

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

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Overall aim



▶ Improve plant economy

- Power plants and Combined Heat and Power (CHP) plants using renewable fuels
- Increase competitiveness towards fossil fuels

▶ Focus on two problem areas

- Water wall corrosion
- Fluidized bed heat exchanger (FBHE) corrosion/erosion

▶ Approach

- Improving the corrosion resistance of the materials used
- Mitigating the corrosive/erosive environment by changing the bed material or optimized design

Project goals

- ▶ Decrease overall cost of water walls and/or loop seal superheaters
 - Enabling new materials
 - Mitigating the corrosive environment by changing the bed material or optimized design
 - **Overall cost may decrease via improving material lifetime or decreasing material cost**
- ▶ Increased knowledge in:
 - Degradation mechanisms of materials
 - Environmental parameters in FBHE superheaters
- ▶ Investigation of materials performance
 - Newly developed steels and commercial alloys for water walls
 - Thermal spray and overlay welding

Roles

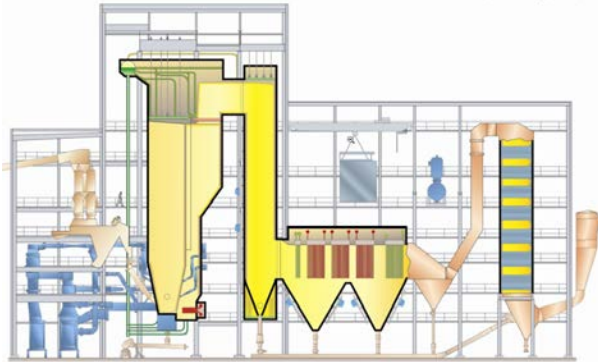


Part	Participants role in the project
E.ON Sverige AB (Navirum)	Responsible fo boiler operation, fuel & gas analysis and collecting other operational data.
Stockholm Exergi AB	Responsible fo boiler operation, fuel & gas analysis and collecting other operational data.
Sumitomo SHI FY Energia OY	Responsible for sample installations, corrosion probe exposures and will also perform some corrosion evaluation and analysis.
Kanthal AB	Providing materials, including newly developed model alloys.
Alleima 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.
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.

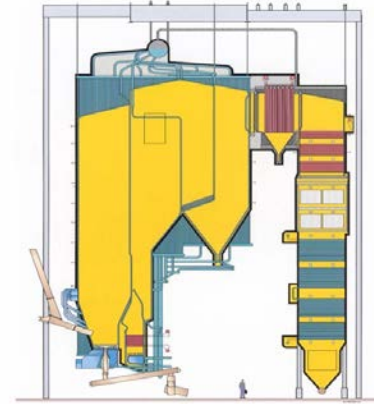
Project plan



CHALMERS
UNIVERSITY OF TECHNOLOGY



Eon – Händelö
P15 Waste-fired boiler



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

WP1

Water walls corrosion

WPO

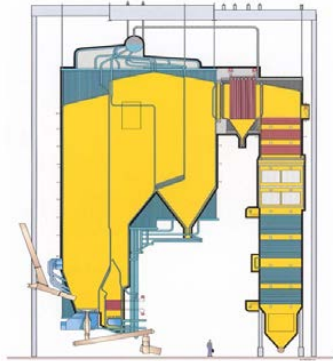
Planning/Methodology development

WP2

FBHE corrosion/erosion

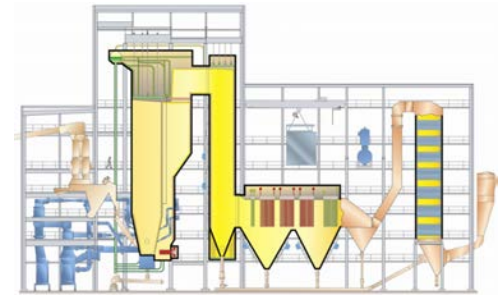
WP1 – Water Walls

Högdalen P6



- A test section of the water wall in the furnace
- 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 Alloy625

WP2 - FBHE



- ▶ Temperature ~ 800-850°C
- ▶ Targets
 - ▶ Reduce material loss
 - ▶ Prolong material lifetime
- ▶ Why ?
 - ▶ Erosion
 - ▶ High Temperature Corrosion
- ▶ Options
 - ▶ Ni-based materials
 - ▶ FeCrAl's



Results

WP 1- Water wall corrosion

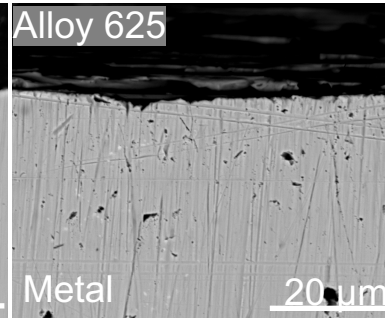
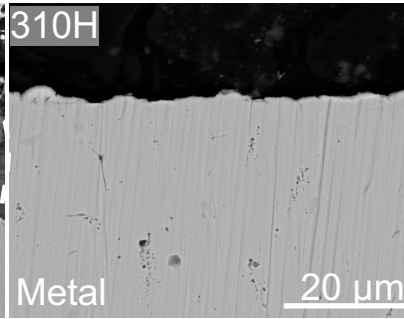
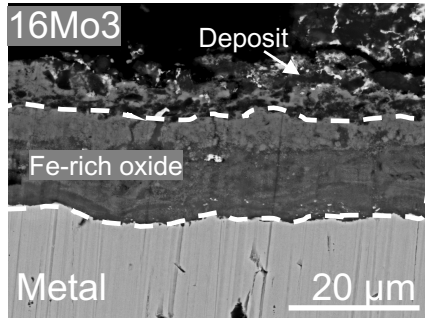
Högdalen

Set	T, °C	Probe-1	Probe-2	Probe-3
1	≈ 300	16Mo3	310HCbN	Alloy 625
2	≈ 300	EF101	EF100	APMT
3	≈ 300	San 28	27Cr33Ni3Mo	San 35

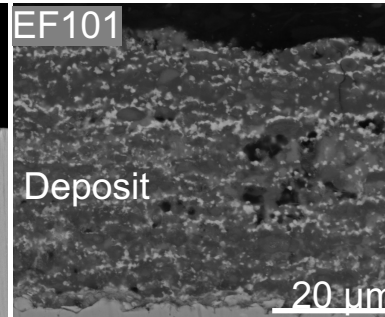
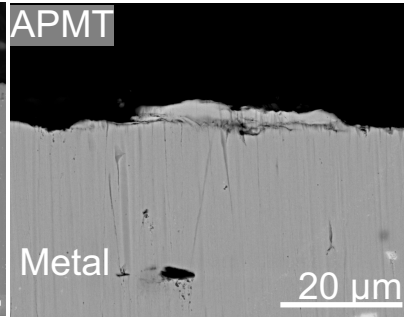
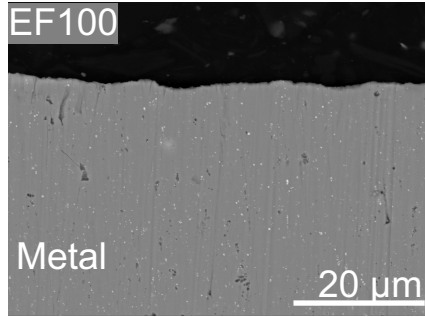


7 days

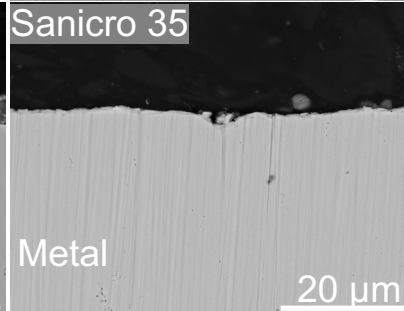
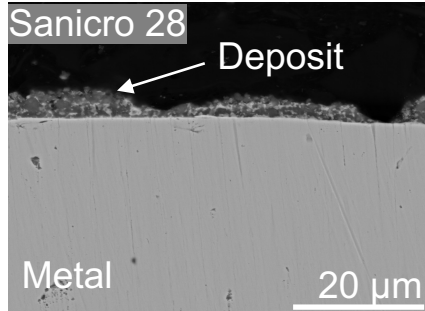
Set #1

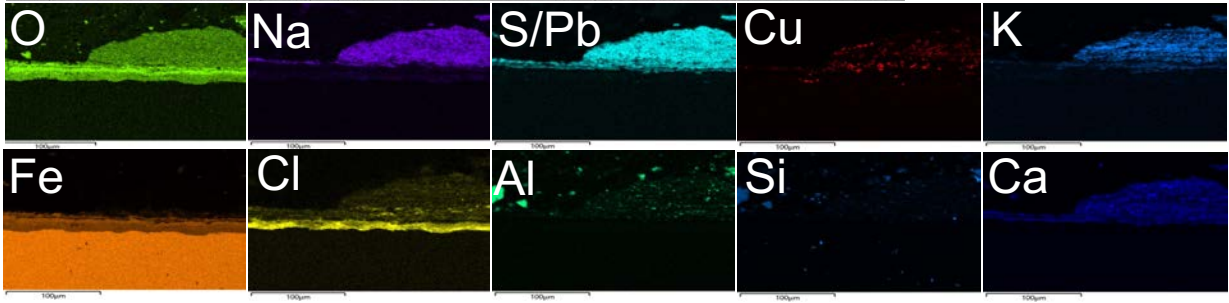
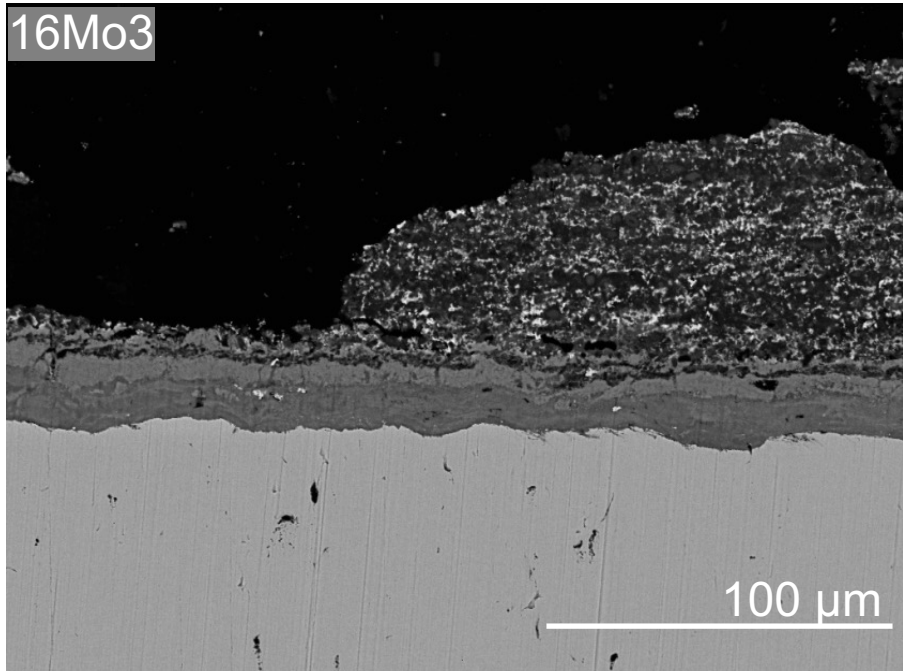


Set #2



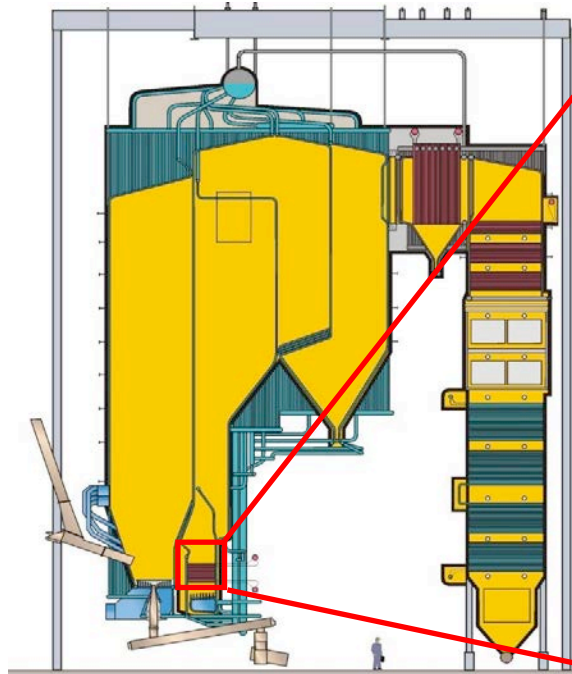
Set #3





WP 2- Fluidized bed heat exchanger corrosion

Högdalen- P6



- Thermal spray coatings
- Weld overlay coatings
- FeCrAl alloys
- Austenitic stainless steels
- Ni base alloy



1-2 years

550 °C

Analysis

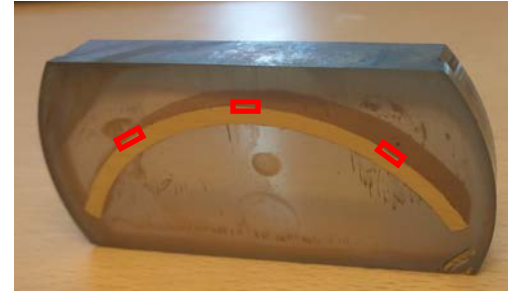
Post exposure



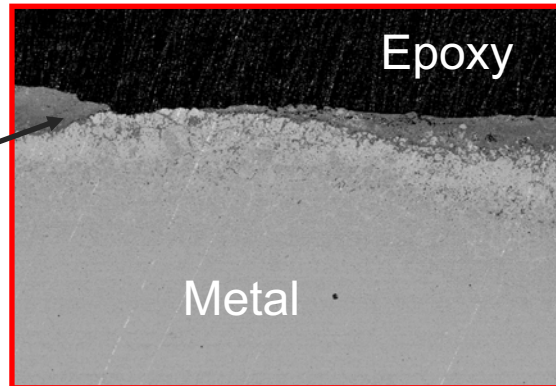
Embedded in epoxy



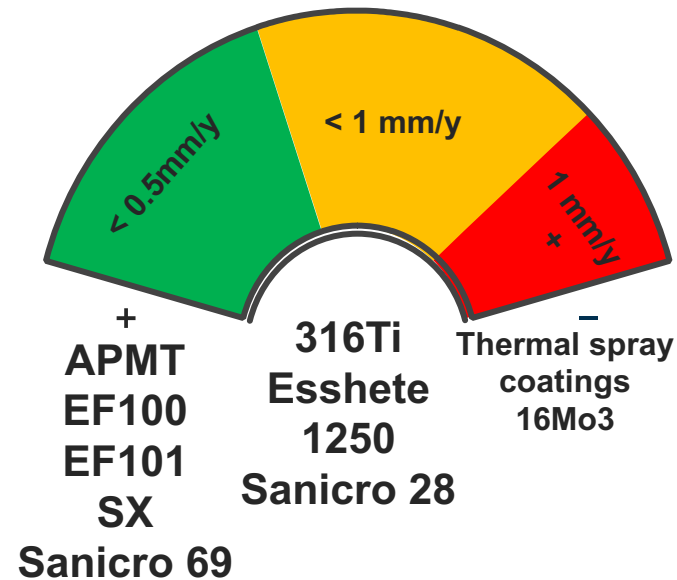
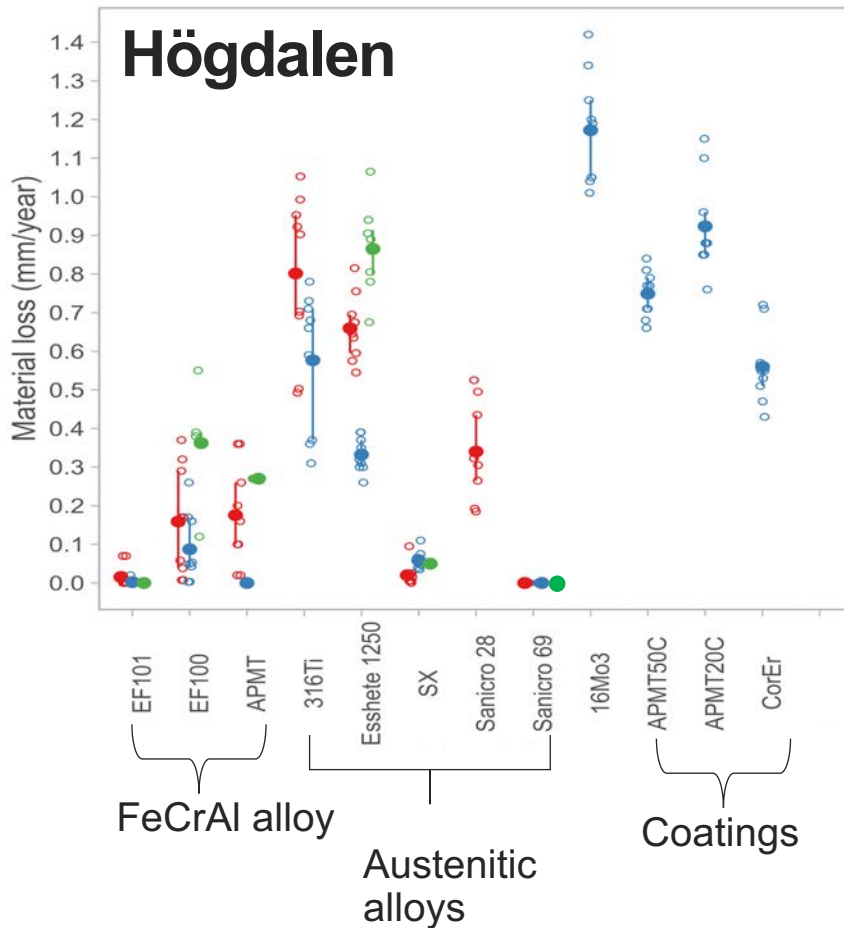
Cross section



Oxidation product



Material loss- Högdalen



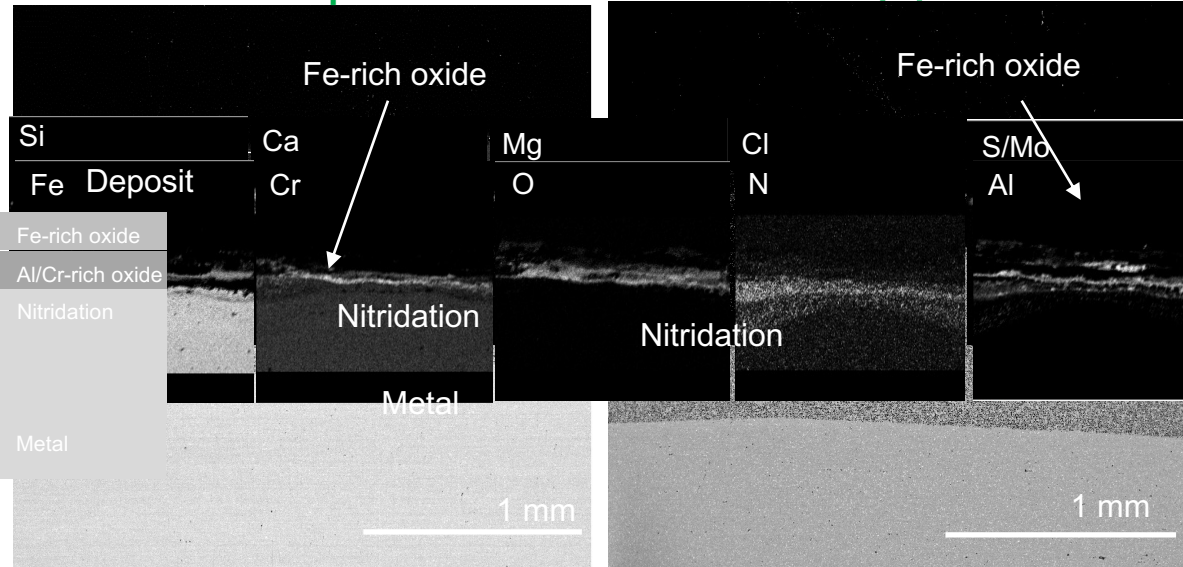
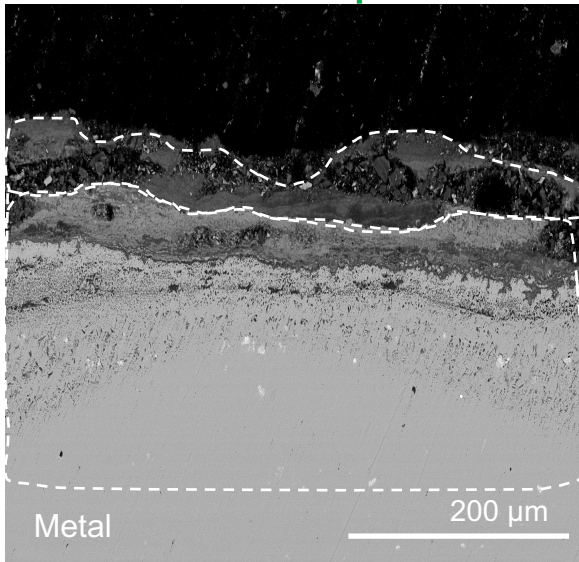
FeCrAl alloys- 1 year Högdalen



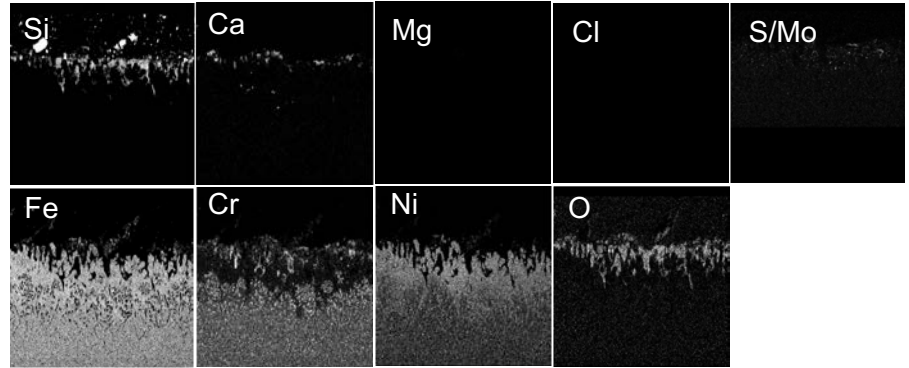
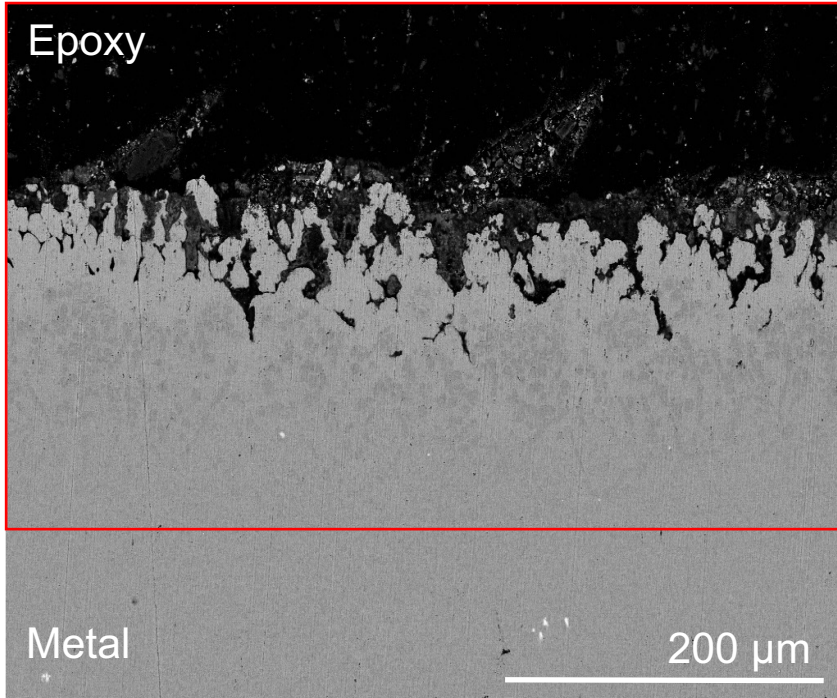
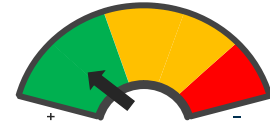
EF101 \$

EF100 \$

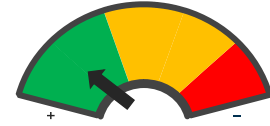
APMT \$\$



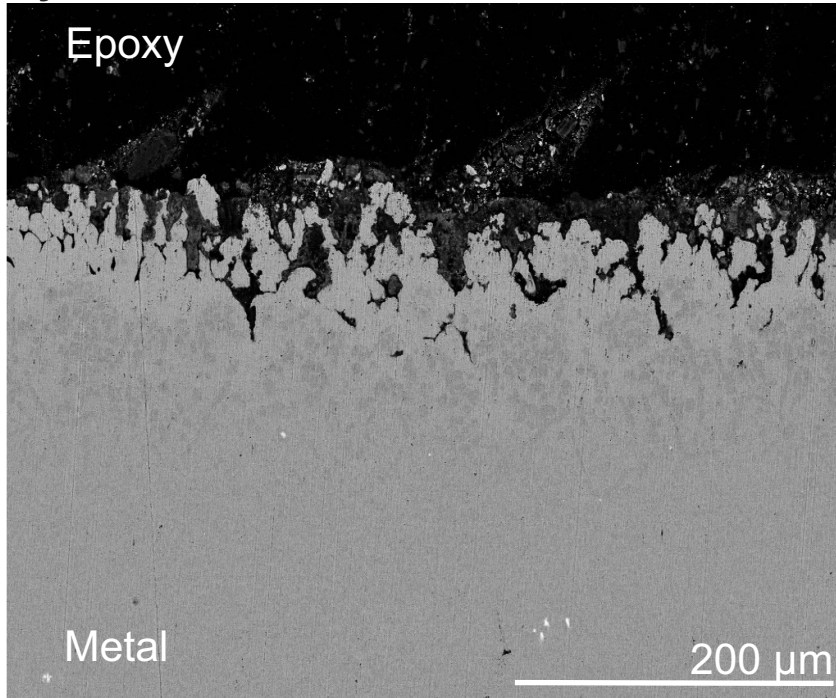
SX- 1 year Högdalen



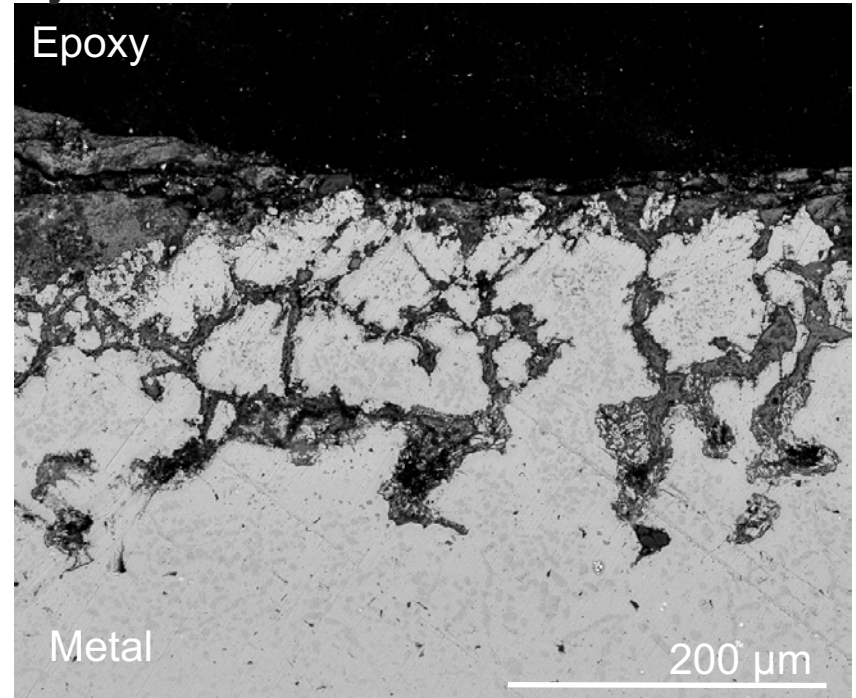
SX- Högdalen



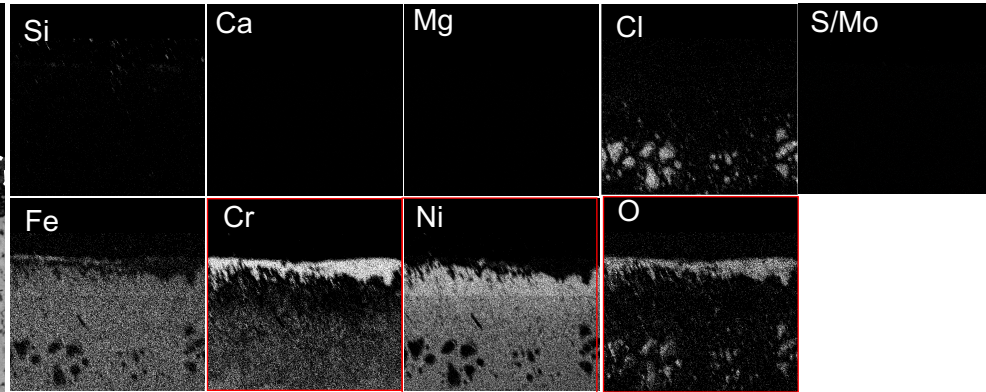
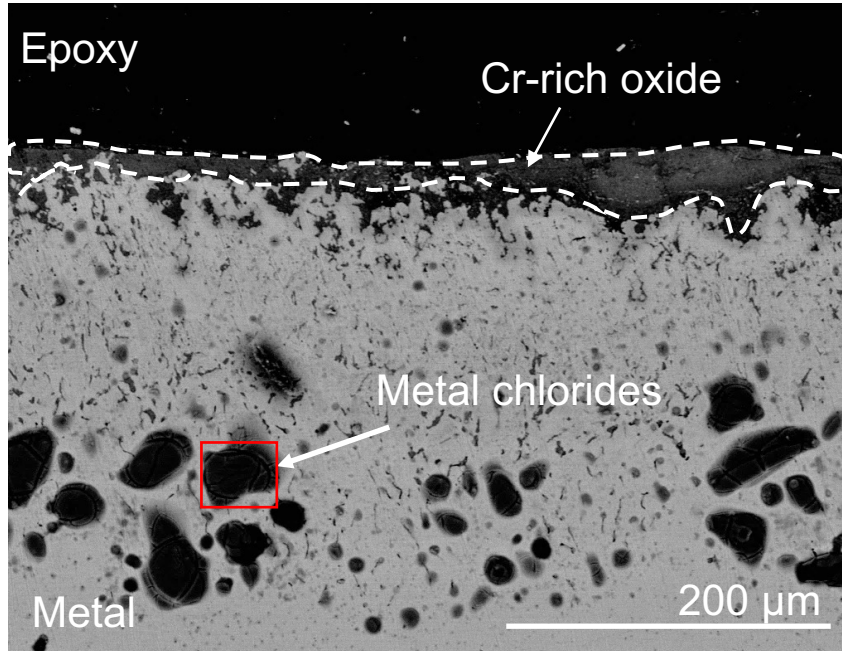
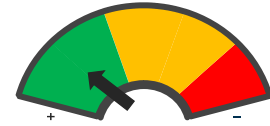
1 year



2 year

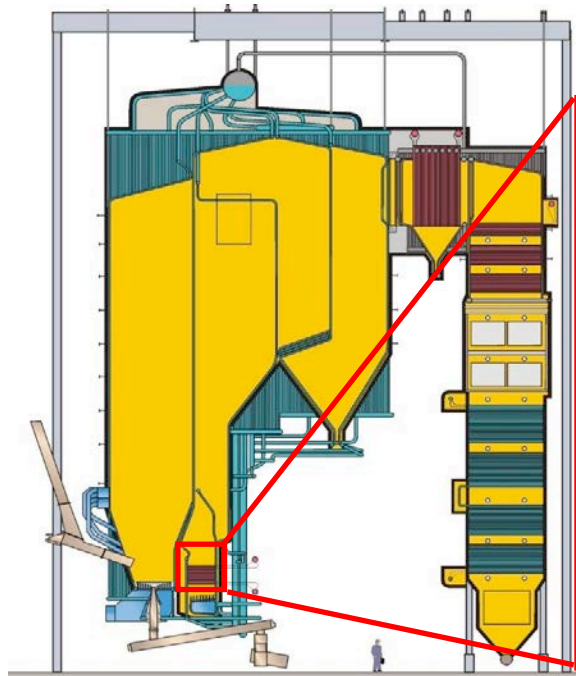


Sanicro 69- 1 year Högdalen



at%	Fe	Ni	Cr	Cl
	1	4	49	46

Högdalen- P6



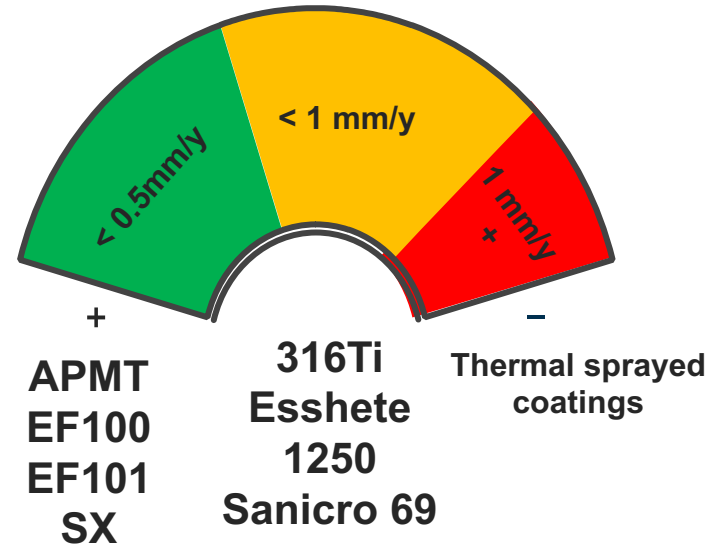
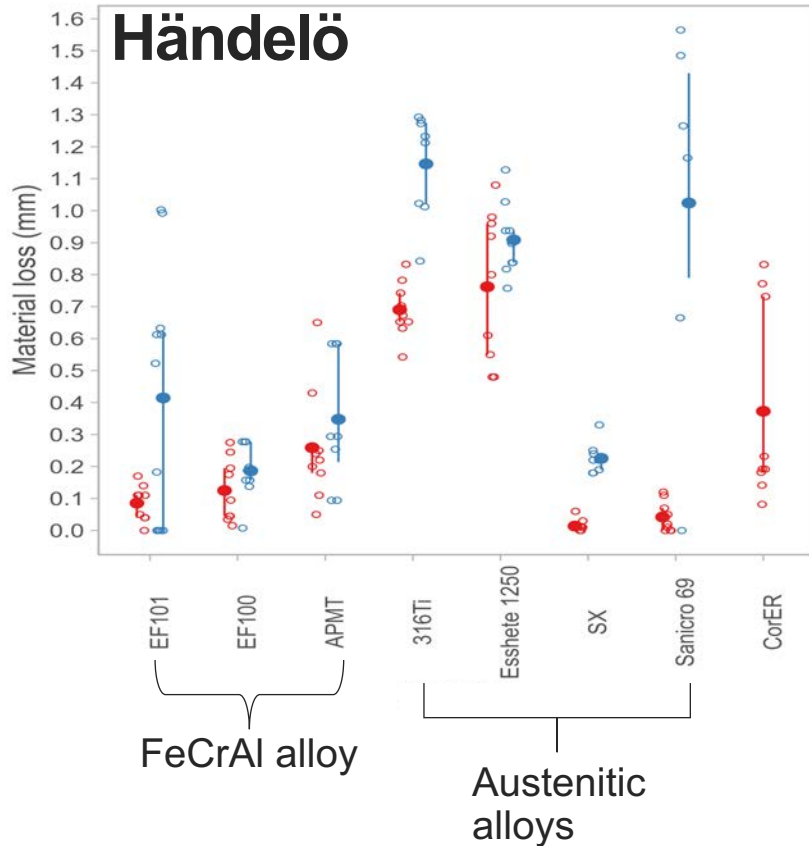
- Thermal spray coatings
- Weld overlay coatings
- FeCrAl alloys
- Austenitic stainless steels
- Ni base alloy



1-2 years

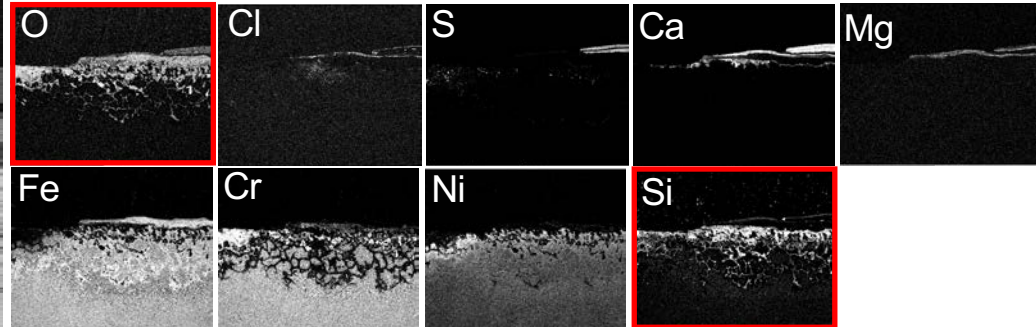
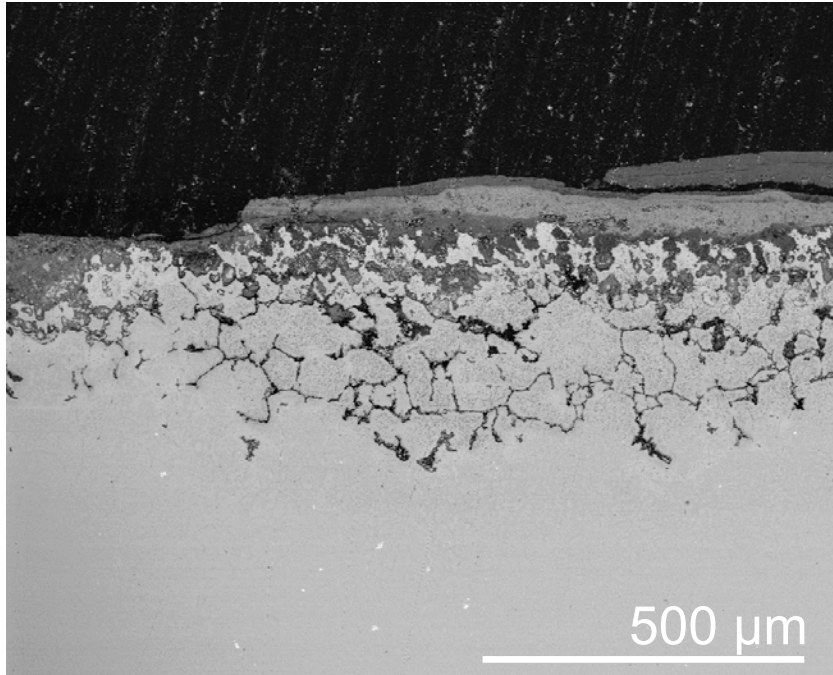
550 °C

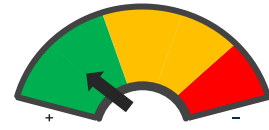
Material loss- Händelö



SX- 1 year Händelö

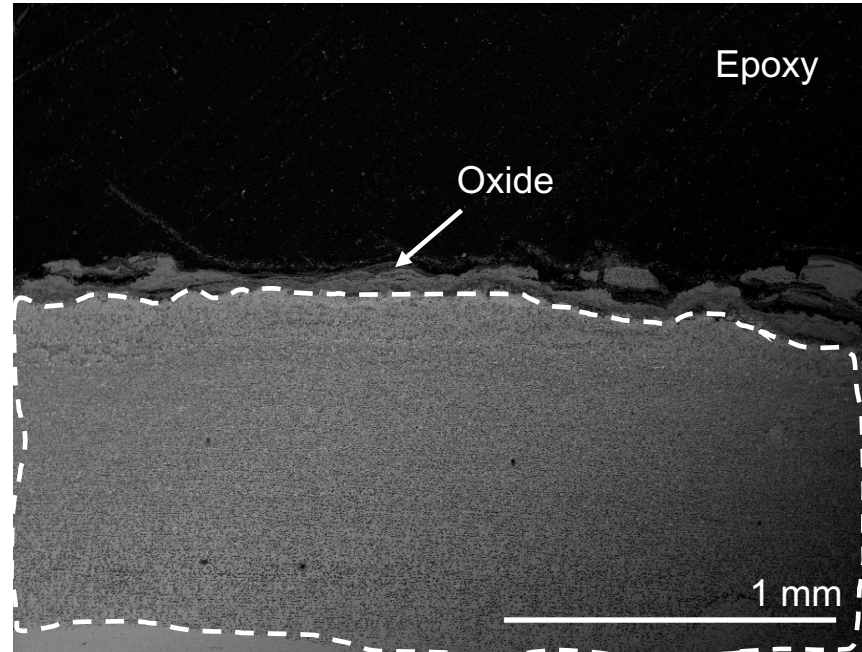
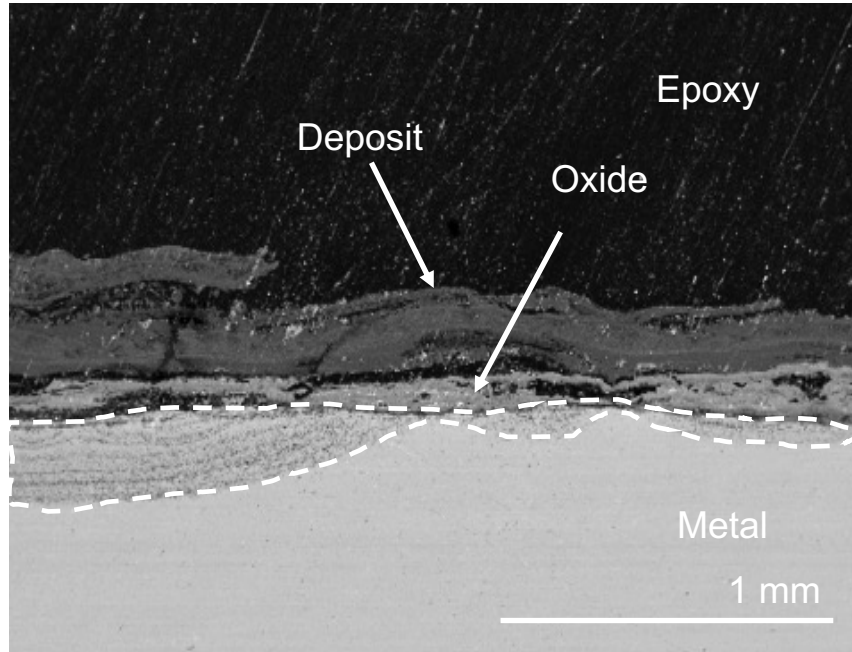
12 month





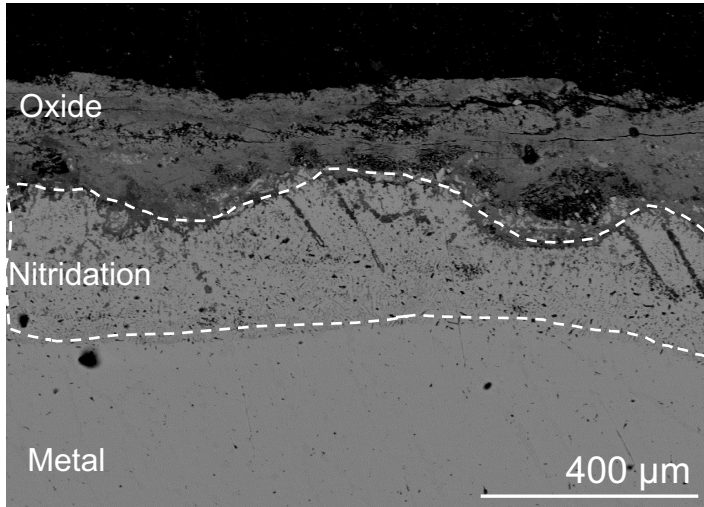
EF101- 6 months

APMT- 6 months

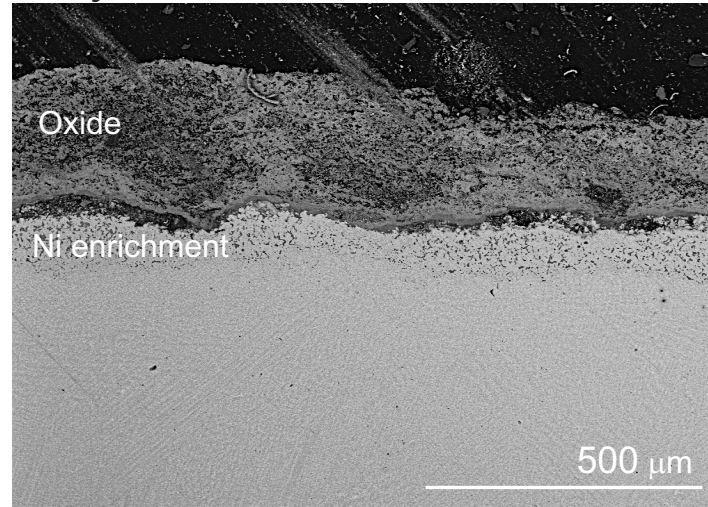


Overlay welded samples

EF100- 12 months



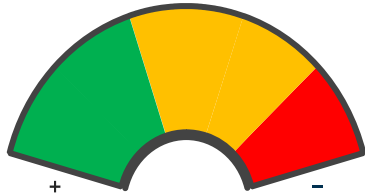
Alloy 59- 12 months



Concluding remarks

WP1- Water wall corrosion

Högdalen

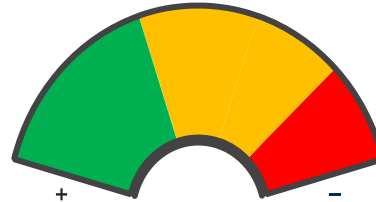


+
APMT
EF100
EF101
310H
Alloy 625
Sanicro 28
Sanicro 35

-
16Mo3

WP 2- Fluidized bed heat exchanger corrosion

Händelö

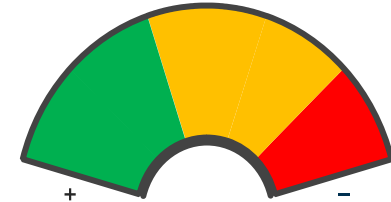


+
APMT
EF100
EF101
SX

316Ti
Esshete
1250
Sanicro 69

-
Thermal
spray
coatings

Högdalen



+
APMT
EF100
EF101
SX
Sanicro 69

316Ti
Esshete
1250
Sanicro
28

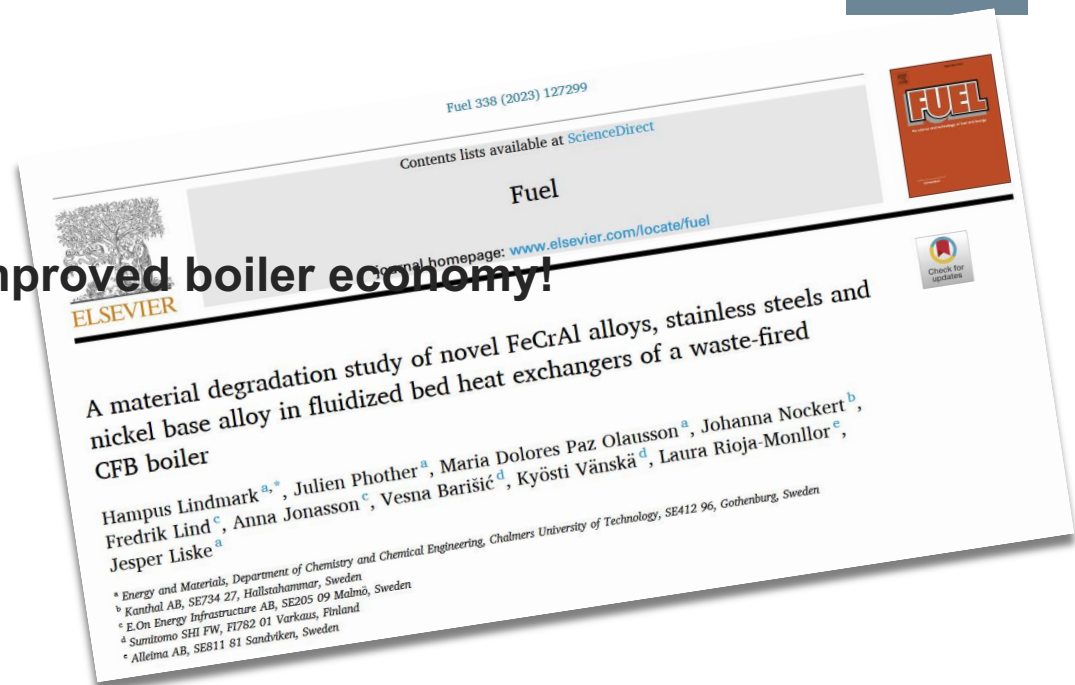
-
Thermal spray
coatings
16Mo3

Promotion of industrial and academical collaboration

- Resource sharing
- Knowledge sharing



Improved boiler economy!



Acknowledgement





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**Thank you for your
attention!**