AQ – 2738

First Semester M. Tech. (M. S. T) F. T. Examination

ADVANCES IN ABSORPTION AND ADSORPTION SEPARATION TECHNOLOGIES

Paper – 1 MST 1

P. Pages : 3

Time : Three Hours]   [Max. Marks : 80

Note : (1) Answer any **Six** questions.
   (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 wherever necessary with the help of neat sketches.

1. How will you determine diameter of packed column based on pressure drop and flooding conditions by various techniques ? Explain.   14

2. (a) Discuss the equilibrium in gas–liquid absor-ption with the help of Henry's Law.   7

   (b) How is minimum liquid rate for absorption column decided ? Why is it so important ? Explain in detail.   6

3. Discuss in detail the design of packed tower and derive expression for HTU and NTU. Also discuss their significance and differentiate between plate towers and packed towers.   13

4. A stream of waste gas containing 0.6% vol. NH_3 in air is to be scrubbed by removing 99.5% NH_3 before it can be discharged to atmosphere. Removal of ammonia is to be done in a packed tower 1 m^2 in cross section in which feed gas rate 2000 kg/m^2 hr and liquid (20% NH_3) is to be supplied at 2000 kg/m^2 hr. Overall mass transfer coefficient $K_G\bar{a}$ = 1350 kg/m^3 hr. $\triangle P$(bar). Total pressure P = 101.3 kPa. the process starts with 1000 kg 20% H_2SO_4 in the storage tank for the scrubbing liquid and the liquid is recirculated through the column continuously. The concentration of H_2So_4 in the liquid decreases as a result.

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Estimate :—

(a) How long will it take for concentration to fall to half ?

(b) Calculate h_T if 0.3 m dry packing is provided above the liquid.

(c) Recalculate h_T if only 95% ammonia is absorbed.   13

5. Carbon disulphide (CS_2) is emitted from the acid bath of a Viscose plant. It is planned to build a permanent total enclosure (PTE). It is estimated that exhaust, from PTE would leave at 12000 Nm^3/hr containing 2% CS_2 in air. Absorption medium is oil with $M = 220$, $\varrho = 840 \ kg/m^3$, $\mu = 4.7 \times 10^{-3} \ N\text{-}s/m^2$. 98% removal is desired.

Liquid flow rate is 1.35 times the minimum liquid rate. Tower diameter is 3.35 m. Overall mass

transfer coefficient $K_G{\cdot}^a = 102 \ \dfrac{kmol}{m^3. \ hr. \ bar}$

Vapour pressure of CS_2 at 25^0C = 359 mm Hg. Oil entering has 50 ppm CS_2. Tower operates at 25^0C and 1.1 bar pressure. Calculate

(i) Value of h_T.

(ii) Number of ideal trays.

(iii) Height equivalent to theoretical plate.

Solution of oil–CS_2 behaves ideally.   13

6. (a) Discuss the characteristics and properties of adsorbent.   7

(b) Discuss the salient features of silica gel and activated alumina as adsorbents.   7

7. (a) How to determine the specific surface area of an adsorbent ? What is its significance ?   7

(b) Explain the adsorption equilibria and the heat of adsorption along with their importance.   6

8. What do you mean by adsorption dynamics ? Discuss in details constant pattern behaviour model of adsorption dynamics.   13

9. (a) How is thermal regenerating of adsorbents is carried out ? 7

(b) Explain the concept of LUB and stoichiometric front and stoichiometeric time. 6

10. Explain the following :—

(i) Molecular sieves salient feature.

(ii) Selection of adsorbent and MTZ. 13

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