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Sour SEWGS application in IGCC

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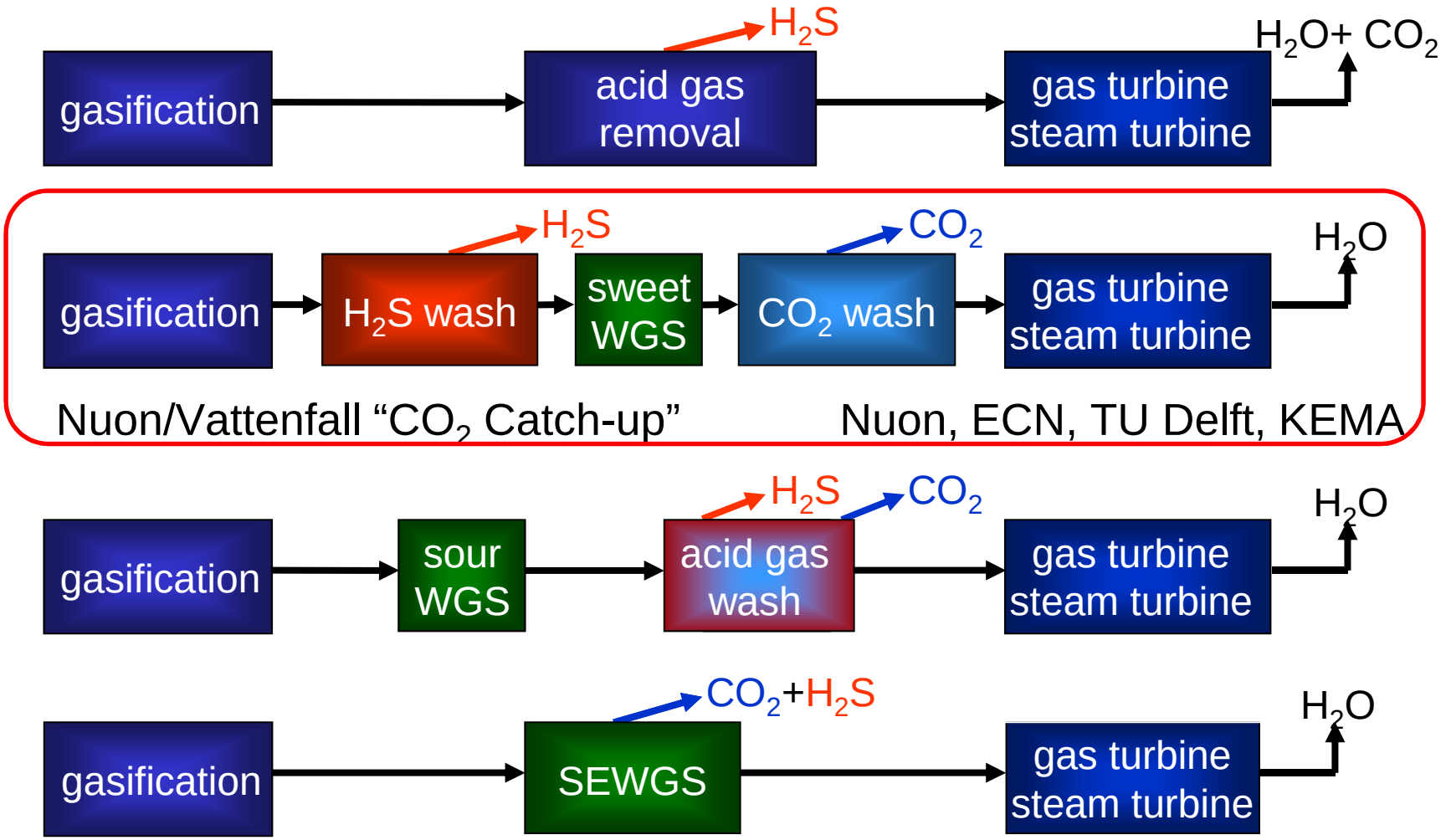
Outline

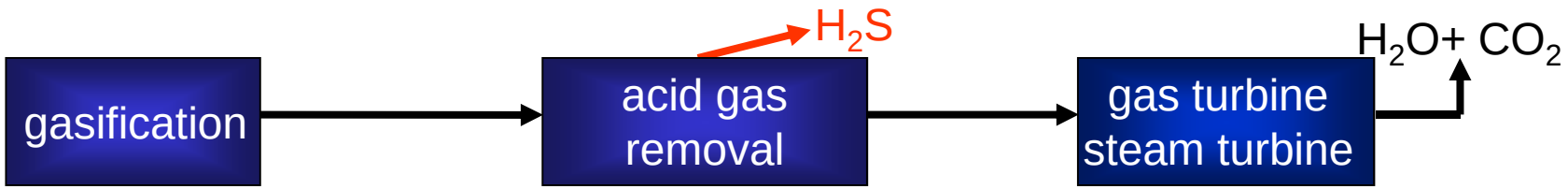
- Introduction on pre-combustion carbon capture
- Sorbent performance under sour conditions
- Sour-SEWGS works
- Recapitulation

www.co2-captech.nl

Pre-combustion CO_2 capture in IGCC

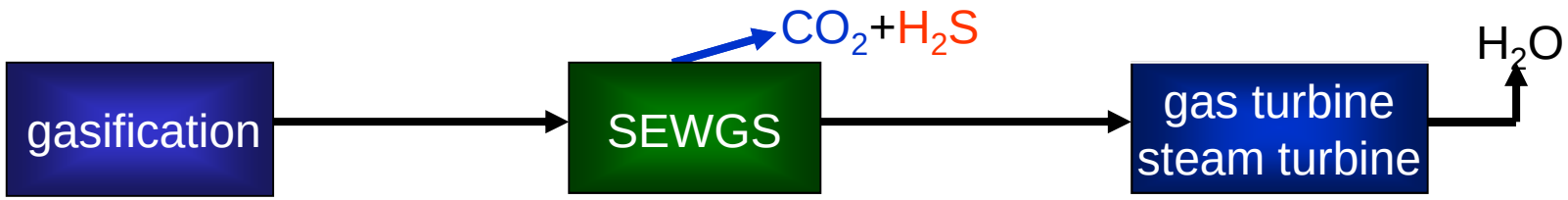


Pre-combustion CO_2 capture in IGCC



Topic of presentation:

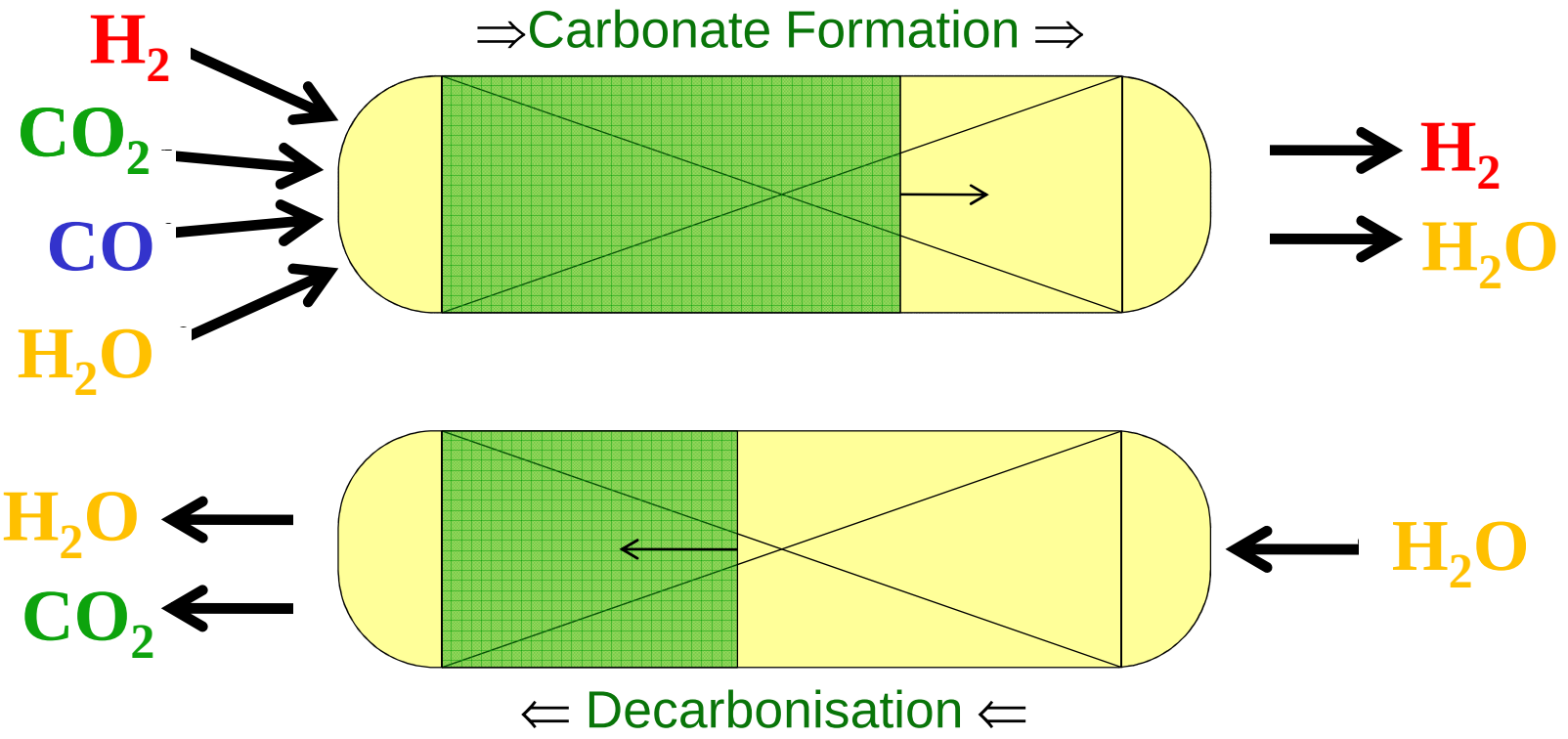
Robustness of the Alkasorb sorbent within the SEWGS process



What is the process?

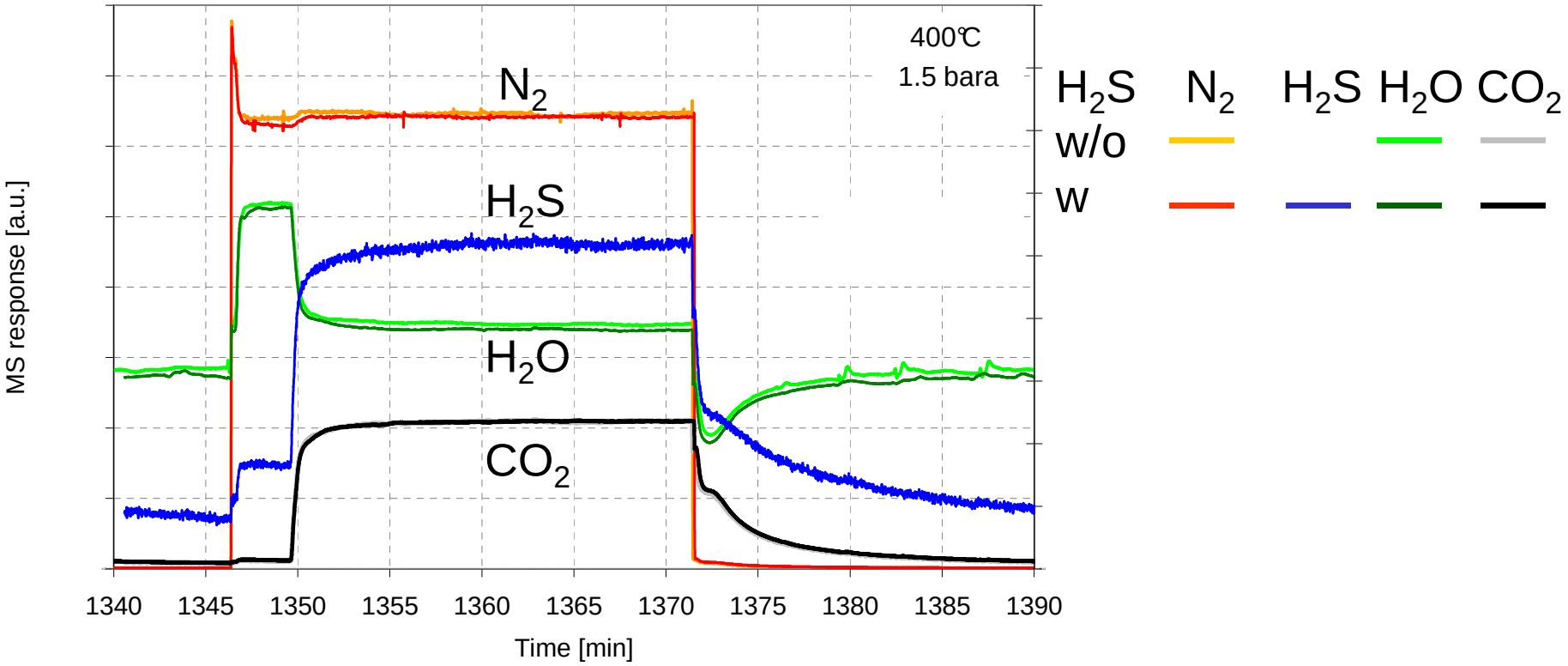
High temperature, high pressure production of Hydrogen from Syngas.

Water-Gas Shift: $CO + H_2O \Leftrightarrow CO_2 + H_2$



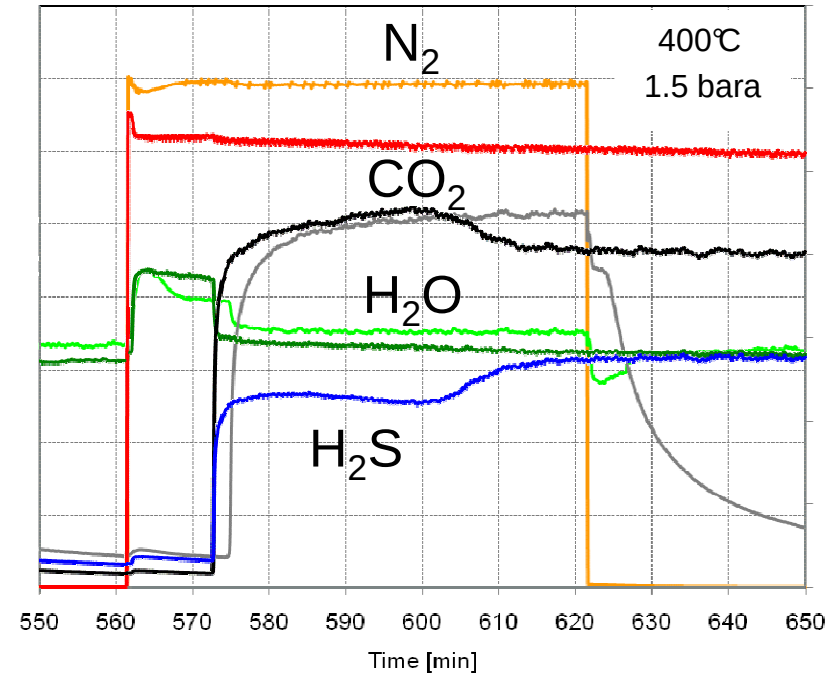
CO_2 + H_2S interaction

17 % H_2O
11 % CO_2 ⟷ 17 % H_2O
w-w/o 500ppm H_2S



CO_2 + H_2S interaction

12 % H_2O
2.5 % CO_2
w-w/o 2.5% H_2S



12 % H_2O

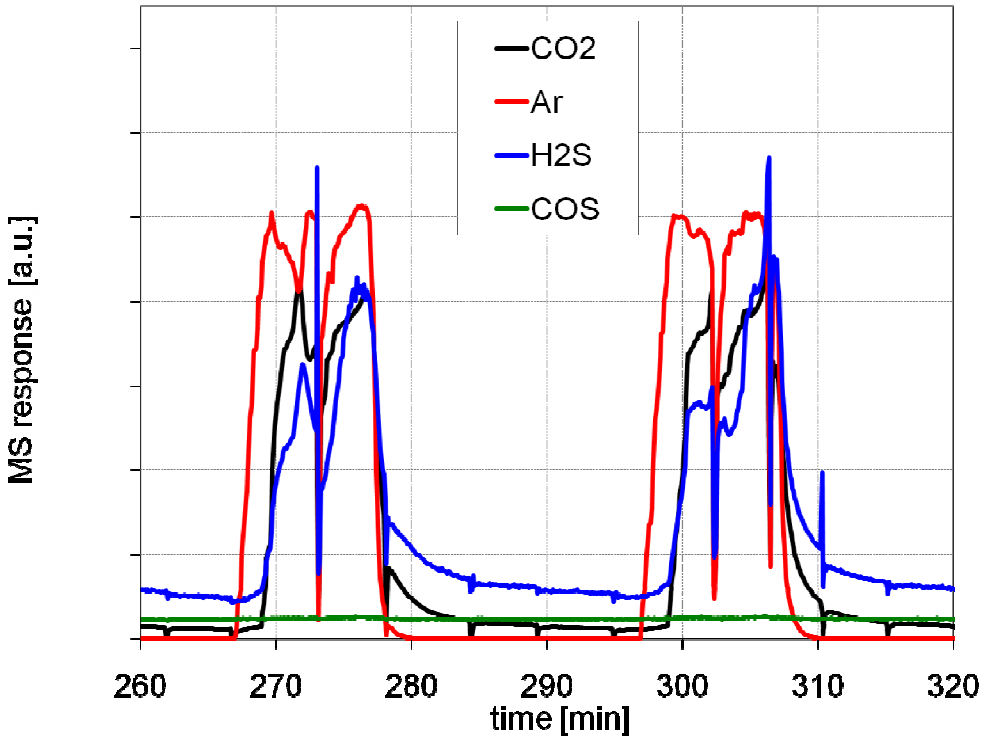
H_2S	N_2	H_2S	H_2O	CO_2
w/o				
w				

- No significant alteration of CO_2 capacity
- Co-adsorption of CO_2 and H_2S in cyclic steady-state

CO_2 + COS interaction

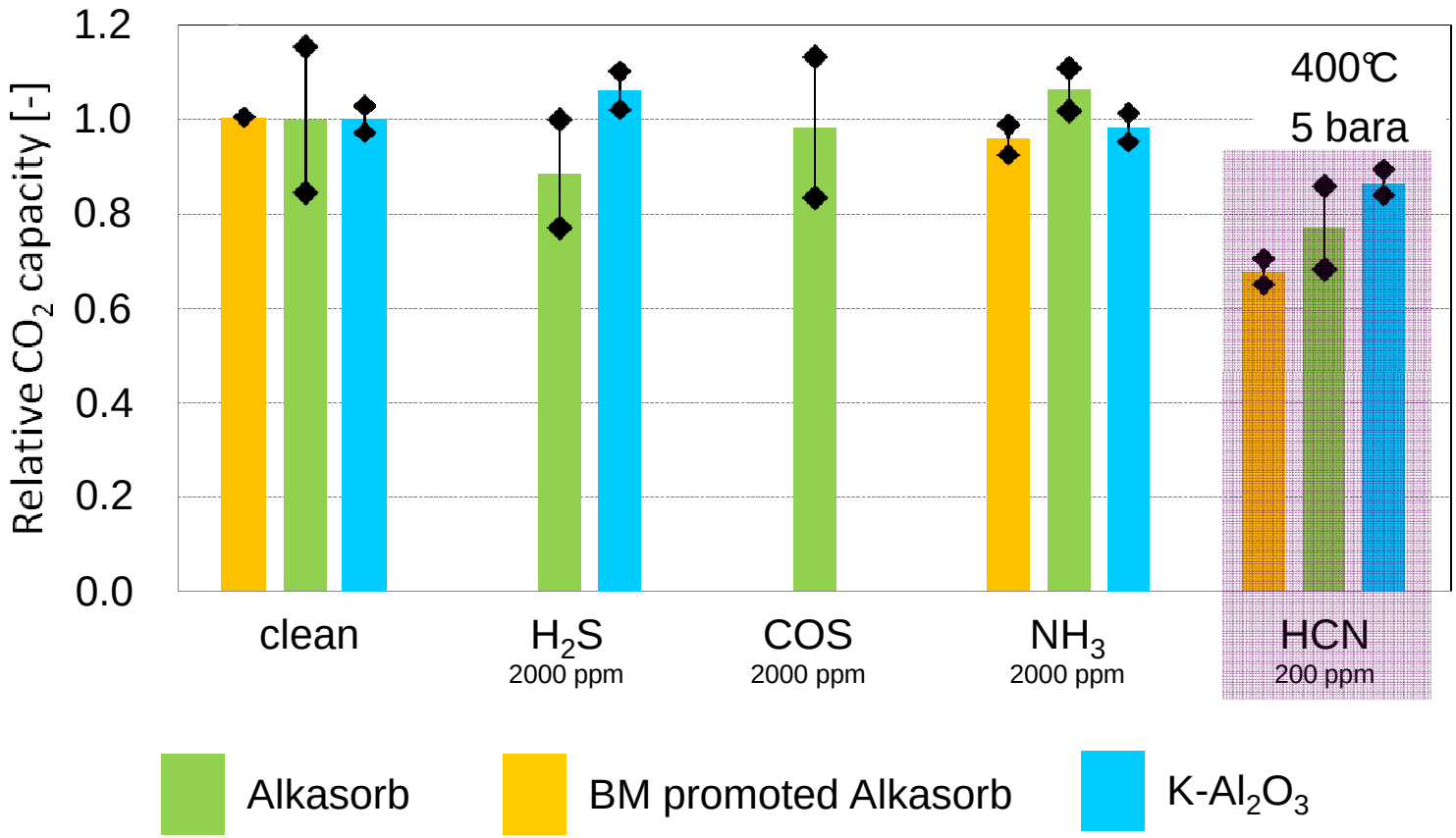
34 % H_2O
23 % CO_2 ⟷ 34 % H_2O
2000ppm COS

400℃
5 bara



- Full COS hydrolysis and adsorption as H_2S
- Simultaneous breakthrough CO_2 and H_2S

CO_2 + contaminants

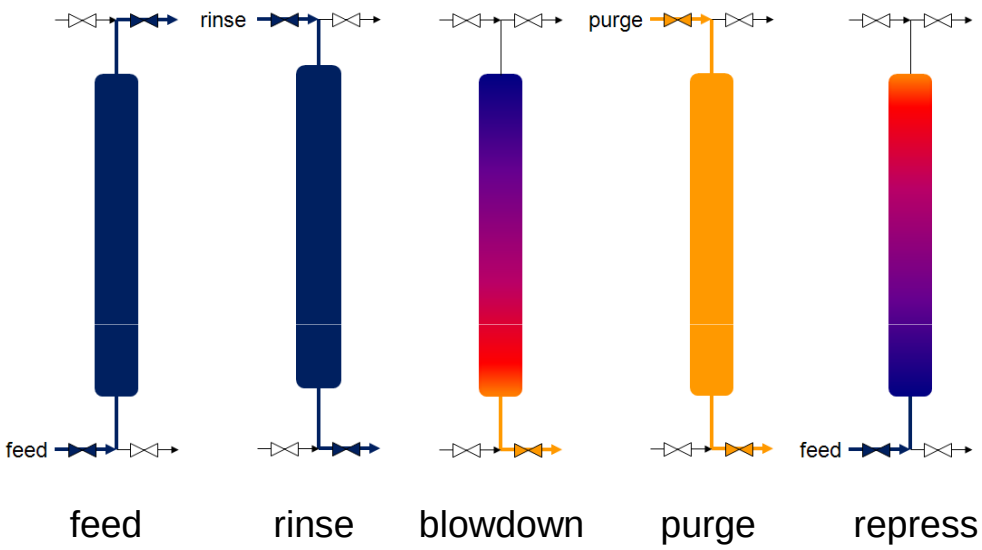


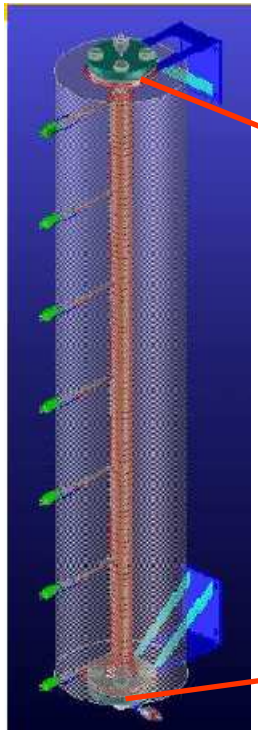
CO_2 + contaminants on Alkasorb

component	C's	P's	capture	conversion	influence on CO_2 sorption
CO_2	syngas	30	full	no	
CO	syngas	30	full	CO_2	no
H_2	syngas	30	no	no	no
CH_4	syngas	30	no	no	no
H_2S	2.5%	30	full	no	no
COS	2000ppm	5	full	H_2S	no
NH_3	2000ppm	5	partial	no	no
HCN	200ppm	5	partial	partial NH_3	slight ↓
Benzene	375ppm	1			no
C_2H_4, C_3H_6	350ppm	1			no
Org-S	50ppm	1			no

Robust sorbent

Sorbent demonstration



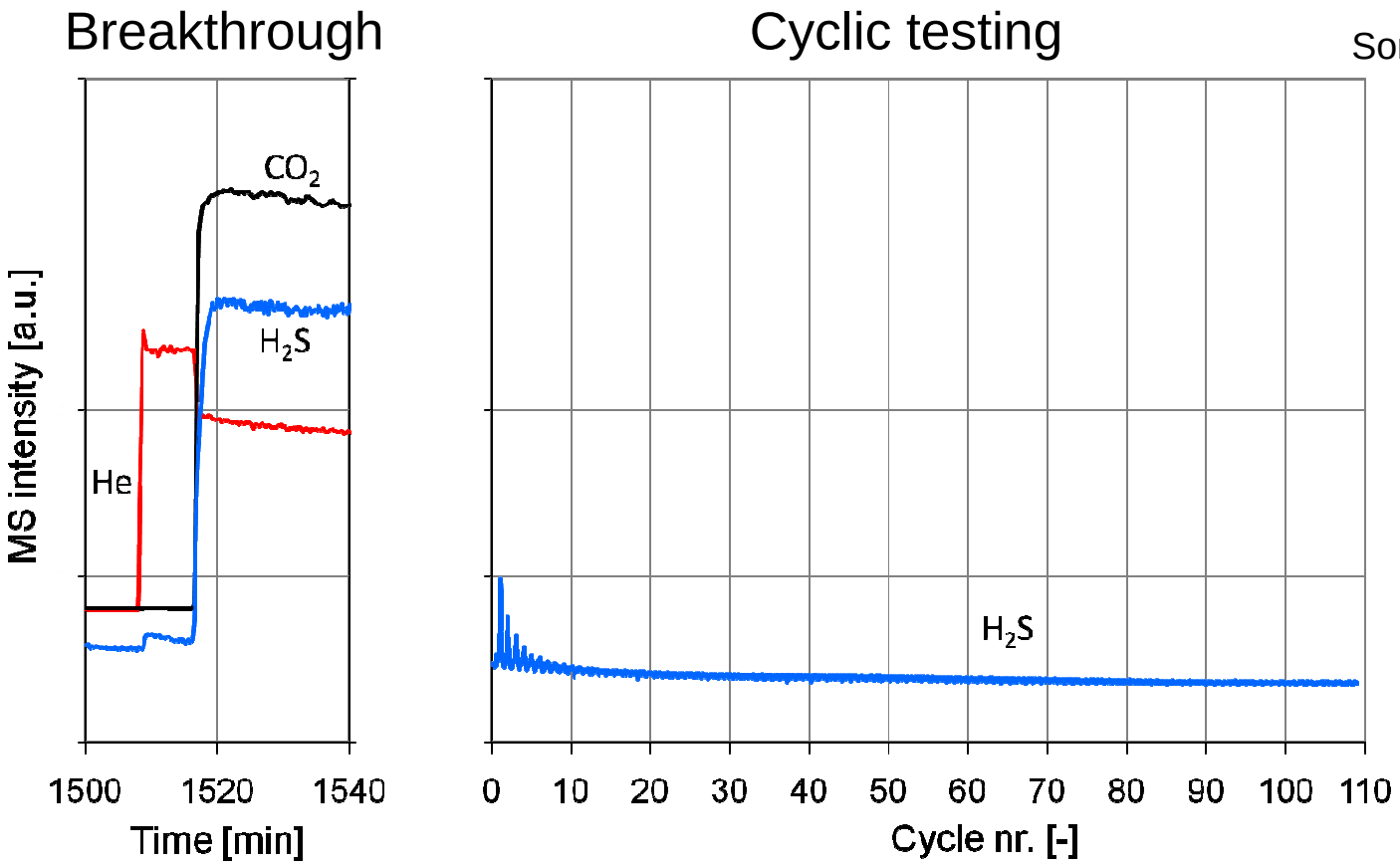


- Adsorption at 30 bar, regeneration at 2 bar
- Counter-current operation

Sorbent demonstration, multi-cycli testing

feed: 30 % H_2O
25 % CO_2
200 ppm H_2S

Sorbent: Alkasorb

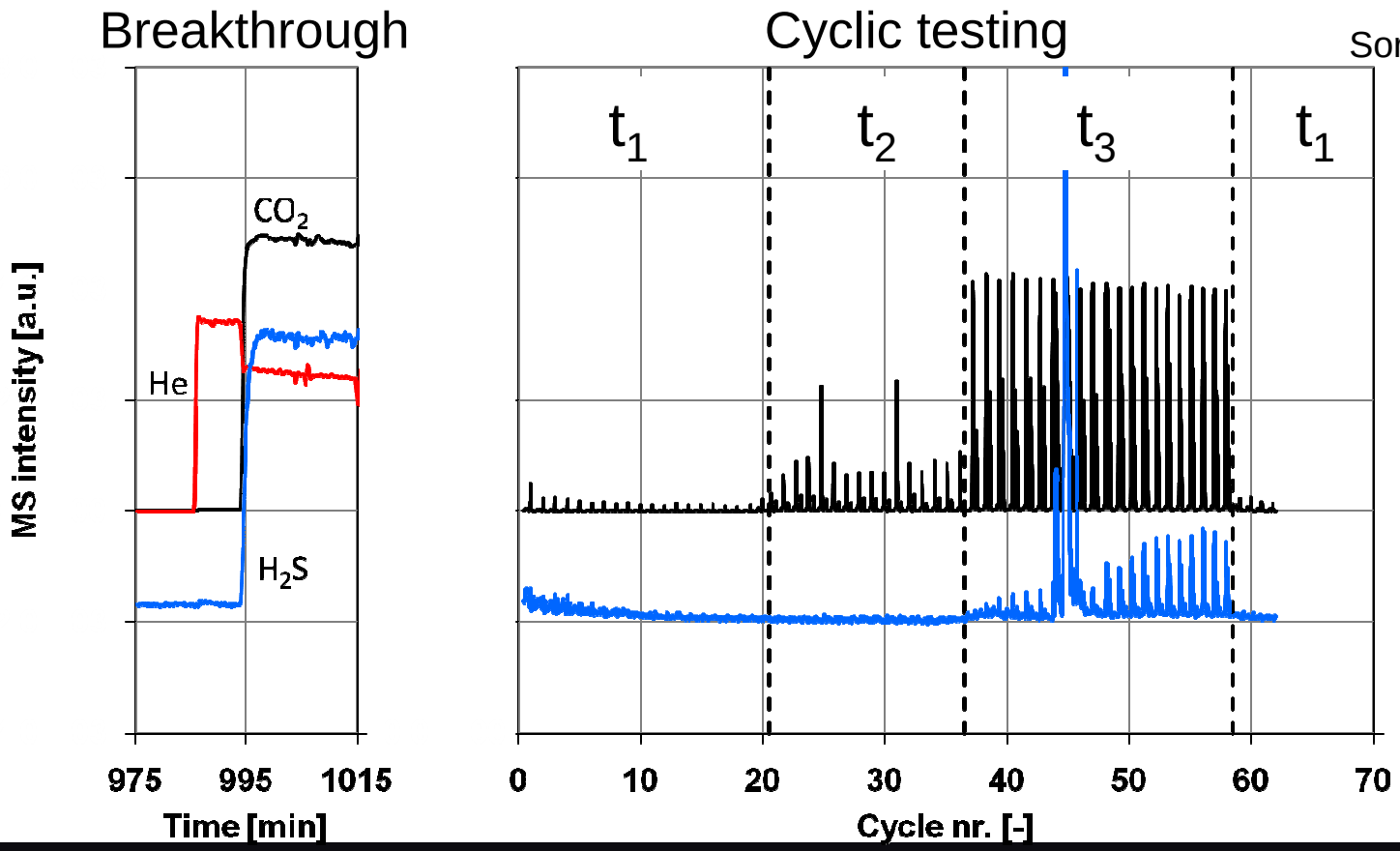


Sorbent demonstration, dynamics

Cycle: variable feed time ($t_1<t_2<t_3$)

feed: 30 % H_2O
25 % CO_2
200 ppm H_2S

Sorbent: Alkasorb



SEWGS assessment for IGCC

		IGCC	SELEXOL	sour SEWGS	advanced sour SEWGS
Net power output	MW	426	384	388	394
Thermal power input	MW_{LHV}	889	1054	1033	1033
Net electric eff.	%	47.5	36.4	37.6	38.2
Emissions	g_{CO2}/kWh_{el}	726	98	22	22
CO_2 avoided	%	--	86.6	96.9	97.0
SPECCA	MJ_{LHV}/kg_{CO2}	--	3.67	2.84	2.65

Source: Caesar project, Politecnico di Milano, 2011 (presented at European CCS meeting, London)

Selexol: fully developed

SEWGS: further optimization possible, especially steam utilization

- syngas feed for WGS
- high pressure rinse
- low pressure purge

Recapitulation

Alkasorb

- High temperature PSA sorbent
- Robust
- Simultaneous decarbonisation and desulphurization demonstrated in SEWGS cycles
- Continuous development for improving CO_2 capacity

SEWGS technology

- Promising with respect to Selexol
- Key: reducing steam need

Questions

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