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Firstranker's choice B. Tech. Seventh Semawar. (ClauRankEngineering) (Caw)w.FirstRanker.com 11657 : Chemical Engineering Operations - III : Mass Transfer - II : 7 CH 01

P. Pages: 3

Time : Three Hours

Max. Marks: 80

AW - 3376

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- Notes: 1. Answer Three question from Section A and Three question from Section B.
 - 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. Discuss the reaction, mechanism wherever necessary.
 - 7. Cell phones are not permitted.
 - 8. Use of pen Blue/Black ink/refill only for writing the answer book.

SECTION - A

- 1. a) Distinguish between distillation and liquid -liquid extraction in brief.
 - b) Explain how does the term relative volatility (α) of distillation is analogous to selectivity (β) in liquid-liquid extraction operation? State it's significance in respective mass transfer operation.

OR

- **2.** a) Define the terms distribution coefficient and distribution constant in dilute solutions at equilibrium.
 - b) Describe continuous multistage cross current extraction system for immiscible solvents with the help of schematic diagram. How would you determine number of stages required using graphical construction method?
- 3. a) A solution containing 5% acetaldehyde and 95% toluene is to be extracted with water (solvent) in a five (5) stage cross current extraction unit to extract acetaldehyde. Toluene and water are immiscible. If 25 kg of water each time are used per 100 kg of feed calculate the amount of acetaldehyde extracted and the final concentration of the exit (raffinate) solution.

The equilibrium relationship is given as Y = 2.20 XWhere

Y= kg of acetaldehyde/ kg of water

X = kg of acetaldehyde/ kg toluene.

b) Describe with the help of neat sketch the working of stage type extractor - mixer settler.

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tranker.com (TMA) and 65% water is to be extracted using benzene as the solvent. A three stage cross current extraction system is suggested. The amounts of (98% benzene, 2% TMA) to be used in successive stages are 815 kg, 950 kg and 2625 kg. Determine the fraction of solute removed if the stages are ideal. The compositions of the raffinate and extract phases as well as the tie line data are given below -

Water - A

Benzene - B Trimethylamine (TMA) - C

Equilibrium data:-

(Raffinate) water -rich phase	XB	0.004	0.006	0.01	0.02	0.03	0.036	0.07	0.13
	XC	0.05	0.10	0.15	0.20	0.35	0.30	0.35	0.40
(Extract) Benzene rich phase	УВ	0.95	0.90	0.84	0.78	0.71	0.63	0.50	0.26
	УС	0.05	0.10	0.15	0.20	0.25	0.30	0.35	0.40
Tie line data	'XC	0.04	0.083	0.13	0.215	0.395			
	УС	0.035	0.068	0.09	0.145	0.31			

- 5. a) How would you classify liquid liquid extractors? Describe with the help of neat sketch spray column extractor.
 - b) What is solid-liquid extraction? When would you prefer it? state any two industrial examples of it.

OR

6. Describe a three stage crosscurrent leaching operation in which unequal amounts of the leaching solvent of the same composition are used in all three stages with the help of schematic diagram.

SECTION - B

- a) Explain flash or Equilibrium distillation with the help of schematic diagram. Derive the 7 operating line equation or material balance equation of flash distillation and show it on equilibrium (x-y) diagram.
 - b) A feed of 50 mole % hexane and 50 mole % octane is fed to a pipe still through pressure reducing valve (P. R. V.) and then into a flash separator. The Vapour and liquid leaving the separator are assumed to be in equilibrium. If the fraction of the feed is converted into vapour is 0.5. Find the composition of the top and bottom products. The equilibrium data is given below.

Mole fraction of hexane	1	0.69	0.4	0.192	0.045	0
Mole fraction of octane	1	0.932	0.78	0.538	0.1775	0

OR

8. a) What is relative volatility (α)? Derive the expression of $y = \frac{\alpha x}{1 + (\alpha - 1)x}$ with the help of

Rault's law and Dalton's law.

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A and 65 mole 'B' is the escenarated in distillation strume Theorem 7 composition of component A in distillate is 93 mole % and 96 mole % of all 'A' is in distillate. The feed is partially vapour and partially liquid. The reflux ratio is 4:1. Relative volatility (α_{AB}) = 2.5. How many number of ideal or theoretical stages are in each section of the column?

What is azeotrope and azeotropic distillation? Describe minimum boiling and maximum 13 boiling azeotropes with the help of temperature composition diagram and equilibrium diagram.

OR

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- 10. Discuss total reflux ratio (R_{∞}) minimum reflux ratio (R_{m}) with the help of (x v/s y) equilibrium diagram. Derive the equation used for calculation of minimum reflux ratio R_{m} (saturated liquid feed).
- 11. a What are different types of plates used for contacting vapour and liquid phases in plate column? Explain sieve plated disperser with the help of neat diagram.
 - b) How would you calculate HETP in packed column for continuous distillation with the help of empirical equation?

OR

12. a) What is extractive distillation method? When would you prefer it?

b) Discuss various factors determining column performance.



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