Separation of di-n-propyl ether and n-propyl alcohol by separation technique pressure-swing distillation

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1. INTRODUCTION:

Distillation is the most widely used separation process in the chemical industries. In this work, it has been studied the separation of binary azeotrope di-n-propyl ether (DPE) + n-propyl alcohol (PA). The aliphatic ethers are obtained normally by dehydration of the corresponding alcohol in the presence of an adequate catalyst. In this case, di-n-propyl ether can be prepared from n-propanol by dehydration with sulphuric acid. In this work, only pressure-swing distillation and extractive distillation have been considered. Laboratory experiments in either pressure-swing distillation or extractive distillation are time-consuming and expensive because of the large number of parameters involved. It would be desirable to predict the experimental data with the help of available simulation programs. A major problem appears to be obtaining a reliable, consistent set of plant data. Nevertheless, in this case, it has been used consistent thermo physical experimental data determined.

2. DEVELOPMENT OF FLOWSHEET IN DWSIM:

The optimization procedure using Aspen Hysys software requires setting the number of trays in both columns. With the short-cut design tool of Aspen Hysys. We did a preliminary optimization (case studies) analyzing the variation of stage number and reboiler heat duty (RHD) as a function of the reflux ratio, in order to set the number of ideal trays and feed position for both columns. From the results of these case studies we selected 12 ideal trays (feed entry at stage 7) for the LPC and 12 ideal trays (feed entry at stage 6) for the HPC. With the design variable specifications and once the number of trays was fixed, the system then converged successfully in the rigorous facility of Aspen Hysys.

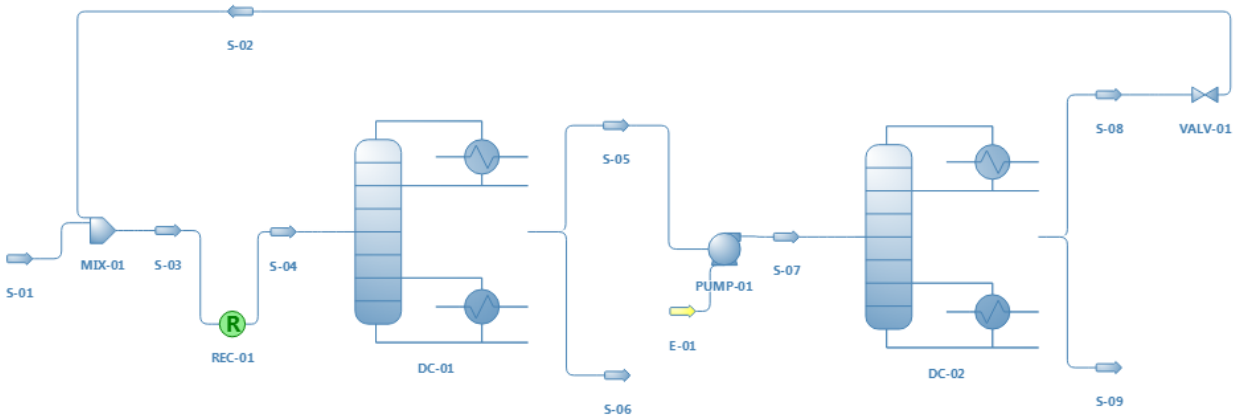

Fig.1 Flow sheet of Separation of di-n-propyl ether and n-propyl alcohol in DWSIM

3. PURPOSE OF STUDY:

In this case, steady-state comparisons have been presented of a pressure-swing distillation process and an extractive distillation process to separate the di-n-propyl ether and n-propyl alcohol azeotropic mixture. The computer simulation and economic evaluation of the two separation alternatives allow us to conclude that, to process12,000 Tm/year (approximately, 1500 kg/h), the process that uses PSD is much more attractive in terms of steady-state economics. Capital investment is very significant lower.

4. DESCRIPTION OF FLOWSHEET:

First, proposed distilling the azeotropic mixtures by PSD. The synthesis and design of extractive distillation processes take place in two steps. The first one involves the selection of one or more candidate solvents. second step, process design, involves the search for optimal process parameter values. The success of the second step depends on the solutions obtained for the first one because efficiency in extractive distillation is largely determined by the choice of a suitable entrainer. The feed is a mixture made up of 50 mol% of di-n-propyl ether and 50 mol% of n-propyl alcohol. In this case, UNIQUAC activity model was chosen. water can be used as coolant for the overhead condenser and steam can be used as a heating medium for the reboiler. the separation sequence is formed by two columns operating at different pressures. The fresh feed, is mixed with the recycled stream from the second column to form the feed stream, pure n-propyl alcohol can be obtained as a bottom product and a mixture near the azeotropic composition at 30 kPa is the distillate. Stream D1 is the feed stream to the next column with different pressure, then propyl ether, can recovered in the bottom product stream, B1, and a near azeotropic mixture becomes the distillate, D2, for recycling to the first column. pressure, in this case 101.3 kPa, High purity of PA (99 molar%) is produced as a bottom stream from the LPC and DPE (99 molar%) is produced as a bottom stream from the HPC.

5.RESULT:

Object	S-01	S-02	S-03	S-04	S-05
Temperature	30	52.9425	53.2381	53.2381	51.9306
Pressure	101.325	30	30	30	29
Mass Flow	1500.18	2008.38	3508.57	3508.57	2941.47
Molar Flow	18.49	22.67	41.16	41.16	31.84
Mass Fraction (Mixture) / 1-Propoxypropane	0.62966	0.781045	0.716316	0.716316	0.848628
Mass Fraction (Mixture) / 1-propanol	0.37034	0.218955	0.283684	0.283684	0.151372

S-06	S-07	S-08	S-09	
67.9538	61.9763	85.2181	90.044	C
31	103	101.3	103	kPa
564.008	2941.47	2008.38	933.083	kg/h
9.32001	31.84	22.67	9.16999	kmol/h
0.016884	0.848628	0.781045	0.994094	
0.983116	0.151372	0.218955	0.005906	

6. REFERENCE:

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