

KME 715 – Composite Metal Polymer (CMP) for non-stick improvements in CHP plants

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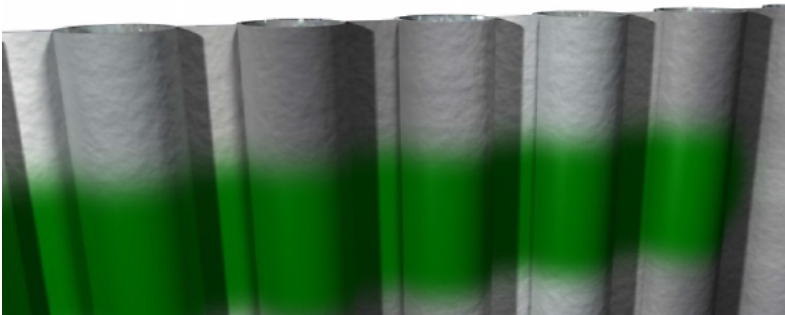
Background – deposits on boiler components

- Generates high outage maintenance cost and decreases availability of the plant
- Decreases electrical efficiency of the boiler
- Important factor for corrosion issues in high temperature boiler components such as furnace walls and superheaters
- Also of importance at lower temperatures in the economiser and cone of electrostatic precipitator

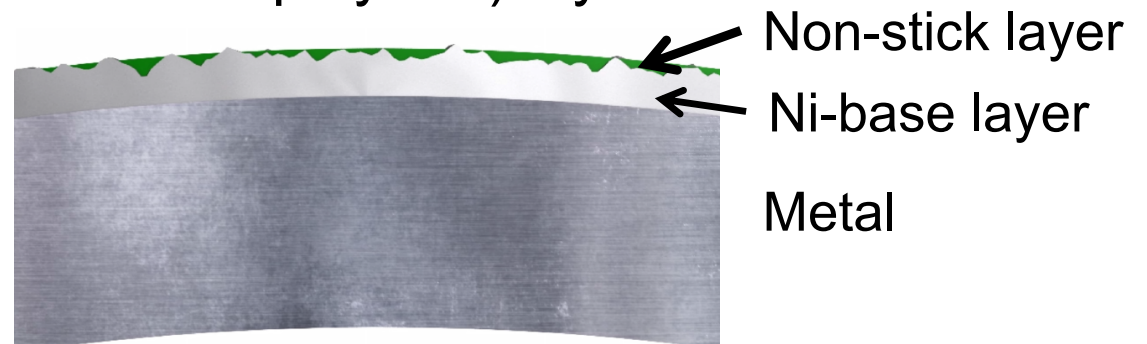


Solutions?

- One suggestion was to reduce the attachment of deposits with the application of a CMP (composite metal polymer) layer



- A Ni-base material is applied to the base metal (grey)
- On top of this layer, the non-stick material is deposited (green)



Cross-section

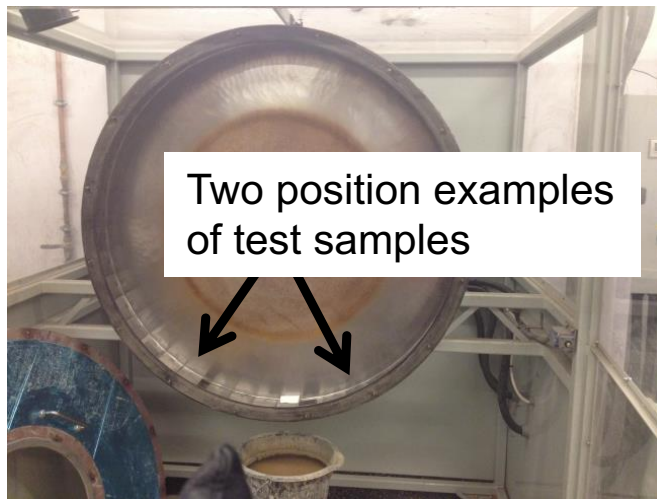
Project aim and content

- Aim: Examine non-stick properties of a steel on which a dual-layer of Ni-base metal and a non-stick material (CMP) has been deposited.
- Research questions: Is the CMP layer left after exposure? Is there less deposit on this layer?
- Project plan includes:
 - Field exposures at two plants, Vesthamnsverket and Avedøre
 - Wear tests
 - Laboratory exposure
- Project partners:
 - MH Engineering (project leader)
 - Öresundskraft Kraft och Värme AB
 - Ørsted (formerly Dong Energy Thermal Power A/S)
 - Swerea KIMAB

Chosen top coatings

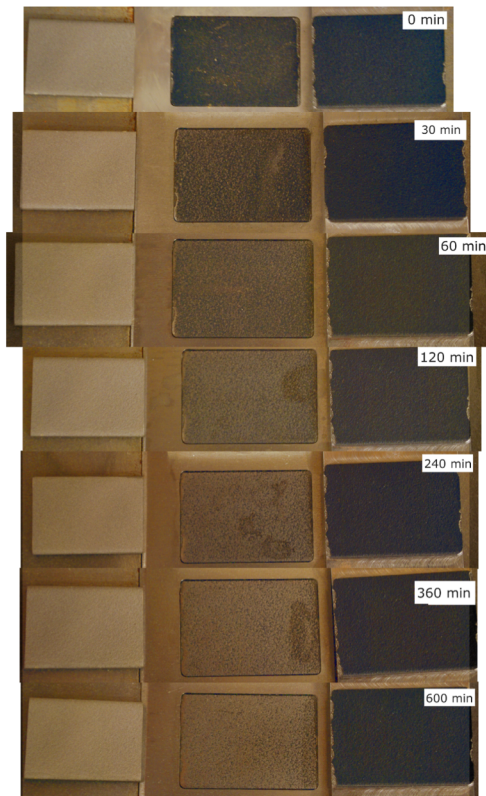
No	Type	T _{max} [°C]
1	PTFE	250
2	Ceramic material	400
4	Boron nitride-silicate	Not available
5	Al phosphate/Boron nitride	Not available
6	Polysiloxane	250
8	Silicone	590
9	Boron nitride	850
10	Graphite based	1200

Wear tests

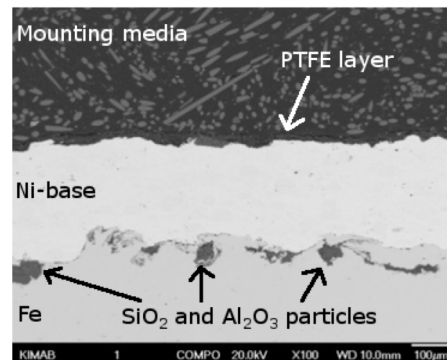
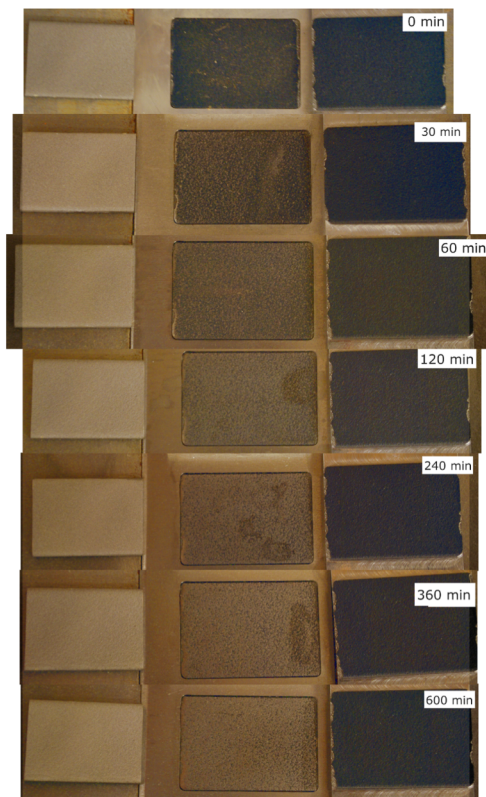


- Samples were attached to the inner circumference of the test apparatus
- The test was performed at room temperature
- The samples were photographed after 30-60-120-240-360-600 min
- Three CMP top layers were chosen and further examined with SEM before and after 30 min – 120 min - 600 min exposure

Wear tests – results, material 1 (PTFE based)

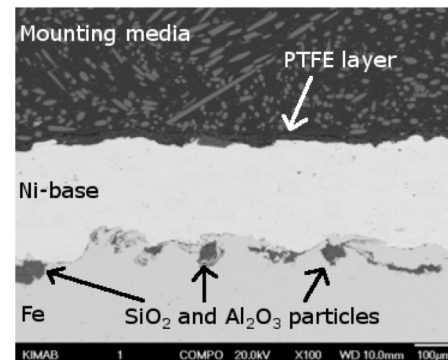
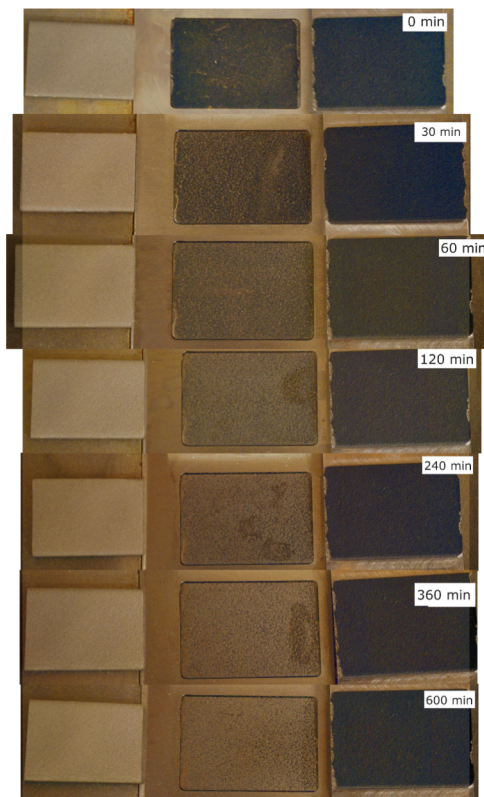


Wear tests – results, material 1 (PTFE based)

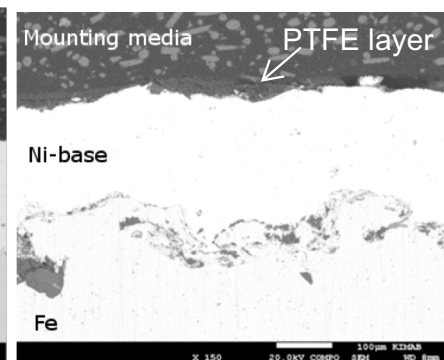


Before exposure

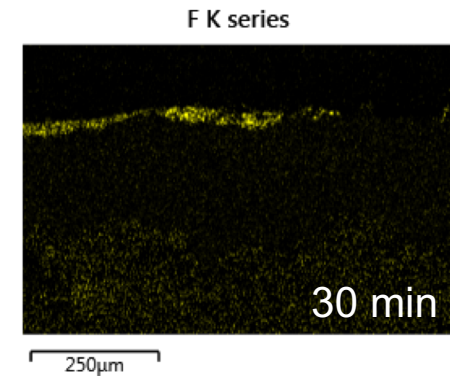
Wear tests – results, material 1 (PTFE based)



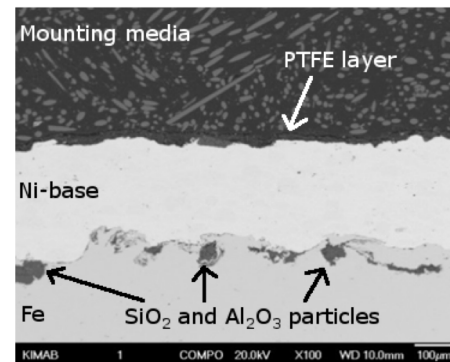
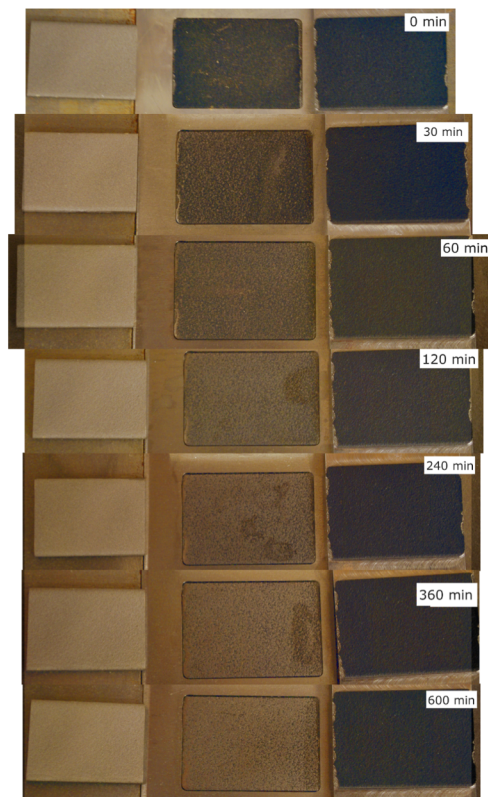
Before exposure



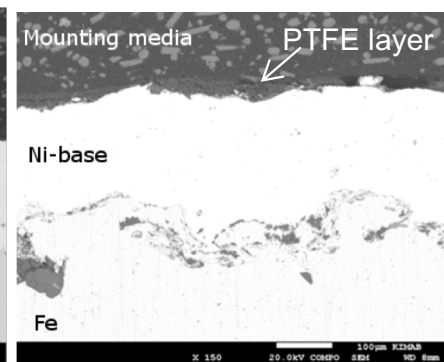
30 min



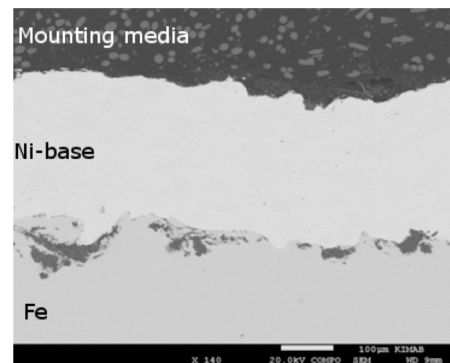
Wear tests – results, material 1 (PTFE based)



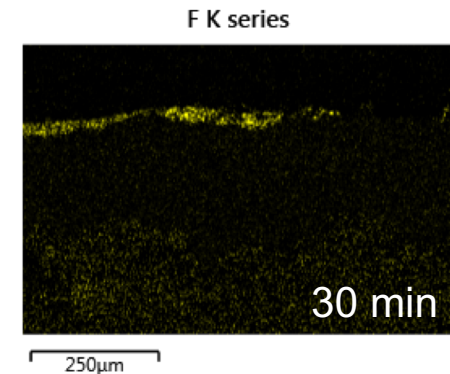
Before exposure



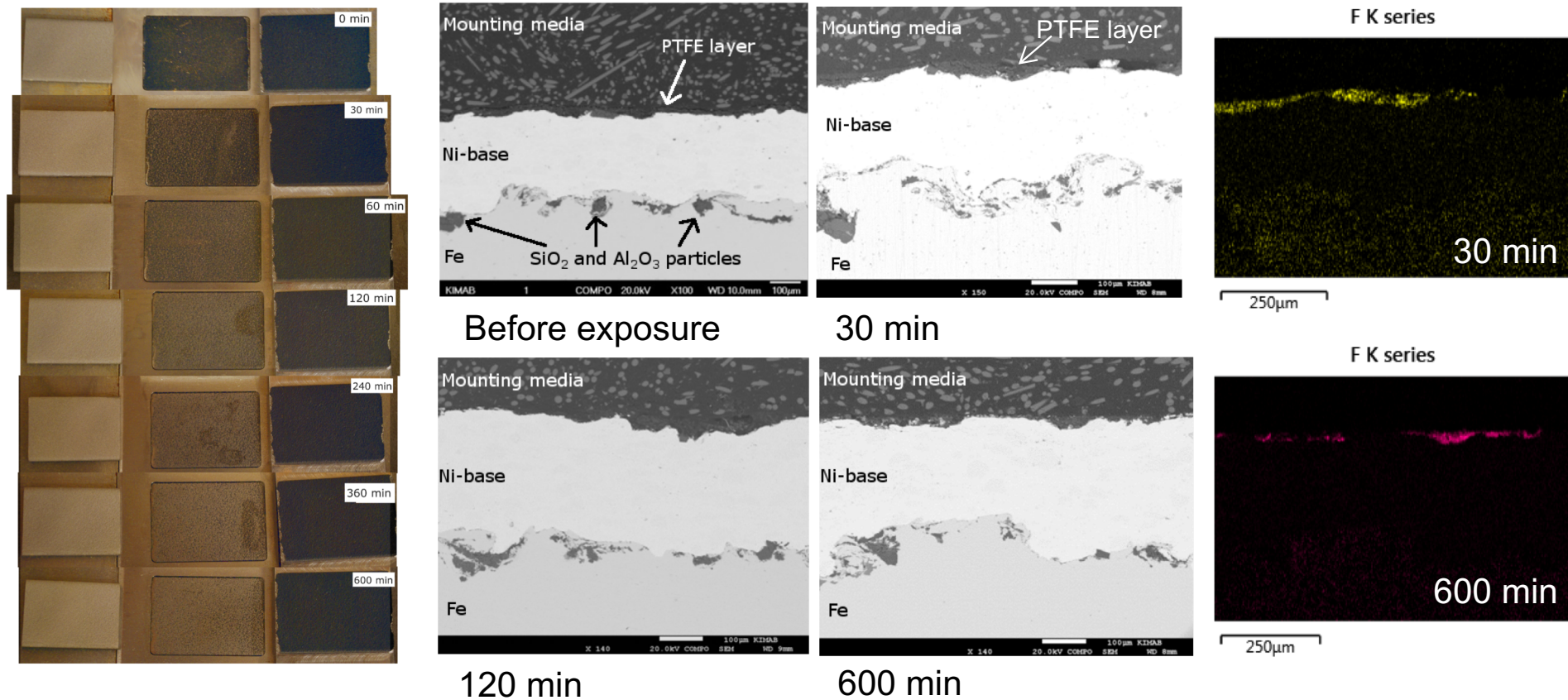
30 min



120 min

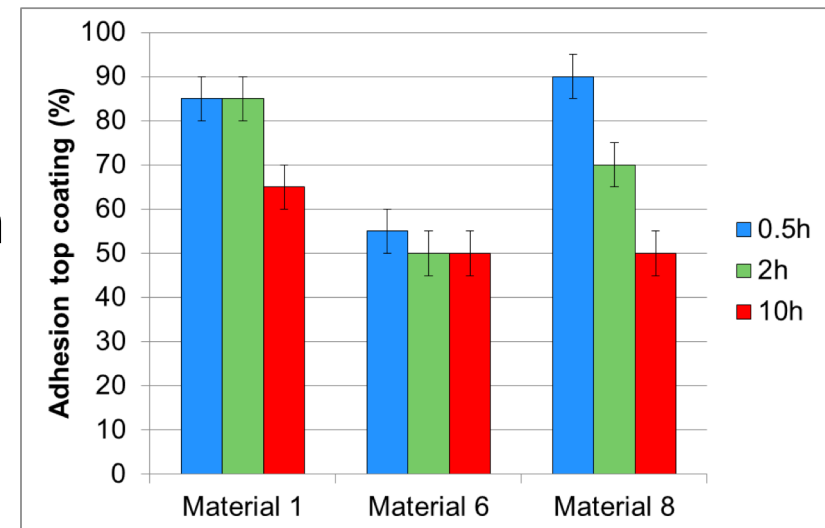


Wear tests – results, material 1 (PTFE based)

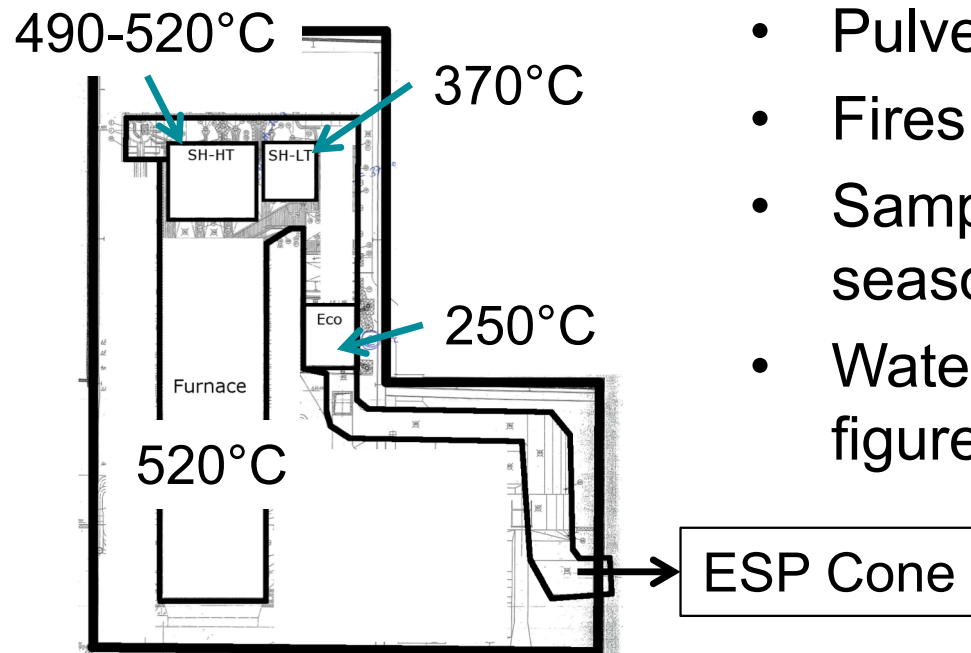


Wear tests - results

- Photographs indicate 25-50 % coverage of top coating after 10 h wear test except for the graphite based material (almost nothing left after 30 min)
- SEM examination for materials with polymeric coatings (#1,6,8) indicate 50-65% coverage after 10 h wear test

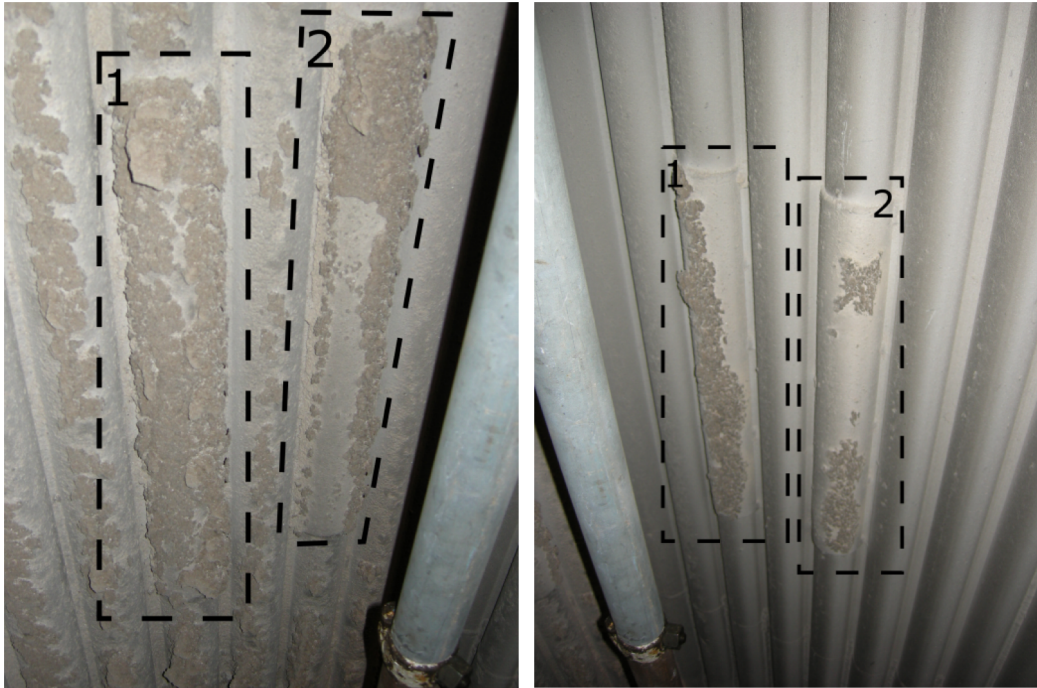


Field exposures - Västhamnsverket



- Pulverised fuel plant
- Fires biomass pellets
- Samples exposed for one or two firing seasons
- Water/steam temperatures given in the figure

Västhamnverket - Furnace



- More deposit on the samples
- Gas flow?
- Mounting of samples?
- Larger exposure area?

Västhamnswerket - Superheater-HT

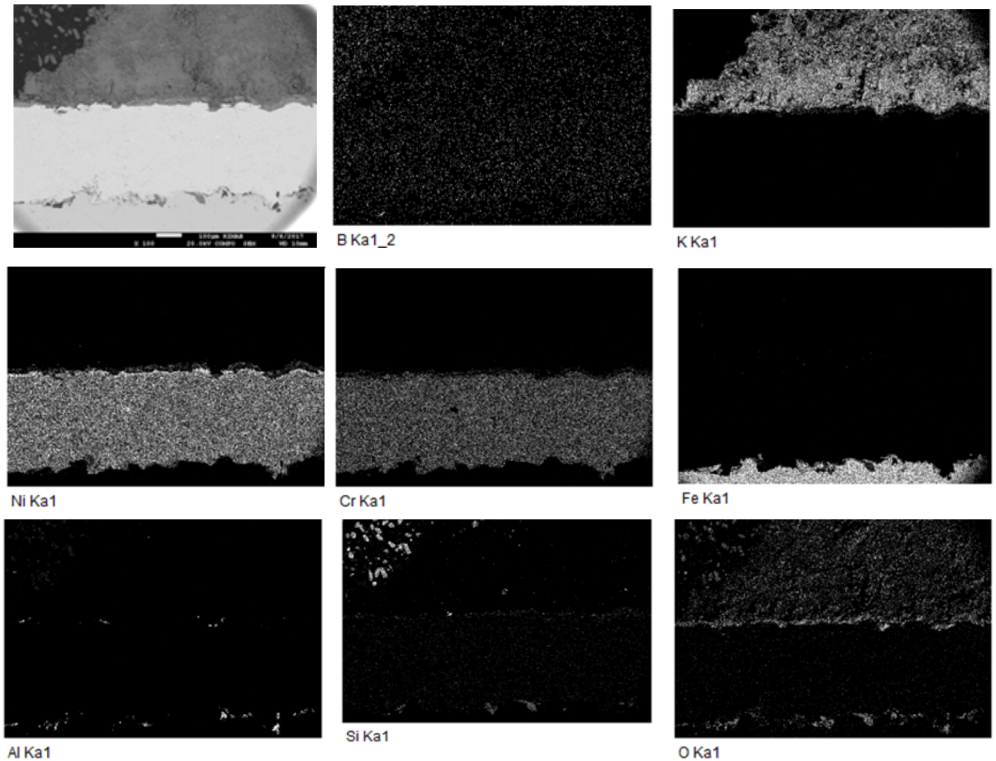


10:Grafit

9:BN material

- Material 9 showed a thick deposit layer with slightly increased O signal at the interface CMP/deposit
- No CMP layer could be identified for the exposed materials 5 (Al-phosphate/BN), 9, 10 after exposure
- Less deposit on material 10, might depend on material handling

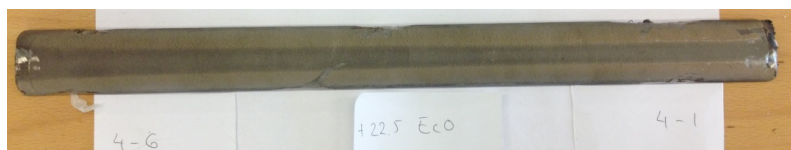
Material 9



Västhamnsverket - economiser

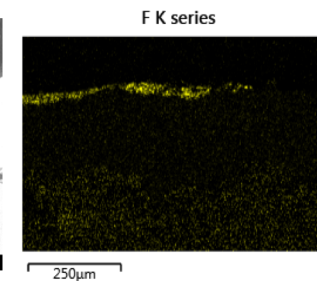
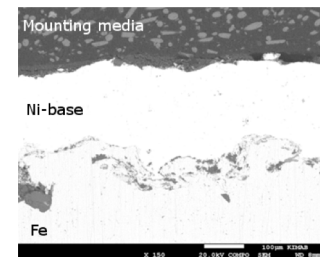


Samples in position in the economiser

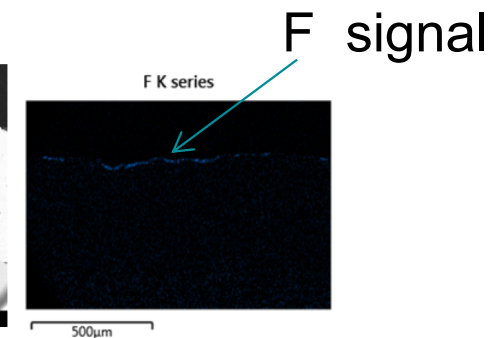
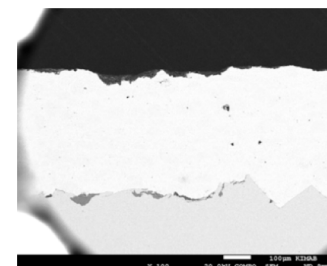


Demounted sample

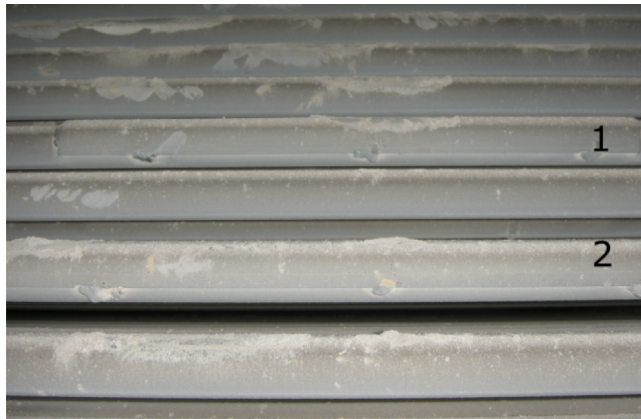
1:PTFE
30 min wear
test



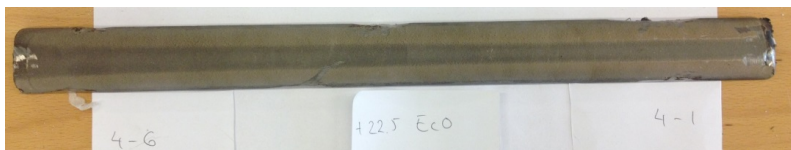
1:PTFE
Economiser



Västhamnsverket - economiser

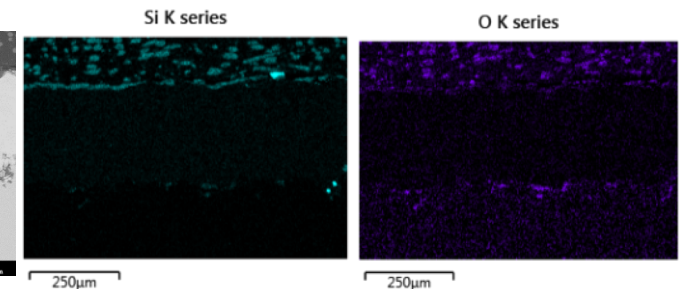
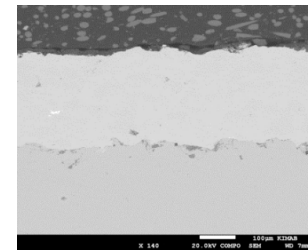


Samples in position in the economiser

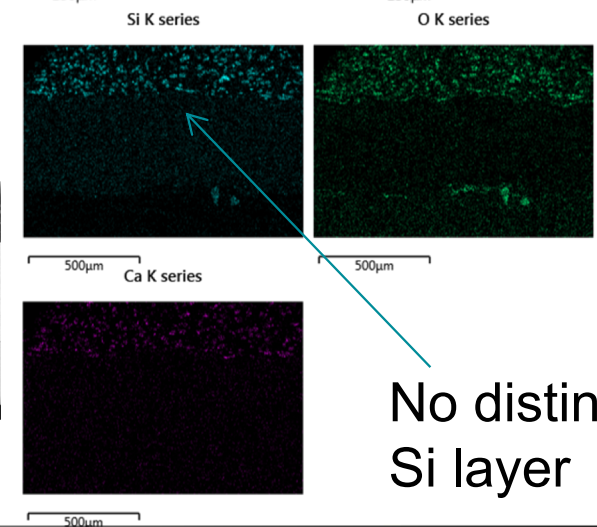
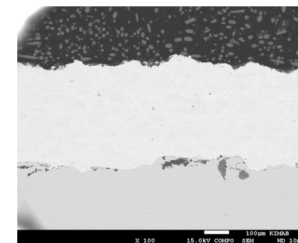


Demounted sample

6:Polysiloxane
30 min wear
test

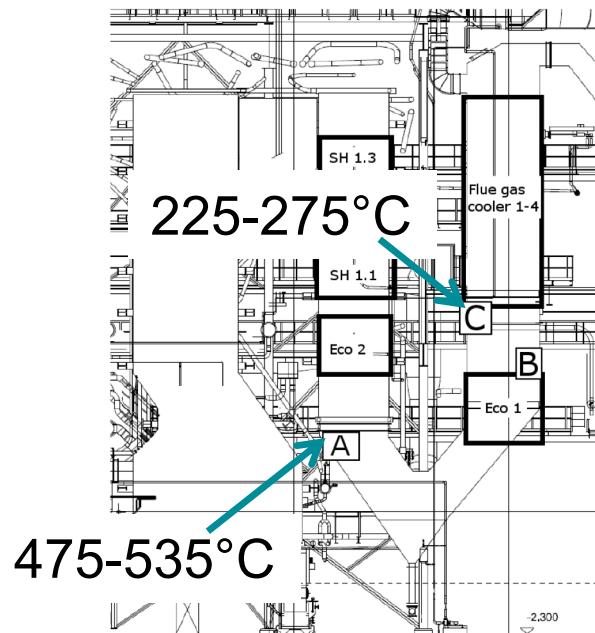


6:Polysiloxane

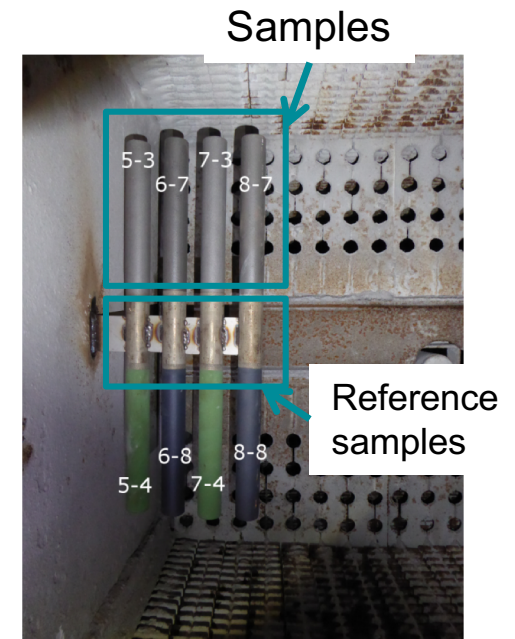


No distinct
Si layer

Field exposures - Avedöre



- Samples exposed 1 firing season
- Grate-fired boiler
- Biomass fired (straw)
- Reference material included



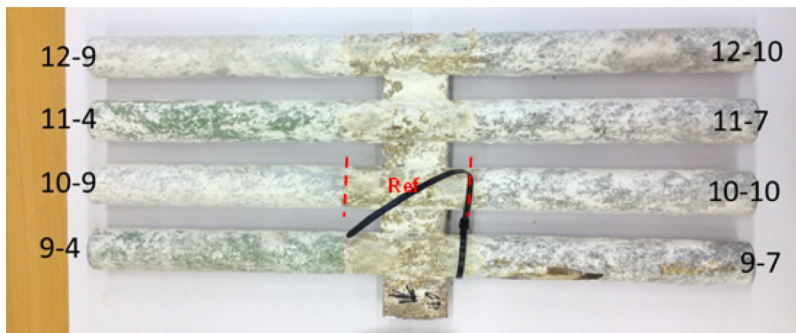
Samples mounted in position B

Avedöre – Position A (SH-HT)

- Exposed materials: 4(BN-silicate), 9 (BN), 10 (graphite), reference
- 475-535°C

Avedöre – Position A (SH-HT)

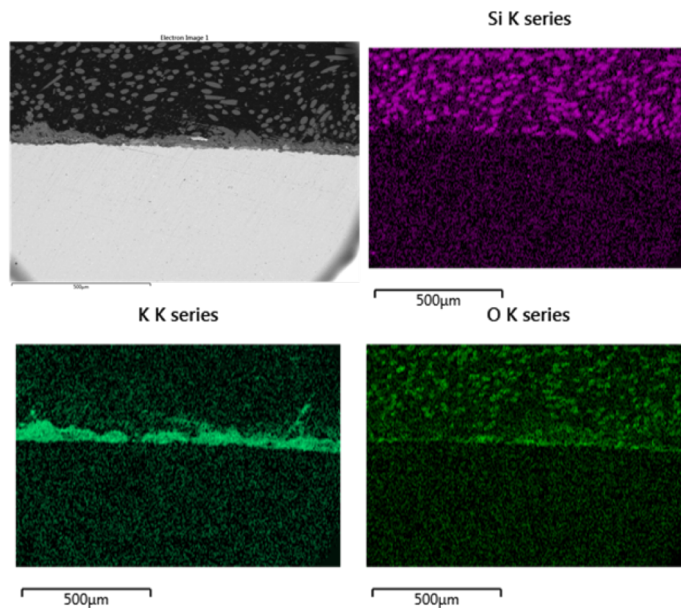
- Exposed materials: 4(BN-silicate), 9 (BN), 10 (graphite), reference (austenitic steel)
- No clear difference in amount of deposit between reference and samples (visual inspection)



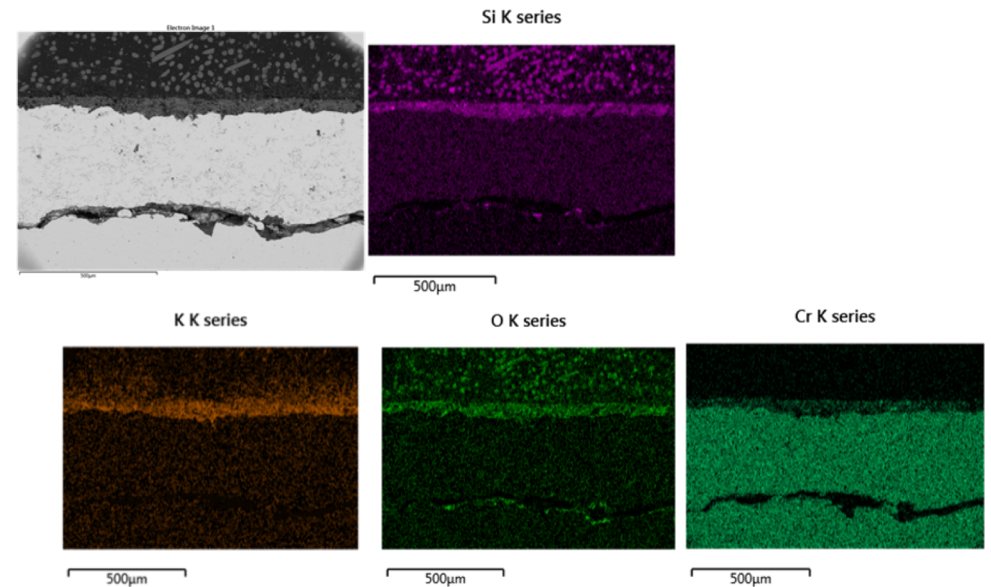
Exposed samples

- Materials 9 (BN) and 10 (graphite) could not be identified at the metal/deposit interface

Avedöre – Position A (SH-HT)



Reference

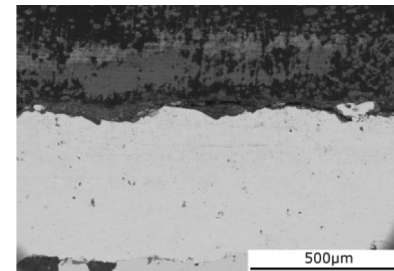


Material 4 – BN Silicate: slightly more explicit Si layer – CMP layer?

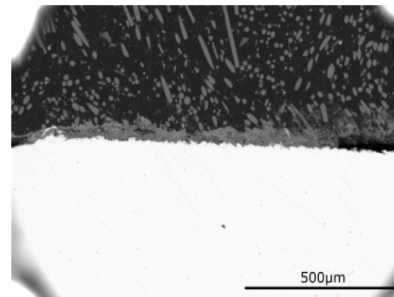
Avedöre – position B



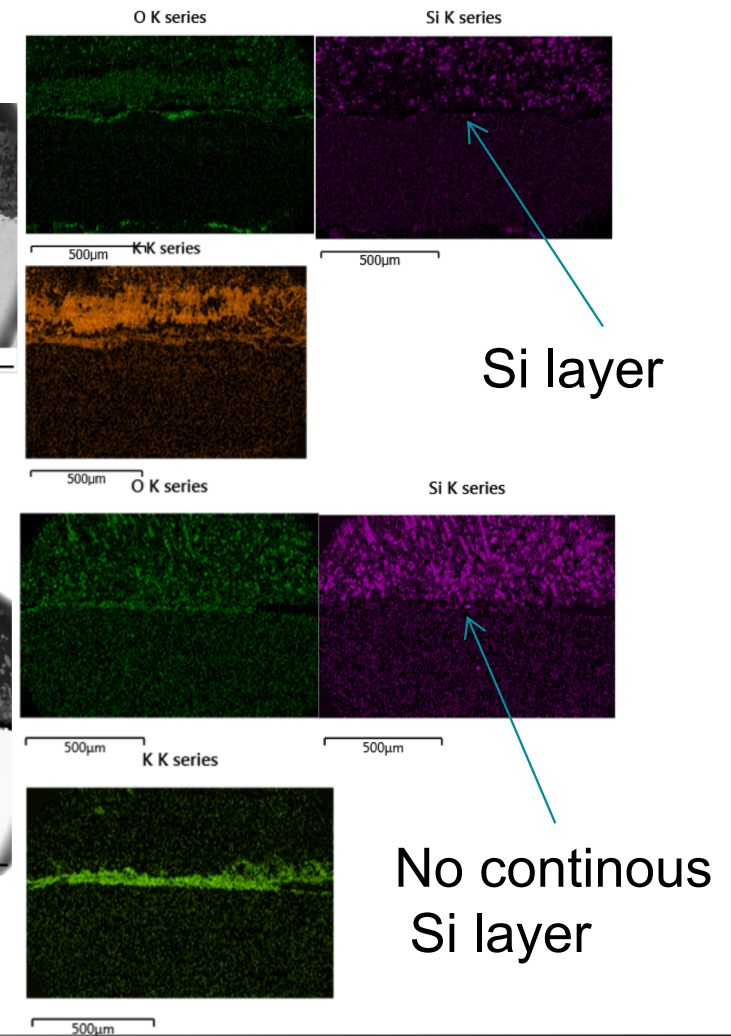
Samples in position B - Avedöre



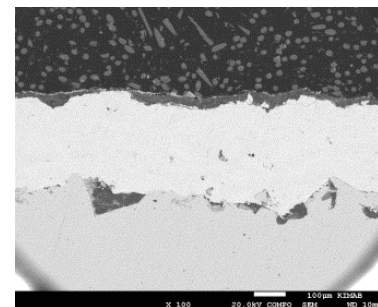
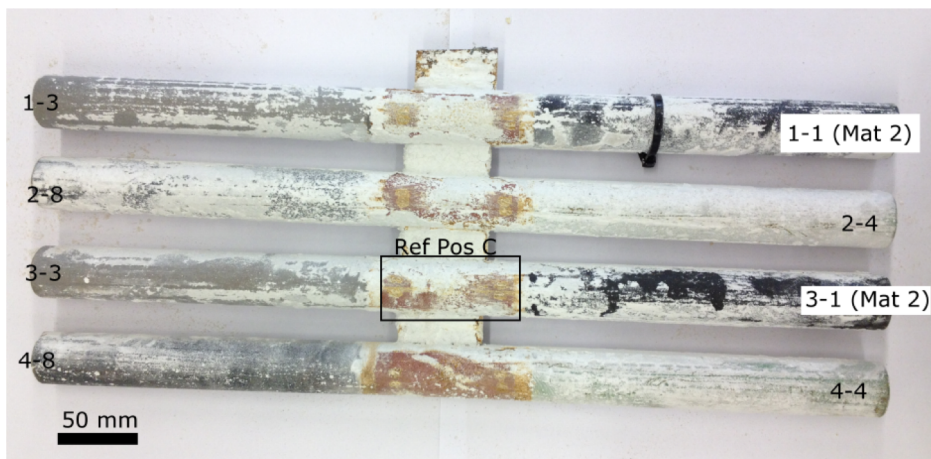
Material 8



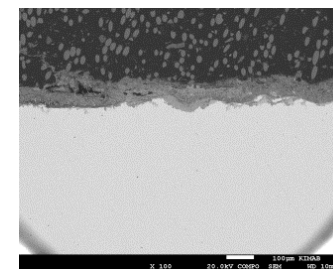
Reference



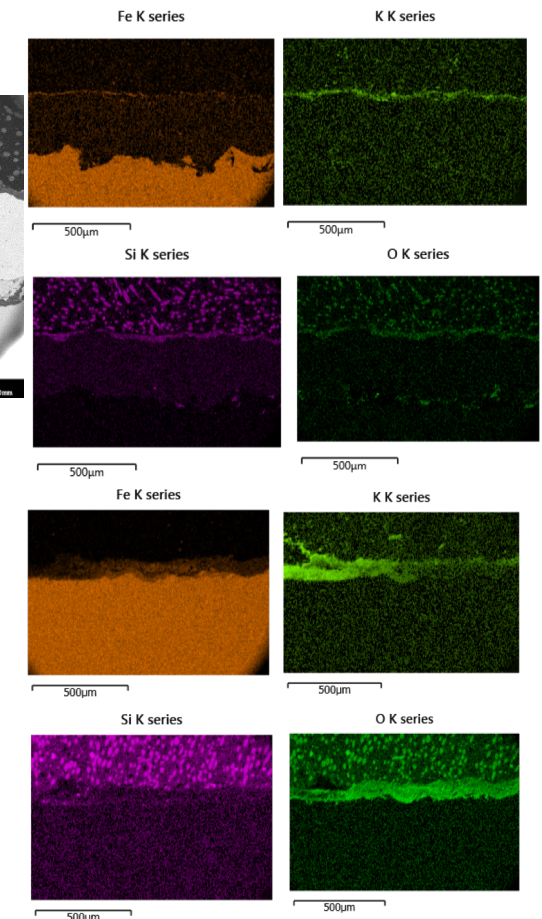
Avedöre – Position C, Eco



Material 8



Reference



Conclusions 1

- The examined top coatings have not shown a reduced deposit formation in the examined lower temperature areas of the two CHP plants at Avedöre or Västhamnsverket. It can be argued that not much deposit formed in the exposure areas.
- For the high temperature areas, material 10 (graphite based) may show reduced deposit formation, but results are uncertain due to lack of a photograph before demounting of the samples.
- No top coating could be detected by SEM/EDS on the samples exposed in the superheater areas position A (Avedöre) or SH-HT (Västhamnsverket).

Conclusions 2

- The PTFE based material (Material 1) showed very good coverage in both wear tests performed for 10 h and in furnace exposures.
- The graphite based material (Material 10) had very poor adherence when exposed in the wear tests.
- There are issues to identify the CMP layer by SEM/EDS due to the composition of the deposit layer, except for for the PTFE material

Thank your for your attention!

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