Aspen-Plus Session A-03

Wednesday 13th April 2016

Problem–1: Manufacture of Methanol

Methanol is manufactured by reacting synthesis gas at high temperature and pressure. Unreacted gases are separated in a flash drum and recycled. Last week, you ran an equilibrium reactor and flash separator problem. Today, you will do "design analysis" for this system. Ensure you are using "SR-Polar" property method for all parts of this problem

Part 1.1: Design of Flash Separator (35 points)

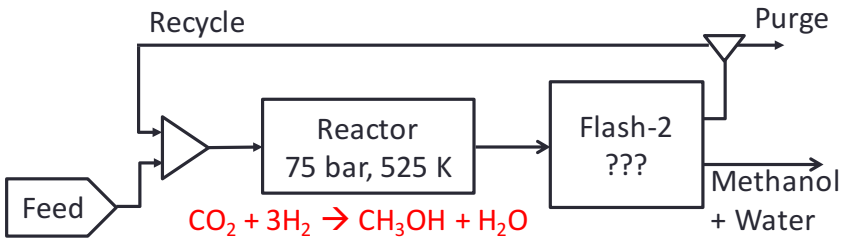
Open the `methanol_equil.apw` flowsheet from previous week. Find out the pressure, temperature and flowrates of output stream from the `RGibbs` reactor of last week. Close the file.

Start a new Aspen-Plus Flowsheet. There is a single `Flash-2` separator, with single `FEED` stream. This stream is at the same conditions (temperature, pressure, flow rates) as you obtained above. Set the temperature of `Flash-2` as 325 K and pressure previous week. Run the simulation.

Next, we want to run Sensitivity Analysis to ensure that at least 90% of `FEED` methanol is condensed. Define two variables `FEEDM` and `LIQM` as molar flow rates of methanol in feed and condensate streams, respectively. Vary the operating temperature in `Flash-2` in the range 275 to 375 K in steps of 5 K. Find the ratio `LIQM/FEEDM`. Select the temperature at which this ratio just exceeds 95%. Save the file as `methanol_sens.apw`.

Part 1.2: Methanol Flowsheet (15 points)

Open the flow-sheet `methanol_equil.apw` from previous week. Change the conditions on the `Flash-2` block to match the conditions obtained in Part 1.1. Complete the flowsheet & simulate. Is the `Flash-2` block as efficient as we designed in Part 1.1? Explain your results.



Problem–2: Separation of Acetone and Water

Previous week, you added distillation column to the flow-sheet for separating acetone and MIBK. You observed that the separation needs to be improved. In today's session, we will use Design Analysis option in Aspen-Plus to design a better distillation column. Ensure that you are using NRTL property method and all streams are at 75 $°F$ and 50 psi pressure.

Part 2.1: Design specification for water purity (25 points)

Open the Aspen-Plus file from the previous week, where you had added `RadFrac` column in the flowsheet. Save this as a different file, say `decant_design.apw`. We will use "Design Specification" to obtain desired purity of water. Change the amount of `MIBK-2` stream such that the mass fraction of water in the bottom stream meets desired target purity of 95% with 0.1% tolerance.

Part 2.2: Design specification for Final Flow Sheet (25 points)

Open the `decant_design.apw` above and save it as `decantSep_Final.apw`.

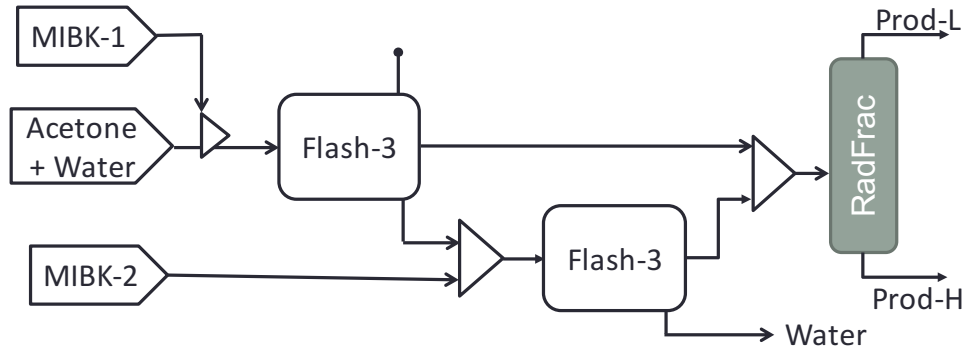
Remove the design specification of the previous problem. Set the amount of `MIBK-2` stream to the flow rate obtained from Part 2.1 above.

Run the simulation for the entire flow-sheet and confirm that the desired water purity is met.

Now, again run the "Design Specification", this time changing the Reflux Ratio of `RadFrac` column to obtain acetone with 95% purity with 0.1% tolerance.

Run the entire flowsheet simulation and observe that the purity of acetone and water is met. What are the design values of MIBK-2 and Reflux Ratio? Explain your observations.

Recall from Last Week



`RadFrac` column requires users to specify several design parameters as given here:

Use 10 trays of the distillation column `RadFrac`, with the distillation inlet at tray-5.

The distillate-to-feed ratio is 0.9.

Choose condenser pressure as 25 psi.