Project OxyCar-FBC

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

Highlights of Bioenergy research 2020
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Key figures OxyCar-FBC

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

Two approaches for improvement

Short-Term

- Improve combustion efficieny
- Increase fuel flexibility
- Reduce maintainance

Oxygen Carrier Aided Combustion (OCAC)

Mid/Long-Term

- Inherent CO_2 capture
- CCU or negative CO_2
- Improved steam parameters

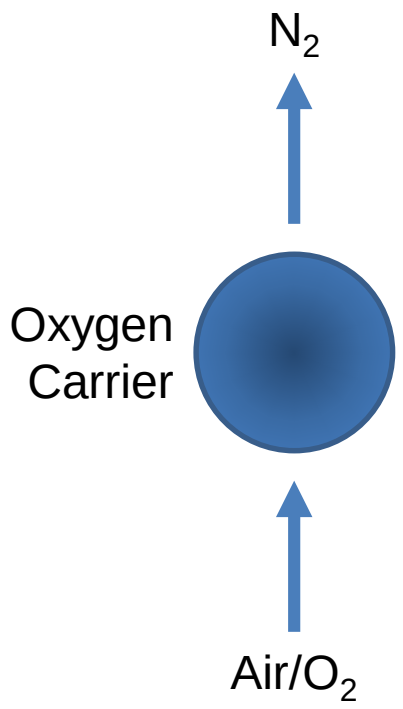
Chemical Looping Combustion (CLC)

What is a fluidized bed combustors?

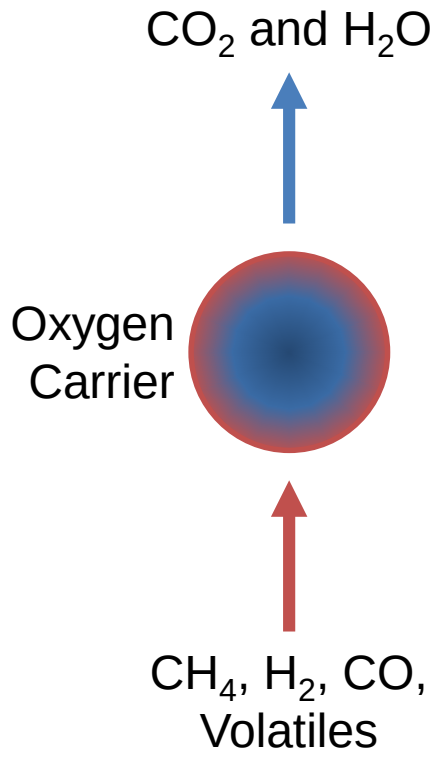
- Bulk of solids is fluidized
- Behaves like a liquid
- Excellent mixing
- Excellent gas solid interaction
- Excellent heat transfer
- Huge heat buffer

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



Oxidation (exothermic)



Reduction (endothermic)

Project content and objectives

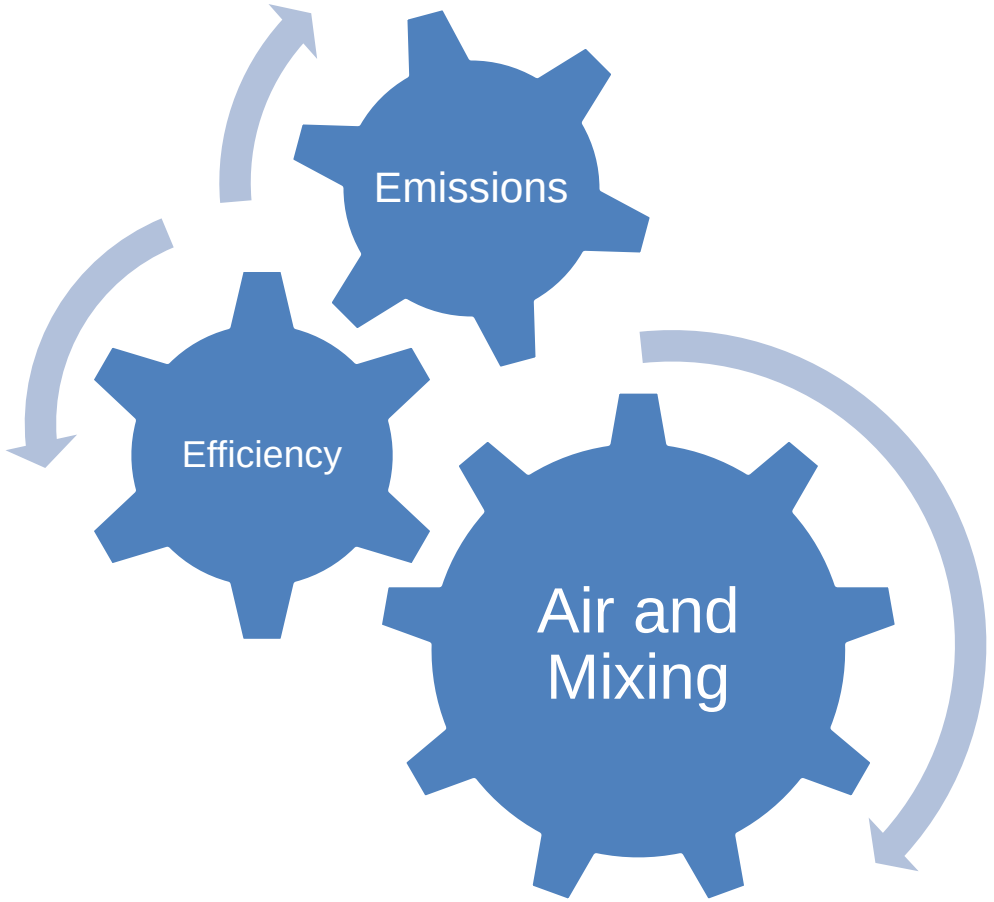
1. Identification of suitable oxygen carrier materials
2. Experimental investigation of both processes
3. Techno-economic benchmarking

Oxygen Carrier Aided Combustion*

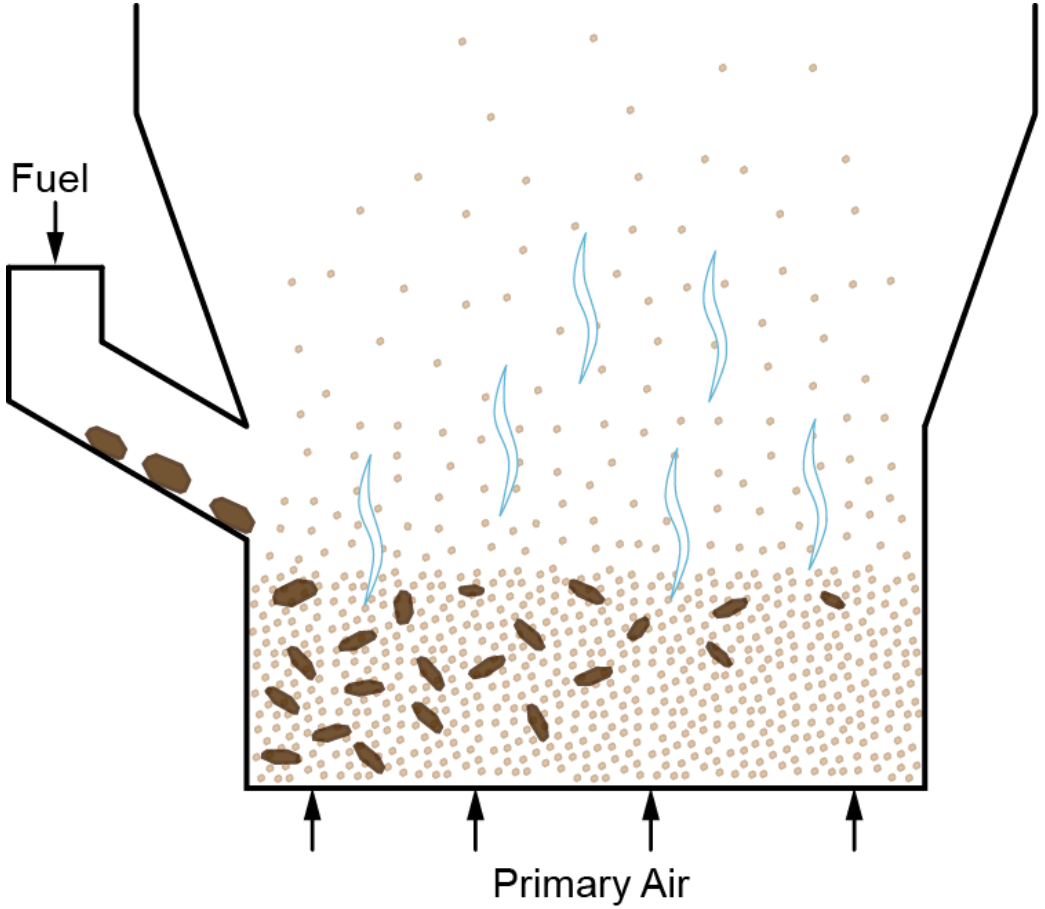
(the short term one)

The problem in fluidized bed combustion

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



Oxygen Carrier Aided Combustion (OCAC)



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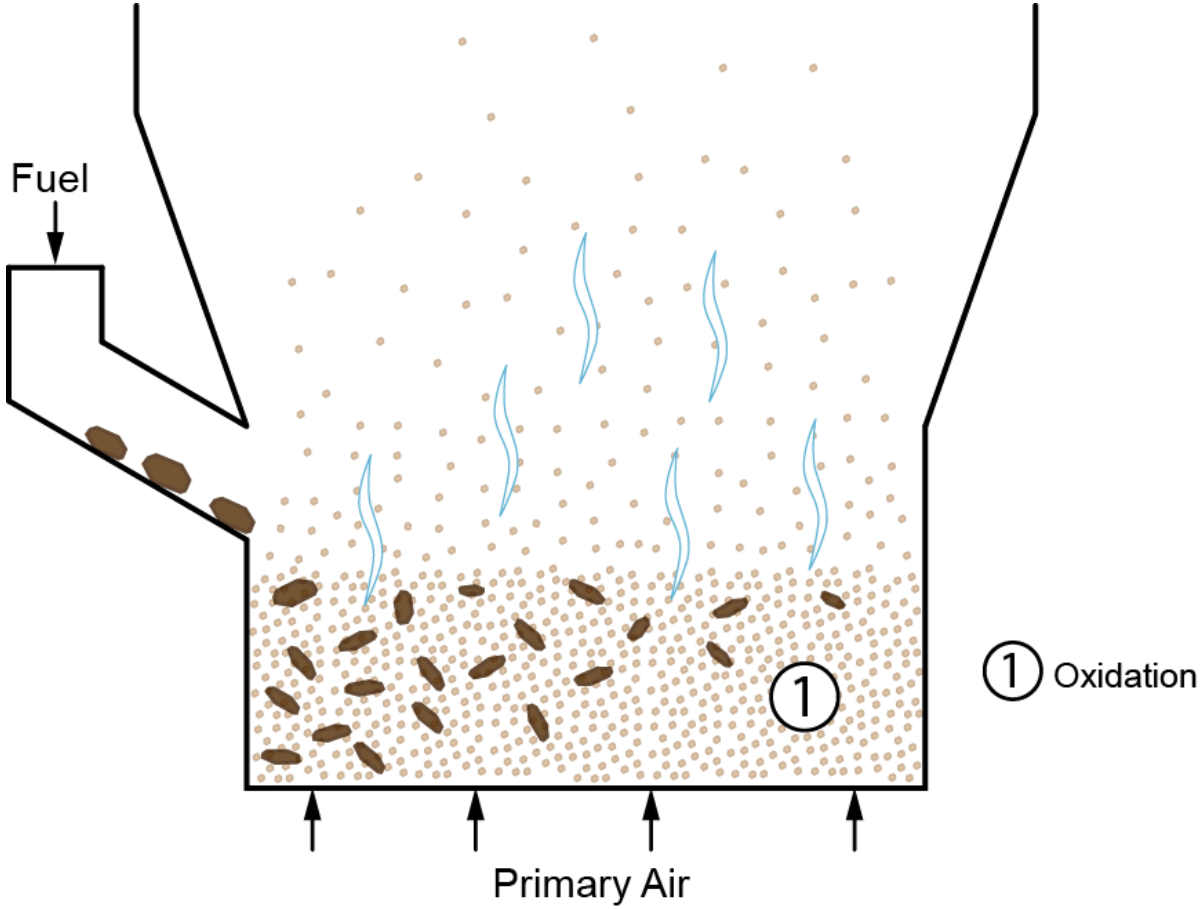

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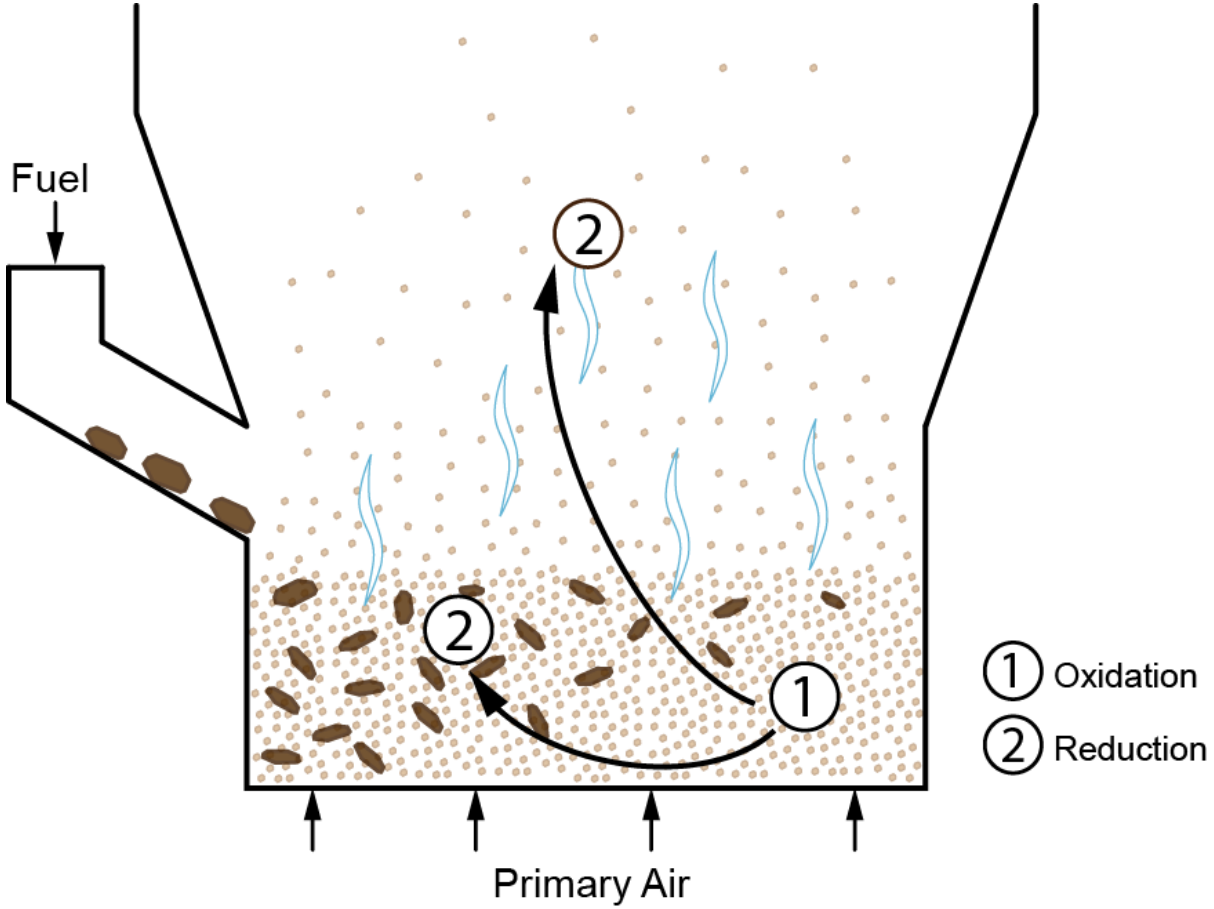

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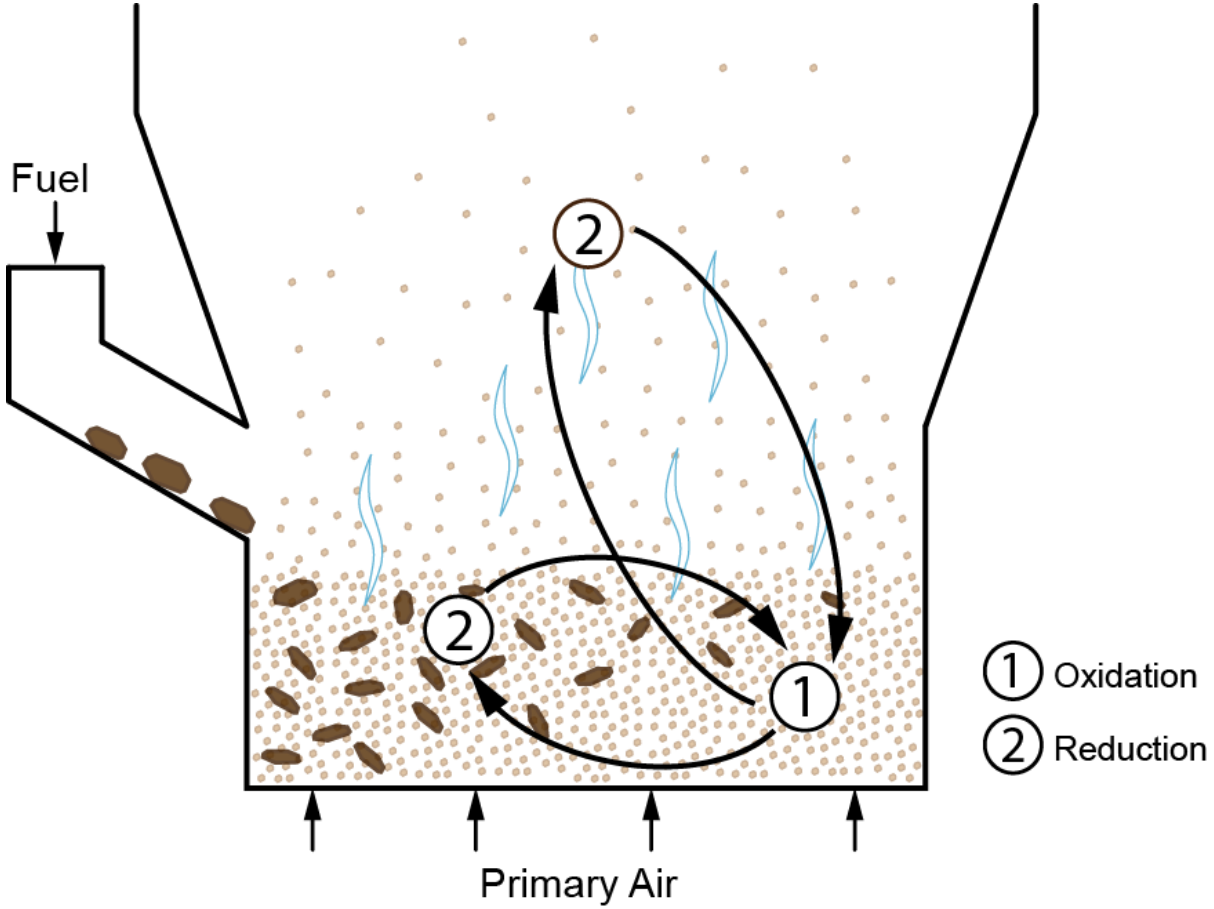
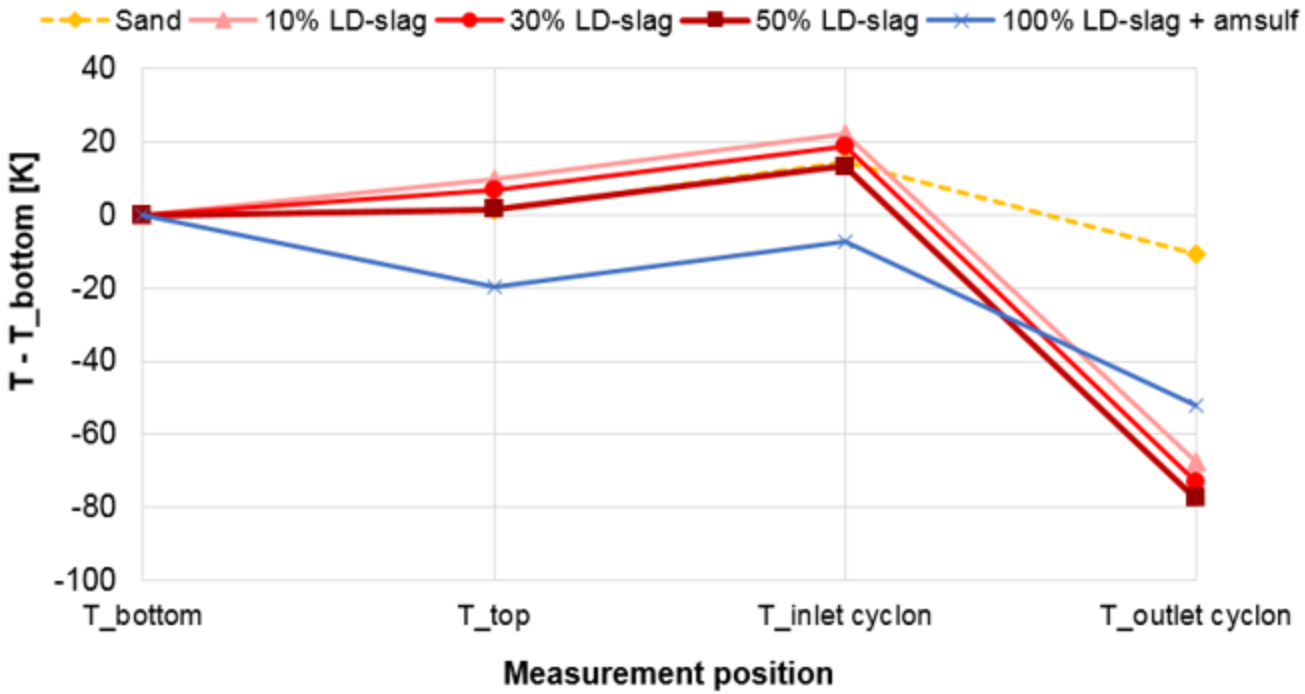


Results OCAC

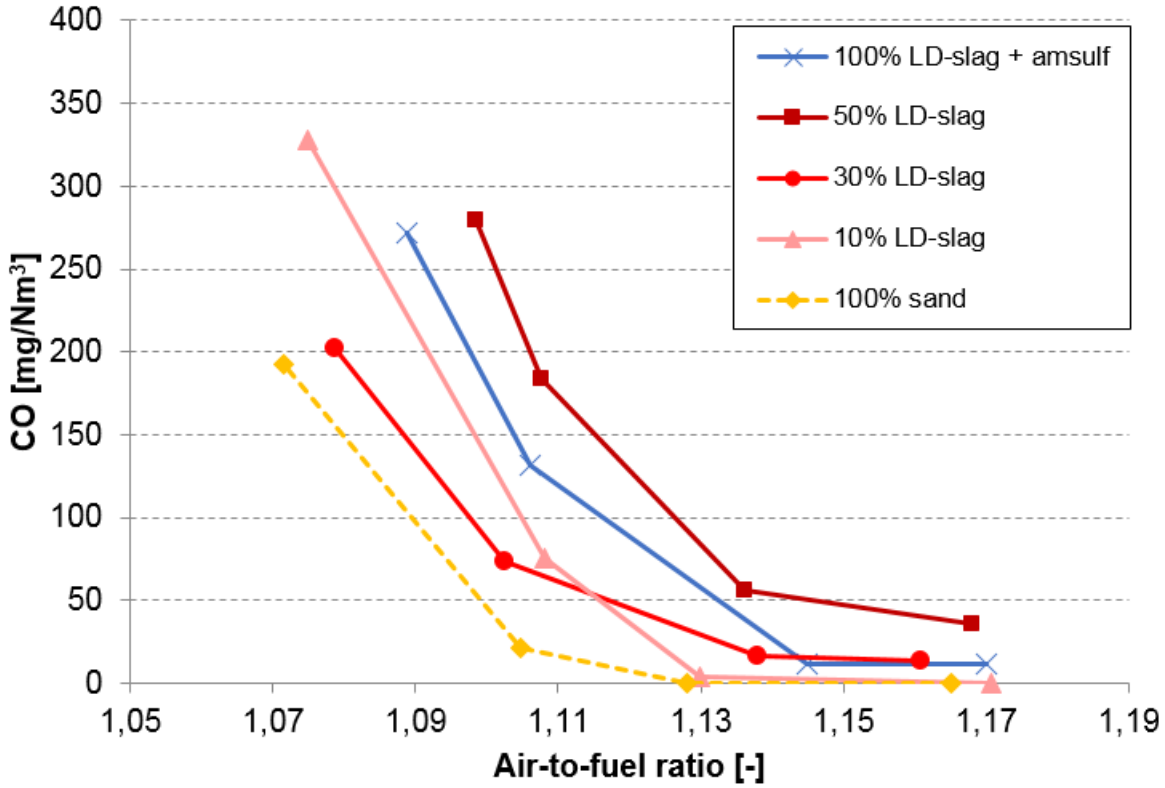
Chalmers 10MW (CFB)

Göteborg Energi 130MW (BFB)

Results OCAC 10MW



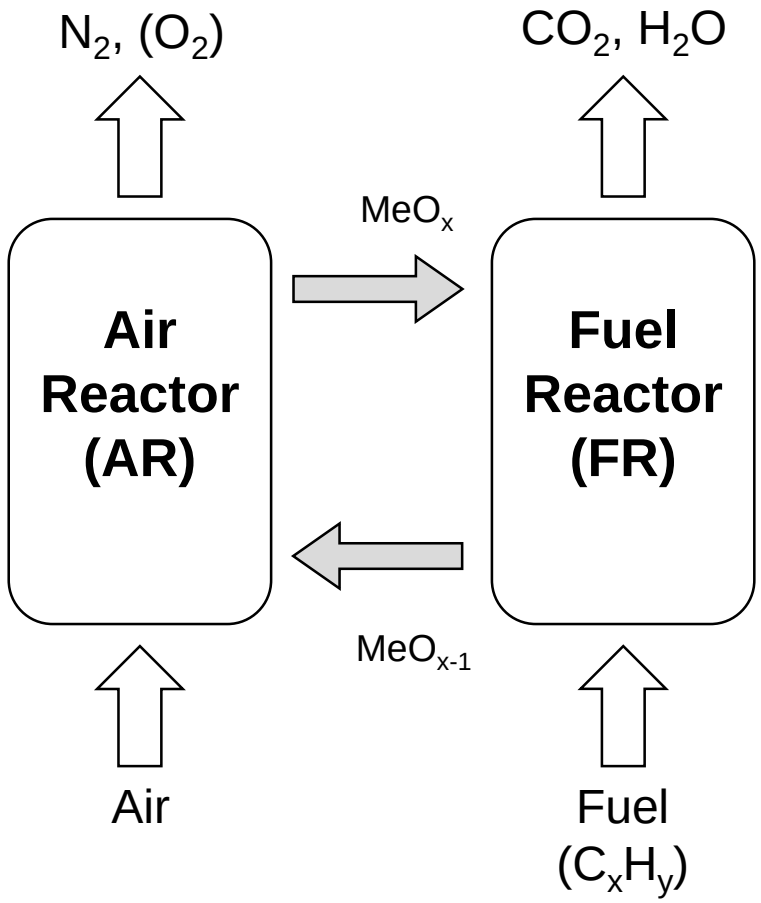
Results OCAC 10MW



Chemical Looping Combustion*

(the mid/long term one)

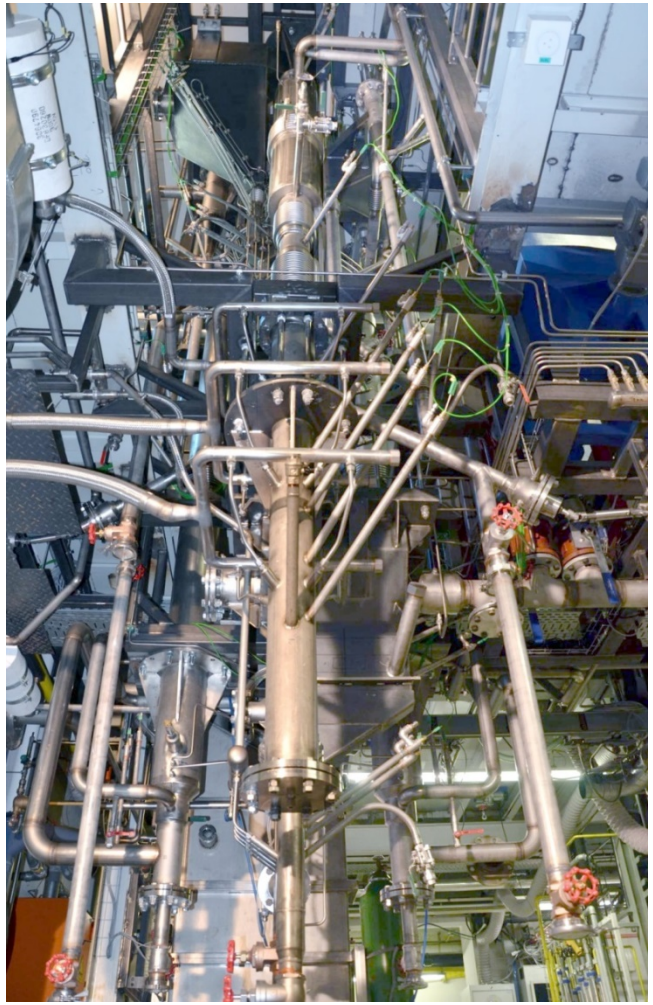
Chemical Looping Combustion (CLC)



- 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

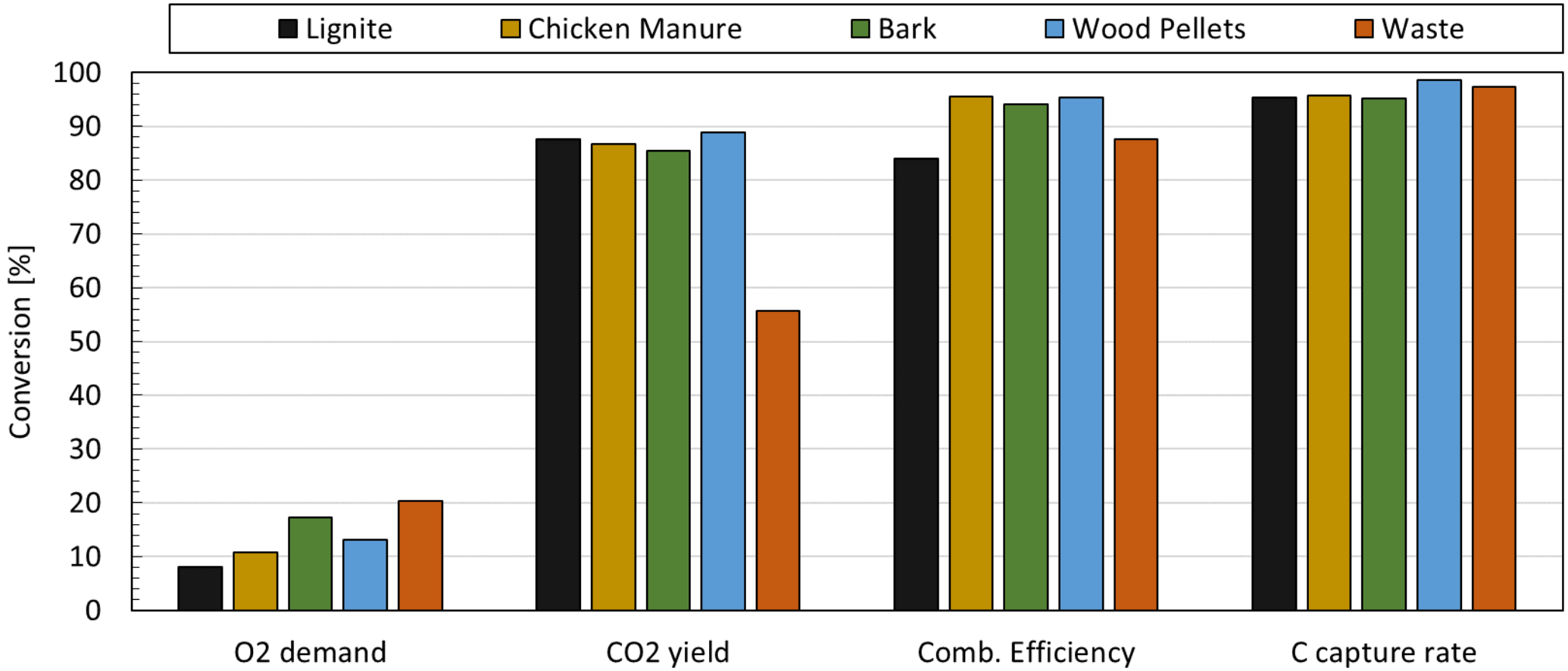
80kW CLC pilot unit



Performance parameters

Parameter	Description
Carbon capture rate	$\frac{Carbon\ in\ FR\ exhaust}{Carbon\ in\ FR\ feed}$
Oxygen demand	$\frac{Oxygen\ demand\ FR\ exhaust}{Oxygen\ demand\ FR\ feed}$
CO_2-yield	$\frac{CO_2\ in\ FR\ exhaust}{Carbon\ in\ FR\ feed}$
Combustion efficiency	$\frac{Heating\ value\ in\ FR\ exhaust}{Heating\ value\ in\ FR\ feed}$

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) were very succesful
- Techno-economic investigations ongoing