Chapter 7

1. For a centrifuge of radius 0.07m and rpm 10000, find out centrifugal force developed.

Ans. r=0.07 m^2

$$\omega = \frac{2\pi N}{60}$$

$$\frac{F_C}{F_g} = 0.001118 r N^2$$

$$= 0.001118 \times 0.07) 10^8$$

$$= 7826$$

$F_c = 7826 F_g$

2. For a centrifuge of radius 0.05m, and rpm of 12000, find out terminal velocity of a particle of diameter 10 µm and density 1260 Kg/m^3 in an aqueous solution.

Ans

rpm=12000

$$\omega = \frac{2\pi N}{60} = \frac{2\pi \times 12000}{60} = 1256 rad / s$$

$$v_t = \frac{\omega^2 r d_p^2}{18\mu} (\rho_p - \rho)$$

r=0.05m

$D_p = 10x0^{-6}$ m; ρ_p =1260 kg/m^3

$$v_t = \frac{1256^2 \times 0.05 \times 10^{-10}}{18 \times 10^{-3}} (1260 - 1000)$$

= 0.114 m/s

3. What is physical interpretation of Σ value?

Ans: It is area (in m^2) of a gravity settler that has the same sedimentation characteristics as the centrifuge at the same feed rate.

4. We have to design a centrifuge that can handle 5 times flow rate in a prototype centrifuge. If all other dimensions between two centrifuges are same, find the ratio of the length of the centrifuge to be designed and prototype?

Ans

$$\frac{q1}{q2} = \frac{\Sigma_1}{\Sigma_2} = \frac{b1}{b2}$$

$$5 = \frac{b1}{b2}$$

$$b1 : b2 = 5 : 1$$

5. A viscous solution contains with a density ρ_p=1500Kg/m^3 is to be clarified by centrifugation. Solution density is 1000Kg/m^3 and viscosity 20 CP. Centrifuge bowl is with r_2=0.02m and r_1=0.008m and height, b=0.5m. Claculate critical diameter of particle in exit stream, if N=1000 rpm and q_f=0.05 m^3/hr.

Ans

N=1000 rpm

$$\omega = \frac{2\pi N}{60} = \frac{2\pi \times 1000}{60} = 104.67 \text{ rad/s}$$

Bowl volume: $v = \pi b(r_2^2 - r_1^2)$

$$= \pi \times 0.5(0.02^2 - 0.008^2)$$

$$= 5.27 \times 10^{-4} \ \text{m}^3$$

q= 0.05 m^3/h =1.39x0^{-5} m^3/s

$$1.39 \times 10^{-5} = \frac{104.67^2 (1500 - 1000) D_{pc}{}^2 \times 5.27 \times 10^{-4}}{18 \times 20 \times 10^{-3} \ln(\frac{2 \times 0.2}{0.02 + 0.008})}$$

$$= 22.48 \times 10^3 D_{pc}{}^2$$

$$D_{pc} = \sqrt{6.18 \times 10^{-10}} = 2.5 \times 10^{-5} = 25 \mu m$$