Pressure Swing Distillation of Toluene - Ethanol

Background:
Due to their excellent dissolution ability; Ethanol and Toluene are widely used in pharmaceutical and other chemical industries. In the production of steroid drugs, there is often a problem of separating mixed solvents. It is a great challenge to effectively separate toluene and ethanol mixture because their highly non ideal vapor-liquid equilibrium produces a minimum-boiling azeotrope.1 When the azeotrope is pressure sensitive, pressure swing distillation are widely used in industries for separating azeotrope.

Description of flowsheet:
Here we use the two columns with the different pressure of 0.5 atm and 11 atm. In this process feed stream containing 0.83721374 mole fraction Ethanol and 0.16278626 mole fraction Toluene is sent to a distillation column which has 35 stages. The feed is sent to stage number 6 whereas the recycled feed is sent to stage number 16. The flow rate of the feed is around 18.149 mol/s., 303.15K and the recycle ratio of the tower is 1.09839. The first distillation column produces bottom with 0.9995 mole fraction Ethanol. Distillates of the first column are sent to a second distillation column. The second distillation column has a reflux ratio of 0.37585 and it produces distillates which are recycled back to the first distillation column and the bottom product has a composition of 0.998 mole fraction Toluene.

Stream	**Bottoms 1**	**Bottom 2**	**Distillate 1**	**Distillate 2**	**Feed**	**Recycle**	**Unit**
Temperature	335.071	493.486	338.297	433.358	303.15	428.76	K
Pressure	50662.5	1.11458E+06	50662.5	1.11458E+06	50662.5	1.11458E+06	Pa
Molar Flow	14.973	1.84225	16.3416	16.3379	18.149	17.5529	mol/s
Molar Fraction(Mixture)/ Ethanol	0.995	0.002	0.79	0.87	0.8372137	0.918367	
Molar Fraction(Mixture)/ Toluene	0.005	0.098	0.21	0.13	0.1627862	0.081633	

References:

[1] Zhaoyou Zhu, Lili Wang, Yixin Ma, Wanling Wang, Yinglong Wang; Separating an azeotropic mixture of toluene and ethanol via heat integration pressure swing distillation",Computers and Chemical Engineering 76 (2015) 137-149.