UNIT-2

PACKAGING OF PHARMACEUTICALS

Mr. Peeyush
Assistant professor
Rama university, Kanpur

INTRODUCTION-

Packaging
A Pharmaceutical Package container is an article or device which contains the Pharmaceutical Product and the container may or may not in direct contact with the product. The container which is designed for pharmaceutical purpose must be stable.

Ideal Qualities of a Pharmaceutical Package -
1. It should have sufficient mechanical strength so as to withstand handling, filling, closing and transportation.
2. It should not react with the contents stored in it.

3. It should be of such shape that can be elegant and also the contents can be easily drawn from it.
4. It should not leach alkali in the contents.
5. The container should not support mould growth.
6. The container must bear the heat when it is to be sterilized.

Types of Packaging -

1. Primary Packaging

Primary packagings are those packages which are in direct contact with the Pharmaceutical formulation. The main aim of primary package is to protect the formulation from environmental, chemical, mechanical and/or other hazards.

2. Secondary Packaging

The package external to Primary package is known as secondary package. This package provide additional protection during warehousing and also provide information about drug product for e.g Leaflets.

3. Tertiary packaging

Examples: Barrel, crate, container, pallets, slip sheet.

It is outer package of secondary packaging & prevents damage to the products. It is used for bulk handling & shipping.

MATERIALS USED IN PACKAING-

1. **GLASS**
2. **PLASTIC**
3. **RUBBER**
4. **METAL**
5. **PAPER AND BOARD**

1. **GLASS-**

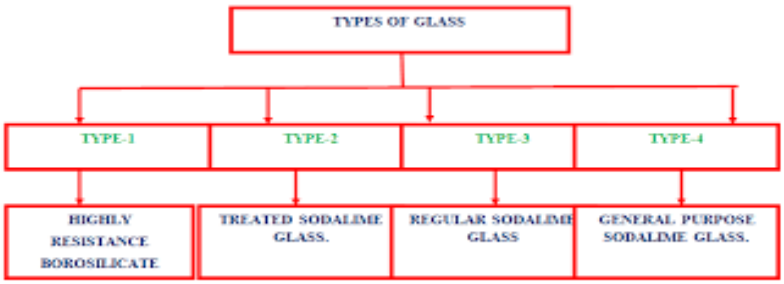
A hard, brittle substance, typically transparent or translucent, made by fusing sand with soda and lime and cooling rapidly.

Composition of glass-

Glass is principally made up of silica (59-80%) with varying degree of calcium oxide (5-12 %) sodium oxide (12-17 %) aluminium oxide (0.5-3.0 %), barium oxide, boric oxide, potassium oxide, and magnesium oxide. The high melting point of glass is due to the presence of silica. The melting point and melt viscosity of the glass is modified by the addition of oxides.

CHEMICAL COMPOSITION		
Chemical	**Symbol**	**Percentage**
Silicon dioxide (silicate)	SiO_2	69 - 74%
Calcium oxide (lime)	CaO	5 - 12%
Sodium oxide (soda)	Na_2O	12 - 16%
Magnesium oxide	MgO	0 - 16%
Aluminium oxide	Al_2O_3	0 - 5%

Classification of Glass-



Glass containers are classified into Type I glass, Type II glass, Type III glass and Type IV glass based on their degree of chemical/hydrolytic resistance to water attack. The degree of attack is dependent on the degree of alkaline release under the influence of the attacking media.

i. Type I glass containers (Borosilicate glass / Neutral glass)

This is a type of glass container that contains 80% silica, 10% boric oxide, small amount of sodium oxide and aluminium oxide. It is chemically inert and possess high hydrolytic resistant due to the presence of boric oxide. It has the lowest coefficient of expansion and so has high thermal shock properties.

Type II glass containers (soda-lime-silica glass/ treated soda-lime glass/ De alkalized soda lime glass)

This is a modified type of Type III glass container with a high hydrolytic resistance resulting from suitable treatment of the inner surface of a type III glass with sulfur. This is done to remove leachable oxides and thus prevents blooming/weathering from bottles. Type II glass has lower melting point when compared to Type I glass and so easier to mould.

Uses of Type II glass containers

- They are suitable for most acidic and neutral aqueous preparations whether parenteral or non-parenteral.

iii. Type III glass containers (Regular soda lime glass)

This is an untreated soda lime glass with average chemical resistance. It contains 75% silica, 15% sodium oxide, 10% calcium oxide, small amounts of aluminium oxide, magnesium oxide, and potassium oxide. Aluminium oxide impacts chemical durability while magnesium oxide reduces the temperature required during moulding.

Uses of Type III glass containers

- They are used as packaging material for parenteral products or powders for parenteral use ONLY WHERE there is suitable stability test data indicating that Type III glass is satisfactory**.**
- They used in packaging non-aqueous preparations and powders for parenteral use with the exception of freeze-dried preparations
- It is also used in packaging non-parenteral preparations.

Type IV glass containers (Type NP glass/General-purpose soda lime glass)

This type of glass container has low hydrolytic resistance. This type of glass containers are not used for products that need to be autoclaved as it will increase erosion reaction rate of the glass container.

Uses of type IV glass containers

- It is used to store topical products and oral dosage forms

Advantages glass containers

- Glass containers are mainly used in packaging liquid preparations due to their rigidity and their superior protective qualities
- Its high transparency allows easy inspection of its contents.
- It offers better protection because it is relatively impermeable to air and moisture.
- It is chemically resistance to most medicinal products.
- Coloured glass (amber glass and red coloured glass) can protect its content from ultraviolet rays and certain wavelengths.
- Glass containers can be easily sterilized using heat.

Disadvantages glass containers

- Glass containers are expensive to manufacture
- They are fragile and relatively heavy
- During heat sterilization, some types of glass containers have the tendency of shedding some part of the silica into the formulation.

2. Plastic as a pharmaceutical container-

The term "plastic" is a general common term used to describe a group of non-metallic substances, of natural, semi-synthetic or synthetic origins, consisting chiefly of one or more organic compounds (polymer) of high molecular weight, which can be moulded into the desired shapes and hardened for use when subjected to heat or pressure, with or without the addition of some additives. Plastics constitute about 20 % of weight of all pharmaceutical packaging. They are used for many different types of packs including

- rigid bottles which serve as packaging systems for solid dosage forms (tablets and capsules)
- sterile plastic packaging systems for human blood and blood components
- plastic packaging systems for aqueous solutions
- bags for parenteral solutions
- infusion dry powder and metered-dose inhalers
- squeezable bottles for eye drops, ear drops and nasal sprays
- jars
- prefillable syringes
- flexible tubes
- sachets, blister packs and strip packs

Composition of Plastic Containers-

- Basically, plastics containers consist of organic materials whose molecules have high molar masses and are composed of a large number of repeating relatively small units referred to as monomers. When these monomers undergo a process known as polymerization, a plastic or a sequentially joined long chain of polymer is formed. This process of polymerization may involve various chemicals which assist the process, such as accelerators, initiators, solvents and catalysts, and as a result, are present in small degree in the plastic formed. These, if found in the plastic after polymerization are generally referred to as process residues.

TYPES OF PLASTICS-

1. Thermoplastics (Thermo softening plastics)-

- ✓ These are heat softening materials which are usually rigid at operating temperatures but can be remelted and remoulded when exposed to high temperature and pressure.

- ✓ When frozen, however, thermoplastics become glass-like and subject to fracture. Examples of thermoplastics include but are not limited to the five most economical plastics – polyvinylchloride, polystyrene, polypropylenes, polyethylenes, and polyester. Others include nylon, polyvinylidene chloride, polycarbonate etc.,

- ✓ Thermoplastics may be further classified into homopolymers which involves one type of monomers, e.g., ethylene polymerized to polyethylene, and copolymers, terpolymers etc., which involve two or more monomers of different chemical substances.

2. Thermosets (Thermosetting plastics)-

- ✓ They are called thermosets because they get distinctly infusible or insoluble when exposed to high temperature/ heat, and thus cannot be remelted and remoulded after their initial heat forming.

- ✓ They are produced by polymerization process involving a curing or vulcanization stage during which the materials become ‘set’ to a permanent state by heat and pressure. Further heating leads to the decomposition of the plastic.

- ✓ Thermosets usually contain additional additives (fillers and reinforcing agents) to obtain best quality. These materials are used as packaging material when good dimensional and heat stability are required. Examples of thermoset resins include phenol formaldehyde (originally known as bakelite), urea formaldehyde, melamine formaldehyde, epoxy resins (expoxies), and certain polyesters and polyurethanes.

- ✓ These materials are commonly used in the pharmaceutical industry as closures for glass and/or plastic containers, small cases as one time used for methanol cones, protective

lacquers and enamels as applied internally and externally to metal containers and a range of adhesive systems.

Evaluation studies on plastic containers-

1. Biological Reactivity
2. Physiochemical Tests

i. Water extraction

ii. Absorbance

iii. Acidity or alkalinity – this test is carried out only when packaging systems are intended to contain a liquid formulation or a formulation that is dissolved in its container before use.

iv. Organic extractable – total organic carbon.

Advantages of plastic containers-

1. Plastic containers are not breakable.
2. They are light in weight and resistant to leakage.
3. They are cheap to manufacture
4. They can be easily moulded or remoulded
5. They have excellent finishing
6. Plastic containers are chemically inert and resistant to corrosion
7. They are collapsible.

Disadvantages of plastic containers-

1. Plastic containers have poor physical stability due to adsorption, absorption lightness and/or interactions between the formulation and the container
2. They have low heat resistant and poor ductility.
3. Most plastic containers are usually not as clear as glass, and, therefore, inspection of the contents is impeded.

3. RUBBER AS A PHARMACEUTICAL CONTAINER-

Rubber is used in the **pharmaceutical** industry to make closures, cap liners and bulbs for dropper assemblies.The **rubber** polymers most commonly used are natural, neoprene and butyl **rubber**. Butyl **rubber**, nitrile **rubber** is some synthetic rubbers used for the manufacturing of closures.

Advantages of rubber-

Advantages: Latex is ready to use right out of the ***container***.

Latex is inexpensive; it exhibits good abrasion resistance, and is an elastic mold ***rubber***. Because of its high elasticity, a feature unique to latex is its ability to be removed from a model like a glove. Latex molds are also good for casting wax and gypsum.

4. METAL AS A PHARMACEUTICAL CONTAINER-

Metal, specifically stainless **steel**, is a common material **used** for larger food processing units, such as aseptic tanks and cubic **containers**, although you can find smaller **metal** meal **containers** too. **Metal** is suitable for protecting food contents, as it is commonly fabricated to be tamperproof in its **container** form.

Advantages –

1. Weight of **metal packaging** is low and its resistance is high.
2. **Metal packaging** is resistant to physical shocks.
3. Therefore **metal packaging** has a low cost of storing, loading and shipping.
4. Application of multi colour printing increases the preference of **metal packaging**, supporting the marketing activities of food products.

Metal packaging.