

Separation of 1-Butene and N-butane by Extractive Distillation

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Problem Statement:-

Separation of 1-Butene and N-butane by Extractive Distillation using Acetonitrile and water mixture.

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 Kmole/h and mass flow rate is taken in Kg/h.

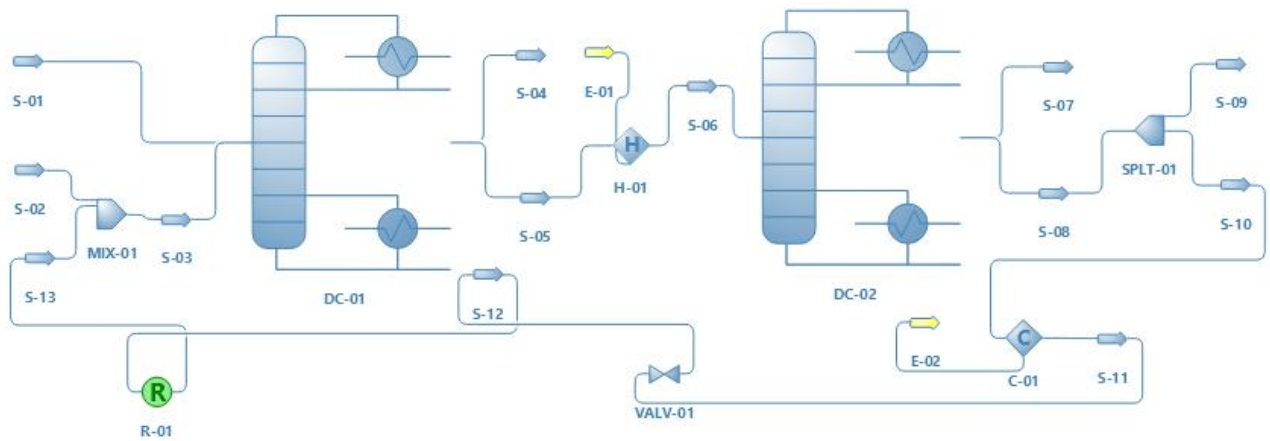
Background and Description:-

Extractive distillation requires solvent, and using appropriate solvent for the particular process gives a significant results in designing of extractive distillation process. 1-Butene and N-butane have very close boiling point, therefore their relative volatility is very low and forms azeotrope with each other. So, we require addition of the solvent to increase relative volatility of component. This solvent increases the volatility and make the separation process economical. In this process one component with the purity (100%) is obtained as the top product of first distillation column and the mixture of solvent and second component is obtained as the bottom product of first distillation column, which is called residual product. This residual product can be easily separated in secondary distillation column because of the solvents higher boiling point and the second component lower boiling point. This is commercially used in the separation of the hydrocarbon mixture with low relative volatility in petroleum refinery.

In this flowsheet separation of mixture of 1-Butene and n-Butane by extractive distillation using mixture of Acetonitrile and water as a solvent. Here, distillation column (DC-01) with 72 stages is operated at variable pressure with top pressure:- 450000 N/m² and bottom pressure:- 630000 N/m². Feed stream was feeded at 41th stage and solvent stream was feeded at 6th stage of distillation column (DC-01). The azeotropic mixture of 1-Butene and N-Butane is separated with help of mixture of Acetonitrile and water as a solvent in distillation column (DC-01) and as a result pure 1-butene is obtained as a overhead product while the bottom product of DC-01 is sent to solvent recovery column (DC-02) with 17 stages and operated at variable pressure with top pressure:- 200000 N/m² and bottom pressure:- 260000 N/m². Bottom product from DC-01 is feeded to solvent recovery column (DC-02) at 9th stage and as a result pure N-Butane is obtained as a overhead product of DC-02 and the bottom product of DC-02 containing mixture of Acetonitrile and water as a solvent is then recycle back.

Flowsheet:-

Extractive distillation of 1-Butene and N-butane



Results:-

Object	Feed	Solvent	1-Butene	Bottom mixed-1	N-Butane	Bottom Mixed-2	Units
Temperature	25.00	19.86	38.24	137.97	18.52	116.56	°C
Pressure	1.01325	1	4.5	6.3	2	2.6	bar
Molar Flow	43.36	532.07	35.07	540.36	7.56	532.8	Kmol/h
Molar Fraction (Mixture) /1-Butene	0.8055	5.18E-06	0.9911	0.0003	0.0217	1.06E-05	
Molar Fraction (Mixture) /N-Butane	0.1944	0.0017	0.0010	0.0172	0.9782	0.0036	
Molar Fraction (Mixture) /Acetonitrile	0.0000	0.7989	7.93E-07	0.7866	2.33E-09	0.7978	
Molar Fraction (Mixture) /Water	0.0000	0.1993	0.0077	0.1957	1.67E-12	0.1985	