

Multicomponent Distillation of Propane, 1-Butene, N-Butane, Trans-2-Butene, Cis-2-Butene & N-Pentane

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Problem Statement:-

Separation of propane, 1-butene, n-butane, Trans-2-butene, Cis-2-butene & n-pentane using simple and extractive distillation.

System of unit:-

The system of unit used in the flowsheet is custom unit system 5 in which temperature is taken in °C, pressure is taken in bar, molar flow rate is taken in Kmol/h and mass flow rate is taken in Kg/h.

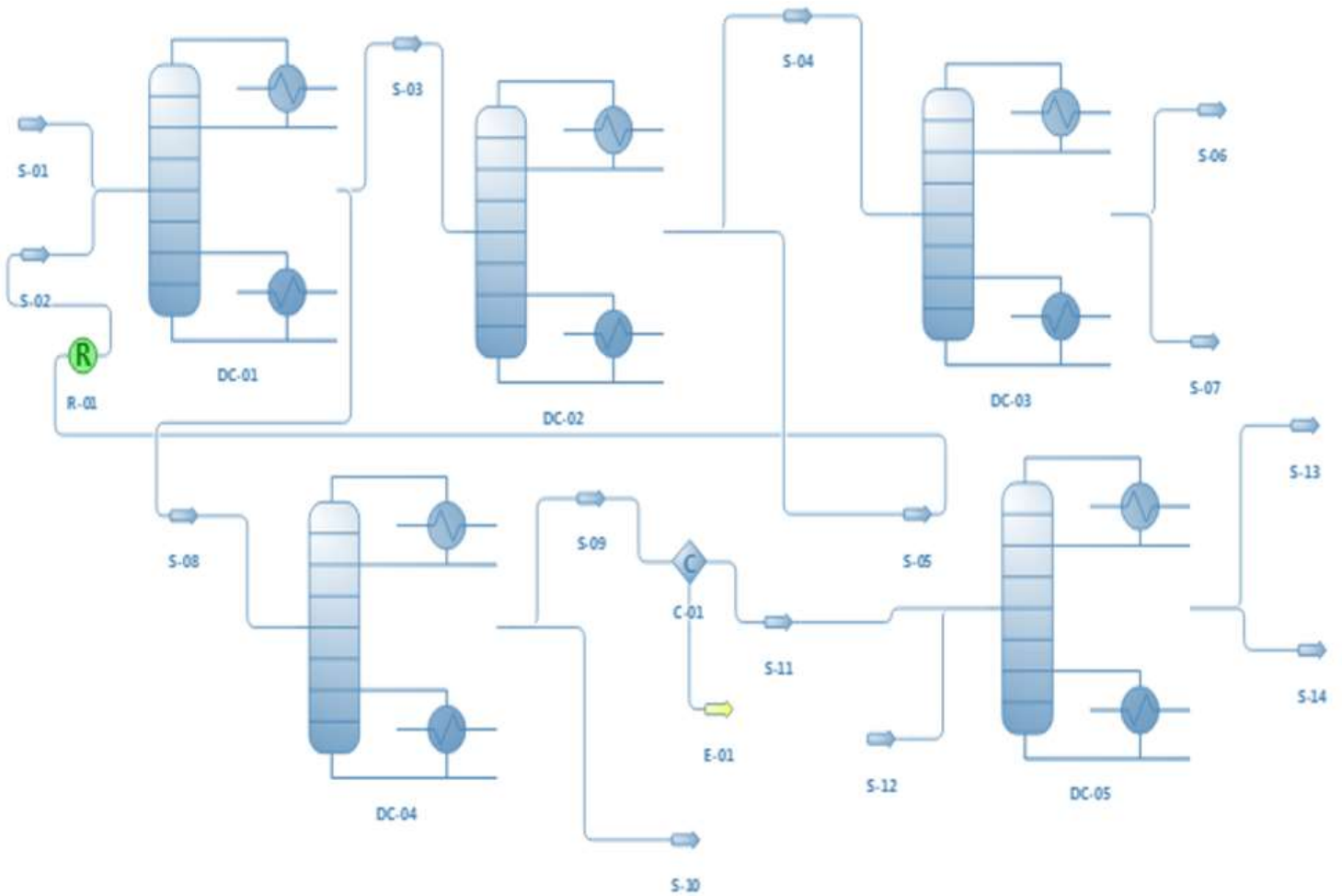
Background and Description:-

Separation of the various component from the mixture of the product is the important downstream process in the petrochemical industries. For the components in the mixture having high relative volatility can be easily separated by simple distillation while the component in the mixture having low relative volatility can't be separated using simple distillation, Hence they are separated using extractive distillation using suitable solvent. In this process 1-butene, propane and n-pentane are separated using simple distillation while the mixture of n-butane, Trans-2-butene & Cis-2-butene forms the azeotropic mixture which is separated using mixture of the acetonitrile and acetone as solvent in the extractive distillation.

In this flowsheet the separation of the mixture of propane, 1-butene, n-butane, Trans-2-butene, Cis-2-butene & n-pentane using simple and extractive distillation. Here, the distillation column (DC-01) and (DC-02) both are combined column each having 75 stages are operated at constant pressure of 10bar. Here to avoid cryogenic condition in the distillation column pressure of the feed as well as the column was taken high to elevate boiling point. More volatile component mixture are separated from column (DC-02) as the top product which is the mixture of propane and 1-butene. While the bottom product of column(DC-02) is then fed to (DC-01) from top, The less volatile component mixture of of n-butane, n-pentane, Trans-2-butene & Cis-2-butene is obtained as a bottom product of column (DC-01). The top product from the column (DC-02) is then fed to column (DC-03) where simple distillation is carried out using 25 stages at the constant pressure of 10 bar, As a result propane is obtained as top product of column (DC-03) and 1-butene is obtained as the bottom product of the same column. The bottom product mixture from (DC-01) is the fed to the column (DC-04) where pentane is separated using simple distillation using 20 stages at constant pressure of 10 bar. While the top product from the column (DC-04) which is the azeotropic mixture of the n-butane, Trans-2-butene & Cis-2-butene is the fed to the column (DC-05) where extractive distillation is carried out using acetonitrile and acetone as the solvent. Column (DC-05 having 100 stages and operated at constant pressure and solvent is fed at 2nd stage. Thus, n-butane is obtained as the top product and the mixture of the Trans-2-butene, Cis-2-butene, acetonitrile and acetone is obtained as the bottom product of the column (DC-05.)

Flowsheet:-

Multicomponent Distillation of propane, 1-butene, n-butane, trans-2-butene, Cis-2-butene, and n-pentane



Results:-

Object	Feed (S-01)	Solvent (S-12)	Bottom product (S-08)	Propane (S-06)	1-Butene (S-07)	N-Pentane (S-10)	N-Butane (S-13)	Solvent Residue (S-14)	Units
Temperature	37.8	-262.03	83.4074	28.2879	74.59	125.79	18.93	79.41	°C
Pressure	10.33	1.01325	10.3352	103352	10.3352	10.3352	2.021	2.021	bar
Molar Flow	307.6	1194.22	251.35	4.2303	52.02	18.0756	142.65	1284.84	Kmol/h
Molar Fraction (Mixture) /N- Butane	0.5031	0.0000	0.5763	9.69E-05	0.1898	0.0036	0.9142	0.0112	
Molar Fraction (Mixture) / Propane	0.0146	0.0000	4.49E-20	0.9982	0.0053	2.05 E-19	1.95 E-19	2.21 E-22	
Molar Fraction (Mixture) /1-Butene	0.1476	0.0000	0.0233	0.0016	0.7600	6.57 E-05	0.0410	6.65 E-06	
Molar Fraction (Mixture) /Trans-2-butene	0.1564	0.0000	0.1822	1.59E-05	0.0442	0.0023	0.0437	0.0307	
Molar Fraction (Mixture) /Cis-2-butene	0.1193	0.0000	0.1459	8.35E-08	0.0000	0.0042	3.65 E-06	0.0284	
Molar Fraction (Mixture) /N-pentane	0.0588	0.0000	0.0720	3.22E-21	1.4 E-19	0.9897	5.99 E-21	0.00016	
Molar Fraction (Mixture) /Acetonitrile	0.0000	0.6112	0.0000	0.0000	0.0000	0.0000	0.00037	0.5678	
Molar Fraction (Mixture) /Acetone	0.0000	0.3890	0.0000	0.0000	0.0000	0.0000	0.00063	0.3614	