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م.م. وسام خلف رافع	اسم التدريسي
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محتوى المحاضرة

Clarification and Filtration

Clarification may be defined as the process that involves the removal or separation of a solid from a liquid, or a fluid from another fluid. The term "fluid" encompasses both liquids and gases. Clarification can be achieved using either **filtration or centrifugation techniques**. Filtration is mainly required to remove unwanted solid particles from a liquid product or from air and centrifugation is normally used to separate fluid from another fluid or to collect the solid as the product

Filtration is defined as the process in which particles are separated from a liquid by passing the liquid through a permeable material. The permeable medium is a porous material that separates particles from the liquid passing through it and is known as a **filter**.

Thus, filtration is a unit operation in which a mixture of solids and liquid, the *feed, suspension, dispersion, influent* or *slurry*,

is forced through a porous medium, in which the solids are deposited or entrapped. The solids retained on a filter are known as the *residue*. The solids form a *cake* on the surface of the medium, and the clarified liquid known as *effluent or filtrate* is discharged from the filter. If recovery of solids is desired, the process is called *cake filtration*

There are numerous applications of filtration in pharmaceutical processing which mainly include:

(i) clarification of products to improve their appearance, i.e. to give them „sparkle“ or „brightness“,
(ii) removal of potential irritants e.g. from eye drop preparations or solutions applied to mucous membranes

(iii) filtration for recovery of desired solid material from a suspension of slurry, e.g. to obtain a drug or excipient after a crystallization process,

(iv) production of water of appropriate quality for pharmaceutical use,

(v) meeting sterility specification (removal of microorganisms) required for some products using *sterile filtration or aseptic filtration*

(vi) Sterilization of solutions and suspensions that are chemically or physically unstable under heating conditions

(vii) detection of microorganisms present in liquids by analyzing a suitable filter on which the bacteria are retained and

(viii) assessment of the efficacy of preservatives. Recently, techniques such as nanofiltration, ultrafiltration, and microfiltration have been used to recover colloidal delivery systems from mother liquor

MECHANISMS OF FILTRATION

Four different mechanisms of filtration according to the way in which the suspended material is trapped by the filter medium are as follows: **1) Surface Straining**

In surface straining, any particle that is larger in size than the pores of the medium deposits on the surface, and stays there until it is removed. Particles that are smaller in size than the pores pass quickly through the medium **2) Depth Straining**

Depth straining is also governed by particle size or shape. For filter media that are relatively thick in comparison with their pore diameters, particles will travel along the pore until they reach a point where the pore narrows down to a size too small for the particles to go any further, so that they become trapped

3) Depth Filtration

In depth filtration, the particles become entrapped in the depth of the medium, even though they are smaller in diameter, and possibly much smaller, than the pore at that point. They become attached to the pore wall, or to another particle already held by means of van der Waals and other surface forces (*entanglement*)

4) Cake Filtration

Cake filtration (which is a development of surface filtration) begins with the formation of a layer of particles on the surface of the filter medium, with larger pores bridged by a group of smaller particles. On this layer, a cake of particles accumulates to act as the filter medium for subsequent filtration. Cake filtration in which solid recovery is the goal is an important pharmaceutical process

These definitions emphasize that the mechanisms of filtration may result in the trapping of far smaller particles than might be expected from the size of the pores in the medium. The actual mechanism or combination of mechanisms in any specific instance is dependent on the characteristics of both the medium and the suspension being filtered