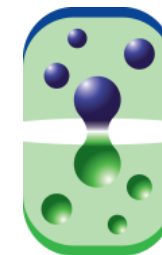


Experimental investigation of the Ca-Cu process for hydrogen production and CO₂ capture

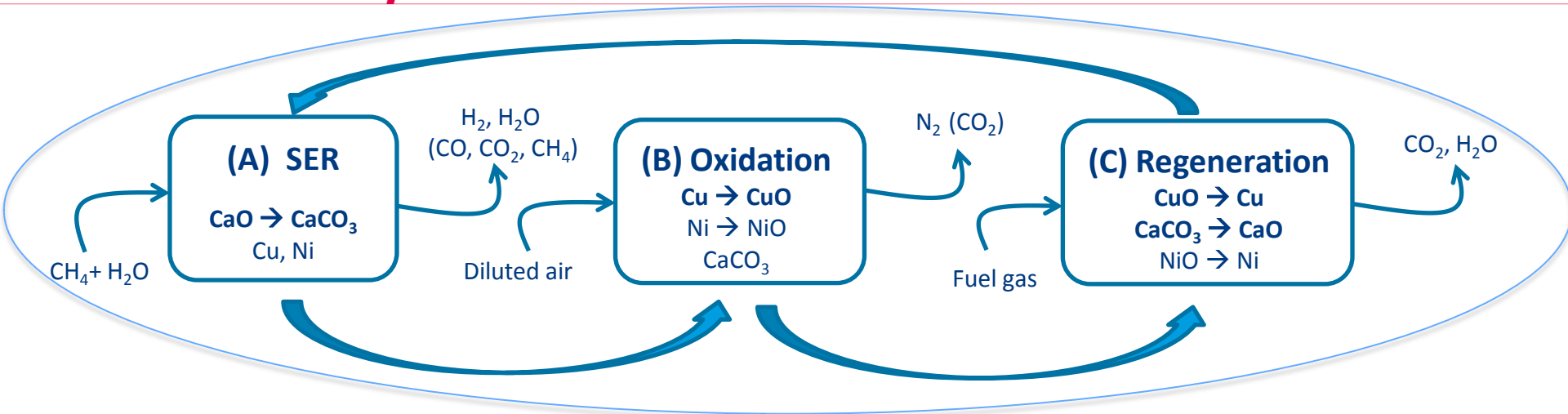
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**Multiphase
Reactors
Group**

Department of
Chemical Engineering & Chemistry

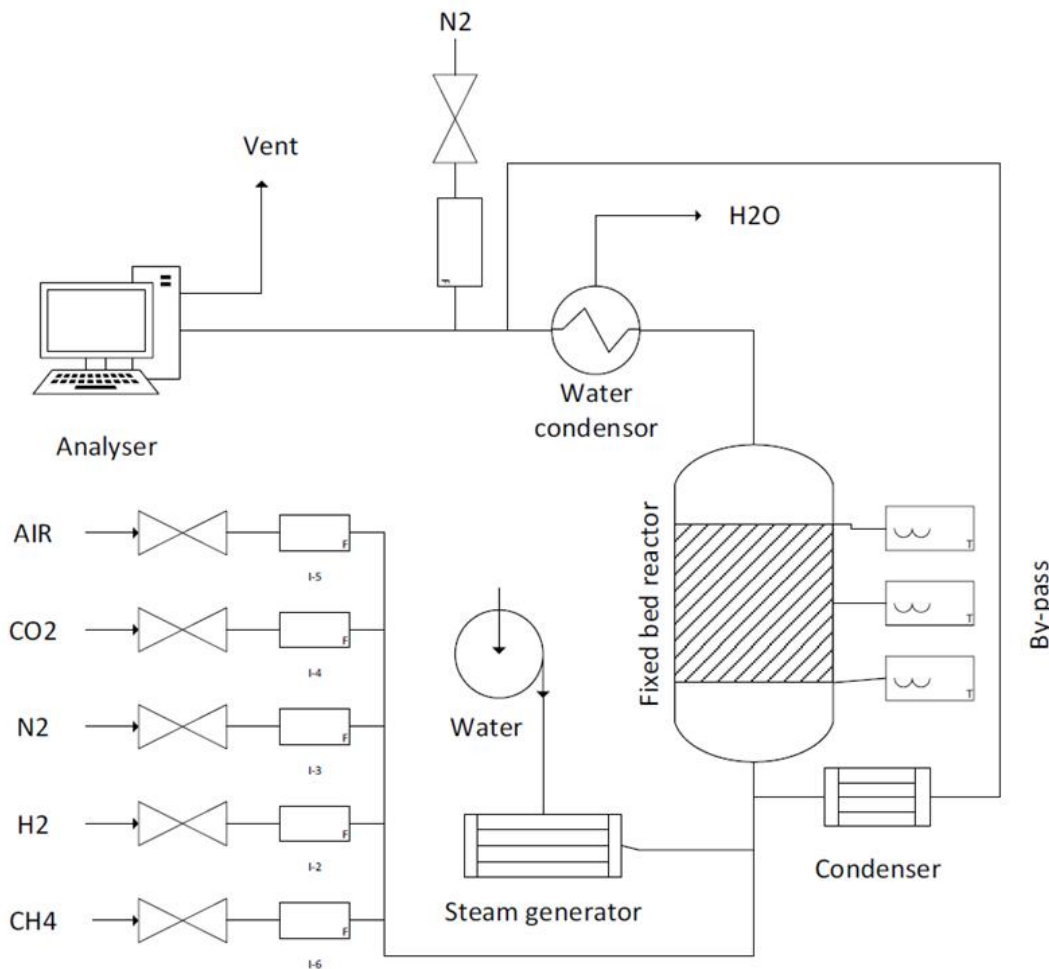


1-D pseudo-homogeneous model for packed bed reactor

Experimental study:

- ✓ SER step: different flow rates, S/C and T
- ✓ Oxidation: different flow rates, % O_2 and T
- ✓ Regeneration step: different flow rates, % H_2 and T

Experimental setup



$L = 1 \text{ m}$

$D = 3 \text{ cm}$

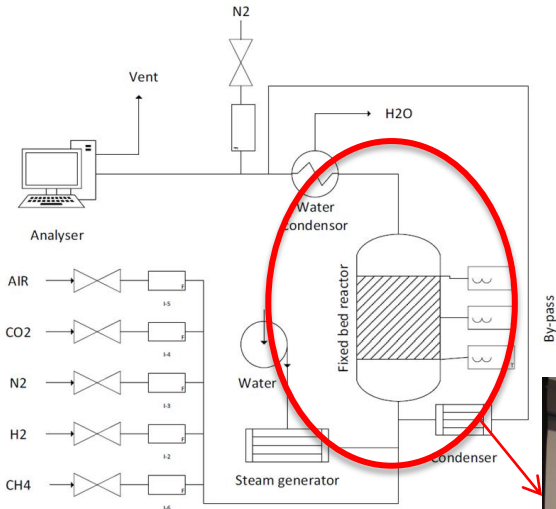
$P = 1 \text{ bar}$

$T_{\text{max}} = 1000 \text{ }^\circ\text{C}$

Amount of solid needed = 500 g

Particle size needed = 1-3 mm

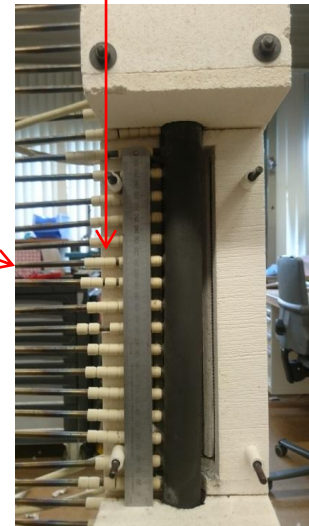
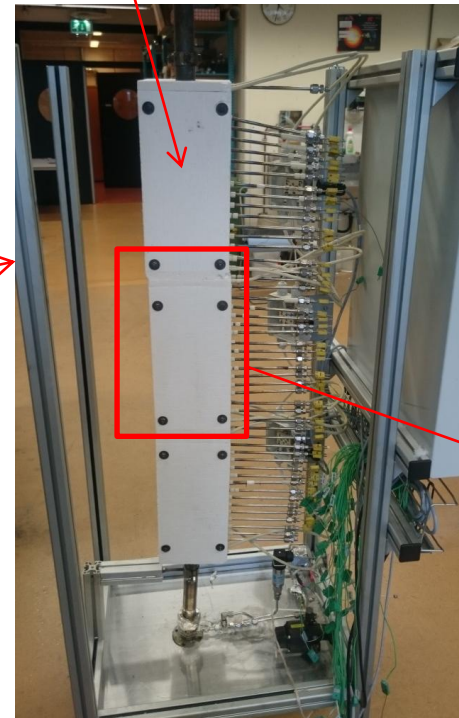
Experimental setup



Control box

3 ovens to control the temperature

50 thermocouples to follow the temperature profile



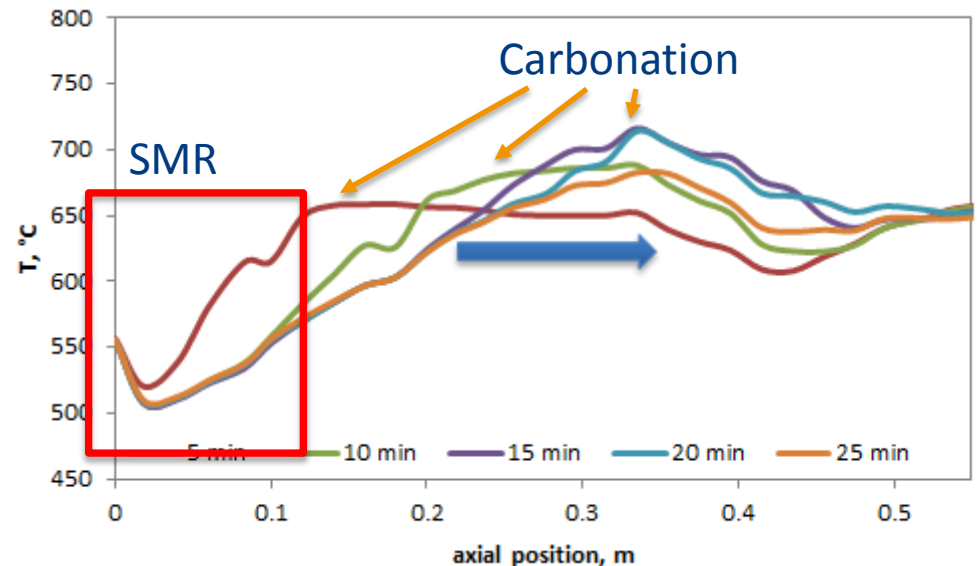
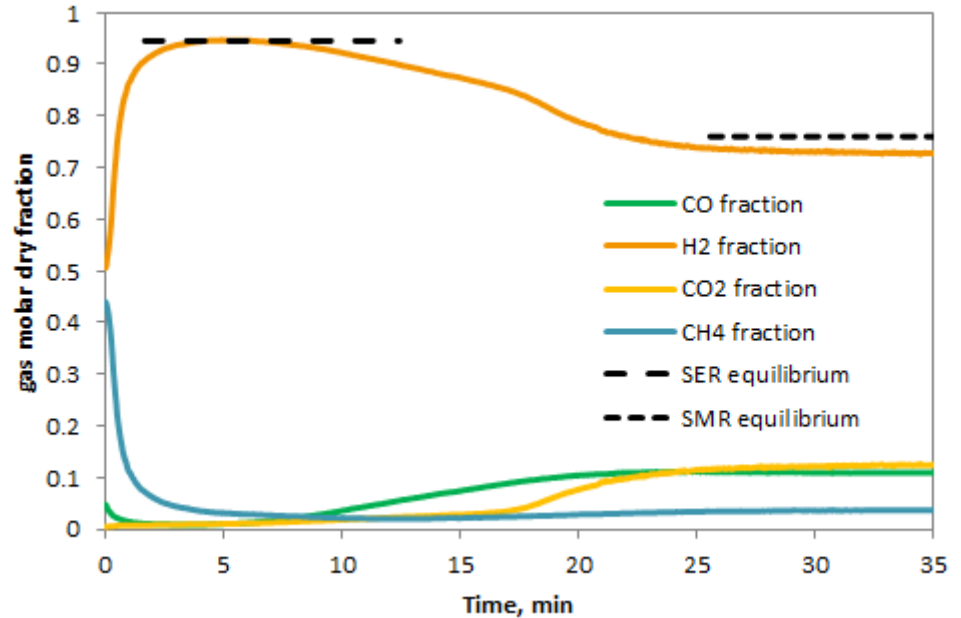
Operating conditions: $S/C = 3$
 $T = 650\text{ }^{\circ}\text{C}$
 4 l/min

Outlet profiles

- SER equilibrium reached
- Quite steep breakthrough
- SMR equilibrium not reached

Temperature profiles in the bed

- First part of the bed only SMR and WGS reactions
- Heat plateau is formed and moving due to carbonation reaction

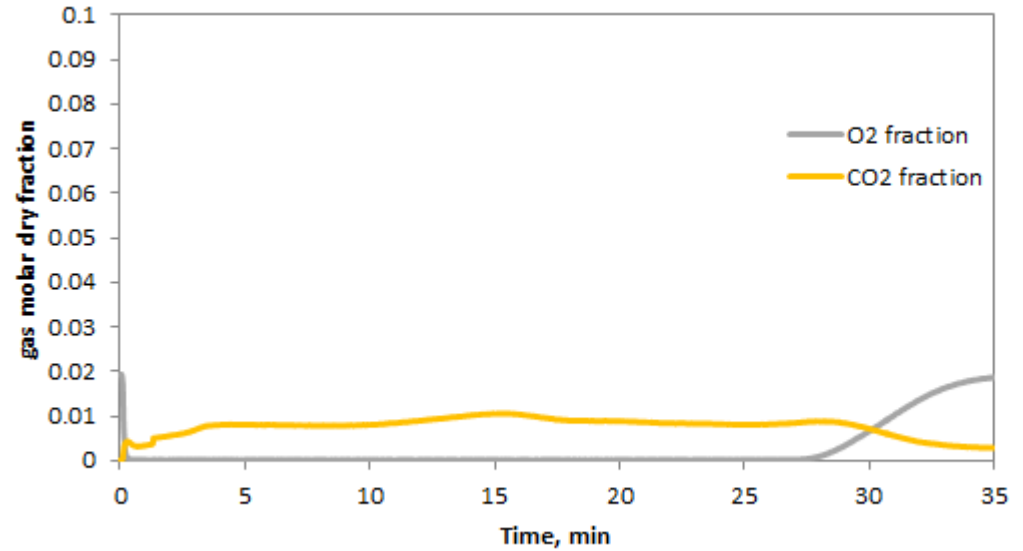


Results: regeneration step

Operating conditions: %O₂ = 2
T = 650 °C
20 l/min

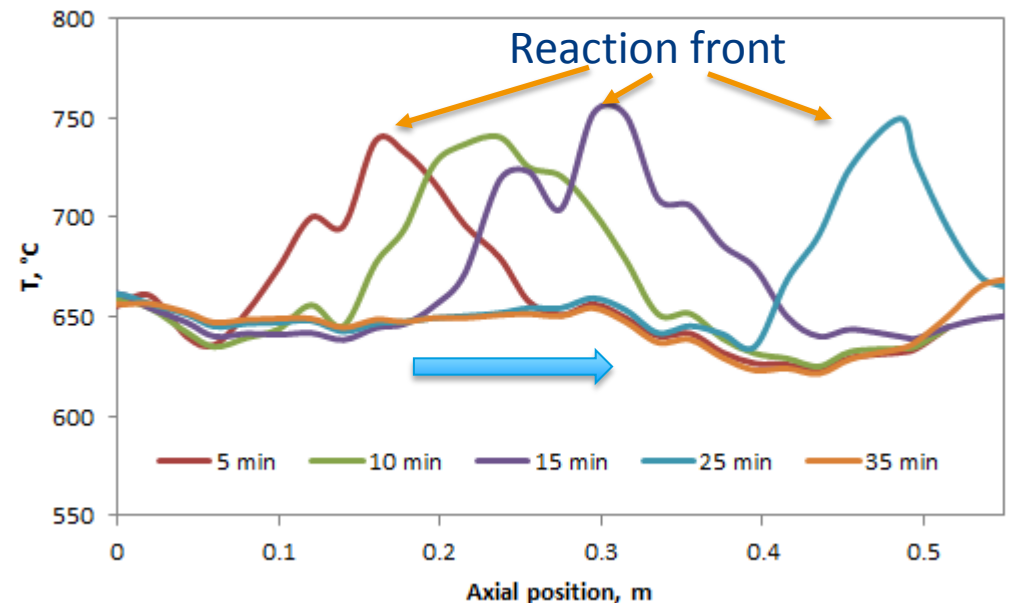
Outlet profiles

- Release of CO₂ (not wanted)
- Quite steep breakthrough



Temperature profiles in the bed

- Temperature picks due to the Cu oxidation reaction
- Clear reaction front moving to the end of the bed



Results: regeneration step

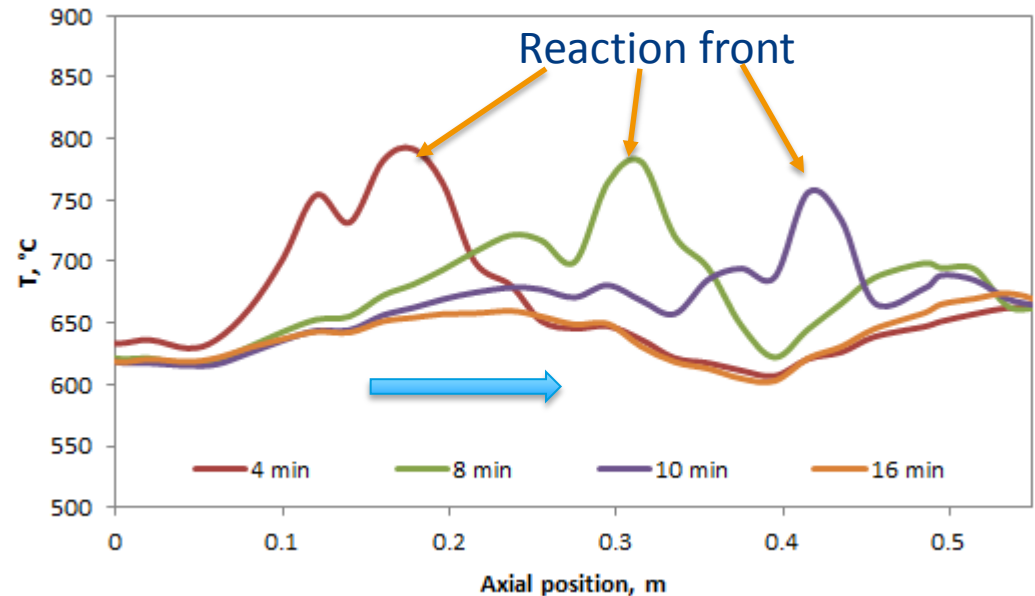
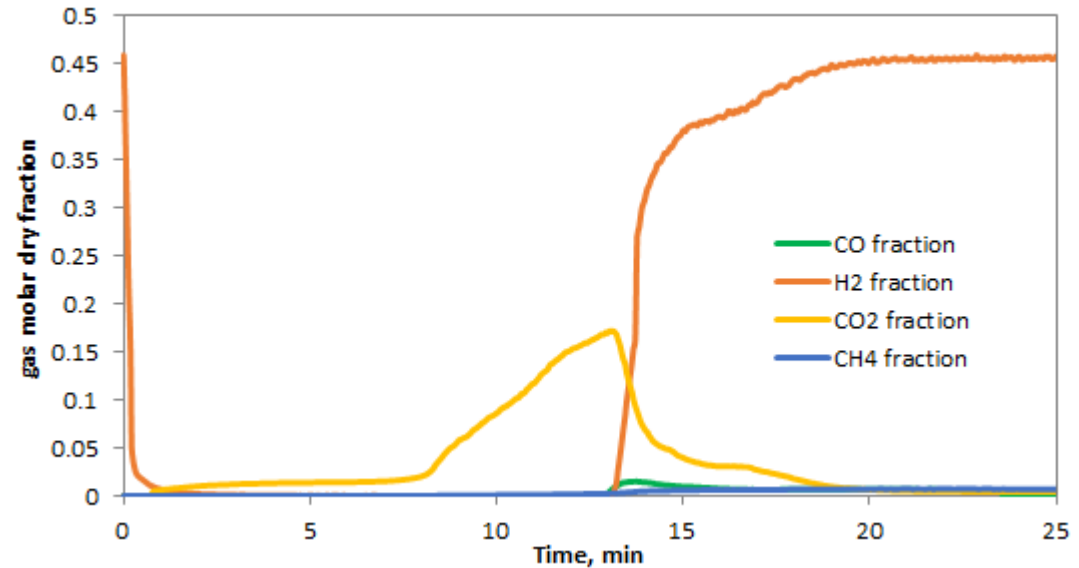
Operating conditions: %H₂ = 45
T = 650 °C
4 l/min

Outlet profiles

- Release of CO₂ after sometime
- Steep breakthrough

Temperature profiles in the bed

- Temperature picks due to the CuO reduction and calcination
- Clear reaction front moving to the end of the bed



Conclusion

- ✓ Clear breakthrough in all the experiments
- ✓ Clear fronts along the bed
- ✓ SER equilibrium is reached
- ✓ Release of CO₂ in the oxidation step (not wanted)

Future steps

- ✓ Model validation with the experimental data

Acknowledgements

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**Thank you
for your attention**