Extractive Distillation of Benzene and Ethanol using P-Xylene as Solvent

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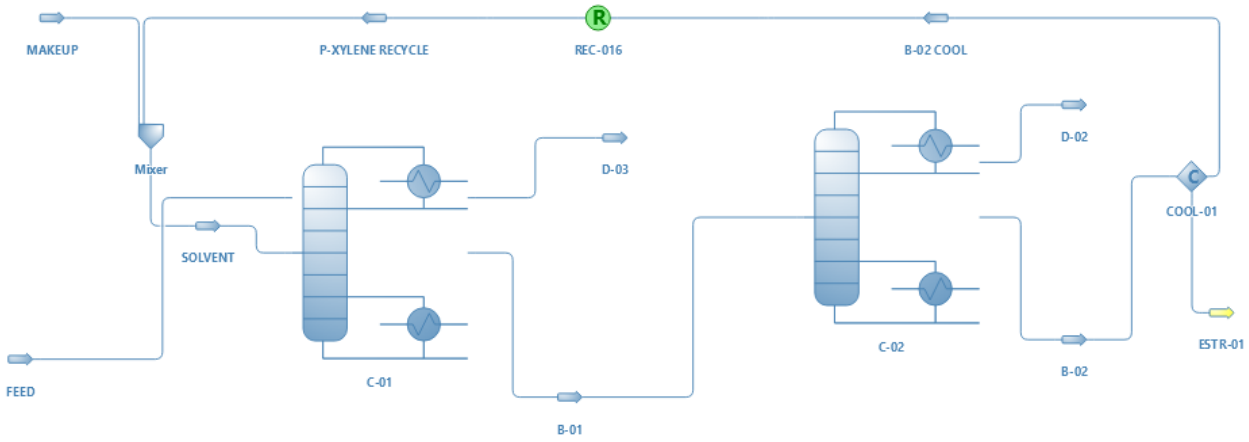
Background Work:

The separation of azeotrope and close boiling mixture is a challenge in most chemical process. For the separation, the use of a single convectional 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 or entrainer.

Process:

In this current flowsheet extractive distillation of benzene and ethanol is carried out and P- xylene is used as solvent for this extractive distillation. Thermodynamic model UNIQUAC is used. The mixture "benzene and ethanol" is feed to the 50th stage of 71 staged extractive distillation column with the solvent 1 p-xylene fed to the 24th stage. The presence of solvent alters the relative volatility between the two, causing pure benzene to move toward the down and pure ethanol on the top of the column. The mixture is feed into the 10th stage of a 21st stage extractive distillation to produce almost pure benzene at top of the column. P-xylene is recycled back to the extractive distillation column and merged with one additional pure make up stream to account for the solvent losses.

DWSIM Flowsheet:



Results:

Object	Feed	Make Up	Solvent	D-01	B-01	D-02	B-02
Temperature	298.15	298.15	323.116	350.506	390.749	352.386	409.921
Pressure	101325	101325	101325	101325	101325	101325	101325
Mass Flow	6209.01	31.9557	22782.8	2380.92	26610.9	3873.4	22737.5
Molar Flow	100	0.301	215.001	50.1	264.9	50.209	214.7
Mole fraction-ethanol	0.5	0	0	0.96818	0.00564	0.02976	0
Mole fraction Benzene	0.5	0	0.007086	0.0163	0.1914	0.970237	0.009315
Mole Fraction P-Xylene	0	1	0.9929	0.01551	0.802942	0	0.990685

References:

Zhang, Xia, et al. "Determination of an optimum entrainer for extractive distillation based on an isovolatility curve at different pressures." *Separation and Purification Technology* 201 (2018): 79-95.