FILTRATION EQUIPMENT

PRINCIPLE, CONSTRUCTION, WORKING, USES, MERITS AND DEMERITS OF

- PLATE & FRAME FILTER
- FILTER LEAF
- ROTARY DRUM FILTER
- META FILTER
- CARTRIDGE FILTER
- MEMBRANE FILTERS
- SEITZ FILTER

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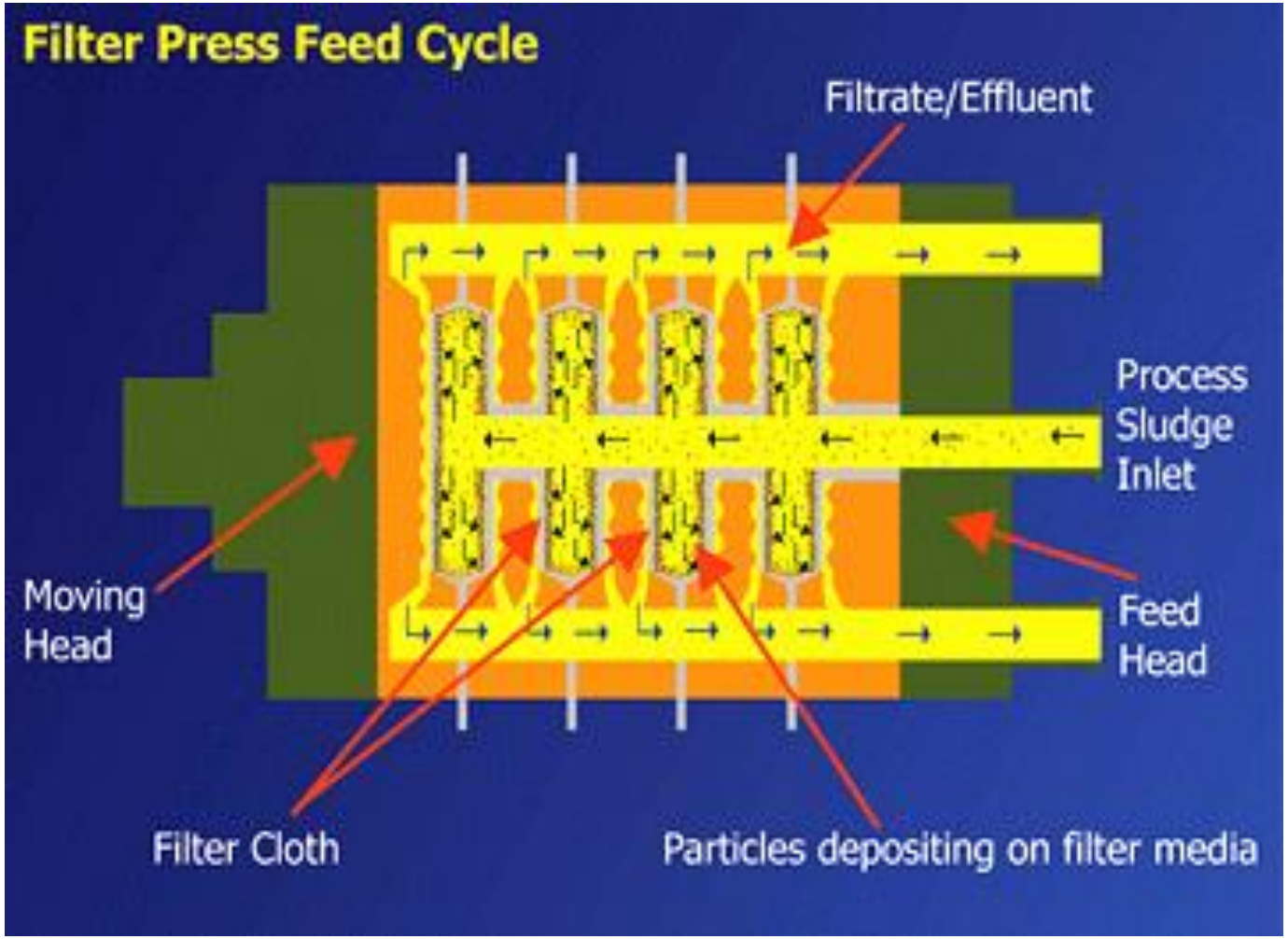
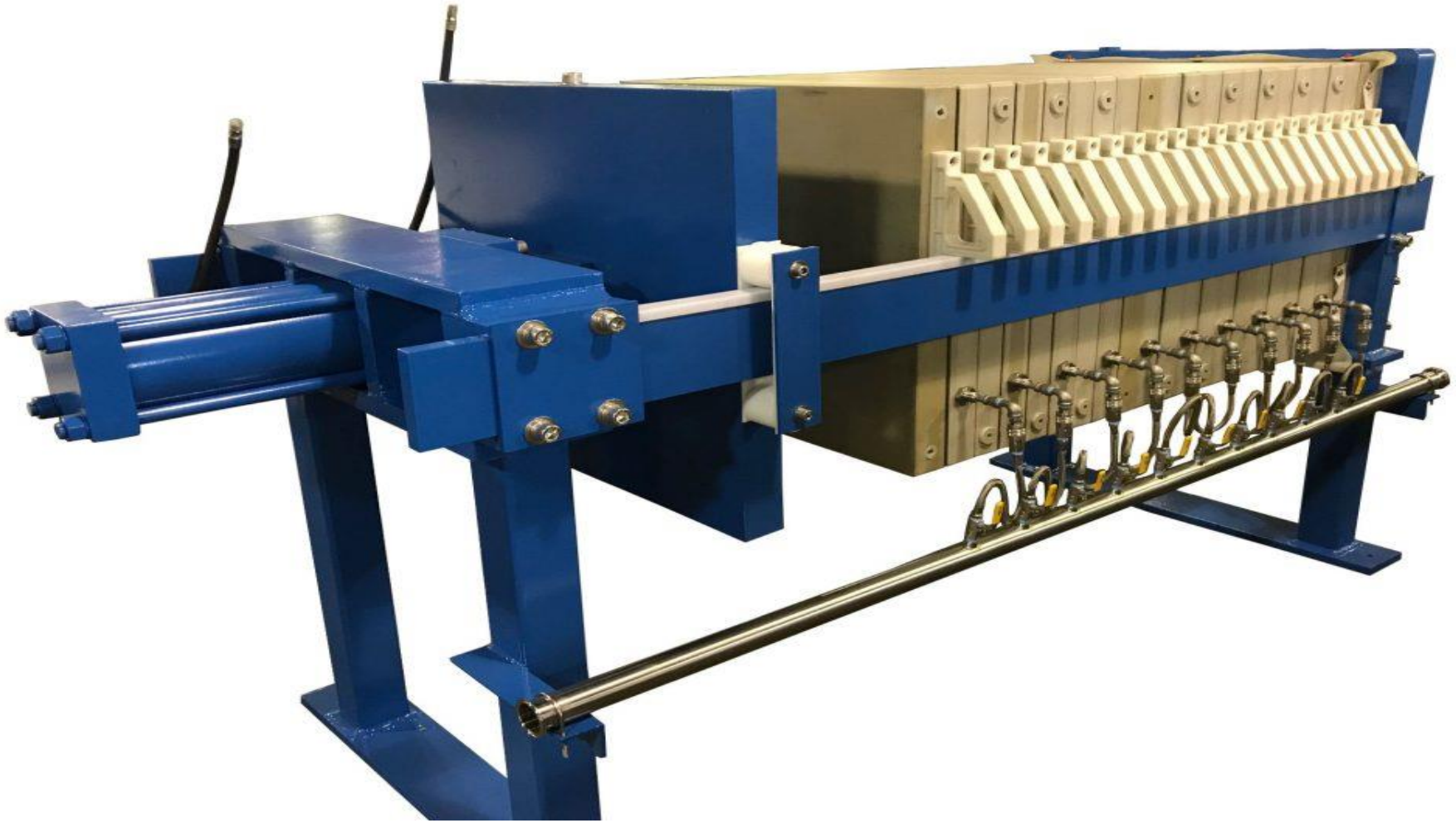
1. Plate and Frame Filter Press

Principle:

- The mechanisms is surface filtration.
- The **slurry** enters the frame by pressure and flows through the **filter medium**.
- The **filtrate** is collected on the plates and sent to the outlets.
- A number of frames and plates are used so that ***surface area increases*** and large volumes of slurry can be processed.



(Plate and Frame Filter Press)



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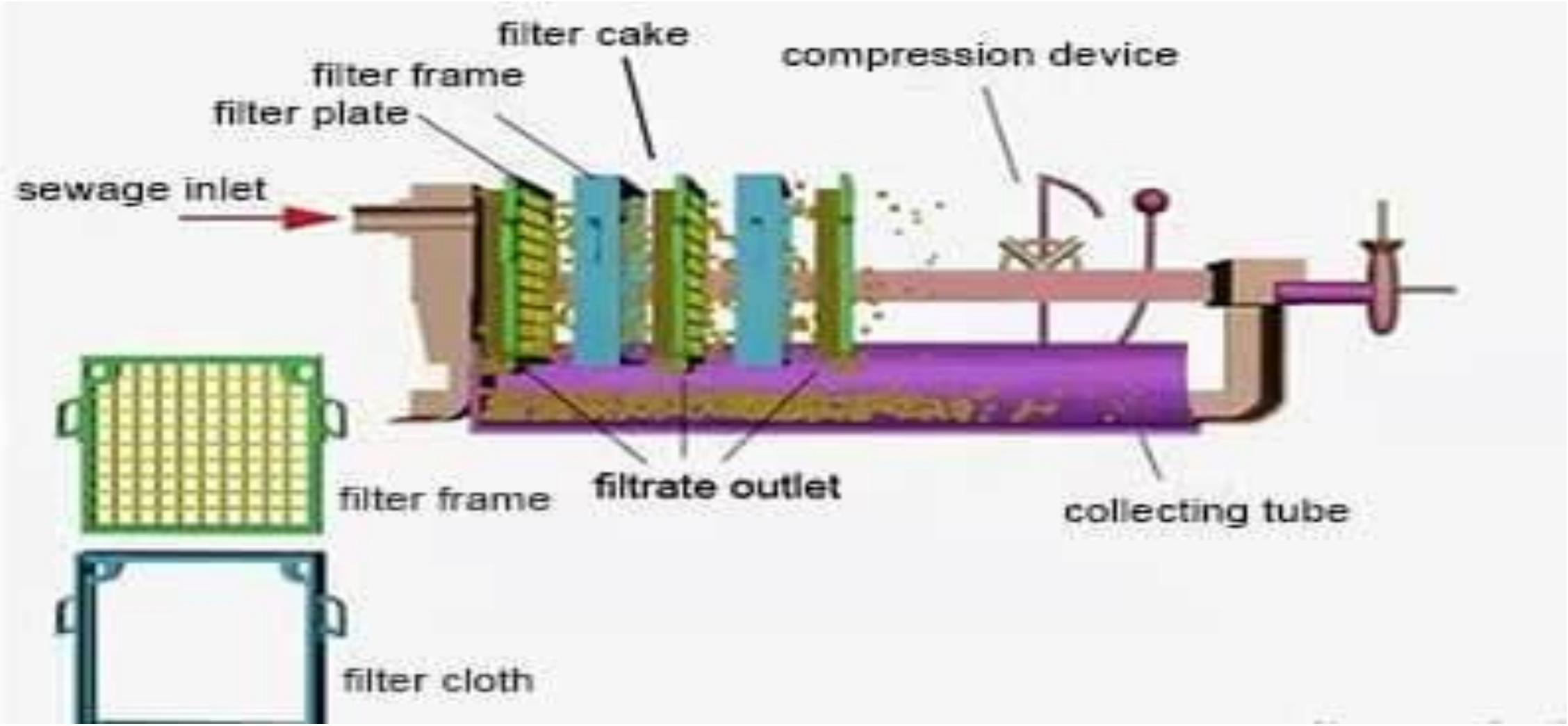


Construction:

- The filter press is made of two types of units: **plates** and **frames**
- Usually made of **aluminum alloy.**
- Frames of **different thicknesses** are available.
- **Plate**, **filter medium**, **frame**, **filter medium** and **plate**……are arranged in sequence and clamped to a supporting structure.

Working:

- Can be described in two steps **1)**Filtration operation and

  2)Washing operation

Uses:

- Filter sheets composed of ***asbestos*** and ***cellulose*** are capable of retaining bacteria, so **sterile filtrate** can be obtained.
- Filter plates and filter medium can be ***sterilized by steam***.
- Examples includes: collection of precipitated antitoxin, removal of precipitated proteins from insulin liquors, removal of cell broth from the fermentation medium.

Advantages:

- Variety of materials can be used for filter press, ***cast iron***, ***bronze***, ***SS***, ***Hard rubber***, ***wood***
- It provides ***large surface area***
- Construction permits the use of ***pressure difference***
- ***Efficient washing*** possible,
- ***Operation*** and ***maintenance*** is straight forward.

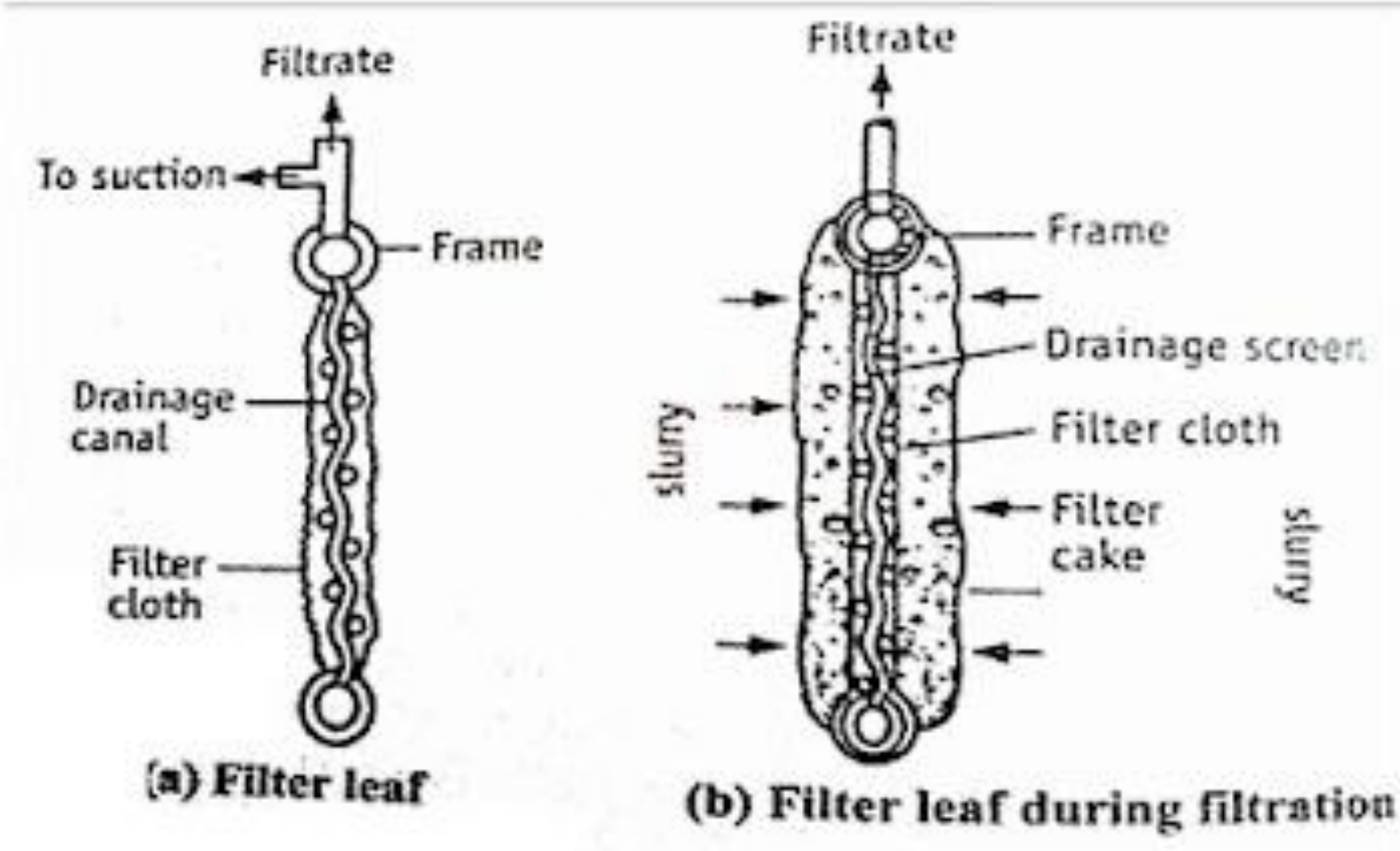
Disadvantages:

- A batch filter which is ***non-productiv***e
- Filter press is ***an expensive filter*** (the emptying time, labor cost)
- Operation is ***critical***
- Only used for slurries containing ***less than 5%*** solids.

2. Filter leaf

Principle:

- The filter leaf is the simplest form of filter**, consisting of a frame that encloses a drainage screen or grooved plate and the whole unit being covered with a filter cloth**.
- The mechanisms is surface filtration and act as sieve or strainer.
- Vacuum or pressure can be applied to increase the rate of filtration.


Filtrate
To suction
Frame
Drainage canal
Filter cloth
(a) Filter leaf
Filtrate
Frame
Drainage screen
Filter cloth
Filter cake
slurry
slurry
(b) Filter leaf during filtration

Construction:

- It consists of narrow frame enclosing drainage screen or grooved plate.
- The frame used may be circular, square, or rectangular in shape.
- The whole unit is covered with filter cloth.
- The outlet for the filtrate connects to the inside of the frame.

Working:

- The filter leaf is immersed in slurry.
- Vacuum system is connected to filtrate outlet.
- The slurry passes through the filter cloth and 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.

Uses:

- The filter leaf is satisfactory, if the solid content of the slurry is not too high, about **5% w/v**. i.e. dilute suspensions

Advantages:

- Simplest form of filter used for batch processes.
- A number of units connected to increase surface area.
- Pressure difference can be obtained.
- Labor cost for operating filter leaf is moderate.
- Efficiency of washing is high.

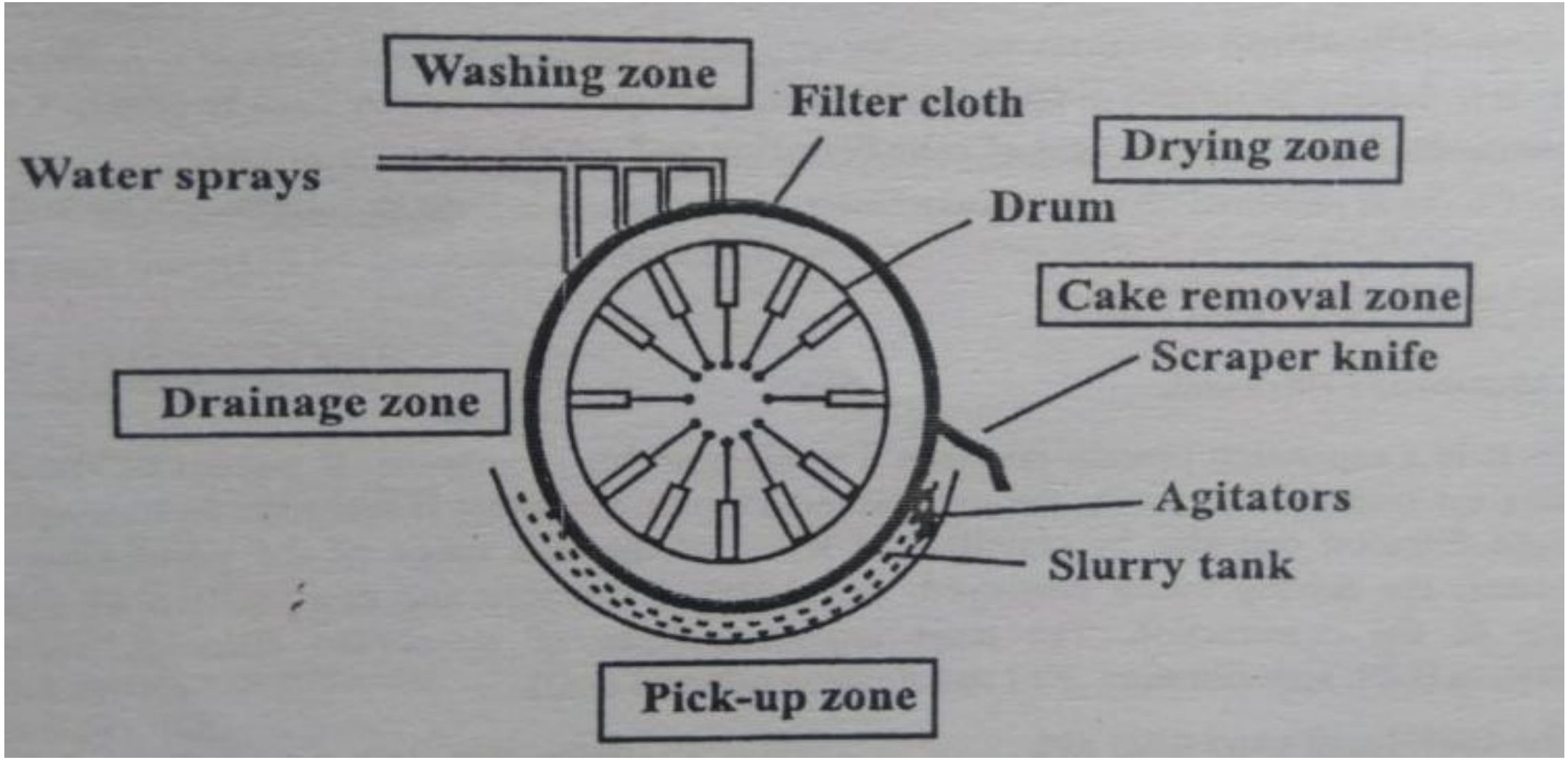
Filter leaf

3. Rotary Drum Filter

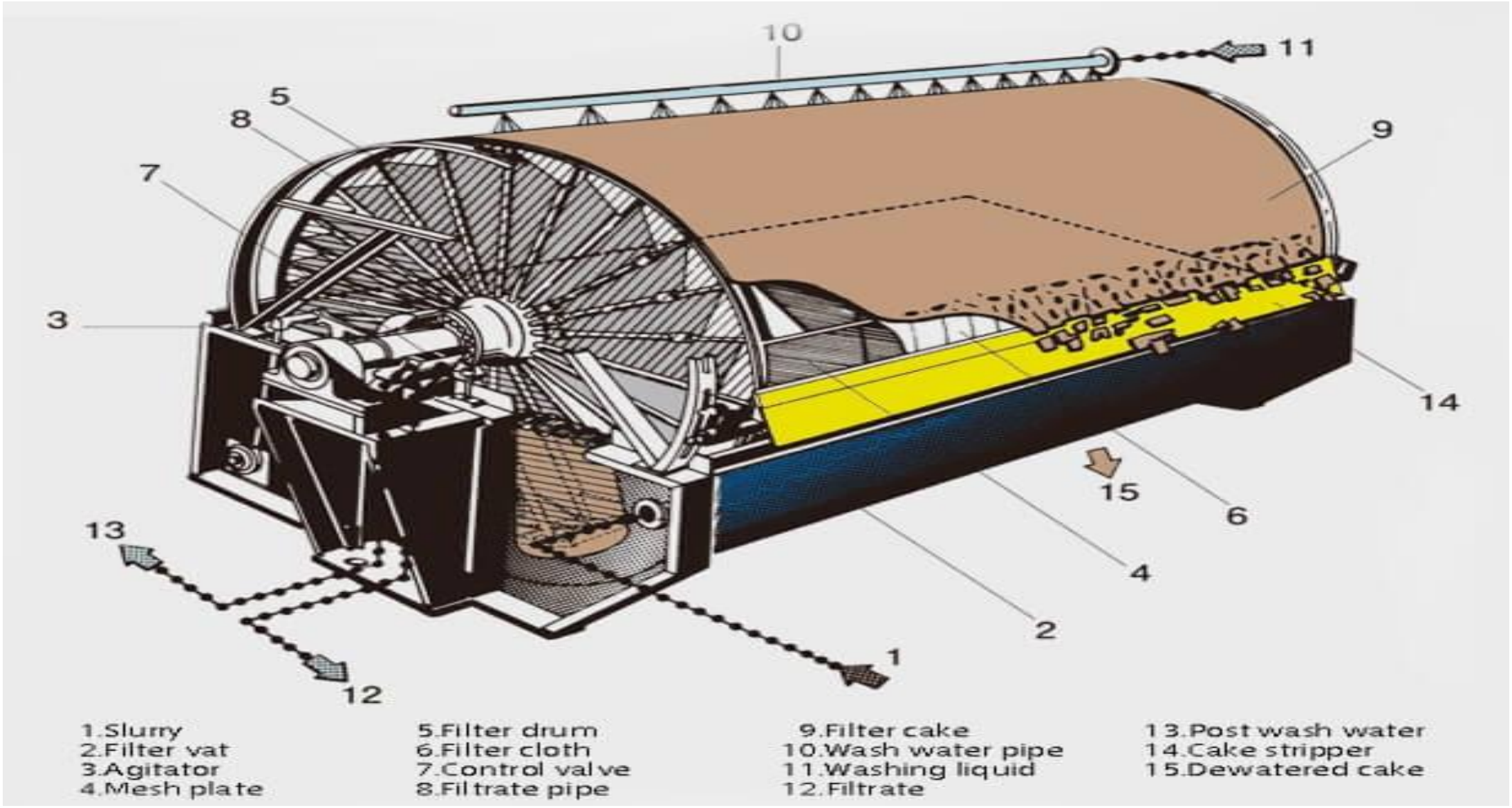
Principle:

- It works on the principle of filtering the slurry through sieve-like mechanisms on a rotating drum surface under the conditions of vacuum.
- In addition compression, drying and removing the filter cake is possible.
- A Rotary vacuum filter drum consists of a cylindrical filter membrane that is partly sub-merged in a slurry to be filtered.

Rotary drum filter



Rotary drum filter



Construction:

- It consists of **metal cylinder mounted horizontally**.
- The drum may be up to ***3 meters in diameter*** and ***3.5 meters in length*** and gives a surface area of ***20 meter square***.
- The curved surface is ***perforated plate*** which supports a filter cloth.
- The drum is radially partitioned dividing the annular space into separate compartments.
- Each of it is connected by **internal pipe.**

Working:

- The drum is rotated at a speed **less than one rpm**.
- The drum just enters the slurry in the tank, as it dips, vacuum is applied in this segment so that the solid is build up on the surface.
- The liquid passes through the **filter cloth** into an internal pipe and valve.
- Finally the filtrate reaches to the **collecting tank.**
- As the drum leaves the slurry section, it enters the **drainage zone**.
- Special **cake compression rollers** may be included at this stage, this improves the efficiency of washing and drying process.
- As the drum leaves the drainage zone, it enters the **water wash section**. Water is sprayed on the cake.
- Then the cake enters into the **drying zone**. Hot air is blown on the cake. Finally the cake is removed using a doctor knife and discharged.
- All these steps are completed in one rotation of the drum.

Uses:

- Drum filter is used for continuous operation
- It is utilized to filter slurries containing high proportion of solids up to 15 to 30% w/v.
- In the production of penicillins, collecting calcium carbonate, starch and magnesium carbonate

Advantages:

- Cake is removed continuously, suitable for use with concentrated slurries.
- The labor costs are very low on account of automatic and continuous operation
- The filter has large surface area

Disadvantages:

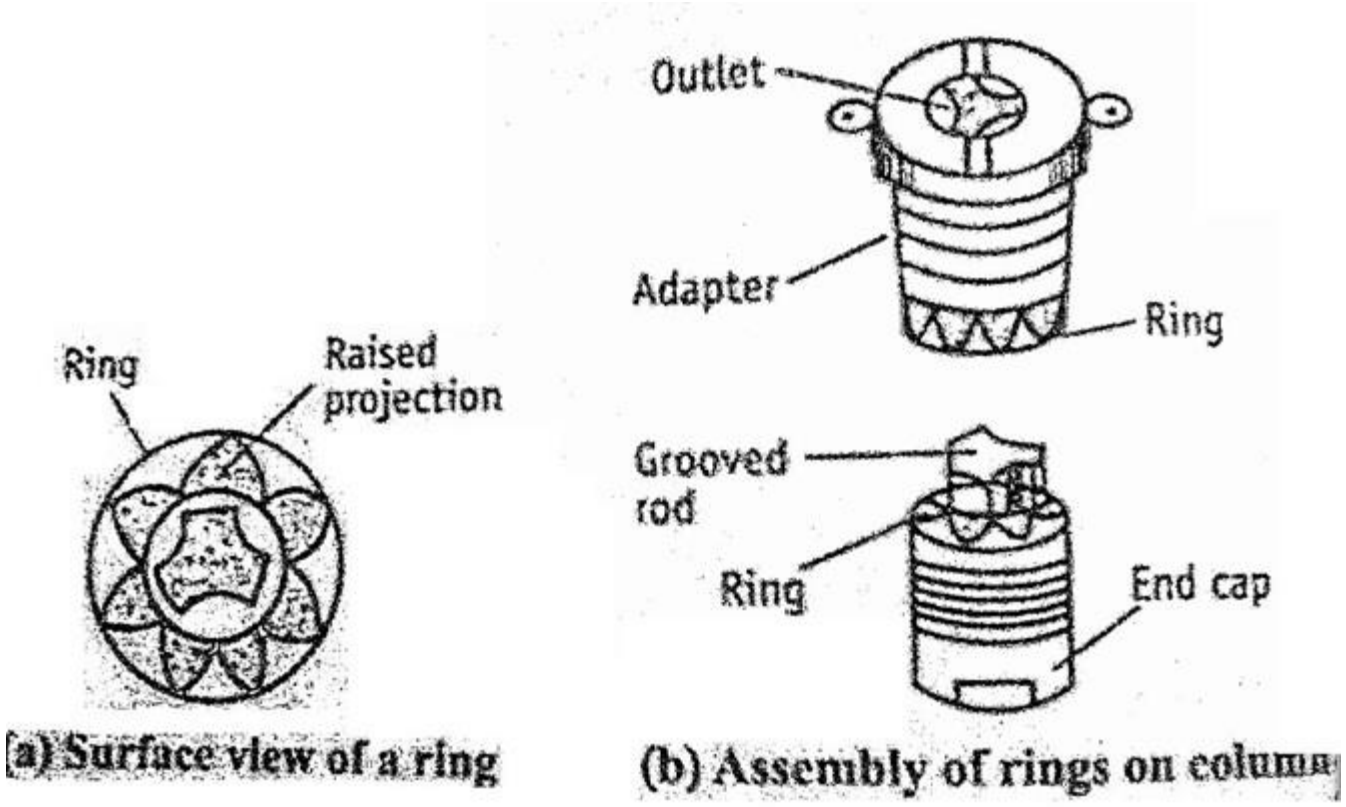
- The rotary drum filter is expensive equipment.
- Only suitable for straightforward slurries which is less satisfactory when impermeable cake forms.

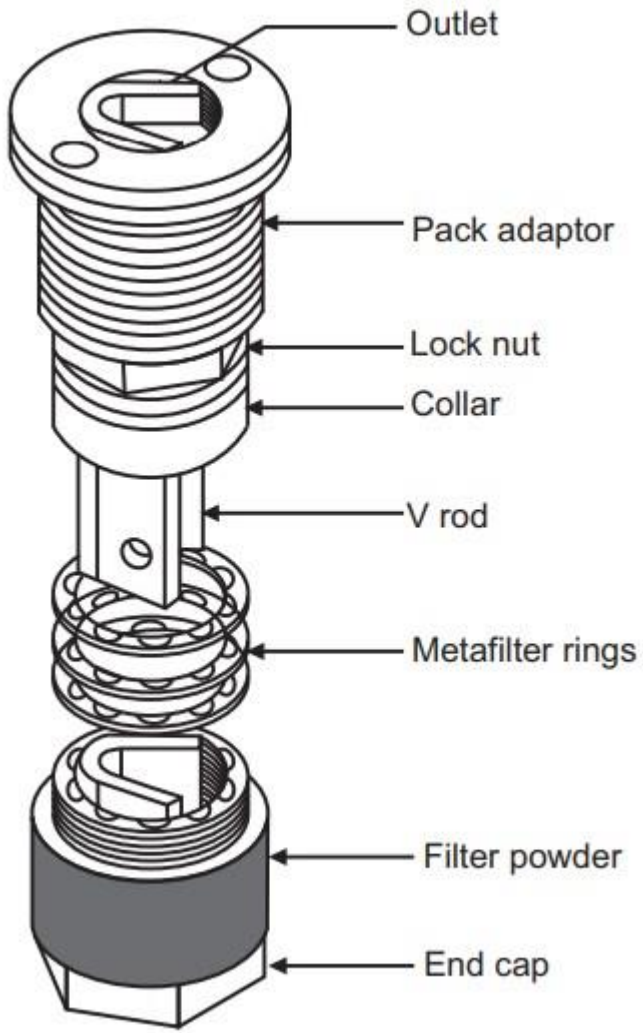
4. **Meta** Filter

Principle:

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

Meta filter


Ring
Raised projection
Outlet
Adapter
Ring
Grooved rod
Ring
End cap
(a) Surface view of a ring
(b) Assembly of rings on column
Metafilter


Outlet
Pack adaptor
Lock nut
Collar
V rod
Metafilter rings
Filter powder
End cap

Construction:

- The meta filter consists of **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 usually made of **SS** and have dimensions of ***15mm internal diameter*** and ***22mm external diameter***.
- Each metal ring has a number of semicircular projections of ***0.8mm*** in thickness.
- These rings are tightened on the drainage column with a nut.
- Therefore **Meta filter** is also known as "**EDGE filter**"

Working:

- These filters are placed in vessels and may be operated by pumping the slurry under pressure.
- The slurry passes through the channels formed on the edges between the rings.
- The clear liquid rises up and collected from outlet.
- Also filter aid can be used.

Uses:

- Meta filter 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:

- Meta filter can be used under high pressure.
- Running costs are low.
- It is an extremely versatile filter.
- Removal of cake is carried out effectively.
- Sterile products can be handeled.

5. **Cartridge** Filter

Thankyou…