

B.FTBE 4th YEAR 1st SEM EXAM SUPPLEMENTARY – 2017

Subject: MASS TRANSFER OPERATION – II Time: 3 Hours Full Marks: 100

Part – I

(Use separate Answer script for each part)

Answer any three questions. All questions carry equal marks.

Psychrometric charts and Stream Tables may be used.

- 1.(a) What is wet bulb temperature? How can you measure wet bulb temperature? (1+5)
(b) Air entering a dryer has a dry bulb temperature of 70°C and dew point of 25°C. Using the humidity chart, determine the absolute humidity, the relative humidity, humid heat and humid volume. (14)
- 2.(a) What are the characteristics of drying in the constant rate and falling rate period? (7)
(b) State and explain the three theories governing drying during the falling rate period. (13)
- 3.(a) State and explain how four process variables affect the constant rate drying period. (10)
(b) What is the general equation for time of drying in the falling rate period? What are the two special cases for which the equation is modified and how? (10)
4. A batch of wet solid was dried on a tray dryer using constant drying conditions and the thickness of material on the tray was 24 mm. Only the top surface was exposed. The drying rate during the constant rate period was $R = 2.14 \text{ kg H}_2\text{O/hr.m}^2$, the ratio of L_s/A used was 26.2 kg dry solid per m^2 of exposed surface. The initial free moisture content was $X_1 = 0.57$ and the critical free moisture content was $X_c = 0.23 \text{ kg moisture per kg dry solid}$. Calculate the time to dry a batch of this material from $X_1 = 0.46$ to $X_2 = 0.32 \text{ kg moisture/kg dry solid}$ using the same drying conditions. (The symbols have their usual meanings) (20)
5. Describe the operation of a (10+10)
(i) batch dryer
(ii) continuous dryer

[Turn over

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Mass Transfer Operation-II

Time: 3 hrs.

Full Marks : 100

Part-II

[Answer any four questions, Marks 4 x 10 =40]

1. The vapour pressure of benzene and toluene, in equilibrium at different temperatures, are shown in the following table. Assuming that mixtures of these materials follow Raoult's law, calculate and plot equilibrium curve for the system at a total pressure of 1 atm.

Table: vapour pressure of benzene and toluene

Vapour pressure (mmHg)	Benzene	877	1016	1168	1344	1532	1748	1800
	Toluene	345	405	475	557	645	743	760

(10)

2. What do you mean by 'relative volatility' ? Find a relation between x and y (mole fractions in liquid and gas phases, respectively) involving relative volatility, α . Derive an equation to calculate composition of the distillate during a batch distillation process. Draw 'dew point curve' and 'bubble point curve' for a two component liquid system. (3+5+2=10)

Contnd...P/2

3. A feed of 40 mole percent hexane and 60 mole percent octane is fed into a still through a pressure reducing valve and then into a flash disengaging chamber. The vapour and liquid leaving the chamber are assumed to be in equilibrium. If the fraction of the feed converted to vapour is 0.5, find the composition of the top and bottom products. The following table gives the equilibrium data for this system.

Mole fraction of hexane in liquid , x	1.00	0.69	0.40	0.192	0.045	0.00
Mole fraction of hexane in vapour, y	1.00	0.932	0.78	0.538	0.1775	0.00

(10)

4. A continuous distillation tower is to be designed to separate 20,000lb/hr of a mixture of 50% benzene and 50% toluene into an overhead (top) product containing 97% benzene and a (bottom) product containing 98% toluene. These percentages are by weight. Determine the values of F, D, W, x_F, x_D and x_W .
5. With the help of neat sketch show how you can achieve operating lines for rectifying section associated with McCabe-Thiele method for calculation of number of trays in a tray distillation tower and write the q -line equation also. Show with proper diagram the effect of feed composition on feed line as well as on the flow pattern of fluid through feed plate for distillation tower.

(6+4)