RECTISOL FOR CO2 CAPTURE

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INTRODUCTION

CO2 capture in IGCC

- Suitable physical solvents (choice due to high CO2 content)
- In CCS-IGCC typically considered same method as for desulphurisation
- Several methods and solvents exist:
  - Selexol (dimethyl ether of polyethylene glycol)
    - In literature slightly favoured in energy demand
  - Rectisol (MeOH)
    - Cheap and commonly available solvent
  - Purisol (NMP)
  - Fluor Solvent (propylene carbonate)
  - Other

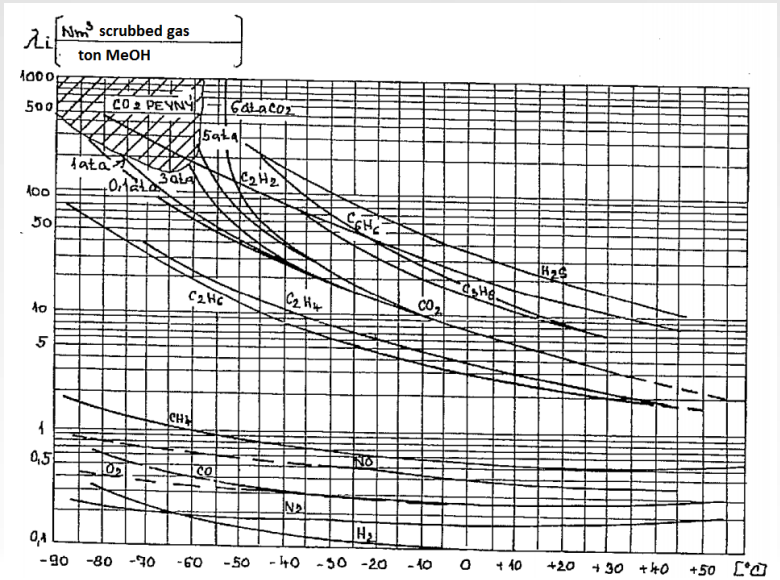
- Direct experience from Vřesová IGCC plant determined use of Rectisol system (at least for first versions of analysis)

- Use of MeOH at very low temperatures (typically below 0°C)

PRINCIPLE

- Absorption (counterflow absorber column)
- Desorption
  - Pressure swing (flash drum)
  - Temperature swing (distillation column)

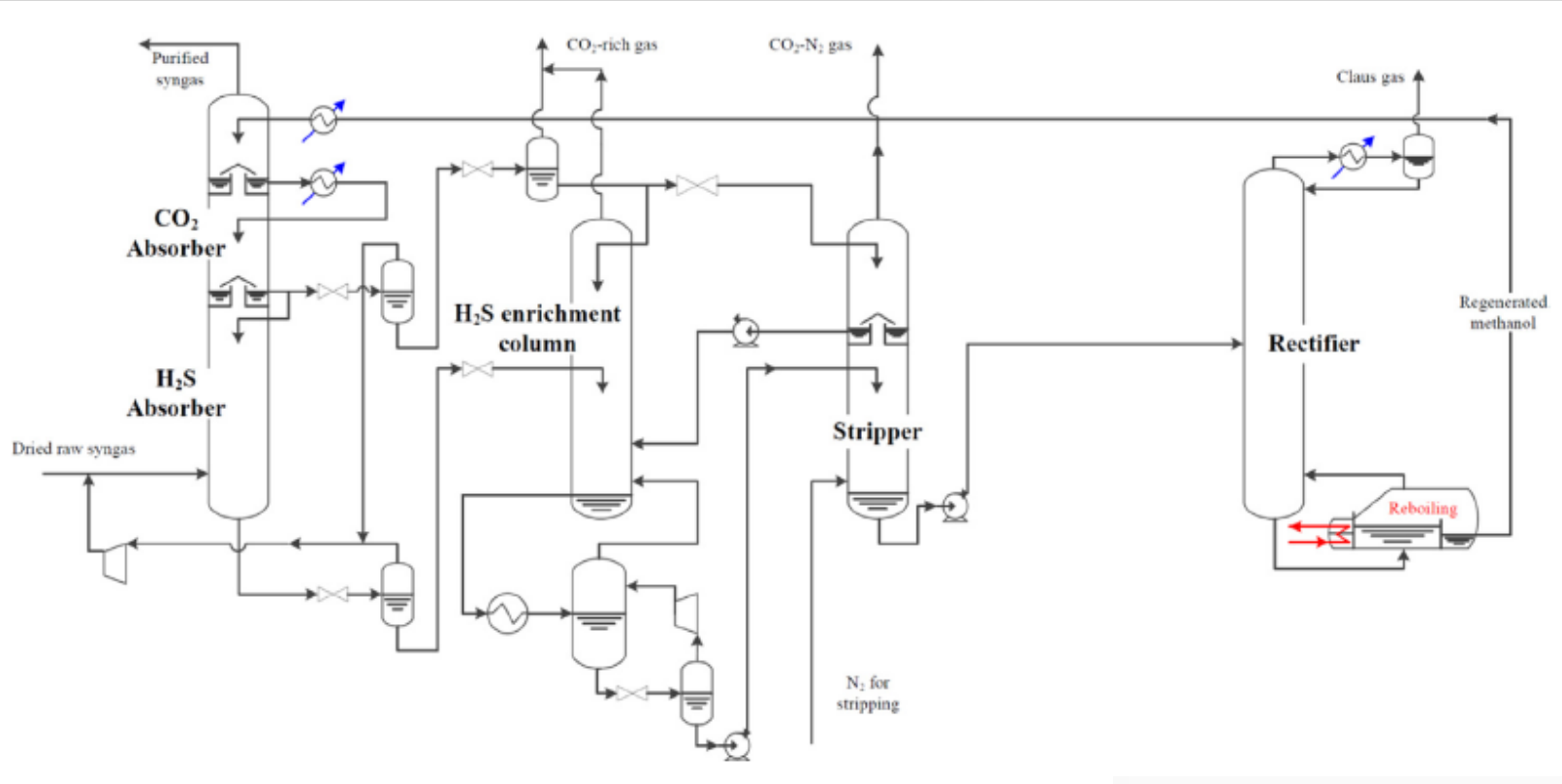
- Higher solubility of H2S than CO2 → H2S must be scrubbed first
- Higher solubility at lower temperatures
- MeOH absorbs all H2O in gas – necessary MeOH regeneration



Solubility of gases present in syngas in MeOH (Linde for Vřesová plant)

PRINCIPLE II

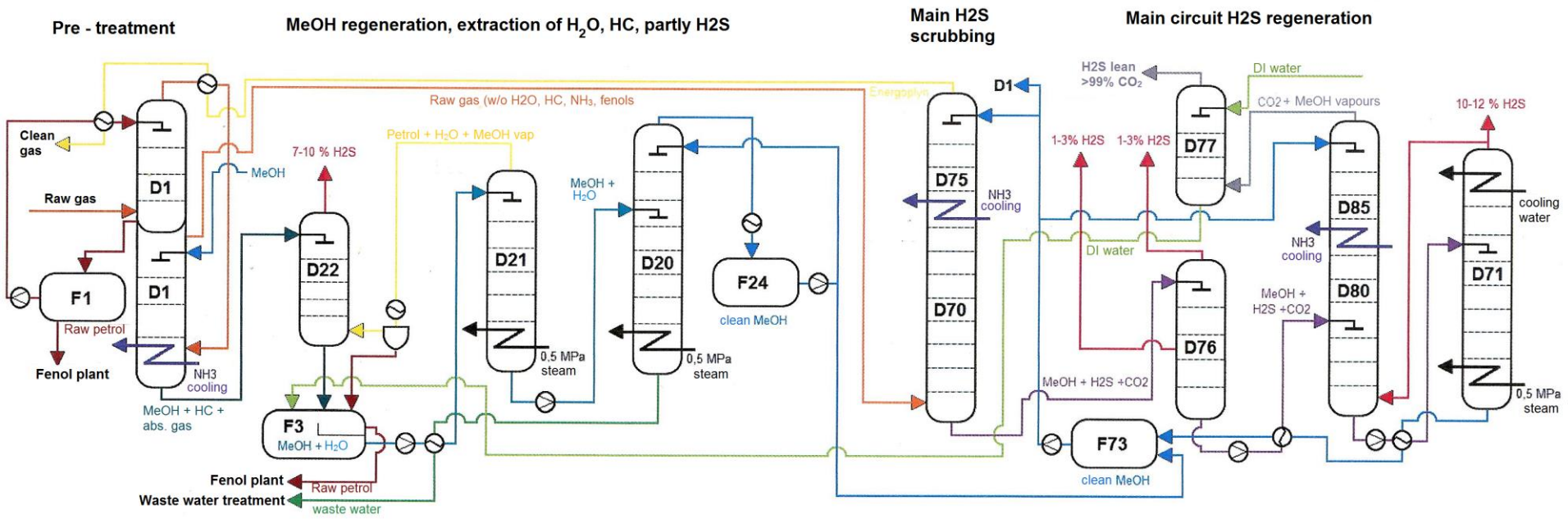
- 2 basic configurations from Lurgi and Linde



Typical Lurgi and Linde scheme of Rectisol process for both H2S and CO2 capture (Gatti, Manuele, et al. 2014)

RECTISOL at VŘESOVÁ

- MeOH at below zero temperatures ~ -20°C
- Necessary MeOH – H2O regeneration
- Scrubbing of MeOH in produced gases (especially in CO2 stream)
- With H2S scrubbed also part of CO2 – potential issue for captured amount



Simplified Rectisol scheme from Vřesová plant for only H2S scrubbing

ASPECTS OF CO2 CAPTURE BY RECTISOL

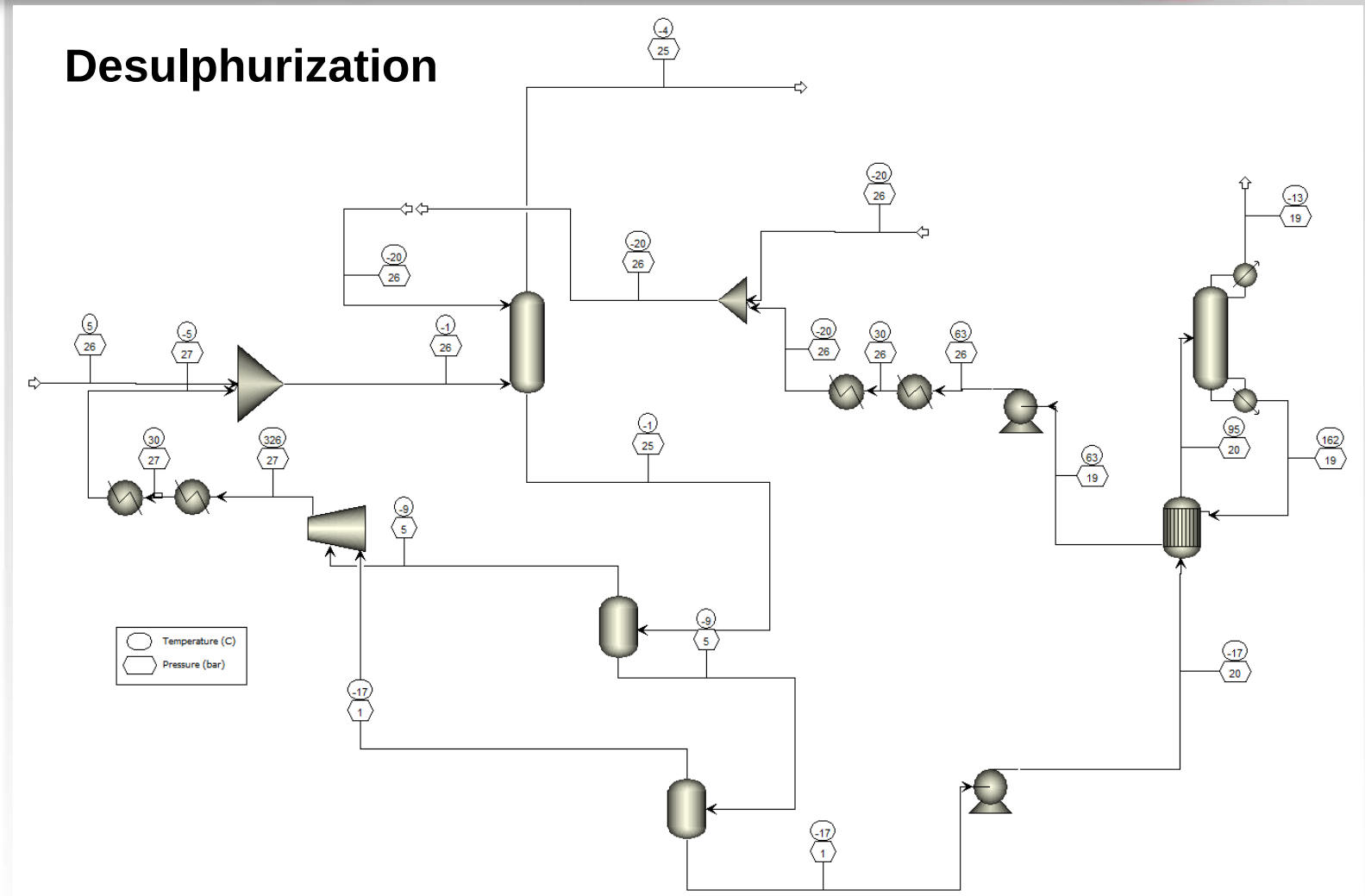
- CO2 scrubbed during desulphurisation
  - Signifficant amount, CO2 has over 90% in several H2S streams
  - Larger than reference case due to sour WGS (higher CO2 on syngas)
  - easily over 10% → possibilities for 90%+ capture limited
  - Unable to capture – released to atmosphere after off-gas processing
  - ➢ Increasing H2S content in off-gas
    - Recirculation (modelled)
    - N2 stripping (questionable effect on CO2 capture rate)

- Residual H2S scrubbed with captured CO2

- Compared to Vřesová
  - Lower content of higher HC, not needed pre-wash
  - Requirements on products require more energy (but simler configuration)

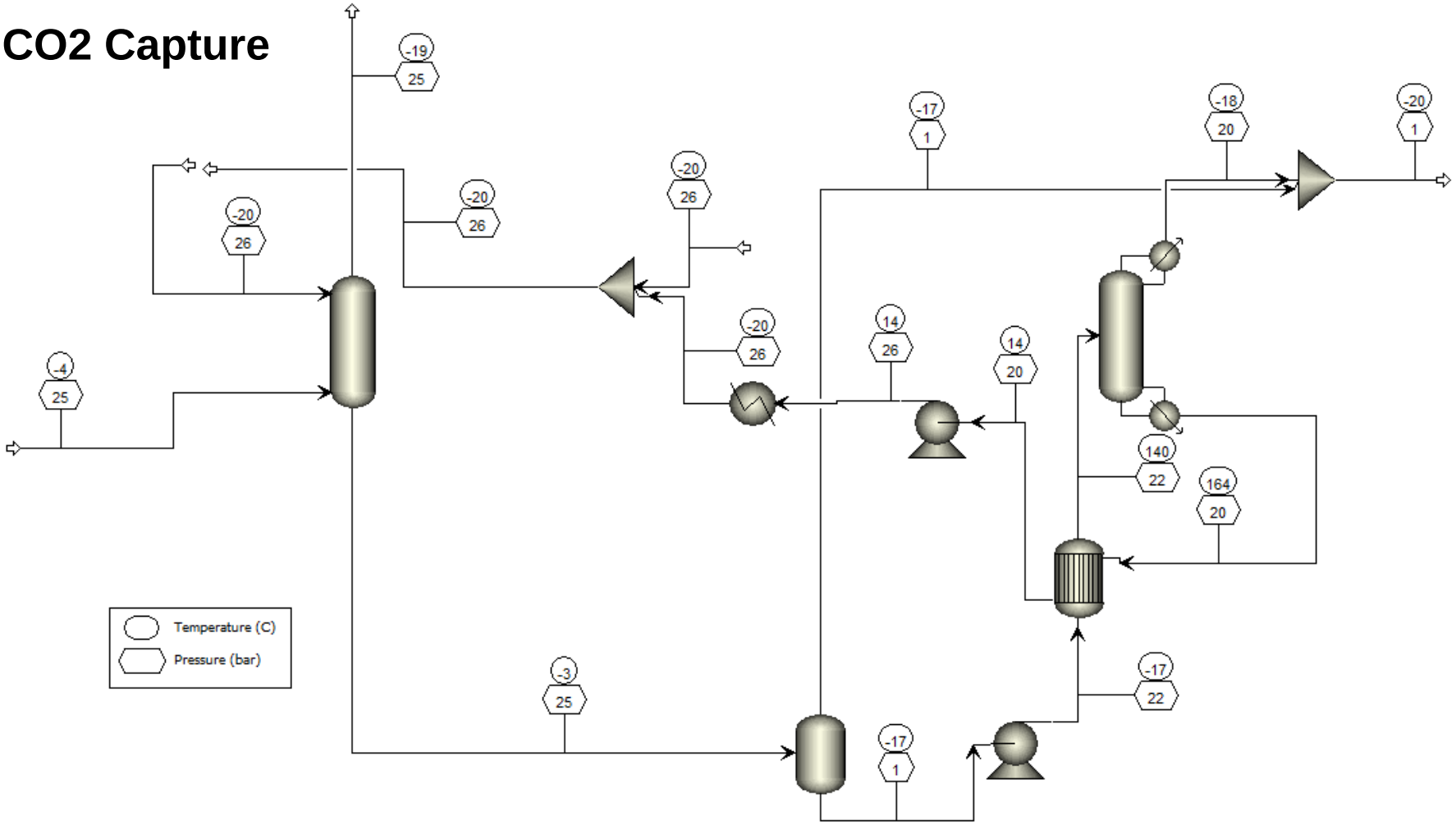
MODELING

Modelled in AspenPlus



MODELING

CO2 Capture



PRELIMINARY RESULTS

Main streams composition

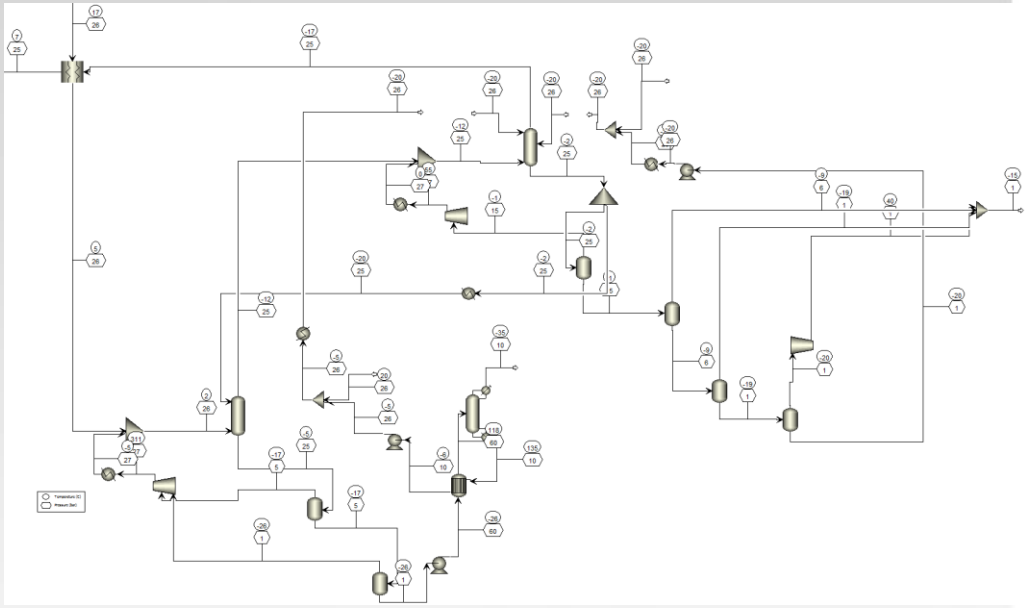
	Gas in	Gas interm	H2 out		H2S	Rec-H2S-1	Rec-H2S-01		CO2-01	CO2-02	CO2-out
Temperature [°C]	5,0	-3,6	-18,6		-13,5	-9,4	-17,2		-17,9	-16,8	-19,7
Pressure [bar]	26	25	25		19	5	1		20	1	1
Mole Frac [-]											
MEOH	0	1,38E-03	4,21E-04		1,06E-05	3,78E-03	9,96E-03		1,50E-04	0,01037	9,17E-03
CO2	0,387	0,379	0,027		0,807	0,969	0,954		0,998	0,979	0,981
H2S	3,15E-03	8,20E-06	1,92E-07		0,17428	0,011	0,030		1,96E-04	3,76E-05	5,63E-05
CO	9,21E-03	9,36E-03	0,015		1,37E-08	3,60E-04	3,21E-06		1,38E-06	2,66E-04	2,35E-04
N2	0,057	0,058	0,089		2,07E-06	5,71E-03	1,48E-04		7,54E-05	4,43E-03	3,92E-03
H2	0,535	0,544	0,856		1,73E-08	6,31E-03	1,56E-05		6,19E-06	4,55E-03	4,02E-03
AR	8,11E-03	8,24E-03	0,013		9,58E-07	1,20E-03	4,65E-05		2,34E-05	9,33E-04	8,26E-04
OTHERS	3,30E-04	2,67E-04	3,38E-05		0,019	2,09E-03	5,05E-03		1,44E-03	5,57E-04	6,61E-04

FURTHER WORK AND OPTIMIZATION

MeOH regeneration (from water, add pre-washing stage)

Interconnected configuration

MeOH from CO2 capture used in H2S capture, single distillation



Optimization of cooling, heating and heat recovery / regeneration

(Current distillation column condensers require low temperature refrigeration)