

III B.Tech I Semester Supplementary Examinations, May 2005
MECHANICAL UNIT OPERATIONS
(Chemical Engineering)

Time: 3 hours

Max Marks: 70

Answer any FIVE Questions
All Questions carry equal marks

1. (a) For flow of solids out of a bin which opening is preferable, side opening or a bottom opening? Why?
 (b) What are the factors on which the rate of flow of granular solids by gravity, through a circular opening in the bottom of a bin, depends upon?
 (c) Discuss about various devices for transportation of solids.
2. (a) Distinguish between kneaders, dispersers and masticators.
 (b) Describe with figures double-motion paste mixers.
3. (a) 3.0 kW has to be supplied to a material crushing at the rate of 0.3 kg/s from 12.5 mm cubes to a product of 3.1 mm. What would be the rate at which same material should be supplied to the machine if its power consumption remains same to get the product of 2 mm cube?
 (b) What is volume surface mean diameter of particles? Give its expression.
4. (a) Explain the working of plate and frame filter press with a neat diagram.
 (b) Discuss about shell-and-leaf filters.
5. A tubular membrane with a diameter of 2 cm and a water permeability of 250 L/m²-h-atm is being used for UF of cheese whey. The whey proteins have an average diffusivity of 4×10^{-7} cm²/s and the osmotic pressure in atmospheres is given by Jonsson's equation:

$$\pi = 4.4 \times 10^{-3}c - 1.7 \times 10^{-6}c^2 + 7.9 \times 10^{-8}c^3$$
 where c is the protein concentration in grams per liter. Calculate the effect of Δp on the flux for a clean membrane if the solution velocity is 1.5 m/s and the protein concentration is 10, 20 or 40 g/L. Assume the gel concentration is 400 g/L and the rejection is 100 percent. Assume the bulk solutions have the same density and viscosity as water:

$$\rho = 1 \text{ g/cm}^3 \quad \mu = 0.01 \text{ g/cm-s}$$
6. (a) Discuss differential settling method and obtain the relation between diameters and densities of two different density particles.
 (b) Write a note about clarifiers and thickeners.
7. (a) With neat sketch explain the construction and working principle of Jet Mixers.
 (b) A pilot-plant vessel 305 mm in diameter is agitated by a six-bladed turbine impeller 102 mm in diameter. When the impeller Reynolds number is 10^4 , the blending time of two miscible liquids is found to be 15s. The power required is 2 hp per 0.4 kW/m³ of liquid..

- i. What power input would be required to give the same blending time in a vessel 1830 mm in diameter.
 - ii. What would be the blending time in the 1830 mm vessel if the power input per unit volume was the same as in the pilot-plant vessel?
8. (a) Explain the phenomena of crystallization from melts.
(b) Describe Brodic purifier counter current cooling crystallizer.

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