Unit III

5. Write short notes on the following : **15**

(a) Adiabatic saturation temperature

(b) Dew point, Theory of Wet bulb temperature

(c) Measurement of Humidity.

6. Air at 1 atm., 35ºC and 90% humidity is to be conditioned to 23.9ºC and 60% humidity by cooling part of the air to 10ºC and mixing it with uncooled air. The resuliting mixture will be reheated to 23.9ºC. For 1000 litre/min. of air at 23.9ºC and 60% humidity, calculate :

(a) the volume of entering air, and

(b) the percentage of entering air that is by-passed.

Assume ideal gas law holds good for water vapour and dry air.

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B. Tech. EXAMINATION, Dec. 2017

(Fifth Semester)

(B. Scheme) (Main & Re-appear)

(CHE)

CHE-307-B

MASS TRANSFER-I

Time : 3 *Hours*] [*Maximum Marks :* 75

Before answering the question-paper candidates should ensure that they have been supplied to correct and complete question-paper. No complaint, in this regard, will be entertained after the examination.

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. All questions carry equal marks. Make suitable assumptions wherever necessary.

Unit I

1. (a) Derive the expression for steady-state equimolal counter diffusion of Gas A and B. **7**

(b) Methane diffuses at steady state through a tube containing helium. At point 1, the partial pressure of mechane is $p_{A1} = 55$ kPa and at point 2 which is 0.03 m apart, p_{A2} = 15 kPa. The total pressure is 101.32 kPa and the temeprature is 298º K. At this pressure and temperature, the value of diffusivity is 6.75 × 10–5 m^2/s. **8**

(i) Calculate the flux of CH_4 at steady state for equimolar counter-diffusion.

(ii) Calculate the partial pressure at a point 0.02 m apart from point 1.

2. What are theories for mass transfer coefficients ? Discuss them in detail. **15**

Unit II

3. (a) Discuss Tray efficiency in detail.

(b) Write down the properties considered for the choice of solvent for absorption. **8**

4. An air-acetone mixture, containing 5% acetone by volume, is to be scrubbed with water in a counter-current packed tower to recover 95% of the acetone. Air flow rate is 1400 m^3/hr at 20ºC and 1.013 × 10^5 N/m^2. The water rate will be 3000 kg/hr. The flooding velocity has been estimated to be 1.56 m/s and the operating gas velocity should be 40% of the flooding velocity. The operation will be carried out under a total pressure of 1.013 × 10^5 N/m^2. The interfacial area of the packing is 204 m^2/m^3 and under the operating conditions the overall mass transfer coefficient K_y is 0.40 kmol/(hr)(m^2)(mol fraction). The equilibrium relation is $y^* = 1.68x$ where y^* and x are mole fractions of acetone in vapour and liquid respectively. Estimate the diameter and packed height of the tower.

Data :

At 23.9ºC and 60% humidity, y = 0.018 kg mole H_2O/kg moles dry air

At 35ºC and 90% humidity, y = 0.053 kg moles H_2O/kg moles dry air

At 10ºC and 100% humidity, y = 0.012 kg mole H_2O/kg moles dry air

Unit IV

7. (a) Derive expression for calculating time of drying for constant rate period and falling rate period. **7**

(b) Discuss the working of a Spray Dryer with the help of neat diagram. **8**

8. A rotary counter current dryer is fed with ammonium nitrate containing 6% moisture at the rate of 100 kg/min and discharges the nitrate with 0.2% moisture. The air enters at 135ºC and leaves at 80ºC. The humidity of entering air being 0.007 kg H_2O per kg dry air. The nitrate enters at 21ºC and leaves at

65ºC Neglecting radiation losses, calculate the kg of dry air passing through the dryer and the humidity of the air leaving the dryer.

Data :

Specific heat of ammonium nitrate = 0.45 kcal/kgºC

Specific heat of dry air = 0.238 kcal/kgºC

Specific heat of water vapour = 0.48 kcal/kgºC

Latent heat of vaporisation = 597.7 kcal/kg.