Production of 1400 TPD of Ethylbenzene by Liquid Phase Alkylation of Benzene

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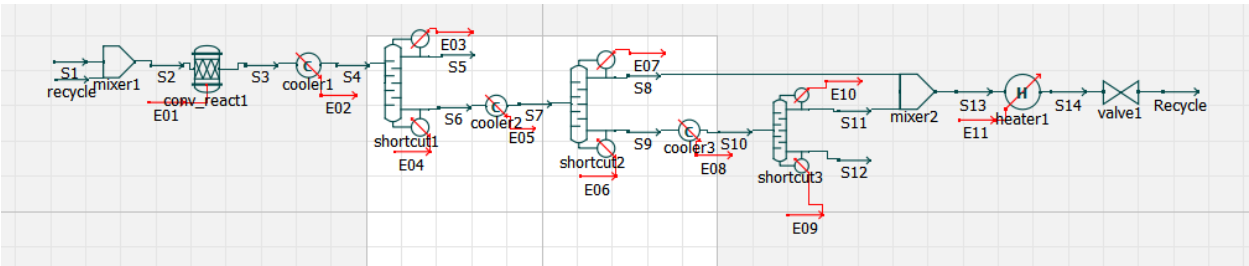
Introduction:

Ethylbenzene is an important precursor for various industrial production particularly for the production of styrene and polystyrene and plays a significant role in the petrochemical industry. It is a highly flammable, colorless organic compound. Ethylbenzene is industrially produced by reacting benzene and ethylene. The following reaction takes place

$$C_6H_6 + C_2H_4 \rightarrow C_6H_5CH_2CH_3$$

Flowsheet Description:



A feed (S1) is mixed along with recycle stream and subjected to a conversion reactor(conv_react1) where 90 % conversion takes place in order to form ethylbenzene. The stream (S3) is cooled and then subjected to three shortcut columns so as to achieve 98% of purity of ethylbenzene. Ethylene is taken as the light key component and the ethylbenzene is taken as the heavy key component. In the first shortcut column (shortcut1) the heavy key mole fraction in the distillate is 0.1148 and light key mole fraction in the bottom is 0. 07539.The condenser and the reboiler pressure is 1.5E6 Pa. The bottom product is then cooled and then subjected to another shortcut distillation column (shortcut 2) where the heavy key mole fraction in the distillate 0.4758 and light key mole fraction in the bottom is 0.00611. The condenser and reboiler pressure were around 200000 Pa. The bottom product is cooled and then subjected to another shortcut column(shortcut3). The heavy key mole fraction in the distillate 0.7613 and light key mole fraction in the bottom is 0.00015 and the condenser and reboiler is operated at 10000 Pa. The distillate S8 and S11 from the shortcut2 and shortcut3 is mixed and then subjected to recycling to achieve the desired purity of ethylbenzene.

Results :

Stream	S1	recycle	S3	S5	S12	S13
Temperature(K)	483.15	513.348	483.15	238.799	332.07	157.304
Pressure (Pa)	2E+06	2E+06	2E+06	1.5E+06	10000	10000
Mole Flows(mol/s)	319.444	35.1762	197.693	3.16132	159.92	34.612
Molar Composition						
Benzene	0.5	0.05154	0.0232533	0.00831629	0.0186747	0.0451618
Ethylene	0.5	0.416257	0.0882051	0.876884	0.00015	0.423926
Ethyl Benzene	0	0.53219	0.888542	0.1148	0.981175	0.530912

Conclusion:

A flowsheet is built to produce ethylbenzene using ethylene and benzene. A product of high purity is obtained using this process.

References:

1. Luyben L.William.,(2010), Design and Control of the Ethylbenzene Process, Department of Chemical Engineering, Lehigh University