DEHYDRATION OF ETHANOL USING ETHYLENE GLYCOL AS ENTRAINER

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BACKGROUND:

The demand for ethanol is more owing to its various assay requirements in fields of Research and Design laboratories for spectral photometric drug standardisation, industries as a raw material for esters, agent in gasoline to improve octane index. The methods used for dehydration includes heterogeneous azeotropic distillation, pervaporation membranes and extractive distillation with salts. However, heterogeneous azeotropic distillation presents some constraints in terms of high order of non- linearity, distillation boundaries in the residue curves, long transients, multiple steady states and specific thermodynamic models for simulation. This is an attempt to discuss ethylene glycol as the potential extractive agent.

PROCESS OVERVIEW:

Ethylene Glycol is cheap, due to its extensive production as a part of manufacturing bio diesel. It also has the potential to modify the liquid-vapour equilibrium which helps in removing the water-ethanol azeotrope. Ethanol–water mixture at atmospheric pressure has a minimum-boiling homogeneous azeotrope at 78.1 C of composition 89 mol% ethanol. Thus, this mixture cannot be separated in a single distillation column and if it is fed to a column operating at atmospheric pressure, the ethanol purity in the distillate cannot exceed 89 mol% while high purity water can be produced out from the bottom.

100 kmol/hr of an azeotropic feed is sent to the 10th stage of an 18 staged extractive distillation column. The entrainer make up along with the recycle from the Entrainer Recover column is sent to the 3rd stage. Glycerol changes the liquid activity coefficients, thereby the relative volatility leading to pure ethanol to the top and Glycerol- water mixture to the bottom. They are sent to the 4th stage of a 7 stage recovery column operating at a reduced pressure to separate the respective entrainer and water. Glycerol at the bottom is cooled recycled back to the extractive column and a small make up is added to account for entrainer losses.

RESULTS:

	WATER	PURE ETHANOL	GLYCOL	GLY MAKE UP	ERC FEED	ENTRAINER RECYCLE	ENTRAINER	AZEO FEED	
Temp	13.5014	78.4346	80	80	175.179	80	176.289	78.3872	C
Pressure	2.0265	101.325	101.325	101.325	101.325	2.0265	2.0265	101.325	kpa
Molar Flow	4.36755	95.7583	45.015	0.045	49.2567	44.8892	44.8892	100	kmol/h
Mol Fraction Ethanol	0.0225277	0.928395	9.94069E-11	0	0.002	2.73188E-06	2.73188E-06	0.89	
Molar Fraction Water	0.95	0.0716053	0.000335686	0	0.0844211	0.000203522	0.000203522	0.11	
Molar Fraction Glycerol	0.0274723	6.08494E-08	0.999664	1	0.913579	0.999794	0.999794	0	

CONCLUSIONS AND RECOMMENDATIONS:

1. The operating pressure of entrainer recovery column is at 0.02 atmosphere to prevent thermal degradation of Glycol.

2. For a given Entrainer Feed Stage and Entrainer to Feed Molar ratio; there is an optimum reflux ratio that gives maximum ethanol purity. However, the value of the recycle ratio should be less to avoid energy losses during operation.

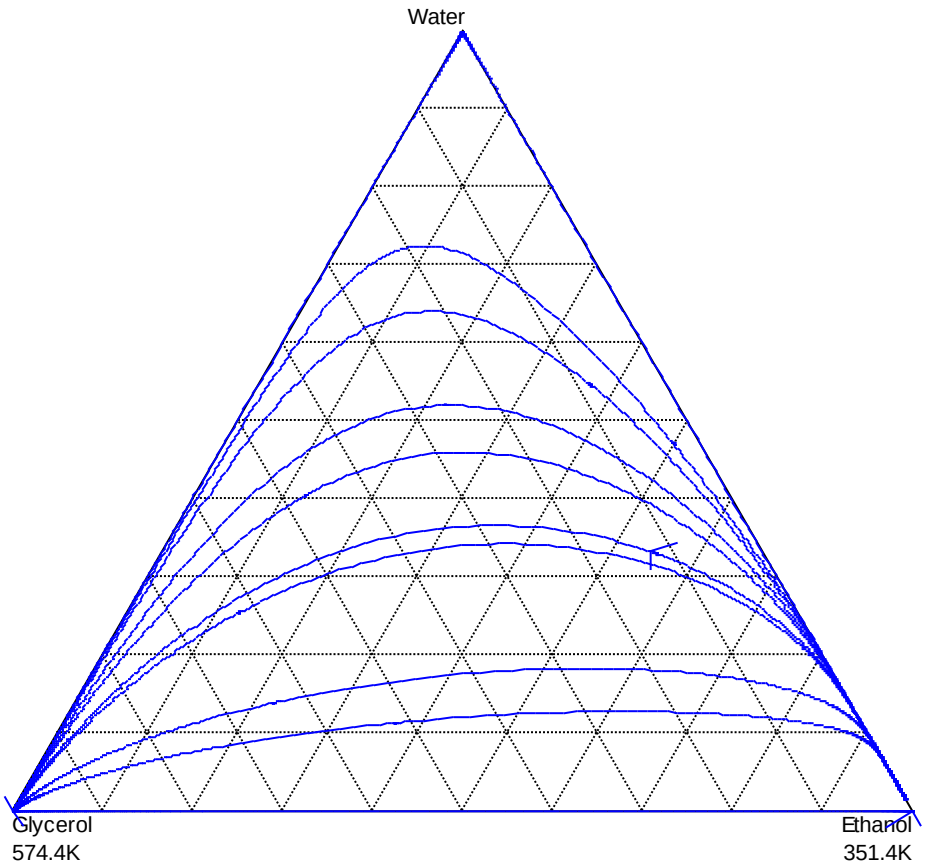
3. Entrainer feed stage should be near to the condenser to improve ethanol purity and has no significant effect on energy consumption.

4.Entrainer feed temperature has an important effect on the distillate composition and the reboiler energy consumption. It should be operated at temperature 5-15^{o}C less than the top plate.

5. Residue curve - composition trajectory of the residue liquid in the still during open equilibrium evaporation.

Residue curve map - diagram that shows residue curves for different initial still composition for a given mixture in the composition space.

Saddle - singular point with finitely many paths both approaching and depart.



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