KERALA AGRICULTURAL UNIVERSITY

B.Tech. (Food Engg.) 2014 Admission

VIth Semester Final Examination – July - 2017

Cat. No: Fden 3209 **Marks: 50**

Title: Food Process Equipment Design and Plant layout(1+1) **Time : 2 hours**

I. Fill up the blanks: **(10 x 1=10)**

1. ---------- is the size of fat globules after homogenization.
2. In a parallel flow heat exchanger, the flow of hot and cold fluid is in ---------- direction.
3. Disc speed of rotating nozzle in a spray drier is ----------
4. A ---------- can be used in separating wheat grains from mustard seeds.
5. ---------- is defined as the slow and progressive deformation of a material with time.
6. ---------- is the unit for expressing overall heat transfer coefficient.
7. ---------- is a mathematical technique for finding maximum or minimum value of a function subjected to a set of constraints.
8. Size reduction in hammer mills is achieved by ----------
9. ---------- is the total load from a viscous liquid, if the liquid is cooled from 75 °C to 60 °C. in a PHE at the rate of 2 kg/s provided C_p of liquid is 3200 J/kg °C.
10. ---------- is the material used for most of the food processing equipment manufacturing.

II. Write short notes on ANY FIVE: **(5x 2=10)**

1. What is product layout?
2. Enumerate various machineries used in the size reduction of agricultural materials.
3. Write the equation for LMTD in heat exchangers.
4. What is Reynolds number?
5. Write down classification of heat exchanger.
6. What is homogenization.
7. Define critical speed.

III Write answers on ANY FIVE: **(5 x 4=20)**

1. Write down the general design procedure for food processing equipments.
2. List out the classification of different materials used for construction of food processing equipments.
3. Write a short note on intended cylinder separator.
4. What are the objectives for a good plant layout?
5. What are the steps involved in design of a tube sheet in shell and tube heat exchanger?
6. Describe factors to be considered in site selection of food processing plants.

7. Citric acid solution is to be spray dried with a capacity of 100 kg/h the feed liquid has 40% solid content and the product moisture content is aimed at 3%, density being 1650 Kg/m^3. Atomizer air flow rate is 90 Kg/h forming droplets of size 100 μm in the chamber. The thermal conductivity of the droplet, density and kinematic viscosity of air may be assumed as 0.028 W/m°C, 1.03 Kg/m^3 and 6.681x 10^{-5} m^3/s respectively. Latent heat of vaporization of moisture is 2520 KJ/Kg, the specific heat and temperature of feed material, product and air are as given below:

Product	**Specific heat (kJ/kg°C)**	**Temperature (°C)**
Feed	3.85	650
Product	1.64	60
Drying air	1.02	100
Ambient air	1.01	30
Exhaust air	---	70
Water	4.18	---

IV. Write essay on any ONE **(1 x 10=10)**

1. Cold water is to be preheated from 16°C to 48°C circulated through 20 mm inside diameter tubes using hot water available at 96°C and 3.33 Kg/s to be cooled to 51°C on shell side in a shell and tube heat exchanger. If the tube length and velocity of water are to be limited to 300 m/s and 500 m/s respectively, propose a suitable design for heat exchanger assuming an overall heat transfer coefficient as 1480 W/m^2K, neglecting the material flowing resistance factors. The value of viscosity of fluid on tube side is 2.764 Kgm/s, friction factor for the tube side is 0.004, tube pitch coefficient is 0.249, coefficient for tube is 2.207 and frictional factor for shell side is 0.0034.
2. Draw the layout of various machineries involved in processing of mango with relevance to processing of mango pulp and explain the processes.

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