Dehydration of reservoir fluid using methanol

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Background

Hydrates are crystalline compounds consisting of gas molecules and water. Hydrates are formed during the transportation of reservoir fluids like natural gas under certain temperature, pressure and composition. Gas hydrates are formed from a gas molecule, which is called “guest molecule”, trapped within a hydrogen-bonded structure of water molecules, called “host molecules”. The formation of hydrates in the pipelines during the natural gas transportation is a major worry for the oil and gas industry as it is accountable for clogging the pipelines and corrosion. Thus, their removal is strongly desirable. During the transportation in the pipelines under certain conditions, where the hydrates could be formed, a possible way to prevent hydrate formation is changing gas composition by injecting inhibitors. By inhibitor injection, hydrate formation temperature can be reduced or formation can be delayed. The most commonly used inhibitors are glycols and methanol. To prevent hydrate formation, methanol is commonly added to well-head gas before it enters into the pipelines for the transportation.

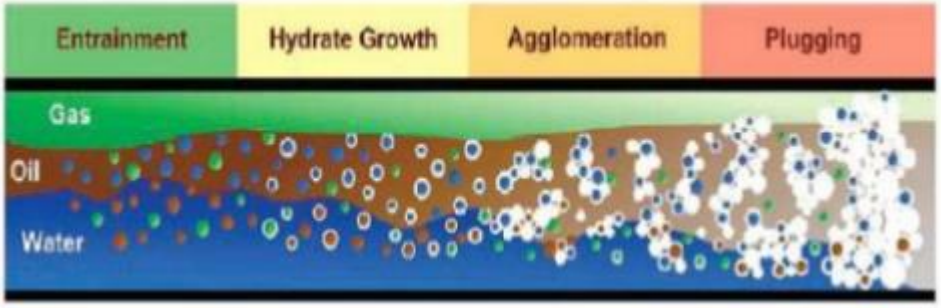
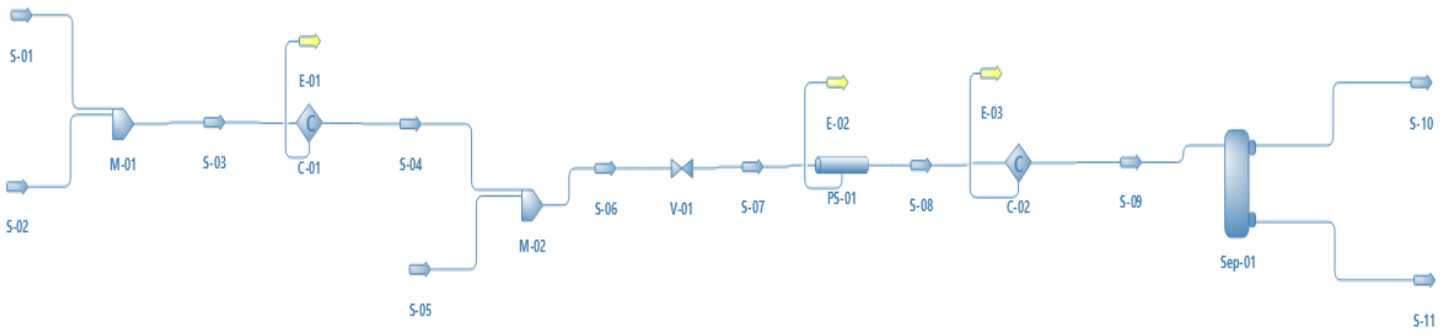


Fig. 1 Hydrate Development

Description of Flowsheet

Reservoir fluid, S-01(at 120°C and 290 bar) having mass flow rate of 1.133E+06 kg/h is mixed with water, S-02(at 95°C and 290 bar) with mass flow rate of 50000 kg/h in a stream mixer, M-01. The resultant stream, S-03(at 100.106°C and 290 bar) is then cooled to 44°C using a cooler, C-01. Then methanol stream, S-05(at 60°C and 200 bar) having mass flow rate of 20000 kg/h is mixed with cooled stream, S-04(at 44°C and 230 bar) in a stream mixer, M-02. The pressure of the resultant stream, S-06(at 40.5864°C and 200 bar) then reduced to 140 bar in stream S-07 using adiabatic valve, V-01. The stream S-07 is then sent to pipeline, PS-01 where the pressure and temperature further reduced to 65.4007 bar and -3.48075°C respectively in stream S-08. The stream, S-08 is further cooled to -13°C in a cooler, C-02. The cooled stream, S-09(at -13°C and 21.4007 bar) is then sent to Gas-Liquid Separator, Sep-01 to get Gas stream, S-10 and Liquid Stream, S-11. Peng-Robinson thermodynamics model is used in this Flowsheet.

Flowsheet



Results:

Object	S-01	S-02	S-03	S-04	
Temperature	120	95	100.106	44	C
Pressure	290	290	290	230	bar
Mass flow	1.133E+06	50000	1.183E+06	1.183E+06	kg/h
Molar flow	43659.5	2775.42	46434.9	46434.9	kmol/h
Volumetric flow	4632.67	51.6771	4254.28	3652.22	m^3/h
Mixture Molar Enthalpy	297.895	-39559.7	-2084.39	-6226.58	kJ/kmol
Mixture Molar Entropy	-34.1166	-106.487	-37.6785	-48.2928	kJ/[kmol.K]
Vapor Phase Mole Fraction	1	0	1	0	
Object	**S-05**	**S-06**	**S-07**	**S-08**	
Temperature	60	40.5864	32.7561	-3.48075	C
Pressure	200	200	140	65.4007	bar
Mass flow	20000	1.203E+06	1.203E+06	1.203E+06	kg/h
Molar flow	624.183	47059.1	47059.1	47059.1	kmol/h
Volumetric flow	26.2558	3788.44	4688.07	9476.36	m^3/h
Mixture Molar Enthalpy	-36032.8	-6621.92	-6621.92	-8068.54	kJ/kmol
Mixture Molar Entropy	-109.119	-48.0822	-45.4705	-46.2515	kJ/[kmol.K]
Vapor Phase Mole Fraction	0	0	.746139	.742386	
Object	**S-09**	**S-10**	**S-11**		
Temperature	-13	-13	-13	C	
Pressure	21.4007	21.4007	21.4007	bar	
Mass flow	1.203E+06	806285	396713	kg/h	
Molar flow	47059.1	38698.2	8360.91	kmol/h	
Volumetric flow	35715.9	35220.5	495.368	m^3/h	
Mixture Molar Enthalpy	-6986.63	-2127.67	-29476.2	kJ/kmol	
Mixture Molar Entropy	-36.2191	-27.3054	-77.4762	kJ/[kmol.K]	
Vapor Phase Mole Fraction	.822332	1	2.40086E-07		

Table 1: Stream wise Results for the Process Flowsheet

References

Merkel, F. S., Schmuck, C., Schultz, H. J., Scholz, T. A., & Wolinski, S. (2015). Research on gas hydrate plug formation under pipeline-like conditions. *International Journal of Chemical Engineering*, *2015*. https://doi.org/10.1155/2015/214638