**AE 335 Separation Processes**

**(by PTS)**

**Problem Set 5**

**(Batch Distillation)**

1. A simple batch distillation with a single equilibrium stage is employed to separate methanol from water. The feed charged to the still pot is 100 moles with 75 mol% of methanol. We desire a final bottom product concentration of 55 mol% methanol. Find the amount of the distillate collected, the amount of material remained in the still pot, and the average concentration of the distillate. The system's pressure is 1 atm; so, the equilibrium data of the methanol-water mixture given in Problem Set 1 can be used.

2. We wish to use a distillation system of a still pot plus a column with *one* equilibrium stage to separate a mixture of methanol and water. A total condenser is used. The feed is 1 kmol with 57 mol% methanol. The desired a final bottom product concentration is 15 mol% methanol. The system's pressure is 101.3 kPa. The reflux is a saturated liquid, and $\dfrac{L}{D}$ is constant at 1.85. Find $W_{\text{final}}$, $D_{\text{total}}$, and $x_{D,\text{avg}}$.

3. We wish to employ a normal batch distillation for the mixture of methanol and water. The system comprises a still pot and a column with 2 equilibrium stages. The column has a total condenser, and the reflux is a saturated liquid. The column is operating with a *varying* reflux ratio, but $x_D$ is held *constant*. The initial feed charged into the still pot is 10 kmol with 40 mol% methanol. The desired final concentration in the still pot is 8 mol% methanol and the desired distillate concentration is 85 mol% methanol. The system's pressure is 1 atm, and CMO is valid.

   3.1) What initial external reflux ratio $\left(\dfrac{L}{D}\right)$ must be used?

   3.2) What final external reflux ratio must be used?

   3.3) How much distillate product is withdrawn, and what is the final amount of material left in the still pot?

4. A mixture of 62 mol% methanol and the remaining water is distilled using a batch distillation. The batch distillation system comprises a still pot and a column with one equilibrium stage. The feed is 3 kmol. The system operates at the *constant* distillate concentration $\left(x_D\right)$ of 85 mol% methanol. The desired final still pot concentration is 45 mol% methanol. The reflux is a saturated liquid. Assume that CMO is valid.

   4.1) Find $D_{\text{total}}$ and $W_{\text{final}}$

   4.2) Find the final value of the external reflux ratio $\left(\dfrac{L}{D}\right)$