Department of Chemical Engineering

Minor II – CHL221 **CRE -II**
Time: 4-5PM Date: 10th Oct., 2014
M.M 20

1. A plant is removing a trace of chlorine (Cl_2) from a waste gas stream by passing it over a solid granular adsorbent in a tubular packed bed. At present, 53.2 % removal is being accomplished, but it is believed that greater removal could be achieved if the flow rate were doubled, the particle diameter were halved, and the packed tube length is doubled. What percentage of chlorine would be removed under the scheme proposed? Assume that chlorine transferring to the adsorbent is removed by an instantaneous chemical reaction. Use the following correlation for the calculation of mass transfer coefficient:

$$Sh = (Re)^{1/2} (Sc)^{1/3}$$ (6)

2. The gas phase cracking of atmospheric gas oil (A), STTR
A (g) ---------→ P(g) + coke (s), is to be carried out in a straight through transport reactor containing a catalyst that decays due to coke deposition. The reaction is carried out at 550° C. The entering concentration of A is 0.4 kmol /m^3. The feed gas and catalyst particles are moving in the bed at a velocity of 5.0 m/s. The first order kinetics of the reaction is given by

$-r'_A = k' C_A a(t)$, with $k' = 0.05\ m^3/kg\ cat.s$.

At 500° C, the drop in the catalyst activity for this reaction is also given by a first order kinetics with, $k_d = 7.5\ s^{-1}$. If the reactor is 8 m long, calculate the conversion at the exit of the reactor. The bulk density of the catalyst in the bed is 80kg/m^3. (7)

3. The elementary first order chemical reaction (A ---→ B), is taking place on the wall of a cylindrical pore (radius **r** and length **2 L**) of the catalyst open from both end. Develop an expression for concentration profile in the pore for diffusion and chemical reaction through the pore. Assume L>>r. (7)