SUPPORTING INFORMATION

Design modification of acid gas cleaning units for an enhanced performance in natural gas processing

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Table 1: Details of the main streams for the base case design

	Sour Feed	Sweet Gas	Dilute H_2S Gas	Acid Gas to SRU	Waste Gas to Thermal Oxidizer
Temperature [°C]	37.8	47.4	58.9	47.6	41.2
Pressure [bar]	63.1	61.0	2.3	2.0	1.8
Molar Flow [MMSCFD]	500.0	457.6	45.0	24.0	19.2
H_2O	0.0011	0.0028	0.0858	0.0545	0.0373
Nitrogen	0.0598	0.0653	0.0001	0.0000	0.0002
CO_2	0.0817	0.0203	0.6803	0.5117	0.9575
H_2S	0.0207	0.0000	0.2299	0.4306	0.0001
MDEAmine	0.0000	0.0000	0.0000	0.0000	0.0000
Methane	0.8016	0.8737	0.0009	0.0000	0.0022
Ethane	0.0282	0.0307	0.0001	0.0000	0.0002
Propane	0.0048	0.0052	0.0000	0.0000	0.0000
i-Butane	0.0005	0.0005	0.0000	0.0000	0.0000
n-Butane	0.0006	0.0007	0.0000	0.0000	0.0000
i-Pentane	0.0003	0.0003	0.0003	0.0000	0.0007
n-Pentane	0.0003	0.0003	0.0004	0.0001	0.0008
n-Hexane	0.0002	0.0002	0.0005	0.0002	0.0009
n-Heptane	0.0001	0.0000	0.0007	0.0012	0.0000
n-Octane	0.0001	0.0000	0.0009	0.0017	0.0000
Molar Enthalpy [kJ/kgmole]	-96495	-77376	-292631	-223310	-385862

Table 2: Details of the main streams for the proposed design

	Sour Feed	**Sweet Gas**	**Low HHV Sweet Gas**	**Acid Gas to SRU**	**Waste Gas to Thermal Oxidizer**
Temperature [°C]	37.8	48.9	53.2	60.7	62.9
Pressure [bar]	63.1	59.6	61.0	2.3	2.3
Molar Flow [MMSCFD]	500.0	457.7	473.1	30.0	16.0
H_2O	0.0011	0.0030	0.0036	0.0930	0.1030
Nitrogen	0.0598	0.0653	0.0632	0.0001	0.0002
CO_2	0.0817	0.0208	0.0506	0.5577	0.8903
H_2S	0.0207	0.0000	0.0000	0.3445	0.0008
MDEAmine	0.0000	0.0000	0.0000	0.0000	0.0000
Methane	0.8016	0.8731	0.8459	0.0014	0.0029
Ethane	0.0282	0.0307	0.0297	0.0001	0.0003
Propane	0.0048	0.0052	0.0051	0.0000	0.0000
i-Butane	0.0005	0.0005	0.0005	0.0000	0.0000
n-Butane	0.0006	0.0007	0.0006	0.0000	0.0000
i-Pentane	0.0003	0.0003	0.0003	0.0003	0.0004
n-Pentane	0.0003	0.0003	0.0003	0.0004	0.0005
n-Hexane	0.0002	0.0002	0.0002	0.0006	0.0006
n-Heptane	0.0001	0.0000	0.0001	0.0008	0.0005
n-Octane	0.0001	0.0000	0.0000	0.0011	0.0005
Molar Enthalpy [kJ/kgmole]	-96495	-77479	-87080	-248544	-374566

Table 3: Formulas used in the economic analysis

CAPEX Calculation	
Material Cost (MC)	First Amine Filling Cost
Equipment Cost (EC)	Summation of All Model Equipment Cost
Fixed Cost (FC)	MC + EC
Base Unit Cost (BUC)	1.12 × FC
Project Contingency (PC)	0.2 × BUC
Total Fixed Investment (TFI)	BUC + PC
Start-up Cost (SC)	0.1 × VOM
Total Unit Investment (TUI)	TFI + SC
Annual Capital Charge Ratio (ACCR)	$\frac{[i(1+i)^n]}{[(1+i^n)-1]}$
Annualized Cost (AC)	ACCR × TUI
OPEX Calculation	
Annual Contract & Maintenance (CMC)	0.05 × TFI
Annual Local Tax & Insurance (LTI)	0.015 × TFI
Annual Direct Labor Cost (DL)	Require Number of Operation Labors × Labor Annual Rate
Annual Labor Overhead Cost (LOC)	1.15 × DL
Amine Makeup Cost (AMC)	Cost of Annual Amine Makeup Due to Losses
Utility Cost (UC)	Cost of All Supplied Utilities in Annual Bases
Annual Variable Operating & Maintenance (VOM)	$[(\mathrm{CMC} + \mathrm{LTI} + \mathrm{DL} + \mathrm{LOC} + \mathrm{AMC} + \mathrm{UC})] \times$ Plant Availability (PA)
Plant Production Rate (PPR)	Daily Sweet Gas Production
Annual Production Rate (APR)	PPR × PA × 365
Total Annual Cost (TAC)	AC + VOM
Gas Processing Cost (GPC)	$\frac{\text{Total Annual Cost (TAC)}}{\text{Annual Production Rate (APR)}}$