M.Tech. First Semester (Membrane & Separation Tech.) (F.T.)

13023 : Advances in Absorption & Adsorption Separation Technologies : 1 MST 1

P. Pages : 2

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Time : Three Hours

0268

Max. Marks : 80

Notes :
1. Answer **any six** question.
2. Due credit will be given to neatness and adequate dimensions.
3. Assume suitable data wherever necessary.
4. Diagrams and chemical equations should be given wherever necessary.
5. Retain the construction lines.
6. Illustrate your answer necessary with the help of neat sketches.
7. Use of slide rule logarithmic table, Steam table, Moller's Chart, Drawing instrument. Thermodynamic table for moist air, Psychrometric Charts and Refrigeration charts is permitted.
8. Discuss the reaction, mechanism wherever necessary.
9. Use of pen Blue/Black ink/refill only for writing the answer book.

1. Discuss about mass transfer coeff. correlations in packed tower. **14**

2. The concentration of undesired impurity in air $\left(\pi = 10^5 \, Pa\right)$ is to be reduced from 0.1% to 0.02% by counter-current absorption in water containing B. $C_{B_l} = 800 \, mol/m^3$. B reacts extremely rapidly as:-

$A(g \to l) + B(l) \to Prod \cdot k = \infty$

Assuming $D_{Al} = D_{Bl}$ calculate tower height.

Data:-

$$k_{Ag} a = 0.32 \frac{mol}{h \cdot m^3 \cdot Pa} \qquad k_{Al} a = 0.1 \, h^{-1}$$

$$\left. \begin{array}{l} F_g/A_{cs} = 10^5 \\ F_l/A_{cs} = 7 \times 10^5 \end{array} \right\} mol/h \cdot m^2 \qquad \begin{array}{l} H_A = 12 \cdot 5 \, Pa \cdot m^3/mol \\ C_T = 56000 \, mol/m^3 \end{array}$$

3. For counter-current absorption in tray tower :-
   Show that :- **13**

$$N = \frac{\ell_n \left[\frac{y_{N+1} - mx_0}{y_1 - mx_0} \right] \left(1 - \frac{1}{A}\right) + \frac{1}{A}}{\ell_n A}$$

4. a) What will be concentration of N_2 dissolved in water at NTP. **10**

   H for $N_2 = 112 \cdot 11 \times 10^6 \frac{L \cdot atm}{mol}$.

   b) How will you select medium for stripping? **3**

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5. Acetone is to be recovered from 5% acetone-air mixture by scrubbing with water in a packed tower using counter-current flow.   13

$$\left.\begin{array}{l} \text{Liquid} = 0.85 \\ \text{Gas} = 0.5 \end{array}\right\} \text{kg/s.m}^2$$

$$K_g\bar{a} = 1.5 \times 10^{-4} \text{ kmol/s.m}^3 \left(\frac{kN}{m^2}\right)$$

Gas film resistance controls. How much will be the height of tower to remove 98% acetone.

x	0.0076	0.0156	0.0306	0.0333
y	0.0099	0.0196	0.0361	0.04

6. a) Explain the difference between physisorption, chemisorption and desorption. What are the most important variables which can affect these process?   7

   b) Explain the basic five types of adsorption isotherms and the assumption made in Langmuir isotherm.   6

7. a) Discuss the salient features of silica gel and its applications.   7

   b) Amount of acetone adsorbed at partial pressure of 10mm Hg and 100mm Hg are 0.10 and 0.40 kg acetone / kg. activated carbon respectively. If Langmuir isotherm is useful to describe adsorption, then calculate the amount of acetone adsorbed in kg/kg of activated carbon at a partial pressure of 50mm Hg and 30°C.   6

8. a) Discuss the factors on which rate of adsorption in a fixed bed depend. Also explain adsorption equilibria.   7

   b) What do you mean by adsorption dynamics of an adsorption column? Explain the salient features of one dimensional model.   6

9. a) How to design a packed bed adsorption column on the basis of Length of Unused Bed (LUB).   6

   b) How is multistage cross current adsorption carried out? Develop suitable expression for two stage operation.   7

10. Explain the following.   14
   i) Production of activated carbon with its characteristics and applications.
   ii) Suitable expression development to determine number of stages in a counter current adsorption system.

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