# Pharmaceutics | Chapter-4.

## Unit- 4 — Filtration.

**Filtration—** It is defined as a process of separation of solid from fluids by passing mixture through a porous medium that retain the solid but allows the fluids to pass through. The mixture or suspension to be filtered is known as slurry. The porous medium used to retain the solids is known a filter medium. The accumulated solid on the filters are referred to as filter cake, while the color liquid passing through the filter is filtrate.

When solids are present in a very low concentration that is not exceeding 1.0% w/v the process of its separation from liquid is called clarification.

## Application of Filtration.

1. **Production of sterile products—** Air is filtered through HEPA filters (high efficiency particulate air filters) or laminar air bench to obtain sterile air, which maintain good environment prior to and during manufacturing of sterile products.
   - A solution is passed through a bacteria proof filter in order to obtain sterile solution, particularly when heat sterilization is not suitable on account of the thermolabile nature of the contents. In case of sterile products particle as small as 0.2µm should be removed, which includes the bio- burden of fungi, bacteria etc.
2. **Production of bulk drugs**—solids of intermediates and finished products are separated from the reaction mixture by filtration techniques by the method, impurities can be removed.
3. **Production of liquid oral formulation**—Filtration is an essential steps in the production of liquid oral for obtaining clear solution.
4. **Affluent and waste water treatment**—Waste solid must be separated from the waste liquid prior to its disposal. Sometimes, the soluble components are precipitated and the separated by filtration.

## Factor influencing filtration.

A simple straining process does not provide a complete description of how particles are removed from s suspension. The particles are exposed to a number of forces including gravity or electrical fields. Some of the factors influencing the filtration rate-

a. **Properties of the liquids**—Density, viscosity, and corrosiveness.
b. **Properties of the solids**—Particle shape, particle size, particle charge, particle density, rigidity or compressibility of the solid under pressure and tendency of particle to flocculate or adhere together.
c. **Temperature of the suspension.**
d. **Filter cake formation rate**.
e. **Surface area of the filter medium**.
f. **Gravity forces**.
g. **Appling pressure**.
h. **Viscosity of filtrate**.
i. **Centrifugal forces**— Centrifugal force could replace the gravitational force and is used to increase the rate of filtration.

## Theories of filtration

The flow of a liquid through a filter follows the basic rules that govern the flow of any liquid through the medium offering resistance. The rate of flow may be expressed as--

**Rate = driving force/resistance.**

- The rate of filtration may be expressed as volume/time.
- The driving force is the pressure differential between the upstream and downstream of the filter.
- The resistance is not constant .it increase with an increase in the deposition of solids on the filter medium.

1. **Poiseuille's Equation**— **Poiceuille** considered that considered that filtration is similar to the streamline flow of a liquid under pressure through Capillaries.

$$V = \pi \Delta P r^4 / 8 L \eta.$$

Where →V = rate of flow, that is volume of liquid flowing in unit time $m^3/s$.
ΔP = Pressure difference across the filter. Pascal.
r = radius of the capillary in the filter bed. Meter
L = Thickness of the filter cake (capillary length). Meter
η = Viscosity of the filtrate. Pascal/second.

2. **Darcy Equation**—

$$V = KA\Delta P/\eta L.$$

K = permeability coefficient of cake $m^2$.
A = Surface area of the porous bed (filter medium) $m^2$.
The term k depends on the characteristics of the cake, such as porosity, specific surface area and compressibility.

3. **Kozeny-Carman Equation**—

$$V = A/\eta s2 \times \Delta P/KL \times \varepsilon^3/(1-\varepsilon)^2$$

Where → Ɛ = porosity of the cake (bed)
S = Specific surface area of the particles comprising the cake $m^2/m^3$.
K = Kozeny constant (usually taken 5).

## Membrane Filter.

**Principle**—Membrane filter consists of microsporous plastics films of specific pore sizes, therefore it is also known as screen, sieve or microsporous filter. Membrane present in these filters retains particles or microorganism (larger than the pore size) by surface capture. It act like sieve and the particulate matter is retained on the surface of membrane.

**Construction**— Membrane filter consists of membrane of cellulose acetate, cellulose nitrate in mixed cellulose ester. The pores size of filter in micron or submicron range.

A membrane filter is 150µm thick and contains about millions of microscopic pores. The diameter of these spores is uniform. Based on the requirement the size

of these pores is adjusted, during the process of polymerization. The most widely accepted membrane filter possesses a pore size of 0.22µm and 0.45µm.

**Working**—The membrane filter functions like a sieve and thus removes particle. The filter of 0.010 – 0.10 µ pore sizes remove even viruses from water or air and filter of 0.30 – 0.65 µ pore sizes remove bacteria. Filter with largest pore sizes is used in aerosol radioactivity and particle sizing applications.

- For sterile filtration, the membrane is autoclaved in the holder and to prevent curling they are packed between thick filters. Some membrane filters which are pre-sterilized (by ethylene oxide or ionizing radiation) are also available.
- A rigid base of perforated metal, plastic, or coarse sintered glass is used to support the membrane filter during filtration process (as in the case of fibrous pad filters).

**Uses/Applications**—

- It is used for sterilization and clarifying aqueous and organic solvents including buffers, microbiological and tissue culture solution.
- It is suitable for filtration of enzyme solution.
- It is used for diagnostic cytology and receptor binding studies.

**Advantages**—

- It does not allow any cross contamination.
- Its filtration rate is rapidly.
- It can be easily disposed off.
- Since absorption is negligible, it does not import any fibers or alkali into the filtrate.

**Disadvantages**—

- It may get clogged
- It ordinary, it is less resistant to solvents like chloroform.

## Sintered glass filter.

**Principle**—It is works on the principle of Reducing pressure. During the filtration high pressure exerts on the sintered glass disc and lower pressure exert on the base of funnel. Due to pressure difference filtration is performing.

**Construction**—It consists of the glass funnel and sintered glass disc. These filters have as a filtering medium a flat or convex plate of Jenna glass powdered and shifted to produce granules of uniform size that are molded together. The variation in porosity depending on size of granules used in the plate. A vacuum attachment is necessary to facilitate the passage of liquid through the filter plate.

**Working**—the sintered glass filters are available in different pore size. Hence the funnel with a sintered filter is numbered according to the pore size. The filtration is carried out under reduced pressure. These funnel are used for bacterial filtration.

**Uses/Applications**— Sintered filters are also available in stainless steel which has a greater mechanical strength. However these are very much liable to attack by the solutions passing through them.

**Advantage**—

It is easy to clean and labor requirement is very low.

Its shows low absorption properties.

**Disadvantage**—

It is fragile in nature so its handling is very tough task.

It is very expensive and time consuming.