Rectisol Wash Process for Removal of H_2S and CO_2 from Sour Syngas

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A. Background

There are several sour gas treatment techniques like chemisorption, physisorption and membrane separation for the removal of H_2S. Of these, physisorption is an efficient and economical process for treatment of sour gas. Rectisol wash process is one such physisorption based treatment method. It uses Methanol as solvent at about -20°C to – 70°C and high pressure to remove H_2S and CO_2 simultaneously. Methanol has a greater absorption capacity towards sour components and hence favours absorption of both CO_2 and H_2S at lower temperatures than most of the other common solvents. Moreover, methanol is also highly stable at lower temperatures making it a better candidate as solvent. This further help in reduction of solvent requirements and regeneration.

B. Process Flowsheet Description

The process flowsheet for Rectisol process is developed in DWSIM (ver 7.3.1) based on Sun and Smith (2013). The crude syngas at about -20.59°C and 34 bar pressure and the pure methanol at -50°C and 44 bar pressure is supplied to an absorption column (Chemsep). The absorption column has 60 stages. The Peng Robinson property package is used for the entire process. The top product from the column is obtained at -47.57°C and consists of purified syngas with more than 99% H_2S removed. The CO_2 rich stream is drawn from the middle of the column and is flashed at 11 bar and 5 bar respectively to remove CO_2. The bottom product from the Chemsep column is flashed at 12 bar to remove H_2 and CO. The CO_2 devoid middle stream and the H_2S rich bottom product is stripped with N_2 at reduced pressure of about 0.2 bar to remove the absorbed CO_2 as tail gas. The H_2S rich stream from this column is subjected to distillation to separate H_2S and methanol.

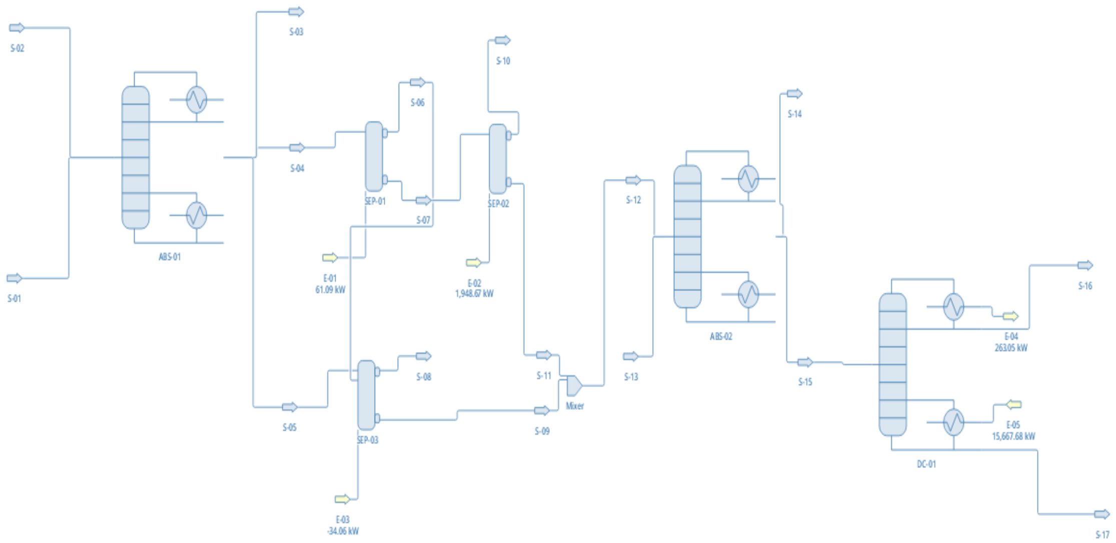

Figure 1. Rectisol wash configuration.

C. Results and Discussion

Syngas with more than 99% H_2S removed is obtained that can be further used for other production processes. Results for important streams developed in the flowsheet are shown in Table 1.

Variable	S-01	S-02	S-03	S-10	S-16	Units
Temperature	-20.59	-50	-47.5745	-17.9697	-78.2585	C
Pressure	34	44	33	5	1.01325	bar
Mass Flow	90775.5	163990	28550.1	25625.7	758.404	kg/h
Molar Flow	4221	5118	2796.12	583.203	21.085	kmol/h
Molar Fraction Argon	0.001141	0	0.00167023	0.0000662	0.0031132	
Molar Fraction Hydrogen	0.4607	0	0.692974	0.00052735	0.000225024	
Molar Fraction Nitrogen	0.0028	0	0.00414031	0.0000837	0.00212989	
Molar Fraction Methane	0.0018	0	0.00259741	0.0001915	0.00477883	
Molar Fraction Carbon dioxide	0.34189	0	0.014054	0.996115	0.199423	
Molar Fraction Hydrogen sulfide	0.00129	0	1.13E-23	0.00000987	0.789679	
Molar Fraction Methanol	0.000289	1	0.0000281	0.00186056	1E-10	

Table 1. Results for important streams

D. Further Works

The H_2S stream obtained as distillate can be further flashed and sent to Claus process for desulfurization. The methanol bottom product can be passed to dehydration column to obtain anhydrous methanol for circulation. The dynamic nature of the columns can be explored by using the controllers in Chemsep columns.

E. Reference

Sun L. and Smith R., Rectisol wash process simulation and analysis, Journal of cleaner production. 39 (2013) 321- 328. http://dx.doi.org/10.1016/j.jclepro.2012.05.049 .