

T.E.-V - Sem. Chemical

11/12/15

Mass Transfer operations-I

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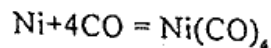
TE/V/CBGS/CEM/MT-I  
QP Code : 5746

(3 Hours)

[ Total Marks : 80

- N.B. : (1) Question No. 1 is compulsory.  
(2) Attempt any three out of remaining five.  
(3) Assume suitable data if necessary.

1. (a) Nickel carbonyl (B) is to be produced by passing Carbon monoxide (A) through a bed of nickel spheres. Find  $\frac{N_A}{N_A + N_B}$



- (b) Derive the equation for adiabatic saturation temperature. 8  
(c) Estimate the diffusivity of benzene in toluene and toluene in benzene at 110°C. The physical properties are as follows : 10

Component	M	Boiling point °C	$V_A$ at B.P. cm <sup>3</sup> /mol	$\mu$ at 110 °C Cp
Benzene	78.11	80.1	86.5	0.24
Toluene	92.13	110.6	118.3	0.26

2. (a) The air pressure in a tyre reduces from 2 bars to 1.99 bars in five days. The volume of air in the tube = 0.025 m<sup>3</sup>, the surface area 0.5m<sup>2</sup> and wall thickness 0.01 metre. The solubility of air in rubber is 0.07 m<sup>3</sup>/m<sup>3</sup>. Estimate the diffusivity of air in rubber. 10  
(b) Derive relation between individual and overall mass transfer coefficient when 10  
(i) Gas phase resistance is controlling  
(ii) Liquid phase resistance is controlling

3. (a) An ammonia air mixture containing 2% by volume ammonia is to be scrubbed with water at 10°C in a tower packed with 1.27 cm Rasching rings. The water and gas rates are 1170 kg/hr m<sup>2</sup> each, based on empty tower cross section. Estimate the height of tower required if 98% of ammonia in the entering gas is to be absorbed. The tower operates at 1 atm pressure. The equilibrium relation is given by the following equation. 12

$$Y_e = 0.746x$$

$Y_e$  = mole fraction of ammonia in air

$X$  = Mole fraction of ammonia in solution with water.

the height of transfer unit may be taken as equal to z meter.

- (b) Compare packed tower with tray tower. 8

[TURN OVER

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TE/II/COGS/CHEM/

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4. (a) It is desired to dry a certain type of fibre board in sheets 0.131 metre by 0.162 metre by 0.071 metre from 58% to 5% moisture (wet basis) content. Initially from laboratory test data with this fibre board, the rate of drying at constant rate period was found to be  $8.9 \text{ kg/m}^2\text{hr}$ . The critical moisture content was 24.9% and the equilibrium moisture content was 1%. The fibre board is to be dried from one side only and has a bone-dry density of  $210 \text{ kg/m}^3$ . Determine the time required for drying. The falling rate may be assumed linear. 10
- (b) Write short note on :-
- (i) Drum dryer
  - (ii) Tray dryer
5. (a) Give classification of cooling tower. Explain mechanical draft cooling tower in detail. 10
- (b) Explain loading and flooding in packed column. 5
- (c) Write short note on wetted wall column. 5
6. Write short notes on any four. 20
- (a) Humid heat
  - (b) Ventury scrubber
  - (c) Fick's first law of diffusion
  - (d) Diffusion through polymers
  - (e) Absorption factor and stripping factor.