Mechanical Operations (New)

Subject Code :BTCH- 301A/301   (RP)

Paper ID : M)18

Batch: ..... onwards

~~Paper ID~~:(2011-batch onwards)

Time allowed: 3 Hrs

Max Marks: 60

Important Instructions:

- All questions are compulsory
- Assume any missing data
- Additional instructions, if any

PART A (10x 2marks)

Q. 1.   Short-Answer Questions:

(a) Differentiate between Angle of repose α_m and Angle of internal friction α_p.

(b) List out any three equipment used for storage of solids.

(c) Define effectiveness of screen.

(d) State 'Bond's law of crushing'. What do you mean by term 'work index'?

(e) What do you mean by closed circuit grinding?

(f) What are the purpose of agitation?

(g) What do you mean by 'Specific cake resistance α_c?

(h) Define the term 'hindered settling'.

(i) Distinguish between 'Clarifier' and 'Classifier'.

(j) List the various mixing equipment used to mix solids and pastes.

PART B (5×8marks)

Q.2   Table salt is fed to a vibrating screen at the rate of 300 lb/hr. The desired product is the   CO1
48/65 mesh fraction. A 48- and a 65- mesh screens are therefore used (double deck), the
feed being introduced on the 48-mesh screen, the product being discharged from the 65-
mesh screen. During the operation it was observed that the average proportion of the
oversize: product: undersize was 2:3/2:1.

(a). Calculate the effectiveness of the screener.

(b). If the screen dimensions are 2ft by 4ft, calculate the capacity of the 65-mesh screen on
the basis of a perfectly functioning 48-mesh screen and also on the basis of the actual
performance of the screen.

Screen Mesh	Feed mass fraction	Oversize mass fraction	Product mass fraction	Undersize mass fraction
-10+14	0.000356	0.0008	....	....
-14+20	0.00373	0.008	0.0005	0.00003
-20+28	0.089	0.189	0.016	0.00012
-28+35	0.186	0.389	0.039	0.0009
-35+48	0.258	0.337	0.322	0.0036
-48+65	0.281	0.066	0.526	0.344
-65+100	0.091	0.005	0.067	0.299
-100+150	0.062	0.005	0.024	0.237
-150+200	0.025	0.002	0.002	0.11

By means of labeled diagrams, explain the various types of industrial screening equipment. What is Screen efficiency? By applying the material balance on a single screen develop an expression of the overall effectiveness of a screen. CO1

Q3. Write the Principle, construction and working of a Tumbling mill. Along with diagram, explain how the segregation of grinding units in a conical ball helps in improving its efficiency? What do you mean by the term 'Critical speed'? Derive a mathematical expression of critical speed. CO2

OR

A crushing mill reduces limestone from a mean particle size of 45mm to a product having size as per the following table: CO2

Size (mm)	12.5	7.5	5.0	2.5	1.5	0.75	0.40	0.20
Percent	0.5	7.5	45.0	19.0	16.0	8.0	3.0	1.0

And in doing so requires 21 kJ/kg of the material crushed.
Calculate the power required to crush the same material at the same rate, from a feed having a mean size of 25mm to a product with a mean size of 1mm.

Q4. Give diagram and explain the working of a Rotary drum filter. For a case of cake filtration derive a relation between volume of filtrate collected and time for constant pressure filtration. What do you mean by the term 'specific cake resistance α'? CO3

OR

A slurry of lime powder giving 50kg of cake solid per cubic meter of filtrate is to be filtered at a constant pressure drop of 5 atm and a temperature of 30°C. Experiments on this sludge and the filter cloth to be used gave a value of Rm = 8.5 x 1010 m-1 and cake resistance of 6.38 x 1010 m/kg. A pressure filter of tank type is to be used. How many square meters of filter surface is needed to give 6 cubic meter of filtrate in a 1-h filtration? The viscosity of water at 30°C is 0.8 cP. CO3

Q5. What are the conditions of fluidization? Describe the two principal types of fluidization & distinguish between them. Explain the application of fluidization in pneumatic conveying of solid particles. CO4

OR

What are the various types of impellers used for agitation equipment. What do you mean by Swirling and how it can be prevented? What are the various shape factors used and give its commercial values in standard turbine design. CO4

Q6. Define the term 'Separation factor' for centrifugal sedimentation. Along with a labeled diagram, describe the process of sedimentation in a disk type centrifuge. For a particle settling in stroke's law regime, the device acting as a classifier with Dp_c as cut diameter, derive expression relating residence time t_T & the volumetric flow rate q_c. CO4

OR

Determine the velocity of settling of spherical sand particles (density = 2650 kg/m³) settling under laminar conditions in water at 298K, the average dia of particles being 900μm. CO4

μ_{water} = 1004 × 10^{-6} kg/ms at 298 K.

ρ_{water} = 1000 kg/m³ at 298 K.