The Maximum Boiling Acetone-Chloroform Azeotropic Distillation system

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Unit System: Pressure-atm; Molar Flow-kmol/hr; Other-SI

Background

Hydrocarbons like Acetone and Chloroform are important raw materials in the medical area. They often require high-purity Chloroform and Acetone. Chloroform is widely used in pesticide formulations, as a solvent for fats, oils, rubber, alkaloids, waxes, gutta-percha, and resins, as a cleansing agent, grain fumigant, in fire extinguishers, and in the rubber industry.$CDCl_3$ is a common solvent used in NMR spectroscopy. A mixture of chlorine bleach with **ethanol** and **acetone** will **produce chloroform**, this reaction often gives us an azeotropes of Acetone and Chloroform. Which must be separated out to obtain highly pure Chloroform and Acetone. The mixer of Chloroform and Acetone cannot be separated out by the simple distillation column because of the less difference between their boiling point(near 5 K) and same boiling point behavior of azeotrope.

Extractive Distillation of Close Boiling Compounds

Extractive distillation is the method of separating close boiling compounds from each other by carrying out the distillation in a multiple columns in the presence of an added liquid or liquid mixture.1 This Liquid or Liquid mixture is known as extractive agent or entrainer. The presence of the entrainer alter the volatility of compounds and thus the degree of separation is increase with the same numbers of plate. This entrainer must have high boiling point than the compounds which are going to separated.

Description of Flow-Sheet

The flow sheet contain total two distillation columns named “Extractive distillation column" and “Entrainer recovery column". Here we use the Di Methyl Sulfoxide (DMSO) as Entrainer and mixer of Acetone and Chloroform as feed. The presence of DMSO alters the relative volatility between Acetone and Chloroform and to make Acetone move toward the top part and Chloroform move to the bottom part of the column. The “Extractive distillation" take Entrainer and feed and give the pure Acetone as top product and the bottom product which has the Chloroform and DMSO are enter to the “Entrainer recovery" column; which separate out Chloroform and the DMSO, this recovered sulfolane are recycled to the “Extractive distillation". Feed rate with the composition of compounds and the other necessary data for the column are shown in the table in Result section with the Top and Bottom products.

Result

Name	Extractive Distillation	Entrainer Recovery
Pressure (atm)	1.1	1.1
Total Stages	22	12
Feed (Kmol/hr) %(mol/mol) %(mol/mol) %(mol/mol)	100 Acetone (50%) Chloroform (50%)	214.3 Acetone (0.10%) Chloroform (23.22%) DMSO (76.68%)
Feed Stage	10	6
2nd Feed (Kmol/hr) (%mol)	164.4 DMSO (100%)	-
2nd Feed stage	4	-
Top (Kmol/hr) (%mol) (%mol)	50 Acetone (99.5%) Chloroform (0.5%)	50 Acetone (0.44%) Chloroform (99.55%)
Bottom (Kmol/hr) (%mol) (%mol) (%mol)	214.3 Acetone (0.1%) Chloroform (23.22%) DMSO (76.68%)	164.4 DMSO (99.99%)

References

1. **William L. Luyben;** "Control of the Maximum-Boiling Acetone/Chloroform Azeotropic Distillation System"**; Ind. Eng. Chem. Res. 2008, 47, 6140–6149**