Perspective for Adsorptive Carbon Capture Processes

B. Schürer

MATESA Dissemination Day

Oslo, 2016-06-16

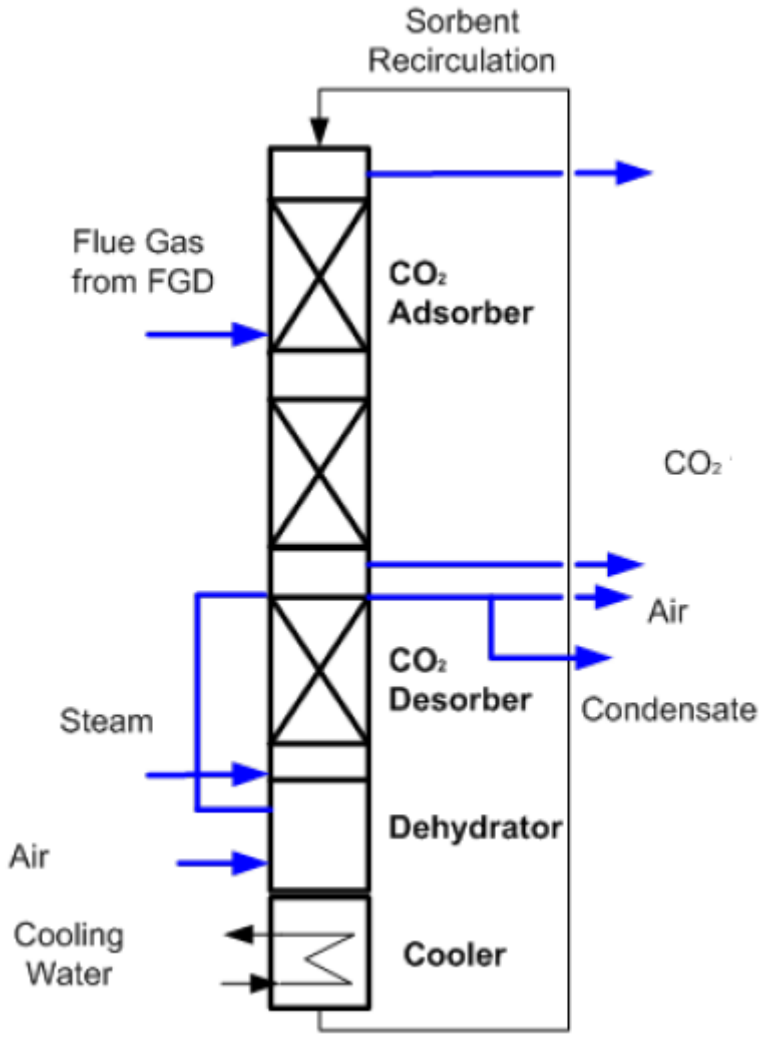
Adsorptive Carbon Capture Processes
Current state concepts

Current state concepts:

- Direct heating
  - Moving bed concept
- Indirect heating
  - Shell and tube adsorber
  - Hollow fibre concept

Adsorptive Carbon Capture Processes
Moving bed concepts

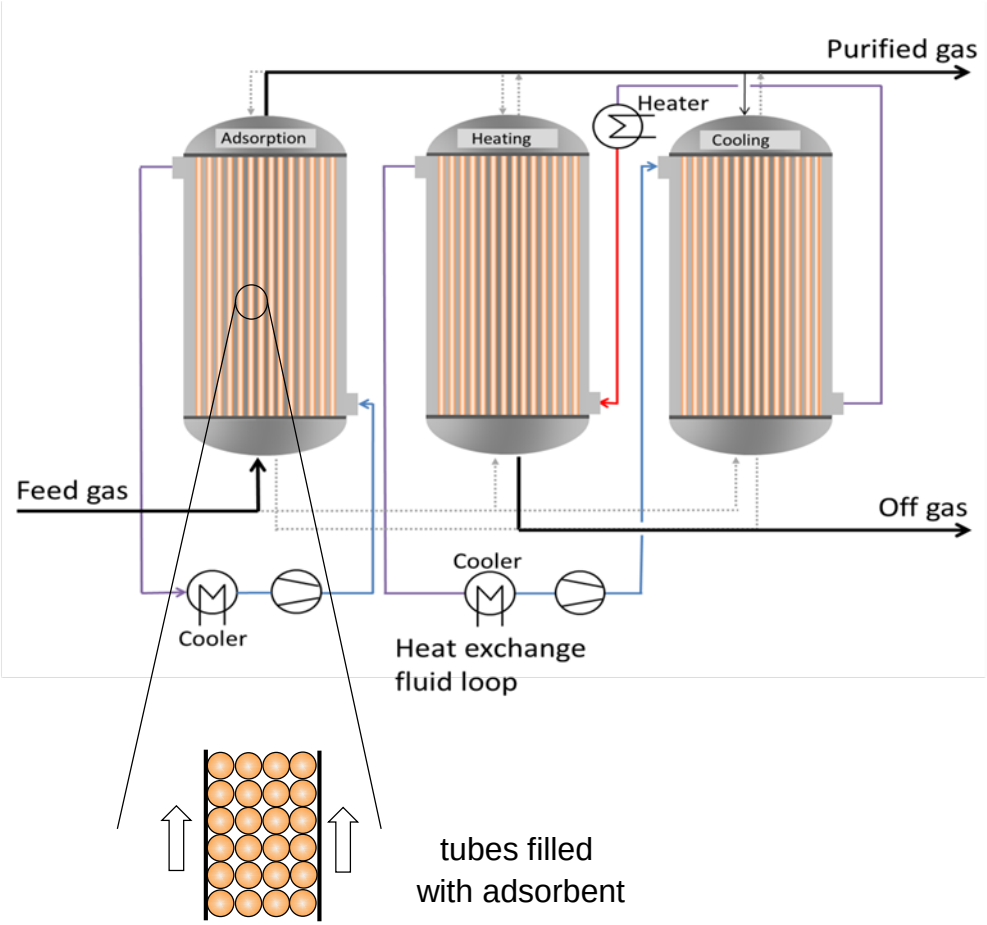
Moving bed concept	
Concept	Moving bed (falling beads in counter current to flue gas)
Adsorbent	Spherical carbon with high attrition resistance Diameter <0.5 mm Low heat of adsorption
Regeneration	Steam
Cooling	Gas / Air
Cycle time	~1 min
Status	Demo plant



[2] SRI International et al., 2015 NETL CO2 Capture Technology Meeting, June 23-26, 2015, Pittsburgh, PA

Adsorptive Carbon Capture Processes
Shell and tube adsorber

Shell and tube adsorber	
Concept	Adsorbent within tubes Heat exchange medium on the shell side
Adsorbent	Variable (standard adsorbents, fibres, monoliths)
Regeneration	Indirect by heat exchange fluid (e.g. water)
Cooling	Indirect by heat exchange fluid
Cycle time	<60 min
Spec. energy	<3.5 MJ/kg CO2
Status	Lab scale



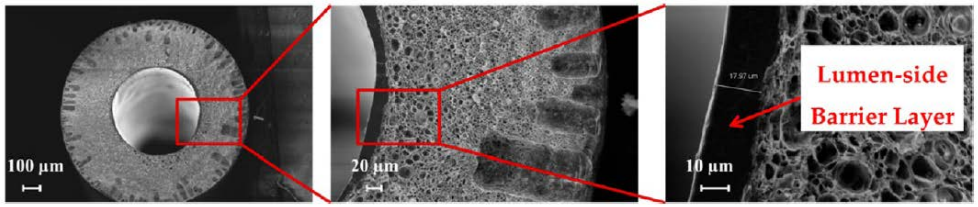
[3] Salazar Duarte et al., Chem. Ing. Tech., 2016, 88(3), 336-345

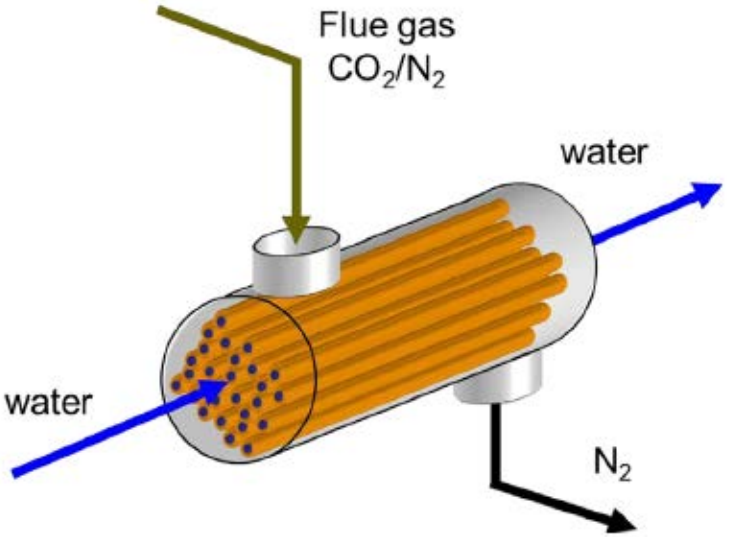
[4] Marx et al., Ind. Eng. Chem. Res., 2016, 55, 703-712

[5] Clausse et al., Int. J. Greenhouse Gas Control, 2011, 5, 1206-1213

Adsorptive Carbon Capture Processes
Hollow fibre concept

Hollow fibre concept	
Concept	Adsorbent within fibres with impermeable membrane Heat exchange medium on bore side
Adsorbent	Fibre with variable adsorbents
Regeneration	Indirect with water
Cooling	Indirect with water
Cycle time	<5 min
Status	Lab scale





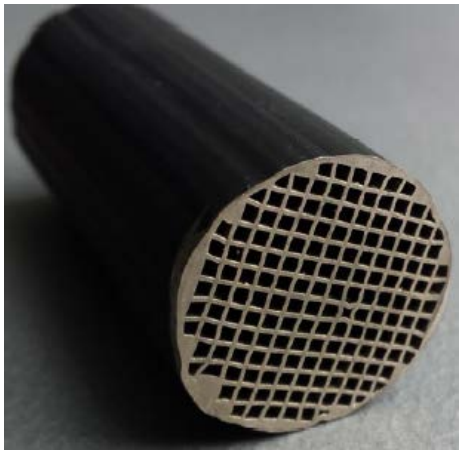
[6] Li et al., Ind. Eng. Chem. Res., 2013, 52, 8928-8935

[7] Rezaei et al., Chem. Eng. Sci., 2014, 113, 62-76

Adsorptive Carbon Capture Processes
Process and Material Requirements

Adsorbent Material:

- Adsorbent with high CO_2 working capacity
- CO2 capacity not influenced by presence of water
- Low pressure drop
- Low heat of adsorption



Process:

- Scalable to extreme flow-rates (1.8 Mm^3/h for 830 MWe NGCC)
- Short cycle time
- Possibility for heat integration

Take-Home-Message:

- Adsorption processes are an alternative to amine based absorption process for carbon capture.

Thank you for your attention.