PACKING

AND

PACKAGING MANAGEMENT

Online Programmes

MBA [Logistics Management]

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SYLLABI-BOOK MAPPING TABLE

Packing and Packaging Management

Syllabi	Mapping in Book
Unit 1 **Packing and Packaging:** Meaning, Functions and Essentials of Packing-Packaging: Meaning, Functions and Essentials of Packaging-Difference between Packing and Packaging-Packing for Storage-Packing for Overseas Shipment-Packing for Inland-Transportation-Packaging for Product Content Protection, Information, Promotion and Comfort Handling-Test of Packaging: Mechanical, Climatic & Lab Test-International Care Labeling Code-Packaging Cost.	**Unit 1:** Packing and Packaging **(Pages 3-37)**
Unit 2 **Packaging Types:** Primary, Secondary and Tertiary-Requirements of Consumer Packaging, Channel Member Packaging and Transport Packaging-Shrink Packaging-Identification Codes, Bar Codes, and Electronic Data Interchange (EDI)-Universal Product Code-GS1 Standards-Package Labels-Symbols used on Packages and Labels- Heavy, Medium and Small Packaging-Active Packaging-Child-Resistant Packaging- Pilfer/Tamper Evident/Proof Packaging-Product-Packaging Compatibility-Pharma Packaging-Food Packaging-Electronic Goods Packaging-FMCG Packaging-Heavy Engineering Goods/Equipment Packaging.	**Unit 2:** Packaging Types **(Pages 39-75)**
Unit 3 **Packing Considerations:** Protection, Convenience, Environment, Use/Re-use-Cost and Competition–Packing as a Systems Approach to Logistics-Transport/Storage Requirements-Physical, Chemical Environmental, Biological Nature of the Products- Packing as Protection Against Hazards-Package Design Considerations: Structural Design, Marketing, Shelf Life, Quality Assurance, Logistics, Legal, Regulatory, Graphic Design, End-use, Environmental Factors-Packaging for Marketing and Visual Appeal-Biodegradation-Recycling: Glass, Plastic & Paper-Reuse-Environmental Engineering-Industrial Ecology-Sustainable Packaging-Waste Management.	**Unit 3:** Packing Considerations **(Pages 77-108)**
Unit 4 **Packaging/Packing Materials & Components:** Various Materials/Metals Made Can, Bottle, Jar, Box, Barrel, Carton, Crate, Drum, Envelope, Keg, Bag, Blister Pack, Pail, Pouch, Sachet, Skin-Pack and Tube-Flexible, Folding, Insulated, Corrugated Packing Materials-Packing Materials: Paper, Wood, Adhesive, Aluminium Foil, Cushioning-Stuff, Packaging Gas, Pallet, Paperboard, Plastic Wrap, Shrink Wrap, Screw Cap, Slip Sheet-Security Printing-Strapping Stretch Wrap-Time Temperature Indicator-Tinplate.	**Unit 4:** Packaging/Packing Material and Components **(Pages 109-134)**
Unit 5 **Packaging Economics:** Packaging Cost Vs Product Cost-Cost Reduction in Packaging-Packing for Inventory Control, Value Analysis- Packing and Value Engineering-Packaging Laws-Consumer Protection in Food Packaging, Marking and Labeling, Eco-friendly Packaging for Exports-Scientific Packaging-Standardization in Packaging.	**Unit 5:** Packaging Economics **(Pages 135-158)**
Unit 6 **Packaging Industry Process and Machining:** Packaging Demands of Consumer Goods Industry-Packaging Demands of Industrial Users-Technology Trends in Packaging Industry–Aseptic Processing-Uthentication-Automatic Identification and Data Capture-Blow Fill Seal-Blow Moulding-Containerization-Electronic Article Surveillance-Graphic Design-Induction Sealing-Plastic Welding-Printing-Quality Assurance-Radio-Frequency Identification-Track and Trace-Vacuum Forming-Verification and Validation-Barcode Printer-Barcode Reader-Bottling Line-Carton machine - Check weigher-Conveyor System-Heat Gun-Heat Sealer-Industrial Robot-Injection Molding Machine-Logistics Automation.	**Unit 6:** Packaging Industry Process and Machinery **(Pages 159-187)**

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INTRODUCTION

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Packing basically refers to the act of preparing a product or commodity for proper storage and/or transportation. On the other hand, packaging entails the entire process of preparing manufactured goods for transport, warehousing, logistics, sale, as well as, use. Simply put, packaging contains, protects, preserves, transports, informs, and sells manufactured goods.

The present environment of the packaging industry is extremely competitive. To preserve market edge, packaging firms need to control the cost of their raw materials and labour. Bringing down packaging costs entails using recycled goods wherever necessary. It also involves innovation in production to cut costs. Finding newer and better ways to manufacture the various packaging needed is a full time job that is pursued throughout the industry. These are the issues that are taken up in the book.

This book, *Packing and Packaging Management*, contains six units. It follows the self-instruction mode wherein each unit begins with an Introduction to the topic of the unit followed by an outline of the Unit Objectives. The detailed content is then presented in a simple and structured format interspersed with Check Your Progress questions to test the student's understanding. A detailed Summary and a set of Questions and Exercises are also provided at the end of each unit for effective recapitulation.

UNIT 1 PACKING AND PACKAGING

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Structure

1.0 INTRODUCTION

Packing and packaging are twofold undertakings that refer to the procedure of covering or preserving merchandises for sale or transporting them from one place to another. Most individuals are unable to distinguish between the process of packing and packaging and thus they are identified as similar tasks of the supply chain. The process of packing entails preparing and shielding the product while it is in storage and transit, whereas packaging not only includes the storage and transportation of the product, but also at the same time, the process of packaging makes the product ready for sale as well. This unit discusses these aspects in detail.

1.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Discuss the meaning, function and essentials of packing and packaging
- Differentiate between packing and packaging
- Understand international labelling codes
- Discuss packing for storage, overseas, inland transport

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1.2 MEANING, FUNCTION AND ESSENTIALS OF PACKING AND PACKAGING

The knowhow of covering and shielding merchandises for movement, warehousing, trading and consumption is termed as packing and packaging.

1.2.1 Packing

The exercise of shielding, storing, enfolding or binding goods in bags, fabric, paper, containers, cans, bottles, and so on, which is best suited for the product is termed as packing. Packing is a task which is done so that the product is safe and can be easily stored or transported from the producers to the end users. Each product in order to reach the consumer has to be packed in an appropriate manner so that it can reach the final users in a usable state.

Functions of Packing

The main purposes of packing are:

- To protect the product during transportation and storage.
- To enable easy handling and distribution of the product.
- To protect the product from injury during storage and transporting and prevent the product from being tampered with or pilfered during these stages.
- To keep the product dust free and clean.
- To aid packed products to be conveniently displayed by the retailers and stored easily till they are sold.
- To help the further processes of packaging. Only after the product is appropriately packed the remaining functions of packaging can be initiated.

Packing: It is the method of placing the packaged articles into bigger containers for distribution.

Essentials of Packing

Packing may be described as the method of placing the packaged articles into bigger containers for distribution. Containing the product well, prior to placing them in boxes, is essential as the packed cartons containing the goods can be placed roughly and may need to be shifted several times. In the absence of proper packing the product can also get damaged and may get exposed to moisture. The items should be absolutely dry prior to packing. Packing is the basis for a product storing or shipping setup. Packing can be basically termed as the practice of enfolding or clubbing the product in a way which facilitates the handling, transferring and storage. Packing involves various methods like covering, muffling and sealing. The packing of the product depends on the nature of the product, weather, mode of transportation, etc. For instance, if the merchandise is breakable, then bubble wrapping is done in order to prevent breakage from jerks and movement. Various kind of material such as bubble wrap, cardboard, cellophane, foam, etc., are used for packing. Packing helps in providing safety against damages such as breakage, leakage, pilferage, etc. Packing is different from packaging yet it is considered as a part of packaging.

Delivering the product safe and sound to the intended recipient is essential. However, the packing should not be overdone as this will not only increase the bulk of

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the product but increase the cost of its transportation which in a way has to be incurred by the consumer. High cost can be a deterrent during the sale of the product. Thus, it is very essential to pack the product in only so much packing material as is required. This will not only be cost effective but also more suitable for the product as well. Sometimes unnecessary packing can lead to generating too much heat and stuffiness in the containers which can damage the products. Products can be packed with packing peanuts or bubble wrappings or foam material so as to provide extra safety. The packing material should be selected by keeping in mind the aspect of environmental preservation because most of the stuffing and cushioning materials like packing peanuts are not biodegradable hence they should be used wisely and only when necessary.

Need for extra packing is felt in the following cases:

- Special care is needed when multiple items are packed into a single container so they need to be wrapped independently in order to prevent them from getting damaged due to friction.
- Glassware and other breakable items need to be wrapped in bubble wrap prior to placing them into the container. Sometimes packing peanuts are also used to fill up the loose space in the package.
- Items with sharp piercing edges need to be wrapped and softened so that they do not tear the cardboard packing.
- Carpets, fabric or wall coverings need to be wrapped prior to packing as they cannot be folded and left in the carton.

Packing is an essential part of packaging. The packing of the product is the prelude to packaging as only a well packed product can be equipped with effective packaging.

1.2.2 Packaging

Packaging involves the procedure of developing, estimating and creating a package. A synchronized coordination of organizing merchandise for the purpose of transporting, storing and taking care of the logistics concerned with delivering the product to the consumer. Due to its significant role several nations have completely incorporated its functions into administration, corporate, manufacturing, and individual use.

The process of packaging has been into practice since ancient times. In earlier times knitted bags, bamboo baskets, ceramic containers, goat skin bags, etc. were used for packaging. Subsequently, containers made out of glass and bronze began to be used. The use of paper for the purpose of packing was noticed by a Persian traveller in Cairo in A.D. 1035, where the vendors of the local market wrapped their purchases in sheets of paper for safekeeping. In the eighteen century packaging started to be done by using tinplate. In the year 1667, the method of tinning was introduced in England by the engineers Andrew Yarranton and Ambrose Crowley. The process was further improved and developed by an ironmaster named Philip Foley. In 1805, tinplate boxes were made and began to be used for packing. The need for sealed boxes for packing food was felt in order to store food for longer duration of time. This led to invention of canning food by Nicholas Appert in 1810. This invention led to the setting up of the world's first canning factory in London in 1812. Packaging of food in cans led to the invention of the can-opener in 1855. Packing with folding boxes started in

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the year 1839. In 1856, pleated paper boxes more commonly known as corrugated boxes were used for packing hats so that they did not lose their shape during transportation or storage. By now paper bags were also used for packaging. In 1890, Robert Gair developed the first pre-cut paperboard box.

By the twentieth century the field of packaging had advanced to a large extent, by now closers for bottles, clear cellophane outer wraps, aluminium foil and sections on cartons began to be used. As a result of these advancements, the process of packaging became effective in preserving products. The use of better quality packing materials led to higher levels of food safety as well. The scientific developments in plastics further benefitted the packaging process. By the 1950s the importance of packaging had been established and it was realized that like all fields, packing also required qualified individuals who were able to realize the science of packaging. In 1952, the Michigan State University recognized Packaging Engineering as a subject of study and began to offer a degree for the same. The packaging process was incorporated with specific packing standards due to the problems which were faced in the military supplies during the Second World War. It was realized that packaging has to be done according to the transport and storage conditions of various products and there cannot be a common procedure. The need for recycling the material used in packaging was also strongly felt. The pre and post-consumer usage packaging material was required to be recyclable in order to make packaging an environmental friendly process. Today, the packaging sector is contributing largely to the gross national product of several developed nations.

Packaging is considered to be an important business function as it is not just limited to manufacturing the product but also comprises all the activities after the product has been produced. Packaging is concerned with developing and creating a cover for the developed product. In order for the product to be placed in the market, it requires a wrapper which should be fitting for it from various viewpoints. In fact, sometimes appropriate packaging is what helps in marketing the product. Packaging comprises resolutions regarding the markers, insets, directions needed for usage of the product, graphic design for striking presentation of the product, decisions regarding the size and style of the package of the solo product and its combined packing for transportation and storage.

Purpose of Packaging

The main purposes of packing and packaging are:

(a) **Safety of the Product:** The primary purpose of packaging is to safeguard the product during transportation.

(b) **Clearly Identifiable:** The package has to not just protect the product but also to make it visible for sale to the customer. The packaging should be such that it is easily identified by the consumer and it should encourage the buyers to purchase the item. The brand of the product should be visible for buyers in various departmental stores where the products are displayed and are personally picked by the consumer. The product has to stand out amongst the various similar products displayed on the store shelves. The package should have an attractive design and colour so that it appeals to the buyers. The packaging of the product is like a magnet which attracts the buyers towards it and thus, aiding in promotion

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of the product. The package helps in promoting the name of a particular brand as well. Packaging is an asset to the process of advertising.

(c) **Helps in Preserving and Easy Handling:** Packaging enables the storing and consumption of products. Packaging makes it easy for safekeeping the product while it is in warehouses and helps the individuals involved in the process to distribute the make it available for usage. The packaging helps the consumer to be able to figure out the correct usage of the product with the help of the content available.

Functions of Packaging

A product should be packaged in such a manner that it can be recognized easily and prompts the buyer to purchase it instantly. The packaging provides following functions:

(a) **A Restraint Function:** The product is kept safe for the consumer with the help of it packaging while it is being shipped from one place to another. Moreover, it can check tampering with the merchandise especially medical and food products. The packaging acts as a protection against any manhandling during storage. Packaging performs an essential role in reducing the security menace during shipment. Enhanced quality tamper resistant packaging helps in identifying whether the package has been tampered with or not. This helps in preventing thefts and wastage as well. The packages can be equipped with anti-tampering seals or anti-theft manoeuvres. This kind of packaging helps in preventing retail losses.

(b) **A Preservation Function**: The packaging acts as a protection for the product while it is being consumed by the individual. Food items or medications are protected against exposure to dust, moisture or leakages. Food products which are purchased without packing are considered unhygienic and are mostly inconvenient to handle.

(c) **A Storing Function**: Packaging is helpful not only for the manufacturer, transportation and storage but it also makes it easy for the consumer to store the product while it is in use. Due to the outer covering, the products can be stored by stacking one over the other and thus even the consumer can store products in the limited space of their homes.

(d) **An Assistance Function**: The details about the product printed/pasted on the packaging helps the consumers to use it correctly and also help in making the consumer aware about contents of the product inside. The packing of the product helps in assisting the retail buyers as well as the whole-sale buyers as the label can be used to trace and track product details.

(e) **An Advertising Function:** The design of the package becomes an integral part of the company's branding programme and facilitates the marketing process. The package design and physical appearance of the product should be exciting as it can make the product stand out and appeal to buyers and compete with other products. Packaging and labels help the manufactures to inspire prospective purchasers to buy their merchandise. Packaging helps in marketing the product as it is the face of the manufacturer and it's the brand as such. Packaging can

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save a lot of effort and money which needs to be spent on marketing the product through other means.

(f) **Packaging Provides Physical Protection:** The articles bound in the package need to be protected against mechanical impact, pulsation, electrostatic expulsion, pressure and heat.

(g) **Provides Barriers:** Packaging provides barriers and protects goods from being exposed to dust. It also helps to make the product airtight and prevents exposure to moisture. This protection is very useful for food and medical supplies. Packaging design has to provide a barrier against dust, moisture and oxygen. In order to make packaging effective desiccant or air guards are placed with the products to increase their shelf life. The packaging helps to keep the product fresh and fit for consumption till its mentioned shelf life. A barricade is also applied for products which need to remain separated till they're used. For instance, medical liquids or glues; these substances need to be combined only at the time of application.

(h) **Containment or Cluster:** Packaging helps to store small items like pens, erasers or other stationary items in a single unit. This helps not only in storage but also in selling the product in whole sale markets.

(i) **Helps to convey the Information and Facts about the Product:** The packages have general information on its labels which carry the brand name and the nature of the product. These labels help to convey detailed information regarding the usage, transportation, recycling methods and information about disposal of the used package, for instance cans of soda always carry the instruction of crushing the can after consumption. Packages which carry substances of medications, food and chemical nature need to have standard regulations as per legal regulations authorized by the government. Medicines and food products carry information about their expiration/best-before date; this is very helpful for the consumer at the time of purchase.

(j) **Packaging Makes the Product Consumer Friendly:** This leads to easy distribution, supervision, assembling, exhibition, transaction, administration, reuse, reprocessing, and simplicity of clearance.

(k) **Serving Regulator:** Nowadays manufacturers pack their products in order to cater to the nuclear families. They package products in single usage packs which help in portion control. The pre-packed one-litre milk tetra packs and poly packs help in maintaining accuracy and hygiene.

Advantages of Packaging

After going through the functions of packaging it will not be wrong to say that packaging is a very important and advantageous process. The usefulness of the process can be judged by the numerous functions mentioned above. In many companies packaging is a task which is undertaken by the marketing department as in today's competitive environment companies pay a lot of attention to their packaging. Manufacturers are able to get their product displayed in the retail market only if their packaging is attractive and practical. The packaging should appeal to the buyers. The self-service stores require the product to self-market itself. The packaging should not only be appealing

but also have utility while in use and after usage. Many food products are packed in attractive containers which can be used for later storage by the consumer. The manufactures need to keep abreast of modern packaging trends. The packaging needs to be eye-catching, practical and eco-friendly as well.

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Disadvantages of Packaging

Conversely, packaging also has disadvantages. Packaging depletes natural resources. It also adds to the cost of the product which has to be incurred by the consumer. Some of the packing material poses a threat to people's health. Packaging of a few products is misleading. Knowledge of reuse and recycling of packaging material is lacking in the society.

1.3 DIFFERENCE BETWEEN PACKAGING AND PACKING

It has already been established that packing and packaging are twofold undertakings that refer to the procedure of encompassing and safeguarding products for trade or transportation. According to most individuals packing and packaging are considered to be similar activities. In order to understand the differences between the two activities it is essential to contemplate these actions as two phases of the same procedure. Packing involves transporting and storing of the product whereas packaging has three functions which involve not only the storage and transportation, but also the added function of preparing the product for trading in the retail as well as wholesale markets. Packaging undertakes all the activities which are required for marketing and promoting the product. Packing can be explained as the procedure of putting the packaged articles into bigger containers for distribution. Packaging the product well before placing them in containers is essential as the cartons can be placed roughly and may need to be shifted several times. In the absence of proper packing the product can get damaged and can be exposed to moisture. The items should be absolutely dry prior to packing. Packing is the groundwork of a product storing or shipping. Packing can be basically termed as the practice of enfolding or clubbing the product in a way which facilitates the handling, transferring and storage. Packing involves various methods like covering, muffling and sealing. The packing of the product depends on the nature of the product, weather, mode of transportation, etc. For instance, if the merchandise is breakable, then bubble wrapping is done in order to prevent breakage from sudden jerks and movement. Various kind of material such as bubble wrap, cardboard, cellophane, foam, etc. are used for packing. Packing helps in providing safety against damages such as breakage, leakage, pilferage, etc. Packing is different from packaging yet it is considered as a fragment of packaging.

Packaging is the procedure of encompassing or shielding merchandises for sale or transference. Packaging contains all the procedures of packing; however it has the added function of marketing and promoting the product. Packaging helps the product ready for sale. Packaging involves determining the safety of the product in its packing. It is concerned about the physical appearance of the packed product. Packaging of the product should be such that it should attract the buyers. Though the appearance of the package is of great importance but at the same time the packaging of the product

Check Your Progress

1. When and how was the world's food canning factory set up?
2. When was tinning introduced in England and by whom?

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has to be such that it safeguards the product and imparts the relevant information regarding the qualities of the product.

Packing and packaging are not interchangeable. They are both essential activities of the same process. Both involve wrapping the product and keeping it safe during storage and transit. Packaging transmutes product for the end user, whereas packing is the process of wrapping particular items into a covering so that they reach the consumer safely and at the same time look appealing. The product has to be packed keeping in mind all the factors which can damage the product. Packed product can get damaged. For the product to reach the consumer safely it needs to be packed as well as packaged efficiently and effectively. Both procedures use similar material such as tapes, nylon threads in order to secure the packing. Packing is an action which is done to complete the process of packaging.

1.4 PACKING FOR STORAGE

Storage can be described as that marketing task which is concerned with stocking of the merchandise post manufacturing and until the time of their disposal to various selling outlets. There is bound to be a gap between production and consumption of the goods. Storage acts as the bridge between production and consumption. Storage includes creating appropriate organization which is aimed at holding merchandise in an impeccable condition. The storage of products should be such that the products nature and quality is maintained for final usage. It generates time and space services. Storage is a crucial function as it protects the packaged product till its consumption. Storage is an imperative function for all production units as all the products have to be preserved before their distribution and final consumption.

Importance of Storage

Storage is an essential function because of its multitude of benefits:

(a) **Storage helps in supplying goods as per their demand:** There are some products that are manufactured all year round but their consumption is at a particular time of the year. These goods are preserved or stored for consumption in storage units and thus can be supplied once their demand is created in the market.

(b) **Storage helps in storing raw material:** Storage helps to supply goods to the business houses as and when needed from different parts of the world. The process helps in creating place utility as the producer or retailer can procure goods quickly.

(c) **Storage provides place utility for the retailers:** Today the retail houses lack enough storage space to be able to store large quantities. Storage helps in making goods obtainable to a purchaser as per the requirement.

(d) **Storage helps the manufacturer to reduce cost of production:** In most cases bulk production always leads to saving costs. The storage helps in storing the excess goods. In few cases stored goods help in enabling the manufacturer to procure funds against the security of stored goods.

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(e) **Storage helps in maturing process of commodities:** Certain products like alcohol, wine and rice, etc., mature and improve in quality while in storage. The maturing of these products is possible in case correct storage environment is provided at the time of packaging.

(f) **Storage helps in keeping a check on prices of products:** The supply of products can be regulated in the market with the help of storage. The goods which are not in demand can remain in storage and be supplied when needed. This prevents creating shortage of goods in the market and escalation of prices.

(g) **Consistent manufacturing of products:** Storage accomplishes the utility of levelling out loopholes in manufacturing. The producers are able to manufacture goods as per their expected demand and supply regularly to the retailers.

(h) **Storage helps in facing natural calamities:** Storing of food items enables the administration to provide essential commodities during crisis like floods, drought, famine etc.

(i) **Reduction in cost of transporting goods:** Storage helps in supplying bulk quantities to the retailers.

(j) **Storage enables large-scale production:** The manufacturer can take up large scale production only if they are able to preserve excess produce.

Need for Packaging in Storage

Storage is needed to fulfil the gap which occurs between production of merchandise and their final consumption. The storage will be effective only if the goods are packaged in the manner in which it will retain its qualities till its consumption.

In order to be able to meet the demands of the competitive market the producers have to be ready to supply goods as per their demand. The gap between production and sale can vary. Producers have to package the goods to be in storage till their final consumption.

Commodities which are produced as per the seasonal availability of their raw material need to be packaged and stored for their all year round consumption. There are certain products which are produced all around the year but consumed at a particular time of the year; such products have to be packaged for the long gaps between their production and consumption.

Commodities: They are raw materials or primary agricultural products that can be bought and sold, such as copper or coffee.

Packaging and storage for specific merchandises such as wine, rice, alcohol, certain chemicals has to be in such a way that they are able mature while in storage. The packing of raw materials while in storage is different from the finished good for which that material is used. The storage and packaging of raw material cannot be similar.

Essentials of Packaging for Storage

Packaging a good for storage depends on the length of time the product is going to be in storage. The storage can be long-term or short-term. The place of storage should be able to adjust according to the changing climate. The packaging should be done keeping extreme weather conditions in kind. The storage should have climate controlling option especially if storage is going to take place for a long duration. Packages of electronic goods can be ruined if faced with short temperature extremities.

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Things to be kept in mind while packaging for storage:

(a) **Choosing the material for packaging:** Preparation for storage contains reviewing the material which is going to be used for packing. The boxes should be treated so that they are not prone to mildew and metal boxes should be rust free. The boxes should have the strength to be able to endure stacking. The box size should be as per the contents which are going to be packed so that there is no lose space and movement during transit can be avoided. Breakable items should be well wrapped and cushioned while placing in the box. Bubble wrapping is done in order to prevent them from damage. Packing peanuts, Styrofoam popcorn, Snissues, or packing noodles are used for giving cushion to products which are fragile and can get damaged while transportation. While packing fragile items it is important to stack them properly and making sure that they are stable and heavy items are not stored over them.

(b) **Labelling and marking the cartons in storage:** The packages should be properly labelled and marked in storage so that they can be easily identified. The labelling helps in proper dispatching of the products.

(c) **The storage units should be well ventilated**: Packaging should be done in such a way that the product is not exposed to moisture at the time of storage. Packages should be spaced well so that they are not close to the wall and enough space is left between the boxes. It is ideal to use pallets under the boxes so that there is a possibility of air to pass from below the stacks, this will help in keeping the floor of the storage unit to be clean.

(d) **The packaging should be able to keep the product free from dust while in storage:** Dust can ruin the surface of most objects specially clothes. Damages because of dust can result in reducing the retail value of the goods. It is recommended that packaging is done using dust covers and tarps while in storage.

(e) **Packaging for storage has to protect the goods from damage due to humidity and dampness:** Humid atmosphere can result in rusting, loss of lustre and deterioration of articles. Vacuum packing should be done for products so that they do not catch moisture. The storage units should be installed with dehumidifiers so that dampness and humidity can be curbed.

1.5 PACKING FOR OVERSEAS SHIPMENT

Overseas packaging is required when the products have to be freighted by the sea or air. The nature of packaging during overseas shipment is similar to that of transport packaging with minor changes. The safety of the merchandise in shipment is of great importance in overseas packaging. This is assured by using packaging material which is durable to sustain the overseas travel. The packaging has to be designed as per the specification of the product. Overseas packaging should not be bulky or heavy. The packaging has to be lightweight so that handling is easy and the cost of shipment can be controlled. The producers have another major concern while packaging for overseas transportation. This is the physical and atmospheric conditions the product will have to bear during travel. Therefore, it is very crucial to give consideration to changing temperatures, infrastructure status, the length of shipment and storage. On the basis of these considerations, packaging of each product should be shaped and sized.

The packaging for overseas should be developed for easy handling so that throughout the transit the product is handled with care. The boxes should be of uniform size so that they can be stacked easily. The erratically shaped boxes should be avoided.

The following things should be considered while packaging goods for transport overseas:

(a) **Protection from wrong handling:** The product has to face multiple handling while being transported overseas. The manufacturer can only make sure that the product is handled carefully at their end. The cargo has to be packaged in durable packing to reach the destination in one piece.

(b) **Goods travelling abroad:** As overseas shipment means transporting goods from one country to another, the packaging must be as per the laws and regulations of the destination country.

(c) **Packaging should be able to maintain product quality:** Overseas travel can be long distance. The shipment should be able to withstand all the exposures during transit.

(d) **Travel by sea:** The goods which are packed to travel by sea should be designed for easy loading and unloading from containers of the ship. The packages should be uniform in size so that space usage can be optimized and the package size should be designed keeping in mind the size of the container.

(e) **Travel by air:** The packaging of products for air travel should be done keeping in mind the limited space and weight restrictions. The nature of product should be considered while air transportation and packaged accordingly. Certain products like alcohol, perfumes and chemicals are not fit for transporting by air.

(f) **Volume of the goods is considered in overseas transportation:** The final invoice of the goods is prepared on the basis of its volume.

(g) **Overseas packages are palletized while shipping:** This is done for the easy mobility of packages and prevent the loss of packages.

(h) **Shipment via LCL (Less Than Container Loads) or FCL (Full Container Loads) Depending on the Number of Packages**. If a transporter has large quantity, then the goods are shipped via FCL. For less quantity the cargo is booked through LCL, where the container will have load of other transporters as well. The goods will be separated at the time of delivery hence it is very important to package the goods in such a manner that they can be separated from others.

(i) **Overseas shipping is centred on weight and volume of the goods:** The charges are based on the weight of the parcel. The packaging should be designed with light weight material which is sleek as well so that it takes less space in the container.

(j) **Labelling:** Overseas packages should properly labelled and they should carry all the relevant information such as-

(i) Transporter information

(ii) Receiver's information

(iii) Origin of the shipment

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Check Your Progress

3. What is packaging?
4. Define storage.
5. List five things that need to be kept in mind while packaging for storage.

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(iv) Destination of the shipment

(v) Proper labelling will prevent misplacement of packages

(k) **Goods with awkward shapes should be packaged in crates:** Such types of goods should also be packaged with adequate cushioning and fillers. The cushioning is required for preventing damage to the product.

(l) **Palletizing is essential for overseas shipment:** Palletizing prevents goods against loss and facilitates their movement. Pallets measurements differ, estimated size is: 42" x 48". Containers are usually arranged up till a height of 85 inches. Pallets are made of wood and are heat resistant. Sometimes plastic pallets are also used.

(m) **Specific requirements of certain destinations:** The packages should be as per the specifications of the destination country. The shape and size of the packages should be according to the country's market requirements where they are going to be shipped. Prior to shipping goods to another port, the manufacturer must find out all the details and necessary information. Customs regulation should also be checked so that packaging is done accordingly.

(n) **Inventory of the goods:** Shipping commercial goods overseas requires an invoice which has details about the product. The packages of the product should match with the information given in the invoice.

Inland transportation: It can be defined as on land transit which is within the boundaries of a country.

1.6 PACKING FOR INLAND TRANSPORTATION

Inland transportation can be defined as on land transit which is within the boundaries of a country. Inland transportation may include transfers through inland waterways. The inland transportation system acts as a crucial link between the seller and buyer. The intention is to deliver the goods without losing its quality as per the demand of the goods. In order to fulfil this intention there has to be a well collaborated network between the supplier and the transport staff. The goods are prone to damages while in transit if the proper methods of dispatching are not adhered to by the sender and the transporter. There are numerous factors which can result in goods not being delivered in their original state. The most crucial of them is the quality of packaging and handling during the journey. The suppliers can supply bulky products with the help of trucks or rail. Road and rail are mostly used for deliveries within the country, sometimes inland system is used for cross-border transfers as well. Delivery by roadways for short distance is considered to be more economical and hassle free in comparison to rail and air transfers. For this reason, roadways is one of the most commonly used mode of transporting goods from one place to another.

Inland transport freight or charges include the cost of loading and unloading of the goods and the freight charges of the transport used for the purpose. There are a few drawbacks of road transit. One of them is that the safety of the goods is low and the packing and packaging of the goods has to be very strong as a result. There is also a strong risk of pilfering due to theft and damage. The risk is comparatively less in rail transits as the goods can be transferred in closed railway wagons. Inland transfers require proper planning, and understanding of the road and weather conditions.

Packaging Considerations for Inland Transfers

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(a) The transfers by road or railways require more firm and secure packaging as compared to ship or air transfers. The transfers take place in non-containerized manner hence the goods are at a risk of being lost or damaged.

(b) Stronger packing is required as the goods are prone to mishandling. There can be loses due to theft and pilferage.

(c) The goods can be subjected to multiple transfers such as rail to truck as the destination may not be a rail head. The cartons should be packed with care for such transits, the goods should be provided with inner packing.

(d) The packages of inland transfers should not be individually heavy as this will pose a problem at the time of loading and unloading. Most transporters do not have adequate lifting gear and the loading is done manually.

(e) The inland transfers are prone to extreme climatic conditions. The packaging should contain a desiccating agent made from silica or bags of clay granules to absorb moisture. The cardboard boxes should have a waxed paper covering so that they can be waterproof. In places with humid climate, cartons can be made of laminated foil. The packaging should be done for protecting the product inside the packing and externally as well. The outer surface of the packages can be protected using corrosion protection films, stretch and shrink films, etc.

(f) In places where freight rates are based on weight of the cases, packaging should be done using light weight material. Less but effective packing material should be used.

(g) Traders must be openly instructed about the standards of export packing. The packaging should be adequate as per the set standards.

(h) Pallets are used for convenient handling for this reason the packages should be clearly marked and labelled so that they can be loaded on the pallets. The labelling will help in identification and tracking in case a pallet is misplaced during transfer.

(i) Tagging of the packages should be administered with care. The package must clearly mention the following information-transporter information, receiver's information and place of origin and final destination of the load.

1.7 PACKING FOR PRODUCT CONTENT PROTECTION

The packaging of manufactured goods is a significant advertising tool. Packaging acts as a cover for the product and keeps it safe; furthermore, it designates a particular firm as the source of the product. The external look of the merchandise draws the buyers' attention, impacts their choices, and assists the customers to get familiar with the market options. The growing significance of packaging of products leads to duplicity of the packing. Manufacture have to protect the packaging of their products from being copied. The package of a product is emblematic to the contents of the

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product. The following methods are adopted by manufacturers to protect their packaging:

(a) **Trademarks:** Producers can protect the manufactured goods packaging by procuring a three dimensional trademark. It can be attained after all the legal necessities are met by the producer. The packaging trademark helps the consumer to distinguish the product from a similar product by another producer. For instance, product boxes can be approved as three-dimensional trademarks. Sometimes the trademark could consist of the wordings, slogans, colour of the package or the design on the package. The producer has individual right to use the registered trademark in all national as well as international markets.

(b) **Industrial Design:** Packaging of products can be secured under industrial design laws. The design of the packaging can be two dimensional and three dimensional. To be qualified for protection, a design's external look has to be new and have a 'distinct feature'. A design is termed as 'new' only if no one else has applied for analogous or matching design to public knowledge. A design has the character of 'distinct feature' if a conversant possessor does not have the same common impression while constructing a contrast to formerly presented designs. The design can be protected by the producer by applying in a national patent office and can be entitled for protection of the packaging by the law.

(c) **Copyright:** Protection can be provided by applying for copyrights. An individual's unique creation of a label on the package can be protected by copyright protection laws. Copyright protection can include visuals sited on the packaging, slogans or write up about the nature of the product. Protection under copyright has no formal requirement like registration. It can be applicable from the moment the package is created, it becomes the exclusive work of the author and its usage is decided by the author. The copyrights can be transferred or traded to another party by the consent of the author.

(d) **Unfair Competition:** The liberty to use somebody else's commercial successes as they are not secured by any of the specific rights mentioned above is subjected to restrictions established by the national laws which govern unfair competition. The state offers protection to those who are not able to secure their designs or labels. Unfair competition laws forbid unscrupulous activities among manufacturers who are rivals in the market; such activities are considered unlawful act. Activities like copying a product packaging can lead to confusing the customer. Such activities can pollute the market atmosphere and create conditions of unrest.

Protection of Content

Poor packaging will not be able to protect the contents inside the package. The dispatcher is accountable for warranting that the freight packaging is sufficient for transportation. Appropriate and protected packaging is very essential for easy handling and transporting of the goods. In order to protect the content inside the package, a few precautions have to be taken at the time of the packing. These include:

(a) Solid outer covering should be used to pack which is appropriate to the content size. The packing should be suitable for the contents that have to be packed.

(b) The contents of the package must be secured against mechanical handling.

(c) The contents should be tightly packed so that there is no hollow space in the container. Enough cushioning should be provided to fill up the gaps.

(d) The packages should be sealed properly with sealing tapes. The packages must be labelled correctly.

(e) The packaging should be done as per the mode of transport which is going to be used. Airfreights should be packed in light weight packing.

(f) Parcels which are heavy should always be handled and loaded using a trolley. Parcels heavier than fifty kilograms should be placed on a pallet. Packages should be placed properly on the pallet and should not spill out of the pallet on the edges. The pallets should be sealed properly.

(g) Vulnerable goods must carry the markings 'Fragile', 'Handle with Care', 'This side up' or 'Arrow Up' for careful handling.

(h) Liquids should be stored in leak-free vessels, which are secured with a lightweight, sturdy, inner substance such as Styrofoam, and wrapped inside a plastic carrier.

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1.8 PRODUCT CONTENT INFORMATION

The information about the product is available on the printed information on the packaging of each product. This printed information is termed as a label. A label can be made of any material such as paper, plastic film, cloth, metal. It is attached to the packaging of the product, and contains all the relevant information about the product and its usage. The process of printing information on the product is termed as labelling. Sometimes the information of the product is written directly on the container.

The primary function of the label is to provide information about the content of the product. Besides this, the label helps in providing information about the source, brand name, usage, shelf-life, date of manufacturing and best before date, and so on. Most labels carry information about the correct disposal of the container after usage. For instance, soda cans need to be crushed before being discarded and this instruction is mentioned on the can. The label of the product carries the information about how to use, as well as storage of the contents of the package. The labels may also carry the methods of production which help the consumers be aware about the quality of the product. In several countries, dangerous goods which are poisonous or flammable have warning signs mentioned on the label.

Labels are helpful in identifying the products which provide similar usage. Food product labels mention the nutritive value of the content; they carry the list of ingredients which the product has, credentials, figures, cautioning, and directions for use, ecological advice or publicity. The label of the product should be secured well, so that it remains safe till the final usage of the product. For instance, the vehicle identification number plate on a vehicle needs to be heat and temper resistant, in the same way a food packaging label should be able to last till it has been utilized completely. Packaging carries the price of the product which enables the consumer to pay the correct price and not get cheated. The presence of barcodes on the labels helps in tracing and

Check Your Progress

6. What all information should the label on an overseas package have?
7. Why is palletizing essential for overseas shipment?
8. With reference to shipments, what is the full form of LCL and FCL?
9. What is inland transportation?
10. What markings must packaging of valuable goods carry?

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tracking of the products. Apparels usually have additional laundry care labels which help the consumer understand the correct storage and laundering process. Material used as labels should be durable so that it remains attached to the garment, it should be heat resistant as well, and the colour of the label should not bleed into the garment. The labels on the garments specify the ingredients of the fabric which help the buyer to make his choices correctly.

1.9 PROMOTION AND COMFORT HANDLING

Package testing includes the range of the features or attributes of the packaging. This takes into account the material of the packaging, packaging mechanisms, primary packages, freight containers, and the weight of the product in relation to the weight of the packaging. Package testing includes all the related processes. Product requirements are essential in deciding the packaging of the product. Package testing is mostly related to the particular manufactured good packed in the package.

Considerations while Packing Food Products

Foodstuffs such as garden-fresh produce, frozen foods, irradiated products, sea food, canned foods, etc., and so on have different regulatory necessities and different packing requirements. Packing has to be based on following aspects:

(a) Safety of the food

(b) Suitability of the package with the product

(c) Transferable material from the packaging to the food

(d) Shelf life

(e) Preventive properties of the package from moisture, air and temperature.

(f) Essential validation from HACCP and meeting the specific quality assurance requirements and produced under good manufacturing practices

Considerations while Packing Pharmaceutical Products

All medicines and medical products are packaged under an extremely regulated environment. The particular aspects to be keep in mind while packaging are:

(a) Protection of drugs and pharmaceuticals

(b) Blockade properties from air, moisture and heat

(c) Shelf life

(d) Suitability of package with the drugs

(e) Sterility

(f) Packaging should be tamper proof and child resistant

(g) Packaged as per quality assurance requirements, good manufacturing practices, meet all the authentication procedures

1.9.1 Test of Packing

Testing processes the properties and interfaces of the standards of packaging, the package substances, physical endurance, and durability. It is done by undertaking

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precise laboratory trials, independent assessments by people, or ground analysis. Recording the findings of these trails and assessments is essential. Testing can be based on approximation or measurable estimates. Package testing is done regularly and it is a physical experiment. Food and pharmaceutical packaging are made to undergo chemical tests in order to decide their suitability when in contact with food or medicines. The procedure for these testing is simple but thorough and based on a variety of variables. Package testing can cover the entire shelf life of the product. The test of the recycling capability of the package is done as well and it assesses the ability of the packing to degrade as ground soil, in a closed ditch or under conducive composting atmosphere.

Functions of Testing

The test of packaging has numerous functions:

(a) It helps in determining and verifying whether the essential specifications needed for the product packing is attained.

(b) It helps in establish evidence of the model and reliability of the packing.

(c) Testing offers general information which may be helpful in developing remaining features such as technical, industrial and quality assurance.

(d) Authenticates appropriateness for final usage.

(e) Testing offers a foundation for further technical correspondence.

(f) It helps in providing a methodological way of comparing other available options and measuring the credibility of each option.

(g) Testing helps in giving legal backing to the claims of the manufacturer. The manufacture can acquire copyrights and other patenting claims on the basis of these tests.

(h) It helps to save cost of using a wrong packaging.

(i) It acts as a tool in determining the expected cost of packaging.

Uses of Testing

(a) The packages and their contents are exposed to pressures and changing aspects which are present in the process.

(b) The packages are made to experience various kinds of calamities which actual product can face while in transit.

(c) The testing helps in maintaining the consistency of production of parcels and its various constituents.

Need for Testing

(a) Testing the resisting capacity of packages helps in preventing insect infiltration.

(b) Testing of certain products as well as their packaging is compulsory by law. These include food products, medical supplies, medical apparatus, hazardous products, etc. The testing is mandatory on the design requirement, testing has to be redone annually or as per regulations. The authenticity of the test has to be approved by quality management systems such as HACCP, statistical process control, validation protocols, ISO 9000, etc.

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(c) The extent till which the packaging has to be tested is a decision which is taken by the business houses based on factors like cost of packaging, the cost involved in undertaking the test, the value of the contents of the package, value of customer safety, the risk of exposure and estimated loss to the product due to inadequate packing.

(d) The packages of products have to be designed and constructed in such a manner that they are able to perform their basic function of providing protection to the product while storage and transportation. If the package is damaged during distribution then it is not going to reach its final user. Generally package testing is a recognized part of all manufacturing processes. Whenever a new package is developed it needs to undergo a proper testing phase. Periodic testing is conducted on existing packages. Testing a new packaging is essential as it helps in saving funds and time in the long run.

1.9.2 Testing in Laboratories

Several contractors or retailers provide some degree of testing for checking the usability of material and package complimentary. Providers of packaging like to deal with suppliers who have certified quality management systems such as ISO 9000 or permit clients to undertake mechanical and quality inspections. Information and facts obtained during the testing is frequently used by other packers as well. As a result, the result may be altered slightly to suit the supplier's needs and thus making the testing not very accurate.

Most manufacturing units of big companies have a well-established department for packaging with trained staff. The packaging department has a separate laboratory for package testing and developing new packaging. The testing is done by corporate engineers as they have complete knowledge about the product's nature and its industrial competence; they also know the importance of testing and its impact on the customers. The testing helps in determining the usability of the material, and at the same time, finds ways of reducing cost of production. Manufacturing units that lack the infrastructure of a laboratory hire specialized contractors or sometimes just the equipment required for conducting the test. These contractors and their equipment have to obtain certifications such as ISO 9000, ISO/IEC 17025, etc.

A number of organizations certifying the standards circulate investigation approaches for package testing. These organizations are seriously concerned about the welfare of people and the environment. They help in providing an effective framework to involved packagers for the improvement, conservation and circulation of required lists of standards and provisions. Example of some of the standards organizations are:

(a) International Organization for Standardization ISO

(b) ASTM International

(c) European Committee for Standardization.

(d) Technical Association of the Pulp and Paper Industry

(e) Military Standards

(f) International Safe Transit Association

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The methods for undertaking the test have to be as per the government and the regulating authority's specifications. There are several standards test that are prescribed by the industrial norms besides regulating authorities. It is advisable for the packaging units to refer to the mechanical instructions and the areas of testing while undertaking the test of the product. The engineers performing the test can take a limited amount of liberty and use alternate methods to perform their respective test and this can also lead to modifications to the prevailing method. While testing in the laboratory, the researchers can create processes as per their requirements. In case any alterations have been made by the researcher during testing it must clearly be specified in the readings of the report.

1.9.3 Material Testing Mechanically

Resources and apparatuses are frequently appraised using an all-purpose testing machine. The material used in packaging has a direct impact on its design and utility. The packaging technicians while designing the packing need to be completely aware about the physical properties and chemical characteristics of the material which is going to be used. Providers circulate information sheets and other official communications which mention the required physical properties and the method used while testing which outline these properties. Occasionally this input is sufficient for the packagers and suppliers of the material, but on certain occasions, detailed testing of the material is needed to determine specific features. After completion of the final package design, its usability should be conveyed to the suppliers. Packaging materials testing is mostly required to recognize the perilous features of the material and its technical endurance. This input helps to develop packaging using material which is as per specifications. For instance, in case shrink film is used for packaging then its data will contain the following parameters, stretching capacity, extendibility, modulus of elasticity, external strength, viscosity, humidity conduction degree, air conduction rate, temperature closure power, heat shutting properties, heat resistance, etc. Mostly, the data will be based on normal and procedural competencies of the shrink film. The shrink film when being tested for food packaging will require the testing of chemical properties as well and its reacting ability with food.

1.9.4 Testing with People

In few cases, packaging is directly tested on people rather than a gadget. The evaluation provided by the general population is preferred. For instance, in case a product packaging claims to be child-resistant then the usability has to be established by experimenting it on children. In order to check the packages a selected group of children are provided with samples, the resistance will be established only when after the children are unable to open the packaging for a period of ten minutes. There can be a few who manage to open but their percentage should be very low. The testing is sometimes tried with elders as well.

The testing is sometimes done by surveying the response of the people and taking their feedback. **Organoleptic** assessment is undertaken for certain food packaging by producers. Individuals decide by smelling or tasting the food whether the components of the package have contaminated the food items. Sometimes people are provided samples to try at home and they give their feedback by posting or emailing

Organoleptic: Something relating to the use the sense organs.

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their experience. The marketing research is possible only if the assessment of packaging is done adequately. People's responses and feedback need not be very accurate, thus in order to attain more accurate results, testing is performed in laboratories as well. Testing done by people are cross checked in laboratories and the testing technicians can determine whether all the parameters were checked.

Applicable Standards

The following are the applicable standards:

(a) **ASTM D7298:** It is a testing technique to measure comparative legibility by using a polarizing filter instrumentation.

(b) **ASTM E460:** Practice for evaluating the effect of packaging on food products and beverage while in storage.

(c) **ASTM E619:** It is a method for assessing extraneous odours in paper packaging.

(d) **ASTM E1870 Test:** This test helps in checking whether odour and taste from the polymeric film packaging is being transferred to food items.

(e) **ASTM 2609:** Inspection for transfer of smell and taste from rigid polymeric packaging.

(f) **ISO 16820 Sensory Analysis:** It defines a technique for systematically examining statistics from sensory discrimination testing, such as the Triangle, Duo-Trio, 3-AFC, 2-AFC. Under this, at the end of each sampling, the conclusion can be derived and changes can be made to stop testing and declare a difference or to discontinue analysis and announce no change, or to carry on testing. The sequential method of testing frequently permits for a conclusion to be made after less sampling of the discrimination test as compared to any other traditional methods which are used to undertake the prescribed tests. The technique is useful as it helps in realizing whether altering a certain ingredient, dispensation, wrapping, treatment or storing will help in packaging. It is helpful for choosing, preparation and observing evaluators.

(g) **ISO 5495 Sensory Analysis:** It refers to a process which helps in deciding in case a noticeable sensory difference is present or whether there is a relationship among testers of two goods regarding the strength of a sensory characteristic. Another name for this testing is directional difference test or a 2-AFC test (Alternative Forced Choice). The process is relevant if a variance occurs in a particular sensory aspect or in numerous aspects, hence it helps in determining the presence of difference of a specific aspect without giving the degree of the difference. The test does not conclude that if difference is not visible then in reality the products are similar.

(h) **ISO 13302 Sensory Study:** This test helps in examining the impact of packaging on food when the flavours are altered.

1.9.5 Climatic Testing

Providing packaging for products which are environmentally friendly is very important. The testing of the packages need to be undertaken in chambers which are temperature controlled and free from humidity. The testing will not be accurate if the environment is not conducive. For instance, while checking the paper packaging, the humidity has to

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be controlled as paper will absorb moisture and that will affect the quality of the product packed, similarly, while testing packaging made of plastic, the temperature has to be adjusted as plastic products react differently in high temperatures. Most products carry the information under which they have been tested. Most products are tested in an atmosphere where temperature is 23 °C (73.4 °F) and relative humidity is maintained at 50 per cent. In case the environment differs than it is mentioned in the product information. The product has specifications about the engineering endurance as well. In most cases the package is acclimatized to a particular atmosphere hence it is tested under similar conditions. The room or the chamber conditions are set as per this atmosphere. In certain cases, the package is accustomed to a particular atmosphere, then it is removed from those surroundings and rapidly tested. The reports of the test have to clearly specify the environment in which the product has been tested. The testing engineers consider it very crucial to understand the complete extent of climatic conditions on the performance of the product packaging. The details can be acquired through the input provided by the manufacturer or by testing the packaging in various conditions.

Applicable Standards

The following are the applicable standards:

(a) **ASTM D4332:** This is the standard practice for conditioning containers, packages, or packaging components for testing. Several constituents that help to develop containers and packages experience variations in physical properties due to heat and humidity. Thus, the package ought to be positioned and retained in definite surroundings for sufficient time so that physical properties can be acclimatized. These conditions are the usual recognized standards or distinct laboratory conditions taken to exemplify specific stages of the atmosphere. These distinct conditions need not be the definite surroundings, but they are mostly the conditions which will impact the usability of the goods and the packaging material.

(b) **ASTM E171:** This is the standard specification for standard atmospheres for conditioning and testing flexible barrier materials. This description outlines the average heat and humidity for analysing the goods at technically ambient conditions. Packaging material like paper and plastic are tested with the help of this standard. The gadgets and methods employed to undertake the heat and humidity test should be confirmed.

(c) **ASTM F2825:** This is the standard practice for climate stressing of packaging systems for single parcel delivery. This exercise offers a technique for preparing packaging to experience the climatic situations which the package is going to experience in the process of distribution. The prescribed intensities are as per the date which is procured in the process of distribution, usage and storing surroundings, present production practices, and available literature. These situations are based on average global temperature. This exercise offers a constant source for performing laboratory testing which helps in assessing the package capability to be able to tolerate various changes in temperature of various places that the package has to travel while distribution.

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Shelf-Life Testing

The shelf-life of the product can be determined in a laboratory by exposing the packaged product to various conditions. Shelf-life testing is very crucial for all products but especially important for food products, drugs and chemicals. The testing is typically as per each product as the contrivances of dilapidation are regularly not the same. The product is exposed to probable and high temperatures and humidity levels in order to check the usage date. The role of packaging in preventing product from losing its quality is commonly tested by assessing its capability to resist the laboratory exposures.

Applicable Tests

The following are the applicable tests:

(a) **ASTM E2454:** This is the standard guide that helps in testing physical shelf - life of consumer products.

(b) **DoD 4140.27M:** Shelf Life Management Manual, 2000.

(c) **ISO 11987 Ophthalmic Optics:** It is the testing done to determine the shelf-life of contact lenses. The test helps in defining the steadiness of contact lenses after being positioned in their closing container through storing and circulation.

Most merchandise like food products, medicines and chemicals vitiate when exposed to air. The package of such products should have the capability to prevent the penetration of air into the package. Assessments are frequently undertaken on the packing constituents initially to check their usability then the testing is carried out on the packed package in this the handling, storage impact during shipping and aspects like pressure and temperature are checked. Parcels can vitiate being in contact to temperature, humidity, steam, radiation, gas, sunlight, and other ecological influences. Few products are tested for metal corrosion, polymer dilapidation, and climate analysis of polymers. Laboratory testing is conducted for checking the accelerated aging of packaging and materials. The packaging is exposed to high temperature as this speed ups the dilapidation mechanism. The chemical reactions taking place at various heat levels are understood with the help of an Arrhenius equation.

Applicable Tests

The following are the applicable tests:

(a) **ASTM D3045**–Standard Practice for Heat Aging of Plastics without Load

(b) **ASTM F1640**–Standard Guide for Packaging Materials for Foods to be exposed

(c) **ASTM F1980**–Standard Guide for Accelerated Aging of Sterile Medical Device Packages

(d) **ASTM G151**–Standard Practice for Exposing Non-metallic Materials in Accelerated Test Devices that are Laboratory Light Sources

Vacuum testing is done to check in case there is any leakage in the packaging of the product as this can reduce the shelf-life of the food. Vacuum compartments help in checking the durability of the package in low pressures. Products can be exposed to

low pressures when the transportation of the goods is done by air freight or to destinations at high altitude. The vacuum testing laboratory puts regulated pressure on the closed package to check the durability of the seal and the degree of its durability.

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Applicable Tests

The following are the applicable tests:

(a) **ASTM D3078:** It is the regular assessment technique for checking leakage in malleable packaging with the help of bubble emission.

(b) **ASTM D4991:** It is the regular assessment technique for checking leakage in stiff packaging with the help of vacuum method.

(c) **ASTM D6653:** It is the regular assessment techniques for checking impact of transit in high altitude with the help of vacuum method.

(d) **ASTM D6834:** It is the standard test for checking in case the product is leaking from the packing with the help of mechanical pump dispenser.

(e) **ASTM F2391:** It is the standard test for checking the seal of the package using Helium as the tracer gas.

It is important to test the packages for their strength in case they are dropped or exposed to any other shock while in transit. The packages are tested for their capability to absorb shock when dropped. All types of packages are prone to accidental dropping. The task of the packaging is to safeguard the product. Tests are undertaken to check the conducted to durability of the product packaging in a controlled environment in the measure the laboratory. The package is exposed to shock and its impact is reported. These test help in realizing as to how much cushion is required in a packing to improve its fragile state.

Applicable Tests

The following are the applicable tests:

(a) **ASTM D880:** It is a test done on shipping containers for checking the impact.

(b) **ASTM D1596:** It is a test for checking the absorption strength of the cushioning material of the package.

(c) **ASTM D3332:** It is a test to check the fragile nature of the product with the help of shock machines.

(d) **ASTM D5265:** It is a test for checking bridge impact.

(e) **ASTM D5276:** It is a drop test for loaded containers by straight dropping.

(f) **ASTM D5487:** It is test for simulated drop of Laden Containers by shock machines

(g) **ASTM D6537:** It is a regular exercise for testing the package performance in shock situations.

Some packaging materials are not heat resistant hence it becomes important to protect the goods in the package by providing insulated transporting containers so that they are not effected by variables in temperature. The resistance is checked in the laboratory by testing the product packaging with adequate jell or ice packs, fillings,

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etc. Furnaces, freezers, and environmental compartments are usually provided for testing. The extent of temperature resistance under various conditions is documented and used for future testing and developing packaging.

Applicable Tests

The following are the applicable tests:

(a) **ASTM D3103:** A regular test that uses thermal insulation in packages while in circulation.

(b) **ISTA 7E:** It helps in assessing the impact of outside temperature contacts of single packaged-products which are transported with the help of a parcel delivery system. In a way it is helpful in common testing and condition of insulated shipping containers.

Glass products have to be protected for sudden hot and cold temperatures. The product will not withstand a thermal shock. In order to test the durability the product is made to shift between extreme hot and cold washes.

Applicable Tests

The following are the applicable tests:

(a) **ASTM C149:** It is a test for thermal shock resistance of glass vessels.

Packaged products have to be tested against the risk of damage due to vibrations which occur during transportation due to vehicular vibration or uneven roads. Impending vibration can damage the product by bruising the delicate products or breaking them; there can also be starches. It is essential for product packaging to be resistant to damages caused due to vibrations. The packaging can be made vibration resistant by undertaking various tests in the laboratory. The frequency at which damages occur can be monitored. The ability of a package to withstand these vibrations and to protect the contents can be measured by several laboratory test procedures. Modal testing practices are often used on few occasions.

Applicable Tests

The following are the applicable tests:

(a) **ASTM D999:** Testing vibration of transporting vessels.

(b) **ASTM D3580:** Test for checking the impact of vibration on products.

(c) **ASTM D4728:** Test of sudden vibration on containers.

(d) **ASTM D7387:** Test for vibration of containers carrying dangerous liquid material.

The packages can be damaged while they are stacked over each other. It is essential to conduct compression test on the packaging and the damages that can occur during shipment. Compression test ordinarily processes the power necessary to press a package or pile of packages. Packages can be crushed while they are empty or filled. The curve of force-deflection is used to attain the ultimate weight or required state.

Applicable Tests

The following are the applicable tests:

(a) **ASTM Standard D642:** A test to check the compressive resistance of Freight containers.

(b) **ASTM Standard D4577:** A test for checking resistance of vessels which are under continuous burden.

(c) **ASTM Standard D7030:** A test for resistance of Corrugated Fibreboard Containers under continuous burden by means of a compression test machine.

(d) **ISO 12048 Packaging:** Test of completely loaded and stacked shipping packages with help of a compression tester.

Laboratory testing helps in recognizing freight container designs which will work with the product in actual situations. However, it should be noted that laboratory testing is unable to completely judge the practical workability as these are based on trails based on average conditions. The advantage of testing in laboratory is that few samples are required while testing. This helps in saving a lot of time and resources. The data derived for the testing can be saved and used for future improvements as well as references.

1.10 INTERNATIONAL CARE LABELLING CODE

A product must be delivered to the consumers with utmost care. Caring for it while in usage is continued in the form of attaching care labelling codes to the product. These care labels are most common in consumer goods like garments and fabric. The codes are standard international symbols. These symbols help the consumer to care for the garment while washing and ironing. Sometimes how to dry instructions are also attached. The tags which carry these codes are recognised as care labels. Care labels help in providing procedures and recommendations through which the consumers are able to take adequate care of their garments. The labels carry instruction about the cleaning techniques that are suitable for the fabric and its construction. Abiding with the guidelines on the labels guarantees the life of the garment and its long usage.

Manufacturers are careful about the contents of the care labels on the garments as early damage to the apparel due to inappropriate laundering instructions can result in grievances and manufactures will have incur the cost of refunds and will lose a acquire bad publicity. Proper care labels will lead to customer satisfaction as they will be aware of the procedure prior to purchasing the product and helps in decision making at the time of the purchase. Most working class consumers prefer to buy garments which can be machine washed rather than only hand-wash or dry-cleaning.

Particulars of Care Labels

(a) The care label of the garment carries the name of the country where it has been stitched.

(b) The location of the care labels must be easy to access at the time of purchase so that the buyer can read its instruction prior to purchase. The label should be secured well with the garment so that it does not come off easily.

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Check Your Progress

11. What does package testing include?
12. Name some standards organisations.
13. What is Organoleptic Assessment?
14. What is ASTM D7298?
15. Under what climatic conditions most product testing done?

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(c) The accurateness of care information is the responsibility of the producer or the distributor who has directed its manufacturing.

(d) The care label has to be attached to the product at the time of its sale even if it has been imported without the label.

Care Labelling Systems

There are five care labelling systems which are commonly seen on labels. These systems are:

- The International Care Labelling System
- The Japanese Care Labelling System
- The Canadian Care Labelling System
- The European Care Labelling System
- The American Care Labelling System

The International Care Labelling System is governed by the International Association for Textile Care Labelling (GINETEX) since 1975. GINETEX members are Belgium, France, Germany, England, Netherlands, Israel, Austria, Switzerland, and Spain.

The goals of the International Association for Textile Care Labelling are to:

(a) Update shoppers on the accurate care labelling of fabrics with the help of a universally constant and easy system of care labelling signs, which are not dependent on language.

(b) Establish and endorse professional care labelling system globally so that there is one common system.

There are five basic signs of International care labelling system and are presented in the given order:

The signs for the International Care Labelling System are identical to the European Care Labelling System.

The maintenance guidelines are:

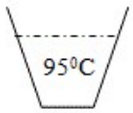
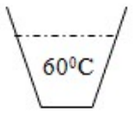
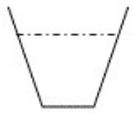
(a) Care required at the time of cleaning.

(b) Instruction to be followed while drying the garments.

(c) Instructions to be followed while pressing the garments.

Signs displayed for Care:

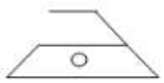
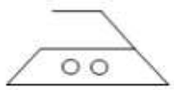
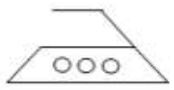
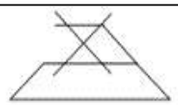
Washing signs

	The temperature of water for the garment should not be more than 95^0C
	Washing should be done with temperature of 60^0C or less
	Washing machine should not be used.
	Washing is not allowed.

Bleaching instructions:

	Cleaning with bleach is acceptable
	Cleaning with bleach is not acceptable

Signs indicating ironing temperature:

	Pressing temperature should be less and not more than110^0C
	Ironing up to 150^0C
	Ironing up to 200^0C
	Ironing not permitted.

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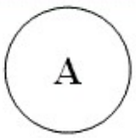
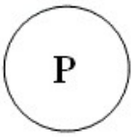
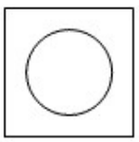
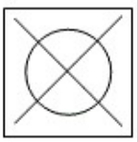
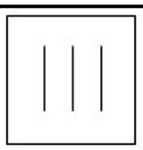
Instructions for dry cleaning:

	Any solvent can be used during the process of Dry cleaning.
	The dry-cleaning can be done by using Para-Chloro-Ethylene, white spirit, solvent-113 and solvent-11.
	White solvent-113 can be used.

Instruction for Drying:

	The garment can be tumble dried.
	Cannot be tumble dried.
	The garment can be dried by hanging.
	The garment should be dried flat.

1.11 PACKAGING COST

The cost of packaging plays an important role in determining the price of the product. The process of packaging is an essential part of the consumer goods industry. The production process is incomplete without packaging. The manufacturing industry uses various kinds of packaging material in order to pack their goods, some of these are glass, wrappers, wooden boxes, polythene, polystyrene, aluminium cans, paper bags, etc. Packaging is an essential fragment of the supply chain as it prevents mechanical loss, improves the shelf-life, aids in handling the goods in transportation and storage, and helps in providing information to the consumer.

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All products need packaging otherwise the produced goods will not reach the final consumer. The product cannot be stored or transported without adequate packaging. The cost of delivering goods will be very high as compared to the handling of packaged goods. Packaging enables the producers to distribute the goods into suitable components which help in delivering goods to the retailer and add to the appearance of the good. The task of the manufacturer today is to develop packaging which is cost effective as well as attractive. The extra stylish packaging will have a higher cost in comparison to basic packaging. The packaging will be dependent on the amount of time the product is in the marketing chain. For example vegetables have to be packed and repacked when in transit. Although packaging is the final process of all industrial movement, yet is considered crucial for distributing the goods. Product can reach the consumer in a usable and presentable state only if it has been packaged well. Still, the cost of packaging has to be controlled as it will have to be bared by the consumer.

The nature of packaging will vary as per the country the product is developed and market trends will impact the cost of packaging. The product is packaged in a stylish and trendy packaging only if it considerably lessens the damages. Products which are used immediately after production, which have perishable qualities, do not need costly packaging. Hence, the option of employing value-added packaging which is economical has to be deliberated well. Packaging cost has to be carefully worked out prior to estimating the entire marketing process cost. The percentage of packaging cost can have a direct impact on the selling cost of the product and can have variable which will be depend on the packaging cost.

Though this cost variables can start from 1.4 per cent and go up to 40 per cent, on an average nine per cent of the money spent on a product is the cost of its packaging. With fluctuations in the marketing atmosphere and enhanced methods of shipping and delivery, the character of packaging has significantly altered. The packaging costs are dependent on the functions that have to be performed by the package.

The modern benefits of packaging have enabled the supermarket owners to be able to administer stock and exhibit a wide variety of merchandises. In the absence of packaging the storage and shipping of products will become more expensive. The wastage levels will increase thus having a direct impact on the price of the goods. The cost of packaging constitutes a tiny part of the entire price of packed manufactured goods. Container cost is less than five percent of the overall cost which is paid by the consumer. In case of drugs, the packaging is less than 0.1 per cent of the production cost. The packaging cost includes the cost of primary, secondary and tertiary packaging all this includes the production, shipping and storage cost. All these various components will decide the complete cost of packaging.

Packaging consumer goods is considered to be an art while packaging industrial goods needs more technical knowledge hence it is considered be a science. There are many contradictory essentials to be considered while working out the cost of packaging. There are many aspects involved in the process. A packaging designer has to consider product safety, appearance and lucrativeness. The aspect of unpacking such as simplicity and care of unpacking by the consumer is another concern of the designers. The packing has to be strong so that it is not tampered while in transit. The transporter wants the packing to be such that it is easily loaded and unloaded. The packing should

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not be very heavy; moreover, one should not worry about damaging the product inside the packing. The transporter wants the packages to be of uniform size so that they can be stacked easily. The transporter wants the convenience of handling the parcels while they are in storage and warehouses. The packages should carry all the information so that they can be stored correctly. The packages should be as per international standards for export to other countries. The trader's requirements are focused on aesthetic aspects of the package as it has an impact on his sales. Product packaging for super markets should be attractive so that they attract the buyer without being prompted. Fulfilling the needs of all in the supply chain would involve increase in the cost of packaging. The basic packing might be able to protect the product from damage but it may not satisfy the transporter, the retailer and the consumer. Costing will be determined after considering which aspect is given more weightage, safety, looks or convenience. Usually, the share of logistic cost requirements in the packaging is twenty percent and the remaining percentage is meant for customer satisfaction and convenience.

The cost of packaging will depend on the legal regulations as well. Even though wooden boxes are a cheap option for packing but as per regulations it is not fit for all products. Packaging material should be environment friendly and should be reusable or recycled easily. Cost of packing depends on the material cost of primary packing. The design of the package will impact the packaging cost. The capital cost involved in undertaking the procedure as well as the cost of labour will impact cost of packing. Costing of the packaging has few indirect cost such as insurance or research and developmental cost. In order to reduce the cost incurred on packing all these cost will have to be reduced without affecting the calibre of these aspects.

The cost of packaging can be reduced by understanding the value of each aspect and then separating the essential cost from the not so essential cost. In this care has to be taken so that the efficiency is not affected. Standardizing cost is another important aspect. The size and dimension of packs which are used for two hundred grams pack of wafers is mostly made of the polythene. The material of the packaging has to be compatible with the contents of the pack. The packing should provide the shelf-life which has been mentioned on the package. In order to provide long shelf-life to the product the packaging cost will increase. The package should have mechanical durability. For instance, wafer packaging should be sealed well so that does not tear or puncture easily and lastly the package should be attractive. After analysing all these aspects of wafer packing the manufacture can decide which of them is most essential. Based on the priority the packaging material such as high thickness plastic or laminate aluminium or see-through plastic or even paper can be used. A costing table can be constructed and the features of each can be discussed by the package designers. Based on their selection the cost of the packaging can be determined.

Check Your Progress

16. What are the five care labelling systems which are commonly seen on labels?
17. List the GINETEX member countries.

1.12 SUMMARY

Some of the important concepts discussed in this unit are:

- The exercise of shielding, storing, enfolding or binding goods in bags, fabric, paper, containers, cans, bottles, etc., which is best suited for the product is termed as packing.

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- Packaging involves the procedure of developing, estimating and creating a package. It is a synchronized coordination of organizing merchandise for the purpose of transporting, storing and taking care of the logistics concerned with delivering the product to the consumer.
- In the year 1805 tinplate boxes were made and began to be used for packing. The need for sealed boxes for packing food was felt in order to store food for longer duration of time. This led to invention of canning food by Nicholas Appert in the 1810. This invention led to the setting up of the world's first canning factory in London in 1812.
- Enhanced quality tamper resistant packaging helps in identifying whether the package has been tampered with or not. This helps in preventing thefts and wastage as well.
- The design of the package becomes an integral part of the company's branding programme and facilitates the marketing process.
- Medicines and food products carry information about their expiration/best-before date; this is very helpful for the consumer at the time of purchase.
- Packing involves transporting and storing of the product whereas packaging has three functions which involve not only the storage and transportation but also the added function of preparing the product for trading in the retail as well as wholesale markets.
- Packing helps in providing safety against damages such as breakage, leakage, pilferage, etc. Packing is different from packaging yet it is considered as a fragment of packaging.
- Packaging is the procedure of encompassing or shielding merchandises for sale or transference.
- Storage can be described as that marketing task which is concerned with stocking of the merchandise post manufacturing and until the time of their disposal to various selling outlets.
- The storage of products should be such that the products nature and quality is maintained for final usage. Storage is needed to fulfil the gap which occurs between production of merchandise and their final consumption.
- Overseas packaging is required when the products have to be freighted by sea or air. The nature of packaging during overseas shipment is similar to that of transport packaging with minor changes.
- The packaging for overseas should be developed for easy handling so that throughout the transit the product is handled with care.
- Delivery by roadways for short distance is considered to be more economical and hassle free in comparison to rail and air transfers.
- Inland transport freight or charges include the cost of loading and unloading of the goods and the freight charges of the transport used for the purpose.
- Labels are helpful in identifying the products which provide similar usage. Food product labels mention the nutritive value of the content; they carry the list of ingredients which the product has, credentials, figures, cautioning, and directions for use, ecological advice or publicity.

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- Package testing includes the range of the features or attributes of the packaging. This takes into account the material of the packaging, packaging mechanisms, primary packages, freight containers, and the weight of the product in relation to the weight of the packaging.
- Testing processes the properties and interfaces of the standards of packaging, the package substances, physical endurance, and durability.
- Package testing can cover the entire shelf life of the product. Test of the recycling capability of the package is done as well and it assesses the ability of the packing to degrade as ground soil, in a closed ditch or under conducive composting atmosphere.
- Package testing of certain products as well as their packaging is compulsory by law. These include food products, medical supplies, medical apparatus, hazardous products, etc. The testing is mandatory on the design requirement, testing has to be redone annually or as per the regulations. The authenticity of the test has to be approved by the are control of the quality management systems such as HACCP, statistical process control, validation protocols, ISO 9000, etc.
- Providers of packaging like to deal with suppliers who have certified quality management systems such as ISO 9000 or permit clients to undertake mechanical and quality inspections.
- The engineers performing the test can take limited amount of liberty and use alternate method to perform their respective test and this can also lead to modification to the prevailing method.
- The testing is sometimes done by surveying the response of the people and taking their feedback. Organoleptic assessment is undertaken for certain food packaging by the producers. In this individual's decide by smelling or tasting the food whether the components of package have contaminated the food items.
- The testing of the packages need to be undertaken in chambers which are temperature controlled and free from humidity.
- Most products are tested in an atmosphere where temperature is 23 °C (73.4 °F) and relative humidity is maintained at 50 percent.
- Vacuum testing is done to check in case there is any leakage in the packaging of the product as this can reduce the shelf-life of the food. Vacuum compartments help in checking the durability of the package in low pressures.
- Some packaging materials are not heat resistant hence it becomes important to protect the goods in the package by providing insulated transporting containers so that they are not effected by variables in temperature.
- Laboratory testing helps in recognizing freight container designs which will work with the product in actual situations. Though laboratory testing are unable to completely judge the practical workability as these are based on trails based on average conditions.
- Caring for products while in usage is continued in the form of attaching care labelling codes to the product. These care labels are most common in consumer goods like garments and fabric. The codes are standard international symbols.

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- The manufactures are careful about the contents of the care labels on the garments as early damage to the apparel due to inappropriate laundering instructions can result in grievances and manufactures will have incur the cost of refunds and will lose a acquire bad publicity.
- The International Care Labelling System is governed by the International Association for Textile Care Labelling (GINETEX) since 1975.
- The cost of packaging plays an important role in determining the price of the product. The process of packaging is essential part of the consumer goods industry.
- The manufacturing industry uses various kinds of packaging material in order to pack their goods, some of these are glass, wrappers, wooden boxes, polythene, polystyrene, aluminium cans, paper bags, etc.
- The modern benefits of packaging have enabled the supermarket owners to be able to administer stock and exhibit a wide variety of merchandises. In the absence of packaging the storage and shipping of products will become more expensive.
- Packaging consumer goods is considered to be an art while packaging industrial goods needs more technical knowledge hence it is considered be a science.

1.13 ANSWERS TO 'CHECK YOUR PROGRESS'

1. In the year 1805 tinplate boxes were made and began to be used for packing. The need for sealed boxes for packing food was felt in order to store food for longer duration of time. This led to invention of canning food by Nicholas Appert in the 1810. This invention led to the setting up of the world's first canning factory in London in 1812.
2. In 1667, the method of tinning was introduced in England by engineers Andrew Yarranton and Ambrose Crowley.
3. Packaging is the procedure of encompassing or shielding merchandises for sale or transference. Packaging contains all the procedures of packing; however it has the added function of marketing and promoting the product. Packaging helps the product ready for sale. Packaging involves determining the safety of the product in its packing. Packaging is concerned about the physical appearance of the packed product. Packaging of the product should be such that it should attract the buyers.
4. Storage can be described as that marketing task which is concerned with stocking of the merchandise post manufacturing and until the time of their disposal to various selling outlets.
5. The five important things to be kept in mind while packaging for storage are :
   (a) Choosing the material for packaging
   (b) Labelling and marking the cartons in storage
   (c) The storage units should be well ventilated
   (d) The packaging should be able to keep the product free from dust while in storage

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(e) Packaging for storage has to protect the goods from damage due to humidity and dampness

6. Overseas packages should properly labelled and they should carry all the relevant information such as-
   (i) Transporter information
   (ii) Receiver's information
   (iii) Origin of the shipment
   (iv) Destination of the shipment
   (v) Proper labelling will prevent misplacement of packages
7. Palletizing prevents goods against loss and facilitates their movement. Pallets measurements differ, estimated size is: 42" x 48". Containers are usually arranged up till a height of 85 inches. Pallets are made of wood and are heat resistant. Sometimes plastic pallets are also used.
8. LCL stands for Less Than Container Loads and FCL stands for Full Container Loads.
9. Inland transportation can be defined as on land transit only which is within the boundaries of a country. Inland transportation may include transfers through inland water.
10. Packaging of valuable goods must carry the markings indicating 'Fragile', 'Handle with Care', 'This side up' or 'Arrow Up' for careful handling.
11. Package testing includes the range of the features or attributes of the packaging. This takes into account the material of the packaging, packaging mechanisms, primary packages, freight containers, and the weight of the product in relation to the weight of the packaging.
12. Some example of some of the standards organizations are:
   (a) International Organization for Standardization, ISO
   (b) ASTM International
   (c) European Committee for Standardization.
   (d) Technical Association of the Pulp and Paper Industry
   (e) Military Standards
   (f) International Safe Transit Association
13. Testing is sometimes undertaken by surveying the response of the people and taking their feedback. Organoleptic assessment is undertaken for certain food packaging by the producers. In this individual's decide by smelling or tasting the food whether the components of package have contaminated the food items.
14. ASTM D7298 is a testing technique to measure comparative legibility by using Polarizing Filter Instrumentation.
15. Most testing on products are done in an atmosphere where temperature is 23 °C (73.4 °F) and relative humidity is maintained at 50 per cent.
16. There are five care labelling systems which are commonly seen on labels. These systems are:
   - The International Care Labelling System
   - The Japanese Care Labelling System

- The Canadian Care Labelling System
- The European Care Labelling System
- The American Care Labelling System

17. GINETEX members are Belgium, France, Germany, England, Netherlands, Israel, Austria, Switzerland, and Spain.

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1.14 QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are the three major purposes of packaging?
2. What are the advantages and disadvantages of packaging?
3. Discuss the need for packaging in storage.
4. What methods are adopted by manufacturers to protect their packaging against counterfeiting?
5. In order to protect the content inside the package, what precautions have to be taken at the time of the packing?
6. What are the main considerations while packaging food products?
7. What are the main considerations while packaging pharmaceutical products?
8. Why is package testing done?
9. What are the goals of the International Association for Textile Care Labelling?

Long-Answer Questions

1. List and explain any ten functions of packaging.
2. What is the importance of storage? Discuss in detail.
3. Elaborate on the factors that must be kept in mind while packaging for storage.
4. What are the things to consider while packaging for overseas shipments?
5. What are the major packaging considerations for inland transfers?
6. What is the need for package testing?
7. What are the applicable standards for climatic testing?

UNIT 2 PACKAGING TYPES

NOTES

Structure

2.0 INTRODUCTION

As you learnt in the previous unit, packaging comprises of all the activities after the product has been produced. It is concerned with developing and creating a cover for the developed product. The product, in order to be placed in the market, requires a wrapper which should be fitting for it from various aspects. In fact, sometimes appropriate packaging is what helps in marketing the product. Packaging comprises resolutions regarding the markers, insets, directions needed for usage of the product, graphic design for striking presentation of the product, decisions regarding the size and style of the package of the solo product and its combined packing for transportation and storage. This unit will discuss the different types of packaging.

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2.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Discuss the different types of packaging
- Understand the requirements of consumer packaging
- Analyse identification codes
- Describe packaging labels
- Discuss product-packaging compatibility

2.2 TYPES OF PACKAGING

There are essentially three types of packaging. The first type is termed as primary packaging. It may also be described as sales packaging. It is the first layer of covering of a product that comes in contact with the product. The second type of packaging is called secondary packaging and this may be described as group packaging. The third type of packaging is called tertiary packaging. This is sometimes described as transport packaging. Tertiary packaging is necessary for producers as it helps in handling, storage and transportation of goods. These general classifications may be to some extent subjective. For instance, based on the usage, when a **shrink wrap** is used as a first wrapping on the product, it becomes the primary packaging. At times, when it is used to club small packages, it is used as a secondary packaging. It becomes tertiary packaging when it is used on packages in the process of distribution.

Shrink wrap: It is a thin, transparent plastic material that tightly covers the thing that it is wrapped.

2.2.1 Role of Primary Packaging

The primary packaging is the covering of the product that remains on the product till it reaches the consumer. Primary packing is removed from the product by the user at the time of its usage. For example, the wrapper of a candy or bottle which contains the soda is the primary packaging. Primary packaging needs to fulfil the basic function of packaging, and at the same time, has to be designed well so that it appears appealing. Usefulness is as essential as appearance so that the consumer can utilise the product without any problem. The packaging should be sturdy so that it can protect the product inside. Consumers will look for alternative products if they find the product in a defective state inside the packaging. This will have a direct impact on the business of the producers. Keeping this aspect in mind, it is very essential for the producers to employ good quality primary packaging so that the product safety is maintained and the consumer is encouraged to purchase the product. Sometimes the packaging product in a reusable container is an added attraction for the consumer. For instance packaging cookies in a plastic air-tight jar will not only retain the quality of the cookies but the jar can be utilized by the customer for storage. Apart from keeping the product safe, primary packaging acts as a significant location to project the symbol, catchphrases, and additional facts which make the product stand out in the crowd.

Primary packaging acts as an effective medium for publicizing the product. The primary packaging is an ideal place to display the brand name and will definitely attract the attention of the buyer. The packaging helps in presentation of the products information which is easily accessible to the user.

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2.2.2 Role of Secondary Packaging

The producers cannot transport individually packed products. After the product has been wrapped or packed in individual packing, it is combined so that the product can be placed into bigger containers. Individual units are held together with the help of secondary packaging. Its objective is to help distribute bulk numbers of the products from the manufacturing units to the retailers. Removing the secondary packaging from the product does not alter its quality or character. Secondary packaging can be the card board box which holds the cans of soda.

Secondary packaging helps in transportation of the goods. The packaging can be removed before the product reaches the final user. Secondary packaging may not be attractive as it is removed and the user is provided the product with the primary packaging. The packaging is not meant to aid the marketing process. Secondary packaging should be sufficiently strong so that it can safeguard the product. The packaging should help in easy handling of bulk quantities. It should be easily removed so that in the process of opening the product or its primary packaging is not harmed.

2.2.3 Role of Tertiary Packaging

The third type of packaging is meant for manufactured goods and is used to safeguard them. It is like the third layer of packaging of the product which is just for the handling of goods by the transporters and the retailers. The retailers discard the tertiary packing before they display the goods in the market for consumer purchase. This packaging is mostly used by manufacturers for goods which have to be exported. Some examples of tertiary packaging include merchandises placed large containers or boxes which are sealed and stacked for shipping. Wooden boxes can also be used for this purpose. The packaging is done for easy handling, storage and transportation of bulk quantities. The packaging is used for distribution of goods. The task of the packaging is to provide convenience of handling, hence the packaging has to be sturdy and evenly shaped so that it can be managed easily at the time of loading and unloading.

Choosing the Right Packaging

Selecting the precise solution for the packaging needs is very important for the manufacturers. Each type of packaging has a crucial role to play in the supply chain and various factors have to be determined while selecting the correct packaging for the product. At the time of selecting the primary packaging, the manufacturer has to deliberate on its appearance as the end user will be affected by the aesthetic aspect of the product. Primary packaging serves the purpose of marketing the good. All manufactures have to use this opportunity of marketing their product as it helps in increasing the returns. Primary packaging should be such that it impresses the buyer and notices the product easily. Besides being attractive the primary packaging needs to be sturdy so that it can keep the product safe. Customers should not be delivered a damaged good. The appearance of the packaging will not help if the consumer is unable to consume the contents of the package. Hence, utility as well as appearance has to be considered at the time of choosing the primary packaging.

Secondary packaging requires being durable in strength. The manufacturers have to choose a secondary packaging which helps to protect the product and its

primary packaging. It should not be very heavy in weight as well as on the manufacturer's pocket. The price of packaging will affect the cost of the product.

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2.3 REQUIREMENTS OF CONSUMER PACKAGING

Packaging intended for retail market is termed as consumer goods packaging. The continuously fluctuating needs of present customer cultures have made consumer goods packaging into a tremendously varied and inventive business.

Features of Consumer Packaging

The following are the features of consumer packaging:

- **Usefulness**: Current consumer goods packaging offers a multiplicity of options and caters to a variety of customer trepidations, the packaging is developed with material which has utility after consumption of the product and it is eco-friendly as well.
- **Product Value**: The chief purpose of consumer goods packaging is to enhance the merchandise's retail value. The packaging not only keeps the product safe but at the same time successfully market's the product to the customer and provides vital and handy data on the product packaging.
- **Shielding**: The chief purpose of the packaging is to protect the veracity of the product.
- **Attention-grabbing**: The consumer goods packaging is meant to excite the customer, hence it should be designed for the purpose of display at retail outlets.
- **Relevant Information**: The consumer goods packaging is considered a source of communicating useful information about the product.
- **Space economy:** Consumer goods packaging must be designed keeping in mind the objects shape and size. It should not require too much display area so that the retailers are able to showcase large quantities of the product.

2.3.1 Trends of Consumer Packaging

Some of the trends of consumer packaging are as follows:

- The consumer packaging must be sustainable as awareness about packaging material becoming a hazard to the environment is affecting the way people are buying products. The users want the packaging to carry assurance that the packaging is made of eco-friendly material. The products with sustainable packaging are attracting buyers. The packaging becomes an identity of a particular brand and brands with sustainable packaging are more preferred by the consumers. It has been realised that producers of packaging industry can no longer provide sustainable packaging as an extra feature as it needs to be the key highlight of the packaging. The modern buyer is not just content with product usability. They are keen to understand its origin, construction and extent of the recyclable material of its packaging.
- Healthy existence has been widely promoted by the wellness industry and the packaging industry is trying to adapt this aspect as its key motto. People have

Check Your Progress

1. What are the three types of packaging?
2. Which packaging type is also referred to as transport packaging?

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become aware of the fact that in order to stay healthy themselves they have to take care of the environmental health. Latest packaging trends of consumer products compel the manufacturer to present health benefits of the product to the customer so that they can make their choices. The packaging has to display the required information as per the prescribed regulations. The market has become congested with wellness products. The packaging of consumer products has to be able to reflect the exclusiveness which makes it stand apart from the others. The packaging should be able to highlight the organic quality of the raw material which has been used in the product. The packaging should be creative as well as be able to preserve the freshness of food. The consumer should be provided with one time serving snack packages so that the consumption and storage becomes simple and encourages the consumer to buy small-bites which will prevent over indulgence.

- The consumer packaging should have the feature of convenience in using, transporting, and disposing. The packaging should be easy to open; light weight and discarding the packaging after use should not be elaborate. The handiness of providing food packaging with zip-lock seal enables the consumer to store the leftover food easily. Many see through packaging are visible in supermarkets, this helps in attracting the buyers due to the visibility of the fresh food items.
- Customer trust once broken will not be retrieved. The producers are soon realising this fact and are constantly trying to provide genuine products. The consumer demands transparency from the manufacturer. The source of the raw-material used in the packaging should be visible this helps in building faith between the suppliers and the users.
- Cost of the product is the prime factor which influences the buyers; people are not willing to pay extra for the packaged product. The shoppers shop for products when they need a particular item rather than stocking it in anticipation. The shoppers are attracted towards packaging which is not big as it becomes difficult to carry and cost more than the smaller packs.

2.3.2 Particulars of Consumer Packaging

The products label's panel should be clearly visible for the customer. The label consists of three compulsory declarations that should be presented in the way that is prescribed by the regulating authority. These declarations are:

- Identity declaration of the product- the common name of the product
- Net quantity
- Name of the dealer and primary place of business

The Product Identity Declaration is not required when the products are sold by count and the packing is clearly seen and can be distinguished easily. The label has to clearly ascertain the common name of the product with respect to its standard name or utility. This may not be applicable to products which are on a test run in the market or in case it is a speciality product. This may not apply to products which require understanding of a particular language. Otherwise most product identity must be presented in English or French. The product identity declaration should be displayed on the primary display panel. The product identity declaration has to be depicted in a clear readable manner and the font has to be as per the prescribed height and style.

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The second important declaration on the label is its net quantity. The net quantity declaration may not be needed in case the measure is given as per the count. The product is commonly retailed by count and packaging is such that the substances are seen and can be recognised and the pack has less than seven or thirteen items as this can be easily tallied. The net quantity declaration should be displayed on the primary display panel. It should be legible and conspicuously mentioned so that it stands out among the rest of the information on the label. The arithmetical section which mentions the net quantity needs to be boldly inscribed and minimum height should be followed in the font of the information. The measurement unit used should match the product requirements and display the accurate quantity. The net quantity has to be acknowledged in English and French with proper metric language and correct usage of symbol displayed for the unit of measurement mentioned in the quantity. All legal metric symbols are supposed to be bilingual. The net quantity should be adequate and precise in case they are rounded off.

The third important declaration on the package is name of the dealer and dealer's identification. In this case the dealer may be the vender, producer, processor, or manufacturer of a product, or just an individual who is responsible for the import, storing, or marketing of any product. The label design has to be such that the dealer is easily identifiable. The label must display the name and location of business of the manufacturer or information about the person or company who is responsible if the product has been manufactured for resale. The address of the dealer has to be appropriate to warrant delivery through post. In instances where decorative containers are used, the trader credentials can be positioned somewhere on the exterior of the container, but not at the foot of the container. The dealer identification has to be listed in English or French. The information about the dealer has to be presented clearly and exhibited in font height of 1.6mm if not more. In case the product has been completely imported then the dealer's information has to be as per the import regulations.

2.3.3 Misleading the Consumer

The packaging of the product should not mislead the customer. The package should not be constructed in such a way that it projects a wrong image about the quantity and the quality of the product. The dealers cannot place any information on the package which misleads the buyers. The product has to fulfil all the claims which are printed on the package and provide the same in the contents of the package. The contents must fulfil the expectations of the buyers which are mentioned on the package in terms of quality, quantity, utility, etc. The claims made about the origin of the product should also be accurate. For example, the 'Made in India' asserted on the package should be true claim by the producers.

2.3.4 General Requirements for the Containers

The safety of the food packages is essential and a container will be not be acceptable for packaging of food items if it does not pass the test of safety.

The following are some of the general requirements:

- The container should not be rusted.
- All vessels have to be packed in a secure manner and sealing has to be strong.

- The outside of the cans cannot have defects like dents, corrosion, punctures and joint bends. Packages cannot be transferred in leaking cans.
- Containers which are made of copper or brass have to be appropriately tinned before food items are packed in them.
- Aluminium containers have to confirm to the chemical composition of IS: 20 requirements for Cast Aluminium & Aluminium Alloy for utensils or IS: 21 requirements for Wrought Aluminium and Aluminium Alloy for vessels.

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2.4 CHANNEL MEMBER PACKAGING AND TRANSPORT PACKAGING

The distribution of the product is the key activity of a marketer. In the absence of an organised system even an effective product will fail. The seller of a product has the function of organising the activities concerning the exchange of the product to various channel members so that the product reaches the final user. The seller has to make sure that all these channel members have strong communication. All marketing activities have to be well coordinated for physical circulation of the product. For instance, the product packaging should be designed in such a way that transit is easy. The size of the packages has to be according to the pallet, maximum packages can be loaded in a truck and shelves of the supermarkets. The price of the product is worked out according to the channel of circulation which is selected by the supplier. Good distribution channel is the key element for the success of a product. The channels of distribution affects the sales as supply of a product will give the customers the opportunity to buy. Moreover distribution has a direct impact on the producer's returns and affordability. As the distribution channels can determine fifty percent of the final selling price of few products. This has impact on cost affordability and even the profit margins as the cost involved in distribution will be considered. Effective distribution will enable prompt delivery and this will lead to increased consumer contentment. Distribution in marketing is an important activity hence the planning as to be done in a very strategic manner. The planning is a long term activity as it intends to create deliberate associations and companies that stand on faith and shared profits.

The life cycle of a product passes through many channels and these channels continue to alter themselves as per the expectations and competition of the market. Guiding the course of goods and facilities from manufacturer to consumer needs cautious deliberation. It can lead to attainment or let-downs in the retail market. The channel has to be selected which comprises of suppliers, representatives, dealers, franchisees, direct marketing and other sales personal. Robust planning is required in order to decide the nature of distribution system which has to be used for a product. Various aspects such as intensities of stock, least order numbers, ways of distribution, and regularity of delivery and whereabouts of warehouses require commitment of funds and consideration has to be given to consumer contentment.

Check Your Progress

3. Mention any five features of consumer packaging.
4. What are the three compulsory declarations that have to be mentioned on product labels?

Distribution Approach

The approach required for distribution is based on the structure of the market, goals of the company, the capital capacity and market planning. The channel of distribution will

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depend on the strength of the target audience. The producers can choose from the different options such as those discussed subsequently.

Concentrated distribution will involve large scale distribution to numerous outlets. This type of distribution is done for confectionary items. Discriminating distribution will involve few selected distributors for the marketing of product. Elite distribution is limited to high-class market outlets which sell expensive brands for example Armani jeans will not be sold at all garment showrooms.

The succeeding decision has to be taken to clarify as to how many members are going to be involved in the distribution process. The number depends on the market structure of the country. For instance, the Japanese market involves several mediators.

The manufacturers have to decide whether they want to adapt to a single channel or multi-channel for their sales. There are many manufacturers that use multi-channels for their sales. A multi-channel system will involve sales through direct members as well as indirect members. Multiple avenues of delivering the product to the buyer are used in a multi-channel system. The concentrated approach of distribution often employs the multi-channel systems. Both direct and indirect marketing takes place in this system.

Distribution involves creating important associations and partnerships. There are two types of marketing systems which can be formed for the process of distribution.

- **Direct Marketing System**: The first system encompasses that the dealers and intercessors work with each other as a team. This system is sometimes referred to as a vertical system because of the closeness maintained between the suppliers and the intermediaries. The manufacturing planning, timetable of delivery, level of quality, advertisings and deciding the prices are done together. The system involves sharing the resources, technical knowhow and equipment. The system involves selecting a channel leader for smooth functioning.
- **Parallel Marketing Systems:** This system comes about wherever businesses are functioning at the similar channel level coordinate with each other. For instance, dealers or two traders share their circulation know-how and delivery channels. This leads faster entry into the market. There is scoop that innovative deals may take place.

Selecting Channel Members

Distribution takes place easily when more resources are available. The dealers and producers can share the logistical load so that customer can be served faster. The number of intermediaries to be used in the distribution of goods is an important decision for the producers to make.

Criteria for Selecting the Members

- **Extent of the Market:** There are many aspects which need to be cleared before selecting the members. The needs of the customer should match the profile of the product. The number of customers has to be realised before distributing the product in the market. There should be enough people to manage the demand of the market. The dealers should have adequate space to store and deliver the goods.

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- **Estimated Sales:** The number of channel members will be based on the expected number of sales. Manufacturers study the advertising strategy which will be adopted by the retailers to promote the product. It is essential for the producer to realise extent of commitment in terms of resources before selecting members in the distribution channel.
- **Budget:** The members have to specify the amount of funds they have allotted to discounts, purchase orders, stock share and marketing maintenance.
- **Additional Assets:** The selection will be based on the capability of the member to be able to provide expert advice, quick services and prompt availability of the product. The distributors should be able to enhance the supplier's resources.
- **Increased Profits:** The supplier will like to choose a distributor who is able to multiply the profits of the supplier and increase his productivity.
- **Commanding Qualities:** The supplier will like his distributors to be completely aware of the market and have a strong reporting system to monitor the fluctuations of the market. The distributor must have a strong repair system so that instant problems can be efficiently dealt with. The market reviews should be frequently conducted. The distributor should be able to present the product in the market.
- **Enthusiasm:** The distributor has to be excited and enthusiastic about the product himself only then will he be able to distribute it to others.
- **Character of the Distributor:** The suppliers before selecting the members are very keen to check the reputation of the dealer. The experience and the conduct are important aspects which assert the distributors dependability and trustworthiness.
- **Display of Rival Products:** The distributor of a particular product cannot display or market the products of rival brand.

2.4.1 Transport Packaging

Transport packaging is intended to guard goods which have to be shipped from one place to another, mainly merchandises that are transported via truck or train. Nonetheless, the supply chain frequently contains other means of transference. Thus, transport packaging has to be developed for local as well as export shipping. Transport packaging is actually a local thing and for that reasons the local situations and potentials have to be paid attention at the time of designing the packaging.

Transport packaging: The packaging that is intended to guard goods that have to be shipped from one place to another.

Factors to be considered for Transport Packaging

The factors that have to be considered for transport packaging are as follows:

- **Safety:** The key element which the packaging must provide is protection of the goods during transportation. Taking into account the condition of the roads and rail system, the packaging must be developed so that it can sustain the sudden shocks and influences. The goods can face unexpected calamities of various kinds. The goods have to be protected from factors like heat, humid weather, rainfall, etc.
- **Accommodative:** Transport packaging has to consider the probability of numerous phases while in passage. Prior to final stoppage, the truck load may

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be loaded as well as unloaded numerous times. The load may have to sit in storage in between the transit, hence the packaging should not only be durable, but also be compact so that it can be easily lifted and placed.

- **Custom-made:** Packaging of all products cannot be the same; it has to be designed as per the shape and size of the product. The transport packaging should be well insulated so that it can bare bumps in the transfers. Transport packaging should be able to match the nature of the product. The emphasis should always be on creating packaging which is light in bulk, tough, handled easily and concise.

2.5 SHRINK PACKAGING

The process of packaging products with layers of see-through plastic film is referred to as shrink packaging. In this process the plastic sheet is draped all over the product to create a firm layer which helps to keep it safe in wet and humid weather. Shrink packaging is made up of pre-heated and cooled stretchable plastic films. Heating the plastic sheet helps the original haphazard distribution of molecules to arrange themselves in firm structures, generating level panes of plastic film.

Shrink-wrap are those wrapping films that are draped around a packaged product and heated again for the molecules to come back to the haphazard uneven state so that the plastic sheet takes the shape of the product around which it is being wrapped. Stretch-wrap is shrink packaging which is not heated after wrapping. It is just overextended and draped all around the product tightly.

Advantages of shrink-packaging

The advantages of shrink packaging are as follows:

- Shrink packaging can be used on a variety of products and proves to be a useful economical layer of protection on the packaged products.
- The plastic by-products used in order to make shrink wrap is elastic and sturdy. It helps in providing effective protection which is tamper-proof for the product.
- Shrink packaging is made of see-through material; the packaged product can be easily identified. The transparent cover makes it appropriate for display in retail stores and smooth surface of the packaging provides an appealing feature to the product.
- Shrink packaging is comparatively cheaper than most packaging materials. It helps in keeping the product cost low.

Type of Plastics used for making Shrink/Stretch Wrapping

The structural composition of shrink wrap is relatively intricate. Polyolefin variety of plastic material is used for shrink wraps. This is formed from oil based chemicals during the process of polymerization; this process involves attaining the right molecules and atoms to combine so that the desired material can be obtained. The plastic materials are polyethylene, polypropylene and poly vinyl chloride.

Check Your Progress

5. What are the factors that determine the distribution approach for a company?
6. What are the two marketing systems which can be formed for the process of distribution?

2.6 IDENTIFICATION CODES

NOTES

The purpose of the identification code is to present reliable shortenings and codes for common understanding. These numeric codes are different for all composite material groups, plastic, paper and cardboard, metals, wood, textile and glass. The most recognized and extensively implemented are the numeric codes found on plastic products. The codes are meant to help in establishing the identity of material and its quality. Most plastic containers carry numbers with arrows around them; these numbers are meant as identification codes of the product. Plastic containers carry resin identification codes, which specify the category of plastic used in the item. These figures help customers distinguish one type of plastic from another and help in recycling different plastic packages and goods. The code system of plastic was established to fulfil recycling requirements of users. It provided a reliable and even system for the producers. It was helpful for civic bodies as they could easily recycle bottles and containers which were gathered from residential areas.

All food product labels carry a consignment number or digital code. These numbers are meant to act as a figure of documentation by means of which the food manufacturer can be traced; it can be identified in the chain of distribution. All packaged food products carrying a common batch number or code will have common qualities and quantities in every aspect. If a customer has a complaint about a particular food product then the first action for investigating the entire batch carrying the identification code will be inspected. In case the food product is found unfit for circulation then all the products carrying the code will be withdrawn from the market. With the help of the identification code food item can be easily sent for examination. Recalling food items which are not fit for consumption becomes very easy due to the identification codes and batch numbers. Existence of these codes help in preventing food adulterations and malpractices as the offenders can be found easily. Food industry manufacturers believe in producing small batches of the product. Food products like milk and bread do not need to indicate the batch or code number or the lot number. All this information has to be given when food is used in its raw form like when it has been at the farm level and sellable final product is ready. Data such as date of harvest, plantation credentials and handling of the yield starting from cultivator to receiver, looking over a product at the time of harvesting or packing, the identification codes are essential for tracing the offender if grievances occur. Each food trader has to describe & give reference of the batch, lot, code number on all the containers of the goods.

2.6.1 Barcodes

The representation of optical information on products which is readable by machines is referred to as the **barcode**. The data generally pronounces information relevant to the product; it can be information about its date of manufacturing or purchase. Initially, barcodes scientifically denoted information with the help of erratic widths and positioning of parallel lines, and were described as linear or one-dimensional. Subsequently, two-dimensional codes were established, with the help of geometrical patterns which mostly consisted of rectangles, dots and hexagons. Even though the bars were no longer used to depict these geometrical images yet they were called barcodes. Earlier specific

Barcode: The representation of optical information on products which is readable by machines.

Check Your Progress

7. Define shrink packaging?
8. What are the materials used for shrink packaging?

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photosensitive scanners were used to read the barcodes. In recent times devices with application software are used to scan these images.

Barcodes have been in use since the later part of the 1960s. They were technologically advanced by General Telephone and Electronics and called KarTrak ACI (Automatic Car Identification). This arrangement consisted of enlisting coloured bands in several arrangements on steel plates that stuck to edges of railroad rolling stock. The coloured bands determined data about the proprietorship, category of apparatus, and numbers of identification. The plates could be read with the help of a trackside scanner which was positioned at the entry to a classification yard. The system had faults hence had to be discontinued after a period of ten years. Commercial success of barcodes came when they began to be established at supermarkets during the checkout. Now they are used for the purpose of automatic identification and data capture (AIDC) in many areas. The earliest scanning of the Universal Product codes (UPC) barcode was done in June 1974, on a packet of Wrigley Company chewing gum. Many similar systems developed in the field of AIDC, nonetheless the uncomplicatedness and economical usage of barcodes has maintained its preference over any other systems. Technologies such as radio frequency identification (RFID) came into usage 2000.

Uses of Barcodes

- Universal Product Code (UPC) barcodes have come to be an omnipresent component of recent societies. It has been generously adopted by stores all over the world. All products comprise of a barcode excluding fresh products.
- This aids in the tracking of objects, and at the same time, curbs the occurrence of theft concerning price tag exchanging.
- The departmental store membership cards carry barcodes which help in recognising the customers instantly and provide customised shopping experience. The cards with barcodes can be used to avail discounts or redemption of points accumulated in the card.
- They are extensively handy in hospitals as they can help in instant recognition of the patient and provide all the required information.
- Barcodes are useful in keeping track of people as well as their belongings. The system is used by car rental companies, airlines, postage system, etc. Tickets which carry barcodes can allow individuals entry to movie halls, stadiums without any hassle. The barcode prevent fraud from occurring at commercial places

Advantages of Barcodes

The advantages of barcodes are as follows:

- In retail transaction barcode structures help in providing the latest data on the business. They help in fast-tracking decisions as instant information about fast moving items can be recorded along with not so fast moving items. This helps the retailers to stock the profitable products more than the other.
- Backdated data can help in predicting seasonal rise and fall very precisely.
- This tool assists the summarizing of individual customers, usually with the help of a volunteer registering of concession cards.

- Barcodes are extremely handy in logistics and supply chain administration.
- Each box which is packaged is assigned a Unique Identifying Number (UID) at the time of shipment, this helps in identification and tracking of the products. A databank can connect the UID to applicable data about the box; it can instantly relay information like order number, items packed, quantity packed, starting point, final destination, etc. These figures can be conveyed with the help of a reporting system such as Electronic Data Interchange (EDI). This will help the vendor to have information concerning the consignment beforehand.
- Barcode scanning machines are fairly economical and enormously precise in comparison to key-entry. The scope of error is very limited in barcodes yet some barcodes can be faulty due to its construction.

Types of Barcodes

- The first barcodes which were introduced were linear barcodes or one dimensional, these were created using parallel lines and spaced at several width. These lines created a particular configuration.
- Latter two- dimensional barcodes were developed these were referred as matrix code. Information was presented in two dimensional style hence these were able to carry more data in their allotted space.

2.6.2 Electronic Data Interchange (EDI)

The computer-to-computer give-and-take of documents pertaining to business can be termed as electronic data interchange. The official documents are exchanged between associates with the help of computers in a standard format. The exchanged documents are no longer paper files. This interaction helps in reducing the cost, faster exchange of information and facts. Moreover, the system has led to improving relations among the business associates as fast and error free data can be exchanged.

Significance of EDI

The significance of EDI are as follows:

- **Computer-to-computer:** EDI substitutes postal correspondence, fax and email. Even though an email is a computer operated task, but it requires manual handling. The involvement of people increases the chances of mistakes and reduces the speed of the exchange. Whereas EDI documents reaches directly from one computer to another, this helps in immediate action. There is bound to be delay and scoop for error where information is on paper and humans are involved.
- **Business documents:** The system of EDI is mostly used to exchange documents such as purchase orders, invoices and advance ship notices. Other legal documents which are exchanged are bills of lading, documents concerning customs clearance of the shipment, inventory of items, export goods declaration and documents for payment.
- **Standard format:** The computer to computer exchange of documents makes EDI have a standard format so that the computer is able to interpret the information correctly. The data and figures have to be documented in a fixed universal pattern and font. The standard format helps the EDI to be free from language

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concerns. The companies cannot develop their individual EDI documents as it is based on a standard presentation. There are numerous EDI standards such as ANSI, EDIFACT, TRADACOMS and ebXML. All these standards various versions are available, for instance ANSI 5010 or EDIFACT version D12, Release A. At the time of the exchange the standard and its version are decided by the companies which will be used for their EDI exchanges. Companies normally employ an EDI decoder with the help of developed in-house software or through an EDI facility supplier. This is done so that the EDI format can be translated and applied internally for dispensation of documents.

- **Business partners:** The give-and-take of EDI documents usually takes place among business associates or trading partners.

Benefits of EDI

The companies are able to save a lot of resources by using EDI and parallel technologies. This exchange provides a convenient substitute for effectively and faster flow of information. Flow of information becomes slow due to human involvement and paper documentation. Though paper records are still maintained in the companies, but the EDI exchange helps in reducing the handling time and cost of cataloguing the documents. EDI helps in faster issuing, consolidating, and examining paper documents. EDI and parallel tools help in saving the effort of making manual entries of all business related transactions as it can store and preserve records in the computer. EDI provides the benefit of reducing and eliminating mistakes which can occur due to physical entry of data. The entry needs to be done from the sender's end and it will automatically reach the receiving party. Another very useful aspect of EDI is the rapidity in which the business partner obtains and integrates the data. The quickness of the exchange of information is a blessing for the latest trend of just-in-time production schemes.

Hurdles in Application of EDI

The adoption of EDI has been observed to face certain barriers. Most companies which are tuned to paper documentation are unable to adapt the changes in the system required for the implementation of EDI. The companies have to make alterations in their system for allowing the electronic system. Businesses have to realise the speed of EDI when compared to paper documentation. There is a need to react and respond quickly. For instance, a company might get the chunk of their shipped materials within a day or two and the invoices of the material by post. This will mean that invoices will reach much later than the material. In case of EDI, the invoice will normally be sent when the goods are dispatched and would need a system which can deal with many invoices for which the goods have not been delivered.

The installation of EDI requires time and funds from the business. The first setting up of system is costly as the company has to make alterations, train their staff for adopting the technology. It is essential to choose the precise combination which suits a particular business.

The fundamental limitation to positive application of EDI is the lack of awareness many businesses have about the features of EDI. Several business owners feel that EDI has technical feature of formatting data. It is a system for transaction of business documents with external entities, and assimilating the information into the internal working

of the company. The exchange of date between two different companies can put a company at risk in the market. It is very important for businesses to fully understand the system prior to implementation.

2.6.3 Universal Product Code

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The group of barcodes found on the product which help in tracking products in stores is termed as the Universal Product Code or UPC. This symbology of barcodes is extensively in practice in many countries such as the United States, Canada, United Kingdom, Australia, New Zealand, and Europe. This helps in locating the product in the stores. UPC is officially also referred as UPC-A, it contains twelve numeric digits, which are exclusively allotted to respective trade item. The UPC is useful for scan at that time the item is being sold in stores as per the conditions of GS1. It is scanned with the EAN barcode. UPC data arrangements are a part of GTINs and are based on the universal conditions of GS1. The specifications of GSI are decided as per the standards followed internationally. However, retailers dealing with products like clothes and furniture use other symbologies of barcodes and do not follow the GS1 system. Same way few do not use the GTIN, they use the EAN/UPC barcode symbology.

Features of UPC

- Manufactures of products can use the UPC for their products only after they apply for the code. After their application is accepted, GSI allocates an exclusive six-figure code which functions as identification code for the manufacturer. The manufacturers have to pay yearly subscription.
- The barcode of UPC contains bands of black parallel bars and white spaces, on top of the code twelve numbers are listed. The code can be scanned and information about manufacturer can be attained
- The standard barcode of UPC will not contain alphabets, characters, or additional information.
- The twelve digit numbers are presented visually in one particular manner and same is the case with the way the bars are represented.
- All symbols representing the UPC comprises of two parts. The numerical digital code can be read by people whereas the barcode needs to be scanned by scanning machine for interpretation. The producer's exclusive numeral is the initial six digits of the UPC number and the following five numbers recognize the particular article.
- The twelfth digit is termed as a check digit. This digit is for the scanning machine to check if the rest of the numerical details are correct.
- After the product is not in distribution the number is superannuated from further use and it cannot be allotted to another item.

Types of UPC barcodes

- UPC-A codes contains 12 digits with the last digit being the check digit. This is the most commonly used UPC code. The first number helps in identifying the product, the next five numbers are manufacturer identification code, numbers from sixth to eleventh are for identifying the particular product and the twelfth is check number for the scanning machine

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- UPC-E is a seven digit of the UPC symbology. Small-scale businesses apply for this code. The first six digits are specified and the seventh number is coded by the barcode machine.

Advantages of UPC

The advantages of UPC are as follows:

- **Uncomplicated Usage:** The UPC barcodes are simple to create and decipher. This makes them very convenient for business houses to adapt
- **Appropriate for all business:** Both small-scale and large-scale producers are able to apply for UPC for their products.
- **Cost effective:** The manufactures do not have to incur heavy expenses for using the UPC barcodes for their product.
- **Designing is not lengthy:** The barcodes can be created very fast and applied on the product.
- **Helps in Tracking:** Universal product codes are helpful in giving information about the product and manufacture by just scanning the code on the product.

2.6.4 GS1 Standards

GS1 Standards offer an exclusive proof of identity of articles and products which help in providing the connection between the item and the facts relating to it. GS1 Standards can be described as the DNA of an item or product throughout the supply chain. GS1 is a non-profitable organisation working towards improving and preserving international standards for business communication. Barcodes on the products are an example of maintaining standards of the product. GS1 has112 local member organisations and 1.5 million user companies are members. GS1 standards aim at improving the competence, security and discernibility of production process in all sectors. These standards create a trade language that helps in sharing crucial facts about the product which concern its origin, distribution, etc. The GS1 standards barcode is the most eminent. It is an exclusive representation that translates a product credentials using an electronic scanner. It assists in tracking, processing and storage of products anywhere in the world. The GS1 barcodes provides the product's security, consistency, rapidity and productivity all through the supply chain. The barcodes are very beneficial for the retailers as it enables quicker and upgraded accounting. Helps in distribution and provides the prospect of online sales anywhere in the world. The adoption of barcodes in has helped the retail industry to expand all over the world. In United Kingdom after the barcodes have been implemented the retail business has been able to make a profit of 10.5 billion pounds approximately annually. EAN/UPC is a GSI standard barcode used for consumer goods, healthcare products GS1 Data Matrix is used. GS1-128, GS1 DataBar, and GS1 QR Code are few others used in tracking parts like date of purchase.

Standards of GS1

- GTIN is the main GS1 standard as it helps in the identification of the exclusive product anywhere in the world. GTIN system is the foundation on which GSI. Several GS1 standards are ISO standards as well. For instance, GTIN, GLN, SSCC.

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- GS1 functions as an administrative authority for the Automatic identification and data capture techniques technical committee establish by ISO. (ISO/IEC JTC 1/SC 31).
- GS1 standards are established and preserved with the help of the GS1 Global Standards Management Process (GSMP). This forum consists of people belonging to several industrial houses and companies. The representatives of the business world come together to establish standards for international trade practices and try to solve various problems which affect the activities of the supply chain.

Industrial Members

The retail industry was the first industry in which GS1 standards were introduced. The retail operations have been the epicentre of the working of the GS1. Currently, four retail sub units, clothes, fresh foods, grocery and general goods function at an international level under GS1. The GS1 focuses on sustaining good practices, improving the quality of data, compliance with legal regulations, tracking the product all through the process, connectivity between producers and the suppliers. With the availability of various shopping options for the buyers the GS1 aims at providing reliable shopping experience, competence, protection and swiftness. GS1 has established standards that exclusively identify merchandises for the advantage of customers by enabling correct and comprehensive digital details of the product. All e-commerce enterprises such like, eBay, Amazon and Google Shopping need firms to use a GS1 number to be able to carry on with any sale through their websites.

The healthcare industry has been another major concentration area of GS1 as the aim is to provide complete protection to the patients and increase the competence in the health sector. Practice of GS1 standards in healthcare helps in tracing products, avert medicine errors, allows recalling faulty supplies, and maintains medical procedures. Implementing GSI standards helps in improving the medical facilities and medical apparatus.

GS1 functions in Transport & Logistics, Foodservice, Technical Industries and Humanitarian Logistics. More than hundred countries are members of GS1 and the standards have been implemented in twenty five industrial sectors. GS1 has more than 1.5 million members internationally.

Authority and organization of GS1 has three levels. The first level comprises of the GS1 General Assembly these are representatives of all member organisations. The second level consists of the GS1 management board of the global companies which is in charge of giving direction to international companies. The third level has the GS1 global office and all the local member organisations of the GS1. All new standards are developed and preserved at this level. The local member organisations focus on providing local services and necessary standards for national companies. The third level consists of the GS1 Data Excellence Board and GS1 Innovation Board, this board is in authority for GS1 improvement and related R&D activities. GS1 Member Organisations everywhere are financed by local members as they have to pay a yearly subscription for using the GS1 services of sales.

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GS1's partners are:

- Consumer Goods Forum
- International Standards Organisation (ISO)
- NATO
- United Nations
- UN Refugee Agency (UNHCR)
- World Customs Organisation (WCO)
- International Society for Quality in Health Care (ISQua)
- Joint Initiative Council (JIC)

2.7 PACKAGE LABELS

Labels on the products present the information regarding the product. The label can be placed on the container, wrapping, or the directly on the product. For a number of consumer and industrial products, the nature and magnitude of data required to be given on the label is administered by the appropriate protection and distribution regulations. A label is a carter of info regarding the product. The label stuck on the product gives the relevant facts to the buyer which helps them to make their purchases in a wise manner. The label helps in providing a satisfying shopping experience to people. Labels may offer following information:

- Maintenance and usage of the product
- Guidelines or recipes for product
- Ingredients or dietary information
- Product assurances
- Name and address of the manufacturer
- Weight declarations
- Best before and manufacturing dates
- Advices and instructions
- Cautioning about certain ingredient

2.7.1 Symbols Used on Labels of Packages

Labels of packages carry several kinds of symbols. The symbols used on packages have to be as per the national and global standards. Symbols are essential in consumer packaging as they help in certifying the product, brand of the products. Symbols help in establishing better communication between the producer and user as these symbols answer many consumer queries. The symbols help in better usage and safety for the consumer. A product carrying a symbol of EU weights and measure assures the consumer about the precision of the quantity and quality. The symbols of recyclable packages help the consumer to dispose the packaging adequately, presence of 'green dot' on packages assures the consumer about the vegetarian contents of the product.

Labelling Laws

Most product labels, especial food and pharmaceuticals, have to carry compulsory information about the nature of the components and various ingredients, nutritional

Check Your Progress

9. What is the purpose of identification codes?
10. What does resin identification code denote on plastic containers?
11. What is a barcode?
12. What does EDI stand for?
13. What is Universal Product Code?

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facts, and cautioning about the ingredients. As per the label laws in the United States, the label on mattresses have to carry a tag which clearly mentions every detail of the material used on the mattress and the contents of the stuffing inside the mattress. The purpose of this law is to educate the user about the nature of the stuffing material so that they are aware if the mattress has been filled fresh or recycled stuffing. The label has to contain the tag of recycling process.

Practically all symbols on labels of packages are internationally consistent. This helps in endorsements, customer usage and security, compliance to laws and regulation. The labels help in enabling smooth shipping of products as they carry the symbols which help in identifying the products such as the barcodes. Companies like Walmart use radio frequency labels along with the standardized international labels, United parcel Service use a two dimensional symbol on the label which is termed as Maxicode.

The symbols on products which are hazardous and unsafe have to be clearly listed on their labels. These symbols have to be as per the requirements laid down by United Nations and other regulating authorities of the particular country.

Fig 2.1 *Symbols for Hazardous Materials*

The labels of packages which are packed for transportation carry the essential symbols on their label which enable proper handling at the time of loading, unloading, stacking and storage. The symbols on transport packages are pictorial which have been listed under ISO-780. The images can be understood by workers at the time of handling the packages.

Fig 2.2 *Goods Handling Symbols*

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The symbols on the label of the package have to suit the nature, size, weight and fragility of the product. Lifting packages with heavy weight products incorrectly can be harmful for the product as well as the individuals handling the product. Adequate symbols should be placed on the label which specifies the weight, contents and handling suggestions. It is not necessary that a heavy weight package will appear bulky and big. The symbol will enable the correct handling of the package irrespective of the appearance of the package. Similarly, labels on packages carrying breakable products should be clearly mention the symbol of fragile item and it should carry warring stating 'handle with care'. The label manual with handling symbols should be circulated among the packaging staff. These manuals are intended to encourage safe lifting, inform the manual workers, and reduce the probability of mishaps and injuries.

Heavy load labels should highlight following facts:

- Lay down safe lifting measures
- Mention the usage of lifting aids, for example image of lifting with forklifts can be added on the label
- Recognize the 'heavy side' of a cargo
- Clearly mention the weight of the product

The safety signs about lifting load on the packages have to comply with different national regulations and manuals. These elaborate on how to lift, lower, carry, push, pull, or support heavy loads. They endorse an approach which has three stages. The first stage mentions the option of using automating process in places where it can be used these include lifting the load with the help of cranes, conveyors, hoists, pallet trucks or forklifts; second phase is assessing the risk manually lifting the load as it is the only option; and the last stage is lifting of load with the help of wheeled trolleys so that physical labour can be reduced.

While lifting heavy load, it is very essential to assess the risks involved. The task should assess aspects like individual strength and capability to repeated bending. The kind of the load, such as bulky, temperature of the load, inconsistent, sharped edged. The surroundings of lifting load are very essential and need to be assessed properly, the surface can be uneven or slippery, and the venue may not be well ventilated and poorly lighted. The safety signs on the label must carter to these aspects of the load.

2.7.2 Active Packaging

The expression active packaging is sometimes interchanged with intelligent packaging or smart packaging. This can be used for packaging all types of products, although it is more visible in packaging structures of food and pharmaceutical products. An active packaging aids in extending the shelf life, retains freshness, presents adequate information about value, increases security, and provides convenience. Active packaging generally refers to packaging which provides more than storage and safety to the product. Intelligent and smart packaging would be such that they would be able to enhance the quality of the product and take into account the internal atmospheric changes which will take place while the product is in transit. These aspects can be enhance the functions of the active packaging and impress the consumers. The choice of material used in the packages is important aspect of active packaging. The application

of advanced technology in packaging has made traditional type of packaging smart and intelligent.

Need for Active Packaging

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Preferences of the modern buyers are undergoing a rapid change. In order to match up to their changing demands and requirements there is a need to create new packaging. The awareness about the environment has made the consumer conscious of their purchases and disposal of used packages. All these latest packaging systems are going to influence the packaging cost and indirectly the cost of the product. On the other hand, the increase in cost is compensated with the diminutions in depletion as the quality of the product is retained which results is better shelf- life of the items. It is essential for all companies to completely assess the particular benefits and repercussions of introducing active packaging for their products.

Active packaging in food products is needed so that the inner atmosphere of the food packaging can be altered in such a way that it can lead to enhanced shelf-life of the product. Active packaging can be described as a system which adjusts the atmosphere of food package internally; in doing so, it modifies the condition of the packaged food so that it improves and maintains its quality by adding to its shelf-life, improvement of sensual qualities, and provides microbial protection. The packaging prevents oxygen and carbon dioxide entry into the packaged product. Substances like ascorbic acid, photo-sensitive dyes, iron powder, are induced into the package in order to search for oxygen and thus preventing the progress of aerobic bacteria and funguses. The involvement and cooperation of various research organizations, manufacturing units and governmental supervisory organizations will be crucial for the active packaging to be adopted on a large-scale by producers.

Features of Active Packaging

The features of active packaging are as follows:

- Moisture control can be achieved with the help of desiccants in sealed packages. A desiccant pouch is kept in the package. It is a hygroscopic material which has the capability of increasing shelf-life by controlling moisture penetration in food as well as medicines.
- Corrosion can be prevented with the application of inhibitors to products which are prone to rusting. Volatile corrosion inhibitors (VCI) or vapour phase corrosion inhibitors pouches can be placed inside the container or may be integrated as a saturated overwrap of special paper. Most of them are organic salts that prevent the metal from corroding. The films have VCI emitting ability and have a copper ion in the polymer structure. This helps in neutralizing the acidic gas in a package and prevents oxidation. VCIs help in establishing internal surroundings which are neutral in nature. The various systems of VCIs are papers, plastics, HDPE papers, oils, foams, chips, aluminium blockade foils, bubble, and emitters all that can avert rusting at various points.
- Metal chelation is required as metal content in the body can do substantial harm to the body. Metals like iron can bring about oxidized dilapidation of a lot of food constituents, especially fats, and result in altering the quality of the product. Active packaging with metal chelation substances are developed by restraining

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compounds which react with the packaging material. The metal-chelating compounds which are not mobilized can forage the transition metals from the product and improve the strength of the product and prevent oxidization. The technology used in metal-chelating active packaging is similar to antioxidant active packaging. This helps in increasing the shelf-life of consumer products by regulating the oxidation. The metal-chelating active packaging technology helps in removing food preservatives from food and helps to keep them fresh and natural. The knowledge is ideal for meeting the latest demand of preservative free food products.

- Oxygen control is essential for maintaining the quality of food. The presence of oxygen absorbers assists in removing oxygen from a sealed package. These absorbers are small pouches which contain iron in powder form, when iron in the pouch corrodes it is able to absorb oxygen present in the package.
- Conducive atmosphere of the package is maintained with active packaging. Packages of products like cheese are flushed with nitrogen before sealing. The passive nitrogen is absorbed into the cheese, permitting a close-fitting shrink film package. The nitrogen eliminates oxygen and intermingles with the cheese to create a functional package. This introduction of the gas helps in increasing the shelf-life of cheese. The same gas is not used for all products as it depends on the nature of food and its rate of dilapidation. Some package components have been developed that incorporate active. The chemistry between the product and the gas helps in maintaining a conducive environment inside the package. Oxygen foragers, carbon dioxide producers, ethanol initiators, etc. are accessible and they support the internal atmosphere of the package.
- Temperature monitoring is possible in active packaging. Few heat metres give an optical indication when the required temperature is surpassed. The packaging with a mechanism which exhibits food depletion as per the temperature helps in providing the consumer a metre so that they can store food in the correct temperature. Digital temperature loggers records the temperatures faced during the freight. These records are helpful in forecasting product dilapidation and assist in determining the speed at which the product should be disbursed. The indicator can help in maintaining better temperature conditions for future shipments. In order to control package temperature insulated shipping containers can be used besides this gel packs are used to maintain the temperatures. Few latest packaging have the capability to keep product hot or cold, these packages consist of separated sections with exothermic or endothermic reactions.
- Active packaging provides security to the packages. Packaged labels consist of radio-frequency identification chips which help in following and finding packages and unit loads all through supply chain. Innovative improvements comprise maintaining the temperature account of consignments and perform several functions of intelligent packaging. RFID helps in establishing the genuineness of the product. Electronic article surveillance helps in preventing shoplifting.
- Packaging with microwavable material. Active packaging in some food products can be used in microwaves for heating purpose.

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- Shock and vibration proof packaging. Shock sensors are tagged to the package or to the product inside the package to decide if unwarranted jolts have been faced during shipment. In recent times many numerical shock and vibration data loggers can be used to monitor and record the shocks and vibrations during shipping. They help in giving details about the nature and the cause of the shock and vibrations during transportation. These recordings are handy for research work and future developments.

Other Advances in Active Packaging

- Few packaging films have been developed which contain enzymes, anti-bacterial agents, foragers, and additional active components which prevent food degeneration and improve and prolong usage life of food products.
- Palatable films for packaging permit the user to eat the covering of the product.
- Certain packaging has been invented in order to ship live organs. The purpose of this special packaging is to keep the organ alive and fit for transplantation.

Active packaging comes into direct and close contact with products. It is very important for designers of active packaging to choose material which is compatible with food items and medicines. Substances used for making the packaging smart have to be used judiciously.

2.7.3 Child Resistant Packaging

Child-resistant packaging or CR packaging is a distinct packaging created to decrease the possibility of children consuming hazardous substances. Special measures are used such as extra safety caps or double seal, etc., for medications, capsules, electronic cigarettes which contain nicotine, all types traditional cigarettes and cigars as they contain nicotine in varying quantities, pesticides, and domestic substances containing chemicals like toilet cleaners or detergents. In few countries packaging containing blister packing is restricted in order to maintain child safety.

In 1967, Dr. Henri Breault invented boxes that contained locking provision which was child-resistant. In 1970, a series of mishaps occurred in which in children swallowed inedible substances due to easily accessible packaging. This prompted the United States Congress to implement the Poison Prevention Packaging Act. The act was framed by U.S. Senator Frank E. Moss of Utah. With the implementation of the act, the U.S. Consumer Product Safety Commission attained power to control the packaging industry. In recent times, many more products which are harmful have been included in the list by the Environmental Protection Agency. Efforts are being made to improve standards of child resistant packaging at a global level.

It is essentially developed in order to prevent children from being able to open the packaging. However, because of this, it has been seen that on few occasions elderly and people with physical disability are unable to open the packaging. In order to control this difficulty, the packaging has to be sample tested where in both adults and children belonging to an age group are made to perform a test for at least fifteen minutes.

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Most packages which claim to be child-resistant are required to have a dissimilar dual motion opening. There are many designs which can be selected by the packaging companies. These have to be certified by the following standards.

- ISO 8317 and ISO 13127 Child-resistant packaging - Necessities and analysis measures for re-closable packages.
- ASTM D3475 Standard Classification for Child-Resistant Packages

2.7.4 Tamper-Evident Proof Packaging

All packages containing over-the-counter (OTC) drug products need to be tamper-proof. The Food and Drug Administration has clearly defined a temper-evident packaging, as 'one having one or more indicators or barriers to entry which, if breached or missing, can reasonably be expected to provide visible evidence to consumers that tampering has occurred.' Furthermore, the indicator or barrier must be 'unique by design,' as the design or the material used in this packaging commonly available to people. The unique designing prevents duplication of the product. The label on the package clearly mentions the added information about the temper-resistant quality. In case of blister packaging, every single pill or tablet is independently taped up; this helps in pointing if tempering has taken place. It is essential that the label contains declaration such as, 'Do not use if blister is open or damaged.'

Products packed in a bottle employ an induction seal, glue seal, or shrink band in order to provide the tamper-evident condition. If out of place, these options provide evidence to consumer that tempering has taken place. The label on the bottle will carry the declaration stating that, 'Do not use if neck wrap printed safety seal is damaged or misplaced.'

The FDA rule for tamper-resistant packaging (TRP) specify that over the counter drugs containing two-piece hard gelatine capsules must be packaged using at least two TRP features and the others need only one of the TRP feature. FDA has not specified any guidelines for Tamper-evident packaging (TEP) yet it is commonly used in packaging industry as it acts as an additional extent of tampering proofing the product.

Manufacturers and packagers are permitted to practise any packaging option. It is important that these options are as per the regulations prescribed by the FDA. The usage of temper-resistant system assures the consumer that the product has not been tempered. It acts like a proof for temper-evident packaging (TEP).

The usage of following packaging technologies properly makes the packaging temper-resistant:

- **Shrink Wrappers:** A see-through film is enveloped firmly around the complete container of the product.
- **Blister or Strip Packs:** These are used for individually packing medicines. The blister pack is made of plastic compartments which exactly the size of the medicine placed inside. The pack is sealed with foil or paper from behind.
- **Bubble Packs:** The product with its container is stuck on a card which acts as the label of the product as all the information is displayed on it.
- **Heat Shrink Bands:** The top part of the container is secured with a shrink band tightly.

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- **Foil, Paper or plastic Pouches:** The product is sealed inside a single pouch which has to be cut open for usage.
- **Mouth Inner seal for the Container:** The mouth of the bottle before placing the cap is sealed with paper, thermal plastic, plastic film or foil. The seal has to be removed for usage.
- **Breakable Caps:** The bottle is taped up by a plastic or metal lid that needs to be detached prior to use.
- **Sealed Metal or Plastic Heat Tubes:** The end of the tube is sealed and the opening has to be pierced to get the product.
- **Aerosol Containers:** Spray cans are mostly resistant to any kind of tempering because of their construction. The container's surface carries the label of the product.
- **Sealed Metal or Composite Cans:** The cans act as an effective temper resistant packaging. The label is directly printed on the can.
- **Capsule Sealing Procedures:** The capsules inside the container have to be sealed properly so that they are not tempered prior to usage. The sonic welding, banding, and sealing systems using solvents and low temperature heating are some of the procedures through which capsules are sealed. The sealed capsules have to be placed inside containers which qualify as TRPs by the FDA.

Tape seals, sealed paperboard, pressure sensitive liners are some temper-evident packaging approved by the FDA. Both TRP and TEP needs are similar to present good manufacturing practice (GMP) guidelines. Action is taken against defaulters if these are not followed. In the long run following TRP and TEP exhibit the caring attitude of the producers towards the consumer.

2.8 PRODUCT- PACKAGING COMPATIBILITY

Packaging of supplies is an essential measure of all industries. Packaging has a direct impact on the value of the product, the dependability and credentials of the product. Packaging arranges for a sufficient amount of security, curtails damages of ingredients and prevents the products from interacting with substances which can harm the consumer.

Qualities of Good Packages

Good packages have the following qualities:

- The package must be capable of holding the contents properly. There should be no damage due to leaking, degeneration or infiltration.
- The product should be protected from atmospheric damages such as moisture, humidity or light. The protection has to be all through transit and storage.
- There should be no penetrability of gases.
- The packages should be durable so that they are shock absorbent.
- The design of the package should be simple and easy to use.
- The contents of the packaging material should not react with the product.

Check Your Progress

14. Why has FPLA been implemented?
15. What are the alternate names for active packaging?
16. Name the person who framed the Poison Prevention Packaging Act?
17. What does the FDA rule for tamper-resistant packaging (TRP) specify?

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- The packaging of the product should not very heavy or bulky.
- The packaging should be cost effective.
- The packaging should be able to maintain the identity of the product and its brand.
- The package should carry the required information about the product and its usage.
- The package should be designed for easy usage and storage of the product.

The packaging which has the above qualities can be called as compatible packaging of the product. All products have different packaging needs. The compatibility of the packaging with the product is very important for the shelf-life and quality of the product.

2.8.1 Pharmaceutical Packaging

Packaging in pharma or pharmaceuticals refers to providing safety, performance, credentials, facts and expediency to reassure end-users throughout the movement of the goods. Packaging components consists of containers, sachets, bottles, tubes, lids or box. The containers are made using glass, plastic, metal or paper. The closing or sealing lids are made of wood, glass, plastic, metal or rubber. The packaging material has to be thoroughly tested before it can be used for packaging drugs and medical aids. There are several tests which determine the quality, reliability and degree of compliance of the material used in pharma packaging. The test are prescribed as per the regulations and guideline laid down by organisations like WHO, GMP, USFDA and The International Council for Harmonisation of Technical Requirements for Pharmaceuticals for Human Use (ICH). Packaging for pharmaceutical products requires considering aspects like transportation, storage, presentation and usage.

Package Testing Process

The testing for pharmaceuticals is done in two parts, in the first, only the material is tested. In the second part, the product is tested placed inside the package.

Testing material

Chemical compatibility- In paper the pH value of materials is tested with substances such as chloride and sulphate; in case of glass, the alkaline properties are tested. Standard mechanical testing is done to check the impact of scrunching, folding, crumpling, etc. Atmospheric testing is done on materials to check the impact of weather changes, moisture absorption, absorption of smells, and impact of light.

Testing Packages

Mechanical testing is done to check the strength of external packaging during transit. During this test the durability and extent of various material is checked so that most durable material can be shortlisted.

Environmental testing is done on packaging by exposing them to various atmospheric conditions. Assessments are made based on their condition.

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Exposures to Packages

The packaged product is exposed to dangers like shock, compression, perforation, pulsation, etc. Climatic dangers like heat, gravity, humidity, fumes, light, pollution etc.

Techniques for Packaging Controls

- Spectrophotometry
- Chromatographic Methods
- Thermal analysis techniques
- Gas transmission analysis
- Leak detection
- Physical test methods
- X-ray Fluorescence Analysis

Quality Control of Packaging Containers

- A container used in pharma packaging is meant to carry a medicinal substance or medicine itself. The substance of the container will be directly in contact with the drug. The container and its lid for closure have to be selected carefully.
- The nature of the container has to be compatible with the substance inside the container. The tolerance should be maintained all through transportation, storage and final consumption.
- The container's design should be such that the product can be accessible all through usage, it should be able to keep the contents of the container safe and effective while it I being consumed.
- Hermetically sealed containers are essential so that it is not affected by dust, air or moisture at the time of handling, storing and transporting. Frequent openings for usage should not affect the nature of the contents.
- The containers should protect the contents from light. The material of the package should be selected keeping this aspect in mind.

Types of Containers

- A multi-dose container is required if the prescription is for long duration. The container size should match the prescription.
- Sealed containers are made with material which fuses naturally thus keeping the contents air-tight.
- Single-dose containers are preferred if one time consumption of the drug is required. Tamper-evident containers help in identifying instances of tampering immediately.
- Tightly-capped containers are must to protect and preserve the drugs from contamination.

2.8.2 Food Packaging Compatibility

A food package offers safety, prevents pilferage, enhances the appearance and helps in storage. The label of the package needs to hold the nutritional facts and additional

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facts about food in the package. Like all packaging, food packaging is also meant to provide safety and storage for the product. The compatibility of primary packaging with the food item is very essential as it is directly in contact with the food. With the help of secondary packaging all the items packed are combined together for easy handling. The packing is further supported with tertiary packaging. It is very essential to choose the correct packaging options and this decision needs to be taken by considering a number of aspects such as practicality, safety and needs of the workers, sustainability, service, dependability, capability to fit in into all the other packaging, cost effectiveness, space requirement, litheness, usage of resources, and the most important aspect is compatibility with the food item.

The safety of the food product is the most essential aspect of packaging. The packaging has to be according to the regulations laid down by the regulating agencies both nationally and internationally. A few regulating bodies of food packaging are the US Food and Drug Administration and the US Department of Agriculture; European Food Safety Authority. The Global Food Safety Initiative helps in organising certification programmes for companies.

Food Packaging Concerns

- Analysing the food to check if dangerous contents are found in the packaging and the extent of the hazard.
- Confirmation and authentication of procedures at the time of packaging.
- Adherence to good manufacturing practices.
- Usage of a strong quality management system.
- Provision for tracking and tracing the product.
- Label contents as per the requirements.
- Material of packaging is as per the food product. There is a need to use specific food contact materials are used when the package is in direct contact with the food product.
- Hygiene of packaging machines is maintained.
- Material and chemicals causing risks to health in the process of packaging have to be monitored carefully. Substance like carcinogens, toxic chemicals, mutagens have to be prevented from penetrating into food products or its packaging.

Packaging is a crucial part of food production as it helps in delivering the product to the final user. Thus the entire process has to be performed conforming to all regulatory necessities. All aspects of food production, including packaging, are tightly controlled and have regulatory requirements. Consistency, hygiene and compatibility are necessary for maintaining good manufacturing practices.

Managing safety of the product is very essential. A comprehensive system of managing quality has to be established throughout the process. One technique of managing the process can be done with the help of danger analysis and identifying the essential ways of controlling. Another important step is to verify and validate all aspects of the process; this will help in asserting the degree of compliance. The quality of the product has to be maintained throughout the process of distribution and at every step of the supply chain.

2.8.3 Electronic Goods Packaging

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Electronic packaging is one of the main branches inside the arena of electronic engineering. An electronic system packaging has to protect the product from mechanical damage, chilling, radio frequency noise emission, safety from electrostatic expulsion, upkeep, operative convenience, and cost. A regular and small scale industrial product can use regular commercially existing packages like the card cages or assembled boxes. These boxes are not suitable for large-scale consumer devices as they require much more advanced packaging so that it can enhance the product image for the consumer. Each electronic system can be packaged in form of handy small electronic equipment or can be modified for stationary framework on a rack or stable fitting. The designing of product packaging meant for aerospace, under water, or military organizations has different standards.

Packaging materials

- Sheet metal as a packaging of electronic products has been in usage for a very long time. It is perforated and shaped out of a metal sheet. The sheet is mechanically durable, offers electromagnetic protection for products which can be affected form them. This packaging can be constructed easily for small-scale and ordinary products as it is very economical.
- Cast metal is very useful in packaging electronics which are exposed to extreme atmospheric conditions. The metal gaskets are useful in heavy industrial products, ships or marine equipment as it prevents leakage as well as penetration of water. Aluminium casting is most commonly used.
- Machined metal is occasionally used for packaging of electronics. These packages are machined out of concrete slabs of aluminium in order to get the desired intricate forms. These are created in small quantities as they can be constructed in a very short time period and hence are made as per the requirement of the design. The cost of this is high.
- Cases made of moulded plastic are constructed using various methods. These can be made in large quantity as they are cost effective and can be made quickly. Injection moulding, transfer moulding, vacuum forming, and die cutting are some of moulded plastic examples. Pl can be post-processed to provide conductive surfaces when confused.
- Potting was previously called 'encapsulation'. Potting is a process where a section of the product is immersed in a liquid resin and then cured. Pre-moulded potting shells can be used for this purpose. In recent times, the process is mainly performed to shield the semiconductor constituents from humidity and mechanical harm, and it provides a mechanical arrangement which is able to hold the chip and the main structure closely. Previously, it was needed to prevent inverse engineering of branded goods manufactured as printed circuit units. Potting is frequently needed in high voltage products so that live parts can be kept close to each other in a way that they do not react with each other. This helps in designing concise products. The process helps to keep surfaces clean and free from pollutants. Additionally, it provides stability to under-water equipment such as sonar transducers; they are able to function under pressure. Potting may be

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firm or flexible. The product is placed in a vacuum chamber in case void free potting is needed.

- Potting done without using a mould is defined as porosity sealing or resin impregnation. Parts of the product are immersed in a polymerizable monomer or solvent-based plastic solution with a low viscosity. The fluid pressure is reduced to a full vacuum as a result when it is relieved it fills the part. The part is cleaned and cured after it is removed from the resin bath. Curing helps in leaving an insulating dielectric material amid diverse voltage constituents. Porosity sealing helps in filling the interiors which improves the dielectric power of transformers, solenoids, lamination stacks or coils, and few high voltage constituents. It averts formation of ionization among the narrowly spaced out active surfaces and instigating a malfunction.
- Liquid filling can provide a substitute for potting or impregnation. The dielectric liquefied substance enhances the chemical compatibility with the rest of the materials. This practice is followed for big electrical equipment like utility transformers, to upsurge breakdown voltage. It may be handy in improving transfer of heat, mainly if permitted to flow by normal convection or enforced convection with the help of a heat exchanger. Unlike potting, liquid filling may be taken out at the time of repairs.
- Conformal coating refers to the application of a thin insulating coating in order to provide mechanical and chemical protection to fragile components. The coating is found on axial-lead resistors, and occasionally on printed circuit boards. It is very cost effective and needs to be applied very uniformly in order to be useful.
- Glop-top is an alternative of conformal coating found on chip-on-board assembly (COB). It contains a droplet of specially developed epoxy or resin placed over a semiconductor chip and wire bonds. The glop-top helps in providing mechanical strength and eliminate pollutants like imprints of fingerprint these can hinder the working of the circuit. It is very often found in electronic toys and inexpensive gadgets.
- Hermetic metal packaging provides complete protection against leakage. Thus it is mostly used in the vacuum tube industry as leakage can prevent effective operations.
- Hermetic ceramic packages contain a main structure surrounded in a transparent paste layer sandwiched between a flat ceramic top and bottom covers. These are seen in integrated circuit chips in ceramic Dual In-line Package system, or intricate hybrid assemblages of chip components on a ceramic base plate. This kind of packaging has two options, the Low Temperature Co-Fired Ceramic (LTCC) and High Temperature Co-Fired Ceramics (HTCC). These materials have outstanding performance features which make it compatible for a huge variety of packaging containing conductors with small electrical-resistance and dielectrics with high flexural power. The second option is pressed ceramic packages. These are more cost effective than the multilayer packages. They are not suitable for many electronic goods due to their simple construction.
- Printed circuit assemblies help in constructing the mechanical structure of products like computer accessory board. They are commonly used for linking constituents hence are extensively used in electronic packaging.

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Considerations in Designing the Packaging

Various packaging variables have to be considered by the engineer or designer at the time of constructing ways of packaging electronic goods. There are various exposures such as mechanical damage, climate, dust, electromagnetic intrusions, etc. The packaging has to be protected against all these.

- Necessity for heat dissipation
- Adjustments amid tooling capital cost and per-unit cost
- Balances concerning time taken for delivery and rate of production
- Accessibility and competence of contractors
- The designer has to give considerations to convenience and utility over consumer appeal
- The design should have easy accessibility to inner parts for the purpose of repairs
- The design should be according to the regulations applicable for maintaining product safety
- Design of the product packaging should be in keeping with market trends and physical appearance should appeal to the consumer
- The packaging should improve the life of the product as well as dependability

2.8.4 FMCG Packaging

As you have learnt, packaging plays a crucial role in determining the position of the product. Design of the package develops the opinions of the consumer and hence can make or break the product. Packaging is a special tool in the recent market trends. The design of the package carries the perception about the brand and the manufacturer. In case of products which lack support of any other means of publicity, packaging has a very crucial role to play in collaborating the brand standing of various **Fast Moving Consumer Goods (FMCG)** or Consumer Packaged Goods (CPG). These are products which are not expensive and sell fast. The sales happen in large numbers and at a high frequency, therefore the aggregate profit on them is relatively high. FMCG mostly comprise of varied variety of regularly bought consumer products like beauty products, detergents, makeup kits, tooth paste, shaving products as well as other soft goods such as glass items, electric bulbs, batteries, paper and plastic household products, certain drugs, beverages and other consumer packaged food products. The manufacturing of fast moving consumer goods is undeniably a gigantic stage where new products occur on a daily basis. Accessibility of committed packaging designs is essential for catering to the vast range of FMCG goods.

Fast-moving consumer goods or FMCG: They are products that are sold quickly and at relatively low cost. Examples include non-durable goods such as packaged foods, beverages, and so on.

In recent times the FMCG packaging material is given a lot of consideration by manufacturers in order to preserve the environment. Green technology is playing an important role in packaging of products so that the packaging after no longer in use can be disposed judiciously. In an attempt to increase product prominence in the market, packaging has appeared as a distinctive instrument to generate an undeviating influence on consumer's opinion about the product.

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Reasons for Popularity of FMCG

- Increase in middle-class population in developing countries.
- Shift in lifestyles of consumers.
- The scientific advances towards developing biodegradable packaged products are bound to increase the need for FMCG packaging in the immediate future.
- Altering consumer lifestyles provide the demand for wide-ranging consumer products.
- Increase in the number of nuclear families in the society.
- Scarcity of storage space available in modern kitchens.

Even though there is a lot of demand for FMCG, but the manufacturers have to comply towards the strict ecological guidelines associated with the packaging. The crucial element limiting market growth is the need to create materials which has sustainable packaging.

The different kinds of packaging materials on the basis of the nature of the product take into account, shielding packaging, flexible packaging, packaging made out of paper, firm plastic packaging and custom packaging. The material used for packaging has to be sourced on various considerations like health awareness, mobility and awareness among consumers in pharmaceutical and health products. In order to cash in on to the willingness of consumers to spend, manufacturers are keen to develop attractively packaged products. FMCG packaging attends to end-user industries, like food, beverages, healthcare, cosmetics, etc. Out of all the food & beverages segments, it functions as the largest market for packaging companies. Packaging in the FMCG's amounts to a big portion of the material cost in producing the final product. Therefore businesses all over the world are creating novel packaging systems to curtail the functioning cost. The FMCG packaging market is extremely disjointed while analysing from the resource point of view. There are very few companies who have a considerable stake in the entire market. Few of the prominent international FMCG companies are Nestlé S.A., Procter & Gamble Company and PepsiCo Inc. Unilever Group, Amcor Limited and Tetra Pak International.

2.8.5 Heavy Engineering Goods and Equipment Packaging

Packaging precautions have to be taken while shipments of all products, but at the same time, heavy products need extra care during shipment. There are various issues which need to be tackled at the time of shipping heavy machinery. The packaging for such equipment and goods has to be selected carefully.

The factors that need to be kept in mind during the process of shipment are as follows:

- **Weight of the Product:** Packaging and shipping heavy objects is considered to be a challenge. In absence of a resilient selection the packaging could miscarry due to the weight of the product. This might damage the product and the people handling the product could be harmed.
- **Size of the product:** Colossal and bulky articles are not easy to pack. Their uneven shape makes it difficult to handle them. Shipment of the package will be safe only if the package is as per the size of the product. Large items have irregular edges which prevent the packages from being secured properly.

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- **Handling during Shipment:** Packages are frequently handled many times when in transit. The handling is done by machines or by human labourers. The package construction should be done keeping in mind the handling process.
- **Various means of transportation:** Products could be shipped using multiple means and this will cause the package to experience different kinds of shocks and vibrations. The packaging material should be able to withstand all type of transportation.
- **Prior Testing of Shipping Materials:** The testing will assert the durability of the material and help in choosing the material as per the product. The testing of heavy goods material is a difficult but an essential task for the safety of the product.

Durable solutions for Shipping Heavy Goods and Equipment

Protection of heavy and large equipment and goods during shipment is difficult. The handling of these products can become easy with packaging solutions which are designed for heavy goods and equipment. Some of these are discussed below.

Pallets and Skids

Pallets and skids are two resilient solutions for shipping and packaging heavy products. Skid helps in moving large and bulky goods whereas pallets help to keep them vertical and safe. They make the movement of heavy goods easy and safe. There are many types of pallets which can be used for different kinds of equipment and bulky goods.

Plastic pallets are made using plastic. These pallets provide safe and sturdy packaging for various types of shipments. They can bear heavy load and are very easy to maintain as plastic does not get affected by humidity. The plastic pallets are not prone to rusting hence can be easily washed so that they can be kept clean.

Wooden pallets are hard-wearing and durable, and qualify international regulatory standards. Wooden pallets which are expandable are very commonly used for shifting heavy products in a one-way flow.

Wooden skids are formed independently to shield large products from moving while being transported. They are durable enough to tolerate very heavy loads during transportation.

Plastic Packaging Solutions

Plastic packing ampules can be handy in shipping heavy and medium weight goods. These are more commonly used in the automotive industry. Packing bulky and heavyweight objects into a plastic container is easy to handle and accessible. Plastic packaging structures are relatively durable in comparison to their weight and have many advantages:

- Easy handling
- Easy to clean, plastic can be simply washed as no risk of rusting or expanding when in contact with water.
- The surface is smooth, hence easy to slide objects.

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- Plastic is easily mouldable so the size of the packaging structure can be customised.
- Plastic is considerable light in weight.

Steel Racks and Containers

Steel products last longer than any other material. Steel provides most durability and hence can be used for very heavy equipment. These racks and containers are able to withstand rough treatment and can take more weight. Folding steel containers are particularly convenient while shipping heavy objects; they can be constructed as per the size of the product. Steel racks are able to tolerate vibration and other types of impact during transit. They are portable which helps in reducing the shipping cost. These can be used for inbound as well as outbound flows.

Wooden Crates and Frames

Wooden mounts and crates offer a durable support for heavy items during transportation. Wood is considered to be very durable and is extensively used in the process of packaging heavy goods. The crates and frames can be constructed as per the size of the product hence providing it handling as well as storage protection. These can also be dismantled while not in use and can be stored easily.

Internal Packing for Large and Heavy Products

An appropriate packaging structure has to provide stability for the product externally as well as inside the container. The product needs to be secure inside the package so that it can withstand the handling during transportation. There are many kinds of filler options available to secure the inner part of the packaging.

- Blocking materials is used to provide stability to the product as it fills all the hollow spaces. The fillers such as corrugated foam, air pads and bubble wraps can be used to fit the product snugly inside the package.
- Corrosion protection is needed for metal objects. The interiors of the package have to be provided with rust proof lining which prevent corrosion. Corrosion inhibitors and desiccants have to be provided. Packaging can be customised as per the climatic atmosphere during shipment and storage.
- Foam cushioning is very useful in protecting the product from vibration and shock. Fabricated foam or moulded foam can be used for this purpose.
- Inner fittings are meant to provide sections or partitions inside the container. These are made using material such as steel, foam, plastic, rubber, or corrugated cardboard. The material used in creating the section will depend on the nature of the product.

All products need packaging as per their size, shape and weight. There is no universal packaging available. The packaging heavy goods and equipment needs lot of consideration. All packaging options should be analysed prior to selecting the material for a specific product.

Check Your Progress

18. What does packaging in pharmaceuticals refer to?
19. What do packaging components in pharmaceuticals consist of?
20. Mention any five international FMCG companies.

2.9 SUMMARY

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Some of the important concepts discussed in this unit are:

- Packaging is considered to be an important business function as it is not just limited to manufacturing the product. Packaging comprises all the activities after the product has been produced. Packaging is concerned with developing and creating a cover for the developed product.
- Packages consist of various types of packaging. Mainly there are three types of packaging.
- The first type is termed as primary packaging. This may be described as sales packaging. It is the first layer of covering of a product and comes in contact with the product.
- The second type of packaging is called secondary packaging. This may be described as group packaging. The third type is called tertiary packaging. This is sometimes described as transport packaging. Tertiary packaging is necessary for producers as it helps in handling, storage and transportation of goods.
- Selecting the precise solution for the packaging needs is very important for the manufacturer. Each type of packaging has a crucial role to play in the supply chain and various factors have to be determined while selecting the correct packaging for the product. At the time of selecting the primary packaging, the manufacturer has to deliberate on its appearance as the end user will be affected by the aesthetic aspect of the product. Primary packaging serves the purpose of marketing the good.
- The products labels should be clearly visible for the customer. The label consists of three compulsory declarations that should be presented in the way which is prescribed by the regulating authority. These declarations are:
  - Identity declaration of the product
  - Net quantity
  - Name of the dealer and primary place of business.
- Distribution of the product is the key activity of a marketer. The seller of a product has the function of organising the activities concerning the exchange of the product to various channel members so that the product reaches the final user. The seller has to make sure that all these channel members have strong communication. All marketing activities have to be well coordinated for physical circulation of the product
- Distribution takes place easily when more resources are available. The dealers and producers can share the logistical load so that customers can be served faster. The number of intermediaries to be used in the distribution of goods is an important decision for the producers to make.
- The purpose of the identification code is to present reliable shortenings and codes for common understanding. These numeric codes are different for all composite material groups, plastic, paper and cardboard, metals, wood, textile and glass

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- Labels on the products present the information regarding the product. The label can be placed on the container, wrapping, or the directly on the product. For a number of consumer and industrial products, the nature and magnitude of data required to be given on the label is administered by the appropriate protection and distribution regulations. A label is a carter of info regarding the product.

2.10 ANSWERS TO 'CHECK YOUR PROGRESS'

1. The three types of packaging are primary, secondary and tertiary.
2. The packaging type which is also referred to as transport packaging is tertiary packaging.
3. The five features of consumer packaging are: usefulness, product value, shielding, attention grabbing and relevant information.
4. These three declarations are:
   - Identity declaration of the product- the common name of the product
   - Net quantity
   - Name of the dealer and primary place of business
5. The approach required for distribution is based on the structure of the market, goals of the company, the capital capacity and market planning.
6. The two marketing systems are direct and parallel marketing systems.
7. The process of packaging products with layers of see-through plastic film is referred to as shrink packaging.
8. Shrink packaging is made up of pre-heated and cooled stretchable plastic films.
9. The purpose of the identification code is to present reliable shortenings and codes for common understanding. These numeric codes are different for all composite material groups, plastic, paper and cardboard, metals, wood, textile and glass.
10. Plastic containers carry resin identification codes, which specify the category of plastic used in the item. These figures help customers distinguish one type of plastic from another and help in recycling different plastic packages and goods.
11. The representation of optical information on products which is readable by machine is referred to as the barcode. The facts generally pronounces information relevant to the product, it can be information about its date of manufacturing or purchase.
12. EDI stands for Electronic Data Interchange.
13. The group of barcodes found on the product which help in tracking products in stores is termed as the Universal Product Code (UPC).
14. In order to standardize the literature of labels on consumer products the Fair Packaging and Labelling Act (FPLA) has been implemented.
15. The alternative names for active packaging are intelligent packaging or smart packaging.
16. The Poison Prevention Packaging Act was framed by U.S. Senator Frank E. Moss of Utah.

17. The FDA rule for tamper-resistant packaging(TRP) specify that over the counter drugs containing two-piece hard gelatine capsules must be packaged using at least two TRP features and the others need only one of the TRP feature.
18. Packaging in pharmaceuticals refers to provide safety, performance, credentials, facts and expediency to reassure submission through the path of treatment.
19. Packaging components of pharmaceuticals consist of containers, sachets, bottles, tubes, lids or box.
20. Few of the prominent international FMCG companies are Nestlé S.A., Procter & Gamble Company and PepsiCo Inc. Unilever Group, Amcor Limited and Tetra Pak International.

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2.11 QUESTIONS AND EXERCISES

Short-Answer Questions

1. Write a short-note on the roles of primary, secondary and tertiary packaging.
2. What are the general requirements for the containers?
3. What are the factors to be considered for transport packaging?
4. Mention the advantages of shrink-packaging.
5. Discuss the importance of identification codes.
6. What are the advantages of barcodes?
7. What facts should heavy load labels highlight?
8. What is the need for active packaging?
9. Discuss the qualities of good packages.
10. What are the main concerns of food packaging?
11. What are the reasons for the popularity of FMCG packaging?

Long-Answer Questions

1. Discuss the process of choosing the right packaging for the product.
2. What are the trends of consumer packaging?
3. What should be the criteria for selecting the channel members?
4. Discuss the uses and types of barcodes.
5. Describe the benefits and significance of EDIs.
6. Write a note on GS1 standards.
7. Discuss child resistant packaging.
8. Write a note on electronic goods packaging.

UNIT 3 PACKING CONSIDERATIONS

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Structure

3.0 INTRODUCTION

While purchasing a product, the consumer pays not only for the product, but also for the contentment which the product accords. Contentment rests on numerous aspects and product packaging plays an essential role in it. Packaging comprises various components. There are seven important features of product packaging—the desirability of packaging, colour used in packaging, pleasant backdrop of packaging, font used in the packaging, published information on the packaging, handling and transportation competence of packaging and depth of the information provided on packaging. These features play a vital role in the purchase decisions of the consumers. These aspects are quite visible and attracts the consumer towards the product. This unit deals with the packaging considerations while purchasing a product.

3.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Discuss the factors such as protection, convenience and environment for the selection of packaging products

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- Describe packaging as a systems approach to logistics
- Assess the various package design considerations
- Analyse the relationship between the environment and packaging
- Explain the concepts of biodegradation, reuse and recycling
- Evaluate the concepts of industrial ecology, environmental engineering, sustainable packaging and waste management

3.2 SELECTION OF PACKAGING: PROTECTION, CONVENIENCE AND ENVIRONMENT

Packaging refers to the holder or the covering in which a product is placed. All packaging is meant to serve the basic function of protection and promotion. Packaging is significant for the traders and consumers of products. Packaging performs essential functions such as preventing spoilage, damage, meddling, or pilferage; improves handiness while usage and leads to easy storage. Furthermore, it acts as a source of identification for the product. A substantial enhancement in packaging may result in improved sales of an existing product, for instance, packaging cookies in a jar rather than plastic wrapping will increase its appeal to many housewives as the jar can be used for future storage in the kitchen.

Earlier, packaging was meant to perform the basic functions, but today, the manufactures in their attempt to lure the customers, want the packaging to protect as well as promote their products. Today packaging has become an integral part of commercial marketing processes. This amplified response to packaging overlapped with the social and economic changes taking place in the world. Contemporary consumers are more educated and aware about their surroundings and expect the product to be of a certain standard. Modern lifestyle has led to increased dependency on easy-to-use products and processed food items. Advancement in technology has made it possible to product processed food without the usage of preservatives but these products require special packaging so that the quality of food can be maintained. Thus, packaging has become a dynamic medium of distinguishing products and enlightening consumers.

Packaging is considered to be a science in the field of marketing. The packaging has to be cost effective, for this reason many companies have changed their methods of packaging, so that they can control the cost of production and handling expenditures. Moreover, sellers started to consider packaging as a means to sell products which already exist in the market by improving their packaging.

These days an impressive packaging design is crucial for the success of the product and producer. The products placed in stores should be able to convey the necessary information and prompt them to buy the product instantly. However, packaging judgements encompass many considerations. The producers aim to enhance the visibility and uniqueness of the product while complying with all other essential elements such as regulations, labelling and protection and cost effectiveness.

3.2.1 Factors for the Selection of Packaging

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The factors to be kept in mind while the selection of packaging are as follows:

- **Protection**: The primary function of packaging is to provide safety to the product when it is being shipped, stored and handled. The product has to be kept safe so that it can be delivered to the consumer in the right condition. The product has to be protected from various impending damage during transferring, storage, marketing and misuse, and to guarantee the convenience while all these functions are being performed. Packaging helps in establishing a connection between the producers and the buyers. Through packaging the producers are enabling the consumer to realize the actual value of the product.
- **Prominence:** Packaging design helps in capturing the attention of the buyer while purchasing the product. Supermarkets have self-help shelves where the product is placed. The packaging of the product has to be bold enough for the product to be picked. The noticeable packages have better visibility as compared to the ordinarily packed products.
- **Add-on value:** The construction of the package has to be kept in mind while designing the packaging. Products which have easy to use packaging will have more saleable value. The producers must give adequate consideration to the structure of a package, for example, a ketchup pouch with easy to pour lid will be more convenient than a simple cut and use pouch.
- **Approval of the distributor:** A supermarket owner will like to display products which are not only appealing but at the same time easy to stack and consumes less space. Placing the product in stores with limited space has to be considered while designing the packaging. The packaging should carry all the required information so that extra staff is not required in the store to promote the product. Moreover, the packaging must done as per the regulations prescribed by the regulating agencies.
- **Cost-effective:** Packaging adds to a considerable cost of the product. Some products add up to forty per cent towards the selling price of the product. The producers need to choose smart packaging for their products so that the cost can be controlled. The design should be well-studied before adopting it as the cost of designing a new packaging is very high and can lead to wastage of resources. The identity of the product is established through its packaging and will last as long as the product. Moreover, changing the packaging frequently is not only expensive, but can lead to confusing the customer and they may start doubting the credibility of the brand.
- **Environmental issues:** Packaging has to be developed keeping in mind its impact on the environment. The frequently discarded packages can be the cause of environmental pollution. Non-biodegradable material used in packaging is a huge concern for the authorities as well as consumers. The producers should be compelled to develop such packaging which will conserve the environment. The packaging should be made using reusable or recyclable materials. The packaging label should carry complete information and instruction about the material used and how it should be discarded. Correct disposal not only helps the environment but also prevents the misuse of packaging. Some retailers have

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started adding the cost of shopping bags while billing so that consumers prevent the usage of plastic or paper shopping bags.

- **Utility while usage and post-usage:** The packaging of the product should be usable during and post consumption of the product. The product quality should be maintained while it is being consumed and ensure that the product is fresh. An easy to use package will increase the selling ability of the product. Products with reusable package are preferred more by the consumers. The post usage packaging helps in maintaining the identity of the product post its usage.
- **Legal and regulatory considerations**: The packaging of various products should be as per the legal requirements decided by the regulating agencies. The producers should adhere to these considerations at all stages of the distribution process. The producers must follow these regulations at the time of designing the packages. The packaging laws are not only for the quality of the product but also apply to the conduct of the producers as well; they must prescribe to the legal bindings against copyright and trademarks and maintain originality of the products.

Packaging products by keeping all the considerations in mind is bound to enhance popularity of the product and benefit the manufacturer. A particular product might not succeed in the market in spite of its superior quality if it is not packaged properly. In order to maintain the selling ability of the product, the following mistakes should not be made in the process of packaging:

Package design is unable to provide consumer satisfaction: The packaging has to be done after realizing the needs of the consumer. There are no universal rules for packaging. The customer's requirements have to be kept in mind while designing the package. The aim of the producer should be to deliver a package which suits the needs of consumer. The packaging that is not up to the expectations of the consumer will not be accepted by them. The aspects which make it difficult for them to accept the packaged product include:

- Packages which are not easy to open and need effort and time to open.
- Products which are not packed keeping environment conservation in mind. Producers need to use bio-degradable material to develop the packaging.
- Material of the package should be reusable.
- Labels with insufficient information puts off the consumer as they have to find other resources to understand the nature of the product. Today, the customer wants transparency, and labels with inadequate data and figures make them doubtful about the credibility of the product.
- Insufficient visibility in the market.

Inadequate packaging fails to capture the USP of the product: Products that are packaged well are able to sell themselves as the consumer is able to get the probable answers for all the queries. The packaging should be able to highlight the USP of the product. Clearly mentioning the USP makes the product more saleable. The package designers have to develop a design which does full justice to the product and its ingredients and yet be innovative.

Package is not fit for selling in retail stores: The design of the market should take

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into account the space restrictions in most stores. Supermarkets have narrow racks on which they want to stack and display maximum amount of products. The irregular shape of the package may prove to be a deterrent. New products get introduced at a fast frequency and the consumer wants to try all the new items but does not want to purchase them in big quantities. Consumers do not like to buy large packages since the storage space is limited at home.

3.2.2 Cost and Competition

There is heavy competition in the market and a new product is launched every single day offering features and products which are equipped to match the existing products in the market. The manufactures are not only facing constant competition due to the increase in the flow of products but also need to compete on the procedures of advertising as well. The cost of advertisement is very high and most manufactures are unable to bear it. The promotion cost of the product is bared by the customers, since instead of advertising through media or any other means, the manufactures use the packaging of the product to act as an essential instrument for publicity, and hence the chances of survival in the market become strong.

Benefits of Incurring the Cost of Packaging

The benefits of incurring the cost of packaging are as follows:

- Packaging has a crucial role in the marketing of the product. Good packaging is assured to establish a special place for the product in the market and make a positive impact on the consumers.
- Packaging gives a better medium to promote the product as compared to advertising; in addition, it is able to distinguish a brand from its opponents. It encourages and strengthens the decision to purchase and the time of purchase while the product is being consumed.
- Availability of products in various quantities can help the product to be attainable for all income groups and make it economical for those purchasing products on a limited budget.
- Packaging is able to recognize brands and this makes a particular packaging more preferred than the other. The packaging helps in promoting brands.
- Packaging helps products stand out in stores and retail outlets. With limited time shoppers prefer to pick packages which are handy and provide quick information.

Need for Reducing Cost of Packaging

The producers are keen on packaging their products in attractive packages so that they are able to compete in the market. The competitiveness in the market has increased the need to use packaging which indirectly increases the cost of the product. Further, the variety in packaging is increasing which results in using raw material which may or may not be safe for the environment. Keeping these aspects in mind, there is a need to reduce the raw materials used in packaging of the product. Packaging manufacturers are pressurized to reduce wastage during packaging as the scrap cost cannot be recuperated from the customers. Similarly, consumers put stress on reduction of packaging weight. In order to sustain in the competition, the producers have to practice

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the down-gauging process. Modest improvements in procedures can achieve the desired results. The problem faced by the manufacturers is lack of updating the recycling equipment. These producers are not able to sustain the competition in the market.

Packaging Strategies for Cost Effectiveness

Packaging plays a crucial role in endorsing the products. An effective packaging strategy would be to make packages which are easy to use and displays all the essential information. The packaging can provide support to marketing the product if it is designed well. The designing of consumer product packages should be done keeping in mind the following aims: to advance the packaging of a prevailing product; in order to supplement a new product to a prevailing series of product line; or to comprehend a completely fresh product.

Re-styling packages is often done to enhance the image of an existing product and to introduce the new features of the product. On few occasions, the increasing competition in the market prompts the producers to redesign the product packaging so that its visibility is enhanced. The advancement in the packaging leads to introducing changes as the improved material will be made keeping in mind the environment and the cost. In spite of the benefits, the re-styling of the packages have to be a well-thought over decision by the manufacturers as changing packaging designs can lead to wastage as well as added expenses. It may also lead to confusing the buyers. On few occasions, the manufactures try to copy the design of a successful product so that their product is easily accepted in the market. The designers have to carefully integrate the product features into the packaging so that the costumers do not get confused and retailers are not harassed. The most essential part of packaging is to design packaging for an entirely new product which is able to compete in the dynamic market and yet be cost effective. The packaging of these products has to have all the normal features yet be able to stand out as new.

3.3 PACKAGING AS A SYSTEMS APPROACH TO LOGISTICS

Even though packaging is acknowledged as ensuring a substantial influence on the competence of logistical systems and undertakings such as production, distribution, storage and handling all through the supply chain, several packaging reliant costs in the logistical system are often ignored by packaging designers. Packaging stipulations openly affect the time needed for concluding packaging processes which eventually alters product lead time and delivery to the consumer. Packaging has an important control on the competence and efficiency of retail supply chains. In the presence of improved packaging logistics, there is bound to be development and advancement in timely distribution of products. For these improvements to take place prototypes are required that assist in evaluating the activities of the supply chain and illustrate the undertakings which are a part of the process of packaging logistics. The information and consciousness of the significance and potential of the packaging logistics actions in the supply chain are not recognized properly.

Packaging Logistics is a new concept which has been realized recently by the industrial engineers. The concept of packaging logistics stresses on the benefits of

Check Your Progress

1. How has the function of packaging changed over time?
2. What is an important consideration for designing products for space constrained supermarkets?

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supply chain due to increased interactions between the system of packaging and logistics. With improved communication between the two, distribution of the goods gets faster. Developments in the packaging system are bound to improve the logistics of packaging. The role of packaging in the supply chain has to be understood in order to understand the logistics of packaging.

3.3.1 Packaging Logistics: Transport and Storage

Packaging is a synchronized system where goods are organized for safe, protected, efficient and effective handling, transporting, distributing, storing, selling, consumption and recovering, reusing or disposing in order to deliver maximum benefits for consumers and producers. It has been well-established that in recent times the functions of packaging are much beyond protection, holding and conserving the product; today these functions have become intricate and multifarious. The functions of packaging can be defined in three categories—logistics, marketing and environment. The packaging system is deliberated as one of the additional logistical sub-systems which contain the transport system, inventory management system, order-processing system and warehousing system. According to a definition by Lambert *et al.,* packaging may be considered as 'an important warehousing and materials management concern'. Ballou (Ballou, 1998) contemplates packaging as a support giving activity to business logistics, where he has termed it as 'protective packaging'.

Packaging is concerned with containing, protecting securing, promoting, selling, informing the source of profit, whereas Logistics is concerned with planning, implementing and controlling. Packaging logistics as one unit focuses on the packaging system, deals with the interfaces between the two systems of packaging and logistics and aims towards increasing competence and efficiency in the joint system, from starting point until consumption point and additional to reuse/recovery or disposal. According to Saghir (2002) the definition of Packaging Logistics is: 'The process of planning, implementing and controlling the coordinated packaging system of preparing goods for safe, secure, efficient and effective handling, transport, distribution, storage, retailing, consumption and recovery, reuse or disposal and related information combined with maximizing consumer value, sales and hence profit.'

According to a professional organization of supply chain management, the American Production and Inventory Control Society (APICS), logistics in the industrial world is an art and science of procurement, manufacturing, and dispensing material and product to an appropriate place and in appropriate quantities. Logistics has been defined as the procedure of developing, executing, and controlling processes for the effectual and effective transference and storing of goods together with facilities, and associated input from the starting point to the final consumption for fulfilling the requirements of customer requirements by the Council of Supply Chain Management Professionals (CSCMP). This description contains all movements whether incoming, outgoing, in-house, and external in nature.

Packaging Logistics and Transportation

Packaging logistics takes care of the planning and these plans are executed with the help of a strong transportation system. The task of transporting a shipment from point A to point B has to be done through transportation.

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- **Product movement:** Transportation is an essential part of packaging logistics as it helps in the movement of various categories of products such as raw materials, components, partly finished goods, packaging material, and other odds and end. The unfinished goods sometimes have to be transported for the completion to another venue; transportation helps to move them for the next phase of manufacturing, and finally helps to move the finished goods to the end users of the product. Transportation helps to maintain the in-transit inventories of the products which are being transported and are essential for the process of the supply chain.
- **Product storage:** Another important function of transportation is to act as a source of temporary storage of goods. This function is often referred to as a secondary function. When the goods are in transit they have to be kept safe and protected from being man-handled or atmospheric damages. During this the product is safely secured inside the vehicle or container as it prevents the hassle of unloading.
- **Packaging for transportation:** Packaging for transportation should be of light-weight and compressed as this will not only add to the appeal and product value at retail outlets but will also help in reducing transportation cost and storage of the product. The design should facilitate safe distribution of the product. Optimum packaging should be used for the product. It is recommended to use standard sizes for packaging so that damages during transportation can be curtailed.
- **Packaging logistics has to cater to the cost of transportation of a product**: This cost not only includes the cost of the transport but also the cost of the driver, cleaner, fuel, taxes, repairs and maintenance. Transportation of a product involves using ecological resources such as fuel. The producers have to be concerned about factors like pollution and congestion.

Packaging Logistics and Storage

Effective supply chain management is influenced by the efficiency of logistics of transportation and storage processes. Storage competences are sometimes influenced by factors such as design of the warehouse, arrangement, and functioning of the warehouse. All products have varied storage conditions, thus, it is essential that the storage facilities are customized as per the needs of a particular product. A tailor made surroundings for storage of the product will result in effective storage and in the long-run will be cost effective. The storage of products is done in warehouses with facilities pertaining to the product. The warehousing functions would involve unloading the packaged goods, unpack (if required), inspect the packages before storage, arrange the products in an orderly manner so that they can be stored at the correct location, update the inventory, prepare materials or products for dispatch and delivery to the consumer. The warehouses should be designed in such a manner to enable optimum storage and handling of the products. The environment should match the physical and chemical nature of the product.

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3.3.2 Requirements for Storage: Physical, Chemical Environment and Biological Nature of the Products

The stored goods need to be protected from various environmental situations.

- **Chemical protection**: Protection is required from environmental inducements such as gases, moisture, light and other harms prompted due to chemical effects. The storage facilities have to be safe from these aspects.
- **Biological protection:** Storage is needed for protection from insects, rodents, micro-organisms, etc. as their invasion can leave food unfit for consumption. Adequate measures have to be taken during storage so the food is not infested with pests of such kind. The storage space should be temperature regulated so that organisms and insects are unable to survive.
- **Physical protection:** Protection is required from mechanical harms which can occur in the storage such as pilferage, theft or tempering with the packages. The storage facility has to be well-guarded all the time.

Different Types of Storage Facilities

There are various types of warehouses and the manufacturers can store the products as per the nature of the product so that the products can be safeguarded from the physical, chemical as well as biological factors.

- **Heated and unheated warehouses:** These are convenient for storage of all types of goods irrespective of their size.
- **Refrigerated warehouses**: These are convenient for storage of perishable goods and products which require a refrigerated atmosphere. The storage facility is equipped with freezers and chilling space for maintaining temperature.
- **Controlled humidity warehouses:** These storage spaces are constructed with vapour blockades and comprise humidity regulators so that the humidity can be regulated as per the requirement.
- **Special-designed warehouses:** These are created as per the specific requirements of the product. For instance, fuel and non-propellants, combustible and inflammable material, radioactive material, hazardous chemicals, and ammunition have to be provided with special storage facilities.

In recent times, the storage facilities are equipped with features like high bays, sophisticated material-handling apparatus, broadband connectivity, and other distribution networks. A varied collection of storage alternatives, lifting options, material handling equipment and software is provided so that the physical, operational, chemical, and biological requirements of products can be provided while the product is at the warehouse. Storage is an essential part of packaging logistics as it acts as a time filler between supply and consumption. Thus, the warehouse designers have to create storage facilities which are safe and convenient.

The warehouse should be located on a flat ground. It should be easily accessible for the manufacturers and retailers. The storage facility should not be very far from the market or highways. The warehouse should have ample space for loading and unloading. The layout should also provide convenience and protection. The flooring of the warehouse should be concrete and strong. It should be smooth for the movement of

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trollies. Smooth surfaces are easy to clean and remain dust free. The warehouse should have a high ceiling so that tall racks can be stored. The high ceiling would provide adequate light and ventilation as well. The storage space should be designed for catering to the present as well as future requirements. There should be enough space between the storage racks for using handling equipment like fork-lifts. The warehouse should be planned keeping in mind the passive solar concepts, solar geometry, and building load requirements.

The structure should have light coloured roof so that it can reflect solar radiation; decrease heating, ventilation, and air conditioning (HVAC) loads; and energy consumption. This feature will help in temperature controlled warehouses. Use of ceiling mounted fans will reduce heat stratification and will increase air circulation; this will provide comfort for the workers and safety for movement of handling equipment.

3.4 PACKAGING DESIGN CONSIDERATIONS

The functions of consumer packaging is to comprehend and converse. According to professor and author Robert D. Hisrich, each product packaging performs these two functions only if the packaging is able to deliver the following requirements: shield the product, adjustable to production-line rapidly, endorse or sell the item, escalate the product's concentration, service the consumer, deliver recyclable worth to the user, placate legal necessities, and keep the expenses of the packaging process low. Packaging design considerations are classified into two sections—the functional requirements and sales requirements.

Objectives of Packaging Design

A product development process is complete only when the product has been packed into a package which is suitable for the product. Package design is a vital part of the development procedure. The first step in the process of designing a package is to identify all the essentials of the product such as structure, presentation, life of the product, quality assurance, logistics, legal requirements, regulations, visuals, final users, environmental aspects, etc. The next step is to analyse designing criteria such as performance, delivery targets, assets, and cost restrictions. Package design processes frequently work on the basis of fixed patterns, computer-developed designs as these designs work well for logistics of transport packaging as they are based on the uniform pallet loads of the freight. The logistics have a direct impact on the package designs, for instance, in case the distribution system contains single loads through a small parcel shipper, the arranging, handling, and assorted loading create major strain on the durability and safety of the transport package. In case, the logistics system contains constant palletized loads, the structure of the package may be developed according to the particular requirements. A package designed for a particular one mode of consignment might not suit others.

There are regulatory considerations for food packages in which the package comes in contact with the food. The packaging material has to be verified by toxicologists and food scientists. The engineers of packaging have to check that after being packed the product will be secure and last till its mentioned shelf life. The methods followed

Check Your Progress

3. What is the focus of Packaging Logistics?
4. What are the three categories of the functions of packaging?
5. How does Lambert define packaging?
6. How does the Council of Supply Chain Management Professionals (CSCMP) define logistics?
7. What are the different types of storage facilities/ warehouses?
8. Why is storage an essential part of Packaging Logistics?

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during packaging, content on the label, and distribution processes should meet the terms of the prescribed regulations and the aim should be to satisfy the final consumer. Occasionally, the intentions of package development appear conflicting. For instance, the packages of over-the-counter drug have strict regulations that their packaging should be tamper-evident and child resistant and not easy to open, yet sometimes even adults are unable to open the package.

3.4.1 Structural Design

The functional consideration of the design of the package should consider the structural aspects of the package for the following reasons:

- Convenient requirements generally command that the packaging should be appropriate for usage and storage in the homes of the consumers, it should prompt re-use. The package should conform to the user expectations and aid in the safe usage of the contents. The package should not only be convenient while in use but also should be easy to dispose off after usage. The material of the package should be eco-friendly and easy to recycle.
- Placement and storage requirements are achieved when the packaging can sell itself by attracting the customer towards itself. The retailers should be able to easily store and stack the product. The packaging should not be erratic or disfigured as it becomes difficult to stack them in the shelves of the store. Packaging with different shapes may attract attention of limited supplies and online selling.
- Structural requirements are the essential functional considerations. The design of the package has to be attractive, practical as well as cost effective. If the cost of production of packaging is high then it is not practical at all. The producers have to take the production cost into consideration. The next important consideration is the speed of producing the container or the box which will carry the product. The production requirements have to look into the aspect of producing a packaging which can be filled easily. For instance, filling liquids into a small or erratically shaped container will take very long, thus slowing the whole process.

3.4.2 Logistics and Packaging Considerations

There are several functional packaging considerations associated with distribution or marketing and safety. Logistics of these aspects is very crucial for the process of packaging. Packages which are damaged are neither fit for storage nor for distribution. Similarly, if the package harms the consumer, the prospect of sale in future would be nil and the company will lose trust and should compensate for the damages. In view of such probabilities, the packaging designers and technicians have to design packaging which is technically sound and at the same time appealing to the eye.

The packaging has to be strong, moisture resistant, and adaptable to various climatic changes and tolerate all the man and machine handling during transportation and storage. The packaging should not be bulky, heavy or irregular in shape as this would increase storage issues and heavy packing would increase the shipping expenses.

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Lastly, the barcodes and other identity codes on the packaging should be clear and easily accessible. Moreover, packages should be designed for easy handling and should not cause harm or inconvenience to the consumer during usage or storage. Packages which are difficult to open or contain edges can cause injury to the consumer.

It is essential that rules and regulations are followed at the time of packaging. Several central regulations have been implemented to protect consumers from falsification and hazardous products. For example, there are specific regulations concerning packaging hazardous products; there are laws which prevent manufacturers from misguiding people about the quality and quantities of the products. There are many laws related to the labels on the products. The label of the product is attached or stuck to the product, it has printed transcript about the product and its usage. No product can be sold without a label as it contains all written and graphic material of products that is necessary for its sale and exports.

The Fair Packaging and Labelling Act of 1966 controls the regulations related to packaging labels. According to the Act, every product package has to carry a label which is clear and easily seen on the product by the consumers. The label has to contain the following informations: Type of product, the name and address of the manufacturer, net quantity or number of servings. Also, the label of the product has to be bold. The label requirements are different for various products such as food, clothes, toys, medicines, and cosmetics. For example, as per the regulations, all packaged food items have to mention the amount of sodium in the information. They need to display ingredients as per their quantity in the item; similarly, labels of clothes have to carry the care labels which provide care information about washing, drying, pressing and storage.

In 1990, the US Congress passed the Nutrition Labelling and Education Act. The purpose of this Act was to discourage producers from conveying incorrect information about the quality of items in the product. It was realized that phrases like 'low fat' or 'high- fibre' featured on the label were misleading buyers as these qualities did not exist in actuality. Essentially, the recent regulations necessitate the food labels to mention facts about calorie count, cholesterol content, percentage of fat and saturated fat, and levels of sodium. Most consumer goods would have a specified 'best before' date on the package. The packaging design should be as per the shelf-life of a given product. The package needs to provide protection to the food. The packaging of the food items plays a significant part towards conserving food during the distribution chain. In the absence of adequate packaging, the quality of the processed food can be compromised as it may get adulterated due to exposure to physical, chemical, or biological contaminants. With the help of advancement in food packaging technology, it is possible to maintain the quality of packaged food and enhance its shelf-life, consequently conveying handiness to consumers. The nature of packaging must be decided according to the extent of time that foods, beverages, pharmaceutical drugs, chemicals, and many other perishable items are going to remain packed before usage and during usage.

3.4.3 Graphic Considerations of Packaging Design

Design of the package should meet the following four criteria of sales requirements; there is no denying to the fact that the primary sale consideration would be to attract

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the customer, but along with that the manufacturers need to keep the following aspects in mind:

- The outward size of the package is larger than the actual content size. This is primarily done so that the external structure of the package seems big and helps in attracting the buyers. The designers often use strong colours and extra drawings so that the package appears conspicuous. The bold colours and sizes used to display vegetables and fruits make the food look more tempting.
- Enhanced aesthetics and use of graphics in designing the package helps in attracting the buyers. The figures or the drawings should be able to generate few emotions in the buyer. The graphics help in constructing a positive impact about the product. These help in impulsive buying of the products. The product is exhibited on the face of the package as a picture, drawing, or is visible through a small transparent window. The additional cheerful colours, lustrous stock, conspicuous container displays help in generating added interest for the product. The legal regulations prevent the producers from creating untrue graphics about the packaged product.
- The package should create an appearance of quality. The packaging which is designed with dull colours or poor backgrounds often fails to impress the buyers. They automatically assume that the product is poor in quality and are not tempted to buy the product.
- An effective packaging must be readable by the consumer. The design of the package should be such that the information given should be relevant to the consumer. The designer should be able to beat the competition by the information provided on the package about the quality of the product. Packages with too many messages will confuse the consumer and obstruct his buying decisions. With so many options to choose, the logos and lettering of the package should be big and similar to other advertising mediums used by the brand so that the consumer is able to relate and choose.

3.4.4 Packaging for Marketing and Shelf-Life

Packaging holds the product and it determines the physical appearance of the product. According to many marketing researchers, packaging is an essential part of production and features very prominently. Packaging acts as a promotional device instead of being just a holder of the product. Although the primary use of packaging is to protect the merchandises in the container but it fills the significant character of providing the identity to the product with the help of labels. The package is of great importance to the customer as it conveys the intention of the producer by conveying all essential informations about the product. Packaging helps in prompting the customer to buy the product.

Packaging is acknowledged as an essential part of contemporary marketing operation, it encircles all stages which take place in the transferring of goods and services to the consumer. The company is able to communicate its profile and identity to the customer with the help of packaging. The entire **branding** process is dependent on packaging of the product. According to author Philip Kotler, packaging consists of all activities of designing and producing the container for a product. Moreover, the

Branding: The process involved in creating a unique name and image for a product in the consumers' mind, mainly through advertising campaigns with a consistent theme.

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Shelf life: It is the extent till which an item can be stored without losing its quality and remain fit for consumption.

packaging is ever so often the most appropriate constituent of a trademark which helps in advertising. Product packaging is a multipurpose activity which performs the function of providing protection and marketing and helps in generating profits for the corporate. The role of packaging is forever shifting between three aspects, at one time it acts as a protecting shield, at another it helps in providing information, and finally it coaxes the consumer.

Packaging for Shelf Life

Shelf life can be defined as the extent till which an item can be stored without losing its quality and remain fit for consumption. Furthermore, it may denote if the commodity can remain on the shelf of a store for sale. Shelf life is applicable for makeups, foodstuffs and liquid refreshment, medical gears, drugs, explosives, medicinal drugs, chemicals, tires, batteries and various other unpreserved objects. In few states, a recommended 'best before', 'compulsory use by' or 'fresh till date' is compulsory on packaged perishable foodstuffs. Packaging helps to regulate or prolong shelf life. Packaging helps in controlling transmission of degrading substance into the product. The packaging engineers pin point the substance which causes specific food items to perish and accordingly install barriers into the package to prevent and control entry of such pollutants. Packaging with oxygen absorbers prevents oxidation or moisture can be controlled with the help of vapour barriers in the package. The procedure of creating an altered atmosphere in the package prolongs the shelf life of most products. Active packaging is done by using antibacterial material.

Food packaging helps in stabilizing food all through the distribution chain. In the absence of packaging, food will not remain fit for consumption as it will be exposed to various physical, chemical, and biological pollutants. With the development of technologies like active packaging, it has become possible to maintain and enhance the food quality of packaged food products. The concept of shelf life is closely associated with packaging, especially food, liquid refreshment, pharmaceutical drugs, chemicals, and many other perishable items which become unfit for sale, usage or consumption post their shelf life or best before date on the package.

Food Packaging and Shelf Life

Packaging helps in educating the consumer about essential aspects related to shelf life, these aspects are:

- Best before or best by dates are visible on a varied variety of frozen, dried, tinned and other foods. Best by dates help in informing the user about the date by which they should preferably consume the product. This advice is helpful at the time of purchase as the consumer's plan their quantity of the product based on this date. The product is not unfit for consumption post the best before date yet it will start to lose some of its texture or taste. For instance, potato chips will not be harmful for health if consumed after the best before date but will surely taste less crisp post the date.
- Use by date is important in food products. The food item should not be consumed after it has crossed its use by date. The use by date is mostly printed on milk packets or bread loafs, consumption post the use by date can be dangerous for health and can have serious consequences. The packaging of such items should

be carefully read in order to be aware of how these items stored after opening, some often read as 'to be stored in temperature less than four degree centigrade'. Cosmetics and toiletries mention the month by which they must be consumed.

- Open dating is present on few food products to ensure the consumer about the quality of the product and inform him about the freshness.
- Sell by/display until dates are not so much for the benefit of the user but for the suppliers so that they can keep track of their sales and stock. These dates do not have any reference with the best before or use by dates of the products. The only consideration is that the product needs to be stored in the correct temperature.

3.4.5 Quality Assurance and Packaging

Quality Assurance (QA) is a means of checking inaccuracies or faults in industrial produces and eluding complications while distributing products or facilities to consumers; this has been interpreted by quality management system standards, ISO 9000 as 'part of quality management focused on providing confidence that quality requirements will be fulfilled'. The aspect of checking inaccuracies in quality assurance varies slightly from fault checking and denunciation in quality control; later attempts are made to check faults and rectify while the product is in the process of production, whereas quality assurance is relevant to the product before reaching the consumer. The expressions 'quality assurance' and 'quality control' are frequently interchanged as both are closely associated with providing quality goods and services. Quality assurance involves and contains managerial and bureaucratic undertakings which are introduced into the quality system so that all the necessary steps and actions can be taken for providing the product and services. Quality assurance can be provided for a product or service if there is a methodical criteria for measuring, comparing and monitoring the process with an established standard. There has to be a provision for providing feedback so that corrective measures can take place. In this aspect, quality control and quality assurance differ from each other as in quality control the stress is on the production process.

Quality assurance is based on dual principles. The first principle states that the product should be apt for the reason it is going to be used for and the second principle states that mistakes should be corrected in the first instance. QA comprises checking the raw material quality, machinery, produces and mechanisms, facilities connected to production, and administration, and process of manufacturing and assessment procedure. Quality assurance aims to provide standard products and services every time. Suitability of the product quality is judged by product consumers, regulars or patrons. The quality of the product is not pertaining to its monetary value, it is about the satisfaction and comfort provided by the product.

All products have to be of high quality and the quality management system (ISO 9000) has taken various steps to guarantee that customers receive high quality products. The system makes it compulsory for the producers to follow the legal regulations required to be followed during the production and packaging of the products. Inferior packaging is a direct outcome of insufficiencies in the quality assurance system during packaging and these results in severe penalties for the manufacturers as well as the consumers. In case there are packaging defects in medicinal or food products, they

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can harm the health of the user. Defects might be in the form of breakage, leakage, inadequate or incomplete information on the label, or the package may not carry the patient information brochure. The producers have to follow Good Manufacturing Practices (GMP) and maintain quality control during the production process so that the products can be distributed with quality assurance.

Packaging procedures and equipment are to be validated and qualified for the process of production. In the production process the following steps can be taken to guarantee that quality is controlled in packaging:

- Sufficient services and amenities need to be provided
- Availability of skilled and qualified workforce
- Sanctioned processes need to be used for sampling, inspecting and testing starting materials, packaging materials, and intermediate, bulk and ûnished products
- Environmental conditions need to be closely monitored during packaging and should subscribe to the GMP purposes
- Raw materials of packaging material for intermediate products, bulk products and ûnished products need to be approved by the personnel of the quality control department
- Methods for testing should be authorized
- Records have to be maintained projecting the occurrence procedures such as sampling, inspecting and testing procedure; the recordings of these results are also to be recorded for future reference as well as proof; the deviations in results should be recorded carefully
- Ingredients present in the ûnal product must comply with the established quality and quantity mentioned on the endorsement; the ingredient quality should be maintained and placed in proper environment which is fit for consumption
- Assessment documents of the product need to contain all the record of the feedback and specifications realized during assessment

3.4.6 Legal Regulations in Packaging

There is a direct link between packaging and consumer protection. The package is the care taker of the product and has the task of providing benign, health-giving, wholesome sustenance to the user. To maintain the well-being of the user and the people of the society, various laws and regulations have been announced by the government for the packaging industry. These laws are applicable to all consumer goods such as food, medicines, drugs, cosmetics and other household consumer products. Several fundamental regulations have been executed to protect consumers from misrepresentation and hazardous products. For instance, there are particular regulations about packaging hazardous products; there are laws which prevent manufacturers from misguiding people about the quality and quantities of the products. There are many laws related to labels on the products. No product can be sold without a label as it contains all written and graphic material of the products that is necessary for its sale and export. The Fair Packaging and Labelling Act of 1966 controls the regulations related to packaging labels. In 1990 the Congress passed the Nutrition Labelling and Education Act, the

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purpose of this Act was to discourage producers from conveying incorrect information about the quality of items in the product.

The Packaging Laws and Regulations for food products in India are mostly enclosed in the following rulings:

- The Standards of Weights and Measures Act, 1976; and the Standards of Weights and Measures (Packaged Commodities) Rules, 1977 (SWMA)
- The Prevention of Food Adulteration Act, 1954; and the Prevention of Food Adulteration Rules, 1955 and its first amendment, 2003 (PFA)
- The Fruit Products Order, 1955 (FPO)
- The Meat Food Products Order, 1973 (MFPO)
- The Edible Oil Packaging Order, 1998
- The AGMARK Rules

In the past customers were not sure about whether they were getting their money's worth in terms of weight or the volume of the product purchased by them. There was no standard system as all packaging units had their own structure of weights and measures. During that time the size of the package which mostly indicates its quantity by weight or volume was also not maintained. Quantities of substances on the containers were not specified in terms of units of weight or measure, a large quantity packs carried expressions like, 'family pack', 'economy pack', 'full size', etc. The confusion about weights and measures continued till 1976. In order to end this chaos, the Government of India implemented the Standards of Weights and Measures Act, 1976 (SWMA).

Some of the important features of SWMA are:

The Chapter One (Section 4) of the Act is on Standard Units. The chapter plainly mentions that the units of weights and measures have to be followed. It institutes that each unit will be established on the metric system.

In Chapter Four (Section 39), the Act specifies that for inter-state trade or commerce of commodities in packaged form which is created for the purpose of sale or distribution needs to carry a label which has to contain clear and eligible statement of:

- Identity declaration of the product—the common name of the product
- Net quantity
- Name of the dealer and primary place of business
- The unit sale price of the commodity in the package
- The sale price of the package

The Act with its very broad and extensive declarations helped in ending lot of malpractices in the packaging of consumer goods.

3.4.7 Elements of a Good Packaging Design

The elements of a good packaging design are as follows:

- **Desirability for the buyer:** Package should be able to create a need for itself among a variety of other packs on the store shelf. It should be able to catch the attention of the buyer.

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- **Strong communication with the buyer:** The product package should be able to communicate all about the product starting from its nature to benefits to the method of use. Each packaging component presents something, hence, the appearance proposed by the package needs to unite with the appearance being pursued for the product. All essential facts need to be noticeable or conveyed in design. Straight communication defines the product, its advantages and usage. Incidental communication is projected by using various colours, figures and backgrounds so that qualities like pureness, worth, coolness, stylishness, femaleness or maleness can be conveyed. Different shades of colour are used for refined consumer communication. For instance, medical products use light and white colour schemes frequently in order to communicate purity, hygiene and proficiency; makeup products use pastel shades, black or gold to project style. The colours used on the packages are very important as they denote a societal culture of the market. It is important that all the written communication on the package is readable by the consumer.
- **Packaging should be convenient to use, both during and after use:** Few packages are with features which make their usage simple, like soaps with a dispensable nozzle or soup in a microwave proof bowl. These features will increase the saleability of the product. The bowl can be useful after the product has been consumed. Convenience of disposal is another essential aspect of good packaging. Today people are ready to spend more money in order to get comfort, look, reliability, and status of enhanced packaging.
- **Packaging for future sales:** Good packaging will leave a good impression and promote future sales. Reusable packages will act as a reminder of the product in the household. Cookies in a plastic jar will remind the user even after the cookies are over and encourage future purchases because of the utility of the jar over other ordinarily packed cookies.
- **Promotion of the product:** The package helps to sell the product by making it stand out among a shelf full of products. The information on the products acts as a promotion as the benefits of the ingredients used tempt the consumer to purchase the product.
- **Distinct packaging:** It helps in distinguishing similar products from each other. The package helps users in identifying the brand of their preference from others. The consumers are able to locate their brand because of the colours on the package.

Check Your Progress

9. What is The Fair Packaging and Labelling Act of 1966?
10. What is the Nutrition Labelling and Education Act, 1991?
11. What does Philip Kotler have to say about packaging?
12. What is Quality Assurance?

3.5 ENVIRONMENTAL CONSIDERATIONS AND PACKAGING

Developing packages requires serious consideration towards the environment. It is the responsibility of the designers to contemplate on the sustainability, environmental concerns and try to develop packaging which is recyclable and conserves the environment. The development of packages should be undertaken keeping in mind the recycling regulations. This might encompass a lifecycle valuation of materials and energy inputs and outputs to the package, the contents of the package, the procedure of

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packaging, the logistics system, waste management, etc. It is essential to be aware of the pertinent regulatory necessities while undertaking the process of production, sale and consumption.

In order to conserve environmental resources and the habitat, the manufactures need to adapt the 'Three R's'—reduce, reuse, and recycle—in their product and packaging processes.

Environment-Friendly Packaging

Environment-friendly packaging should involve the following:

- ***Prevention:*** The primary concern should be the prevention of wastage. Packaging must be used where necessary. Appropriate packaging helps in preventing wastage. Packaging is important for keeping the product safe, hence, using packaging judiciously does not imply inadequate packing. Efforts should be made to develop packaging which is durable.
- ***Curtailing:*** The packaging should be made according to the measurements of the product so that materials used per package can be minimized. Big packaging requires fillers which are more resources being consumed in packing a product. Moreover, fitted packaging will provide more protection for the product. Smaller size will reduce the transportation cost as well.
- ***Reuse:*** Refillable packaging is an effective means to conserve resources. Though there is the task of going-over, washing, and restoration. Few producers re-use the packaging of the received parts for a product.
- ***Recycling:*** Recycling is the reusing of materials and creating a new product. The packaging industry gives lot of importance to recycling the constituents used in packaging such as steel, aluminium, papers, plastics, etc.
- ***Energy recovery:*** Turning waste into energy is done in refuse-derived fuel in permitted facilities, here the heat available from incinerating is used for packaging components.
- ***Disposal:*** Some materials are burned and placed in a sanitary landfill. Thorough care has to be taken in packages with poisonous substances, as they will generate discharge pollutants and ash from burning in the landfill. Packages must not be scattered.

Expansion of sustainable and environment-friendly packaging is of significant interest for various standard groups, governments, customers, packagers, and traders.

3.5.1 Biodegradation and Packaging

The process of breakdown of materials due to bacteria, fungi, or other biological means is defined as **biodegradation**. The word is frequently mentioned in the context of biomedicine, waste management, ecology, and the bioremediation of the natural environment. Today, it is mostly connected with products which are eco-friendly and are able to decompose back into nature. Organic substances are able to degrade themselves with or without the presence of oxygen. Biodegradable material is usually organic material as it offers nourishment for microorganisms. Many substances can be biodegraded, such as hydrocarbons (oils), polycyclic aromatic hydrocarbons (PAHs),

Biodegradation: It is the process of breakdown of materials due to bacteria, fungi or other biological means.

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polychlorinated biphenyls (PCBs) and pharmaceutical substances. Microorganisms discharge bio surfactant which speeds up the process.

Since the beginning of the Green Revolution and cumulative analysis on the impact of conventional packaging material on environment, there has been a fall in the usage of Styrofoam packing peanuts. A fresh group of packaging materials is being used in the market with the assurance of being eco-friendly. These are not only biodegradable materials but are recyclable materials as well. The impurities which form while the packaging material is manufactured must not be overlooked. If a specific product cannot be manufactured minus the toxins released then it does not fall into the category of eco-friendly. One more element to be considered for it to classify as safe for the environment is its possibility of being recyclable. All material which is recyclable should be recycled for proper disposal of substance. The preeminent biodegradable packing materials available in the market is the one which is made out of starch-based plastics. The plant starches are used to make a thermoplastic and heat resistance of the material is increased using additives. The plant starch-based materials are very useful in packaging as they are not only biodegradable but also prevents moisture to build as the plant starch is able to absorb the humidity.

3.5.2 Recycling and Packaging

The procedure of transforming waste materials into new things and substances is defined as recycling. It is a substitute to the traditional method of disposing waste which helps in saving materials and aids in lowering greenhouse gas emission. Recycling prevents wastage of useful materials and decreases the ingesting of new and fresh resources; in so doing it helps conserve energy, curbs air pollution caused due to burning of materials, and helps in controlling water pollution due to land filling.

Recycling is a vital element of present day waste reduction methods and is an effective method used by the manufacturers. There are few ISO standards associated with recycling, for plastic waste ISO 15270:2008 and ISO 14001:2004 for environmental management control of recycling practice. Recyclable materials contain several types of glass, paper, cardboard, metal, plastic, tires, textiles, and electronics. Reusing food or garden waste as manure is considered as recycling. Materials which need to be recycled are mostly collected and brought to the recycling unit where they are arranged, cleaned, and salvaged into fresh materials intended for being produced.

Plastic Recycling

Plastic recycling is a method being used by convalescing scrap or unwanted plastic and salvaging the material into beneficial produces since the 1970s. Most varieties of plastic cannot be biodegraded, reusing it is the best way to lessen plastic waste in the environment, particularly when roughly about eight million metric tonnes of waste plastic is found in the oceans of the earth annually. Recycling plastic helps in lessening the high percentage of plastic pollution. Plastic recycling can be done for any type of plastic, after arranging it into different polymers and then making bits of it so that it can be melted into balls. Once this stage is done the melted plastic can be used to make fresh products like chairs, tables or plastic pallets for packaging. Soft plastics are recycled into creating polyethylene film and bags. Recycling plastic is tougher and costlier than recycling of metal and low value of glass, as plastic polymers have low density and low value. There are many technical hitches while recycling plastic.

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Bio-plastics are derivatives of renewable biomass sources, namely vegetable fats and oils, corn starch, or micro-biota. Agricultural by-products and used plastic bottles can be used to make bio-plastics. Fossil-fuel plastics or petro-based polymers are resultant of petroleum or natural gases. Few of the bio-plastics are biodegradable as they can break down into the environment. Bio-plastics can contain starches, cellulose, biopolymers, and a variety of other materials.

Recycling Codes of Plastic

All plastic products contain a resin identification code, frequently shortened as the RIC. These are symbols featuring on plastic products that help in identifying the plastic background out of which the product is made. These codes are very helpful in the process of recycling plastic. They help in tracking the resin of the plastic. Companies find it convenient using these codes as they can identify the product and use it for making similar products. The codes help in segregating the plastic for recycling.

- **Plastic #1:** This is polyethylene terephthalate, also identified as PETE or PET. Mostly all disposable soda and water bottles are prepared with #1 plastic, and it is generally clear. This plastic is considered safe yet prolonged reuse is not recommended as its porous surface provides ground for bacterial growth. This plastic is easily accepted for recycling at various centres.
- **Plastic #2:** This is high density polyethylene, or HDPE. Milk jugs, detergent bottles, juice bottles, butter tubs, and toiletry bottles are made of this. It is generally cloudy and not clear. This plastic is known to be safe and has low risk of discharging any chemical substances. It can be easily recycled.
- **Plastic #3:** This is polyvinyl chloride, or PVC. It is used for making food wrapping covers, cooking oil bottles, and plumbing pipes. PVC is a strong plastic. The PVC plastic may contain phthalates which is known for interfering with hormonal development of humans. The usage of this plastic should be avoided for food packaging if it requires to be exposed to heating, for instance do not heat food using the plastic wrap. Plastic #3 plastic is not readily accepted for recycling.
- **Plastic #4:** This is low density polyethylene (LDPE). It is used for making grocery bags, some food wraps, squeezable bottles, and bread bags. This plastic is deliberated as safe, yet not easily accepted by various recycling units.
- **Plastic #5:** This is polypropylene. Cups used in packaging curd, yogurt and ice-cream are made using this plastic. Most food packaged in wide-mouthed containers and water bottles are made using this plastic. This plastic has an opaque finish. Medicine bottles, syrup bottles, and straws are made using this plastic as it is considered safe and can be easily recycled.
- **Plastic #6:** This is polystyrene or Styrofoam, disposable containers and food packaging are made using this plastic. This plastic should not be heated as it is known for leaking chemical substances while exposed to heat. This plastic should not be used for food products and it is difficult to recycle as it is not easily accepted by recycling units.
- **Plastic #7:** This number essentially refers to rest of the plastic. Polycarbonate and BPA are in this category of plastic. This plastic is very extensively used for

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making variety of product packaging such as computer cases or food storage containers. This is not recommended for food products. The plastic is not easy to recycle as most units are not sure about the components of the plastic.

Resin Identification Number	Resin	Resin Identification Code –Option A	Resin Identification Code –Option B
1	Poly(ethylene terephthalate)		
2	High density polyethylene		
3	Poly(vinyl chloride)		
4	Low density polyethylene		
5	Polypropylene		
6	Polystyrene		
7	Other resins		

Fig. 3.1 *Recycling Codes of Plastic*

Glass Recycling

The process of recycling waste glass into functional new products is defined as glass recycling. Glass waste has to be segregated as per its chemical composition, sometimes its colour, and processing abilities. The most common colours used for containers are transparent, green or brown. The only way of reusing glass is through the process of recycling as it cannot be biodegraded.

- Glass recycling is beneficial for the environment. A glass bottle may take more than a million years to breakdown if left in a landfill whereas in less than a month the used glass container can be sent to stores for sale after being recycled into a new product.

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- Glass recycling is sustainable as glass can be recycled numerous times and still not lose its purity or quality.
- Glass recycling is the efficient use of recuperated glass which forms the part of all fresh products. Speaking of industry estimations, almost 80 per cent of all new glass containers are made from recycled glass.
- Glass recycling saves natural resources and energy as fresh raw material is not required for production of new glass articles. It saves energy as making new glass would require high temperatures to heat the sand which will result in excessive pollution. Using recycled glass requires only 40 per cent of the total energy in comparison to using fresh raw material.
- Recycled glass is suitable for the environment as the main ingredients of glass are sand and limestone and they cause no chemical reactions when they interact with each other. Glass is an ideal material to use for packaging as it is compatible with all consumer products because of its low to nil rate of chemical reaction with the contents of the package. Recycling glass is the simplest of all the materials which can be recycled.

Paper Recycling

Recycling of paper helps in conserving natural resources, saves energy, decreases greenhouse gas emissions and frees landfill space which can be used for other trash dumping. There are three types of paper that are used for recycling namely, mill broke, pre-consumer waste and post-consumer waste. Mill broke is paper trimmings and other paper scrap which are obtained while manufacturing paper and is recycled in a paper mill. The second type of recyclable paper is pre-consumer waste. This waste is a result of discarded paper after leaving the mill and the paper is not used by the consumer. The third type of paper is post-consumer waste which is used paper material which includes newspapers, discarded corrugated containers or maybe even old magazines. Paper used in recycling is called 'scrap paper' and is mostly used to develop moulded pulp packaging. The paper needs to be free from any printed matter before recycling, this process is known deinking. Recycling one tonne of paper can help to save seventeen trees, seven thousand gallons of water, three hundred and eighty gallons of oil, more than three cubic yards of landfill space and four thousand kilowatts of energy and decrease greenhouse gas discharges by one metric tonne of carbon equivalents.

Paper packaging is the largest sector which undertakes recycling packaging and amounts to around 65 per cent of all recycled materials. In the United States and Canada, the salvaging of paper and paperboard has increased by 81 per cent in recent years and the rate of recycling is 70 per cent in the United States and 80 per cent in Canada. European countries like Belgium and Austria are able to recycle around 90 per cent of the paper recovered. Most of Europe is able to recycle 75 per cent of paper. Most of the paper pulp needed for making newspapers can be supplied from the recycled paper. In United States almost 37 per cent of **paper pulp** demand is fulfilled using recovered paper. The paper pulp demand is rapidly growing in developing countries. There is an increase in demand of paper packaging, this is directly increasing the demand for recycled paper. Recycled paper is extensively used in producing containerboard packaging and corrugated packaging. The recovered paper is exported

Paper pulp: It is the raw material for paper manufacture that contains vegetable, mineral, or man-made fibres.

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to Asian countries, mostly China, where it is used to develop several types of paper packaging such as boxboards, folding boxes, etc.

It is expected that by 2018 the demand for recycled paper will increase tremendously The paper industry in developing nations are investing in paper packaging plants to be able to cope with the growing demand. Soon paper packaging will replace plastic packaging as it is safer for environment as well as humans. Many big companies like Starbucks have started to get involved in paper recycling programmes and they have started using paper made cups. The recycling technologies are advancing rapidly to suit the growing demand; now coated paper packaging and corrugated paper can be recycled together. Recycled paper is being frequently used in the food service market as well. Awareness among the consumers is continuously increasing and the damages of litter and solid waste.

3.6 CONCEPT OF REUSE

Reuse is a recent concept which is not same as recycling, though individuals frequently interchange the two. Even though recycling is an advantageous exercise, but it consumes lot of energy and entails an industrialized alteration of a product. Method of reuse also helps in developing a new product but does not require so much energy and the product is not of very high quality. Reusing a product, on the other hand, does not need any significant industrial operations. A reprocessed item is made operational for a purpose. Illustrations of reusing supplies contains contributing old, operational computers to an educational institute; letting consumers to return used packaging boxes, packing peanuts, bubble wrap, for the purpose of using again; equipping an office with retrieved things rather than buying new furniture. Reusing resources helps in conserving the environment and also provides cost effective options for businesses. It upsurges the lifecycle of funds and saves a corporate the expenditure of procuring new products.

Practice of Reuse

Reuse has a positive impression on the community as businesses frequently donate used items to institutes which can be used for training. The business houses can reuse used paper which is considered to be trash and can be shredded and converted into packing material. The offices can reuse paper in offices to take notes and other unofficial task which need not require fresh sheets of paper. An old wooden crate can be used to make small stools or racks for storage. It is advisable for corporates to undertake an audit of all the waste products, may be their waste can be used by someone else. It is a good idea to post your waste products on the various reuse network sites so that people can become aware about their existence.

There are many stores which undertake reuse deposit programmes wherein the customers are encouraged to return packaging with an incentive of discounts. Reusable bottles are used expansively in several European states, for instance, 98 per cent of bottles reused in Denmark are returned by the consumers. Few departmental stores offer to give cash refunds for bringing personal carry bags. In 1991, Sainsbury Ltd. initiated a penny back programme. It is believed that this programme helped to save 970 tonnes of plastic annually. Similar programme was initiated in Mumbai local train stations in 2017 for returning packed water bottles and a refund of one rupee was offered.

Check Your Progress

13. What are the 3 R's of environmental considerations and packaging?
14. What are the ISO standards associated with recycling of plastic wastes?
15. What are the uses of recycled paper?

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3.6.1 Environmental Engineering

Environmental engineering is often referred to as a division of applied science and technology which reports the problems of energy preservation, protection of resources and controller of waste caused due to the activities of humans and livestock. In addition, it is employed for searching workable resolutions for improving public health. Environmental engineering tries to control diseases caused due to human and animal waste and water. Efforts are made to implement laws so that better sanitation can be provided especially in rural areas. It includes waste water management, air pollution control, recycling, waste disposal, radiation protection, industrial hygiene, animal agriculture, environmental sustainability, public health and environmental engineering law. Along with these, it conducts studies of the construction projects to be able to realize the impact of construction on the environment.

Environmental engineers are involved in learning the influence of technological advances on the environment. In order to understand the influence various hazardous substances in the environment and steps to treat and contain their impacts are studied. Environmental engineers develop systems for municipal water supply and industrial waste water. They study the national and global environmental concerns such as the impact of acid rain, packaging waste, global warming, ozone depletion, water pollution and air pollution from automobile exhausts and manufacturing units.

3.6.2 Industrial Ecology

Industrial ecology contemplates industries to be similar to an ecosystem which has been cultivated by humans. The industrial ecology functions as the natural system as the remaining or by-product of any procedure acts as raw material of some other process. Industrial ecology intermingles with natural ecosystems and tries to be cyclical rather than linear. Similar to a natural ecosystem, industrial ecology is in a constant state of change.

Most industrial processes influence the environment in an adversative manner. These influences are reduced with the help of industrial ecology. Industrial ecology recognizes industrial growth as a natural process and renders support for expansion keeping in mind environmental conservation.

The principles of industrial ecology are as follows:

- **Construct industrial ecosystems:** Waste of one industry is viewed as a resource for another. This helps in creating partnerships with other industries and transfer by-products for their processes.
- **Stability to natural levels:** It helps in managing the boundary between industry and environment. It also increases responsiveness towards the environment and understanding the environmental limitations needed during the industrial process.
- **Reuses industrial output:** Resources are better utilized as waste of one industry is reused in another process. This saves raw materials as well as energy.
- **Develops the competence of industrial processes:** Restructuring products, procedures, apparatus; material is reused to save resources.

- **Integrates energy supply inside the industrial ecology:** It integrates using alternate sources of energy that are less harmful for the environment.

Advantages and Disadvantages of Industrial Ecology

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The industrial ecology works towards reducing the cost of processes. It enhances environmental protection, and generates income by selling trash and by-products. It also improves the industrial image of the company, hence, the company has an advantage in marketing its products.

Restrictions to industrial ecology comprise: The demand for such material is very low, the system has not been completely recognized by the government thus lacks membership in the industry, the industries are not willing to invest in technology as there are very few customers.

3.6.3 Sustainable Packaging

Sustainable packaging can be described as packaging which has the capacity to sustain environment. This encompasses amplified use of Life Cycle Inventory (LCI) and Life Cycle Assessment (LCA) to support the use of packaging which is not harmful for the environment and the ecological system. For this it is important to take into account the entire supply chain. The objectives are to mend the future capability and quality of life for individuals and to increase the endurance of natural ecologies. The packaging needs to comply with the practical as well as the economic requirements of the present-day without compromising the facilities of the future population for their personal gains. Sustainability is a continuous process with advancement at every stage. Packaging with sustainability is a new concept. The packaging designs have to be developed after analysing the sustainable aspects. The concept is not a temporary green packaging movement which has come up in recent past, rather it is seriously being followed by companies which are implementing sustainable packaging in various ways. Presently, a lot many companies have taken eco-friendly measures to reduce the content of carbon by using recycled products and reusing many of the packaging constituents.

A sustainable design will have the following features:

- Practicing the use of minimal amount of materials by reducing the extra layers of packaging. This will help in making the product packaging not only eco-friendly but also less bulky.
- Increasing logistics competence with the help of cube utilization, tare weight, enabling of effective transporting system.
- Increasing energy efficiency by using more renewable energy.
- Using more recycled produce to create packaging. The recycled plastic and paper packaging should be done keeping in mind the prescribed governmental regulations.
- Common use of materials which can be easily and regularly recycled. Lessening of materials which obstruct recyclability of main constituents.
- Repeated use of packaging by following the concept of reuse.
- Using biodegradable and compostable products.
- Eluding the usage of ingredients which are toxic to people or the atmosphere.

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- Adequate waste management techniques to be employed for reducing pollution of air and water.
- Maintaining health and safety of the staff and workers.
- Using materials which are beneficial for the environment all through the process and the lifecycle.
- Avoid using auto produced designs as this will lead to use of excess material and energy.
- Constructing packaging to suit the size of the product. This will help to optimize the usage of materials.
- Adhering to the requests of the 2015 United Nations Climate Change Conference.

Advantages and Disadvantages of Sustainable Packaging

Sustainable packaging is environmental friendly and created following the regulations applied by the supervisory body. It increases the value of the product in the market as the eco-friendly quality will attract investors, buyers, retailers and consumers. It helps in boosting the image of the company. It is beneficial for the society and people as it helps in conserving the environment.

The procedure of manufacturing environment suitable packages may embrace high costs. Sometimes the process of recycling is not cost effective. Developing new packaging can lead to surplus and wastage in some cases. The consumer has to bear the extra cost. Less packaging may not provide enough safety for the product. People buying recyclable products are not making the effort to dispose the packaging in the correct manner. The step towards creating green packaging has to be wholeheartedly taken by all manufacturers as only then actual sustainability will be achieved.

3.6.4 Waste Management

Waste management can be described as all the activities and actions essential for managing waste from its origin to its absolute disposal. This comprises assemblage, transportation, handling and throwing away of waste under proper checking and parameters. It includes all legal and regulatory agendas that are related to waste management incorporating direction and assistance on recycling.

Waste management: It can be described as all the activities and actions essential for managing waste from its origin to its absolute disposal.

Waste management in general refers to all types of waste, which may be produced during the drawing out of raw materials, the handling of raw materials into intermediary and finishing products, the ingesting of finished products, or other social residential or agricultural activities. Waste management works towards reducing adversative effects of waste on people and environmental health.

Principles of Waste Management

The main principles of waste management are based on the Three R's of waste hierarchy—reduce, reuse and recycle. The aim of these three activities is to excerpt the concentrated paybacks from products and to create the least amount of waste. Another principle of waste management is to make the best of the life-cycle of the product. The life-cycle starts with design, and then continues through production, distribution, usage and then trails over the waste hierarchy's phases of reduce, reuse

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and recycle. The basic idea behind the life-cycle of a product is to enhance the use of the restricted resources available and make the best without wasting much. The next principle is to use all the resources to the best of their efficiency so that economic and social development can take place. The last most essential principle is to make the polluters pay for harming the environment.

Methods of Waste Disposal

The various methods of waste disposal are:

- A landfill site such as a rubbish dump, garbage dump or dumping ground is used for disposal of waste materials by burying it under the ground. This is the most traditional method of waste disposal.
- Incineration is a disposal method in which solid organic wastes are burnt and allowed to turn into ashes. This method is beneficial for disposal of the remainder of solid waste management and solid residue from waste water management. This helps in reducing the bulk of the waste by almost 30 per cent.
- Recycling is another effective method of waste management which helps in using waste to create a new product.
- Re-use method of waste management uses processes like biodegradation in order to convert waste into energy and other resources. Energy recovery from waste is the transformation of non-recyclable waste materials into operational heat, electricity, or fuel with the help of various procedures. Pyrolysis is a progression of thermochemical decomposition of organic materials with the help of heat without the presence of oxygen. Resource recovery is the methodical alteration of waste into a particular next use. It is the treating of recyclables to excerpt or recuperate materials and resources and transform it to energy.

There is a strong need for management of waste in businesses to be able to maintain their ISO14001 certification. Companies are exhilarated to expand their environmental efficiencies every year by eradicating waste with the help of resource recovery practices; these are sustainability-related activities. An effective way of achieving this is by adapting resource recovery practices like recycling materials such as glass, food scraps, paper and cardboard, plastic bottles and metal.

Waste management can have many advantages for present as well as future resources. With balanced and reliable waste management practices there can be several advantages, these include:

- Refining trade and industry competence with the help of resource use, treatment and disposal as this will generate markets for recycling products. Waste management will help in the recovery of material with the help of reuse and recycling. The economy will flourish and there will be creation of job opportunities and development of new business ventures.
- Waste management will improve the social life of people and provide them with more comfortable standard of living. The economic growth will improve the social status of people and help in reducing poverty.
- Decreasing or eradicating adversative influences on the environment with the three 'R's' will help in conserving the natural resources and end pollution.

- Adapting effective waste management techniques will enable the future generations to enjoy their share of natural resources as the present usage will not exhaust the natural reserves. The present and future society will have a clean environment.

3.7 SUMMARY

Some of the important concepts discussed in this unit are:

- While purchasing a product, the consumer pays not only for the product, but also for the contentment which the product accords.
- Packaging comprises various components. There are seven important features of product packaging—the desirability of packaging, colour used in packaging, pleasant backdrop of packaging, font used in the packaging, published information on the packaging, handling and transportation competence of packaging and depth of the information provided on packaging.
- Packaging refers to the holder or the covering in which a product is placed. All packaging is meant to serve the basic function of protection and promotion.
- Earlier, packaging was meant to perform the basic functions, but today, the manufactures in their attempt to lure the customers, want the packaging to protect as well as promote their products.
- Packaging is considered to be a science in the field of marketing. The packaging has to be cost effective, for this reason many companies have changed their methods of packaging, so that they can control the cost of production and handling expenditures.
- The primary function of packaging is to provide safety to the product when it is being shipped, stored and handled. The product has to be kept safe so that it can be delivered to the consumer in the right condition.
- Packaging has to be developed keeping in mind its impact on the environment. The frequently discarded packages can be the cause of environmental pollution. Non-biodegradable material used in packaging is a huge concern for the authorities as well as consumers. The producers should be compelled to develop such packaging which will conserve the environment.
- The packaging has to be done after realizing the needs of the consumer. There are no universal rules for packaging. The customer's requirements have to be kept in mind while designing the package.
- There is heavy competition in the market and a new product is launched every single day offering features and products which are equipped to match the existing products in the market.
- Packaging plays a crucial role in endorsing the products. An effective packaging strategy would be to make packages which are easy to use and displays all the essential information. The packaging can provide support to marketing the product if it is designed well.
- Packaging Logistics is a new concept which has been realized recently by the industrial engineers. The concept of packaging logistics stresses on the benefits

Check Your Progress

16. What is environmental engineering?
17. What is sustainable packaging?
18. What processes are included in waste management?

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of supply chain due to increased interactions between the system of packaging and logistics.

- Packaging logistics as one unit focuses on the packaging system, deals with the interfaces between the two systems of packaging and logistics and aims towards increasing competence and efficiency in the joint system, from starting point until consumption point and additional to reuse/recovery or disposal.
- Transportation is an essential part of packaging logistics as it helps in the movement of various categories of products such as raw materials, components, partly finished goods, packaging material, and other odds and end.
- Effective supply chain management is influenced by the efficiency of logistics of transportation and storage processes. Storage competences are sometimes influenced by factors such as design of the warehouse, arrangement, and functioning of the warehouse.
- In recent times, the storage facilities are equipped with features like high bays, sophisticated material-handling apparatus, broadband connectivity, and other distribution networks.
- A product development process is complete only when the product has been packed into a package which is suitable for the product. Package design is a vital part of the development procedure.
- Structural requirements are the essential functional considerations. The design of the package has to be attractive, practical as well as cost effective.
- There are several functional packaging considerations associated with distribution or marketing and safety. Logistics of these aspects is very crucial for the process of packaging.
- The Fair Packaging and Labelling Act of 1966 controls the regulations related to packaging labels. According to the Act, every product package has to carry a label which is clear and easily seen on the product by the consumers.
- In 1990, the US Congress passed the Nutrition Labelling and Education Act. The purpose of this Act was to discourage producers from conveying incorrect information about the quality of items in the product.
- Packaging holds the product and it determines the physical appearance of the product. According to many marketing researchers, packaging is an essential part of production and features very prominently.

3.8 ANSWERS TO 'CHECK YOUR PROGRESS'

1. Earlier, packaging was meant to perform the basic functions, but today, the manufactures in their attempt to lure the customers, want the packaging to protect as well as promote their products. Today packaging has become an integral part of commercial marketing processes. This amplified response to packaging overlapped with the social and economic changes taking place in the world.
2. The design of the market should take into account the space restrictions in most stores. Supermarkets have narrow racks on which they want to stack and display maximum amount of products. The irregular shape of the package may prove to be a deterrent.

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3. Packaging Logistics as one unit focuses on the packaging system, deals with the interfaces between the two systems of packaging and logistics and aims towards increasing competence and efficiency in the joint system, from starting point until consumption point and additional to reuse/recovery or disposal.
4. The functions of packaging can be defined in three categories; these are logistics, marketing and environment.
5. Lambert *et al.* define packaging as 'an important warehousing and materials management concern'.
6. Logistics has been defined as the procedure of developing, executing, and controlling processes for the effectual and effective transference and storing of goods together with facilities, and associated input from the starting point to the final consumption for fulfilling the requirements of customer requirements by the Council of Supply Chain Management Professionals (CSCMP).
7. The different types of warehousing facilities are Heated and Unheated Warehouses, Refrigerated Warehouses, Controlled Humidity Warehouses and Special-designed Warehouses.
8. Storage is an essential part of packaging logistics as it acts as a time filler between supply and consumption. Thus, the warehouse designers have to create storage facilities which are safe and convenient.
9. The Fair Packaging and Labelling Act of 1966 controls the regulations related to packaging labels. According to the Act, every product package has to carry a label which is clear and easily seen on the product by the consumers.
10. In 1990, the US Congress passed the Nutrition Labelling and Education Act. The purpose of this Act was to discourage producers from conveying incorrect information about the quality of items in the product. It was realised that phrases like 'low fat' or 'high-fibre' featured on the label were misleading buyers as these qualities did not exist in actuality.
11. The entire branding process is dependent on packaging of the product. According to author Philip Kotler, packaging consists of all activities of designing and producing the container for a product.
12. Quality Assurance (QA) is a means of checking inaccuracies or faults in industrial produces and eluding complications while distributing products or facilities to consumers; this has been interpreted by quality management system standards, ISO 9000 as 'part of quality management focused on providing confidence that quality requirements will be fulfilled'.
13. The Three R's are reduce, reuse, and recycle.
14. There are few ISO standards associated with recycling, for plastic wastes ISO 15270:2008 and ISO 14001:2004 for environmental management control of recycling practice.
15. Recycled paper is extensively used in producing containerboard packaging and corrugated packaging.
16. Environmental engineering is often referred to as a division of applied science and technology which reports the problems of energy preservation, protection

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of resources and controller of waste caused due to the activities of humans and livestock.

17. Sustainable packaging can be described as packaging which has the capacity to sustain the environment.
18. Waste management processes include assemblage, transportation, handling and throwing away of waste under proper checking and parameters.

3.9 QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are the issues related to package designs that are unable to provide consumer satisfaction?
2. What are the benefits of incurring the cost of packaging?
3. What are the components of packing logistics and transportation?
4. What are the ideal requirements for a storage facility?
5. What is the structural consideration of packaging?
6. What are the laws and regulations related to food products in India?
7. List any three benefits of glass recycling.
8. Write a short note on environmental engineering.
9. What are the principles of industrial ecology?

Long Answer Questions

1. What are the essential factors that needs to be kept in mind while selecting packaging for a product?
2. Write a descriptive note on the graphic considerations of packaging design.
3. Discuss the importance of food packaging for shelf life.
4. In the production process, what steps must be taken to guarantee that the quality is controlled in packaging?
5. Describe the elements of a good packaging design.
6. What are the recycling codes of plastic? Explain.
7. What are the features of a sustainable design? Discuss.
8. Describe the various methods of waste disposal.

UNIT 4 PACKAGING/PACKING MATERIAL AND COMPONENTS

Structure

4.0 INTRODUCTION

Packaging technology has experienced noteworthy growth in the last three decades and this has been possible due to the availability of various materials for packaging. The development has helped in cost effective distribution in various parts of the world. The advancement is packaging materials has led to better storage of products; now they can be stored for long duration in different climatic states without losing their quality. Packing material has helped in improving the shelf life of the products as well. Improved packaging assists in collaboration amongst product, process of packaging and usage of material, which leads to benefits for all the players of the supply chain. Research has also led to the discovery of various eco-friendly options of packaging. These are not only safe for the product but also help in conserving the environment.

4.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Study the various materials and components used for packaging
- Understand and examine the role and benefits of corrugated packaging materials
- Discuss the various types of packing materials

4.2 MATERIAL AND COMPONENTS OF PACKAGING

Commonly used packaging materials packaging are: plastics, paper, paper board, metal, glass, and wood.

Paper is extensively used for packaging since it is low in cost, is able to hold its shape and can be folded and ornamented easily. All the paper which is available for commercial use is mostly prepared with cellulose fibre. Paper and paperboard are

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generally measured by weight. Material which weighs below 250 grams per square metre (gsm) is denoted as paper, and material which weighs about 250 gsm is denoted as paperboard. The paper made in machines has to run parallel to the machine or else the paper will tear easily and not fold properly. Laminated paper provides more strength and barricade features. The material can have gloss or nonglossy or engraved finish. Packaging formed with paper and paperboard consist of cartons, labels, leaflets, tubes, corrugated cases, rigid boxes and pulp packs.

Glass available for commercial purpose uses silica, sodium carbonate and calcium carbonate. Various compounds are added to make coloured or sparkled glass. Glass is a common and convenient packaging material because it is compatible with all products and creates no chemical disturbances with food or medicines. Glass can be sterilised, moisture-resistant, reasonably pressure resistant, easily mouldable, clear glass helps in visibility, can be easily recycled, glass can be beautified and labelled easily. In spite of these advantages glass has a common shortcoming of being exceedingly fragile and sometimes the clear glass can absorb too much unwanted heat which can harm the product.

Tin-plate or aluminium are metals which are commonly used packaging material for food and beverage cans, spray cans, tubes, drums and slip or hinged lids. Metal boxes make very attractive confectionery packaging and they are easy to recycle. Metal is frequently used as a packaging material because of it is sturdy and solid form, does not absorb moisture, completely pressure resistant, can tolerate high heat, with effective coating it is resistant to rusting, can be sterilised easily and can even act as a labelling surface. Drawbacks of metal packaging are its weight and the difficulty in moulding it as compared to other packaging material options.

Plastic is a convenient and common packaging material which can be used in its solo state or in combination with other materials. It is the most common packaging option as it is light in weight, easy to mould in numerous shapes, can be rigid as well as flexible as per requirement, it is durable, provides a firm surface for labelling and beautification and it can tolerate heat to some extent as well. Plastic provides a cost effective option of packaging material. The plastics usually are as per its polymer and it is essential to choose the correct type of plastic of packaging of products. All plastics do not provide moisture and heat resistance, chemical resistance of different types vary widely. The chemicals compositions of a few types of plastics make them unsafe for food and medical products.

Regular plastic polymers used in packaging are as follows:-

- **Polyethylene** (PE) is available in low density (LDPE) and has a low melting point and does not provide moisture blockade. High Density (HDPE) is generally used for bottles and tubs. It has a high melting point although it cannot take oven heat. It has high chemical resistance but cannot be used for aerated drinks. Linear Low Density (LLDPE) plastics are mainly used as seals in bottles and pouches.
- Polypropylene (PP) has a high melting point and is durable for making lids, dispensers, bottles, jars, cartons, trays, etc. Polypropylene typically have higher melting point than PE yet they are not 'ovenable' and are better suited to hot fill products.

Polyethylene: It is any of various lightweight thermoplastics (CH2CH2)x that are resistant to chemicals and moisture and are used especially in packaging, insulation, surgical implants, prostheses, and tubing.

- Polyethylene Terephthalate (PET) is extensively used for stretch blown bottles holding beverages, shampoos and foodstuff, jars, trays and tubes. It acts as an effective barrier to gas and moisture. It can be used for packaging aerated drinks and because of its heat resistance it can be used to make trays to be used in ovens.
- Polyvinyl Chloride (PVC) is commonly used for making inserts, clam packs and blister packs. PVC films ensure tremendous stretch and sticking capabilities for usage in cling wrapping fresh foodstuff.
- Polyvinylidene Chloride (PVDC) can act as a strong barrier to moisture and gas. PVDC helps in packaging of blister packs for medicines.
- Polystyrene (PS) provides a protective layer while packaging fragile goods and is used for making moulded toiletries/makeup containers, bottles, jars and cups.

Wood and bamboo are evolving as a new packaging material option. Though wood has been in usage for some time and is frequently used for making crates and pallets but now a days wood boxes are being used to package cigars, gifts, tea, cheese and various other expensive goods. Bamboo cushions are being used for supporting netbooks and laptops.

Metal Can

Aluminium cans, commonly referred to as a tin-cans, are usually used to package food stuff and liquid drinks and have been in usage since 1957. They can be used for liquids such as oil and chemicals. Aluminium cans are extensively produced all over the world; and their annual production is a staggering hundred and eighty billion cans. Cans offer superior flexibility, ensuing easy production; the packaging cans are made in two parts wherein the central part and base are constructed from a flat plate and after adding the product it is secured with the top which is sealed over it. A label can be stuck to it or due to its firm structure labels can be printed directly on the can. Cans are made from aluminium or tinplate (steel). Aluminium is preferred over steel as it is light in weight, cheaper and can be provided with easy to open top, aluminium has better rust resistance than steel. Aluminium cans are mostly made using recycled aluminium.

Aluminium cans are useful for making packaging because of following reasons:

- They deliver complete safety for content
- They cannot be tampered easily and it would be evident if tampering has taken place
- They are cost effective and durable
- They are suitable for decoration and can contain a printed label.

Limitations of metal cans

- They are heavy in comparison to paper packaging hence cost of transporting increases.
- They need high temperature during production hence consume lot of resources if produced in small quantity.

Bottle

A bottle is a firm container with a narrow neck and straight body. The mouth of the bottle is broader than its neck so that liquids can be poured easily. Bottles are frequently made of glass, terracotta, plastic, aluminium or other impermeable materials and usually help in packaging and storing liquids such as water, milk, soft drinks, beer, wine, cooking oil, medicine, shampoo, ink and chemicals, etc. A bottle is sealed with help of an external closure or stopper. Few bottles are secured with an inside seal for more protection from leakage. The bottle has been used for the purpose of storage since ancient times and evidences have been found in ancient civilizations of China, Rome and Crete.

Bottles are regularly recycled conferring to the SPI recycling code. In order to encourage recycling of bottles, some states have an officially authorised security deposit when purchasing a bottle which is reimbursed once the bottle is returned to the retailer.

Glass bottles are most usually available in sizes varying between about 10 ml and 5 litres. Bottles are generally used for storing food items, soda, alcohol, make-up, sauces and other condiments. Glass bottles are useful for storage of wine as it can hold the contents for a long duration' without changing the quality in fact it help's in maturing of the wine. Hiram Codd of Camberwell in 1872 created soft drink or aerated drink bottle. This bottle was specially designed to hold the aerated drinks without affecting the fizz of the soft drink. In recent times, the usage of bottles is reducing and being replaced by plastic because of the fragility of glass and frequent breakage while handling and storage. The plastic bottles are commonly used for storing liquids and they are now replacing glass and aluminium bottles.

Jar

A jar is a firm cylinder-shaped container which has a broad opening. Jars are normally made using glass, ceramic, or plastic. They are ideal for storing foods, cosmetics, medications and chemicals which have a thick consistency as then the broad opening provides an easy outlet for usage. Glass jars make for an ideal packing container for preserved and cured products as they contain preservatives which do not react with glass. Glass jars provide a reusable packaging for many products and tempt homemakers to buy products as the jars can be used a's storage in' the ladder. Jars can be easily sterilised and recycled. A jar needs to be provided with a lid, the closure has to be used to secure the mouth of the jar. The closure can be a screw cap, lug cap, cork stopper, roll-on cap, crimp-on cap, press-on cap, plastic shrink.

Box

A box can refer to a selection of containers and holders that are used for transportation of goods and long-term or short-term storage. Boxes are made of various durable substances like wood, metal, corrugated fibre-board, paperboard, or other non-durable materials. The size of the box can be as small as a matchbox to the size of a refrigerator. A corrugated box is the most frequently used shipping container. Cardboard boxes were introduced in the world of packaging in 1817. They have been in use since then as they are cheaper to produce and lighter to handle than wooden boxes. In recent times, fibre-board is used to make corrugated boxes, this adds strength to the box.

For extra protection, double waxed boxes are used as they are not only stronger but are water resistance as well.

Packaging and Storage Boxes

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There are many kinds of boxes that can be used for packaging as well as storage. A corrugated box is made out of corrugated fibre-board. These boxes are mostly used as containers for transportation and distribution.

A foldaway carton or box is made-up from paperboard. The paperboard can be printed if required, die-cut and notched to form a blank. These are constructed at the time of filling and remain in a flat state during storage and transportation. They are used to package a variety of goods. These boxes can be used for long-term as well as short-term usage.

Folding gift box are fold away boxes used to pack gifts. These are lightweight and created at the time of packaging. They can be decorated and beautified for presentation. An inflexible paperboard box is prepared of hard paperboard, enduringly pasted together with printed or coloured paper skins. These boxes are not created at the time of usage but are factory made and are stored and transported in their original state. These boxes are durable and used to store and ship expensive and fragile items. The cost of this packaging is more than folding boxes.

A crate is a heavyweight strong shipment container made of wood. Crates are not made of one piece of wood but are made using broad strips. The durability of the crate depends on the item which needs to be shipped or stored in the crate. A crate is used for the shipment of bottles especially wine. Today decorative and gifting crates are also used for promotional and gifting purposes.

A bulk box is a big box frequently used for industrial purposes. It is large enough to sit on the pallet. Depending on location and particular usage, a carton and box refer to same things. In recent times large steel boxes are also used for the purpose of overseas shipments using water ways as these provide safety during long distance transportation.

Barrel

A **barrel** is a large hollow cylindrical container which is made of wooden bands attached to each other with metal nails or loops. It is sometimes referred to as a cask, or tun. Earlier, the barrel was a usual size of measure which referred to a fixed amount of weight. With reference to a barrel of beer, it denoted a fixed amount of 160 litres or wine barrel consisted of 119 litres.

Barrel: It is a large hollow cylindrical container which is made of wooden bands attached to each other with metal nails or loops.

Modern wooden barrels of wine have the following measures; the 'Bordeaux type' has 225 litres, 'Burgundy type' 228 litres and 'Cognac type' 300 litres. In recent times, barrels need not be made of wood only. They are made using aluminium, stainless steel, and HDPE plastic as well. In earlier days wooden barrels were used to storing and maturing of wine and other alcohols such as arrack, sake, cognac, sherry, port whiskey and beer but today plastic and aluminium barrels are used for storage as well as transportation of various liquids such as oils, chemicals, paints, milk and water.

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Cartons

A carton is a container mostly made using paperboard or corrugated fibreboard. Cartons are mostly shaped like a cuboid and are used for packaging of products. All cartons are not fit for food packaging as they need to be of food grade quality and safe for food products to be in contact with the carton material. Cartons are rigid as well as flexible and can be waxed or polyethylene coated for providing moisture resistance. Cartons fitted with a polyethylene lining can be used for packaging of liquid products as well. Cartons have been used for packaging since 1879; National Biscuit Company packaged their crackers in a carton in 1896. After this cartons began to be frequently used for packaging cookies and biscuits as they prevented them from being crushed while transporting and storage. Folded cartons were developed by Dr. Winslow in the 1900s. By 1915, milk cartons were introduced by John Van Wormer of Toledo, Ohio. Wormer named it the "Pure-Pak." In the 1960s Mario Lepore created an appliance to fold and seal a gable top paper carton.

Types of cartons

There are various kinds of cartons which are used for packaging of various products. Some of these are:

- **Folding Cartons** are mostly used for packaging of food, medications, hardware, and various other dry products. Folding cartons are easy to transport, they are transported as flat blanks and are assembled by the packer. Some packers have high speed apparatuses to set up, fill and close the cartons.
- **Egg Cartons** or trays are used to transport eggs. They have hollow space in the tray which can hold the eggs safely during transit. The tray or egg cartons are made of recycled moulded pulp. Few egg cartons are made using plastic polystyrene and PET.
- **Aseptic Cartons** are cartons used for carrying liquids. These cartons have a laminated interiors in which foil or polyethylene is used. They are designed on system of Tetra Pak or SIG Combibloc and can conveniently hold liquids like juices, milk, soups, oils, medicines and make-up products.
- **Gable Top Cartons** due to their structure and internal construction can hold liquids very well. They have a similar coated as the aseptic cartons but are attached with a gable which enables the follow of liquid and can be secured back tightly while the liquid product is in usage. Most juice, cream and milk packages are packed in gable top cartons.

Crate

A crate is an outsized shipment container, frequently constructed using wood. A crate is used for transporting and storage of bulky and large products. In place of wood sometimes steel, aluminium and plastic are used for making crates. Crates can be constructed according to the specifications of the product and can be reused for transporting the same product. For instance, milk and beverages bottles are transported using crates which have sections as per the bottle size. This helps in safe transporting of the bottles. Plastic crates are often used for transporting bottles. Metal crates are not very common due to their weight and are prone to corroding.

Crates can be designed as closed, open or framed crate. An open crate is made using planks at regular intervals and does not have a lid. When there is no gap between the planks then it is referred as a closed crate. An uncovered crate is a frame crate. A frame crate only contains a casing on the sides and is used more for supporting the heavy product. It does not provide protection at the base. The product in the framed crate is prone to pilfering. Usually an open crate will be assembled using 12 pieces of planks, in both directions for support. The crate should be constructed for the products keeping in mind the method of shipping and storage settings. The crate should be sturdy for the handling during transit and distribution.

Drum

A drum is a tube-shaped vessel which is helpful in transporting bulky freight. Drums are mostly made using steel, dense fibre board or plastics. The usage of drum is common for shipping of liquids and dry powders. Drums which contain hazardous product have to be labelled with proper certification. Goods packaged in a drum should be compatible with the material. Drums are often referred as barrels due to their cylindrical shape and common capacity and measurements. Plastic drums are also used for packaging of oils and fuels.

Drums are mostly two types, they can be open top or soldered top. Soldered tops are used for transporting and storage of liquids. Plastic drums are constructed with the help of blow moulding injection technology and have a detachable lid. Metal drums are produced with sheets of cold-rolled steel, soldered together into long pipe-like sections and joined together with the help of a stamping press to create the cylindrical shaped vessel. The top and the bottom are made with a help of a rolled seam. The standard measure of drum in United States is a 200-litre drum which has the capacity of 200 litres. Standard drums internal dimensions are 22.5 inches diameter and 33.5 inches height. These dimensions produce a volume of approximately 218.681 litres. The external measurements of a 200-litre drum are usually 23 inches in diameter at the top or bottom rim, 23.5 inches in diameter at the ridges around drum and height of the drum is 34.5 inches. Precise measurements are stated by the American National Standards Institute in ANSI MH2.

Steel drums with their ribbed walls are considered more durable and easy to roll than the plastic drums. The lid is secured using a head gasket and bolt ring. Drums are normally conveyed on pallets for easiness of handling by means of a fork truck and for shipment. The construction of the drum is such that it can be easily moved around using a two-wheeled hand truck. They are normally used for shipping oils, fuels, chemicals, and dry goods. The manufacturing and enactment of drums which carry hazardous materials are administered by United Nations shipping regulations.

Envelope

An envelope is made with help of a flat thin substance. It helps in packaging letters or cards. Earlier paper was used to make envelopes. The paper could be cut into various shapes such as quadrilateral, diamond shape or a square. An envelope has four flaps which are glued at the reverse side keeping the front plain for writing the address.

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Types of Envelopes

- A windowed envelope consists of a plastic or glassine window which allows a look inside the packet. This type causes a problem during the recycling process of the paper as the plastic window has to be separated from the paper.
- Some envelopes have distinctive feature of providing a seal which if tampered is easily evident. This makes these envelopes tamper-resistant and tamper-evident. They are often referred as security envelopes. These are useful for packaging expensive products essential official or legal documents. Few security envelopes have a mottled tinge printed on the inner side, this acts as a safe guard for the printed text.
- Mailers are large envelopes used for packaging official papers which cannot be folded. They have to be glued on one side after securing the papers inside the envelope. These can be made using paperboard, corrugated fibreboard, polyethylene, fabric like felt (nonwoven fabric), etc.
- Padded envelopes are useful for shipping items which require cushioning as they provide stiffness to the mailer. The stuffing can be of ground newsprint, plastic foam sheets, or bubble packing.

Keg: It is a small barrel, especially one of less than 10 gallons or 37 litres.

Keg

A small tube shaped container is called a **keg**. Usually, a wooden keg is constructed by a cooper. A keg is useful in carrying items like nails, gunpowder, and different types of liquids. A small barrel is sometimes called a keg. In recent times kegs are made using steel or aluminium. Keg is helpful in storage and transportation of spirits like whiskey, rum, etc. and various non-alcoholic aerated drinks which need to be stored under pressure; though it can be used for storage of non-aerated drinks as well.

Bag

A bag is a flexible container which can be made of paper, plastic, jute, felt or cloth such as cotton. In earlier days bags were made using animal skin or plant fibres. Inexpensive throwaway paper bags and plastic grocery bags are frequently used in retail and various convenience stores. Paper bags have been in usage for packaging since the Tang Dynasty (618–907 AD) in China. In the contemporary world, usage of bags is universal, most individuals use some sort of bag in their daily routine. Some bags are made secure for products with the help of zip fastener or snap fastener etc. Bags are produced in various sizes so that different sized products can be packaged in them.

The unavoidable usage of bags makes it important to use bags which are eco-friendly and should be either recyclable or reusable. Today, shopping bags are chargeable to customers; this encourages them to carry bags when going for shopping. A one-use bag may also be reused in order to conserve the environment. There are many types of bags which are used for the purpose of packaging, such as antistatic bag that is used for shipment of electronic components, Bag-in-box, garbage bag, book bag, bulk bag, a flexible intermediate bulk container, flour sack, gunny sack, laptop Bag, paper bag, plastic bag, plastic shopping bag, reusable shopping bag, thermal bag this is thermally insulated shipping back, etc.

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Blister pack

A packaging with a hollow space is referred to as a blister pack. It is used for several Fast Moving Consumer Goods (FMCGs). The key constituent of a blister pack is a hollow or cavity created in the packaging with the help of thermoformed plastic. After placing the product in the cavity the rear of the pack is covered with paperboard or a sealed aluminium foil or plastic. A clamshell is term used for the blister packs which are foldable. Blister packages are often seen for medicines, pens, toys etc. The packing provides safety for breakage and moisture. Milky finish blisters provide protection from light and UV rays, hence very useful for tablets and medicines.

Pail

A pail in the shipping world is referred to as the tube like vessel with wide range of capacity. It can hold three to fifty litres of liquid. A pail is a bucket like container with straight or curved sides it has a handle which makes it convenient to handle the pail. Pails are usually made of wood, steel, tinplate, aluminium, plastic or fibreboard. There are two types of pails, the one with a detachable cover is called open head and the one with screw able lid is called tight head. Metal pails are used to store and transport milk. Most pails have a tight closure for this reason they are very useful for transportation of liquids without leakage, many hazardous liquids are transported using pails.

Pouch

A pouch is an air tight leak resistant packaging which is mostly used for food packages such as ready to eat meals or sauces. These pouches are made from flexible laminated plastic or metal foils. They are heat resistant to some extent as the packaging carries the instruction to immerse the pack in boiling water for the purpose of heating and cooking. These are used for packaging food products which have preservatives since the package is completely air tight. Popular brands like MTR, Capri Sun, Tasty Bite, etc., frequently use the retort pouches. These are used for packaging food for high altitude supplies or even space as they are not affected by pressure.

Sachet

A sachet is a small bag which can be made of cotton, jute cloth or nonwoven fabric like felt or plastic. These are mostly used to package herbs, potpourri, or perfumed materials. A sachet is sometimes used to package desiccants which need bag so that it can absorb the moisture of the packaging which may harm the product quality. Sachets are occasionally used to package small gift items and perfume bottles.

Skin Pack

Skin pack is kind of carded packaging where a product is under portion of paperboard, and then the two are wrapped with a skinny layer of see-through plastic. A heat-seal coating is applied on the printed paperboard. The LDPE or PVC plastic film is exposed to heat so that it becomes soft and then can be easily wrapped around the product and the board. A vacuum is occasionally applied to enable a tight fit. After this the products are cut into individual pieces. The packaging is very useful for packing food items which need to be stored in brine. This packaging helps to pack various fresh products like meat and fish as it keeps the food preserved for longer. Skin packaging to some

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extent looks like a blister pack, but in this the cavity is created while the product is placed on the board due to the shape of the item. Skin packaging is done mostly using different types of plastic films such as, polyethylene, PVC, Ionomer and PET.

Tube

A tube is a lax squeezable ampule which is needed for packaging dense liquids like adhesive, caulking, ointment, and toothpaste. Essentially, a tube is cylindrical deep container with a small round opening. Tubes are made using plastic, paperboard, or aluminium. One side of the tube is sealed during manufacturing and other side is left open for the insertion of the product. This opening is then closed by providing a closure or cap with threaded opening system. The other end of the tube is sealed very tightly to make it airtight. The aluminium tube is coated internally with a special substance which prevents it from reacting with the filled product. The tubes are manufactured by using the process of impact extrusion. In this process, the tube body is pulled out from a coin shape piece of aluminium. The tubes can be easily printed on and the information about the product can be easily placed on the tube. The contents of the tube are conveniently pressed out using little pressure. The content inside the tube is completely safe from the atmosphere thus tube packaging is very suitable for packaging.

Along with aluminium, plastic is also used for making tubes. Plastic tubes are useful for storage of make-up creams. The tubes can be well decorated and patterned as they retain their shape even during usage and frequent squeezes. Extrusion method is used to manufacture plastic tubes. The cover of the tube is created first with the help of a special extrusion line. The cover has to be durable so that it can tolerate the process and the subsequent beautification. Once the cover is shaped the tube dome is fixed with the help of a programmed heading machine. Tube is printed and decorated with the help of silk screen printing machine. The prepared tubes are sent for product filling and then sealing. Plastic tubes are commonly used as they are compatible with most products and provide protection against moisture, light and high heat. Long items are packed in tubes made of paperboard or corrugated fibreboard.

Flexible Intermediate Bulk Container

An industrial usage container created for storing and shipment of easy flowing substances like sand, fertilisers, and small pellets of plastic is referred to as a Flexible Intermediate Bulk Container (FIBC), bulk bag, or big bag. These are mostly made using dense intertwined polyethylene or polypropylene can be treated or untreated and the standard size is 45–48 inches in diameter and height is between 35 to 80 inches. It can hold around 1000 kg. The weight of an empty container which can hold load of one metric ton is about 2000 to 3000 kilograms. Transporting and stacking is done on pallets or with loops. Each bag contains three to four loops for the purpose of lifting. Bulk bags are emptied with ease due to the provision of discharge spout at the base of the bags. Flexible containers are used to transport chemicals, pharmaceutical preparations, fertilizers, fiberglass, food grains, sand, gravel, plastic pellets, seeds, peanuts, starch, dangerous waste material approved by United Nations.

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Folding Container

Folding containers or cartons for packaging began to be used in the last part of the nineteenth century. The procedure of folding cartons comprises of printing, coating, cutting, then folding and pasting before carrying to packagers. These cartons are made of paperboard they are carried in flat state and assembled by the packers. The folding process can be done using machines as well. These cartons are often used to package medicine, breakfast cereals, cracker biscuits etc.

Insulated Container

Insulated shipping containers are very useful for transporting product which need protection from fluctuating temperatures especially food and medicinal products, live organs, blood and chemicals. Insulated containers are useful for maintain freshness and quality of the item. Insulated freight container are made of a vacuum flask or thermos, contrived thermal blankets or liners, moulded stretched polystyrene foam or cooler, sheets of foamed plastics, vacuum insulated panes (VIPs), metallised film, bubble wrap or other gas packed panes.

Insulated shipping containers help in maintaining the temperature of the product throughout the supply chain. These containers can contain cooling agents such as cube ice, slurry ice, dry ice, ice packs, phase change materials (PCMs). Frozen products do not need extra cooling agents due to their adequate thermal quantity this helps in maintaining their temperature. A digital Temperature data logger is provided in the container to be able to monitor the temperature throughout the shipment. Labels should carry all the required information about the internal and external temperature requirements. Individuals involved with the shipping of these containers should be well trained and equipped to handle the products during storage and transportation.

4.3 CORRUGATED PACKING MATERIAL

Ridged boxes are very convenient shipping containers and are regularly used for the purposes of packaging. Boxes are required in order to store and distribute products from manufacturing units till the market place. Products inside the box are convenient to handle and keep the product safe. Some fragile products need to have extra cushioning, stuffing, stimulation and barriers in the box for safety. The shipment vulnerabilities are influenced by the logistics system that is in use. For instance, containers centralized in a single cargo on a pallet will not be exposed to human handling, whereas the boxes which are shipped as mixed cargo are exposed to personal handling and may be exposed to shocks at different levels of the supply chain.

Regular shipment containers need to be properly labelled so that it can be easily identified. The information about the nature of the product, handling symbols and other essential regulatory information including the barcode has to be printed on the corrugated packaging so that the product can be tracked and traced easily. Packages which are meant for promoting and retailing frequently carry exclusive graphics about the product packaged in the container. Few boxes are intended for presentation of substances in the store. The rest are created for easy distribution of the substances. Corrugated boxes provide sturdiness, stability and agility during the distribution process.

Check Your Progress

1. What are paper sheet materials which weigh over 250 gsm called?
2. What are the six commonly used plastic polymers that are used in packaging?
3. Who is credited with the creation of the soft drink or aerated drink bottle and when?
4. In which year were cardboard boxes introduced in the world of packaging?
5. What are the three types of modern wooden barrels of wine and what are their respective capacities?
6. What are the four commonly used types of cartons?
7. What is a Flexible Intermediate Bulk Container?

They are cost effective and easy to recycle as well as reuse. The boxes are frequently used for packaging food product. They help in storage as they can be easily stacked on each other. In the US, boxes are very commonly used almost ninety five percent of products are packaged in corrugated boxes.

Loading Strength

Boxes are essential part of all producing companies as they can be stacked easily in the warehouses. The crush resistant feature of the boxes not only provides safety to the products but stacking those saves a lot of space in warehouse as well as during shipment. One of the important functions of a corrugated box is to provide crush resistance (product protection) and adequate strength for stacking in warehouses. The box strength can be provided as per the product requirements. They can even be constructed with extra moisture resistance if required by the product. The application of the right technique of piling boxes on pallets is very important as columns vertically stacked will provide the best service and intertwining outlines of boxes considerably lessen the performance. The interface of the boxes with the pallets is essential.

The boxes are evaluated for testing their stacking strength and combined load in applicable surroundings with the help of a Box Compression Test. The boxes are also practically tested, although the dynamics in practical tests cannot be completely controlled. Compression strength may be appraised by various parameters like the structure, weight and size of the box. On the basis of these evaluations physical testing is done. Packaging engineers are continuously auditing the results of the testing and try to develop new designs without the problems.

Material of Corrugated Containers

Corrugated containers are made using ridged fibreboard. It consists of pleated corrugated sheets and one or two flat linerboards. Flute Lamination Machines which are referred as 'corrugators' are used to make fibreboard sheets. The sheets are used to construction of shipping containers and corrugated boxes.

The linerboard used in corrugated containers is made using kraft containerboard. This is a paperboard with a thickness of 0.01 inches. The ridged fibreboard and paperboard together are occasionally referred corrugated cardboard. The use of pleated paper or corrugated paper started as early as 1856 in England, it was used for lining hats. In December 1871, corrugated boxboard began to be used as a shipping material by Albert Jones to wrap bottles and glass lamps so that they can be protected during shipping. Large scale production of the corrugated board started in 1874 when G. Smiyth developed the machine. In 1890, Robert Gair developed the pre-cut paperboard box. The corrugated boxes initially were used for glass and pottery products but by 1950 they began to be used to package fruits. Since then they have been used to transport variety of products.

Features of Corrugated Fibreboard

The features of corrugated fibreboard include:

- Corrugated board is tested through the edge crush testing technique to imply that has been tested in laboratory and has ample cross-section strength.

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- Corrugated board has stacking strength because it has been tested for burst strength and flat crush strength.
- Bending resistance and impact resistant.
- Impact resistance.
- Provides cushioning to the product hence it is able to absorb shock during shipping and storage.

Corrugated fibreboard has all the above features provided it is handled properly. The fibreboard is said to be is anisotropic. The strength of the fibreboard is strongly determined by the technique used to stack it on the pallet or at the time of storage.

Corrugated plastic or corriboard denotes an extensive variety of extruded twin-wall plastic-sheet products which are formed from high-impact polypropylene resin. These closely resemble the properties of corrugated fibreboard. Corrugated plastic is developed by various brands under the names of- Polyflute, Coroplast, FlutePlast, IntePro, Proplex, Correx, Twinplast, Corriflute or Corflute.

Features of Corrugated Plastic

The features of corrugated plastic are as follows:

- It weighs very less and yet it is very durable.
- It can be cut and shaped very easily.
- The corrugated plastic is available in varied thicknesses and many colours. The thickness of the plastic helps in creating containers as per the nature of the product.
- Corrugated plastic can be made of polycarbonate, this is called twin-wall plastic. This can be easily recycled and carries the resin code 5.
- The sheet is inactive to most chemicals and its pH factor is neutral, at consistent temperatures oils, solvents and water resistant.
- It is not affected by varying temperature.
- It can provide protection to products from ultra-violet, anti-static, heat, rust, etc.
- This substance is frequently used for making plastic containers and reusable packaging. It is extensively used in the signwriting industry for creating signs for real estate, construction sites and advertisings.

4.4 PACKING MATERIALS

Packing involves transporting and storing of the product. It explained as the procedure of putting the packaged articles into bigger containers for distribution. Packaging the product well before placing them in containers is essential as the cartons can be placed roughly and may need to be shifted several times. In the absence of proper packing the product can get damaged and can be exposed to moisture. The items should be absolutely desiccated prior to packing. Packing is the groundwork of a product before storing or shipping. Packing can be basically termed as the practice of enfolding or clubbing the product in a way which facilitates the handling, transferring and storage. It

Check Your Progress

8. What are the benefits of using corrugated boxes in the distribution process?
9. Who started the use of corrugated boxes in shipping and when?

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involves various methods like covering, muffling and sealing. Various materials are used to perform the task of packing effectively.

Paper

Flexible thin sheets are produced when wet fibres of cellulose pulp is pressed together. This pulp is obtained from wood or plant shrubs. Paper is a multipurpose item which has numerous uses. Paper is extensively used in making packaging for industrial goods. The pulp papermaking process can be traced to China in the 2nd century BCE. As a result, China is the leading manufacture of paper today with US at the second place. Paper is expansively used for the reason that it is low in cost, is able to hold its shape and can be folded and ornamented easily. Laminated paper provides more strength and barricade features. The material can have gloss or nonglossy or engraved finish. Packaging formed with paper consists of cartons, labels, leaflets, tubes, corrugated cases, rigid boxes and pulp packs.

Wood

Wood is evolving as a novel packaging material option. It is frequently used for making crates and pallets but today wood boxes are being used to pack various expensive goods. Wooden boxes are frequently used for heavyweight packaging as they are able to provide:

- High strength for bulky and problematic loads
- Provides protection to goods when longstanding storage is required
- Wooden crates can be used to accommodate large size objects
- Firmness for the product packaging
- Helps in stacking goods of heavy weight

Adhesive: It is a substance used for sticking objects or materials together.

Adhesive

It is essential in packing as it helps in gluing and pasting two surfaces. The pasting of surfaces helps in keeping things together. The strength of the adhesive is decided as per the kind of material which needs to be joined and the climatic surroundings.

Advantages of adhesives

The adhesives offer numerous benefits above trussing methods such as stitching, mechanical buckling, bonding using heat, etc. These are as follows:

- These comprise the capacity to join many types of substances
- It is able to divide the stain more uniformly at the joints
- It is able to distribute stress more efficiently across the joint
- The use of adhesive is more economical as compare to other methods
- The joined surface appears neat and does not alter its looks

Disadvantages of adhesives

The following are the disadvantages of adhesive use:

- Less durability at high temperatures

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- Not suitable for joining large objects with small surface area
- Difficult to separate the items through testing

Adhesives are usually arranged by the technique of adhesion. These are then arranged according to reactive and non-reactive adhesives, to check the chemical compatibility of the adhesive and how it behaves on drying. They are then again arranged as per the nature of the material which needs to be joined.

Aluminium foil

Aluminium are primed with thin metal leaves which are 0.2 mm thin and can be as low as 6 mm also. Aluminium foil meant for domestic usage is usually 0.024 mm. The foil is flexible, and can be freely twisted or draped about substances. Due to the fragility of the thin foils, they are occasionally coated on plastic or paper to increase their strength and usability. In the middle of twentieth century aluminium foil replaced tin foil.

Aluminium because of its malleability is useful in packaging:

- It can be without difficulty transformed to thin sheets and doubled, roll along or filled.
- Aluminium foil is able block light and air, smells and tastes, wetness, and microorganisms, and hence it is very useful in food and pharmaceutical packaging, plus aseptic packaging for beverages and milk products, since they need storing in cooled environment.
- Aluminium foil dishes and platters are used to make bake and serve containers for bakery and confectioneries.

Package Cushioning

It is useful in packaging and keeping fragile objects safe in the course of transportation. It protects objects against mishandlings like dropping, pushing and other such impacts. Cushioning is needed against shocks during transportation like vibration, jerks, bumps, etc.

Cushioning is mostly provided inside the cargo container. The cushioning thickness can range between 50 and 75 millimetres. Several inner packaging materials similar to cushioning are required to provide stability to the product inside the container and prevent them from moving and fill extra space.

Regular Categories of Cushioning

The different categories of cushioning are as follows:

- Loose fill: Few materials used as cushioning are free flowing and are just loosely stuffed inside to fill space and keep the product in place. This contains stretched polystyrene foam pieces or commonly known as foam peanuts, similar to them are starch-based foams or common popcorn.
- Paper: Paper can be physically or bundled up with machines for using as cushioning. Heavy grade of paper deliver extra strength as compared to light weight paper like the newspapers. Creped cellulose padding can be used for stuffing or wrapping.
- Corrugated fibreboard pads: Layered or cut-and-folded forms of corrugated board make useful cushioning and stuffing. They are constructed in such a way

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that they deform and crush due to stress to provide some level of cushioning. Paperboard compound honeycomb assemblies are similarly used for softening the impact.

- Foam structures: These are made using polymeric foams and make for ideal cushioning. The frequently used are: Expanded Polystyrene or Styrofoam, polypropylene, polyethylene, and polyurethane. These are moulded engineered forms or sheets cutting which are stuck into cushion assemblies. Few of the foams are biodegradable.
- Foam-in-place is additional technique of consuming polyurethane foams. These seal the box, fully condensing the product and do not allow it to move.
- Moulded pulp is moulded into the desired shape of the product which has to be cushioned. Prevents the product from moving. This pulp is made from recycled newspapers and the moulded pulp can also be is recycled.
- Bubble wrap is a plastic film sheet with hemmed in boils of air. These sheets can be used to cover or enfold the product inside at the time of packing. A range of engineered inflatable air cushions are available for cushioning. Bloated air pillows are not used as cushioning material though they help to fill the empty space in the container.
- Numerous other categories of cushioning are used such as suspension cushions, thermoformed end caps and clamshells and shock mounts.

Packaging Gas

It helps in packing delicate materials like foods in an altered atmosphere setting. The gas used is generally inactive and does not react with the food products, preventing undesirable chemical reactions like food decay or oxidation. Few help packaging whipped cream into spray cans. These packaging gases are permitted by controlling organisations.

Pallet

It is a plane conveyance structure that helps in supporting the products at the time of handling and transportation. It provides stability at the time of fork-lifting, pallet jack, front loader, work saver, or additional jacking manoeuvres, or by crane. A pallet provides structural foundation to a unit load this helps in easy handling and storage of goods. Pallets are useful while carrying bulk shipping loads of current packaging like corrugated boxes and Intermodal containers.

Types of Pallets

The following are the different types of pallets:

- Wooden pallets usually contain three or four strips that provide backing to various deck-boards on which the goods are kept. Stringer pallets can have an indentation cut into them which allows a four-way access. Forklifts are able to lift a stringer pallet from all four ways.
- Block pallets are usually sturdier than stringer pallets. They employ parallel and perpendicular stringers together for easy and convenient handling. A block pallet also has a four way access.

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- Flush pallets are pallets in which the deck boards are level with the stringers and stringer boards are provided along the ends and sides of the pallet.
- Perimeter base pallet is a combination of both stringer and block pallets these have few unidirectional bases in which the base board is slanted towards one direction. However automatic handling gear can be considered for perimeter base pallet as it helps in fast operation. The pallet is able to function more effectively if the lower ends of a pallet have the lower base boards sloping in both directions.

Materials

Although initially pallets were made with wood but now pallets can also be made of plastic, metal, paper, and recycled materials.

- The most inexpensive pallets are made of softwood and are often considered dispensable. These pallets are common stringer pallets, and can be lifted from two sides. Hardwood, plastic and metal pallets can be elevated from all four sides. These are expensive and are reusable and issued against a deposit to the packers. They are colour coordinated as per the nature of the goods that need to be handled. Wood pallets can cause severe bio-hazard dangers as they are prone to bacteriological and chemical contagion, like E. coli complications in food and produce transportation and are prone to insect.
- Paper pallets are often referred to as 'ecopallets' and are useful for carrying lightweight loads as compared to wooden pallets. Paper pallets are easy to recycle. They are easy to clean, nontoxic, and are cost effective and most of all eco-friendly.
- Steel pallets are sturdy and are useful for carrying heavyweight loads, high-stacking loads and long duration storage. They are frequently used for military ammunition. Metal pallets are not as common as the other pallets they are made carbon steel, stainless steel, and aluminium. Carbon steel pallets are most durable and cost effective and stainless steel is easy to maintain as no anti rust coating is needed. Carbon steel pallets are costlier than wood pallets. Stainless and aluminium are two times more expensive than carbon steel. Though they are expensive but they have a longer life than of wood and plastic pallets. Common benefits of metal pallets are great strength and rigidity, outstanding sturdiness; insect resistant, no cracks, hygienic, and eco-friendly. Disadvantages comprise most investment cost, substantial weight, and vulnerability to corroding (carbon steel).
- Aluminium pallets are sturdier in comparison wood or plastic, lightweight, and better resistance to varied weather conditions, hygienic and rust free. They are occasionally used for air-cargo, long-duration overseas storage and military shipments.
- The International Organization for Standardization (ISO) gives authorizations of six pallet measurements, mentioned in depth in ISO Standard 6780: It has allowed flat pallets for intercontinental materials handling with the standards of strength and measurements.

Paperboard

It is a dense paper-based substance. Though there is no fixed distinction between paper and paperboard, paperboard is usually thicker than paper. According to ISO standards, paper and paperboard are generally measured by weight. As discussed earlier, material which weighs below 250 grams per square metre (gsm) is denoted as paper, and material which weighs about 250 gsm is denoted as paperboard. Paperboard is easy to cut and shape. It is frequently used in packaging because of it weigh less and still durable. It can be printed and decorated easily hence makes good packaging for retail market.

Plastic Wrap

It is also referred as cling film, cling wrap, food wrap, or pliofilm. It is a thin plastic film usually used for closing food stuffs in vessels so that they remain fresh for a long time. Plastic wraps are retailed in a roll form packed inside a long tube package with a cutter. These wraps cling easily to smooth surfaces without using any glue. Plastic wrap is very thin, it thickness is approximately 0.5 thousandth of an inch. Domestic plastic wraps are even thinner; they are 8, 9 or 10 mm thick.

Shrink wrap

Shrink wrap or shrink film, is made using polymer plastic film. With the application of heat the wrap tightly wraps itself around the object and shrinks to suit its size. Heat can be applied using a hot air gun or for large scale operations it can pass through a heat conveyor.

Shrink wrap is available in many forms.

- Flat roll-stock is draped around the item and heat helps to secure it.
- Centre-folded film is provided on a roll with the plastic folded in half: merchandise is positioned in the centre part, the left over three ends are sealed to form a bag, and then the package is exposed to heat which makes the film shrink tightly around the shape of the merchandise.
- Pre-formed shrink bags are plastic bags with one end open: the object is positioned inside the bag, closed, and directed for heat shrinking.

Uses of Shrink-wrap

Shrink wrap has many uses it is often used by retailers to wrap magazines and books to prevent unnecessary scooping. Compact discs or DVDs are frequently packaged in shrink wraps. It is also frequently used to externally wrap cardboard boxes, liquid refreshment cans and pallet loads. A range of products could be walled in shrink wrap to steady the products, combine them, prevent them from being contaminated or make it tamper proof. Wraps are the primary layer of certain food items like cheese, meats, vegetables and fruits. In order to cover electric wiring heat-shrink tubing is used. Labels of packages can be protected from being tampered by covering them with shrink-bands. Shrink warp is used to hold two components of a product together inside the packaging.

Shrink wrap is frequently used in various other manufacturing processes though the durability and denseness is more. The way it is used is the same, a heat shrinking

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procedure with the help of a heat gun. The following shrink wrap uses are commonly seen in industrial use:

- Industrial shrink wrap helps in controlling large plant apparatus and machineries.
- Scaffold wraps is used on buildings and bridges for containment while the work is in process.
- It is used for creating temporary structures for storage of various business operations.
- Marine shrink wrapping is used on boats and other vehicles.
- Shrink wraps are used to wrap freight on pallets.
- Shrink wrap is used to cover damaged roofs and buildings.

Screw Caps

They are closures used to secure the openings of bottles, jars, and tubes. Regular screw caps are seen on plastic bottle which have plastic screw cap; dispensing closure for salad dressing bottles and sauces have a dispensing closure which control the follow. Syrupy liquids have a break-away closure, some liquid soap or dressings have a dispensing pump closure. Glass jars mostly have metal lids, few closures are designed for keeping them safe from children, toothpaste tubes and other tubes have plastic screwing cap as closure.

Uses of Screw Caps

Screw caps are mostly attached to the opening of the container with continuous threads or lugs. The purpose of the screw cap is to seal the product and provide a convenient access for users. The cap should be designed keeping the consistency of the product in mind so that the consumer can easily use and secure it back for later use. The closure should retain the freshness and quality of the product. The screw cap should be economical and designed keeping in mind the prescribed regulations. It should be able to be child-resistant and tamper-evident. Most caps have an inner seal which helps in making them tamper-resistant.

Slip Sheets

They are used at the time of shipping goods. Their function is similar to pallets. Slip sheets are often called thin pallet sheets. The slip sheets are mostly made using plastic, dense coated kraft paperboard, or corrugated fibreboard. They provide a good substitute for wooden pallets. The load on the slip sheet is mostly stretch wrapped so that it is stable during handling.

Uses of Slip Sheets

The following are some of the uses of slip sheets:

- Slip sheets allows convenient handling of material as compared to wooden pallets. Substantial saving in material handling costs, particularly during air shipments as these are lightweight.
- Eradicates the requirement for exchanging pallets.
- Slip sheets can be reused and are lasting.

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- These can be recycled easily.
- Slip sheets are economical when compared with metal or wooden pallets.
- They provide easy maintenance as are easy to clean, weather resistant and insect-resistant.

Disadvantages of Slip Sheets

The disadvantages of slip sheets are as follows:

- Slip sheets take more space during storage and they can be unloaded from the transport with the help of lift truck.
- Slip sheets are not as sturdy as pallets.
- Slip sheets are not easy to use with cranes, forklifts and hand-jacks
- The slip sheets are very low hence they do not provide protection to goods from wet surfaces.
- It becomes difficult to manoeuvre slip sheet loads on uneven or jerky floor.
- Lift truck attachment decreases cargo capacity.

Security Printing

It is very important for the packaging industry as they print tamper-evident labels, product authentication, stock certificates, postage stamps and identity cards. The chief objective of security printing is to avert falsification, tampering, or imitating. Companies are guarding their official papers such as transcripts, coupons and prescription pads by using security printing.

The security printing can be done through various methods:

- Special paper is used which is made from cotton fibres and provides strength and reliability. These paper documents cannot be forged.
- Watermark is an identifiable appearance or design in paper that looks lighter or darker if light is reflected from behind.
- Intaglio is a printing method in this the image is engraved into a surface. Usually, copper or zinc plates are used and the notches are formed by engraving the picture. This printing cannot be copied easily.
- Geometric lathe work is a decorative design formed of two several curled bands that interweave to recurrence a spherical design. They are prepared with a geometric lathe.
- Micro-printing contains usage of very small text and mostly not visible to naked eye.
- Optically variable colour-changing inks are magnetic inks in this pearlescent tinctures are observed at diverse positions of the angle of the light as it's apparent makes the colour seem to alter as the magnetic fields inside the spots change direction.
- A hologram can be entrenched through a hot-stamping foil or it might be openly stamped a holographic paper or into the coated card itself. This is often in shape of the logo of the brand and cannot be copied easily. After stamping it on a product, it cannot be detached or counterfeited. It adds to the appearance of the product as well.

- Security threads are metal threads and foils found in documents.
- Serial numbers aid the tracking and auditing of official documents. A check digit is added to the serial number to identify counterfeits.
- Prismatic coloration helps in preventing forgeries.
- Halo is creating of images in the background of the document or in a picture which cannot be copied. Halo helps to authenticate the original documents. For instance, the discount coupon can be programmed with a Halo image that might be confirmed at the time of reclamation.
- False-positive testing may be carried out for papers to check their originality. With the thump of a pointer a symbol, word or value may be exposed which will confirm the original coupon from a photocopied one.
- Fluorescent dyes are incorporated into documents which may be visible in regular lighting.
- Registration of features on both sides as seen on currency note, this technique cannot be duplicated easily.
- Electronic devices such as a RFID chip may be inserted into the article which needs to be kept safe.
- Thermo-chromatic ink is security ink which when exposed to a temperature of 88°F may disappear or alter colours once the ink is wiped, frequently by the fingertips.
- Latent images on labels are put with the help of pressure or heat. At the time of viewing them under a special filter an additional image is visible.

Strapping

It can be referred to as bundling and banding. It is the procedure of putting on a strap to an object in order to conglomerate, steady, clamp, strengthen, or clip it. In packaging strapping is a common practice.

Uses of strapping

The uses of strapping are as follows:

- Bundling objects helps in handling and shipment
- Strapping is useful when products are placed on the pallets, skids, and crates
- Increases the strength of the cartons, crates and corrugated boxes
- Helps in securing them to flatcars, flatbed semi-trailers
- Combing helps in keeping the load together
- Secures the corrugated boxes and shipping containers
- Locking coils of steel or paper
- Stocking bundles of agricultural products or textiles

Strapping is mostly done in horizontal and vertical direction. The load at the corner is secured with the help of edge protectors. The protectors are required so that the load is not exposed strapping tension. Strapping helps in attaching loops to rail car and skids.

Stretch wrap

Stretch wrap or stretch film is an extremely elastic plastic film which is used to drape around objects. The pliant repossession retains the objects firmly together. The wrap is secured loosely and application of heat makes it tightly wrap around the object. It is regularly employed to combine the load on the pallets. Sometimes it is used in order to bind small components of a product together in the package. Various types of stretch film contain bundling stretch film, hand stretch film, extended core stretch film, machine stretch film and static dissipative film.

Linear Low-Density Polyethylene or LLDPE is used to develop stretch wraps. This is produced by copolymerization of ethylene with alpha-olefins. When more of alpha-olefins are used it helps to improve the strength and flexibility of the stretch wrap. Polyethylene and PVC can be used to make stretch wraps. After it is stretched, the elastic recovery helps to secure the load tight.

Stretch wraps can be produced by two methods:

- **Blown:** The plastic is melted and extruded in an annular die then it is cooled with air. This is a time consuming procedure but produces better quality of stretch wrap. The slowness increases the cost of production as well.
- **Cast:** The plastic film is extruded via a slot die, and then spread on cooling rollers. This is faster process but gives inferior quality of wrap and as it is faster it is more economical.

The wrap should have the following qualities, resistance to breaking, good stretch ability, cling nicely, transparent, enhanced static discharge.

Functions of Stretch Wrap

The functions of stretch wrap are as follows:

- The stretch wrap is required to keep the products united on the pallet.
- It helps in enhancing the steadiness of products or packages when in a unit load.
- It leads to extra effectual handling and storage of loads.
- It helps protect from dust and humidity.
- It helps in providing resistance from tampering and hinders pilferage.
- The UV stretch wraps provide protection from sun light
- It keeps the product fresh hence enhances the shelf life and quality of few food items.

Time Temperature Indicator (TTI)

It helps in showing the time temperature data of the product while in transportation and even storage. The TTI is sometimes referred as a smart label because of this feature. Time temperature indicators are normally meant for food, pharmaceutical, and medical products so that it can be indicated that they were not exposed to unwanted temperature during transit.

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Usage of TTI in food industry

Time-Temperature Indicators are very handy for food products which are reliant on precise temperature surroundings. This technology helps in rectifying the lapses when they occur. It is essential to monitor the temperature throughout the supply chain and pin-point the area of lapse. The TTI prevents wastage of food and prevents contamination which leads to superior customer satisfaction.

The World Health Organisation controls the usage of TTIs for few medical products. There are wide-ranging directives by the FDA in the usage of TTIs on seafood products in the United States.

Tinplate

It is the procedure of finely covering sheets of wrought iron or steel with tin, and the product which is derived by this is known as tinplate. The process is often referred as tinning.

The process is conducted so that rusting can be prevented. This process is used for securing the ends of wires so that oxidation does not take place. This helps in increasing the electrical resistance and prevents them from unravelling or wearing out. This process helps to control a short circuit as it blocks the terminal. Today the process of creating tin-plates is used to manufacture tin cans. These cans are used for packaging preserved foods such as meats, vegetables or fruits so that they can be available all through the year. The tin cans are used for packaging cookies, cigarettes and several cosmetics products and toiletries. The tinplate is useful in creating household utensils and decorative items.

4.5 SUMMARY

Some of the important concepts discussed in this unit are:

- Paper is extensively used for packing because it is low in cost, is able to hold its shape and can be folded and ornamented easily.
- Tin-plate or aluminium are metals which are commonly used packaging material for food and beverage cans, spray cans, tubes, drums and slip or hinged lids.
- Polyvinyl Chloride or PVC is commonly used for making inserts, clam packs and blister packs. PVC films ensure tremendous stretch and sticking capabilities for usage in cling wrapping fresh foodstuff.
- Aluminium cans or commonly referred to as a tin-cans, are usually used to package food stuff and liquid drinks and have been in usage since 1957.
- Hiram Codd of Camberwell in 1872 created the soft drink or aerated drink bottle. This bottle was specially designed to hold the aerated drinks without affecting the fizz of the soft drink.
- Glass jars make for an ideal packing container for preserved and cured products as they contain preservatives which do not react with glass.
- A corrugated box is the most frequently used shipping container. Cardboard boxes were introduced in the world of packaging in 1817.

Check Your Progress

10. Name any five packing materials.
11. What are the three forms of shrink wrap?
12. What is the importance of security printing?
13. What material is used for making stretch wraps?
14. What is TTI and what is its use?

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- Folding cartons are mostly used for packaging of food, medications, hardware, and various other dry products.
- A crate is an outsized shipment container, frequently constructed using wood. A crate is used for transporting and storage of bulky and large products.
- A keg is useful in carrying items like nails, gunpowder, and different types of liquids. A small barrel is sometimes called a keg.
- Paper bags have been in usage for packaging since Tang Dynasty (618–907 AD).
- Skin packaging is done mostly using different types of plastic films such as, polyethylene, PVC, Ionomer and PET.
- An industrial usage container created for storing and shipment of easy flowing substances like sand, fertilisers, and small pellets of plastic is referred to as Flexible Intermediate Bulk Container (FIBC), bulk bag, or big bag.
- Corrugated boxes provide sturdiness, stability and agility during the distribution process. They are cost effective and easy to recycle as well as reuse. The boxes are frequently used for packaging food product.
- Large scale production of corrugated board started in 1874 when G. Smiyth developed the machine. In 1890, Robert Gair developed the pre-cut paperboard box. The corrugated boxes initially were used for glass and pottery products but by 1950 they began to be used to package fruits. Since then they have been used to transport variety of products.
- The pulp papermaking process can be traced to China in the 2nd century BCE. As a result, China is the leading manufacture of paper today with US at the second place.
- Adhesive is essential in packing as it helps in gluing and pasting two surfaces. The pasting helps in keeping things together. The strength of the adhesive is decided as per the kind of material which needs to be joined and the climatic surroundings.
- A pallet is a plane conveyance structure that helps in supporting the products at the time of handling and transportation.
- The chief objective of security printing is to avert falsification, tampering, or imitating.
- Stretch wrap or stretch film is an extremely elastic plastic film which is used to drape around objects. The pliant repossession retains the objects firmly together.
- Linear Low-Density Polyethylene or LLDPE is used to develop stretch wraps. This is produced by copolymerization of ethylene with alpha-olefins. When more of alpha-olefins are used it helps to improve the strength and flexibility of the stretch wrap.
- Time-Temperature Indicators are very handy for food products which are reliant on precise temperature surroundings. This technology helps in rectifying the lapses when they occur.

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4.6 ANSWERS TO 'CHECK YOUR PROGRESS'

1. Paper sheet materials which weigh over 250 gsm are called paperboards.
2. The six commonly used plastic polymers in packaging are: Polyethylene (PE), Polypropylene (PP), Polyethylene Terephthalate (PET), Polyvinyl Chloride (PVC), Polyvinylidene Chloride (PVDC) and Polystyrene (PS).
3. Hiram Codd of Camberwell in 1872 created the soft drink or aerated drink bottle.
4. Cardboard boxes were introduced in the world of packaging in the year 1817.
5. Modern wooden barrels of wine have the following measures; the 'Bordeaux type' has 225 litres, 'Burgundy type' 228 litres and 'Cognac type' 300 litres.
6. The four commonly used carton types are folding cartons, egg cartons, aseptic carton and gable top cartons.
7. Industrial usage container created for storing and shipment of easy flowing substances like sand, fertilisers, and small pellets of plastic is referred to as a Flexible Intermediate Bulk Container (FIBC) or a bulk bag or a big bag.
8. Corrugated boxes provide sturdiness, stability and agility during the distribution process.
9. In December 1871 corrugated boxboard began to be used as a shipping material by Albert Jones to wrap bottles and glass lamps so that they can be protected during shipping.
10. Packing materials include paper, wood, aluminium foil, adhesive,
11. The types of shrink wrap include flat roll-stock, centre-folded film and pre-formed shrink bags are plastic bags.
12. Security printing is very important for the packaging industry as they print tamper-evident labels, product authentication, stock certificates, postage stamps and identity cards. The chief objective of security printing is to avert falsification, tampering, or imitating.
13. Linear Low-Density Polyethylene or LLDPE is used to develop stretch wraps.
14. TTI stands for Time Temperature Indicator. It is used for showing the time temperature data of the product while in transportation and even storage. The TTI is sometimes referred as smart label because of it this feature.

4.7 QUESTIONS AND EXERCISES

Short Answer Questions

1. What are the limitations of using aluminium cans?
2. Write a short note on packaging and storage boxes.
3. What is a barrel and what are the various modern wooden barrels?

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4. What is a drum and what are its standard sizes and measurements in the United States?
5. What is an insulated container?
6. What are the various packing materials commonly used today?
7. What are the various types of pallets?
8. Discuss the uses of shrink wraps.

Long Answer Questions

1. Write notes on PE, PP PET, PVC, PVDC and PS polymer plastics used in packaging.
2. What is a carton and briefly explain its various types.
3. Write a note on envelopes and its various types.
4. Compare the features of features of corrugated fibreboard and the features of corrugated plastic.
5. What are the regular categories of cushioning?
6. What are slip sheets and what are their uses. Discuss the disadvantages of using slip sheets?

UNIT 5 PACKAGING ECONOMICS

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Structure

5.0 INTRODUCTION

Product packaging is an important part of product manufacturing as the process of packaging establishes the identity of the product. All companies have to develop smart strategies for their product packaging. However, sometimes smart packaging is unable to enhance the sales of the product. In that case creating packaging that leads to customer satisfaction will eventually improve the sales and thereby profits of the organization.

It should be understood that smart packaging is what appeals to the consumers. At the same time it does not add too much cost to the product. This unit explains the cost reduction techniques of packaging along with value engineering and value analysis. It also discusses the packaging laws and the essentials of packaging for exports and scientific packaging.

5.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Differentiate between packaging cost vs product cost
- Analyse the different ways of cost reduction in packaging
- Explain the concept of value engineering
- Discuss the concept of marketing and labelling
- Discuss the emergence of eco-friendly packaging for exports
- Understand the importance of standardization in packaging

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5.2 PACKAGING COST VS PRODUCT COST

Packaging is inevitable in the present-day of value addition of products. The second inevitable aspect is the cost which is involved in packaging whaich can sometimes be a very considerable amount when compared to the product itself.

The dynamics of package costing are many and most of them are unavoidable. Let us discuss some of them here.

- **Cost of developing the package**: The preferred package has to be demarcated, theorized and functional and visuals have to be planned, sample produced, market verified, legalized, and, lastly, introduced in the market. Every stage of development of the packaging costs money.
- **Preliminary costs**: This encompasses manufacturing costs for starting the production and includes cost of equipment required for producing and the desired packaging such as dies, moulds, etc.
- **Primal matter costs**: This includes obtaining of materials necessary for marketing, primary, secondary and tertiary packaging.
- **Packaging technology and procedure costs**: This consist of procurements or chartering of packaging equipment, the cost of depreciation of machinery and labour costs.
- **Cost of storage and distribution**: The packaging cost involves the logistics like cost of storage and transportation. The cost has to cater for damage or accidental loss to the product hence the manufacturer will insure his product and the distribution and storage will include insurance cost.
- **Package developmental cost**: The product company could hire a packaging contractor to create a fresh package, but the manufacturer has to specify the nature of the product and essentials of the package. He has to pay to the contractor as well. But, the package developer needs to create packages at the least conceivable costs.

Impact of Packaging on Product's Selling Ability

A product's packaging can be the selling aspect of the product as the packaging is experienced before the customer experiences the product. The package reflects on the product's image. The right packaging can make the consumer choose a particular product over the competitor's product.

- **Consumer behaviour**: The buyer's attention can be attracted towards a product just because of the colour and design of the product packaging. According to researches the colour of packaging has a great impact on buying decisions of the product.
- **Packaging reflects on the brand of the product**: Consumers relate the style of packaging with the level and type of the brand. The product packaging helps buyers to differentiate from competitors products.
- **Protected packaging:** Protected packaging assures the consumer about the quality of the product. Poor packaging discourages the buyers as they are not able to trust the product.

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- **Eco-friendly packaging**: The material of the packaging which help to conserve the environment encourage buyers as they build a good image about the company.

The dynamics and impact of packaging prove that packaging is very essential for enhancing the sales of the product. In order to make the packaging appealing the producers incur high expenses in order to develop attractive and trendy packaging. The cost of packaging is estimated to be almost forty per cent of the product cost. The cost of product is paid by the consumer. The packaging is only the prelude to buying and has no other utility for the consumer; it is the product which gives the consumer service and satisfaction. Both the producers and the consumers have to realise that packaging often leads to wastage of resources and harms the environment and thus there is a strong need for developing 'smart packaging'.

5.3 COST REDUCTION IN PACKAGING

An important aspect of developing 'smart packaging' would be to find means to reduce the cost of packaging of a product. Research constantly indicates that departments handling the materials are trying to function with a serious stress on monitoring costs, evolving efficient practices and refining facilities for the consumers. The capability to secure and transport objects in an effective and practical style is considered to be one of the basic requirements of each producing and distributing business. The process of packaging is an area where the companies need to consider lowering the expenses without compromising on consumer contentment and environmental aspects. It has been realised during surveys that companies presently are investing profoundly on packaging costs of the product without consideration for the escalating product cost. Almost one-fourth of the manufacturer's complete resources budget is consumed on packaging elements and other constituents concerning logistics of packing.

Essential Factors of Packaging Cost

- In order to reduce the cost of packaging it is important to determine the areas where cost reductions are possible. This has to be done with reference to the market set up and cost reduction has to be attempted at not only the high costing factors in the distribution chain but the smaller components contributing to expenses have to be studied, like costs that are incurred prior to actual start of the production. The realisation has to start from the material from which the packaging is going to be made and not the product which is going to be packaged. According to Entrepreneur.com the cost of packaging is estimated to be ten per cent to forty per cent of a product's selling price. While figuring the strategy of sales the company must consider the total cost of packaging and cost of packaging each pack. This will help in realising the product cost.
- Strategies of packaging require considering features like dimension, colour and form of a product. All markets require different colours and forms of the products. For instance children's products need to be extra bright and require varied packaging as compared to the products belonging to the adult's age group. The product of a brand should be able to stand out amongst its competitors. Positioning a package well is bound to give a boost to the sales of the products.

Check Your Progress

1. What does preliminary costing include?
2. What does primal matter costs include?

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- The packaging should be such that it can fulfil the requirements of the consumer. All consumers have diverse requirements and wish to be able to easily use same product for various events. The packaging should be able to meet the requirement by being portable and functional at the same time. The information about the product should be provided on the package to be functional. Customer needs keep changing so the packaging should be able to evolve itself according to the changing needs.
- Packaging requires detailed research. The research will help in realising the trends in the market and help in designing packaging which suits the needs of the market.
- Eventually, the customer reins the price of the product. They will weigh the utility of the product and then decide whether the packaging will serve its value. The package designer should develop packages at the minimum feasible expenses.
- When substitute packages are present for a product, the product producer must choose the economical substitute. For instance, cream may be packed in a gable top tetra pack, PET cups, polyethylene-coated Kraft paper or bottles. Tetra packs and laminated Kraft paper need intricate equipment and are more practical for a large-scale production, the small scale manufacturer must opt for PET cups rather than other options so that they can reduce the prize of the cream.

Ways to Reduce Packaging Costs

While businesses are considering reducing costs, their primary emphasis is on changing the design of the product which needs to be packaged so that the amount of material used in the packaging can be decreased. Most businesses entirely ignore the alternative of improving the design of the packaging. Refining and amending the packaging design will help in cutting down the cost of packaging but at the same time will provide more safety to the product and conserve the environment. The companies will have to leave traditional ways of packaging and modernize their thinking and technique.

1. **Highlight research and improvement:** It is not right to assume that all boxes are same and all products can be packaged in a common package. The producers need to consecrate time to methodically explore and examine various design and material possibilities. Spending time initially in order to research properly will prevent later disappointment in shape of injured merchandises, unsatisfied consumers and cost of redesigning and wastage of raw material. Packaging ought to be competently deliberated and it should be sturdy to undertake all the shocks during transportation and distribution. Elements to consider in designing the packaging:
    - Overall price of materials
    - Resistant to tampering
    - Sturdiness during transportation
    - Comfort of handling
    - Appearance
    - Legal regulations

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2. **Ascertain essential vs. superfluous costs:** Enumerating the costs helps in determining the suitability of the packaging of the product. It outlines the best option which can perform the essential functions of packing and aspects which are only enhancing the graphics of the packaging. Ascertaining costs helps in realising the resourcefulness of the design and gives scope for improvement or eradicating features which are unnecessary. After the essential features are outlined the budget can be drawn. Factors to consider while judging essential and superfluous cost are:
   - Figuring out whether an inside box is required along with the external box.
   - Checking if the relevant and essential information is provided on the box
   - Colour printing is expensive and not required for all products. It is essential to see that is colour printing avoidable if the black and white colour scheme is able to work well with the product.
   - Providing a transparent space in the package provides an actual view of the product but such packaging cost more than just putting a photograph of the product. The option has to be selected wisely.
   - Checking whether each box needs a label, or the info can be written on the external package.
3. **Working out the exact size and strength of the package:** Packaging costs money so less packaging will help in reducing the cost of packaging. The exact dimensions of the product should be calculated before constructing its package; large box will not only cost more money but at the same time will create empty space in the package which can damage the product at the time of transportation and distribution. The strength of the package should be as per the weight of the product, light products which are breakable need firm packaging. The main aim of the packaging is to deliver the product in a useable state to the final consumer. The damaged package will result in wastage of funds, consumer dissatisfaction and finally spoil the reputation of the manufacturer. Reduced packaging does not mean inadequate packaging. A modern day example of reduction in packaging can be seen in bottled plastic bottles; various brands have made the bottles thinner without affecting the quality of the product. This has led not only reducing the cost of packaging but at the same time helps in conserving the environment. Factors to analyse while determining the size and durability of the package are:
   - Measurement of internal pack
   - Measurement of exterior container
   - Technical aspects of the container
   - Arrangement of stacking the containers on pallet
   - Alignment of containers while loading
   - Making up for container dunnage if required
4. **Opt for light-weight packaging:** Another way to reduce cost is by using less weighing packaging options without compromising on the safety of the product. The packaging should not only be lightweight but should be light in volume as well. Bulky items are bound to take up extra space in the container. Shipment cost is not always decided according to the weight of the product.

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5. **Constant testing is required:** The packaging for a product needs to be tested for various aspects other than durability. The amount of time the product is going to remain inside the packaging which will remain closed into another airtight shipping container can expose the product to high temperature which may not have been the case in other circumstances. The designers have to test the packaging as per such factors also. Properly analysing the process of transportation and making constant enhancements to improve functions of packaging will help in saving funds for the future handling. Factors to think through are:
   - Compression during stacking
   - Pulsation during transportation
   - Bearings
   - Weather variations
6. **Reconsideration the method of acquiring material:** Sometimes it is more feasible to procure the packaging or the raw material needed for developing packaging in small quantities as it helps in keeping the inventory low. This helps in preventing wastage and outdated inventory, particularly if the manufacturers like to alter the designing of the packaging sometime in future or they wish to keep adding new features to the product to beat the competition.
7. **Designing eco-friendly packaging:** The initial design itself should be based on using packaging material which is eco-friendly. The regulatory laws are against using packaging which is not recyclable or reusable. The awareness among the consumer is forcing the manufacturers to use options of packaging which are conserving the environment. Using recycled material for developing packaging costs relatively less as compared to using fresh material.
8. **Easy disposal of packaging:** This will help in reducing the waste. Increasing awareness among consumers is making them support companies which are environment friendly and are ready to use sustainable packaging as it helps in easy disposal of packaging after usage. Germany and England have implemented stringent rules on consumer product waste as a result consumers in these countries are very conscious about correct disposal of used packaging of products.
9. **Selecting sustainable constituents:** Choosing new environmental friendly packaging options will stop the usage of blister packs and clam shells and Styrofoam as these types of packaging are not easy to recycle and are often dumped into a landfill, where they take ages to degrade. Using biodegradable paper air bags or dunnage made out of natural fabric would be much preferred. With the advancement in technical know-how the markets are flooded with new products everyday; it is very essential for the producers to elevate their packaging in ways which improves the quality of service and not the price of the product. The manufacturers need to recognize extents for enhancement and cost-saving prospects. The task is to enhance the functions of the packaging without bearing high costs.

Check Your Progress

3. What elements should be considered while designing a product's packaging?
4. Why is it necessary to ascertain costs when designing a product's packaging?
5. Name two countries that have implemented stringent rules on consumer product waste.

5.4 PACKING FOR INVENTORY CONTROL

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All organisations have an organised system to monitor the movement of products and services within the organisation as well as outside; this system is referred to as the inventory management system. An establishment might adopt single method of maintaining the inventory or include multiple methods of inventory management. The method is as per the organisational requirements of the firm or establishment. Businesses utilize inventory management strategies to generate dispatch note and proof of purchase, create receipts and control inventory-related to statements of accounts which help in bookkeeping of bills and expenses.

Need for Inventory Control

The key function of **inventory control** is to enable well-organized conveyance of resources and merchandises according to the establishment's planned strategies. As mentioned in the book *Operations Management for Dummies* by Mary Ann Anderson, Edward J. Anderson and Geoffrey Parker; companies specifically hold inventories so that they are able to balance the demands of the customer and reduce the cost. According to Heather Wood of the Houston Chronicle, it can cost a lot of money for the company to hold inventory. The products stored in warehouses occupy space, need equipment and labour for shifting it from one place to another. The companies have to develop a system where they allocate only necessary space for holding inventory so that they can cut down on the cost. Moreover companies suffer enormous losses when they have to discard out-dated or expired goods as they are no longer saleable.

Inventory control: It is the process of ensuring that appropriate amounts of stock are maintained by a business, so as to be able to meet customer demand without delay while keeping the costs associated with holding stock to a minimum.

At the same time in case a producer maintains very low inventory level then there will be shortage of the product in the market which will lead to disappointed customers and the company will lose its patrons. According to Anderson et al. a shortage of goods can make the buyers unhappy and turn towards other options in the market. Hence, guaranteeing adequate supply of products in order to meet the demand is the main concern in inventory control.

Additional functions of inventory control include keeping materials and goods safe and trailing information and data about sales. Companies create procedures to maintain safety of handling of goods in warehouses. Companies are able to monitor the performance of product in the market with the help of various inventory control software programs.

When products are shipped then it is important not only to be able to track the inventory of the product but at the same time it is essential to track the shipping supplies as well. The packaging materials could be a basis of unused and repetition of expenditures. To contest the inclination of overspending on containers, crates, bubble wrap, shrink wrap, tools like machines and staplers, and labels for shipping, it is very essential to develop a strong system of tracking. Most companies order shipping supplies independently and thus this requires a separate tracking system.

Inventory of Packaging Supplies

- **Yearly figures**: Companies can take the inventory of their packaging supplies when the year starts and then conduct the inventory for the same supplies when

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Invoices: Commercial documents that itemizes a transaction between a buyer and a seller.

the year ends. If the two inventories do not justify each other then there is clear indication that the company is ordering excess of packaging material. In case there is less inventory of material at the end of the year then there is no wastage and over spending.

- **Invoices**: The **invoices** issued from the vendors can be used to keep a track on the amount of packing material that has been procured. Though, these invoices will only indicate the purchases and not the stock. The invoices will help in showing how much packaging material is being ordered each year and will outline the trend of the company.
- **Information from distribution-centre**: Companies which distribute from a number of places, they can track the inventory with the help of automated inventory-tracking system available at the distribution centre. This software permits the centre to give input about the existing supplies as well as the ones which are frequently reordered. This enables in giving an inventory for packing materials which is currently available. This is more useful than the annual approach.
- **Membership of purchasing-group**: Companies often find it useful to become members of various purchasing groups. There are organisations that procure materials for numerous parallel companies; therefore facilitating them by being eligible for quantity concessions. The record of orders placed with these groups helps in providing inventory of the materials that has been ordered.

Types of Inventory Control System

There are mainly two types of inventory control systems used by companies, namely manual and barcode systems. The selection of the system adopted by a company is determined by how usable the system is for the company. There is a third system which is an expensive option so few companies adopt this for keeping inventory – it is called the radio frequency identification inventory control system.

- A **manual inventory control system** is appropriate for small-scale production houses. This system is used by maintaining the spreadsheets to keep track of the purchase and sale of products. For example, an owner of a grocery shop can calculate his opening stock of a particular month by manually computing and recording the worth in the spreadsheet. A comparison can be made by counting the existing stock with the monthly orders of customers that are incomplete; this will decide the amount that consumers are expected to buy through the month and can be manually recorded on the spreadsheet. On the basis of these two records the shop owner can decide the amount of stock that is needed for a month in the shop.
- A **barcode inventory control system** is a precise and well-organized system that is appropriate for big retail shops and the inventory is maintained with the help of barcode technology. The computer deciphers the barcode on every product that is sold in the store. This data is stored by the computer which helps in running an inventory of the number of products left for sale and enables the personnel to procure stock based on this inventory.
- **Radio Frequency Identification (RFID) inventory system** is a more advanced system than the barcode inventory. Radio tags are attached to the

product. The plastic tag contains a programmable microchip and a small antenna. This tiny tag encompasses a large amount of information regarding the product and is deciphered using a hand-held reader. Though radio tags are costlier than bar codes, they can carry a lot of information about the product. The tags can give information about the complete pallet of tagged goods with just one scan. The information can be conveyed to other destinations where the product is going to be transported. The tags have an alarm system which can alert about any unwanted movement thus the tags help in keeping the product safe.

- Another system of maintaining inventory control is the **Japanese system called the Kanban** which helps to keep inventory levels; an indicator is showed to produce and supply a fresh shipment as material is expended. These indicators are traced with the help of the replenishment cycle and help in maintain reflectivity to dealers and buyers. This inventory control system is suited for supermarkets where the products for sale are placed on shelfs. In this system as soon as the last displayed product is lifted from the shelf a card is exposed which helps in providing the whereabouts in the stockroom where rest of the items can be located. The same card helps to provide information about the depleting number in the stockroom as well hence this helps in timely ordering of the item. This system helps in smooth functioning of the demand and supply chain.

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Kanban: It is a system in which the supply of components is regulated through the use of an instruction card sent along the production line.

5.5 VALUE ANALYSIS: PACKING AND VALUE ENGINEERING

The methodical system of increasing the 'value' of merchandise or products and services with the help of examining the functions is defined as Value Engineering (VE). Value can be defined as the ratio between function and cost. In order to increase the value there has to be an enhancement in the functions or reduction in the price of the product. It is a key principle of value engineering that rudimentary functions be conserved and should not be abridged in the quest for improving value. Value Engineering is sometimes called 'Value Management' or 'Value Methodology' (VM), and 'Value Analysis' (VA). VE is developed as an organized process which helps in solving problems on the basis of function investigation. It involves clear interpretation of the function. For instance, the function of soap is to help cleaning, once this is realised other materials which can perform the same cleaning function can be considered and the best option can be selected.

The rationale behind value engineering is as follows

When a product is expected to become essentially or stylistically outdated over a definite span of time, then the manufacturers may choose to develop the product making it better over the same period of time. The products might be constructed with high-quality constituents; however this is not done because of Value Engineering as this might levy a pointless cost on the producer as well as the buyer. Value engineering will help in reducing the unnecessary costs. A firm will usually employ the components which are low in costs and those which placate the manufactured goods shelf life predictions. Value Engineering is the system of planning and manufacturing packaging which is effective and smart at the same time. This may comprise the following:

Check Your Progress

6. What is the key function of inventory control?
7. What are the two main types of inventory control systems?
8. What is the name of the Japanese system of inventory control?

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- Keeping the quality intact and subtracting few of the aspects of the packaging
- Altering the size marginally
- Modifying structures to accomplish the identical look by cutting the expenses
- Providing essential information needed for using the product and cutting the unnecessary frills
- Refining manufacturing of labels by making it speedy and more well-organized application
- Changing the product packaging or labelling to enable effective usage.
- Wisely choosing the number of colours in printing
- Opt for cheaper material
- Considering the need for laminated or coated techniques
- Strength and thickness of the packaging can be modified as per the weight and fragility of the product.
- Manner in which the packaging is produced
- Well planned logistics

Persistent stress on cost cutting gives rise to Value Engineering of packaging materials. The idea is to use the finest design which costs the least. In today's times of unpredictable commercial environment, attaining all-out value at lowest cost is crucial for survival in the market. It is for this reason that Value Engineering; in the packaging arena has become indispensable. The Value Engineers try to reduce packaging expenditures without compromising on value, utility or risking the expressive charm of the brand. The value engineering can be done by altering the design, material usage, procedure followed for production or method adopted for transportation. In modern times where it is not always possible to reduce the cost of packaging the value engineering service put emphasis on other value adding forces such as expediency, excellence, time conserving, security, exclusiveness and sustainability. This approach is completely based on enhancing the function of the packaging by providing for simple usage, and greater shelf-life.

5.6 PACKAGING LAWS

The connection between packaging and consumer safety is of great importance. A package is considered as the means of transportation of safety and performs the task of transporting safe, healthy, nourishing food to the end user. In order to defend the wellbeing of the end user and the whole society, a number of laws and regulations have been implemented in the field of packaging.

Check Your Progress

9. Define value engineering (VE)?
10. Define value in value engineering.
11. What is the key principle of value engineering?

5.6.1 Consumer Protection in Food Packaging

Food packaging has to be done in suitable packaging. The packaging has to be compatible with the food item which it is going to be packed in it. The label of the food item must carry the symbol which certifies that the container in which food has been packed is suitable for food. There are separate regulations for various materials used in food packaging, such as plastics, ceramics or cellophane. The producers have to

obtain a 'declaration of compliance' from the packaging supplier to confirm that the material quality of the packaging is food friendly and will not affect the quality of the food and health of the user.

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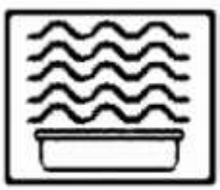
Common Symbols

Appropriate packaging has to carry the sign of wine glass along with a fork; these two images convey the message to the consumer that packaging is acceptable for food contact.

Food products containing ingredients which can cause an allergic reaction will always indicate this symbol with the allergy causing ingredient mentioned under the symbol, such as peanuts or milk products.



This is the symbol is placed on packaging of food items which are microwavable.

This symbol is seen on packaging of food products which are meant for freezing along with the packaging.

It is essential to make sure that food safety is maintained throughout the process of food production, packaging, handling, storage transportation and distribution. Adherence towards the prescribed rules is essential. There are various organisations which are working towards streamlining the process of food packaging and maintaining consumer safety by implementing regulations for food items which have to be packaged. Few of these are the US Food and Drug Administration and the US Department of Agriculture, the European Food Safety Authority. The food packaging companies have to constantly attain certification from programs such as the Global Food Safety

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Initiative. Food packaging concerns might contain regulations based on, using hazardous material and how to control, certification and endorsement procedures, good manufacturing practices, developing an active quality management system, development of systems for being able to track and trace, and necessities for extent of information on labels. Food items which are directly in contact with packaging material have to be packed in packaging which is compatible and safe for direct contact for long duration or till the consumption by the final user. The regulations are not just to be followed for the material of packaging but proper maintenance and cleaning of machinery which is used for packaging or production of product has to be maintained. There are regulations about the cleaning procedure and packaging environment of the food products. Usage of material which contains chemicals and can cause risks to the health of the consumer has to be controlled. Substances like carcinogens, toxic chemicals, mutagens etc. must be kept away from food contact and prevented from migrating into food items.

5.6.2 Consumer Protection in Food Packaging in India

In India, the packaging of food products is controlled by Food Safety and Standards Authority of India (FSSAI). The rules and regulations concerning food packaging are mentioned in the Food Safety and Standards (Packaging and Labelling) Regulations, 2011. The FSSAI clearly specifies that irrespective of the nature of the food, the packaging has to be tamper proof and should be as per the applicable regulations.

Common Necessities for Food Containers

The containers used for food packaging have to keep the product safe; they have to be of the following standards:

- The container has to be rust free.
- All containers have to be safely packed and properly sealed.
- The external part of the container cannot have too many dents, corroded surfaces, punctures and closure alterations.
- Container cannot be in a leaking state.
- Container with enamel coating should not be chipped or rusted.
- Copper or brass if used in can, it has to be adequately coated prior to usage.
- Aluminium Containers have to confirm to the IS:20 specification of the chemical composition it contains.
- Plastic containers material has to be as per the specification standards. They have to confirm with the Indian Standards Specification, meant for appliances or vessels for storing or packing food products. These specifications are:
    - IS : 10146 (Specification for Polyethylene in contact with foodstuffs)
    - IS : 10142 (Specification for Styrene Polymers in contact with foodstuffs)
    - IS: 10151 (Specification for Polyvinyl Chloride (PVC), in contact with foodstuffs)
    - IS: 10910 (Specification for Polypropylene in contact with foodstuffs)
    - IS : 11434 (Specification for Ionomer Resins in contact with foodstuffs)
    - IS: 11704 Specification for Ethylene Acrylic Acid (EAA) copolymer
    - IS: 12247 – Specification for Nylon 6 Polymer

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- IS: 13601 – Ethylene Vinyl Acetate (EVA)
- IS: 13576 – Ethylene Metha Acrylic Acid (EMAA)

- Containers made of tin and plastic meant for packaging edible oils and fats will not be re-used.

Common Packaging Necessities for Milk and Milk Products

The following aspects have to be kept in mind during packaging of milk and products made using milk:

- Bottling or filling of containers with Ultra-high temperature processed milk and milk product must be done mechanically and the fastening of the containers has to be automatic.
- Cover or package of milk products is not reused unless it is done in reusable containers which also have to be thoroughly cleaned and sanitized.
- The bottles or containers of UHT milk have to be immediately sealed after being filled with the help of the sealing device so that no external contaminants can affect the quality of the milk.
- After the milk products have been packaged they should be placed in appropriate environment for further storage.

Common Packaging Necessities for Edible Oil or Fat

The process of producing the tin containers (tinplate) for packaging edible oils and fats should be carried out as per the standards laid down by Bureau of Indian Standards. The stipulated guidelines are as under:

- The container has to be rust free.
- All containers have to be safely packed and properly sealed.
- The external part of the container cannot have too many dents, corroded surfaces, punctures and closure alterations.
- Container cannot be in a leaking state.
- Container with enamel coating should not be chipped or rusted.
- Copper or brass if used in can it has to be adequately coated prior to usage.
- Aluminium Containers have to confirm to the IS:20 specification of the chemical composition it contains.

Packaging Necessities for Fruits and Vegetables Products

The following things have to be kept in mind while packaging fruits and vegetable products:

- Containers meant for packaging have to be completely tamper proof. The seal is at the top or the neck of the container carries the licensing number and the particular classification mark of the manufacturer.
- The tinplate container used for packaging of canned fruits, juices and vegetables have to be hygienic and made as per the regulations.
- Bottles and jars meant for packaging fruits, juices and vegetables have to carry hermetic seals.

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- Bottles of juices, squashes, pulps, cordials, syrups, and various other liquid drinks have to be clean and well-sealed. The products meant for storage in freezers have to be packed in containers meant for such storage.
- Preserves, jams, jellies, and marmalades have to be packaged in hygienic jars with metal caps which are well secured.
- Pickles are supposed to be packed in hygienic bottles, jars. If tin containers are used then they have to be coated internally with a lining of polythene 250 gauge or suitable coating of lacquer has to be used to prevent it from reacting and oxidising.
- Tomato ketchups and sauces are bottled in hygienic bottles. In products where the acidity level of acetic acid is maintained at 0.5% an open top tin container can be used.
- Candied fruits and peels and dried fruits and vegetables can be packed in paper bags, cardboard or wooden boxes, new tins, bottles, jars, aluminium and other suitable approved containers.
- Aseptic and flexible packaging material which confirms to the standards of BIS can be used as alternate packaging for fruits and vegetable products.

Packaging Necessities for Canned Meat Products

The following things have to be kept in mind while packaging canned meat products:

- Open Top Sanitary Cans (OTSC) approved by IS:9396-2 have to be used for packaging canned meat products. These cans have to be internally coated with lacquer so that the foodstuff does not react with the metal can. The coating should not react with sulphur and has to be insoluble in fat and salt water. The cans have to be completely airtight after sealing.
- The containers in which minced pork is packaged have to contain an inner coating of safe to eat gelatine or lard. It can be layered by using vegetable parchment paper prior to filling.
- The airtight containers used for packaging meat products should be designed to be able to retain the food quality throughout the process of distribution.

Packaging Necessities for Drinking Water

The packaging of drinking water has to be done in dirt-free, sanitized, colourless, clear and tamper resistant bottles or cups. The bottles or cups have to be prepared using:

- Polyethylene (PE) meeting the requirements of IS:10146
- Polyvinyl chloride (PVC) meeting the requirements of IS : 10151
- Polyalkylene terephthalate (PET and PBT) meeting the requirements of IS : 12252
- Polypropylene meeting the requirements to IS : 10910

Food grade polycarbonate or sterilized glass bottles which are tamper proof and are able to maintain the quality of water. Plastic origin packaging material has to confirm to the approved general migration and colour migration restrictions.

Check Your Progress

12. Which organisation lays down guidelines for food packaging in India?
13. Which Indian organisation regulates and stipulates guidelines for producing the tin containers (tinplate) for packaging edible oils and fats?

5.7 MARKING AND LABELLING

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The packaged goods meant for transporting and distribution have to be accurately branded, filled, labelled, marked and documented by the producers and packagers. The labelling and marking should be done with conformity of national and international shipping regulations. Guaranteeing labelling and marking requirements is crucial in the secure transportation of goods. It is universal for each product which needs to be marketed to enclose various types of markings in form of tag, silkscreen, impression, stamping. Each standard of safety has clear mention about the importance of labelling and marking. Label of the product is the most frequently used and recognised marking used by majority of the products. Product label carries all the essential information such as electrical rating, advisory, cautioning announcement, usage instructions or mechanism instructions. The labelling process because of its signification to the packaging industry has to be undertaken keeping in mind all the standard regulations so that the label is able to endure all the handling and distribution ups and downs along with the product. The written matter or the visuals have to be smudge resistant and eligible till the packaging is disposed.

Label specifications of food and beverages products

The label must contain the following elements:

- The content should be apparent and simple to read
- Lasting and stable
- Easily comprehendible
- Perfect visibility
- Should not be confusing and ambiguous
- Should contain essential information
- List all the ingredients
- Carry the advisory statements
- Label of wines has to list the required information as per the regulations
- The name of the foodstuff
- Clear mentioning of 'best before' or 'use by' date. The package must specify the part of the label where the information is displayed on the label.
- The name and address of the producer, packaged by or sold by details have to be included
- The country of origin, if necessary
- The lot number
- Specific storage conditions
- Directions for consuming or steps of cooking/heating, if required
- Net quantity of the product

Information about the net quantity: Quantity information on the package must have net quantity in grams, kilograms, millilitres or litres on the label of all the packages which weigh more than five grams or five millilitres for liquids. In case solid food is

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packaged in liquid state then the actual drained weight should be mentioned. The quantity should be mentioned close to the name of the product on the label as this helps in instantly getting relevant information. The strength of alcohol in a beverage must be mentioned along with the quantity. Food products sold as per their numbers do not have to mention the volume or weight of the product. Provided the number of the items mentioned is visible through the packaging.

Labelling for ingredients list: The edible products which contain more than two ingredients have to provide a list of all the constituents in the product; this list has to include the additives as well as the preservatives. The list must be provided in a descending order. The list must contain:

- The first ingredient is the main ingredient and then all other ingredients.
- Quantities of the ingredients, quantities are mentioned in weight or percentage.
- Names of substance which can cause an allergic reaction. These names should be very prominent hence can be done by using a varied colour or font. Some common allergens are celery, cereals with gluten, crustaceans like prawns, eggs, milk products, nuts especially peanuts or sesame seeds.
- Product containing more than 10 mg per kilogram/litre of sulphur dioxide.
- Food and drink advisory about the ingredients of the products which can be dangerous for health if consumed in high quantities.

Nutrition labelling: This is an essential part of the label and needs to contain true and relevant information about the product. In case a product makes claims about the nutritive aspects of the ingredients used then rules have to followed, for instance 'low fat', and 'improves bones'. The product cannot make claims about treating, preventing or curing any ailment. There are regulations which have to be followed while manufacturing, marketing or distributing food supplements, fortified foods, baby milk formula, infant foods, food for weight control, medical foods. In few countries like United Kingdom permit has to be obtained from the health department to sell instant formula or food with medical benefits.

Labelling for organic food: The label of organic products can assert itself as 'organic' only if food is prepared through processes that conform to the standards of organic farming. Standards fluctuate all around the world, but organic farming is done following the resource cycle in order to promote ecological equilibrium, and preserve environment. Producers marketing organic products might control the usage of few pesticides and fertilizers in farming. Organic foods cannot be generally developed via irradiation, industrial solvents or synthetic food additives.

Presently, in countries like the United States, Canada, Mexico, Japan, and many countries in Europe need manufacturer to attain specific documentation to be able to market organic foods. Food labels claiming to be organic produce can do so if during production all the regulations have been complied with. Retailing food with an organic label is monitored by parliamentary food safety authorities, namely the US Department of Agriculture (USDA) or European Commission (EC). Organic certification can be attained by one of the organic food controlling agencies. After registering the producers have to follow prescribed national as well as international labelling regulations. Records have to be maintained and permit yearly inspections to take place.

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There are few products which are excused from the Consumer Packaging and Labelling Act and Regulations; these are mostly products which are not displayed in retail outlets:

- Medicines and medical devices for hospitals
- Commercial products for industrial or institutional use only
- Products meant for export
- Products sold at duty-free store
- Pre-packaged textile products
- Alternative parts for consumer durables such as cars and appliances which are not displayed to the consumer
- Specific artist's materials

Labelling helps in identification of products. It helps consumers to differentiate one product from another. Labels help in spreading awareness among the consumers regarding the product and adequate disposal of the packaging.

Types of Labelling

- **Branded product labels**: These are for products which are produced by leading companies and the label helps in establishing their identity and promotion of the brand. These convey the information about the product and an insight about the manufacturer. Products need to be branded to help with identification and play a key role in company brand building programs. Branded product labels need to be securely bonded to the product surface in a way that is best suited to that product. The branded labels can be removable labels or un-removable labels. The un-removable are permanent in nature and are not easy to separate from the product. The removable are temporary and need not stay with the product till the final usage.
- **Information labels**: These are meant for consumer products specifically food products. These are meant to convey information about the nature, usage and other aspects related to food ingredients.
- **Other product label**: These cover mostly general products which are available in national and international markets. These carry general information about handling of the product.

The process of marketing cannot take place without proper labelling of products. The labels act as a guide of the product. It helps in attracting the buyer's attention. It is essential to design the label in such a way that it instantly tempts the consumer to purchase the product.

5.8 ECO-FRIENDLY PACKAGING FOR EXPORTS

All business proprietors have the duty to package their products into an appropriate packaging. The process of selecting packaging involves considering factors like expenses, materials to be used and many other logistics. The new trend in packaging today is to use eco-friendly packaging, and many large packaging companies are offering their products with packaging which is environment friendly. The trend of using eco-friendly packaging has become a universal trend and most export houses

Check Your Progress

14. What information does a product label necessarily carry?
15. What are the three types of labelling?

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are opting to use this option not only for consideration to the environment and well-being of the people but they are doing it for their image building as well.

There are several benefits of eco-friendly packaging

- **Healthier for environment**: The main advantage of using eco-friendly packaging is because of its positive impact on the environment. Eco-friendly packaging is generally prepared by using recyclable supplies this helps in reducing the wastage of natural resources. Moreover, the production process of such packaging helps in conserving the environment. The nature of raw material used during the process is eco-friendly.
- **Trouble-free disposal**: The eco-friendly packaging helps to save the environmental resources from start till the end. The production process helps to conserve recourses, the usage of such packaging helps the product maintain its quality and the positive impact is felt in the easy disposal as well. Most of the eco-friendly packaging is easily recycled or compostable. The packaging is conveniently biodegradable. Some of the packaging is designed to be reused.
- **Adaptable**: This packaging can be used to package various products. It is not just suitable for electronic or wellness industry but can be freely used to package food products, cosmetics, etc.
- **No damaging plastics**: Eco-friendly packaging uses plastic which can be easily recycled and completely avoid the non-recyclable plastic variety. The idea is to use sustainable packaging so that the health concerns related to plastic usage with food products can be resolved.
- **Reflection of positive image**: Another significant advantage of using eco-friendly packaging is that it enhances the brand and the name of the manufacturer. The consumer respects the brands which makes efforts to conserve the environment as this shows that they care about the well-being of the people in the society. The brand manages to attract consumers and creates goodwill for the company.

5.9 SCIENTIFIC PACKAGING

The conventional packaging material has started to show its effects on the environment. Most of the traditional packaging material is made of plastic and much thought has not been given about the recyclability of plastic. Some of the plastic based packaging like bubble wrapper or packaging peanuts contain substances which are very harmful for the environment. Expansion in awareness about the environment has led to usage of various recyclable and biodegradable packaging materials which is being developed due to advancement in scientific technology. The application of scientific packaging is not only improving the function of the packaging but helping in reducing the cost of packaging as well.

Scientific packaging is a vast area which needs to start from the time the packaging design is conceptualised and ends only after the product has been delivered to the final user. It has to be implemented at all the stages of production. Introducing scientific packaging in all the processes involved in product packaging would help in desired results. Package science would contain all aspects of industrial engineering, material

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science, marketing and all the logistical aspects of distribution of the product. The engineers working on design of the packaging need to collaborate research and development process with the production process. They have to consider the market, graphic design, regulations, saleability, usability and disposal of the packaging. Scientific packaging will enable the product to remain safe and sale worthy along with maintaining its utility and cost effectiveness. The development in the field of scientific packaging has led to exceptional growth in packaging material which is lightweight yet efficient, corrugated boxes with external as well as internal coating to make it weather resistant. The scientific development in packaging has enabled the manufacturers to conveniently replace material which are harmful for the environment and fail to provide adequate protection to the product. Scientific packaging confirms to all the regulations laid down by the regulating authorities, provides additional consumer satisfaction and it is able to upkeep with the latest fluctuating trends of the market without increasing the cost of packaging too much.

Features of Scientific Packaging

- Scientific packaging will exhibit compatibility with the product from every aspect. Engineers build packages from a large range of firm and flexible materials. Few of the materials have grooves which allow the packaging material to be flexible and take the shape as per the product. The technological development in field of packaging has made it possible to use technologies like extrusion, thermoforming, moulding, etc. in the process of developing the packaging. Packages are able to bear the strain during elevated speed fabrication, filling, processing and transportations. Packaging engineers are able to improve the strength of the packages without much alteration to the size and weight with the help of scientifically analysis of the structure and heat exposures experienced during the production process. There are many standards testing which are conducted so that the final package is completely compatible with the product.
- With the help of scientific packaging strategies are being developed to create sustainable designs so that the packaging is eco-friendly. This advancement is helping the packagers to realise that covering the product with too many layers is not required. Reducing the weight and bulk of the packaging helps in reducing the costs incurred during shipment. The technical aspects of packaging have resulted in increased usage of recyclable and reusable material. Many packaged bottles can be reused because of availability of machines which can sanitise the used bottles and make them fit for refilling.
- Alternatives have been found for securing the product instead of using the bubble wrap or packing peanuts as stuffing and cushioning. These not only harm the environment as they do not breakdown easily but are unsafe for human health as well. The main ingredient of these packaging materials is Polystyrene which contains benzene and styrene; both are carcinogenic which can have ill effects on the health of the workers. Scientific research has made it possible to replace polystyrene with natural starches; these are used for manufacturing of packing peanuts and can be conveniently recycled. Bubble wrap has been replaced by paper based packaging which helps in performing the similar functions and can be easily recycled.

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- Scientific packaging has enable companies to adopt greener material options for packaging and save the environment. Various researches and technological experiments are helping the packagers to incorporate material which is not only cheaper but better for the environment.
- Development in methods of scientific packaging has helped in creating packing as per the need of the product. The packaging is developed after analysing the nature and distribution chain of the product. This method assesses the impact of climatic and dimensional aspects before formulating the package so that it can provide maximum safety. The package will contain barriers as per this analysis. The material required for packaging will be selected on the basis of the barriers required in the package. The scientific packaging has helped in providing effective packaging for most products but this technology has been especially beneficial for the food and pharmaceutical products.

5.10 STANDARDIZATION IN PACKAGING

Standardisation: It is the application of regulations for a systematic functioning of particular activity.

Application of regulations for a systematic functioning of particular activity is defined as **standardisation**. The process is beneficial for all participants of the activity and thus it requires equal cooperation from all involved in the activity. The end result of standardisation benefits the society as a whole. The production of the product has to be undertaken considering all functional as well as safety measures. Standardisation requires the involvement of technology, scientific research and individual experience. The efforts of maintaining standards in present activities help in future advancements and growth. Prescribing standards in the packaging industry enables expansion of national as well as international exports which has a positive impact on the economy of every country.

There are a number of components of standards. These might contain:

- Standard specifications of products and their materials
- Policy standards
- Standard for testing techniques
- Standard for labelling the product which may include terms, symbols, colour schemes, arrangement, information, etc
- Standard for process of sampling
- Standards for conducting assessment
- Criterion for compliance

The standardisation may be conducted at various levels, such as individual, standards of a firm, association, country, or international standards. The standards of each level will be different and can be based on simple or specific aspects.

Standardisation has many advantages to various people involved in the cycle of distribution.

To the Manufacturer:

- Helps in accounting for the process of production
- Better management of raw materials and procedure of production
- Improved rate of production

Check Your Progress

16. What kind of material is used for eco-friendly packaging?
17. What are the two carcinogenic ingredients of Polystyrene?

- Diminution of inventories
- Overall increase in sales and profits

To the Consumer:

- Guarantee of product quality
- Value for money
- Transparency of products
- Prevention of duplication and forgery

To the Industry:

- Deliveries on time
- Clear cut rules for accepted and unaccepted products
- Uniformity in dealings
- Stable markets
- Avenues for exports
- Uniformity in handling and transportation costs
- Better working environment

Packaging is done for the benefit of the consumer and the cost of packaging is included into the product cost hence the consumer indirectly bears the cost of packaging. Standardisation of product should cater to all the aspects which have an impact on the consumer's life. These aspects would include standards for security, healthiness, suitability for purpose, ease and dependability. Standards will need to include environment safety and conserving the natural resources.

5.11 SUMMARY

Some of the important concepts discussed in this unit are:

- Product packaging is an important part of product manufacturing as packaging establishes the identity of the product. All companies have to develop smart strategies for their product packaging.
- Package is inevitable in the present-day value addition of products. The second inevitable aspect is the cost which is involved in packaging which can sometimes be a very considerable amount when compared to the product itself.
- A product's packaging can be the selling aspect of the product as the packaging is experienced before the customer experiences the product. The package reflects on the product's image. The right packaging can make the consumer choose a particular product over the competitor's product.
- The dynamics and impact of packaging prove that the packaging is very essential for enhancing the sales of the product. In order to make the packaging appealing the producers incur high expenses in order to develop attractive and trendy packaging. The cost of packaging is estimated to be almost forty percent of the product cost. The cost of product is paid by the consumer.

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Check Your Progress

18. What is standardization in packaging?
19. What is the benefit of prescribing standards in the packaging industry?

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- An important aspect of developing 'smart packaging' would be to find means to reduce the cost of packaging of a product. Research constantly indicates that departments handling the materials are trying to function with a serious stress on monitoring costs, evolving efficient practices and refining facilities for the consumers.
- While businesses are considering reducing costs, their primary emphasis is on changing the design of the product which needs to be packaged so that the amount of material used in the packaging can be decreased.
- Packaging costs money so less packaging will help in reducing the cost of packaging. The exact dimensions of the product should be calculated before constructing its package; large box will not only cost more money but at the same time will create empty space in the package which can damage the product at the time of transportation and distribution.
- The strength of the package should be as per the weight of the product, light products which are breakable need firm packaging.
- All organisations have an organised system to monitor the movement of products and services within the organisation as well as outside; this system is referred to as the inventory management system.
- The key function of inventory control is to enable well-organized conveyance of resources and merchandises according to the establishment's planned strategies.
- There are mainly two types of inventory control systems used by companies, namely - manual and barcode systems. The selection of the system adopted by a company is determined by how usable the system for the company.
- The methodical system of increasing the 'value' of merchandise or products and services with the help of examining the functions is defined as value engineering (VE).
- The connection between packaging and consumer safety is of great importance. A package is considered as the means of transportation of safety and performs the task of transporting safe, healthy, nourishing food to the end user.
- The packaged goods meant for transporting and distribution have to be accurately branded, filled, labelled, marked and documented by the producers and packagers. The labelling and marking should be done with conformity of national and international shipping regulations. Guaranteeing labelling and marking requirements is crucial in the secure transportation of goods.
- The new trend in packaging today is to use eco-friendly packaging, and many large packaging companies are offering their products with packaging which is environment friendly.
- Scientific packaging is a vast area which needs to start from the time the packaging design is conceptualised and ends only after the product has been delivered to the final user. It has to be implemented at all the stages of production.
- Application of regulations for a systematic functioning of particular activity is defined as Standardisation. The process is beneficial for all participants of the activity and thus it requires equal cooperation from all involved in the activity. The end result of standardisation benefits the society as a whole.

5.12 ANSWERS TO 'CHECK YOUR QUESTIONS'

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1. Preliminary costing encompasses manufacturing costs for starting the production and includes cost of equipment required for producing and the desired packaging such as dies, moulds, etc.
2. Primal matter costs includes obtaining of materials necessary for marketing, primary, secondary and tertiary packaging.
3. While designing a product's packaging the following elements should be considered:
   - Overall price of materials
   - Resistant to tampering
   - Sturdiness during transportation
   - Comfort of handling
   - Appearance
   - Legal regulations
4. Ascertaining costs helps in realising the resourcefulness of the design and gives scope for improvement or eradicating features which are unnecessary.
5. The two countries that have implemented stringent rules on consumer product waste are Germany and England.
6. The key function of inventory control is to enable well-organized conveyance of resources and merchandises according to the establishment's planned strategies.
7. There are mainly two types of inventory control systems used by companies, namely – manual and barcode systems.
8. The Japanese system of inventory control is called the Kanban system.
9. The methodical system of increasing the 'value' of merchandise or products and services with the help of examining the functions is defined as value engineering (VE).
10. Value can be defined as the ratio between function and cost.
11. In order to increase the value there has to be an enhancement in the functions or reduction in the price of the product. It is a key principle of value engineering that rudimentary functions be conserved and should not be abridged in the quest for improving value.
12. In India, the packaging of food products is controlled by Food Safety and Standards Authority of India (FSSAI).
13. The process of producing the tin containers (tinplate) for packaging edible oils and fats should be carried out as per the standards laid down by Bureau of Indian Standards.
14. Product label carries all the essential information such as electrical rating, advisory, cautioning announcement, usage instructions or mechanism instructions.
15. The three types of labelling are branded product labels, information labels and other product labels.

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16. Eco-friendly packaging is generally prepared by using recyclable supplies. This helps in reducing the wastage of natural resources.
17. The main ingredient of these packaging materials is Polystyrene which contains benzene and styrene.
18. Application of regulations for a systematic functioning of particular activity is defined as standardisation.
19. Prescribing standards in the packaging industry enables expansion of national as well as international exports which has a positive impact on the economy of every country.

5.13 QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are the factors that need to be considered while judging essential and superfluous cost?
2. What are the factors that need to be analysed while determining the size and durability of the package?
3. Discuss the different types of inventory control systems.
4. What is the need for inventory control?
5. What is the rationale behind value engineering?
6. What are the common standards for designing food containers?
7. What aspects have to be kept in mind during packaging of milk and products made using milk?
8. Mention the things which have to be kept in mind while packaging drinking water or mineral water.
9. What are the label specifications of food and beverages products?
10. What is nutrition labelling?

Long-Answer Questions

1. Discuss the impact of packaging on product's selling ability.
2. Discuss the essential factors of packaging cost.
3. Explain consumer protection in food packaging.
4. What are the packaging necessities for fruits and vegetables products?
5. Discuss the benefits of eco-friendly packaging.
6. Describe the features of scientific packaging.
7. Discuss the benefits of standardisation in packaging to manufacturers.

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UNIT 6 PACKAGING INDUSTRY PROCESS AND MACHINERY

Structure

6.0 INTRODUCTION

Packaging has a significant part in endorsing, guarding and transferring of products. Insufficient analysis of package design or materials can result in making the brand incur losses and gain a bad reputation. The motto of the World Packaging Organizations (WPO) is, 'Better Quality of Life through Better Packaging' and this clearly elaborates the significance packaging has in the current manufacturing processes. To guarantee that people continue to buy products industries have to pay attention to their primary concerns like assemblage, separation and reusing the packaging supplies and following the necessary regulations throughout the process. This unit will discuss these aspects in detail.

6.1 UNIT OBJECTIVES

After studying this unit you will be able to:

- Discuss the packaging demands of the consumer goods industry
- Analyse the technology trends in the packing industry
- Study the various types of packaging processes
- Evaluate the various types of packaging machinery

6.2 PACKAGING DEMANDS OF CONSUMER GOODS INDUSTRY

Consumer goods packaging is the kind of packaging intended to be used in a retail business setting. The ever-changing requirements of the contemporary users have made consumer goods packaging to be exceedingly multifarious and inventive business. Things that fall in the category of consumer goods are electronic appliances, household devices, food and beverages and various household daily use items. Packaging is the most

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essential part of the distribution process. A package has to fulfil the following demands to be effective:

- **Adaptability**: Present consumer goods packaging needs to exhibit an implausible multiplicity of resolutions and adequately respond to the variety of consumer requirements. For instance, the awareness among the shoppers has forced the producers to adopt packaging material which is eco-friendly.
- **Marketing Value**: The consumer goods packaging should be done in such a way that it enhances the value of the product for the user. This is achieved by ensuring that the product is delivered to the end user safely and the consumer is able to easily use the product. The product will be easy to use if all the relevant information about the product is placed in the correct manner.
- **Guarding Authenticity**: It is essential that the packaged products are of the quality and quantity which is mentioned on the package and is as per the expectations of the consumer. It is a crucial requirement of the package to be genuine and this is achieved by adding features in the package which are tamper resistant and tamper evident.
- **Suitable For Retail Display**: The package should be adequately appealing to look at so that the consumer is attempted to instantly purchase the product
- **Adequate Communication**: The consumer goods packaging is meant to convey the necessary information about the contents and the ingredients of the product. Packaging provides a perfect standard for conveying information to the consumer about the product; hence, the extra resourceful and smart information is sure to derive extra sales.
- **Convenience of Placement**: The packagers must consider the space limitation in departmental stores and supermarkets. The product weight and volume should be such that it can fit easily on the shelf space of the store.
- **Eco-Friendly Packaging**: Modern packaging has to fulfil the demand of being reusable or recyclable so that the environment is not harmed. The material of the packaging has to be environment friendly and along with that the packaging must carry all the steps for safe disposal of the package so that the consumer is able to perform his part in keeping the environment safe.
- **Cost Effective and Maximum Efficiency**: The product packages which are able to provide these two features are bound to be successful. The packagers have to be inventive and create packages which can provide these features. The designers are constantly making efforts to find packaging solutions which can cost less and are able to keep the product safe and usable.

Presentation and advertisings play an essential part in increasing the saleability of a product; however, the promotion by the consumer through his personal experience is much more effective for the sale of the product. With the expansion in the demand for consumer goods the packaging for these goods is also on the rise. There is a demand for sustainable material packaging which promotes a green environment. The consumers are now interested in using products with packaging which is going to preserve the environment for the future. There has been massive flare-up of development in hypermarkets and utility stores; this has led to the development of packaging industry. The industry needs to act efficiently and trustworthily to provide for consumer goods

packaging. Major consumer goods packaging companies that are established globally and generate high revenues are namely, ALPLA, Amcor, Ball Corporation, Graphic Packaging, Rexam, Mondi, Toyo Seikan, and Reynolds Group Holding.

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6.3 PACKAGING DEMANDS OF INDUSTRY USERS

Industries function in order to generate income by undertaking various activities to produce goods. The only industry which creates wealth by manufacturing activities, and at the same time, helps in conserving the income of other companies is the packaging industry. The packaging industry helps in adding value to the products which cannot be distributed without being packed. The packaging enhances the appeal of the product besides protecting the product till it reaches the final user. The packaging industry helps manufacturing companies by increasing the shelf-life of the product and maintaining the quality. The producers can produce goods but they will reach the market for consumption only after they are packed. There is no product which is manufactured and not packaged. The packaging industry indirectly serves the economy of the country as it is instrumental in preservation and distribution of numerous products ranging from daily use household items like milk, grocery fruits vegetable, medicines or electronic goods or even industrial machinery and equipment which needs to be transported to various parts. At present, even basic commodity like water has to be packaged so that it can be consumed safely. Packaging is a much broader activity than packing, and is recognised as a crucial activity for economic development. The packaging of all the products should be done to suit the preference of the customer. The products which do not suit the consumer fail to get a share in the market. Intensified competition among products has led to smart and cost effective packaging options. The packaging of food and medicinal products has become exceedingly sophisticated and specialised. The packing materials used in these sectors are chosen keeping in mind the preservation of the environment.

Functions of Packaging Industry to Industrial Users

Some of the functions of the packaging industry to industrial users are as follows:

- **Encompassment**: All products need to be encompassed prior to moving to another place. The package can function effectively only after the product has been encompassed into the package. The function of encompassment helps in safeguarding the environment. In case the packaging is faulty or inadequate it can result in leakage or breakage of the product. Sometimes the packages contain hazardous substances which can cause lot of harm if spilling or leakage takes place. This will lead to losses for the producers as well as harm the environment.
- **Maintenance and Security**: The basic function of the package is to protect the product throughout the supply chain. The packaging industry is constantly involved in developing packaging which can easily perform the basic function. The package has to protect as well as maintain the quality of the product till it reaches the end user. The product has to be protected from high temperatures, humidity, contaminants and theft.

Check Your Progress

1. Name five essential elements that an effective packaging must have.
2. List major international goods packing companies that generates high revenues.

- **Additional Product Security**: Packaging helps in securing the breakable item by providing stuffing and cushioning for the product. The packaging industry is not just involved in creating the packaging to carry the product but its purpose is to provide extra protection with the provision of stuffing like shredded papers, sheets of corrugated paperboard, bubbled plastic or casings. Advancements in technology in the packaging industry has made it possible to package food without spoiling the quality and has reduced wastage.
- **Better Transmission of Data**: The packaging industry tries to function on the slogan, 'A package must protect what it sells and sell what it protects'. Present systems of retail market will not function if adequate messages are not communicated to the consumer. The packaging must carry all the relevant information about the way the product is supposed to be handled at the time of shipment. Heavy products should clearly mention the weight and method of handling symbols should be easy to locate on the package. The information provided on packaging lets the end user to make conversant choices about the product's procurement and usage.
- **Suitability**: Packaging helps in delivering a variety of products to the consumers as packaging is designed to suit the nature of each product. The packaging industry helps the manufacturer to be able to cater to varied needs of the modern consumer. Today it is easy to package ready to eat meals, frozen foods, etc. The packaging industry has been able to support the needs of the industries providing such products by developing packs which can retain the freshness of cooked food, microwavable vessels for heat and serve food items, frozen food packing where provision is made to regulate the temperatures throughout the distribution process. The packaging not only provides protection to the product it also manages to retain its original quality. Medical products like live organs can be transported from one place to another due to the advancement in packaging industry and logistical support.
- **Conservational Features**: Packaging decreases the quantity of waste being dumped in the landfill. The industrial growth requires more packaging and there is a need to develop packaging which is able to conserve natural resources. The product is consumed by the consumer and increased variety of products has initiated the need to properly dispose the packaging. The packaging has to be recyclable so that it can be disposed adequately.
- **Tamper-proof Packaging**: Products are being placed in self-serviced supermarkets and they need to be provided with packaging which cannot be easily manhandled or pilfered. Tamper-proofing saves the manufacturer from losing products during distribution and transportation.
- **Fast Changing Trends**: Increasing competition and availability of multiple choices makes the consumer fluctuating from one product to another. The manufacturers need to keep up with the fluctuations in demand with the help of the packaging of the product. The package should be adaptable to the changing trends of the market. Packaging supports in selling products as it provides distinction, appeal, better brand alertness and suitability. The constantly shifting requirement of shoppers entails sophisticated graphic features graphics which help in promoting the product and identification of the brand.

Factors responsible for the growing demands of industries on the packaging industry in India are as follows:

- **Development and Rapid Urbanisation**: Up-to-date technology is essential for the society in order to meet the demand of product packaging to be exclusive in nature. With the rise in consumerism, norms of urban society are spreading to rural parts of the country. The impact of **globalisation** has led to increase in international brands in India. With liberalization of the country's economy, the expansion in exports has made it essential for the quality of both primary as well as secondary packaging to be of an improved standard. Moreover, industrial development and predictable appearance of the systematized consumer goods industry is stimulating the progress of packaging industry.
- **Growing Health Concerns**: Today, people are becoming aware about the ill-effects of buying cooked food packed in newspaper or plastic bags. They are willing to pay for appropriate packing and company products rather than open unlabelled items. They are slowly becoming aware of health hazards of using plastic container which are not compatible with the nature of the foodstuff.
- **Low Buying Capacity**: Sometimes people prefer to buy small quantities as they cost less and are affordable for the common man. Most households in order to avoid wastage prefer to buy the smallest of the packaging available. A large variety of options prompts buyers to try various brands. Thus, they prefer to buy the smaller less priced pack rather than one an expensive bigger pack. The packaging industry has to package products to suit every section of the population and provide packaging which suits their budget.
- **Rapidly Growing Economy**: The growth rate of the economy is fast and has resulted in having a positive impact on the retail goods market. The economic growth is giving a boost to the purchasing power of many in the society.
- **Changing Lifestyle and Growth of Nuclear Families**: The society has more working people which increases the demand for packaged and ready to eat meals as their fast-track lifestyle does not leave time for cooking food on a daily basis. The nuclear family setup is also adding to the need for cooked options for packaged food. The exposure to international cuisines has led to demand for products like pasta, noodles, and various sauces and spices. The changing taste is increasing the demand for such products and at the same time powering the advancement in packaging these products.
- **Increasing Demand for Packaged products in Rural India**: The manufacturers are packaging low priced small packs of their products to sell in villages and small towns where people are keen to purchase small packing as they lack adequate storage facilities and have fewer funds to spare.
- **Awareness has led to Green Packaging**: People are becoming aware about disposal and manufacturing issues pertaining to most packaging material. They like to buy products with packaging that are easily recyclable or reusable. The production of certain plastic packaging emits chemicals into the environment which pollute the air. Paper packaging is slowly depleting the trees and causing global warming.

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Globalisation: It is the process by which businesses or other organizations develop international influence or start operating on an international scale.

Check Your Progress

3. What is the significance of the packaging industry to manufacturing companies?
4. List the factors responsible for increasing the demands made by industries on the packaging industry in India.

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6.4 TECHNOLOGY TRENDS IN PACKING INDUSTRY

Consumers are frequently altering their views about how they want their product packaging to function. All packaging producers and manufacturers of products need to be vigilant about the changing trends. They have to consider the trends prevailing in the market before designing the packaging of the product. The changing needs of the consumer require the technology of packaging to be at par so that it can accommodate the demands of the market. The latest packaging has to be compatible with the consumer requirements, as well as the product, and its producers. The packaging has to be able to capitalize the competition in the market. The technological advancement in the packaging industry has enabled the product packaging to be convenient and traceable.

Advancements in technology has to keep up with the following trends of the packing industry:

- **Sustainability**: Shoppers are changing their buying habits so that they can resolve the issues related to environment. They are no longer insensitive to facts about depleting ozone layer or ill-effects of deforestation as slowly the people all over the world have started to bear the brunt of carelessness towards natural resources. Consumers are aggressively trying to convey to the manufacturers that they will only use products which have been packaged using eco-friendly packaging. Today, the key to attracting and retaining buyers is to adopt green packaging for the products. The manufacturers have to adapt technical know-how which enables them to design the sustainable packaging. Sustainable packaging is a trend which has come to stay and it is not just a myth. This has been further elaborated by a strategy expert of PWC (PricewaterhouseCoopers), who says that adopting sustainable practices has become indispensable for the reputation and personality of a brand. In an attempt to become most the preferred sports brand, Puma developed sustainable packaging and they realised that there was an incline in their profits throughout their supply chain due to their sensitivity towards the environment. As a result of this achievement they have enhanced their efforts to introduce higher sustainability and inspire more consumers to become a part of their green achievements. It appears that sustainability is not just an add-on option for the packaging industry. Today, it has become the most crucial aspect of being able to sustain the competition in the market. The consumer wants to buy the product only after they know the origin, process and recycling prospects of the product.
- **Need to provide the health credentials of the product**: The trend of healthy living in society has become a chief trend for the packaging industry. People know the difference between healthy and not healthy not just for themselves but for the environment as well. They want that the product packaging must clearly mention the health benefits of the product accurately and briefly so that they can make the correct choice. The packaging must list the ingredients and the nutritive value of the ingredients clearly and as per the prescribed regulations. The text should not be misleading.
- **Handiness**: Hectic routines of the individuals make them desire for easiness in usage and handling of the packaging. The packaging should be concise,

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light and easy to transport and dispose after using the product. Developments in technology has made all this possible today. The packaging of the product is being designed with the no-fuss aspects, for instance soups are packaged in microwaveable containers or soaps are provided with a dispenser. The material used for packaging can be discarded easily and carry adequate instructions about their disposal. This need for ease is predominantly noticeable in the frozen food section of stores. Many brands provide their savoury snacks in zip-lock bag seals which can be secured after each usage and helps in retaining the freshness and the crispness of the snack. There are many supermarkets which sell cut vegetables and fruits in vacuum see through packed packings which retain the nutrients and vitamins of the items and instantly tempt the consumer to buy the item.

- **Genuineness and Dependence**: Technology has made the relationship between providers and buyers to become very transparent. There are numerous ways through which it is easy to make the packaging tamper-resistant and easily traceable with the help of barcodes and other identification codes. The consumer is sure that the product is authentic and fresh because of the information provided on the package.
- **Visual Appeal**: The development in technology of the packaging processes has enabled the designers to create eye-catching packaging which tempt and compel the consumer to buy the product.
- **Pocket Friendly Shopping**: The cost of the product is the key factor determining the buying choices. People like to buy small and easy to transport packages as this not only costs less but helps them handle their shopping bags without extra help. The packaging designers are constantly trying to develop packaging which is cost effective and does not increase the product cost too much. Packaging has to be made so that it can suit every packet.
- **Improved Atmospheric Packaging**: The food packaging industry understands the growing health awareness amongst consumers. The consumer realises the importance of compatibility of the package with the packaged food and its atmosphere. An analyst has observed that 'Multidimensional functionality is the key goal in the packaging industry today'. Packaging has to be such that it is able to increase shelf life, confirm safety of the food by controlling the atmosphere inside the package, and reduce loss subsequent of microbial occurrence. Modified Atmosphere Packaging (MAP) is developing as an extremely beneficial packing procedure for preserving food quality by modifying the atmospheric environment inside the package. This is mostly helpful for packaging fresh and frozen food. Smart food packaging is a result of advancement in biotechnology and enzyme technologies.

6.5 PACKAGING PROCESS

Let us now discuss the packaging process:

I. Aseptic Processing

It is the procedure through which a hygienic product normally foodstuff or medicinal products are packed in a sterile container in such a manner that the sterility is maintained.

Check Your Progress

5. What drives the buying choices for a product?
6. What is the significance of the Modified Atmosphere Packaging (MAP) technique?

Sterility is accomplished through a process termed as flash-heating in which the temperature is maintained between 91 to 146 C. This range of temperature helps to preserve most of the nutrients. The energy consumption is low as compared to traditional methods like retort or hot-fill canning. Sterilisation of medical products comprises usage of hygienic rooms, filters to prevent bacteria, dehydrated or vapour heat. Sterilized food preservation procedures allow food to remain fresh and edible without the usage of addictive. The sealed package of food is preserved at room temperature until it is opened.

Construction of Aseptic Containers

The Aseptic Packages are usually a blend of seventy per cent paper, twenty four per cent polyethylene (LDPE), and six per cent aluminium, along with a close-fitting internal layer of polyethylene. Sterilized medications are frequently packed in plastic or glass. Both the materials provide airtight protection against microbiological organisms, pollutants, toxins, and degradation, excluding the requirement for refrigerated storage. In 1961, the earliest aseptic milk filling plant was established in Switzerland. The Tetra Pak Company was the prominent provider of processing and packaging equipment for dairies. Aseptic systems started in the United States in the 1980s. Aseptic containers can be of varied sizes, ranging from a small number of fluid ounces to an almost 8-million-US-gallon aseptic tank to be shipped via sea. Aseptic processing enables global export and import of fresh, cheap and secure food products. Lightweight and easily handled technology of the bag-in-box is frequently employed as it is durable and easy to fill. Along with this drink boxes and pouches are also used sometimes.

Advantages of Aseptic Processing

The advantages of aseptic processing are as follows:

- Aseptic processing is usually useful for packaging of milks, fruit juices, liquid whole eggs, gravies, sauces and tomatoes. It is done for fresh tomatoes so that they can be packaged for use later.
- These containers can be easily recycled through the method of hydra-pulping. Recycling these packages is considerably low in cost. The main difficulty, though, is that the facility of hydra-pulping is not common, and as these containers are made up of a combination of materials hence it needs specific recycling plants. Tetra Pak Company is making efforts to increase the recycling of aseptic containers.

Authentication: It is the process or action of proving or showing something to be true, genuine, or valid.

II. Authentication

Authentication in packaging is becoming very essential as fake products are frequently presented to consumers as genuine. Bogus consumer goods are often sold as genuine are electronics, cosmetics, clothing, medications, etc. Many efforts are being made by the packagers and manufacturers to ensure that consumers receive authentic products. There are various methods that are used for authentication, a few are listed as follows:

- A protected key storing device may be installed for confirmation in consumer electronics, network authentication, license management, supply chain management, etc. This would comprise of a wireless or wired digital linking with the host system or a network. The authentication chip can be attached

mechanically and can be deciphered with the help of a connector to the host. For instance, a printer can be attached with an authentication ink tank.

- Packaging and labelling are helpful in preventing forgery, resale or theft of consumer goods. Packages can be designed with unique graphics which are difficult to copy. They can carry tamper-evident seals which immediately show if tampering has been attempted. The packages can contain authentication seals and security printing techniques can be used to prevent forgery. Packages may comprise anti-theft devices like dye-packs, RFID tags, or electronic article surveillance tags these will be helpful in detection at the exit of the stores.

There are several technologies of packaging which can help in preventing counterfeiting:

- Taggant Fingerprinting: Exclusively coded microscopic materials which can be confirmed with the help of a database.
- Encrypted Micro-Particles: Randomly positioned markings (numbers, layers and colours) which cannot be seen by human eye.
- Holograms: Graphics printed on seals, patches, foils or labels and helpful during sale for graphical confirmation.
- Micro-printing: his is useful for currency notes. It contains a second-line authentication.
- Serialized Barcodes
  - o UV printing – symbols visible under UV light
  - o Track and trace systems – usage of codes to connect products to database tracking systems
  - o Water indicators – develop only when in contact of water
  - o DNA tracking – genes rooted onto labels which are traceable.
  - o Colour-shifting ink or film – noticeable symbols that change colours or texture once tilted.
  - o Tamper evident seals and tapes – easily breakable or graphically confirmable at time of sale.
  - o 2D barcodes – data codes which are trackable
  - o RFID chips
  - o NFC chips

III. Automatic Identification and Data Capture

Automatic Identification and Data Capture (AIDC) is essentially the means of mechanically recognizing objects, assembling data about them, and feeding them straight into computer systems, without physical involvement of individuals. Knowhow normally deliberated as part of AIDC contain bar codes, Radio Frequency Identification (RFID), biometrics, magnetic stripes, Optical character recognition (OCR), smart cards, and voice recognition. AIDC is referred to as 'Automatic Identification,' 'Auto-ID,' and 'Automatic Data Capture'.

AIDC is the procedure or methods of capturing external data, mainly with the help of analysing images, sounds or videos. In order to capture the data, a transducer is engaged which helps in converting the real image or a sound into a numerical file. The file is saved in the computer for later analysis or comparison for the verification of

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identity. Data can be attained through various methods; good results can be got by application of correct method.

Components of AIDC

Biometric security systems involves getting hold of identifying characteristics such as finger image, palm image, facial image, iris print or voice print which contains audio data and the video data. Radio-frequency identification or RFID is comparatively a fresh AIDC technology as it evolved during the 1980s. A variety of markets have adopted RFID some of these are Livestock Identification and Automated Vehicle Identification (AVI) systems as it has the ability of tracking objects while they are in movement. These automated wireless AIDC systems provide an effective substitute for barcode.

Approximately all of the automatic identification technologies contain three principal components, which are the sequential steps in AIDC:

- Data encoder: This is a code which contains a set of symbols or signals which frequently represent alphanumeric characters. Encoding the data provides characters that are interpreted into a machine decipherable code. The item which has to be identified carries the tag or label with the encoded data.
- Machine reader or scanner: The device helps in reading the programmed information changing it into an electronic analogue signal.
- Data decoder: This component converts the electrical signal into numeral data and again into the original alphanumeric characters.

IV. Blow Fill Seal

The technique of manufacturing liquid filled containers is referred to as Blow-Fill-Seal (BFS). This method is used for producing 0.1mL and 500mL or bigger containers. BFS developed in Europe in the 1930s and by 1960s in the United States. It is mostly used in the pharmaceutical industry and is widely used as an advanced form of aseptic processing by several medicine governing organizations. It is also approved by the U.S. Food and Drug Administration (FDA) as a packaging option for pharmaceutical and healthcare products.

The BFS is the process where in the container is moulded, filled, and sealed in a non-stop process and there is no human involvement. The entire process takes place in a sterilised walled area within a machine. Therefore this technology is ideal for aseptic manufacturing of sterilised pharmaceutical liquid prescription formulas. Blow-fill-seal technology decreases human involvement creating it an extra healthy technique for the aseptic preparation of hygienic pharmaceuticals. BFS is helpful for filling of vials for parenteral preparations and infusions, eye drops, and inhalation products. Normally the plastic containers are prepared of polyethylene and polypropylene. Polypropylene is mostly used to shape the containers these are additionally sanitized by autoclaving since polypropylene contains better thermos-stability.

V. Blow Moulding

Blow moulding or BrE moulding is used as a process to manufacture hollow plastic parts. Glass bottles can also be formed using this method. Overall, there are three

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types of blow moulding: Extrusion Blow Moulding, Injection Blow Moulding, and Injection Stretch Blow Moulding. The Extrusion Blow Moulding process starts by melting the plastic and shaping it in a parison and in the case of Injection and Injection Stretch Blow Moulding (ISB) a preform is formed. The parison resembles a tube shaped plastic and it contains a hole in one end from which compressed air can pass. The parison at that point compressed into a mould and air is propelled into it. The air pressure then shoves the plastic out to match the mould. After the plastic has ventilated and toughened the mould is released and the part is cast out.

VI. Containerization

Containerization: It is the system of intermodal cargo transport which uses shipping containers.

The system of intermodal cargo transport which uses shipping containers is termed as **containerization**. These intermodal containers are referred to as ISO containers as they have uniform standard measurements. These containers can be used for long distance shipments as they can be easily handled. They are suitable for all types of means of transportation used for shipping commodities. The containers are moved without being opened and are handled with the help of cranes or forklift trucks. Containers can be easily tracked by just feeding their numbers into the computer. The practice of containerization has been into existence from many centuries however its worth was realised when the system sustained the explosion in international trade after the Second World War and since then it has been helping nations in their quest for globalization. Containerization helped in doing away with the physical cataloguing of several shipments and the requirement of a warehouse facility. Though as a result of containerization many dock labourers lost their livelihood as their services were needed for loading and unloading of freight. Furthermore, containerization helped in making the ports less congested, considerably reduced delivery time and decreased damages occurring due to breakages and pilfering. Weathering steel is used to make these containers as it is durable and can be maintained easily.

VII. Electronic Article Surveillance

It is a high-tech method for averting thievery from retailing stores, stealing of library books or impounding of possessions from public places or offices. In this the product or item which has to be secured is attached with a tag. The tag has to be deactivated before getting it out of the premises. The sensors are attached at the exit point of stores, buildings or various public places, the alarm will sound in case the product is being stolen or removed without detaching the tag. It may have been noticed that electronic goods like mobile phones or cameras are displaced with wired alarm chip in order to keep it safe during display. These wired alarmed chips are referred as spider wraps.

VIII. Graphic Design

It is the procedure of pictorial communication and developing an image using various types of formatting, photographs and drawings. The field of graphic design is closely related with visual communication and communication design, but then again, occasionally the term 'graphic design' is mentioned. The task of a graphic designer is to construct and associate signs, pictures and script in the concepts and communicate them with the help of a visual design. This is done with the help of lettering, pictorial arts and different methods for laying out the pages so that a meaningful visual composition

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is created. Graphic designing is visible in the logos, brand slogans and various aspects of packaging are done using graphic designs. Design helps in generating a physical appeal for the product which helps in sale of the product. Branding team of the company has to involve a creative graphic designer for effective branding.

IX. Induction Sealing

The process is often referred to as cap sealing. It is a mechanical process of heating an inside seal so that the top of containers made of plastic and glass can be hermetically sealed. First the container is filled and covered so that the sealing process can take place. The closure on the bottle contains a layer of liner made of aluminium foil. The common induction liner contains multi-layers, the first layer is paper pulp and is stuck to the cap, and then there is of polymer film coated on the foil. Once the cap or closure is placed on the container it goes through an induction coil that radiates an oscillating electromagnetic field which helps in sealing all the layers properly to the container. The correct amount of heat emitted during this process will not harm the container or the product, yet overheating can result in creating a faulty seal. The sealing process can be carried out using a hand held unit or a conveyor belt machine.

This process in recent times can be done to containers which do not have a cap or a closure. The foil can be directly used to seal the container. This procedure is identified as direct application or sometimes 'cap-less' induction sealing.

Advantages of Induction Sealing

This method is frequently used by manufacturers as it has many advantages for them and the product. These include:

- Tamper proofing and temper evidence, the process has been approved by U.S. Food and Drug Administration (FDA) regulations regarding tamper-resistant packaging standards.
- Prevents the liquids to leak from the container
- Retains the freshness and hygiene of the product
- Provides safety against pilferage
- Provides sustainability to the container as it can be lightweight
- The method can speedily seal the containers
- The process makes the container airtight hence helps in extending the shelf-life of the product

The long list of advantages makes it a highly preferred process for sealing products of many industries such as food and beverages, pharmaceutical, dairy, cosmetics, automobile petroleum products, chemicals, paints and various grocery products.

X. Plastic Welding

The process involves welding semi-finished plastic materials, and according to the listing of ISO 472, it is referred as a process of using heat to combine softened surfaces of materials. Welding of thermoplastics is completed in three consecutive steps; the first step involves preparing the surface, in the second step heat and pressure are applied and finally it is left to cool. Several welding techniques are used for the fitting

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together semi-finished plastic materials. Thermoplastic can be welded using two methods namely external and internal heating methods. In order to produce fine quality welded substance not only should the method of welding correct but also assessment of welding ability of the base material is also crucial.

Different types of plastic welding are:

- Hot gas welding
- Hot plate welding
- Ultrasonic welding
- Spin welding
- Vibration welding

Advantages of Plastic Welding

The advantages of plastic welding are as follows:

- Provides structural strength
- Helps in assembling many types of constituents
- Helps in improving the aesthetics of a part and helps in altering the designs.
- There is no requirement to treat the material prior to welding
- Accurate joining heat produced inside the joint keeps the surrounding area intact.
- Facilitates long 3D or even multiple bond lines to be welded at the same time

All methods have advantages as well as disadvantages. The choice of method should be made after assessing the nature of the plastic material. The welding helps in joining two substances hence the joint area will always be the weaker section of the welded part.

XII. Printing

This method is used for duplicating script and pictures with the help of a master form or stencil. The first non-paper products which were used for printing were clay cylinder seals such as the Cyrus Cylinder and the Cylinders of Nabonidus. The first acknowledged paper printing was done on paper was woodblock printing, which is dated as early as 220 A.D. in China. In 1042 AD, Bi Sheng invented the movable type printing technology. In the fifteenth century the printing press was developed by Johannes Gutenberg. The advancement in printing technology is considered crucial in the Renaissance movement and the scientific revolution, as this set the platform for construction of contemporary well-read economy and led to spreading knowledge among the masses.

There are several types of printing companies and these are characterized as per the clientele they cater, matter they print and the kind of apparatus employed by them for printing. The printing companies can be divided into four categories:

- **Commercial Printing:** These printers undertake printing material pertaining to a variety of products, beginning from stationery to leaflets and journals.

- **Packaging Printing:** Packaging printers concentrate on printing on all types of packaging options like packets, containers, cartons, boxes, cases, metal cans, tags, and labels.
- **Publication Printing:** These printers undertake bulk work for particular market such as the newspapers, books, magazines or directory printings.
- **In-plants:** Few companies have an in-house printing plant and this printing facility only functions for the company it is owned by.

Processes Used for Printing

- **Offset** – The process is actually termed as offset lithography. It is extensively employed printing technique and is used for printing on paper, cardboard, plastic and various even materials. Books, newspaper, stationery, packaging are printed using this method.
- **Flexography** – In this process flexible rubber printing plate is used to print on surfaces such as plastics, metals, cellophane, etc. Flexography is essentially used for printing on packaging and labels and to a sometimes for newspapers.
- **Digital Printing** – This process involves various printing know-hows such as inkjet and xerography. The process of digital printing is the up-to-date process and slowly substituting old processes. The inkjet and xerography allow variable data printing; in this every printed copy is diverse from the earlier one.
- **Screen Printing** – This printing method can be used on uneven surfaces as well hence it is used on a variety of objects, such as apparels, glass, wood, etc.
- **Gravure** – This process is referred as rotogravure, the method is used to engrave an image on a printing cylinder. The ink from the cylinder then appears on the paper. The printing on newspapers, magazines and high quantity packaging is carried out using this process.

XII. Quality Assurance (QA)

The process of checking inaccuracies or faults in industrial produces and eluding complications while distributing products or facilities to consumers: this has been interpreted by quality management system standards ISO 9000 as 'part of quality management focused on providing confidence that quality requirements will be fulfilled'. The aspect of checking inaccuracies in quality assurance varies slightly from fault checking and denunciation in quality control, in later attempts are made to check faults and rectify while the product is in the process of production, whereas quality assurance is relevant to the product before reaching the consumer. The expressions 'quality assurance' and 'quality control' are frequently interchanged as both are closely associated with providing quality goods and services.

Quality assurance involves managerial and bureaucratic undertakings which are introduced into the quality system so that all the necessary steps and actions can be taken for providing the product and services. Quality assurance can be provided for a product or service if there is a methodical criteria for measuring, comparing and monitoring of process with an establish standard. There has to be a provision for providing feedback so that corrective measures can take place. In this aspect quality control and quality assurance differ from each other as in quality control the stress is

Quality Assurance: It refers to the maintenance of a desired level of quality in a service or product, especially by means of attention to every stage of the process of delivery or production.

on the production process. In case there are packaging defects in medicinal or food products they can harm the health of the user. Defects might be in form of breakage, leakage, inadequate or incomplete information on the label, the package may not carry the patient information brochure. The producers have to follow Good Manufacturing Practices (GMP) and maintain quality control during the production process so that the products can be distributed with quality assurance. In the production process, the following steps can be taken to guarantee quality is controlled in packaging:

- Sufficient services and amenities need to be provided.
- Availability of skilled and qualified workforce.
- Sanctioned processes need to be used for sampling, inspecting and testing starting materials, packaging materials, and intermediate, bulk and ûnished products.
- The environmental conditions need to be closely monitored during packaging and should subscribe to the GMP purposes.
- Raw materials of packaging material for intermediate products, bulk products and ûnished products need to be approved by the personnel of the quality control department.
- The ingredients present in the ûnal product must comply with the established quality and quantity mentioned on the endorsement. The ingredient quality should be maintained and placed in a proper environment which is fit for consumption.
- Assessment documents of the product need to contain all the record of the feedback and specifications realised during assessment.

XIII. Radio-Frequency Identification (RFID)

The process of RFID functions due to the presence of an electromagnetic field which mechanically recognizes and tracks tag attached to object. The tags have electronically deposited data. Passive tags gather energy from a close RFID reader's functioning radio waves. Active tags contain a confined power source which is a battery and due to this it can function away from the RFID reader. The tag can be implanted in the tracked object. As discussed earlier, RFID is one of the techniques used in Automatic Identification and Data Capture. RFID tags can be helpful in tracking and tracing processes of various manufacturing units for instance an RFID tag can be applied to an automobile for the duration of assembly so that the progress may be tracked in the assembly line; RFID-attached pharmaceutical products may be trailed in the stores; and RFID microchips can be used to trace and identify livestock and pets. The wide usage of the RFID tags has led to controversy over hindering people's privacy. These apprehensions gave rise to development of standard specifications dealing with privacy and security concerns. ISO/IEC 18000 and ISO/IEC 29167 use on-chip cryptography methods for intractability. ISO/IEC 20248 requires a digital signature data structure for RFID and barcodes providing data, source and read method authenticity. All this is covered in the listings of ISO/IEC JTC 1/SC 31 Automatic identification and information capture methods.

The RFID tag can be attached to an article and helps in tracking and managing records, resources, etc. For instance, these may be attached to cars, computer

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equipment, books, mobile phones, etc. RFID is more useful than using a manual systems or bar codes. The tag is easy to read and it need not be in the vicinity of the reader. It is faster as it can be read numerous times in one instant whereas a bar code can be read only once with the present available devices.

XIV. Track and Trace

The process is used during distribution and logistics of several varieties of products. Tracking and tracing involves a procedure of figuring out the current and past locations and other related information of a specific object or material goods. The process helps in calculating and recording the location of means of transportation and containers during shipment and storage. The method also helps in keeping record about the coming or leaving of the article and it helps in recognition, exact location, the time, and the status. This approach is very useful for various courier companies such as Deutsche Post, United Parcel Service, AirRoad, or FedEx, as they have to constantly keep track of the shipped objects till their delivery is made to the consumer.

As a result of increasing instance of recalling products various food and pharmaceutical companies have employed track and trace solutions such as radio-frequency identification and barcodes to trace the delivery of their products and find the slags in the process. RFID is a useful track-and-trace solution, and plays a very vital role in the distribution chain. Barcoding is another common and economical technique which helps in tracing the items. In recent times buyers can trace their product from the time it is shipped to them and they are able to get information about the status of their product at different stages of its shipment and expected the time and date of arrival can be found out by them.

XV. Vacuum Forming

It is a basic form of thermoforming. In this, the plastic sheet is heated till it reaches the temperature required for developing objects, then it is pushed onto a single-surface mould, and forced into the mould by a vacuum. This process helps in forming permanent plastic objects such as turnpike signs and protective covers. Normally, a draft angle of minimum three degrees is present in the design of the mould so that the shaped plastic can be easily removed from the mould. Parts with reasonable depth can be shaped by properly stretching the sheet before inserting it into the mould and using vacuum. The sheet can be stretched by using machines or with the help of pressurised air. Vacuum forming can be done using usual thermoplastics of High Impact Polystyrene Sheeting (HIPS). Wood, structural foam or cast or machined aluminium mould are used to mould the plastic into many shapes. Vacuum forming is useful for see-through materials such as acrylic; these are frequently used in producing aerospace products like canopies for cabin windows in the aircrafts and compartments for rotary wing aircraft. The easy moulding ability of vacuum forming helps in shaping various low-level technology classes of plastic.

XVI. Verification and Validation

Verification and Validation are separate measures which are simultaneously used in order to check whether the product, service, or system is meeting the necessary requisites and conditions which are required for performing its function. These are vital

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mechanisms of any quality management system like the ISO 9000. The terms verification and validation are occasionally stated with reference with 'independent', showing that the verification and validation is to be executed by an unbiased third party. 'IV&V' is often used as an abbreviation for 'Independent Verification and Validation'. Occasionally these are used in substitution but they both have varied functions.

'Validation' is the guarantee that a product, service, or system fulfils the requirements of the customer and other recognized shareholders. It frequently includes receipt and appropriateness with outside patrons. 'Verification' is the assessment whether a product, service, or system conforms to regulatory prerequisite, description, or levied condition. It is mostly an in-house process. Verification is planned to asses that a product, service, or system (or portion thereof, or set thereof) complies with settings of the design. During the development stage, verification processes include executing distinctive examinations to prototypical or mimic a portion, or the completeness, of a product, service or system, after which an appraisal or investigation of the modelling results is conducted. After the product or service has developed, verification processes include frequently recapping examinations planned precisely to guarantee that the product, service, or system carries on to meet the original design necessities, conditions, and regulations even after passage of time progresses. It is a procedure which is helpful in evaluating the product, service, or system conformations with procedures, provisions, or conditions levied originally.

Validation is planned to guarantee a product, service, or system fulfils functional requirements of the consumer. Validation processes might include modelling either flow or expending mock-ups to forecast mistakes or breaches that could result in void or inadequate verification or development of a product, service, or system. A fixed list of validation necessities, conditions, and regulations can then help in establishing the foundation for qualifying as a verification flow for a product, service, or system. Extra validation processes may consist of those flows which specify the alterations made to the original verification flow. It is a process which helps in ascertaining that a product, service, or system achieves its planned necessities. This frequently includes receipt of suitability of functions for the final consumer of the product and other shareholders. This is mostly a peripheral process.

It is very likely that a product may clear in process of verification and face challenges during validation. This may occur when the final user is not satisfied with the functions of the product, even though the product is designed as per specifications.

Features of Validation

Validation contains the following features:

- Discernment and specifications
- Exactness and meticulousness
- Reoccurrence
- Replication
- Limit of exposure
- Limit of quantification

Check Your Progress

7. What is aseptic packaging?
8. How is the sterility of packages accomplished?
9. Where and when was the first aseptic milk filling plant set up?
10. What is Automatic Identification and Data Capture (AIDC)?
11. What is blow moulding used for?
12. Define containerization.
13. What is electronic article surveillance?
14. What are the different types of plastic welding?
15. When was the first paper printing done?
16. What is gravure printing?
17. Define validation and verification.

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6.6 PACKAGING MACHINERY

Let us now discuss packaging machinery.

I. Barcode Printer

A barcode printer is a computer constituent which helps in production of barcode labels or tags. These tags are directly attached to the object or sometimes printed on the packaging labels. Barcode Printers are frequently used on label of cartons prior to shipment, or to label retailing items with UPCs or EANs.

General barcode printers use one of two varied printing machineries. Direct Thermal Printers needs a print-head to produce heat which creates a chemical reaction on a specifically intended paper which turns the paper black. This is the result of the chemical reaction. Heat is used in thermal transfer printers as well but the printing takes place as a result of heat melting the resin material on the ribbon and flows over the label which leaves an ink impression on the paper. Direct thermal printers cost comparatively less but do not produce permanent labels as they ink fades away due to exposure to heat, light or chemical fumes. Different markets need varied types of barcode printers. Industrial Barcode Printers are useful in big storage houses and manufacturing units. The paper capacity of these printers is heavy and provides fast and extended service life. For retail and office settings, desktop barcode printers are frequently used.

II. Barcode Reader

An electronic device which is helpful in reading and deciphering data printed in a barcode and transfers it to the computer is termed as a barcode reader or scanner. The barcode reader resembles a flatbed scanner. It comprises of a light source, a lens and a light sensor interpreting visual impulses into electrical ones. In addition, approximately all barcode readers comprise of a decoder circuit board which helps in studying the barcode's image data delivered by the sensor and sends the barcode's content to the scanner's output port.

III. Bottling Lines

The filling of liquid products into bottles on a large-scale basis is termed as bottling line. This machinery helps in bottling of tomato ketchup in plastic bottles, bottling of alcoholic drinks like beer, wines, whisky in glass or pet bottles, bottling of soft drinks, vinegars, edible oils, perfumes and spirits, etc. Packaging of bottled liquid products usually includes taking out the product from a stock tank and filling it into bottles with the help of a filling machine, and then these bottles are secured with a cap. Once the bottles are sealed they are labelled and packed into boxes or cartons. The re-usable bottles are unloaded and then each bottle is rinsed with filtered water or air, and sanitised prior to be filled. The drinks like beer and other aerated beverages after filling are injected with small quantity of inert gas.

Subject to the extent of the bottling enterprise, there are numerous different kinds of bottling machinery existing. Liquid level machines fill all the bottles until the same level whereas volumetric filling machines fill every bottle with the same quantity of liquid. Overflow pressure fillers are commonly used machines by various beverage

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manufacturers whereas gravity filling machines are considered to be an economical option. From the mechanization point of view, inline filling machines are very prevalent. On the other hand rotary machines are considerably faster although cost more than other options.

IV. Carton Machine

A packaging machine which helps in developing cartons is termed as a cartoning machine. Cartons can be erect, closed, folded, side seamed and sealed. Packaging machines that shapes a carton board into a carton is known as a carton machine. There are two kinds of carton machines:

- A Horizontal Cartoning Machine lifts one piece from a pile of folded carton and set it up, fills it with a product or container of products or number of products in a straight form via an open end and encloses by inserting the end flaps of the carton or smearing adhesive or bonding agent. The product can be inserted in the carton via the mechanical sleeve or by pressurized air. In most cases the products are manually inserted into the carton. This kind of Cartoning machine is commonly used for packaging foodstuffs, confectionery, medicine, cosmetics, sundry goods, etc.
- A Vertical Cartoning Machine sets up a folded carton, fills it with a product or number of products perpendicularly via an open end and encloses with the help of inserting the end flaps of the carton or smearing adhesive or bonding agent. This type of machine is the vertical cartooning machine or an end load cartoning machine. They are helpful in packaging foodstuffs which are packed in bottles, confectionery, medicine, cosmetics, etc.

V. Checkweigher

The weight of the packaged commodity is checked with the help of a machine termed as a Checkweigher. The Checkweigher can be automatic as well as manually operated. The machine is required at the end of the packing process as it helps in ensuring whether the weight of the commodity is as per the specified levels. The packages which cross the specified level are automatically rejected and removed. A Checkweigher has a capacity to weigh more than five hundred items per minute. Checkweighers may include features where it is able to employ metal detectors and X-ray machines to check other components of the pack and verify their presence in the pack.

Types of Checkweighers

The following are the types of checkweighers:

- **In-Motion Scales**: This type of weighing machine can perform a variety of functions. The most common use of the machine is to weigh the cases at the final point of the conveyor line to guarantee that the weight of the final package has not crossed the prescribed weight limit. An in-motion conveyer machine is able to identify omitted parts of a package, for instance it is able to identify if an electronic gadget has been packed without placing the manual or some other attachment required for the functioning of the gadget. These are used at both ends of the conveyer chain in in case of livestock of a poultry farm would be weighed at the start of the chain as well as at the end after it has been dressed

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and packed. This helps in checking if the bird has been packed in a very wet state as this will create issues at the final point of the checkweigher if the weight of the bird is not within the prescribed limit.

- **A High Speed Conveyor Scale**: is helpful in regulating the speed, placement and pitch of the products on the conveyer line. The measurement of the product is referred as 'pitch'. The scale is able to measure the product dimensions from edge to edge.

Uses of Checkweighers

The uses of checkweighers are as follows:

- Helps in counting of the pack
- Calculates the total weight of packages on a pallet
- The machine is able to individually check the weight and the dimensions of each pack
- The overseer's computer is able to print the shipment label and a bar-code label so that the weight, measurements, receiver's address and other relevant information required for transporting the package. This input can be easily checked by the receiver's bar-code reader and verified
- Helps in determining if any carton or box is missing or has been tampered
- Checkweighers are very helpful in the process of managing quality
- Checkweighers can contain an in-built metal detectors, x-ray machines, open-flap detection, bar-code scanners, holographic scanners, heat feelers, image examiners, timing screws, indexing gates and concentrator ducts
- An industrial motion checkweigher can categorise products from a fraction of a gram to any amount of kilograms
- Specific checkweighers are able to check weight of aircrafts, and figure out the centre-of-gravity
- The machines function at an extraordinary speeds and are able to detect very minute degrees of weight hence are very useful for medicinal purposes
- The machine can be constructed in a variety of forms and proportions; they can be suspended from ceiling, elevated on mezzanines, activated in ovens or in refrigerators
- Checkweighers are able to function in any environment for which they are built, whether dry or wet, sheds, food processing, drug processing, etc

Usually, checkweighers which are constructed for the production line are made with mild steel. The weighers that need harsh cleaning are made with stainless steel parts, even load cells. These machines carry the label which specifies the washing environment they can be exposed to. Checkweighers can function continuously for very long durations and need to be stopped only for the purpose of maintenance.

VI. Conveyor System

A conveyor system helps in systematic handling of material and goods to various locations. These are particularly convenient when heavy and colossal items have to be

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transported. Conveyor systems permit rapid and competent transference of a large range of materials. They are a necessity in all material handling and packaging processes. There are several types of conveying systems. They can be employed in the industry as per the requirements of the process. They are helpful in performing a number of tasks, such as

- Conveyors are used for safe transportation of material to various levels of the plant. They are fast and more efficient than human labour. The system is cost-effective.
- There are no weight restrictions as it can lift heavy weights as well.
- The machine can be conveniently fitted, and provides an effective alternative for forklifts and other transporting machines.
- They can transfer materials of any form, dimension and load. The machines are safer as humans can drop the load and harm themselves as well as the load.

There are many types of conveying systems available for transporting of goods from one level to another; these include hydraulic, mechanical and fully automated systems. The system can be selected on the basis of the requirements of the manufacturing unit. These are used in almost all industries such as mining, automobile, agriculture, electronic, food processing, aerospace, pharmaceutical, chemical, bottling and canning, print finishing and packaging.

The selection of the conveyer system has to be done in a precise manner as it should be compatible with the nature of the goods that have to be transported. A few distinct capacities which need to be considered to determine the extent of conveyor tasks might be conveyance, amassing and categorization, the material dimensions, bulks and forms and location of the loading and unloading.

VII. Heat Gun

This device is helpful in releasing a stream of hot air at temperatures ranging 100 C and 550°C and few even up to 760 C. It is held by hand and resembles the shape of an actual gun, though it is longer so that the item which needs to be heated can be placed at a convenient distance. These are used in a number of fields such as physics, materials science, chemistry, engineering, and in various laboratory and workshop surroundings. They are used for a number of purposes like strip paint, shrink heat shrink tubing, shrink film, and shrink wrap packaging, dehydrate moist wood, twist and join plastic, unstiffen bonding agents, and melt frozen pipes. The guns are selected on the basis of their heat operating temperatures which may be required for the task.

Heat guns can be referred as hot air guns or hot air stations for these purposes. Sometimes these are used for de-soldering or reworking surfaces of a circuit board of an electronic gadget. Heat guns are employed for practical testing of overheat protection devices, so that an overheat setting can be created. They help in eliminating lead paint temperatures below 590 °C and are useful for controlling vaporization.

VIII. Heat Sealer

This device heat is used for sealing components of thermoplastic materials in products and their packaging. This is done with even thermoplastic monolayers or with materials that have numerous layers, though one of the layers has to be of thermoplastic. Heat

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sealing is used for joining materials together which have at least one layer of thermoplastics.

Kinds of heat sealing

- Hot bar sealers or direct contact thermal sealing: In this sealing method, constant temperature is maintained for the heated tooling. More than one heated bars, irons, or dies are used. This helps the material to heat the edge and form a bond. The bars, irons and dies have numerous arrangements that can be enclosed with a release layer or use Teflon films to avert touching of the hot tooling.
- Continuous heat sealers or Band type heat sealers-use movable belts on the elements that have to be heated.
- Impulse heat sealers: They have heating elements made of an alloy mostly nickel, chrome and iron. These are located in the middle of a resistant synthetic rubber and a release surface of film or fabric. The heating elements are not constantly heated; heat is produced only when current is supplied. After the materials are positioned in the heat sealer with the help of the pressure, they are held in place. The required temperature is maintained for a specific time for the heating elements. When the heat is stopped with the material is kept in place. Occasionally cold water is used so that pressure can be applied. Hot melt bonding agent is smeared on the edge so that it is kept joined. The bonding agent can be applied at an earlier stage of process as well for effective joining.
- Hot wire sealing: It contains a heated wire that not only opens the surfaces but also joins them with help of a molten edge bead. This is used when the barrier properties are strong and durable.
- Induction sealing is used for internal closures of bottle lids and it is a non-contact type of sealing.
- Induction welding is heat sealing by induction where no contact is made.
- Ultrasonic welding is used to weld work pieces with the help of high-frequency ultrasonic acoustic vibrations. Pressure is used throughout the welding process.

Quality of sealing is an outcome of accurate timing, application of heat and pressure on a clean surface. Numerous standards testing techniques can be used to quantify the durability of heat seals. Along with that, package testing is done to figure out the capacity of finished packages to endure identified stress or vacuity. Numerous techniques are present to check the capability of a taped up package to preserve its reliability, resistant features, and productiveness. Heat sealing procedures are monitored by a range of quality management systems like HACCP, statistical process control, ISO 9000, etc. Verification and validation procedures are employed to guarantee that conditions are adhered and the product is appropriate for final usage.

IX. Industrial Robot

Industrial robots are computerized, programmable machines that are used in industrial plants for a wide variety of use. Usual uses of robots contain welding, painting, assembly, pick and place for printed circuit boards, packaging and labelling, palletizing, product inspection. All the tasks performed by the robot are completed with super efficiency, rapidity and accuracy. They are useful in handling of materials.

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The most universally found robot formations in industrial plants are articulated robots, SCARA robots, Delta Robots and Cartesian Coordinate Robots, gantry robots. In the framework of common robotics, robots are classified based on the robotic arms. These have been approved by ISO standard 1738. Robots display wavering amounts of self-sufficiency.

Few robots are encoded to dependably undertake particular movements and activities repeatedly without alteration and with supreme levels of correctness. These movements and activities are possible due to programmed practices which identify the course, rapidity, swiftness, braking, and expanse of a sequence of synchronized motions. There are few robots which are reasonably flexible as to the direction of the object that has to be accepted. These robots need support while functioning. For instance, they might contain the image of the object in their secondary system for the purpose of sensing the image of the object. Simulated brainpower is an essential feature for the present industrial robot. These robots are slowly becoming indispensable from the process of packaging.

X. Injection Moulding (BrE or Injection Moulding AmE)

The process of injection moulding involves producing parts with the help of a mould. The part which has to be manufactured is injected into a mould so that it can be shaped accordingly. Injection moulding is done for a variety of materials like glasses, elastomers, confectioneries and usually on thermosetting polymers. The process is done for metal as well and is referred as die-casting. Material that needs to be moulded is put into a heated drum. Then it is blended and inserted into the cavity of the mould. The mould is left to cool with the material during which it takes the shape of the cavity. The products are designed by the industrial designer or an engineer and according to the product design, the moulds are created by mould-maker or toolmaker. The moulds are made using steel or aluminium, and a precision-machine is used to create the intricate features of the mould. Injection moulding is very helpful in producing minute and large parts needed in the car panel. Progress in 3D printing technology and use of photopolymers has helped in the progressive use of injection moulding in packaging industry as now moulds can be made according to the size of the product which will help in providing more safety to the product during handling and distribution.

The moulding process will be effective only if the parts which have to be injection moulded are cautiously planned. Aspects like material, shape, nature of the part should be taken into account. Injection moulding is helpful in creation of items like spools, packaging, bottle caps, motorized parts and gears, game-boys, small combs, parts of musical instruments, small furniture items, storing vessels. Several plastic products are made using this process and it is ideal for bulk production as the moulds help in maintaining precision and are cost effective. The machine used for moulding is referred as injection press as well. It comprises of an injecting unit for inserting the heated material and clamping unit which helps in holding it together till the shape is formed.

XI. Logistics Automation

The use of computer software or any other form of programmed technology in operations of logistics is referred to as logistic automation. The purpose is to enhance the quality and competence of logistics operations. Usually, the use of software or any

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other technology is seen in activities which are performed at warehouses or various distribution outlets. This is because these units try to control all the activities of the supply chain and hence need to have an effective system. Logistics automation systems can be regulated as per the needs of the operation.

Logistics automation systems contain a range of hardware and software components.

Hardware components

- Fixed machinery includes automated storage and retrieval systems.
  - o This involves cranes, as cranes assist a rack of locations, permitting numerous heights of stock to be arranged vertically, and sanctioning extremely high storage compactness and enhanced space consumption as compared to other options.
  - o Automatic directed vehicle transfers items to a human picker in arrangements produced by Amazon Robotics.
  - o Conveyors: Automatic conveyors let the input of containers in specific area to be selected and received at the selected destination.
  - o Vertical Carousels are created on the paternoster system which provides optimised utilisation of space. These resemble a large vending machine.
  - o Sortation or sorting systems: This is parallel to conveyors but usually has greater ability and is able to locate and deliver containers at a faster speed. It is normally helpful in distributing large quantities of small boxes to various locations.
  - o Industrial robots: These are also referred as Palleting Robots they can move in multiple axes and are usually used in loading pallets, unloading pallets and packaging and picking ordered material. Usually the robots are able to pick the correct container due to the presence of their bar-codes or RFID tags.
  - o Motion check weigher is used to reject cartons or single products after inspection for not matching with the prescribed weight. They are mostly used in kitting conveyor lines to guarantee all components of the kit are enclosed in the packaging. It is a basic requirement for the kit to be adequately equipped with all the parts and many wholesalers and retail stores reject products if not packaged as per the specifications.
- Mobile technology
  - o Radio data terminals: They are hand held or truck mounted terminals that are connected by wireless to logistics automation software and deliver information to operators anywhere in the warehouse. Various contain an in-built bar code scanner to help in identifying the container. Bar code permits the spontaneous accurate capture of information even in the absence of the computer keyboard.

Software

- Integration software: This delivers complete control of the automation machinery to the extent that the cranes can be linked with conveyers and enables continuous stock movements.

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- Operational control software: It offers basic decision making, like about storage and retrieving of containers.
- Business Control software: It offers advanced level operational capability like documentation of incoming deliveries and stock and arranging order fulfilment, allotting stock to outbound trailers.

Benefits of Logistics Automation

A usual warehouse or distribution centre obtains stock of a range of products from various providers and stocks them till a demand is generated. A logistics automation system may provide the following:

- Automatic processing of the goods: Entering goods may be attached with a barcode at the time of arrival so that the stock can be maintained. This will help in scanning and identifying the goods and can be sent to the conveyers easily.
- Automatic recovery of goods: On receiving of orders, the automation system will automatically arrange for the load to be sent to the pick-up location.
- Processing automatic dispatch: Merging all the information about the orders will help the warehouse's automation system to conveniently help in identifying the outbound goods to the conveyers to move into outgoing trailers. The process can instruct repacking of the products which are not according to the specification.

A comprehensive warehouse automation system will help in significantly decreasing the labour force necessary to run the operations. The logistic automation provides efficiency as there is reduced scope of error which is more possible with increased human involvement. The system is not only efficient but it is able to lift heavy to very heavy weight without restrictions and accidents.

6.7 SUMMARY

Some of the important concepts discussed in this unit are:

- Consumer goods packaging is the kind of packaging intended to be used in a retail business setting.
- Consumer goods packaging should be done in such a way it enhances the value of the product for the user. This is achieved by ensuring that the product is delivered to the end user safely and the consumer is able to easily use the product.
- Modern packaging has to fulfil the demand of being reusable or recyclable so that the environment is not harmed.
- Industries function in order to generate income by undertaking various activities to produce goods. The only industry which creates wealth by manufacturing activities, and at the same time, helps in conserving the income of other companies is the packaging industry.
- Up-to-date technology is essential for the society in order to meet the demand of product packaging to be exclusive in nature.

Check Your Progress

18. What is a bottling line?
19. Name the two types of cartoning machines.
20. What is a checkweigher?
21. What is the use of the conveyor system?
22. What are heat guns used for?
23. List the most commonly found robots.
24. Describe injection moulding.
25. Define logistic automation.

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- Today, the key to attracting and retaining buyers is to adopt green packaging for the products. The manufacturers have to adapt technical know-how which enables them to design the sustainable packaging. Sustainable packaging is a trend which has come to stay and it is not just a myth.
- Aseptic processing is the procedure through which a hygienic product normally foodstuff or medicinal products are packed in a sterile container in such a manner that the sterility is maintained.
- Aseptic packages are usually a blend of seventy percent paper, twenty four percent polyethylene (LDPE), and six percent aluminium, along with a close-fitting internal layer of polyethylene.
- Authentication in packaging is becoming very essential as fake products are frequently presented to consumers as genuine. Bogus consumer goods which are often sold as genuine are electronics, cosmetics, clothing, medications, etc.
- Packages may comprise anti-theft devices like dye-packs, RFID tags, or electronic article surveillance tags.
- Overall, there are three types of blow moulding: Extrusion Blow Moulding, Injection Blow Moulding, and Injection Stretch Blow Moulding.
- The system of intermodal cargo transport which uses shipping containers is termed as containerization. These intermodal containers are referred to as ISO containers as they have uniform standard measurements.
- Electronic Article Surveillance is a high-tech method for averting thievery from retailing stores, stealing of library books or impounding of possessions from public places or offices.
- Graphic design is the procedure of pictorial communication and developing an image using various types of formatting, photographs and drawings. The field of graphic design is closely related with visual communication and communication design, but then again occasionally the term "graphic design" is mentioned.
- Induction sealing is the process of heating an inside seal so that the top of containers made of plastic and glass can be hermetically sealed.
- Quality assurance can be provided for a product or service if there is a methodical criteria for measuring, comparing and monitoring of process with an establish standard. There has to be a provision for providing feedback so that corrective measures can take place.
- Vacuum Forming is a basic form of thermoforming. In this the plastic sheet is heated till it reaches the temperature required for developing objects. Then it is pushed onto a single-surface mould, and forced into the mould by a vacuum.
- Validation is the guarantee that a product, service, or system fulfils the requirements of the customer and other recognized shareholders. It frequently includes receipt and appropriateness with outside patrons. Verification is the assessment of whether a product, service, or system conforms to regulatory prerequisite, description, or levied condition. It is mostly an in-house process.
- A packaging machine which helps in developing cartons is termed as a cartoning machine. The cartons can be erect, close, folded, side seamed and sealed cartons.

- The weight of the packaged commodity is checked with the help of a machine termed as a Checkweigher.
- Usually, checkweighers that are constructed for the production line are made with mild steel. The weighers which need harsh cleaning are made with stainless steel parts, even the Load cells.
- There are many types of conveying systems available for transporting of goods from one level to another; these include hydraulic, mechanical and fully automated systems.
- A heat gun is helpful in releasing a stream of hot air at temperatures ranging 100 °C and 550 °C and few even up to 760 °C. They are used for a number of purposes like strip paint, shrink heat shrink tubing, shrink film, and shrink wrap packaging, dehydrate moist wood, twist and join plastic, unstiffen bonding agents, and melt frozen pipes.
- Injection moulding is a process that involves producing parts with the help of a mould. The part which has to be manufactured is injected into a mould so that it can be shaped accordingly.

6.8 ANSWERS TO 'CHECK YOUR PROGRESS'

1. Five essential elements that an effective package must have are that it must be adaptable, add to the marketing value, suitable for retail display, convenient for placement, cost effective.
2. The major consumer goods packaging companies that are established globally and generate high revenues are namely, ALPLA, Amcor, Ball Corporation, Graphic Packaging, Rexam, Mondi, Toyo Seikan, and Reynolds Group Holding.
3. The packaging industry helps manufacturing companies by increasing the shelf-life of the product and maintaining the quality. The producers can produce goods but they will reach the market for consumption only after they are packed. There is no product which is manufactured and not packaged.
4. The following factors are responsible for increasing the demands made by industries on the packaging industry in India:
   - Development and rapid urbanisation
   - Growing health concerns
   - Low buying capacity
   - Rapidly growing economy
   - Changing lifestyle and growth of nuclear families
   - Awareness has led to green packaging
5. Usually, the cost of the product is the key factor determining the buying choices.
6. Modified Atmosphere Packaging (MAP) is developing as an extremely beneficial packing procedure for preserving food quality by modifying the atmospheric environment inside the package. This is mostly helpful for packaging fresh and frozen food. Smart food packaging is a result of advancement in biotechnology and enzyme technologies.

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7. Aseptic processing is the procedure through which a hygienic product normally foodstuff or medicinal products are packed in a sterile container in such a manner that the sterility is maintained.
8. Sterility is accomplished through a process termed as flash-heating in which the temperature is maintained between 91 to 146 °C. This range of temperature helps to preserve most of the nutrients and energy consumption is low as compared to the traditional method like retort or hot-fill canning.
9. In 1961, the earliest aseptic milk filling plant was established in Switzerland.
10. Automatic Identification and Data Capture or AIDC refers to the means of mechanically recognizing objects, assembling data about them, and feeding them straight into computer systems, without physical involvement of individuals.
11. Blow Moulding or BrE moulding is used as a process to manufacture hollow plastic parts. Glass bottles can also be formed using this method.
12. The system of intermodal cargo transport which uses shipping containers is termed as containerization.
13. Electronic Article Surveillance is a high-tech method for averting thievery from retailing stores, stealing of library books or impounding of possessions from public places or offices. In this the product or item which has to be secured is attached with a tag. The tag has to be deactivated before getting it out of the premises. The sensors are attached at the exit point of stores, buildings or various public places, the alarm will sound in case the product is being stolen or removed without detaching the tag.
14. The different types of plastic welding are:
    - Hot Gas Welding
    - Hot Plate Welding
    - Ultrasonic Welding
    - Spin Welding
    - Vibration Welding
15. The first acknowledged paper printing was done on paper was woodblock printing, which is dated as early as 220 A.D. in China.
16. Gravure printing process is also referred to as rotogravure. The method is used to engrave an image on a printing cylinder. The ink from the cylinder then appears on the paper. The printing on newspapers, magazines and high quantity packaging is carried out using this process.
17. Validation is the guarantee that a product, service, or system fulfils the requirements of the customer and other recognized shareholders. It frequently includes receipt and appropriateness with outside patrons. On the other hand, verification is the assessment whether a product, service, or system conforms to regulatory prerequisite, description, or levied condition. It is mostly an in-house process.
18. The filling of liquid products into bottles on a large-scale basis is termed as bottling line.

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19. The two types of cartoning machines are Horizontal Cartoning Machine and Vertical Cartoning Machine.
20. Checkweigher is a machine used to weigh a packaged commodity.
21. A Conveyor System helps in systematic handling of material and goods to various locations.
22. Heat guns are used for a number of purposes like strip paint, shrink heat shrink tubing, shrink film, and shrink wrap packaging, dehydrate moist wood, twist and join plastic, unstiffen bonding agents, and melt frozen pipes.
23. The most universally found robot formations are Articulated Robots, SCARA robots, Delta Robots and Cartesian Coordinate Robots, gantry robots.
24. Injection moulding is a process which involves producing parts with the help of a mould. The part which has to be manufactured is injected into a mould so that it can be shaped accordingly. Injection moulding is done for a variety of materials like glasses, elastomers, confectioneries and usually on thermosetting polymers.
25. The usage of computer software or any other form of programmed technology in operations of logistics is referred to as logistic automation.

6.9 QUESTIONS AND EXERCISES

Short-Answer Questions

1. Which are the trends in the packaging industry that advancements in technology should keep up with?
2. How are aseptic containers constructed?
3. List the advantages of aseptic processing.
4. What are the technologies of packaging which can help in preventing counterfeiting?
5. Discuss the components of Automatic Identification and Data Capture (AIDC).
6. Write a brief note on graphic designing.
7. What are the advantages of induction sealing?
8. In the production process, what steps can be taken to guarantee that quality is controlled in packaging?
9. What are the types of checkweighers?
10. Write a short note on injection moulding.

Long-Answer Questions

1. Write a detailed note on the packaging demands of the consumer goods industry.
2. Discuss the various aspects of plastic welding.
3. Elaborate on the history of printing and delineate the types and processes of printing.
4. What is heat sealing and what are its various types?
5. Discuss in details the various aspects of logistics automation.