

Filtration :- It may be defined as a process of separation of solid from fluid (liquid/gas) by passing through a porous medium/filter medium that retain the solid but allows the fluid to pass.

Slurry:- The suspension to be filtered is known as slurry.

Filter medium/Porous medium:-

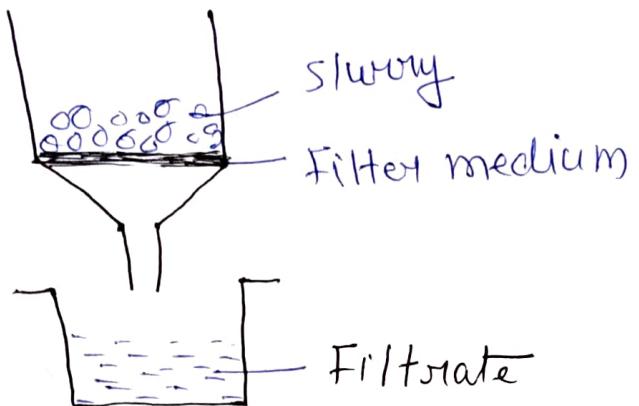
The porous medium is used to retain the solid from the slurry.

Filter cake:-

The accumulated solids on the filter medium is known as filter cake.

Filtrate:- The clear liquid which is passed through the filter medium is known as filtrate.

Clarification:- It is a separation process of solid from liquid, when solid are present in very low concentration . i.e - not exceeding 1% w/v.



Process of Filtration

- ⇒ The pores of filter medium are smaller than the size of the particles to be separated.
- ⇒ Filter medium is placed on a support.
- ⇒ When slurry is passed over the filter medium, the fluid flows through the filter medium by virtue of pressure difference across the filter.
- ⇒ Gravitational force is acting on it. Therefore, solid are trapped on the surface of filter medium.
- ⇒ After that we get the filtrate in the vessel.

Objectives and Application of filtration :-

① Production of Sterile product :- Air is filtered through HEPA (High Efficiency Particulate Air) filter or laminar air bench to obtain sterile air, which maintains good environment prior to and during manufacture of sterile product.

② Production of Bulk drug :-

Solids of intermediates and finished product are separated from the reaction mixture by filtration technique. By this method impurities can be removed.

③ Production of liquid oral formulation:-

Filtration is essential step in production of liquid oral solutions for obtaining clear solution by clarification.

ⓐ Dewaxing of oil :- Waxes are removed from oil by filter.

ⓑ Removing of suspended particles from suspension aqueous solution.

ⓒ Removing of undesirable solids which interfere with transparency of the liquids.

Example:- honey and fruit juices.

④ Waste water treatment :- Waste solids must be separated from the waste liquid prior to its disposal.

Types of Filtration

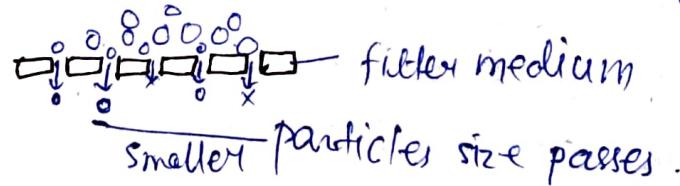
Surface filtration

Depth filtration

Cake filtration

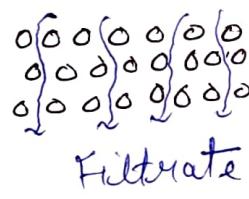
① Surface filtration :- It is a screening action by which pores or holes of the filter medium prevent the passage of solid.

→ Filter medium is generally thin & metallic sieve. / membrane filter.



② Depth filtration/ Deep bed filtration :-

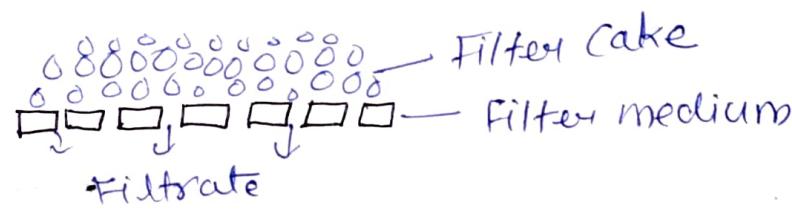
- ⇒ This type of filtration is particularly useful for removal of small amount of contaminant from large volume of liquids.
- ⇒ The thickness of filter medium is more, compared to surface filtration.
- ⇒ In this the slurry penetrates in the medium to the point where further movement of particles restricted.
- ⇒ Particles retained by either of two ways/combination of both.
 - ① Physical restriction
 - ② Impact between filter medium and particles
 - adsorption of particles on filter medium.



Ex- Ceramic filtration
- Cartridge filters

③ Cake Filtration :-

- ⇒ If the slurry is with high proportion of solids, solids may deposit over the surface of the filter medium.
- ⇒ This deposits offer small resistance to the flow of liquid because fluid passage is not restricted, it passes through small interfaces between particles.
- ⇒ Original filter medium will then starts acting as supportive medium as filtration process through cake only.



Differences Between Surface and Depth Filtration

Surface filtration

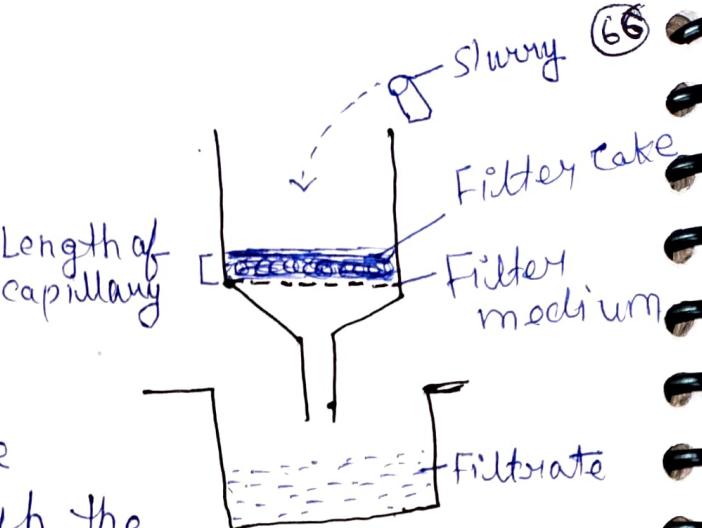
- The size of the particles retained is slightly higher than the mean pore size of the medium.
- Mechanical strength of the filter medium is less, unless it is made of stainless steel.
- It has low capacity.
- The size of the particles retained is more predictable.
- Equipment is expensive because it should require ancillary equipment such as edge clamps, which should have much finer tolerances.
- Ex. cellulose membrane filter

Depth filtration

- The size of the particles retained is much smaller than the pores through which fluid passes.
- Mechanical strength is high.
- It has high capacity.
- The size of the particles retained is less predictable.
- Cheaper because ancillary equipment is not required.
- Ex- ceramic filters and sintered (bed) filters.

Theory of Filtration

In filtration, the flow of liquid through a filter medium follows the basic rules of fluid flow that govern the flow of any liquid through the medium offering resistance.



$$\text{Rate of filtration} = \frac{\text{Driving force}}{\text{Resistance}}$$

⇒ The driving force is the pressure difference between upstream pressure and downstream pressure
So,

$$\text{Rate of filtration} = \frac{\text{Upstream pressure} - \text{downstream pressure}}{\text{Resistance.}}$$

- ⇒ Once the filter cake is formed, its surface acts as a filter medium.
- ⇒ The length of filter cake is known as length of app. capillaries.

$$\text{Rate of filtration} = \frac{\text{Upstream pressure} - \text{downstream pressure}}{\text{Length of Capillaries}}$$

Poiseuille's Equation: Poiseuille considered that filtration is similar to streamline flow of a liquid under pressure through capillaries.

$$V = \frac{\pi \Delta P r^2}{8 L \eta}.$$

Where,

V = rate of flow

ΔP = Pressure difference

r = radius of capillary

L = thickness or length of capillary

η = viscosity of filtrate.

Darcy's equation :-

The factors influencing the rate of filtration has been incorporated into an equation by Darcy.

$$V = \frac{K A \Delta P}{\eta L}$$

Where,

V = Rate of flow

K = Permeability coefficient

A = surface area of filter medium

ΔP = Pressure difference

η = Viscosity

L = Thickness of filter cake.

Kozeny - Carman Equation :-

This is the resultant equation of Poiseuille's equation and Darcy's equation, which is widely used in filtration.

$$V = \frac{A}{\eta S^2} \cdot \frac{\Delta P}{KL} \cdot \frac{\varepsilon^3}{(1-\varepsilon)^2}$$

Where,

V = rate of flow

A = surface area of filter medium

ΔP = pressure difference

K = Permeability Coefficient (Kozeny constant)

L = thickness of filter cake

ε = porosity of cake

S = specific surface area of particles

Factors influencing rate of filtration

i) Surface area of filter medium.

Rate of filtration is directly proportional to a surface area of filter medium.

Rate of filtration \propto surface area of filter medium

When we increase the surface area of filter medium, rate of filtration also increases.

When we decrease the surface area of filter medium, rate of filtration also decreases.

ii) Particle size of solid

Rate of filtration is directly proportional to the size of particles.

Rate of filtration \propto Particle size

When we increase size of particle, rate of filtration also increases.

→ When we decrease the particle size, the rate of filtration also decreases. (69)

iii) Filter Cake: The rate of filtration is indirectly proportional to the filter cake.

$$\text{Rate of filtration} \propto \frac{1}{\text{filter cake}}$$

→ When we increase the ^{length of} filter cake, rate of filtration is decreases.

→ When decrease the ^{length of} filter cake, rate of filtration is increases.

vi) Viscosity: The rate of filtration is indirectly proportional to viscosity of liquid.

$$\text{Rate of filtration} \propto \frac{1}{\text{viscosity}}$$

→ When the viscosity of liquid increases, rate of filtration is decreases.

→ When the viscosity of liquid decreases, rate of filtration is increases.

v) Pressure difference:

The rate of filtration is directly proportional to the pressure difference across the both filter medium & filter cake.

$$\text{Rate of filtration} \propto \text{pressure difference}$$

- ⇒ When the pressure difference is increases, rate of filtration also increases.
- ⇒ When the pressure difference is decreases, rate of filtration also decreases.

Filter Media

Filter medium are those substance which helps in filtration process, which retain the solid residue (filter cake) and allow to pass liquid and also provide a mechanical support for filter cake.

Characteristics: The filter medium should have following characteristics -

- i) It must be inert (not sensitive).
- ii) It should have sufficient mechanical strength.
- iii) It should allow the passes of maximum liquid.

Materials:- The following material are used as a filter medium,-

- i) Woven material such as cloth.
- ii) Perforated sheet metal.
- iii) Prefabricated porous solid unit.
- iv) Membrane filter media.

v) Bed of granular solid built up and supporting medium-

These are obtained by using filter aids like, Bentonite, paper pulp.

Filter Aid

Filter aid forms a surface deposit which screen out the solids and also prevents the plugging of the supporting filter medium.

Characteristics:-

- ▷ It must be inert.
- ii) Porous rather than dense.
- iii) Low specific gravity.
- iv) Recoverable.

Ex:- Talc, Bentonite, charcoal, asbestos, Paper pulp, Keiselguhr.

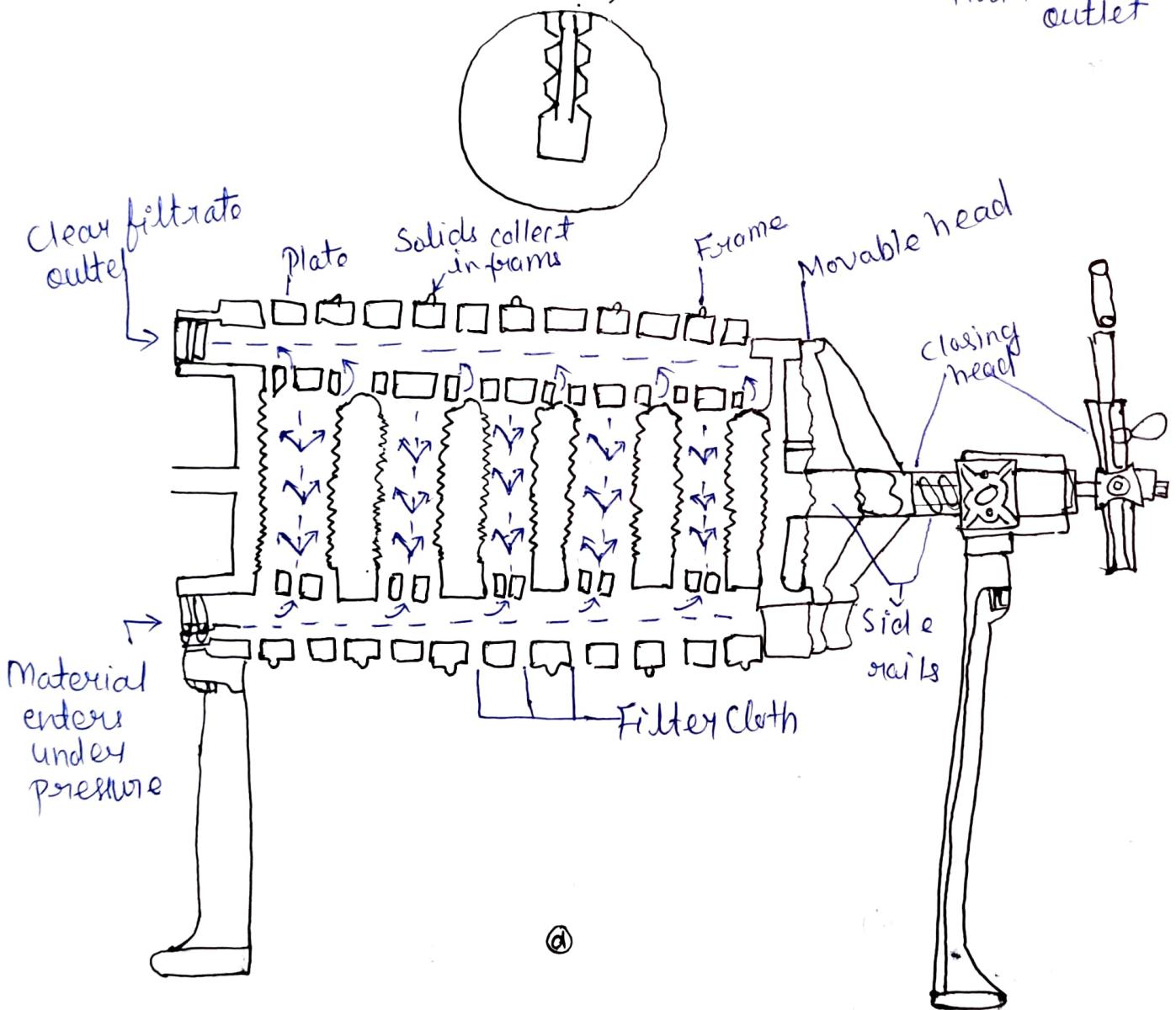
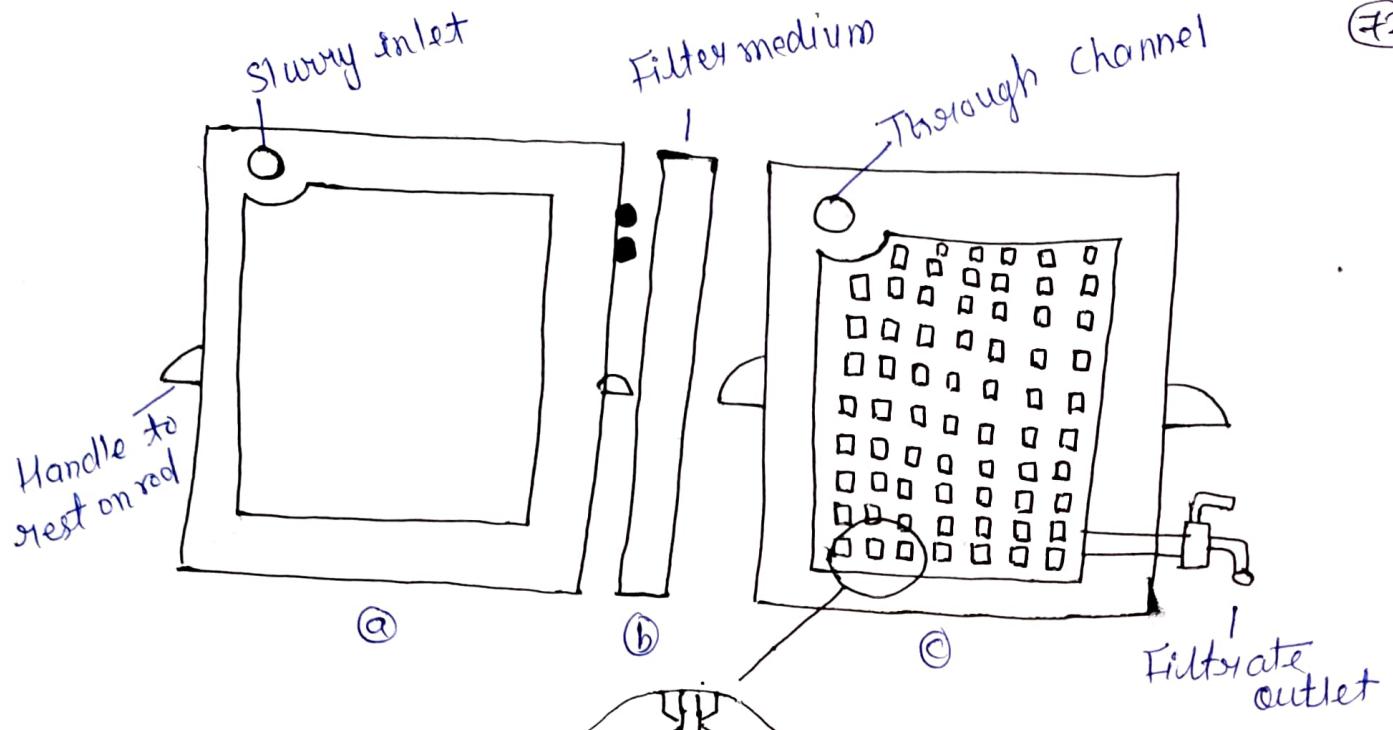
Plate & Frame Filter

Principle :-

- ⇒ The mechanism is surface filtration.
 - ⇒ The slurry enters the frame
- ↓
- Passed through filter media
- ↓
- filtrate is collected in plates
- ↓
- send to outlet.

Construction :-

- ⇒ The filter press is made of two units of plates and frames.
- ⇒ These are usually made of aluminium alloy.
- ⇒ Sometimes these are also lacquered for protection against corrosive chemicals and made suitable for steam sterilisation.



- Frame contains an open space for slurry reservoir and an inlet to receive the slurry.
- The plate has a grooved surface to support the filter cloth and an outlet.
- Filter media usually filter cloth is placed between plate and frame.
- Plate - filter media - frame - filter media - plate are arranged in sequence.
- A number of plates and frames are used to increase filtration area.

Working :-

Working is in two steps -

① Filtration operation :-

- Slurry enters the frame and passes through the filter medium to the surface of the plate.
- The solid form a filter cake and remain in the frame.
- Each side of the frame filtration occurs so two filter cakes are formed.
- The filtrate are collected in the projections on the surface of the plate and escapes from outlet.
- As filtration proceeds the resistance of the cake ~~increase~~ increases and the filtration rate decreases.

② Washing operation :-

- The washing of press involves following steps -
- ① Filtration proceeds in ordinary way until frames are filled with cake.
 - ② To wash the filter cake the outlet of washing plate are closed.
 - ③ Wash water is pumped which pass through the filter cloth and enters frame.
 - ④ Finally washed water escapes through the outlet of the frame.

Uses :-

- Filter media composed of asbestos and cellulose are used for sterile filtration.
- It is used in removal of precipitated proteins from insulin liquors.

Merits :-

- ① Construction of filter press is very simple.
- ② It provides large filtration area.
- ③ The strong construction permits the use of considerable pressure difference.
- ④ Efficient washing of the cake is possible.

Demerits :-

- ① It is a batch filter.
- ② Expensive filter.
- ③ Operation is critical.

Filter Leaf

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Principle :-

The mechanism involves surface filtration and acts as a sieve or strainer.

- Vacuum or pressure can be applied to increase the rate of filtration.

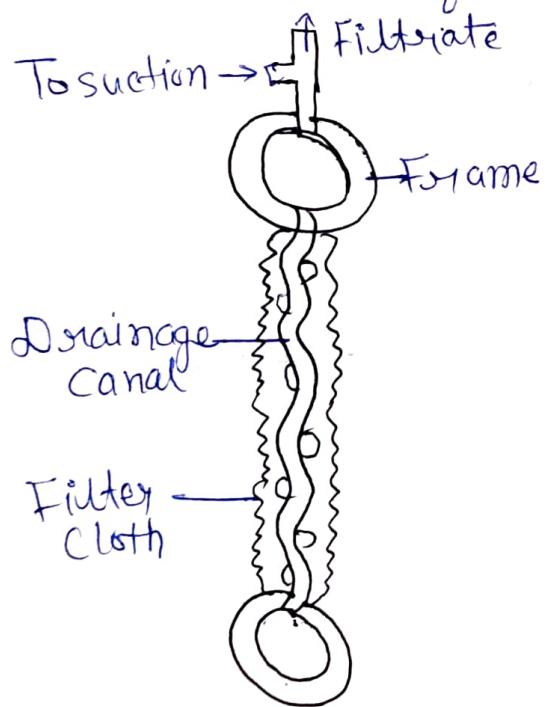
Construction :-

It consists of a narrow frame enclosing a drainage canal or screen.

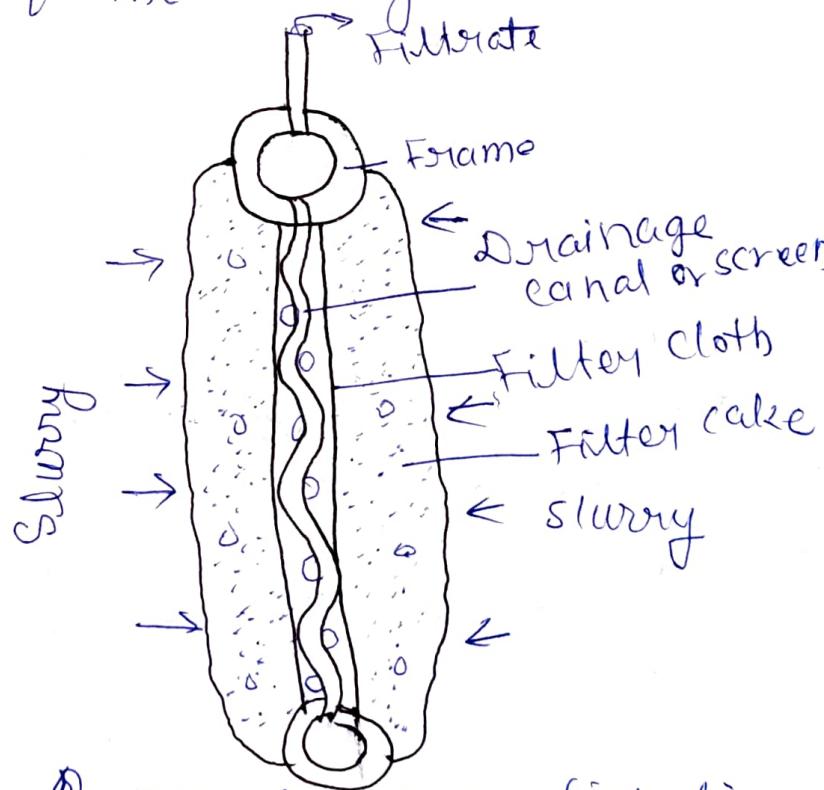
⇒ Frame may be of any shape, circular, square or rectangular.

⇒ The whole unit is covered with filter cloth.

⇒ The outlet for the filtrate connects to the interior of the frame through suction.



(a) Filter leaf



(b) Filter leaf during filtration

Working :-

- The filter leaf is immersed in the slurry.
- Vacuum system is connected to the filtrate outlet.
- The slurry passes through the filter cloth.
- Finally filtrate enters the drainage canal and goes through the outlet into the receiver.
- Air is passed to flow in reverse direction which facilitates removal of cake.

Use :-

The leaf filter is satisfactory, if the solid content of the slurry is not too high about 5% that is dilute suspension.

Merits :-

- i) A number of units can be connected in parallel to increase the surface area for filtration.
- ii) Slurry can be filtered from any vessel.
- iii) Washing The efficiency of washing is high.

Demerits :-

- 1) Large floor space is required for dismantling the cake on horizontal vessels.
- 2) Maintenance.
- 3) The leaf filter requires attention on a regular basis to safety.

Rotary Drum Filter

Principle: Rotary Drum filter functions on the principle of filtering the slurry through sieve-like mechanism on a rotating drum surface, under the conditions of vacuum.

Construction:

- It consists of a → metal cylinder \rightarrow 3m diameter \rightarrow 3.5m length
↓
mounted horizontally.
- It gives surface area of 20 m^2 .
- The surface is perforated → supports a filter cloth.
- The drum is radially partitioned divided the annular space into separate compartments.



Working

- ⇒ Drum rotated at less than \pm RPM
drum just enters the slurry in the trough
vacuum is applied in this segment
solid is build up on the surface
liquid passes through filter media into
on internal part of pipe
filtrate reach the collecting tank.

⇒ In working process involves many process and zone -

- vacuum is applied to carry the slurry along with the drum.
- Draining zone
- Water washing arrangement
- Drying zone - dry air supply
- Cake removal zone.

Uses :-

- ① Used to filter slurries containing high proportion of solids (15 to 30%)
- ② Used in filtration of penicillines
 - calcium carbonate
 - starch
 - magnesium carbonate

Merits :-

- ⇒ The filter has large surface area.
- ⇒ The speed of rotation can be changed \rightarrow to control the cake thickness.
- ⇒ Labour costs is low + automatic and continuous operation

Demerits :-

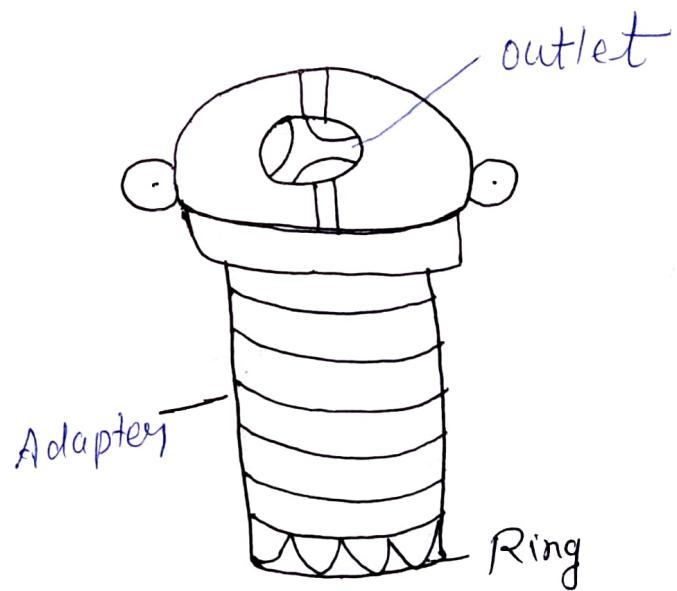
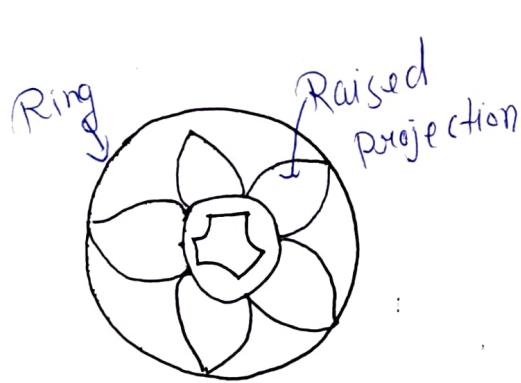
- ⇒ High energy consumption by vacuum.
- ⇒ Expensive equipment with complex functioning.
- ⇒ Suitable for straightforward slurries.

Meta Filter or Edge filter

Principle :- Meta filter functions as a strainer (surface filtration) for the separation of particles.

Construction :-

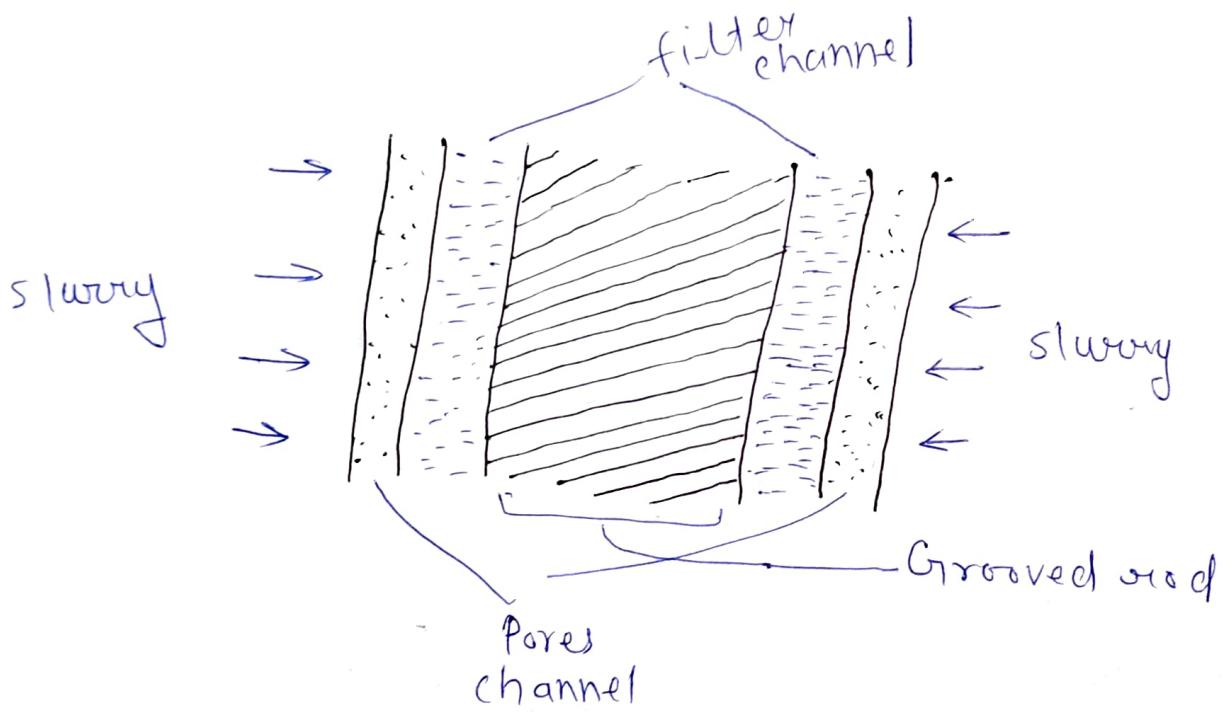
- ⇒ The metafilter consists of a series of metal rings contain semicircular projections.
- ⇒ These are arranged so that a channel is formed on the edges.
- ⇒ These ring are usually made of stainless steel and have internal diameter of about 15 mm and 22 mm external diameter.



- ⇒ These rings are tightened on the drainage column with a nut.

Working :-

- ⇒ These filters are placed in a vessel and operated by pumping the slurry with pressure or vacuum at outlet.
- ⇒ The slurry passes through the channels formed on the edges b/w the rings.
- ⇒ The clear liquid rises up and collected into the receiver.



Uses:-

- ⇒ Used as clarification of syrups.
- ⇒ Filtration of the injection solutions.
- ⇒ Clarification of the insulin liquors.
- ⇒ filtration of viscous liquids.

Merits:-

- ⇒ It can be used under high pressure.

- ⇒ No filter medium is required, so running cost is low.
- ⇒ It can be made of corrosion resistant material.
- ⇒ Removal of cake is very effectively carried out by back-flushing with water.

Demerits:

- ⇒ It is used for low solid content.

Cartridge Filter

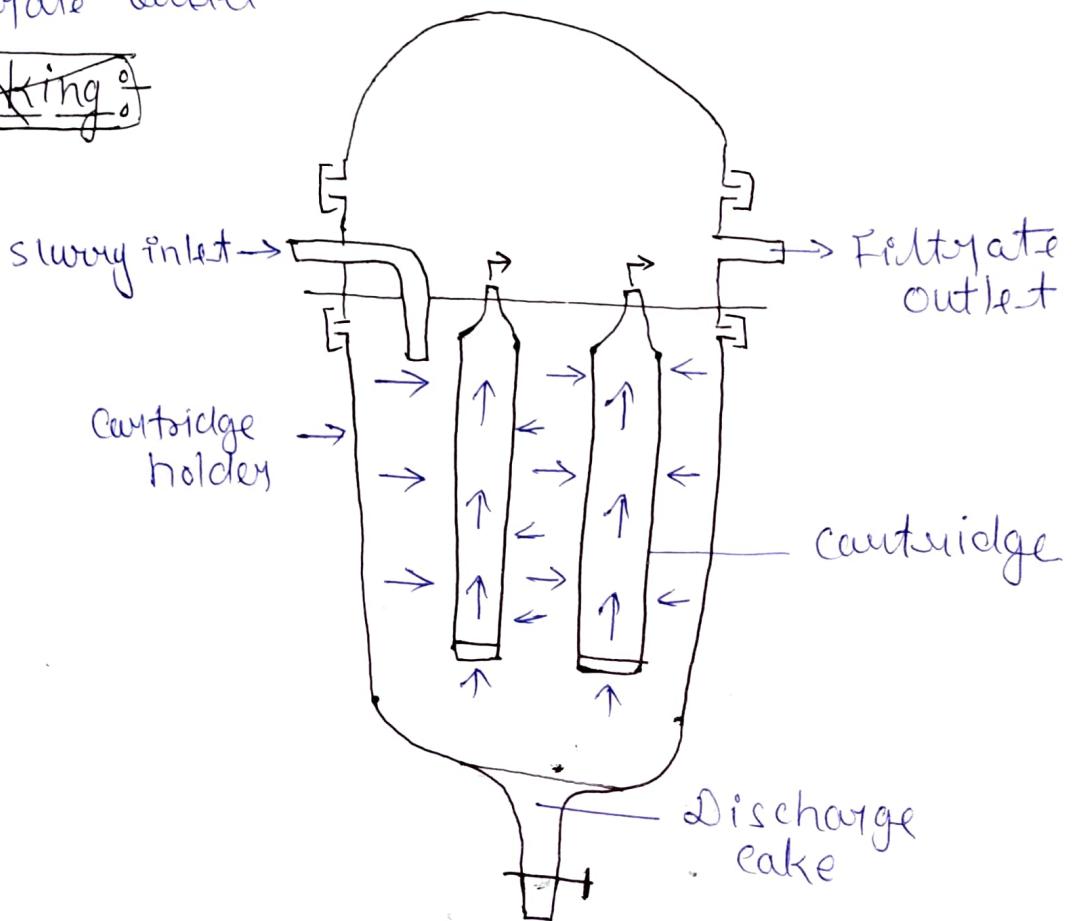
- Principle: It is a thin porous membrane in which pre-filter and membrane filter are combined into single unit.
- ⇒ The mechanism is surface filtration.

Construction:

- ⇒ Cartridge filter has → cylindrical configuration
with disposable or changeable filter media.
- ⇒ These are made of → Plastic
→ or
→ metal
- ⇒ It is made of two membrane filters
made of polypropylene
 - a prefilter
 - an actual filterhoused in a holder.

- A number of cartridge can be placed in the same housing.
- The housing has provisions for slurry inlet and filtrate outlet.

Working



① Fig. Filter assembly

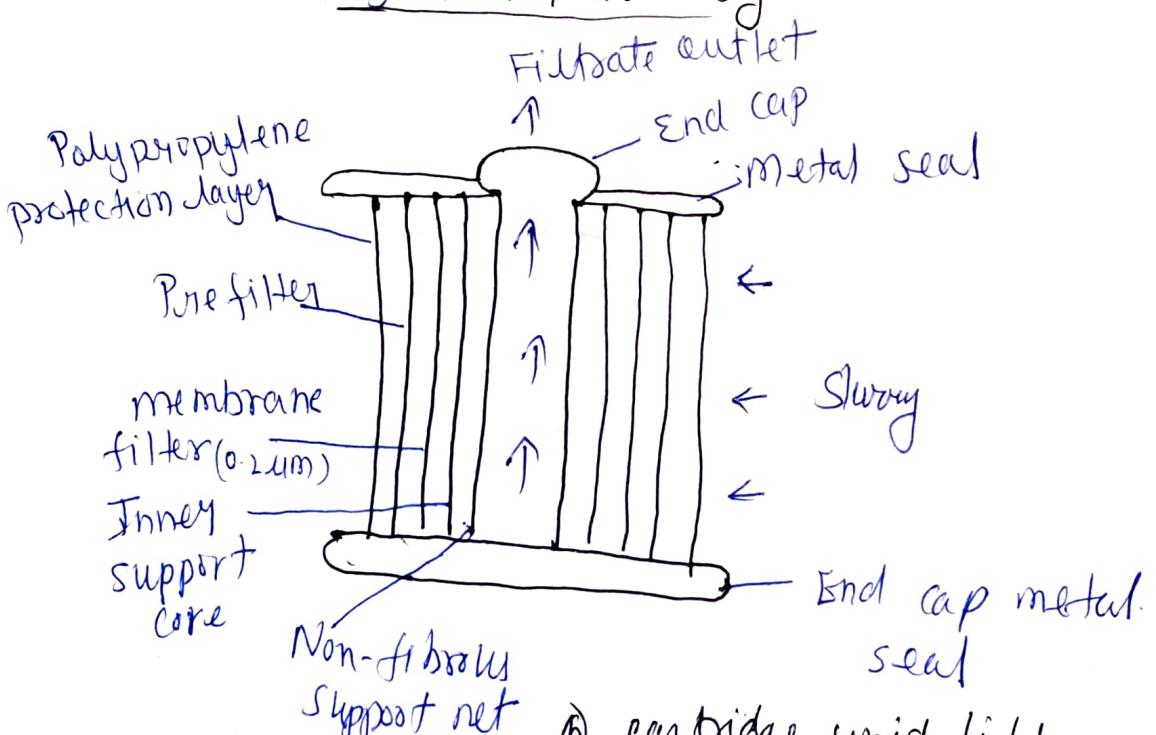


Fig. Cartridge filter. ① cartridge unit filter

Working :-

- ⇒ The slurry pumped into cartridge holder passes through cartridge filter unit by mechanism of straining
- ↓
- Clear liquid passes to the centre and move up → collected through outlet

Uses :

- ⇒ These are used in filtration of sterile solutions.
- ⇒ Useful for particulate free solution for → Parenteral
↓
1000 to 1500 liter per hour. → ophthalmic

Merits :

- ⇒ Stainless steel construction is used for autoclaving for sterile operations.
- ⇒ Rapid change and reusing of filter media is possible.
- ⇒ Cartridge with self-cleaning device are advantageous.
- ⇒ Used as in-line continuous filtration.

Demerits :

- ⇒ Expensive equipment due to cost of disposable elements.
- ⇒ A number of manufacturers provide the components which are generally not interchangeable b/w suppliers.

Seitz Filter

Principle: It works on the surface filtration mechanism.

Construction:

- ⇒ Seitz filter consist of ~~two~~ a pad of compressed asbestos as a filtering medium. Typical seitz filter pads are about 2 mm thick and offers a wide range of size
- ⇒ The finest pore size gives almost perfect filtration and retains small viruses.

Working:

- ⇒ Put the
- ⇒ ~~the~~ slurry on the
- ⇒ ~~the~~ asbestos filter pad which allow only finest particle size less than ~~1000~~ μm.

- ⇒ Pass the filtrate which are collected in any receiver.

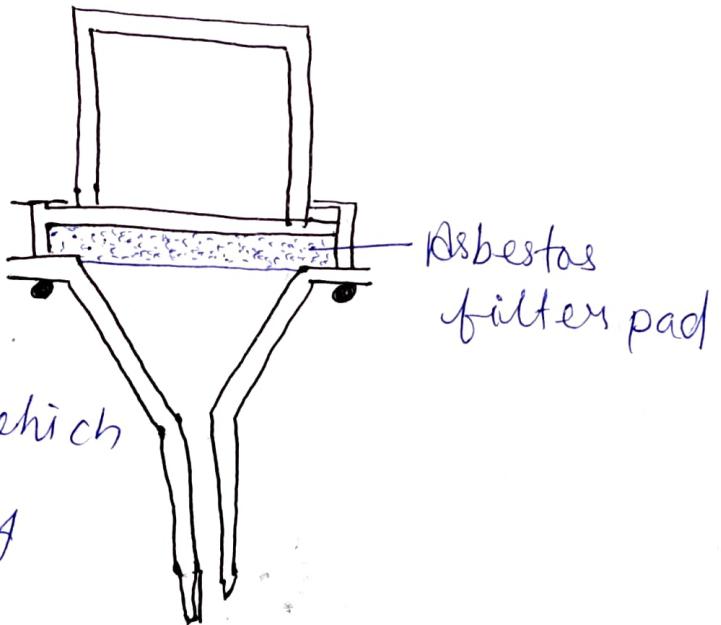


Fig. Seitz filter

Uses:

- ① Seitz filter are getting used for filtration sterilization.

- ⇒ Viscous solutions can also be filtered.
- ⇒ These filter can be used for air filtration.

Merits:-

- ⇒ Apparatus is very simple to handle.
- ⇒ Filtration is rapid with fewer tendencies to clog.

Demerits:-

- ⇒ Asbestos may shed loose fibres.
- ⇒ Pad may absorb sufficient amount of solution or drug.

Membrane Filter

Principle:- It is act just like sieve and retained the particulate matter along with micro-organisms according to their sizes.

Construction:-

- ⇒ These are plastic membrane based on cellulose acetate, cellulose nitrate or mixed cellulose ester with pore sizes in the micron or submicron range.
- ⇒ They are very thin about $120\text{ }\mu$ and must be handled carefully.
- ⇒ Several grades of filters are available with pore sizes ranging from 0.010 ± 0.002

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micron to \bullet . $5.0 \pm 1.2 \mu$.

- ⇒ Filters with pore sizes from 0.010 to 0.10μ can remove virus particles from water or air.
- ⇒ Filters with pore sizes from 0.30 to 0.65μ are employed for removing bacteria.
- ⇒ Filters with large pore size viz. $0.5, 1.2$ and 3.0 to 5.0μ are employed, for example, in aerosol, radio activity and particle sizing applications.

Working:

- ⇒ During use membrane filters are supported on a rigid base of perforated metal, plastic or coarse sintered glass as in the case of fibrous pad filters.
- ⇒ If the solution to be filtered contains a considerable quantity of suspended matter, pre-purification filtration through a suitable depth filter avoids clogging of the membrane filter during sterile filtration.

Uses:

- ⇒ It is used for sterilization of solutions containing heat sensitive materials.
- ⇒ Membrane filters fitted in disc containing growth media can be used to grow micro-organisms.

Merits :-

- ⇒ No bacterial growth through the filter takes place during prolonged filtration.
- ⇒ They are disposable and hence no cross contamination takes place.

Demerits

- ⇒ They may clog through rarely.
- ⇒ Ordinary types are less resistant to solvents like chloroform.

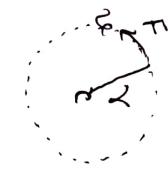
Centrifugation

Centrifugation is a technique that helps to separate mixture by applying the centrifugal force.

→ Centrifugal force → is a pseudo force in a circular motion which acts along the radius and is directed away from the centre of circle.

→ Consider a body of mass m kg. is rotating in a circular path of radius r meter. act of velocity v meter/second minute

$$F = \frac{mv^2}{r}$$



where,

F = Centrifugal force

m = mass of body

v = velocity of body

r = radius of circular path

⇒ Centrifugation is useful when separation by ordinary filtration is difficult.

Example → Separation of highly viscous mixture

⇒ A centrifuge is a device generally driven by an electric motor that puts an object.

⇒ A centrifuge works by using the 

Principle of sedimentation.

Sedimentation - It is a process in which particles separate from a liquid because of gravity.

Centrifuge

Sedimentation
Centrifuge

⇒ Sedimentation centrifuge is a centrifuge that produces sedimentation of solid based on the difference in the densities of two or more phases of mixture,

Filtration
Centrifuge

⇒ Filtration centrifuge is a centrifuge in which solid phase are retained by porous medium allowing liquid to rush out due to centrifugal effect.

Objectives:

- ① To separate immiscible liquids.
- ② To purify the component by removing impurities in the supernatant liquid.
- ③ To separate coag. soluble drugs from mother liquor.
- ④ To test the emulsions and suspensions for creaming and sedimentation at accelerated speed.

Potential Applications of Centrifugation

① Production of bulk drugs : Centrifugation technique is used to separate crystalline drugs such as aspirin from the mother liquor. Free flowing product results due to removal of drosses of mother liquor and avoidance of effervescence.

② Production of biological products:

The proteinaceous drugs and macromolecules are present as colloidal dispersion in water. By normal separation methods, it is difficult to produce them in large scale. Centrifugal methods are used for the separation of these constituents from water.
→ Centrifugation is employed for separating the blood cells from blood.

③ Biopharmaceutical analysis of drugs:

Drug present in the blood, tissue fluids and urine are normally present in the form of colloidal dispersions. Centrifugation is well for separating the drugs.

④ Evaluation of suspension and emulsions:

One of the problem of suspensions is sedimentation and one of the problem of emulsions is creaming.
→ So quick evaluation of these problems can be done by enhancing the speed of creaming and sedimentation - by centrifuge machine.

⑤

⑤ Determination of molecular weight of colloids:

①

Determination method is used at molecular weight of a polymer is not possible by usual methods. Ultra-centrifugation method are used for determination of molecular weight of serum albumin, insulin and raty cellulose.

⑥ Separation of

Centrifuges :-

- ① Perforated basket centrifuge
- ② Non-perforated basket centrifuge
- ③ Semi-continuous centrifuge
- ④ Super centrifuge

1. Perforated Basket Centrifuge

Principle :- Perforated basket centrifuge is a filtration centrifuge. The separation is through a perforated wall based on the difference in the densities of solid and liquid phases.

Construction :-

It consists of a basket, made of steel or copper or monel or any other suitable metal. The basket material of construction should be such that it offers the greatest resistance to corrosion.

It consists of a rotating basket suspended on a vertical shaft and driven by a motor from top. The sides of the basket are perforated and are also covered with a screen on the inside. Surrounding the basket is a stationary casing that collects the filtrate.

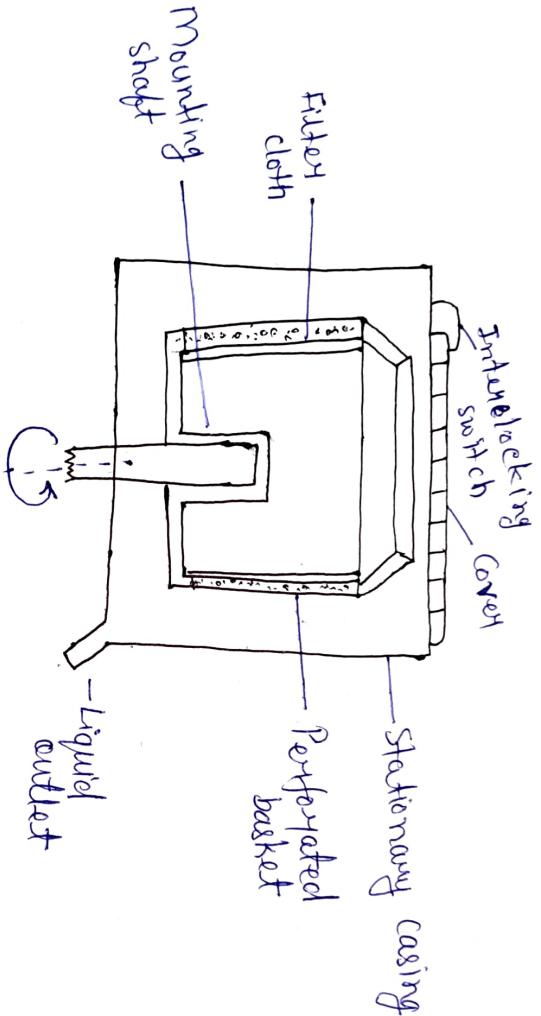


Fig. Perforated basket centrifuge.

Working:

- ⇒ The material or feed is kept in the basket when the basket is stationary. The amount of material should be optimum, otherwise, during centrifugation it puts a great strain on the basket.
- ⇒ During centrifugation, the liquid passes through the perforated wall, while the solid phase remains in the basket.

The liquid leaves the basket and is collected at the outlet.

Uses:-

- ① Crystals can be separated from mother-liquor.
- ② Liquids can be clarified by removing unwanted solids, dirt from oils.
- ③ Sugar crystals are separated using perforated basket centrifuge.

Merits:-

- ⇒ The centrifuge is very compact and occupies very little floor place.
- ⇒ The final product has very low moisture content.

⇒ It is a fast process.

- ⇒ In this method, the dissolved solids are separated from the cake.

Demerits:-

- ⇒ The entire cycle is complicated resulting in considerable laborious costs.
- ⇒ It is a batch process.

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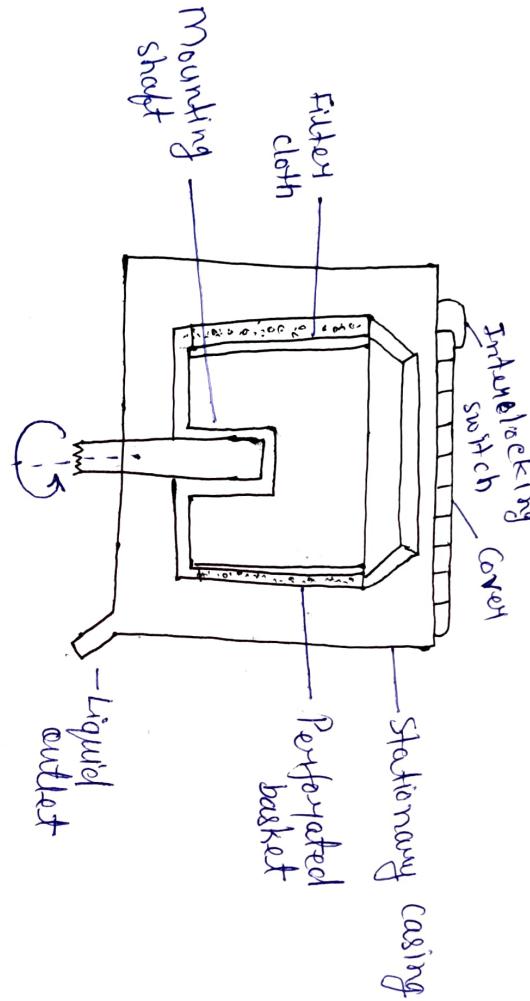


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Q. Non-perforated Basket centrifuge (q4)

Principle: This is a sedimentation centrifuge. The separation is based on the different densities of solid and liquid phases without a porous basket.

Construction:-

It consists of a basket, which may be made of steel or may any other suitable metal. The basket is suspended on vertical shaft and is driven by a motor using a suitable power system.

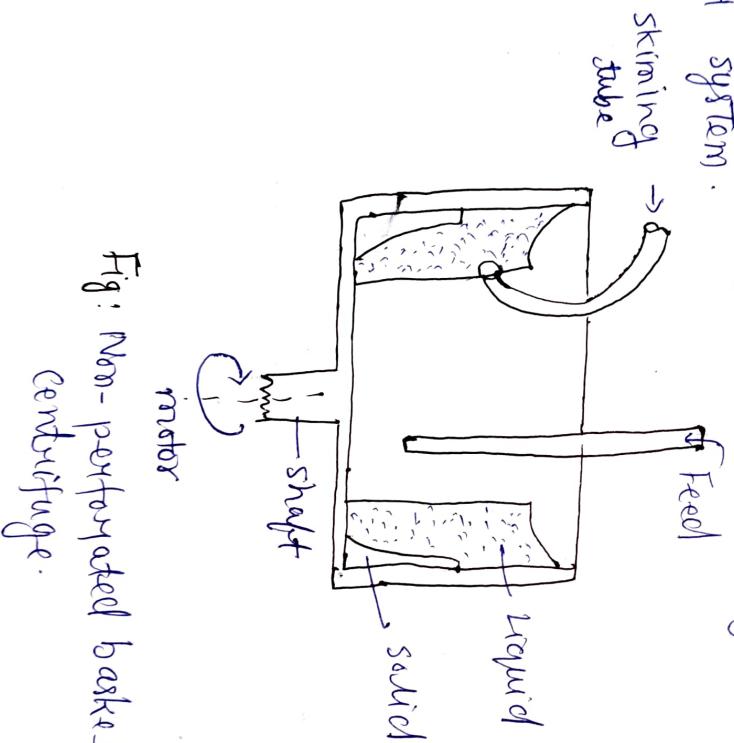


Fig: Non-perforated basket centrifuge.

(as)

Working:

- ⇒ The suspension is fed continuously into the basket.
- ⇒ During centrifugation, solid phase is retained on the sides of basket, while liquid remains on the top.
- ⇒ The liquid is removed through the skimming tube.

Uses:

- ⇒ Non-perforated basket centrifuge is useful when the deposited solid offer high resistance to the flow of liquid.

3. Semi-continuous centrifuge

- Principle:- Semi-continuous centrifuge is a filtration centrifuge. The separation is done on the basis of difference in the densities of the solid and liquid.
- * It is also known as short cycle Automatic Batch centrifuge.

Construction:

It consists a vertical perforated basket, which is supported from a horizontal shaft driven by a motor.

At the centre to introduce a feed and wash pipe through horizontal tubes are connected.
⇒ It has a knife for removal of filter cake.

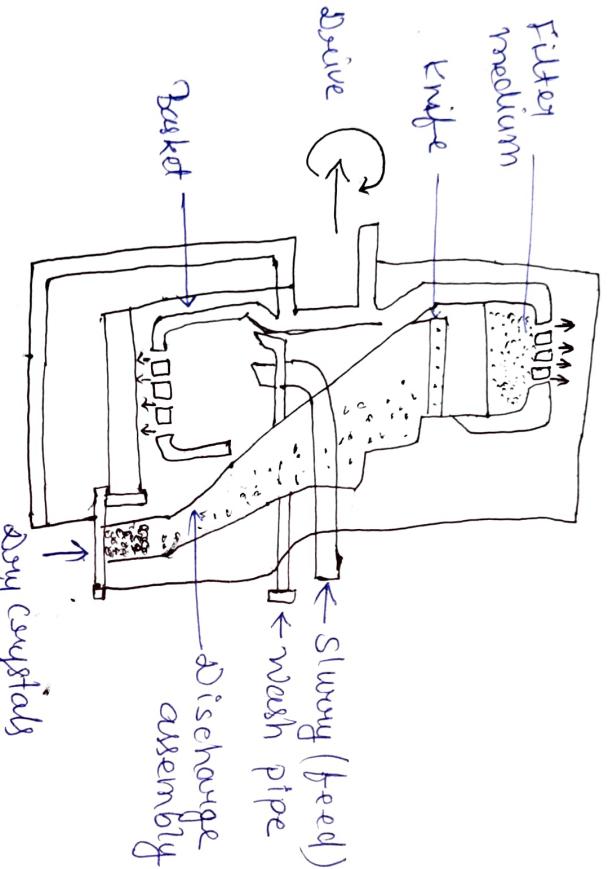


Fig. Semi-Continuous Centrifuge

Working:

The perforated basket is allowed to rotate and slurry introduced from the side pipe. During centrifugation, the slurry passes through the perforated wall. The solid are retained in the basket, while the filtrate leaves the basket.

which collected at outlet. Further, the cake is washed with water.

Uses: This is a semi-continuous type of centrifuge.

- ① Crystals can be separated from mother-liquor.
- ② Liquid can be clarified by removing unwanted solids dirt from oils.

Advantages:

⇒ Short-cycle automatic batch centrifuge is used when solids can be drained fast from the bowl.

Disadvantages:

⇒ During discharge, considerable breakage of crystals is possible. Many moving parts are involved making the construction and functioning more complicated.

4. Super Centrifuge

Principle: Super centrifuge is a sedimentation centrifuge. The separation is based on the difference in the densities b/w two immiscible liquids.

⇒ During centrifugation the heavier liquid is thrown against the wall of the bowl and lighter liquid remains as an inner layer.

Construction:-

It consists of a long, hollow, cylindrical bowl of small diameter. It is suspended from a flexible spindle at the top and guided at the bottom by loose-fit bushing. It can be rotated on its longitudinal axis. Two liquid outlets are provided at different heights at the top of the bowl, and modified weirs, are attached.

Motor

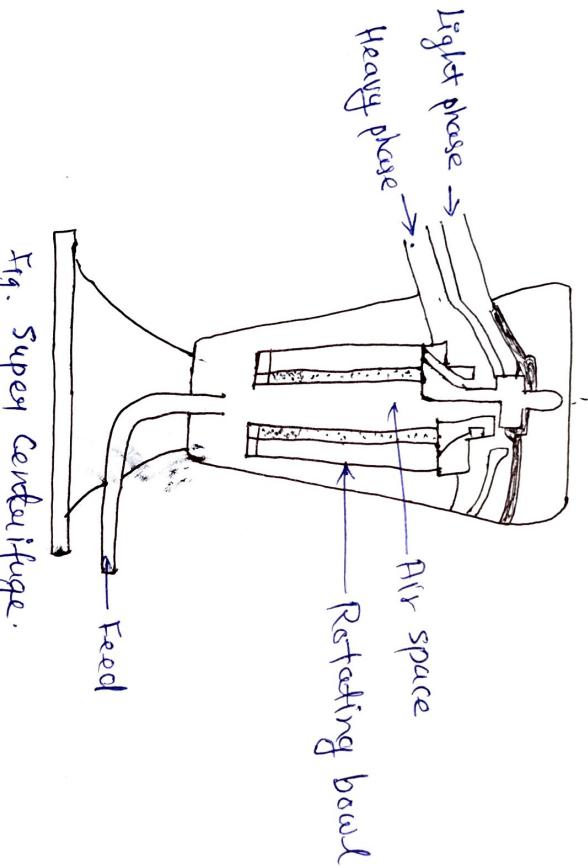


Fig. Super centrifuge.

Working :-

⇒ The centrifuge is allowed to rotate on its longitudinal axis at a high speed, usually about 2000 revolutions per minute with the help of drive - assembly.

⇒ The feed introduced from the bottom of centrifuge using a pressure system.

→ During centrifugation, two liquid phases separate based on the difference in their densities.
⇒ The heavier liquid is thrown against the wall, while the lighter liquid forms an inner layer.
Both liquids rise to the top of the vertical bowl.
Use:- Super centrifuge is used for separating liquid phases of emulsions in foods and pharmaceuticals.