EX\BTF\31D\06

B. TECH. (F.T.B.E.) FINAL EXAMINATION 2006

1st Semester

SEPARATION PROCESS-II

Time: Three hours Full Marks: 100

Answer any ***five*** questions.

All questions carry equal marks.

Psychrometric charts and steam tables may be used.

1. a) What is the difference between the absolute humidity and relative humidity of an air-water vapour mixture? How is the wet bulb temperature of an air-water vapor mixture determined? 3+4

   b) The air-supply for a dryer has a dry bulb temperature of 30°C and a wet bulb temperature of 24°C. It is heated to 85°C by coils and blown into the dryer. In the dryer, it cools along an adiabatic cooling line as it picks up moisture from the dehydrating material and leaves the dryer fully saturated.

      (i) What is the dew point of the initial air.

      (ii) What is the humidity?

      (iii) What is its percentage relative humidity?

      (iv) How much heat is needed to heat 100 m^3 of air-water vapor mixture to 90°C?

[Turn Over]

(v) How much water will be evaporated per 100 m^3 of air entering the dryer?

(vi) At what temperature does the air leave the dryer?

13

2. a) What are the characteristics of drying in the constant rate drying period? 5

b) A granular insoluble food material wet with water is being dried in the constant rate period in a pan 0.50 m by 0.50m and the depth of the material is 25.4mm. The sides and bottom are insulated. Air flows parallel to the top drying surface at a velocity of 3.5 m/s and has a dry bulb temperature of 65°C and a net bulb temperature of 32°C. The pan contains 12 kg of dry solid having a free moisture content of 0.32 kg water/ kg dry solid and the material is to be dried in the constant rate period to 0.24 kg water per kg dry solid.

(i) Predict the drying rate and the time needed for drying.

(ii) Predict the time needed if the depth of the solid material is increased to 50.8 mm. 15

3. What are the expressions for time of drying in the falling rate period when (i) rate is linear function of X land (ii) rate is a linear function passing through the origin? What are the principal characteristics of drying in the falling rate period? 15+5

4. Explain the different theories based on the moisture movement in solids during drying in the falling rate period. 20

5. A wet food solid is to be dried in a tray dryer under steady state conditions from a free moisture content of x_1 = 0.45 kg water per kg dry solid to x_2 = 0.05 kg water per kg dry solid. The weight of the dry solid is 100 kg and the top surface area for drying is 5.65 m^2. The drying rate curve can be represented by the following data:

X	0.195	0.150	0.100	0.065	0.050	0.040
R	1.51	1.21	0.90	0.710	0.370	0.270

a) Calculate the time needed for drying using graphical integration in the falling rate period.

b) Repeat using a straight line passing through the origin as a drying rate curve. 20

6. a) Define bound and unbound water in a wet solid substance using Relative humidity vs moisture content curves of solids. How can moisture in solid be bound and free at the same time? 10

b) A cabinet dryer is to be used for drying a food product from an initial moisture content of 75% (wet basis) and requires 10 mins. to reduce the moisture content to a critical level of 30% (wet basis). Determine the final moisture content of the product if a total drying time.

of 15 min. is used. Assume the falling rate curve to be a straight line passing through the origin. 10

7. What is meant by triple point of water? Deduce an expression for time required to reduce moisture content of a food material from X_1 to X_2 in a freeze dryer. 20

———————x———————