Tert-Butanol Dehydration Via Extractive Distillation using Glycerol

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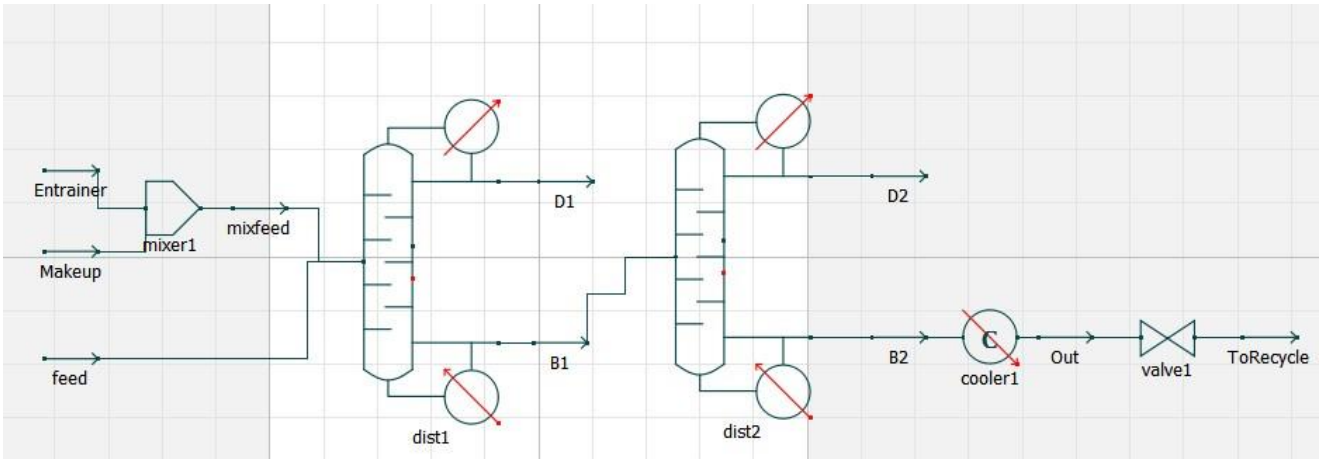
Background & Description:

Tert-Butanol (TBA) is widely used as a solvent, paint remover ingredient, gasoline octane booster and can react with methanol to produce methyl tertiary butyl ether (MTBE). It is derived commercially from isobutane as a co-product of propylene oxide production. This process gives water containing TBA. Tert-butanol and water form an azeotrope at normal pressure. Simple distillation cannot be used to separate these two components because of the minimum boiling azeotrope. TBA can be readily separated from water by using extractive distillation.

Extractive distillation is a method for the separation of azeotropic mixture. In this method, a third component is added into the system as entrainer to alter the relative volatility of the component to be separated. With the presence of the suitable entrainer, the relative volatility of the original two components can be enhanced.

The flowsheet contains two column, column-I is Extractive column and column-II is for recovery of Entrainer Glycerol. The azeotropic mixture of tert-Butanol -Water along with Entrainer is fed to column-I which is operating at a pressure of 101325 Pa. The top product of column-I is our desired product i.e. 98 wt. % tert-Butanol. The bottom product is fed to column-II operating at a pressure of 2026.5 Pa for Entrainer recovery where Water is separated from mixture and separated water is then obtained from the top with 98 wt. % purity. This Entrainer is again recycled to column-I after cooling and adding make-up stream of Entrainer to account for the loss of Entrainer in distillates of column-I and column-II

Flowsheet:



Results:

1) DWSIM Output:

STREAM TABLE							
Object	**tert-BUTANOL**	**WATER**	**RECYCLE STREAM**	**MSTR-010**	**MSTR-007**	**MIXER FEED**	
Temperature	328.334	290.579	318.25	451.384	356.816	288.717	**K**
Pressure	30397.5	2026.5	32424	2026.5	30397.5	32424	**Pa**
Molar Flow	27.3577	13.9115	11.8051	11.8051	25.7167	25.2966	**mol/s**
Molar Fraction (Mixture) / 2-methyl-2-propanol	0.988373	0.0244816	4.02243E-07	4.02243E-07	0.0132436	0.533326	
Molar Fraction (Mixture) / Glycerol	5.25259E-06	1.0119E-08	0.9999	0.9999	0.459	0.466627	

2) OpenModelica Output:

COMPONENT	B1	B2	D2	D1
2- methyl 2-propanol	0.0163645	3.04458e-07	0.0302509	0.985478
Glycerol	0.459	0.9999	7.81229e-09	3.54088e-05
Water	0.524636	9.96953e-05	0.969749	0.0145182