MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION

SUMMER-13 EXAMINATION

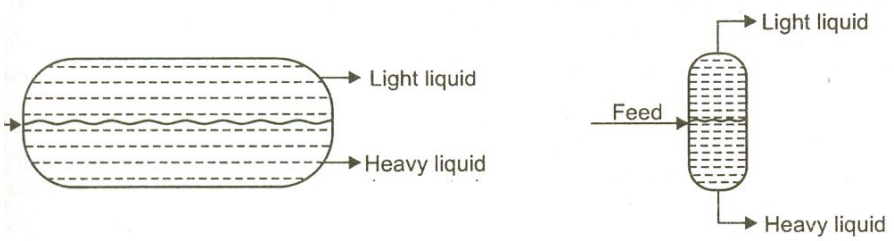
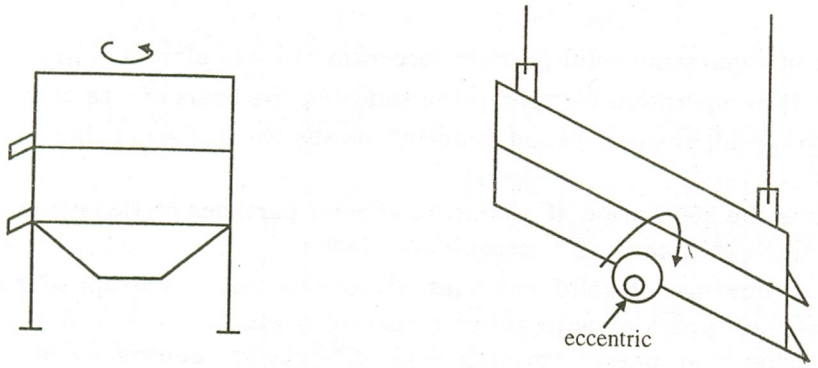
Model Answer

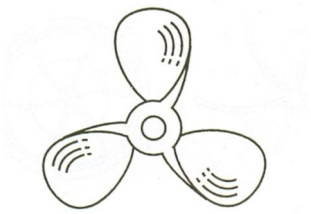
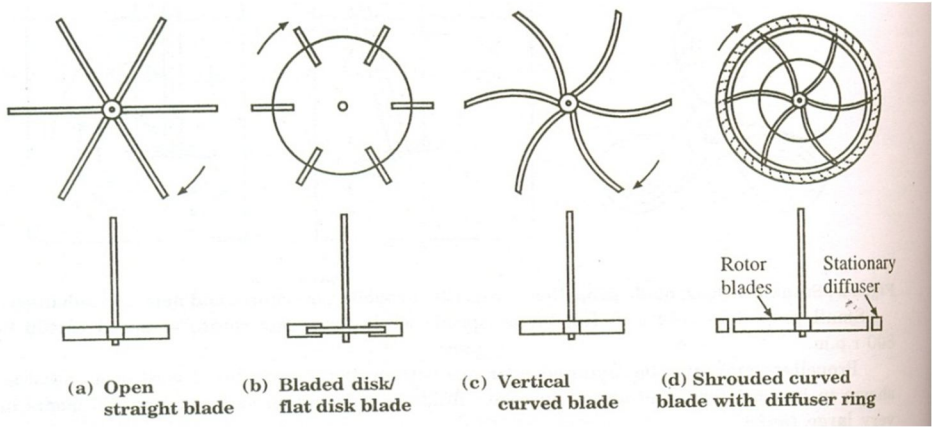
Subject & code : MOP(12080)

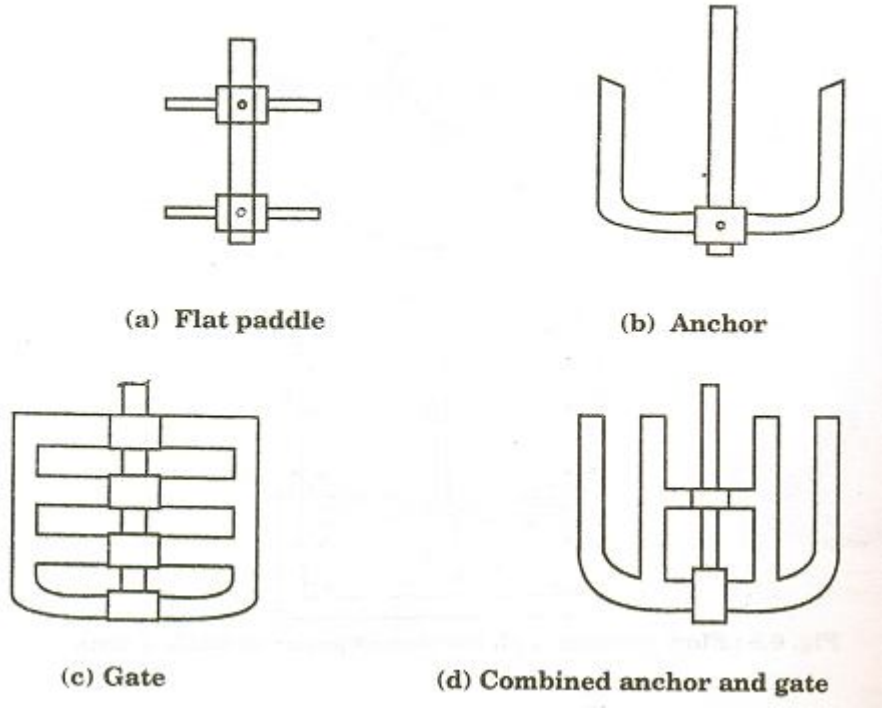
Important instructions to examiners :

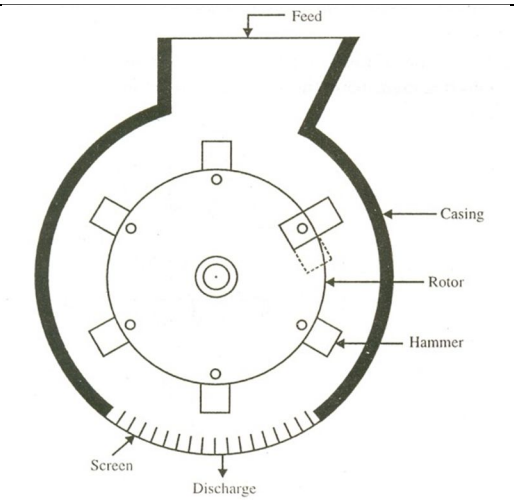
1. The answers should be examined by keywords and not as word to word as given in the model answer scheme.
2. The model answer and the answer written by candidate may vary, but the examiner may try to assess the understanding level of the candidate.
3. The language errors such as grammatical, spelling errors should not given more importance.
4. While assessing figures, examiner may give credit for principal components indicated in a figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5. Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answer and model answer.
6. In case of some questions credit may be given by judgment of relevant answer based on candidates understanding.

Q No:	Answer	Mark	Total marks
1.a	**Mechanical operations:** Unit operations carried out using mechanical devices are known as mechanical operations Eg: size reduction, sedimentation, filtration, screening, magnetic separation, electrostatic separation(any two)	1 1	2
1. b	**Continuous gravity decanter:** (Any one diagram)	2	2

			
1.c	**Electrodialysis:** It is a membrane separation process in which ions are transported through a membrane from one solution to another under the influence of an electric potential.	2	2
1. d	**Kick's law :** Kick's law states that the work required for crushing a given mass of material is the log of ratio of the initial particle size to final particle size. **Mathematical Expression** $P/m = K_k \ln((D_{sa} / D_{sb})$	1 1	2
1.e	**Centrifuging of ball mill :** If the ball mill is operated at very high speed , the balls are carried right round in contact with the mill without falling down. This is known as centrifuging **Critical speed of ball mill :** Critical speed is the speed at which centrifuging occurs in a ball mill. When centrifuging occurs no grinding takes place.	1 1	2
1.f	**Angle of nip**: Angle of nip is the angle formed by tangents to the roll faces at a point of contact with particle to be crushed.	2	2
1.g	**Crushing efficiency:** The ratio of surface energy created by crushing to the energy absorbed by solid is the crushing efficiency η_c **Expression**: $\eta_c = e_s(A_{wb}-A_{wa}) / W_n$	1 1	2
1. h	**Mesh:** It is the number of openings per linear inch counting from the centre of any wire to a point exactly one inch distant. **Screen size aperture**: Minimum clear space between edges of openings in the screening surface is termed as screen aperture	1 1	2
1.i		1 mark each	2

	Gyration in horizontal Plane. Gyration in vertical Plane.		
1j	i) **Free settling:** It is the settling of the particle unaffected by other particle and the boundary of the container. ii) **Hindered settling** : If the settling of particle is affected by other particles and by the boundary of the container, then it is known as hindered settling	1 1	2
1. k	**Role of coagulants in sedimentation** Coagulants are substances added to slurry which form flocculant precipitate which coalesce the suspended impurities and cause them to sink rapidly. When coagulants are added to sedimentation tanks , the settling of solids will takes place rapidly and the supernatant liquid will be very clear.	2	2
1.l	**Different types of impellers** Propeller, paddle, turbine **Diagram (any two)**  Propeller  Turbine	1 ½ mark each	2

	 paddle		
2.a	**<u>Screen analysis:</u>** Screen analysis of the material is carried out by using testing sieves. An analysis is carried out by placing the sample on the top screen and shaking the screen manually or mechanically for a definite time. The material retained on each screen is removed and weighed. There are two methods for analysis of the particle- 1. Differential analysis 2. Cumulative analysis **Differential analysis**: The average particle size of the material retained on any particular screen is tabulated or plotted against the weight fraction of the material retained **Cumulative analysis** : It is obtained from differential analysis by adding cumulatively the individual weight fraction retained on each screen and plotting the cumulative sums against the screen opening of the retaining screen. It can also be reported by incorporating cumulative fraction passing through screen	2 1 1	4
2. b	**<u>Hammer mill</u>** **Diagram**	 2	4



1

Construction

It contains a high speed rotor rotating inside a cylindrical casing. A set of swing hammers are pinned to the rotor disk. The shaft is horizontal. Screen or grate is provided at the bottom for the discharge of the product.

1

Working

Feed is dropped into the top of the casing . Particle of feed is being struck by the set of swing hammers. The feed after being struck by the hammer fly against a stationary anvil plate inside the casing and break into still smaller fragments. They are again rubbed into powder by the hammers and pushed through the grate or screen which covers the discharge opening

2.c

Diameter of the ball mill = 1200mm = 1.2m
Radius of the ball mill(R) = 600mm= 0.6m
Diameter of the ball = 75mm = 0.075m
Radius of the ball(r) = 0.0375m

$N_c = (1/2\pi) \times \sqrt{(g / (R - r))}$

$= (1/ 2 \times 3.14)\sqrt{(9.81 / (0.6 - 0.0375)}$

0.665 rps = 39.9 rpm

2

Operating speed is 50% to 70% of critical speed
Operating speed = 19.95 rpm to 39.9 rpm

2

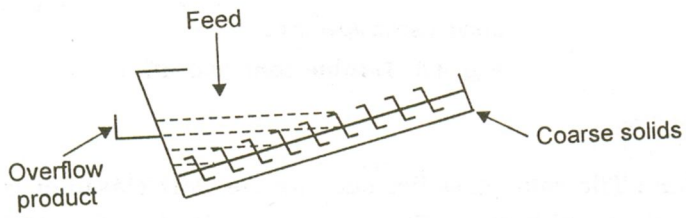
4

2. d

Ideal screen	Actual screen
1. The overflow will contain only particles larger than cut diameter	The overflow may also contain particles smaller than cut diameter
2. Underflow will contain only particles smaller than cut diameter	Underflow may also contain particles larger than cut diameter
3. Yields sharp separation	Does not yield sharp separation
4. Efficiency is 100%	Efficiency is less than 100%

1 mark each

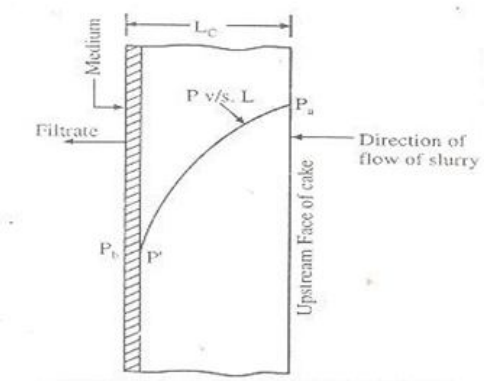
4

<table>
<tr>
<td>2.e</td>
<td><u>Spiral classifier:</u>
Diagram:
 

Description:
It consists of a semi cylindrical trough inclined to the horizontal. The trough is provided with a slow rotating spiral conveyor and a liquid overflow at the lower end. Slurry is fed to the middle of the trough. Heavy particles settle to the bottom of the trough and spiral conveyor moves the settled solid upward along the floor of the trough. Fines do not have time to settle and are carried out with the overflow liquid.</td>
<td>2

2</td>
<td>4</td>
</tr>
<tr>
<td>2.f</td>
<td><u>Difference between filtration and sedimentation:</u>
<table>
<tr><th>Filtration</th><th>sedimentation</th></tr>
<tr><td>1. Filter medium is used for separation of solids from slurry</td><td>Filter medium is not required</td></tr>
<tr><td>2. Driving force for separation is the pressure difference across the filter medium</td><td>Driving force is the gravitational force</td></tr>
</table>
.</td>
<td>2 marks each</td>
<td>4</td>
</tr>
<tr>
<td>3.a</td>
<td>Solids Separation based on Magnetic Properties:
1. Magnetic separation is a method of separation of solid Particles by means of magnetic field.
2. In this method materials having different magnetic attract ability are separated by passing them through a magnetic field.
3. Differance in Magnetic properties of different materials is responsible for such a separation.
4. Diamagnetic solids which when placed in a magnetic field are repelled by it.
5.Paramagnetic solids which when placed in a magnetic field are attracted by magnetic field</td>
<td>½ mark each for any four</td>
<td>4</td>
</tr>
</table>

	Two Equipments for Solids Separation based on Magnetic Properties: 1. Magnetic pulleys 2. Magnetic drum separator	2	
3. b	**Different types of Filtration Processes**: There are two types of Filtration: **1.Constant Pressure Filtration:** The method in which the pressure drop over the filter is held constant throughout a run so that the rate of Filtration is maximum at the start of filtration and decreases continuously towards the end of the run is called Constant Pressure Filtration **2.Constant rate Filtration:** The method in which the pressure drop is varied usually from minimum at the start of filtration to a maximum at the end of filtration so that the rate of filtration is constant throughout the run is called Constant rate Filtration	2 2	4
3.c	**Distribution of Overall Pressure drop in Filtration Process:**	1	4



Section through filter medium cake showing pressure drop

2

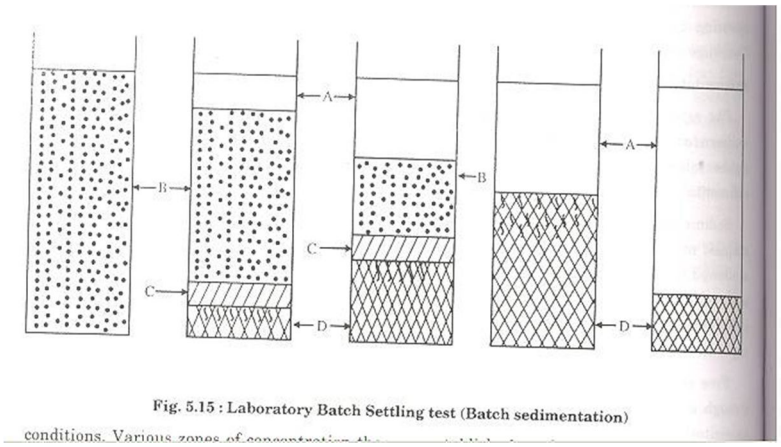
1. With the help of the pressure difference applied between the slurry inlet and the filtrate outlet ,the filtrate is forced through a filter.
2. During filtration, the solids are retained in the form of cake through which the filtrate must flow.
3. The filtrate has to pass through three resistances in series
   - Resistance of the feed and filtrate channel
   - Resistance of the cake
   - Resistance offered by the filter medium
4. The Overall or total pressure drop over the filter at any time is equal to the sum of the individual pressure drops over the medium and cake.
5. Usually, resistances offered by the inlet and outlet connections are small as compared with those of cake and medium and thus can be neglected.
6. If the resistances of channels is neglected then the Overall pressure drop is the sum of the pressure drops over the medium and cake.

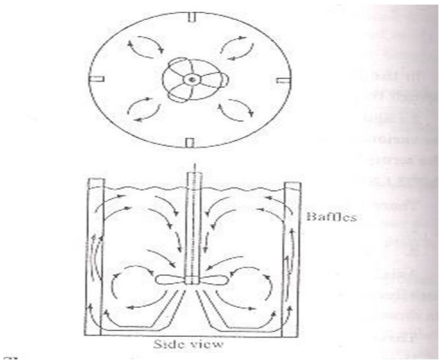
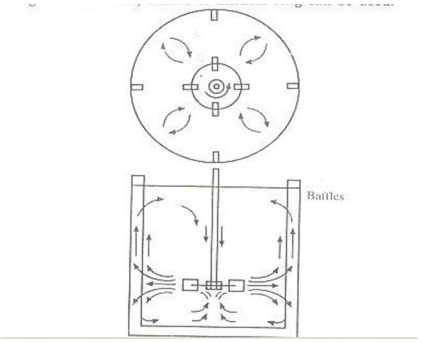
1

$$\Delta P = Pa - Pb = (Pa-P') + (P'- Pb) = \Delta Pc + \Delta Pm$$

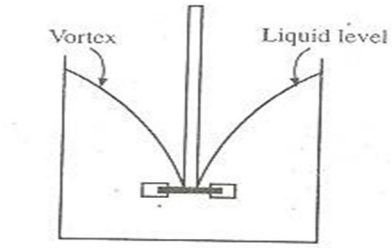
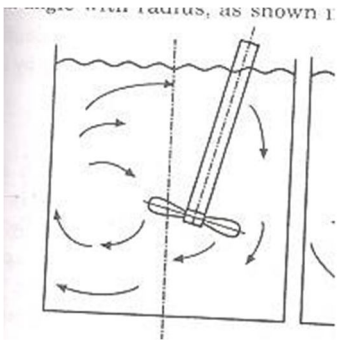
Where

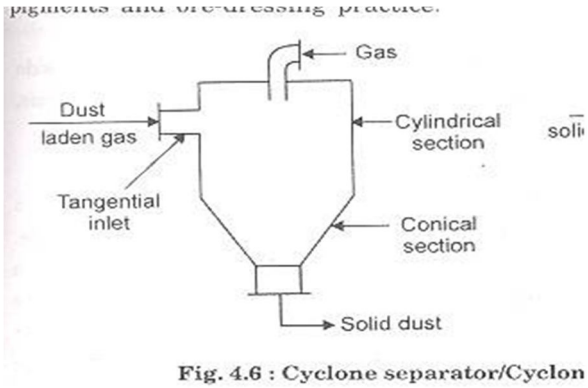
Pa = Inlet pressure

	Pb = Outlet pressure P'= pressure at the interface between cake and medium ΔP = Overall Pressure drop ΔPc = Pressure drop over cake ΔPm = Pressure drop over medium		
3. d	**Laboratory test of Batch Sedimentation:**  Fig. 5.15 : Laboratory Batch Settling test (Batch sedimentation) conditions. Various zones of concentration th 1.The mechanism of settling may be described by batch settling test in glass cylinder in laboratory. 2. As shown in figure, cylinder containing a newly prepared slurry of a uniform concentration of uniform solid particles through. 3. As soon as the process strats, all the particles begin to settle and are believed to approach rapidly terminal settling velocities under hindered settling condition 4. Various zones of concentration then are established. The heavier faster settling particles settled at the bottom of glass cylinder are indicated by Zone D. 5.Above zone D forms another layer, called zone C ,a region of variable size distribution and non uniform concentration. 6.The boundary between C and D is usually obscure and is marked by vertical channels through which fluid is rising from	2 2	4

	the lower zone D as it compresses. 7. Above zone C is zone B, which is a zone of uniform concentration of approximately the same concentration as that of original pulp. 8. Above the zone B is zone A, which is a zone of clear liquid. if original slurry is closed sized with respect to smallest particles, the boundary between A and B is Sharp.		
3.e	**Different Types of flow patterns generated in Agitated vessel:** **1 Axial Flow pattern:** When impellers generate flow currents parallel to axis of shaft the flow pattern is called as Axial Flow pattern . In axial flow pattern longitudinal velocity component acts in the direction parallel with the shaft  **2 Radial Flow pattern:** When impeller generates flow current in tangential or radial i.e. in direction perpendicular to shaft the flow pattern is called Radial Flow pattern.  	1 1 1 1	4
3.f	**1. Specific Cake Resistance :** A specific cake resistance α can be defined by the equation	2	4

	$$\alpha = \frac{\Delta P_c \, A}{\mu \, u \, m_c}$$ where , ΔP_c = Pressure drop over cake A = filter area perpendicular to the direction of flow u = linear velocity of filtrate based on the filter on the filter area. μ = viscosity of the filtrate mc = total mass of solids in cake **2. Filter Medium Resistance :** A filter medium resistance can be defined by the equction $$\frac{\Delta P_m}{R_m} = \mu \, u$$ $$R_m = \frac{\Delta P_m}{\mu \, u}$$ where , ΔP_m = Pressure drop over filter medium u = linear velocity of filtrate based on the filter on the filter area. μ = viscosity of the filtrate	2	
4.a	**1. Swirling:** If a low viscosity liquid is stirred in an unbaffled tank mounted agitator, there is a tendency for a Swirling flow pattern to	2	8

	develop. **2. Vortex:** For the lighter fluid to be drawn in to form a vortex at the surface of the liquid and for the degree of agitation and mixing to be reduced. In the vortexing low viscosity liquid, the vertical velocities are low relative to the circumferential velocities in vessel. A vortex is produced owing to centrifugal force acting on a rotating liquid **Prevention of Swirling and Vortex Formulation:** There are three methods of prevention of swirling and vortex formation a) Off-center mounting of the impeller. b) Use of Baffles c) Use of diffuser ring with turbines  	2 2 2	
4. b	**Cyclone Separator:** **Principle:** A cyclone separator is essentially a settling chamber in which the gravitational separating force is replaced by a much stronger	2	8

	centrifugal separating force. **Diagram:**  Fig. 4.6 : Cyclone separator/Cyclon	2	
	Construction: 1. It consists of a tapering cylindrical vessel. 2. A cylindrical vessel consisting of a top vertical section and lower conical section terminating in an apex opening. 3.It is provided with a tangential feed inlet nozzle in the cylindrical section near the top and an outlet for the gas , centrally on the top. 4. The Outlet is provided with a downward extending pipe to prevent the gas short circuiting directly from the inlet to the outlet and for cutting the vortex.	2	
	Working: 1.The dust laden gas is introduced tangentially into a cylindrical vessel at a high velocity (30 m/s) 2.Centrifugale force throws the solid particles out against the wall of the vessel and drop into conical section 3. Then removed from the bottom. 4. The clean gas is taken out through a central outlet at the top	2	
4.c	**Expression for calculating overall effectiveness of screen :** Effectiveness of screen is measure of success of the screen in closely separating under size and oversize materials.	1	8

The screen effectiveness based on the oversize material is the ratio of amount of oversize material A that is actually in the overflow to the amount of oversize material A in the feed

Let F = mass flow rate of feed in Kg/hr

D = mass flow rate of overflow in Kg/hr

B = mass flow rate of underflow in Kg/hr

X_F = mass fraction of material A in feed

X_D = mass fraction of material A in Overflow

X_B = mass fraction of material A in Underflow

Screen effectiveness based on material A = Quantity of over size in Overflow / Quantity of over size in Feed

$$E_A = \frac{D.X_D}{F.X_F} \qquad 1$$

Similarly, the screen effectiveness based on the undersize material is given by 1

$$E_B = \frac{B.(1-X_B)}{F.(1-X_F)}$$

The overall effectiveness of a screen can be given by

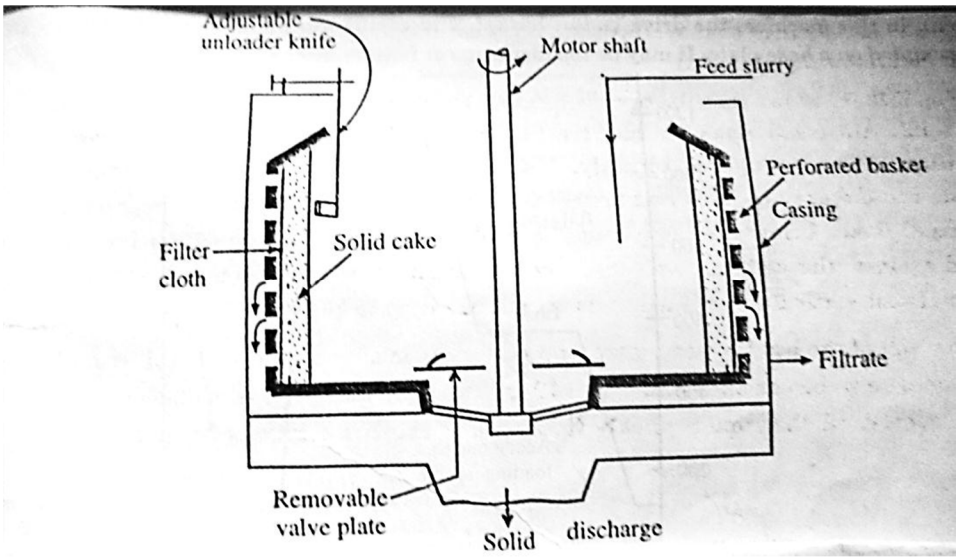
$$E = E_A . E_B$$

Putting values of E_A & E_B in above equation

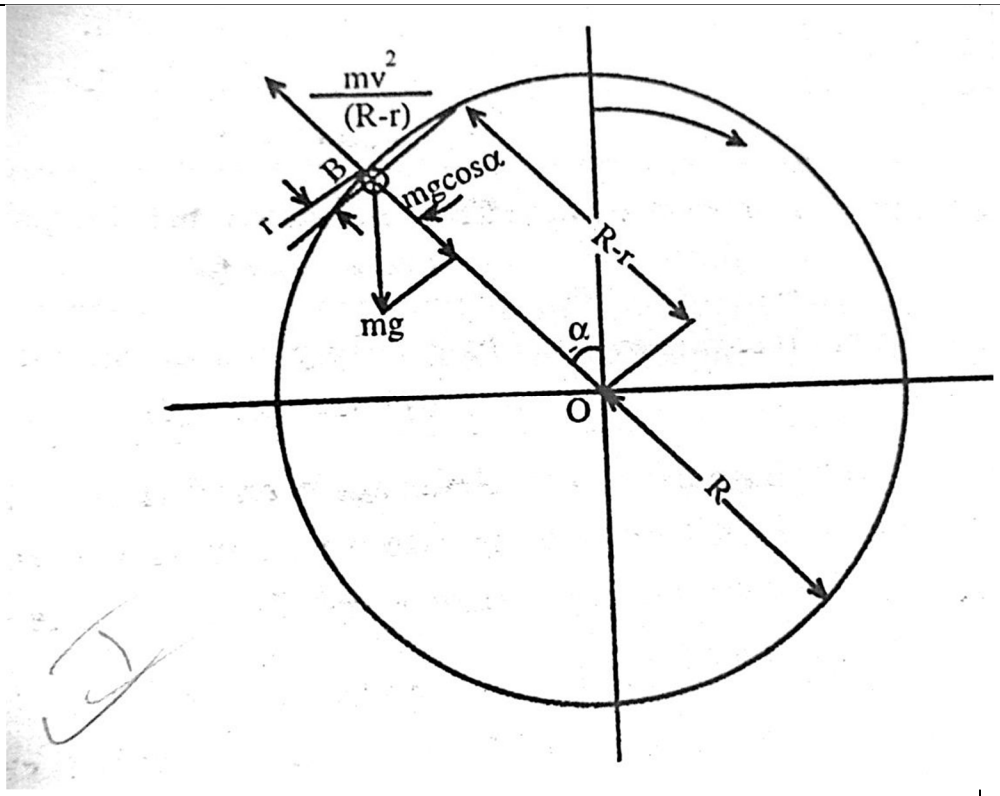
$$E = \frac{D.B.X_D.(1-X_B)}{F^2.X_F.(1-X_F)} \quad \text{------ 1} \qquad 2$$

But from material balance of screen , 1

$$\frac{B}{F} = \frac{X_D - X_F}{X_D - X_B} \quad \text{and}$$

	$\frac{D}{F} = \frac{X_F - X_B}{X_D - X_B}$ Putting these values in above equation 1 ,then $E = \frac{(X_F - X_B)(X_D - X_F).X_D.(1 - X_B)}{(X_D - X_B)^2 . X_F.(1 - X_F)}$	2	
5.a	**Centrifuge(Centrifugal Machine) Construction** A Centrifuge Is Any Rotating Machine In Which Centrifugal Force Is Utilized For Phase Separation. The Components Of A Centrifuge Are| 1)A Rotor Or Bowl In Which Centrifugal Force Is Applied To The Contents Of Bowl 2)A Drive Shaft 3) A Drive Mechanism(Electric Motor) 4) A Frame For Support 5) A Casing	2	4
	 	2	
	It Consists Of A Basket(Dia.750 To 1200 Mm, Depth 450 To 750mm) With A Perforated Sides. Basket Rotates At Speeds Between 600 To 1800	1	

	Rpm .Basket Is Held At Lower End Of A Free Moving Vertical Shaft. ,Driven By Electric Motor .A Filter Medium Is Placed Around The Inside Surface Of The Basket Sides .Casing Is Provided Around Basket With A Filtrate Discharge Connection At Bottom. Material Of Construction Is Mild Steel,Monel& Stainless Steel. ,Lined By Lead, Rubber. **Working**: Slurry Is Fed To Rotating Basket Thro Inlet Pipe Forced Against Basket Sides By Centrifugal Force. Liquid Passes Filtre Medium Into Casing & Out A Discharge Pipe. Cake Is Formed On Filter Medium. Thickness Of Cake Varies From 50 To 150 Mm. Cake Is Washed By Spraying Wash Liquid To Remove Soluble Material. It Leaves The Centrifuge Thro Discharge Pipe. Then Cake Is Spun At Higher Speed Than That During Charging & Washing Steps. Motor Is Shut Off & Basket Speed Is Reduced By A Brake. At Basket Speed 30 To 50 Rpm, Cake Is Discharged By Cutting It Out With A Un loader Knife .Knife Peels The Cake Off The Filtre Medium &Drops It Thro Opening In Basket Floor. The Valve At Bottom Is Opened To Allow Cake Discharge. After Unloading, The Filtre Medium Is Rinsed Clean & Cycle Is Repeated. Use: In Sugar Refining, With Cycle 2 To 3 Minutes Per Load ,Production 5 Tonnes \Hr.	1	
5. b	Critical Speed Of A Ball Mill :The Minimum Speed At Which Centrifuging Occurs Is Called As Critical Speed.(Centrifugal Force Is Exactly Balanced By Weight Of Balls)		4



1

Let R & R Be Radii Of Mill & Ball Resp.

R-R Represents The Distance Between Center Of Ball & Axis Of Mill.

Let A Be Angle Between OB & The Vertical.

The Forces Acting On Ball Are

1) Force Of Gravity "Mg"
2) Component Force "$Mv^2/(R-R)$" V = Peripheral Speed

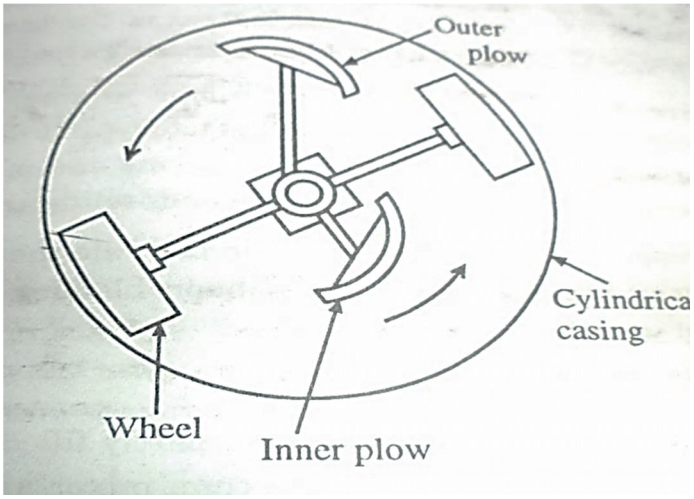
   Component Of Gravity Opposing The Centrifugal Force Is "Mg.Cos A."

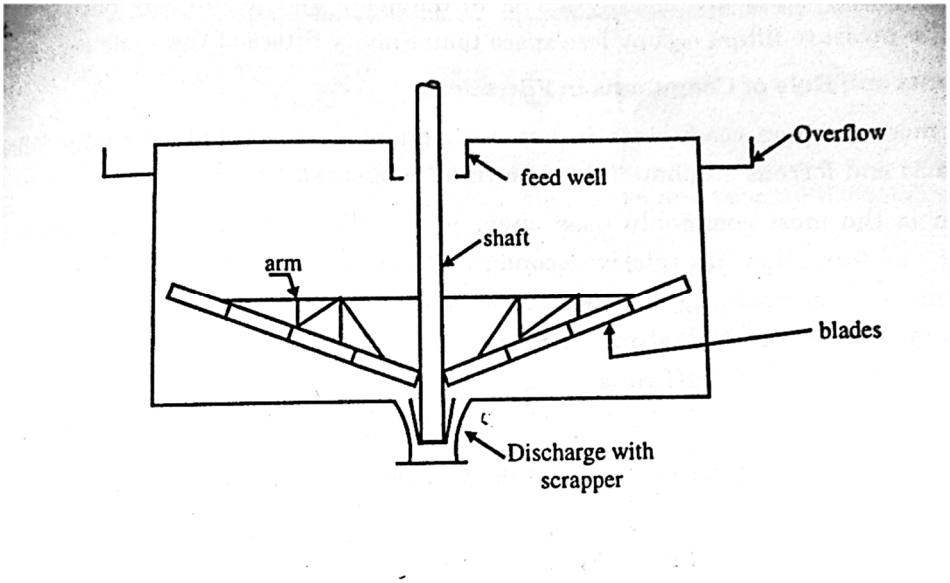
   As Long As Centrifugal Force Exceeds The Centripetal Component Of Force Of Gravity ,The Particle Will Not Loose Contact With The Wall.AsAngle A Decreases,Centripetal Force Increases, Aaa7 Unless The Speed Crosses The Critical Value , A Stage Is Reached Where The Opposing Forces Are Equal & Ball Is Ready To Fall Away.The Angle At Which The Said Phenomenon Occurs Is Found Out By Equating The Opposing Forces:

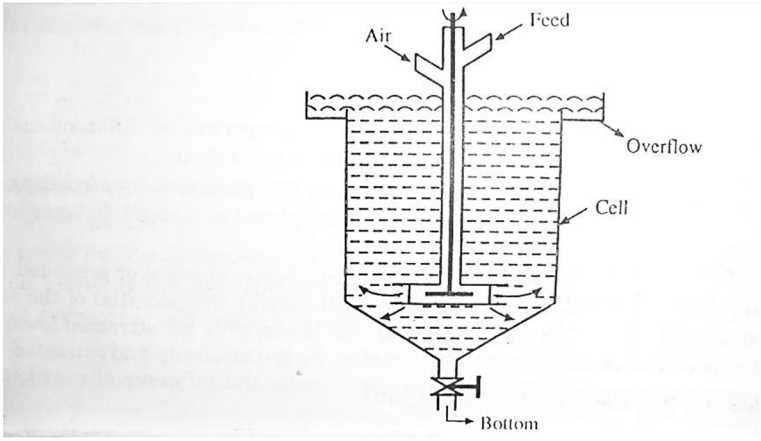
   $Mg.Cos\ A. = Mv^2/(R-R)$

3

	$\text{Cos A.} = Mv^2/(R-R).G$ Relation Between Peripheral Speed & Speed Of Rotation $V = 2 \Pi N(R-R)$ Putting Value Of V $\text{Cos A} = 4\pi^2N^2(R-R)/G$ At Critical Speed : A = 0 & Cosα = 1 &N Becomes The Critical Speed Nc $\text{Cos A} = 1 = 4\pi^2N^2(R-R)/G$ $Nc^2 = G/4\pi^2(R-R)$ $Nc = 1/2\pi(\sqrt{\frac{g}{(R-r)}})$		
5.c	**Factors Affecting The Performance Of A Screen:** 1) Method Of Feeding: For Maximum Capacity &Efficiency, Feed Should Be Spread Evenly Over The Full Width Of Screening Surface, In Direction Parallel To Longitudinal Axis Of Screen, With Low Velocity. 2)Screening Surfaces :Use Of Single-Deck Screens Results Into Most Efficient Than Multiple-Deck Screens In Which Lower Decks Are Not Fed & Each Separation Requires A Different Combination Of Angle, Speed & Amplitude Of Vibration For Best Performance. 3)Screen Slope :As Screen Slope Increases ,Traveling Rate Of Feed Increases & At The Same Time Bed Thickness Decreases. Increase In Travelling Rate Means Increased Tonnage Passing Over The Screen Per Unit Time. Due To Reduction In Bed Thickness, Fines Pass Through Screen Openings .Slope Of Screen Can Not Be Increased Beyond A Certain Value, As Material Will Travel Down Screen Much Faster Without Getting Screen ,Efficiency Will Decrease. 4)Vibration Amplitude &Frequency: Proper Amplitude Of Vibration Is Selected To Prevent Binding Of Screen & For Long Bearing Life. Frequency Of Vibration Affects Capacity Of Screening Equipment By Regulating No.Of Impacts Between Material & Screening Surface. 5) Moisture In the Feed: The Moisture In Feed Adversely Affects	1 Mark Each For Any 4 Points	4

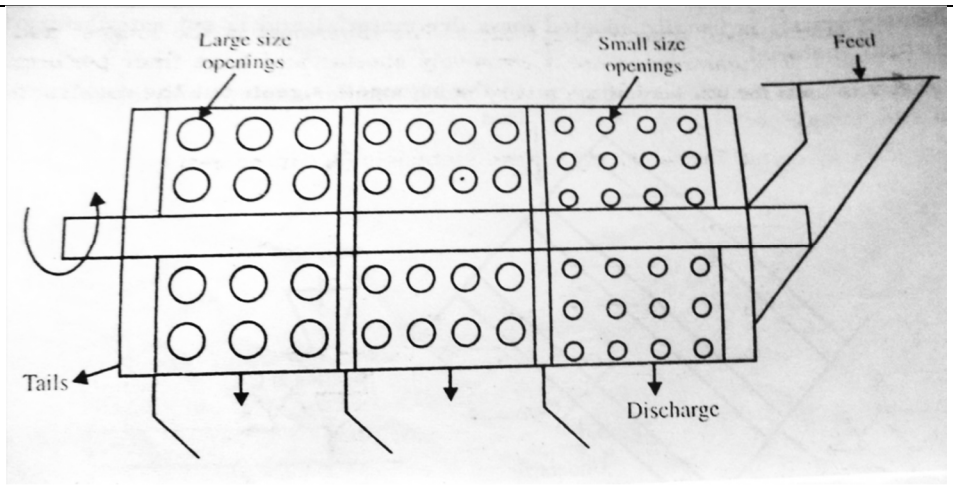
	Screening Operation &Shoule Be Removed.		
5d	**Muller Mixer** **Construction:** It Consists Of A Pan Incorporating Muller Wheels.In Some Designs,Pan Is Stationary & Wheels Rotate,While In Other Designs,Pan Is Rotated & Axis Of Wheels Is Held Stationary.In Stationary Pan Muller Mixer , Central Vertical Shaft Is Driven,Causing The Muler Wheels To Roll In A Circular Path Over A Layer Of Solids On Pan Floor.Flows Guide The Solids Under Muller Wheels During Mixing Or To An Opening In Pan Floor For Discharge Of Mixer At The End Of Cycle. The Muller Wheels Crush Material,Breaking Down The Lumps & Agglomerates. Capacity Of Muller Mixer : A Fraction Of Cubic Meter To More Than 1.6 M3 Power Required: From 1\3 To 75 HP. Applications: Suitable For Handling Heavy Solids & Pastes& Effective In Uniformly Coating The Particles Of Granular Solids With A Small Amount Of Liquid.  	2 2	4

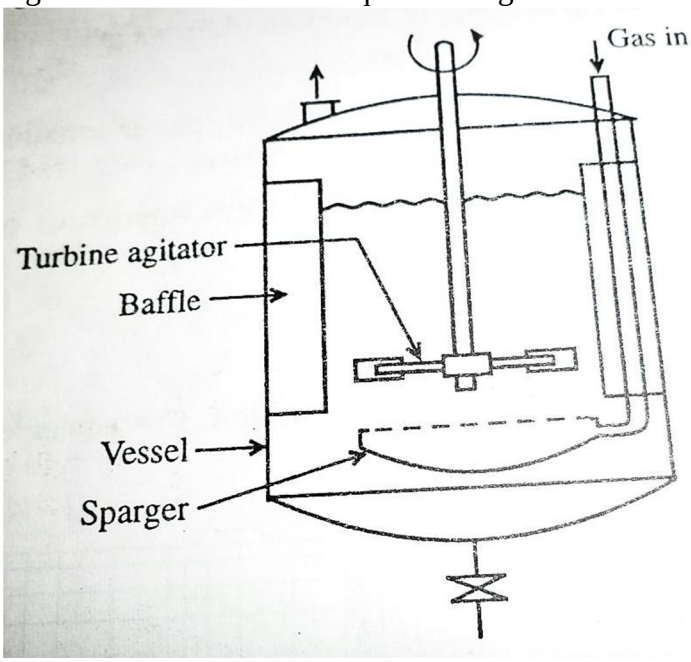
5.e	**Functions Of Thickners**: Sedimentation: The Separation Of Solids From A Suspension In A Liquid By Gravity Settling Is Called As Sedimentation. It Is One Of The Most Widely Used Processes For Water Treatment & Purification. The Process Of Sedimentation Is Carried Out Batchwise Or Continuously In An Equipment Called As A Thickner. For Relatively Fast Settling Particles A Batch Setting Tank Or A Continuous Setting Cone May Be Adequate With Mechanical Agitations. The Thickner Is A Large ,Fairly Shallow Tank With Mechanically Moving Radial Rakes Driven From A Central Shaft. The Slurry Is Fed At Center Of Tank & Allowed To Settle. After A Sufficient Time Clear liquid Is Decanted & Sludge Is Withdrawn From Bottom. The Large Thickners Are Useful When Large Volumes Of Dilute Slurry Must Be Thickened As In Cement Manufacture Or Production Of Magnesium From Seawater. They Are Extensively Used I Sewage Treatment & In Water Purification.  :	2 2	4

5.f	**Factors Affecting Rate Of Filtration:** Filtration : It Is The Method Of Removal Of Solid Particles From A Fluid By Passing The Fluid Through A Filtering Medium/Septum On Which The Solids Are Deposited. The Factors Affecting Filtration Are As Follows: 1) Pressure Drop Across The Feed Inlet & Far Side Of The Filter Medium(If Pressure Drop Is More, Filtration Rate Is More.) 2) Area Of Filtering Surface(Rate Of Filtration Is Directly Propotional To Area Of Filter Surface) 3)Viscosity Of Filtrate: Rate Of Filtration Is Inversely Propotional To Viscosity Of Filtrate. 4)Resistance Of Filtre Medium & Initial Layers Of Cake: Rate Of Filtration Is Less Is Resistance Of Filtre Medium & Initial Layers Of Cake. 5)Resistance Of Cake: Thickness Of Cake Increases ,Resistance To Flow Increases 7 Hence Rate Of Filtration Decreases.	1 Mark Each For Any 4 Points	4
6.a	FroathFloatation Cell:  **FroathFloatation Cell(Lab. Model)** Construction: Mechanically Agitated Cell Consists Of A Tank Having Square Or Circular C/S,With An Agitator Which Violently Agitates The Pulp. The Air From Compressor Is Introduced Into System Thro A Downpipe Surrounding The Impeller Shaft.	2 1	4

	The Bottom Of Tank Is Conical & Is With A Discharge For The Tailings. An Overflow Is At Top For Mineralized Froth Removal. **Working:** Water Is Taken Into The Cell, Material Is Fed To The Cell. The Promoters(Sodium Ethyl Xanthate) & Frothers (Liquid Soaps, Pine Oil, Cresylic Acid Etc.) Are Added .Agitations Are Given & Air Is Bubbled In Form Of Fine Bubbles. Air-Avid Particles Due To Reduction In Their Effective Density, will Rise To The Surface & Be Held In Froth Before They Are Discharged From The Overflow. Hydrophilic Particles Will Sink To The Bottom & Removed From The Discharge.	1	
6. b	$\dot{m}$ = 150 T\Hr Work Index Wi = 12.74 Dpb= Product Size = 3.125 Mm Dpa= Feed Size = 50 Mm Power Required $\frac{P}{\dot{m}} = 0.3162\ Wi\ \left[\frac{1}{\sqrt{Dpb}} - \frac{1}{\sqrt{Dpa}}\right]$ $$\frac{P}{150} = 0.3162\ (12.74)\ \left[\frac{1}{\sqrt{3.125}} - \frac{1}{\sqrt{50}}\right]$$ P = 256.4 Kw	2 2	4

6.c	**Trommels:** Trommels Are The Revolving Screens Consisting Of A Cylindrical Frame Surrounded By Wire Cloth Or Perforated Plate. They Are Open At One Or Both Ends, And Inclined At A Slight Angle To The Horizontal So That The Material Is Advanced By The Rotation Of The Cylinder. They Are Rotated At Slow Speeds Of 15 To 20 Rpm. The Perforations In Screening Surface May Be Of The Same Size Throughout Or May Be Of Different Size In Which Case The Small Size Perforation Section Is Near The Feed End. It Is Driven At The Feed End Thro A Gear Mechanism. It Has A Feed Point At The Upper End, An Undersize Product Discharge Below The Screening Surface & An Oversize Discharge At The Lower End. **Working:** Feed Is Fed At The Upper End & It Gradually Moves Down The Screening Surface Towards The Lower End. In Doing So, Material Passes Over The Apertures Of Gradually Increasing Size(As The Single Cylinder Is Provided With Perforations Ranging From The Finest Desired At The Feed End To The Coarsest At The Discharge End.) The Finest Material Is Collected As The Underflow In The Compartment Near The Feed End & Coarsest Is Withdrawn From Discharge End. The Operating Speed Of The Trommel Is 30 To 50% Of The Critical Speed. Trommels Are Well Suited For Relatively Coarse Materials 1\2 Inch Or More.	3	4

	 Trommel(With Screens Of Different Openings)	1	
6. d	Principles Involved In Size Reduction Equipment: 1) Compression. 2) Attrition 3) Impact 4) Cutting **Compressio**n Is Characteristic Action Of Crushers (Ex: Jaw Crusher, Gyratory Crusher, Smooth Roll Crusher). **Grinders** Employ Impact & Attrition (Ex: Ball Mill, Hammer Mill, Roller Mill, Rod Mill). **Ultrafine Grinders** Operate Principally By Attrition (Ex: Hammer Mill With Internal Classification, Agitated Mills ,Fluid Energy Mills). **A Cutting** Action Is Characteristic Of Cutters, Dicers, & Slitters	1/2 Mark Each For 4 Points Eg.2 Mks	4

6.e	Agitated Vessel For Gas-Liquid Mixing:  Mixing Of Gases With Liquids Is Accomplished By Spraying A Gas Under A Turbine(Flat Blade) Near The Flat Bottom Of A Cylindrical Vessel.Injecting The Gas Under A Propeller Is Useless Because The Flow From Propeller Is Axial &Downward.It Consists Of A Baffled Vertical Vessel Incorporating A Flat Blade Turbine Agitator.The Diameter Of Turbine Is 1\3 Rd Of Tank Diameter.The Depth Of A Pool Of Liquid Is Equal To Tank Diameter.ASparger(Ring Shaped)Is Mounted Below The Impeller With Holes On The Top.The Diameter Of Sparger Is Equal To Less Than Diameter Of Impeller.The Gas Is Introduced From Top & Injected In A Pool Of Liquid In The Form Of Fine Bubbles Thro The Sparger.	2 2	4
6.f	Filter Aids: They are slimy or very Fine Solids That Form A Dense ,Impermeable Cake Quickly Plug Any Filter Medium, That Is Fine Enough To Retain Them. Practical Filtration Of Such Materials Requires That Porosity Of Cake Be Increased To Permit The Passage Of The Liquor At A Reasonable Rate. This Is Done By Adding A Filter Aid	2	4

	to The Slurry Before Filtration. The Filter Aid May Subsequently Be Separated From The Filter Cake By Dissolving Away The Solids Or By Burning Out The Filter Aid.If The Solids Have No Value. Filter Aid Can Be Used By Precoating ie.. Depositing A Layer Of It On The Filter Medium Before Filtration. Precoats Prevents Gelatinuous Solids From Plugging The Filter Medium & Give A Clearer Filtrate. The Precoat Is A Part Of Filter Medium Rather Than Of The Cake. **Examples of filter aid :** Such As Diatomaceous Silica, Perlite,Purified Wood Cellulose,Or Other Inert Porous Solid. Properties Of Filter Aids: 1) It Should Be Of A Low Bulk Density. 2) It Should Be Porous. 3) It Should Be Capable Of Forming A Porous Cake 4) It Must Be Chemically Inert To The Filtrate.	1 1	