Production of absolute alcohol from industrial alcohol by Azeotropic distillation

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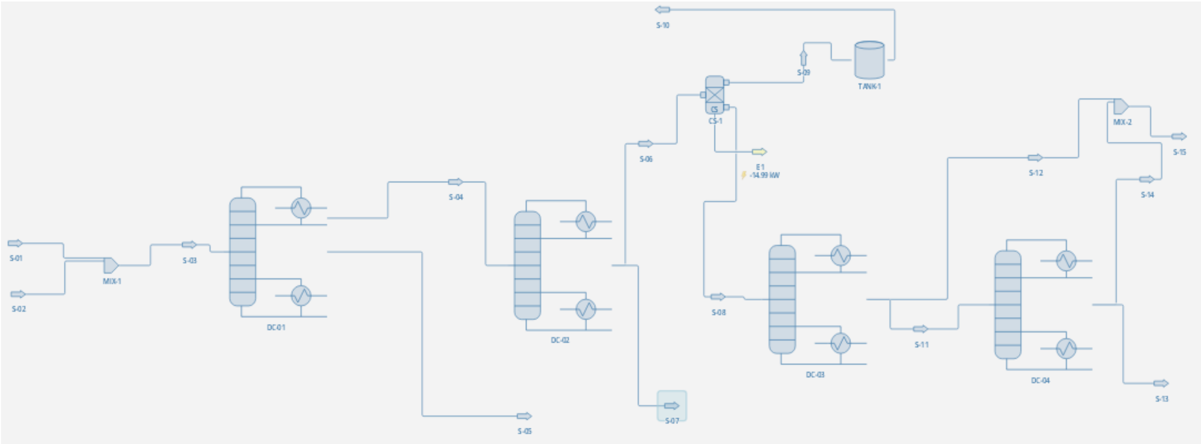
Background and Process Description:

Alcohol is the most common product used in industrial processes for different purposes and other uses. Alcohol further categorizes into industrial alcohol and Absolute alcohol on the bases of concentrations. Industrial alcohol contains **95% alcohol and 5% water** another Absolute alcohol contains **99% alcohol and 1%** water. This Absolute alcohol is widely used in reagents, solvents, antiseptics, feedstock, plasticizers, and chromatography.

The feed(S-01) contains **95% alcohol and 5% water** mixture at a temperature of 353.317 K, Pressure of 101325 Pa, and a mass flow rate of 1 Kg/sec another side solvent benzene feed (S-02) at temp 362.65 K, the pressure of 101325 pa, mass flow rate 0.8 kg/sec. Now both feed streams mix through a mixer (MIX-1) and go to **Azeotropic distillation**. It has a reflux ratio of **3 and 22 stages**, the bottom comes out with **99.96% absolute alcohol**(S-05), and top feed(S-04) to simple distillation(DC-02) and the bottom product(S-07) comes with **99.99% absolute alcohol** Now top product(S-06) contacted to a separator which 100% benzene further recycle but by iteration time limitation we store it in the tank(S-10) now, another stream(S-08) feed to third distillation column (DC-03) which give the top product(S-12) as 89.90% alcohol and another bottom stream(S-11) feed to the fourth column which gives a top product(S-14) as 89.60% alcohol and bottom product(S-13) further used. We mix the S-12 and S-14 stream to MIX-02 so, it gives 89.70% alcohol. However, we can recycle **S-10 but recycle block iteration time we cannot.**

Flowsheet:



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Results:

Master Property Table								
Object	S-15	S-13	S-10	S-06	S-05	S-04	S-03	
Temperature	351.543	351.776	343.021	343.021	351.787	347.382	344.573	K
Pressure	101325	101325	101325	101325	101325	101325	101325	Pa
Mass Flow	0.0584682	0.273175	0.789562	1.12121	0.607737	1.1603	1.8	kg/s
Molar Flow	1.35401	7.09988	10.1081	18.562	13.2197	19.4105	32.6302	mol/s
Volumetric Flow	7.76469E-05	0.000347474	0.000955334	0.00138567	0.381589	0.553271	0.722391	m3/s
Specific Enthalpy (Mixture)	-832.181	-963.204	-349.769	-546.453	80.8989	62.8869	-91.3885	kJ/kg
Specific Entropy (Mixture)	-2.22247	-2.51357	-1.00921	-1.36739	0.259689	0.407312	-0.111477	kJ/[kg.K]
Molar Fraction (Overall Liquid)	0.999999	1	1	1	0	0	0.217477	
Mass Fraction (Overall Liquid)	0.999999	1	1	1	0	0	0.198355	
Molar Fraction (Mixture) / Ethanol	0.897096	0.729357	0	0.344415	0.996	0.373029	0.651821	
Mass Fraction (Mixture) / Ethanol	0.957069	0.87328	0	0.262678	0.998091	0.287483	0.544352	
Molar Fraction (Mixture) / Water	0.102904	0.270643	0	0.111026	0.00373873	0.10619	0.0343064	
Mass Fraction (Mixture) / Water	0.0429311	0.12672	0	0.0331135	0.00146512	0.0320029	0.0112038	
Molar Fraction (Mixture) / Benzene	2.62385E-15	2.4368E-22	1	0.544559	0.000261273	0.520781	0.313872	
Mass Fraction (Mixture) / Benzene	4.74632E-15	4.94704E-22	1	0.704208	0.000443935	0.680514	0.444444	
Energy Flow	-367.736	-1944.43	561.595	-1775.31	-3056.06	-1288.85	-4583.53	kW

Conclusion:

Water and ethanol are known to form an azeotropic mixture. This mixture can be separated via the process of azeotropic distillation. In order to achieve this, material separation agents' benzene was used. Achieving 99% pure ethanol required 22 no of stages and a 3-reflux ratio. Economic studies will be done after finding the total cost of distillation. The total cost of distillation is the sum of capital cost and operating cost. This pure alcohol can be used for the production of useful chemicals.