1,3 butadiene extraction using furfural

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Background & Description:

Distillation is a reliable separation technique, and remains often the most efficient fractionation method. Extractive distillation is a ubiquitous technique used for the separation of close-boiling mixtures as well as non-ideal binary mixtures presenting either a minimum-boiling or a maximum-boiling azeotrope. A large number of stages and a high reflux ratio are required for low relative volatility separations. As a result, energy conservation becomes a major concern. When some solvents, known as entrainers in the context of extractive distillation, are added to a mixture, they change the relative volatility of one component selectively.

Process:

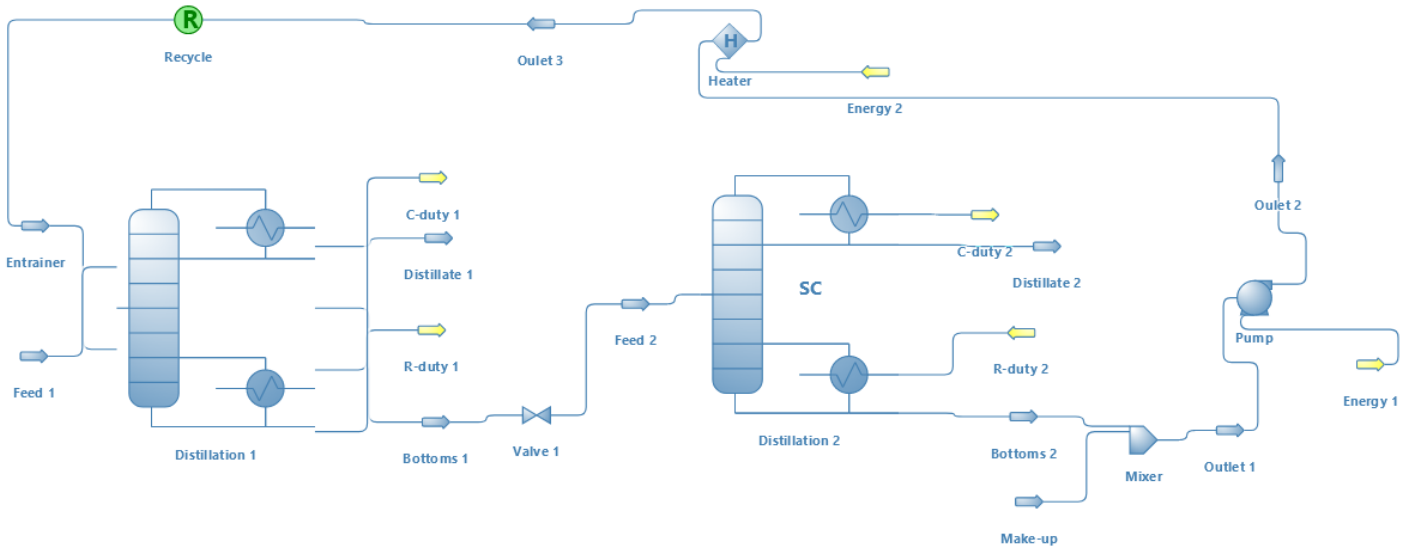
Extractive Distillation Column

An extractive distillation column with 50 equilibrium stages, a partial reboiler, and a total condenser, operating at 300 kPa, is used in this current flowsheet. An upper feed of pure furfural (i.e., the entrainer) with a flow rate of 55 kmol/hr is used in this column. It is introduced at 20 °C at stage 3 counting from the top. The extractive column has also a lower feed composed of 5 mol% n-butane, 15 mol% i-butene, 20 mol% i-butane and 60 mol% 1,3-butadiene. At stage 40, counting from the top, the lower feed enters at the same temperature of 20 °C and a flow rate of 10 kmol/hr. The distillate is composed of n-butane, i-butene and i-butane with a small fraction of 1,3-butadiene. The bottom stream has a flow rate equal to 61.55 kmol/hr and is composed mainly of 1,3-butadiene and furfural. Because the relative volatility of n-butane and 1,3-butadiene is so near to unity, a non-negligible amount of n-butane is found in the bottom stream.

Solvent Recovery Column

This column is used to recover the main product 1,3-butadiene and regenerate the solvent for recycling. The separation is carried out in a 20-stage distillation column with a partial reboiler and a total condenser, operating at 200 kPa. It is supplied with the bottoms of the extractive distillation column as feed that is introduced at stage 10 counting from the top. The reflux and reboil ratios are set to 5 and 0.777, respectively. Furfural is obtained as a bottom product and 1,3-butadiene as an overhead stream. The distillate stream has a flow rate equal to 6.55 kmol/hr. The bottom stream is pure furfural and with a flow rate of 55 kmol/hr. A minor make-up solvent stream is necessary to compensate for evaporation.

Flowsheet:



Results:

Output									
Object	**Make-up**	**Feed 2**	**Feed 1**	**Entrainer**	**Distillate 2**	**Distillate 1**	**Bottoms 2**	**Bottoms 1**	
Temperature	20	116.223	20	20	14.5592	23.3631	169.583	119.683	**C**
Pressure	200	200	300	300	200	300	200	300	**kPa**
Mass Flow	0.0960841	5645.82	554.008	5328.98	322.633	237.163	5323.18	5645.82	**kg/h**
Molar Flow	0.001	61.56	10	55.7237	5.89758	4.16374	55.6622	61.56	**kmol/h**
Molar Fraction (Mixture) / 1,3-butadiene	0	0.0944935	0.6	0.00999978	0.891925	0.177774	0.01	0.0944935	
Molar Fraction (Mixture) / Furfural	1	0.895415	0	0.989198	0.01	1.71387E-05	0.989231	0.895415	

Thus according to this flow sheet, we get majorly 1,3 butadiene as our desired product.