

### DDR COLLEGE OF PHARMACY

#### PHARMACEUTICS – I

#### D. Pharmacy First Year

**Question 01:** Define sterilization. Discuss briefly various methods of sterilization. Differentiate between dry and moist heat Sterilization.

**Question 02:** What should be characteristics of material for containers? Discuss glass & plastics containers in detail for packaging of pharmaceutical preparations with merits and demerits.

**Question 03:** Enumerate the various factors affecting size reduction. What is need or importance of size reduction? Discuss ball mill and fluid energy mill in detail.

**Question 04:** a) Explain the evaluation of tablets.

(b) What is significance of adding binding agent to powder mixture in manufacturing of tablets? Give examples of binder

**Question 05:-** Define aerosols and discuss about their packaging. Give advantages and disadvantages of aerosols.

**Question 06:** Write a short note on the following:

(a) Aseptic technique (b) Lavigation and Elutriation (c) Isotonic solution (d) Freeze drying **Question**

**07:** Write short a note on: (a) Grades of powder as per I.P (b) Sieving/Sifting (c) Filter aids (d) Cyclone separator (e) Steam distillation

**Question 08:** Discuss any four (a) Pasteurization (b) Maceration process (c) Difference between sterilization and disinfection (d) Sintered glass filters (e) Colloid mill (f) Tray dryer

**Question 09:** Write the difference between hard and soft gelatin capsule. Discuss with the help of neat and well labeled diagram the filling of hard and soft gelatin capsule.

**Question 10:** (a) Define filtration. Discuss filter press in detail.

(b) Define extraction. What is percolation? Explain its method with advantages and disadvantages.

**Question 11:** (a) Define immunity. Explain B.C.G and D.P.T vaccine.

(b) What is Pharmacopoeia? Explain Indian Pharmacopoeia and British Pharmacopoeia in detail.

**Question 12:** Define the following terms: (a) Linctuses (b) New drug delivery system (c) Emulsions (d) Suspension (e) Tablets (f) Syrups (g) Elixirs.

**Question 13:** Differentiate the following terms:-

(a) Organized/Unorganized drugs (b) Purified water I.P. and Water for injection I.P (c) Liniments and Lotions (d) Mouth washes and Gargles (e) Sera/vaccines & Toxoids (f) Active and Passive Immunity (g) Wet granulation and Dry granulation (h) Evaporation and Drying (i) Infusion and Decoction

**Question 14:** Define the given terms: (a) Antigen (b) Phagocytosis (c) Enteric coating (d) Satvas (e) Bhasam (f) Sieve number

### ANSWERS

**Pharmaceutics:** It is branch of science that deals with the formulation of an effective dosage form of active medicament, which is administered by suitable route to produce desired pharmacological effect.

**Question 01: Define sterilization. Discuss briefly various methods of sterilization. Differentiate between dry and moist heat sterilization.**

**Ans. Sterilisation:** Sterilization may be defined as process of removing or destroying all the living microorganisms present in any preparation or part thereof. Various methods of sterilization are used to prepare the pharmaceutical products.

#### Methods of sterilization:

##### (1) Physical method:

- a) Dry heat sterilization: It includes flaming technique, hot air oven method and sterilization by I.R radiations.
- b) Moist heat sterilization - It includes autoclaving, tyndalization and pasteurization.
- c) Radiation sterilization - By UV and gamma radiations.

**(2) Chemical methods:** Chemical methods of sterilization includes sterilization by heating with bactericides and gaseous sterilization.

**(3) Mechanical methods:** In this process sterilization is done by filtration with bacteria proof filters. These are ceramic filters, seitz filter, sintered glass filters, sintered metal filters, and membrane filters.

**(1) Physical methods:** All microorganism including spores, can be killed by the application of heat. Heat can be applied in different forms in sterilization.

**(a) Dry heat sterilization:** In dry heat sterilization the microorganisms are destroyed due to oxidation of essential cell constituents. Dry heat sterilization is mainly done by "Hot air oven".

**Hot air oven:** It is used for sterilization of pharmaceutical products and other materials. It is double walled chamber made of steel. This method is used for sterilization of those substances, which get spoiled during moist heat sterilization. According to pharmacopoeia sterilization by dry heating is effected by heating at a temperature of  $160^{\circ}\text{C}$  for 1 hour for most of the equipments.

#### Advantages:

- 1) It is used for sterilization of those substances, which get spoiled during moist heat sterilization. For example oily materials and powders are destroyed due to presence of moisture in moist heat sterilization.
- 2) It is not so damaging to glass and metal equipment as moist heat.

### Disadvantages:

- 1) This technique is not suitable for thermolabile and aqueous and alcoholic preparation.
- 2) Rubber closures and surgical dressings cannot be sterilized by this method.

### Uses:

- 1) This method is used to sterilize the glass wares.
- 2) This method can be used for the equipments like mortar pestle, ointment tubes and surgical equipments.
- 3) Fixed oils, ointment base, liquid paraffin and wool alcohol can also be sterilized by this method.
- 4) This technique can also be used for surgical catguts and gelatin sponge.

**(b) Moist heat sterilization:** This method is more effective than dry heat method, due to the fact that steam has more penetration power than dry heat. The moist heat penetrates the spores and capsules of bacteria, ruptures it and escaping protoplasm is coagulated. Generally the holding temperature in moist heat sterilization is  $121^{\circ}\text{C}$  to  $124^{\circ}\text{C}$  for 15 minutes. In this method the instrument used for sterilization is "**Autoclave**". In which steam is used for sterilization. Other methods of moist heat sterilization are tyndallisation, pasteurization and sterilization of vaccines

### Advantages:

- 1) Autoclaving destroys microorganisms more efficiently than dry heat sterilization.
- 2) Equipments or parts of rubber and plastic, such as, nylon and polyvinyl chloride can withstand the temperature and pressure required for moist heat sterilization.
- 3) Sterilization can be done after packing the pharmaceuticals preparations in its final container.

### Disadvantages:

- 1) This technique is not suitable for oils, fats, ointments, powders and oily injection and aqueous and alcoholic preparation.
- 2) It cannot be used for sterilization of plastic which get spoiled at  $115-116^{\circ}\text{C}$  for 30 minutes.

### (c) Radiation Sterilization:

**Sterilization by ultra-violet light:** Direct sunlight can destroy microorganism on account of its ultra violet rays of long wavelength. Ultra-violet rays for sterilization can be produced by passing a low current at high voltage through mercury vapour in an evacuated glass tube.

**Sterilization by ionizing radiation:** The ionizing radiations are x-rays and  $\gamma$ -rays. These are lethal to bacterial cell and destroy the nuclei of the bacterial cell. Gamma rays are produced from radioisotopes such as Cobalt-60 or Cesium-137. The material to be sterilized is packed in the final container and then exposed to ionizing radiations.

### (2) Chemical methods:

**(a) Sterilization by heating with bactericide:** This method is used for sterilizing aqueous preparations,

which are unstable at higher temperature. The medicament is dissolved or suspended in a suitable

solution of bactericide. The preparation is then transferred into its final container, which is then sealed so as to exclude microorganisms and the final container is then heated at 98-100°C for 30 minutes in boiling water.

**(b) Gaseous sterilization:** In this process sterilization is done with a chemical in gaseous state. Formaldehyde was used in olden days but now ethylene oxide is used for sterilization.

**(3) Mechanical methods:** The solution containing thermolabile medicament can be sterilized by filtration through bacteria proof filters. These filters retain the bacteria and sterile filtrate is collected in sterilized receiver. Various filters used for sterilization are: (i) Membrane filters (ii) Ceramic filters (iii) Sintered glass filters (iv) Seitz filter (v) Sintered metal filters. Only important one membrane filter is discussed here.

**(a) Membrane filters:** These are made up of cellulose acetate or cellulose nitrate. These are fixed in metallic holders. The pore size in the membranes lies in the range of 0.01 to 14  $\mu\text{m}$ . These are also called millipore filters. Pore size of 0.2-0.22  $\mu\text{m}$  best for sterilization. Membrane filters are suitable for sterilizing aqueous and oily solutions but are not suitable for organic solvents such as, alcohol and ketones etc. Filtration can be carried out under positive or negative pressure.

**Advantages:** This technique is suitable for thermolabile preparations. This process occurs continuously. It is very rapid and useful process for large quantity of solution.

**Disadvantages:**

- 1) Process has to be carried out under aseptic conditions.
- 2) This technique cannot be used for the suspensions and viscous liquids.
- 3) Toxins and pyrogens cannot be removed
- 4) Clogging of filter media can takes place.

### Difference between moist and dry heat sterilization

S. no.	Moist heat sterilization	Dry heat sterilization
01.	In Moist heat sterilization steam is used which also penetrates in bacterial spores and cause coagulation of protoplasm part of bacteria.	In dry heat sterilization the microorganism are killed due to oxidation of bacteria.
2.	This method is used for killing bacteria and bacterial spores.	Only bacteria are killed by this method. Spores are not killed.
3.	Surgical dressing, rubber and plastic containers can be sterilized easily without any deterioration.	Oily material, powders, which get spoiled during moist heat sterilization, can be sterilized easily.
04.	Temperature of sterilization is 121 to 124 °C for 15 minutes.	Temperature of sterilization is 160°C for one hour.

05.	This method is suitable for most of the medicaments as the temperature of sterilization is comparatively low for shorter duration, however the medicaments that get deteriorated in the presence of moisture cannot be sterilized.	This method is not suitable for most of the medicaments as the temperature of sterilization is very high for long duration. However the medicaments that get deteriorated in the presence of moisture can be sterilized.
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**Question 02: What should be characteristics of material for containers? Discuss glass & plastics containers in detail for packaging of pharmaceutical preparations with their merits and demerits.**

**Ans. Packaging:** It may be defined as an art or science involves in preparing the goods or items for safe transportation, storage, display and use of the products to ultimate customer in desired conditions with minimum efforts. Various types of containers and closures are used to pack pharmaceutical products.

**Containers:** Container has been defined as a device that holds the drugs and it may or may not be in direct contact with the pharmaceutical preparations.

**Closures:** - Closures are the device by means of which container can be opened and closed.

**Characteristics of material used for containers:**

- 1) The material must not interact physically or chemically with the substance which is retained, so as to change the strength, quality or purity of the substance.
- 2) It should help in maintaining the stability of the product against the environmental factors which cause its deterioration.
- 3) The material used for making of container must be non-toxic.
- 4) It should not impart any taste or odour to the preparations.

Generally the materials used for making of container and closure are **glass containers** and **plastic containers**.

**Glass containers:** Glass containers are very commonly used in pharmaceutical packaging because of following advantages.

**Advantages of glass containers:**

- 1) Glass containers are transparent and allow visual inspection.
- 2) Glass apparatus are rigid, strong and can be withstand at very high pressure.
- 3) They are available in different shapes and sizes.
- 4) They are available in different compositions. So according to the product we can select the containers of desired features.
- 5) They protect the photosensitive medicament from light.

- 6) They are heat resistant and can be easily sterilized.
- 7) They can be easily drawn or moulded into various shapes.

### Disadvantages of glass containers:

- 1) **Flaking:** Sometimes at very high temperature alkali gets started to leach out from the glass containers. This results in the formation of silica rich layer in the form of shiny flakes. So, this is main problem in the case of injectables.
- 2) **Weathering:** In case of high moisture content, moisture condenses on the surface of glass and a white deposit is left which mainly contains alkali carbonates. If deposit is allowed to remain on the surface of glass container then further condensation may lead to formation of alkaline solution which dissolves the silica and cause the loss of brilliance of glass containers.
- 3) **Fragility:** Glass containers are fragile in nature, therefore there are more chances of loss of content or dosage forms.

### The various types of glass containers used in pharmaceutical packaging are:

Type	Composition	Remarks	Uses
<b>Type-I (Borosilicate glass)</b>	SiO <sub>2</sub> -80%, Boric acid-12-14%, Al <sub>2</sub> O <sub>3</sub> -2-3%, Na <sub>2</sub> O- 4-5%, CaO and others-less than 1%	Highly heat resistant material, higher chemical stability, higher hydrolytic resistance. Difficult to mould it. Costly or uneconomical.	For laboratory glasswares, ovenwares and for alkali-sensitive products.
<b>Type-II (Treated soda-lime glass or sulphured containers)</b>	SiO <sub>2</sub> -75%, Al <sub>2</sub> O <sub>3</sub> -2%, Na <sub>2</sub> O- 10%, CaO 10%	Highly heat resistant material. Higher chemical stability. Higher hydrolytic resistance due to surface treatment by sulphur dioxide. Can be easily moulded. Economical than Type-I glass.	Used for alkali sensitive products and parenteral products.
<b>Type-III (Soda lime ordinary glass)</b>	Mainly have SiO <sub>2</sub> -75%, CaO (lime stone 0-12% and soda ash- 12-19%.	It is cheap having low melting point, can be easily moulded and having high concentration of alkali oxide. It has very low mechanical strength and liberates alkali.	It can be used for solids products.
<b>Type-IV-NP (Non-parenteral)</b>	It is also called as general purpose soda-lime glass.	It cannot be used for the parenteral products.	It is used for oral and topical preparations.
<b>Colored glass</b>	During the preparation small amount of metal oxides like Cu, S, Fe and MnO <sub>2</sub> are added	Ultra violet rays cannot pass through it. Metal may leach out from glass, so it is not suitable for the preparations, which react with	Used for light sensitive drugs.

	during the fusion to provide the color.	metals.	
<b>Silicon treated glass</b>	Soda lime glass is treated with dimethyl siloxane.	It is chemically inert, resistant to heat and oxidation. It does not impart any color and odour to the preparations.	It can be used for liquid preparations and parenteral but cannot be reused because it gets erodes on repeated heating.
<b>Neutral or Resistant glass</b>	It is inter-mediate between borosilicate and soda-lime glass (Type-I and II)	It is highly heat resistant and imparts no alkalinity. It is cheaper than Type-I.	Widely used for parenteral products.

**Plastic containers:** Plastic containers are becoming very popular for packaging different sterile or nonsterile products including injection, dialysis fluids and eye drops. Ready filled disposable plastic syringes are also very popular. This popularity is due to the variety of plastics available and their adoptability to many package forms like bottles, boxes, pouches, syringes and tubes. Generally plastic may be classified as two types: (1) Thermosetting plastic (2) Thermoplastic plastic

**Thermosetting plastic:** It is very hard and brittle at room temperature but becomes flexible at high temperature. It is generally used for the closures. e.g. phenol-formaldehyde resin, urea- formaldehyde resins and melamine formaldehyde.

**Thermoplastic plastic:** It softens to viscous fluid on heating and again become hard on cooling. It is more popular in nature and used for packing the mixtures, tablets, capsules and ointments. From various types of thermosetting plastics, only PVC is used for I.V. fluids and polyethylene, polystyrene and polyamides are used in packaging of pharmaceutical products. Polypropylene plastic containers are more resistant to heat, flexible, economical and can be autoclaved repeatedly. They can be used for disposable syringes, for dialysis fluid, syrups and packaging of juices. Polystyrene plastic is hard, rigid easy to mould, cannot be sterilized and permeable to water. It is used only for making jars, closures and bottles etc.

**Advantages of plastic containers:**

- 1) They are light in weight, economical, tough and flexible.
- 2) They have sufficient mechanical strength.
- 3) They can be transported easily.
- 4) They are unbreakable.

**Disadvantages:**

- 1) They are permeable to water vapors.
- 2) They cannot withstand heat without softening.

3) They may interact with certain chemicals.

**Question 03: Enumerate the various factors affecting the size reduction. What is the need or importance of size reduction? Discuss ball mill and fluid energy mill in detail.**

**Ans. Size reduction:** It is the process of reducing drugs into small particles or fine powder. Crushing, grinding, milling and pulverization all are the synonyms of size reduction.

**Factors affecting size reduction:**

- (a) **Method of size reduction:** The selection of the method of size reduction depends upon the physico-chemical properties of the dosage forms.
- (b) **Hardness:** Hardness of a material depends upon its surface properties that can be determined with the help of Moh's scale. This scale gives the no. from 1 to 10. It is difficult to reduce the particle size of a hard material (moh's no. 7) and soft material having the moh's no.3
- (c) **Toughness:** It is more difficult to reduce the size of a soft and tough material as compared to the hard and brittle material.
- (d) **Stickiness:** Stickiness causes the adhering of the material to the grinding surface. Mainly this problem occurs in the case of gummy and resinous material.
- (e) **Moisture content:** Moisture content has a great effect on the hardness, toughness and stickiness which effects the size reduction of a drug. Moisture content below the 5% is suitable for the dry grinding and greater than 50% is suitable for the wet grinding.
- (f) **Purity required:** Certain size reduction equipments involves considerable wear and tear of grinding surface. So it should be avoided if high degree of purity is required.
- (g) **Bulk density:** The capacity of most of the batch mills depends upon the volumes. The volume of a material depends upon the bulk density of it.
- (h) **Temperature:** In case of the thermolabile drugs that may undergo degradation and very fine powder may explode if there is an excessive increase in the temperature occurs.

**Objectives of particle size reduction:** Size reduction is required

- 1) To increase the rate of solubility because particle size reduction leads to increased surface area, this results in increased solvent action.
- 2) To allow the rapid penetration of solvent.
- 3) To get a uniform powder because particle size reduction helps in uniform mixing of drugs.
- 4) To increase the rate of absorption of drug. The smaller the size, greater will be the absorption.
- 5) To improve the stability of dosage form like suspensions.
- 6) To help in separation of solid from liquid by filter action or by sedimentation.

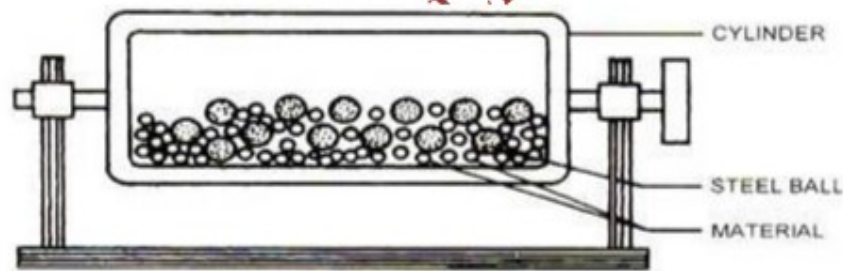


**Ball mill**

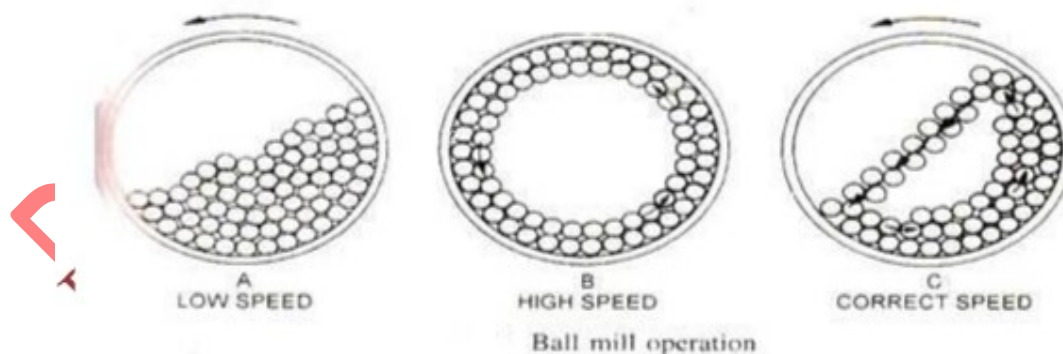
**Principle:** It works on the principle of impact and attrition.

**Construction:** It consists of a hollow cylinder, which is mounted on metallic frame in such a way, that it can be rotated on its longitudinal axis. The length of the cylinder varies usually 1-3 meters in diameter. The cylinder contains balls that occupy 30-50% of the mill. The balls are made up of the same material as that of the cylinder. These balls act to grind the material. If the pebbles, rod or bars are present at the place of balls, then they are called as pebble mill, bar mill or rod mill respectively. The mill usually contains the balls of different size so the efficient reduction in particle size takes place. The upper size of the cylindrical vessel is fitted with the tightly closed lid through which the material can be introduced.

**Working:** The drug to be grounded is put into the cylinder of the mill and mill is rotated. The speed of rotation is very important. At low speed, the mass of balls will slide or roll over each other and size reduction does not take place. At high speed, balls will throw out to the walls by centrifugal force and no grinding will occur. At  $2/3$  speeds, the centrifugal force just occurs with the result that the balls are carried almost to the top of the mill and then fall. After suitable time, material is taken out and passed through sieve to get a powder of uniform size.



Ball Mill

**Uses:**

- 1) The mill used to grind brittle drugs to fine powder.
- 2) It can also be used for wet grinding

also. **Advantages:**

- 1) It can produce very fine powders.
- 2) It can be used for continuous production if sieve is attached.
- 3) Suitable for wet and dry grinding.
- 4) It can also be used to grind toxic materials.

### **Disadvantages:**

- 1) It is very noisy machine.
- 2) Wear and tear occurs from the balls.

### **Fluid energy mill**

**Principle:** It works on the principle of impact and attrition.

**Construction:** It consists of a hollow loop of pipe, which has a diameter of 20 to 200 mm depending on the overall height of loop, which may be upto about 2 m. The lower part of the loop has the nozzles through which a fluid, generally compressed air is injected at very high pressure. The mill has an inlet and outlet for the entry and exit of the material. For the collection of the reduced particles a cyclone separator is also present at the outlet.

**Working:** The air or inert gas is introduced with a very high pressure through the nozzles. Solid are introduced into air stream through inlet. Due to high degree of turbulence, impact and attritional forces occurs between particles. The fines particles are collected through classifier.

### **Uses:**

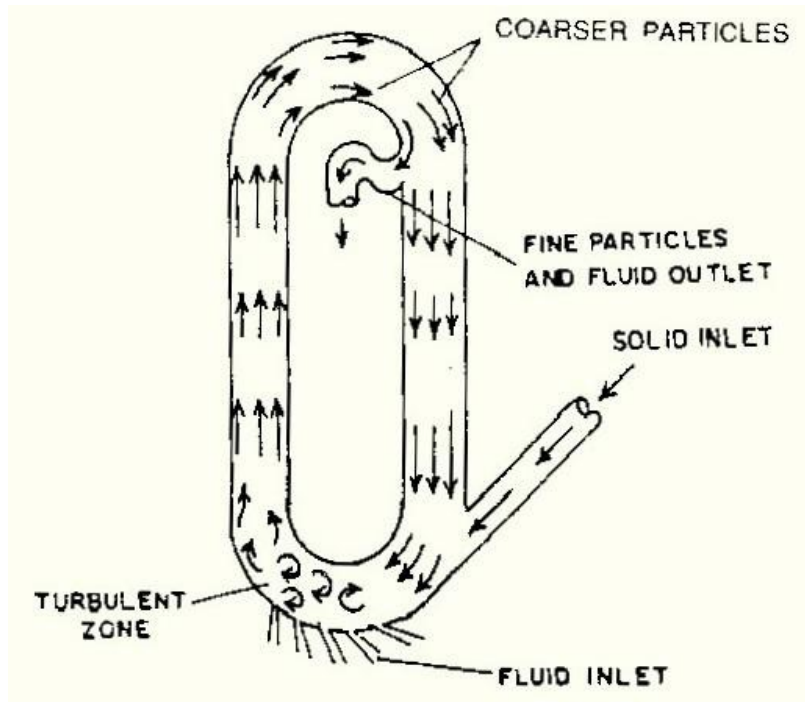
- 1) The mill is used to grind heat sensitive material to fine powder.
- 2) It is used for coating of fine particles.

### **Advantages:**

- 1) The particle size of powder can be controlled due to the use of a classifier.
- 2) There is no wear and tear in the mill.

### **Disadvantages:**

- 1) Process is not economical,
- 2) Premilling is also required.



Fluid Energy Mill

**Question 04:** (a) Explain the evaluation of tablets.

(b) What is significance of adding binding agent to powder mixture in manufacturing of tablets? Give example of binder.

**Ans. (a) Evaluation of tablets (quality control of tablets):**

The various tests are carried out to maintain quality control of tablets as prescribed in pharmacopoeia. These are as follow:

**1) Shape of tablets:** In the pharmacopoeia the shape of the tablets is defined as circular with flat or convex faces.

**2) Appearance:** When broken section of an uncoated tablet is examined under a lens, uniform texture of single layered tablet or a stratified texture in multilayer tablet. Coated tablets will appear with a smooth and colored surface.

**3) Uniformity in weight:** It is desirable that every drug or tablet should have uniform weight. Little variation is liable to occur but large variation cannot. Test for uniformity in weight: 20 Tablets are selected and determined their average weight and not more than two tablets vary from average weight by more than the percentage deviation given in the table:

*Average weight of tablet*

*Percentage deviation*

(i) 80 mg or less

10

(ii) More than 80 mg but less than 250 mg

7.5

(iii) 250 mg or more

5

**4) Uniformity in content:** Tablet must comply with the requirement for uniformity of content specified in the individual monograph. The percentage of medicament is calculated by doing assay for a particular drug, by the method that is given in pharmacopoeia. If any drug does not comply with test, it is rejected.

**5) Measurement of hardness or mechanical strength:** Mechanical strength determines the strength or hardness of a tablet. It is necessary to ensure that the tablets should withstand the normal risk of handling and transportation. The instruments which are used for testing the hardness of tablets are *Monsanto hardness tester* and *Pfizer hardness tester*

**6) Friability test:** During the course of compression of tablet, a sufficient pressure is applied on the granules, so that tablet can withstand wear and tear during transportation. In this test a tablet friabilater is used. The apparatus consists of a plastic chamber, which is divided into two parts and it revolved at a speed of 25 r.p.m. 20 tablets are weighed and placed in the plastic chamber. The chamber is rotated for 4 minutes or 100 revolutions. During each revolution tablet falls from the distance of 6 inches. Loss in weight is indicated by weighing the tablets after 100 revolution. The tablet is considered to be of good quality if the loss of weight is less than 0.8%.

**7) Disintegration test:** Disintegration of a tablet means breakdown of the tablet into smaller particles after swallowing. The time required to disintegrate the tablet is called "Disintegration Time". The rate of disintegration depends upon type of tablet. In this test the instrument used is known as Disintegration apparatus. If a tablet does not comply with the test time, it is rejected or again tested if any error exists in testing.

**8) Dissolution test:** Dissolution test is generally performed to determine the amount of active ingredient dissolved in the specified time. The dissolution media and time is specified in particular monographs in I.P. Generally two types of dissolution apparatus are used for the dissolution of tablets and capsules.

*Type-I apparatus (basket type apparatus) and Type-II apparatus (paddle type apparatus).*

**Type-I apparatus (basket type apparatus):** Basket type apparatus is generally consists of a cylindrical vessel made up of borosilicate glass apparatus with hemispherical bottom *having* the capacity of 1000 ml. A vertical shaft is attached with an electrical motor which rotates the basket. Water bath is set up to the temperature  $37 \pm 2^{\circ}\text{c}$ .

**In case of Type-II apparatus (paddle type apparatus)** assembly is same as type-I apparatus except that the stirring equipment is paddle.

**Procedure:** Put the tablet into the basket in type-I apparatus and directly into the vessel in case of type-II apparatus and put the dissolution media in the vessel. The temperature of the vessel should be maintained at  $37 \pm 0.5^{\circ}\text{c}$ . Rotate the basket or paddle for the specified time period and withdraw the aliquot samples of dissolution media after a specified time intervals. Immediately replace the equal volume of dissolution media

to the vessels and then calculate the amount of dissolved active ingredient by U.V. analysis in solution and calculate the % age of stated amount that comply with the standard. Standards according to the Indian Pharmacopoeia are given in the table.

Stage	No. of the tablets tested	Acceptance
S <sub>1</sub>	6	Each tablet should have the dissolution not less than $D \pm 5\%$
S <sub>2</sub>	6	Average of 12 tablets should have the dissolution $\geq D$ and no tablet should have the value less than $D-15\%$ .
S <sub>3</sub>	12	Average of 24 tablets should have the dissolution $\geq D$ and only two tablets should have the value less than $D-15\%$ and no unit should show the value less than $D-25\%$ .

*Where D is the amount of dissolved active ingredient dissolved in specified monograph.*

**Ans. (b) Significance of binding agent-** Binding agents are added to glue the powder and cause them to form granules. They also increase the cohesive strength of the formulation. The choice of binding agent depends on the binding force required to form the granules and its compatibility with the drug and other additives. There might be two ways of adding binding agents to the formulation. One is to add in dry form and blend it with the powder mixture and then activate it by the addition of other solvent. Second is to add in the form of slurry or paste and then mix it with dry powder mixture. Some of the binding agents that find use are water, alcohol, acetone, starch paste, sucrose syrup, gelatin solution, acacia mucilage.

**Question 05:- Define aerosols and discuss about their packaging. Give advantages and disadvantages of aerosols.**

**Ans.** Aerosols may be defined as disperse phase system in which very fine solid particles or liquid droplets or gaseous phase get dispersed in the gas, which acts as a continuous phase. This is also known as pressurized system because medicaments come out of container when pressure is applied on valve. **Classification of**

**Aerosols:** Aerosols may be classified as:

- 1) **Space sprays:** These are finely divided sprays having particle size upto  $50 \mu$  e.g. insecticides.
- 2) **Surface coats:** These are also sprays but disperse particles are of coarse size upto  $200 \mu$ . They produce a wet coat when sprayed on a surface e.g. hair sprays, personal deodorant.
- 3) **Foam:** These are produce by rapid expansion of propellants through an emulsion. Hence, the product comes out in the form of a foam or froth e.g. shaving cream.

**Packaging of Aerosols:** The aerosols products can be filled in aerosol containers by two ways:

- (a) Cold-fill process    (b) Pressure- fill process

**(a) Cold-fill process:**

- 1) This process is used to fill metered aerosol products using a fluorocarbon propellant. By lowering the temperature of a propellant below its boiling point, the propellant becomes liquid at atmospheric pressure.
- 2) The active ingredients and propellant are cooled to a low temperature of about  $-30^{\circ}\text{F}$  to  $-40^{\circ}\text{F}$ .
- 3) The active ingredients are generally cooled to below  $0^{\circ}\text{C}$  in order to reduce loss of propellant during the filling operation. The chilled active ingredients are poured into chilled container and propellant is added.
- 4) Sufficient time is given for the propellant to partially vaporize, in order to expel the air present in the container.
- 5) The valve is fitted on to the container which is placed into a water bath so that the contents are heated to  $130^{\circ}\text{F}$  ( $54^{\circ}\text{C}$ ) in order to check any leakage and strength of container.

**(b) Pressure-fill process:** This process is used for filling aerosols containing hydrocarbon propellant. The product concentrate is placed into the container and the valve is sealed. The propellant is forced through the valve under pressure. After this the container is immersed in a water bath at  $130^{\circ}\text{F}$  (or  $54^{\circ}\text{C}$ ) in order to check any leakage and strength of the container. It is essential that the air present in the container must be expelled before filling the contents into the aerosol container.

### **Advantages:**

- 1) The medicament can be delivered directly to the affected area.
- 2) Absence of air prevents oxidation of product.
- 3) The hydrolysis of medicament can be prevented.
- 4) Drug can be given by oral inhalation.
- 5) Sterility of the product is maintained.
- 6) The application of medicament is easy.
- 7) Drug decomposition does not take place.

### **Disadvantages:**

- 1) Aerosol packaging process is costly.

- 2) Sometimes propellants are toxic.
- 3) Cooling effect of volatile propellants may cause discomfort.

**Question 06: Write a short note on the following:**

**(a) Aseptic technique (b) Lavigation and Elutriation (c) Isotonic solution (d) Freeze drying**

**Ans. (a) Aseptic technique:** The method that is used to prevent the entry of microorganisms during the preparation of parenteral products and their testing. Good aseptic technique can only be applied if one knows the possible sources of contamination.

**The various sources of contamination are:**

- 1) Atmosphere, which is contaminated with dust droplets.
- 2) The hands are a major means of infection.
- 3) The unsterile equipments.
- 4) Coughing and sneezing also cause contamination.
- 5) Hairs, the working surface and raw materials are also the part of contamination.

**To minimize the contamination following steps should be considered.**

- 1) Design of working area or Aseptic room and cleaning of working area.
- 2) Sterilization of surgical and various equipments.
- 3) Cleaning of walls, floor, and windows and working bench.
- 4) Use laminar air flow cabinet.
- 7) Gowns should be worn over normal clothing.

So by these methods we can prevent the entry of microorganism.

**(b) Lavigation and Elutriation:** Levigation is the process of wet grinding. The material is converted into paste with water and then grinding of paste is done in a mortar. In case of large scale, grinding is done by using colloidal mill. The process is used for the preparation of light kaolin chalk, red and yellow mercuric oxide. After the process of levigation, the paste obtained contains fine particles along with small proportion of coarse particles. The fine particles are separated from coarse particles by process of elutriation.

**Elutriation** is the process of separation of fine particles and coarse particles from a paste obtained from levigation. The paste is mixed with a large volume of water and the mixture is allowed to stand for a short period during which the heavy coarse particles with high density settle down on the bottom of vessel. The fine particles of low density remain suspended in upper layer. The upper layer liquid is poured off and the fine particles are allowed to settle down on the bottle. The wet paste containing fine particles is then dried. On large scale elutriation tanks are used.

**(c) Isotonic solutions:**

Osmosis is the flow of solvent from low concentration of solute to high concentration of solute through a semi permeable membrane. The solutions having same osmotic pressure are known as iso-osmotic solutions.

When a R.B.C. cell is placed in contact with a solution that has same osmotic pressure as that of blood plasma, the cell wall will neither swell nor shrink. It means it will retain its tone and therefore the solution is said to be isotonic. It is not necessary that solutions, which are isoosmotic, will also be isotonic. Parenteral preparation should be iso-tonic with blood plasma, but there can be some flexibility depending on the route of administration and quantity of solution to be injected.

**(d) Freeze drying:** In freeze-drying process, there is removal of water vapors from a frozen material by sublimation. Therefore it is also called sublimation drying process or lyophilization.

**Theory:** In this process, the material is frozen in a suitable container connected to a high vacuum system, so that the vapour pressure of water vapours is reduced to less than that of the material being dried. It reduces the temperature and pressure to values below the triple point. Under these conditions, ice sublimates directly to vapour state. The water vapours are removed from the system by condensation in a condenser maintained at a temperature lower than temperature of a frozen material. The process is mainly used for drying of biological products such as antibiotics, blood products, and vaccines.

**Parts of freeze dryer:**

(i) A chamber for vacuum drying (ii) A vacuum source (iii) A heat source (iv) A Vapor removal system

**Working:** The working of freeze dryer involves the following steps.

**1) Pre-treatment:** This step is done to reduce the volume of the solution to be introduced into the container which has limited capacity. The solution is pre-concentrated under normal vacuum tray drying.

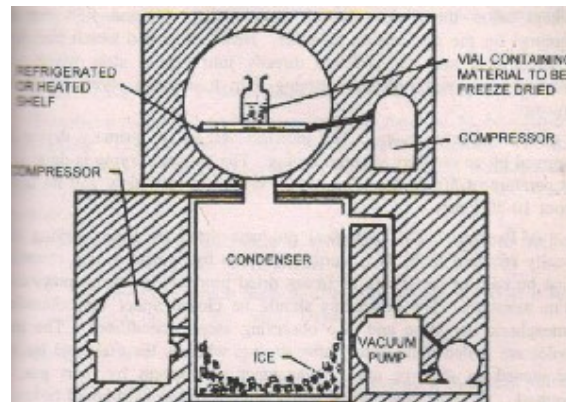
**2) Pre-freezing:** This is done to solidify water. The ampoules, vials and bottles in which aqueous solution is packed, are frozen in cold shelves at a temperature below  $-50^{\circ}\text{C}$ .

**3) Primary drying:** the material to be dried is spread to increase the surface area for sublimation. Heat is supplied which transfers as latent heat and ice sublimates directly into vapor state which are ultimately removed.

**4) Secondary drying:** The moisture left in the primary drying is removed by an ordinary vacuum drying. The vacuum drying is done at a temperature of  $50^{\circ}\text{C}$ - $60^{\circ}\text{C}$ .

**5) Packing:** The biological products dried by freeze drying are packed in sterile container under sterile conditions.





Freeze Dryer

**Advantages:** 1) The product obtained is light and porous having excellent solubility.

- 2) The heat sensitive material can be dried.
- 3) The loss of volatile material is minimum.
- 4) The sterility of the product is maintained.

**Disadvantages:** 1) The process is very expensive.

- 2) The product obtained by freeze-drying is hygroscopic.

**Question 07: Write short note on: (a) Grades of powder as per I.P (b) Sieving/Sifting (c) Filter aids (d) Cyclone separator (e) Steam distillation**

**Ans. (a) Grades of powder:** The I.P/ B.P specifies 5 grades of powder:-

- 1) **Coarse powder:** A powder of which all the particles pass through sieve no. 10 and not more than 40% pass through sieve no. 44.
- 2) **Moderately coarse powder:** A powder of which all the particles pass through sieve no. 22 and not more than 40% pass through sieve no. 60.
- 3) **Moderately fine powder:** A powder of which all the particles pass through sieve no. 44 and not more than 40% pass through sieve no. 85.
- 4) **Fine powder:** A powder of which all the particles pass through sieve no. 85.
- 5) **Very fine powder:** A powder of which all the particles pass through sieve no. 120.

**(b) Sieving/Sifting:** In sieving, the fine powder is separated from the coarse powder by using sieve of desired number. The degree of fineness of powder is known with the help of sieve through which the powder material is passed. Size separation of powder is done by passing the powdered material through a set of sieves. Sieves are arranged in descending order according to their pore size. It means the sieve of the large pore size is at the

top and smallest one at the bottom. The bottom sieve is attached to a receiving pan. The material is placed in the upper most sieves. The sieves are shaken with help of mechanical sieve shaker. During the vibration of the sieve a fraction of powder will be retained on each sieve while other fraction will pass through the sieve. After shaking for required period of the time, the machine is stopped and for the purpose of analysis. The weight of each fraction is determined and the % is calculated.

**(c) Filter aids:** These are the substance, which reduce the resistance of the filtrate to flow. These are added to the preparation in concentration from 0.1 to 0.5% before filtration. An ideal filter aid should possess the following qualities.

- i) It should be able to remain suspended in the fluid.
- ii) It should be free from impurities.
- iii) It should be inert to the liquid being filtered.
- iv) It should have a particle size distribution suitable for retention of solid as required.

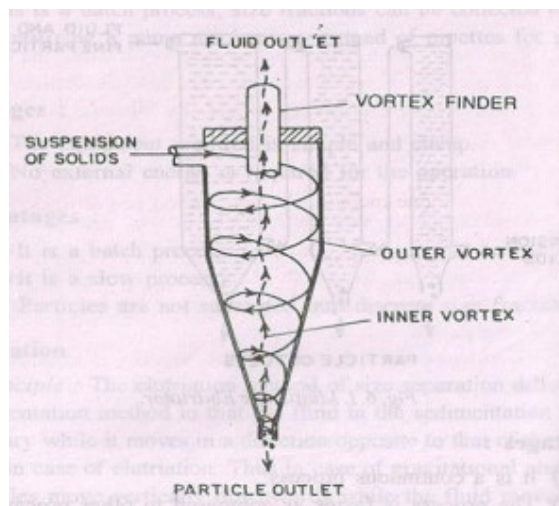
The object of the filter aid is to prevent the filter medium from becoming blocked. Filter cake must be light, porous and inert. Various filter aids are used like cellulose asbestos, carbon and diatomaceous earth. They are used according to their advantage and chemical composition.

**(d) Cyclone separator:**

**Principle:** In cyclone separator, the centrifugal force is used to separate solids from fluids. The separation depends upon particle size and density of particles.

**Construction:** It consists of cylindrical vessel with a conical base. The upper part of the vessel is fitted with a tangential inlet and a fluid outlet and at the base it is fitted with solid outlet.

**Working:** The suspension of a solid in gas is introduced tangentially at a very high velocity, so that rotary movement takes place within the vessel. The fluid is removed from a central outlet at the top. The rotatory flow within cyclone separator causes the particles to be acted on by centrifugal force. The solids are thrown out to the walls; thereafter it falls to the conical base and discharged out through solids outlet.

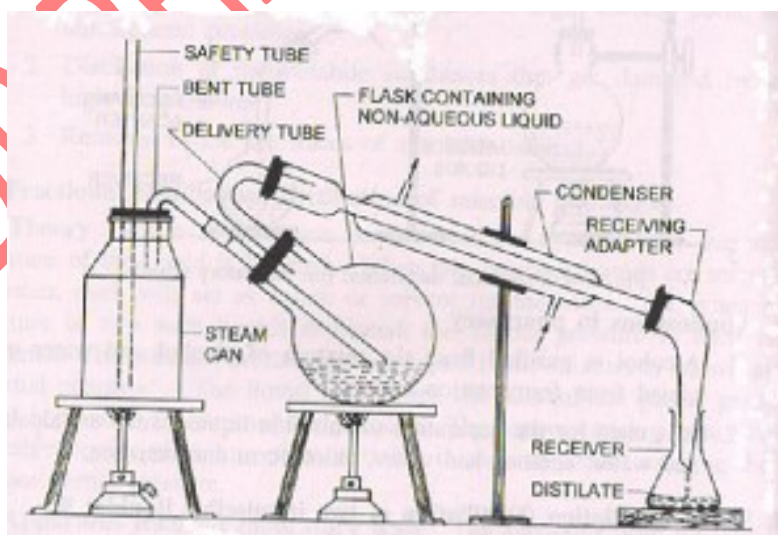


Cyclone Separator

**(e) Steam distillation:**

**Distillation:** Distillation is the process of converting liquid into its vapours by heating and reconvertng it again into liquid by condensing the vapours. It is a method of separating substances which differ in their vapour pressure. Steam distillation is used for the separation of two immiscible liquids or preparation of volatile oils.

**Apparatus for steam distillation:** It consists of steam can, safety tube, bent tube, flask, delivery tube, condenser and receiver.

**WORKING:-**

Steam Distillation

**Uses:** It is used for the distillation of water immiscible liquid of high boiling points for example turpentine oil etc. By introducing steam through the mixture of two immiscible liquids, it boils at temperature below the

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normal boiling point of either component. The distillate consists of two liquids in the same proportions as in the vapors. It is also used for distillation of volatile oil for its purification without any decomposition.

**Question 08: Discuss any four (a) pasteurization (b) maceration process (c) difference between sterilization and disinfection (d) sintered glass filters (e) colloid mill (f) tray dryer**

**Ans. (a) Pasteurization:** It is moist heat sterilization method is used to make milk safe and also to improve its keeping properties. Two methods are used for pasteurization:

**i) Holder method:** The milk is heated at temp  $62.8^{\circ}\text{C}$  for 30 minutes in a stainless steel tank. Clean dry steam is blown to the space above the liquid to prevent formation of foam. This method kills all type of bacteria.

**ii) Flash Method:** The milk is heated to  $71.6^{\circ}\text{C}$  for 15 seconds and then quickly cooled. The milk is heated by passing through narrow horizontal pipes through which water passes in opposite direction. This method is commonly used by most of the firms due to less time consuming.

**(b) Maceration process:**

**i) Simple maceration for organized drugs:** Organized drugs are those drugs which have a specific cell structure like roots, stems, leaver, flowers etc.

In this process the extraction of drug is carried out by placing the solid drugs in contact with whole of the menstrum in a closed vessel for 2-7 days with occasional stirring. The liquid is strained and marc is pressed, Then add the expressed liquid to the strained liquid. The combined liquids are clarified by decantation or filtration. Final volume is not adjusted.

**ii) Simple maceration for unorganized drugs:** Unorganized drugs are those drugs which have no cellular or tissue structure. In this process the extraction of drugs is carried out by placing a weighed amount of drug in contact with  $4/5^{\text{th}}$  volume of the menstrum in a closed vessel for 2-7 hours with occasional shaking. After the specified period of time the clear liquid is decanted or filtered. The marc is not pressed but volume is adjusted by passing more of menstrum through the marc.

**iii) Multiple maceration:**

**Double maceration process:** In the process, the drug is macerated twice by using the menstrum which is divided in to two parts in such a manner that the same volume is used for each maceration. The quantities of menstrum required for two macerations are calculated as follows:

$$\text{Volume of menstrum for first maceration} = \frac{\text{Total vol. of Menstrum - volume to be retained by the drug} + \text{volume to be retained by the}}{2}$$

Volume of menstrum required for second maceration = Total vol. of menstrum – vol. of menstrum used in first maceration.

**Triple maceration process:** In this maceration process, the drug is macerated thrice by using the menstrum which is divided into three parts in such a manner that the same volume is used for each maceration.

$$\text{Volume of menstrum for first maceration} = \frac{\text{Total vol. of menstrum} - \text{volume to be retained by the drug}}{3} + \text{volume to be retained by the drug}$$

$$\text{Volume of menstrum required for 2}^{\text{nd}} \text{ \& 3rd maceration} = \frac{\text{Total vol. of menstrum} - \text{volume of menstrum used in 1}^{\text{st}} \text{ maceration.}}{2}$$

**(c) Difference between sterilization and disinfection:**

Sterilization	Disinfection
1) It is a process in which all the viable microorganisms are destroyed	1) It is a process to inactivate all the pathogenic microorganisms
2) It is capable to destroy resistant spores	2) It cannot destruct resistant bacteria spores.
3) Sterilization can be done by physical, chemical and mechanical methods.	3) Disinfection is usually carried by use of chemical agents.
4) Sterilization process can be used on food products & medicinal agents.	4) It cannot be used on eatables & medicines: and they are more harmful and strong to human body.

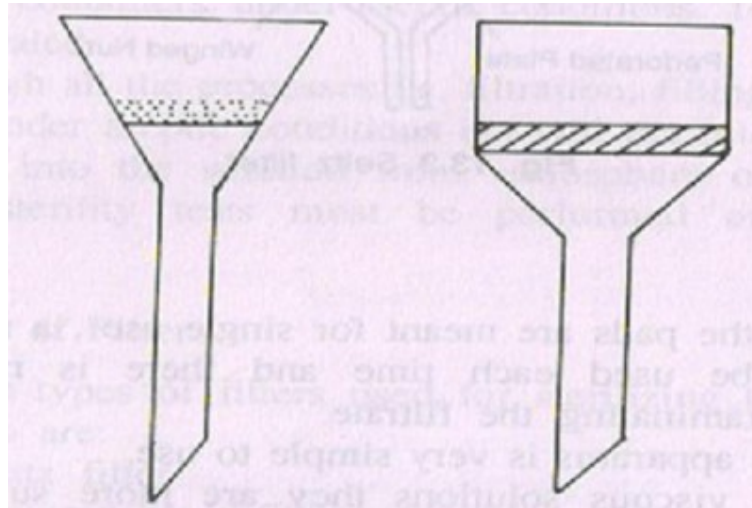
**(d) Sintered glass filters:** These are made from borosilicate glass. The glass is finely powdered and particles of the required size are separated and is then packed into disc mould and heated until a suitable adhesion has taken place between the granules. These discs are fused to funnels of suitable shape and size. Sintered glass filters are available into different pore size. The filtration is carried out under reduced pressure.

**Advantages:**

- 1) These filters do not absorb the medicaments from the solution.
- 2) These filters also do not change the pH of the solution.

**Disadvantages:**

- 1) They are very costly and unsuitable for large volume of filtration.



Sintered Glass Filter

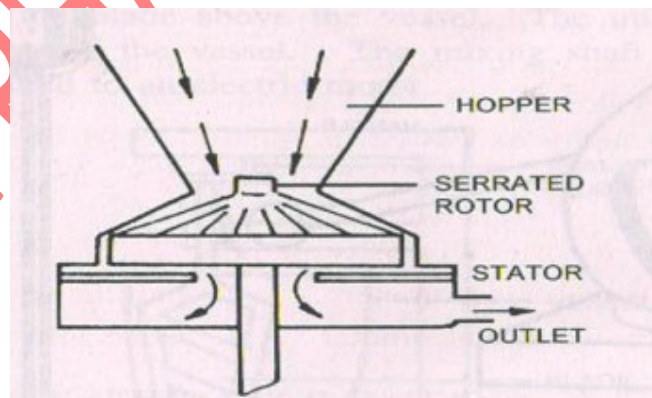
**(e) Colloid mill:**

**Principle-** The size reduction is affected due to shearing, when the material is passed between the narrow gap of milling surfaces of rotor and stator.

**Construction:** It consists of a rotor and stator. The rotor rotates at a speed of 3,000 to 20,000 r.p.m. The stator have conical milling surface between which there is an adjustable clearance between 0.002 to 0.03 inches.

**Working:** The material e.g emulsion or suspension is placed into the hopper of the mill. It is then passed through the narrow gap between the rotor and stator and thus reduced to fine particle size.

**Uses:** Colloidal mills are used to prepare pharmaceutical suspensions and emulsions having particle size less than 1 micron.



Colloid Mill

**(f) Tray dryer (Compartment dryer):**

These dryers are also known as shelf dryer. The simplest form of dryer in this category is a cabinet with a heater at the bottom e.g “Laboratory Oven”.

**Construction:** If a fan is fitted to the oven, the forced hot air is circulated, which helps in increasing the heat transfer. The material to be dried is spread in thin layers on trays. The trays used have solid, perforated, or

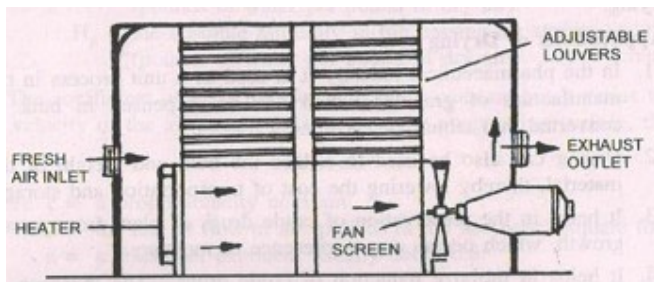
wire mesh bottoms. The best type of a tray dryer is that of the directed circulation form, in which air is heated and is directed across the material in a controlled flow. In modern tray dryers, a uniform temperature and air flow is maintained by the use of a well-insulated cabinet with fan and heating coil. There is an alternative

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arrangement of shelves. Heater is fixed in such a way that the air is reheated. When the air passes over each shelf, a certain amount of heat is given up to provide latent heat of vaporization.

**Uses:** Tray dryers are used for drying of crude drugs, chemicals, powders and granules used in tablet manufacturing.



**Question 09:-** Write the difference between hard and soft gelatin capsule. Discuss with the help of neat and labeled diagram the filling of hard and soft gelatin capsules. **Ans.**

**Hard and soft gelatin capsules are differentiated as follow:**

S. no.	Hard gelatin capsule	Soft gelatin capsule
01.	It consists of two parts i.e., body and cap.	It is a single unit after sealing the two halves of the capsule.
02.	They are cylindrical in shape.	They are available in round, oval or tube shape.
03.	It consists of gelatin, TiO <sub>2</sub> , coloring agent and plasticizer.	These are prepared from gelatin, plasticizer and preservative.
04.	It is used only for solid medicament.	It is used for filling of solid, liquids or semisolids.
05.	Sealing is done to ensure medicament may not come out on rough handling after filling.	Filling and sealing is done in a combined process

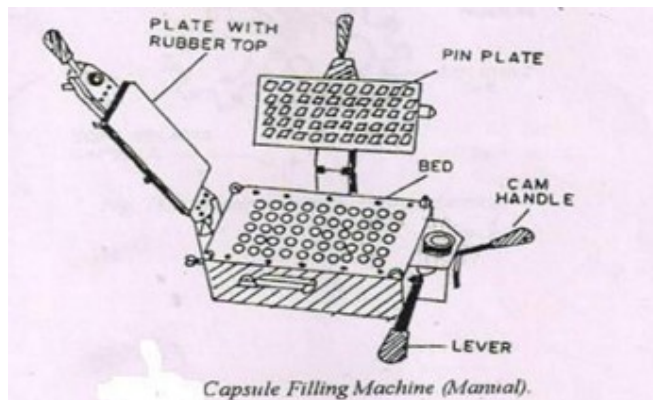
**Filling of Hard gelatin capsule:**

Capsule filling machine (hand operated): It consists of a bed having 200-300 holes, a loading tray having 200-300 holes, a powder tray, a pin plate, a sealing plate, a lever and a cam handle.

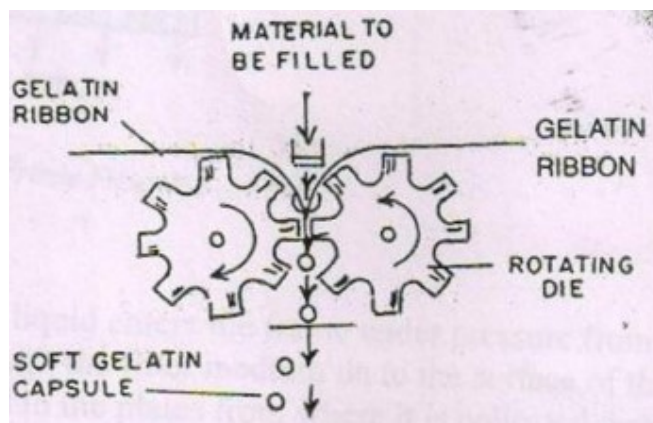
**Procedure**

- 1) Empty capsules are filled in loading tray and placed over bed and lock the body with lever.

- 2) The cam handle is operated to separate body and cap.
- 3) The powder tray is placed in proper position and filling is done.
- 4) The pin plate is lowered and filled powder is pressed by moving pin downwards.
- 5) Pin plate is raised and remaining powder is filled.
- 6) The cap holding tray is placed again in position.
- 7) Body and cap are jointed and capsules are collected.
- 8) Cleaning of capsule is done by soft cloth.
- 9) Sealing is done to ensure that the medicament may not come out in rough handling.



**Filling of soft gelatin capsule:** It is done by rotary die machine. In rotary die machine, the soft gelatin capsule are prepared and then filled immediately with liquid medicament. The machine consists of two hoppers, one for liquid gelatin and other for liquid material to be filled. The gelatin is placed in the hoppers and liquid medicament to be filled is placed in other the hopper. There are two rotary dies, which rotates in opposite direction when liquid gelatin mixture enters into machine from hopper, it produce continuous ribbons. This ribbon comes over the rotating dies from opposite direction and enters in between dies. Thus half shell of capsule is formed. At this stage measure quantity of medicament is filled with subsequent movement of dies the other half of capsule is formed. Sealing is done by heat and pressure of rotating dies. Capsules formed are washed and dried. This machine produces 25000 to 30000 capsules in one hour.



Rotary Machine

**Question 10: (a) Define filtration. Discuss filter press in detail.**

**(b) Define extraction. What is percolation? Explain its method with advantages and disadvantages. Ans.**

**(a) Filtration:** Filtration is the process, where solid particles are separated from the liquid or gas by passing it through a porous medium.

**Filter press:** There are two basic forms of the filter press but only the plate and frame press has a wide application in pharmaceutical industries.

**Plate and frame filter press:**

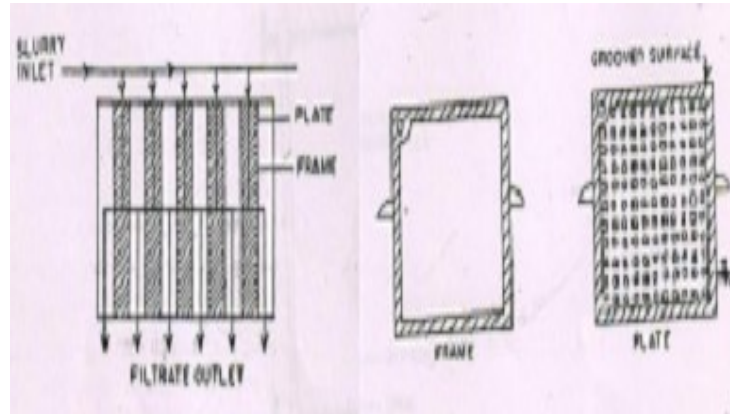
**Construction:** It consists of plates and frames. The frame is open and is used as an inlet for the material to be filtered. Plate is supported by filter cloth. The filter cloth is fitted on each side of the plate. Plates and frames are placed alternatively.

**Working:** i) the filtering liquid enter the frame under pressure from the feed channel.

ii) The filtrate passes through the filter medium on to the surface of the plate.

iii) The filtrate is collected in the plates from common outlet pipe.

iv) The cake is deposited in the frames. The process of filtration is continued until the frames are filled with filter cake. Then the process is stopped, the frame is emptied.



**Principle of operation of filter press**

**Advantages:**

- 1) The filtering media can be used repeatedly.
- 2) Operation and maintenance is simple.
- 3) It requires less space and provides large surface area for filtration.

**Disadvantages:**

- 1) It is not a continuous process.
- 2) Leakage between plate and frame can take place.

**(b) Extraction:** Extraction may be defined as the treatment of the plant or animal tissues with solvent, whereby the medicinally active constituents are extracted. The solvent used for extraction is known as menstrum. The various processes used for extraction are infusion, decoction, maceration, percolation and digestion.

**Percolation:** Percolation means filtering and movement of fluids through porous medium. It is another method of extraction of active constituents from the drugs used in the preparation of tinctures and liquid extracts.

**Types of percolation:**

- 1) Simple percolation or percolation process for tinctures.
- 2) Percolation process for concentrated preparation such as (a) reserved percolation process and (b) modified percolation process
- 3) Continuous hot percolation or soxhlation.

**Simple percolation:** In this process there are three stages. These are:-

**a) Imbibition:** The powdered drug is moistened with menstrum and allowed to stand for 4 hours and packed in percolator.

**b) Maceration:** The moistened drug is left in contact with menstrum for 24 hours.

**c) Percolation:** It consists of downward displacement of saturated solution formed in maceration. After collecting  $\frac{3}{4}$ <sup>th</sup> of the required volume of finished product, the marc is pressed and mixed the expressed liquid with the percolate.

Examples: Tincture of belladonna, compound tincture of cardamom are prepared by this process.

**Advantages:** This process is used to make tincture in 24 hours as compared to maceration, which takes 10-14 days.

**Disadvantages:** More menstruum is required to exhaust the drug in simple percolation.

### 2) Percolation process for concentrated preparation such as:

**a) Reserved percolation process:** In this process, a  $\frac{3}{4}$ <sup>th</sup> the volume of the finished preparation, is reserved and the percolation process is continued till the drug is completely exhausted.

**Advantages:** 1) The reserved part of the percolate which contains the maximum amount of dissolved active principles is not subjected to heat, only the dilute portion is evaporated. Hence, the major portion of the active constituents of the drug is saved from deterioration.

2) The process is economical as the whole of the percolate is not evaporated.

**b) Modified percolation process:** In simple percolation process the drug/percolate (d/p) is in about 1:4 ratio. The d/p ratio is reduced to 1:3 by modifying the percolation process.

**Advantages:** In this process there is a lot of saving in heat, time and menstruum.

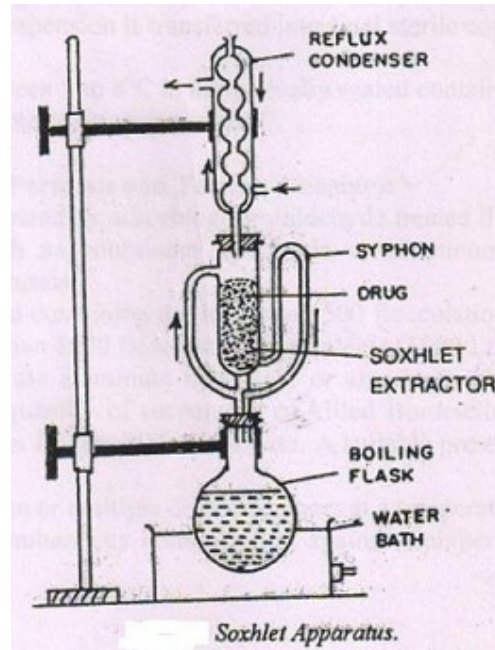
**3) Continuous hot percolation/Soxhlet extraction:** When active constituents of the drug are not freely soluble in the solvent, then it becomes necessary to extract the crude drug by the action of hot menstruum. The fixed oils from seeds and alkaloids from the drug are extracted by continuous hot percolation process using benzene, chloroform, ether etc.

**Apparatus:** The apparatus used for this process is consist of :

**Flask:** The solvent used for extraction is placed in the flask which is boiled with the help of heat.

**Soxhlet extractor:** In which the drug to be extracted is packed. It has a side tube which carries the vapors of the solvent from the flask to the condenser and a syphon tube which takes over the extract containing medicaments from soxhlet extractor to the flask.

**Condenser:** In which the vapors of the solvent are again condensed into the solvent.

**Procedure:**

- 1) The drug to be extracted is packed in a paper cylinder made from a filter paper and it is placed in the body of soxhlet extractor. The solvent is placed in the flask.
- 2) When solvent is boiled on heating the flask, it gets converted into vapors. These vapors enter into the condenser through the side tube and get condensed into hot liquid which falls on the column of the drug.
- 3) When the extractor gets filled with the solvent, the level of the syphon tube also up to its top. The solvent containing active constituents of the drug in the syphon tube will come back into flask, thus emptying the body of extractor.
- 4) This alternation of filling and emptying the body of the extractor goes on continuously.
- 5) The soluble active constituents of the drug remain in the flask while the solvent is repeatedly volatilized.

**Advantage:** In this process less menstrum is required.

**Disadvantages:**

- 1) Some drugs can block the soxhlet apparatus e.g opium, gum, resin, orange peel etc
- 2) Only pure solvents or constant boiling mixtures can be used for this process.
- 3) Thermolabile drugs cannot be extracted by this process.

**Question 11: (a) Define immunity. Explain B.C.G. and D.P.T. vaccines.**

**(b) What is Pharmacopoeia? Explain Indian Pharmacopoeia in detail.**

**Ans. (a) Immunity:-**The power of the body to resist the effects of the invasion of microorganisms is called immunity.

**B.C.G. vaccines (Freeze dried):** B.C.G. vaccine is in the form of white pellet which when constituted yields opalescent suspension. It is freeze dried preparation of live culture of bacillus of Calmette and Guerin strain of *Mycobacterium tuberculosis*.

**Preparation:** The bacilli are grown on suitable media on suitable solid culture media and should show not less than 20 millions colonies. Growth period should not be more than 14 days. After growth, they are separated by filtration to form cake. Cake is homogenized in grinding flask and suspended in sterile liquid medium. Antigenicity is preserved and suspension is transferred into final sterile container and then container is sealed.

**Storage:** Store at temperature between 2<sup>0</sup>C to 8<sup>0</sup>C in hermetically sealed container.

**Use:** Immunizing agent, which protect from tuberculosis.

### **D.P.T. vaccines (Diphtheria, Pertusis and Tetanus Vaccine):**

It is a white sterile suspension prepared by adsorbing formaldehyde treated diphtheria toxoid and tetanus toxoid on a mineral carrier, such as aluminum hydroxide or aluminum phosphate and adding a suspension of killed *Bordetella pertussis*.

**Preparation:** The diphtheria toxoid containing not less than 1500 flocculation equivalents (1500 Lf) and tetanus toxoid containing not less than 1000 flocculation equivalents (1000 Lf) per mg of protein nitrogen. They are added to a suspension of hydrate aluminum phosphate or aluminum hydroxide in a normal saline solution. It is then mixed with a quantity of suspension of killed *Bordetella Pertussis* so that the final products contain not more than 20 x 10<sup>9</sup> bacilli in each dose. A suitable preservative other than phenol is added.

**Storage:** It is stored in a single dose or multiple dose containers at a temperature between 2<sup>0</sup>C and 8<sup>0</sup>C.

**Uses:** The vaccine is used for simultaneous immunization against diphtheria, tetanus and pertussis in infants and small children.

### **(b) Pharmacopoeias:-**

The books containing the standards for drugs and other related substances are known as pharmacopoeias.

**Indian Pharmacopoeia (I. P.):** In 1946 the Government of India published the Indian Pharmacopoeial list which served as a supplement to British Pharmacopoeia. This list included the drugs which were of substantial medicinal value and were later on included in the Pharmacopoeia.

**The first edition** of Indian Pharmacopoeia was published in 1955 and a supplement of it was published in 1960.

**The second edition** of Indian Pharmacopoeia was published in 1966 and a supplement of it was published in 1975.

**The third edition** of Indian Pharmacopoeia was published in 1985. A working group was constituted by the committee to prepare monographs, appendices and general notes which were finalized by the pharmacopoeia committee. The same were published in the form of the pharmacopoeia of India in 1985, in two volumes, volume I and volume II by the controller of publications, Delhi on behalf of government of India, ministry of

health and family welfare. The volume I contains legal notices and preface, acknowledgements, introduction, general notices and monographs from A to P. the volume II contains monographs from Q to Z, appendices, contents of appendices and index.

The 4<sup>th</sup> edition of I.P. was published in 1996. It contains 1149 monographs and 123 appendices and available in two volumes.

**Fifth edition of I.P. (2007):** Fifth edition of I.P. was published in 2007. It is expanded in the three volumes.

Vol. I: This volume gives the information about the general topics.

Vol. II: This volume provides the information about the pharmaceutical aids, dosage forms and general knowledge about the herbs and herbal products.

Vol. III: This volume provides the complete knowledge about the drugs, human used materials and products.

**Question 12: Define the following terms: (a) Linctuses (b) New Drug Delivery System (c) Emulsions (d) Suspension (e) Tablets (f) Syrups (g) Elixirs**

**Ans. (a) Linctuses:** Linctuses are viscous oral liquid preparations that are used for the relief of cough. They contain medicaments, which have demulcent, sedative or expectorant action. Linctuses should be taken in small dose without diluting with water in order to have the maximum and prolonged effect of medicament. Example: Codeine linctus-BPC

**(b) New Drug Delivery System:** There are large disadvantages of various drug delivery systems are bitter taste, poor penetration power, high or low therapeutic value, long term use and gastric instability. To overcome these problems of conventional drug delivery system various new drug delivery system are developed and classified as prolong drug delivery system like prodrug and targeted drug delivery system e. g. liposomes and nanoparticles.

**Prodrugs:** Prodrug is chemically modified inert drug, which upon biotransformation liberates the pharmacologically active parent compound. For example: chloramphenicol (an antibiotic), which has bitter taste and it is not used as such. Modification is done by palmitate ester, which mask the taste and prodrug formed is chloramphenicol palmitate.

**Liposomes:** Liposomes are microscopic vesicles composed of concentric bilayers of phospholipids that are separated by aqueous space within the drug can be incorporated.

**(c) Emulsion:** An emulsion can be defined as biphasic liquid dosage form, in which one liquid is dispersed in the form of minute globules in another liquid with the help of a substance known as emulsifying agent/emulsifier. The liquid, which is dispersed as minute globules is known as dispersed phase and the liquid in which the globules are dispersed is called continuous phase. The emulsions are of two types:



**Oil in water type [o/w]:** In this type of emulsion, oil is present as a dispersed phase whereas water is present in the form of continuous phase.

**Water in oil [w/o]:** In this type of emulsion, water is present as a dispersed phase whereas oil is present as continuous phase. Emulsions are given by various routes such as oral, intravenous and external.

**(d) Suspension:** These are biphasic liquid dosage form in which finely divided insoluble drug is dispersed /suspended in a liquid medium with the help of suspending agent. The solid particles act as disperse phase whereas liquid vehicle acts as continuous phase. They may be used by oral, parental and external route. All the suspensions should be packed in containers having adequate air space above the liquid for adequate shaking before use, because the dispersed solid particles settled down on prolonged storage.

**(e) Tablets:** Tablets are solid unit dosage forms or medicaments that are prepared by either moulding or by compression. Certain excipients are also added in the medicaments during formulation of tablets. Tablets are usually available in circular shape with either flat or convex faces. Tablet dosage form is widely used because they are easy to transport and medicaments are more stable even when mixture of two or three is present in the same tablet. The major advantage of tablet is that they can be produced on a very large scale with much lower cost than other dosage form.

**(f) Syrup-** Saturated solution of sugar such as sucrose (66.7% w/w) in water or other aqueous liquids. At place of sucrose, other polyhydric alcohols such as glycerin & sorbitols may be added to retard crystallization of sucrose & to increase solubility of ingredients. For examples: Codeine phosphate syrup and squill syrup.

**(g) Elixirs:** - Elixirs are sweet aromatic preparations and are usually coloured. The main ingredient of elixirs is ethyl alcohol (4-40%). Water, glycerin or propylene glycol, flavouring agent, syrup and some suitable preservative can also be used. The elixirs may be medicated or non-medicated. Aromatic elixirs USP is a nonmedicated and Chlorpheniramine melate elixirs is a medicated elixir.

**Question 13: Differentiate the following terms: (a) Organized/Unorganized drugs (b) Purified water I.P. and Water for injection I.P (c) Liniments and Lotions (d)Mouth washes and Gargles (e) Sera/vaccines & Toxoids (f) Active and Passive Immunity (g) Wet granulation and Dry granulation (h) Evaporation and Drying (i) Infusion and Decoction. Ans. (a) Organized drugs and unorganized drugs**

S. No.	Organized Drugs	Unorganized Drugs
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01.	Drug along with the whole menstrum is used in maceration process.	Drug along with 4/5th of menstrum is used in maceration process.
02.	The period of maceration is 7 days.	The period of maceration is 2-7 days.
03.	Strain off the liquid and press the marc.	Decant the liquid and marc is not pressed.
04.	Mix the liquid with macerate, filter the liquid and filtrate is not adjusted to volume.	Filter it and pass remaining 1/5th menstrum through filter to make final volume.
05.	Example: Tincture of orange	Example: Tincture of Tolu

**(b) Purified water I.P. and water for injection I.P.:**

S. No.	Purified water I.P	Water for injection I.P
01.	The water which is free from volatile and non volatile impurities is called purified water.	Water which is free from volatile and non volatile impurities, microorganism and pyrogen is called water for injection.
2.	It is prepared by distillation, ion-It is obtained by distilling purified water or exchange treatment, reverse osmosis or any other suitable process.	It is obtained by distilling purified water or distilled water from neutral glass or suitable metal still fitted with efficient device for preventing the water drops to go along with water vapors into condenser.
03.	It is not stored in tightly closed container	It should be stored in tightly closed neutral glass container and should comply with the test for pyrogen.

**(c) Liniments and Lotions:**

S. no.	Liniments	Lotions
01.	Liniments are liquids or semiliquid preparations meant for external application to skin.	They are liquid preparation for external use.
02.	Liniments are usually applied to skin with friction or rubbing.	They are applied without friction with the help of cotton wool.
03.	Liniments may be alcoholic or oily solutions or emulsions. Example: Camphor liniment-BP.	Lotion may be alcohol preparations. Example: Calamine lotion-USP.

**(d) Mouthwash:** These are aqueous solution with a pleasant taste and odour used to make clean and deodorize the buccal cavity. They contain antibacterial agents, alcohol, glycerin, sweetening agents, flavoring agents. Example: Zinc sulphate and zinc chloride mouthwash-BPC.

**Gargles:** Gargles are aqueous solutions used to prevent or treat throat infections. They are usually available in concentrated form. So they are used with direction for dilution with warm water before use. They are used for relieving soreness of throat infections. An antibacterial agent also present in it. Example: Phenol gargles.

**(e) Vaccines:** Vaccines are preparations which contains antigens. Vaccines stimulate the immune system of body to produce antibodies. These antibodies make the person or animal immune to that disease for which the vaccine is given. Vaccine may contain living, attenuated or killed bacteria, virus or rickettsia.

Example: B.C.G. Vaccines (Freeze dried):

**Toxoids:** The pathogenic bacteria during their growth in a liquid medium release a toxic substance known as "toxin". These toxins are disease producing and are antigenic in nature. When toxins are treated with chemicals such as formaldehyde, their toxic properties are destroyed without causing any loss of antigenic property. These are called as toxoid.

**Example:** Tetanus toxoid

**Tetanus toxoids:** This is prepared from the exotoxin of *Clostridium tetani*. Tetanus toxoid is available in following forms

**(i) Formal toxoid (FT):** Prepared by treating sterile culture filtrate of *Clostridium tetani* with formaldehyde.

**(ii) Alum precipitated:** Prepared by adding alum to tetanus toxoid. The precipitates are separated, washed and suspended in normal saline solution.

**(f) Difference between the active and passive immunity.**

S. No.	Active Immunity	Passive Immunity
01.	The body takes an active part in the formation of antibodies to develop resistance against disease (slowly produced but long lasting).	The body does not play an active role in having immunity against a disease. It receives ready-made antibodies to produce immunity (quickly produced but short lived).
02.	This type of immunity is acquired by body as a result of infection by the causative organism. e.g. A patient recovers from diphtheria, small pox.	In this type of immunity the antibodies are transmitted from the mother to the foetus through the placental blood. e.g. in diseases like chickenpox, measles.
03.	When the antigenic substance such as vaccines is introduced into the body, it stimulates the body to produce antibodies.	The immunity is produced by injecting ready-made antibodies (antisera, sera or immune sera) containing preparation in body.
04.	It is used for prophylactic purpose.	It is used for therapeutic purpose.

**(g) Difference between the wet granulation and dry granulation**

S. no.	Wet Granulation	Dry Granulation
1.	It is a wet process.	It is a dry process.
2.	Not suitable for both hydrolysable and thermolabile materials.	Useful for both hydrolysable and thermolabile materials.
3.	Tablets are hard and disintegration time is long.	Tablets are friable and disintegration time is less.
4.	Time, space and equipment requirement are more.	Time, space and equipment requirement are less.
5.	Not suitable for effervescent materials and single ingredients.	Useful for effervescent materials and single ingredients.

**h) Difference between the evaporation and drying**

S. no.	Evaporation	Drying
1.	Removal of large amount of water from solutions is called evaporation.	Removal of small amount of moisture from solid or nearly solid materials is called drying.
2.	It provide dry/viscous product.	It provide solid product.
3.	Removal/evaporation of H <sub>2</sub> O takes at boiling point.	Removal of H <sub>2</sub> O at temp. less than boiling point.

**g) Difference between infusion and decoction.**

S.no.	Infusion	Decoction
1.	Cold and boiling water used for menstruum.	Drug is boiling in water.
2.	Drug having soft tissue is used.	Drug having hard tissue is used.
3.	Drug constituents may be volatile.	Drug constituents may be non-volatile.
4.	Final volume is not adjusted.	Adjustment to volume is done.

**Question 14: Define the given terms: (a) Antigen (b) Phagocytosis (c) Enteric coating (d) Satvas (e) Bhasam (f) Sieve number**

**Ans. (a) Antigens:** Antigens are the external substances which enter in the body through different means. These antigens stimulate the body to produce antibodies.

**(b) Phagocytosis:** Phagocytosis means the ingestion of bacteria by certain cells of the body, which make them harmless. This process is caused by two types of body cells, by the cells of reticulo-endothelial system and white blood corpuscles (WBC).

(c) **Enteric coating:** This coating is given to the tablets in order to ensure that these tablets will not disintegrate in the intestines. Cellulose acid phthalate and polyvinyl acetate phthalate etc polymers are used.

An ideal enteric coating material should have the properties like:

- 1) It should be resistant to gastric fluid.
- 2) it should be economical and non- toxic in the required quantity.

(d) **Satvas:** These are extracts of herbs. A fresh herb is crushed into a coarse mass and allowed to remain in contact with water for about 12 hours and then strained the liquid. The upper clear liquid is decanted off and the sediment (which contains active ingredients) is dried into a fine powder.

(e) **Bhasam:** These are ashes which are prepared from vegetable and mineral substances. The vegetable drugs are cut into a coarse powder or pieces and then burnt, till they are completely reduced to ashes. The mineral ashes are prepared from metals. Ashes are also prepared from various animal products such as from horn and pearls.

(f) **Sieve number:** A number used to designate the pore size of sieve, usually the approximate number of opening per inch square area. The number mentioned for sieve is the number of meshes of standard diameter present in 1 inch square area. For example a No. 10 sieve has 10 meshes in 2.54cm/ inch in each direction.