Pharmaceutical Technology I

Lecture-15

Clarification

By

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Clarification

- Clarification is an operation which involves the removal of suspended matter from a fluid medium.
- From where these materials come ?

1. The inadvertent introduction of foreign particles (unintended or accidental)
2. The precipitation of undesirable materials during the course of manufacture and
3. The presence of impurities in raw materials used to manufacture the preparation.

These result in requirements for clarification as the last stage in its manufacture as well as in preceding steps.

Clarification

- The specific procedure and equipment which may be used to achieve clarification are dependent on a number of factors:

1. The particle size of suspended matter.
2. The physical state of the suspended matter. Whether it is divided solid or insoluble liquid.
3. The quantity of suspended matter. The liquid to be clarified may be a slurry, containing a high concentration of solids or a colloidal dispersion in which the concentration of suspended matter is small.
4. The characteristic of the fluid medium: viscosity, the temperature at which the fluid is to be clarified, the presence of volatile constituents in solution, etc require special consideration.
5. The speed of the operation; this depends primarily on the quantity of liquid to be clarified

Clarification methods

1. Settling: the simplest method of clarification is to allow the liquid to stand in a suitable container until the suspended matter either has settled or has risen to the top of the liquid.

The latter occurs when the density of the suspended matter is less than that of the fluid medium.

The insoluble matter may be separated from the clear liquid phase by:

1. Skimming
2. Decantation or
3. Siphoning

Advantages and disadvantages of settling

- Settling may be advantageous when the suspended particles are large and settle rapidly, it is also may be used to remove fine particles, specially those which tend to flocculate, (if a long waiting-period is feasible).

Advantages and disadvantages of settling

- If the viscosity of the liquid is high, as is true of syrup, the waiting period may be excessive.
- The method fails when the suspended matter is colloidal or when its density is approximately equal to that of the liquid phase.
- Acceleration of settling process can be accomplished by centrifugation. In this operation, the liquid is rotated in a special container at high speeds. The centrifugal forces developed in the rotating container drive the suspended particles to the bottom and the sides of the container.

Filtration and Collation

- Filtration is the process of removing solid particles from a fluid by passing the suspension through a porous, fibrous or granular substance.
- Collation or straining is crude filtration. The distinction between the two processes is based only on the degree of fineness of the straining or filtration medium involved.
- A filter (or strainer) functions primarily by impeding the passage of suspended particles with diameters greater than that of the pores, while allowing the liquid to pass.
- The retentiveness of filters varies over a wide range, depending on the average pore size.

Filtration and Collation

- Ultrafilters: are filters which are retentive to colloidal matter.
- Examples: bacteria-, virus-and pyrogen-retentive filters as well as microsieves capable of separating molecules of differing sizes have been developed.

Factors affecting filtration rate

The factors which influence the rate at which fluids can be passed through a porous medium are summarized in their simplest form in the following expression:

$$Rate\ of\ filtration \propto \frac{(filter\ area)(pressure\ drop)}{(liquid\ viscosity)(filter\ resistance)}$$

Factors affecting filtration rate

- The rate of filtration, measured as the volume of liquid passed through the filter per unit time.
- It will be increased in proportion to the pressure drop across the filter and filter area; and will be reduced in proportion to the filter resistance and viscosity of the filtrate.
- Pressure drop is determined by the weight of the liquid above the filter. Usually, this is not great enough to effect filtration in reasonably short periods if highly retentive filters are employed or highly viscous liquids such as syrups are being filtered.
- The pressure drop can be alter by use

Factors affecting filtration rate

1. Suction filter, which may be employed with properly designed equipment to increase the pressure drop by lowering the pressure beneath the filter, or
2. Pressure filtration (in which the pressure above the liquid is increased).

- Filter resistance is increased as the size of the pores is decreased.
- Another factors which has an important effect on the potential filtration rate is the blocking potential of the filter. Small particles which tend to be trapped in the pores can increase the efficiency of filtration, as measured by removal of insoluble matter, in addition to reducing the filtration rate.

Filter Media

What are the properties of filter medium?

1. It must be capable of delivering a clear filtrate at a suitable production rate.
2. It must withstand mechanical stresses which may be imposed on it without rupturing or being compressed significantly.
3. No chemical or physical interactions with the components of the filtrate should occur (it should be inert).

Types of filter media

1. Sheets of woven or felted material: These include fabrics of cotton, muslin and surgical gauze (strainer) and filter paper.
2. Porous plates: these include perforated metal or rubber plates; natural porous materials i.e. porcelain (ceramic). These are often used as support for other filter media, they are highly retentive and they frequently can be reused after cleaning.

Types of filter media

3. Membrane filters: these are made by casting for example Millipore filters, these are prepared from cellulose esters and is a thin porous membrane. The pore volume may occupy as much of 80 percent of the volume of the filter, so this permits very high liquid flow rates, with maximum retentiveness.

Example of the use of membrane filters include the removal of bacteria from parenteral products.

Types of filter media

4. Unwoven fibrous materials:

These include cotton, paper pulp and are employed with woven or felted material or porous plates used as supports.

5. Granular or powdered materials, with suitable supports:

These include sand, gravel, charcoal.

Absorption and adsorption

Filter media effect clarification through the operation of absorptive and adsorptive processes, in addition to their “sieve” action.

Frequently, agents other than the filtration medium itself, i.e. filter aids, are used to provide the absorptive and adsorptive functions.

Absorption and adsorption

Absorption	Adsorption
• In absorption, foreign particles are “soaked up” or trapped within the medium. • Filter media which act by absorption have a high degree of porosity.	• In adsorption, foreign material adheres to the surface of the media. • Filter media which act by adsorption present a large surface area to the liquid to be clarified.

Filter aids

Filter aids are finely divided materials or, in some instances, fibrous materials which deposit on the filter medium. They include talc, pulped filter paper.

1. Filter aids may be added directly to the liquid which is to be filtered or
2. Used in the form of a slurry in the solvent to precoat the filter.

Filter aids should be 1. chemically inert, 2. they should have a high adsorptive capacity and 3. they should be of such particle size that can be readily filtered out of the solution.

Filter aids

Albumin, which is water-soluble and is coagulated by heating of the solution, is example of a filter aid which function by trapping smaller particles within the precipitate, which then is removed readily.