



Energy research Centre of the Netherlands



Experimental Investigation of Sorption-Enhanced Water-Gas Shift Process Cycles

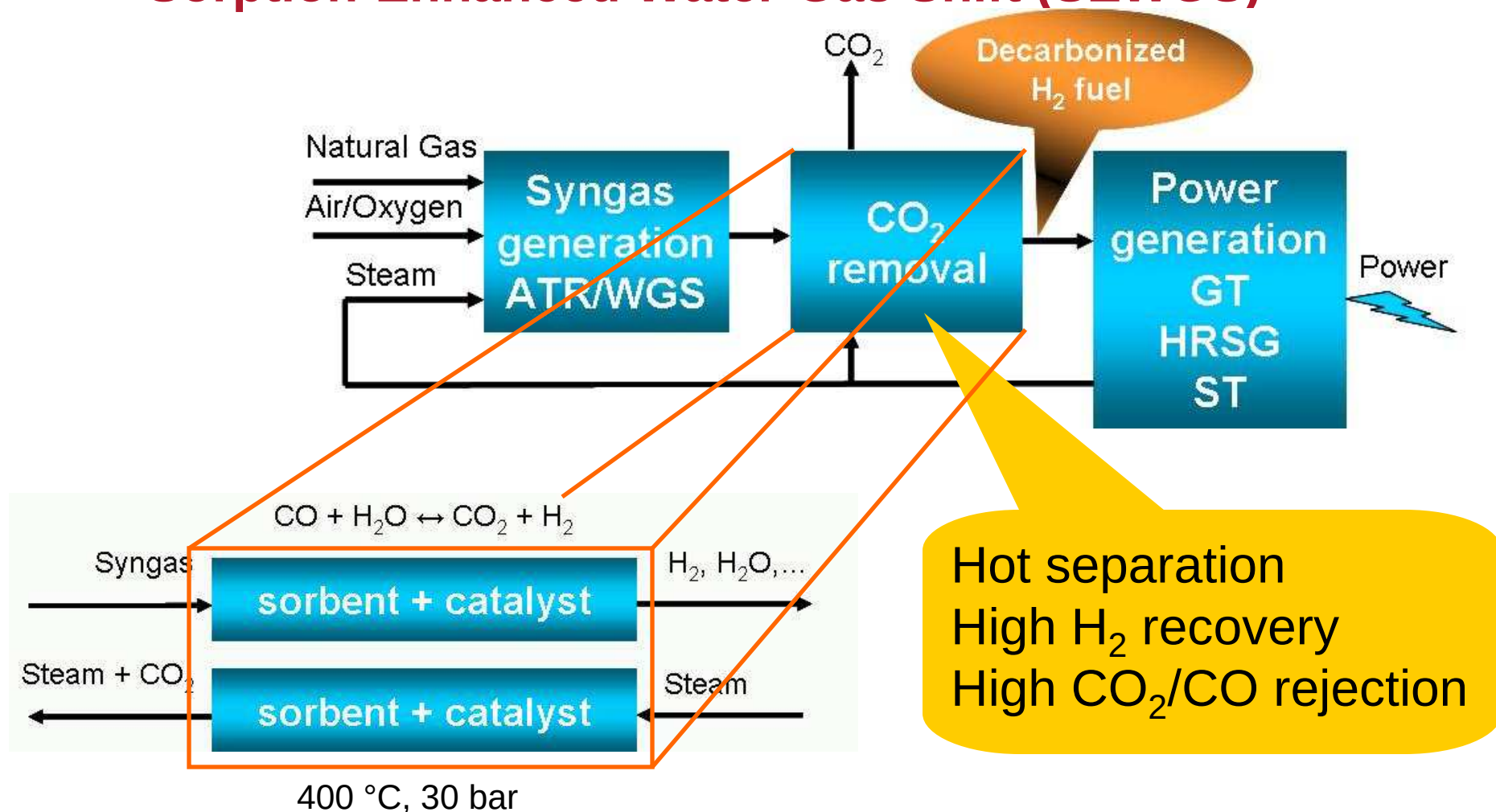
E.R. van Selow, P.D. Cobden, R.W. van den Brink,
A. Wright, V. White



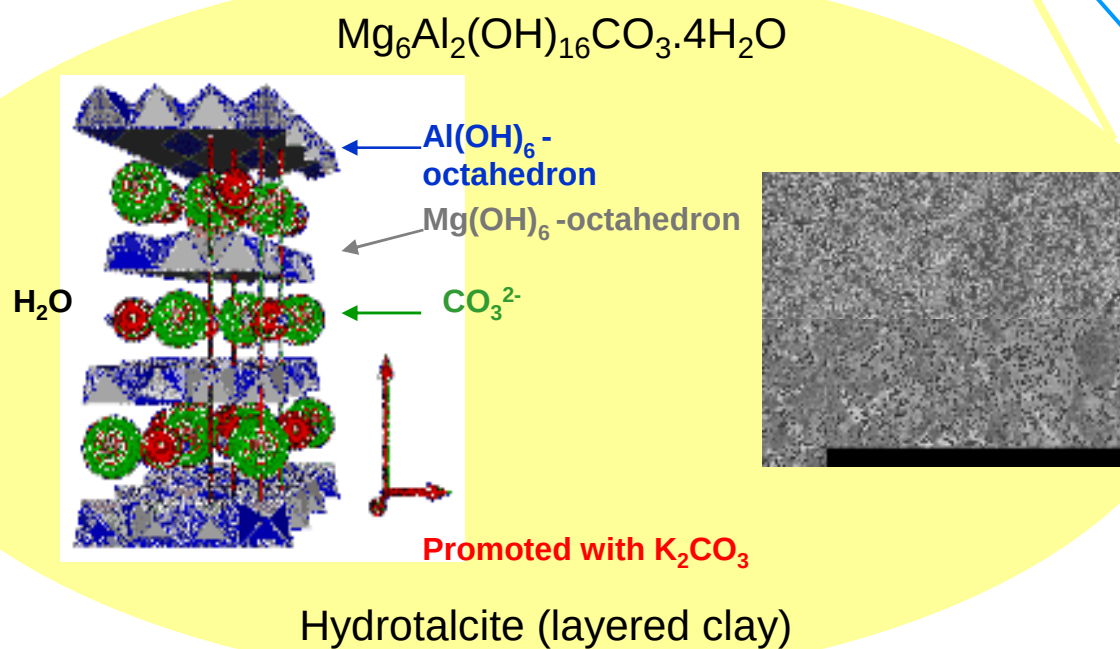
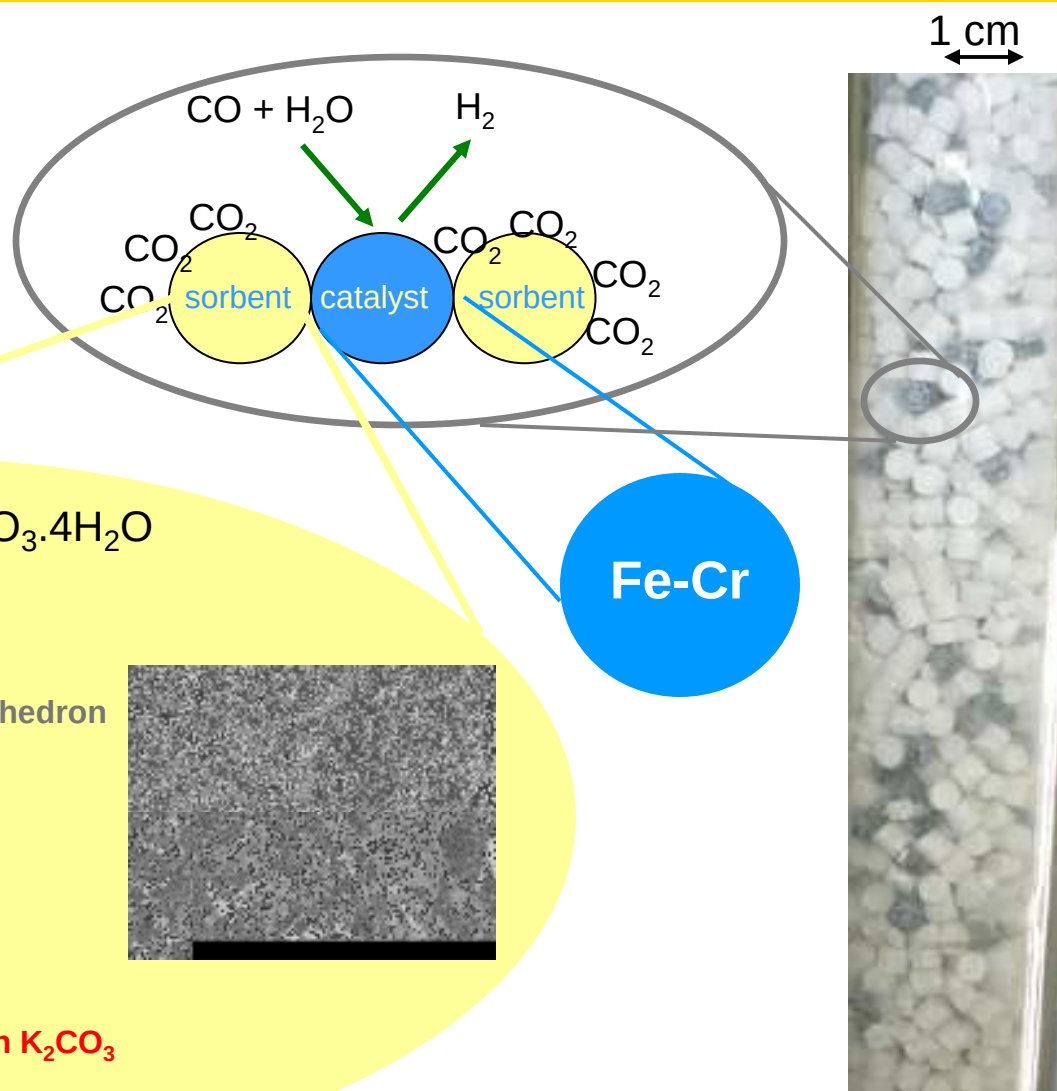
5th CCS conference, Trondheim, 17 June 2009

www.ecn.nl

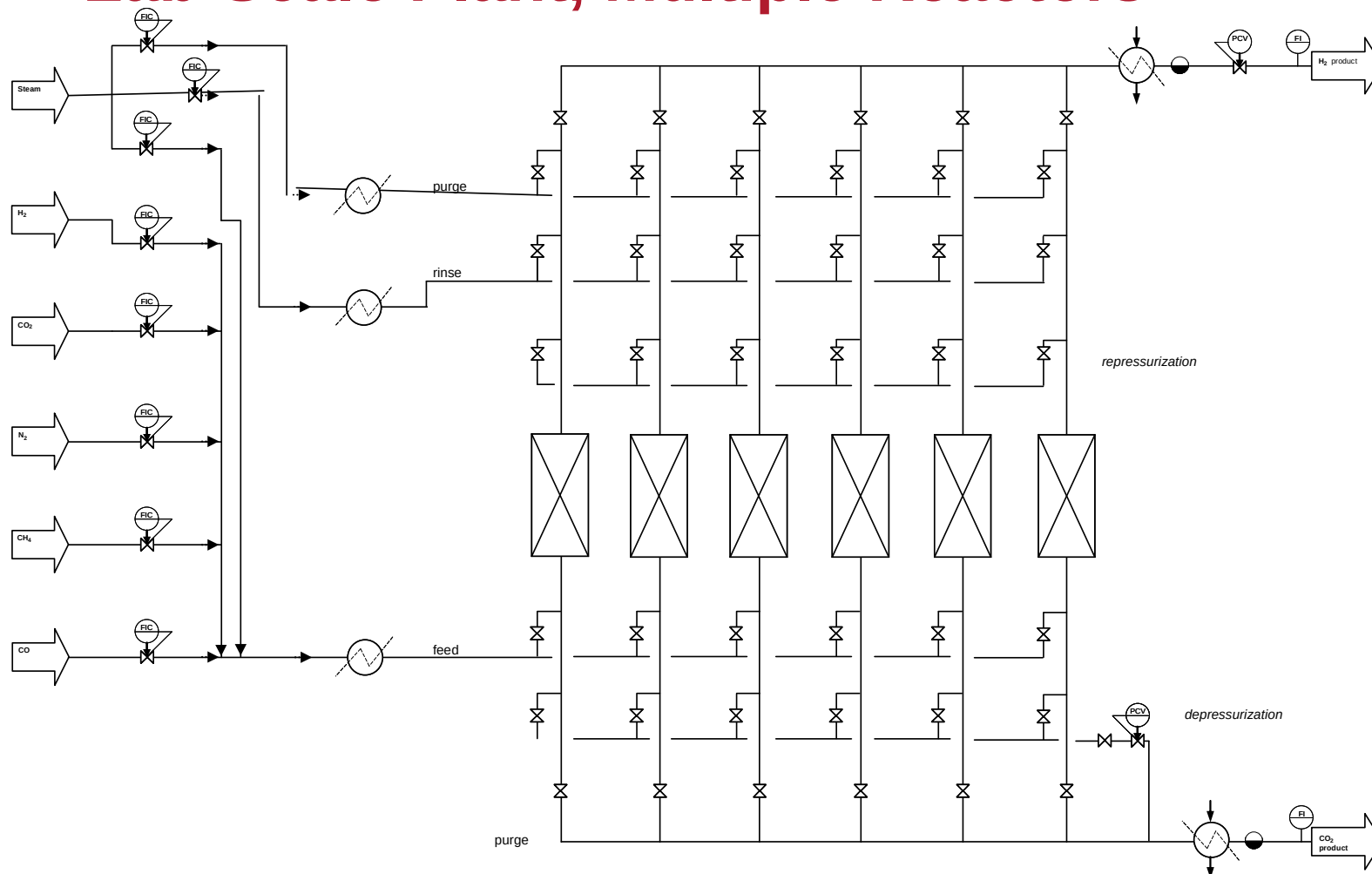
Sorption-Enhanced Water-Gas Shift (SEWGS)

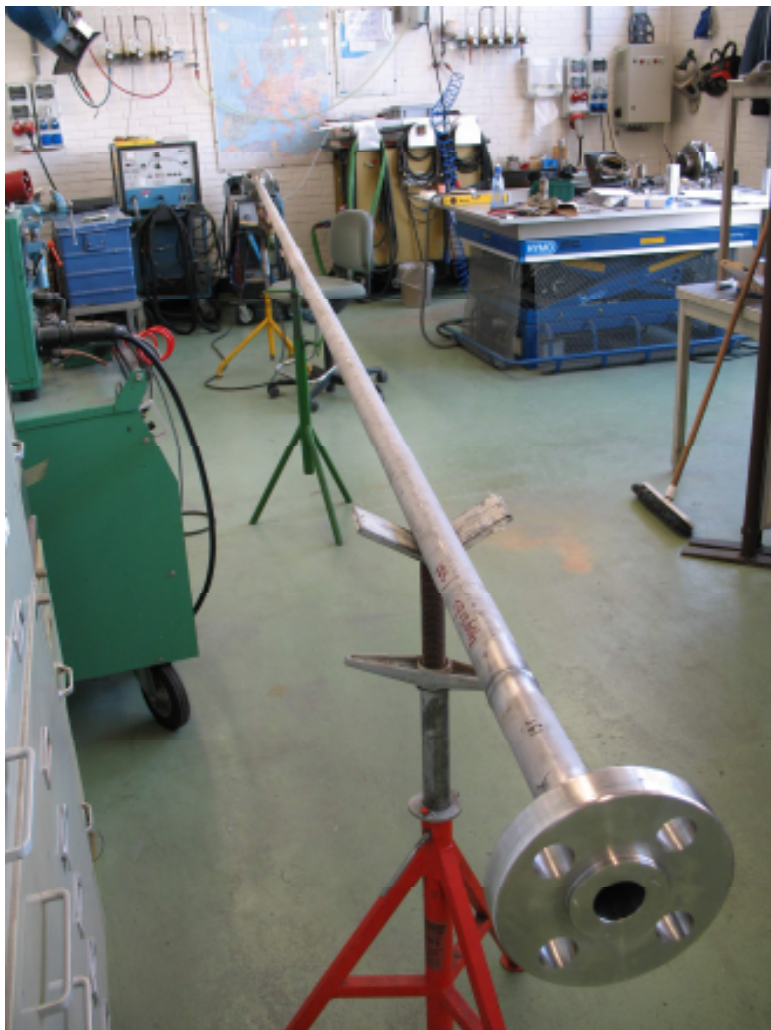


Materials

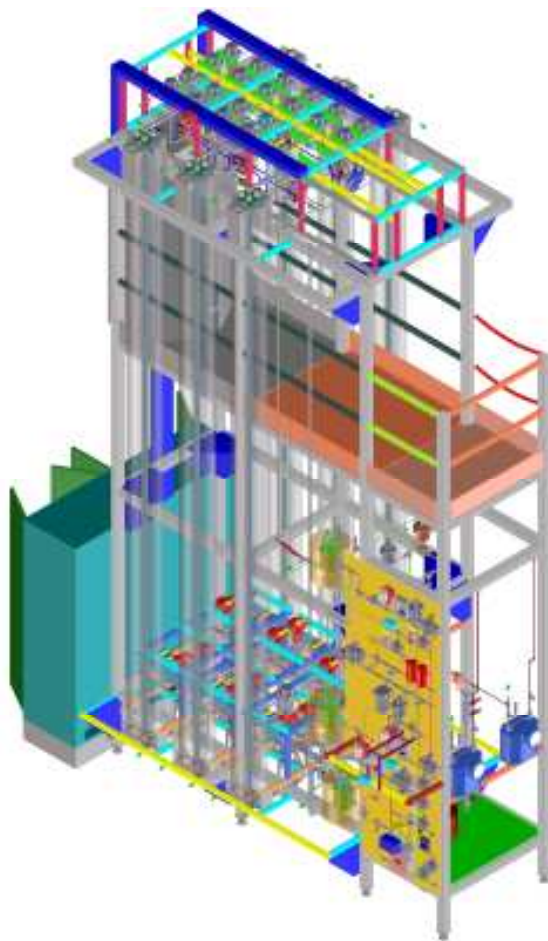


Lab-Scale Plant, Multiple Reactors



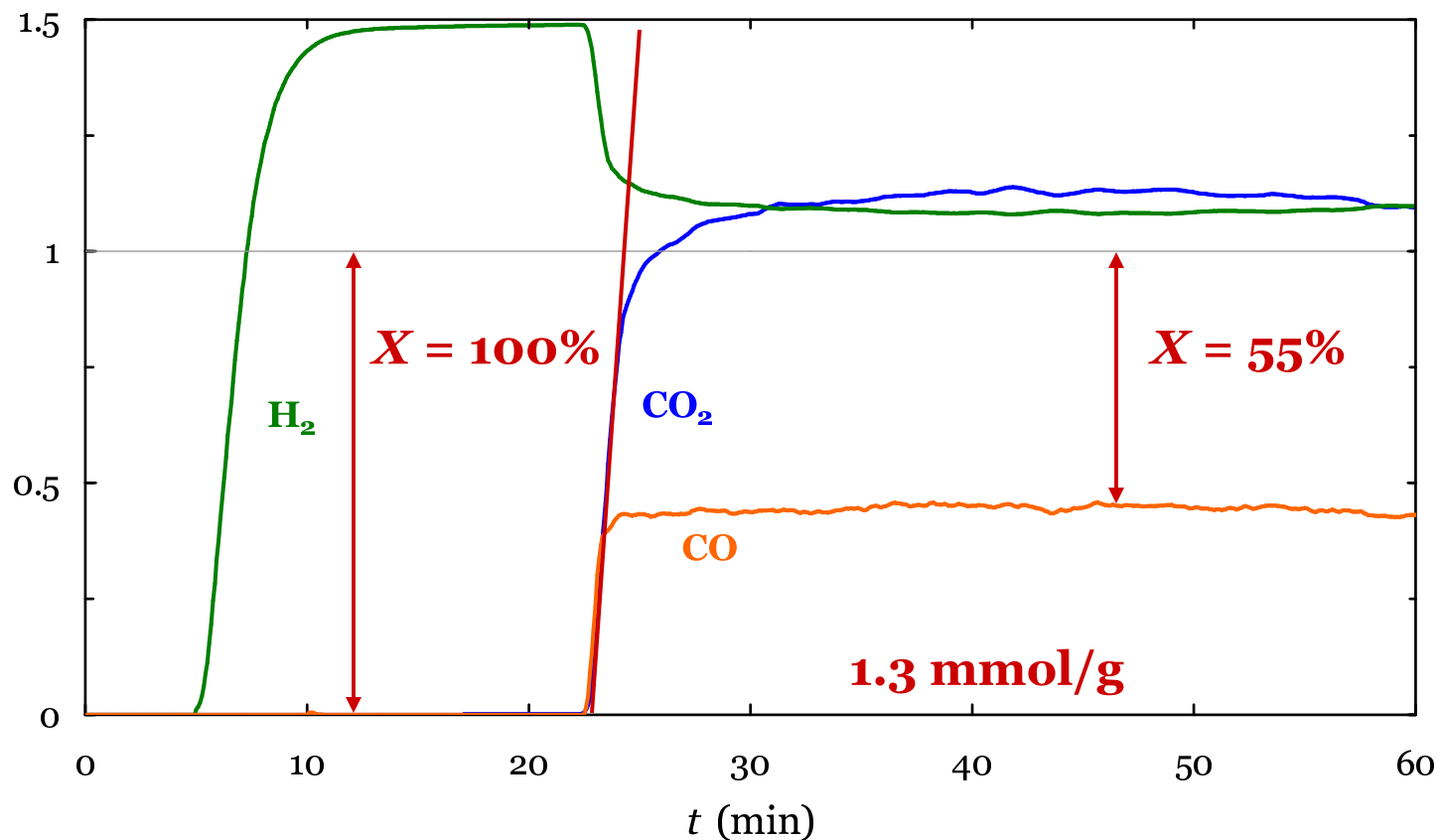


From Design to Commissioning

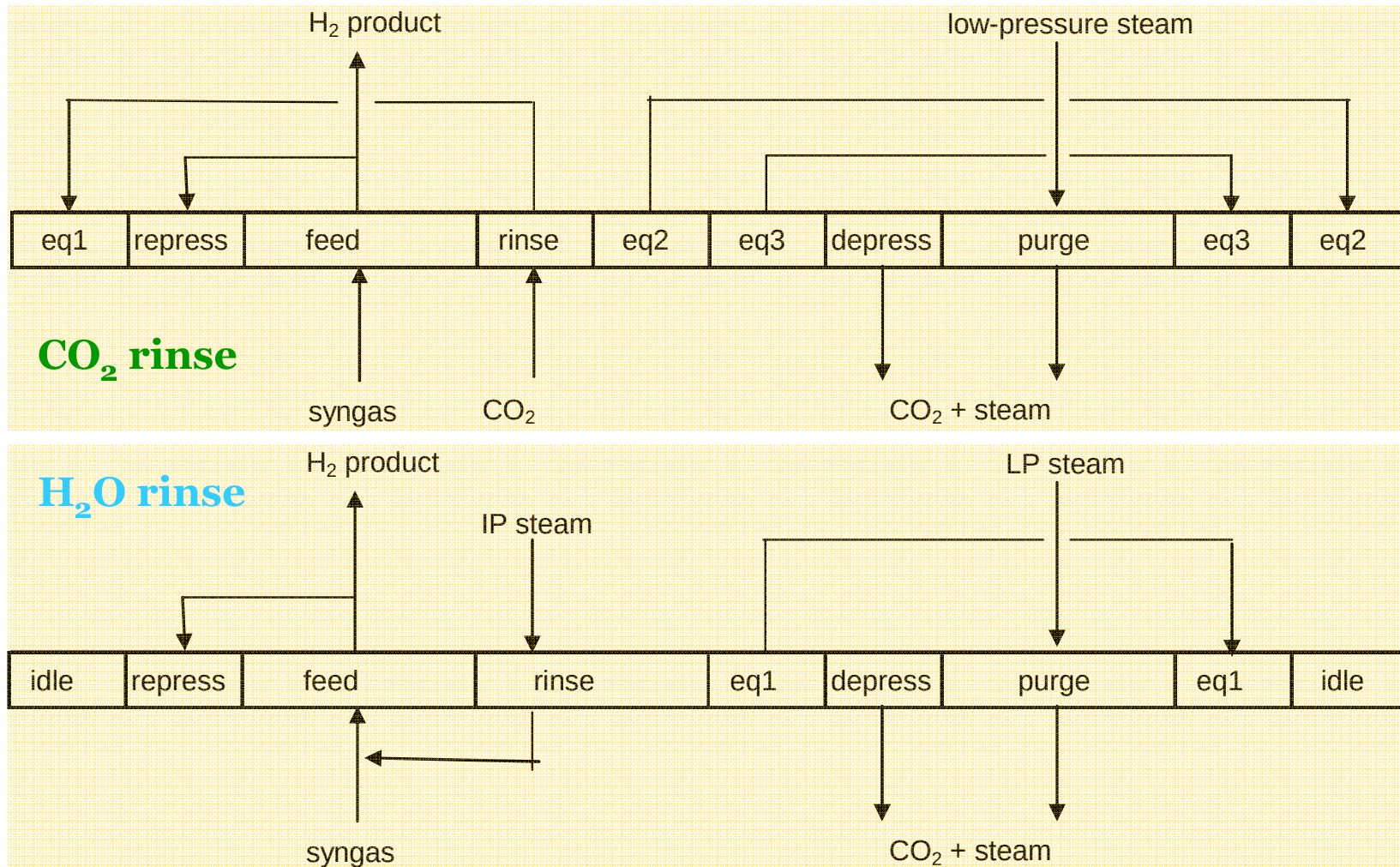


Breakthrough Tests (syngas)

$y_{i,out} / y_{i,in}$ 28 bar, 400 °C, CO₂ 15%, CO 9%, H₂ 51%, H₂O 25%



Cycle Types

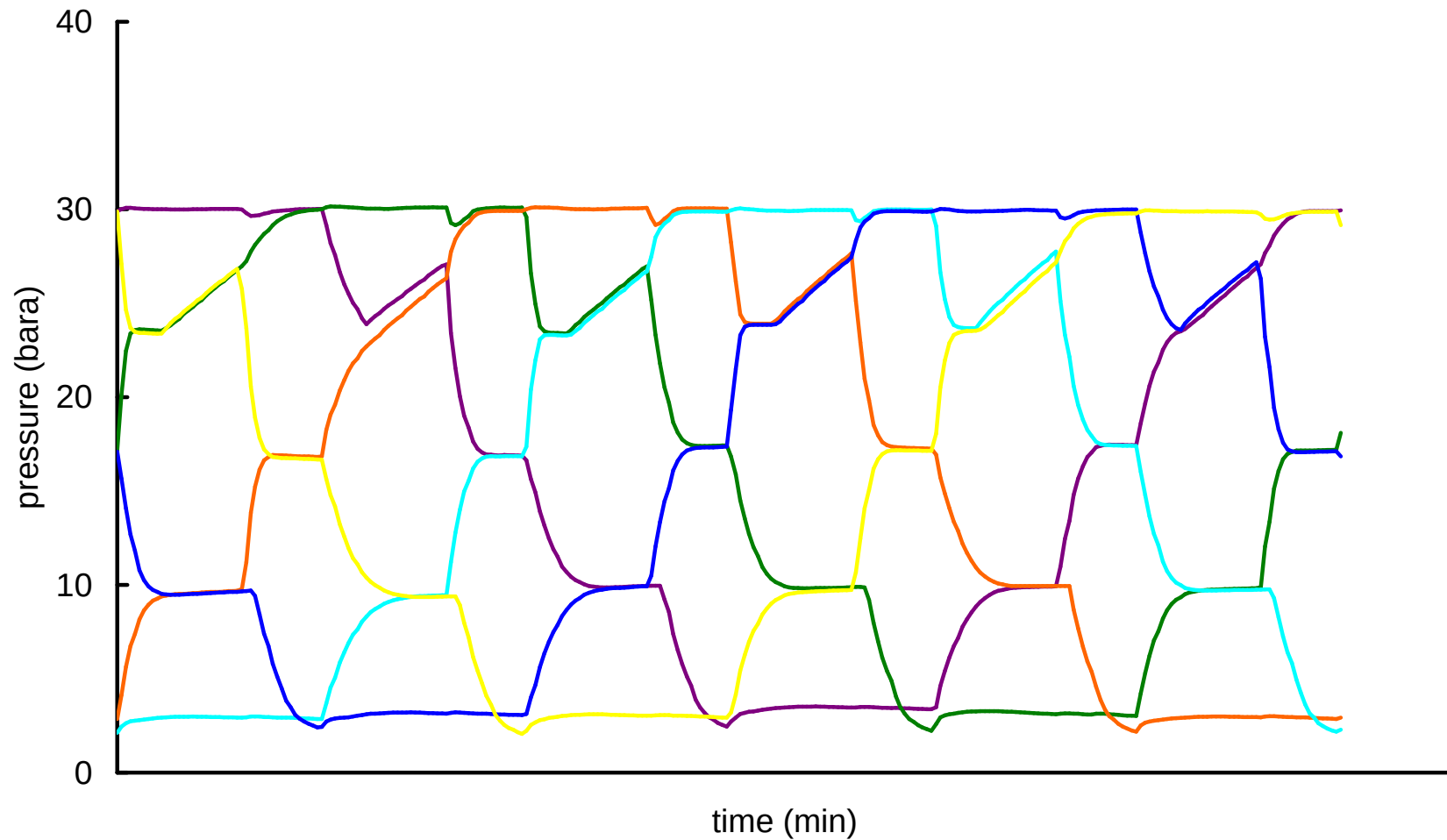


Experimental Conditions

Feed pressure	30 bar
Reactor temperature	400 °C
Purge flow / carbon feed flow	2 mol/mol
Feed composition:	

H ₂	CO ₂	CO	N ₂	H ₂ O	
38	13	6.4	43	12	%

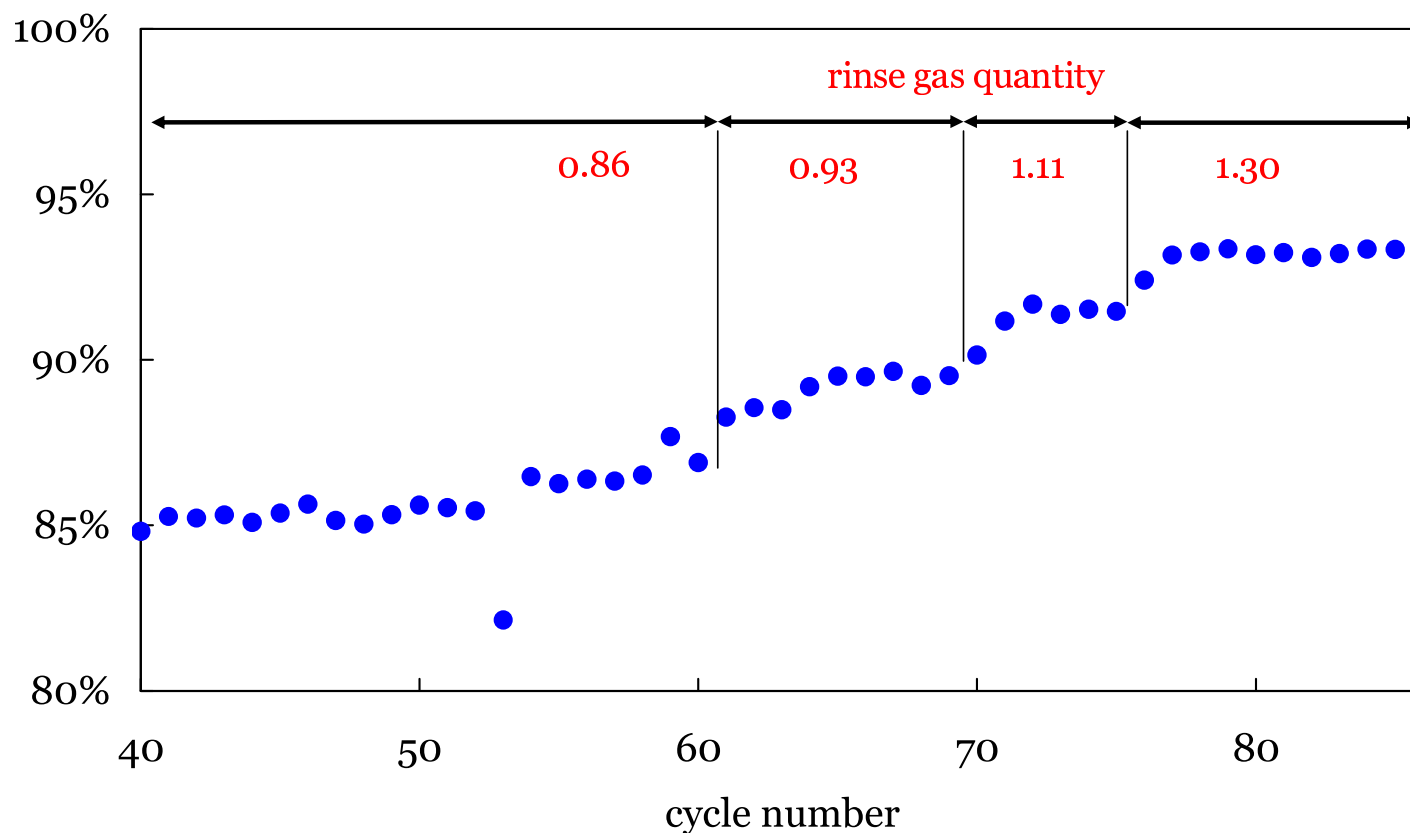
Reactor Pressures



Rinsing Effectiveness

CO₂ product purity

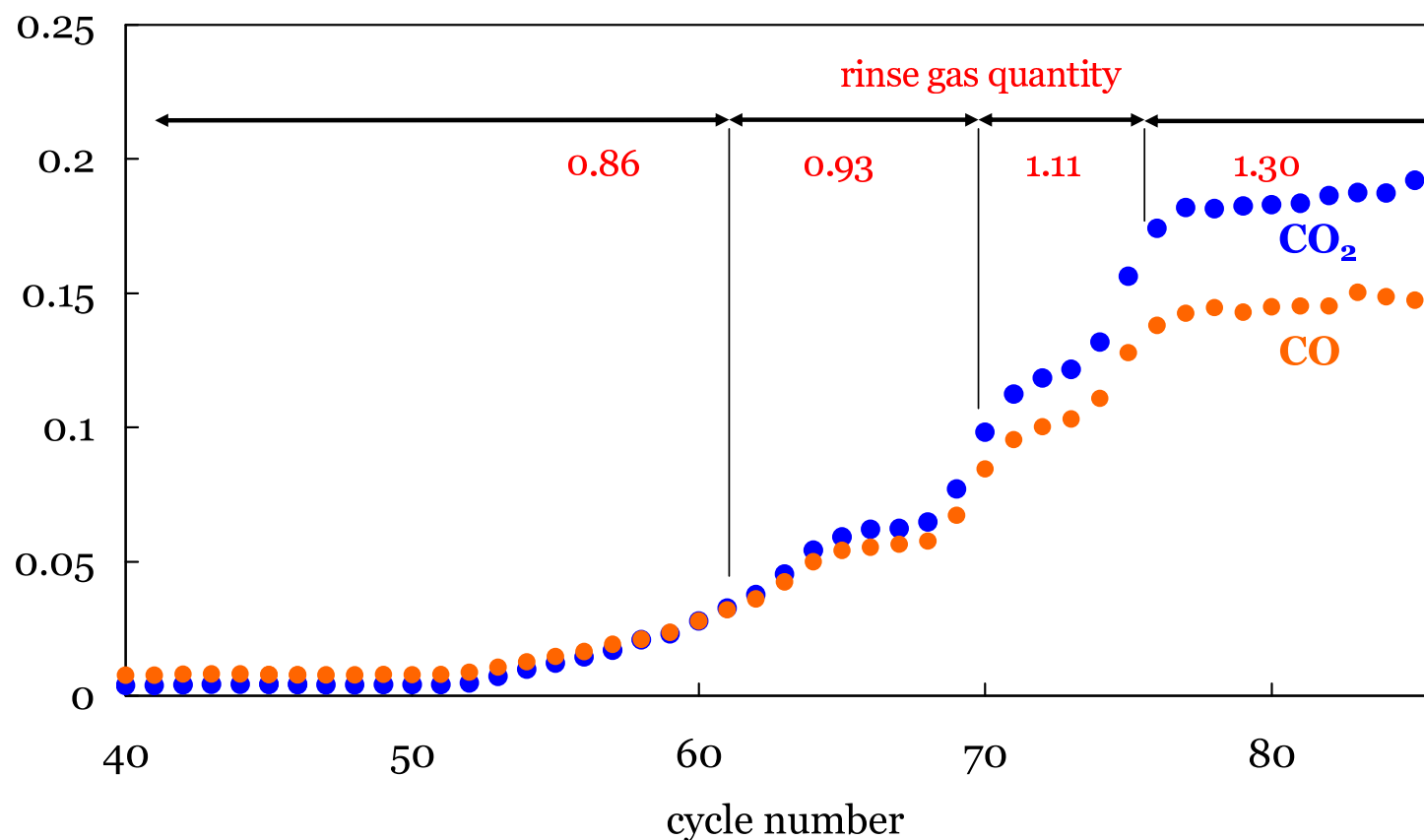
Feed not containing N₂



Impurities in H₂ product

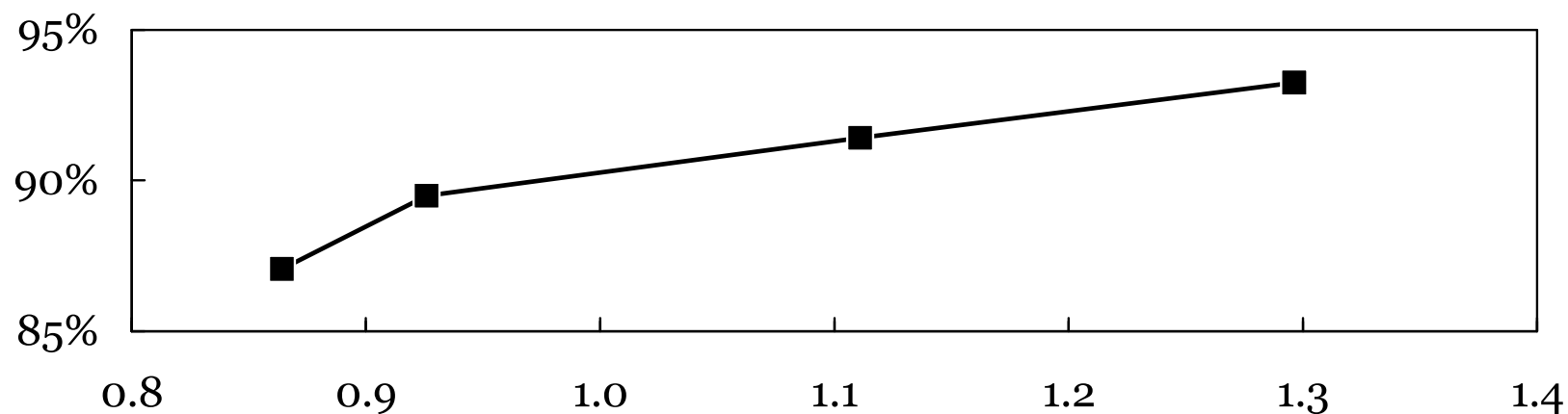
$y_{\text{product}}/y_{\text{feed}}$

Feed not containing N₂

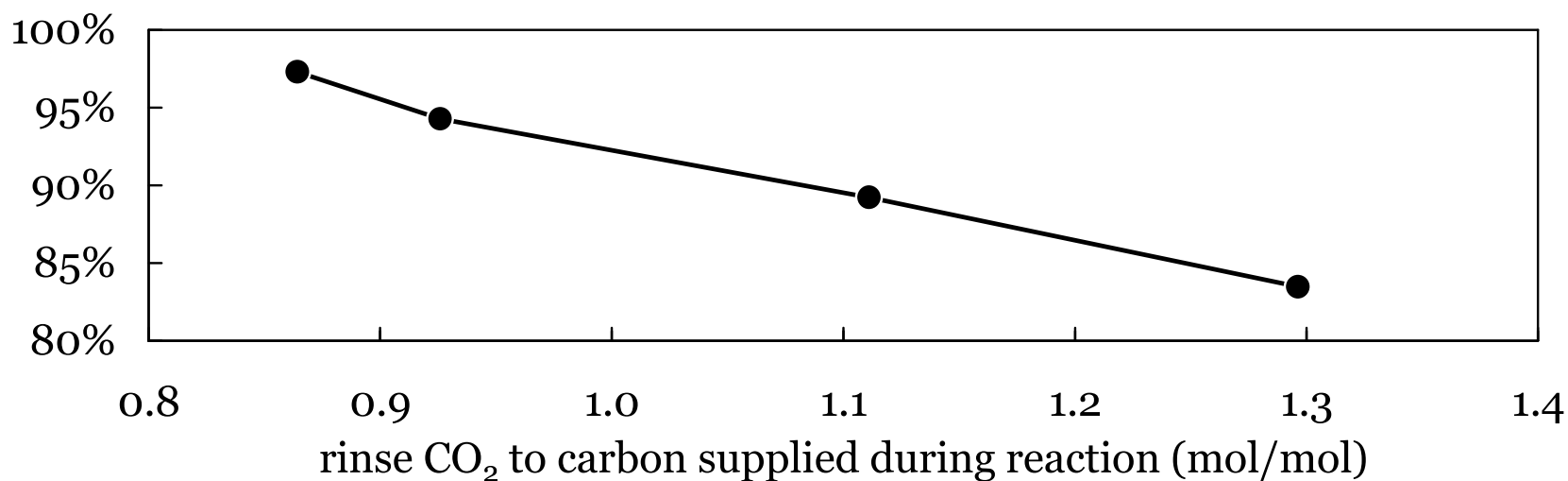


CO₂ purity

Feed not containing N₂



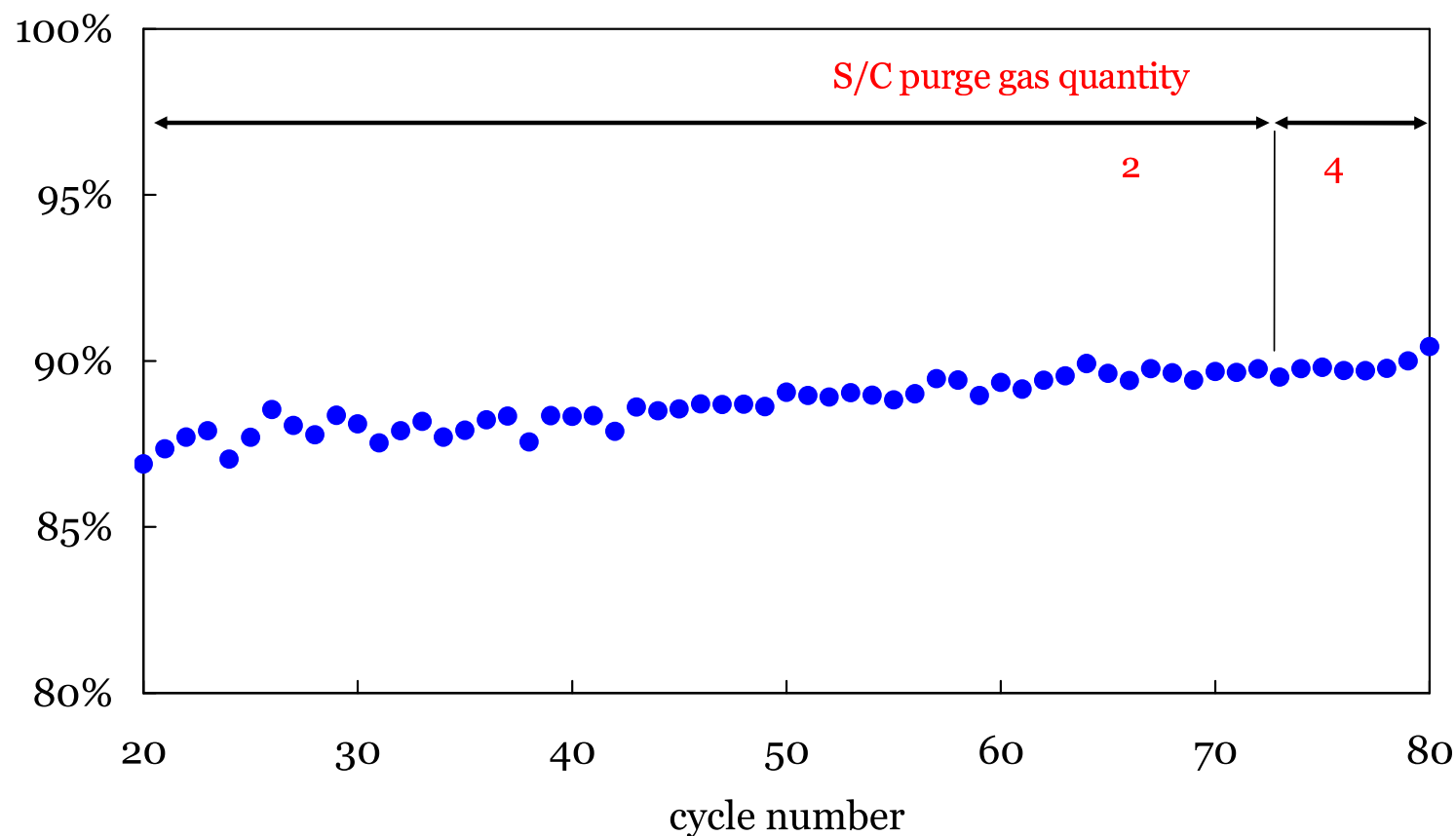
carbon capture ratio



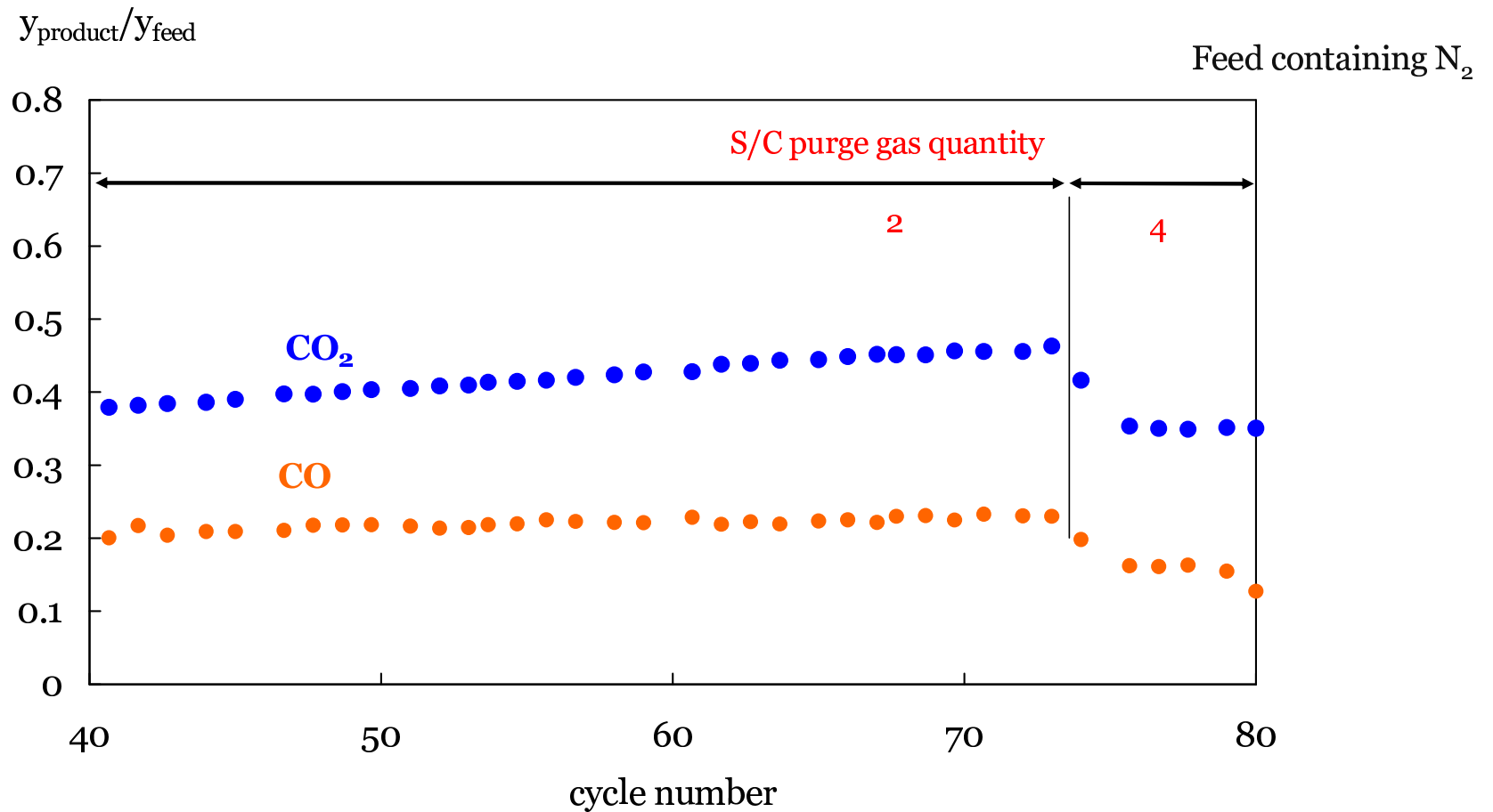
CO₂ product purity, purge flow

CO₂ product purity

Feed containing N₂

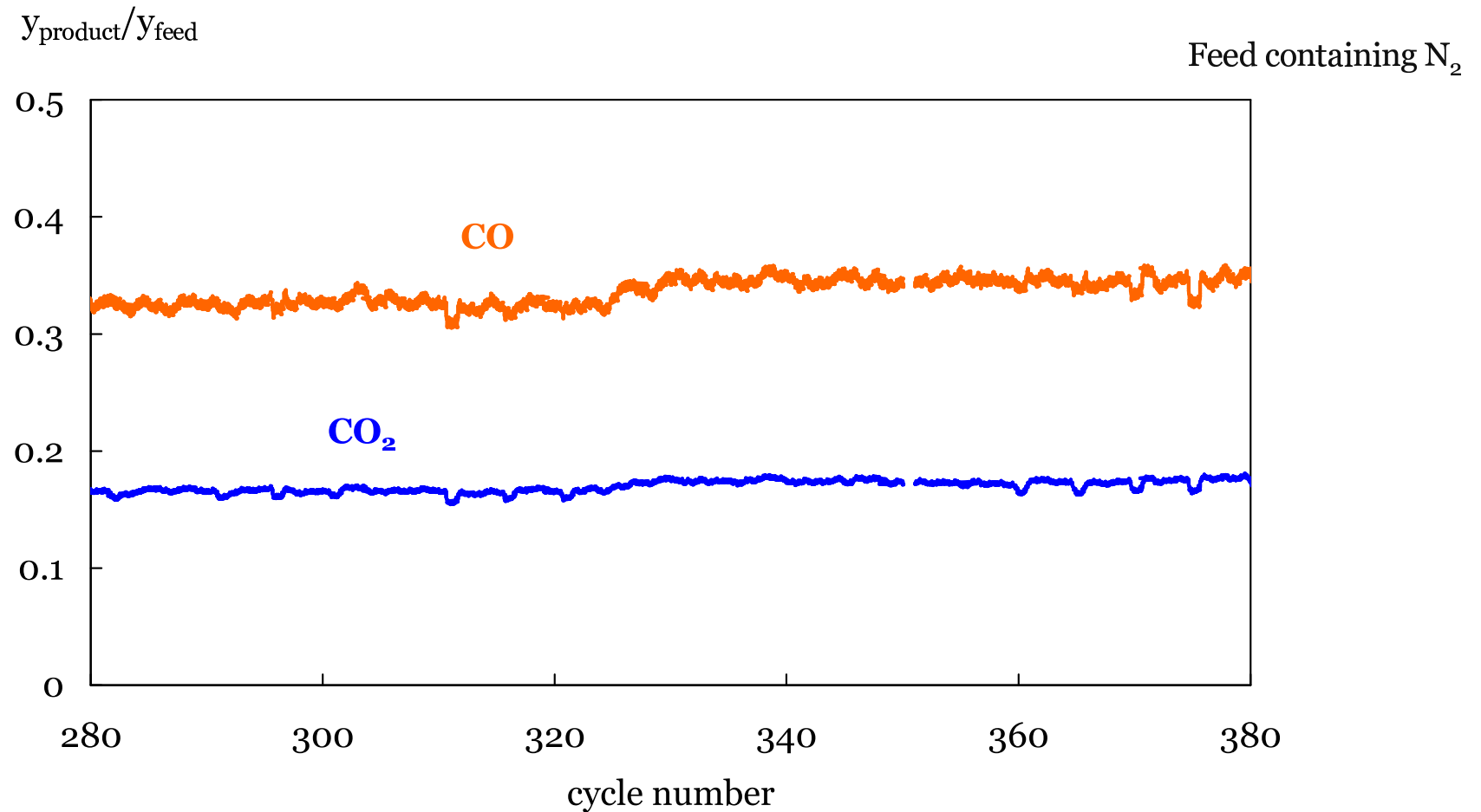


Impurities in H₂ product, purge flow



Impurities in H₂ product

steam rinse cycle

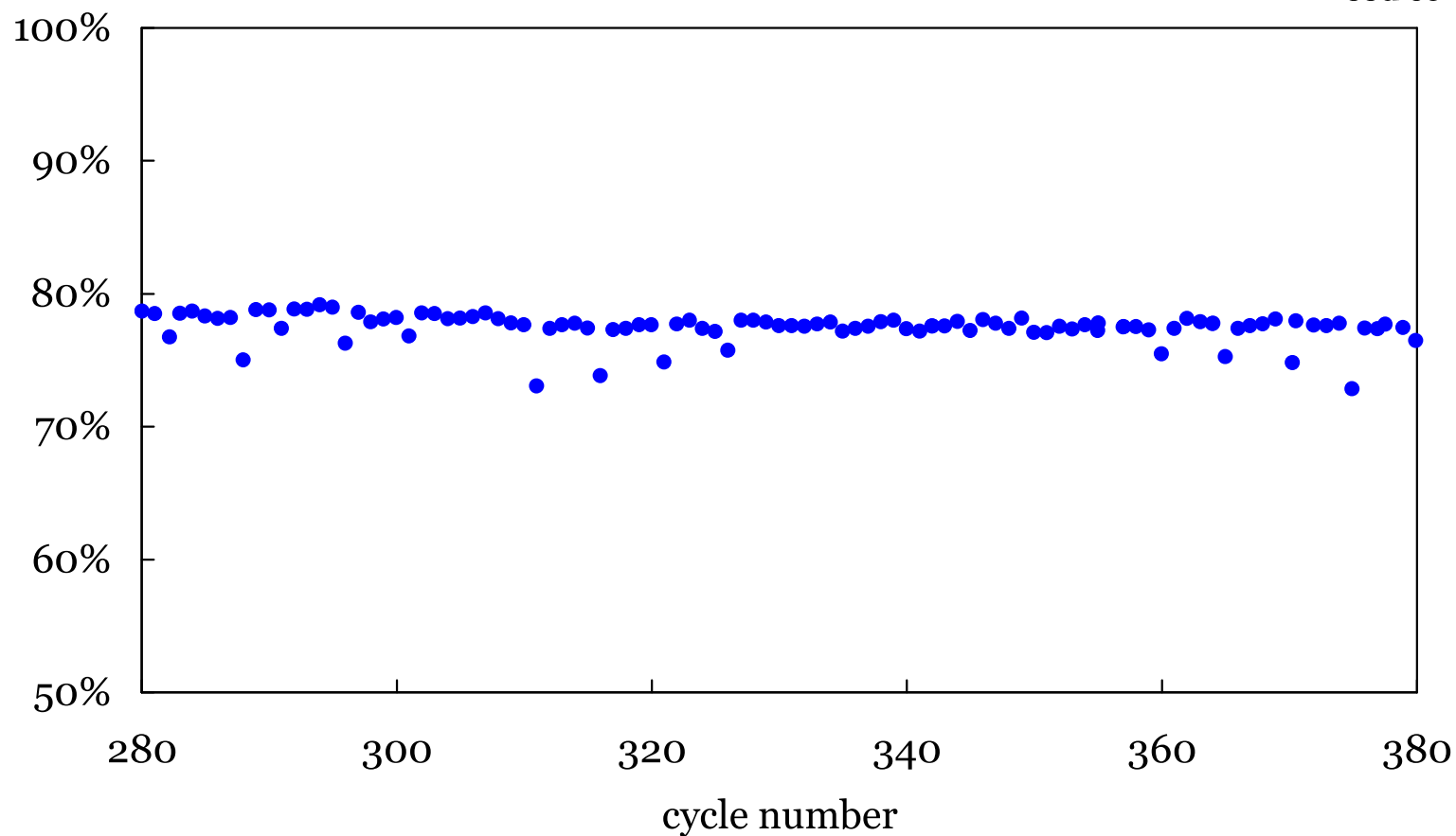


CO₂ product purity

steam rinse cycle

CO₂ product purity

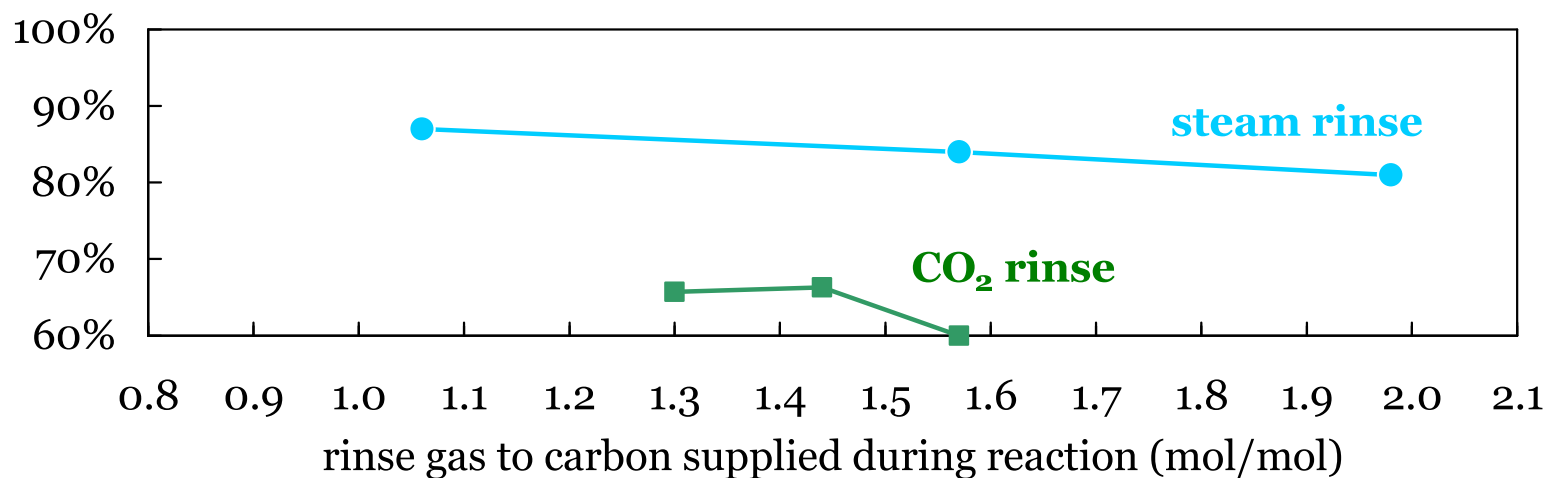
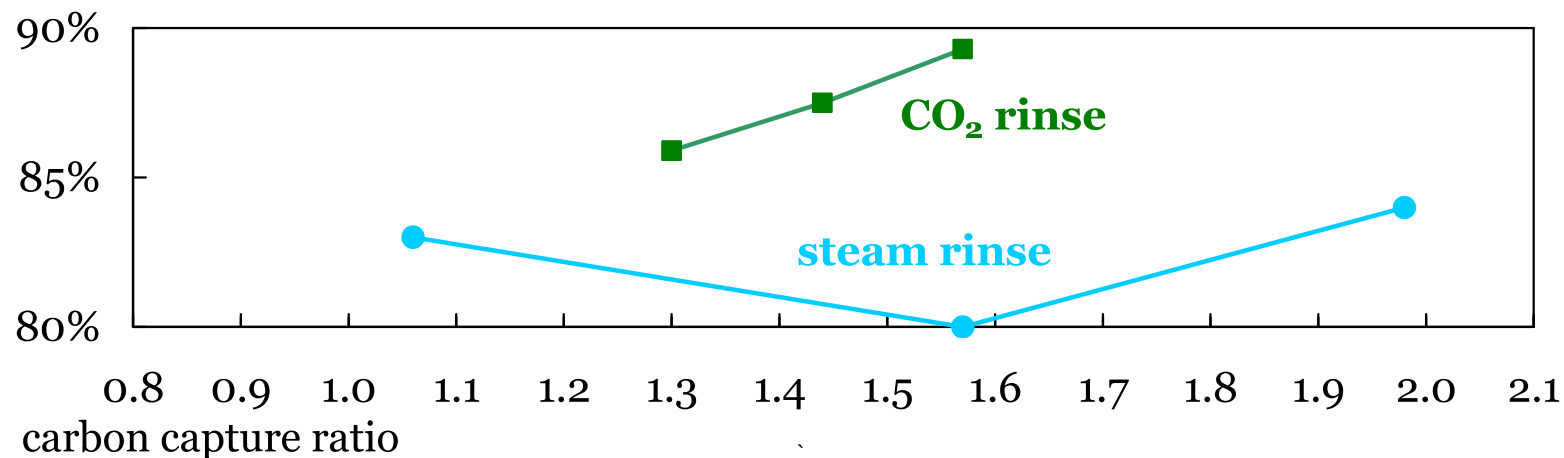
Feed containing N₂



Effects of quantity of rinse gas

CO₂ purity

Feed containing N₂



Recap

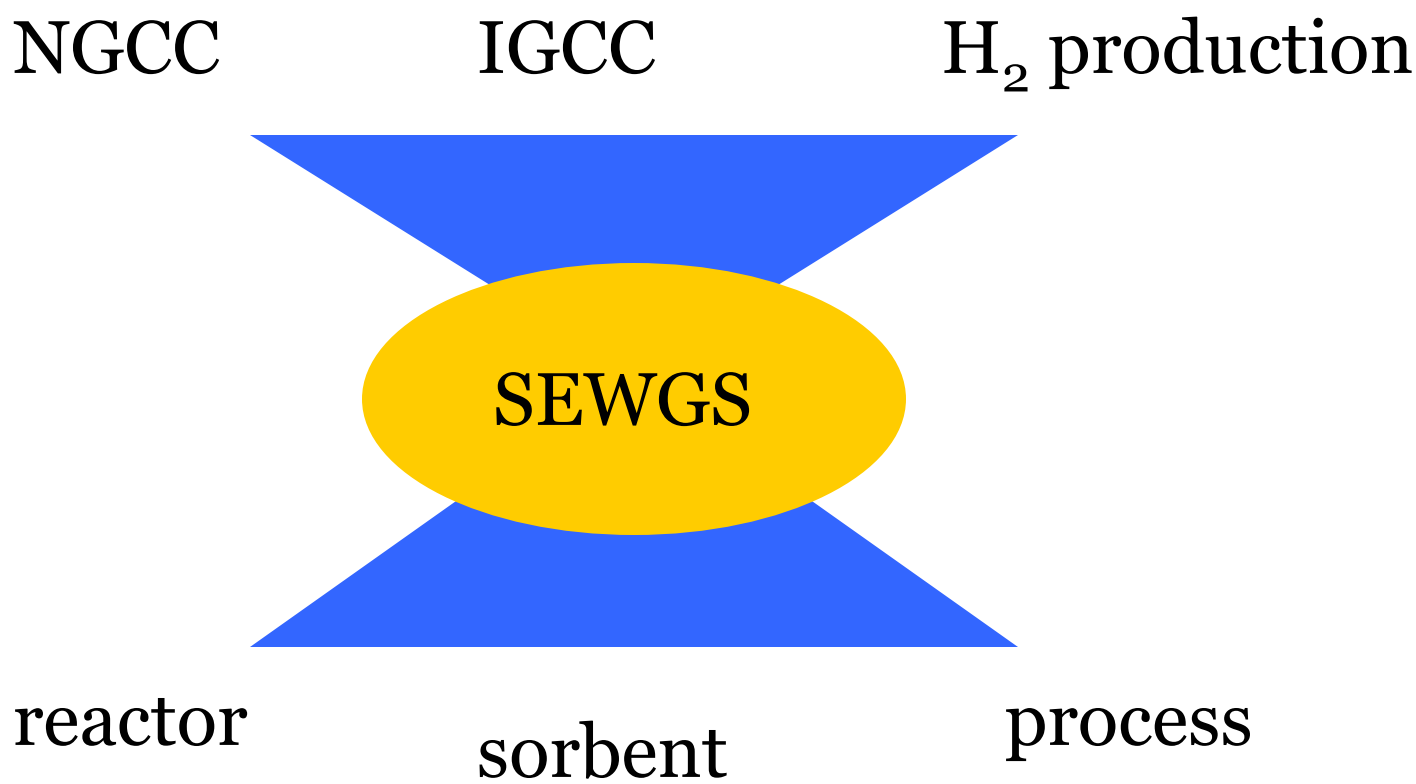
- HTC is suitable (breakthrough capacity 1.3 mmol/g, fast kinetics)
- Proof-of-concept SEWGS, 1000 cycles continuous H₂ & CO₂ production, two different cycle types
- Performance better for O₂-blown ATR than air-blown ATR. For O₂-blown ATR carbon recovery 90% and CO₂ purity 90% demonstrated
- CO₂ rinse cycle yields higher CO₂ purities than steam rinse cycle, but lower carbon recoveries
- By modelling optimisation of feed, rinse and purge flows to increase H₂ and CO₂ purities and determine best cycle type

Outlook

NGCC

IGCC

H₂ production



SEWGS

reactor

sorbent

process

CO₂ Catch-up Pilot Plant, Buggenum

Objective: Testing pre-combustion CO₂ capture technology at IGCC

- Identify and mitigate potential risks associated with the novel application
- Verify technology performance and operation window in the field environment
- Optimize technology selection and design
- Gather operating experience
- Prepare for large-scale application in Magnum

Pictures: NUON



More Info at www.cachetco2.eu



CO₂ Capture Project

