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Question Paper Code: 56901

B.E./B.Tech. DEGREE EXAMINATION, NOV 2018

Sixth Semester

Chemical Engineering

15UCH601 - MASS TRANSFER - II

(Regulation 2015)

Duration: Three hours

Maximum: 100 Marks

Answer All Questions

PART A - (10 x 1 = 10 Marks)

- Absorption factor is defined as CO1- R
(a) mGL (b) mG/L (c) G/mL (d) L/mG
- Use of raschig rings in place of crushed stones as packing in packed beds CO1 -R
(other things being same)
(a) increases pressure drop, increases surface area
(b) increases pressure drop, decreases surface area
(c) decreases pressure drop, increases surface area
(d) decreases pressure drop, decreases surface area
- The relative volatility CO2 -R
(a) is independent of pressure (b) decreases with increasing pressure
(c) increases with increasing pressure (d) increases with decreasing pressure
- At minimum reflux ratio for a given separation CO2 -R
(a) number of plates is zero.
(b) number of plates is infinity
(c) minimum number of the theoretical plates is required
(d) separation is most efficient
- The solvent used in liquid extraction should not have high latent heat of vaporisation, because CO3 -R
(a) it will decompose while recovering by distillation
(b) it cannot be recovered by distillation
(c) the pressure drop and hence the pumping cost will be very high
(d) its recovery cost by distillation may be prohibitatively high

6. At the plait point selectivity is CO3 -R
 (a) zero (b) 1 (c) 10 (d) infinity
7. Sugar is leached from sugar beats with CO4 -R
 (a) cold water (b) hot water (c) sulphuric acid (d) nitric acid
8. On addition of solute in the solvent, the _____ of the solution CO4- R
 decreases
 (a) boiling point (b) freezing point (c) vapour pressure (d) both (b) and (c)
9. Freundlich equation applies to the adsorption of solute from CO5 -R
 (a) gaseous solutions at high pressure
 (b) dilute solutions, over a small concentration range
 (c) concentrated solutions
 (d) none of these
10. Physical adsorption of a gaseous species may change to chemical CO5 -R
 adsorption with _____.
 (a) decrease in temperature
 (b) increase in temperature
 (c) increase in surface area of adsorbent
 (d) decrease in surface area of adsorbent

PART – B (5 x 2= 10Marks)

11. Give the importance of absorption factor. CO1 -R
12. Define: Raoult's Law. CO2 -R
13. Give the significance of "selectivity" in extraction. CO3 -R
14. What is Decoction? CO4- R
15. Define thermal diffusion CO5 -R

PART – C (5 x 16= 80Marks)

16. (a) Ammonia 'A' diffuses through a stagnant layer of air 1 cm thick at CO1- App (16)
 25°C and total pressure is 1 atm. The partial pressure of ammonia on
 two sides of the air layer are P_{a0} and P_{a1} is 0.9 atm and 0.1 atm
 respectively. Air is non diffusing . Calculate the molar flux of
 ammonia. Given $D_{AB}=0.214 \text{ cm}^2/\text{s}$

Or

- (b) An effluent gas containing 12% benzene is to be scrubbed in a packed column continuously, operating in counter-current manner at 43°C and 1 atm pressure. The column is to be designed for treating 15 m³ of entering gas per hour per square meter of the column cross section, such that the exit gas will contain 1% benzene. The solvent for scrubbing is mineral oil which will enter the top of the column at a rate of 28 kmol/hr.m² and a benzene content of 1%. Determine the height of the column assuming height of transfer unit to be 0.75 m. The equilibrium concentration at the operating conditions may be estimated as $y^* = 0.263 x$. CO1- U (16)

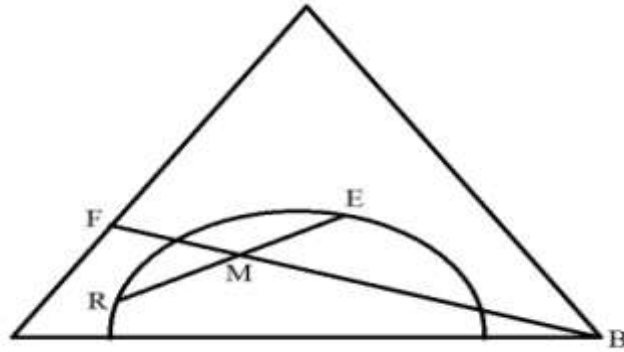
17. (a) A continuous rectifying column handles a mixture consisting of 40 per cent of benzene by mass and 60 per cent of toluene at the rate of 4 kg/s, and separates it into a product containing 97 per cent of benzene and a liquid containing 98 per cent toluene. The feed is liquid at its boiling-point. CO2 -App (16)
- (i) Calculate the mass flows of distillate and waste liquor.
(ii) If a reflux ratio of 3.5 is employed, how many plates are required in the rectifying part of the column?

Mole fraction Benzene Liquid	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Mole fraction Benzene Vapour	0.22	0.38	0.51	0.63	0.7	0.78	0.85	0.91	0.96

Or

- (b) A mixture of benzene and toluene containing 38 mole % of benzene is to be separated to give a product of 90 mole % of benzene at the top and bottom product with not more than 4 mole % of benzene. It is proposed to operate the unit with a reflux ratio of 3.0. Locate the feed plate and calculate number of plates. The feed enters the column at its boiling point. The vapour pressures of pure benzene and toluene are 1460 and 584 mm Hg respectively. Total pressure is 750 mm Hg. CO2 -U (16)

18. (a) (i) In the ternary diagram represented in the figure for a batch separation process, a stream F is mixed with solvent 'B' to produce product Raffinate 'R' and Extract 'E'. Substance A is the carrier liquid and C is the solute to be extracted. The amount of B and E are 1kg and 1.2 kg respectively. The length FM = 3.1 and length FB = 8.5 units. The Ratio of R/E is estimated to be.



- (ii) Derive the material balance relation for multistage counter current extractor. CO3 -Ana (8)
- (b) Explain the following with suitable sketch CO3- U (16)
- (i) Centrifugal Extractor
- (ii) Rotsry Agitated Column Extractor
19. (a) Explain the design procedure to determine the number of stages/ desired separation in a multistage cross current leaching. CO4 -U (16)
- Or
- (b) Explain the design procedure of single stage leaching with various step involving in the estimation of R1 CO4- U (16)
20. (a) Design a cross current multistage adsorption operation and what are all the steps involved in the determination of no. of stages. CO5- App (16)
- Or
- (b) Briefly discuss about the basic principles and the commercial application of the following: CO5- U (16)
- (i) Membrane separation process
- (ii) Reverse osmosis
- (iii) Electrodialysis