

B.Tech. SEM -VI (Chemical 2014 Course (CBCS) : SUMMER - 2019

SUBJECT : SEPARATION TECHNIQUES

Day : Wednesday

Time : 02.30 PM TO 05.30 PM

Date : 22/05/2019

S-2019-2705

Max. Marks : 60

N. B. :

- 1) All questions are **COMPULSORY**.
- 2) Figures to the right indicate **FULL** marks.
- 3) Draw neat and labeled diagram **WHEREVER** necessary.
- 4) Assume suitable data, if necessary.

Q. 1 a) Derive the Rayleigh's equation. **(05)**

b) Describe constant pressure equilibrium with neat diagram. **(05)**

OR

Use Raoult's law and calculate the vapor liquid compositions in equilibrium **(10)**
for benzene toluene system using vapor pressure data mentioned below:

Temperature	Vapor pressure in mm of Hg	
	Benzene	Toluene
353.3	760	–
358.2	877	345
363.2	1016	405
368.2	1168	475
373.2	1344	557
378.2	1532	645
383.3	1800	760

Q. 2 a) Describe the method of Ponchon-Savarit with H-x,y diagram. **(05)**

b) What is the significance of reflux in distillation? Explain minimum and total reflux. **(05)**

OR

A fractionating column separates a liquid mixture containing 45 mole % of A **(10)**
into an overhead product of 96 mole % of A and a bottom product of 5 mole of A. Determine the number of theoretical plates needed if the reflux ratio is 3.8 and feed enters at its B.P.

x	0	0.1	0.16	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
y	0	0.215	0.3	0.52	0.625	0.725	0.78	0.89	0.91	0.95	1.0

Q. 3 Draw a schematic arrangement of multistage countercurrent adsorption **(10)**
operation and state the solute balance. Also discuss the steps involved in determining the number of stages.

OR

A solid adsorbent is used to remove the colour impurity from an aqueous **(10)**
solution. The original value of colour on an arbitrary scale is 48. It is required to reduce this to 10 % of its original value. Using the following data, find the quantity of fresh adsorbent used for 1000 kg of solution for a two stage crosscurrent operation when the intermediate value is 24. Equilibrium Data:

P. T. O.

X Colour adsorbed/ kg adsorbent	0	5000	4125	3312.5	1975	1112.5
Y Colour/ kg solution	48	43	31.5	21.5	8.5	3.5

- Q. 4 a) What are the desirable characteristics for a solvent in liquid extraction? (05)
 b) Explain triangular diagram. (05)

OR

- a) A nicotine in water solution is extracted with kerosene at 293 k. Water and kerosene are essentially immiscible. The equilibrium relation is given by:
 $Y = 0.9 X$ where
 $Y = \text{kg nicotine / kg kerosene}$
 $X = \text{kg nicotine / kg water}$
 Determine the percentage extraction of nicotine if 150 kg of feed containing 30% nicotine in water, is extracted with 150 kg of solvent in a single stge. Repeat the calculations using 50 kg solvent in each of 3 cross current stages. (06)
- b) What is the effect of temperature on the binodal curve? (04)

- Q. 5 a) Describe the functioning and construction of Bollman extractor. (05)
 b) Draw a schematic diagram of multistage continuous counter-current leaching operation and state the solute balances. Also explain the graphical stepwise procedure to obtain the no. of theoretical stages in the said process. (05)

OR

Caustic soda is made by treatment of slaked lime with a solutions of Na_2CO_3 . (10)
 The resulting slurry consists of $CaCO_3$ suspended in a 10 % solution of Sodium Hydroxide, 0.125 kg suspended solid per kg of solution. This is settled, clear $NaOH$ solution is withdrawn and replaced by an equal weight of water and the mixture is thoroughly agitated. After repetition of this procedure (one fresh water wash), what fraction of original $NaOH$ in the slurry remains unrecovered and therefore lost in the sludge.

x = wt. fraction of NaOH in clear solution	N = kg $CaCO_3$ / kg solution in settled sludge	y*=wt. fraction of NaOH in solution in settled sludge
0.09	0.495	0.0917
0.07	0.525	0.0762
0.0473	0.568	0.0608
0.033	0.600	0.0452
0.0208	0.620	0.0295
0.01187	0.650	0.0204
0.00710	0.659	0.01435
0.0045	0.666	0.01015

- Q.6 a) Explain the functioning of crossflow membranes and their functioning. (05)
 b) With a neat diagram explain the use of membranes in water purification. (05)

OR

- a) Explain dialysis in detail with application. (05)
 b) What is meant by semi permeability? (02)
 c) What is a composite membrane? Explain in detail its various parts. (03)

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