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Flex Flores Webinar
09th December 2020



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MANAGE NATURAL
RESOURCES AND
ENERGY

Flexible CFB Combustion of Biomass and Waste with Lignite in a 1 MW_{th} Pilot Plant - Experimental and Numerical Investigations

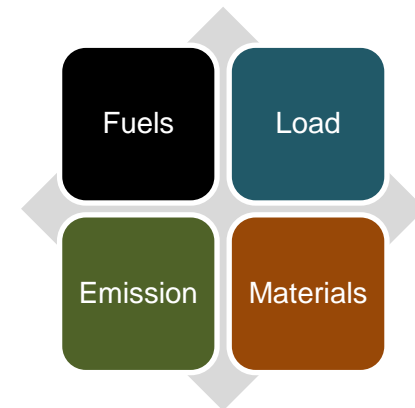


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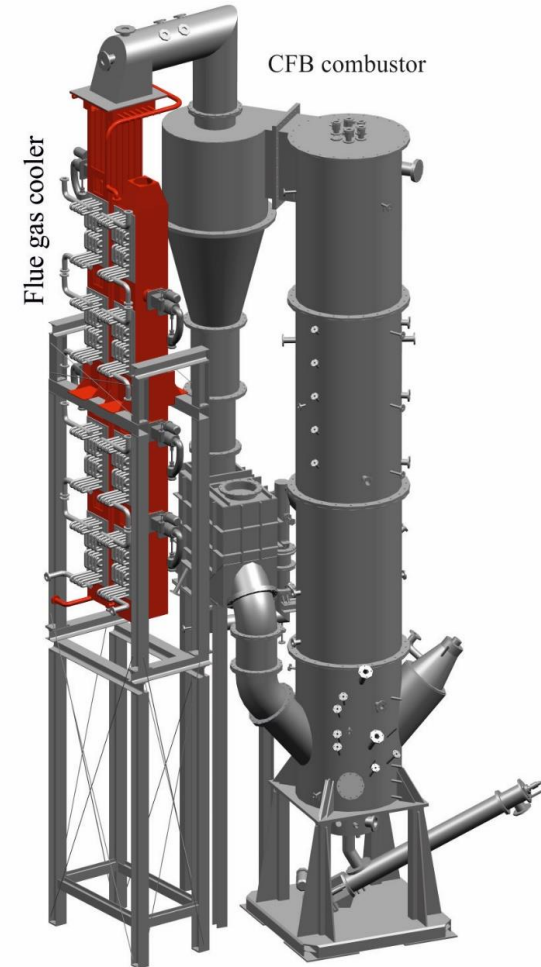
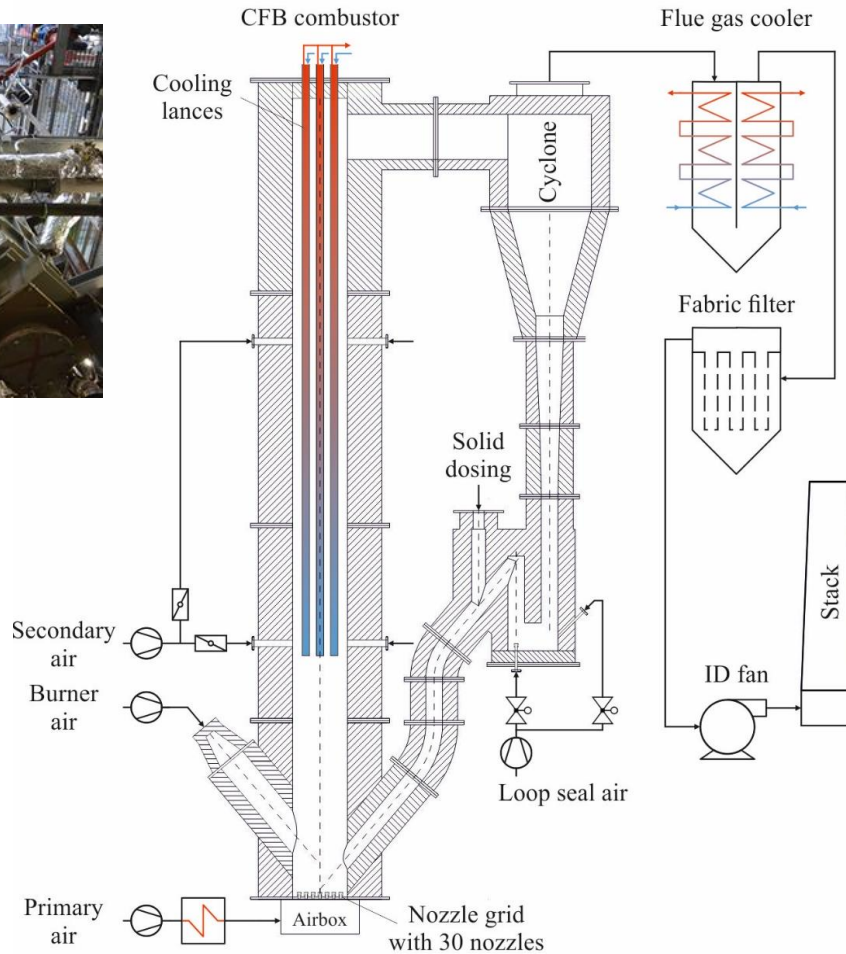
Outline



- Experimental setup
- Experiments and simulations:
 - Fuel flexibility
 - Load flexibility
 - Pollutant emission control
 - Innovative material testing



Experimental setup



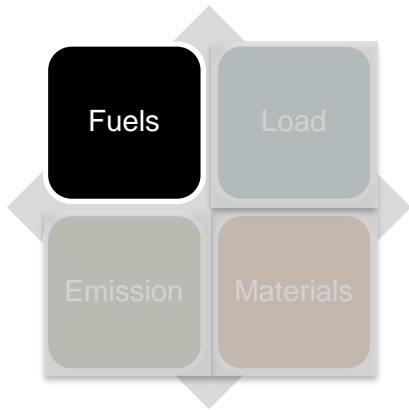
1 MW_{th} CFB

d_i 600 mm

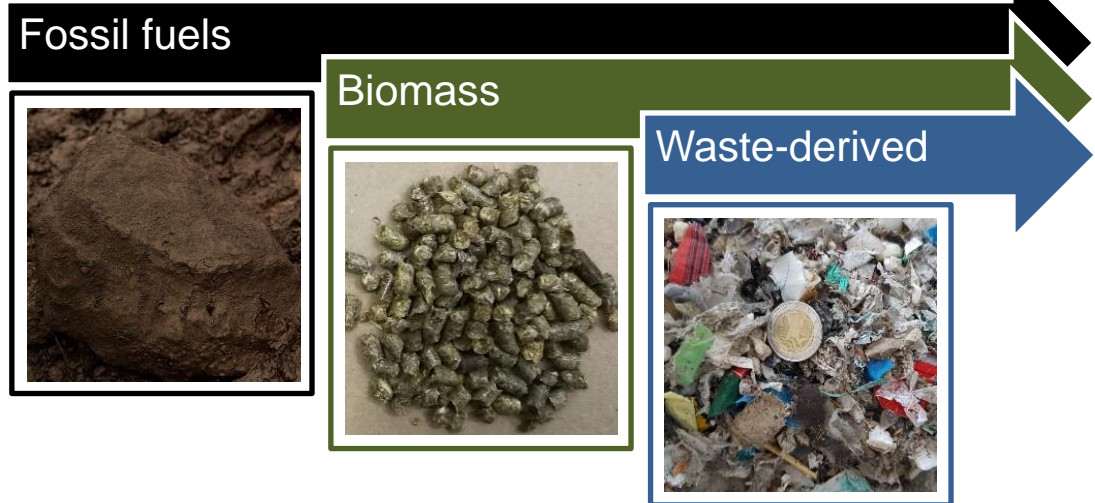
d_o 1300 mm

h 8.66 m

Fuel flexibility



Increasing share of alternative fuels

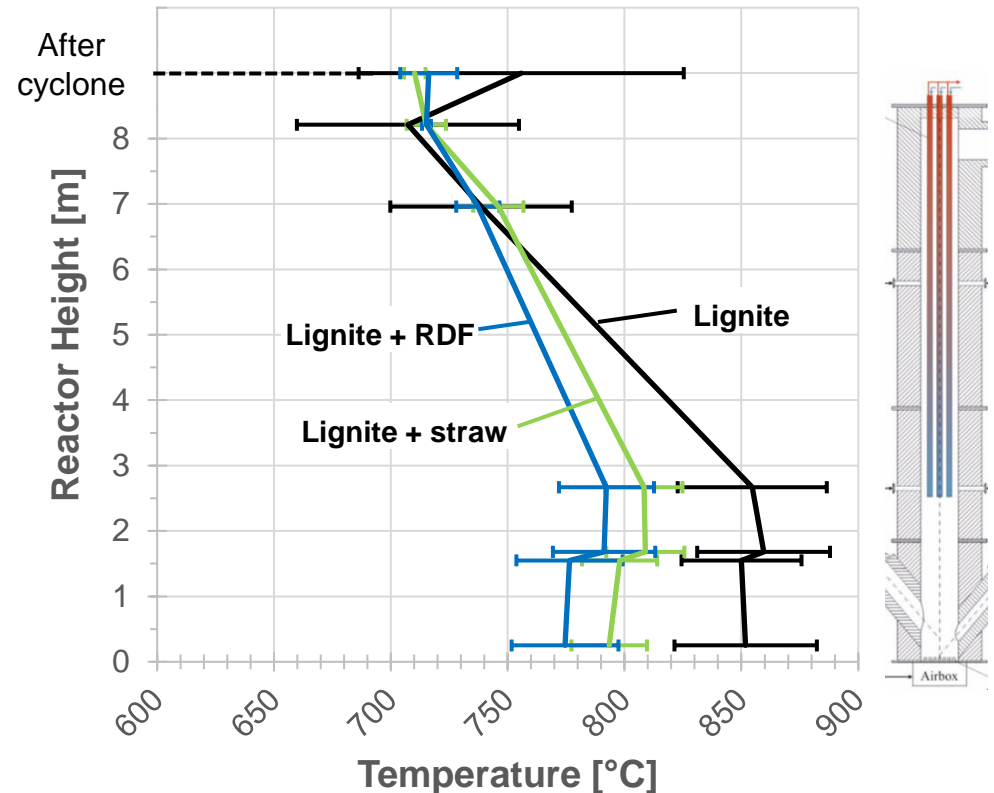


- Two test campaigns, 30 days of operation
- 6 low-rank fuel mixtures with varying share of co-fuel:
 - 3x lignite (German, Greek, Polish)
 - 2x lignite + straw pellets (7-23% straw)
 - 1x lignite + RDF (16-28% RDF)

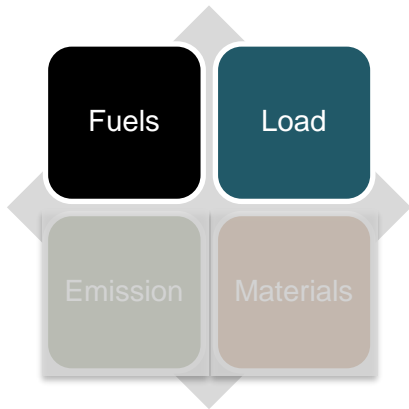
Fuel flexibility

3 basic principles for stable operation with different fuels:

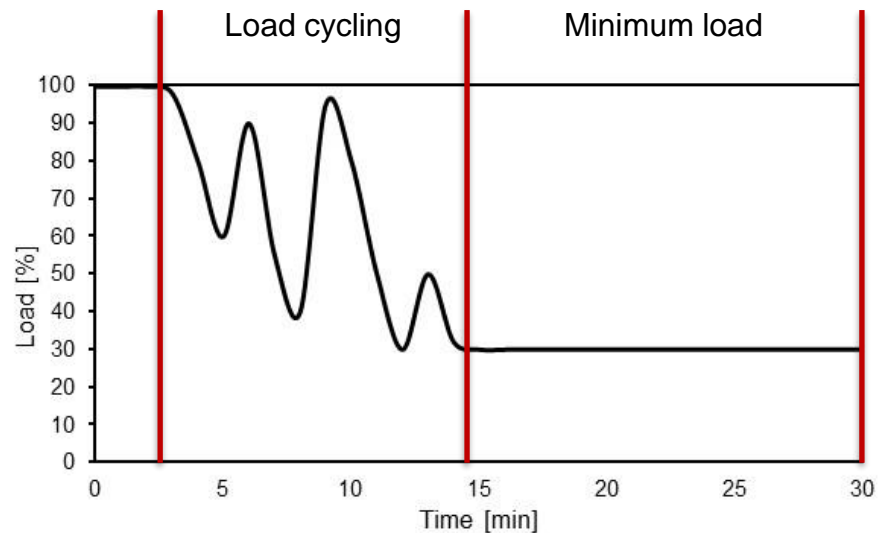
1. Sufficient hot-loop circulation/ entrainment for temperature control and heat transfer
2. Control of the bed temperature to prevent agglomerates
3. Keep the particles fluidized



Load flexibility



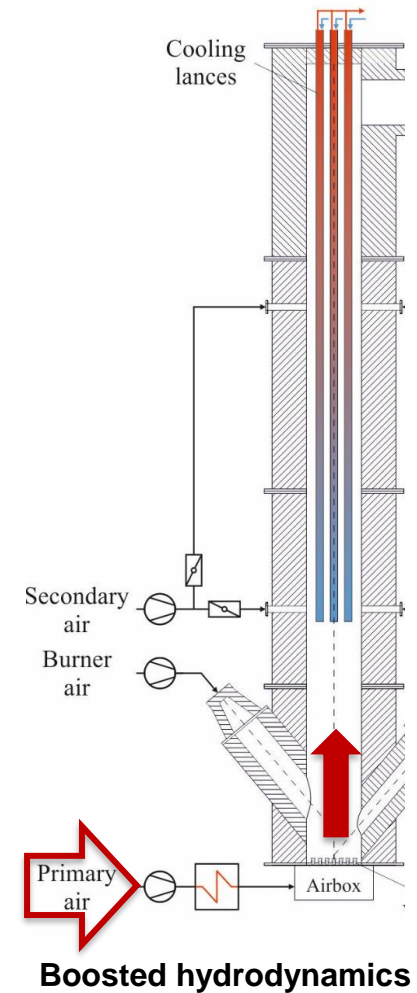
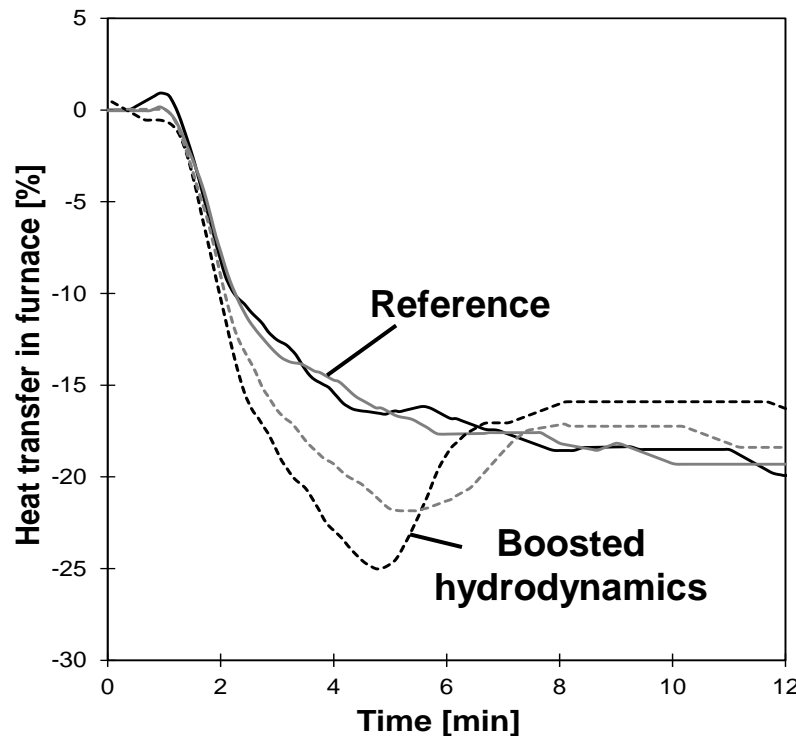
Extending the operating range of CFBC



- 23 load changes with four fuel mixtures
 - Influence of operational parameters
 - Influence of co-combustion of renewable fuels
 - „Boosted hydrodynamics“ for accelerated load ramps

Load flexibility: load cycling

- Larger primary air steps can accelerate load ramps
 - Change of hydrodynamics → heat transfer coefficient



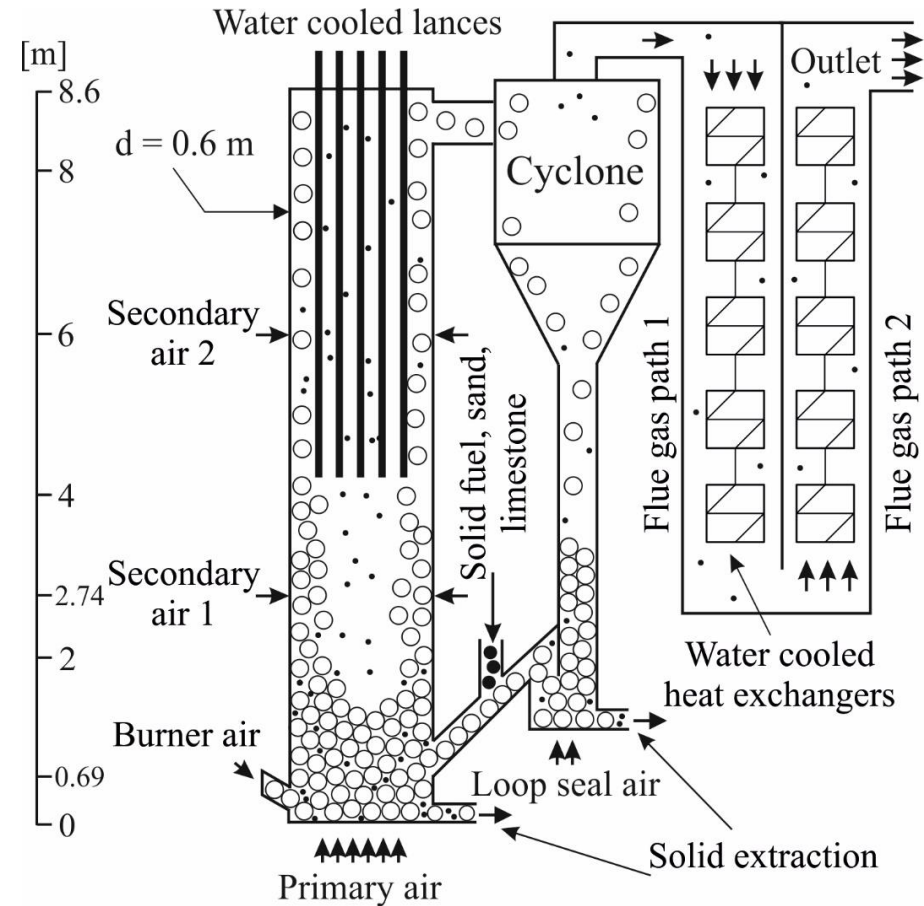
Load flexibility: Numerical investigations

Sophisticated dynamic process model of 1 MW_{th} CFB pilot plant :

- a) Circulating fluidized bed (1.5D core/annulus model)
- b) All peripheral systems (air supply, fuel supply, flue gas path, cooling system, etc.)

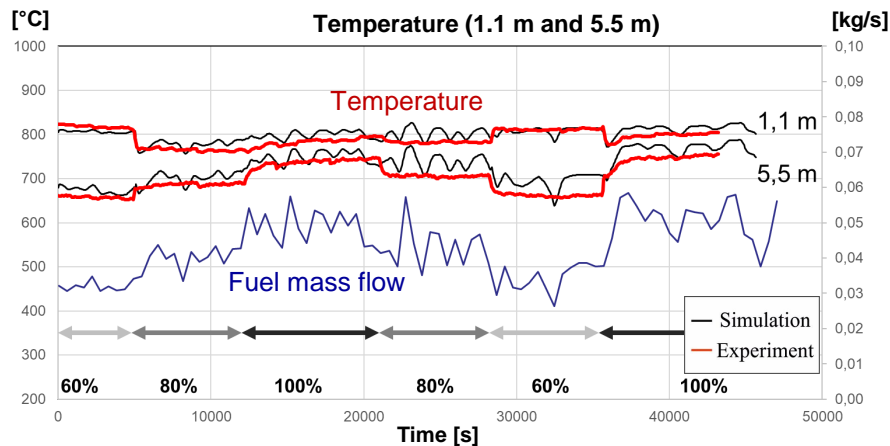
Specification data from test facility

Two papers published

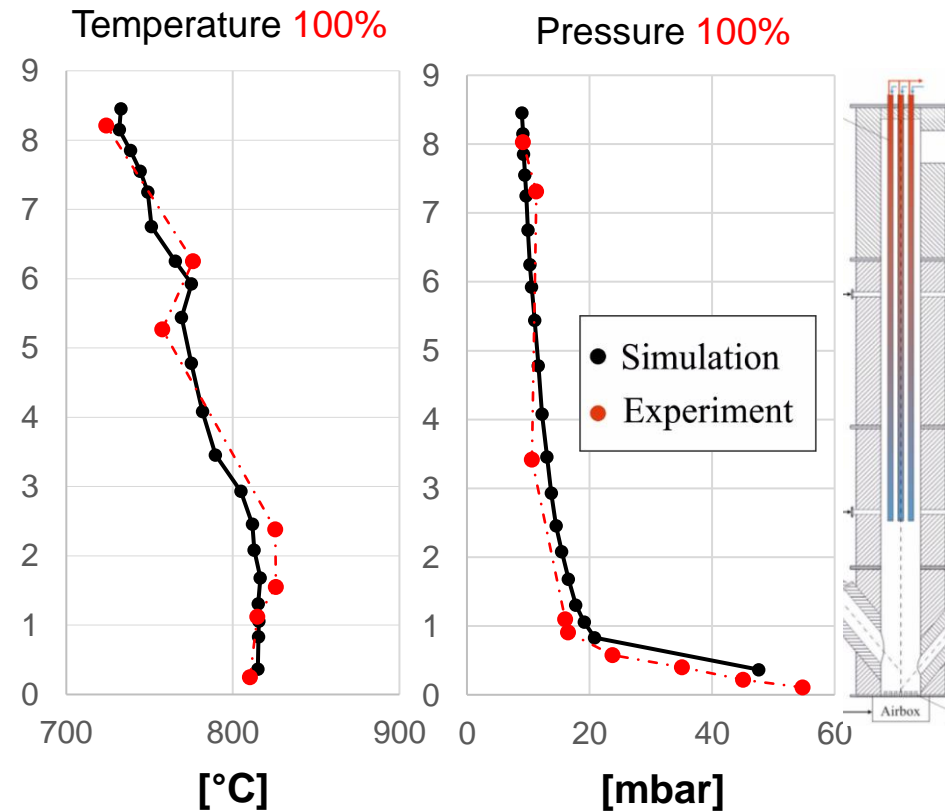


Load flexibility: Results co-combustion

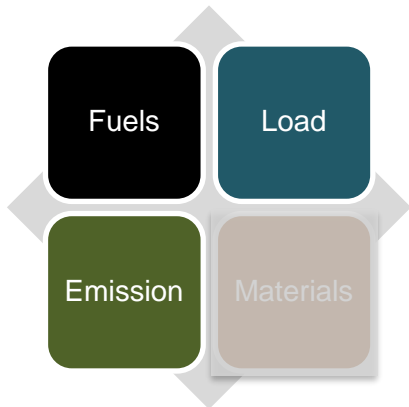
- Model parameters tuned with experimental results of one single test-point
- Validation by dynamic test series with load variations from 60% – 100% load



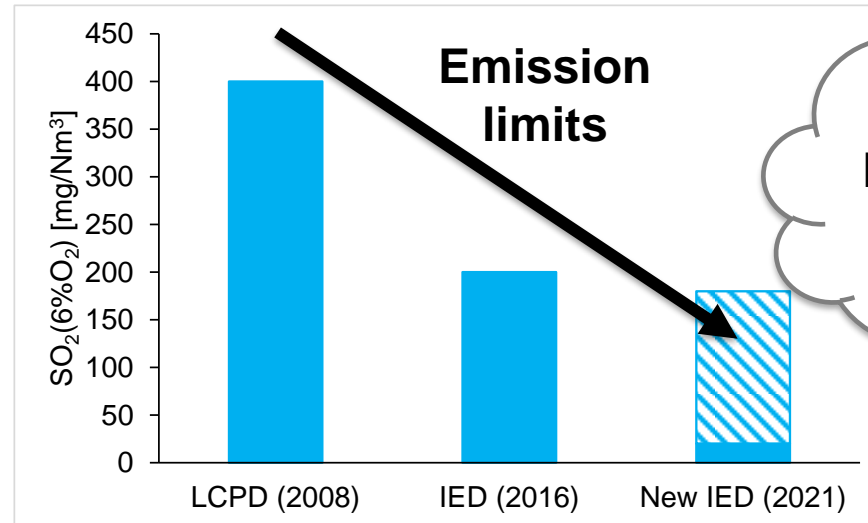
Co-combustion of lignite and straw



Pollutant emission control

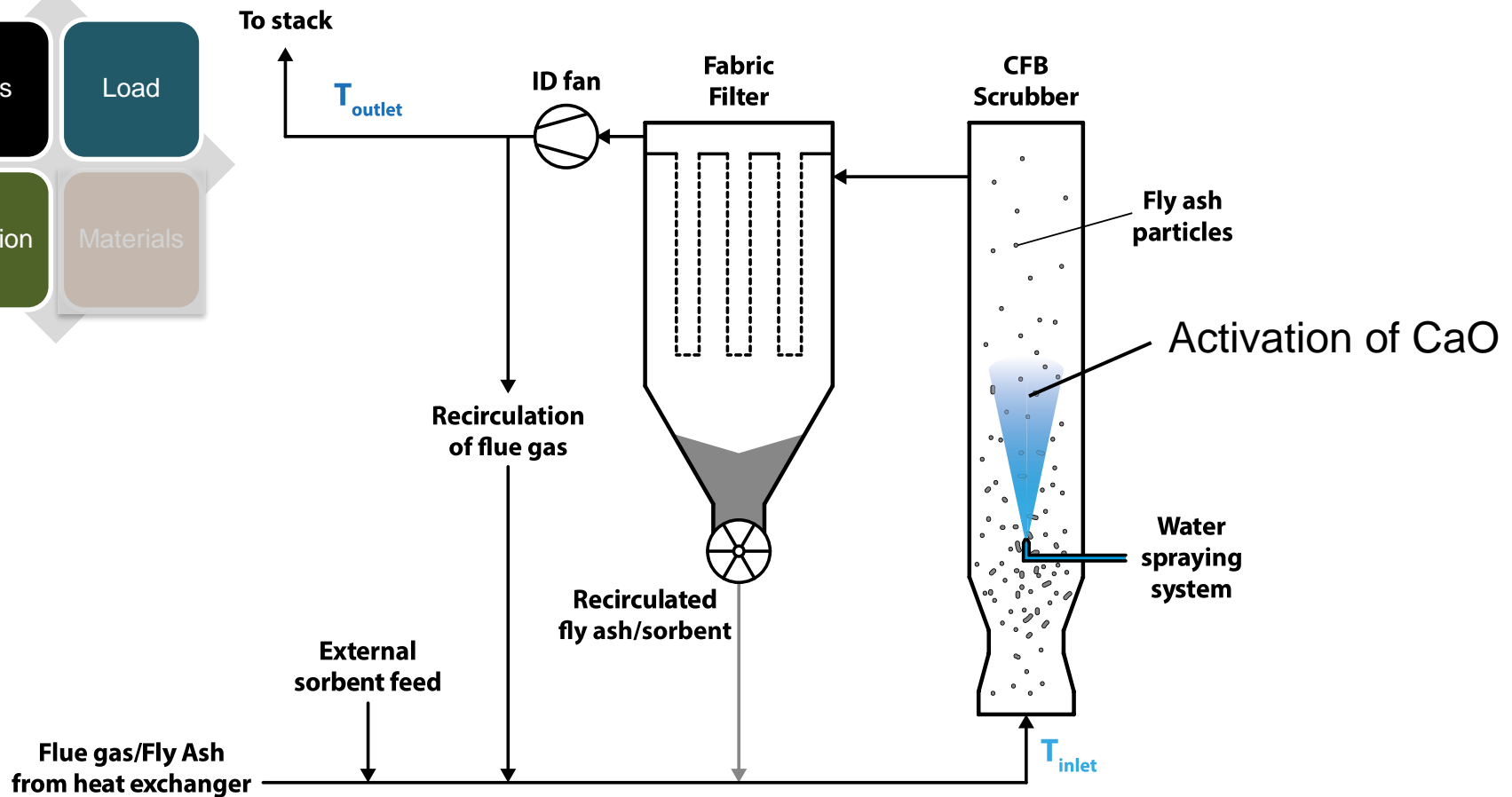
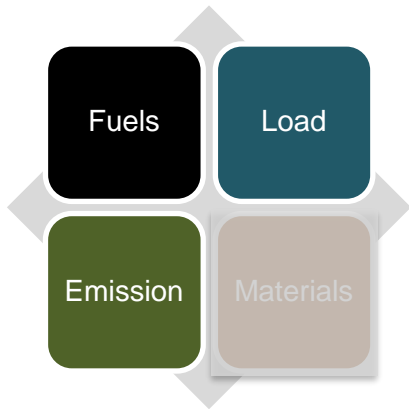


Multipollutant flue gas cleaning

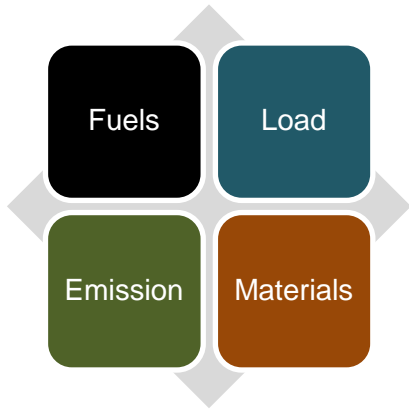


- Investigation of 1 MW_{th} multipollutant flue gas cleaning unit (downstream the furnace)
 - Influence of operating mode
 - Influence of different sorbents (Limestone, Ca(OH)₂, CaO)

Pollutant emission control



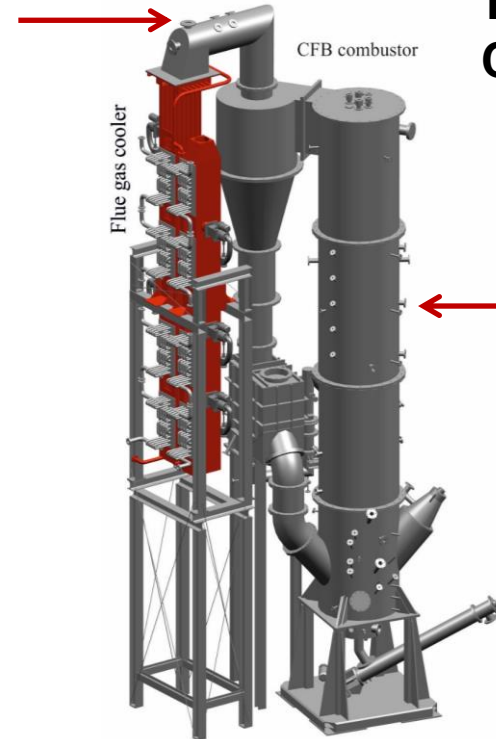
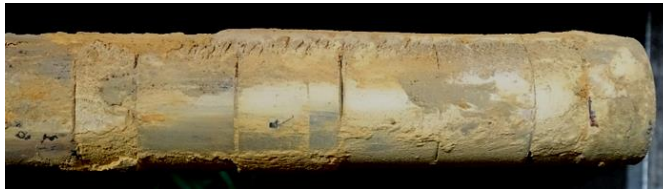
Innovative material testing



Corrosion



Fouling



Tests in 1 MW_{th}
CFB pilot plant

Refractory tests



- Testing of innovative materials for flexible operation
 - Investigation of corrosion and fouling at multifuel environment
 - Innovative, durable and sustainable refractories → **Next presentation**

Thank you for your kind attention



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