Chapter 7
Compounding and dispensing

DISPENSING: In dispensing, medicines are supplied to the individual patient usually in response to prescription. It concerned with proper distribution of medicines.

It requires the extensive knowledge of

- ⇨ The stability of medicines and their ingredients
- ⇨ Principles of compounding
- ⇨ Dosage
- ⇨ Physical, chemical and therapeutic incompatibilities
- ⇨ Packaging methods
- ⇨ Labeling procedures
- ⇨ Legal requirements for storage, containers, labeling, supply (drug sale) and records.

General dispensing procedure

- ➢ Wear a freshly laundered overall coat. It should be spotless and clean.
- ➢ Provide yourself with clean glass-cloth and a duster or sponge. It is used for cleaning the dispensing area.
- ➢ Work in a clean and tidy manner. Don't accumulate stock bottles and equipment in the working area.
- ➢ Read the prescription carefully
- ➢ If necessary, find the formula of preparation in an appropriate source of information (official books: BP,USP etc)
- ➢ Check the doses of internal preparations
- ➢ Confirm that there are no incompatibilities in the preparation or between different preparations on the prescription.
- ➢ Look up the storage conditions for the preparation
- ➢ Check the calculations
- ➢ Collect the correct container and closure
- ➢ Write the main label and collect any special labels that are required
- ➢ Make the preparation, pack it in container
- ➢ Check the labels and fix them to container
- ➢ Check the finished preparation

- Wrap the container and write the patients name and address on the wrapper
- Make the appropriate records

The prescription

Prescription is a written order from a physician, dentist or any other registered medical practitioner to compound and dispense a specific medication for the patient.

The order is accompanied by directions for the pharmacist that what type of preparation is to be prepared and how much is to be prepared. It is also accompanied with the directions for the patient.

Parts of a Prescription

A complete prescription should have following parts.

- ✓ **Name, age sex and address of the patient**

  Age and sex helps the pharmacist in checking the medication and the dose, especially in the case of children. The address is recorded to help for any reference at later stage.

- ✓ **The date prescribed**

It helps pharmacist to find out the cases where prescription is brought for dispensing long time after its issue. The prescription should be filled within suitable time after it is written.

- ✓ **Superscription**

This part is represented by a symbol Rx which is always written at the beginning of the prescription. This is an instruction to the pharmacist. It is an abbreviation for the Latin world "*recipe"* meaning you take.

- ✓ **Inscription**

  This is the main part of prescription. It contains the names and quantities of the prescribed ingredients. The medicament may be prescribed as:

  a) An official preparation
  b) A proprietary product
  c) A special formula with the description of the type of preparation i.e. lotion, tablet.

- ✓ **Subscription**

This part contains prescriber's directions to the pharmacist regarding the dosage form to be prepared and number of doses to be dispensed.

- ✓ **Signatura**

It is usually abbreviated as" Sig" and consists of directions to the patient regarding: administration, quantity of medicament, number or dosage units to be taken, how many times in a day and at what time drug to be taken.

- ✓ **Refill status**

Prescription can be used for refill or not.

- ✓ **Name, address and signature of prescriber**

EXAMPLE OF TYPICAL PRESCRIPTION

GENERAL HOSPITAL MULTAN

NAME: SHAHID SEX: M AGE: 45
ADDRESS: VEHARI CHOWK, MULTAN

Rx

LINCOCIN - 500mg
Disp. 20 tabs
One T I D
REFILL –
LABEL-

Dr. SIGNATURE AND REGISTERATION NUMBER

HANDLING OF PRESCRIPTION

The manner in which a pharmacist handles a prescription can enhance his image in the eyes of both physician and patient.

Handling of prescription comprises of following steps:

1 .Receiving 2.Dosage calculation 3 .Compounding
4 .Finishing 5 .Pricing 6.Delivering

1 .RECEIVING THE PRESCRIPTION:

Pharmacist should receive the prescription from the patient in a professional manner .If a verbal order is received, the pharmacist has to transcribe it into written form.

Receiving include:

A: READING THE PRESCRIPTION;

The prescription order first should be completely and carefully read from top to bottom .There should be no doubt as to the ingredients and quantities prescribed. There should not be any "guess work" regarding the spelling etc .as this may lead to serious consequence

B.CHECKING THE PRESCRIPTION:

Prescription is also checked for any incompatibility, likely to exist and should be removed after consulting physician.

2. DOSAGE CALCULATION:

The dose of each ingredient should be calculated and its safety is verified by the pharmacist .Age is important for dose administration .A child's dose is calculated as a function of adult dose and is calculated by following formula.

A.YOUNG'S RULE:

Child dose =child's age in years× adult dose /child's age in years +12.

b. COUNTING 'S SCALE :

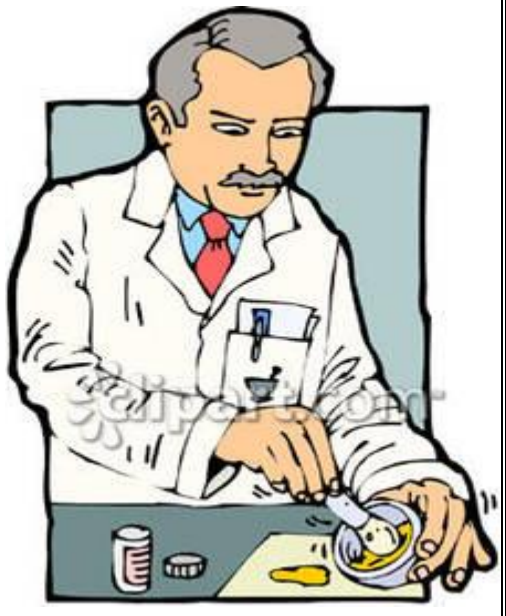
Child dose=age+2/24 × adult dose

c. CLARK'S RULE:

Child dose=Childs weight in pounds(lb)/150 x adult dose

d. FRIED'S RULE:

Child dose= child's age (month)/150 ×adult dose.



3. COPMPOUNDING:

After reading and checking, pharmacist should follow the procedure for compounding the medicine.
Materials to be used in compounding the prescription should be collected on the left hand side of the balance. After weighing the ingredients are shifted to the right. The ingredients should be accurately weighed and after being used, should be placed in their proper sites. A white paper should be placed on table while compounding, use electric machine for correct and accurate weighing.

4. FINISHING THE PRESCRIPTION:

Finishing the prescription includes"

a. Packaging b. Labeling c. Rechecking d. Filing /Recording

a. PACKAGING:

After compounding the prescription the drug is transferred to a container which is by the pharmacist choice, best suited considering the drug container interactions and drug stability .

1. Syrup in glass bottles
2. Tab. in glass or plastic bottles
3. Cream in jar
4. Ointments and emulsion in collapsible tubes

b. LABELING:

The container should be applied with appropriate label which reflect neatness and professional attitude of pharmacist .A carelessly made dirty label will destroy the reputation of the pharmacy. The following information should be written on the label.

1. Type of preparation (mixture, emulsion, powder etc.) and their strength.

2. Patient bio data
3. Date of dispensing
4. Direction for use
5. Storage condition
6. Precaution
7. Name and address of pharmacy

c. RECHECKING:

Every prescription should be checked against preparation order. After labeling, the container should be thoroughly polished to remove the finger prints and then dispense.

d. FILLING/RECORDING:

A variety of prescription files are available which serve to maintain and preserve original prescription orders in numerical order .A clean and concise record of all the prescription is maintained.

5. PRICING OF PRESCRIPTION:

The prescription should be priced immediately after receiving it and informed the patient about it. This should be done before starting the compounding of prescription so that there will not be any dispute cost is evaluated by considering following

1. Cost of ingredient
2. Cost of container
3. Cost of overhead coverage
4. Personal fee
5. Net profit.

System 1: some pharmacist use coding system

e.g**. P H A R M A C I S T**

1 2 3 4 5 6 7 8 9 10

If patient is poor than code P is used i.e. 1% net profit

System 2: some formula have also been evaluated

Price =cost of ingredients + (cost of ingredients multiply %markup)

If cost of ingredient is Rs .8 and mark up is 10%than price =8+ (8 ×10/100) = Rs 8.8

System 3: Price=cost of ingredients + (cost of ingredients × markup) +main fee

If cost of thing is Rs 8, markup is 10 %and main fee is 0.2

Than price is=8 + (8multiply10/100) + 0.2=Rs .9

PRICE VARIATION: The unfavorable attitude of public towards prescription prices is due to large variation in prices charged in different stores for filling the same prescription. It also occurs in same store when prescription is filled by different pharmacist.

THEORY OF PRICE

The price charged for filling a prescription must be sufficient to cover the cost of ingredients container, time required for compounding and dispensing, professional services fee and in addition to yield a net profit.

6. DELIVERING THE PRESCRIPTION:

Delivering the prescription to the patient is of three types

a. Store Delivery :

Most prescriptions are delivered in the store to customer .In this type of delivery, the pharmacist personally deliver prescription medication .By doing so pharmacist assures himself that patient understands how to assure medication.

b. Home Delivery:

Home delivery of prescription is offered by many pharmacies in large cities. Telephoned order for refill to be delivered, especially frequent delivery charges may be added and special instructions are also added in the box.

C .Main delivery:

In mailing the finished prescription to patient, it is necessary to observe all postal and legal restrictions. Packing and labeling requirements should be checked by first class mailing.

REFILLING OF PRESCRIPTION;

The refilling of prescription is governed by Federal Law which divided the drug into two categories.

1. Those drugs which are potentially toxic or dangerous causes harmful effects These can't be dispensed without a prescription .These can also be divided into three groups.

GROUP A:

Very dangerous drug cannot be refilled .e.g. .morphine

GROUP B:

These drugs are dispensed with prescription which can be refilled .e.g. Apomorphine

GROUP X:

These drugs contain very small amount of dangerous ingredients and can be issued without prescription but its record is kept .e.g. Corex

1. Syrup contain very small amount of codeine .Drugs containing 2 gram of opium 1 gram of codeine or ¼ gram morphine in this group.

2. Those drugs which are not harmful and can be dispensed without a prescription such OTC cover Rx counter drugs .These are common drugs such as NSAID; s etc.

CONTAINERS AND CLOSURES

Packaging: it is the art and science in preparing a product for transport, storage, display and use. Pharmaceuticals are suitably packed so that they should retain their therapeutic effectiveness from the time of their packaging till they are consumed.

A package may consist of:

Container: In which the drug is placed and is in direct contact with the drug.

Closure: This seals the container to exclude oxygen, carbon dioxide, moisture, microorganisms and prevent the loss of volatile substances. It also prevents the loss of medicament during transport and handling.

Factors selecting container for packaging

The selection of container for packaging of pharmaceuticals product is depended on following factors:

I. Nature of product:

- Its chemical activity, sensitivity to moisture and oxygen, compatibility with packaging material.

II. Type of patient:

- Is it to be used by an elderly or arthritic patient or by a child?

III. Dosage form

- Either solid or liquid or gas.

IV. Method of administrating the medication.

V. Required shelf-life.

VI. Product use

- Such as for dispensing or for an over the counter product**.**

VII Cost of container.

VII. Type of container

- Child resistant closure and temper evident seals**.**

Desirable feature of containers:

1-Container must be rigid enough to prevent damages to the contents.

2-The materiel of construction must not react with the content.

3-Closure must prevent.

- Access of moisture to tablets and capsules.
- Loss of moisture from cream ointment and paste.

- Unintentional escape of the content.

4-Closer must be easily removed and replaced.
5- It must not be difficult to abstract the content or to empty the container completely.
6-Medicament must not be absorbed by container material nor must diffusion through the wall be possible.
7-It must be easy to label the container correctly.
8-It must have a pharmaceutically elegant appearance.

TYPES OF CONTAINERS

According to method of closure and use

1. **Well closed containers**

To protect the preparation from contamination and to prevent the loss of potency of active constituents during transport, storage and handling.

2. **Air-tight containers**

To protect preparation from atmospheric contamination of liquids, solids or vapours. Prevent loss of drug due to efflorescence or evaporation.

3. **Light resistant containers**

Protect drugs which undergo decomposition in the presence of light. These drugs may be enclosed in amber colored or opaque containers.

4. **Hermetically sealed containers**

Which does not allow the air and other gases to pass through it. Generally used for injectable. A glass ampoule sealed by fusion is most common example.

5. **Single dose containers**

They are used to supply only one dose of the medicament. e.g ampoules

6. **Multi-dose containers**

This type of container hold a number of doses. It is sealed in such a way that successive doses can be withdrawn easily. e.g.multidose vials

7. **Aerosol containers**

Containers for aerosol must be strong enough to withstand the pressure evolved at the time of use of the preparation.

8. **Temper-Evident Container**

These are closed containers fitted with a device that irreversibly indicates if the container has been opened**.**

According to their shapes

1.Glass / polyethylene bottles

a) Narrow mouth

Liquid oral preparations intended to be swallowed like syrups, elixirs, emulsions, suspensions are required to be dispensed in narrow mouthed bottles.

b) Wide mouth

Semi-solid preparations like ointments, creams, pastes are dispensed in wide mouth containers. On manufacturing scale collapsible tubes are preferred.

Bulk powders and granules for internal use, and dusting powders are dispensed in air tight, wide mouthed glass or plastic jars.

2.Dropper bottles

Eye drops, Ear drops, Nasal drops should be dispensed in amber colored glass bottles fitted with a dropper.

3.Collapsible tubes

4.Ampoules

5.Vials

6.Polythene packets for intravenous fluids

7.Envelops, strips, blister packs, cartons, boxes.

Solid dosage forms like tablets, hard and soft capsules are generally packed in strips. Individual powders are dispensed in paperboards or plastic boxes.

MATERIALS USED FOR CONTAINERS

1. **Glass**
2. **Plastics**
3. **Metals**
4. **Paper**

They are used either singly or sometimes in combination with each other.

Glass

It is hard, brittle and transparent and is composed of a network of silicon and oxygen atoms. Special types of glass e.g. colored glass or heat resistant glass can be produced by adding certain other substances.

Various types of glass used for pharmaceutical purposes.

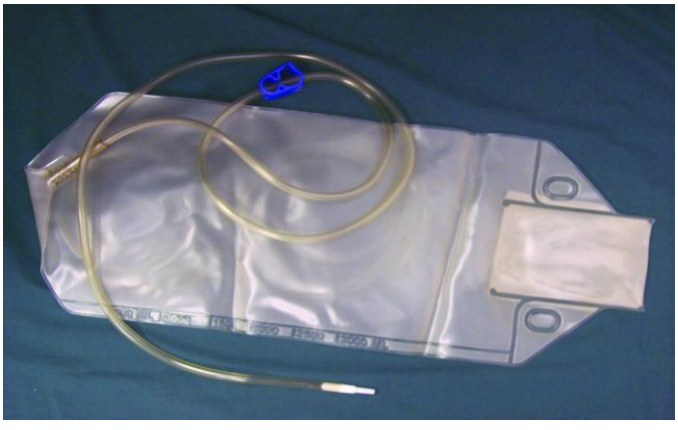
- Type-I Borosilicate glass
- Type-II Treated soda lime glass
- Type-III Soda lime glass
- Type NP Non parenteral glass
- Colored glass
- Neutral glass

Plastics

Plastics are high molecular weight polymers possessing long carbon chains.

The various polymers used for the manufacture of containers are:

- Polyethylene
- Polyvinyl chloride (PVC)
- Polystyrene
- Polypropylene
- Polyamides (Nylons)



Metal

Metal containers are not very popular for packing the pharmaceutical products because they react with the preparations.

However they are used for packing aerosols, powders and tablets.
Metals used for pharmaceuticals:

- Tin
- Aluminum
- Lead
- Iron

Collapsible tubes made from aluminum, tin and lead are used. They are used for packing semi-solid preparations i.e. ointments, creams, pastes, toothpastes and cosmetics. They are attractive containers. Lead should never be used alone for anything taken internally due to risk of lead poisoning. They are used with internal linings.

Paper

It has an insignificant role in primary packaging but it remains the predominant in secondary and tertiary packaging material

TYPES OF CLOSURES

Closures are available in five basic designs:

1. Screw-on

These are of two types

a) Threaded screw cap

When screw cap is applied its threads engage with the corresponding threads moulded on the neck of bottles. Fig 1

b) Lug cap

It is similar to threaded screw cap and operates on same principle but it has interrupted thread on closure instead of a continuous thread .it is widely used in food industry. i.e. jam bottle caps. Fig 2

Fig 1

Fig 2

2. Crimp-on

These are crown type closures used as crimped closures for beverage bottles and remain unchanged for more than fifty years.

3. Press-on

a) **Snap seals** : these are used in Cac 1000

b) **Bung seals:** they are conical and can be inserted for about half their length into the neck of container. Rubber is excellent material for bung closure i.e. closure of vials of penicillin powders. Fig 5

4. Roll-on

The aluminum roll on cap can be sealed securely, opened easily and resealed effectively. Pilferproof types of roll on closures are available for glass and plastic bottles. These are thread less straight –sided shells.

Materials used for closures

1. Cork

It is wood obtained from bark of oak tree. Used as stoppers for narrow mouth bottles. Fig3

2. Glass

As compared to cork glass is ideal material for making the stoppers. But they don't provide leak-proof closure. Fig 4.

3. Plastics

Plastic closures are more popular than other closure materials. They are unbreakable and easily moulded into various sizes and shapes. Fig 1

4. Rubber

Rubber closures are mainly used for vials, multi-dose containers and IVfluid

Fig 3 **Fig 4**

Fig 5

bottles, because it can withstand sterilization temperatures. Fig 5

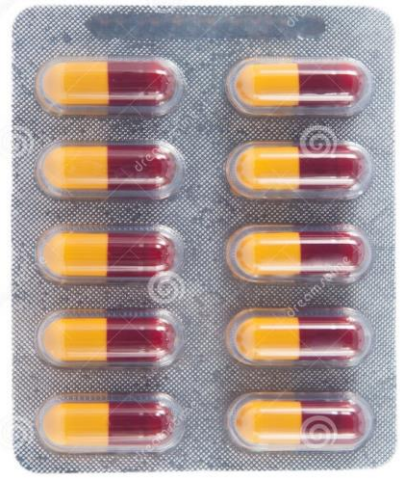
5. Metals

Tin plate and aluminum are most commonly used. To make the closures pilfer-proof they may be sealed with aluminum cap.

Unit Dose Packaging

The unit dose package for oral solids is made from some flexible material or may be the strip type package.

Blister packaging



The package consists of a transparent plastic material and a heat sealable backing material.(Fig a)

Strip packaging

In strip packaging the tablets and capsules are packaged in a flexible film or foil that are connected in a continuous film. i.e. aluminum foil(Fig b)

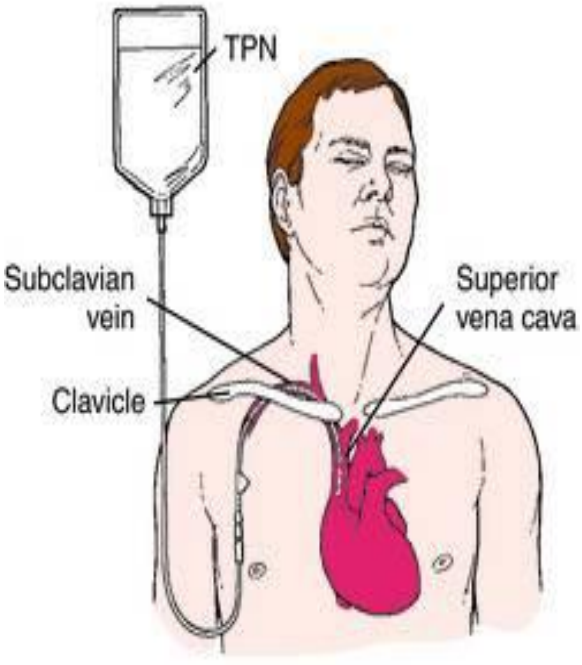
Fig a **Fig b**

Child-Resistant Containers (CRCS)and Closures:

Any container and closure system should provide an effective seal to retain the container contents and exclude external contamination, in response to demands for greater protection of children against accidental poisoning is known as child-resistant containers &closures (CRCS).

They take advantage of the greater strength of adults for ease of opening and generally incorporate a locking mechanism.The commonly consist of a glass or plastic vial or bottle with a specially designed closure e.g. palm and turn tablet and capsule container is replaced by pressing down on the lid with palm of the hand and turning at the same time.

The closure in common use with dispensed medicines are the snap-safe closure and push down turn clic-loc^{R} closure.



Chapter8
Total parenteral Nutrition (parenteral hyperalimentation)

It is a method of administering enough basic nutrients to achieve active tissue synthesis and growth via parenteral route.

It is characterized by the long-term IV feeding of protein solutions containing high concentrations of dextrose (approximately 20%), electrolytes, vitamins, and in some instances insulin. The individual components and amounts vary with the patient's needs.

Components of TPN formulation:

It contain following components

- **Water**
- **Protein source**: lack of nitrogen cause poor wound healing interfere with body defense mechanism. Amino acid is included in TPN as a source of nitrogen.
- **Energy source** : Carbohydrates and fats
  The carbohydrate of choice is dextrose in the form of 5-70% w/v solution. if required in large quantities insulin can be

administered in TPN to increase uptake of dextrose.

Fat is administered in the form of oil in water emulsion. They provide high calorie source in low volume.

- **Electrolytes** : Sodium, potassium, magnesium, chloride, calcium, phosphate
- **Trace elements**: These act as metabolic cofactors and essential for proper functioning of several enzymes in body. These are zinc, copper, manganese
- **Vitamins/ Minerals**: Fat soluble and water soluble vitamins are essential they act as co-enzymes in carbohydrate metabolism and DNA synthesis.

	ADULTS	**CHILDREN**
Water	30-40ml/kg/day	30- 40ml/kg/day
Energy	30-60kcal/kg/day	20- kcal/kg/day
Amino Acid	1-2gm/kg/day	2.5-3.5gm/kg/day

TPN/HPN Bags

Bags should be sterile. In past polyvinyl chloride bags were used. Now ethyl vinyl acetate bags are commonly used.

Addition Of Components To TPN

Amino acid solutions and glucose added into the bag first. Followed by any fat emulsion if required. To prevent precipitation of vitamins, they are added immediately before administration.

Labeling And Packaging **Details on label are:**

- Patient Name (ward and unit no)
- Components of bag
- Total volume(ml)
- Energy content (kcal)
- Nitrogen (g)
- Infusion rate (ml/h)
- Expiry date and storage conditions

Packaging

TPN bag is sealed into dark colored outer plastic bag. Outer label identical to inner is placed. It is refrigerated until required to maintain stability.

Administration of TPN

The formulation is administered via catheter. The solution is administered slowly through a large vein, such as the superior vena cava(central vein). The superior vena cava is accessed through the subclavian vein immediately beneath the clavicle and near the heart. This permits rapid dilution of the concentrated fluid and

minimizes the risk of tissue or cellular damage due to the hyper-tonicity of the solution. Generally, final concentrations of dextrose (not greater than 10%) can be given peripherally. Solutions containing more than 10% dextrose should be given via the superior vena cava.

The following abbreviations may be used in hospitals in describing the desired order for parenteral nutrition:

CVTPN (central vein TPN)
TPN (total parenteral nutrition)
PPN (peripheral parenteral nutrition)
HPN (Home parenteral nutrition)

INDICATIONS

GIT diseases: ulcerative colitis, pancreatitis, malabsorption syndrome
Trauma: severe burn, acute renal failure
Abdominal surgery

ROLE OF PHARMACIST

- Pharmacist can provide information on aseptic techniques
- Handling & setting TPN bags
- Formulation requirements
- Stability problems
- Storage conditions

Aseptic Dispensing

Aseptic dispensing is the preparation and supply of sterile medical products, which require some dilution or other handling before administration. The preparation is carried out in the pharmacy by trained pharmacy technicians, assistants and pharmacists.

The preparations are aseptically dispensed in response to a prescription/ order for a patient, under the supervision of a pharmacist.

Sterilization

Sterilization is a process that eliminates (removes) or kills all forms of microbial life such as fungi, bacteria, viruses, spore forms, etc.

Basic Approaches for Sterile Preparation

1.Terminal Sterilization

2.Aseptic Process

(Aseptic: the complete absence of living microorganisms)

1.Terminal Sterilization

Terminal sterilization is a more traditional method of sterilizing products. In terminal sterilization, we fill a container, seal it and then sterilize it.

Whenever possible, products intended to be sterile should preferably be terminally sterilized by heat in their final container.

2.Aseptic Process

Aseptic processing is the process by which a sterile product is packaged in a sterile container in a way that maintains sterility. Aseptic processing is a simple idea. Sterilize a container, sterilize its cap, sterilize its contents and put them together.

Where it is not possible to carry out terminal sterilization by heating due to the instability of a formulation, a decision should be taken to use filtration and/or aseptic processing.

In order to maintain the sterility of the components and the product during aseptic processing, careful attention needs to be given to the environment, personnel, container & closure sterilization and transfer procedures.

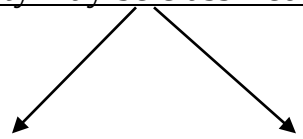
Chapter 9

INCOMPATABILITIES

Incompatibility is defined as:

"The change which occur in the quality of a preparation" as a result of prescribing or mixing the substances which antagonize (opposite) each other and an undesirable product is formed which may affect the safety, purpose or appearance of the preparation.

Incompatability may be classified as follows



Pharmaceutical incompatibility

1. Physical
2. Chemical

Therapeutic incompatibility

1.PHARMACEUTICAL INCOMPATIBILITY

It is a type of incompatibility which results during the process of compounding or preparation of pharmaceutical dosage form. Primarily they affect the appearance of products. Occasionally they can lead to therapeutic incompatibility if not corrected. It is of two types:

a) Physical incompatibility

It is a result of direct physical interaction between two or more components of a preparation. It is due to

- **Insolubility (incomplete solution)**

When two or more substances are combined they may not give a homogenous product due to insolubility.

- **Immiscibility (separation of immiscible liquids: salting out)**

Separation of a liquid from solution upon addition of another solvent takes place with which liquid is immiscible. e.g oils dissolved in alcohols separates on addition of water.

- **Precipitation**

A substance is precipitated from its solution upon addition of another solvent in which substance is insoluble.

- **Liquefaction**

Mixtures of solids sometimes liquefy due to absorption of water or release of water of hydration.

- **Gelatinization**

Solutions may form a gel when combined with certain substances

Physical incompatibility usually causes non-uniform dosage (difficult to measure accurate dose), unpalatable mixtures.

CORRECTION

- ✓ Change the vehicle
- ✓ Modify the mixing order
- ✓ Addition of suspending agent, emulsifying agent, solubilizing agents.
- ✓ Add adsorbents
- ✓ Remove the troublesome ingredient
- ✓ Change the dosage form

b) Chemical incompatibility

It may be result of chemical interactions between the ingredients of a prescription and a harmful or even dangerous product may be formed. These generally result from:

❖ **Hydrolysis**

It is addition of water. Aspirin (acetyl salicylic acid) upon hydrolysis converts into salicylic acid and acetic acid.

❖ **Oxidation-reduction reaction**

- Sugars are oxidized by Cu^{++}& Ag^{+} in alkaline PH.
- Oils and fats are oxidized by light to become rancid. All organic compounds are oxidized by oxidizing agents Fe^{+3} (ferric) is an oxidizing agent.
- Silver compounds are reduced to metallic silver by light and reducing agent.

❖ **Acid-base reactions**

These may be indicated by: i. **Evolution of gas** (carbonates react with acid and release carbon dioxide)

ii. change in color (reaction causes change in color indicating change in PH.

iii.precipitation (when soluble compounds react with hydroxyl (OH^{-}) ion or strong acids they form insoluble compounds).

❖ **Combination reactions**

In these reactions ions of one compound reacts with ions of other compound to form precipitates.

$AgNO_3 + NaCl \longrightarrow AgCl\downarrow + NaNO_3$

CORRECTION

- ✓ Complete the reaction before packaging
- ✓ Protect from air, light and moisture.
- ✓ Add desiccants.
- ✓ Addition of anti-oxidants, buffering agents and chelating agents.

2.THERAPEUTIC INCOMPATIBILITY

When the effect produced by one or more drugs is different in nature and intensity from that intended by the prescriber.

It is due to administration of:

- **Overdose and under dose of a drug(Improper dose)**

Over dosage may results from → Excessive single dose
→ Excessive daily dose
→ Synergistic combination

Under dosage may be due to → Antagonistic combinations
→ Prescription writing errors

- **Incorrect drug**

Trademark error: it may be due to products with very similar names. Error in prescription handling may be due to difficult hand writing.

- **Wrong dosage form**

Toxic external preparation is prescribed internally. Skin preparations are prescribed for eye.

- **Contraindicated drugs**

Prescription calls for a drug to which patient is allergic. Patient is still taking a previous prescription which may be contraindicated with new one.

CORRECTION

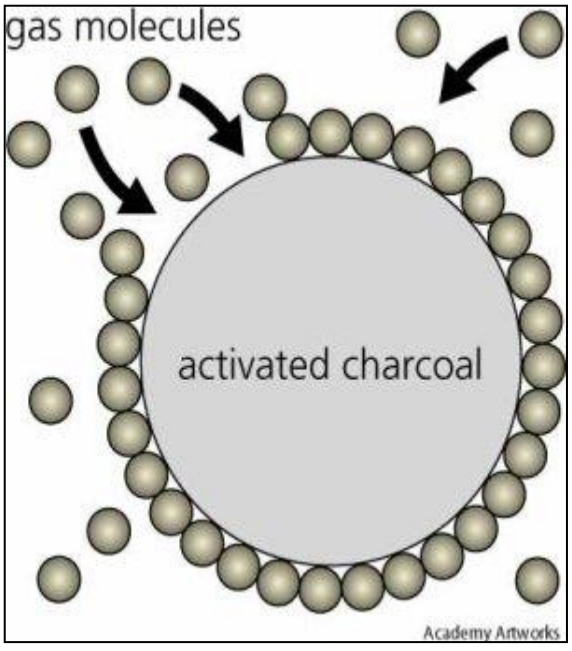
- ✓ Review prescription for possible errors
- ✓ Educate patient about proper use of drug. (Time, frequency and dose)
- ✓ Enquire patient about other prescription and OTC drugs.

Chapter 10

INTRODUCTION AND APPLICATION OF VARIOUS PROCESSES IN PHARMACY

1. Adsorption

When a solid surface is exposed to gas or liquid molecules then gas or liquid molecules accumulate at the surface it is called adsorption.
The substance that deposits at the surface is called **adsorbate**. And the solid on whose surface the adsorption occurs is called **adsorbent**.



Attachment of Particle
The solid particles have more compact molecules than liquid or gases. So, it acts as a foundation in adsorption for liquid or gas particles. On surface they can join by the following ways

- Ionic bonding
- Physical interactions
- Chemical Interaction

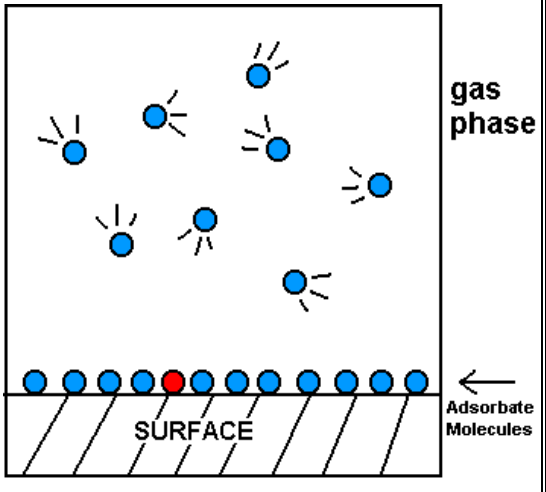
Difference between adsorption and absorption
Adsorption means deposition on surface only while absorption means penetration into the body of solid.

Types of adsorption

Adsorption fundamentally divided into two main categories

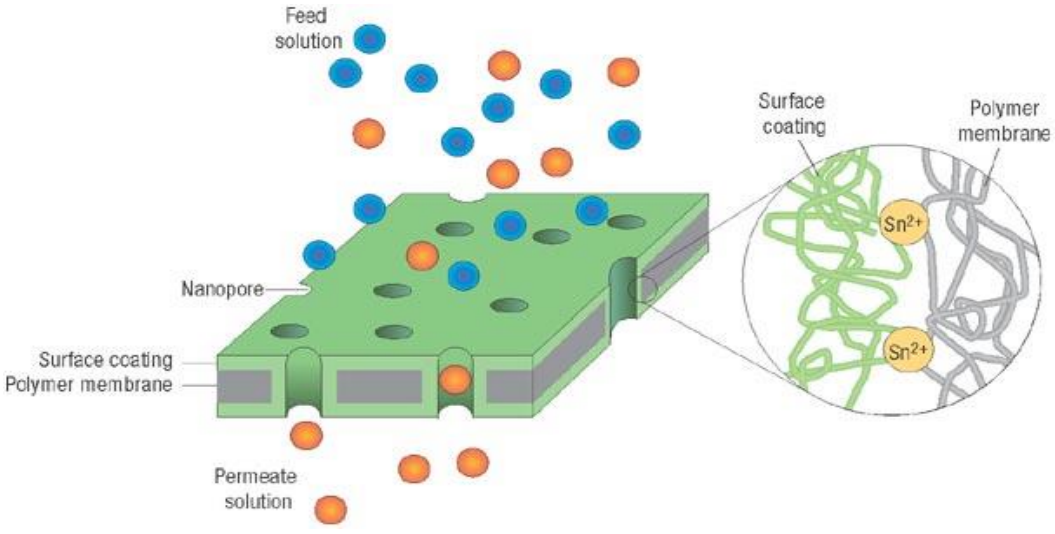
1. **Physical Adsorption**
   It is the interaction of liquid or gas particles with solid particles surface and there is physical characteristics are involved

Example
Many drugs are absorbed from GIT and skin through physical adsorption mechanism.



2. Chemical Adsorption

It is the process in which liquid or gas particle binds to solid particle surface through chemical interaction is known as chemical adsorption
Example Accumulation of O2 on the surface of iron



Factors affecting adsorption

Surface area
Increase in surface area leads to increase in the amount of gas adsorbed

Nature of gas
More liquefiable gases adsorbed more readily e.g SO_2

Temperature
Adsorption decreases by increasing temperature**.**

Application of Adsorption

1. Adsorption is the mechanism of absorption through skin and GIT.
2. Adsorption is the fundamental mechanism of antidotes.
3. Removal of access acid from stomach by using weakly basic adsorbents.
4. It is used in discoloration of different substances. Activated charcoal remove color from solution.
5. It is the main mechanism to combat with intestinal toxin Example etox-P
6. Removal of poisonous gases from atmosphere.

2. Calcination

Calcination is the process in which the inorganic substances are strongly heated so as to remove their volatile components and fixed component are preserved.

Mechanism of Calcination

On laboratory scale we use silica or platinum crucibles, china dishes and glass dishes for this process. Firstly we add the chemical substance to respective apparatus, now heat this chemical substance until volatile components are evaporated and fixed components remain in apparatus. On industrial scale rotary kilns are used in the process of calcination.

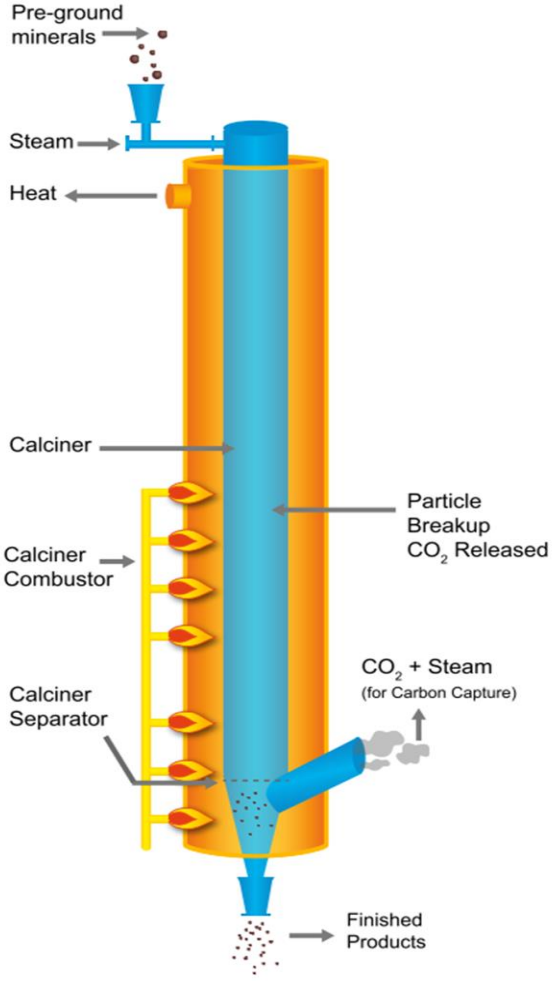
Examples

$CaCO_3 \longrightarrow CaO + CO_2$

$ZnCO_3 \longrightarrow ZnO + CO_2$

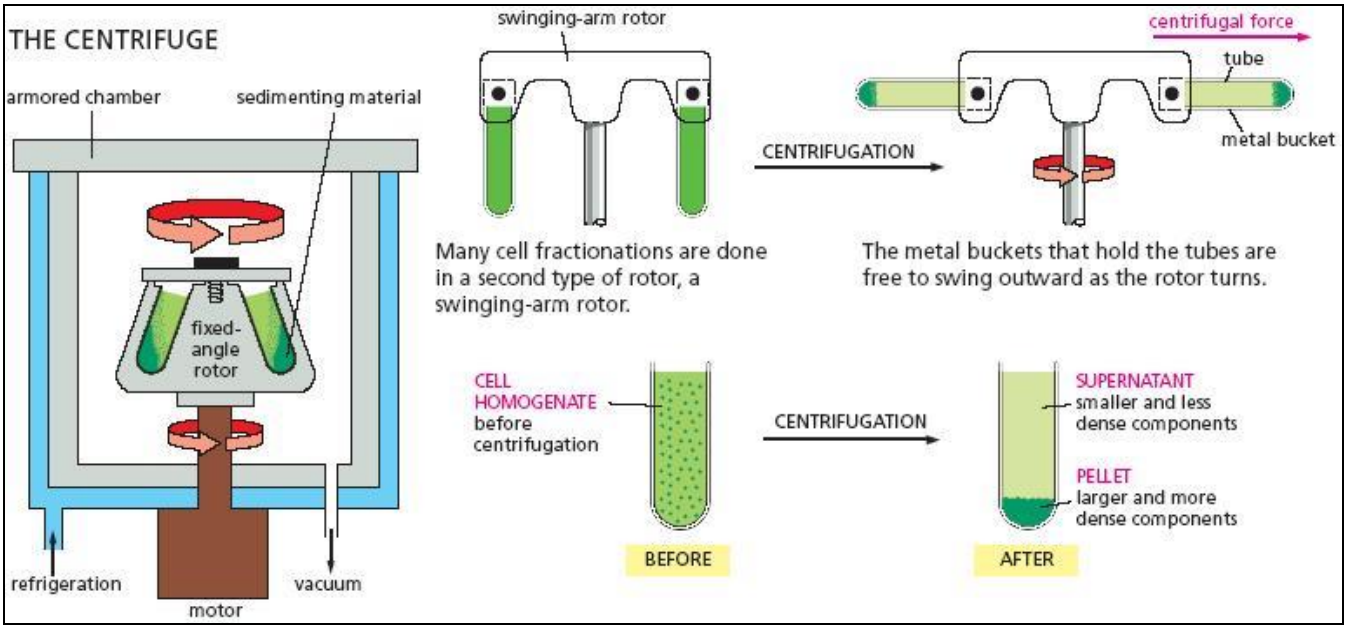
Application in Pharmacy

1. Calcination is used in the separation and purification of certain inorganic substances e.g. calcium oxide Zinc oxide and red mercuric oxide.
2. It is used in the conversion of carbonates to oxides.
3. Calcinations is used in Gravimetric analysis which is used widely in pharmaceutics and chemical industries



3. Centrifugation

"Centrifugation is the process of separating lighter portions of a solution, mixture or suspension from the heavier portions by centrifugal force".
The rate of centrifugation is specified by the angular velocity measured in revolutions per minute (RPM).



Microcentrifuges

Microcentrifuges are used to process small volumes of biological molecules, cells, or nuclei. Microcentrifuge tubes generally hold 0.5 - 2.0 mL of liquid, and are spun at maximum angular speeds of **12,000–13,000 rpm.**

High-speed centrifuges

High-speed or superspeed centrifuges can handle larger sample volumes, from a few tens of millilitres to several litres. Additionally, larger centrifuges can also reach higher angular velocities (around **30,000 rpm**). The rotors may come with different adapters to hold various sizes of test tubes, bottles, or microtiter plates.

Ultracentrifuges

Ultracentrifugation makes use of high centrifugal force for studying properties of biological particles. Compared to microcentrifuges or high-speed centrifuges, ultracentrifuges can isolate much smaller particles, including ribosomes, proteins, and viruses. Ultracentrifuges can reach maximum angular velocities in excess of **70,000 rpm**.

Applications

Industrial centrifuges are used:

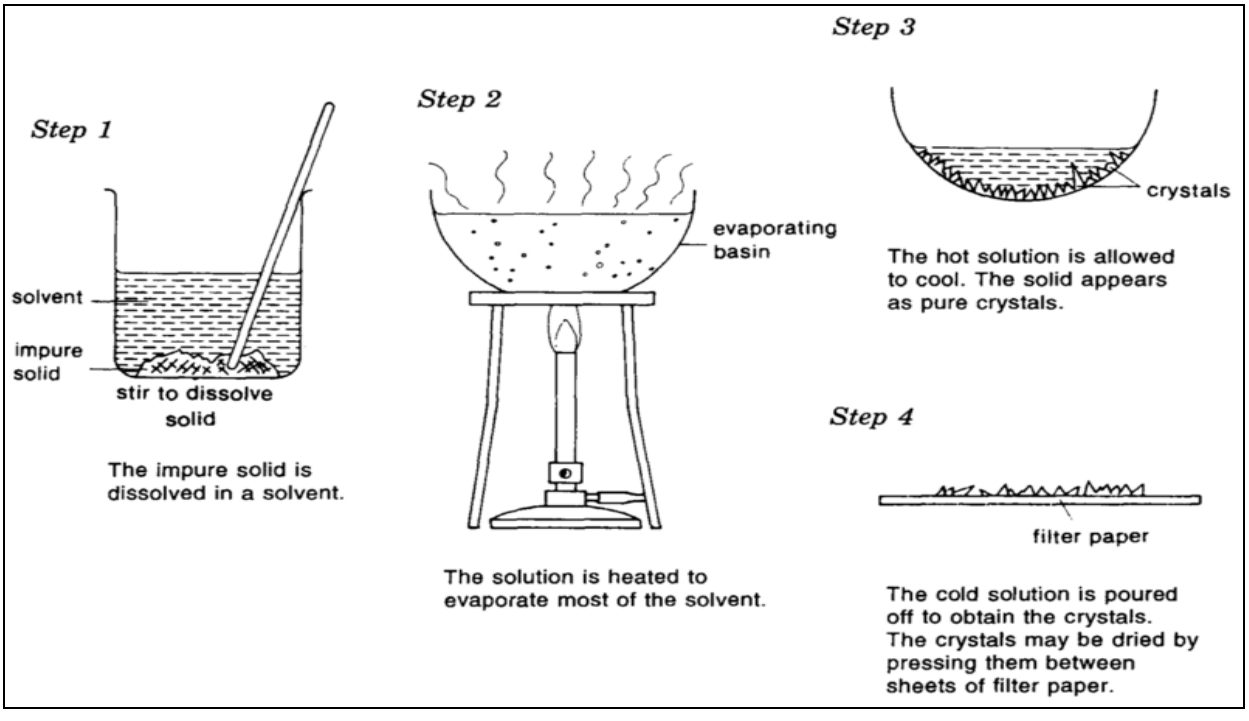
- For separating solids from liquids, liquid-liquid separation, and liquid-solid separation.
- Removing fat from milk to produce skimmed milk
- Separation of urine components and blood components in forensic and research labs.
- In laboratories performing biochemical analyses on body fluids, centrifuges are routinely used: To separate blood cells from serum/plasma.
- To separate sediment from urine
- To measure the volume fraction of erythrocytes in blood (the hematocrit)

4. Crystallization

It can be defined as highly specific method which is used to convert liquid into solids by using evaporation, cooling or precipitation method is known as crystallization.

Basic steps of crystallization

- Make supersaturated solution
- Formation of crystal nuclei
- Initiation of crystal growth
- Complete growth of crystals in mother liquor (liquid left behind after getting crystals is called mother liquor).



Methods of crystallization

1. Evaporation

In this method the temperature of the liquid raised and the liquid evaporate so finally we get a solid crystals of compounds.

2. Cooling

In this method we use cooling procedure to form solid crystals it is a very selective method for heat sensitive materials. Supersaturated solution is cooled and then by filteration of solution, crystals can be obtained on filter paper.

The cooling method is divided into two subclasses

I. **Slow cooling crystallization** : large sized crystals can be obtained.

i. **Rapid cooling crystallization**: small sized crystals can be obtained.

3. Precipitation

In this method two chemical liquids are mixed together and precipitates are formed and then separate out the solid material. It is very rarely used method of crystallization

Factors affecting Crystallization

1. Temperature
2. Cooling rate
3. Precipitation rate
4. Rate of growth of crystals
5. Nature of solvent
6. Nature of substance
7. Impurities

Pharmaceutical application of crystallization

i) It is important purification mechanism used in pharmaceutical industries to get pure solid drugs e.g. insulin, sulphur, cortisone acetate purified by crystallization.
ii) Penicillin –G is solidify by this process
iii) Crystallization process is used to get proteinaceous drugs in solid form.
iv) Stability of drug is enhanced by crystallization.
v) It is very simple and less time consuming method to get extremely pure drugs.

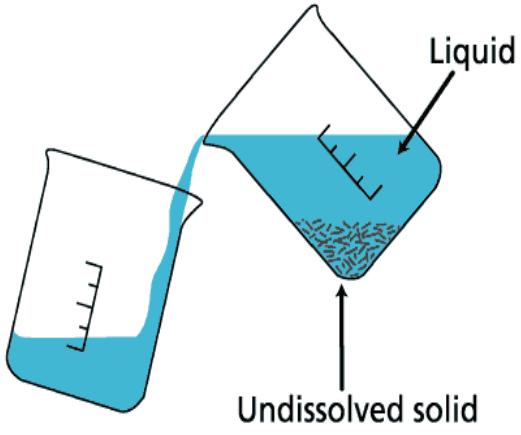
5. Decantation

It is a process used in pharmacy to separate out the impurities from the soluble portion of the solution

Process

Decantation involves following steps

1. washing of the Solids
2. Adding the Solids in solvents and stir it
3. After the Solution formed separate all the impurities After the removal of impurities we will get a pure solution



Applications

ii. This method is used to purify the solids.
iii. This process is also used to separate the solids from liquids.
iv. It is also use in the separation of gels and magmas.

6. Deliquescence

It is chemical process in which any anhydrous compound catch up the water from its surrounding environment and convert itself into hydrated form. It is also known as hygroscopicity.

The compound have the tendency to convert itself from anhydrate to hydrated form are known as hygroscopic or deliquescence compound.

Mechanism

In deliquescence the humidity level of product as compare of the humidity level of atmosphere if this kind of material directly interact with the atmosphere. The humidity from atmosphere moves inside the product and convert it from anhydrous form to hydrous form.

Precautions

1. These products should not be kept open.
2. These products should be kept in well closed containers.
3. We add silica gel packet to absorb the humidity that is enclosed in container.

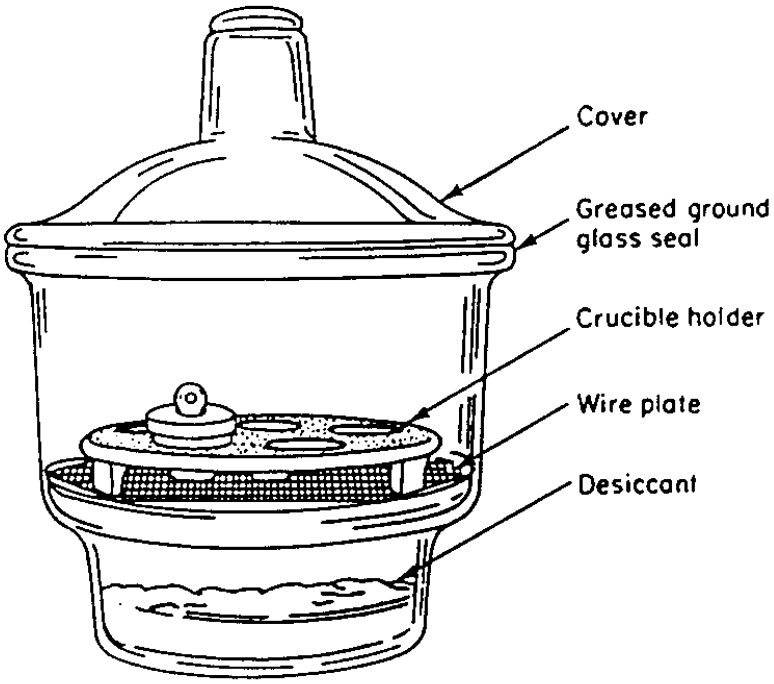
7. Dessication

It is drying procedure which is widely used in pharmacy to remove the admixed water from the product. The term dessicated is applied to those substances or product that have undergone the Dessication procedure.

The admix water is completely remove from the substances or products. These are also termed as dried products.

Mechanism

In Dessication the dessicant (silica gel) is used to remove the extra or admixed water from the substance or product and term dry is usually used for those products that do not have the noticeable quantity of moisture.



Desiccants

The chemical used for desiccation are called desiccant. These are also called dehydrating agents. They include:

1. P_2O_5
2. Silica gel
3. Exsiccated $CaCl_2$
4. Conc. H_2SO_4
5. NaOH

Applications

1. Aid in preservation

Vegetable and animal drugs soon undergo decomposition by the bacteria and fungi due to the presence of moisture. Desiccation process remove moisture from drugs. It preserves them for longer period of time.

2. Reduce bulk weight

It reduced the bulk weight of drug by removing moisture, in the way reduce the cost of transportation.

3. Increase the stability of drugs

Stability of drugs is increase by desiccation.

4. To facilitate communition

Desiccation process makes the drugs less elastic and more brittle. Brittle drugs are triturated more easily as compared to elastic drugs.

1. Increase shelf life of crude drugs.

Shelf life of crude drugs is increased by desiccation.

Application

1. By using Dessication the stability of pharmaceutical product enhances
2. Dessication is a renowned process for drying
3. All the hygroscopic drugs are dried through Dessication process.
4. For Dessication dried silica gel and alumina is used in the bottles of hygroscopic medicine.

8. Distillation

It is the method of separating the constituents of a liquid by vaporizng the liquid. The different componenets separate on the basis of their volatilities.

Principle

It is a purification as well as separation process in which a chemical substance is boiled up to their boiling point until it convert into vapors then these vapors are converted back into liquid and collected in the receiver, it is called distillate.

Apparatus

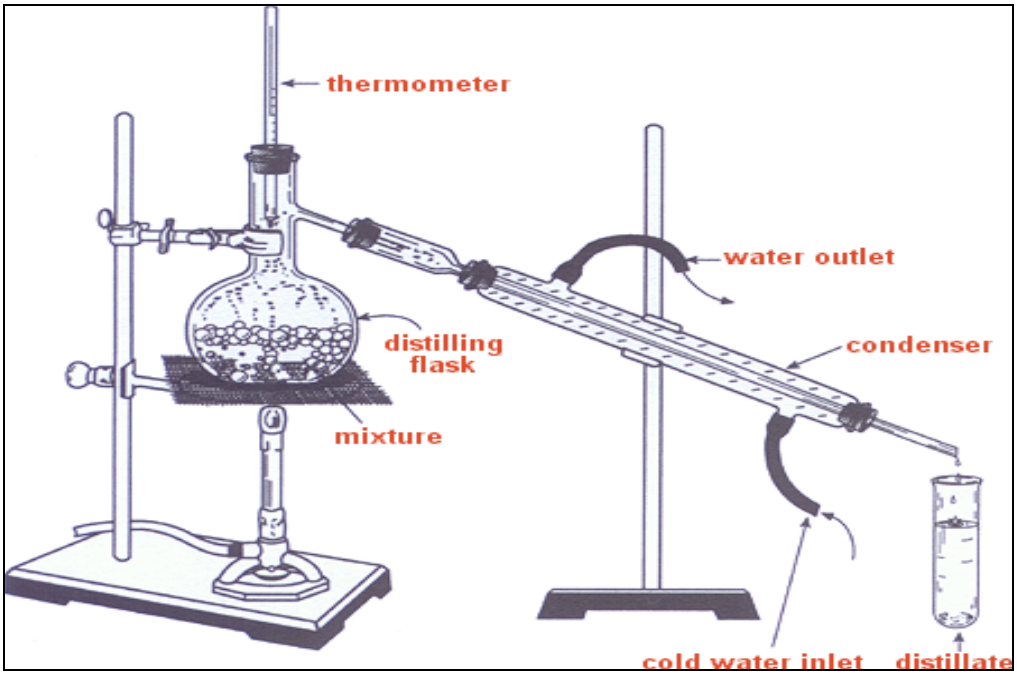
1. **Still** : the vessel or the container in which the liquid is hated.
2. **Condenser** : through which cold water is circulated to carry out condensation
3. **Receiver** : vessel in which the condensed liquid is collected

Types of distillation.

1. Simple distillation (Distillation under atmospheric pressure)
2. Steam distillation
3. Fractional distillation
4. Vaccum distillation (Distillation under reduced pressure)

1. Simple distillation

The apparatus generally used for simple distillation consists of still, the condenser and the receiver. Flask should be filled not more than half or two third of its size.
The liquid is converted into vapors which are passed through cooling surface to condense the vapors.



Simple Distillation Apparatus

2.Fractional distillation

This process is used to separate miscible volatile liquids having different boiling points.i.e. mixture of alcohol and water. Miscible liquids can be separated by using fractionating columns in between the still and the condenser. Fractionating column condensing vapors of the less volatile component of the mixture and return it to the still. The vapors of more volatile component pass through the condenser and collected in receiver.

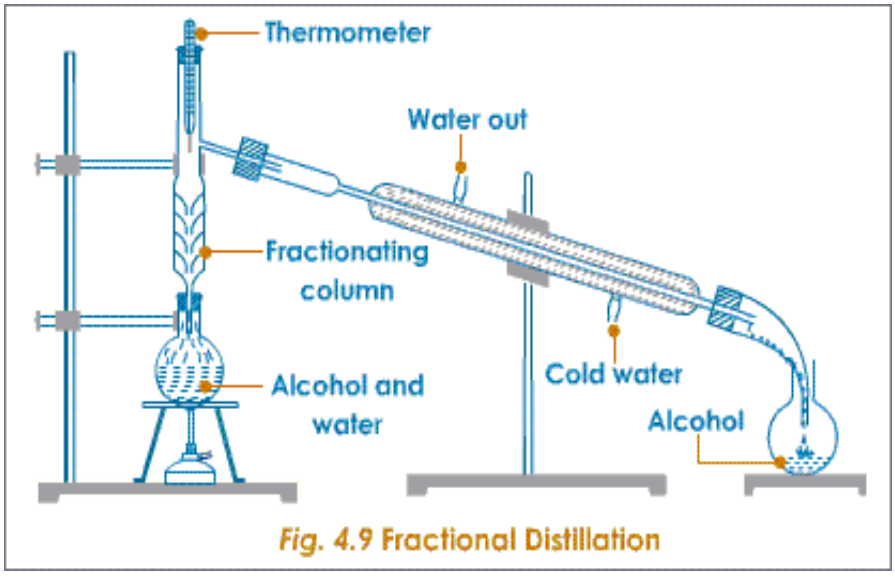
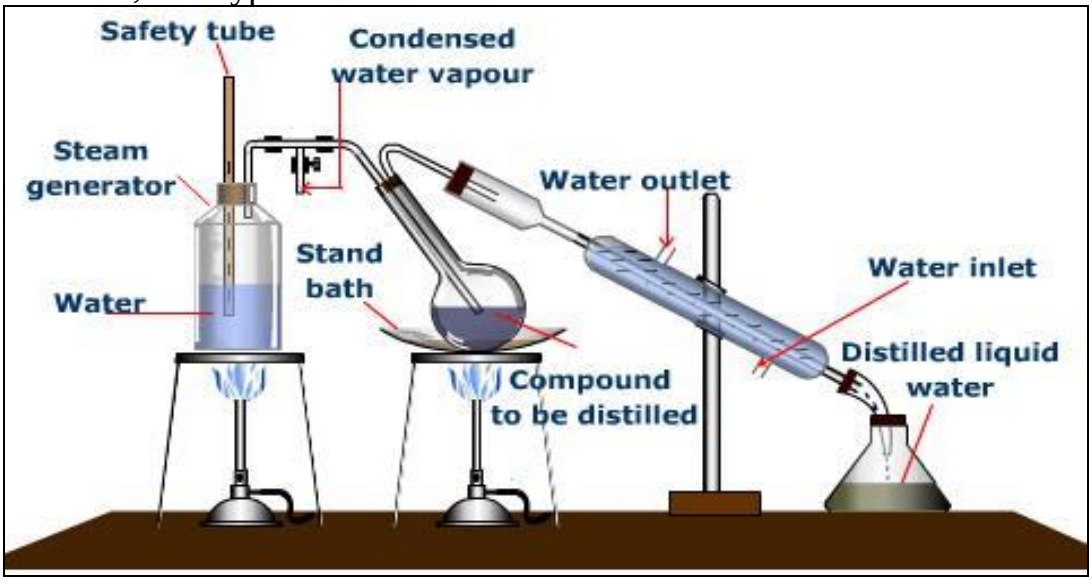


Fig. 4.9 Fractional Distillation

3.Steam distillation

Steam distillation is used for the distillation of two immiscible liquids one of which is water. The distillation apparatus consists of steam generator fitted with a tube which carries the steam to the flask containing the liquids. When steam is passed through a mixture of these liquids, it boils at a much lower temperature than the boiling point of pure water. The vapors are allowed to pass through condenser and distillate forms two layers which are separated from each other as completely as possible.

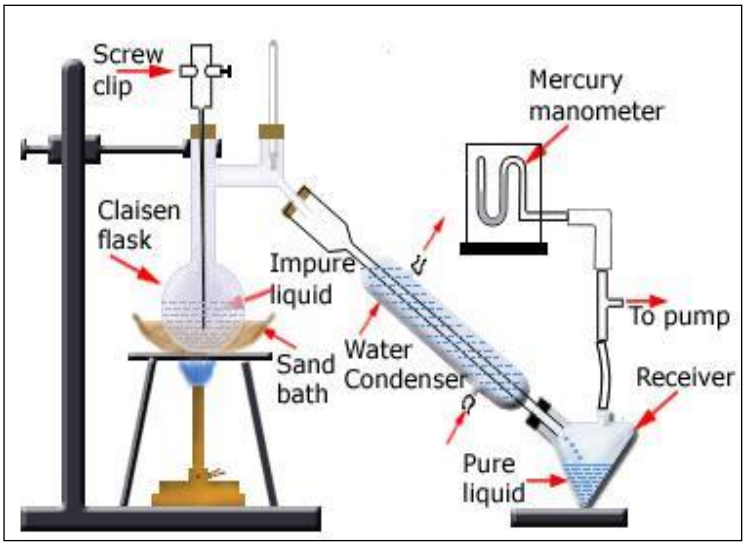
This method is used for distilling heat-sensitive compounds as volatile oils i.e. clove oil, eucalyptus oil.



4.Vaccum distillation

The liquids which are decomposed at their boiling point under atmospheric pressure can be distilled at a much lower temperature when pressure is reduced on the surface of liquid.

This process is carried out in claisen flask(has two necks). Through one inserted thermometer and attached to condenser and other hold fine capillary. Side tube of receiver connected to vaccum pump, a pressure guage(manometer) is inserted b/w receiver and vaccum pump.



APPLICATIONS

- ✓ Distilled water, rose water and other pharmaceuticaly active ingredients are obtained by distillation.
- ✓ Steam distillation is used for extraction of volatile oils from their crude drugs i.e. clove, anise,eucalyptus oil.
- ✓ Petrol, kerosene, fuel oil, lubricant oil produced from fractional distillation of crude oil
- ✓ For purification and separation of miscible and immiscible liquids.

9. Exsiccation

"Exsiccation is the process of removing the water of crystallization from the hydrated crystalline substances by heat" and making them anhydrous.
After removing water molecules the abtained material is called "exiccated material".

- **EXAMPLES:**

  The examples of exsiccated substances include

  1. Exsiccated magnesium sulphate
  2. Exsiccated ferrous sulphate
  3. Exsiccated magnesium sulphate
  4. Exsiccated sodium sulphate
  5. Exsiccated sodium carbonate
  6. Exsiccated alum
  7. Anhydrous sodium arsenate

- **Method:**

  In the laboratory, exsiccation may be carried out by taking a weighed amount of the substance in a tarred dish which is heated on water bath,

  Sand bath as or in an over, with continuous stirring until a constant weight is obtained or until the calculated loss in weight has taken place.

- **THE TEMPERATURE REQUIRED TO REMORE WATER OF CRYSTALIZATION IS VERY IMPORTANT**:

- **Examples:**

1. Copper sulphate, **$CuSO_4$.$5H_2O$**, when heated at about 30°C loses two molecules of water of crystallization at 100°C it loses two more water molecules and the last water molecule is removed when it is heated at 200°C thus forming $CuSO_4$.$5H_2O$, $CuSO_4$.$3H_2O$ and $CuSO_4$ respectively.

2. **Ferrous sulphate $FeSO_4$. $7H_2O$** when heated on water bath lose six molecules of water of crystallization but when further heated to remove last water molecule, decomposition take place. Hence ferrous sulphate with one molecule of water of crystallization $FeSO_4$. H_2O is called exsiccated ferrous sulphate.

- **STORAGE OF EXSICCATED SALTS:**

Since the exsiccated salts are very hygroscopic, so must be stored in well closed containers.

- **APPLICATIONS**

1. To increase the shelf life of drugs and prevent from microbial contamination.
2. It is also carried out to reduce the bulk and weight of certain drugs so that they can be easily administered.
3. To obtain fine powder of the substance.

10. Ellutriation

This is a process of separating a substance into powders of different degrees of fineness by stirring the substance with a large volume of liquid in which it insoluble and withdrawing the liquid at different heights. The upper layers of liquid contain suspension of the finer particles, while the lowers layers contain the coarser or heavier particles.

Explanation

Elutriation on large scale is carried out in elutriation tank consisting of vessels of large capacity having taps placed at different intervals from top to bottom.
So that liquid can be draw at different levels. On small scales it is carried out in elutriation jar it is made of glass and usually only as three taps.

Example

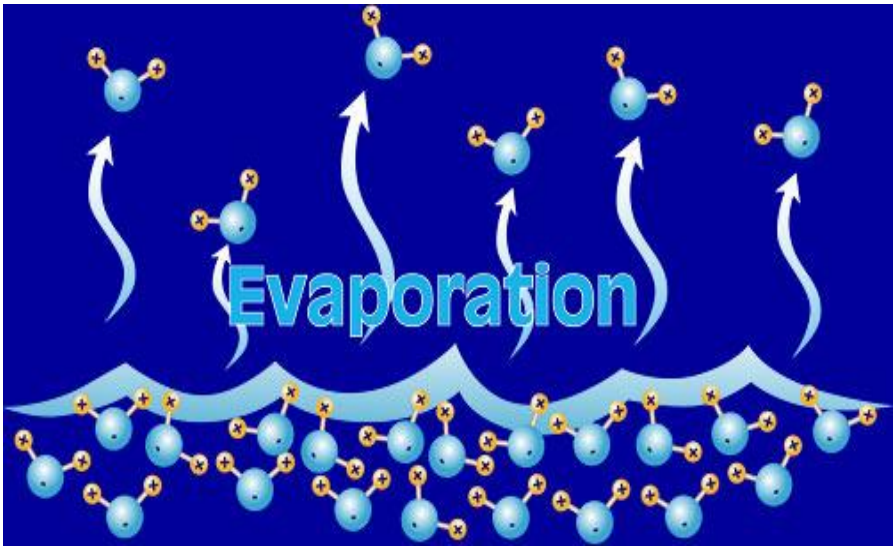
Chalk is prepared from native CaCO3 by elutriation. The $CaCO_3$ is first levigated with water then large volume of water is added to the mixture and it is stirred briskly, after which different layers of liquid with different size of particle can be separated. Upper layers is decanted containing with it finer particles while the lower layers contain heavier or coarser particles.

Application

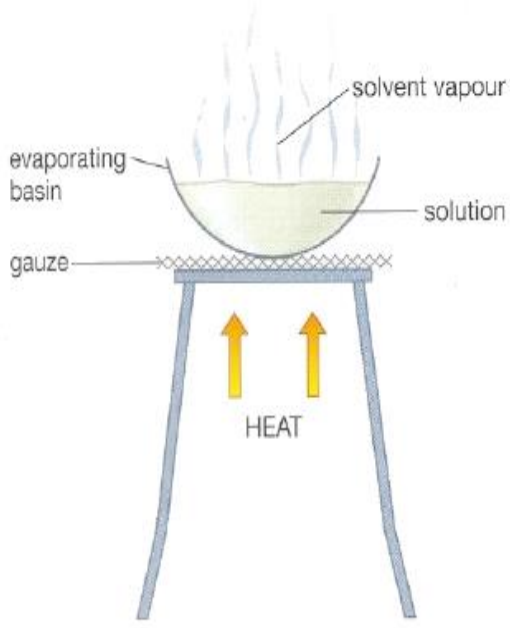
1. Calamine may be produced in the same manner from native Zinc Carbonate.
2. Kaolin is also prepared from pharmaceutical purposes by elutriation.
3. Chalk is produced from native $CaCO_3$ by elutriation.

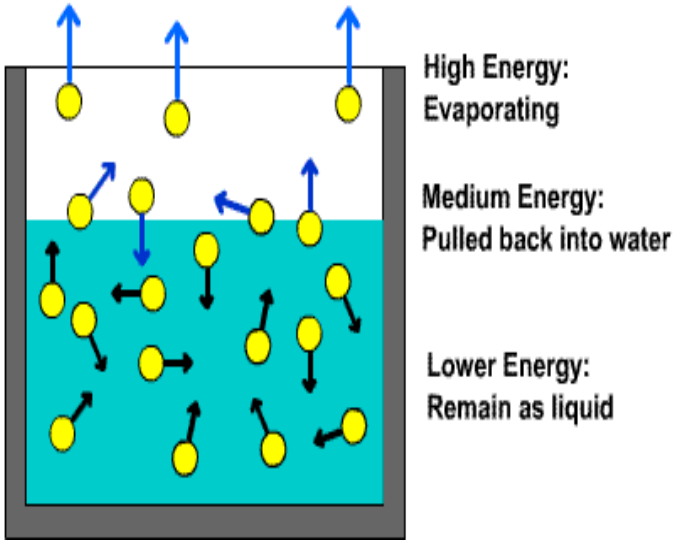
11. Evaporation

Evaporation is a phase transition from the liquid phase to gas phase that occurs at temperature below the boiling temperature at a given pressure. It is a type of vaporization of a liquid that occurs only on the surface of a liquid. Evaporation produced cooling effect. In summers when sweat evaporates it produces cooling effect on skin.



Thus practically evaporation may be defined as removal of liquid from a solution by boiling the solution is a suitable vessel.





Factors influencing the rate of evaporation

1. Flow rate of air

Higher the flow rate greater will be the rate of evaporation.

2. Inter-molecular forces

The stronger the inter-molecular forces lesser would be the rate of evaporation.

3. Surface area

Large the surface area greater will be the rate of evaporation.

4. Temperature of the substances

Greater the temperature greater will be the rate of evaporation.

5. Density

Higher the density slower a liquid will evaporate.

6. Agitation

The process of agitation increases the rate of evaporation.

7. Atmospheric pressure

Rate of evaporation will increase with decrease in atmospheric pressure.

8. Concentration of other substances in air

If the air is already saturated with other substances then substance will evaporation more slowly.

DIFFERENCE B/W Boiling Point AND Evaporation:

"Evaporation differs from boiling that evaporation takes place at all temperature whereas boiling takes place only at one temperature at a given pressure.

DIF B/W Evaporation AND Distilation:

"Evaporation differs from distillation that is evaporation the solvent which is generally water is not condensed and collected whereas is distillation the solvent vapors are condensed and are collected in a receiver

EVAPORATORS

SMALL SCALE METHODS

A fixed maximum temperature can easily be attained by employing different types of baths as a source of indirect heathing. A water bath is most suitable when the liquids are to be heated up to 100^{o}c. or soft paraffin may up to 150^{o}c to prevent decomposition.

LARGE SCALE METHODS

1. **Evaporating pans**

On a manufacturing scale, liquid extracts containing water as a menstrum are evaporated in open pans called evaporating pans. They consist of hemispherical or shallow pans made of copper, stainless steel, aluminum, enameled iron or other metal and surrounded by a **steam jacket**. These pans may be fixed or made to tilt to remove the product.

Advantages

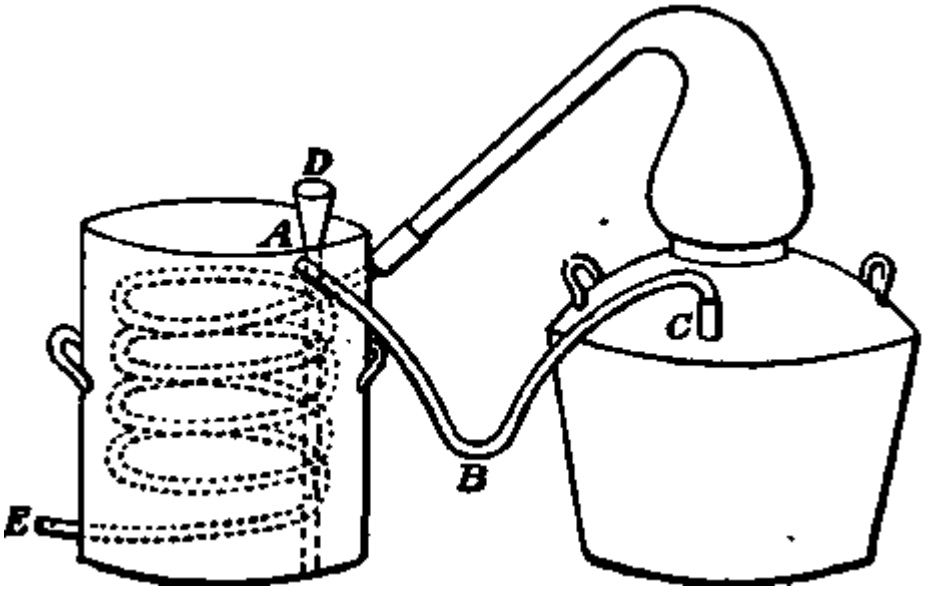
1. They are simple, easy and cheap to construct.
2. They are easy to use and clean.
3. Stirring of the evaporating liquids can be done easily.

Disadvantages

1. The whole of the liquid is heated all the time which may lead to decomposition of the components.
2. On the evaporating surface, scum is rapidly formed which decreases evaporation. Solids may be deposited at the bottom which makes the stirring necessary.
3. The pan can only be used for evaporating aqueous and thermo-stable liquid extracts. They cannot be used for evaporating extracts containing organic solvents like alcohol etc.

2. Evaporating stills

Evaporating stills are quite similar to evaporating pans, it consists of a vessel made from copper condenser so that the solvent is condensed and collected in a receiver. At the lowest point of the pan, a tube fitted with a tap is connected for the removal of the product from the pan. The pan is surrounded by a steam jacket. For cleaning the pan or easy removal of the product the cover of the vessel may be fitted with quick-release system of clamps.



Advantages

1. They are very simple to construct and are quite easy to clean and maintain.
2. The still can be used for evaporating liquids containing aqueous and other organic solvent.

Disadvantages

1. The whole of the liquid is to be heated all the time which may lead to deterioration of the product.
2. The heating surface is very limited.
3. This methods of evaporation is widely used in pharmaceutical industries when small batches of liquids are to be evaporated.

Applications of evaporation

1. Evaporation is one of the most important processes in the manufacture of pharmaceuticals.
2. It is used in the preparation of liquid extracts, soft extracts and dry extracts and in the concentration of blood plasma and serum.
3. It is also used in the manufacture of drugs containing antibiotics, enzymes, hormones and many other substances.

12. Fusion

Fusion process is commonly called "melting". It is the process by which the solids get converted into liquids without adding any solvent. It may also be defined as the process of heating the solids until they melt.

Process of fusion

All the substances are melted together and then cooled slowly with constant stirring until a uniform product is obtained. To avoid overheating substances with higher melting points are heated first to which substances with lower melting points are added. Heat-labile substances and any volatile components are added in last when temperature of the mixture is low enough not to cause decomposition or volatilization of components.

Explanation

Fusion process is employed only when components are stable at fusion temperatures.

Application

1. Fusion is done to purify certain solid and semi-solid substances e.g bees wax, wool fat, soft paraffin are heated to melt and filtered while hot to remove the dissolved impurities.
2. This method is used for preparation of ointments.
3. It is used in pharmacy for incorporating drug components into base.
4. Creams, pastes and gels are also formulated through fusion process.

13. Ignition

Ignition is also called **incineration**. Ignition is a process used in pharmacy in which the organic substances are strongly heated until its carbon part burn and converted into ash.

The temperature is maintained at 200^{o}C to 300^{o}C. The temperature is provided by putting platinum crucibles in furnace.

Application in pharmacy

1. Ignition process is used as a standardization test to evaluate the quality and purity of organic compounds
2. Ignition is also used as sterilization process.
3. This process is used in combustion analysis.

14. Levigation

Levigation also called "wet grinding" .The incorporation of small quantities of drugs by using spatula is also known as levigation.

Method of Levigation

In levigation solid is first converted into paste. The solvent used should be somewhat viscous such as mineral oil or glycerin. Levigation is a process of mixing throughly or grinding to make a smooth paste.

Levigation is performed for two functions

- Grinding technique for making the fine powder.
- For mixing of various ingredients

Application of Levigation

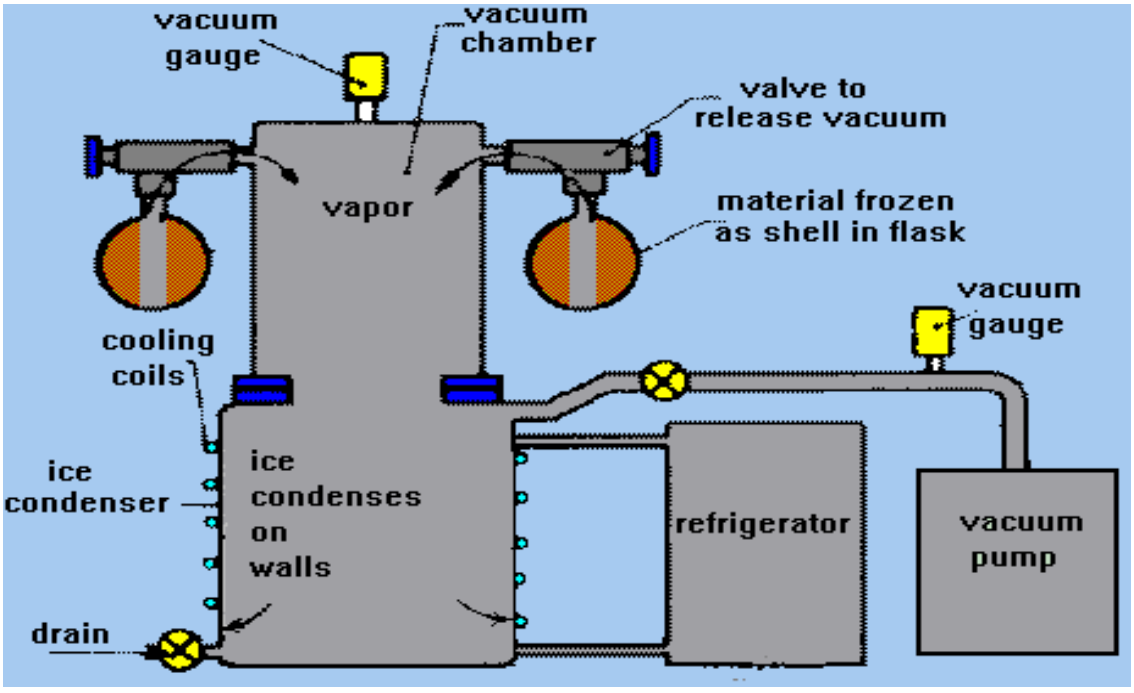
1. It is the leading method that is used in dispensing pharmacy to mix up the medicaments with the fat or water soluble base.
2. Levigation process can be used in the formulation of ointments creams pasts and gels.
3. Levigation used for the mixing and blending of various ingredients of drugs.

15. LYOPHILIZATION (Freeze drying)

Freeze drying is the process in which water is removed from liquid prroducts by sublimationThe material is first frozen to ice then reducing the surrounding pressure(by vaccum) to allow the frozen water in the material to sublimate directly from solid to gas phase.

Freeze drying process carried out in various stages.

1. Pre treatment
2. Freezing
3. Drying



1. Pre treatment

It is stage product is prepared for freezing. It may be include concentrating the products or addition of components to increase the stability.

2. Freezing

In laboratory it is done by placing the material in the freeze drying flask and rotating the flask in the shell freezer bath which is cooled by dry ice, methanol or mechanical refrigeration etc. On large scale it is down by using freeze drying machine. To produce large size crystals products should be frozen slowly.

3. Drying

At this stage vaccum is applied to the chamber which has been previously chilled. Pressure is lowered and enough heat is supplied to material for sublimation of water. At this stage 95% of water in the material is sublimed. The process is continued till the product is dry and spongy solid material left behind. Freeze dried products are sealed to prevent the re-absorption of moisture.

Applications

1. This process is used for the manufacture of certain pharmaceutical and biological product which are thermolabile. It is used for drying blood plasma, enzymes, hormones, antibiotics and vitamins.
2. Freeze dried products remain protected from spoilage for many years.
3. It increases the shelf life of pharmaceutical products like vaccines and other injections.
4. It is used to preserve food and resulting products is low and light weight.

16. SUBLIMATION

Sublimation is the process in which, on heating, a solid directly gets converted to vapours without passing the liquid state and vapors get converted back to the solid state.The product so obtained is known as sublimate (sublimed material).

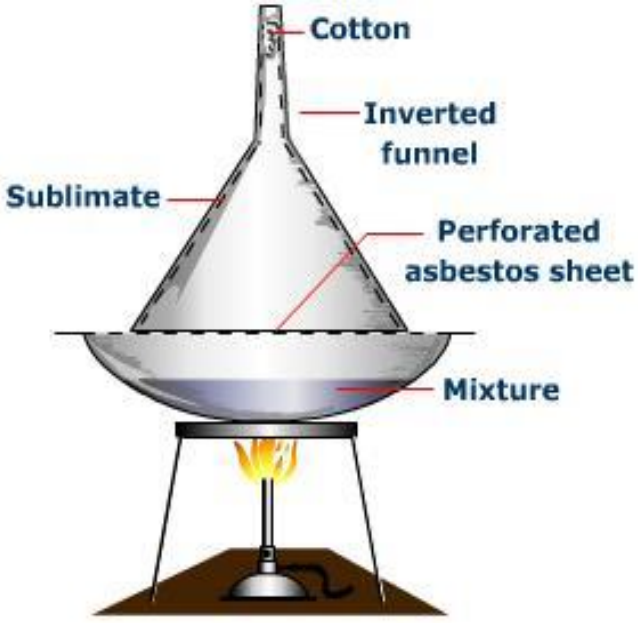
METHOD OF SUBLIMATION:

On laboratory scale sublimation may be carried out by using a very simple apparatus consistiong of;

APPARATUS:

- China dish
- Perforated filter paper
- Funnel
- A plug of cotton wool.

The material to be sublimed is put in the china dish which is covered with a perforated filter paper. A glass funnel the open end of sublimed product; is placed in the inverted position over the filter paper. The china dish is heated over sand bath and vapours pass through the perforations of the filter paper which are collected on the inner surface of the glass funnel which is kept cool from outside bay wrapping a wet filter paper or cotton wool. The vapours on cooling are converted into a solid which is collected afterwards.



Applications

- ✓ Used in the purification of many pharmaceutical substances such as iodine, camphor, sublimed sulphur.
- ✓ It is also used in the manufacture of iodine, ammonium chloride and naphthalene.

17. Trituration

Word trituration comes from "triturate" which means "rub to pieces". It is a process of reducing the particle size by grinding.

Mechanism of Trituration

In Trituration pestle and motor is used for size reduction of different organic and inorganic substances. Trituration is the production of a homogenous material through mixing. It is a dry process and is different from levigation. It is the continous rubbing or grinding of the powder in a mortar with a pestle. To avoid complication we use only one direction of movement either clockwise or anticlockwise

Application in Pharmacy

1. Use for the size reduction of different substances
2. Use for the mixing of different pharmaceutical components
3. It is used in the formation of creams lotion and ointments
4. It is used in pharmacy for the dispensing of different drugs

18. Efflorescence

Efflorescence is the loss of water of crystallization from hydrated substances into the atmosphere.

Explanation

In hydrated form the water molecules attached to the compound. The surrounding atmosphere also has vapours and definite vapour pressure due to water vapours present in atmosphere. If the vapour pressure of hydrated substance is greater than the surrounding atmosphere then hydrated substance loses water molecules to become less hydrous and finally become anhydrous this phenomenon is known as efflorescence.

Prevention of Efflorescence

- By closing the container immediately after use
- By filling the container completely so that no space for air storage is available in the container

- **Dispensing portion**

Types of dispensed pharmaceutical products

1. **Elixir.**

Storage:
Since elixir contain alcohol and usually some volatile ingredients which deteriorate in the presence of air and light so should be stored in tightly closed containers and in cool place.

2**.EAR DROPS**
Ear drops are the liquid preparation in which the drugs are dissolved or suspended in a suitable vehicle like water, dilute alcohol, Glycerin , propylene glycolor any other suitable solvent and are intended for instillation the ear with dropper.

Commonly Used Vehicles:
=> Propylene glycol, Polyethylene glycol Glycerin are commonly used vehicles
=> Water is disfavored bcz it would face difficulty in mixing with the secretions of ear which are mainly fatty.

Uses:
Ear drops are generally used for cleaning the ear, drying weeping surfaces, softening the wax and for treating the mild infections.

Method Of Dispening
Ear drops are dispensed in colured fluted bottles attached with a dropper or in suitable plastic containers . label on container is for external use only

3. NASAL DROPS
Nasal drops are usually aqueous solutions intended for instillation into the nostrils by means of dropper.

Uses:
They are commonly used for their antiseptic, local analgesic or vasoconstrictor properties

Vehicles For Nasal Drops
At one time , oily preparation containing liquid paraffin or vegetable oils as vehicle

were used prolong the action of the drug but now the use of oily vehicle in the preparation of nasal drops discouraged because on prolonged use the oil retards the colliery action of the nasal mucosa of drops of oil may enter the trachea and cause lipoid pneumonia .so aqueous vehicles are preferred .

Dispensing Of Nasal Drops :

1. Nasal drops should be made isotonic with 0.9% Nacl
2.Ph Natural
3.Viscosity similar to nasal secretions achieved by the addition of 0.5%methyl cellulose.

4.Should be dispensed in colored fluted bottles attached with a dropper.

4.PASTES

Pastes are semisolid preparation They differ from ointments and creams in containing a high proportion of finely powdered medicaments

=> The base may be anhydrous (liquid soft paraffin)
=> Or water soluble (glycerol or mucilage)
=> They contain a high proportion of fine powder Example. Starch
=>This makes them very stiff and means they do not spread readily over the skin's surface
=> Corrosive drugs such as dethrone are often formulated as pastes .
=> Paste is applied to the lesions But will not spread onto healthy skin and compromise it's integrity

5.GELS

Def: It is dosage form for topical use.
=> They are usually transparent or translucent and have a variety of uses.
=> Spermicides and lubricants are often presented in gel form.
=> Preparation containing coal tar or other drug used in the treatment of psoriasis and eczema are also presented in this from .
=> Many patients prefer this formulation

(Gels are also used to describe aqueous colloidal suspensions of the hydrated forms of insoluble medicaments Examples. (Aluminum hydroxide gel, used as antacids)

Cachets..

Enclosure in cachets provides a means of administering nausious or disagreeable powders in a tasteless form.

Definition.

Cachets are moulded from rice paper, a material made by pouring a mixture of rice flour and water between two, hot polished, revolving cylinders; the water evaporates and a sheet of water is formed.

There are two kinds; wet seal', so called because water is used to seal them, and dry seal. the wet seal type consists of two halves, both alike, convex in shape and having a broad flange that is used for sealing. The dry seal type has a shallow cylindrical base and a slightly larger, slip over cap. Both are made in a variety of sizes holding from 0.2 to 2 g of a powder of medium density. They are softened by immersion in water for few seconds and then taken with a draught of water.

Collodions.

Collodions are fluid preparations use. They are applied with a brush or rod. The vehicle is volatile and evaporates on application to the skin, leaving a flexible protective film covering the site. The volatile solvents are ether and alcohol, the film producing in gradient is pyroxylin (nitrocellulose) and the substance having the flexibility is castor oil. Unmedicated and medicated forms are available, the former are useful for protecting small cuts while the later provide prolonged contact between the skin and a medicament.

Draughts.

Draughts are liquids oral preparations of which only one or two rather large doses, of the order of 50ml are prescribed. Each dose is issued in a separate container lpecacuanha Emetic draught, paediatric, is exceptional, the normal dose is 10 or 15 ml and therefore, a multiple dose volume is prescribed.

Enemas.

Enemas are solutions, suspensions, or oil in water emulsions of medicaments intended for rectal administrations.

Gargles.

Gargles are aqueous solutions used to prevent or treat throat affections. Usually they are dispersed in concentrated form with directions for dilution with warm water before use.

Gels.

Gels are aqueous colloidal suspensions of the hydrated form of insoluble medicaments eg, aluminium hydroxide gel, used as an antacid also see jellies).

Granules.

Granules are a comparatively unusual means of administering drug that process an unpleasent taste. The drug is mixed with sugar, a flavouring agent and inert adjuncts, moistened to produce a coherent mass, granulated by passage through a sieve and dried. The resultant small irregular particles, ranging from 2 to 4 mm in diameter are often supplied in single dose sachets the contents of which are stirred in water before taking.

Insufflations.

Insufflations are medicated dusting powders that are blown by an insufflator (a device similar to an atomizer) into regions, such as the nose, throat, body cavities and ear, to which it would be difficult to apply the powder directly. Occasionally, insufflations intended for the nose (eg, pituitary (posterior lobe) insufflation) are used as the same way as snuff.

Irrigations.

Irrigations are solutions of medicaments used to treat infections of the bladder, vagina and less often, the nose. They are administered via a thin, soft, rubber or a plastic tube known as catheter (bladder) a vulcanite or plastic pipe (vagina) or a specially designed glass irrigator (nose). Solutions and equipment used for bladder irrigations must be sterile.

Jellies (Gels).

Jellies are translucent, non-greasy, semisolid preparations mainly used externally. The gelling agent may be gelatin, or a carbohydrate such as starch, tragacanth, sodium alginate or cellulose derivative.

Linctuses.

Linctuses are viscous, liquid oral preparations that are usually prescribed for the relief of cough. They are simple solutions or admixtures containing a high proportion of syrup and sometimes, glycerin which as well as giving a sweet taste, have a demulcent effect on the mucous membranes of the throat. The dose is small (5 ml).

Lozenges (troches).

These are solid preparations consisting mainly of sugar and gum, the later giving hardness and cohesiveness and ensuring slow release of the medicament. They are used to medicate the mouth and throat and for the slow administration of indigestion and cough remedies.

Mouthwashes.

These are similar to gargles but are used for oral hygiene and to treat infections of mouth.

Nasal drops.

Nasal drops are solutions of drugs that are instilled into the nose with a dropper. They are usually aqueous because oily drops inhibit movement of cilia in the nasal mucosa and, if used for long periods, may reach the lungs and caused lipoidal pneumonia.

Pills.

Pills are oral dosage forms that are largely be replaced by tablets and capsules. They are spherical, or less often, ovoid, and usually sugar coated.

Poultices.

Poultices are paste like preparations use externally to reduce inflammation because they retain heat well. After heated the preparation is spread thickly on a dressing and applied, as hot as the patient can bear it, to the affected area.

Solutions.

Solutions are used for many purposes. For some of these sterility necessary, eg. Parenteral, peritoneal, dialysis and anticoagulant solutions, bladder irrigations and dermatological solutions for application to broken surfaces. Unsterile solutions are used orally, either alone or as ingredient for medicine, or externally, on unbroken surfaces.

Chapter 11

Weights and Measures

Weight

It is a measure of the gravitational force acting on a body and is directly proportional to its mass. Or

The weight of an object is usually taken to be the force on the object due to gravity

Measures

Finding out the size, amount, or degree of (something) by using an instrument or device marked in standard units is called measures. Or

A standard unit used to express the size, amount, or degree of something.

System of Measurement

A system of measurement is a set of units of measurement which can be used to specify anything which can be measured

There are two Systems of weights and measures

1. **The Imperial System**
2. **The Metric System**

1.Imperial System

A system of weights and measures originally developed in England.

Example of Imperial measures:

Length: inches, feet, yards

Area: square feet, acres

Weight: pounds, ounces,

Volume: fluid ounces, gallons

The Imperial System has been replaced by the Metric System in most countries (including England). We will discuss only metric system in detail

2.Metric System

The most commonly used system of weights and measures in pharmacy is the metric system. Understanding of the metric system is important to perform calculations in the pharmacy.

Values of Prefixes in the Metric System

The three basic units of the metric system are the meter, the gram, and the liter. The names of the other units are formed by adding a prefix to one of the basic units. Each prefix has a numerical value as indicated below:

Prefix Values

Micro - (mc) = 1/1,000,000

Milli - (m) = 1/1,000

Centi - (c) = 1/100 times the basic unit.

Deci - (d) = 1/10

Deka - (dk) = 10

Hecto - (h) = 100 times the basic unit.

Kilo - (k) = 1000

Standard Unit of Weight in the Metric System Used in the Pharmacy

Common measures of weight in metric system

(a) 1 kg = 1000 g

(b) 1 g = 1000 mg

(c) 1 mg = 1000 mcg

Whereas

Kg = kilogram

g = gram

mg = milligrams

mcg = microgram

The gram (g or gm) is the basic unit of weight used to weigh solids in the pharmacy.

1 kilogram (kg) = 1000 gm

1 hectogram (hg) = 100gm

1 decagram (dag) = 10gm

1 gram (gm) = 1000 milligrams (mg)

1 decigram (dg) = 0.1gm or 100mg

1 centigram (cg) = 0.01gm or 10mg

1 milligram (mg) = 0.001gm or 1mg

Standard Unit of Volume in the Metric System

1 kiloliter (kl) = 1000 liters

1 hectoliter (hl) = 100 liters

1 decaliter (dal) = 10 liters

1 liter (l) = 1,000 milliliters (ml)

1 deciliter (dl) = 0.10 L or 100ml

1 centiliter (cl) = 0.01 L or 10ml

Domestic measures

1 drop = 0.06ml

1 tea spoonful = 4ml

1 desert spoonful = 8ml

1 table spoonful = 15ml

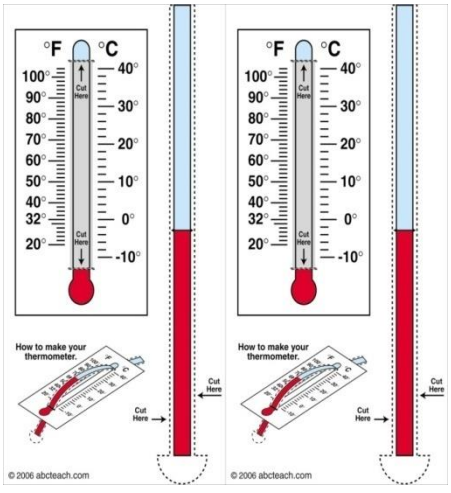
1 tea cupful = 120ml

1 fluid ounce = 30ml

Measurement of Temperature

Centigrade or Celsius temperature scale

Celsius temperature scale also called centigrade temperature scale, is the scale based on 0 for the freezing point of water and 100 for the boiling point of water.



Fahrenheit temperature scale

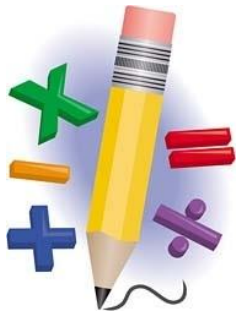
Fahrenheit temperature scale is a scale based on 32 for the freezing point of water and 212 for the boiling point of water.

Conversions of Temperature

The following formula works for converting both ways; that is, conversions can be made from Fahrenheit to Centigrade or from Centigrade to Fahrenheit using this formula:

$5F = 9C + 160$

Calculation



Density

Density is defined as the mass of a substance per unit volume. Or

Density is defined as mass divided by volume

Density = mass/volume

Or

Density = mass divided by volume

or

$$\rho = \frac{m}{V},$$

The unit of density is kg/m^3 (kg per cubic meter)

Mass

A measure of how much matter is in an object is called mass

Mass = density x volume

The unit of mass is kg (kilogram)

Volume

Volume is the measure of space occupied by an object.

Volume = weight /density

In metric system unit of volume is liter (L), on the other hand, one liter is the volume of a 10-centimetre cube, 1 liter = (10 cm)3

Percentage

Percent means "parts per hundred" and is expressed in the following manner.

Or

Percentage is the rate, number, or amount in each hundred.

Percentage = number of parts/ 100 parts

Percentage Preparations

There are three types of percentage preparation

1. **Weight in volume (W/V)**
2. **Weight in weight (W/W)**
3. **Volume in volume (V/V)**

Weight in Volume (W/V)

W/V of Weight/Volume percent is defined as the number of grams in 100 milliliters of solution.

Example

(10% w/v solution of NaCl)

A 10 percent (w/v) sodium chloride (NaCl) solution would contain 10 grams of sodium chloride in every 100 milliliters of water.

Weight in Weight (W/W)

W/W percent or Weight/Weight percent is defined as the number of grams in 100 grams of a solid preparation.

Example

(5% w/w boric acid ointment)

A 5 percent (w/w) boric acid ointment would contain 5 grams of boric acid in each 100 grams of boric acid ointment.

Volume in Volume (V/V)

V/V percent or Volume/Volume percent is defined as the number of milliliters of a liquid in every 100 ml of solution.

Example

(70% v/v solution of alcohol)

A 70% (v/v) alcoholic solution would contain 70 milliliters of alcohol in every 100 ml of solution.