

Pressure Swing Distillation for Separation of Tetrahydrofuran-Methanol

Background:

Tetrahydrofuran (THF) is one of the most commonly used solvents in the chemical and pharmaceutical industries due to its excellent dissolution ability. The production of steroid drugs faces the problem of separating solvent which contains THF and methanol. The separation and recycle of THF and methanol are of high economic significance and environmental importance. However, difficulties occur in the separation process because a minimum-boiling azeotrope is formed in the binary system.

The pressure-swing-distillation (PSD) process, commonly used to separate azeotropic mixtures based on the shift of the relative volatilities and azeotropic compositions by changing the system's pressure, is another suitable separation method for the separation of azeotropes. Efficient separation is achieved by two columns operating at two different pressures.

Description of flowsheet:

Here we use the two columns with the different pressure of 1 atm and 10 atm. In this process feed stream containing 0.75 mole fraction Methanol and 0.25 mole fraction Tetrahydrofuran is sent to a distillation column which has 51 stages. The feed is sent to stage number 24 whereas the recycled feed is sent to stage number 34. The flow rate of the feed is around 27.7778 mol/s., 320K and the recycle ratio of the tower is 3.11472. The first distillation column produces bottom with 0.999 mole fraction Methanol. Distillates of the first column are sent to a second distillation column. The second distillation column has a reflux ratio of 1.79392 and it produces distillates which are recycled back to the first distillation column and the bottom product has a composition of 0.999 mole fraction Tetrahydrofuran.

Stream	Bottoms 1	Bottom 2	Distillate 1	Distillate 2	Feed	Recycle	Unit
Temperature	337.775	433.14	338.374	413.87	320	410.018	K
Pressure	101325	1.01325E+06	101325	1.01325E+06	101325	1.01325E+06	Pa
Molar Flow	14.973	6.78525	9.3117	9.30491	27.7778	11.7322	mol/s
Molar Fraction(Mixture)/Methanol	0.999	0.001	0.497	0.781	0.75	0.79	
Molar Fraction(Mixture)/Tetrahydrofuran	0.001	0.999	0.503	0.219	0.25	0.21	

References:

1. Yinglong Wang,* Peizhe Cui, and Zhen Zhang. "Heat-Integrated Pressure-Swing-Distillation Process for Separation of Tetrahydrofuran/Methanol with Different Feed Compositions." *Ind. Eng. Chem. Res.* 2014, 53, 7186-7194.
2. Zheng, Z.; Li, F.; Wen, Y.; Liu, X. "Recovery of Tetrahydrofuran and Methanol from Pharmaceutical Wastewater by the Extractive Distillation." *Chem. World* 2010, 12, 734-737.