Q.P. Code : 3399

(3 Hours)

[Total Marks : 80

Mass transfer Operation

B. : (1) Question No. 1 is compulsory.
(2) Attempt **any three** questions out of **remaining five** questions.
(3) **Figures** to the **right** indicate **full** marks.
(4) Assume suitable **data** if necessary.

Solve any four.

(a) Compare Penetration theory with surface renewal theory for mass transfer coefficient. 5

(b) List advantages of packed bed over tray towers. 5

(c) Derive equation for equimolal counter diffusion of gases. 5

(d) Define Lewis relation. Explain differnce between Wet bulb temperature and Adiabatic saturation temperature. 5

(a) Calculate the rate of diffusion of oxygen (A) through non diffusing mixture of methane (B) and hydrogen (C) in the volume ratio of 3:1. The diffusivities are estimated to be. 10

D_{O_2} - H_2 = 6.99 × 10⁻⁵ m²/s

D_{O_2} - CH_4 = 1.86 × 10⁻⁵ m²/s.

The total pressure is $1 \times 10^{*5}$ N/m² and temperature is 0°C. The partial pressures of oxygen at two planes 2 mm apart is respectively 13000 and 6500 N/m².

(b) Derive the relation between overall mass transfer coefficient and individual mass transfer coefficient when the mass transfer is both gas phase and liquid phase controlled. 10
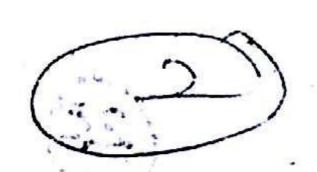
(a) Write short notes on :– 10
(i) Wetted wall column
(ii) Sparged Vessels. 10

(b) Describe flux equations for diffusion through polymer membranes and porous solids.

4. (a) 5000 kg/hr of a SO_2 - air mixture containing 5% by volume of SO_2 is to   10
be scrubbed with 2,00,000 kg/hr of water in a packed tower. The exit
concentration of SO_2 is reduced to 0.15%. The tower operates at 1atm.
The equilibrium relation is given by :-

$Y = 30X$,

$Y = \dfrac{\text{mole of } SO_2}{\text{mole of air}}$

$X = \dfrac{\text{mole of } SO_2}{\text{mole of water}}$

If the packed height of tower is 0.42 m. Calculate the height of transfer unit.
(b) Give crieteria for the choice of solvent for Absorption.   10

5. (a) Explain loading and flooding in packed column.   5
(b) Give the classification of cooling tower. Explain mechanical draft cooling   10
tower.
(c) Write short note on humid volume.   5

6. (a) A batch of solid for which the following table of data applies is to be   15
dried from 25% to 6% moisture on wet basis 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 1m²/8 kg dry weight. Determine
the total time for drying.

X	0.35	0.25	0.2	0.18	0.16	0.14	0.12	0.10	0.09	0.08	0.064
N	0.3	0.3	0.3	0.266	0.239	0.208	0.180	0.15	0.097	0.07	0.025

Where, $X = \dfrac{\text{Kg moisture}}{\text{Kg dry solid}}$

$N = \dfrac{\text{Kg moisture evaporated}}{\text{hr m}^2}$

(b) Explain Drum Dryer.   5

6. Write short notes on any **four** :-   20
(a) Tray Efficiency
(b) Venturi scrubber
(c) Working of tray tower
(d) Hydrodynamic flow of gases through porous solids
(e) Fick's first law of diffusion.

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