Rectisol Process for SynGas with CO2 for Enhanced Oil Recovery

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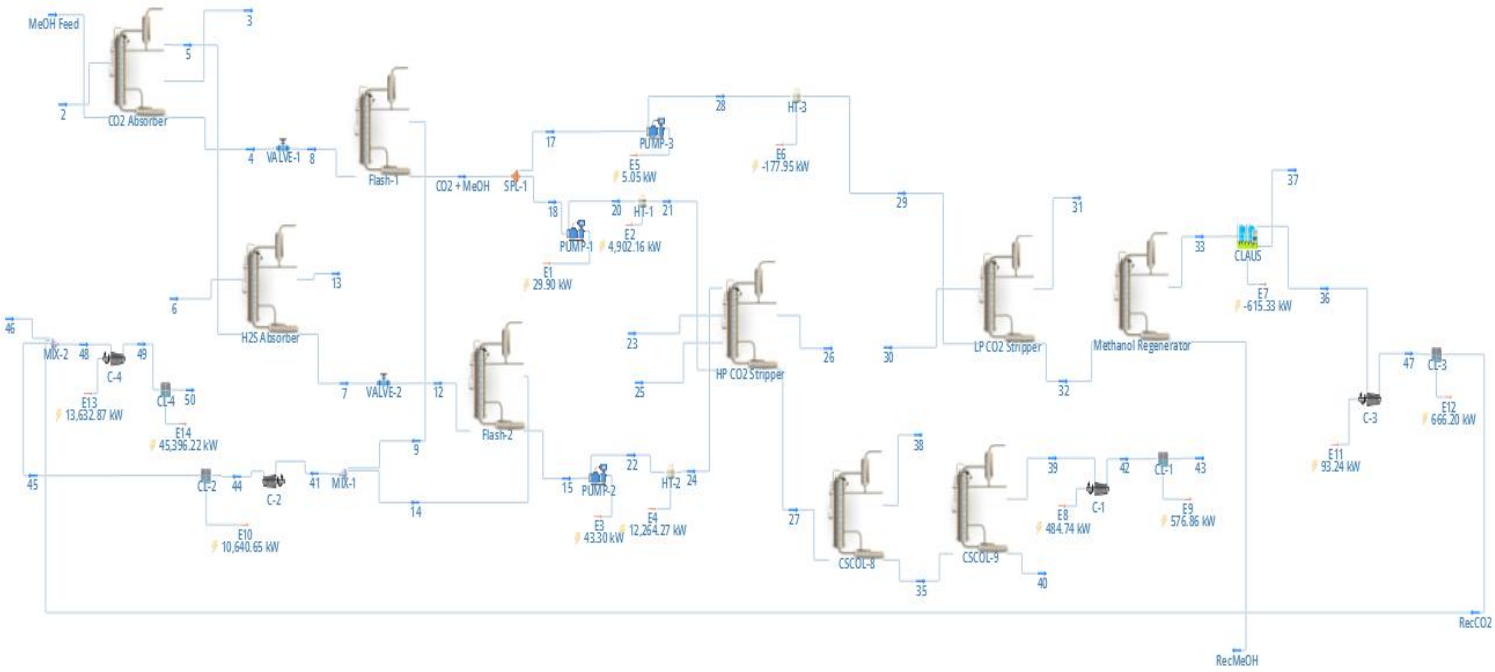
Background & Description:

The Rectisol process is a type of gas purification technology primarily used for the removal of acidic impurities, such as carbon dioxide (CO_2) and hydrogen sulfide (H_2S), from gases like synthesis gas (syngas) and natural gas. The process is used in various industrial applications, including the production of clean fuels, chemical feedstocks, and enhanced oil recovery (EOR). CO_2 injection into an Oil reservoir is one of the methods used in EOR to enhance oil recovery by reducing the viscosity of oil and increasing its mobility, while also pressurizing the reservoir and displacing oil towards production wells. This paper discussed and reviewed few of the schemes for Rectisol process for CO_2 capture. One of the schemes is used in this report to generate data and flowsheet is simulated using DWSIM.

In this flowsheet, two absorption towers (H2S absorber-10 stages and CO2 absorber-15 stages) are used. One is to absorb H_2S coming from the syngas with 10 stages and other to absorb CO2 from the remaining stream Methanol (MeOH) is used and top product of this CO2 absorber is clean SynGas. Then, the bottom products of the two absorbers goes to two separate flash units. The bottom product of the Flash-1 unit is sent to a splitter to split the stream in to two halfs, one is going as a top feed to the HP CO2 Stripper column (20 stages) and another is going as a top feed to the LP CO2 Stripper column (reboiled stripper is used with 15 stages). The bottom product of the Flash-2 unit is sent to the HP CO2 stripper as a bottom feed at stage 20. Top product of both HP & LP CO2 strippers are rich in CO2 with HP has nearly 89% and LP has almost 100% CO2. Bottom product of LP CO2 stripper is sent to a distillation column (Methanol Regenerator) to recover methanol from the bottom product which has 99.99% of methanol and H2S + CO2 will be leaving as top products from the column with H2S as 89.8% and CO2 as 10.5%.

Thermodynamic packages: For all the Material streams NRTL property is used. For 2 Absorption Columns (H2S absorber & CO2 absorber), 4 Flash columns, 2 Stripper columns (LP and HP), and a distillation column – Predictive SRK Equation of State (EOS) is used.

Flowsheet:



Results: Few of the Stream summary of Simulation results are shown in Table 1

Table 1: Simulation Results

Object (Streams)	Raw Syngas (46)	MeOH Feed	Clean SynGas (3)	H2S (Traces of CO2+MeOH)	Units
Temperature	30	-50	-50.186	-54.2584	C
Pressure	35	60	60	1.2	bar
Mass Flow	396140	755547	136562	7988.38	kg/h
Molar Flow	19440	23580	13393.5	233.635	kmol/h
Volumetric Flow	13999	885.017	4137.87	3542.34	m3/h
Mixture Molar Fraction					
Methanol	0	0.999999	3.91203E-05	7.95298E-05	
Carbon dioxide	0.28	1.44289E-11	7.0605E-12	0.0111727	
Hydrogen sulfide	0.013	9.99731E-07	1.19976E-07	0.988748	
Carbon monoxide	0.234	0	0.310568	1.96443E-11	
Nitrogen	0.004	0	0.00408245	5.58947E-14	
Hydrogen	0.469	4.16829E-23	0.685311	5.67543E-13	

References: Manuele Gatti, Emanuele Martelli, François Marechal, Stefano Consonni, (2014). Review, modeling, Heat Integration, and improved schemes of Rectisol®-based processes for CO2 capture, Applied Thermal Engineering, Volume 70, Issue 2, 2014, Pages 1123-1140, ISSN 1359-4311, https://doi.org/10.1016/j.applthermaleng.2014.05.001