Chemical Engineering 476

Homework 29

1. Suppose that you are transferring ammonia into water at 25°C and 1.5 atm. The following mass transfer values have been estimated from measured values for systems where the gas and liquid phase contributions could be separated.

   $k_L a = 0.0098\ s^{-1}$

   $k_p a = 0.001\ mol/s\text{-}m^3\text{-}Pa$

   The solubility of ammonia in water under these conditions is 0.77 mol frac (liq)/atm. Please determine:

   a. The fraction of the total resistance that is due to the gas phase.
   b. The transfer rate of ammonia per volume if the ammonia concentration in the water (bulk) is zero and the ammonia in the gas is 5 vol%. Assume dilute solution. Use K_x.
   c. Repeat part (b) for K_y
   d. The interfacial mol fractions in the gas and liquid.

2. Carefully tudy Section 16.1 of your text and address the following:
   a. Examine equations 16-1 and 16-2 and make sure that you understand the definition of each of the variables
   b. What does dy_A represent physically?
   c. Which variables change with height in the column? Why?
   d. What is H_G? Would we like its value to be large or small?
   e. Does the material balance presented in this section assume that the transfer rate is constant along the height of the column?
   f. Does the assumption of constant V require dilute solutions? Is V the total flow rate or just that of the carrier gas?
   g. What is the goal of the material in this section?
   h. What is the advantage and disadvantage of using overall coefficients for this type of calculation?