BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
First Semester 2016-2017
CHE F313 Separation Processes – II
Comprehensive Examination
(Closed Book)

Date: 03.12.2016 **Maximum Marks: 120**

---

1. (30 Marks) Give precise answers to the following questions:

(a) What is the adiabatic-saturation temperature? Why is it almost identical to the wet-bulb temperature for the air–water system, but not for other systems?

(b) What is a mass-transfer zone (MTZ) and what causes it? Is it desirable? If not, why?

(c) Describe differential and cumulative screen analysis? Which one is more precise and why?

(d) Differentiate among silo, bin and hopper. How are these containers loaded and discharged? What is the major problem in bin storage?

(e) What are the principles involved in size reduction? Give examples for each. What kind of product do we get by using these principles?

(f) Define sphericity in two different ways. Obtain the sphericity of a cuboid whose length, breadth, and depth are in the ratio of 3:2:1.

2. (20 Marks) A saturated solution containing 2500 kg of potassium chloride (KCl) at 90^{o}C is cooled in an open tank at 20^{o}C. If the density of the solution is 1200 kg/m^3 and the solubility of potassium chloride per 100 parts of water is 54 and 35 at 90^{o}C and 20^{o}C respectively, calculate the capacity of the tank required and the weight of the KCl crystal obtained. Neglect the loss of water by evaporation.

3. (20 Marks) A leaf filter with 1.865 m^2 of filtering area has the following data during constant pressure filtration at 3.3 atm. The mass of solid per unit volume of filtrate is 23.5 g/L and the viscosity of filtrate is 0.9 cP.

t (min)	15	30	45	60	90
V (m^3) volume of filtrate	2.848	4.643	6.067	7.349	9.542

Obtain the values of specific cake resistance and filter medium resistance in m/kg and m^{-1} respectively.

4. **(15 Marks)** Answer the following questions:
(a) A soil containing 10 percent moisture was mixed in a large muller mixer with 12 wt% of tracer consisting of dextrose and picric acid. After 3 minutes mixing, 5 random samples were taken from the mix and analyzed calorimetrically for tracer material. The measured concentrations in the sample were, in weight percent tracer, 11.24, 9.30, 10.94, 8.24 and 12.8. Calculate the mixing index. Given: $\mu = 0.12$ and $N = 5$.

(b) The power required to crush 100 tons/hr of a material is 179.8 kW. If 80 % of the feed passes through a 51 mm screen and 80 % of the product passes through a 3.2 mm screen. What is the work index of the material?

(c) A sand mixture was screened through a standard 10-mesh screen. The mass fraction of the undersize material in feed, overflow and underflow were found to be 0.38, 0.79 and 0.22 respectively. Calculate the overall screen effectiveness.

5. (15 Marks) For a case where the cation NH_4^+ (A) replaces H^+ (B) in a polystyrene resin, calculate the equilibrium constant K_{AB}. The total regin capacity (Q) = 2.0 equiv/L wet bed volume. The total concentration (C) = 0.20 N in the solution. Calculate at equilibrium the equivalents of NH_4^+ in the resin when the concentration of NH_4^+ in solution is 0.04 N. $K_{NH4+(A)} = 2.55$ and $K_{H+(B)} = 1.27$.

6. (20 Marks) A batch of solids is to be dried from 25% to 8% moisture under conditions identical to those for which data is available. The initial weight of the wet solid is 200 kg and the drying surface is 1 m^2/8 kg of dry weight. Determine the time of drying.

X	0.35	0.25	0.2	0.18	0.16	0.14	0.12	0.10	0.09	0.08	0.064
R	0.3	0.3	0.3	0.266	0.239	0.208	0.18	0.15	0.097	0.07	0.025

where X refers to kg of water per kg of dry solid and N refers to kg of moisture evaporated per m^2 of drying surface per hour.

~