CL 312: Computer Aided Process Equipment Design Laboratory

Indian Institute of Technology, Guwahati.

Assignment-3

Use Aspen Plus V10 or V11 for process simulation.

Total Marks: 20

A feed consisting of 40 mol% propane and 60 mol% iso-butane is to be separated using distillation.

Feed flowrate is 1 kmol/sec which is available at a temperature of 322 K and 20 atm pressure, enters a distillation column that uses 32 number of stages, a total condenser, a kettle-type reboiler and double-pass sieve-type trays (tray spacing = 0.6094 m). The condenser is operating at 16.8 atm and the stage-wise pressure drop being 0.0068 atm inside the column. Assume that the feed stage is situated in the middle of the column, molar distillate flowrate is 0.4 kmol/sec and molar reflux ratio is 2.

However, the desired specification of the heavy key component in the distillate is 2 mol% and that of the light key component in the bottom is 1 mol%.

Design a distillation column that will bring about the desired separation (**Hint**: Use Design Spec), also find the following:

a) Corresponding distillation column height and diameter

   (**Hint**: Column internals. No pressure drop update involved.)

b) Tabulate the effect of feed stage location on the reflux ratio, condenser and reboiler duties (Vary the feed stage location from 12 to 18 for the analysis)

c) Report the feed stage location at which the reflux ratio, condenser and reboiler duties altogether were found to be minimum. (Mention all their values)

d) Plot the graphs of reflux ratio vs feed stage, condenser duty vs feed stage and reboiler duty vs feed stage (All plotted separately)

Use Chao-Seader correlation with Lee-Kesler enthalpy as the thermodynamic basis for designing the RadFrac distillation operation.

Guidelines for submission of Assignment 3

1. All steams/equipment in the Aspen flowsheet must be labeled properly
2. All sorts of assumed data / input must be mentioned clearly in the report (if any)
3. Save the simulation file as Aspen Plus Compound (.apwz) file
4. Name of the files: Group(no.)_Assignment(no.) .apwz/.pdf
5. Report the following in **.pdf** file:
   a) Distillation column height and diameter
   b) Table of the feed stage location, reflux ratio, condenser duty and reboiler duty values
   c) Minimum reflux ratio, minimum condenser and reboiler duties; and the corresponding feed stage location values.
   d) Graph plots (well labeled) of the following

      "Reflux ratio vs Feed stage"

      "Condenser duty vs Feed stage"

      "Reboiler duty vs Feed stage"

   e) Snapshot of the final, well labeled Aspen flowsheet
6. Upload the following 2 files: .apwz and .pdf file on **Microsoft Teams** portal.

Last date of Assignment-3 submission: 26th March 2024, 11:59 p.m.