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

Julien Phother & Jesper Liske

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

Overall aim

- Improve plant economy
  - Power plants and Combined Heat and Power (CHP) plants using renewable fuels
  - Increase competitiveness compared to fossil fuels
- Focus on two problem areas
  - Water wall corrosion
  - Loop seal superheater 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 (1/2)

- 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 loop seal superheaters
- Investigation of materials performance
  - Newly developed steels and commercial alloys for water walls
  - Thermal spray and overlay welding

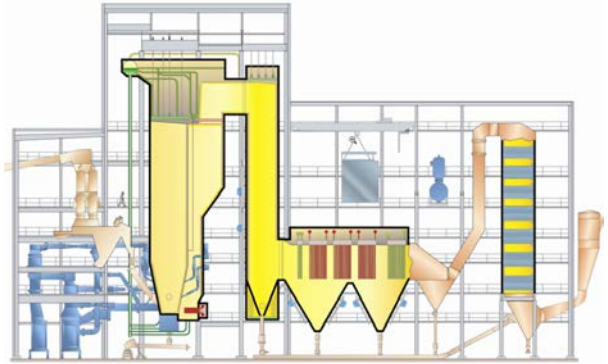
Project goals (2/2)

- Collaboration with other biokraft project(s)
  - Facilitate synergistic effects between the projects
  - Jointly perform measurements campaigns in boilers
  - Share results of material performance of newly developed model alloys
- Collaboration with HTC
  - Corrosion issues in combustion of biomass and waste
  - Share results regarding corrosion mechanisms
- Academic goals
  - 2 academic theses
  - 1 journal article
  - 2 conference proceedings

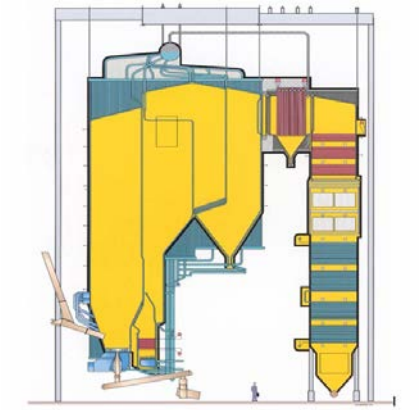
Roles

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

WP1

Water walls corrosion

WP0

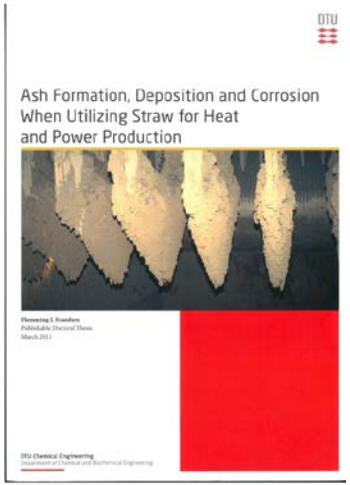
Planning/Methodology development

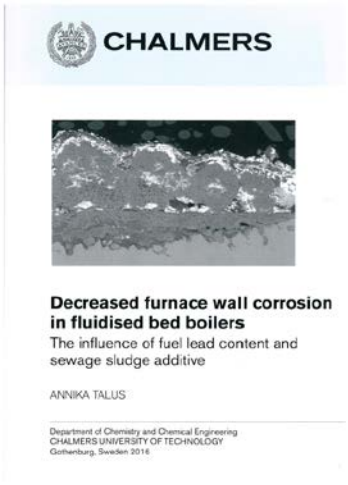
WP2

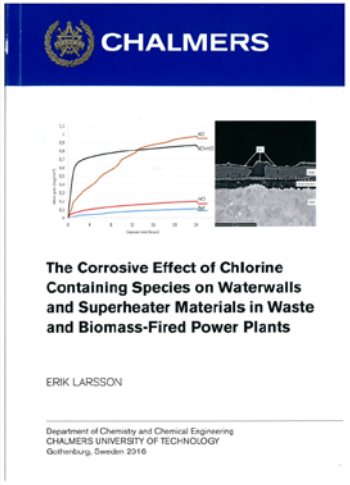
Loop seal corrosion/erosion

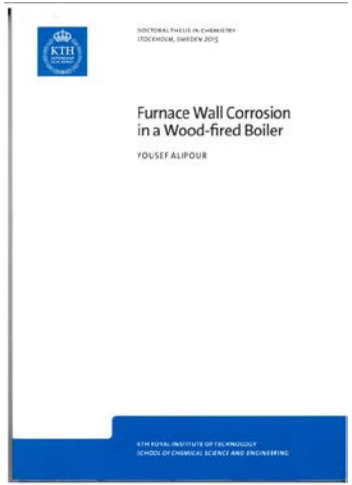
WP0

Literature review









Water walls

- Materials
  - Low-alloyed steels
- Temperature
  - Water ~ 350 °C
  - Flue gas ~ 750-1000 °C
  - Material ~ 400 °C
- What is the problem ?
  - Accelerated corrosion
- Why ?
  - Molten species
  - Waste-fired boilers: zinc and lead compounds
  - Lower melting point of deposits

300-800 °C

200-400 °C

Salt and mixture	Melting point (°C)
$ZnCl_2$	318
$PbCl_2$	489
KCl	772
NaCl	801
$FeCl_2$	673
KCl-$ZnCl_2$	230
KCl-$PbCl_2$	412
KCl-$FeCl_2$	355
NaCl-$ZnCl_2$	262
NaCl-$PbCl_2$	415
NaCl-$FeCl_2$	375

Loop seal

- Temperature
  - Sand temperature ~ 800-900 °C
- What is the problem ?
  - Extremely high material loss (up to 5 mm/year)
  - Short life of the material (1-3 years)
- Why ?
  - Erosion
  - High Temperature Corrosion
  - Stress
  - Creep

?

- Options
  - Ni-based materials
  - FeCrAl's

WP1 – Water walls

Högdalen P6

- Installation of test section of the water wall in **furnace chamber**
  - Using overlay welding and thermal spray coatings
  - **Test commercial materials as well as newly developed alloys and coatings**
  - Current installed material: Overlay welding Inconel625

Händelö P15

- Installation of test section of the water wall in **empty pass**
  - Using overlay welding and thermal spray coatings
  - **Comparison with overlay welding Alloy825**

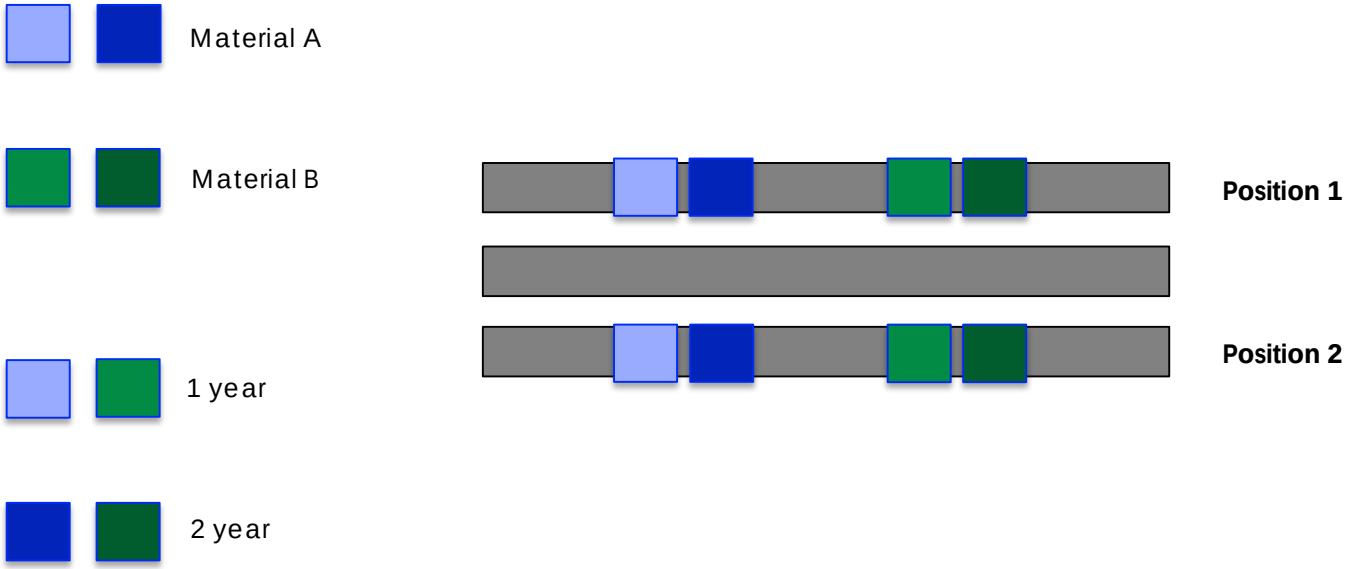
Short-term tests will be performed by means of probe exposure

Investigation of initiation of corrosion attack

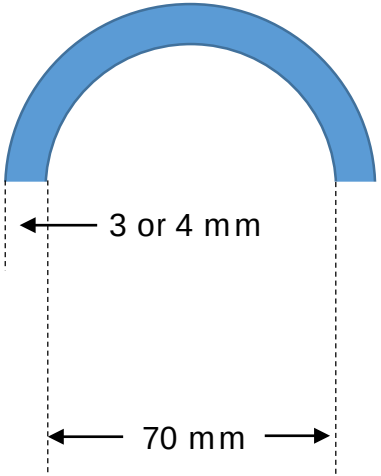
WP2 – Loop seal

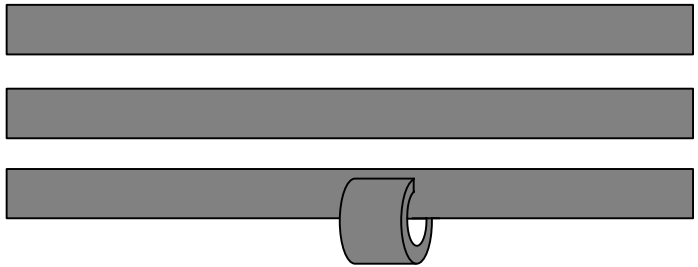
Högdalen P6

Händelö P15



WP2 – Loop seal





WP2 – Loop seal

Händelö - Installation of clamps on the loop seal superheaters during revision in March-April

Materials
APMT
16Mo3
Sanicro 28
316 Ti (TPW)
K92
RM80
Sanicro 69
Coatings
Alloy 59
Model alloys

Summary

- Water walls corrosion tests:
  - Högdalen: Furnace chamber
  - Händelö: Empty pass
  - For both: Short-term exposures using probes => Investigation of the initiation of corrosion
- Loop seal superheaters:
  - List of materials to be confirmed
  - Händelö: Installation of the clamps during revision in spring. Material tests will be combined with the change of bed (collaboration with Improbed-project)

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