

Design and Control of Distillation Processes for Methanol – Chloroform Separation

Gaurav Tiwari

Bachelor of Technology Chemical Engineering

SASTRA Deemed University , Thanjavur

Email: gauravbfg@gmail.com

Abstract:

Methanol is the simplest alcohol, being only a methyl group linked to a hydroxyl group. It is a light, volatile, colorless, flammable liquid with a distinctive odor very similar to that of ethanol (drinking alcohol). However, unlike ethanol, methanol is highly toxic and unfit for consumption. At room temperature, it is a polar liquid. It is used as an antifreeze, solvent, fuel, and as a denaturant for ethanol. Chloroform, or trichloromethane, is an organic compound with formula CHCl_3 . It is a colorless, sweet-smelling, dense liquid that is produced on a large scale as a precursor to PTFE. It is also a precursor to various refrigerants. In terms of scale, the most important reaction of chloroform is with hydrogen fluoride to give monochlorodifluoromethane (CFC-22), a precursor in the production of polytetrafluoroethylene. It is also used as an anesthetic, solvent and a reagent in several other chemical processes. The binary mixture of methanol–chloroform exhibits a minimum-boiling azeotrope with ~ 34 mol% methanol at 327 K under atmospheric pressure. A method known as Pressure Swing Distillation can be used. It is also found to be more economical than the Extractive Distillation method as no extra solvent is required to achieve the separation. Therefore, here Pressure Swing Distillation for the separation of Methanol and Chloroform has been carried out.

Process Description:

In this process feed stream containing 0.5 mole fraction Methanol and 0.5 mole fraction Chloroform is sent to a distillation column which has 24 stages. The feed is sent to stage number 9 whereas the recycled feed is sent to stage number 18. The flow rate of the feed is around 27.777 mol/s., 300K and the recycle ratio of the tower is 0.55. The first distillation column produces bottom with 0.995 mole fraction methanol. The distillates of the first column are sent to a second distillation column. The second distillation column has a reflux ratio of 0.95 and it produces distillates which are recycled back to the first distillation column and

the bottom product has a composition of 0.995 mole fraction Chloroform. The first distillation column is a low pressure distillation column maintained at a pressure of 101325 Pa whereas the second distillation column is a high pressure distillation column maintained at a pressure of 1013250 Pa.

Stream Properties

Stream	Bottom1	Bottom2	Distillate1	Distillate2	Feed	Recycle	Unit
Temperature	337.738	426.501	335.431	416.004	300	404.85	K
Pressure	101325	1013250	101325	1013250	101325	1013250	Pa
Molar Flow	14.0516	13.9244	37.1846	23.2602	27.777	23.4584	mol/s
Molar Fraction(Mixture)/ Methanol	0.995	0.005	0.352469	0.564077	0.5	0.562649	
Molar Fraction(Mixture)/ Chloroform	0.5	0.995	0.647531	0.439523	0.5	0.437351	

References

1.Eda Hosgor, Tugba Kucuk, Ilayada N.Oksal, Devrim B.Kaymak ,Design and control of distillation processes for methanol – chloroform separation ,Computers & Chemical Engineering , Volume 67, 2014, Pages 166-177, ISSN 0098-1354,

<https://www.sciencedirect.com/science/article/pii/S0098135414001070>