Extractive Distillation of Ethanol and Water using EthyleneGlycol as an entrainer

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Unit System: Temperature – C and Molar Flow- kg/hr (other units- C5)

❖ Background

Azeotrope between water and ethanol (grain alcohol). Water boils at 100 ºC and ethanol boils at 78.3 ºC. The mixture will boil at 78.2 ºC and have a composition of 95% ethanol and 5% water by volume. This is a binary azeotrope because it involves two components. Thus, Ethyleneglycol is used as a solvent to separate the mixture of ethanol and water. Ethanol is used extensively as a solvent in the manufacture of varnishes and perfumes; as a preservative for biological specimens; in the preparation of essences and flavorings; in many medicines and drugs; as a disinfectant and in tinctures (e.g., tincture of iodine); and as a fuel and gasoline additive

❖ Extractive Distillation

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 solvent . This Liquid solvent is known as extractive agent or entrainer. The presence of the entrainer alter the volatility of compounds and thus the degree of separation increases with the same numbers of plate.

❖ Description of Flowsheet

The Flowsheet contains Two Extractive Distillation Columns . The first column is feeded with a stream of ethanol and water blended with entrainer stream comprising of Ethyleneglycol . The column seperates Ethanol as the top product while water and entrainer are obtained as bottom product . The bottom products are feeded to the next Extractive column which furthermore seperates entrainer from water, water is obtained as top product while entrainer is obtained as bottom product . The entrainer is reused after mixing with some makeup amount of entrainer to continue the process. 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 Column (ethanol)	Extractive Column (water)
Feed Molar flow(Kg/hr)	3250(ethanol water feed),65.5(solvent feed)	414.383
Total Stages	22	12
Feed Stage	14(ethanol water feed),3(solvent feed)	6
Mole Fraction(Top products)		
Ethanol	0.99	0.0118
Water	0.0099	0.988
Solvent	0.0	0.0
Mole Fraction(Bottom Products)		
Ethanol	0.001	0.0
Water	0.8335	0.01
Solvent	0.1565	0.9899
Pressure(N/m2)	101325	101325

❖ **Reference**

https://www.researchgate.net/figure/Flowsheet-for-extractive-distillation-with-ethyleneglycol_fig2_266414738