53 (FPT 812) CADH

2015

CONCENTRATION & DEHYDRATION OF FOODS

Paper : FPT 812

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1. *(a)* Define sorption isotherm ? Explain its phases with proper diagram. 4

(b) Derive the relationship between wet weight basis and dry weight basis moisture content. 5

(c) The ambient air at $50^{o}C$ dry bulb temperature has 15% RH at atmospheric pressure. Find the following 7

(i) Partial pressure of water vapour

(ii) Dew point temperature

(iii) Specific humidity

(iv) Degree of saturation

(v) Enthalpy of moist air

(vi) Humid volume of moist air.

(d) 200 *kg* of wheat at 23% moisture content *(wb)* is dried to 12% *(db)*. Calculate

(i) The first moisture content in *wb*

(ii) How much moisture is removed ? 4

2. (a) Describe the evaporator components with neat diagram. Write *two* differences between forward feed and parallel feed triple effect evaporator. 5+2=7

(b) Estimate the requirements of steam and heat transfer surface, and the evaporating temperatures in each effect, for a triple effect evaporator evaporating 500 $kg\,h^{-1}$ of a 10% solution up to a 30% solution. Steam available at 200 kPa gauge and the pressure in the evaporation space in the final effect is 60 kPa absolute. Assume that the overall heat transfer coefficients are 2270, 2000 and 1420 $Jm^{-2}s^{-1}{}^{o}C^{-1}$ is the first, second and third effects respectively. Neglect sensible heat. Assume no boiling point elevation and also equal heat transfer in each effect. 10

(c) How the efficiency of an evaporator is affected ? 3

3. (a) Write the principle of electro dialysis. What are its disadvantages ? 4+2=6

(b) What is a membrane ? Classify the various membrane modules and explain with suitable diagram. 1+6=7

(c) Write three applications of reverse osmosis and dialysis each. 3

(d) Differentiate the following : 4

(i) Microfiltration and Nanofiltration

(ii) Osmosis and diffusion.

4. (a) Draw the phase diagram for simple binary system. Explain with diagram. 4

(b) Describe the freeze concentration system process of food. 5

(c) How freeze concentration is useful in food industry ? 4

(d) How the process parameters influence the freeze concentration process ? 7

5. (a) Write short notes on : 3×4=12

(i) Fluidized bed dryer

(ii) Freeze dryer

(iii) Drum dryer

(iv) Tray dryer.

(b) Design a drum dryer for drying a product from an initial solid content of 10% to final product of 3% moisture content. The rate of production of final product should be 25 *kg/h.*

Given, Overall heat transfer coefficient $(v) = 1800\ w/m^2{}^\circ C$; Design temperatures difference = 80°C, latent heat of vaporization = 2257 *kJ/kg.* 6

(c) What is the maximum value of water activity of a food material ? Write its importance in drying. 2

6. (a) The following data were obtained on the dehydration of a food product : initial moisture content = 89·7% *(wb)*.

Drying time (Min)	*Net weight (kg)*
0	24·0
10	17·4
20	12·9
30	9·7
40	7·8
50	6·2
60	5·2
70	4·5
80	3·9
90	3·5

Draw the drying curve for this material and construct a curve for the drying rate as a function of moisture content.

(i) What is the critical moisture content of each of the falling rate zone.

(ii) What is the constant rate drying ? 8

(b) Define the following : 4

(i) Critical moisture content

(ii) Atomizer

(iii) Relative humidity

(iv) Settle down period

(c) What do you mean by equilibrium moisture content ? How many types of moisture are there in a food material. 4

(d) Write four EMC models and give the water activity range for each. 4

7. (a) Describe working principle of freeze drying. How it is superior to other drying methods ? 3+2=5

(b) How heat and mass transfer occur during freeze drying ? 3

(c) "The drying rate is dependent on the mode of heat transfer". Elaborate. 5

(d) Derive the following equation 7

$$t = \frac{L^2}{4KV_S} \frac{\Delta H_S}{M_A} \frac{1}{T_c - T_f} \left(x_1 - x_2 - \frac{x_1^2}{2} + \frac{x_2^2}{2} \right)$$