TE | Sem V | CBSGS | Chem | MTO - I 19/12/16

Mass Transfer Operation - I

Q.P. Code : 574002

29

(3 Hours) **[Total Marks : 80]**

N.B. 1) Question No 1 is compulsory.
2) Attempt any three questions from the remaining five questions.
3) Assume suitable data wherever necessary.
4) Figures to the right indicates full marks.

1. a) Define molar flux with respect to molar average velocity as well as molar flux with respect to fixed co-ordinates and find relation between them. **05**

b) Compare penetration theory with surface renewal theory for mass transfer coefficient. **05**

c) List advantages of packed bed over tray towers. **05**

d) Define Lewis relation. Explain difference between wet bulb temperature and Adiabatic saturation temperature. **05**

2. a) Methane diffuses at steady state through a tube containing Helium between two points 0.03m apart. The partial pressures of methane are 55kPa and 15 kPa, when total pressure is 1 atmosphere. If diffusivity is $6.75 \times 10^{-5} m^2/s$, and temperature 25°C calculate flux under equimolar counter diffusion and profile of partial pressures between the two points as a function of distance from first point. **10**

b) The diffusivity of the gas pair O_2-CCl_4 is determined by observing steady state evaporation of CCl_4 liquid into a tube containing O_2. The entire system is held at constant temperature and pressure. Both the gases are assumed to be ideal and O_2 is stationary. The distance between the CCl_4 liquid level and top of the tube is 0.171m. The total pressure on the system is 100.658×10^3 N/m^2 and the temperature is 273°K. The vapour pressure of CCl_4 is $4.399 \times 10^3 N/m^2$ at that temperature. The cross section area of the tube is $0.09 \times 10^{-3} m^2$. After steady state is attained $0.0208 \times 10^{-6} m^3$ of CCl_4 liquid is evaporated in 36000 seconds. What is the diffusivity of gas pairCCL_4-O_2? Assume specific gravity of liquid CCl_4 as 1.59. **10**

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3. a) Describe flux equations for diffusion through polymer membrane and porous solids. 10

b) Explain concept of individual and overall mass transfer coefficient and procedure to calculate interfacial coefficient both graphically and using appropriate formula. 10

4. a) Explain loading and flooding in packed column. 08

b) 4500kg/hr of SO_2-air mixture containing 5% by volume SO_2 is to be scrubbed with 200,000kg/hr of water in a packed tower. The exit concentration of SO_2 is reduced to 0.15%. The tower operates at one atmosphere. The equilibrium relationship is given by 12

$$Y=30X$$

Where, Y=Mole SO_2/Mole air

X= Mole SO_2/Mole water

If the packed height of tower is 400cm, estimate the height of transfer unit (H.T.U.).

5. a) A batch of solid for which the following table of data applies is to be dried from 25% to 6% moisture under conditions identical to those for which the data were tabulated. The initial weight of the wet solid is 300kg and the drying surface is $1m^2$/8kg dry weight. Determine the time for drying. 12

X	0.35	0.25	0.20	0.18	0.16	0.14	0.12	0.10	0.09	0.08	0.064
N	0.35	0.35	0.35	0.3	0.26	0.239	0.20	0.18	0.15	0.097	0.07

Where, X=kg moisture/kg dry solid

N=kg moisture evaporated/hr m^2

b) Explain the mechanism of batch drying. 08

6. **Write short notes on any four:** 20

a) Wetted wall column

b) Mass transfer analogy

c) Overall tray efficiency

d) Natural draft and forced draft cooling towers

e) Humid heat and humid volume

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