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53 (FPT 812) CADH

2017

**CONCENTRATION AND DEHYDRATION
OF FOOD**

Paper : FPT 812

Full Marks : 100

Time : Three hours

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

Answer **any five** questions from **seven**.

1. (i) Discuss briefly about the following :
4×2.5=10

Dry bulb temperature

Wet bulb temperature

Equilibrium moisture content

Water activity

Contd.

- (ii) Write about important controlling factors for drying.
- (iii) Briefly write about dehydration mechanism. $5+5=10$
2. (i) Mention different air drying methods. Among them write about Tunnel drying and Drum drying. $2+4+4=10$
- (ii) Write short notes on : $5+5=10$
Vacuum dryer
Fluidized bed dryer.
3. (i) Discuss briefly about application of spray drying in food industry.
- (ii) Write fundamental steps in freeze drying; freezing followed by primary and secondary drying steps.
Mention associated mass and heat transfer in diagrams. $8+12=20$
4. (i) What is open and vacuum evaporator?

(ii) Mention controlling factors for evaporation.

(iii) Discuss mass and energy balance in evaporator. $5+5+10=20$

5. Write short notes on : **(Any two)**

$10 \times 2 = 20$

(i) Freeze concentration

(ii) Membrane concentration

(iii) Application of osmotic dehydration and hurdle technology in food industry.

6. (i) A bin dryer holds 2000kg of wet grain containing 500kg of water. The grain is to be dried to a final moisture content of 14% (wb).

What are the initial and final moisture content of the grain (wet basis, dry basis, decimal and per cent) ?

How much water is removed in drying ?

- (ii) An insulated pan $0.5 \times 0.5m$ and $2.5cm$ deep contains wet food material, is subjected to air drying. The sides and bottom of the pan is insulated. An air stream flowing over food surface provides the heat for drying by convection. Air flows at $6m/s$ at $T_{Dry\ bulb} = 65^\circ C$ with specific humidity $0.02kg\ H_2O/kg\ Dry\ air$. Determine constant rate of drying.

$$[\text{Humid volume at } T_{Dry\ bulb} (65^\circ C) = 0.9873m^3/kg\ dry\ air]$$

Latent heat at wet bulb

$$(32.5^\circ C) = 2423kJ/kg] \quad 8+12=20$$

7. (i) A single effect evaporator is used to concentrate syrup from 10% to 70% solid. Production rate $50kg/h$. The evaporation occurs at a pressure of $50KPa$ (a boiling point of $81.3^\circ C$ for pure water). The feed syrup enters at $20^\circ C$. Energy for evaporation is provided by steam entering as saturated vapor at $200kPa$ and exits as saturated liquid at same pressure. What steam flow is required to accomplish the evaporation if it's assumed energy is not lost?

Data from Steam Table :

At 200 kPa, $h_{fg} = 2201.6 \text{ kJ/kg}$ (for condensing steam)

At 82°C $h_{fg} = 2303.8 \text{ kJ/kg}$ (for boiling solution)

Specific heat of water at $82^\circ\text{C} = 4.2 \text{ kJ/kg K}$

Specific heat of syrup at $82^\circ\text{C} = 3.99 \text{ kJ/kg K}$

(ii) Find out the evaporation rate in a drum dryer from the given data :

Steam temperature = 150°C ,

Vaporization temperature

of milk = 103°C

Heat transfer coefficient $1.3 \text{ kW/m}^2\text{K}$

Drum diameter = 60 cm

Length of drum = 100 cm

Latent heat of vaporization = 2261 kJ/kg

The product is scraped at $3/4$ of a revolution of the drum. Assume no other heat loss.

$$12+8=20$$