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Pharmaceutical Packaging Technology: A Brief Outline

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ABSTRACT

Packaging is used to keep a product contained and prevent it from interacting with the environment. Protection, identification, and information must be provided against physical damage, loss of content or ingredients, and entrance of undesired environmental components such as water vapour, oxygen, and light. Pharmaceutical packaging plays a significant part in transforming the formulation into a palatable and marketable product. Many concerns with pharmaceutical products, such as stability, sale, and patient compliance, are related to packing, and the current analysis focuses on the numerous improvements in packaging techniques as well as the selection of packaging material, technology, and labelling. The following article examines the numerous packaging materials and packaging types used in the pharmaceutical sector.

KEYWORDS: *Packaging, Protection, Materials, Machinery, Labeling*

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INTRODUCTION

Packaging

A Pharmaceutical Package Container is an article or device that holds a Pharmaceutical Product and may or may not come into direct contact with it. A sturdy container suitable for medicinal use is required.

Ideal Qualities of a Pharmaceutical Package

1. It must be mechanically strong enough to survive handling, filling, sealing, and transportation.
2. The contents stored in it should not react with it.
3. It should be designed in such a way that it is both elegant and allows the contents to be quickly accessed.
4. The ingredients should not leach alkali.
5. Mold should not be allowed to grow in the container.
6. When being sterilised, the container must be able to withstand the heat.
7. The contents of the container must not be absorbed by it.
8. The container's construction material should be neutral or inert.
9. No part of the container or closure should react with any other part of the container or closure.
10. The closure should be non-toxic.

Types of Package

1. Primary Packaging

Containers that come into direct contact with pharmaceutical formulations are referred to as primary packaging. The primary packaging's main objective is to protect the formulation from contamination caused by environmental, chemical, mechanical, and/or other dangers.

2. Secondary Packaging

Secondary package is a package that is not part of the primary package. This packaging provides additional protection during storage as well as drug product information, such as leaflets.

Functions

- Keep the flexible containers safe.
- Transportation protection from rough handling.

Tertiary packaging

- Barrel, crate, container, pallets, and slip sheet are just a few examples.

It is the outer package of secondary packing and protects the items from damage. It's utilised for shipping and bulk handling.

Components of packaging

1. Container: A container is a container in which a product or medicine is placed and enclosed. It is a case of direct drug contact.
2. Closure: It tightly seals the container to keep oxygen, carbon dioxide, and moisture out while also preventing water and volatile compounds from escaping.
3. Carton/outer: This layer of protection provides secondary protection against mechanical and other environmental threats. It's a protective layer. Cartoons are composed of cardboard, wood pulp, and other materials.
4. Box: This is where a large number of things are packed. It is the first line of protection against external threats. Thick cardboard and wood are used to construct the boxes.

Packaging Materials

The packing materials chosen must have the following characteristics:

- Mechanical characteristics. • Physico-chemical characteristics
- Biological characteristics.
- Aspects of cost.
- It has medicinal properties.
- They must not be harmful.

Types of packaging materials

The following materials are used for the consruction of containers and closures.

1. Glass

borocilicate glass of type 1
c. Sodalime glass that has been treated with Type-2.
c. Regular sodalime glass, type 3.
c. Type-4 NP sodalime glass for general use.
e. Colored glass is a type of glass that comes in a variety of colours.

Preparation of glass: Glass is primarily made out of sand, soda ash, and lime stone. Pure silica glass is formed up of a three-dimensional network of silicon atoms, each of which is surrounded by four oxygen atoms in a tetrahedral pattern.

Properties

1. It is extremely difficult.
2. Chemically impervious
3. Because the structure is less rigid, the m.p. is lower.
4. Glass made entirely of silica.

Types of glass

Type-1: Borocilicate glass

- Examples include pyrex and borosil.
- Main constituents: Sio2-80%, Al203-2%, Na2o, and Cao-6%
- Properties: Chemically resistant, with less leaching activity.
- Injection of water in a laboratory glass apparatus

Type-2: Treated soda lime glass

- **Main constituents:** 1This item is made of soda lime glass. At elevated temperature and moisture, the surface is treated with acidic glass such as so2.
- Large volume container for alkali sensitive items, infusion fluids, blood, and plasma.
- Glass has the property of being resistant to water attack for a period of time.

Type-3: Regular soda lime glass

- **Main constituents:** Cao, Sio2, Na2O
- **Properties**: Flakes quickly detach, and many break as a result of a temperature change.
- **Uses:** Usefulness, Not for ampoules, but for oral use.
- **Type-4 NP** (Non-parenteral glass or soda lime glass for general use).
- **Uses:** Not for ampoules, but for topical use.

• Glass with a neutral tint.

- **Main constituents:** Sio2 is 72 to 75 percent, B2o3 is 7 to 10, Na2o is 6 to 8%, K2o is 0.5 to 2%, and Bao is 2 to 4%.
- **Properties:** They are less expensive than borosilicate, are softer, and can be easily shaped.
- **Uses:** Large transfusion bottles, small vials (25 mL).

• Bottles with different colours

- **Main constituents:** Iron oxide + glass
- **Properties:** Produce amber-colored glass that can withstand UV visible radiation at wavelengths of 290-400-450nm.
- **Use:** photosensitive goods

2. METALS

Advantages

A. Metal containers are durable and opaque.
B. Chemical-assault resistance
C. Bacteria are unaffected by water vapour.
D. Coats a variety of metals quickly and efficiently.

Disadvantages

Among the metals tin, lead, aluminium, and iron, this is the most expensive. b. Some eye ointments are still packaged in pure tin ointment tubes at this time.

Aluminum

Advantages

1. Because aluminium is a light metal, the product's shipping costs are lower.
2. They supply tin's appeal at a reduced cost.

Disadvantages

H2 may be produced as a result of the corrosion process. b. Corrosion can be caused by any material that reacts with the oxide covering.

Uses: Screw capes, aluminium ointment tubes

Iron

Advantages

Although iron isn't utilised for pharmaceutical packaging, considerable amounts of tin combine the strength of steel with tin's corrosion resistance.

Use: Milk cans, screw caps, and aerosol cans are all made here.

Lead

Advantages

Soft metal is the least expensive of all the metals used in pharmaceutical containers.

Disadvantages

When lead is consumed internally, it poses a danger of poisoning. As a result, lead containers and tubes should always have an inert metal or polymer lining on the inside.

Use: with lining lead tubes are used for products such as fluoride tooth paste.

1. Plastics

Plastics have the following general characteristics: • They are synthetic polymers with a high molecular weight.

- It's simple to use.
- They carry heat poorly, which is a drawback if the contents have to be autoclaved.
- Only a few types of plastics entirely block the passage of water vapour, and some are permeable to gases such as oxygen and carbon dioxide.

Types of plastics

- Plastics are divided into two classes based on how they react when heated.
- **Thermoplastic type:** On heating, they soften to a viscous fluids which hardens again on cooling. **Eg:** Polyetyline, Polypropylene, PVC, Polystyrene, Nylon etc.
- **Thermosetting type:** They may become flexible when heated, but they do not become liquid; at room temperature, they are normally rigid and brittle. For example, phenol, formaldehyde, and urea.

2. Rubber

The cis component of natural rubber is made up of long chain polymers of isoprene units bonded together. The tree Hevea braziliensis is the most important source, as it produces latex containing 30 to 40% rubber in colloidal suspension when shallow cuts in the bark are made.

A. Butyl rubber: These are isobutylene co-polymers with 1-3 percent butadiene.

B. Advantages

- •• Water vapour and air permeability is extremely low, as is water absorption.

When compared to other synthetic rubbers, they are less expensive.

- Oil and solvent resistance is poor. • Slow degradation occurs over 130°C.Nitrile rubber

Advantages: Because of the polar nitrile group, it is oil and heat resistant.

Disadvantage: The amount of bactericide absorbed and extractives leached is significant.

C. Chloroprene rubber

These are 1:4 choprene polymers.

Advantages

- These rubbers age well due to the presence of a cl group adjacent to the double bond, which makes the bond resistant to oxidation.
- Because this rubber is more polar, it is more oil resistant.
- The heat stability is excellent (up to 1500c).Due to the presence of cl group close to the double bond so the bond is resistant to oxidation hence these rubbers age well.
- This rubber is more polar hence oil resistant.
- Heat stability is good (up to 1500c).

D. Silicon rubbers

Advantages

- Resistant to heat (up to 2500c)
- Extremely low water absorption and permeability.

Disadvantage: They are very expensive.

Labeling

Definition: The phrase "labelling" is used in the pharmaceutical sector. It's the text that appears on the label of a bottle or box. It provides the most up-to-date information about a drug's efficacy, safety, and quality. All labels and other written, printed, or graphic matter on or in any packaging or wrapper in which it is wrapped are referred to as labelling. The label includes the following information: the name of

the preparation, the percentage of medication in a liquid preparation, the volume of liquid to add to make an injection or suspension from a dry preparation, the mode of administration, a statement of storage condition, and the expiration date. Include the name of the manufacturer or distributor as well.

Types of labels
Various materials are used for labelling such as paper, foil and fabric. It is also possible to print directly on a bottle or other containers by means of silk screen or hot transfer process. Choice will depend on need and economy.

1. Paper labelling
The majority of labels are printed on paper because it is the most cost-effective option, regardless of the quantity. In the case of a paper label, the colours and techniques that can be employed are limited.

2. Foil labels
To ensure that the label works properly in the labelling machines, it is almost always essential to liminate foil with paper. For optimal results, the foil and paper should be between 0.0025 and 0.003 inch thick.

3. Transfer Labels
Transferring heat sensitive inks from a pre-printed strip to the container to be decorated can be done in a number of ways. These are referred to as a. Therimage and b. Electoral.

Sleeve Labels
Sleeve labels are divided into two categories.
1. Shrink tubing and 2. Stretch band

Method of Applying a Label

1. Hot Melts
A pasting out board is a straightforward way to put a label on a package. A brush is used to apply glue on the board, and the labels are placed face up on the adhesive. They are removed and set on the containers by hand.

2. Semi Automatic Labelling
The operator positions the container in this method, and the machine applies the label. The speed of the procedure is usually determined by how quickly the operator can remove the old container and replace it with a new one. The highest optimum condition is around 3600 per hour.

3. Fully Automatic Labelling
A rubber pad is used to apply glue to the bottle, which is frequently the label paper of labelling. The operation of labelling is completed when the bottle is returned to the pressure station, leaving a label adhered to the bottle.

MACHINERY FOR PACKAGING[4,6,8,9,10]
The machinery is an important techniqe for packing the any medicines or other materials.

1. Strip packing machine

Figure 1: Strip packing machine.

2. Application
This model is used for automatic double-aluminum foil hot sealing of tablets, sweets, and pills in the pharmaceutical, healthcare, chemical, and food industries, among other industries. It satisfies the sealing requirement for preventing light, as well as the need for double plastic hot sealing packing.

Blister Packing Machine

Figure 2: Blister Packing Machine.

It is a high-quality equipment that can handle automatic loading, filling, or continuous feeding. The pharmaceutical sector uses blister packaging equipment to package capsules and tablets. The capsules or tablets are fed into a hopper and then into a feeder, which can be either a linear feeder or a brush box feeder, depending on the shape of the product and the substance to be employed.

Applications

- Hospital packs with unit doses.
- Tray packs for ampoule and vials
- Blister packets with many products and kid resistance.

Cartoning Machine

Figure 3: Cartoning machine.

Description

This equipment is used to pack pharmaceutical boards, medicine bottles, soft boxes with palletized granules, and ointment into boxes mechanically. For example, automatically packaging pharmaceutical and cosmetics packages. This machine has a consistent performance, a small structure, and a lovely appearance. It can also print stainless steel stamps automatically. It is equipped with a multi-functional identifying system. When no tablets or vials are available, the process will automatically halt or be eliminated. Cartoners can produce anything from 30 to 100 cartons every minute.

Depending on whether the machine is vertical loading, intermittent cartoning, or continuous action, it may produce up to 300 cartons per minute. Blister stripes and other pharmaceutical packaging can be handled by these machines.

4. Ampoule Filling Line

Figure 4: Ampoule filling machine.

Description

These high-precision devices entirely encapsulate the medicine in inert glass, with no rubber stopper or other material coming into direct touch with the drug. Ultrasonic washing, three times water washing (twice circulating water washing, plus one time fresh water washing), three times air spraying, drying and sterilising, cooling, liquid filling, and protection gaseous filling are all automatic methods that can be used to fill 1-20ML ampoules (compressed air filling and nitrogen filling).

5. Liquid Filling Machine

Figure 5: Liquid filling machine.

Description

1. It has an innovative control system, precise filling, consistent performance, and a great look.
2. Filling liquid injection and lyophilization injection equipment.
3. The filling accuracy of the imported peristaltic pump technology is excellent.
4. Completely purifying laminar flow protection at 100 degrees Celsius.
5. With the ability to halt filling without using a vial.
6. It can count the filled vials automatically.

6. Syringe Filling Machine

Figure 6: Syringe filling machine.

These devices are used to fill syringes, cartridges, and other containers with high precision and dependability. Rotary piston pumps are used to fill the containers. The format spectrum of the machine can range from 0.2 to 29ml.

1. Semi-automated syringe filling machine: These machines require human loading of syringes into the machine, which are then automatically filled and capped. Oral dose syringes and dental gels are examples of applications.
2. Fully automatic syringe filling machine: These high-speed, compact devices fill saline flush syringes, dental gels, and oral dosage syringes automatically.

7. Automatic Labelling / Gumming / Stickering Machine

Figure 7: Automatic labeling machine.

Description

- A fully automatic labelling machine is useful for correctly placing labels on round products.
- Labeling of the entire or partial wrap can be done. A unique characteristic of the machine is that if the body diameters vary, the machine continues to function without the need to alter parts.
- To assure quality, the labelling speed is automatically linked with the conveyor speed.

Pharmaceutical Printing Machine

Figure 8: Pharmaceutical Printing Machine.

Description

This machine is suitable for printing labels, batch number, validity time and series numbers on the surface of cartons, tissue paper, non-ferrous plastic film and aluminum film. No matter with the dry-ink roller or instant liquid ink, it has the features of instant printing and instant drying, and strong adhesion.

CONCLUSION

Pharmaceutical packaging technology has become increasingly essential in the pharmaceutical sector in recent decades. Packaging is the next stage after formulation. It is a significant technique in pharmaceuticals since it provides product protection, identification, and protection against physical damage, as well as increasing product attractiveness and improving patient compliance. Other better research is being done on packaging for better results, and pharmaceutical businesses are progressively attempting to enhance efficiency and cut costs in their production and packaging processes, which leads in superior pack quality, good sales, and cost savings. Increased demand for packaging items has resulted from expanding markets and creative marketing techniques.

CONFLICT OF INTEREST

You declare that we do not have any competing interests.

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