

Faculty: Dr. Y K Suneetha , Associate Professor in Chemical Engg. Dept. , BMSCE

2015 revised scheme syllabus

Screen analysis

CO1: Apply the basic working principles different size reduction equipment to obtain desired particle size.

1. Differentiate between

- i. Ideal and actual screens considering effectiveness
- ii. Cumulative and differential analysis

2. Explain the working of vibrating screen shaker

3. Explain the meaning and significance the following in particle technology.

- a. Arithmetic mean diameter
- b. Mass mean diameter
- c. Volume Mean diameter
- d. Work index

4. Derive an expression to find overall effectiveness of a screen. Explain the method in stepwise to represent the data on graph based on the cumulative method.

5. Explain the following terms with respect to particle technology. Why is it required to define the particle size in different way?

6. Define the following using cumulative weight fractions.

- i. Arithmetic mean diameter
- ii. Mass mean diameter
- iii. Volume Mean diameter

7. Classify the size reduction equipment.

8. State the laws governing energy requirement for size reduction

9. A quartz mixture having the screen analysis shown below is screened through 10 mesh.

Calculate the mass ratios of the overflow and underflow of feed and overall effectiveness of the screen.

Sl. No	Mesh. No (BSS)	Aperture Size D_{pi} mm	Cumulative fraction larger than D_p		
			feed	overflow	underflow
01	4	4.669			
02	6	3.327	0.025	0.071	
03	8	2.362	0.15	0.43	

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04	10	1.651	0.47	0.85	0.195
05	14	1.168	0.73	0.97	0.580
06	20	0.833	0.885	0.99	0.83
07	28	0.589	0.94	1.00	0.91
08	35	0.417	0.96		0.94
09	65	0.208	0.98		0.975
10	Pan	00	1.00		1.00

10. From the following screen analysis data, determine the average diameter of the particles by volume surface mean diameter method.

BSS No.	D _{pi} (mm)	Mass on screen(g)
3	6.7	00
4	4.699	1
6	3.327	1.5
8	2.362	4.0
10	1.651	1.5
14	1.168	1.2
20	0.833	0.5
Pan	00	3.5

11. Explain the working principle and construction of a ball mill with a neat diagram showing design and principle of operation.

12. Execute the following screen analysis data to determine the average diameter of the particles by volume surface mean diameter method.

ISS No.	80	70	60	50	40	35	30	25	Pan
D _{pi} (mm)	0.75	0.592	0.500	0.420	0.351	0.296	0.251	0.211	000
Material retained on screen, g	----	32.5	29.0	17.8	13.6	0.04	9.0	7.92	4.84

13. Draw the schematic of a crusher used in industries. Explain the construction and working of it.

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14. Derive an expression for the effectiveness of a screen. Explain stage wise procedure of finding the effectiveness of a screen in the laboratory.

Sub sieve analysis and flow of particles suspended in fluids CO2: Apply the basic working principles different size reduction equipment to obtain desired particle size.

15. What is meant by sub sieve analysis? Describe any one method of sub sieve analysis giving principle of operation and schematic of equipment used.

16. . Write notes on air elutriation and its application.

17. Explain the following terms with respect to flow of fluid past immersed bodies.

- Drag, and drag coefficient,
- Stokes equation.
- The variation of drag coefficient versus Reynold's number

18. Obtain an expression to find terminal settling velocity of particles settling under gravitational force. Give the criterion for settling regimes in Stoke's law region. State the assumptions made.

19. Define specific gravity. What will be the settling velocity of spherical steel particles having 0.038 cm diameter, settling in an oil of specific gravity 0.82 and viscosity of 0.1 poise. Density of steel particles=7.87 g/cc.

20. Derive terminal settling velocity equation for laminar flow conditions

Batch sedimentation test and thickener design

CO3: Familiarize with the different types of mixing, agitation and conveyance of solids and estimate the power required.

21. A single batch settling test was conducted on lime stone slurry. The interface between clear liquid and suspended solids was observed as a function of time and the results are tabulated. The test was made using 236 g/L of slurry. Design the thickener if the slurry is fed at a rate of 5000 kg of dry solids /h to produce a thickened sludge of 550 kg/ m³.

Time in h	0.0	0.25	0.5	1.0	1.75	3.0	4.75	10.20	12
Height of	36	32.4	28.6	21	14.7	12.3	11.55	9.8	8.8

Mechanical Operations 15CH3DCMOP and 19CH3DCMOP
Question Bank

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interface in cm									
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22. Explain the working of an industrial thickener with a neat diagram.

23. State the assumptions made in deriving the equation used for designing thickener. Derive the equation to find the area of a thickener using data from a batch sedimentation test.

Filtration - Plate and frame filter press calculations CO3

24. What are filter aids? Give examples for filter aids.

How is the bag filter different from cake filter? Give the classification of filters.

25. Laboratory filtrations conducted at constant pressure (46196.5 N/m^2) on slurry of calcium carbonate in water gave the data as given below. The filter area and mass of solids per unit volume of filtrate were 0.044 m^2 and 23.5 kg/m^3 . Filtration was carried out at temperature of 25°C . Given viscosity of filtrate = 0.886 cp , estimate the values of filter medium resistance and cake resistance.

Filtrate volume in liter	0.5	1.0	1.5	2.0	2.5	3.0
Time, s	17.3	41.1	72.0	108.3	152.1	201.7

26. Lab filtration conducted at constant pressure of 18 kN/m^2 on a slurry of CaCO_3 in water gave the data as shown below. The filter area was $6'' \times 4''$ plate. Concentration of slurry is 25 kg/m^3 . Evaluate filter medium resistance and cake resistance.

Volume, liter	0.5	1.5	2	2.5	3	3.5	4	4.5	5
Time, second	6.3	24.2	37	52	69	89	110	134	160

27. Explain the working principle and construction of a filtration equipment with a neat diagram showing design and principle of operation.

28. Derive the Kozeny Carmen equation applicable to filtration operation.

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29. What is the principle of working of leaf filter? ? Explain with a neat diagram showing design and operation.

30. What is the principle of working of vacuum drum filter? Explain with a neat diagram showing design and operation.

31. Explain the construction of Plate and frame filter press with a neat diagram.

CO4: Familiarize with the different types of mixing, agitation and transportation of solids and estimate the power required.

32. Describe the methods adopted in industry for storage of solids. Explain both open and closed storage techniques.

33. Explain the working principle and construction of cyclones with a neat diagram.

34. Draw a neat schematic of suspended batch centrifuge. Explain the working of equipment.

35. Discuss how is power required in mixing is calculated based on power correlation.

36. Describe the working principle and construction of internal screw mixer with a neat diagram showing internal design of equipment.

37. Explain the working principle and construction of froth floatation with a neat diagram.

CO5:

Conduct experiments for particle size analysis, separation of high value products by filtration , sedimentation and decantation techniques.

Questions

- i. Determine the particle size of sample in sub-sieve range using ICI sedimentation experimental observations given below. Also find the particle size by area test.
- ii. Determine the crushing law constants for the observations obtained by crushing granite and setting the product to screen analysis. Verify which law is applicable.

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- iii. Determine the minimum cross sectional area of a continuous thickener required to handle 350 tons/day of dry solids from initial concentration of 4% to give an underflow concentration of 50% by using the observations of a batch sedimentation test.
- iv. Determine the specific cake resistance (α) and filter medium resistance (R_m) using the observations given below by carrying out an experiment using plate & frame filter press with 4% by weight of CaCO_3 slurry.
- v. Determine the specific surface area of the given sample for the observations obtained by conducting an experiment using air permeability technique.
- vi. Estimate the effectiveness of 100 mesh screen using the observations.
- vii. Determine the Rittinger's law constant & Kick's law constant by using observations from crushing operation in a drop weight crusher. Also verify the laws of crushing.
- viii. Determine the average particle size differentially and cumulatively using the experimental results.
- ix. Determine the average particle size of the given powdered sample obtained by beaker decantation method and find the particle size by area method.
- x. Determine the specific cake resistance (α) and filter medium resistance (R_m) by using observations obtained by filtering CaCO_3 slurry in a vacuum leaf filter apparatus.