Extractive Distillation of THF and Ethanol using Ethylene glycol as Solvent

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Background & Description:

There are several separation methods that can be employed to separate the azeotropes, which includes extractive distillation, pressure swing distillation, etc. For the separation, the use of a single conventional distillation column is impossible. Extractive distillation is a method where the relative volatilities of components to be separated are altered by using an additional component called solvent.

In the flowsheet, extractive distillation of Tetrahydrofuran (THF) and Ethanol is carried out and ethylene glycol is used as solvent. Thermodynamic model Raoult's Law is used. The mixture (feed) Tetrahydrofuran and Ethanol is fed to the extractive distillation columns (dist1) with the solvent ethylene glycol fed to the 3rd stage at a temperature of 320 k and 101325 Pa of pressure where the THF is obtained with 99.8% purity from Distillate (d1) and Mixture of THF, Ethylene glycol, Ethanol from bottom (b1).
The mixer from b1 is fed again to distillation column (dist2) where the temperature of mixer is 391.13K and 101325 Pa of pressure. From the distillation column (dist2) Ethanol is obtained from top (d2) with purity of 96.2% and from bottom we get Ethylene glycol (99.8%) which is sent back to distillation column (dist1) by recycle stream.

Flowsheet:
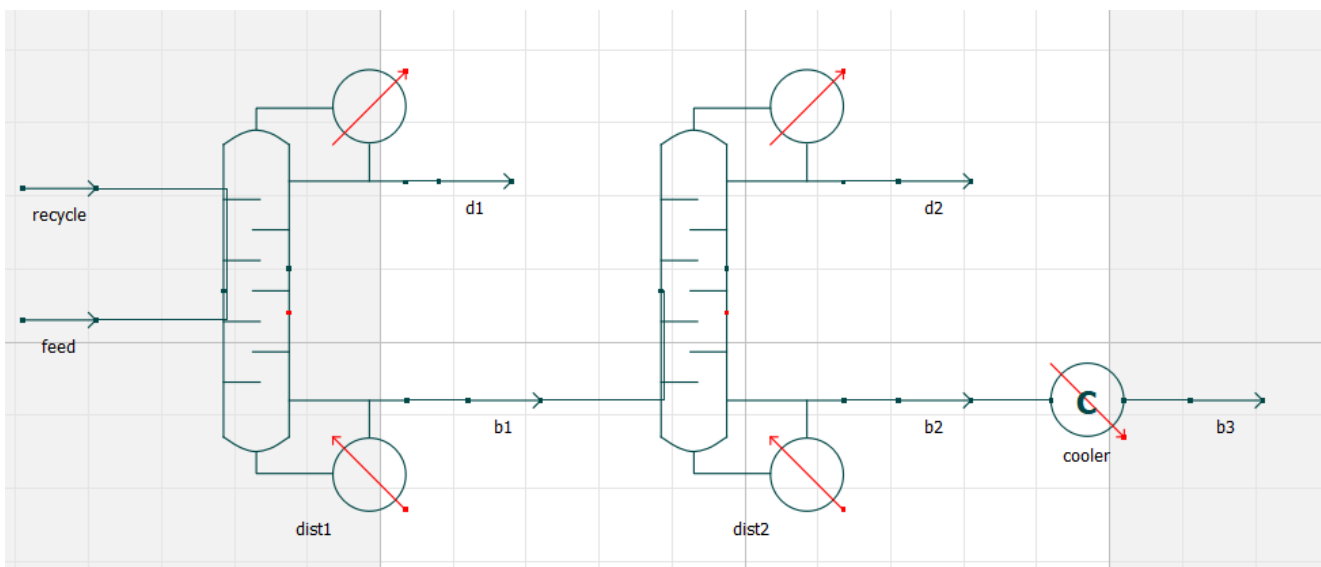
Results:

1) DWSIM output

MASTER PROPERTIES								
Object	solvent(ethylene glycol)	feed	d2	MSTR-011	D1	B1	B-2	
Temperature	320	320	351.563	320	339.15	391.135	469.141	K
Pressure	101325	101325	101325	101325	101325	101325	101325	Pa
Molar Flow	158.079	100	51.9212	158.079	48.469	210	158.079	kmol/h
Molar Fraction (Mixture) / Ethylene glycol	0.998953	0	0.0075406	0.998953	4.88681E-06	0.753832	0.998953	
Molar Fraction (Mixture) / Tetrahydrofuran	4.71259E-05	0.5	0.0303884	4.71259E-05	0.998995	0.00754883	4.71259E-05	
Molar Fraction (Mixture) / Ethanol	0.001	0.5	0.962071	0.001	0.001	0.238619	0.001	

2) OpenModelica Output

COMPONENT	B1	B2	D2	D1	B3
Ethylene glycol	0.751965	0.998953	0.00014008	6.53672e-06	0.998953
Tetrahydrofuran	0.00941469	9.32609e-05	0.0377889	0.999356	99.32609e-05
Ethanol	0.23862	0.000953869	0.962071	0.0006374	0.000953869