



ICEBE
IMAGINEERING
NATURE

Project OxyCar-FBC

Improving Biomass Combustion in Fluidized Beds for higher Efficiency and lower Emissions

Highlights of Bioenergy research 2020

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Zero Emission Technologies

Graz, 24.01.2020

Key figures OxyCar-FBC

- Funding scheme ERA-NET Bioenergy
- 4 partners from Sweden (2) and Austria (2)
- February 2017 – August 2020
- Total budget 1.5 Mio Euro



Two approaches for improvement



Short-Term

- Improve combustion efficiency
- Increase fuel flexibility
- Reduce maintenance



Oxygen Carrier Aided Combustion (OCAC)

Two approaches for improvement



Short-Term

- Improve combustion efficiency
- Increase fuel flexibility
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**Oxygen Carrier Aided Combustion
(OCAC)**



Mid/Long-Term

- Innovative combustion technology
- Inherent CO₂ capture
- CCU or negative CO₂



**Chemical Looping Combustion
(CLC)**

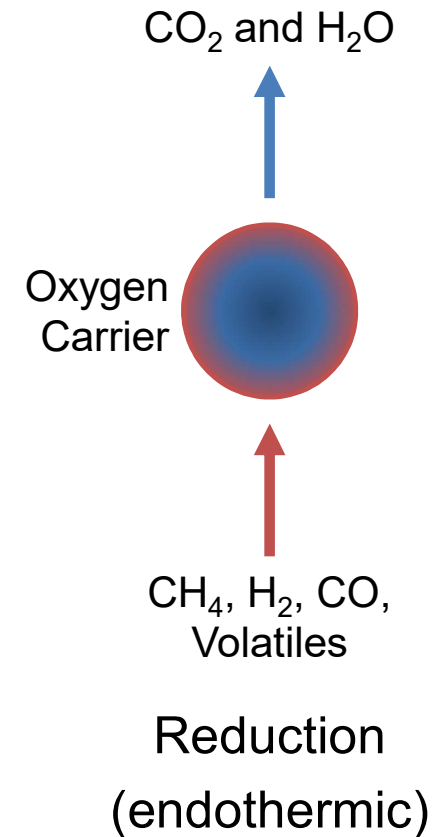
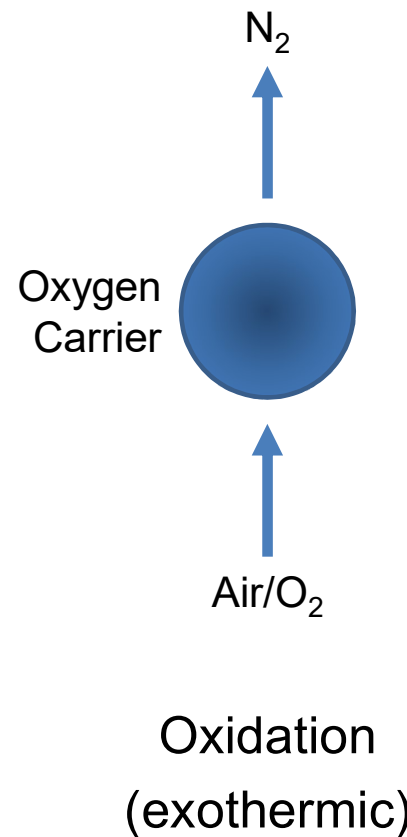
What is a fluidized bed combustor?



- Bulk of solids is fluidized
- Behaves like a liquid
- Excellent mixing
- Excellent gas solid interaction
- Excellent heat transfer
- Huge heat buffer

What is an active bed material?

- Metal oxide particles (Fe, Mn, Cu)
- Contribute to fuel oxidation
- Natural ores or waste materials
- Thermodynamically suitable
- Economically suitable



Project content and objectives

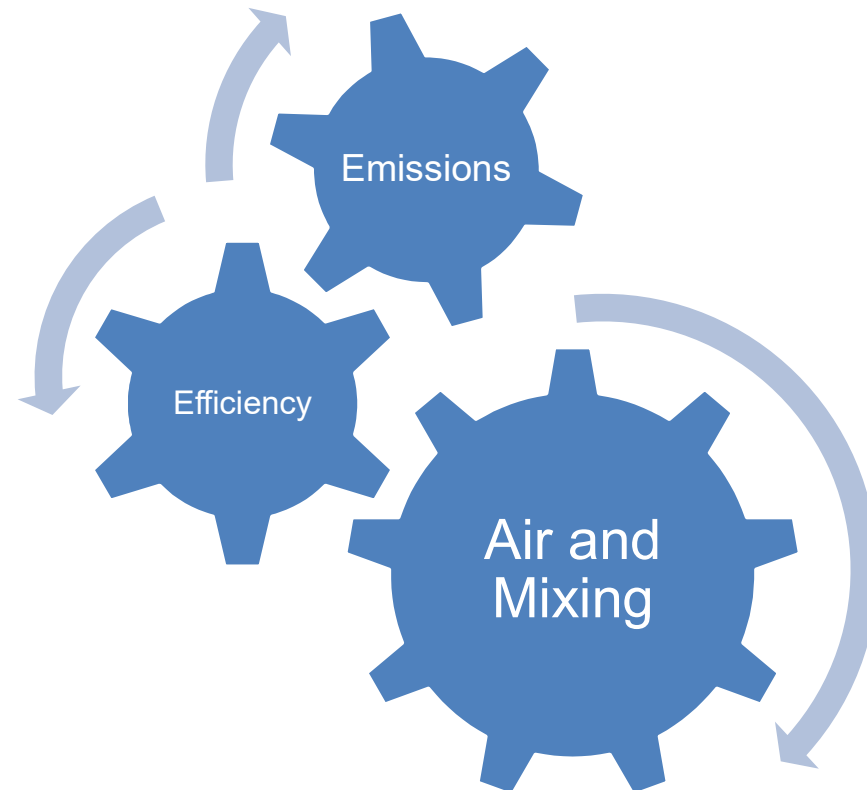
1. Identification of suitable oxygen carrier materials
2. Experimental investigation of both processes
3. Techno-economic benchmarking

Oxygen Carrier Aided Combustion*

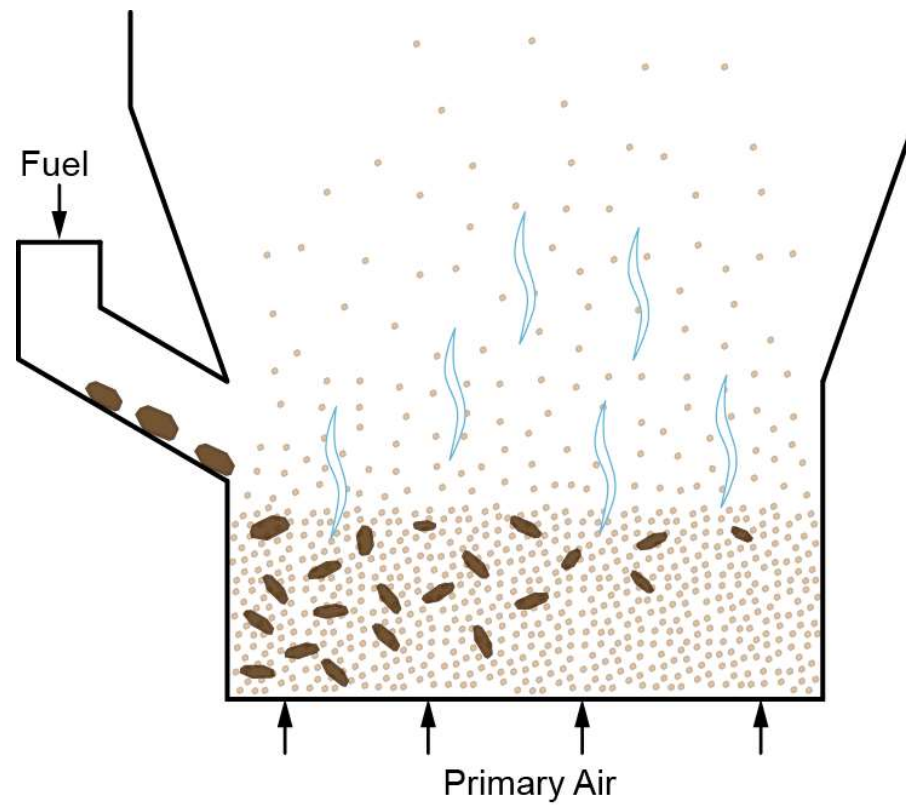
(the short term one)

The problem in fluidized bed combustion

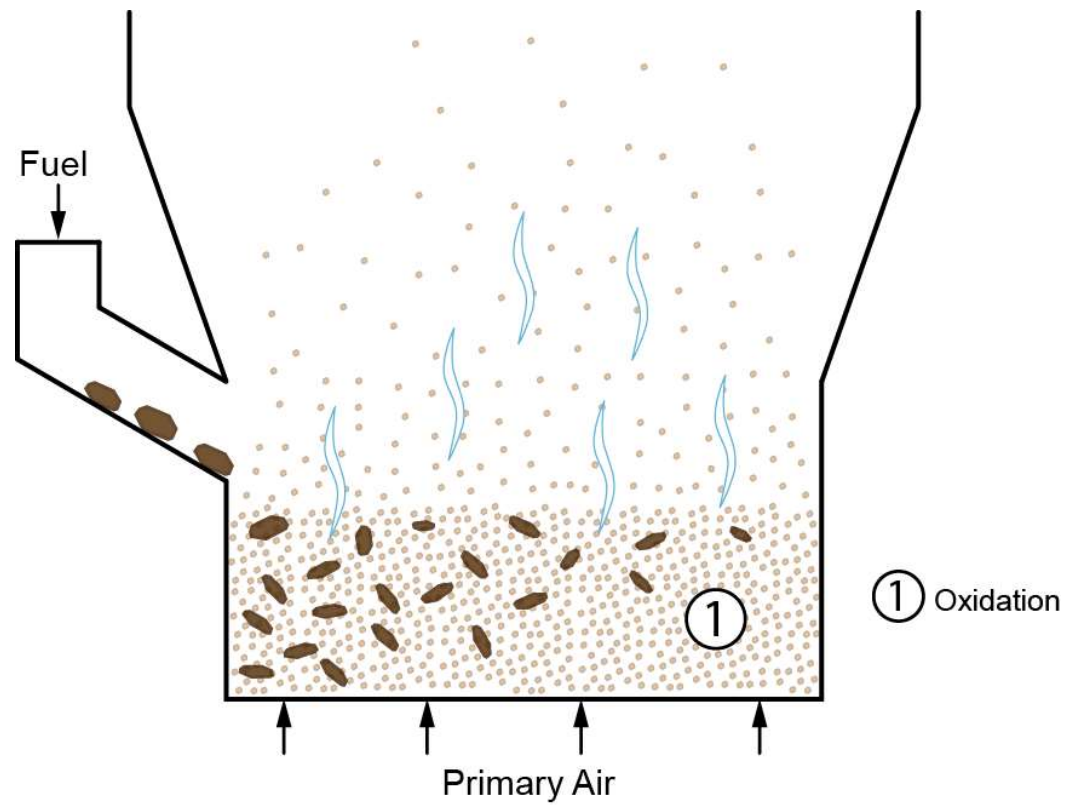
- Oxidation by combustion air
- Silica sand and ash
- Heat storage only
- Inactive bed material
- Mixing in time and space



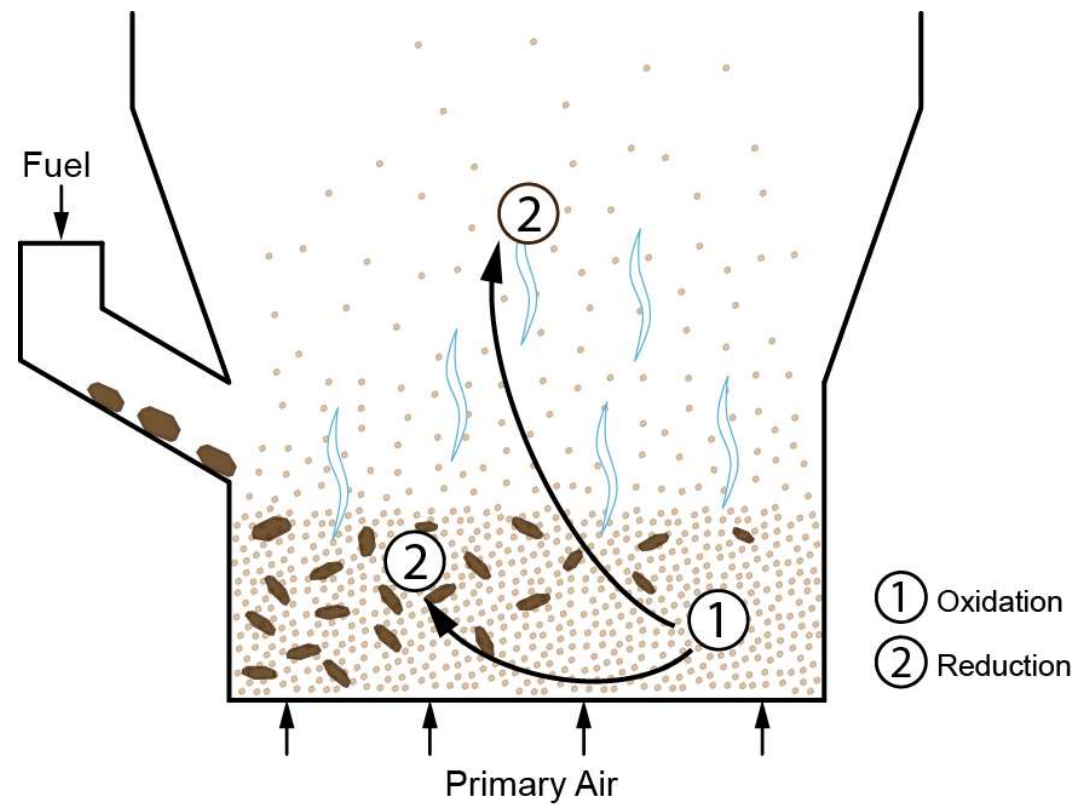
Oxygen Carrier Aided Combustion (OCAC)



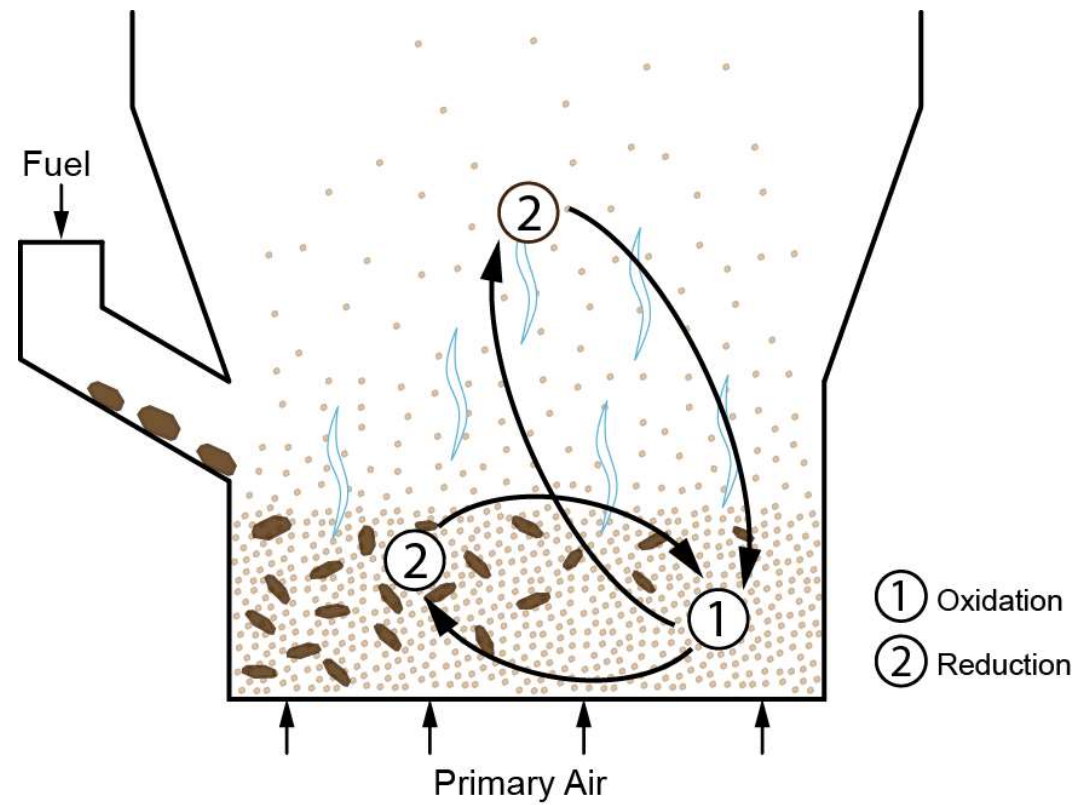
Oxygen Carrier Aided Combustion (OCAC)



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Oxygen Carrier Aided Combustion (OCAC)



Results OCAC

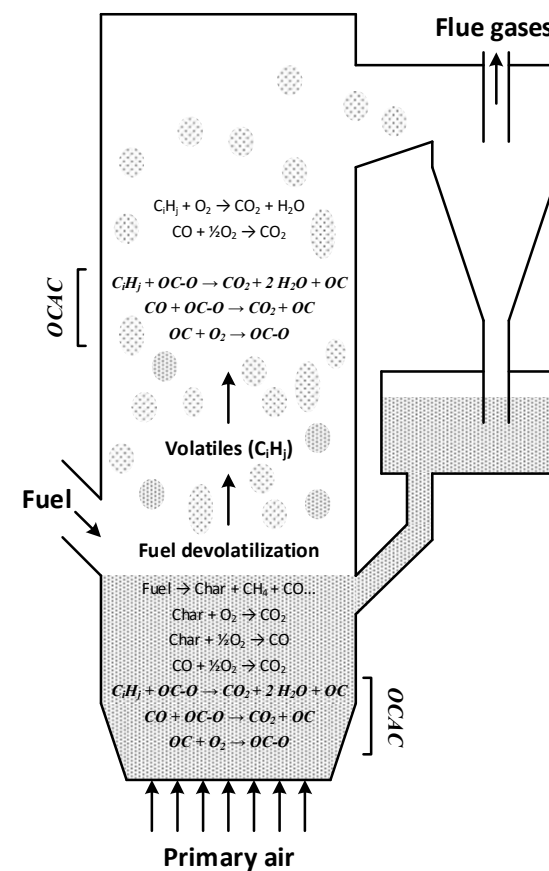
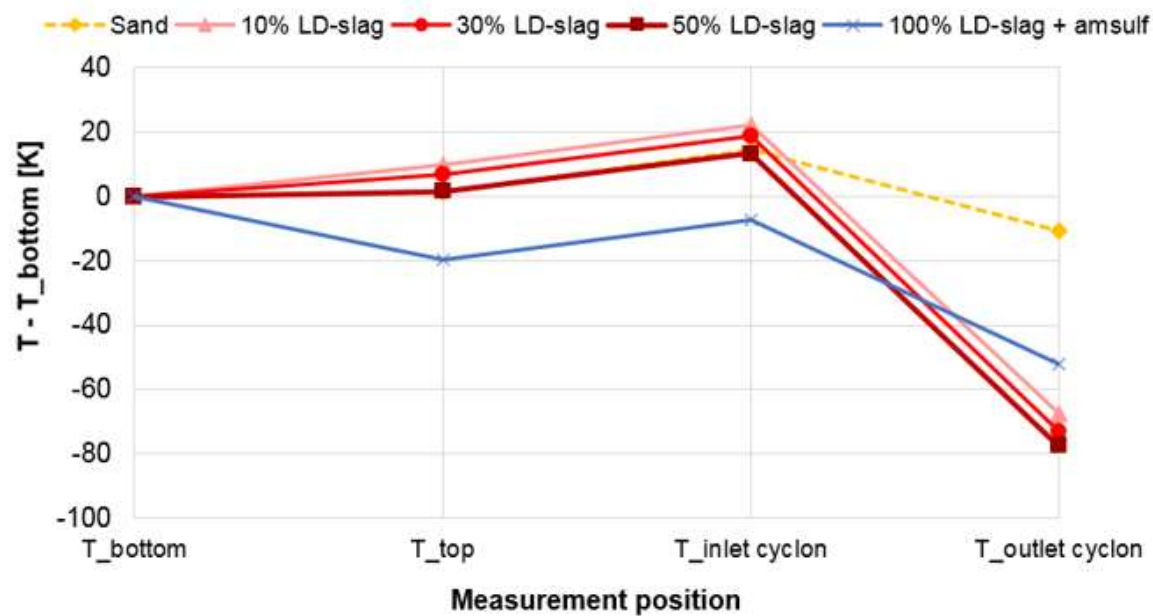


Chalmers 10MW (CFB)

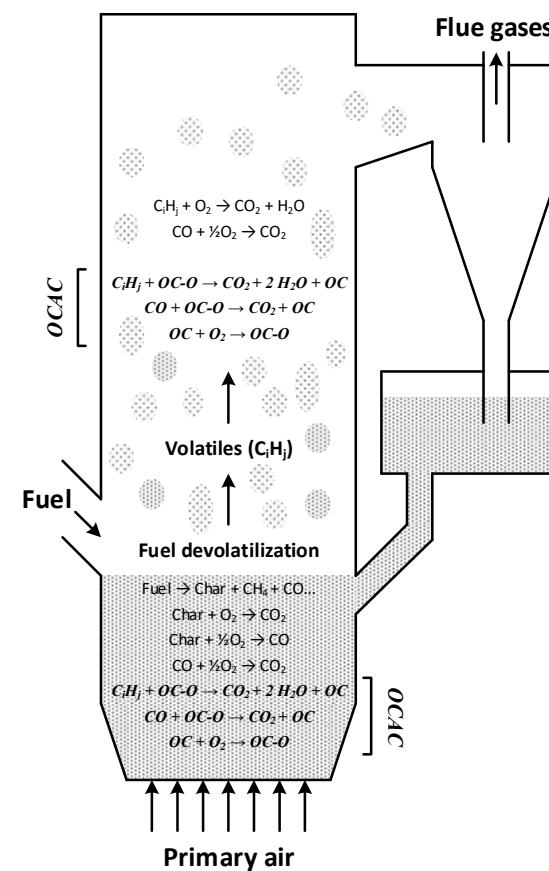
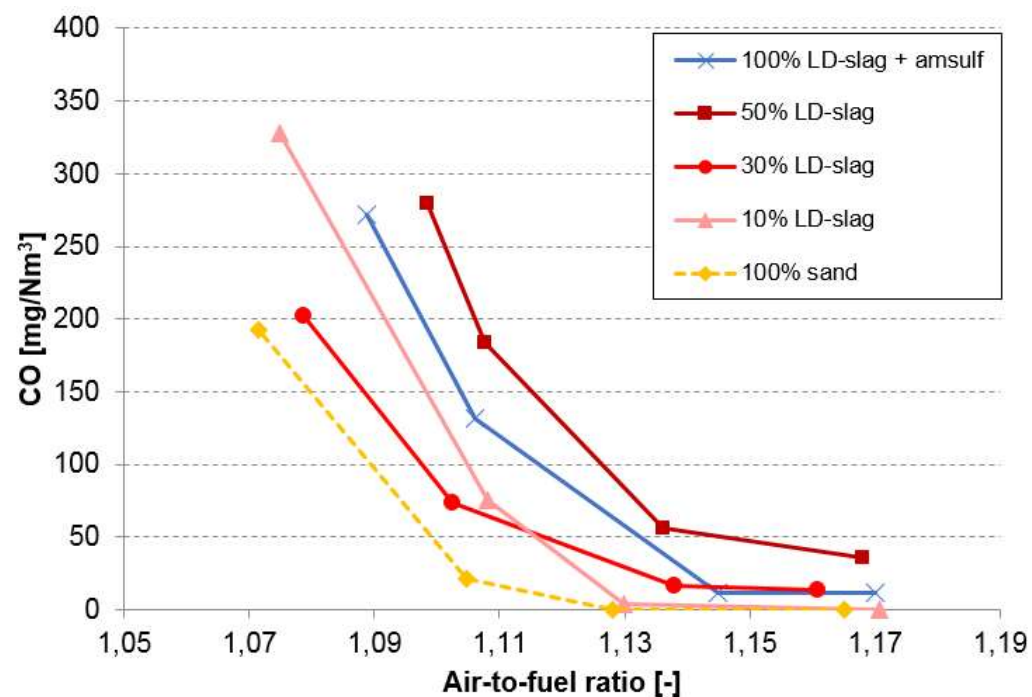


Göteborg Energi 130MW (BFB)

Results OCAC 10MW



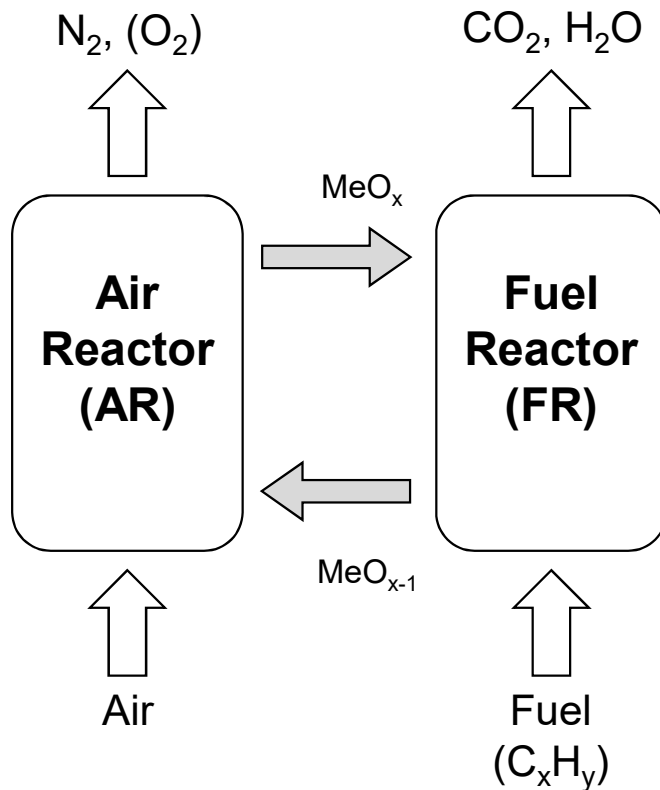
Results OCAC 10MW



Chemical Looping Combustion*

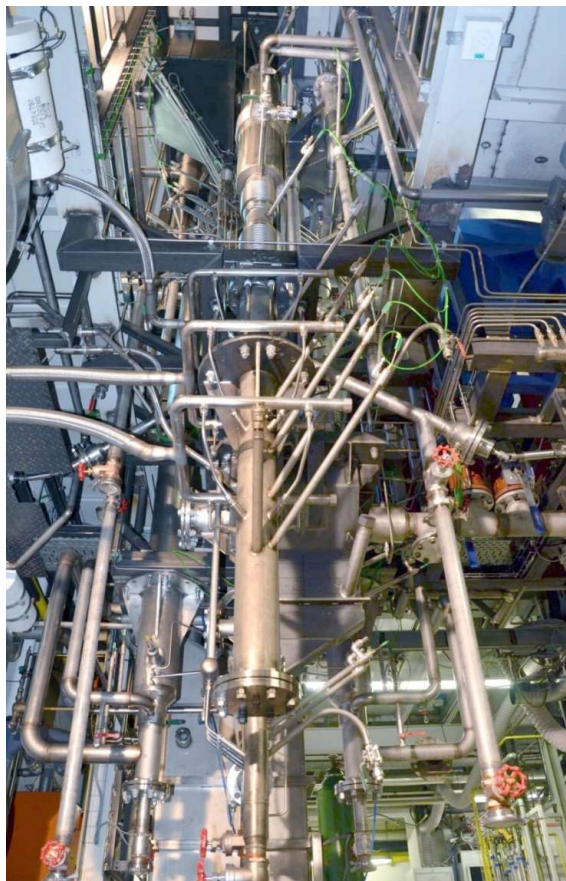
(the mid/long term one)

Chemical Looping Combustion (CLC)



- Inherent CO_2 separation
 - No mixing of air and fuel
 - Oxygen carrier transports O_2
 - Coupled fluidized beds
-
- Temperature 900-1000°C
 - Combination with steam cycle
 - Improved steam parameters
 - Low NO_x

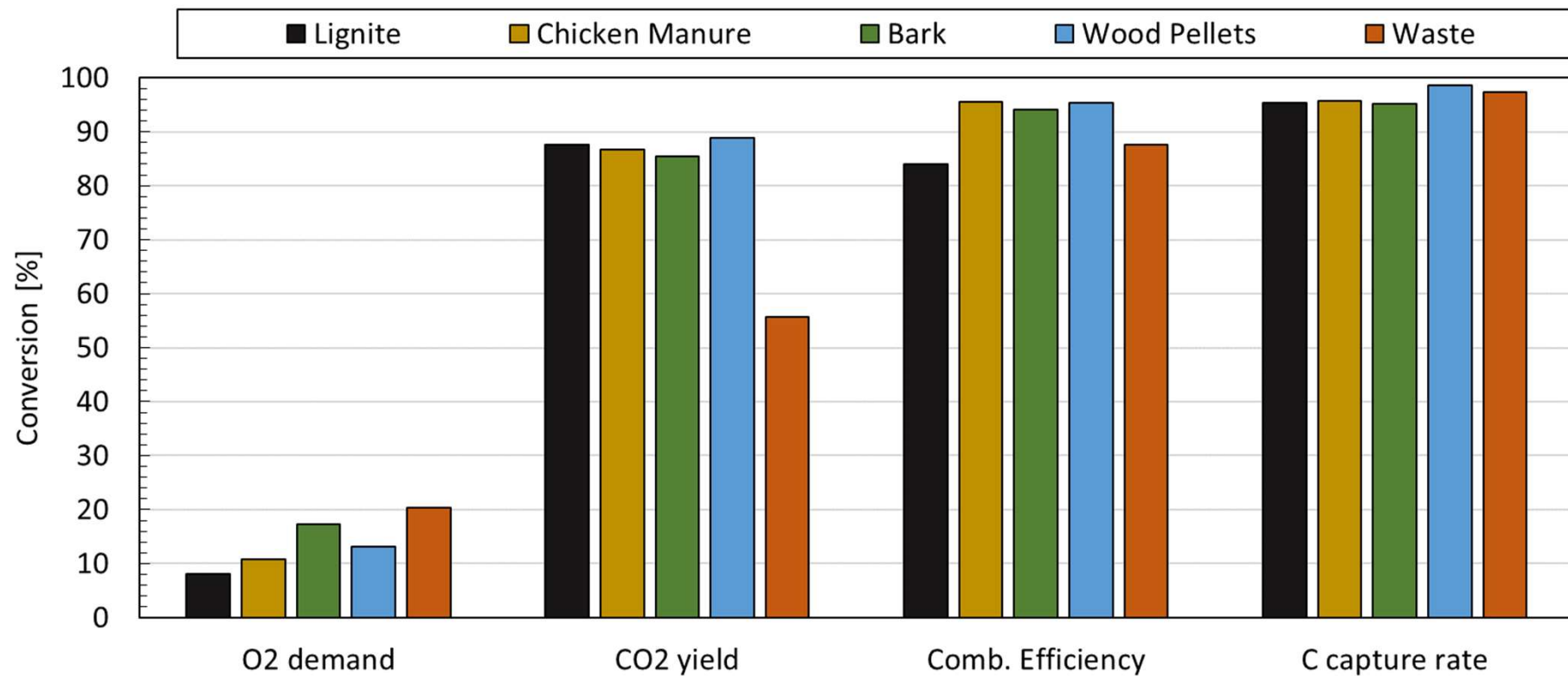
80kW CLC pilot unit



Performance parameters

Parameter	Description
Carbon capture rate	$\frac{\text{Carbon in FR exhaust}}{\text{Carbon in FR feed}}$
Oxygen demand	$\frac{\text{Oxygen demand FR exhaust}}{\text{Oxygen demand FR feed}}$
CO ₂ -yield	$\frac{\text{CO}_2 \text{ in FR exhaust}}{\text{Carbon in FR feed}}$
Combustion efficiency	$\frac{\text{Heating value in FR exhaust}}{\text{Heating value in FR feed}}$

CLC Tests at 80kW



Conclusions & Outlook

- OxyCar-FBC investigates two different ways of biomass combustion
- Work at experimental and industrial facilities
- OCAC (the short term one) results need further investigation
- CLC (the mid/long term one) experiments were very successful

➤ **Demonstration, Demonstration, Demonstration!**