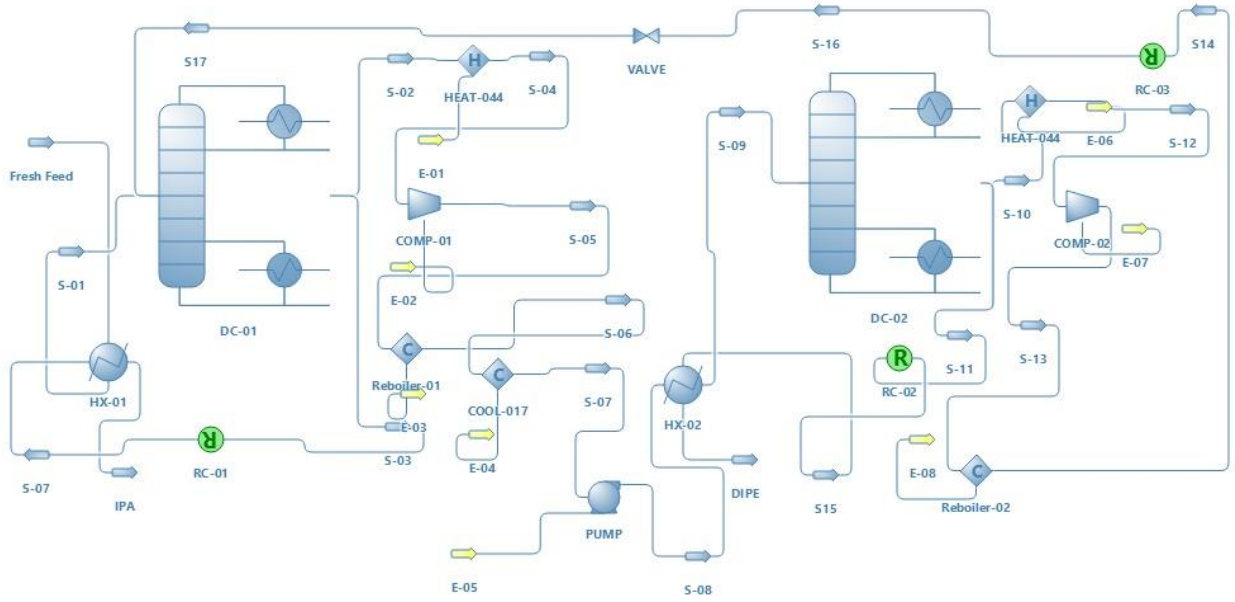
Separation of Di-isopropyl Ether and IsoPropyl Alcohol using Pressure Swing Distillation Process with Vapor Recompression

Problem Statement

Di-isopropyl ether (DIPE) and Isopropyl alcohol (IPA) form the minimum boiling azeotrope at 101325Pa and 65.97°C . Feed has 75% by mole IPA at 25°C in azeotropic binary mixture . Components have to be separated using Pressure swing distillation with vapour recompression technique.

Description

In pressure swing distillation, the total condenser of column 1 is operated at 101325Pa with 1000 Pa pressure drop at each stage. Column 2 is operated at 405300 Pa with 1000 Pa pressure drop at each stage. IPA is recovered from the column 1 as the bottom product with 99.9% purity and azeotropic mixture from the condenser as the top product is sent to the column2 where the DIPE is recovered as bottoms product from column 2 with 99.9% purity and azeotropic mixture as the top product is recycled back to the column 1.



In the simulation, the inbuilt model of CheSEP distillation block is used which has condenser and reboiler as a part. Therefore condenser must have some finite load, thus only vapour recovery is difficult. The distillate(azeotrope) and reflux(azeotrope) are obtained as the liquid from the total condenser. Equivalent load of total condenser is put to a vaporizer to change the phase of distillate to conceptually obtaining vapours from the top of the column. Further distillate in the vapour phase is compressed and fed to a cooler /condenser acting as a heat exchanger to boil up the liquid from the bottom of the column has loaded is equivalent to the reboiler load. Conceptually exchanging

heat from hot vapours coming from the compressor. The vapours change phase to liquid is pumped to preheater with DIPE coming from column2, preheats the azeotropic mixture. Ultimately reboiler load equates to the work done by compressor and heat load of the total The preheated azeotrope is fed to column 2 for further separation. A similar approach is used for vapour recompression for the second column. The azeotropic mixture from the second column obtained as the top product is recycled back to the first column. For simulation customized unit system is used in which temperature is in Kelvin, the pressure is measured in atm and the flow rate is in kmole/hr. For the given feed, 75.05 kmol/hr of IPA is obtained with 99.9% purity and 24.95kmol/hr of DIPE is obtained with a purity of 99.99%.

Reference:

Design and control of a pressure-swing distillation process with vapor recompression