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ADVANCE TECHNIQUES IN PACKAGING OF PHARMACEUTICAL

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ABSTRACT

Packaging may be considered as a system by which the product safety reaches from producer to consumer. Packaging play an important role in providing protection, Presentation, Convenience, Identification, Information and Compliance of a product during storage Transportation, Display and until the product is safely consume. Packaging is the key for sale safety and success. The advancement in research of Pharmaceutical Development had always being depends on the packaging technology. Packaging also play important role in maintaining stability of Pharmaceutical Product. The selection of packaging, Therefore begins with a determination of Physical and chemical characteristic of product.

KEYWORDS: Pharmaceutical packaging, Current trends, difficulties in packaging, advanced technologies of packaging.

INTRODUCTION

Packaging is the process which provides protection, presentation, identification, information and convenience for pharmaceutical product from the moment of production until it is used or administered. The packaging must also be convenient in use in order to promote good patient compliance. A package consists of the container, closure, carton and box components. The container refers in which the final product is enclosed for distribution from manufacturer to consumer. A knowledge of packaging materials will ensure the adoption of a rational approach to the original choice of container and, if required, to the use of alternative packs.

CLASSIFICATION OF PACKAGING [2]

1. **Primary packaging**

Fig. No.1

This is the first packaging envelope which is in touch with the dosage form or equipment. The packaging needs to be such that there is no interaction with the drug and will provide proper containment of pharmaceuticals E.g.: Containers, closures, blisters, strips, space fillers, desiccant etc.

3. **Critical Secondary Packaging**

To protect primary packaging

E.g.: Pouches, Thermoform trays for pre-filled syringes etc.

4. **Secondary Packaging**

Fig.No2

This is consecutive covering or package which stores pharmaceuticals packages in it for their grouping.

This encloses one or more primary packs, also known as non-critical Packaging Component

E.g.: Cartons, e-flute boxes, e-fluted trays, etc.

5. **Additional Packaging:**

To hold primary packs

E.g.: trays, display cartons.

5. **Final external Packaging:** (Tertiary packaging)

Fig.No.3

This is to provide bulk handling and shipping of pharmaceuticals from one place to another.

Transport pack, also known as non-critical Packaging component.

E.g.: Shippers, drums and Pallets.

ADVANTAGES OF PACKAGING [2]

- The packaging material should have good Uniformity.
- It should be possess better Integrity
- The packaging material should be free from impurities.
- They should have minimum side effect
- They should have good stability with clearly define shelf-life

CHOICE OF CONTAINERS

- Nature of product
- Type of patient
- Form of the dose
- Method and side of administration
- Capacity of the packaging
- Method of distribution

Functions of packaging[4]

Containment

The containment of the product is the most fundamental function of packaging for medicinal products. The design of high-quality packaging must take into account both the needs of the product and of the manufacturing and distribution system. This requires the packaging:

- Not to leak, nor allow diffusion and permeation of the product
- To be strong enough to hold the contents when subjected to normal handling

- Not to be altered by the ingredients of the formulation in its final dosage form.

Protection

The packaging must protect the product against all adverse external influences that may affect its quality or potency, such as:

- Light
- Moisture
- Oxygen
- biological contamination
- Mechanical damage.

The compatibility of the packaging with the active pharmaceutical ingredients is very important in maintaining the integrity of the product.

Stability

Information on stability is given in the guidelines for stability testing of pharmaceutical products containing well-established drug substances in conventional dosage forms.

EXPECTATIONS OF PHARMA INDUSTRY FROM PACKAGING INDUSTRY

➢ Packaging quality must be of a good design relevant to the need of :

✓ Product

✓ Manufacturing and distribution system

➢ Stability parameters :

✓ Protect the product from moisture, light, temperature gas.

✓ Microbiological integrity

✓ pH stability

Packaging materials and closures

- In accordance with the methods of use and administration of medicinal products, packaging materials, closures and containers vary a great deal and have to meet a wide variety of different requirements.
- All the routes used for systemic access have demanding requirements, which often can only be met by complex structured and formulated medicinal products. This is particularly true of the new medicinal products that are now appearing, such as those administered via transversal delivery systems.

- To ensure the efficacy of a product during its total shelf-life, pharmaceuticals must be regarded as a combination of the medicinal product itself and the packaging.

Types of material[4]

Only the most commonly used packaging materials and containers are described here.

Glass:

Fig. No. 4

- For a large number of pharmaceuticals, including medicinal products for oral and local administration, glass containers are usually the first choice (e.g. bottles for tablets, injection syringes for unit- or multi-dose administration).
- Different types of glass may be necessary, depending on the characteristics and the intended use of the medicinal products concerned.
- Plastics some containers are now being made of plastics; the main use is for bags for parenteral solutions.
- Plastic containers have several advantages compared with glass containers:

✓ They are unbreakable

✓ They are collapsible

✓ They are light.

- The European, Japanese and United States pharmacopoeias all describe materials of the same type, but there are considerable differences in the classification and presentation.
- As far as tests are concerned, the three pharmacopoeias are extremely difficult to compare. The European pharmacopoeia is the most detailed and requires tests in relation to the use and routes of administration of the medicinal product. Moreover, the same concept is extended to bulk containers for active ingredients.

Metal

Fig. No. 5

- Metal containers are used solely for medicinal products for non-parenteral administration. They include tubes, packs made from foil or blisters, cans, and aerosol and gas cylinders.
- Aluminum and stainless steel are the metals of choice for both primary and secondary packaging for medicinal products.
- They have certain advantages and provide excellent tamper-evident containers.
- Since metal is strong, impermeable to gases and shatterproof, it is the ideal packaging material for pressurized containers.

Closures

Fig. No.6

- Closures used for the purpose of covering drug containers after the filling process should be as inert as possible.
- They should not give rise to undesired interactions between the contents and the outside environment, and should provide a complete seal. Besides their protective function, closures must also allow the easy and safe administration of the drug.
- Depending on the application, closures may have to be pierced with a needle for intravenous sets. Such closures are made from elastomeric materials (rubbers), while those that cannot be pierced are generally made from plastics such as polyethylene or polypropylene.
- Depending on the type of container, closures may have different shapes and sizes, e.g. stoppers for infusion or injection bottles or plungers for prefilled syringes. A special

design of stopper May also be required for some pharmaceutical production processes such as lyophilization.

- Closures, as primary packaging components, are of critical importance and must be carefully selected. They are an essential component of the container and, as such, an integral part of the drug preparation.
- A container type which does not require a removable closure at the time of administration is usually preferred since such a container/closure system avoids, or at least minimizes, the risk of biological another contamination as well as tampering.

Rubber closures

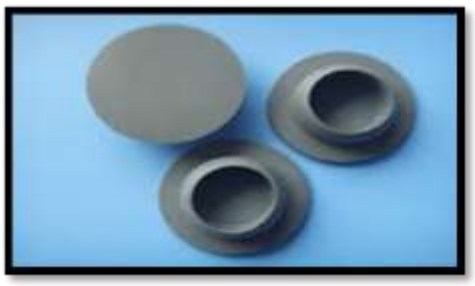

Fig. No.7

- Rubber consists of several ingredients, one of which is elastomeric.
- Modern rubber compounds used in packaging pharmaceuticals contain only a limited number of ingredients, which are very difficult to extract. Closures made from such materials generally do not pose any problems, and can be used in contact with a large number of drug preparations.
- Rubber closures for pharmaceutical use must meet the relevant requirements of the most important pharmacopoeias (the European, **135Japanese** and United States pharmacopoeias). International standards have also been established (ISO 8871). It should be emphasized that the requirements of pharmacopoeias and standards must be seen as minimal requirements. The suitability of a rubber closure for a given application can only be established by means of stability studies

NEED OF DEVELOPMENT OF PHARMACEUTICAL PACKAGING

- In India, pharma packaging today occupies a significant portion of the overall drug market
- Earlier, the requirement of pharma packaging focused exclusively on the preserving the quality of enclosed medication

- Now they are extended to cover such criteria :
- Prevention of product tempering and counterfeiting
- Assurance of product dispensing
- Promotion of patient compliance with product dosage schedule

RECENT ADVANCES IN PACKAGING TECHNOLOGIES

"Need is mother of all inventions" phrase is best describing the emerging technologies towards pharmaceutical packaging. The following are advanced techniques which are used to pharmaceutical packaging:

Blow –fill seal technology

- Blow- fill- seal technology was initially used for filling many categories of liquids, such as non-sterile devices, foods and cosmetics. Recently, Blow- fill- seal technology is used to produce aseptically sterile pharmaceuticals such as respiratory solutions, ophthalmic, and wound care products. Blow- fill- seal is an advanced aseptic processing technique within which plastic containers are formed by means of molded extruded polymer granules that are file dand sealed in one continuous process. Due to the advanced automation of the entire process, very little human intervention is necessary during manufacture as compared to traditional aseptic filling. This is considered an advanced aseptic filling process. It is therefore possible to achieve very high levels of sterility confidence with a properly configured Blow fill-seal machine designed to fill aseptically.

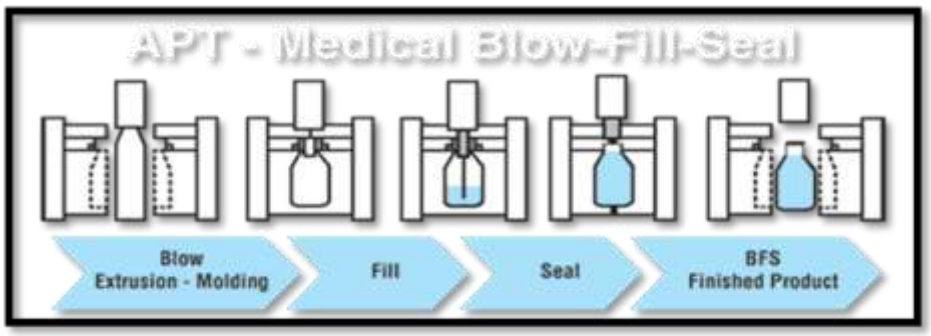

Fig. No. 8

Outline of blow fill seal technology

1. **container molding**

   Thermoplastic granules are continuously extruded in a tubular shape. After that tube reaches to a correct length, the mould closes and prison is cut. The bottom of the prison is pinched closed and the top is held in place with a set of jaws. The mould further transferred under a filling station.

2. container filling

The nozzle assembly lowers into the prison until the nozzles form a seal with the neck of the mould. Container formation takes place in a mould by blowing an sterile filtered air inside the container. The nozzles come into their original position. The patented automated devices are available in the market6

3. container sealing

After completion of filling the top of a container is sealed hermetically and filled, sealed container is thrown out of the machine.

- Tamper evident pharmaceutical technology
- Tamper evident pharmaceutical packaging can be defined as Packaging having an indicator barrier to entry which, if breached or missing, can reasonably be expected to provide visible or audible evidence to consumers that tampering has occurred. Tamper-evident packaging involves immediate-container/carton systems or any combination.

Various technology for making a temper evident packaging

1. Induction cup sealing technology[6]

The process of Induction Cup Sealing is based on the principle that a conductive material like aluminum foil heats up on exposure to high frequency magnetic field generated by an Induction Unit. This is a non-contact process without direct heat transfer. Due to this, the sealable closure liner can be placed in the cap by the manufacturer prior to sealing. The Induction Sealing process can be very easily incorporated on any existing filling lines from manual filling to the fully automated filling and capping lines. The Induction unit can have its own conveyor or can be mounted on the existing conveyor line. Separate operation of sealing foil and lid assembly are no longer required.

2. Induction wads[6]

1. The wad basically consists of four layers
2. Cardboard or Foam Packing
3. Wax Layer
4. Aluminum Foil
5. Sealing Film

The line of force radiates through the foil and induces current flow in it. This increases the temperature of the foil. Due to this the sealing film melts and adheres to the lip of the

container. After the seal is broken, the board or foam packing is retained by the cap. Wads for HDPE.LDPE, PET and PP in different thickness are easily available.

2. Heat shrink bands or wrappers[6]

The shrink wrap concept involves the packaging of a product in thermoplastic film that has been stretched and oriented during its manufacture and that has the property of reverting back to its unscratched dimensions as the film unwinds on the overwrapping machine, a pocket is formed in the fold of the sheet, in to which the product is inserted. An L shaped sealer seals the remainder of overwrap and trims off the excess film. The loosely wrapped product is then moved through heated tunnel which shrinks the overwrap in to a tightly wrapped unit.

Fig. No. 9

FUTURE PROSPECT [1]

- The earlier used old glass and elastomeric closure system may not provide the effective barrier properties much needed for high value, life saving therapies.
- Packaging R&D provides us with new materials and technologies that ensure extended drug product shelf life.
- To maintain integrity of pharmaceuticals during storage. shipping and delivery, quality of packaging provides assurance for all those.
- Automated devices also lead to increase in flexibility of packaging equipment and decrease in time consumption, increased output and reduced labor cost.
- For packaging development there is need to improve production efficiencies i.e. Blow-fill seal.
- Pharmaceutical packaging demands high standards such as, user safety, preservation, hygiene, packaging differentiation and efficiency.
- Chemical resistance, Transparency and toughness of packaging enhance safety and efficiency of the drug.

STORAGE CONDITION[4]

1. Packaging material should be store in according to GMP for storage areas.
2. The characteristic of the API will determine whether different packaging will be needed. For Example: The packaging requirements of medicinal products kept at temperatures between 2° and 8°C may differ from those of products intended for tropical countries or light sensitive products.
3. If the contents are sterile, sterility must be maintained, including that of any unused remaining product .required minds of medicinal product kept at temperature between 2° to 8°C degree may differ from those of product intended for topical countries or light sensitive product.
4. The self life and utilization period are always determined in relation to storage condition and stability of API.

CONCLUSION

- Packaging of pharmaceuticals deals with protection, presentation, convenience, identification information, and compliance of a product during storage, transportation, display and until the product is safely consumed.
- Also increasing demand of market enforced development in pharmaceutical packaging.
- A knowledge of packaging materials will ensure the adoption of a rational approach to the original choice of container & if required, to the use of alternative packs.
- The packaging material should be full filled ideal conditions like industrial expectations, quality maintenance, GMP etc.
- For getting better result there is needed to accept or apply new advanced technologies.

REFERENCES

1. Pareek V, Dr. Khunteta A, "Pharmaceutical Packaging: Current Trends and Future" International Journal of Pharmacy and Pharmaceutical Science, 2014; 6: 480-485.
2. Jadhav G, Zalte A, Saudagar R, "Advances in Pharmaceutical Packaging" 3(5): 194-204.
3. Pawar A, "Theory and Practice of Pharmaceutics-I,1st edition 2006; 223-247.
4. Guidelines on Packaging for Pharmaceutical Products. WHO Technical Report Series, No. 2002; 902; 154-156.
5. Herbert A. Leon Lachman, "The Theory and Practice of Industrial Pharmacy" Third edition.2005; 711-32.

6. Kumbhar M,Chaudhari N, Dighe D,Singh M, "Tamper Evident Pharmaceutical Packaging-Needs and Advances"International Journal of Pharmaceutical Sciences Review and Research, 2012; 13(2): 141-153.