Fiche de TP Simulateurs en Génie des procédés Master 1 GC 2021/2022

Exercise 1 Generate xy, Txy and Pxy diagrams

Learning Objective:

Learn how to generate xy, Txy and Oxy diagrams for the binary mixture in Aspen HYSYS

Problem statement:

Generate xy, Txy and Pxy diagrams for a binary mixture of benzene-toluene:

For xy: Use pressure as 1 bar.

For Txy: Use pressure as 1 bar, 2 bar, 3 bar.

For Pxy: Use temperature value of 25°C, 50°C and 75°C.

Exercise 2 Enthalpy of vaporization

Learn how to calculate heat of vaporization (Enthalpy of vaporization ΔH_{vap}) using the heater block in Aspen HYSYS.

Problem Statement:

Three solvents:

a) Water
b) 3-Methylhexane
c) 1,1,2-trichloroethane.

Select the appropriate solvent with the least Enthalpy of vaporization ΔH_{vap}. The pressure and the molar flow were 1bar and 1kgmole/h, respectively.

Heat of vaporization determines the amount of energy required. Therefore, it is important to know the heat of vaporization of various species during solvent selection.

Exercise 3 vapor liquid separations

Objective:

To investigate vapor liquid separation at different operational conditions

Initial conditions:

Binary mixture: Benzene and Ethanol

Pressure = 1bar, Temperature= 25°C, Flowrate= 1 kgmole/h.

Table 1

Conditions	PV Flash	TP Flash	TV Flash	TQ Flash	PQ Flash
Parameter	0.5		0.5		
V					
T (°C)					
P (bar)	1.00	1.00			1.00
Q (kcal/h)					

Exercise 4

Toluene is produced from n-heptane by dehydrogenation over a Cr2O3 catalyst:

$$CH_3\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_2\text{-}CH_3 \rightarrow C_6H_5CH_3 + 4H_2$$

The toluene production process is started by heating n-heptane from 65 to 800 oF in a heater. It is fed to a catalytic reactor, which operates isothermally and converts 15 mol% of the nheptane to toluene. Its effluent is cooled to 65 oF and fed to a separator (flash). Assuming that all of the units operated at atmospheric pressure, determine the species flow rates in every stream.

Exercise 5 Steam power plant

Steam generated (basis= 100 kg/h) in a power plant at a pressure of 8600kPa and a temperature of 500°C is fed to a turbine. Exhaust from the turbine enters a condenser at 10kPa where it is condensed to saturated liquid which then pumped to the boiler. (a) Determine the thermal efficiency of a practical cycle operating at these conditions if the turbine efficiency and pump efficiency are both 75%. (b) If the rating of the power cycle of part (a) is 80000kW, what is the steam rate and what are the heat transfer rates in the boiler and condenser? (Note: Fluid Package= NBS steam or Peng-Robinson*). Use Spreadsheet in the calculations where the efficiency of the cycle= (Wout-Win)/*Q_H.

Exercise 6

We have a steam containing 15% ethane, 20% propane, 60% i-butane and 5% n-butane at 50°F and atmospheric pressure, and a flow rate of 100 Ibmole/hr. This steam is to be compressed to 50 psia, and then cooled to 32°F. The resulting vapor and liquid are to be separated as the compositions of these two streams?

Exercise 7 Rectification of a Benzene-Toluene Mixture

A liquid mixture of benzene-toluene is to be distilled in a fractionating tower at 101.3kPa pressure. The feed of 100kg mol/h is liquid and it contains 45 mol % benzene and 55 mol % toluene and enters at 327.6K (130°F). A distillate containing 95 mol % benzene and 5 mol% toluene and a bottoms containing 10 mol % benzene and 90 mol % toluene are to be obtained. The reflux ratio is 4:1. The average latent heat given 32099 kJ/kg mol (13800 btu/Ib mol. Calculate the kg moles per hour distillate, kg moles per hour bottoms and the number of theoretical trays needs.

Exercise 8 calculation of trays in distillation column

A mixture of benzene and toluene containing 40 mole % benzene is to be separated to give a product containing 90 mole % benzene at the top, and a bottom product containing not more than 10 mole % benzene. The feed enters the column at its boiling point, and the vapour leaving the column which is condensed but not cooled, provides reflux and product. It is required to final the number of theoretical plates needed and the position of entry for the feed.

Data: Summer temperature 35°C, pressure 100kPa and Molar flow 100kgmole/h.