VIT

Vellore Institute of Technology

Continuous Assessment Test – II

Programme Name & Branch: B.Tech - Chemical Engineering

Fall Semester (2019-20)

Course Name and Code: Mechanical Operations & CHE1022

Class Number: VL2019201001170   Slot: C1+TC1

Faculty Name: Dr.A.Babu Ponnusami   Exam Duration: 90 Minutes. Maximum

Marks: 50

General instruction(s): Ordinary graph sheet to be provided.

Answer all the questions (5 x 10 =50 marks)

1. (a) Two identical size spherical particles A & B having densities ρ_A and ρ_B respectively are settling in a fluid of density ρ. Assuming free settling under turbulent condition, find the ratio of the terminal settling velocity of particle A to particle B. (5)

   (b) Beer with a specific gravity of 1.042 and a viscosity of 1.04×10^{-3} N s/m^2 contains 1.5% solids which have a density of 1160kg/m^3. It is clarified at a rate of 240 L/h in a bowl centrifuge which has and operating volume of 0.09 m^3 and a speed of 10000 rev/min. The bowl has a diameter of 5.5 cm and is fitted with a 4 cm outlet. Calculate the effect on feed rate of an increase in bowl speed to 15000 rev/min and the minimum particle size that can be removed at the higher speed. (5)

2. Calculate the minimum area and diameter of a thickener with a circular basin to treat 0.1 m^3/sec of slurry of solids concentration of 150 kg/m^3. Also, calculate volumetric flow rate of underflow for the underflow concentration of 1300 kg/ m^3. The results of batch settling tests are as follows:

Solid Conc. (kg/m^3)	100	200	300	400	500	600	700	800	900	1000	1100
Settling Velocity (µm/sec)	148	91	55.33	33.25	21.40	14.50	10.29	7.38	5.56	4.20	3.27

3. Estimate the cut diameter and overall collection efficiency of a cyclone given the particle size distribution of dust from cement kiln. Particle size distribution and other pertinent data are given below

Avg.Particle size in range, d_p, µm	2	4	10	15	25	35	40	55	>55
Weight retained	03	07	12	11	16	06	08	03	02

Gas viscosity   : 0.02cp;   Specific Gravity of the particle   : 3.0

Inlet gas velocity of cyclone : 15 m/sec; Effective number of turns within cyclone : 5

Cyclone diameter   : 2.5 m;   Cyclone inlet width   : 0.5 m.

4. (a) Find centrifugation time t, of a particle d=0.5mm.

Given data:

Speed of centrifuge	: 1000 rpm
Viscosity of liquid	: 8.1×10^{-4} Pa s
Density of particle	: 1200 kg/m^3
Density of fluid	: 1000 kg/m^3
Outer wall radius	: 0.3 m
Inner liquid layer radius	: 0.25 m

(5)

(b) A bowl centrifuge is used to break an oil-in-water emulsion. Determine the radius of the neutral zone in order to position the feed pipe correctly. Assume that the density of the continuous phase is 800 kg/m^3 and the density of the oil is 600 kg/m^3. The inner and outer radiuses from the centrifuge are 4 cm and 5.5 cm.

(5)

5. Suggest a separation technique which is economically feasible to separate solids from liquid in an effluent treatment plant? Mention various settling zones in that techniques using neat diagram.