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

13023 : Advances in Absorption & Adsorption Separation Technologies

1 MST 1

P. Pages : 2

Time : Three Hours

AV - 3375

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. Illustrate your answer necessary with the help of neat sketches.
6. Use of pen Blue/Black ink/refill only for writing the answer book.

1. a) What do you mean by HTU, NTU and HETP ? Explain in details. **7**

b) Explain the meaning of minimum liquid rate for adsorption and how to select the medium for stripping ? **7**

2. For counter current absorption in tray tower show that : **13**

$$N = \frac{\ell_n\left[\frac{y_{n+1} - m x_0}{y_1 - m x_0}\right]\left(1 - \frac{1}{A}\right) + \frac{1}{A}}{\ell_n A}$$

where A - absorption factor. All other terms have there usual meanings.

3. a) Discuss in details the comparison between packed column and plate column for absorption. **7**

b) How to design a packed tower for absorption based on the overall mass transfer coefficient ? **6**

4. A gas absorption column is to receive 130 kmol/hr of feed gas containing 12 mol% solute. It is required to remove 93% of the solute using 150 kmol/hr of a solvent. The feed solvent has 0.4 mol% of residual solute in it. The Murphree plate efficiency is known to be 0.45. Determine the number of ideal trays required for the separation, and how many will be real trays ? the equilibrium data for the system is : **13**

x	0.0133	0.0333	0.0493	0.064	0.0747	0.0933	0.1053
y	0.01	0.0266	0.0433	0.06	0.0733	0.10	0.12

Also explain the meaning of overall tray efficiency.

5. Explain the following : **13**
i) Correlations proposed for mass transfer coefficient in packed tower
ii) Structured packings for packed towers.

6. a) What is physiosorption and chemisorption ? Discuss the important variables of adsorption equilibrium. **7**

b) How is activated alumina prepared ? Explain. **7**

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7. a) Discuss the criteria for selection of adsorbents and the heat of adsorption How to determine surface area of adsorbent ? **7**

b) Explain the terms factors affecting rate of adsorption. breakthrough conditions and stoichiometric front in operation of a packed bed adsorber. **6**

8. a) What are the models proposed to study adsorption dynamics ? Explain one dimensional model in details. **13**

9. a) Adsorption equilibrium data for the decolorization of a sample of waste oil using a special type of clay collected from a set of laboratory experiments could be fitted by a Henry's law type relation $Y = 4.2 \times 10^{-4} X^*$ **7**

where Y - number of colour units per kg oil X^* - number of colour units per kg clay in equilibrium.
1000 kg of a waste oil having an initial colour concentration of 50 units to be treated to reduce the concentration to one colour unit. The adsorbent has an effective surface area of 25 m^2/kg, and the surface mass transfer coefficient is $k_l = 5.2 \times 10^{-6}$ m / sec (on the solid-phase concentration basis). The density of the oil is 950 kg/m^3.
Calculate the minimum quantity of adsorbent required and what is the required contact time if 1.2 times the minimum amount of adsorbent is used.

b) Discuss in details the Langmuir and Freundlich adsorption isotherms. **6**

10. Explain the following : **13**
i) design of adsorption column on the basis of LUB.
ii) pressure swing and temperature swing adsorption.

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