Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – II • EXAMINATION – WINTER • 2014

Subject code: 1723003 Date: 04-12-2014

Subject Name: Advance Equipment Design

Time: 02:30 pm - 05:00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** List out and explain the selection criteria for dryers. **07**

(b) Derive the equation of pressure drop through filter cake. **07**

Q.2 **(a)** Explain the stepwise procedure for design of cyclone separator. **07**

(b) A clarifying centrifuge to separate a pharma product has following specification. **07**
Dia. Of bowl = 0.6 m , depth of bowl = 0.4 m thickness of liquid layer = 0.4 m speed = 1200 rpm
If the slurry has following properties,
s.g. of liquid = 1.2, s.g. of solid = 1.6, viscosity of liquid = 2 cp, cut size of particle = 30 µm and the quantity of clear liquor to be obtained is 200 m^3/hr, show whether the centrifuge will be suitable or not.

OR

(b) Sodium sulfate crystals are to be produced from an aqueous solution of sodium sulphate available at 104 ^{0}C . Total weight of solution is 8600 kg and it contains 29.6.% by weight of anhydrous sodium sulphate. During cooling, 4.5% of the initial water is lost by evaporation. The mother liquor contains 18.3% by weight of anhydrous sodium sulphate. Estimate the yield of crystals and the quantity of mother liquor to be recycled from crystallizer? **07**
Data; Mol. Wt. of anhydrous sodium sulphate crystals = 142
Mol. Wt. of hydrated sodium sulphate = 322

Q.3 The sugar remaining in a bed of bone char used for decolorization is leached by flooding the bed with water,, following which the bed is drained of the resulting sugar solution. The bed diameter is 1 m, depth of bed is 3 m, the temperature is 65^{0}C. The sugar solution which drains has a density 1137 kg/m^3 and surface tension is 0.066N/m. the bulk density of char is 960 kg/m^3 and individual particle density is 1762 kg/m^3. Particle have a specific external surface of 16.4 m^2/kg. **14**
Find (1) mass of the solution still retained by bed after dripping of the solution has stopped.
(2) express it in terms of mass of solution / mass of dry bone char.

OR

Q.3 Explain in detail stepwise procedure to calculate number of theoretical stages required for desired degree of separation using counter current extraction. Also explain the procedure to calculate dimension of belt and speed of belt if contact time and drainage time are provided. **14**

Q.4 A rotary drum filter with 30 % submergence is to be used to filter contaminated aqueous slurry of $CaCo_3$ containing 236 kg of solids per $1M^3$ of solution. The pressure drop is to be 20 in Hg. If the filter cake contains 50 % moisture on wet basis , calculate the filter are required to filter 45lt/min of slurry when the filter cycle time is 5 min. assume that the specific cake resistance , is $= {}_0 P^s$ where ${}_0 = 1.95 * 10^{10}$ M/kg s= 0.26. The filter medium resistance is negligible. The temperature is 20^0C. what will be diameter and length of drum? Draw the layout of plant. **14**

OR

Q.4 A furnace utilizes the combustion gas which is a mixture of CO_2, H_2O and N_2 with partial pressure of CO_2 and H_2O 0.13 and 0.11 respectively. It is assumed that the temperature of hot flue gases is constant and is 1200 ^{0} C. if the volume is $19.5m^3$, calculate the total emissivity of the flue gas and the radiation flux emitted by the gases if the total surface of enclosure is 30 m^2. **14**

$= 0.567*10^{-7}$ w/$m^{20}K^4$

Q.5 A tray dryer with 12 trays is available. Area of one tray is 1 m/1m , which can accommodate 144 molds of wet cake of size 5 cm diameter and 5 cm height. One phase of the mold will be resting on the plate. For the given drying rate datato dry the material 120 kg (bone dry), how much time will be required? **14**

Data

Initial moisture content = 0.2 kg/kg of dry solid

final moisture content = 00.2 kg/kg of dry solid

density of wet cake = 1740 kg/m^3

moisture content kg/kg of dry solid	0.3	0.2	0.14	0.096	0.056	0.046	0.026	0.016
Rate N kg/hr m^2	1.71	1.71	1.71	1.46	1.29	0.88	0.54	0.376

OR

Q.5 **(a)** Discuss in detail about various factors affecting crustal growth in crystallization unit. **07**

(b) Discuss about spray dryer in detail. **07**

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