



A VERY COMPACT CO₂ ABSORPTION- DESORPTION PLANT

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Who?



cmr Prototech



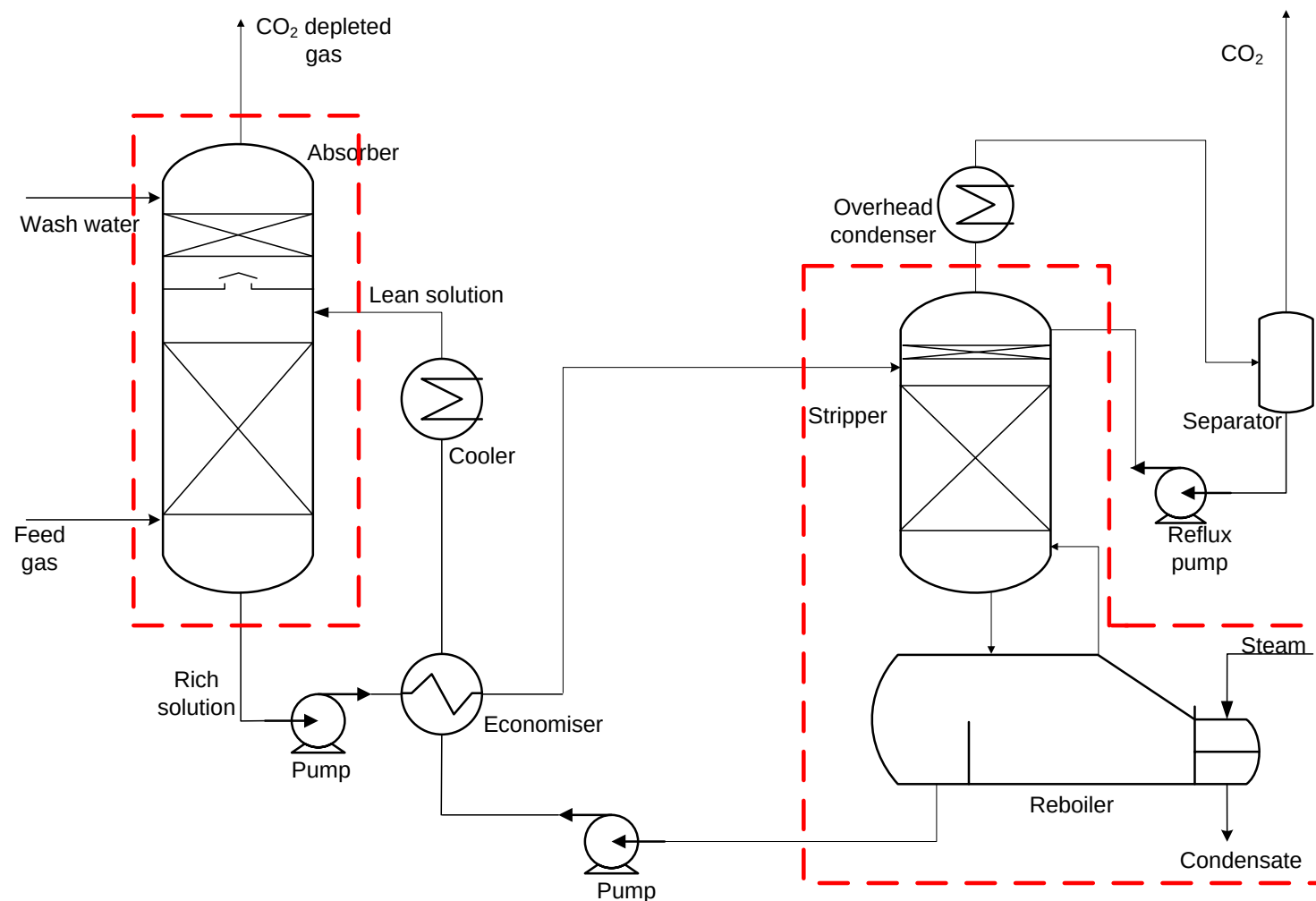
CLIMIT

We do **PROCESS INTENSIFICATION**

Two defining statements:

- **Size reduction by two orders of magnitude**
- **Eliminate equipment item by combining functions**

Absorption-Desorption Plant Impact - 1

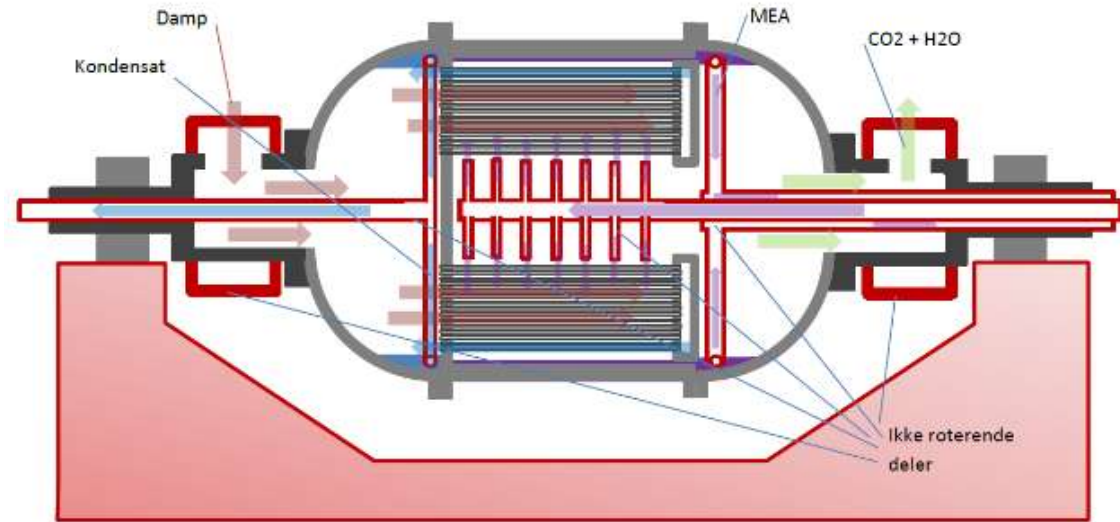


Units of flowsheet subjected to process intensification (PI) within red border.

Two separate units:

- CFA
- RDW

Absorption-Desorption Plant Impact - 2



RDW: Rotating Desorber Wheel

<< CFA: Cross-Flow Absorber

Solvent (absorbent) neutral, any liquid may be used

Desorber Skid – RDW Test Results

- 50-200 kg/h CO₂ stripped
- Solvent flow 1000-2500 kg/h
- 30wt% - 85 wt% MEA
- Steam pressure <8 bara
 - <3 bar ΔP to process
 - Leading to CO₂ delivered <5 bar
- Specific desorption rate: 200 kmol/m³.h
- Conventional design: 2.4 kmol/m³.h
 - Ratio RDW/conventional: >80

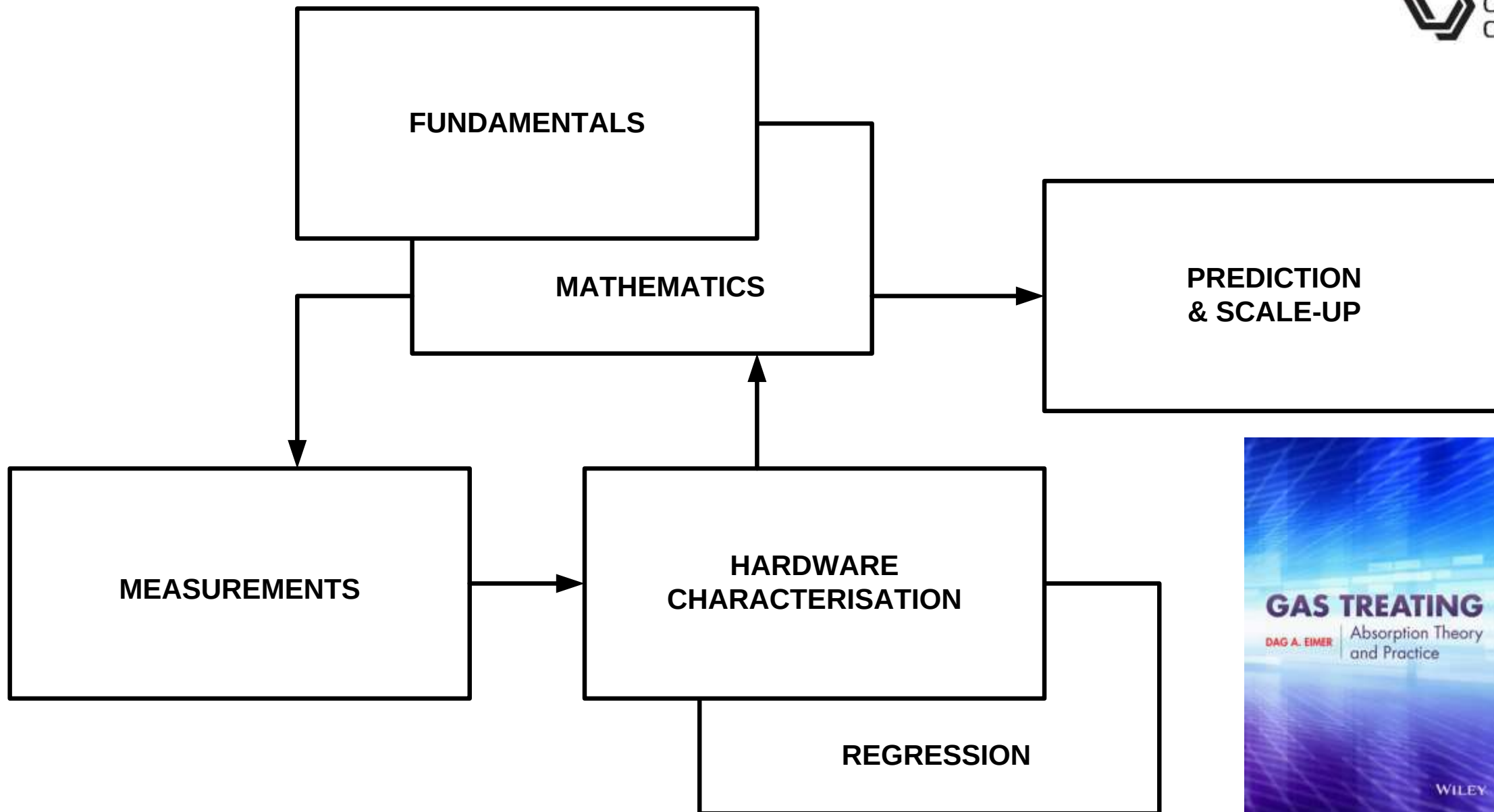


Present State of Development



Research Approach

- **Developed from basic principles:**
 - **Measuring fundamental properties and kinetic data**
 - **Modelling from first principles to the extent possible**
 - **CFD used for fluid flow analysis**
- **Using model to interpret small scale tests**
 - **Developing empirical model**
 - **Contact area gas/liquid plus plus**
- **Verification of model and design in pilot plant**

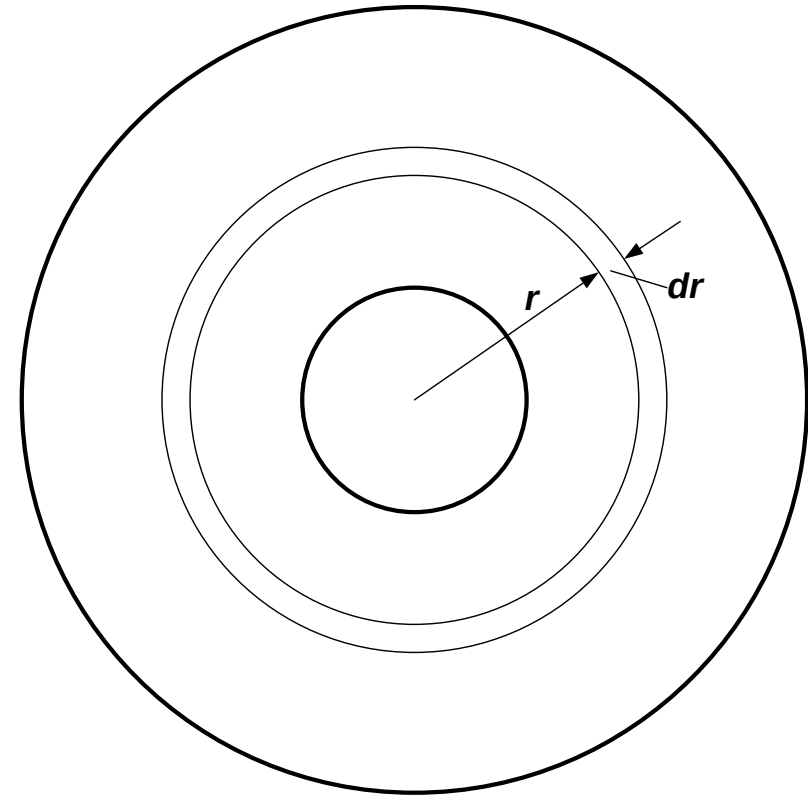


Model Concept

$$N_{CO_2} = a_{wet} k_L^o E (\Delta c)$$

$$E = \frac{\sqrt{D_{CO_2} k_2 [Amine]}}{k_L^o}$$

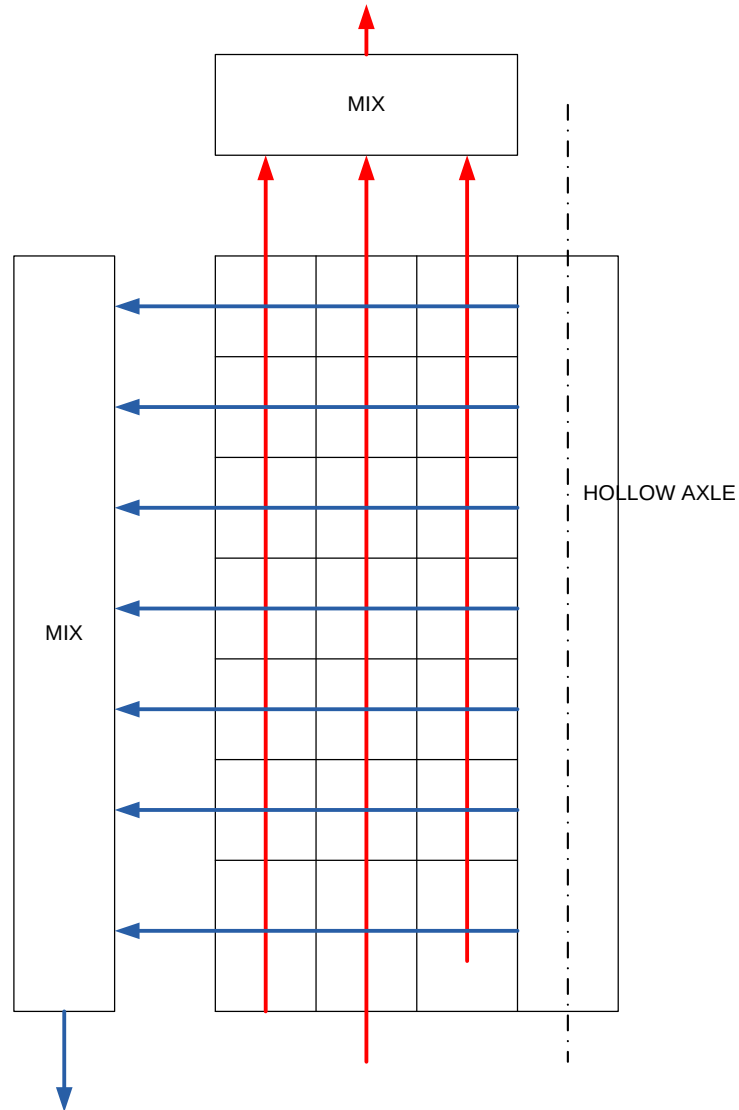
$$N_{CO_2} = a_{wet} \sqrt{D_{CO_2} k_2 [Amine]} (\Delta c)$$



One Stage, Small Scale CFA Test Rig

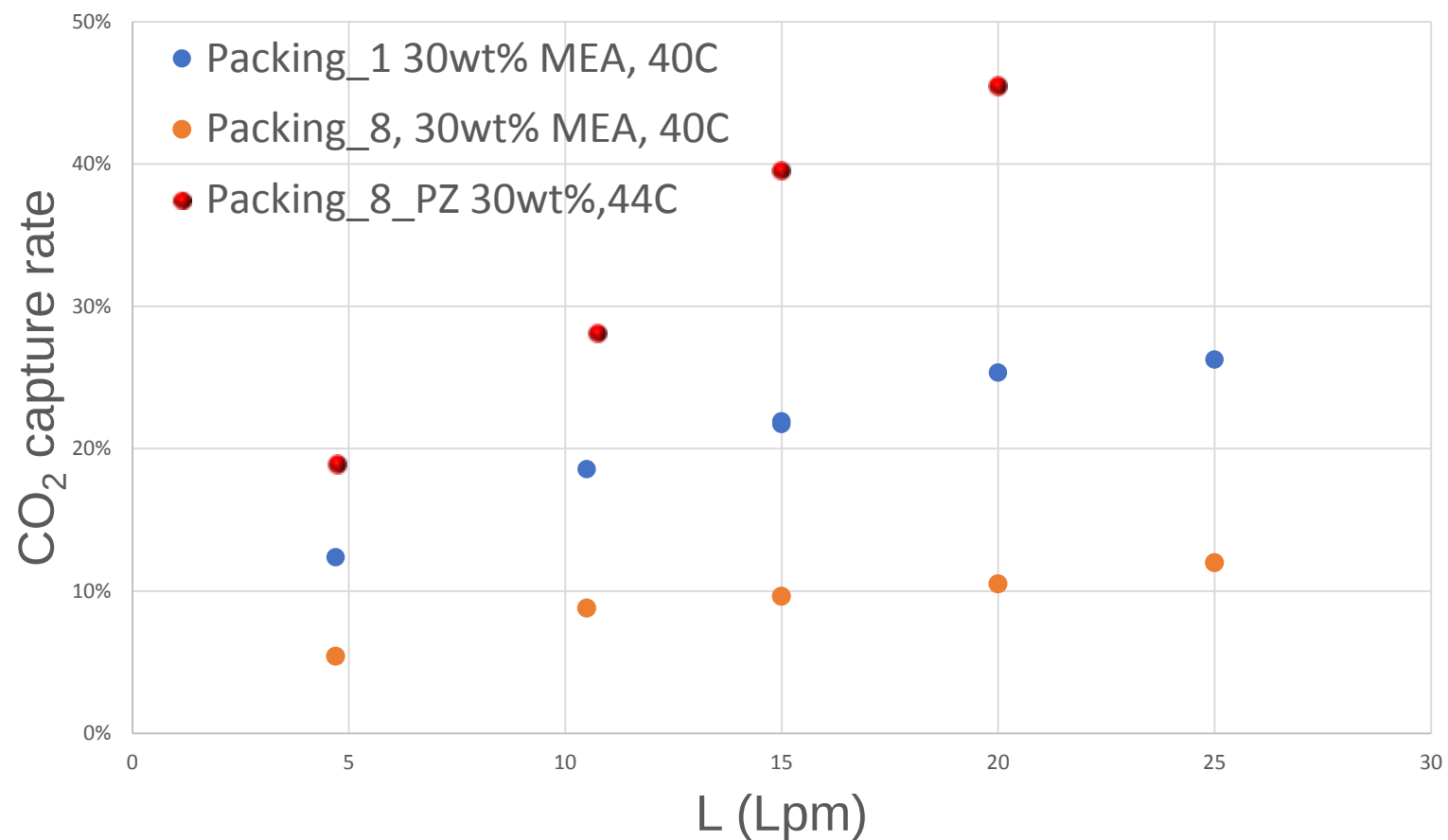


3C – Cross-Flow Absorber Concept



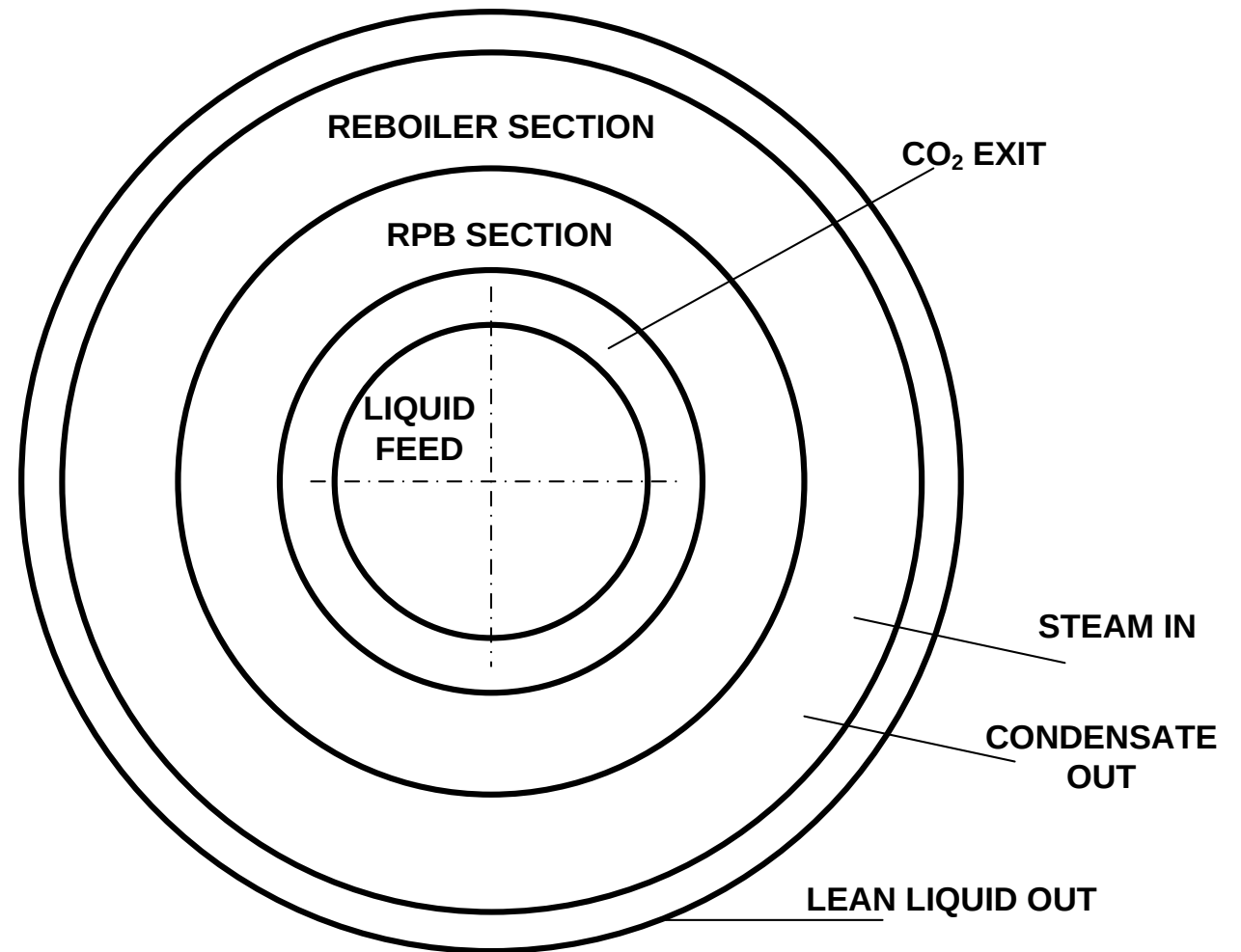
- **Reduced pressure drop**
 - (Relative to classic «Higee»)
- **Better than co-current**
- **May be «staged»**
 - **Approaching counter-current**
- **Robust design**
- **Horizontal axis equally possible**
- **Modelled!**

The CFA Small Scale Test Rig Results



RDW principle

- **MT & HT sections rotate**
- **Concentric sections**
- **Counter-current**
- **Pressurised**
- **Active section**
 - **id/od 170/650 mm**
 - **Length 75 mm**



RDW results

- **Liquid flow 1000 - 2500 kg/h**
- **MEA concentrations 35 – 85 % wt**
- **CO₂ desorbed <180 kg/h**
- **Temperatures 120 – 160 °C**

DERIVED DATA:

- **Reboiler duty*: 2.4 – 3.6 MJ/kg CO₂**
- **Volume specific CO₂ desorption: <250 kmol CO₂/(m³.h)**
 - **One study of a conventional plant: 2.4**

* Accounting for pressure of CO₂ and reduced compression power



Salient Data for Pilot Plant

CFA

- 4 sections available
- Inner/outer diameter 300/800 mm
- Height 300 mm
- Packing: Wound mesh
- Gas flow cross section: 0.44 m²
- <600 rpm



RDW

- Axial length 75 mm
- Inner/outer diameter 250/650 mm
- <900 rpm
- Recovery of kinetic energy of stripped absorbent



Data from CFA Pilot Plant

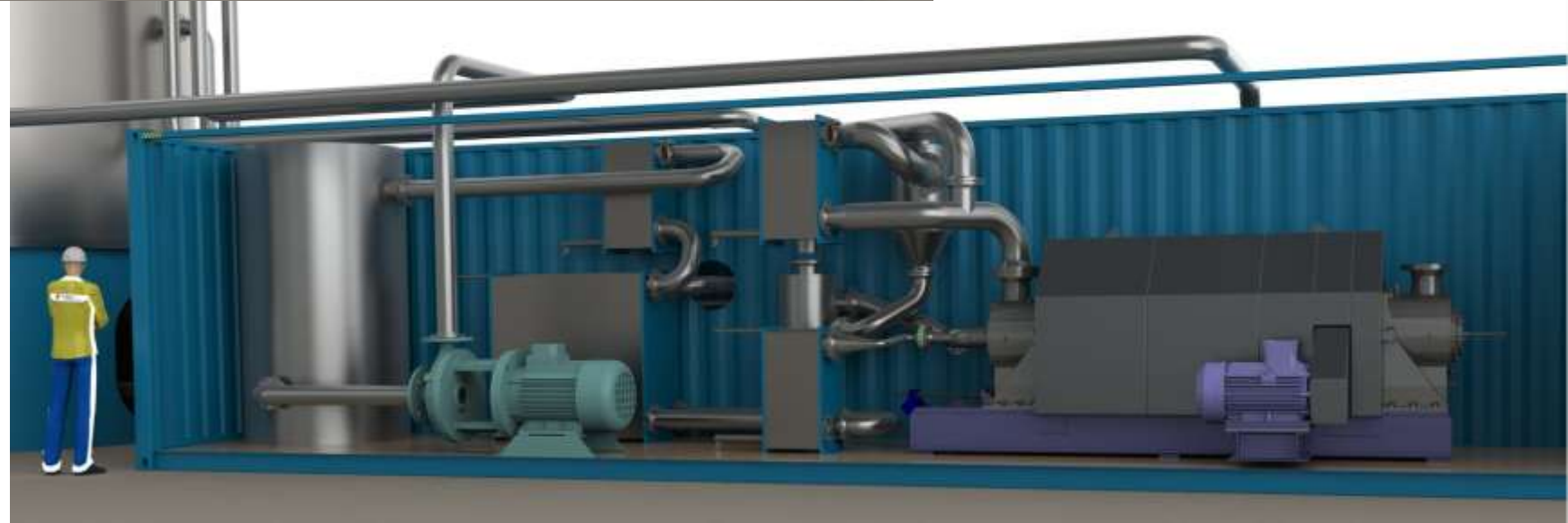
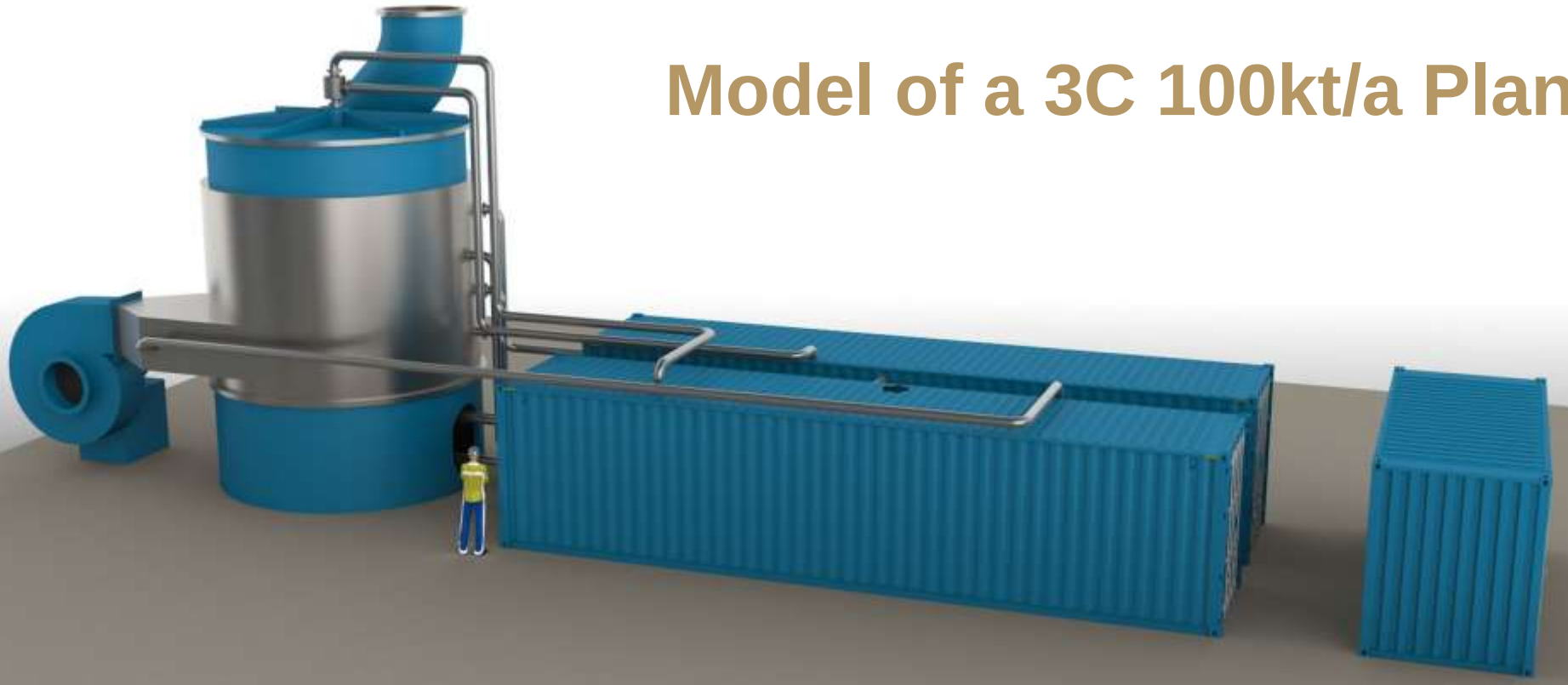


Liquid flow	Gas flow	CFA	CO2 inlet	Capture of CO2	CO2 loading out
Lpm	kg/h	rpm	vol%	%	mol/mol
31.8	2750	450	4.2	86	0.18
27.6	1150	550	9.4	96	0.24

Specific absorption rate (kmol/m ³ .h)			
	Conventional	0.99	
	CFA	32	
	Ratio	32	

CFA data are initial,
no optimisation.
70 % wt MEA

Model of a 3C 100kt/a Plant



VANTAGE POINTS

Compact

Low weight

Reduction in tag numbers

Less «secondary steel»

Lower footprint

Shop fabrication

Elements of mass production

Viscous liquid handled

3C in industrial
scale



TCM Mongstad



The old Homenkollen Skijump

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THANK YOU!

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