T.E- V Sem - Chem.

Mass Transfer Operation -I

(19)

CHEM.

02/06/2016

TE/V/CBGS/MTO-I

Q.P. Code : **31231**

(3 Hours) [Total Marks : 80

N.B. : (1) Question 1 is compulsory.
(2) Attempt any 3 question out of remaining five
(3) Assume suitable data if necessary

1 A) Explain the factors affecting choice of solvent in gas absorption. 20
B) What is diffusivity? Explain FICK's first law of diffusion.
C) What is molecular diffusion?
D) Explain the concept of equilibrium in inter phase mass transfer.

2 A) Derive equation for molar flux for steady state equimolar counter diffusion for gases. 10

B) Calculate the rate of diffusion of butanol across a film of nondiffusing water(B) solution,0.1cm thick at 20 deg.C when the concentration on opposite sides of the film are respectively 10 and 4 percent acid. The diffusivity of butanol in the solution is 5.9×10^{-6} cm ^{2}/s. At 20 deg.C,the density of 10% solution is 0.971g/cc, and that of 4% solution is 0.992 g/cc. Mol. wt. of butanol is 74. 10

3. A) Explain diffusion through porous solid. 10

B) Ammonia is absorbed at 1bar from an ammonia air stream by passing it a vertical tube down which dilute H_2SO_4 is flowing . The following laboratory test data are available: Length of the tube=825 mm, Diameter of tube=15 mm, Partial pressure of ammonia at inlet= 7.5 kN/m ^{2}, Partial pressure of ammonia at out let= 2 kN/m^2 o The amount ofammonia absorbed at this condition is 1.12×10^{-6} kmol/sec. Determine the overall transfer coefficient K_G based on gas phase. 10

3 A) In a typical chemical process, component A is desorped from an aqueous solution into an air stream in a mass transfer tower at a certain operating temperature and pressure. At a particular point in the tower, analysis report shows that $P_{A,G} = 12$ mm Hg, $C_{AL} = 4$ kmol/m ^{3} The overall mass transfer coefficient K_G =0.269 Kmol A/(m^2 .hr.atm.). If Henry's law is applicable to this system and if 56 % of total mass transfer resistance is in gas film. Calculate (a) Gas film coefficient k_g (b) Liquid film coefficient (k_l) (c)Molar flux of component A, N_A. 10

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B) Explain following terms 10
(a) Equilibrium stage(b) Stage efficiency (c) Murphee stage efficiency(d)Stage(e)Cascades

4. A) Carbon disulphide is to be absorbed from a dilute gas mixture of CS_2-N_2 into a pure non volatile oil at atm.pressure in a counter-current absorber. The mole fraction of CS_2 in inlet gas stream is 0.05 and the flow rate of gas stream, G is 1500 kmol/hr. The equilibrium relation is given by $y = 0.5\ x$ where x is mole fraction of CS_2 in liquid stream and y is mole fraction in gas stream It is desired to reduce the mole fraction of CS_2 in exit gas stream to 0.005. (a) Calculate the minimum L/G where L is the liquid flow rate in kmol/hr (b) Derive the equation for the operating line if L/G is equal to 1.5 times minimum value. 10

B) Compare Packed tower and tray tower. 10

5.A) Explain... 10
(i) Saturated vapour gas mixture
(ii) Relative humidity
(iii) Humid volume
(iv) Dew point
(v) Humid heat

B) Explain adiabatic saturation process. Derive equation for adiabatic saturation temperature. 10

6: A) With neat diagram,explain various types of moisture. 5

B) With neat diagram explain fluidized bed dryers 5

C) A batch of wet solid was dried on a tray dryer using constant drying conditions and a thickness of material on the tray of 25.4 mm. Only the top surface was exposed. The drying rate during constant rate period was $R = 2.05$ kg/(kg hr m^2). The ratio used was 24.4 kg dry solids/ 1m^2 exposed surface. The initial free moisture content was X=0.55 and critical moisture content $X_c = 0.22$ kg moisture/kg dry solid.Calculate the time to dry a batch of this material from $X_1 = 0.45$ to $X_2 = 0.30$ using the same drying conditions but thickness of 50.8 mm, with drying from the top and bottom surfaces. 5

D) Write applications of spray dryer. 5
