CHE 362 **HW #5** **Due 6/8/23**

#2 Methanol is to be removed from a nitrogen gas stream by absorbing the methanol into water is a countercurrent absorber. The gas enters at 2 mol% methanol at a rate of 100 kmol/hr. Pure water is fed to the absorber. The unit is operated at 25 °C and 1 atm pressure. The mole fraction of methanol in the gas is to be reduced to 0.1%. You can use the (Y-X) diagram from HW #4 for equilibrium calculations.

a) Draw a diagram of this process labeling the streams with all of the known information assuming the process is a cocurrent process. Assume the water phase is the L phase and the gas phase is the V phase. Label the streams with both mole fractions and mole ratios.

b) If a countercurrent process were to be used, what minimum water flow rate would be required? Show your solution graphically. (Note: Please scale your X-Y diagram in Excel to get the highest resolution for your operating line.)

c) If 1.4 times the minimum water rate is used. How many stages would be required? Show your solution graphically.

d) For 1.4 times the minimum water rate, estimate the number of stages using the Kremser equation.

#2 A leaching process is to be designed to recover oil from safflower seeds. In the process, crushed seeds are contacted with a solvent that dissolves the oil in the seeds. The oil/solvent solution is then mechanically separated from the remaining non-soluble part of the seed which is referred to as the meal. Note that by definition, the meal contains no oil.

In the first part of the process, the seeds are presoaked in solvent for a sufficient amount of time for the oil in the seeds to dissolve in the solvent. This mixture is then sent to the leaching process. Equilibrium data for the distribution of oil between the meal stream and the solvent stream is shown in the attached diagram. The seeds entering the process contain 0.2 lbs of oil per lb of seeds. Fresh solvent enters free of any oil. A process is to be designed to recover 95% of the oil from the seeds. The feed rate is to be 1000 lbs of seeds/min.

a) If a single cocurrent stage is used, what is the minimum solvent rate needed? Show your solution graphically.

b) If 2 times the minimum solvent rate is used, how many lbs of oil will there be per lb of solvent exiting the process?

Suppose a multistage, countercurrent process is to be used.

c) What is the minimum solvent rate that is needed?

d) If 1.5 times the minimum solvent rate is used, how many stages are needed? Show your solution graphically.

Suppose a multistage, cross-current process is to be used.

e) If fresh solvent is fed to each stage at a rate of 1600 lb/min, how many stages would be needed? Show your solution graphically.

f) Estimate the number of countercurrent stages using the Kremser equation

Equilibrium Diagram for Leaching Operation