

[This question paper contains 4 printed pages.]

3144

Your Roll No.

M.E.

J

POLYMER TECHNOLOGY

Paper – CH.504

(Unit Operations – II)

Time : 3 Hours

Maximum Marks : 100

*(Write your Roll No. on the top immediately
on receipt of this question paper.)*

Attempt any five questions.

All questions carry equal marks.

1. Discuss the general principles underlying mass transfer operations employed in chemical process industries. Explain the gas absorption and leaching operations with the help of suitable sketches. (20)

2. Draw schematic diagrams of any **Four** of the following :
 - (a) Mixer settler for liquid-liquid extraction
 - (b) Sieve tray column (light liquid dispersed)
 - (c) Bubble cap distillation column
 - (d) Fractionating column with a still
 - (e) Rotary dryer (5×4)

P.T.O.

3. (a) Explain the Flash vaporisation operation with the help of a sketch. (10)

(b) Under constant drying conditions, a wet solid is dried from 30% to 4%. The time taken is 4-hours. The equilibrium moisture content is 2%. Critical moisture content 10%. How long would it take to dry to 7%. All percentages are on dry solid basis. Assume the falling rate period is linear, i.e. rate of drying is proportional to free moisture content. (10)

4. An evaporator is operating at atmospheric pressure. It is desired to concentrate the feed from 5% solute to 20% (by weight). At a rate of 5000 kg/hr dry saturated steam at a pressure corresponding to saturation temperature of 399°K is used. The feed is at 298°K and boiling point rise (elevation) i.e. BPE is 5°K. Overall heat transfer coefficient is 2350 W/M²K. Calculate the economy of evaporator and area of heat transfer to be provided.

DATA : Treating solution at pure water and neglecting the BPE :

Latent heat of vaporisation of water at 101.325 KPa and 373°K = 2257 KJ/Kg.

Latent heat of condensation of steam at 399°K = 2185 KJ/Kg

Specific heat of feed = 4.187 KJ/Kg°K (20)

5. (a) Show that the counter current flow principle employed in unit operations gives better result compared to co-current flow of two streams.

(10)

- (b) Water system is a representative system for explaining phase rule and phase equilibria.

Explain.

(10)

6. In an oxygen-Nitrogen gas mixture at 101.3 KPa and 298°K, the concentration of oxygen at two phases 2 mm apart are 10% and 20% by volume respectively. Calculate the flux of diffusion of oxygen for the cases where :

(i) Nitrogen is non diffusing

(ii) There is equimolar counter diffusion of two gases

Diffusivity of O_2 in N_2 is $1.81 \times 10^{-5} \text{ m}^2/\text{sec}$. (20)

7. Light oil is being absorbed from a mixture of light oil vapour and air by means of a non volatile absorption oil. The absorber is of plate and bubble cap type. The lean oil entering the absorber contains 0.5% by weight of light oil and the rich oil leaving the absorber contains 5% by weight of the light oil.

The gas entering the absorber contains 2.25% by volume of light oil and scrubbed gas leaves the

P.T.O.

absorber containing 0.18% of light oil by volume. The molecular weight of the light oil is 80 and the average molecular weight of Air is 29.

The equilibrium curve for the absorbing oil-light oil mixture at the temperature of operation is represented by equation,

$$Y_i = 0.65X_i, \text{ where}$$

Y_i = kg of light oil per kg of light oil free air

X_i = kg of light oil per kg of light oil free absorption oil.

Calculate (a) The kg of light oil free air to kg of light oil free absorption oil.

(b) The number of theoretical plates in absorber solution. (20)

8. Write short notes on any **FOUR** of the following :

(a) Venturimeter

(b) u-tube manometer

(c) Bimetallic thermometer

(d) Industrial crystallization

(e) Selection of materials of construction for chemical process equipment (5×4)