A 318

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2005.

Fifth Semester

Industrial Biotechnology

IB 333 — MASS TRANSFER AND SEPARATION

Time : Three hours

Maximum : 100 marks

Missing data may be suitably assumed.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define mass flux.

2. How do you obtain over–all mass transfer coefficient from individual mass transfer coefficients?

3. How the slope of the feed–line is estimated?

4. Define relative volatility.

5. Represent the ternary system in a triangular diagram.

6. Name four important factors to be considered in the selection of solvents for extraction operation.

7. Explain briefly about break–through curve.

8. Differentiate between physical adsorption and chemisorption.

9. Name the modules of membrane units.

10. What is a liquid membrane?

PART B — (5 × 16 = 80 marks)

11. Derive the relevant equations of diffusion for the following cases :

    (i) Diffusion of gas A through a non diffusing gas B. (8)

    (ii) Equimolar counter – diffusion of both A and B. (8)

12. (a) A liquid mixture of benzene and toluene containing 40 mol% benzene is to be separated to give a product of 95% benzene at the top. The bottom product should not contain more than 2% benzene. Feed is a vapor liquid mixture with 40% liquid. A reflux ratio of 3 is used. The relative volatility for the system can be taken as 2.48. Determine

    (i) Theoretical number of plates

    (ii) Actual number of plates assuming Murphry plate efficiency of 60%. (8 + 8)

Or

    (b) An initial charge of 100 moles of furfural and water mixture containing 50 moles of water and remaining furfural is distilled in a batch still operating at 1 atm. It is desired to have 95% of furfural in the bottom. Compute the number of moles to be distilled. Also derive the equation used. (16)

x :	0.04	0.06	0.08	0.1	0.2	0.3	0.5
y :	0.19	0.36	0.68	0.81	0.89	0.905	0.908

13. (a) In a multistage counter current extraction operation 26% solution of dioxane in water was continuously extracted at the rate of 2,000 kg/hr with benzene to remove 95% of the dioxane.

    Determine :

    (i) the minimum solvent rate used

    (ii) if 1,000 kg/hr of solvent was used, how many theoretical stages were required. (8 + 8)

    Equilibrium data :

wt% of dioxane in water :	5.1	18.9	25.2
wt% of dioxane in benzene :	5.2	22.5	32.0

Or

    (b) (i) Discuss the application of extraction in industries.. (4)

    (ii) Explain the types of extractors used in industries with the aid of neat sketches. (12)

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14. (a) The equilibrium decolorisation data of a system is given by the relationship $y = 4 \times 10^{-4} x^2$ where y is the gm of colored impurity in 1,000 gm of solution and x is the gm of colored impurity per 1,000 gm of activated carbon. Calculate the amount of carbon required per 1,000 kg of solution to reduce the impurity from 0.9 to 0.1 gm per 1,000 gm of solution for the following cases :

   (i) a single stage operation

   (ii) a two stage operation with minimum amount of carbon. (6 + 10)

Or

   (b) Explain the ion–exchange process. Give a detailed account of ion exchange resins and list the industrial applications. (16)

15. (a) (i) Discuss the separation of a gaseous mixture using a membrane. (8)

   (ii) Discuss the solution–diffusion model. (8)

Or

   (b) Discuss briefly the principle and operation of the following membrane processes.

   (i) Electrodyalisis.

   (ii) Pervapouration. (8 + 8)

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