and alloys** together with commercially available materials for water walls. Both thermal spray coating and overlay welding will be investigated.

Project plan

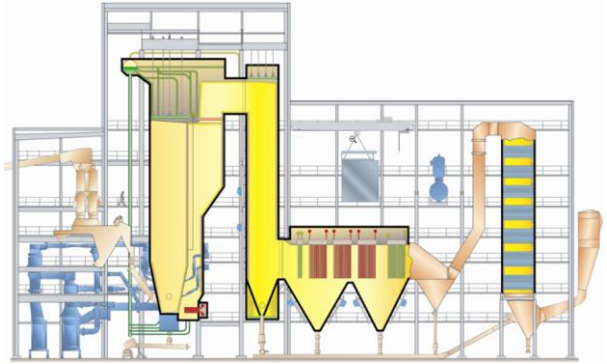
- **This project will collaborate with other biokraft project(s)** in order to facilitate synergistic effects between the projects. This may include to jointly perform measurement campaigns in the boilers, investigating different aspects (e.g. corrosion issues and process performance during a measurement campaign involving the change of bed material). This may also include sharing results of material performance of newly developed model alloys between projects. This project will also collaborate with the project within the High Temperature Corrosion center (HTC) direct towards corrosion issues in combustion of biomass and waste with respect towards sharing results regarding corrosion mechanisms.

- Academic goal: 2 academic theses are achieved within the project; 1 journal article and 2 conference proceedings are published.

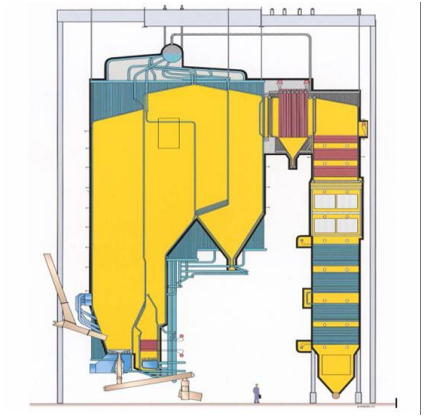
Roles

Part	Participants role in the project
E.ON Värme Sverige AB	Responsible fo boiler operation, fuel & gas analysis and collecting other operational data.
Stockholm Exergi AB	Responsible fo boiler operation, fuel & gas analysis and collecting other operational data.
Sumitomo SHI FW Energia OY	Responsible for sample installations, corrosion probe exposures and will also perform some corrosion evaluation and analysis.
Kanthal AB	Providing materials, including newly developed model alloys.
Sandvik Materials Technology AB	Providing materials, including newly developed model alloys.
MH Engineering AB	Providing coating materials.
Energiforsk AB	Responsible for results dissemination, collaboration and continuous knowledge exchange between the academia and the industry stakeholders. Drafting the project agreement
Chalmers University of Technology AB HTC	Project leader. Responsible for short term corrosion testing, corrosion evaluation and analysis. Responsible for successful collaboration with another Biokraft project application managed by CTH/ET.
Chalmers University of Technology AB Energy Technology	Responsible for short term gas analysis and fluidization evaluation. CTE/ET will be responsible for another Biokraft project application for which this project aims to collaborate with.

Project plan



Eon – Händelö
P15 Waste-fired boiler



Stockholm Exergi - Högdalen
P6 Paper-, Wood- and Plastics-fired boiler

WP1

Water walls corrosion

WP0

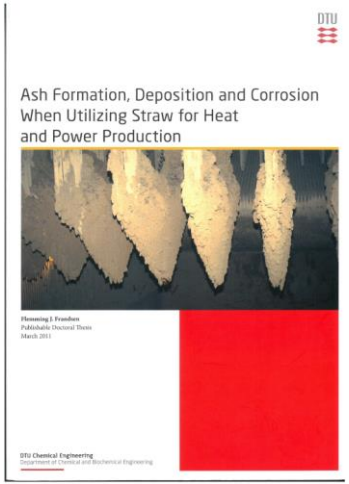
Planning/Methodology development

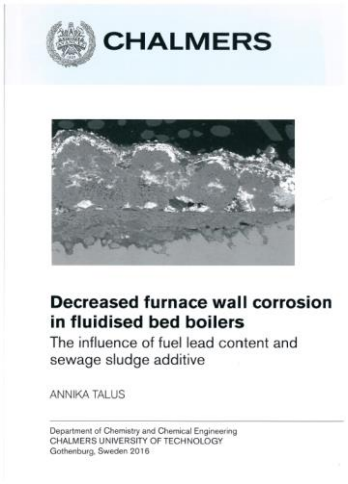
WP2

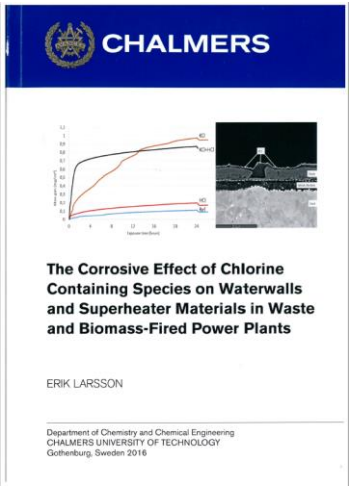
Loop seal corrosion/erosion

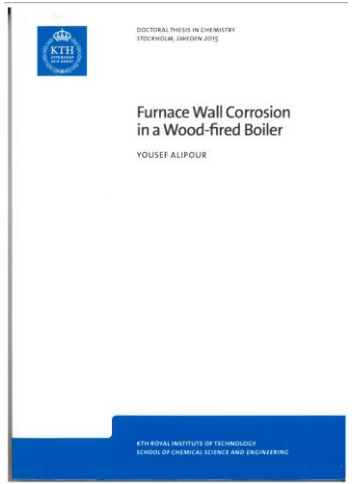
WP0

Literature review

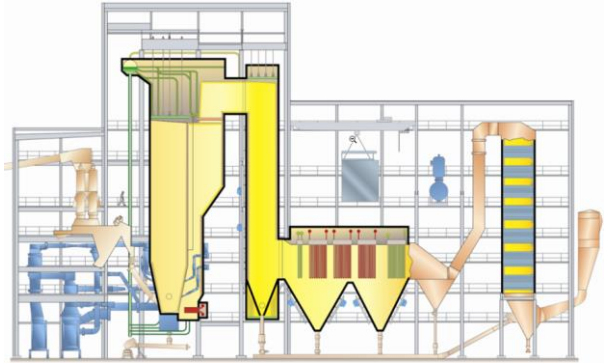




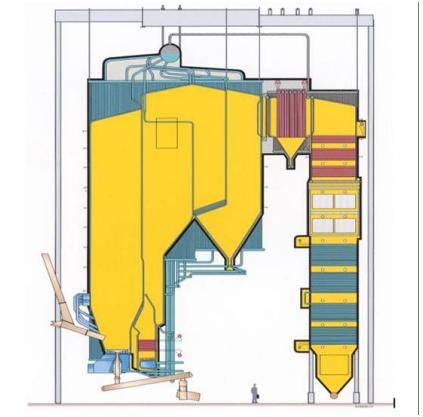




Project plan



Eon – Händelö
P15 Waste-fired boiler



Stockholm Exergi - Högdalen
P6 Paper-, Wood- and Plastics-fired boiler

WP1 ← **WP0** → **WP2**

Water walls corrosion

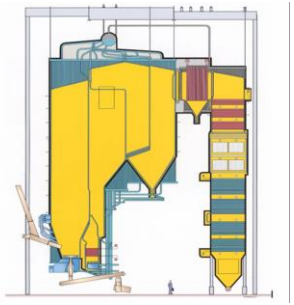
Planning/Methodology development

Loop seal corrosion/erosion

WP0:
Planning/
Methodology development ☑

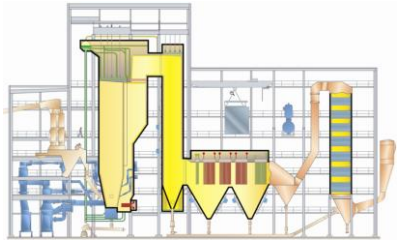
WP1:
Water walls

Högdalen P6



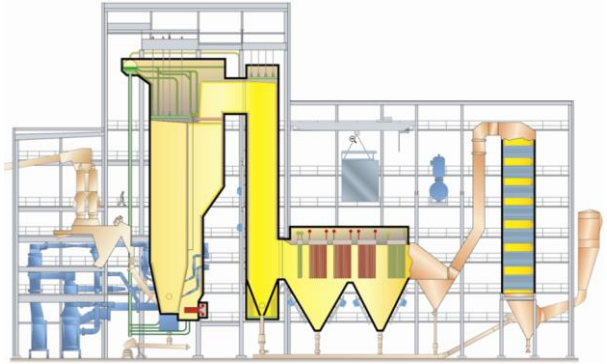
- *A test section of the water wall in the furnace chamber will be installed*
- *The aim is to test commercially available materials as well as newly developed alloys and coatings*
- *The current material installed today is overlay welding of Inconel625.*

Händelö P15

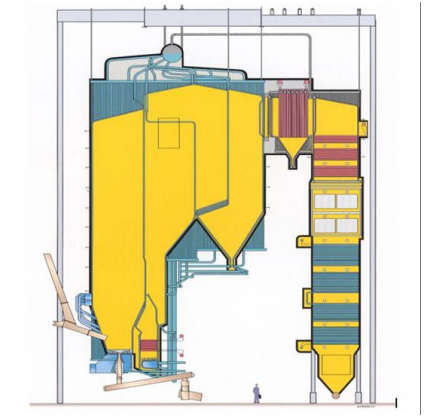


- *A test section of the water wall in the empty pass will be installed*
- *The corrosion results of this test section will be compared to water walls overlay welded with Alloy825*

Project plan



Eon – Händelö
P15 Waste-fired boiler



Stockholm Exergi - Högdalen
P6 Paper-, Wood- and Plastics-fired boiler

WP1 ← **WP0** → **WP2**

Water walls corrosion

Planning/Methodology development

Loop seal corrosion/erosion

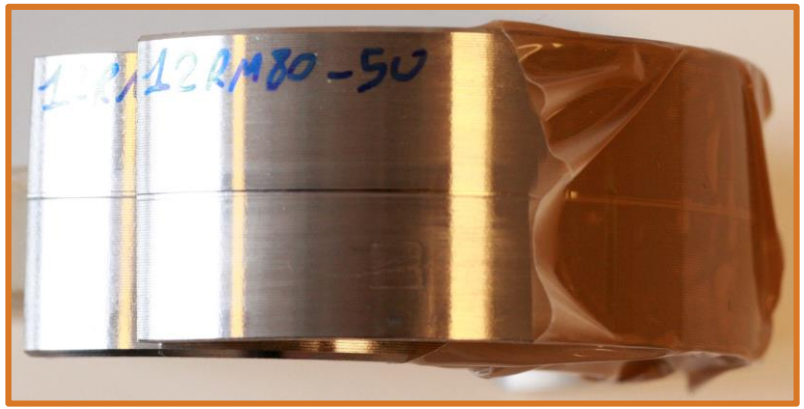
Preliminary Results of the Clamps Exposures In Händelö

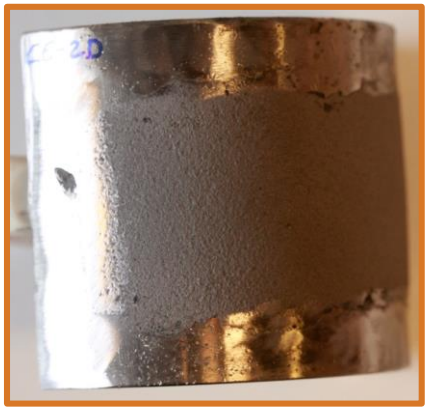
Material loss & SEM overview of bulk materials

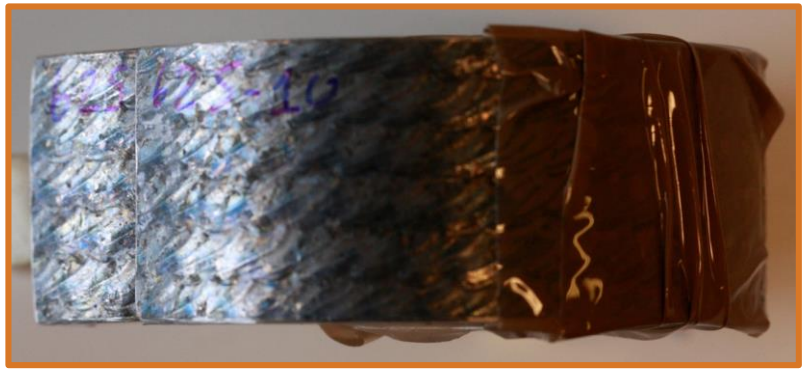
Materials
197
198
APMT
316
K92 (SX)
12RM80 (Esshete1250)
San69

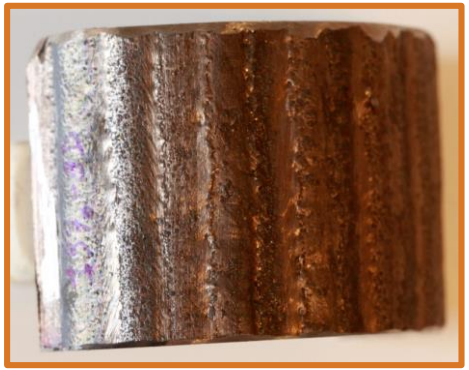
Results of the Clamps Exposures In Händelö

Visual Inspection







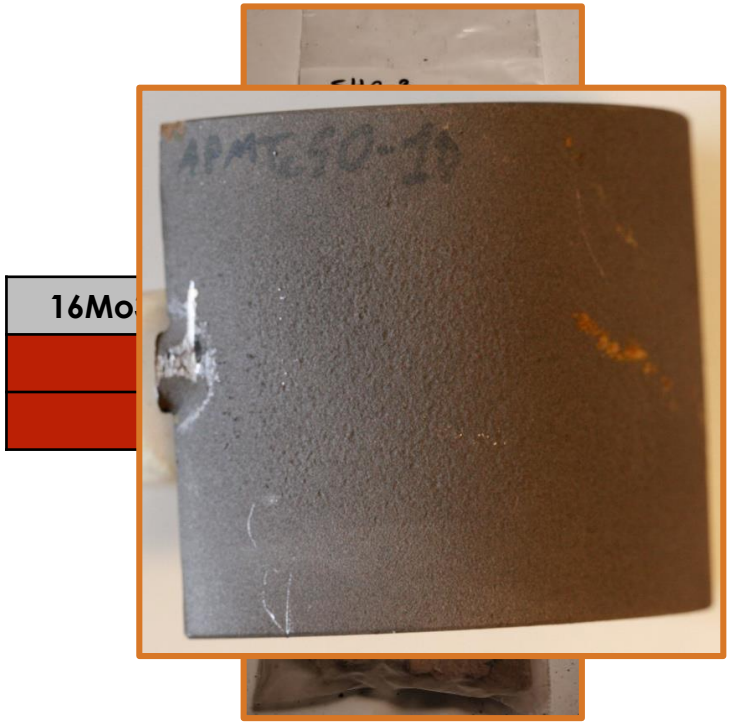


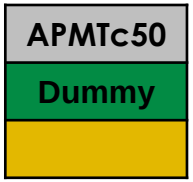
Superheater 3

197

198

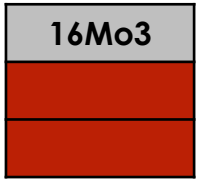
Superheater 2



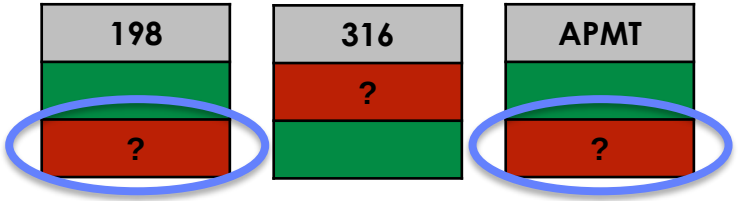


Summary – Bulk materials

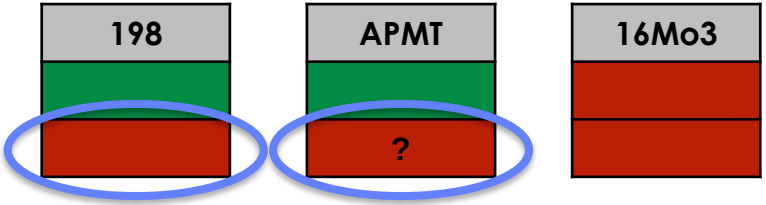
Superheater 2



Superheater 3 – Position 1



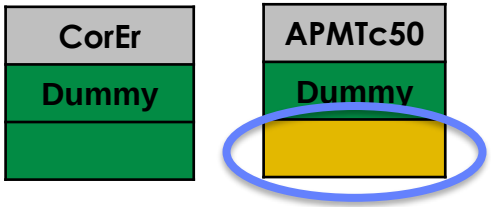
Superheater 3 – Position 2



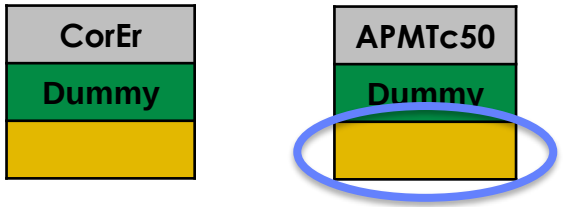
- Corrosion/erosion in SH3 seems more agressive than in SH2.
- Deposits can remain on materials in a highly erosive environment (based on clamps facing downwards).

Summary – WOL and Coatings

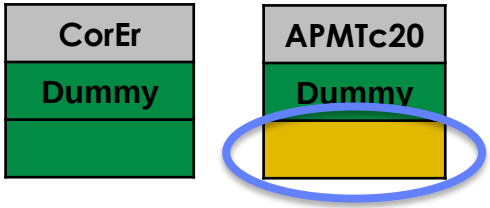
Superheater 2



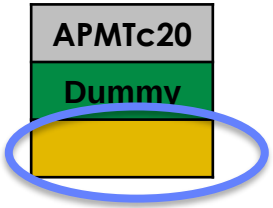
Superheater 3 – Position 1



Superheater 3 – Position 2



Superheater 3 – Position 3



Material loss of bulk materials

197 U
198 U
APMT U
316 U
K92 (SX) U
12RM80 (Esshete1250) U
San69 U

Superheater

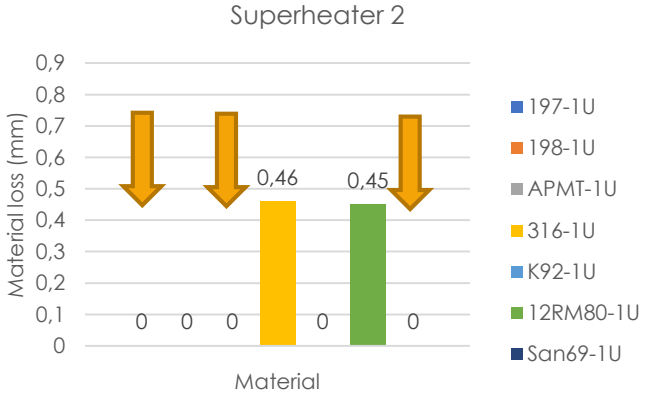
Superheater 3 Position 1

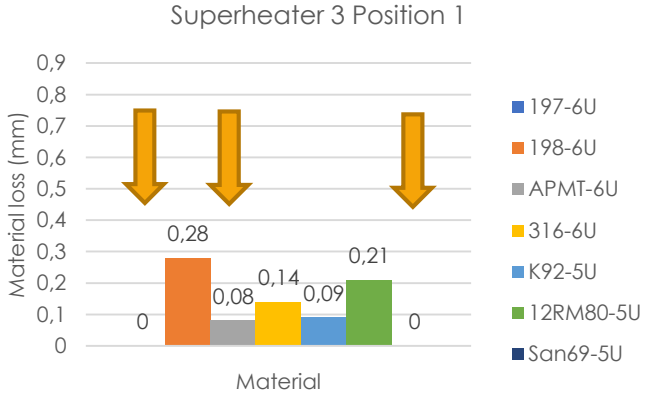
Superheater 3 Position 2

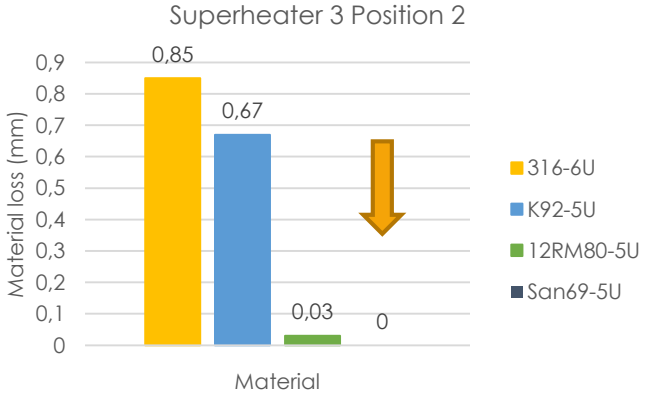
6 months

March-September 2019

Material loss of bulk materials





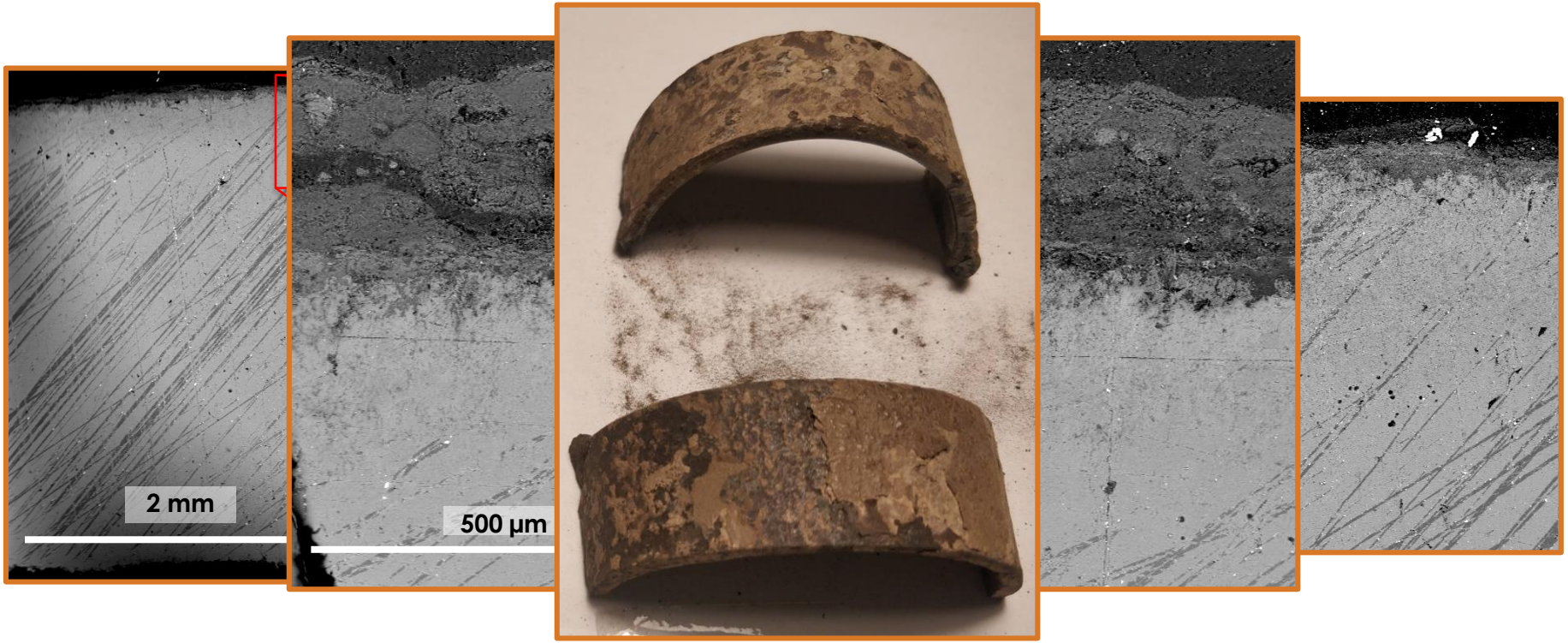


197
APMT
San69
San33

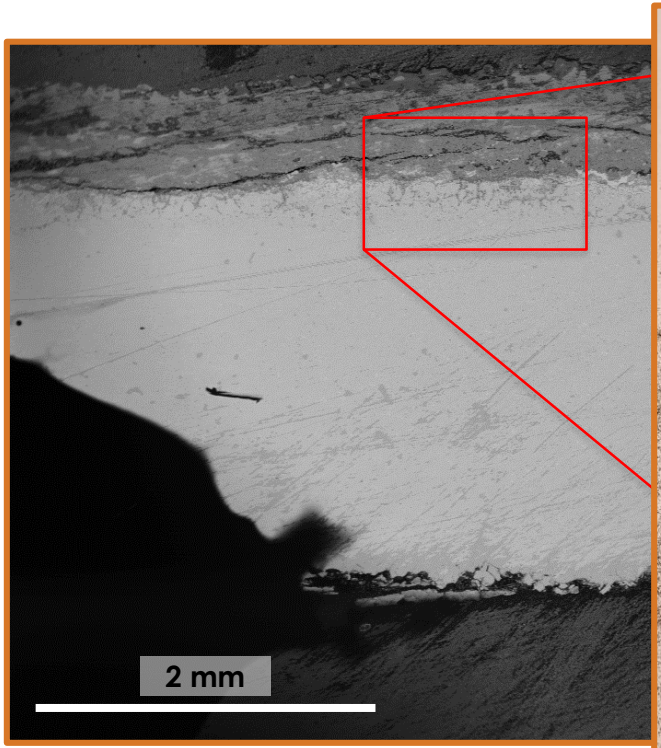
Second batch

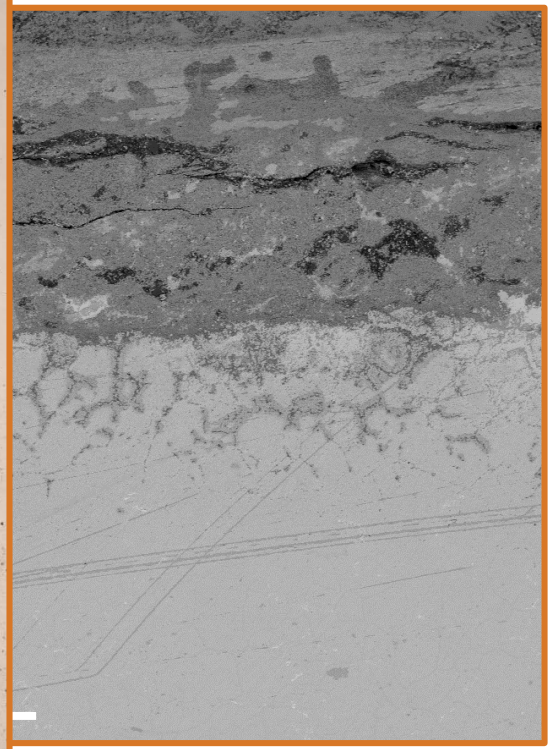
Sent to Händelö (20/03/20)

San69 – Superheater 2



K92 (SX) – Superheater 3





Ongoing and future work

Material loss measurements of previously and « newly received »

Ion chromatography (chlorine and sulphur content in deposits)

Cross-sectional EDX analysis

X-ray diffraction on deposits

CHALMERS

UNIVERSITY OF TECHNOLOGY