Nytt koncept för bäddmaterial reducerar förbrukningen med 90% — Resultat och erfarenheter från E.ON Händelö

Patrick Moldenhauer och Bengt-Åke Andersson
VoK Borås 9 -10 april 2019

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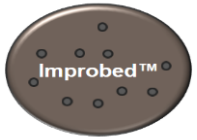
www.improbed.com

Transforming the fluidized bed boiler industry

Improbed™ values

Oxygen transport



Alkali absorption

Proven Values

- Increased boiler efficiency and capacity
- No risk for agglomeration and sintering
- Increased bed material efficiency

Expected Value

- Reduced maintenance costs

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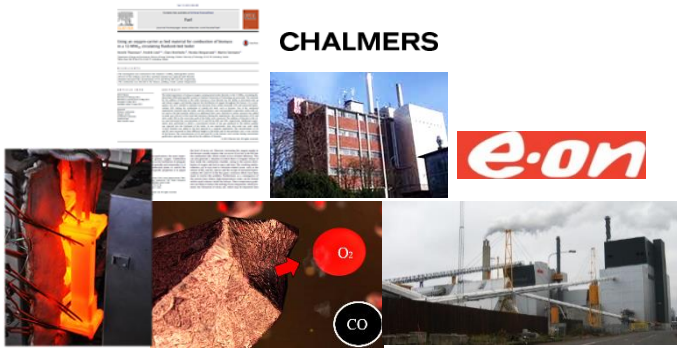
The history of Improbed™

Cooperation between Chalmers TH and E.ON

Scale-up from lab to industrial operations and to commercialization

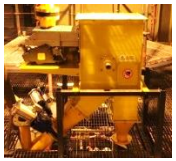


2013 – 2014

The concept is published.
Proof of Concept in Chalmers' 12 MW boiler, followed by industrial 75 MW waste boiler (P14).

2015 – 2016

Improbed AB is set up.
Awarded "Best of IVA", continuous operations in P14, new test at W2E plant, IPR development, publications.
Presentation at VoK Panndagar, Karlstad 2016



2017 – 2018

20 000 h of operation, test at 115 MW bio & RT, publications. Magnetic separation at Händelö.

2018 –

Ongoing cooperations, new tests and implementations.

Improbed™ reference list

- Chalmers 12 MW_{th} CFB biomass (2013)
- P14 Händelö 75 MW_{th} CFB waste (2014)
  continuous operations
- Sollefteå 17 MW_{th} BFB biomass (2016)
- Borås 20 MW_{th} BFB waste (2016)
- P15 Händelö 85 MW_{th} CFB waste (2017)
- Örtofta 115 MW_{th} CFB biomass/waste wood (2018)
  agreement for continuous operations
- Eskilstuna 60 MW_{th} CFB biomass (2019)
  test analysis is ongoing
- Örebro 170 MW_{th} CFB biomass (2019)
  test analysis is ongoing

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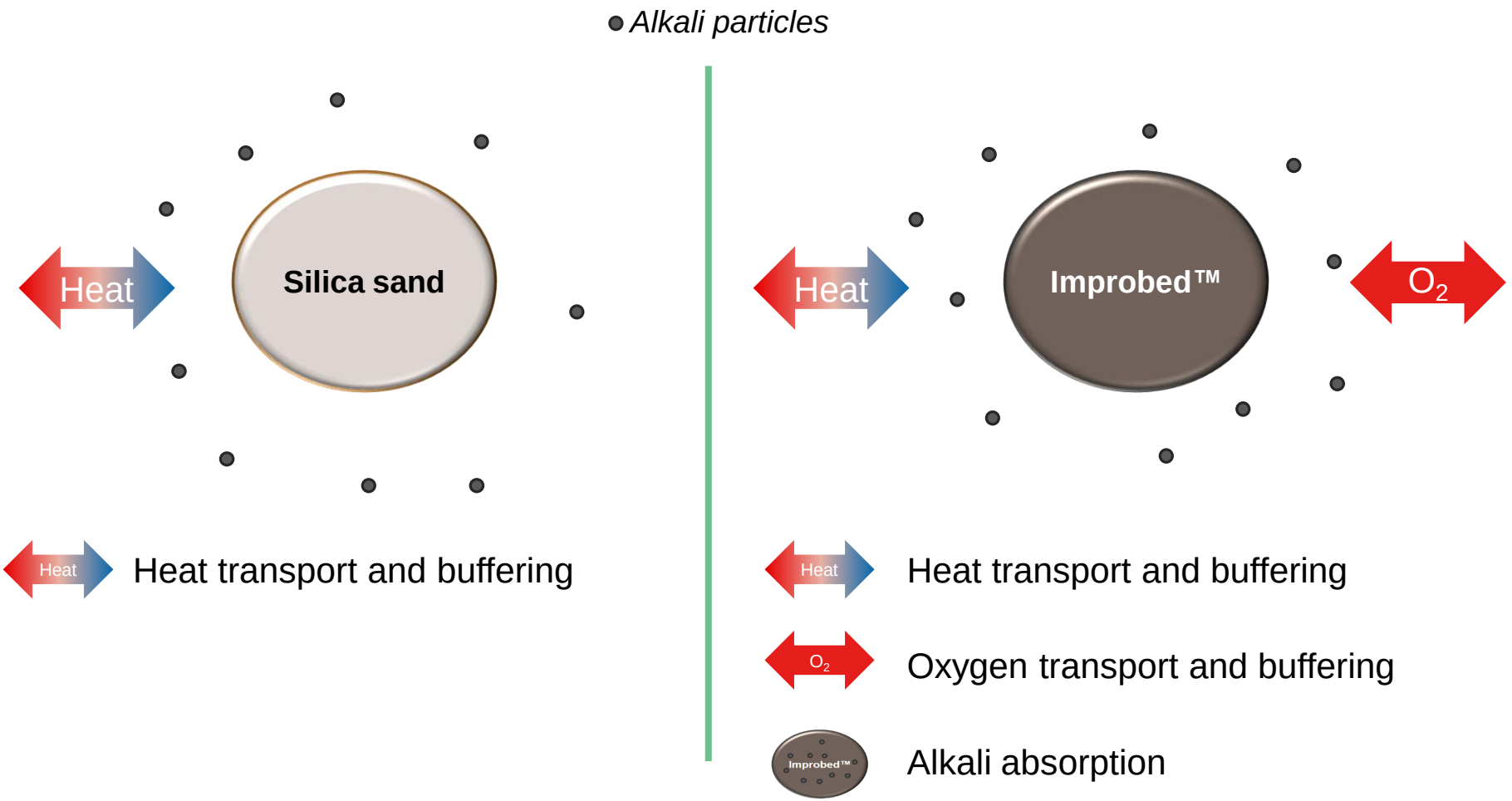
How does Improbed™ work?



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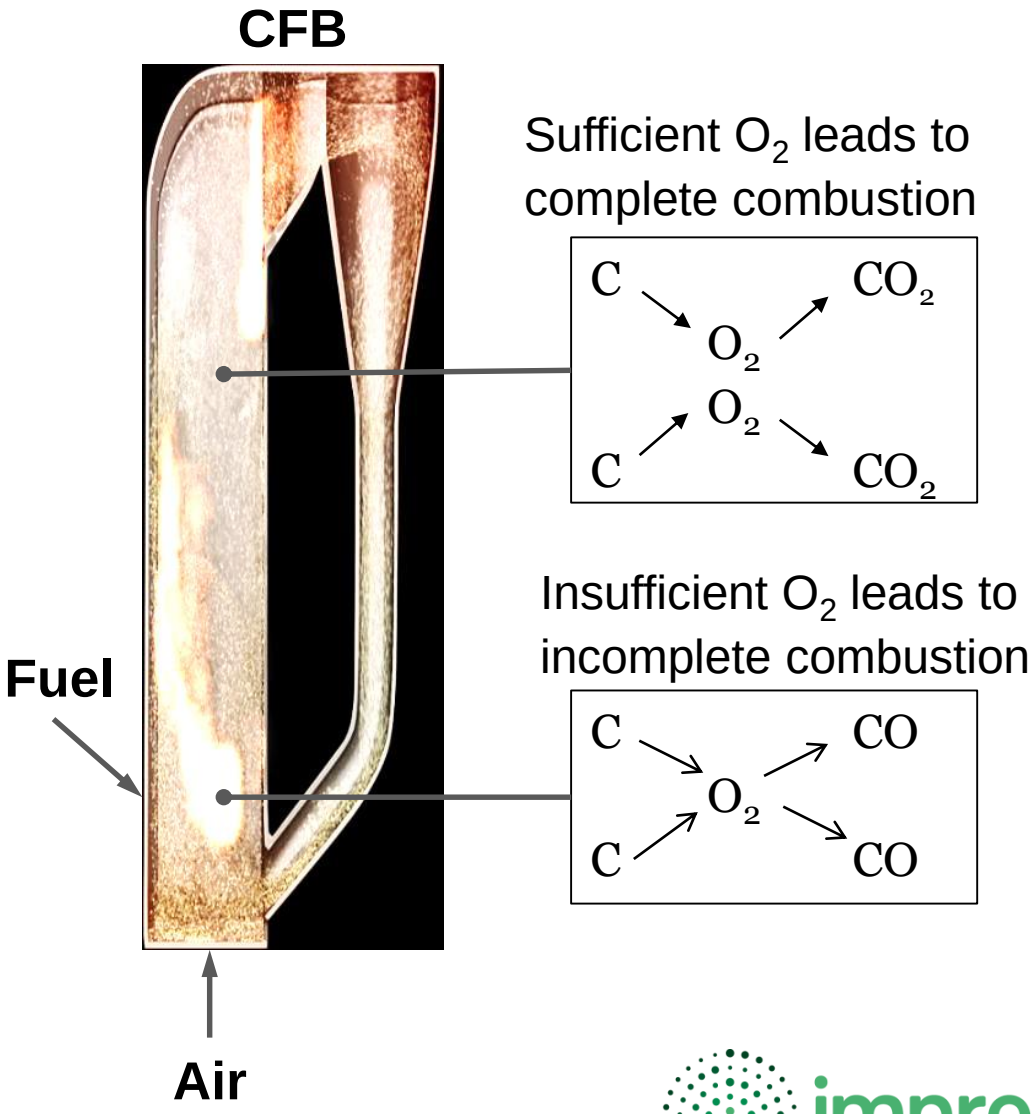
How does Improbed™ work?

Insufficient mixing between air and fuel gives O_2 streaking and emissions of CO.

Improbed™ …

1) **distributes O_2 and decreases CO**
2) **absorbs alkali**
3) **is attracted by a magnetic fields**



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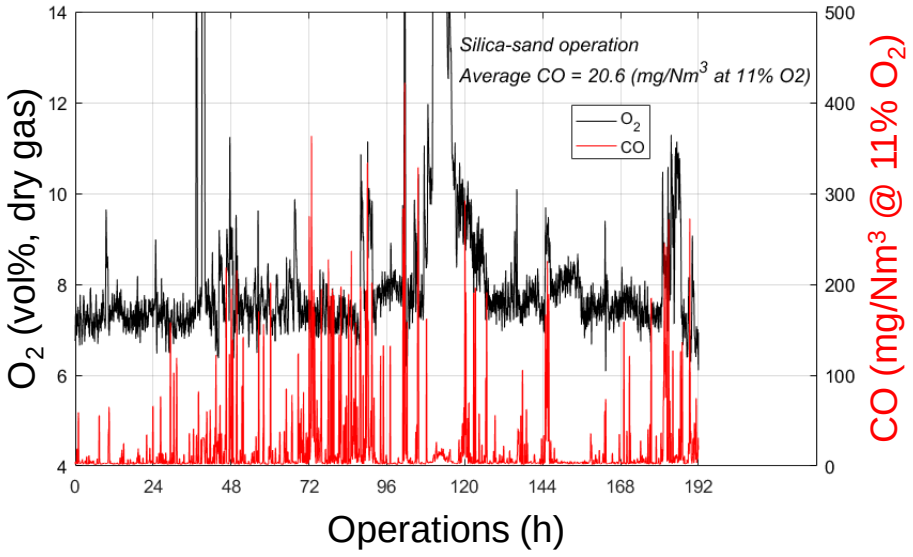
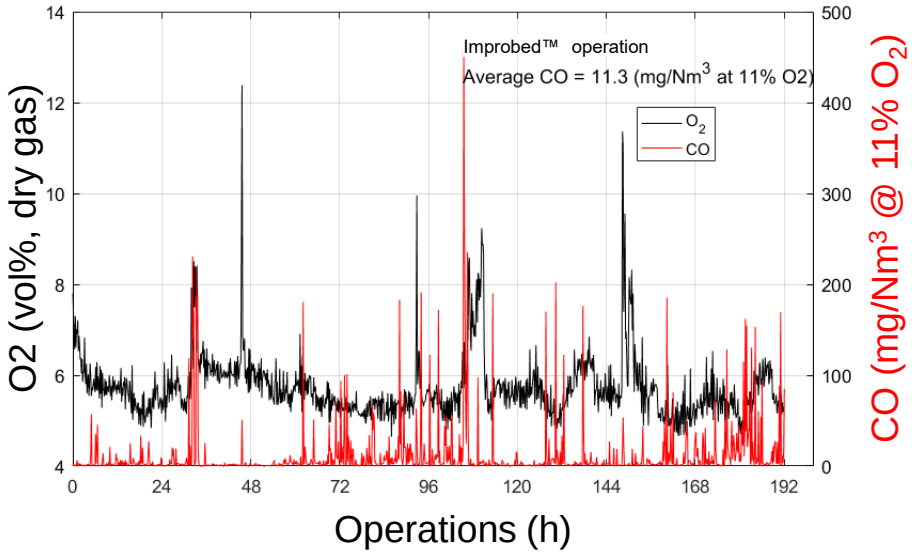
Reduction of O_2 and CO at Händelö P14

- O_2 reduced by 20%
- Daily average values for CO decreased by 50%
- Reduction of bed material turnover from 11 kg/MWh to 3 kg/MWh

Silica sand



Improbed™



Lind, F. Corcoran, A. Andersson B-Å. Thunman H. 12,000 Hours of Operation with Oxygen-Carriers in Industrially Relevant Scale (75,000 kW_{th}). VGB Power TECH Journal 2017.

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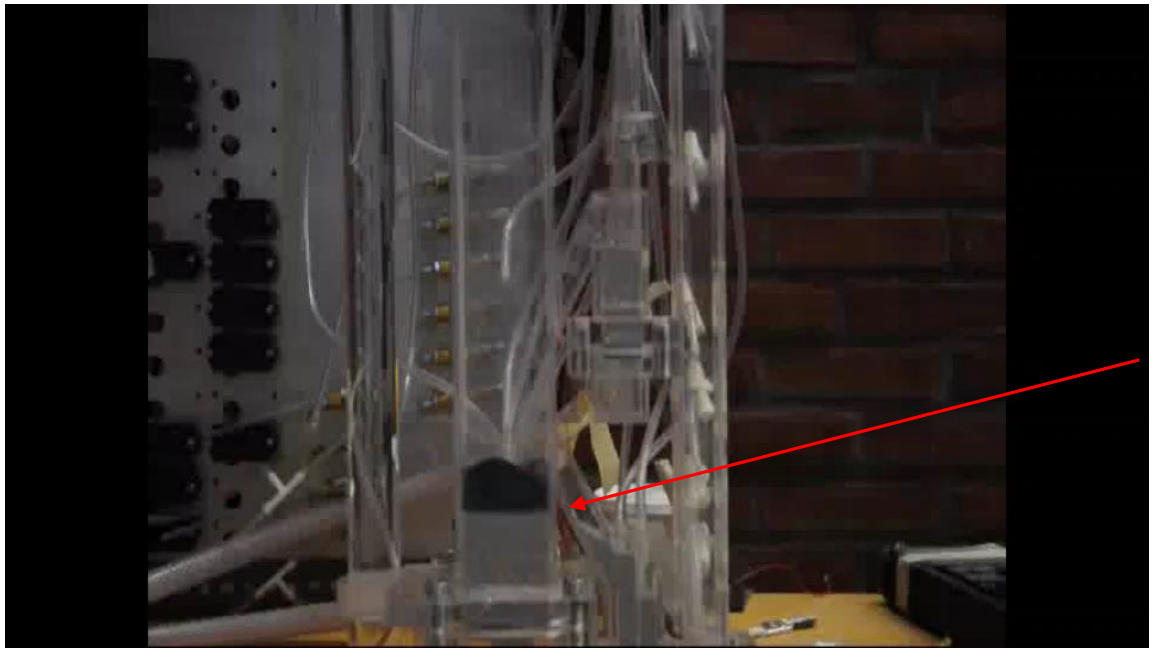
How to determine the concentration of Improbed™?

- Improbed™ is attracted by a magnetic field
- Lab-scale magnet with high separation efficiency
- Experiments in P15, 85 MW_{th}
  ash sample analysis → concentration of Improbed™
- P14: air classifier — P15: rotary sieve drum

Magnet



Good mixing

Complete separation

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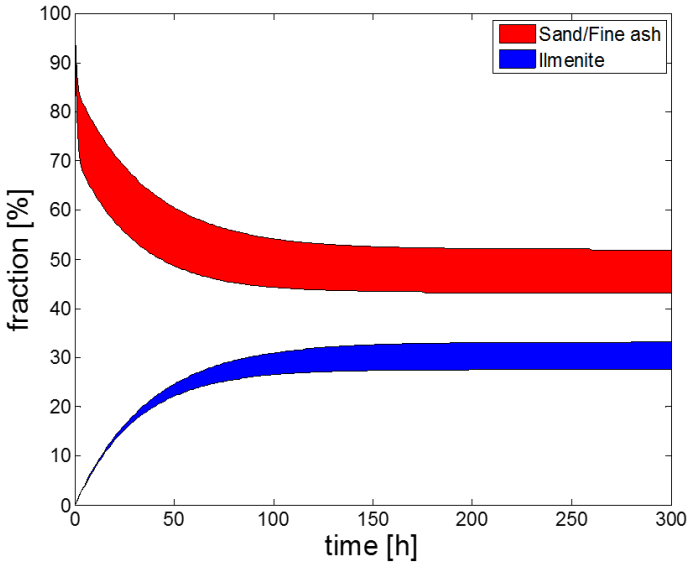
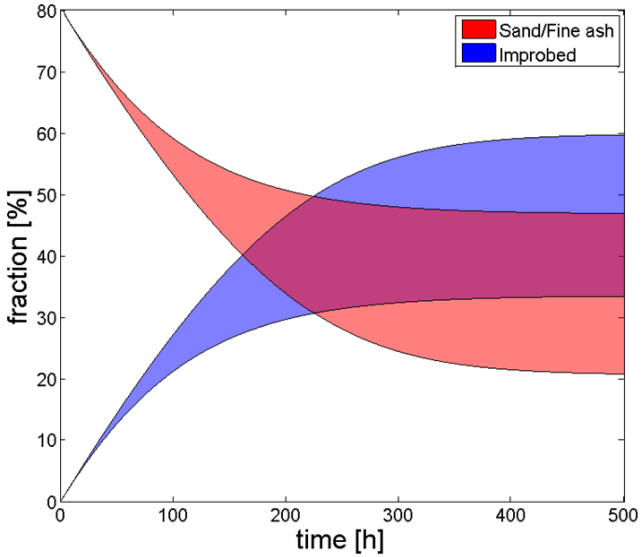
Improbed loop™ – recirculation of bed material

- Further improvements by magnetic separation of the bottom ash and recirculation
- Theoretical ash flow modelling based on tests in Händelö P14 and P15
- Pilot system implemented at Händelö P14



3 kg/MWh <u>w/o</u> recirculation



1 kg/MWh <u>with</u> recirculation

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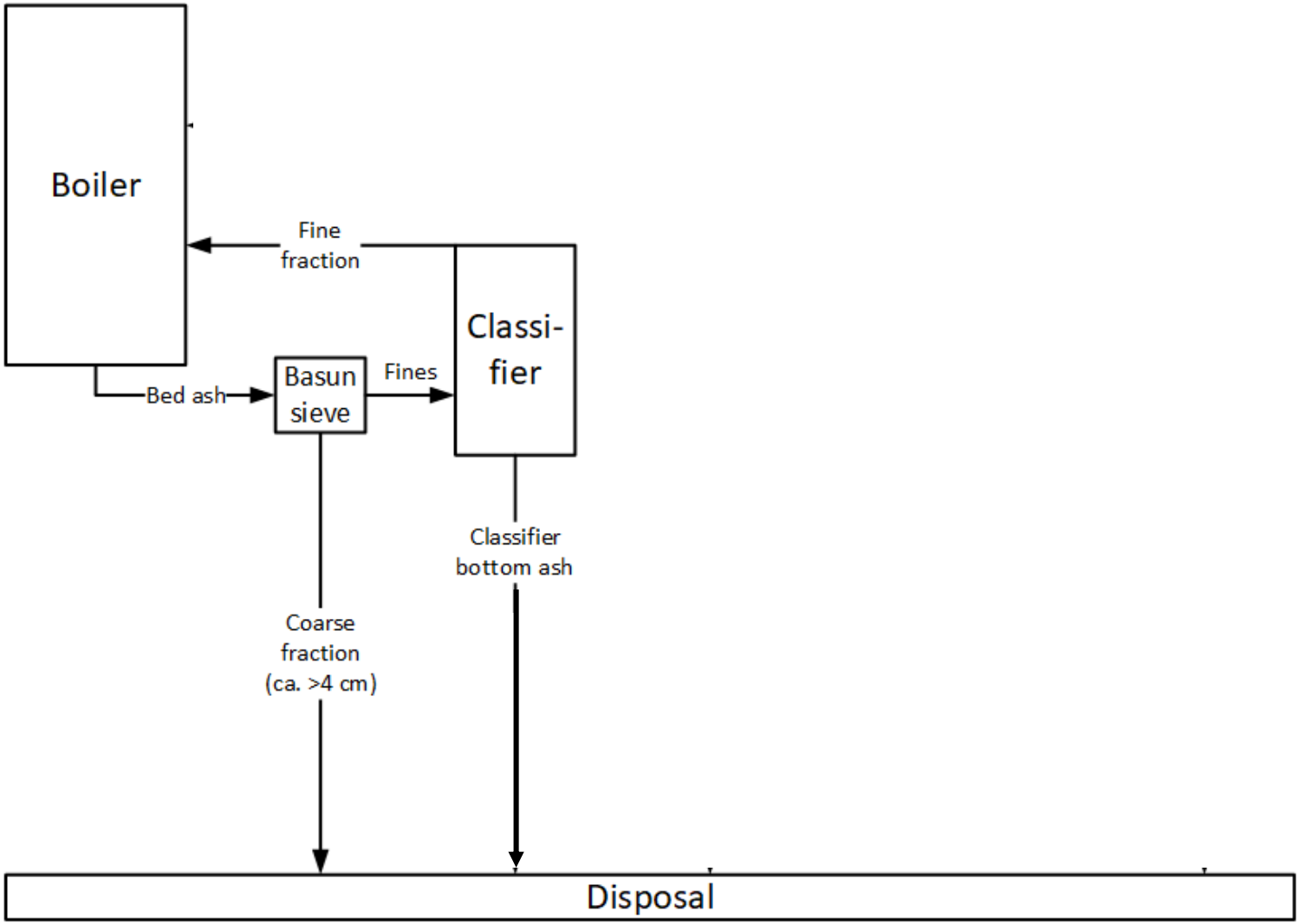
Bed ash system Händelö P14 — original



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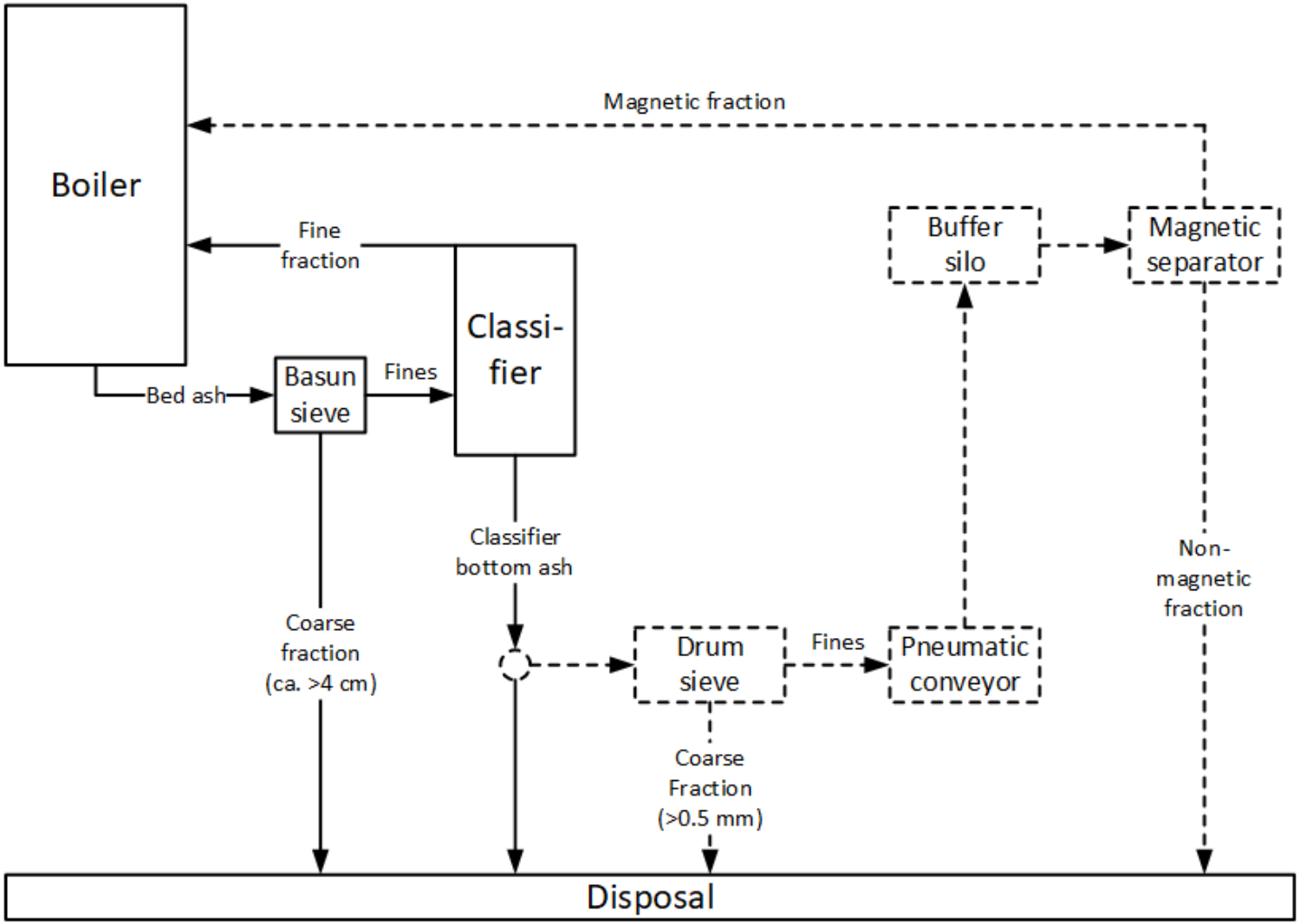
Bed ash system Händelö P14 — rebuilt



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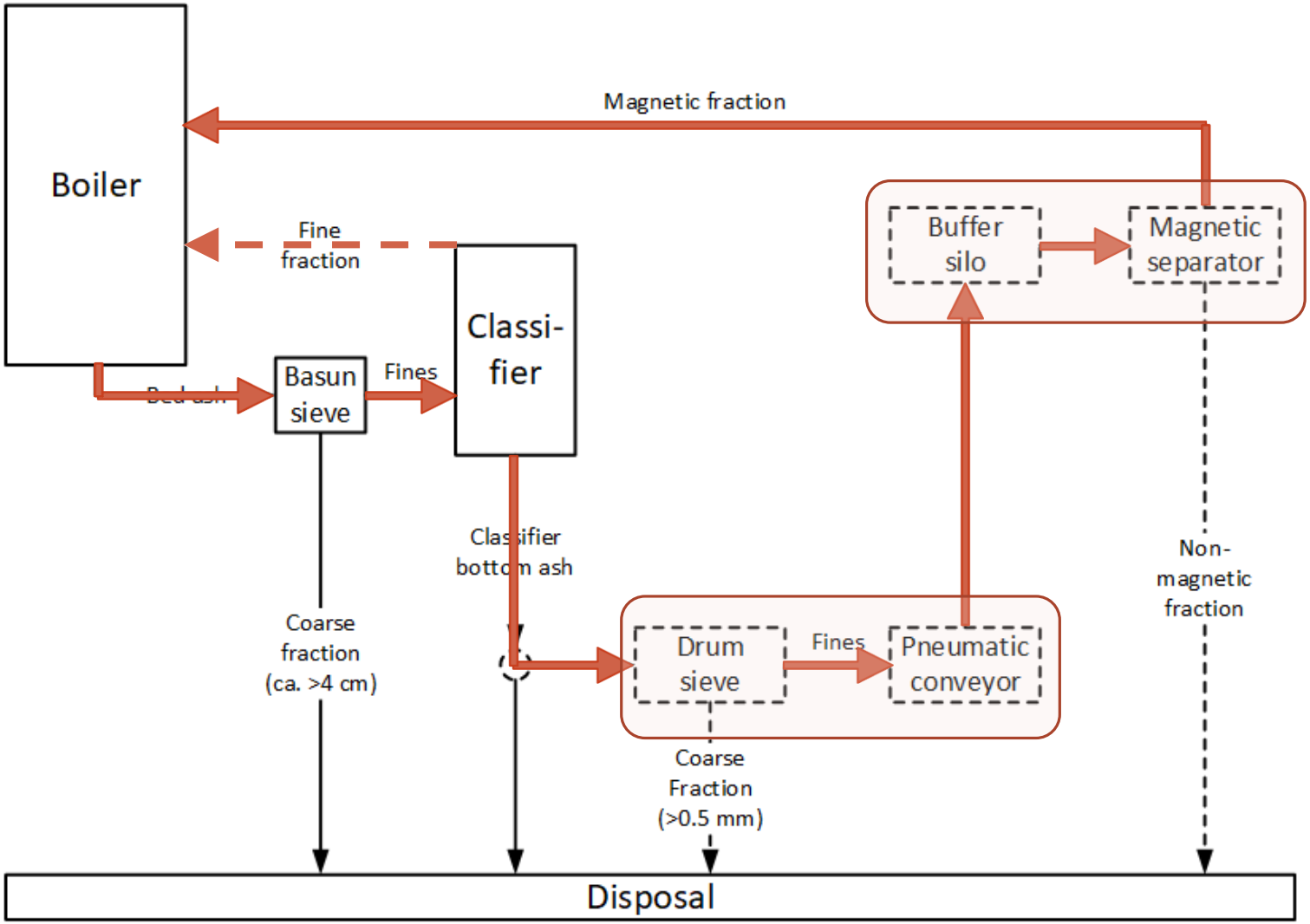
Improbed Loop™ at Händelö P14



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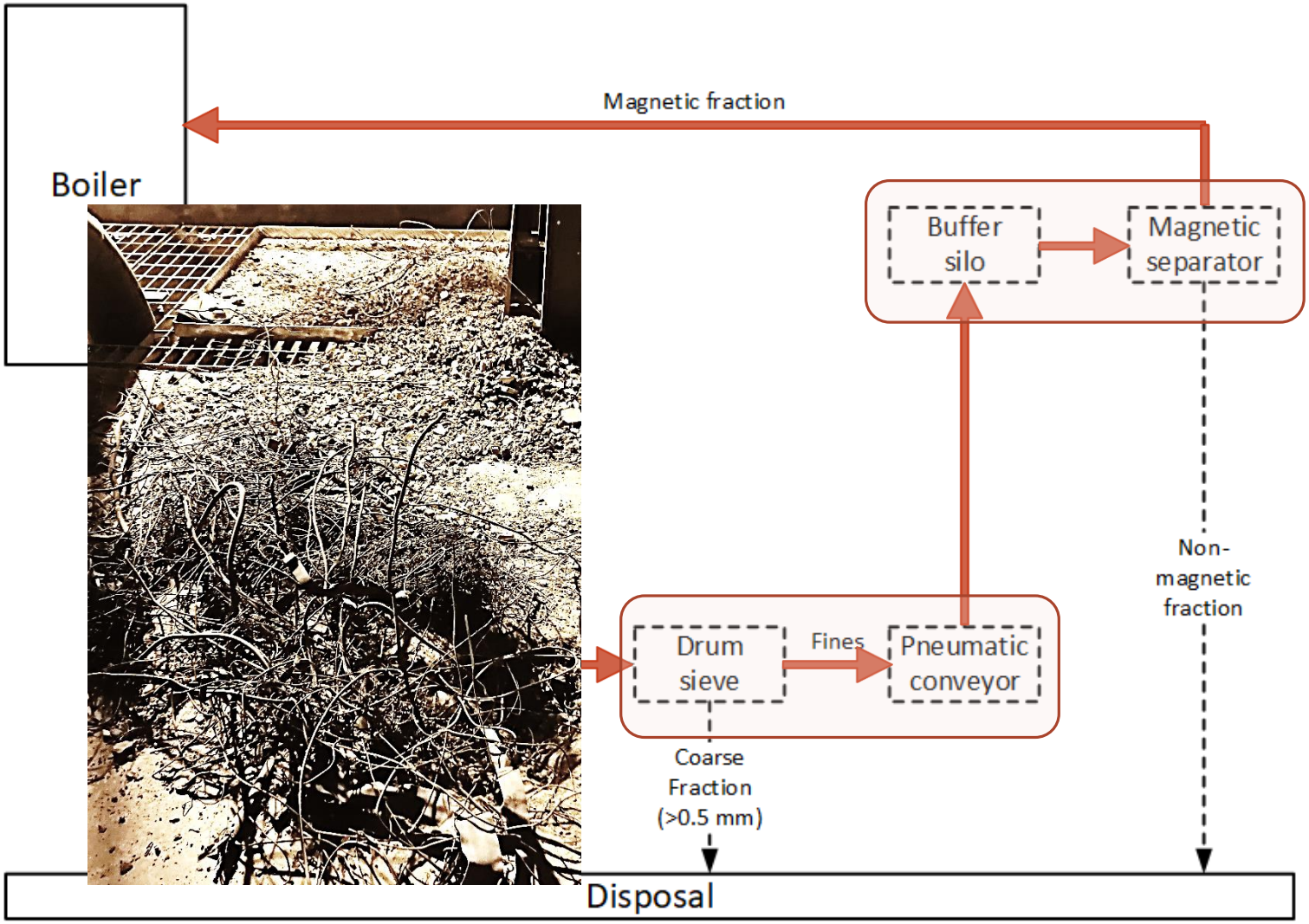
Improbed Loop™ at Händelö P14



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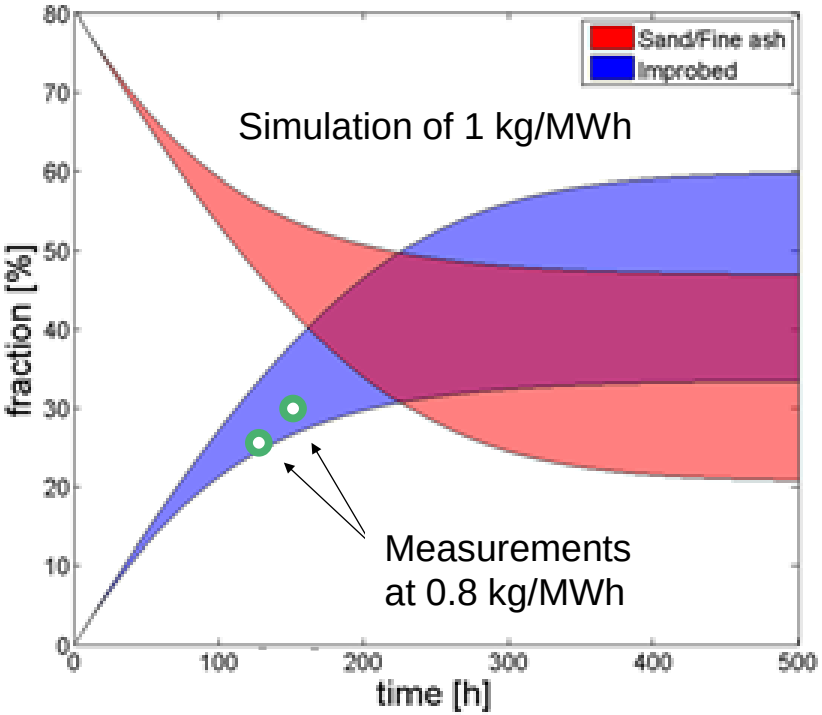
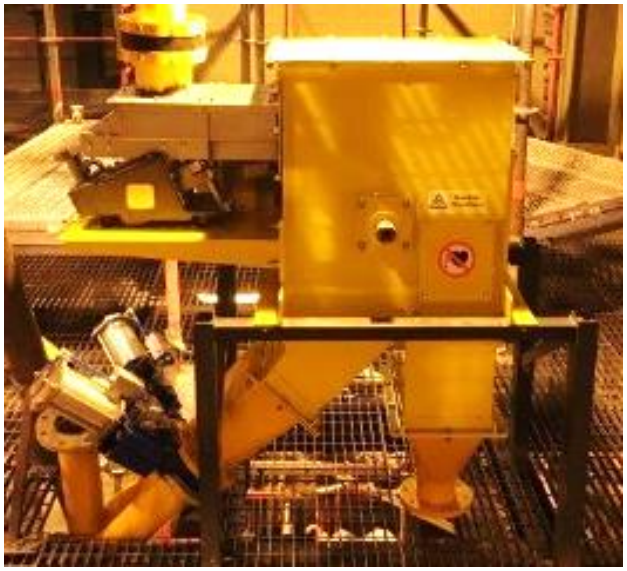
Increased Improbed™ concentration and reduced make-up feed at Händelö P14

- Stable operations at 0.8 kg/MWh Improbed™ turnover, i.e. 90% reduction
- Further optimization tests planned for 2019



Magnet



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Experiences from Händelö P14 and P15

Experiences

- With waste fuel the high amount of bed-like fuel ash dilutes the Improbed™ material in the boiler
- Higher feeding of Improbed™ gives higher effect

Conclusion

- Magnetic separation and recirculation of Improbed™ are of special importance for waste-fired (W2E) boilers

Anticipated effects

- Increased concentration of Improbed™ in the boiler
- Increased oxygen transfer (=combustion performance)
- Decreased make-up feed of fresh bed material
- Reduced amount of ashes
- Improved process profitability

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Experience from the Örtofta plant

Örtofta, 115 MW, biomass/waste wood
(3-weeks test)

- Increase of boiler load by 7%, from 115 MW to 123 MW
- Reduction of bed material turnover, from 8 to 2 tons per day
- Low ash content => good effect without magnetic separation

- Similar good effects from Eskilstuna 60 MW CFB (biomass) and Örebro 170 MW CFB (biomass)

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Summary

Proven Values

- Increased boiler efficiency and capacity
- No risk for agglomeration and sintering
- Increased bed material efficiency

Expected Value

- Reduced maintenance costs

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Contact Information

Lars Bierlein
Carl Gustafs väg 4
205 09 Malmö

+46 (0) 705 750 725
lars.bierlein@improbed.com

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