New Problems Chapter 25

25.1-2 ***Gas Permeation Membrane for Methane Removal.*** At 25°C a gas containing methane at a mole percent of 10% and air at 90% is flowing over a natural rubber membrane (thickness = 0.2mm) at 5 atm. The resistance to mass transfer on the top of the membrane was k_{c1}= 0.002 m/s and for the bottom $k_{c2} = \infty$. If the partial pressure of methane on the other side of the membrane is 0.01atm, what is the flux of methane through the membrane?

25.2-6 ***Design using Complete-Mixing Model.*** A gaseous feed stream having a composition of x_f = 0.45 and a flow rate of 2.5 x 10^{-4} ft^3/hr is to be separated in a membrane unit to give a desired reject composition of x_o = 0.25. The feed – side pressure is 60 psi and the permeate is 15 psi. The membrane has a thickness of 6 x 10^{-4} in, permeability

$P'_A = 8\times10^{-8}\dfrac{ft^3(\text{STP})*ft}{hr\cdot ft^2\cdot psi}$, and α*=9.5.

a) Using the Complete-Mixing Model calculate the permeate composition, fraction permeated and membrane area

b) Calculate the minimum reject concentration.

25.3-3 ***Separation of Multicomponent Gas Mixtures.*** A multicomponent gaseous mixture having a composition of x_{fA} = 0.4, x_{fB} = 0.4 and x_{fC} = 0.2 is to be separated by a membrane with a thickness of 3 x 10^{-3} cm using the complete mixing model. The feed flow rate is 2.5 x 10^4 cm^3/s and the permeabilities are

$P'_A = 300\times10^{-10}\dfrac{cm^3(\text{STP})*cm}{s\cdot cm^2\cdot cmHg}$, $P'_B = 100\times10^{-10}$, and $P'_C = 150\times10^{-10}$. The pressure on the feed side is 400 cmHg and 30 cmHg on the permeate side. The fraction permeated will be 0.3. Calculate the permeate composition, rejection composition, and membrane area using the complete mixing model.

25.4-2 ***Design of a membrane Unit using Cross-Flows.*** In this case the flow is cross-flow. A gaseous feed stream having a composition of x_f = 0.45 and a flow rate of 2.5 x 10^{-4} ft^3/hr is to be separated in a membrane unit where θ = 0.58. The feed – side pressure is 60 psi and the permeate is 15 psi. The membrane has a thickness of 6 x 10^{-4} in, permeability

$P'_A = 8\times10^{-8}\dfrac{ft^3(\text{STP})*ft}{hr\cdot ft^2\cdot psi}$, and α*=9.5. Calculate y_p, x_o, and A_m.