Natural Gas Dehydration using Triethylene Glycol

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Background:

At the wellhead, reservoir fluids generally are saturated with water. The water in the gas can present some problems such as:

- Formation of solid hydrates can plug valves, fittings or pipes;
- The presence of water along with H_2S or CO_2 can cause corrosion problems;
- Water can condense in the pipeline causing erosion or corrosion problems.

Thus, it becomes very important to reduce the water content in the gas stream to below or within the tolerated limit of 6-7lb/MMSCFD.

Generally, a dehydration unit is used in gas plants to meet a pipeline specification. There are several different processes available for dehydration using glycols, silica gel, or molecular sieves. The natural gas industry commonly uses tri-ethylene glycol (TEG) for gas dehydration where low gas dew point temperatures are required, such as in the design of offshore platforms in the Arctic or North Sea regions or for other cryogenic processes.

Absorption is the transfer of a component from the gas phase to the liquid phase, and is more favorable at a lower temperature and higher pressure. Water vapor is removed from the gas by intimate contact with a hygroscopic liquid desiccant in absorption dehydration. The contact is usually achieved in packed or trayed towers. Glycols have been widely used as effective liquid desiccants. TEG has gained nearly universal acceptance as the most cost effective of the glycols due to its superior dew point depression, operating cost, and operation reliability.

Process Description:

In this study, dehydration of natural gas using triethylene glycol (TEG) as a dehydrating or absorption agent was studied considering the use of DWSIM as the process simulator.

For this case, Peng Robinson EOS is used as the fluid package with the following components: N_2, H_2S, CO_2, C_1, C_2, C_3, i-C_4, n-C_4, i-C_5, n-C_5, H_2O, and TEG.

Wet natural gas is first flashed in an inlet separator to remove liquid and solid content. The process condition of the feed stream are; temperature was at 30 ^{O}C and a pressure of 6200kpa and a flow rate of 500kgmol/h and all the components of the natural gas was used with their various mole fractions, after reducing the liquid content in the separator. The gas stream (S-04) from separator is dried in contactor unit (ABS-01) which is design of an absorber using counter current TEG stream (S-17), the rich TEG stream coming out from the bottom (S-06) of the absorber unit passes through the valve to the pressure of the stream and is then fed to a heater. The cooler is meant to take out heat from where is not needed. The regeneration operation is carried out using a separation column to recover fully the TEG against wastage. The stream S-12 contains more of TEG to be recycled is flashed in a mixer (MIX-02) operation to ensure material balance of the TEG, because some quantities of TEG has been lost during the dehydration. Pump (PUMP-01) is installed to raise the pressure of the TEG stream before it enters the contactor streams. The sales gas (S-19) is flashed to the component splitter (CS-01); this will remove completely the TEG in the sales gas because one of the criteria used to determine the efficiency of a dehydration facility is the water dew point of the dry gas. This can easily be checked by finding the temperature at which water will just begin to condense. Therefore, all traces of TEG must be removed from the stream to be tested because TEG affects the water dew point.

Flowsheet:

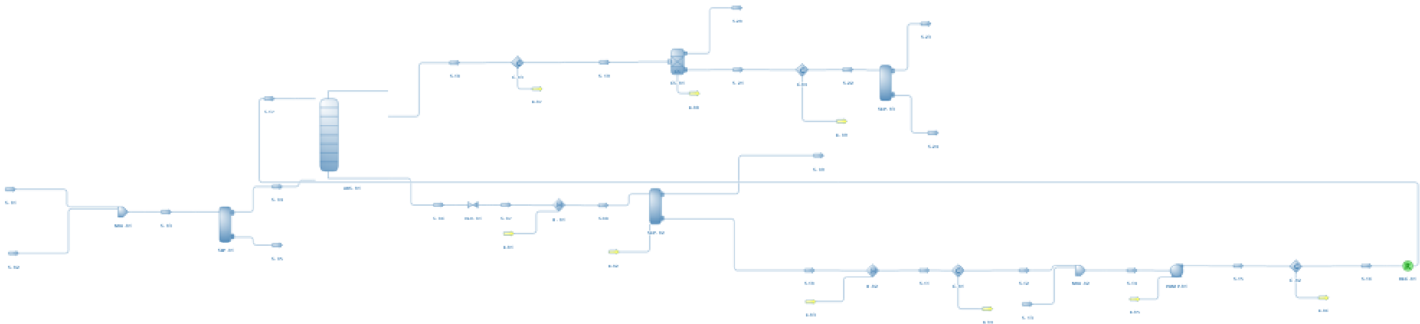

Figure1. Process Flowsheet for Dehydration of Natural Gas using Triethylene Glycol using DWSIM

Results Table:

Object	S-01	S-02	S-04	S-06	S-17	S-23	S-24	
Temperature	30	30	29.0663	50.9591	50	-20	-20	C
Pressure	63.2085	63.2085	63.2085	62.19	64.3335	62.09	62.09	kgf/cm2
Mass Flow	9218.49	497.931	9228.35	353746	351521	3437.04	0.0641557	kg/h
Molar Flow	284280	15714.6	284607	1.48529E+06	1.33539E+06	121186	0.279066	m3/d @ SC
Volumetric Flow	176.089	0.5	175.272	290.165	318.165	58.6012	4.89466E-05	m3/h
Mixture Molar Enthalpy	-1147.11	-45196	-1195.77	-67119.6	-75161.7	-3144.51	-82378.1	kJ/kmol
Mixture Molar Entropy	-34.1987	-121.853	-34.2787	-110.995	-138.728	-43.9529	-166.104	kJ/[kmol.K]
Vapor Phase Molar Fraction	1	0	1	1.8678E-05	0	1	0	
Phases	Vapor Only	Liquid Only	Vapor Only	Mixed	Liquid Only	Vapor Only	Liquid Only	
Energy Flow	-159.32	-346.997	-166.27	-48706	-49037.4	-186.177	-0.0112316	kW

References:

[1] Elendu, C., Ude, N., Odoh, E., and Ihedioha, J., “Natural gas dehydration with triethylene glycol (TEG),” *European Scientific Journal*, 11(30), (2015).