

FILTRATION

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Plate and frame filter press

Principle:

- Mechanism is surface filtration.
- The slurry enters the frame by pressure and flows through filter medium.
- The filtrate is collected on the plates and send to outlet.
- A number of frames and plates are used so that surface area increases and consequently large volumes of slurry can be processed simultaneously with or without washing.

Diagram

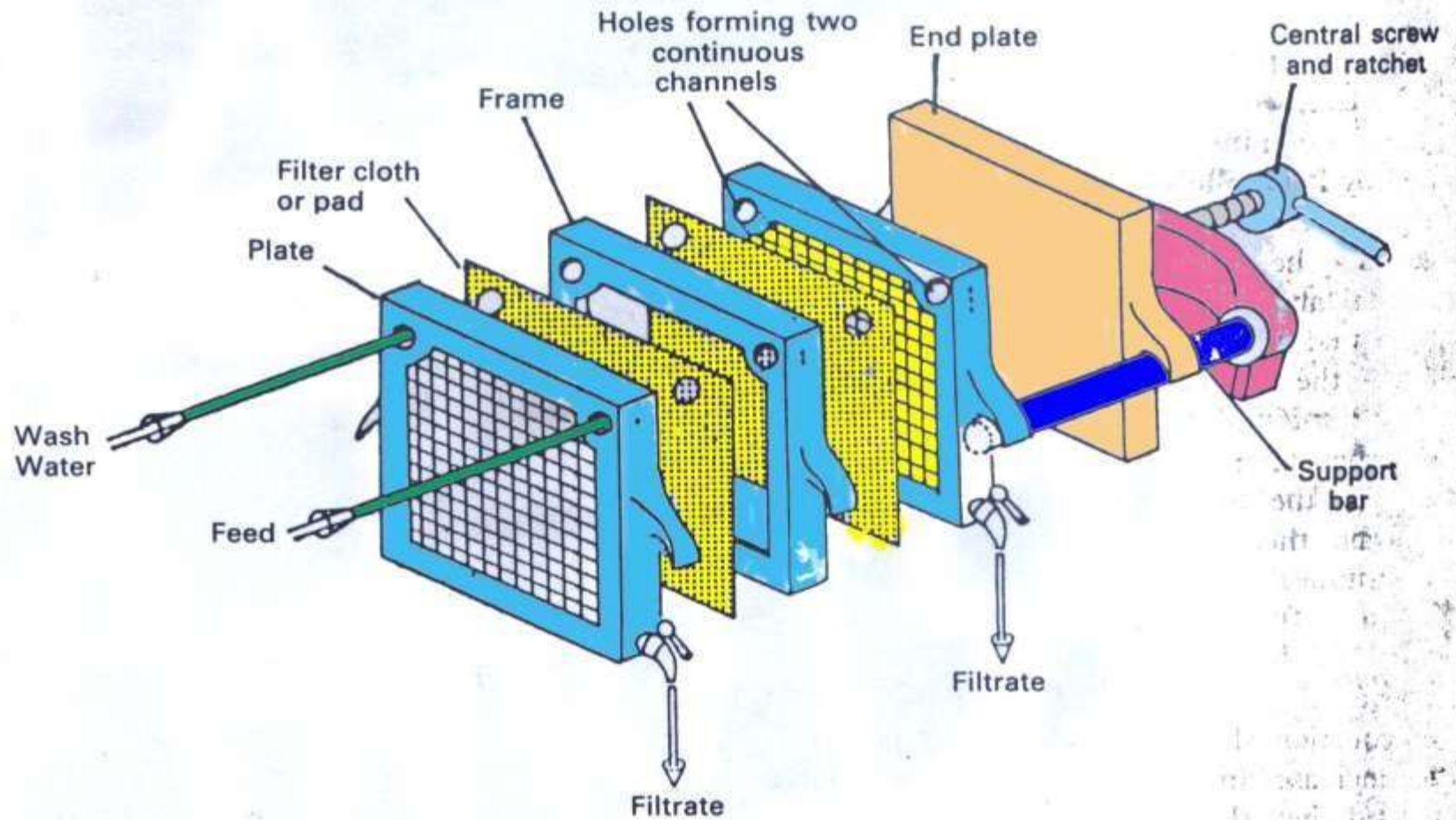
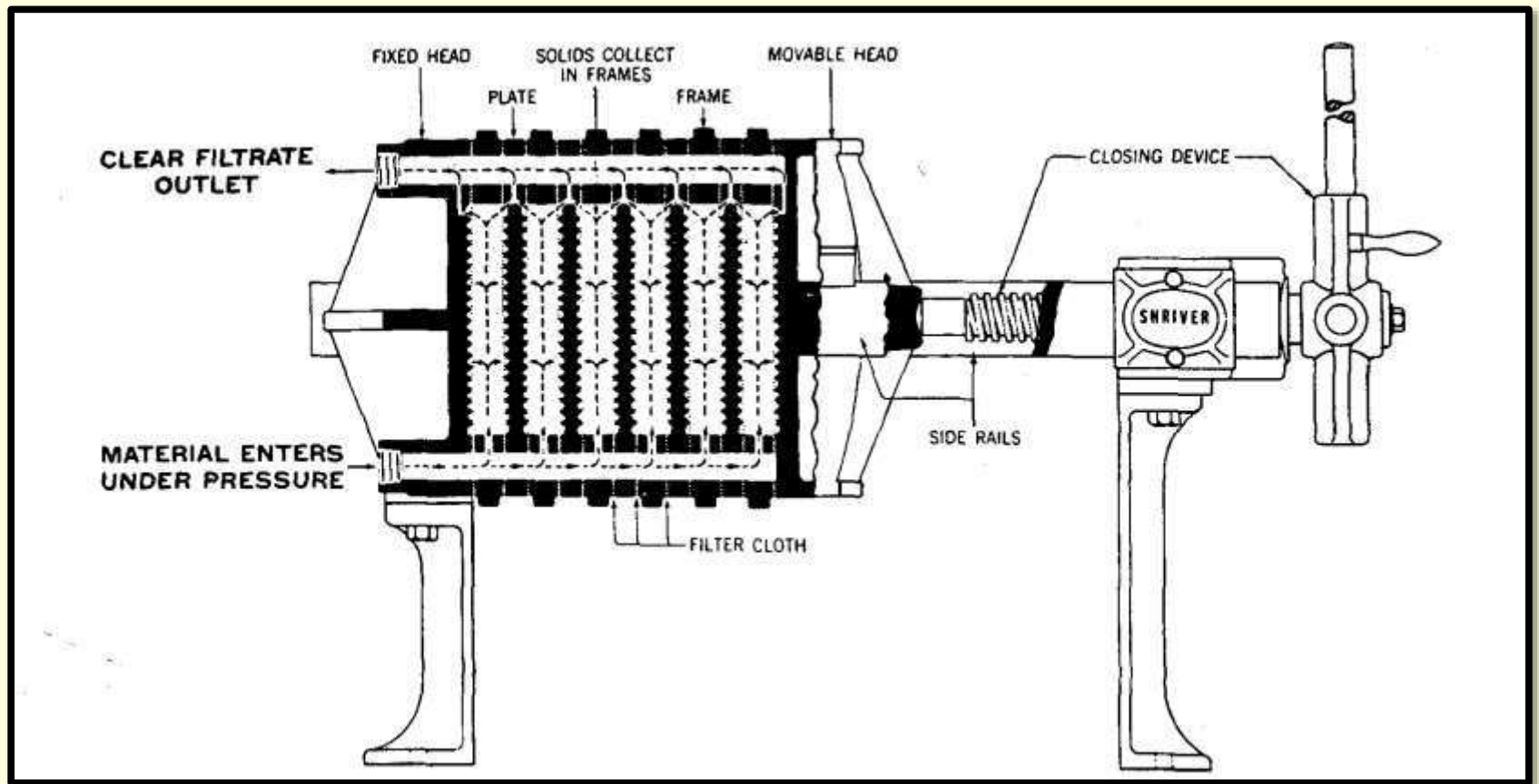


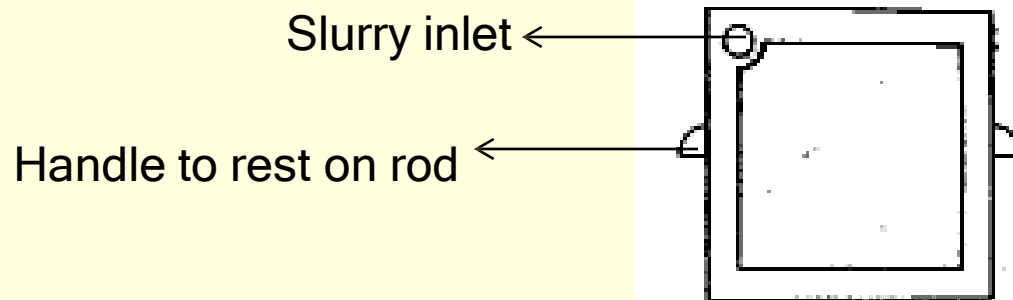
Fig. 31.5 Filter press. Assembly of plates and frames

Assembly of plate and frame filter



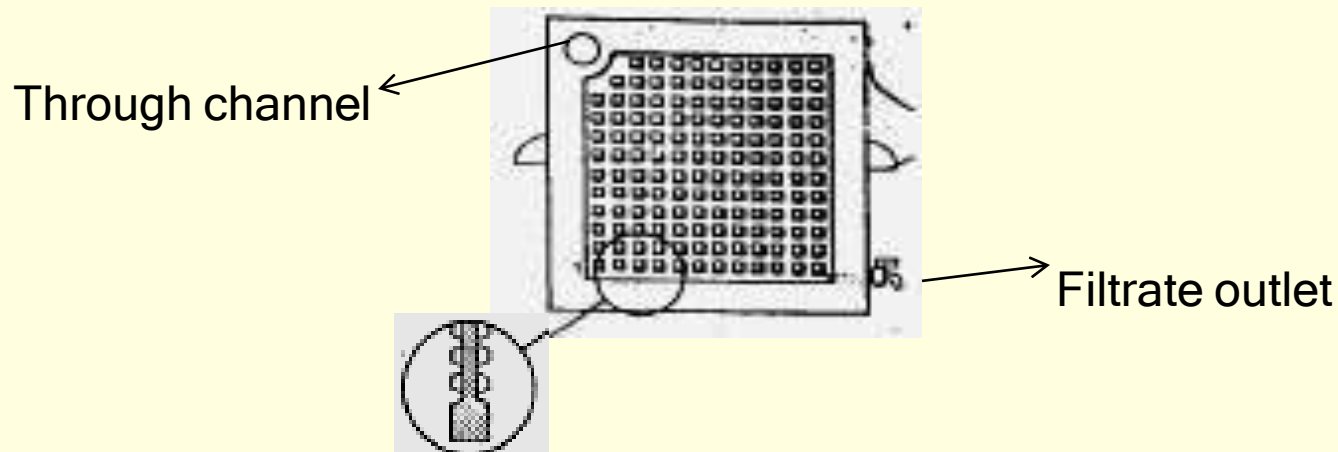
Construction

- The Filter press is made of two types of units, plate and frames.
- Usually made of aluminium alloy.
- Sometimes, these are also lacquered for protection against corrosive chemicals and made suitable for steam sterilization.
- **Frame**
 - It contains a open space inside wherein the slurry reservoir is maintained for filtration and an inlet to receive the slurry.
 - It is indicated by two dots in description.



Continue....

- Frames of different thickness are available.
- It is selected based on the thickness of cake formed during filtration.
- Optimum thickness of frame should be chosen.
- **Plate**
 - The plate has a studded or grooved surface to support the filter cloth and an outlet.
 - It is indicated by one dot in description.



Continue....

- Plate supports the filter medium, receiving the filtrate and outlet.
- The filter medium usually cloth is interposed between plate and frame.
- Plate, filter medium, frame, filter medium and plate are arranged in sequence and clamed to a supporting structure.
- It is normally described by dots as 1.2.1.2.1 so on.
- A number of plates and frames are employed so that the filtration area is as large as necessary.
- Number of filtration units are operated in parallel.
- Channels for slurry inlet and filtrate outlet can be arranged by fitting eyes to the plates and frames, these join together to form a channel.
- In some types only one inlet channel is formed, while each plate is having individual outlets controlled by valves.

Working

- Working can be divided into two steps-
 1. Filtration operation
 2. Washing of cake (if desirable)

- Filtration operation

Frame- marked by 2 dots
Plate - marked by 1 dot

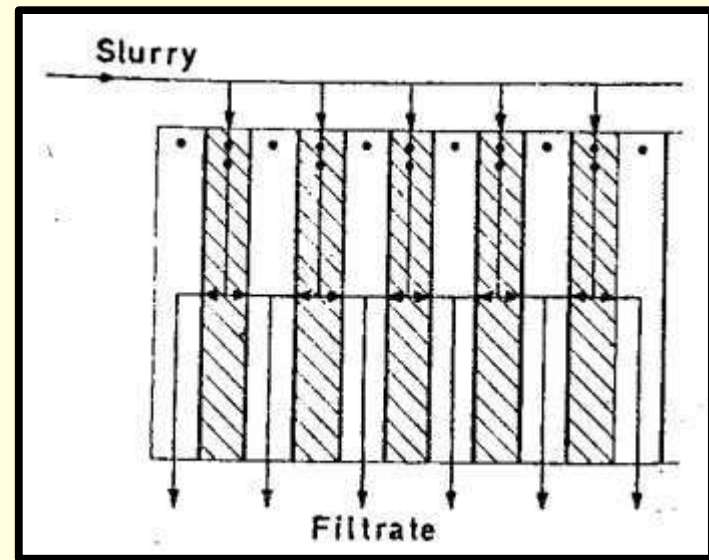
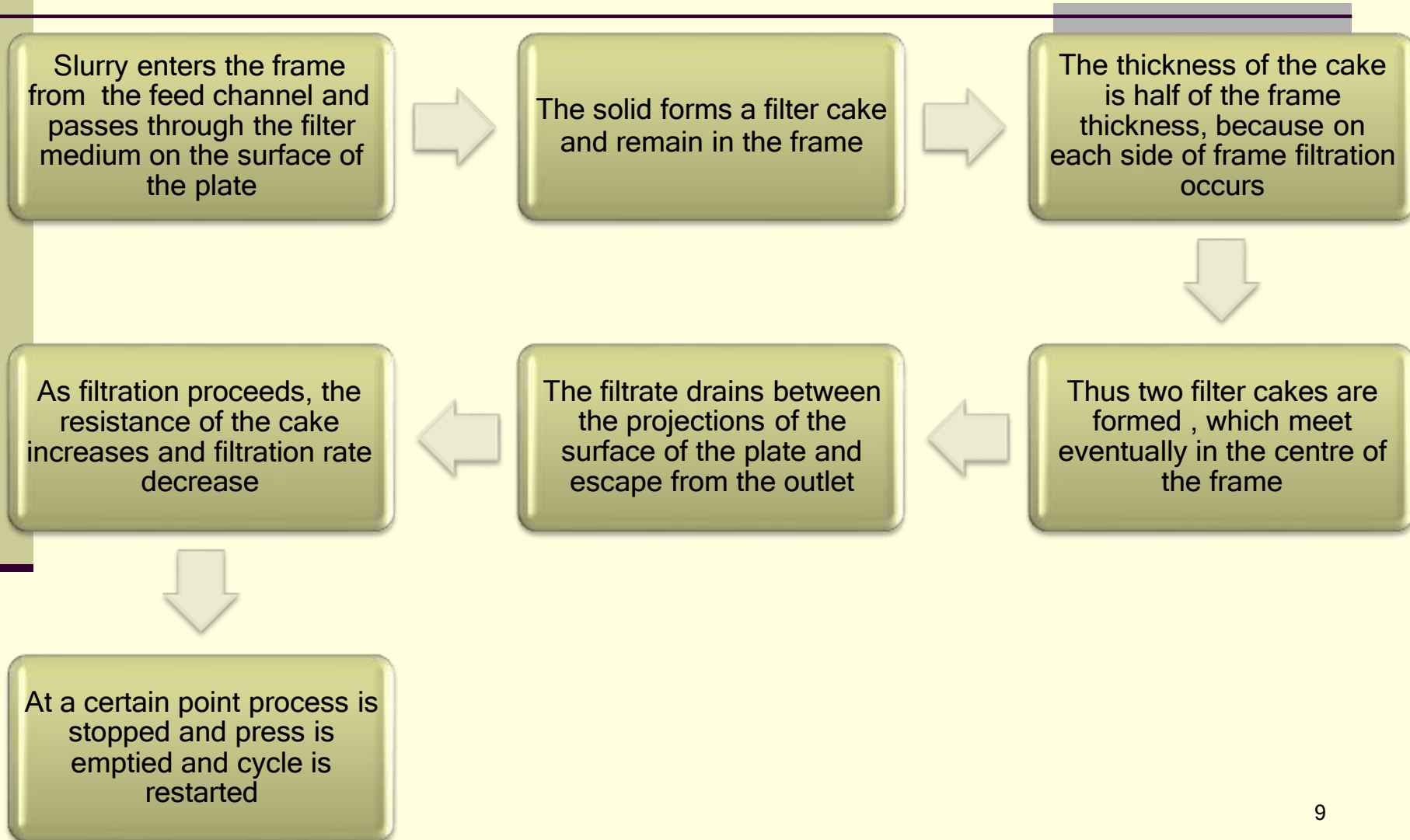


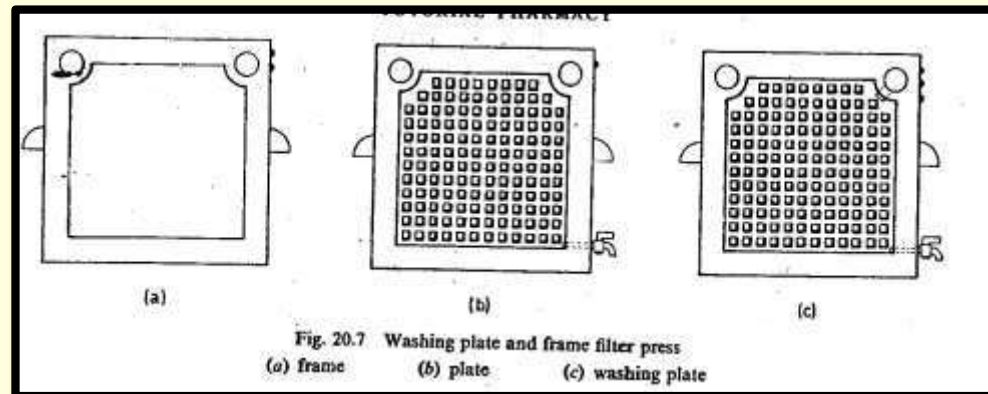
Plate and frame filter press, principle of filtration operation

Continue.....



Washing operation

- When washing of cake is also required modified plate and frame filter is used.
- For this purpose an additional channel is included called as washing plate and are identified by 3 dots.
- In the half of the washing plate, there is a connection from wash water channel to the surface of plate.
- The sequence of arrangement of plates and frames can be represented by dots as 1.2.3.2.1.2.3.2.1 so on (between 1 and 1, 2.3.2 must be arranged).



Procedure for washing the press

Step 1

- Filtration proceeds in the ordinary way until the frames are filled with cake.

Step 2

- To wash the filter cake, the outlets of washing plates are closed.

Step 3

- Wash water is pumped in the washing channel.
- The water enters through the inlets on the surface of washing plate.

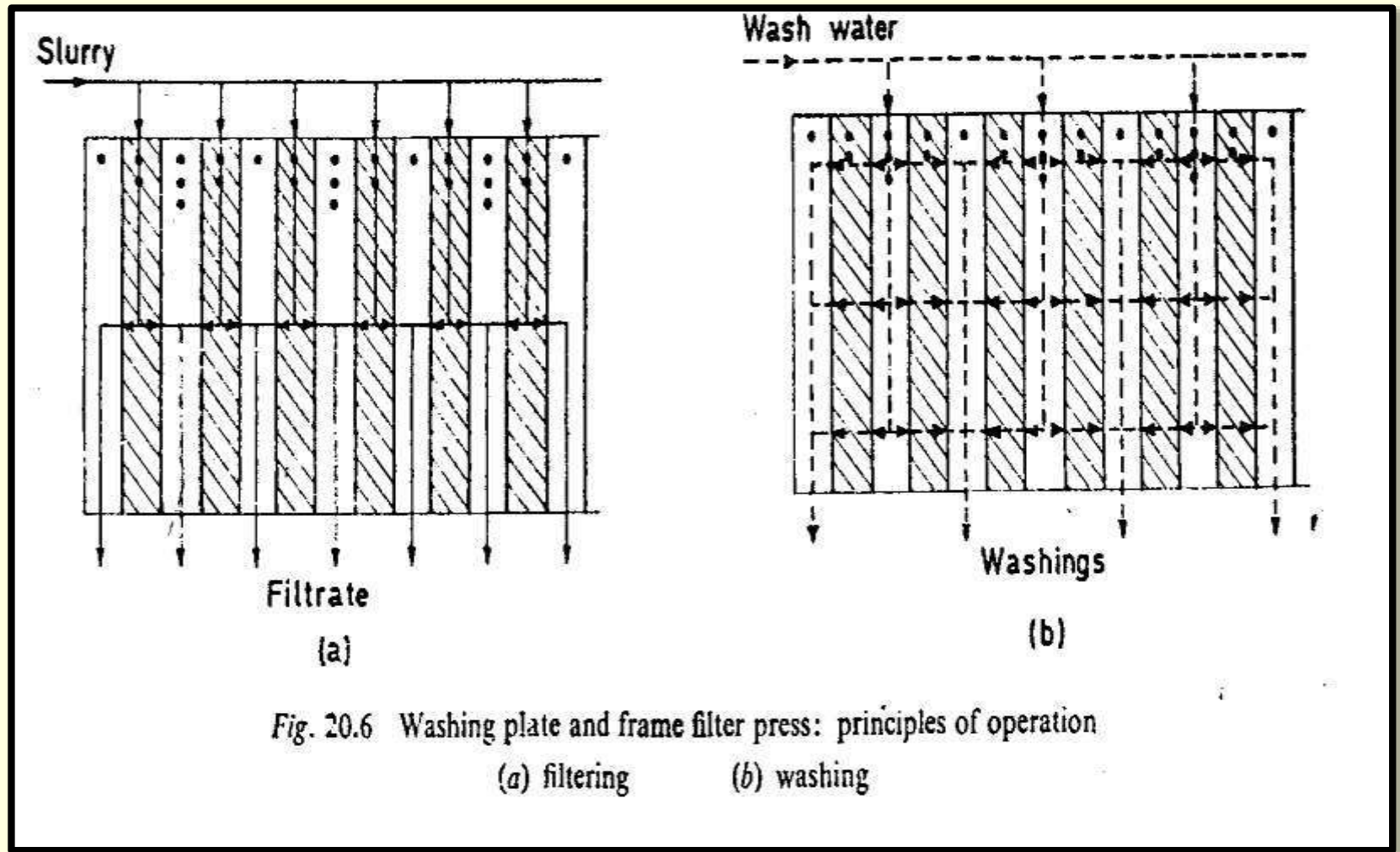
Step 4

- Water passes through the filter cloth and enters frame which contains the cake.
- Then water washes the cake, passes through the filter cloth and enters the plate down the surface.

Step 5

- Finally washed water escapes through the outlet of that plate.

Diagrammatic procedure



Uses:

- Sterile filtrate can be obtained by using asbestos and cellulose filter sheet (for this, whole filter press and filter medium have been sterilized previously).
- Filtration of viscous liquid can also be done by incorporating heating/cooling coils in the press.

Advantages

- Construction of filter press is very simple and a variety of materials can be used.
 - I. Cast iron - for handling common substances.
 - II. Bronze - for smaller units.
 - III. Stainless steel - contamination can be avoided.
 - IV. Hard rubber and plastic- used where metals must be avoided.
 - V. Wood- for lightness though it must be kept wet.
- Provide large filtration area in relatively small floor space. The capacity being variable according to thickness of frames and number used.
- Sturdy construction permits the use of considerable pressure difference. (2000 Kilopascals normally used)
- Efficient washing of cake is possible.
- Operation and maintenance is easy.
- It produce dry cake in form of slab.

Disadvantages

- It is a batch filter, so it is a time consuming.
- The filter press is an expensive filter, the emptying time, the labour involved, and the wear and tear on the cloths resulting in high costs.
- Operation is critical, as the frames should be full, otherwise washing is inefficient and the cake is difficult to remove.
- The filter press is used for slurries containing less about 5 % solids
- In view of the high labour costs , it is most suitable for expensive materials e.g. the removal of precipitated proteins from insulin liquors.

Filter leaf

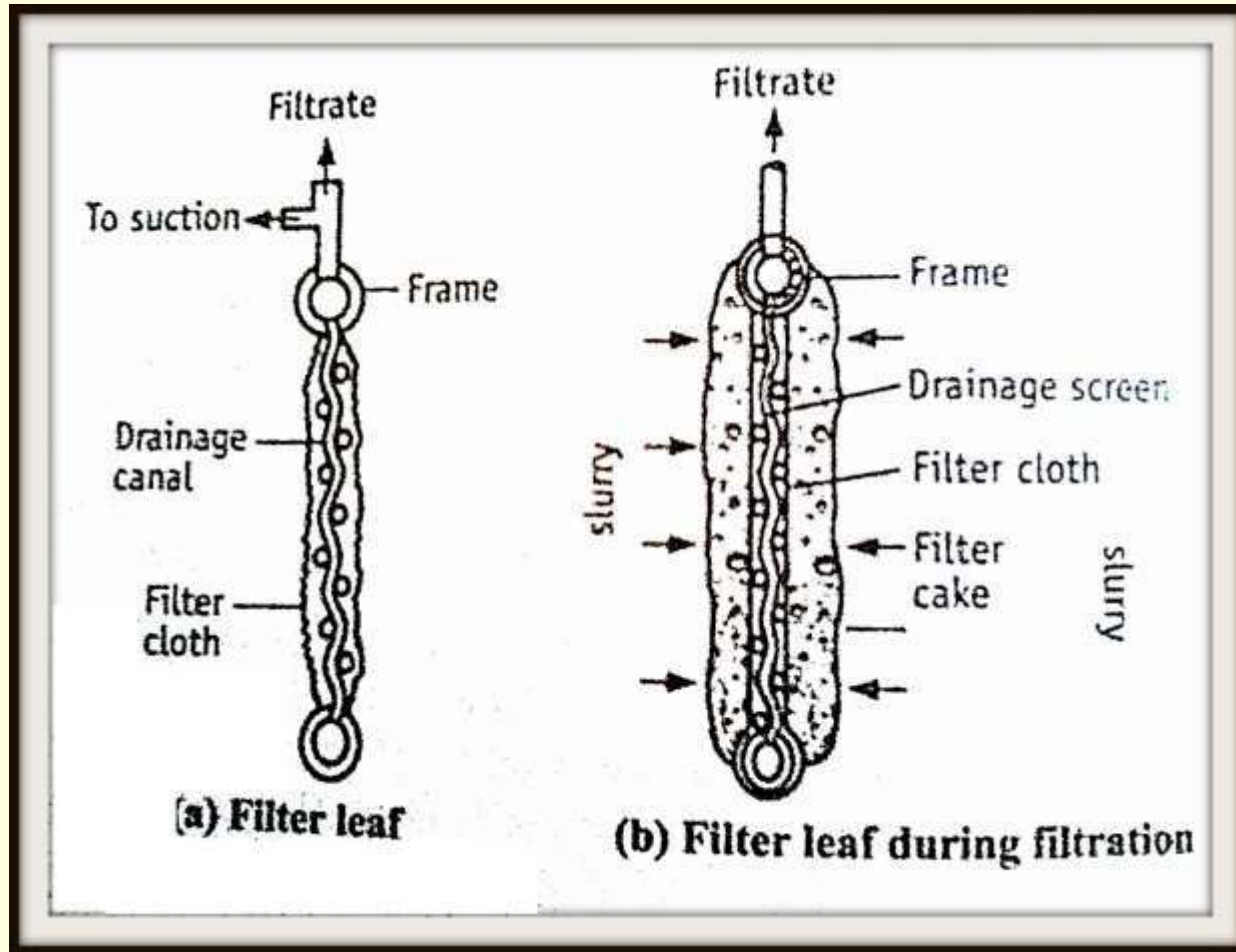
Principle:

- It is an apparatus consisting of a longitudinal drainage screen covered with a filter cloth.
- The mechanism is surface filtration and acts as sieve or strainer.
- Vacuum or pressure can be applied to increase the rate of filtration.

Construction:

- The leaf filter is consisting of a frame enclosing a drainage screen or grooved plate.
- The frame may be any shape circular, square or rectangular.
- The whole unite being covered with filter cloth.
- The outlet for the filtrate connects to the inside of the frame through suction.

Diagram



Working and uses

Working:



Use:

- Use for the filtration of slurry which do not contain high solid content, about 5%, i.e. dilute suspensions.

Advantages

- Simplest form of filter used for batch process.
- A number of units can be connected in parallel to increase the surface area of filtration.
- Pressure difference can be obtained either with vacuum or using pressure up to the order of 800 kilopascals.
- Labour costs for operating the filter leaf are fairly moderate.
- The efficiency of washing is high.
- The slurry can be filtered from any vessel.
- The cake can be washed simply by immersing the filter in a vessel of Water.

Metafilter

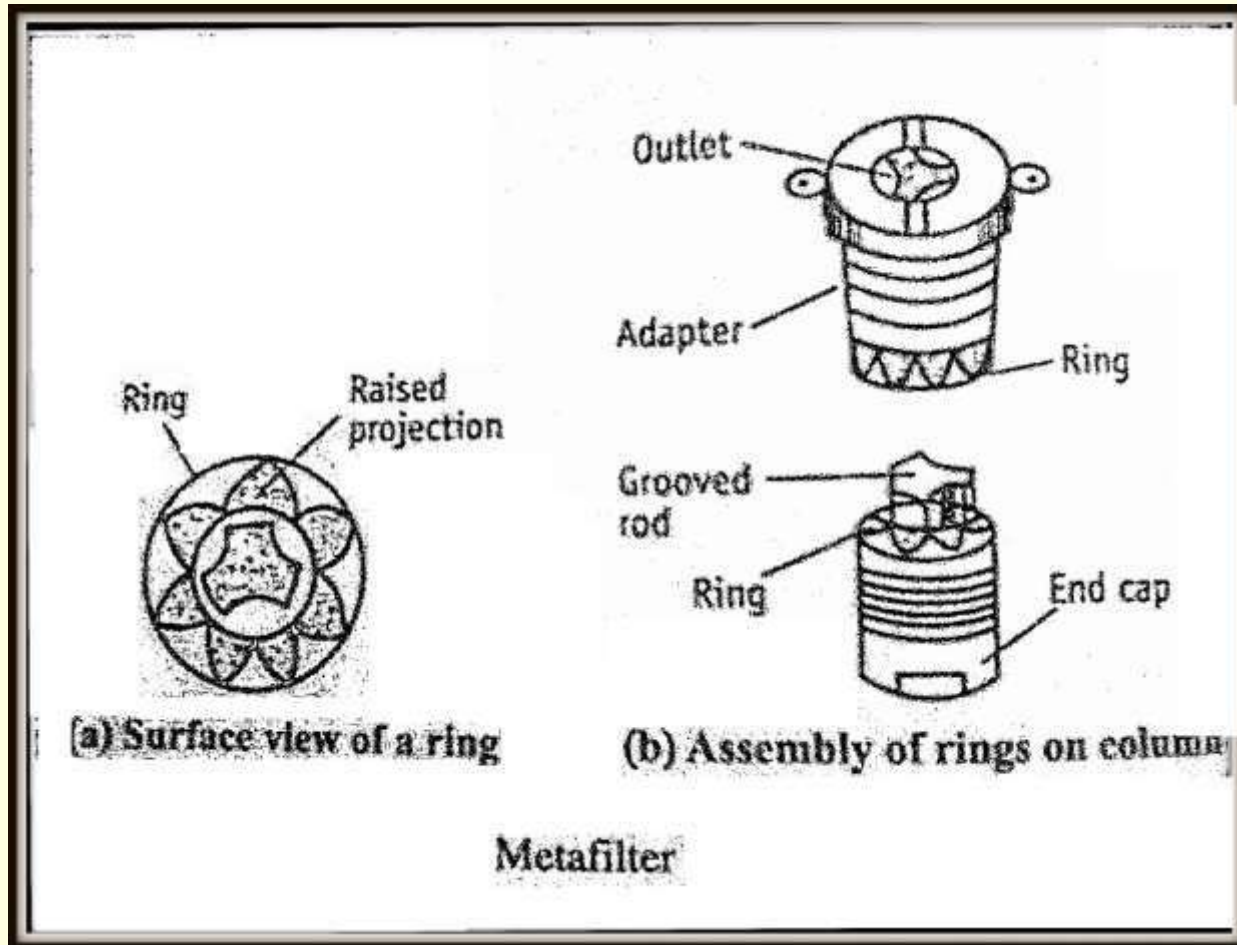
Principle:

- Mechanism is surface filtration.
- In this, metal rings contain semicircular projections, which are arranged as a nest to form channels on the edges.
- This channel offers resistance (strainer) to the flow of solids (coarse particles).
- The clear liquid is collected into receiver from the top.

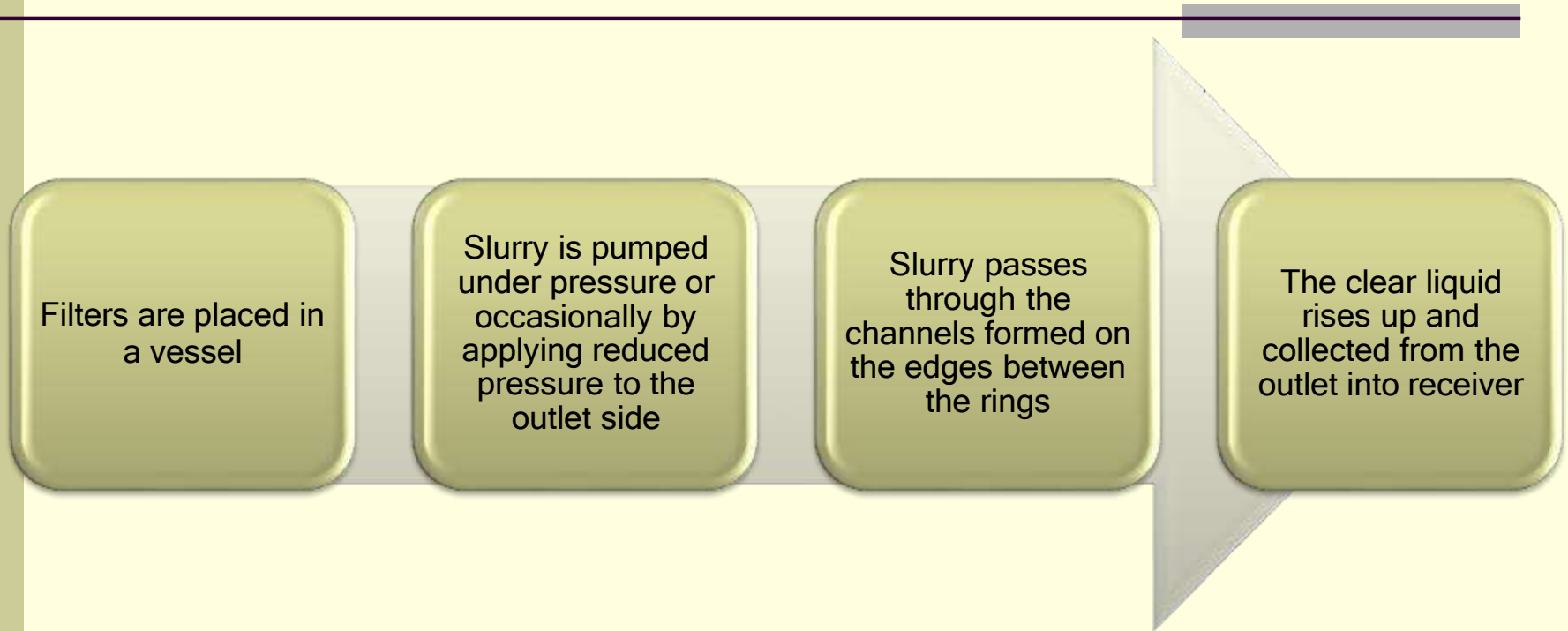
Construction

- Metafilter consists of a series of metal rings.
- These are threaded so that a channel is formed on the edges.
- It contains a grooved drainage column on which a series of metal rings are packed.
- These rings are usually made up of stainless steel and have dimensions of about 15.0 mm internal diameter and 22.0 mm external diameter.
- Each metal ring has a number of semicircular projections (0.8 mm in thickness) on one side of surface.
- The projections are arranged as a nest to form channels on the edges.
- These rings are tightened on the drainage column with a nut.
- Metafilters are also known as edge filters.

Diagram



Working



- For separation of fine particles, a bed of suitable materials such kieselguhr is first built up.
- The pack of rings serves essentially as a base on which the true filter medium is supported.

Uses

- Metafilters can be used for-
 - Clarification of syrups
 - Filtration of injection solutions
 - Clarification of insulin liquors
 - Filtration of viscous liquids can be achieved by applying pressure.

Advantages

- Can be used under high pressures, without any danger of bursting the filter medium.
- Running cost are low, as separate filter medium is not used.
- Can be constructed from a material that can provide excellent resistance to corrosion and avoid contamination of sensitive products.
- Removal of cake can be carried out by simply back- flushing with water.
- Change over from one batch to another or one product to another is easy.
- Sterile products can be handled.

Cartridge filter

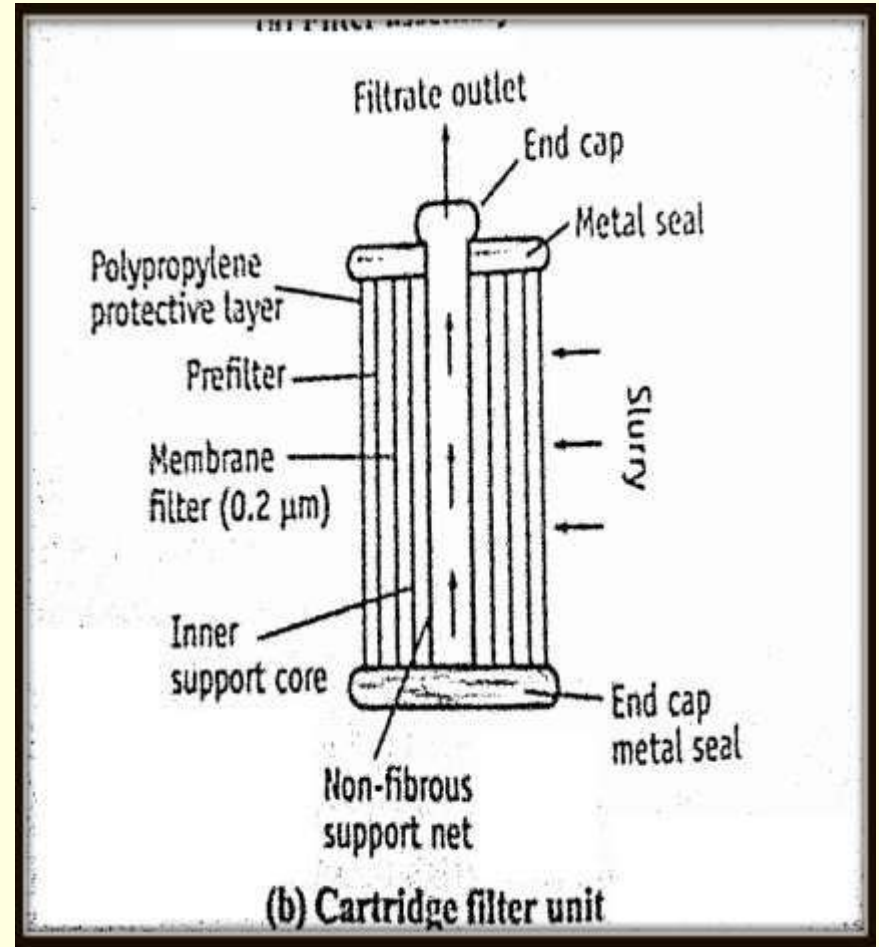
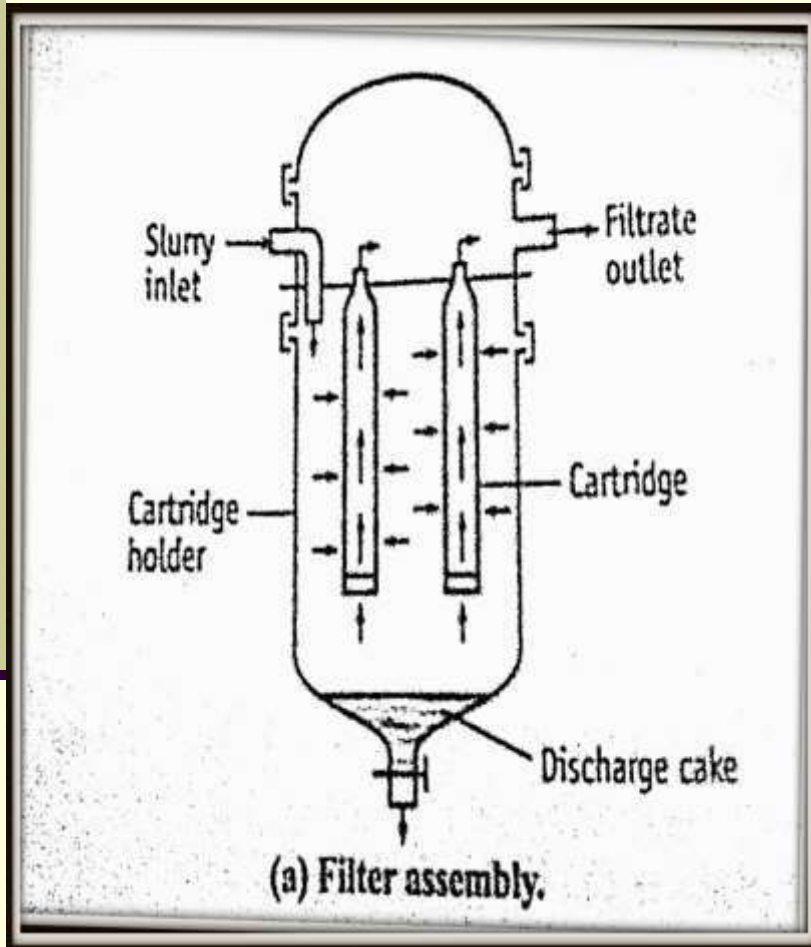
Principle:

- It is a thin porous membrane in which pre filter and membrane filter are combined in a single unit.
- The filtration action is mainly sieve like and particles are retained on the surface.

Construction:

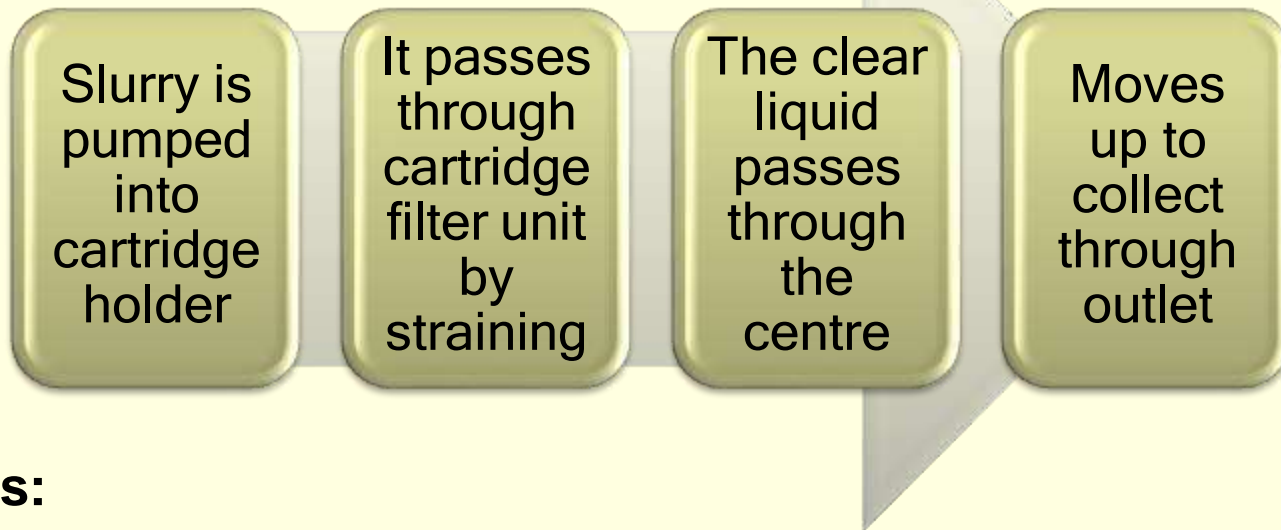
- It has cylindrical configuration made with disposable or changeable filter media.
- Made up of either plastic or metal.
- Consist of two membrane filters (sieve like) made of polypropylene: pre filter and actual filter for filtration.
- A protective layer surrounds them.
- The cartridge are housed in a holder and a number of cartridges can be placed in a same housing.
- The housing is closed with the lid.
- Housing has provisions for slurry inlet and outlets.

Diagram



Working and uses

Working:



Uses:

- Particularly useful for preparation of particulate free solutions for parenterals and ophthalmic uses.
- This filter holder will process 1000 - 15000 litres of sterile solution per hour.

Advantages and Disadvantages

Advantages:

- Autoclaving can be done for sterile operations due to stainless steel construction.
- Cartridge with self cleaning devices are advantageous.
- Rapid disassembling as well as reusing of filter medium is possible.
- Cartridge are not brittle, when they are dry.
- Used as in-line continuous filtration, which reduces handling of solutions. It minimize chances of contaminations.

Disadvantages:

- A number of manufactures provide the components, which are generally not interchangeable between suppliers.
- Cost of disposable elements offsets the labour saving in terms of assembly and cleaning of cartridge clarifiers.

Rotary drum filter

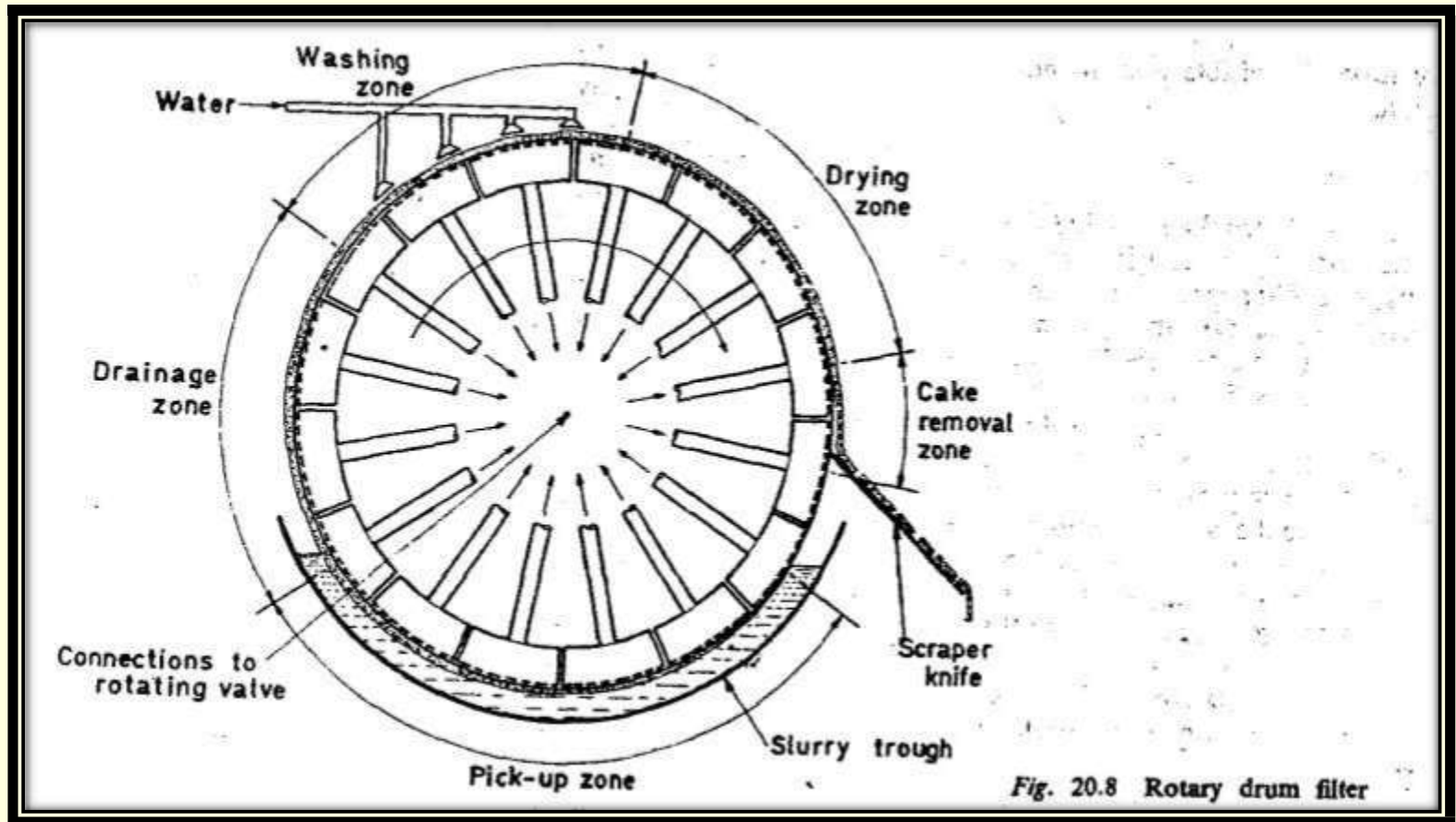
Principle:

- Slurry filtered through sieve like mechanism on the rotation drum surface, under the condition of vacuum.
- In addition compression, drying (using hot air), and removing the filter cake (using knife) are possible.

Construction:

- It consist of a metal cylinder mounted horizontally.
- The drum may be up to 3 meters in diameter and 3.5 meters in length and gives surface area of 20 meter square.
- The curved surface being a perforated plate, supporting a filter cloth.
- Internally, it is divided into several sectors and a separate connection is made between each sector and a special rotary valve.

Diagram



Working

- The drum is dipped into the slurry and vacuum applied to the outlet, which is connected to the filtrate receiver.
- When the cake has formed, the cake drained or partially dried by vacuum.
- The drum is sprayed with water to wash the cake.
- Retaining the vacuum connection drains the cake and produces partial dryness then, removed by a doctor knife.
- When the solids of the slurry are too much that the filter cloth becomes blocked with the particles, a pre-coat filter may be used.
- A pre-coat of filter aid is deposited on the drum prior to the filtration process.

Uses

- The rotary filter for continuous operation on large quantities of slurry.
- Suitable for slurry contains considerable amounts of solids in the range 15-30%.
- Examples of pharmaceutical application include
 - the collection of calcium carbonate, magnesium carbonate, and starch.
 - The separation of the mycelium from the fermentation liquor in the manufacture of antibiotics.

Advantages

- The rotary filter is automatic and is continuous in operation, so that the labour costs are very low.
- The filter has a large capacity , so it is suitable for the filtration of highly concentrated solutions.
- Variation of the speed of rotation enables the cake thickness to be controlled.
- Filter has large surface area.

Disadvantages

- The rotary filter is a complex piece of equipment , with many moving parts and is very expensive,.
- In addition to the filter itself, some accessories are connected ,e.g., a vacuum pump, vacuum receivers , slurry pumps and agitators are required .
- The cake tends to crack due to the air drawn through by the vacuum system, so that washing and drying are not efficient.

