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FICSI
Food Industry Capacity and Skill Initiative

# Participant Handbook

Sector
**Food Processing**

Sub-Sector
**Generic**

Occupation
**Research and Development**

Reference ID: **FIC/Q9302, Version 1.0**
**NSQF Level 5**

# Food Packaging Developer

**Published by**

Food Industry Capacity and Skill Initiative

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**Printed in India at**

Food Industry Capacity & Skill Initiative



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> Skilling is building a better India. If we have to move India towards development then Skill Development should be our mission.

**Shri Narendra Modi**
Prime Minister of India

# Certificate

## COMPLIANCE TO QUALIFICATION PACK - NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

Food Industry Capacity & Skill Initiative

for

**SKILLING CONTENT : PARTICIPANT HANDBOOK**

Complying to National Occupational Standards of

Job Role/ Qualification Pack: **" Food Packaging Developer"** 'QP No. **FIC/Q9302, NSQF Level 5**

Date of Issuance: 30/12/2021

Valid up to*: 30/12/2024

*Valid up to the next review date of the Qualification Pack

Authorised Signatory

Food Industry Capacity & Skill Initiative

## Acknowledgement

FICSI is thankful to all organizations and individuals who have helped us in preparation of this participant handbook

We also wish to extend our gratitude to all authors who reviewed the content and provided valuable inputs for improving the quality, coherence, and content presentation in chapters.

The preparation of this participant handbook would not have been possible without the support of the Food Processing Industries. The Industry feedback has been extremely encouraging from inception to conclusion & it is with their inputs that we have tried to bridge the skill gaps existing today in the Industry.

This participant handbook is dedicated to all the aspiring youth who desire to achieve special skills which would be a lifelong asset for their future endeavors and help them make a bright career in the Food Processing Sector.

## About this book

This Participant Handbook is designed to enable training for the specific Qualification Pack (QP). Each National Occupational (NOS) is covered across Unit/s.

This book is designed to enable a candidate to acquire skills that are required for employment. The content of this book is completely aligned to the National Occupation Standards QP/NOS and conform to the National Skills Qualification Framework (NSQF).

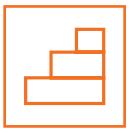
The Qualification pack of Food Packaging Developer, Level 5 includes the following NOS's which have all been covered across the units

1. **FIC/N9303:** Prepare for developing packaging material
2. **FIC/N9304:** Perform tasks for testing packaging material
3. **FIC/N9904:** Ensure food safety at the workplace
4. **FIC/N9903:** Ensure workplace health and safety
5. **DGT/VSQ/N0101:** Employability Skills (30 Hours)

Key Learning Objectives for the specific NOS mark the beginning of the Unit/s for that NOS. The symbols used in this book are described below.

## Symbols Used


Key Learning Outcomes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# 1. Introduction to food processing sector and the job of a "Food Packaging Developer"

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Unit 1.1 - Introduction to the Training Program

Unit 1.2 - Introduction to the Food Processing Industry

FIC/N9303

## Key Learning Outcomes

**At the end of this module, you will be able to:**

1. Describe the food processing industry and its sub-sectors in brief
2. Discuss the roles and responsibilities of a Food Packaging Developer

# Unit 1.1 Introduction to the Training Program

## Unit Objectives

**At the end of the session, participant will be able to:**

1. Explain the purpose and benefits of the training program.
2. Explain the outcomes of the training program
3. Introduce the fellow participant and the trainer

## 1.1.1 Purpose and Benefits of the Training Program

This training program is developed to impart specific knowledge and skills relevant to job role required to perform as a "Food Packaging Developer", in the "Food Processing" Sector/ Industry. The training program of Food Packaging Developer is based on the Qualification Pack (QP) code FIC/Q9302. A QP consists of a set of National Occupational Standards (NOS). A NOS specify the standard competency, a worker must possess while conducting any job/activity at the processing area. The following NOS are compulsory to QP Food Packaging Developer

1. **FIC/N9303:** Prepare for developing packaging material
2. **FIC/N9304:** Perform tasks for testing packaging material
3. **FIC/N9904:** Ensure food safety at the workplace
4. **FIC/N9903:** Ensure workplace health and safety
5. **DGT/VSQ/N0101:** Employability Skills (30 Hours)

Occupation Standards (OS) is the set of standards related to performance at workplace, an individual must accomplish while performing any job/activity, along with the knowledge and understanding need to achieve that standard without fail. Occupational Standards are relevant to the Indian and global contexts.

After successful completion of training and passing the assessment, participant will be issued a skill card.


*Figure 1.1.1: Skill card*

**The Skill Card**

Skill Card is issued to Certified Trainers and Assessors, displaying the following:

- Name
- Unique ID
- Certification Grade
- Validity of the Certification

The skill cards have a quick response (QR) code and by scanning it, an employer can understand what kind of skill course the person has undergone and what type of certification he/she has been awarded. For a trained jobseeker, it is hassle free; he/she will not have to carry bundles of certificates. The card may be converted into a smartcard, with embedded chip overtime.

# Unit 1.2: Introduction to the Food Processing Industry

## Unit Objectives

**At the end of the session, participant will be able to:**

1. Classify the Food and Agro Processing Industry
2. Describe the status of food processing industry in India as well as globally.
3. Debate the criticality of food processing industry

## 1.2.1 Food Processing

The food processing industry (FPI) is among the largest in the world India's industries rank fifth in terms of production, consumption and exports. India is the second-largest food producer worldwide next to China. India has a production advantage in many agricultural products, with complex agro-climatic conditions, with the ability to cultivate a wide range of agricultural raw materials needed by the food processing industry. Total food production in India is likely to double in the next ten years and there is a potential for major investments in food processing, especially in the areas of canning, dairy processing, specialty processing, packaging, frozen food/refrigeration, and thermal processing.

India is a leading producer of food products such as meat, black tea, milk, fruit and vegetables, among others. The country has quality food items to sell to the world including Basmati rice, Darjeeling tea and Alphonso mangoes. India's government has played an important role in growing and developing the food processing industry.

## 1.2.2 Classification of Food Processing Industry

The food industry is a dynamic, global community of diverse businesses that supply most of the food the world's population consumes. The food processing industry in India can be segmented as:


*Figure 1.2.1: Classification of food processing industry*

## 1.2.3 Status of Food Processing Industry

One of the major global industries is the food processing industry. Only look around and you'll find juice businesses, cold drinks, wafer chips, chain restaurants to be among the biggest ones. Italian pizza and pasta are now used in nearly every country, so are the burgers and sandwiches. Among the most requested consumer items are cornflakes, rice, ketchup, sugar-free foods etc. Just 2 per cent of India's production of vegetables and fruits is currently processed. By contrast, China and the USA process 90 percent and 40 percent respectively of their produce. Other developing nations, such as the Philippines, Thailand, and Brazil, process their production as high as 30%, 78%, and 70%. As India's world's fifth-largest food processing sector in production and exports, the food processing industry is given considerable importance and justifies government priority treatment. Accordingly, the sector has become an item of the initiative 'Make in India.'

## 1.2.4 The Indian Food Processing Industry

In India the food processing industry plays a very important role in the economy of India. Between agriculture and crop harvest up to product consumption, each commodity has a substantial level of expansion. This value expansion can be of different kinds as it lastly goes from manufacturer to distributor to retailer to the shopper, each stage increases the product's value. There could be value expansion in this value chain by sorting, evaluating, bundling, branding and so on. These activities do not make the product attractive and usable; it gives consumers choice and attention and also improves the time frame for the realistic usability of the items.

In its original shape, the greater part of rural goods is not consumable. Wheat is transformed into flour, sugar cane into jaggery, sugar, ethanol, liqueur, paddy into rice, etc.

Food processing thus not only improves agro-products but also increases their usefulness. We realise that in an economy, exercises are largely divided into agriculture, industry and services. The food processing sector is a product of the agriculture and the agribusiness.

India's food processing industry is valued at 135 billion dollars of production, which rises at about 8 per cent per year. This rate of growth is more than the rate of rural development, which remains about 4%. These signs indicate a sensational move from conventional ways toward food processing. Through manufacturing, the gross domestic product accounts for around 10 per cent of that of agriculture.

India is the world's largest producer of pulses, ginger, mangoes, banana, buffalo milk, meat and rice, cashew nuts, wheat, garlic, potato groundnut, green peas, dry onion, pumpkin, gourds, sugar cane, cauliflowers, and tea. We supply 17 percent of the global vegetable aggregate, and analyse 14 percent of natural products. In India, around 40 per cent of the world's mangoes and 30% of the world's bananas and papayas are delivered. In addition, India has several one-of-a-kind items to offer, e.g. Alphonso Mangoes and Madhya Pradesh wheat is especially protein-rich.

## 1.2.5 Importance of Food Processing Industry

Indian agriculture tackles a big issue, that is, waste after processing. It is about 30-40% in a class of foods produced from the earth. Overall, the waste cost is projected at 18 per cent from 50,000 crores to 1 lakh crore. Waste of agricultural products is mainly due to a few variables including non- accessibility of offices to organise, package, stock, transport, cool chain and low processing rates.

Consumption patterns in India are increasingly changing from grains to foods and crops rich in proteins. Likewise, India has the remarkable extent of the populace that is undernourished, inhibited, and wasted. Cultivation and natural goods are desirable for this problem and the reduction in waste here would have an unambiguous impact.

Food processing industry could potentially turn the entire economy around. India's economy is still agrarian, given that around 55% of the population is directly dependent on agribusiness. FPI explicitly targets component cultivation as it strives to produce more varieties of single yield products. This will generate interest for farmers and hence rentable costs.

India's statistical income is debated extensively and the majority of this lies in rural India. Due to low productivity, the Indian youth are getting some distance from agriculture. FPI is perhaps the best wager to seize the statistical profit opportunity. This can give us a kind of diverse visionaries of country business.

Aside from the growing economy of this present India, income levels are rising upward. A significant number of family groups regularly abandon the desire to be a member of a white-collar community. Income per capita is growing, as the rate of GDP growth is substantially higher than the rate of population development. Complements Fl here is no doubt that the request will increase; however, it must be seen to what extent the Indian industry seizes the opportunity and what amount is left to outside organisations.

Tactical geographical location and proximity to food-importing nations also make India complementary to processed food exports. At last, annual integration of world financial systems is rapid even. A country, then, has no choice but to remain competitive. Food processing has a significant role to play in linking Indian farmers to domestic and foreign consumers. The industry employs around 1.85 million people in about 39,748 registered units with INR 2,461,201,800 of fixed capital. Major food processing industries are grain, sugar, edible oils, beverages and dairy products.

**The main food processing industry sub-segments in India are:** dairy, fruit and vegetables, processing of poultry and meat, farming, food retail, etc.

**Key Facts**

| |
|---|
| **311.71 mn tones of horticulture crop production in 2017-2018** |
| **Milk production of 176.3 mn tones during 2017-18 with per capita availability of milk at a level of 375 grams per day in 2017-18** |
| **Egg production of around 95.2 bn during 2017-18** |
| **Food Retail Market is majorly dominated by Food Grocery (growing at CAGR 25%) and Food Services (growing at CAGR 15%) segments** |
| **Food Retail Market is majorly dominated by Food Grocery (growing at CAGR 25%) and Food Services (growing at CAGR 15%) segments** |

*Figure 1.2.3: Some key facts of India's food processing industry*

India's food ecosystem offers huge investment opportunities with stimulating food retail growth, favorable economic policies and attractive fiscal incentives. India's Food and Grocery industry are the sixth-largest in the world. The India food and grocery retail market also accounts for nearly 65 percent of India's total retail market.

The Government of India is also taking all necessary steps through the Ministry of Food Processing Industries (MoFPI) to boost investment in the food processing industry. The Government has sanctioned 42 Mega Food Park Scheme to be established in the country. At the moment 17 Mega

## 1.2.6 Growth of Food Processing Market in India Report


*Figure1.2.4: The Growth of Food Processing Market in India*

- Improvement in the 9-10% of GDP in India in FY2017
- By 2024, the Food Processing industry will potentially attract $33 billion in investments and generate employment for 9 million people predicting revenue generation by INR 50,571 billion, exhibiting a CAGR of 12.4% and 12% during 2019-2024 and 2021-2026 respectively
- By2030, Indian annual household consumption to treble, making India the 5th largest consumer
- 100% FDI is permitted under the automatic route in the Food processing industries
- 100% FDI is allowed through government approval route for trading, including through e-commerce in respect of food products manufactured or produced in India
- Quickest double-digit growth of packed food in Indian market


*Figure1.2.5: Food parks classified in categories of operations, progress and principle*

Scan the QR code or click on the link to watch related videos

www.youtube.com/watch?v=5VlYw38hCxU
Scope of food processing in India with National and International perspective

www.youtube.com/watch?v=J-2EiMVNtpM
Overview of Food Processing Industry

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# 2. Prepare for Developing Packaging Material

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Unit 2.1 – Introduction to Food Packaging

Unit 2.2 – Prepare for Packaging Material Development

Unit 2.3 – Prepare for Testing

FIC/N9303

## Key Learning Outcomes

**At the end of the module, the participant will be able to:**

1. Identify requirements for Packaging
2. Prepare for the development of packaging materials.
3. Prepare for the testing of packaging material.

# Unit 2.1 – Introduction to Food Packaging

## Unit Objectives

**At the end of the module, the participant will be able to:**

1. Define food packaging
2. Demonstrate food supply and protective role of packaging
3. Define packaging strategy
4. Prepare for packaging design and development

## 2.1.1 Introduction to Food Packaging

**Packaging** is the science, art and technology of enclosing or protecting products for distribution, storage, sale, and use. Packaging also refers to the process of design, evaluation, and production of packages. Packaging is heavily integrated into our daily lives. The main use for packaging is the protection of the goods inside. Packaging also provides us with arecognizable logo or packaging.

**Food packaging** is vital for providing physical protection, preventing post-process contamination, extending shelf life, and communicating vital information to the consumer. Food packaging is of paramount significance in preserving the quality of fresh and processed foods. It would be practically impossible for food processors to distribute food without packaging. Developments in packaging have moved beyond these basic packaging functions. Introduction of new packaging methods, such as modified atmosphere packaging, active packaging (oxygen scavenging, antimicrobial activity), and intelligent technologies, have performed beyond basic functions; have increased product quality, safety, and shelf life beyond consumer expectations; and have furthered outreach to distant markets.


*Fig 2.1.1: Food Packaging*

A variety of packaging materials and technologies are in use to extend the shelf life of food products. Packaging design and material properties determine the end-use of a package and the shelf life of packaged foods. Glass, paper, metal, and plastics are the most important groups of materials used for

food packaging. Plastic or polymer-based packaging is still the most widely used in the food industry, but developments in bio-based packaging are gaining importance to reduce pollution and improve environmental sustainability.

## 2.1.1.1 Functions of Food Packaging

**Food packaging serves many important functions. They may be broken down as follows.**

- **Containment:** For granulated items, paper-based packages are the best, with a sealing system to prevent the infiltration of moisture into the product. Other products are packaged using metal cans, plastic bags and bottles, and glass containers. Another factor in containment is packaging durability—in other words, the packaged food has to survive transport from the food processing facility to the supermarket to the home for the consumer.
- **Protection:** The packaging must protect the food from (a) biological agents such as rats, insects, and microbes; (b) mechanical damage such as product abrasion, compressive forces, and vibration; and (c) from chemical degradation such as oxidation, moisture transfer, and ultraviolet light.
- **Communication:** Packaged food must be identified for consumer use, mainly with label text and graphics. It can also be done by using special shapes for the food package, such as the Coca-Cola bottle or the can of Spam. Other well-known food package shapes include potato chip bags and milk bottles. These packages also detailed nutritional information, and whether they are packaged according to kosher or halal specifications. The label may also indicate whether it is safe to put the packaged food (such as a TV dinner) through a microwave process.
- **Environmental issues:** To protect the environment, we must be willing to reuse or recycle the packaging or reduce the size of the packaging.
- **Package safety:** Before using a particular type of package for food, researchers must ensure that it is safe to use that packaging for the food being considered and that there are no adverse interactions between the package and the food. This includes any metal contamination issues from a can to the food product or any plastic contamination from a bottle to the food product.
- **Product access:** The packaging must be such that the product is readily accessible when the consumer is ready to use it. For example, pouring spouts on milk cartons can make it easy to dispense the milk.

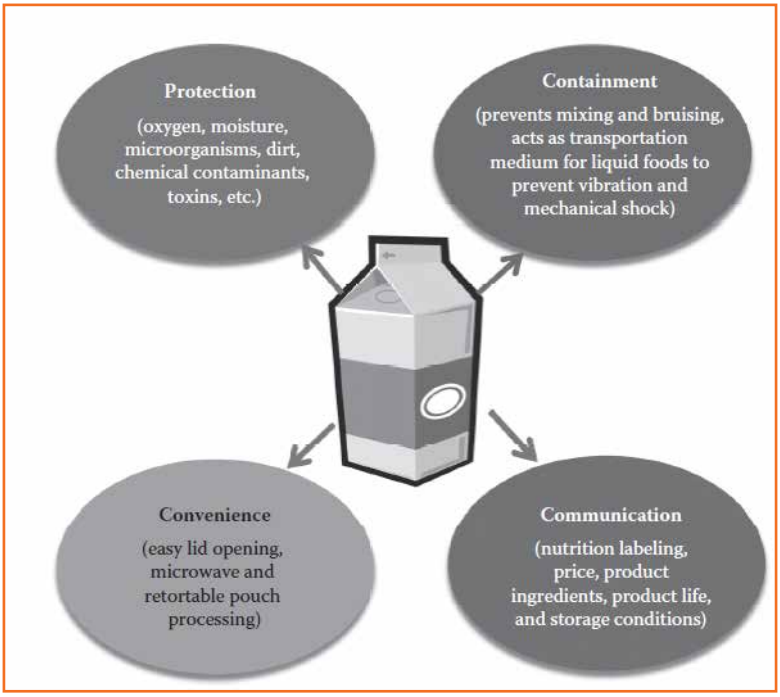


*Fig 2.1.2: Major functions of food packaging.*

## 2.1.1.2 Food Packaging Types

The materials mentioned can be fashioned into different types of food packages and containers. Examples are given below -

**Primary packaging** is the main packaging that holds the food that is being processed. **Secondary packaging** combines the primary packages into a single box. **Tertiary packaging** combines all of the secondary packages into one pallet.

| Packaging type | Type of container | Examples of foods packaged |
|---|---|---|
| Aseptic packages | Primary | Liquid whole eggs |
| Plastic trays | Primary | Portion of fish |
| Bags | Primary | Potato chips |
| Bottles | Primary | Bottle of a soft drink |
| Boxes | Secondary | Box of soft drink bottles |
| Cans | Primary | Can of tomato soup |
| Cartons | Primary | Carton of eggs |
| Flexible packaging | Primary | Bagged salad |

| Packaging type | Type of container | Examples of foods packaged |
|---|---|---|
| Pallets | Tertiary | A series of boxes on a single pallet, to transport packaged food from the manufacturing plant to a distribution centre. |
| Wrappers | Tertiary | Used to wrap the boxes on the pallet for transport. |

*Table 2.1.1: Food Packaging Types*

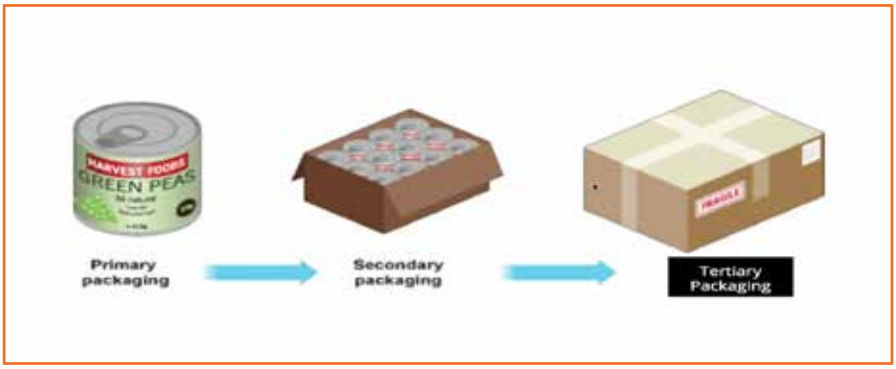


*Fig 2.1.3: Type of Packaging Container*

| Packaging type | Type of container | Examples of foods packaged |
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| Aseptic packages | Primary | Liquid whole eggs |
| Plastic trays | Primary | Portion of fish |
| Bags | Primary | Potato chips |
| Bottles | Primary | Bottle of a soft drink |
| Boxes | Secondary | Box of soft drink bottles |
| Cans | Primary | Can of tomato soup |
| Cartons | Primary | Carton of eggs |
| Flexible packaging | Primary | Bagged salad |
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*Table 2.1.1: Food Packaging Types*

## 2.1.1.3 Food Packaging Developments – A historical perspective

The last 200 years have seen the pack evolve from being a container for the product to becoming an important element of total product design – for example, the extension from packing tomato ketchup in glass bottles to squeezable co-extruded multi-layer plastic bottles with oxygen barrier material for long shelf life.

Military requirements have helped to accelerate or precipitate some key packaging developments. These include the invention of food canning in Napoleonic France and the increased use of paper-based containers in marketing various products, including soft cheeses and malted milk, due to the shortage of tinplate for steel cans during the First World War. The quantum growth in demand for pre-packaged foods and foodservice packaging since the Second World War has dramatically diversified the range of materials and packs used. These have all been made possible by developments in food science and technology, packaging materials and machine technology.

Since the advent of the food can in the 19th century, protection, hygiene, product quality and convenience have been major drivers of food technology and packaging innovation. In recent years, there has been a rising demand for packaging that offers both ease of use and high-quality food to consumers with busy lifestyles. The 1980s, in particular, saw the widespread adoption by the grocery trade of innovations such as gas barrier plastic materials utilised in aseptic FFS plastic containers for desserts, soups and sauces; plastic retail tray packs of premium meat cuts in a modified atmosphere; and reportable plastic containers for ambient storage ready meals that can be microwave heated.

Technological developments often need to converge for a packaging innovation to be adopted. These have included developments in transportation, transport infrastructures, post-harvest technology, new retail formats and domestic appliances such as refrigerators, freezers and microwave ovens. For example, the development of the microwave oven precipitated the development of convenience packaging for a wide range of foods. In addition, the socio-cultural and demographic trends, consumer lifestyles and economic climate must generate sufficient market demand for an innovation to succeed.

## 2.1.2 Food Supply and the Protective role of Packaging

Packaging for consumer products is an area where supply and demand are continuously changing due to the development of an international food market and adaptation to consumer, distribution, legal and technological requirements. Broad external influences on packaging for fast-moving consumer products may be summarised as follows:

- technological
- political/legal
- socio-cultural
- demographic
- ecological

- raw material availability
- economic.

Consumer demand for pre-packaged food continues to increase in advanced economies and a growing global population is also fuelling the demand.

Increasing market segmentation and the development of global food supply chains have spurred the adoption of sophisticated logistical packaging systems. Packaging is an integral part of the logistical system and plays an important role in preventing or reducing the generation of waste in the supply of food. Figure 2.4 illustrates the distribution flows of food from the farm to the consumer. It should be noted, however, that some parts of the chain permit the use of returnable packages.

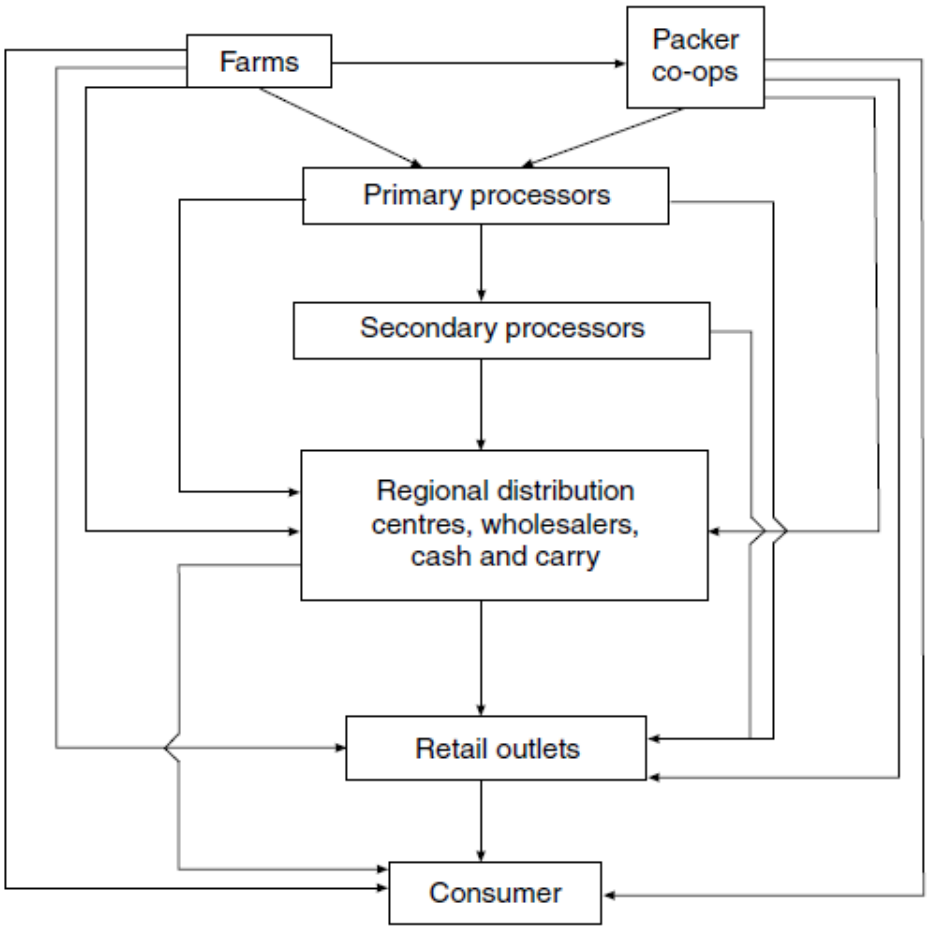



*Fig. 2.1.4: Food distribution systems*

Packaging combined with developments in food science, processing and preservation techniques, has been applied in a variety of ways to ensure the safety of the consumer and the integrity of the product.

## 2.1.3 Packaging strategy

Packaging may also be defined as a means of safely and cost-effectively delivering products to the consumer in accordance with the marketing strategy of the organisation.

A packaging strategy is a plan that addresses all aspects and all activities involved in delivering the packaged product to the consumer. Packaging strategy should be allied to clearly defined marketing and manufacturing strategies that are consistent with the corporate strategy or mission of the business. Key stakeholders in the strategic development process include management from technical/quality, manufacturing, procurement, marketing, supply chain, legal and finance functions.

Packaging is both strategically and tactically important in the exercise of the marketing function. Where brands compete, distinctive or innovative packaging is often a key to the competitive edge companies seek.

## 2.1.4 Packaging Design and Development

Marketing pull is a prerequisite to successful innovation in packaging materials, forms, designs or processes. The most ingenious technological innovation has little chance of success unless there is market demand. Sometimes, an innovation is ahead of its time but maybe later adopted when favoured by a change in market conditions. Specialist technical research, marketing research and consumer research agencies are employed to identify opportunities and minimise the financial costs and risks involved in the development, manufacture and marketing of a new product.

Ideally, package design and distribution should be considered at the product concept stage. Insufficient communication may exist between marketing and distribution functions; a new product is manufactured and pack materials, shape and design are formulated to fulfil the market requirements. It is only then that handling and distribution are considered. Product failure in the marketplace due to inadequate protective packaging can be very costly to rectify.

The development of packs is frequently a time-consuming and creative endeavour. There may be communication difficulties between business functions and resource issues that impede pack development. The use of multidisciplinary teams may expedite the packaging development process. This has the effect of improving the quality of the final product by minimising problems caused by design consequences that can result from sequential development. Computer-assisted design (CAD) and rapid prototyping facilities for design and physical modelling of packs give packaging development teams the ability to accelerate the initial design process.

In packaging development, thorough project planning is essential. In particular, order lead times for packaging components need to be carefully planned with suppliers at an early stage to ensure a realistic time plan.

# Unit 2.2 – Prepare for Packaging Material Development

## Unit Objectives

**At the end of the module, the participant will be able to:**

1. Identify different food packaging material
2. Demonstrate properties of packaging materials
3. Describe the type and function of packaging equipment
4. Define vendor management

## 2.2.1 Introduction to Food Packaging Material

A variety of packaging materials and technologies are in use to extend the shelf life of food products. Packaging design and material properties determine the end-use of a package and the shelf life of packaged foods. Glass, paper, metal, and plastics are the most important groups of materials used for food packaging. Plastic or polymer-based packaging is still the most widely used in the food industry, but developments in bio-based packaging are gaining importance in order to reduce pollution and improve environmental sustainability.

## 2.2.1.1 Packaging Materials for Food Applications

Approved packaging materials for food use are mainly glass, metal, paper, plastic, and biobased materials. The material properties determine the end-use of packaging material, and the shelf life is product specific. Plastic, metal, glass, and paper are commonly used as packaging materials to preserve the freshness and quality of different food products. However, biobased packaging is a focus of current research in order to avoid the environmental impact of polymeric packaging materials. Following is a brief overview of packaging materials for food use.

1. **Glass**

   This inert packaging material provides an absolute barrier to gases and moisture, making it suitable for flavour retention and freshness of food products such as beer and wine. Glass can withstand high thermal-processing conditions, provides good insulation, and can be formed into different shapes—either transparent or opaque. Aluminium oxide coatings improve its barrier properties, especially from chemical attacks.


*Fig 2.2.1: Glass Packaging of Food*

2. **Paper**

Paper is modified with additives (lacquers, waxes, resins, etc.) or coextruded with other polymers to improve its barrier properties. Paper and paper boards are used in different forms (corrugated boxes, cartons, bags, sacks, and wrapping paper) for several packaging levels in food and allied products. Different forms of the paper include:

- **Kraft paper:** Natural brown, unbleached, bleached white, and heavy-duty, this paper is used to fabricate bags and wrappings. It is the strongest paper and is used for packaging flour, sugar, and dried fruits and vegetables.
- **Sulfite paper:** This paper is glazed to improve its appearance, wet strength, and oil resistance. Sulfite paper is relatively lighter and weaker than kraft paper but has high print quality. It is often used with plastic or foil laminates to prepare packaging materials for biscuits and confectionery.
- **Greaseproof paper:** Offering resistance to oil but allowing moisture migration, greaseproof paper is commonly used to pack cookies, butter, oily foods, candies, and so forth.
- **Glassine:** This greaseproof paper has a high degree of smoothness and a glossy finish. It is commonly used for packaging biscuits, fats, fast foods, and so on.
- **Parchment paper:** Made from acid-modified cellulose to improve its air and moisture barrier properties, parchment paper is used for butter, lard, and fat packaging.
- **Paperboard:** Paperboard is available in several forms (whiteboard, solid board, chipboard, fibreboard, and paper laminates) and is mainly used in secondary packaging to improve the handling and distribution of food products.

*Fig 2.2.2: Paper Packaging of Food*

3. **Metal**

The commonly used metals for food packaging are tin, steel, aluminium, and chromium. They offer excellent barrier properties, physical protection, printability, consumer acceptance, and recyclability.

Metal is commonly used in the retort processing of fruits, vegetables, meats, fish, and pulses, as well as in cans for drinks or containers for baby foods, powders, confectionery, and so on. Aluminium is commonly used to make the foil, laminated paper/plastic films, laminates and metalized films, or cans. It has several advantages over other metals such as being light in weight and corrosion resistant, aswell as providing a barrier to air, temperature, moisture, and chemical attack. Aluminium-based packaging materials are used for soft drink cans, seafood, can/ bottle closures, and so forth.


*Fig 2.2.3: Metal Packaging of Food*

4. **Plastics**

Plastics can be classified into thermosets and thermoplastics, which are often made by the process of condensation or additional polymerization. Thermosets are mainly used in non-food applications, while thermoplastics constitute the major packaging material used for films, bottles, jugs, and so on for food industries.

Although several plastics are allowed for food use (such as polyolefins, polyesters, polyvinyl chloride, polyvinylidene chloride, polystyrene, polyamide, ethylene vinyl chloride, laminates, and coextrusions), there is a growing tendency to replace them with bioplastics to protect the environment.


*Fig 2.2.4: Plastic Packaging of Food*

## 2.2.2 Properties of Packaging Materials

Packaging materials are selected based onthe characteristics of the food to be packed for a specific period of time. The basic material properties of packaging materials that influence food quality and safety are barrier properties (light, oxygen, and water vapour transmission rate), mechanical properties, chemical reactivity, and migration properties.

In order to predict the performance of a package, scientists and packaging technologists perform an array of tests to ensure that the packaging material has the desired properties for a selected product to keep it safe throughout the distribution chain. Some of the critical factors while determining the packaging materials properties are discussed as follows -

- **Permeability:** Should have selective permeability for gases, moisture, and flavours as per the product requirements.
- **Light barrier properties:** Should protect foods from adverse effects of light.
- **Microbial contamination:** This should prevent microbial contamination from the environment and from the package itself.
- **Tensile strength:** Should have sufficient tensile strength to contain the food during distribution and throughout its entire cycle.
- **Migration aspects:** Food package interaction is a serious concern of consumers mainly with regard to food safety. All packaging Materials should meet migration limits as per standards and regulations.

| Type | Physical Properties | Mechanical, Chemical, and Miscellaneous Properties | BarrierProperties | Food Use |
|---|---|---|---|---|
| **Polyolefins** | | | | |
| **LDPE** | Density (910–925 kg m−3), transparency (poor–fair), low crystallinity, temperature range (−50°C to 80°C) | Tough, flexible, resistant to grease and chemicals, good sealing properties | High moisture barrier, very low gas barrier | Bread and frozen food bags, flexible lids, squeezable food bottles, etc. |

| Type | Physical Properties | Mechanical, Chemical, and Miscellaneous Properties | BarrierProperties | Food Use |
|---|---|---|---|---|
| **LLDPE** | Density (910–940 kg m−3), transparency (poor–fair), high crystallinity, temperature range (−30°C to 100°C) | Tough, extensible, good resistance to grease, good sealing properties | High moisture barrier, very low gas barrier | Stretch/cling wrap, heat sealant coating, etc. |
| **HDPE** | Density (945–967 kg m−3), transparency (poor), high crystallinity, temperature range (−40 to 120°C) | Tough, stiff, strong, resistant to grease and chemicals, good sealing properties, easy to process and form | Extremely high moisture barrier, very low gas barrier | Used for bottles of milk, juice, and water; cereal box liners, margarine tubs; trash and retail bags |
| **PP** | Density (900–915 kg m−3), transparency (fair), low crystallinity, temperature range (−40°C to 120°C), a high melting point of 160°C | Moderately stiff, strong, good resistance to grease and chemicals | High moisture and low gas barrier | Used for bottles of milk, juice, and water; cereal box liners; margarine tubs; hot-filled and microwavable packaging; trash and retail bags |

| Type | Physical Properties | Mechanical, Chemical, and Miscellaneous Properties | BarrierProperties | Food Use |
|---|---|---|---|---|
| **Polyesters** | Density (900–915 kg m−3), high transparency (like glass); temperature range (−10°C to 220°C), high meting point of >200°C | High impact resistance, low scratch-resistance, tough, strong, and resistance to grease and oil | High moisture and gas Barrier | Refillable water bottles, sterilizable baby bottles |
| **PETE or PET** | Density (1380–1410 kg m−3); high transparency (good), low crystallinity, temperature range (−60°C to 200°C) | Stiff, strong, good resistance to grease and chemicals | Good barrier to gases and moisture, good grease resistance | As containers (bottles, jars, and tubs), semirigid sheets (trays and blisters), and thin oriented films (bags and snack food wrappers) |
| **PEN** | Density (1.36 g cm−3), transparency (good), applicable at both high and low temperatures | Stiff, chemical and hydrolytic resistance, thermal and thermooxidative resistance | Good gas and moisture barrier, UV light barrier | Suitable for hot refills, rewashing, and recyclable. Suitable for beer and wine bottles to pre-serve the flavour |
| **Polycarbonate** | | | | |
| **PVC** | Density (1350–1450 kg m−3),transparen-cy (good), temper-ature range(−2°C to 80°C) | Strong, stiff ductile, resistant to chemicals, stable electrical properties | High moisture barrier, moderate oxygen barrier, good resistance to grease and oil | Used in bottles and packaging films. Limited use in food applications |

| Type | Physical Properties | Mechanical, Chemical, and Miscellaneous Properties | BarrierProperties | Food Use |
|---|---|---|---|---|
| **PVdC** | Density (1600–1700kg m−3), transparency (good), temperature range (−20°C to 130°C) | Strong, stiff ductile, resistant to chemicals, stable electrical properties | Excellent oxygen and moisture barrier properties, very good grease and oil resistance | Suitable for poultry, cured meats, cheese, tea and coffee, snack foods, and confectionery. It May be used in hot filling, low-temperature storage, and modified atmosphere storage conditions |
| **Polysty-rene** | Density (1030–1100 kg m−3); transparency (very good), tempera-turer ange (−20°C to 90°C) | Hard and brittle with a low melting point | Low moisture and air barrier, fair to good resistance to oil and grease | Used as protec-tive packaging for eggs, dispos-able plastic ware, cups, plates, bottles, and trays. The expanded form may be used as cushioning material |
| **EVOH** | Density (1140–1210 kg m−3), transparency (good), applicable-temperatures (−20°C to 150°C) | Stiff, strong, very strong oil and grease resistance | Excellent moisture barrier, high air barrier, very good resistance to grease and oil | Used in coex-truded films to avoid its contact with water |

| Type | Physical Properties | Mechanical, Chemical, and Miscellaneous Properties | BarrierProperties | Food Use |
|---|---|---|---|---|
| **Polyamide** | Density (1130–1160 kg m−3),transparency (good), applicabletemperatures (−2°C to 120°C) | Stiff, strong, good resistance to grease and chemicals | High air and moisture barrier, good resistance to grease and oil | Used for boil-in-bag packaging |

*Table 2.2.1: Properties of the Commonly Used Plastic Packaging Materials for Food Products*

**Some of the critical factors while determining the packaging materials properties are discussed as follows:**

1. **Permeability:** Should have selective permeability for gases, moisture, and flavours as per the product requirements.
2. **Light barrier properties:** Should protect foods from adverse effects of light.
3. **Microbial contamination:** This should prevent microbial contamination from the environment and from the package itself.
4. **Tensile strength:** Should have sufficient tensile strength to contain the food during distribution and throughout its entire cycle.
5. **Migration aspects:** Food package interaction is a serious concern of consumers mainly with regard to food safety. All packaging Materials should meet migration limits as per standards and regulations.

## 2.2.2.1 Barrier Properties

The barrier properties of packaging materials have a significant influence on the shelf life, safety, and quality of packaged food products. Water vapour, gas, and light barrier properties are primary considerations when designing a packaging material for specific end-use.

1. **Water vapour barrier**

   Food products tend to dry out or gain moisture if they are not packed appropriately. Dried milk and protein powders tend to agglomerate, while deep-fried products, cookies, and wafers tend to lose their crispy texture upon absorption ofmoisture. Furthermore, fresh produce requires packagingmaterials with a certain amount of mass transfer to maintain an optimal level of oxygen required by the produce to respire and to prevent excessive condensation within the package.

   Therefore, the water vapour permeability of packaging materials greatly influences the quality of food products. The water vapour transmission rate, a standard practice to measure water

permeability, determines the ability of a package to allow water vapour to pass through it. The standard test conditions are 90% relative humidity at 37.8°C.

2. **Oxygen barrier**

   Oxygen may be kept away by appropriate packaging to avoid many undesirable changes in foods. Oxidation causes discolouration of fresh and processed meat products, off-flavourdevelopment or rancidity in products rich in oil, and mould growth in cheese and bread, and it accelerates spoilage in several food products.

   Therefore, oxygen-sensitive food products require packaging with adequate oxygen barrier properties. The oxygen transmission rate is measured as the number of millilitres of oxygen that pass through one square meter of packaging in 24 hours at one unit of atmospheric pressure. Packaging materials with values of 10 to 100, 1 to 10, and less than 1 millilitre are considered as good, very good, and extremely good, respectively. Oxygen may also find its way inside the package through inappropriate seals, folds, or through a damaged package. Factors such as temperature and humidity influence the oxygen barrier properties and must be considered during the selection of specific packaging material.

3. **Light barrier**

   Light-mediated oxidation creates unpleasant odours and tastes in a number of food products. It also causes discolouration of meat products and off-flavour development. When products are illuminated, components of the food product become oxidized and this creates unpleasant odours and taste. The food also loses vitamins A, B, and C, and pigments in the food lose their colour. Most vulnerable are dairy products, meat and meat products, and fats and oils.

## 2.2.2.2 Physical and Mechanical Properties

The physical and mechanical properties of packaging materials are important in determining the physical strength they can withstand under applied stress. Therefore, it is important to measure and improve the mechanical properties of packaging materials using a range of mechanical testing methods, such as:

- Tensile testing
- Seal and peel testing
- Testing of tear, flexural, and impact properties
- Testing of seal strength and puncture resistance
- Peeling test
- Edge compression test and box compression test
- Drop test

## 2.2.2.3 Migration Aspects of Packaging Materials

The migration of polymers, additives, and other components from metal and paper packaging has been a serious concern for consumers. Several factors such as the processing, hot filling,pH, and poor processing of polymers increase themigration risk of packaging constituents into the foodstuffs. Liquid products have more serious problems than solid or semisolid foods.

The migration of polymeric compounds, such as vinyl chloride, acrylonitrile, styrene, plasticizers (phthalate, adipate esters, acetyltributyl citrate, BHT [butylated hydroxytoulene], BHA [butylhydroxyanisol], odours, etc.), tin, lead, aluminium, epoxy resin coatings, dioxins, benzophenone, nitrosamines, chlorophenols, and so on, can be evaluated using gas or liquid chromatography to ensure the safety of food products.

## 2.2.3 Packaging Equipment

Depending on the type of food being packed, packing comes in various types. To pack these food materials, various food packaging machines are used. The packing styles also change depending on the storage life of the product.

**Here are the various types of food packaging machines:**

In order to address the variety of packaging needs, there is a wide variety of packaging equipment types. Categorized by the method used to package products, the main types include filling machines, sealing machines and vacuum packaging machines.

1. **Filling Machine**

   Filling machines are used to take previously manufactured packaging and fill that packaging with a certain number of parts, whether it is one large part or a hundred small parts. A bagging machine is a type of filling machine in which the packaging is specifically limited to bags; bags are defined as containers made from flexible materials such as paper or plastic that have a single opening. Flexible packaging systems like bagging machines work well for liquid packaging. They're often used for storing beverages like soda.

*Fig 2.2.5: Filling Machine*

2. **Sealing Machine**

Sealing machines are packaging machines used to close and make airtight packaging after a product has been put inside it. One of the most common types of sealing machine is the heat sealer, which seals thermoplastics like shrink wrap using the direct application of heat and pressure. Sealing machines are common as food packaging equipment, for packaging bakery goods and fresh produce. Variations on the seal machine include the bag sealer.

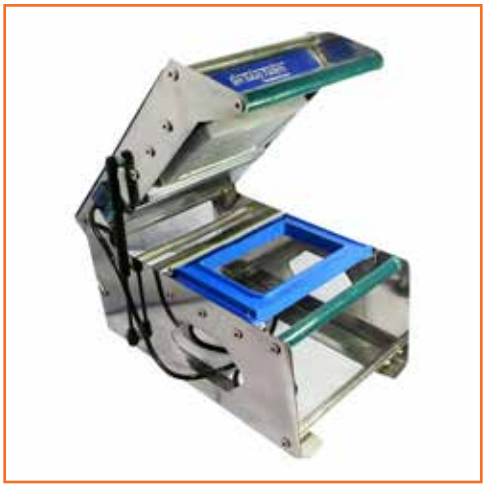


*Fig 2.2.6: Sealing Machine*

3. **Vacuum Packaging Machine**

This is perhaps the most common type of packaging machinery for industrial and food handling applications. Vacuum packing machines provide air-tight packaging by first removing the atmospheric oxygen in the package and then sealing the package. Vacuum packaging is also a popular way to seal electronics like cameras into waterproof packaging.

*Fig 2.2.7: Vacuum Packaging Machine*

**Vaccum Package Machine**

*Fig 2.2.8: Vaccum Sealing Machine for Sweets*

1. **Labeling Equipment**

An important aspect of any complete packaging operation is labeling. Labeling equipment provides the finishing touch to packaging by adhering labels for purposes like - product identification, pricing, usage guidance, barcoding, shipping instructions and indication of tampering. Labeling equipment can be large enough to tackle high industrial loads, or it can be as small enough for small business purposes, as is the case with a handheld label applicator.

*Fig 2.2.9: Labeling Equipment*

2. **Fill Machine**

Filling machines, or fillers, are designed to fill containers with a predetermined amount of material. This material can be a finished product, like glass bottles, or it can be liquid that goes into those bottles, or it can be industrial materials, such as palletized plastic. Fillers are typically components of conveyors, and their design varies based on whether they are meant to liquid fill or solid fill.

A popular filler process is “form fill seal” (FFS), a process during which the machine takes v-fold or flat material, forms it into a container or bag, and then fills it and seals it. Similar is filling capping sealing, during which bottles are filled, capped and sealed.

*Fig 2.2.10: Filling Machine*

3. **Case Packing**

Case packing equipment is packaging machinery designed specially to work with cases of all sizes and volumes. They help manufacturers pack cases of product more quickly, efficiently and uniformly. To finish the operation, responsible manufacturers also send their cases through a case sealer, which ensures that all the contents are securely inside, and nothing can get in or get out. Common case packing equipment varieties include, top load case packers, side load case packers and robotic case packers. As high-traffic industrial packing equipment, case packers can be designed to work in conjunction with palletizers.


*Fig 2.2.10: Case Packing*

4. **Shrink Packaging Machinery**

   Shrink packaging, also known as shrink wrap, is a type of plastic used during packaging. When heated, it shrinks and takes the form of the item it surrounds. Shrink packaging can be used to wrap a wide range of products, and so, shrink wrapping jobs can be done with large machines or heat guns.

*Fig 2.2.11: Shrink Packaging Machinery*

## 2.2.4 Vendor Management

**Vendor management** is the process that empowers an organization to take appropriate measures for controlling cost, reducing potential risks related to vendors, ensuring excellent service deliverability and deriving value from vendors in the longrun.This includes researching about the best suitable vendors, sourcing and obtaining pricing information, gauging the quality of work, managing relationships in case of multiple vendors, evaluating performance by setting organizational standards, and ensuring that the payments are always made on time.

## 2.2.4.1 Benefits of Vendor Management

**By having proper vendor management in place, an organization can experience the following benefits:**

1. **Better Selection**

   By implementing appropriate vendor management in place, your organization can benefit from a larger selection of vendors, resulting in more choices and ultimately better costs.Your organization can benefit from a bidding war between vendors while ensuring that you get your money's worth.

2. **Better Contract Management**

   In a multi-vendor scenario, the lack of a vendor management system elevates the issue of managing contracts, documentation and other vital information in your organization.

   By implementing a proper VMS in place, your organization can benefit from a centralized view of the current status of all contracts and other useful information which will enable your organization to achieve better decision-making capabilities and save valuable time.

3. **Better Performance Management**

   An integrated view of the performance of all the vendors can be achieved through the implementation of a vendor management system.

   This can give your organization a clear understanding of what is working and what is not! This ultimately leads to improved efficiency, which in turn improves the overall performance of the organization.

4. **Better Vendor Relationship**

   It is never easy to manage multiple vendors at the same time. While some vendors may prove fruitful, others may not. But managing relationship among the vendors is the key to successful project completion.

   By getting all vendor related information in a single place, you benefit from getting all required information at once and it can influence your decision-making process, thereby simplifying it!

5. **Better Value**

   Ultimately the goal of a vendor management system is to get the most value for your buck. So, implementation of a vendor management system, when done properly can result in long-term savings as well as improved earnings over a period of time.

## 2.2.4.2 Challenges in Vendor Management

Although there are many benefits, some challenges need to be overcome to ensure the smooth functioning of the organization.There are many challenges that an organization may face if vendor management is not implemented correctly. They are as follows -

1. **Vendor Compliance Risk**

   Setting standards before dealing with vendors can save you loads of time and money spent. Not all vendors may perform as per your standards. It is important to choose the right vendor from multiple vendors, who meet your organizational standards and criteria while promising excellent performance.

2. **Vendor Reputation Risk**

   Dealing with multiple vendors is not an easy task. Also, the quality of work has to be gauged upfront before getting into a contract, which makes the process more complicated.

   While some vendors may get your task done really well, others can put up with some poor performance and throw all your deadlines in a tizzy. Hence, background checks are a must

   before any selection is made. This may provide you with some insights into vital points that you may have missed in the first place.

3. **Lack of Visibility**

   While it is really important to have a centralized data storage solution for managing vendor data, it also benefits the organization from a centralized view and improved visibility, which can lead to better resource allocation and improved efficiency.

4. **Vendor Data Storage**

   As your organization grows, it becomes essential to have a vendor data storage solution in place. In the absence of a vendor management system, storing and retrieving data might prove to be really tough, considering the fact that you may be dealing with multiple vendors for multiple projects at the same time.

5. **Vendor Payment Risk**

   Some vendors may have different payment terms, while some may adhere to industry standard terms. Figuring out the terms and ensuring that the payment is always made on time is one of the major issues, especially while dealing with multiple vendors at the same time.

## 2.2.4.3 Vendor Management Process

At this point, we can infer that having effective vendor management is crucial. An organization has to plan and execute a process to guide how they will engage with their vendors at every step.

While it is not possible to have one specific vendor management process that encompasses all enterprises and vendors, we can bring together the basic steps that underlie an organization's start-to-finish engagement with its vendors:

1. **Identification and Establishment of Business Goals**

   Before the vendor management process starts, it is crucial to identify and establish business goals that necessitate vendor involvement. This helps in understanding the requirements of every business unit and prevents duplication of efforts and wastage of resources in terms of selecting and contracting with vendors. It also helps in the later stages of measuring and evaluating vendor performance as these goals establish appropriate metrics.

2. **Establishment of a Vendor Management Team**

   After the business goals are recognized, the next step should be the foundation of a dedicated vendor management team. This centralized team should be skilled in identifying business goals and KPIs for vendor management, selecting relevant vendors, negotiating the contracting process, periodically assessing the performance of the vendors and tracking all transactions activities.

   This team is crucial as they will act as an intermediary between the business units and the vendors and ensure collaboration between the two.

It will also prevent the engagement of too many stakeholders – When vendor management is decentralized to the business units, it results in a large number of contracts with the same vendor or disparate transactions with multiple vendors. This impedes the tracking and evaluation of vendor performance and exposes the organization to vendor risk.

3. **Creation of a Database for all Vendor-related Information**

   After the business goals are clear and the vendor management team is up and running, the next step should be to build an updated and categorized database of all relevant vendors and vendor-related information.

   **The benefits of this are manifold**

   i. it will match the needs of the business units to the right vendor. For example, the administration can identify the relevant vendors for office supplies, computer equipment, etc.
   ii. after the categorization of vendors based on their type, a cross-vendor comparison will become easier for evaluation
   iii. **it will streamline information –** scattered, disparate vendor information will be stored in a single location and provide insights into the current stage of the vendors, for example, vendors with a contract in place, vendors that require renewals, etc. and
   iv. **it will enable effective budgeting –** you can easily recognize the long-term, critical vendors and the short-term, tactical vendors and assess the budget assignment accordingly.

4. **Identification of the Selection Criteria for Vendors**

   Once all vendor-related information is streamlined, updated and categorized, you have to select the criteria based on which all relevant vendors will be chosen.

   While cost has been the primary selection criterion for choosing vendors, businesses are increasingly looking at other criteria to determine which vendor would best serve their requirements – after all, the lowest cost doesn't guarantee the highest value.

5. **Evaluation and Selection of Vendors**

   At this stage, the vendors need to be evaluated based on the selection criteria and, if applicable, the bidding process.

   The submitted proposals need to be thoroughly assessed to understand the pricing structure, scope of work and how the requirements will be met, the terms and conditions, expiry and renewal dates, etc. This will ensure that your organization is deriving the maximum value from the vendor. Look out for hidden savings opportunities.

   Assess the internal strengths and weaknesses of the vendors and study how the external opportunities and threats can affect your transaction as well as the vendor management process.

   Once you have ensured a complete start-to-finish evaluation process, it's time to choose your vendor.

6. **Developing Contracts and Finalizing Vendors**

   Well, now you have the chosen one. It's time to complete the contracting process and get your vendor(s) onboard.

   Typically, the contracting stage is assigned to the legal and finance team and the senior management involved with the vendors. The rest of the business units receive the contract and engage with the vendors after the finalization process. This tends to be sub-optimal in the long run – the business units are the ones finally collaborating with the vendors on a day-to-day basis and have valuable insights on how to maximize the vendors' operational performance. Hence, all the relevant stakeholders need to be involved, at least in the decision-making process.

## 2.2.4.4 Packaging's Vital Role in Vendor Management

Vendor management is the discipline through which companies seek optimal value from the combined total of their vendors. The management of packaging vendors, therefore, is a component of vendor management.

Since vendor management encompasses all of a company's purchases, it's helpful to recognize why packaging presents certain challenges. Packaging is performed at primary, secondary, and tertiary levels, and any given level can require multiple vendors. For example, the primary packaging for a beverage might consist of a bottle, label, and closure. Then there's the likelihood that a company will have more than one vendor for a given packaging item. Complexities further increase in proportion to the number of different products a company has in the market. Even a small company can have a considerable number of packaging vendors.

The discipline most associated with vendor management is procurement, a role that acts as the liaison between the company's purchasing needs and the vendors that fulfil them. Given the amount of communication that's involved alone, vendor management needs to be supported by information technology (IT), specifically specialized software. Anything less lends itself to losing time and human error.

Following is a discussion of some major aspects of vendor management and their relationships to packaging.

1. **Supporting company's mission and objectives**

   A company's reason for existing is explained in its mission. A company's objectives are the quantifiable means through which the mission is fulfilled. Since no company is completely self-sufficient, the goods (and services) supplied by vendors serve both supportive and enabling roles. When mission and objectives rely on mass manufacturing/production, mass marketing, and mass distribution, packaging can be a source of competitive advantage. Packaging vendors, therefore, can be strategic partners.

2. **Vendor selection**

A packaging vendor should be selected through a stepwise process. It starts with requirements, established by departmental stakeholders such as marketing, manufacturing, distribution, legal, etc. It's the packaging department, in its interdisciplinary role, that must systematically reconcile the inherent conflicts and trade-offs.

Next comes the identification of prospective vendors. When packaging requirements are rendered in material specifications, the vying vendors will be members of the same industry segment. However, when the rendering is in performance specifications, vendors from competing segments can be considered.

Then there's the development of the criteria by which prospective vendors will be evaluated. Size, financial strength, technology, service, and reputation are among the essentials. Even so, each criterion should be assigned weighted values, depending on what's being purchased. Some procurement departments are large enough to have one or more purchasing agents who specialize in packaging, even down to specializing in a particular type. There is no degree of agent specialization, however, that can't be bolstered by informed inputs from the packaging department.

And there's the necessity of letting vendors know that they are being sought. Requests of proposals are one way. Others include referrals, internet searches, and responses to previously sent sales/promotional literature.

At some juncture, dealings between the company and vendor finalist become more involved and personal. Mutual briefings on pertinent topics typically are done at this time, along with reciprocal facility visits.

Finally, based on all the aforementioned (and possibly more), a selection is made.

3. **Managing risk**

Every vendor relationship comes with risk. The type that might come most readily to mind is that of performance, or rather a lack thereof. As related to a packaging vendor, underperformance can be an inconvenience at best, and disruption at worst.

Another type of risk relates to the information given to a packaging vendor. There's a risk that the vendor makes unauthorized use of this information, and that risk becomes greater the more proprietary and sensitive the information is. The risk need not be totally about integrity. An unintentional breach can be as harmful as an intentional one. How secure a vendor's computer network is against hacking is an important consideration.

4. **Fostering win-win partnerships**

Effective packaging vendor management builds on mutual interests. Although there are a variety of obstacles to that pursuit, a perennial challenge is pricing, since the vendor's and the buyer's preferences are natural opposites. A recommendable approach - the vendor decides its lowest acceptable price, the buyer decides its highest acceptable price, and the partners engage in good-faith efforts to reach a mutually acceptable price.

The odds for success are increased the more each partner understands the cost structure of the other. That way, either partner might be able to suggest other ways to restructure costs for mutual benefit. Thus avoided will be the penny-pinching, zero-sum belief that one partner's gain is equivalent to the other partner's loss.

As their very name implies, consumer packaged goods companies can't exist without packaging. The same is true for a variety of non-retail categories (medical devices, for example). Broadened, any company that uses any packaging, whatsoever, can benefit from making the management of its packaging vendors a well-integrated component of a vendor management program.

# Unit 2.3 – Prepare for Testing

## Unit Objectives

**At the end of the module, the participant will be able to:**

1. Introduction to Testing and its requirements
2. Identify different types of tests on food packaging and packing material

## 2.3.1 Introduction to Testing

Material properties (e.g., mechanical, permeability, sealing, and food contact material migration) have a significant impact on food quality, shelf life, and safety. Therefore, food packaging materials are tested to ensure that they have correct gas and water permeability, an appropriate tin or lacquer layer, thickness, and strength.

*Fig. 2.3.1: Food Packaging Material Testing*

Over the years, packaging technology has been grown in multidimensional ways. The overall growth and development have been witnessed by the innovations like waste materials used as resources of packaging raw materials, innovations in conversion technologies and also in the packaging machinery sector. But the recent era of ISO 9000 and ISO 14000 has compelled society to understand the term 'quality' with greater prospects.

In the same line, testing of packaging materials has got greater importance in order to check the existing quality and also to make the judgement about shortcomings. This helps to take appropriate measures for the improvement of quality.

## 2.3.1.1 Sampling Plan

A sampling plan is required to draw the samples for testing from a large size of lot or batch. A batch is a set of a particular type of packaging materials that can be regarded as homogeneous. A set of samples in the total number of individual samples taken from a batch of packaging materials e.g. paper, paperboard, Corrugated Fibreboard Box, a roll of plastic films or laminates. And a specimen is a piece of a particular type of packaging material from an individual sample.

## 2.3.1.2 Condition of Test Specimen

The packaging materials like paper and allied products are hygroscopic. Due to this fact, these materials absorb moisture and their properties change with humidity. In order to ensure repeatability and reproducibility to avoid misunderstanding amongst all concerned, a standard test atmosphere has been established. The process of exposing the test specimen to a standard condition is known as "conditioning of test specimens". As per Indian Standards IS: 1060 (Part – I) 1966, a standard atmospheric conditions of 27°C ± 1°C and 65% ± 2% relative humidity is maintained to expose the samples for to 24 hours prior to conducting the tests.

## 2.3.1.3 Requirement of Testing

Packaging products have a great impact on the quality of the contents and also influence consumer purchasing decisions. Both factors represent major challenges for product design, especially where food packaging is concerned.

## 2.3.2 Types of Tests on Food Packaging and Packing Material

**Function testing on the entire packaging**

Packaging is as varied as the methods for opening them. Individual values are determined because testing standards are rare. Such tests are -

| Type | Image |
|---|---|
| Piercing beverage cartons with a straw |  |

| Type | Image |
|---|---|
| Piercing of pre-perforated openings |  |
| Opening force of ring-pull cans |  |
| Tearing off opening tabs, for example, those on lids |  |
| Tearing off carrying handles |  |

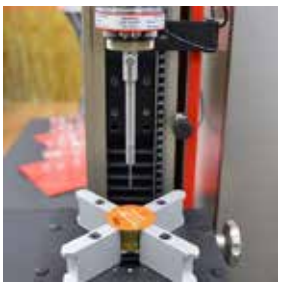
| Type | Image |
|---|---|
| Puncture test on coffee capsules |  |
| Actuating force on spray pumps |  |

*Table 2.3.1: Types of Function Testing*

## 2.3.2.2 Peel Test on Lid or Sealing Material

The ability to peel off dimensionally stable or rigid packaging depends on material combinations, machine parameters, and sealed seam and tear-off geometries. Performing a test of the peel forces with a special peel test kit can help to optimize these elements. The most important value is the cracking force, but the regularity of the sealing is also significant.

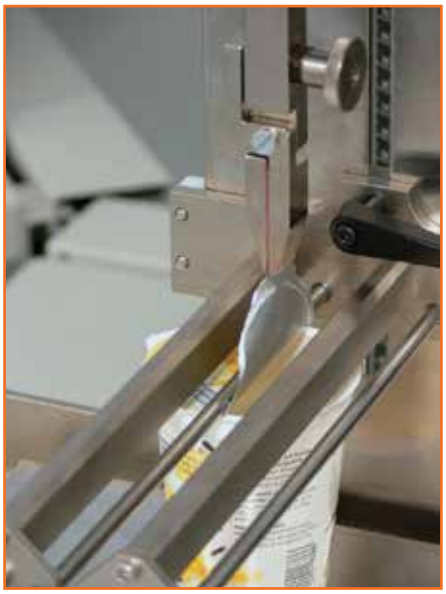


*Fig 2.3.2: Lid peel-off Clamp - Peel Test on Lids or Seals*

*Fig 2.3.3: Lod Peel-off Test Kit – Test on Food Packaging*

## 2.3.2.3 Compression Tests on Dimensionally Stable Packaging

**Compression tests have different purposes, for example:**

- **Determination of stacking characteristics:** There are different methods, depending on the standard and material being used. One or more packages are loaded up to failure, enabling the maximum stacking height to be determined. This test can also be performed on plastic cups with filled trays. Or a certain load may be applied for a preset length of time or until failure.
- **Determining the inherent stiffness:** This test provides information for the packaging manufacturing process. The package is loaded with a defined force on closing (lid attachment) and must withstand this process without becoming damaged.
- **Fatigue tests:** A hysteresis test is performed on a pail to see with what frequency a certain load can be applied before it breaks. In practice, this happens when palettes are loaded and unloaded. Not every loading and unloading cycle is shown. Only the 1st, 100th, 500th, and 1,000th cycles are displayed for monitoring.

*Fig 2.3.4: Compression Test for Plastic Cups to Determine Stackability*


*Fig 2.3.5: Stacking Crush Test on Boxes*

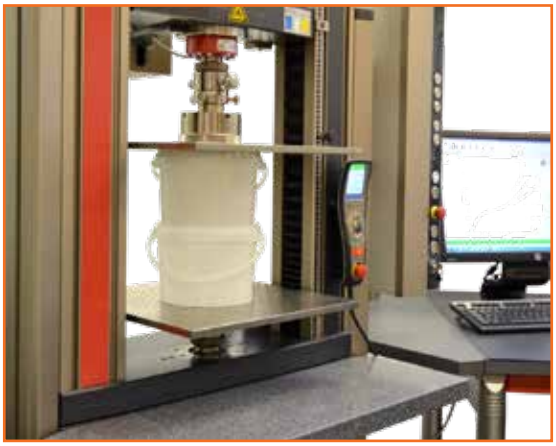


*Fig 2.3.6: Compression Platens for Stack Test of Plastic Bucket*

## 2.3.2.4 Tear Growth Test on Plastic Films

**Standards ISO 34-1, ISO 6383-1, EN 495-2 and DIN 53363 relate to tear tests on plastic foils.**

The test simulates the behaviour of packaging foils when the package is opened. When opening a plastic bag, the initial tearing strength should be approximately as much as the remaining tearing strength. If the maximum force at initial tearing is too high, the danger exists that the plastic bag will suddenly tear open completely and the contents will spill out. The ideal behaviour is not easy to adjust because the tear resistance (as well as the tensile strength), is very direction-dependent with stretched foils.

*Fig 2.3.7: Tear Growth Test on Plastic Film*

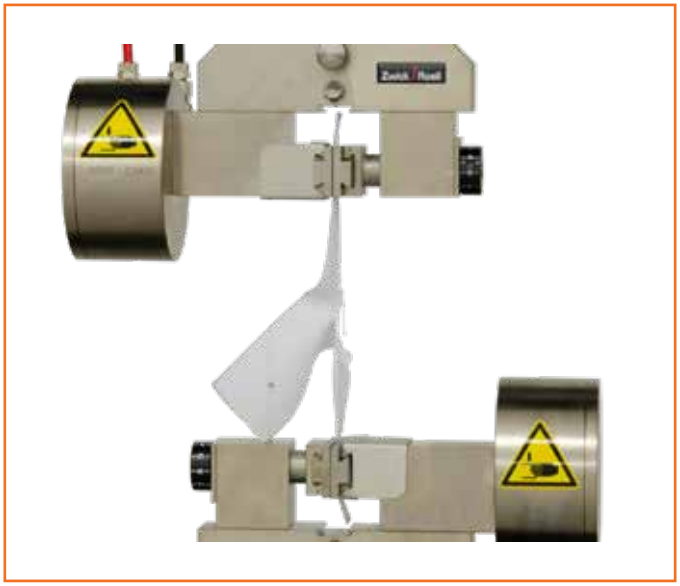


*Fig 2.3.8: Tear Growth Test on Plastic Films – Trouser Specimen*

## 2.3.2.5 Sealed – Seam Strength

A tensile test is performed on 15-mm wide strips with a peel angle of 180°. This seal must demonstrate a certain stiffness, depending on the type of packaging material used.

*Fig 2.3.9: Seal Strength of Packaging Films*

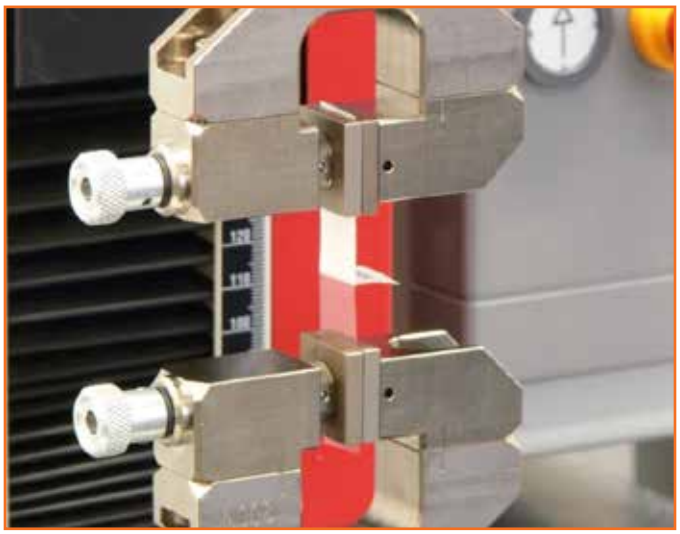


*Fig 2.3.10: Seal Seams*

## 2.3.2.6 90°/180° Peel Tests

This type of test is used to determine the adhesive characteristics as adhesion and tear strength. There are many peel and tear tests that use the same principle.

There are so many because different substrate materials and adhesives are used for many different applications. Test plates made of glass or stainless steel with a standardized surface are used to compare the adhesion properties of the different materials.

**The tests determine the adhesive or adhesion strength:** The force that is necessary to tear a strip of tape constantly from a test plate or glass. The result is the force referred to the width of the tape.

**The tack test is often important:** It determines the ability to adhere to a surface and to obtain a measurable tearing force. The adhesion on a substrate is achieved by touching or having little contact without applying force.

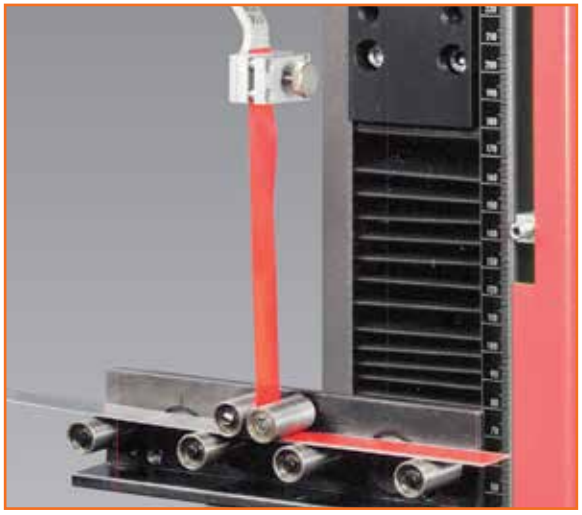


*Fig 2.3.11: 900 Pull–off to Measure Peel Resistance*

*Fig 2.3.12: Peel Off Test on Self-Adhesive Insulating Tapes – Peel Test Kit for Adhesive Tapes*

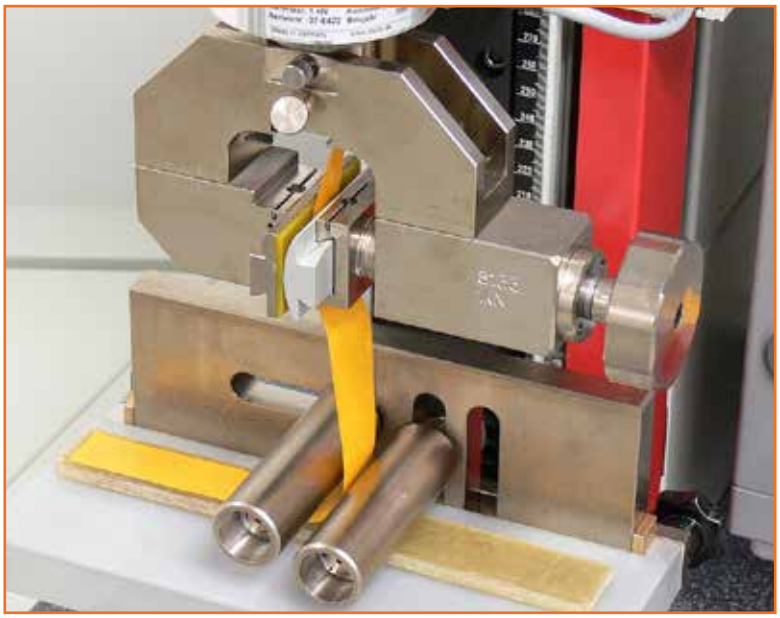


*Fig 2.3.13: 900 Peel Test Kit to Measure Peel Resistance of Adhesive Tapes*

## 2.3.2.7 Tack Loop Test for Testing the Adhesive Strength of Adhesive Tape

Tack is the initial adhesion. It is expressed as the tearing force of a loop material that has been brought into contact with the surface of a test plate.

A strip of a pressure-sensitive material is formed into a loop with the adhesive side outwards. The testing machine brings the loop in contact with a test plate. When a defined contact area is reached, the loop is pulled off.

*Fig 2.3.14: Determination of Initial Adhesion of Adhesive labels in Loop Track Test*

## 2.3.2.8 Unscrewing Lids/Torsion Testing

A torsion drive is used in conjunction with a linear axis for opening a sealing cap. With this test, tightening and loosening torques and the ease of the closure cap can be tested, taking into consideration the thread pitch.

*Fig 2.3.15: Torsion Test – Test Fixture for Unscrewing Caps*

*Fig 2.3.16: Material Testing Machine With Torsion Drive – Unscrewing Caps*

## 2.3.2.9 Customized Test Fixtures

Some examples of this test are fixtures to determine the push-out force on blister packs, fixtures for special-shaped containers or testing tools to test the pull-out force of wine corks.

*Fig 2.3.17: Floating Roller Peel Test Device*

*Fig 2.3.18: Push–Out Tests on Blister Packaging*

## 2.3.2.10 Pure Materials Testing

**Basic materials such as plastic, paper, and metals have the most varied material tests performed on them. A few examples:**

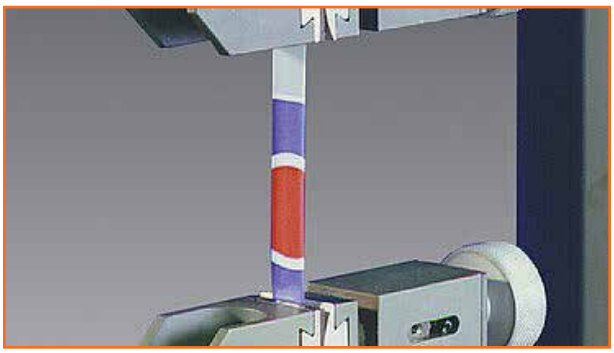


*Fig 2.3.19: Tensile properties of Films and Sheets*

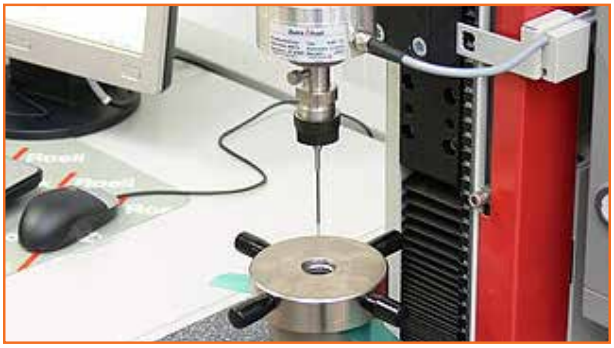


*Fig 2.3.20: Puncture Test*

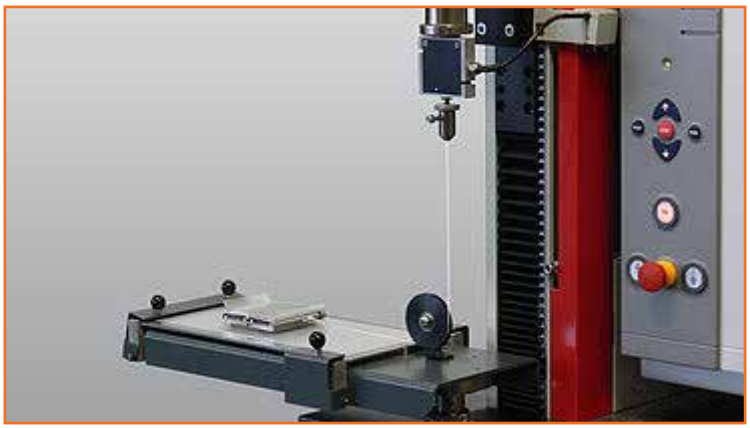


*Fig 2.3.21: Determination of Coefficients of friction*

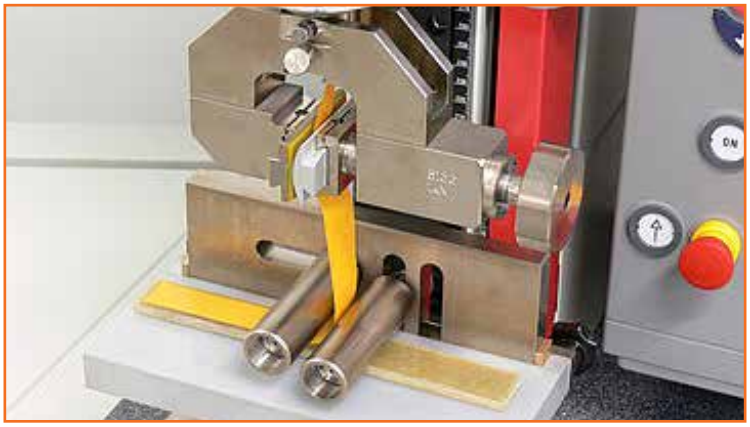


*Fig 2.3.22: Tear growth, peel, and adhesion characteristics of Films and Sheets*

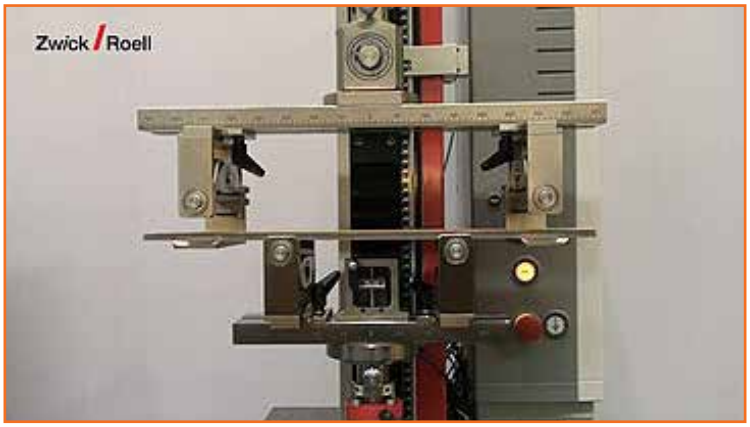



*Fig 2.3.23: 4-point flexure test on  Cardboard*

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Transforming the skill landscape

# 3. Perform Tasks for Testing Packaging Material

FICSI
Food Industry Capacity and Skill Initiative

Unit 3.1 – Testing Packaging Material

Unit 3.2 – Packaging Material Standards

Unit 3.3 – Post-trial activities

FIC/N9304

## Key Learning Outcomes

**At the end of the module, the participant will be able to:**

1. Illustrate testing of packaging material
2. Discuss packaging material standards
3. Demonstrate post-trial activities

# Unit 3.1 – Testing Packaging Material

## Unit Objectives

**At the end of the module, the participant will be able to:**

1. Demonstrate testing of Packaging Materials
2. Identify the factors affEcting shelf-life of a food product
3. Identify the defects of packaging material
4. Describe the steps of developing the packaging material
5. Demonstrate testing of Rigid Packaging Materials
6. Demonstrate testing of Semirigid Packaging Materials
7. Manage the documentation during food packaging development
8. Define Legal Metrology Act 2009

## 3.1.1 Testing of Packaging Materials

For several decades, plastic packaging films or containers have been produced by a variety of processes including extrusion, injection, or thermoforming, using various synthetic polymers or biobased polymers by various food production systems. The properties of commercial plastic polymer packaging products are also highly dependent on the processing conditions used to produce the final product. Food packaging is the largest portion of plastic packaging applications among various business sectors. Unfortunately, when foods are packed into a plastic packaging system and delivered for sale in the marketplace, the quality of both the food and packaging product gradually starts to reduce during transportation, distribution, storage, and display before consumption by consumers. By using appropriate packaging materials supported by advanced food packaging techniques, the quality of food products will be extended and consumer satisfaction and safety will be achieved.

## 3.1.1.1 Paper and Paper Board

The types of tests for paper and paper boards are almost the same. But there is a certain test like stiffness which is conducted for paper board only.


*Fig 3.1.1: Paper and Paper Board Packaging*

**Significance and Tests of Important Parameters**

1. **Grammage**

   - **Significance:** It specifies the mass of a unit area of a sheet of paper or paper board and it is expressed in gms per square meter.
   - **Test Method:** The test method is described in Indian Standard 1060-Part-I (1987). Cut the test specimen of size 10cm x 10cm and then take the weight in the weighing balance. At least, ten readings are taken and then taken the average value and expressed in gms/square meter.

2. **Moisture Content**

   - **Significance:** It is necessary to understand the presence of moisture content in a paper which affect the other properties of paper such as printing, absorbency etc.
   - **Test Method:** This test method is described in Indian Standard IS: 1060-PartI (1987).

3. **Thickness**

   - **Significance:** This test is important to measure the thickness of an individual sheet which affect the total thickness of the board used in packaging.
   - **Test Method:** In the laboratory, the single sheet as test specimen is measured at several points by means of a micrometre and an average value is calculated.

4. **Bursting Strength**

   - **Significance:** This test is performed to determine the resistance of a paper against rupture in use.
   - **Test Method:** The apparatus generally used "the Jumbo Muller Tester" is either motor driven or hand driven. The testing is done by means of hydraulic pressure communicated through the medium of glycerin or by compressed air to a pure gum rubber diaphragm in contact with the paper. The test values are expressed in kg/cm2 or pound/sq inch or kilopascals.

5. **Water Absorption Test**

   - **Significance:** This gives an indication of resistance to water absorption (normally referred to as cobb value). In this, the quantity of water absorbed by a specified area of paper surface when in direct contact with water over a period of time is measured.
   - **Test Method:** The details are given in IS: 4006 – Part – I, 1987.

6. **Breaking Length**

   - **Significance:** It signifies that when a paper roll is hanged and allowed to fall, then the extent of the length of paper at which the paper breaks on its weight is measured in meters, and that is expressed as breaking length.
   - **Test Method:** The breaking length is measured by the following formula:

$$\text{Breaking Length (meter)} = \frac{\text{Tensile Strength}}{\text{Grammage}} \times 1000$$

7. **Stiffness to Bend**

   - **Significance:** The test signifies the rigidity of the test sample. Normally, the test is carried out on a paper board.
   - **Test Method:** One end of the test specimen is clamped on jaws and then allow to be bent at a 15-degree angle. Measure the force required to bent the sample without cracking, measures the resistance against bending. Stiffness is expressed in either Kenley or Taber or mN.

8. **Tear Resistance**

   - **Significance:** The resistance against tearing of paper is measured.
   - **Test Method:** The specimens are clamped on the jaws of the Elmendorf Tear Tester. 25% of the specimen is cut by means of a knife inbuilt in the tear testing equipment. Then, the pendulum is released to tear the balance 75% of the test specimen. The force required to tear the paper is measured from the recording scale. The tear resistance is expressed as gms force.

## 3.1.1.2 Plastic Films and Laminates


*Fig 3.1.2: Plastic Films and Laminates Packaging*

**Significances and Tests of Important Parameters:**

1. **Calliper or Thickness**

   - **Significance:** To measure the thickness of the film in millimetres or micrometres or microns.
   - **Test Method:** The centre portion of the test specimen is placed in between the flat jaws of the micrometre to check the uniformity of thickness. (Reference IS 1060 (Part –I) – 1966.

2. **Density**

   - **Significance:** To check the specific gravity or density or the ratio of mass upon volume.
   - **Test Method:** The detailed test method is described in IS: 2508 - 1987.

3. **Tensile Strength and Elongation at Break**

   - **Significance:** To measure the force required to break the test specimen while the samples are kept under tension in between the jaws of the tensile machine.
   - **Test Method:** Two ends of the test specimen are clamped in the machine at the grips separated by 50mm. Start the machine at the pre-adjusted speed of 500 mm/min and note the load and elongation at break. Tensile strength is expressed as kg/cm2 or Mn/m2 and elongation at break are expressed as a percentage.

4. **Dart Impact Resistance**

   - **Significance:** To measure the impact resistance of the plastic film by measuring the load or dart at which 50 per cent of the specimen fail when tested by this method
   - **Test Method:** The details are described in IS: 2508 – 1987.

5. **Co-Efficient of Friction or Slip**

   - **Significance:** It is the ratio of the frictional resistance to the normal pressure acting on two surfaces in contact.
   - **Test Method:** A sledge of 120 mm square is allowed to move over the plastic film and record the frictional force acting at the contact surface. The value is expressed in Newton. Calculate the dynamic coefficient of friction using the mean load represented by the straight line.

6. **Determination of Gloss**

   - **Significance:** To measure the percentage of reflectance of light at a particular angle where the angle of incident light and the angle of reflected light will be the same. This is an optical property of the plastic film.
   - **Test Method:** The gloss meter is set up to 450. Take reading with plastic film by replacing the standard used for calibrating the instruments. Repeat the test five times with different specimens. It is expressed as specular gloss at 450.

7. **Determination of Haze**

   - **Significance:** The haze of the specimen is the percentage of transmitted light that is passing through the specimen that deviates from the incident beam by forwarding scattering. This is also an optical property of the film.
   - **Test Method:** Illuminate the specimen by unidirectional beam making an angle with the direction of its axis not exceeding 30. Determine the reading with haze meter and then expressed in percentage.

8. **Peel Bond Strength for Flexible Laminate**

   - **Significance:** To measure the tackiness between the two substrates of the laminate in terms of force.
   - **Test Method:** The two ends of the test specimen where one end clamped at the jaws of the Tensile machine by keeping the gauge length of 50 mm. Run the test at the speed of 300 mm/min and record the force in gm/15 mm width and then calculate the average from the graph.

## 3.1.1.3 Aluminium Foils

*Fig 3.1.3: Aluminium Packaging*

**Significance and Tests of Important Parameters:**

1. **Thickness or Caliper**

   - **Significance:** To measure the thickness of the aluminium foil or web.
   - **Test Method:** Properly calibrated dead weight micrometre is used to measure the thickness.

2. **Pin Hole Test**

   - **Significance:** To ascertain the number of pinholesthat exists in the aluminium foil.
   - **Test Method:** The aluminium foil is checked by means of illumination equipment where a tungsten lamp is positioned in a cylindrical structure and all the surroundings are covered with black paper. The test specimens are placed at the top end of the cylinder and then observed the pinholes against the light.

3. **Water vapour transmission rate (WVTR) –** This is also referred to as moisture vapour transfer rate (MVTR), is the standard indicator of how easily moisture can permeate a packaging film. WVTR values are expressed as g/m2 and g/100in2 at 38°C and 98% relative humidity. Increasing WVTR values indicate greater permeability, and lower ability to keep dry products dry, and moist products moist

   The two common and standardized methods for measuring WVTR are ASTM E96, and ASTM F1249.

$$WVTR = \frac{Q}{At} = \frac{slope}{area} = \frac{g\ H_2O}{day\ m^2}$$

4. Oxygen Transmission Rate (OTR) - It is the measurement of the amount of oxygen gas that passes through a substance over a given time period. OTR for plastic film material is the steady state rate at which the oxygen gas permeates through a film at specified conditions (temperature and relative humidity).

   In food packaging, permeation of oxygen through the packaging over time contributes to a process of food decay called oxidation, therefore, extending product shelf life through customized material barrier structures to reduce the rate at which oxygen permeation occurs is critical to maintaining the safety and quality of the food product.

$$OP = \frac{OTR \times e}{\Delta p}$$

   where OP is the oxygen permeability coefficient (mL m−1 s−1·Pa-1), OTR is the oxygen transmission rate (mL m−2 s−1), e is the film thickness (m), and Δp is the oxygen partial pressure difference (Pa). In our experimental setting, the oxygen Δp was 0.21 atm, that is, 2.127 × 104 Pa

   **OTR = k L a (C* - C L )**

   - OTR [mg O2 / L / h]
   - **k L :** oxygen transfer coefficient (cm/h)
   - **a :** gas-liquid interfacial area per unit vol. (cm 2/cm 3)
   - **k L a :** volumetric oxygen transfer coefficient (1/h)
   - **C* :** saturated DO concentration (mg/L)
   - **C L :** DO concentration in the broth (mg/L)

## 3.1.2 Packaging Factors Affecting Shelf-life of Food Product

**Shelf Life –** It is the time during which a product remains desirable. A product may exhibit some changes during shelf life, but the end of shelf-life is defined as a point where the product is no longer acceptable consumers. Unacceptable changes could be sensory characteristics, a loss of chemical stability, a change in physical properties, microbial growth, vitamin degradation, and more.

Packaging can help protect food from the various factors that may cause spoilage, so there is a direct link between food packaging and shelf life. Many different kinds of packaging extend shelf life, and various types of packaging that reduce food spoilage focus on protecting against different threats. Here are some of the ways packaging can extend shelf life.

- **Modified atmosphere packaging:** This process involves replacing the air in a package with another gas mixture to prevent oxidation. Optimizing this gas mixture according to the ideal conditions of the packaged food helps preserve it.
- **Vacuum packaging:** In this process, you remove as much of the air as possible from a package, and then seal it so minimal air remains in the package. The package will also have low oxygen permeability. Use this method for foods that do not need air to stay fresh.
- **Proper gas permeability:** For products that need air to remain fresh, you need to choose packaging that has the proper permeability based on the rate of oxygen transmission of the food products. This packaging may contain tiny holes or use a material with optimal gas permeability.
- **Physical protection:** Packaging also physically protects food items, which is crucial for preventing damage that can make food more vulnerable to other spoilage risks.
- **Barrier packaging:** Packaging may contain a foil, metalized or clear barrier that protects the product from oxidation, moisture and other risks.

**How to conduct a shelf life study**

The ten steps below, gleaned from industry experience and best practices, outline few steps to set up a shelf life study.

- **Define the objective:** What is the reason for the shelf life study? The shelf life study can be initiated due to development of a new product, a formulation change or an alternate package evaluation.
- **Identify mode of deterioration:** End of shelf-life criteria vary for different food commodities. For chilled foods, the end of shelf life is elevated levels of spoilage microorganisms. Other modes of deterioration may be oxidation of fats for fried snack foods, vitamin degradation for fruit juices, and starch retrogradation or staling for breads.
- **Define key attributes to monitor:** Microbial examination, chemical analysis (for example lipid oxidation and vitamin degradation), physical testing (for colour or viscosity) or sensory evaluation can be monitored throughout the shelf-life study.
- **Select test methods:** For chemical analysis, lipid oxidation could be monitored by measuring peroxide, free fatty acid or thiobarbituric acid reactive substances formation. Sensory evaluation could be determined by various methods such as discrimination, descriptive or acceptance testing.

- **Set storage conditions:** Select the variables such as temperature, relative humidity and lighting conditions. Product storage conditions can be optimal, typical or average, or worst-case scenario.
- **Set target end point and testing frequency:** For products with a short shelf life (seven to 10 days), evaluation can be performed daily or every two days. For products with a moderate shelf life (three weeks) or long shelf life (one year), testing can be done at initial point and end point, plus at two to three occasions in between and at one point beyond the end point.
- **Determine appropriate test and control samples:** Set the ingredients, process and packaging for the shelf-life study. Test samples should be from the same batch to minimise variation and enough samples should be stored for duplicate or triplicate testing. Select the appropriate sensory control; freshly manufactured product if the product deteriorates over time or chill or freeze samples to ensure minimal deterioration.
- **Perform a shelf-life study:** Store the samples under conditions outlined in study and test at the selected intervals.
- **Analyse results:** In the absence of standards (legal or voluntary), manufacturers have to set their own end point based on microbiological, chemical or sensory criteria. The shelf-life date is usually assigned as the last day of an acceptable sensory score or analytical results. The preliminary shelf-life date can be conservative and based on the worst-case manufacturing and storage scenario.
- **Monitor and confirm shelf life:** Once the product has been introduced into the market, sample at the distribution and retail levels and adjust the shelf-life date accordingly.

## 3.1.3 Packaging Material Development System

Most packaging operations in food manufacturing businesses are automatic or semi-automatic operations. Such operations require packaging materials that can run effectively and efficiently on machinery.

Packaging needs to be of the specified dimensions, type and format within specified tolerances. The

properties of the material will need to take account of the requirements of the packing and food processing operations. They will, therefore, need to have the required properties such as tensile strength and stiffness, appropriate for each container and type of material.

For example, a horizontal form/fill/seal machine producing flow wrapped product will require roll stock film of a particular width and core diameter, with a heat- or cold-sealing layer of a particular plastic material of a defined gauge, and film surfaces possessing appropriate frictional, anti-static and anti-blocking properties to provide optimum machine performance

Packaging machinery is set up to run with a particular type of packaging material and even minor changes in the material can lead to problems with machine performance. The introduction of new packaging materials and new designs must be managed with care. Materials should be selected after machine trials have shown that the required machine efficiency and productivity can be realised. New designs may require minor or major machine modification that will add direct costs in retooled parts. Design changes

in primary packs can have a knock-on effect on secondary packs and volume (cube) efficiencies during distribution and storage that results in height and diameter modifications.

For example, a minor change in container profile can impact on machine operations from depalletising through conveying, rinsing, filling, sealing, labelling, casing and palletising. Depalletisers will need adjustment to cope with the new profile of containers. Conveyor guide rails may require resetting. Filler and labeller in-feed and out-feed star-wheels spacing screws may need replacing or modification. Fill head height may require adjustment and new filler tubes and cups may be required. Closure diameter may be affected having an effect on sealer heads that might necessitate adjustment or modification. New labels may be needed which will require modifications and possibly new components such as label pads and pickers. Casing machines may need readjustment to match the new position of containers. A redesigned case may be required and a new pallet stacking plan needed to optimise pallet stability. The direct costs of new package design and machine modification and the indirect costs of reduced productivity prior to packaging lines settling down can be significant. It is important to bring machine and material suppliers into the design project and keep line operations informed at all stages of implementation.

**Performance requirements of packaging in production may concern**

- Machinery for container forming
- Materials handling
- Filling, check-weighing and metal detection
- Sealing, capping or seaming
- Food processing treatments
- Labelling/coding
- Casing
- Shrink-wrapping; stretch-wrapping
- Palletisation
- Labour requirements
- Consumer needs and wants of packaging
- Quality - Processing and packaging for flavour, nutrition, texture, colour, freshness,
- acceptability etc. Information-Product information, legibility, brand, use etc.
- Convenience- Ease of access, opening and disposal; shelf life, microwaveable etc.
- Product availability -Product available at all times
- Variety -A wide range of products in variety of pack sizes, designs and pack types
- Health - E.g. Enables the provision of extended or long shelf life foods, without the use of
- preservatives
- Safety - The prevention of product contamination and tampering
- Environment -Environmental compatibility

## 3.1.4 Packaging Material Defects

Defective packaging can affect the overall quality of the product that you have worked hard to put to market.

**Few common packaging material defects are –**

- Cracks
- Fractures
- Stone or air bubbles in glass
- Uneven or rough surface

**Packaging defects may be categorized in the following manner:**

1. **Class A:** Critical defect

   ❑ Prevents a package from performing its intended function

   ❑ Causes safety hazard in material handling

   **Example:** Cracked glass bottle, missing liner

2. **Class B:** Major defect

   ❑ Causes reduced functionality

   **Example:** Heat seal too narrow

3. **Class C:** Minor defect

   ❑ Affects appearance, but leaves functionality intact

   **Example:** Stone or air bubbles in glass

The selection of package begins with determination of products physical & chemical characteristics. Quality control of a packaging component starts at design stage. All the aspects of a pack development may give rise to quality problems. It must be identified & minimized by performing quality control tests.

## 3.1.5 Testing of Rigid Packaging Materials

**Glass Containers**

*Fig 3.1.4: Glass Containers Packaging*

**The Important Parameters of Testing are:**

1. **Visual Defects**

   - **Significance:** This is required to check the quality of the glass container physically.
   - **Test Method:** The critical and major defects to be examined are:

     i. **Critical Defects:** Cracked or broken glass, choked bore, internal fins, flanged finish, overpress, split finish, channelled and wrapped sealing surface, shifted finish and rocker bottom.

     ii. **Major Defects:** Stones, seeds, cords, blisters, oil marks, bad distribution, deformation etc

2. **Inspection of Colour**

   - **Significance:** To cross-check the colour of the bottle as per requirement.
   - **Test Method:** The selected colour glass bottle is examined by comparing it with an approved sample in terms of colour shade.

3. **Dimensions**

   - **Significance:** The dimensions of the glass container are highly critical as the dimensions of containers directly affect the automatic filling operation, labelling operation, capping, sealing and thus cause hindrance to marketing.
   - **Test Method:** The measurement of dimensions are done by means of the 'Go', 'No-Go' gauge. A number of dimensions are examined for glass containers

4. **Overall Height**

   **For checking any one type of bottle a 'Go' 'No-Go' gauge may also be adequate:**

     i. **Leading Horizontal Dimensions:**A 'Go' and 'No-Go' gauge is generally satisfactory for checking body dimensions.

     ii. **Verticality:** The verticality of bottles can be measured as deviations, with a suitable set-up consisting of a vertical shaft, a 'V' block and dial gauge. The details of this test are prescribed in IS: 2091 – 1983

     iii. **Ovality:**The ovality is determined by measuring the maximum and the minimum leading horizontal dimension along the circumferences using a vertical calliper.

     iv. **Finish Dimensions:**The term 'Finish' refers to that part of the glass container which takes on the closure. The dimensions are examined with the help of the 'Go' and 'No-Go' gauges.

5. **Capacity Measurement**

   - **Significance:** The capacity of the bottle is defined either as the brimful capacity or capacity upto a filling height agreed upon.
   - **Test Method:** The glass bottle is filled with water and then the actual quantity is measured by measuring cylinder and thus, the capacity of the bottle is expressed as a cubic centimetre or C.C.

6. **Mechanical Impact Strength**

   - **Significance:** This test is useful to the extent of defecting gross manufacturing defects in respect to the mechanical strength of glass bottles.
   - **Test Method:** The normal test is to use a pendulum consisting of a hardened steel ball as a striker. This method is called as pendulum method to determine the mechanical impact strength.

7. **Annealing**

   - **Significance:** To determine the interface of the colour of glass containers which might happen during the gradual cooling process.
   - **Test Method:** The specimen sample is subjected to a polariscope and then viewed the glass containers through the polarised light to determine any sign of stained glass due to the interface of colour.

8. **Thermal Shock Test**

   - **Significance:** The main objective of this test is to determine the resistance of thermal shock of glass containers.
   - **Test Method:** The test specimen of glass containers are subjected to sudden temperature differences by means of filling hot water followed by cold water. And then, the observations are taken for any breakage or cracks on the glass containers.

9. **Hydrostatic Pressure Test**

   - **Significance:** To determine the resistance of glass containers against withstanding pressurized liquid.
   - **Test Method:** This particular test is performed by means of hydrostatic pressure test equipment.

10. **Impact Testing**

    - **Significance:** To determine the rigidity or impact strength of glass containers.
    - **Test Method:** This test will signify the impact strength or resistance against breakage due to sudden load on the containers.

11. **Pendulum Test**

    - **Significance:** To check the vertical impact strength of glass containers.
    - **Test Method:** This particular test is conducted in testing equipment where the glass container is placed in a vertical position and then a steel ball is allowed to swing and strike the bottle. Subsequently, the glass containers are checked for any kind of breakage or cracks due to impact.

12. **Chemical Test**

    - **Significance:** To identify the composition of glass materials.
    - **Test Method:** The glass container are broken into pieces and then glass pieces are analysed in the laboratory by means of sedimentation process to identify the composition of glass materials.

**Metal Containers**


*Fig 3.1.5: Metal Containers Packaging*

**The important parameters for the testing of metal containers are as follows:**

**Visual Inspection**

- **Significance:** To inspect visually the printing aspect and other manufacturing defects to assess the quality of packaging materials.
- **Test Method:** The test specimens are selected by following the standard sampling method and then samples are inspected visually for different important parameters like manufacturing defects, printing defects, any spots cuts, proper joints etc. of the containers.

1. **Dimensions**

   **Significance:** To check the dimensions of the metal containers in order to comply with the standard sample (Ref IS: 1060 – PART 1, 1985).

   ii. **Container Height:** The height of containers is very important as affects the automatic filling line. The dimensions are measured either by using a sealed or digital gauge.

   i. **Overseam Diameter:** The dimensions are checked by means of a particular dial gauge and expressed in millimetres.

   ii. **Capacity**

   - ❑ **Significance:** To determine the actual capacity of the container so that there should be any hindrance in the automatic filling operations.
   - ❑ **Test Method:** The particular metal container is taken and filled with water up to the brimful capacity. The containers are then emptied where water is measured in the measuring cylinder and thus, the capacity of metal containers is calculated.

2. **Tin Coating Thickness**

   **Significance:** To check the thickness of the tin coating (internal) as well as (external) of the tin plate.

   **Test Method:** The tin coating is measured either by using a chemical solvant (CLEARK'S solution) or by elcometer.

3. **Hydraulic Pressure Test**

   **Significance:** To check the extent of withstanding capacity of the metal container when exposed to hydraulic pressure.

   **Test Method:** The filled metal containers are subjected to hydraulic pressure test equipment and then held for 5 minutes to observe any leakage of the container.

4. **Air Pressure Test**

   **Significance:** To determine the leakage of the metal container.

   **Test Methods:** The empty metal containers are filled with air and then dipped in the water tank to observe any appearance of air bubbles and to identify the leakage.

5. **Product Compatibility**

   **Significance:** To check the compatibility of the product with the internal contact surface of metal containers.

   **Test Method:** The metal container is filled with skimmed milk powder and exposed to accelerated conditions i.e. 8°C +-1° C & 90% +- 2% R.H. for a minimum period of 90 days. The exposed samples are also withdrawn at an interval of 7 days and the products are analysed for all the parameters.

**Plastic Containers**

*Fig 3.1.6: Plastic Containers Packaging*

**Significances and Test of Important Parameters:**

The details of important tests are discussed below -

1. **Identification of Plastics**

   **Significance:** To determine the type of polymeric material used for the manufacturing of blow moulded plastic containers.

   **Test Method:** The samples are subjected to a burning test to get the smell, appearance of smoke etc to identify the polymer. Subsequently, the density of polymeric materials could be identified.

2. **Wall Thickness**

   **Significance:** This is important to check the uniformity of thickness of containers.

   **Test Method:** The thickness is measured by slide calliper or any other dial gauge micrometre and it is expressed as millimetre or micron.

3. **Dimensions**

   **Significance:** To check the dimensions of plastic containers.

   **Test Method:** All the dimensions like neck diameter, body diameter, height, thread dimensions, etc are determined by means of dial gauge micrometres.

4. **Capacity**

   **Significance:** To check the brimful capacity of containers.

   **Test Method:** The plastic container could be filled with water and the capacity of water is measured by the gravimetric method.

5. **Environmental Stress Crack Resistance**

   **Significance:** To determine the resistance to crack of the plastic container against the environment.

   **Test Method:** The test is conducted in the laboratory by following the method prescribed in IS: 8747 ( Environmental stress crack resistance of blow moulded plastic container).

6. **Extrability Test**

   **Significance:** To check whether the polymeric materials are of food grade or not.

   **Test Method:** This test is conducted in the laboratory by following the test methods as prescribed in IS: 9845 (Extractability studies on plastics).

**Corrugated Fibre Board Boxes**

*Fig 3.1.7: Corrugated Fibre Board Boxes Packaging*

**Significances and Test of Important Parameters:**

1. **Kraft Liner, Fluting Media**

   The following tests are performed on liner and fluting medium

   a. **Grammage**

   **Significance:** Grammage is a measure of the weight of paper or paper board expressed in gms per square meter. It is also called a substance. Its unit is gms/ sq mt and is popularly known as gsm.

   **Test Method:** TAPPI T 410 or IS: 1060 (Part – I) 1987 are the reference for a test method. Minimum 10 numbers of a specimen of size 10 cm X 10 cm are cut, weighed and calculate the gsm by diving the area.

   b. **Calliper of Thickness**

   **Significance:** Caliper is the measure of the thickness of a sheet of paper. Its units are mm or microns.

   **Test Method:** The reference of test methods are TAPPI T-441 or IS: 1060- Part-I-1966. The thickness of test specimens is measured by using a calibrated micrometre.

   c. **Water Absorptiveness of Nonbibulous Paper and Paperboard (COBB Test)**

   **Significance:** Water absorbency is a characteristic pertaining to the sheet's ability to resist water penetration and absorption.

   The details about test methods are prescribed in TAPPI T 441 and IS 1060 Part – I – 1966. The test specimens are clamped, poured 100 ml. of water. Allowed to absorb water for 60 seconds. The water is removed after 45 seconds prior to 30 minutes, the additional water is wiped and weighed. The difference in weight divided by sample area gives the value in gm/ml.

   d. **Bursting Strength**

   **Significance:** To measure the force required to rupture the board when pressure is applied from one side.

   **Test Method:** The sample is subjected to mullen bursting testing equipment and the force required to burst the paper is measured The test values are expressed as kg/cm2 or pound/ sq inch or kilopascals.

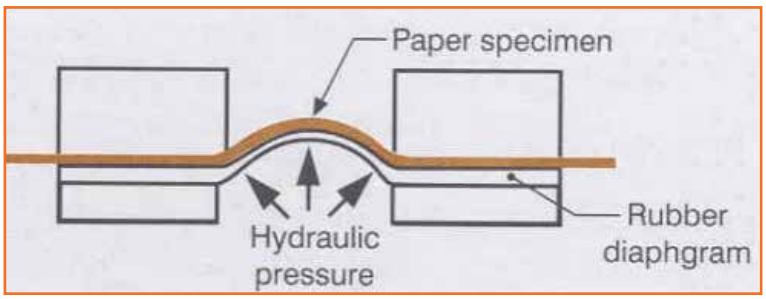



*Fig 3.1.8: Bursting Strength Test*

e. **Burst Factor**

**Significance:** The mathematical expression is as follows:

$$\text{Burst Factor (BF)} = \frac{\text{Bursting Strength(BS)}}{\text{Grammage (gsm)}} \times 1000$$

f. **Ring Crush Test (RCT)**

**Significance:** The RCT of papers is defined as the maximum vertically applied compressive force on the rim of a circular ring of the paper without the paper buckling. Expressed in KN.

**Test Method:** RCT is measured according to TAPPI T822. In RCT. The test specimen is formed in a ring, inserted into the holder as shown below. A top download is applied to the strip of paper till it buckles.

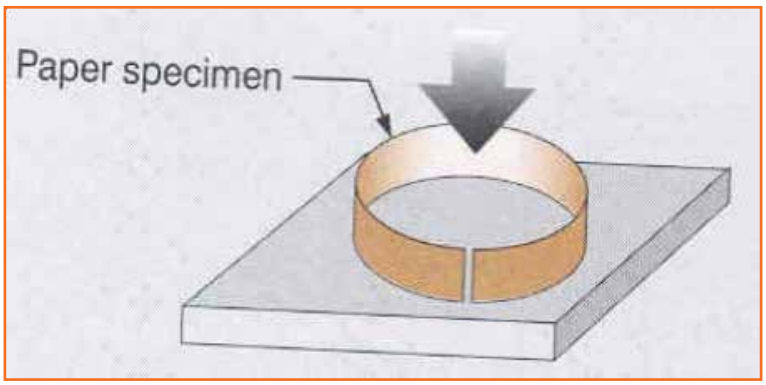



*Fig 3.1.9: Ring Crush Test (RCT)*

g. **Corrugating Medium Test (CMT)**

**Significance:** CMT is a measure of the crushing resistance of a laboratory-fluted strip of corrugating medium. Unit is Newton. 'N' is also called 'Concora'.

**Test Method:** The reference test method is TAPPI T 809. The force at which the flute is crushed is the CMT value and can be read on the indicator. The single facer sample is kept in between the platen as shown in Figure below.

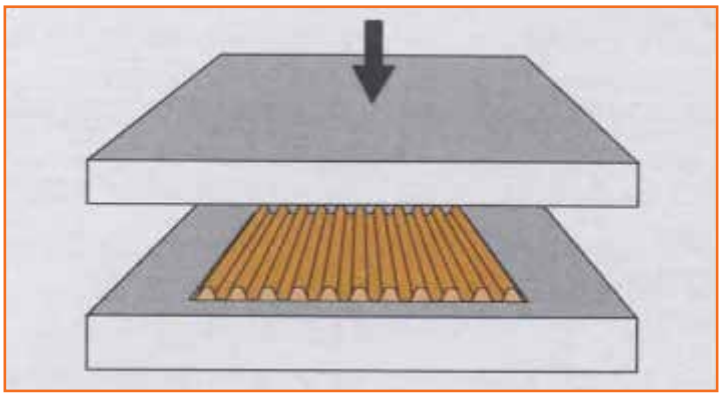


*Fig 3.1.10: Corrugating Medium Test (CMT)*

h. **Tensile Breaking strength**

**Significance:** It is the maximum tensile force per unit width developed in a test specimen at rupture or break.

**Test Method:** Test specimen cut to specified size is clamped between two jaws of the tensile tester. Then the two jaws move away from each other at a specific speed. The force at which the specimen breaks is recorded. This test is conducted five times. The average breaking force divided by specimen width gives tensile strength in KN / m.conducted five times. The average breaking force divided by specimen width gives tensile strength in KN / m.

2. **Corrugated Board**

The following parameters are assessed in the laboratory for corrugated fibreboard.

a. **Calliper**

**Significance:** The thickness of the corrugated board is the distance in millimetres measured between the two parallel contact plates of micrometres between which the specimen is subjected to a pressure of 20 kpa.

**Test Method:** The reference of list methods are TAPPI T-441 or IS: 1060- Part-I-1966

b. **Board Grammage by Ply Separation Method**

**Significance:** To determine the basic weights of the combined board and its components. As per TAPPI, the average readings are considered.

**Test Method:** The samples are soaked in water to allow the adhesive to dissolve in water. Then the layers of paper are peeled off to separate the layer carefully

c. **Bursting Strength**

**Significance:** To measure the strength properties of the board in terms of kg/ cm2.

**Test Method:** The sample is subjected to a mullen bursting strength tester and the force required to rupture or burst the board is determined.

d. **Puncture Resistance**

**Significance:** The puncture resistance is a measure of the energy needed to punch through a material.

**Test Method:** The reference test method is TAPPI T 803. A pendulum with a pyramidical shaped head, selected to simulate

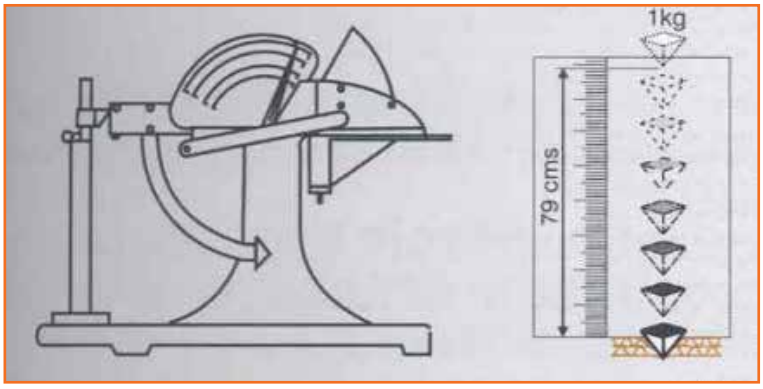



*Fig 3.1.11: Puncture Resistance Test*

a corner of a box, is released from a certain height. The freely falling pendulum acquires kinetic energy and the head puncture the board. The energy consumed is expressed in an ounce inch per tear inch or kg-cm.

e. **Flat Crush Test (FCT)**

**Significance:** To measure the resistance of the flutes in the corrugated board to a crushing force applied perpendicular to the surface of the board.

**Test Method:** TAPPI T 825 or IS: 4006 – Part-I are the reference standards. Circular shaped CFB is kept in between the platen and compressed till rupture the flutes. Measure the force is measured in Kg.

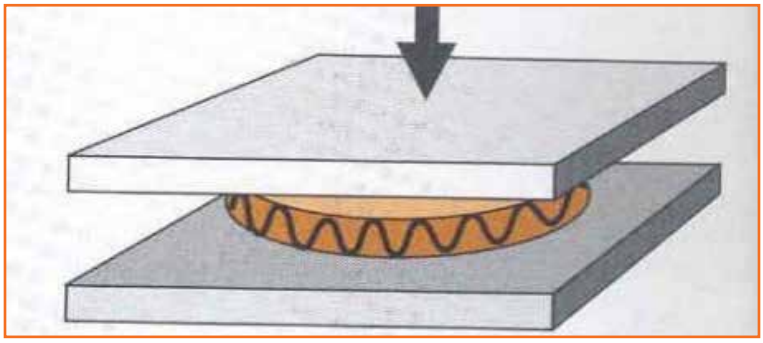


*Fig 3.1.12: Flat Crush Test (FCT)*

f. **Edgewise Compression Test or Edge Crush Test (ECT)**

**Significance:** ECT of a corrugated board is defined as the maximum vertically applied compressive force along the edge of the board without the board bucking.

**Test Method:** The reference is TAPPI T 811. The sample is kept under horizontal plates with the flutes vertical. The plates are then passed down with a constant speed of 10 ± 3mm/ minute so that the load on the edge of the board gradually increases. The load at which the board buckles gives the ECT. SI unit of ECT is KN/m.

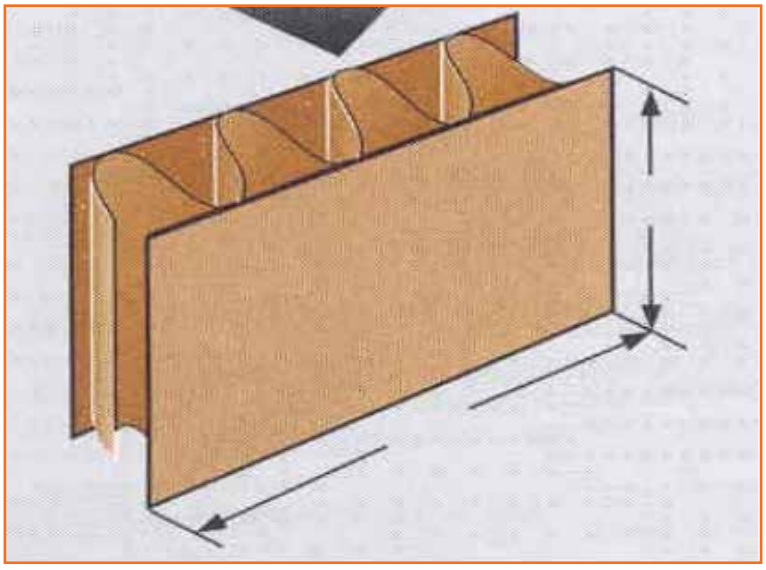


*Fig 3.1.13: Edgewise Compression Test or Edge Crush Test (ECT)*

3. **Performance Tests of Corrugated Fibre Board Boxes**

a. **Box Compression Test (BCT)**

**Significance:** This is the most important and the most common test for corrugated boxes. BCT is the measure of the ability of a corrugated box to take the top downloads. It is the measure of stackability of the box and determines how much load can be stacked upon the box without the walls of the box buckling.

**Test Method:** TAPPI T 804 or IS: 7028 (Part-VI) are the reference test method for BCT. The box is placed in a press between two parallel plates which apply pressure to the box at right angles to its flaps. The bottom plate is fixed and the top plates move at the speed of 10±3mm/ min. Now, run the machine and continue till the box gets a crush. Take the reading from the recorder in kgs. This will indicate how much force is required to compress the box.

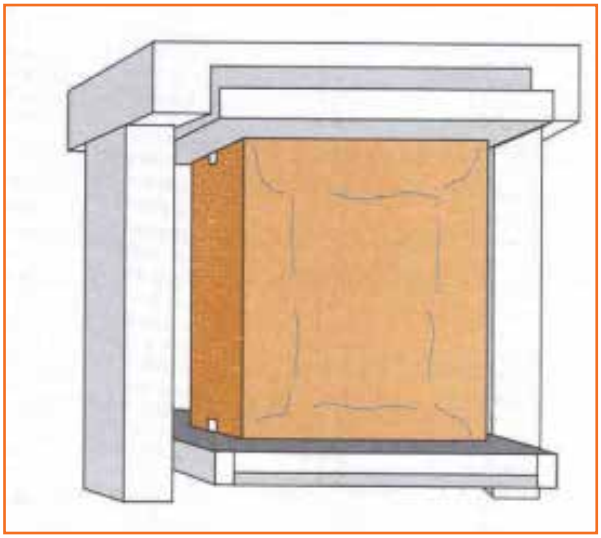


*Fig 3.1.14: Box Compression Test (BCT)*

b. **Drop Test**

**Significance:** This test is conducted to determine the ability of the package to stand up to rough handling, the degree of protection offered to the contents by the package and to compare the different types of packaging for the same product.

c. **Vibration Test**

**Significance:** This test aims to simulate the vibrations to which the box and its contents are subjected during transportation and to determine the effects on the box, the degree of protection offered to the contents by the package and to compare the different types of packaging for the same product.

**Test Method:** The test method has the reference of TAPPI T 817 and IS: 7028. Normally the package is vibrated for the one-hour duration at an amplitude of one inch for 120 cpm.

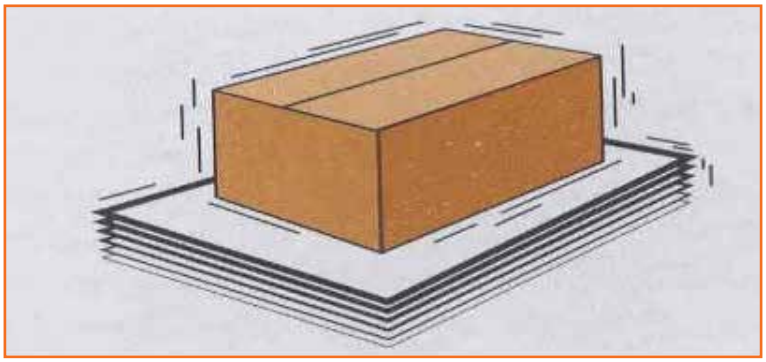


*Fig 3.1.15: Drop Test*

d. **Inclined Impact Test**

**Significance:** This test is conducted to determine the ability of the package to stand up to rough handling, determine the degree of protection offered to the contents by the package and compare different types of packaging for the same product.

**Test Method:** The reference test method is TAPPI T 801.

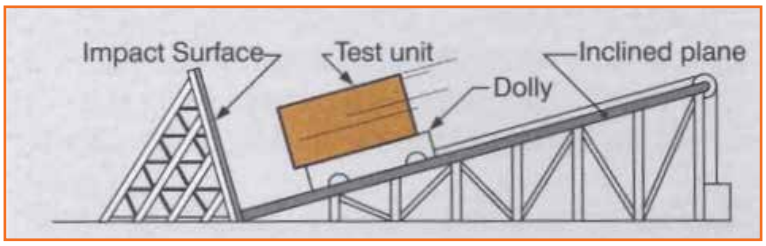



*Fig 3.1.16: Inclined Impact Test*

The distance travelled or the speed at the moment of impact is noted. The test is repeated a certain number of times until there is a sign of damage.

e. **Rolling Test**

**Significance:** To check the performance of the box during transit.

**Test Method:** The reference test method is DIN 55449. The full box is tipped over on its side. The test is performed according to the shape and the centre of gravity of the package.

f. **Climatic Test**

**Significance:** To check the performance of boxes at different climatic conditions.

**Test Method:** The same packages area was also subjected to 380 C ± 10 C and 90% ±2% RH to observe the performance.

g. **Rain Test**

**Significance:** The test is carried out to determine to what extent the package protects its components from the rain and to prepare the package for a test or a series of tests to determine the effect of rain on the performance of the package.

## 3.1.6 Testing of Semirigid Packaging Materials

**Folding Cartons**

The important tests and their significance are given below:

**Significances and Tests of Important Parameters**

1. **Grammage**

   **Significance:** To measure the weight of the paper board expressed in gms/square metre. It is also called substances and is popularly known as grammage.

   **Test Method:** The test method is the same as for paper or kraft lines.

2. **Thickness or Caliper**

   **Significance:** It is to determine the thickness of the paper board used for making the folding carton. It is important for the design and development of a folding carton.

3. **Stiffness**

   **Significance:** To determine the rigidity of paper board to assess the load-bearing capacity of product in folding carton.

   **Test Method:** The test method is explained in IS: 4060 – Part-II- 1987. The values are expressed in Taber or Kenley or milliNewton (MN).

4. **Brightness**

   **Significance:** The objective is to measure the brightness in percentage.

   **Test Method:** The test method is explained in IS: 1060 – Part-II, 1987.

5. **Surface Oil Absorption Time (SOAT)**

   **Significance:** To determine the characteristics of the paper board about the absorption capacity of surface oil, which depends on the quantity of sizing and filler materials that exist on the paper board.

   **Test Method:** The test specimen of the paper board is placed on the table. Then two drops of printing inks are put on the board and allowed to penetrate inside. The time taken to absorb ink completely by the board is recorded. Offset inks are oil-based which acts as a vehicle. The high soat indicates penetration of ink will be slow drying of ink as well as set off.

6. **Moisture Content**

   **Significance:** The objective is to determine the presence of moisture content in percentage on the paper board.

   **Test Method:** The test method can be referred to in IS: 1060 – Part-I 1987.

7. **Water Absorption or Cobb Value**

   **Significance:** The objective is to determine the water absorption capacity of board or cobb value.

   **Test Method:** The test method is explained in IS: 4060-Part-II-1987.

8. **Surface Smoothness**

   **Significance:** The objective is to measure the smoothness of the board. This is important to get a good quality of printing.

   **Test Method:** The test specimen is exposed to the testing equipment & then surface smoothness is measured in terms of ml/sec.

9. **Physical Observation**

   **Significance:** To check the physical properties of the paper board.

   **Test Method:** The samples are checked physically to check properties like appearance on spots, speaks, loose fibre/waviness prior to acceptance for conversion into folding carton.

10. **Folding Endurance**

    **Significance:** To determine the sustainability of the duplex board against the double fold.

    **Test Method:** The test specimen of 15 mm x 76 mm are cut and then clamped into the machine. The test is run till the samples get torn due to double fold. This will indicate the sustainability of the duplex board and this is expressed in terms of No.of double fold.

11. **Compression strength**

    **Significance:** To measure the load-bearing capacity of folding cartons.

**Lined Carton**

Significances and tests of important parameters -

1. **Paper Board Carton**

   a. **Stiffness**

      **Significance:** To measure the resistance of the carton against bulging, crushing, and bowling of the sides. Low stiffness of the board causes less compression strength and stackability of cartons.

      **Test Method:** The test specimen is subjected to stiffness equipment and the test values are measured in the machine direction (MD) and cross direction (CD).

   b. **Moisture Content**

      **Significance:** It is very important to assess the moisture content of the paper board.

      **Test Method:** The details of the test method is given in. Normally, the paper board is having moisture content between 6 to 9 %.

   c. **Calliper**

      **Significance:** To check the thickness of the paper board.

**Test Method:** The test specimen are measured by means of digital or mechanical micrometre and the values are expressed as micron or millimetres.

d. **Grammage**

**Significance:** To measure the weight of paper board in gms. A high grammage board offers resistance against bursting, puncturing and tearing.

e. **Ply Bond Strength**

**Significance:** This parameter pertains to the strength of the interlayer bond in the board. If the plyboard is less, these layers would tend to separate, particularly during creasing.

**Test Method:** The test specimen are taken and then place in between two metallic plates, subjected to heat and then observe the degree of separation of the layer. No separation will indicate good ply bond strength.

f. **Surface Appearance**

**Significance:** This test is important as attributes relevant pertain to brightness, smoothness, oil absorption capacity and blemishes affecting the surface finish. Test Method: This is a subjective method and the observations are taken visually. However, laboratory tests on brightness, smoothness, SOAT etc. are also conducted to assess the overall surface appearance of lined cartons.

2. **Liners**

a. **Barrier Properties**

**Significance:** To measure the barrier properties in terms of water vapour transmission rate and oxygen transmission rate as these properties have got a direct effect on the degree of deterioration of the dairy product and thus affect the shelf life of products.

**Test Method:** The details are described in IS: 1060 – Part-III and ASTMD 3985.

b. **Treatability**

**Significance:** To measure the level of treatability or the surface energy of the film or laminate.

**Test method:** Normally, the energy level should have more than 38 dynes/cm

c. **Peel Bond Strength**

**Significance:** To measure the force required to separate the two plies of the laminates.

**Aseptic Cartons**

Significance and Tests of Important Parameters

**The significance and test method of important parameters are as below:**

1. **Delamination of Laminate & Thickness & Grammage**

   **Significance:** The objective is to separate all the important layers and to check the thickness and grammage of the layer.

   **Test Method:** The details are given in IS: 1060 – Part-I – 1985.

2. **Leakage Test for Aseptic Carton**

   **Significance:** To check the integrity of the seals of the carton and to assess the leakage.

   **Test method:** A filled aseptic carton is immersed into a beaker filled with water. Keep it for 15 minutes and take the observation about the appearance of any air bubbles through the water. This will indicate the integrity of the seal or leakage properties of the aseptic carton.

3. **Barrier Properties**

   **Significance:** To check the barrier properties of the laminate against moisture, Oxygen gas, light etc.

4. **Mechanical Properties**

   **Significance:** The objective is to determine the mechanical properties of the laminate in order to ascertain various parameters like tensile strength, stiffness, tear properties, bursting strength etc.

   **Test Method:** The test method of paper-based laminate is the same as paper and paper board.

5. **Dimensional Stability**

   **Significance:** The objective of this test is to determine the dimensional stability of the laminate.

   **Test Method:** The test specimen is measured for all the dimensions like length, width and height. The sample is then exposed to high temperature & high humidity i.e. 38°C ± 1°C & 90% ± 2% R.H.

6. **Flex Crack Resistance**

   **Significance:** This test is conducted to determine the performance of laminate in terms of resistance against flex cracks.

   **Test Method:** The test specimen is cut into a size of 30 cm x 20 cm. And then the laminate is clamped into Gelbo flex Tester and then run the machine for 2800 cycles.

**Thermoformed Containers**

Significances and Tests of Important Parameters

**The important parameters are considered for the qualitative tests. The details are as follows:**

1. **Identification of Polymeric Materials**

   **Significance:** The main objective of this test is to determine the kind of plastic materials used for making thermoformed containers.

   **Test Method:** The chemical method is normally employed for identification purposes. However, differential scanning calorimetry (DSC) is also used for the identification of polymetic materials.

2. **Extractability Test**

   **Significance:** To check the level of extractable residues so to ascertain their suitability for processed food products.

   **Test Method:** The testing is done in the laboratory by referring to IS:9845 – 1987. (Migration test).

3. **Product – Package Compatability Test**

   **Significance:** This test will ascertain their suitability for the packaging of a particular product. In other words, the test will confirm Compatability due to interaction during storage, handling and transportation.

   **Test method:** In the laboratory, the thermoformed containers are filled with a particular type of dairy product. Then the filled packages are exposed to accelerated condition i.e. 38°C ± 1°C and 90% ± 2% RH for a specified period of time.

## 3.1.7 Key Terms

| Term | Definition/Full Form |
|---|---|
| TQM | Total Quality Management |
| Accelerated Condition | The extreme climatic conditions with high temperature and high humidity. Normally, the environmental conditions like 38 °C ±1°C & 90% + 2% R.H. are considered. |
| Performance Test | The tests pertain to the evaluation of packages during transit |
| Burst factor | It is the ratio of bursting strength and grammage Burst factor = Bursting St. x 100 Grammage |

| Term | Definition/Full Form |
|---|---|
| Go, No Go Gauge | The measurement is done without any adjustment of the gauge meter, where the arms are fixed and checking is done only by pushing the gauge inside the glass Neck or body etc. |
| Polariscope | This is an instrument to determine the interface of colours of glass containers during the gradual cooling process. |
| Clearks' Solution | A chemical solvent developed by Scientist, Cleark, was used to dissolve the Tin coating for the determination of the Tin Coating thickness. |
| Concora Medium Test | It is the same as corrugating medium test. |
| Finish | The important part of the glass container that fits onto the closures |
| Pendulum | A steel ball swings like a Pendulum and then hits the glass container while checking the Impact strength. |

## 3.1.8 Documentation During Food Packaging Development

- The name of the product, the batch number and the quantity of product to be packed, as well as the quantity actually obtained and its reconciliation
- The date(s) and time(s) of the packaging operations
- The name of the responsible person carrying out the packaging operation
- The initials of the operators of the different significant steps
- The checks made for identity and conformity with the packaging instructions, including the results of in-process controls
- Details of the packaging operations carried out, including references to equipment and the packaging lines used and, when necessary, instructions for keeping the product unpacked or a record of returning product that has not been packaged to the storage area
- Whenever possible, the regular check for correctness of printing (e.g. batch number, expiry date and other additional overprinting) and specimen samples collected
- Notes on any special problems, including details of any deviation from the packaging instructions, with written authorization by an appropriate person
- The quantities and reference number or identification of all printed packaging materials and bulk product issued, used, destroyed, or returned to stock and the quantities of product obtained; this is necessary to permit an adequate reconciliation.
- Equipment cleaning and use record Records of major equipment use, cleaning, sanitization and/or sterilization, and maintenance should show the date, time (if appropriate), product, and batch

number of each batch processed in the equipment and the name and signature of the person who has performed the cleaning and maintenance. The persons performing and double-checking the cleaning and maintenance should date and sign or initial the log, indicating that the work was performed. Entries in the log should be in chronological order.

- Complete records should be maintained of any testing and standardization of laboratory reference standards, reagents, and standard solutions.
- Batch production record review
- Written procedures should be established and followed for the review and approval of batch production and laboratory control records, including packaging and labeling, to determine compliance of the intermediate before a batch is released or distributed.

# Unit 3.2 – Packaging Material Standards

## Unit Objectives

**At the end of the module, the participant will be able to:**

1. Define various packaging regulations.
2. Prepare for food packaging and labeling
3. Demonstrate food quality and shelf life

## 3.2.1 Packaging Regulation

FSSAI has created separate packaging regulations as it recognizes the importance of packaging in the food sector and its impact on food safety. The new packaging regulations have been separated from the labelling regulations and a separate Scientific Panel for food packaging is planned.

These regulations may be called the Food Safety and Standards (Packaging) Regulations, 2018. They shall come into force on the date of their publication in the Official Gazette and the Food Business Operator shall with all the provisions of these regulations by 1st July 2019.

**In these regulations unless the context otherwise requires:**

- "Act" means the Food Safety and Standards Act, 2006 (Act 34 of 2006);
- "food grade" means a material made of substances that are safe and suitable for their intended use, and shall not endanger human health or result in an unacceptable change in the composition of the food or organoleptic characteristics
- "multilayer/composite food packaging" means a food packaging material composed of two or more layers of the same or different types of packaging materials specified under these regulations
- "overall migration limit" means the maximum permitted amount of non-volatile substances released from a material or article into food simulants;
- "package or container" means a pre-packaged box, bottle, casket, tin, barrel, case, pouch, receptacle, sack, bag, wrapper or such other things in which an article of food is packed;
- "packaging material" means materials such as cardboard, paper, glass, metal, plastic, multi-layer packaging material used for packaging of food products;
- "primary food packaging" means packaging material in direct contact with food products;
- "secondary food packaging" means packaging material that encloses the primary food packaging and does not come in direct contact with food products;
- "specific migration limit" means the maximum permitted amount of a given substance released from a material or article into food or food simulants.

All other words and expressions used herein and not defined, but defined in the Act, rules or regulations made thereunder, shall have the meanings assigned to them in the Act, rules or regulations, respectively.

## 3.2.1.1 General Requirements

- Every food business operator shall ensure that the packaging material used shall be in accordance with these regulations - Provided where Indian Standards are not available, then relevant International Standards may be complied with.
- Any material which comes in direct contact with food or is likely to come in contact with food used for packaging, preparation, storing, wrapping, transportation and sale or service of food shall be of food-grade quality.
- Packaging materials shall be suitable for the type of product, the conditions provided for storage and the equipment for filling, sealing and packaging of food as well as transportation conditions.
- Packaging materials shall be able to withstand mechanical, chemical or thermal stresses encountered during normal transportation. In the case of flexible or semi-rigid containers, overwrap packaging may be necessary.
- Food products shall be packed in clean, hygienic and tamper-proof packages or containers.
- The sealing material shall be compatible with the product and the containers as well as the closure systems used for the containers.
- Tin containers once used, shall not be re-used for packaging of food.
- Plastic containers of capacity 5 litre and above and Glass bottles, which are reused for packaging of food, shall be suitably durable, easy to clean or disinfect
- Printing inks for use on food packages shall conform to IS-15495.
- The printed surface of packaging material shall not come into direct contact with food products.
- Newspaper or any such material shall not be used for storing and wrapping food.
- In the case of multilayer packaging, the layer which comes in direct contact with food or layers likely to come in contact with food shall meet the requirements of packaging materials specified in Schedule I, II and III of these regulations.
- The materials listed in Schedule I, II and III of these regulations shall be compatible with their intended use as a packaging material so as not to alter the quality and safety of the food product.
- Every food business operator shall obtain the certificate of conformity issued by NABL accredited laboratory against these regulations for the packaging material which comes in direct contact with food or layers likely to come in contact with food to be used.

## 3.2.1.2 Specific Requirements for Primary food packaging

**Paper and board materials intended to come in contact with food products**

- Paper and board material shall be of uniform formation, thickness, and substance.
- It shall be free from visible specks, grease marks, cuts, pinholes, and other blemishes.
- The paper used for the manufacture of boxes, cartons, plates, cups and paper lids or paper which are meant to be directly in contact with food shall be of food-grade and shall be free from contaminants.

- Paper and board materials used for the manufacturing of containers for packing or storing the food products shall
- conform to either of the Indian Standards specifications as provided in Schedule – I.

**Glass containers intended to come in contact with food products**

- As far as possible, they shall be free from blisters, mould marks, stones and chippings and as far as possible shall be free from cords, seeds, and other visible defects.
- They shall have a smooth surface without cracks, pinholes, and sharp edges.
- The sealing surface shall be free from hairline cracks and prominent seam marks.

**Metal and Metal Alloys intended to come in contact with food products**

- A utensil or container made of the following materials or metals, when used in the preparation, packaging and storing of food shall be deemed to render it unfit for human consumption

  i. rusty containers;

  ii. enamelled containers which have become chipped and rusty;

  iii. copper or brass containers that are not properly tinned.

- Appropriate grades of metal and metal alloys where applicable shall be used for packing or storing food products.
- Metal and metal alloys used for the manufacturing of containers for packing or storing the food products shall conform to either of the Indian Standards specifications as provided in Schedule – II.

**Plastic materials intended to come in contact with food products**

- Plastic materials used for the manufacturing of containers for packing or storing the food products shall conform to either of the Indian Standards specifications as provided in Schedule – III -

  Provided that Drinking Water (both Packaged and Mineral Water) shall be packed in colourless, transparent and tamper-proof bottles or containers made of polyethylene (PE) conforming to IS-10146 or polyvinyl chloride (PVC) conforming to IS-10151 or Polyethylene terephthalate (PET and PBT) conforming to IS-12252 or polypropylene (PP) conforming to IS-10910 or food-grade polycarbonate conforming to IS-14971 or polystyrene conforming to IS-10142 or sterile glass bottles only. The transparency of a container shall not be less than 85 percent in light transmittance -

  Provided also that all pigments or colourants as specified in Indian Standard IS-9833 may be allowed in plastic containers of five litres and above made of Polycarbonate and Polyethylene Terephthalate (PET) used for packaging of mineral water and packaged drinking water. The transparency of such containers shall not be less than 85 percent in light transmittance.

- All packaging materials of plastic origin shall pass the prescribed overall migration limit of 60mg/kg or 10mg/dm$^2$ when tested as per IS-9845 with no visible colour migration.
- Plastic materials and articles shall not release the substances in quantities exceeding the specific migration limits listed under Table 1.

- Pigments or Colorants for use in plastics in contact with food products and drinking water shall conform to IS-9833.
- Products made of recycled plastics including carry bags shall not be used for packaging, storing, carrying or dispensing articles of food.

  The requirement for specific migration limits of substances from plastic materials intended to be in contact with articles of food.

| Sl. No | Substances | Maximum Migration Limit (mg/Kg) |
|---|---|---|
| 1. | Barium | 1.0 |
| 2. | Cobalt | 0.05 |
| 3. | Copper | 5.0 |
| 4. | Iron | 48.0 |
| 5. | Lithium | 0.6 |
| 6. | Manganese | 0.6 |
| 7. | Zinc | 25.0 |

- A list of suggestive packaging materials which may be used for packaging of food products falling under the specified categories is provided in Schedule – IV -

  Provided that this is an indicative list not restricting the use of any other packaging material complying with the specified standards.

## 3.2.1.3 Schedule – I

**Paper and board materials intended to come in contact with food products**

| Sl. No | List of Standards |
|---|---|
| 1. | Greaseproof paper – IS 6622 |
| 2. | Vegetable parchment or Greaseproof paper or Aluminium Foil Laminate – IS 7161 |
| 3. | Aluminum Foil Laminates for Packaging – IS 8970 |
| 4. | General-purpose packing or wrapping Paper – IS 6615 |
| 5. | Folding Box Board, uncoated – IS 1776 |
| 6. | Corrugated Fibre Board Boxes- Specification (Part 1) – IS 2771 |

**Note:** The wax used for coating the paper or board shall be paraffin wax conforming to Type I of IS 4654.

## 3.2.1.4 Schedule – II

**Metal and Metal Alloys intended to come in contact with food products:**

| Sl. No | List of Standards |
|---|---|
| 1. | Cold-reduced Electrolytic Tinplate – IS 1993/ISO 11949 |
| 2. | Cold reduced Electrolytic Chromium or Chromium Oxide – Coated Steel – IS 12591/ISO 11950 |
| 3. | Wrought Aluminium and Aluminium Alloy Sheet and Strip for General Engineering – IS 737 |
| 4. | Aluminium and Aluminium Alloy Bare Foil for Food Packaging – IS 15392 |
| 5. | Specification for Crown Closures – IS 1994 |
| 6. | Specification for Round Open Top Sanitary Cans for Foods and Drinks – IS 9396 (Part 1) |
| 7. | Specification for Round Open Top Sanitary cans for Foods and Drinks – IS 9396 (Part 2) |

## 3.2.1.5 Schedule – III

**Plastic Materials intended to come in contact with food products:**

| Sl. No | List of Standards |
|---|---|
| 1. | Specification for Polyethylene for its safe use in contact with foodstuffs, pharmaceuticals, and drinking water – IS 10146 |
| 2. | Specification for Polystyrene for its safe use in contact with foodstuffs, pharmaceuticals and drinking water – IS 10142 |
| 3. | Specification for Polyvinyl Chloride (PVC) and its copolymers for its safe use in contact with foodstuffs, pharmaceuticals and drinking water – IS 10151 |
| 4. | Specification for Polypropylene and its copolymers for its safe use in contact with foodstuffs, pharmaceuticals, and drinking water – IS 10910 |
| 5. | Specification for Ionomer Resins for its safe use in contact with foodstuffs, pharmaceuticals, and drinking water – IS 11434 |
| 6. | Specification for Ethylene Acrylic Acid (EAA) copolymers for their safe use in contact with foodstuffs, pharmaceuticals, and drinking water – IS 11704 |

| Sl. No | List of Standards |
|---|---|
| 7. | Specification for Polyalkylene Terephthalates (PET & PBT) for their safe use in contact with foodstuffs, pharmaceuticals and drinking water – IS 12252 |
| 8. | Specification for Nylon 6 Polymer for its safe use in contact with foodstuffs, pharmaceuticals and drinking water – IS 12247 |
| 9. | Specification for Ethylene Vinyl Acetate (EVA) copolymers for its safe use in contact with foodstuffs, pharmaceuticals, and drinking water – IS 13601 |
| 10. | Specification for Ethylene Metha Acrylic Acid (EMAA) copolymers and terpolymers for its safe use in contact with foodstuffs, pharmaceuticals, and drinking water – IS 13576 |
| 11. | Specification for Polycarbonate Resins for its safe use in contact with foodstuffs, pharmaceuticals, and drinking water – IS 14971 |
| 12. | Specification for Flexible Packaging Materials for packaging of Edible Oils, Ghee and Vanaspati – IS 14636 |
| 13. | Specification for Polyalkylene Terephthalates (PET & PBT) for Moulding and Extrusion – IS 13193 |
| 14. | Specification for Polyethylene Films and Sheets – IS 2508 |
| 15. | Specification for Linear Low-Density Polyethylene (LLDPE) Films – IS 14500 |
| 16. | Specification for High-Density Polyethylene Materials for Moulding and Extrusion – IS 7328 |
| 17. | Specification for Melamine-Formaldehyde Resins for its safe use in contact with foodstuffs, pharmaceuticals and drinking water – IS 14999 |
| 18. | Low-Density Polyethylene Films – IS 2508 |
| 19. | Blow Moulded Polyolefin Containers – Part 2: Over 5 Litres, up to and Including 60 Litres Capacity – IS 7408 |
| 20. | Stretch Cling Films – IS 14995 |

## 3.2.1.6 Schedule – IV

**List of suggestive packaging materials:**

| S. No | Product Category | Types of Packaging materials |
|---|---|---|
| 1 | **Milk and Milk products** | Glass bottle with metal caps or plastic (polypropylene (PP) or High-density Polyethylene (HDPE)) caps. |
| | | Rigid Plastic container made of PET with plastic (polypropylene (PP) or High-density Polyethylene (HDPE)) caps. |
| | | Rigid Plastic container made up of High-density Polyethylene(HDPE) Polypropylene (PP) or Polystyrene (PS) with Plastic (PPor High-density Polyethylene (HDPE) caps. |
| | | Flexible plastic pouch made of Polyethylene(PE) or Polypropylene (PP) based co-extruded multi-layered material. |
| | | Aseptic and flexible packaging material (Paper board or Aluminium foil or Polyethylene) based multi-layered structure. |
| | | Tin plate container. |
| | | Paper-based lined cartons with a liner made of aluminium foil based laminated structure. |
| | | Plastic-based polypropylene (PP) or polystyrene (PS) cups with paper or Peel-off lid. |
| | | Wax coated paper butter wrappers. |
| | | Paper and Paper Board based folding carton inside butter wrapped with butter paper. |
| | | Metal Containers with plastic polypropylene (PP) caps or metal or plastic lid. |
| | | Plastic pet container with plastic lid. |
| | | Thermoform cup or tray with paper or peel-off lids. |
| | | Paper and Paper Board setup boxes with or without lamination – plastic film inside. |

| S. No | Product Category | Types of Packaging materials |
|---|---|---|
| | | Paper and Paper Board setup boxes with or without greaseproof paper placed inside |
| | | Plastic Based multi-layered flexible laminated heat-sealed pouch. |
| | | Mud or clay pots |
| | | Thermoformed Plastic container (blister pack) with aluminium foil or Polyethylene (PE) based lid |
| 2. | **Fats, oils and fat emulsions** | Tin plate container. |
| | | Glass bottle with metal caps or plastic polypropylene (PP) or High-density Polyethylene(HDPE) caps. |
| | | Plastic rigid container (jar) made of High-density Polyethylene(HDPE). |
| | | Plastic bottle or Jar Polyethylene terephthalate (PET) with plastic caps |
| | | Plastic Pouch made of Multilayered laminated or co-extruded structure. |
| | | Aseptic and flexible packaging material (Paper board or Aluminium foil or Polyethylene) based multi-layered structure. |
| | | Plastic laminated pouch in duplex board box (Bag in Box). |
| | | Thermoformed plastic-based jar with plastic caps. |
| | | Paper-based lined cartons with a liner made of aluminium foil based laminated structure. |
| 3. | **Fruit and Vegetable products** | Glass bottle with metal caps or plastic (polypropylene (PP) or High-density Polyethylene (HDPE) caps. |
| | | Aluminium can with the easy-open end. |
| | | Tinplate container. |
| | | Aseptic and flexible packaging material (Paper board or Aluminium foil or Polyethylene) based multi-layered structure |

| S. No | Product Category | Types of Packaging materials |
|---|---|---|
| | | Plastic rigid container (jar) made of either High-density Polyethene (HDPE) or Co-extruded structure with Plastic (polypropylene (PP) or High-density Polyethylene (HDPE) caps. |
| | | Stand up Pouch made up of Plastic based structure with a plastic spout. |
| | | Flexible Plastic pouch made of either Polyethylene (PE) or Laminated structure. |
| | | Thermoformed Plastic container (Blister Pack) with aluminium foil or Polyethylene (PE) based lid. |
| | | Plastic jar (Co-extruded) with metal caps. |
| | | Plastic trays with overwrap. |
| | | Polyethylene terephthalate (PET) or polypropylene (PP) or Poly Vinyl Chloride (PVC) Punnets |
| 4. | **Sweets and Confectionery** | Metal Containers with plastic polypropylene (PP) caps or metal or plastic lid Plastic based multi-layered laminated Heat-sealed pouches. |
| | | Composite containers made up of Paper Board or Aluminium foil or plastic base films with plastic or metal lids. |
| | | Plastic-based rigid containers. |
| | | Foil wrap. |
| | | Plastic film-based twist wraps (Polyethylene terephthalate (PET) or polypropylene (PP) or Poly Vinyl Chloride (PVC) |
| | | Thermoformed tray and punnet with lid. |
| | | Glass bottle with metal or plastic caps. |
| | | Plastic cups with a film lid. |

| S. No | Product Category | Types of Packaging materials |
|---|---|---|
| 5. | Cereals and cereal products | Tin container. |
| | | Aluminum Foil Based laminated pouch in the metal container. |
| | | Wrapper made of wax-coated paper. |
| | | Wrapper made of the three-layered laminated structure. |
| | | Plastic-based multi-layered laminated pouch (heat sealed). |
| | | Plastic-based thermoform container with plastic lid. |
| | | Lined carton with a liner made of the multi-layered laminated structure. |
| | | Plastic-based multi-layered laminated structured Zipper Pouch. |
| | | Thermoform trays with plastic lids or overwraps. |
| | | Glass bottle with metal caps. |
| | | Polyethylene terephthalate (PET) or Plastic based rigid containers with metal or plastic (polypropylene (PP) or High-density Polyethylene (HDPE) caps |
| | | Plastic films or co-extruded film or polypropylene (PP) or Polyethylene (PE) |
| 6. | **Meat and Meat Products or Poultry Products** | Glass jars with plastic (polypropylene (PP) or High-density Polyethylene (HDPE) caps. |
| | | Metal Containers with metal lid (lacquered tin containers). |
| | | Plastic-based flexible pouches in paper & paper Board cartons. |
| | | Plastic-based multi-layered flexible laminates heat sealed pouches. |
| | | Plastic tray with overwrap. |
| | | Aluminium foil wrap |

| S. No | Product Category | Types of Packaging materials |
|---|---|---|
| | | Polyethene terephthalate (PET) punnets or containers with plastic caps |
| 7. | **Fish and fish products or Seafood** | Glass jars with plastic (PP or High-density Polyethylene (HDPE) caps. |
| | | Metal Containers with metal lid (lacquered tin containers). |
| | | Polyethylene terephthalate (PET) punnets or containers with plastic caps. |
| | | Plastic-based multi-layered flexible laminates heat sealed pouches. |
| | | Plastic tray with overwrap. |
| 8. | **Sweetening agents including Honey** | Glass bottle with Metal Caps or Plastic (polypropylene (PP) or High-density Polyethylene (HDPE) Caps. |
| | | Plastic-based Thermoformed container. |
| | | Blister Pack with foil or Polyethylene lid. |
| | | Polyethylene Terephthalate (PET) container with Plastic Caps. |
| | | Plastic laminated Tube. |
| 9. | **Salt, Spices, Condiments and related products** | Glass bottle with a metal lid or plastic (polypropylene (PP) or High-density Polyethylene (HDPE) caps. |
| | | Plastic-based rigid container with Plastic cap (Polyethylene terephthalate (PET) and High-density Polyethylene (HDPE) Containers). |
| | | Paper & Paper board or Aluminium foil or Plastic Film based Composite Container. |
| | | Folding cartons with Plastic based flexible laminated structure (heat sealed) pouch placed inside. |
| | | Plastic-based multi-layered layered laminated pouch (heat sealed). |

| S. No | Product Category | Types of Packaging materials |
|---|---|---|
| 10. | **Beverages (other than Dairy and Fruits & vegetables based)** | Plastic bottles are made of either Polyethylene terephthalate (PET) or Polycarbonate (PC) with Plastic (Polypropylene (PP) or High-density Polyethylene (HDPE) or Aluminium caps. |
| | | Heat-sealed Plastic pouches made of Polyethylene (PE). |
| | | Glass bottles with metal caps or plastic caps. |
| | | Plastic pouches made up of Polyethylene (PE) in Corrugated fiberboard Boxes. |
| | | Aluminium can with the easy-open end. |
| | | Tin plate container. |
| | | Plastic pouch made of the laminated structure. |
| | | Aseptic and flexible packaging material (Paper board or Aluminium foil or Polyethylene) based multi-layered structure. |
| | | Plastic-based multi-layered structure heat sealed pouches. |
| | | Plastic-based multi-layered structure heat-sealed Zipper pouches or stand up pouches. |
| | | Metal Containers with plastic or Polypropylene (PP) caps or metal or plastic lid, Rigid Plastic container with plastic caps (Polypropylene (PP) Caps). |
| | | Wooden cask (for wines). |

## 3.2.2 Food Packaging and Labelling

Packaging is the science, art and technology of enclosing or protecting products for distribution, storage, sale, and use. Packaging also refers to the process of design, evaluation, and production of packages. Packaging can be described as a coordinated system of preparing goods for transport, warehousing, logistics, sale, and end-use. Packaging contains, protects, preserves, transports, informs and sells. In many countries, it is fully integrated into government, business, institutional, industrial, and personal use.

Package labelling or labelling is any written, electronic, or graphic communications on the packaging or on a separate but associated label.

**The purposes of packaging and package labels**

Packaging and package labelling have several objectives

- **Physical protection** - The objects enclosed in the package may require protection from, among other things, shock, vibration, compression, temperature, etc.
- **Barrier protection -** A barrier from oxygen, water vapour, dust, etc., is often required. Permeation is a critical factor in design. Keeping the contents clean, fresh, sterile and safe for the intended shelf life is a primary function.
- **Containment or agglomeration -** Small objects are typically grouped in one package for reasons of efficiency. For example, a single box of 1000 pencils requires less physical handling than 1000 single pencils. Liquids, powders, and granular materials need containment.
- **Information transmission -** Packages and labels communicate how to use, transport, recycle, or dispose of the package or product. With pharmaceuticals, food, medical, and chemical products, some types of information are required by governments. Some packages and labels also are used for track and trace purposes.
- **Marketing -** The packaging and labels can be used by marketers to encourage potential buyers to purchase the product. Package graphic design and physical design have been important and constantly evolving phenomenon for several decades. Marketing communications and graphic design are applied to the surface of the package and (in many cases) the point of sale display.
- **Security -** Packaging can play an important role in reducing the security risks of shipment. Packages can be made with improved tamper resistance to deter tampering and also can have tamper-evident features to help indicate tampering. Packages may include authentication seals and use security printing to help indicate that the package and contents are not counterfeit. Packages also can include anti-theft devices, such as dye-packs, RFID tags, or electronic article surveillance tags that can be activated or detected by devices at exit points and require specialized tools to deactivate. Using packaging in this way is a means of loss prevention.
- **Convenience -** Packages can have features that add convenience in distribution, handling, stacking, display, sale, opening, reclosing, use, dispensing, and reuse.
- **Portion control -** Single serving or single dosage packaging has a precise amount of contents to control usage. Bulk commodities (such as salt) can be divided into packages that are a more suitable size for individual households. It also aids the control of inventory - selling sealed one-litrebottles of milk, rather than having people bring their bottles to fill themselves.

**Symbols used on packages and labels**

Many types of symbols for package labelling are nationally and internationally standardized. For consumer packaging, symbols exist for product certifications, trademarks, proof of purchase, etc. Some requirements and symbols exist to communicate aspects of consumer use and safety. Examples of environmental and recycling symbols include the Recycling symbol, Resin identification code (below), and Green Dot (symbol).


*Fig 3.2.1 Identification symbol*

Bar codes (below), Universal Product Codes, and RFID labels are common to allow automated information management in logistics and retailing. Country of Origin Labelling is often used.


*Fig 3.2.2 Bar code*

**Food Labelling**

Grocery store aisles are avenues to greater nutritional knowledge. With today‘s food labels, consumers generally get the following information -

- Nutrition information about almost every food
- Distinctive, easy-to-read formats enable consumers to quickly find the information to make healthy food choices.
- Information on the amount per serving of saturated fat, cholesterol, dietary fibre and other nutrients of major health concern.
- Nutrient reference values expressed as % Daily values that help consumers see how a food fits into an overall daily diet.
- Uniform definition for terms that describe a food‘s nutrient content – such as —light‖, —low fat‖ and —high fibre‖ to ensure that such terms mean the same for any product on which they appear.
- Claims about the relationship between a nutrient or food and diseases or health-related condition such as calcium & osteoporosis, and fat & cancer. These are helpful for people who are concerned about eating foods that may help keep them healthier longer.
- Standardized serving sizes that make a nutritional comparison of similar products easier.
- Declaration of the total percentage of juice in fruit drinks to enable consumers to know its quantity.


*Fig 3.2.3 Food Labelling*

- **Green Dot/ Red Dot -** Currently, packaged food products sold in India are required to be labelled with a mandatory mark indicating whether source of the product was vegetarian or non-vegetarian, Vegetarian food is identified by a green symbol while non-vegetarian food with a red dot.


*Fig 3.2.4 Nutrients information*

- **Nutritional facts information -** It shows you some key nutrients that impact health. You can use the label to support your personal dietary needs – look for foods that contain more of the nutrients you want to get more of and less of the nutrients you may want to limit.
- **Preservatives -** The term "preservatives" refers to the functional name for a wide variety of compounds that help slow or prevent bacterial growth in a wide range of products, including foods, medicines, and personal care products. These compounds can be natural or synthetic. Preservatives play important roles in many products people use every day – for example, by helping prevent the growth of harmful microorganisms and protect products from spoilage or contamination.

## 3.2.3 Food Quality and Shelf Life

In those countries of the world with industrial food production, the indication of acertain type of shelf life on packed food is common practice or even mandatory. Forconsumers, the indicated shelf life is important in their decision to purchase, consume,and also possibly waste food. Overall, packaging has a large influence onshelf life, and properly selected packaging materials determine the efficiency of thefood supply chain.

It will always be difficult to establish a quantitative relationship between the propertiesof food and the performance of its packaging with regard to shelf life. Because of thehuge variability of the products involved, every combination of a new food productand its packaging will need an individual analysis and optimization procedure.

**What is Shelf Life?**

Shelf life is a guide for the consumer of the period of time that food can be kept before it starts to deteriorate, provided any stated storage conditions have been followed. The shelf life of a product begins from the time the food is prepared or manufactured. Its length is dependent on many factors including the types of ingredients, manufacturing process, type of packaging and how the food is stored. It is indicated by labelling the product with a date mark.

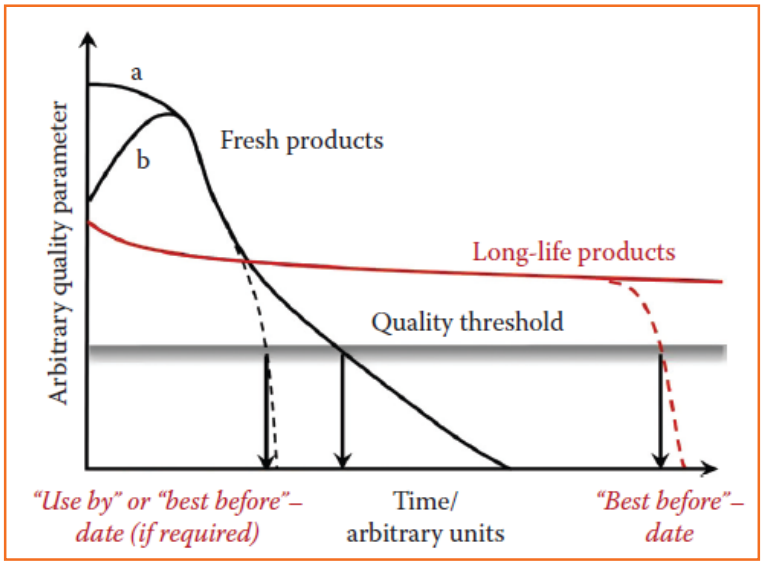



*Fig 3.2.5: Quality decay of fresh and long-life food products, schematic.*

**Note:** Straight lines indicate a steady decay, whereas dotted lines symbolize fast decay after exceeding a critical limit.

**Factors influencing the shelf life of a product**

All foods spoil with time, but there is considerable variation in spoilage rates. Some of the factors involved in the loss of quality are explained below:

1. **Microbial Growth**

   The growth of some bacteria, yeasts and moulds in food may lead to either food spoilage or food poisoning.

The time taken for microorganisms to affect foods will depend on their levels in the food when it is produced, as well as any further contamination the food may suffer during packing, storage and another handling. The temperature and time of storage, as well as the type of food, are also important factors. Moist foods will usually spoil faster than dry foods.

2. **Non – Microbial Spoilage**

There are many other ways in which quality and nutrients can be lost. They may not necessarily result in the product being harmful but can mean that it is no longer of an acceptable standard.

- Moisture gain/loss can result in loss of nutrients, browning and rancidity. Dry foods can become vulnerable to microbial spoilage if they take on moisture.
- Chemical change can result in off flavours, colour changes, browning and loss of nutrients.
- Light-induced change can cause rancidity, vitamin loss and fading of natural colours.
- Temperature changes increase or decrease the speed of other forms of spoilage.
- Physical damage to food can result in spoilage, for example bruising of fruit and vegetables. Damage to food packaging can make the food vulnerable to both microbial and non-microbial spoilage. For example, pinholes in cans or tears in plastic bags allow microorganisms to enter the food and moisture to be lost from the food.

3. **Other**

- Spoilage by rodents and insects
- Flavours and odours from storing food near other strongly smelling products
- Product tampering

Sometimes, the quality may suddenly decrease after a critical concentration has been reached (e.g., that of microorganisms in the case of fresh products or that of reacted oxygen in the case of autoxidation of fatty acids). These cases are symbolized by dotted lines. The three different groups of reasons for the limited lifetime of food are as follows -

- Quality-related reasons, which require a “best before” date that, in turn, represents the shelf life in a narrower sense. Here, the gradual decay of quality will occur without creating health risks for consumers, and the term “specific properties” of a food product should be correlated to measurable parameters.
- Declaration-related reasons where the quantifiable amount of an ingredient (e.g., a vitamin or, even simpler, of the whole contents) may fall below its specified value in the course of time. Related processes also show a gradual mechanism of decay but allow for the setting of unambiguous threshold values for the shelf life. The decay is also not linked to direct health risks for the consumer.
- Safety-related reasons require a “use by” date that represents a safe life.

## 3.2.3.1 Different Cases for Shelf-life Investigations

Asan important prerequisite,wecannot test an isolated product without packaging— whether the package is realistic or a model—because there is a large difference between open storage and storage in a package, even for the simplest type of packaging. Even if we just want to investigate a product under a controlled atmosphere (CA), we need a package for it in the form of an appropriate container.

The three different main reasons for an assessment of the shelf life of a packed product are distinguished by the different consequences from the sequence of measurements and the methodology to be applied.

- The first reason is the development of a new food product, which calls for parallel development of the food and its packaging. There will always be a step, which is called the initial shelf-life study which the relevant degradation mechanisms of the food have to be identified.
- The second reason for the shelf-life assessment, which occurs similarly in industrial practices, is that an alternative package has to be designed for an existing food product. Here, the basic mechanisms of the product degradation are already known, thus eliminating the need for the initial shelf-life study. But because the properties of the new package will probably be different from those of the original one, the study will be similar to the optimization phase for testing a new product that was mentioned earlier.
- The third type of assessment takes place in the production routine, where storage tests of packed food are performed at regular intervals as an element of quality control.

# Unit 3.3 – Post-trial activities

## Unit Objectives

**At the end of the module, the participant will be able to:**

1. Demonstrate Preventative Maintenance and Inspection
2. Identify waste management techniques
3. Define waste management hierarchy in food services

## 3.3.1 Preventative Maintenance and Inspection

Regular maintenance and inspections keep the testing systems running and ensures the safety and the safety of the machine. Additionally, one can significantly minimize wear and reduce downtime.

Cleaning and maintenance work should be performed by trained service technicians. Settings and fill levels should be adjusted and checked so that the calibration of the testing machine can follow.

Preventive and regular maintenance and inspections ensure that the materials testing machines and instruments function properly and reliably. Maintenance and inspection maintain the value of the machine and protects against unexpected repairs, prolonging the testing system's service life.

During the inspection, vulnerabilities can be uncovered and rectified in advance which could otherwise lead to erroneous test results and thus defective products. The system's general condition, its functions, and most importantly the safety-critical points should be checked regularly. Additionally, the wear and tear of wear parts should be assessed and documented.

**Need for inspection prior to calibration**

The inspection not only maintains the reliability and full functionality of your testing machines, but it is also important since the normative directives specify the need for inspection prior to calibration.

**Changing the oil and filter**

During operation, hydraulic oils are subject to wear and ageing and must be changed at regular intervals.

**Oil analysis**

Constantly increasing demands on the reliability, availability and cost-effectiveness of hydraulic systems call for ever-cleaner hydraulic fluids.In addition to the size of the particles, the number is also decisive for the wear process of the system. Not every particle is damaging to the system, however, the smaller the number of critical particles the lesser the likelihood of damaging the components.

**Hydraulic hose change**

The use of ageing hydraulic hoses can be dangerous. Hydraulic oil escaping at high pressure or whipping hoses can not only permanently damage the machine, but can also present heightened safety risks for the employees.

To eliminate these risks caused by wear, ageing or damage, hydraulic hoses must be replaced according to requirements after a specified time in operation and storage.

**Advantages**

- Reduced costs through the elimination of component wear
- Avoidance of unscheduled machine downtime, system failures or production losses
- Ensured operational capability and reliability of your hydraulic instruments
- Active reduction of accident risk
- Cost-saving and increased machine availability in combination with oil analysis

## 3.3.2 Waste Management

The increasing amount of food packaging waste is perceived as a problem in urgent need of a solution in all industrialized countries. According to the environment protection act, waste is any substance that constitutes scrap material, an effluent, unwanted surplus substance, an article which requires disposing of as being broken, worn out, contaminated or otherwise spoiled.

Waste leads to the production of significant greenhouse gas, methane which is over 20 times more potent than carbon dioxide. Source reduction, reuse and recycling are the most powerful and effective things we can do to manage waste. Plastic Waste Management has assumed great significance because of the urbanization activities. Plastic waste generated by the polymer manufacturers at the production, extrusion, quality control and laboratory testing etc., stages, as well as, by the consumers require urgent disposal and recycling to avoid health hazards. Various strategies are being devised to mitigate the impact of plastic waste in India.

According to the environment protection act, waste is any substance that constitutes scrap material, an effluent, unwanted surplus substance, an article that requires disposing of as being broken, worn out, contaminated or otherwise spoiled. The main approaches to waste management are,

- Recycling
- Combustion for energy recovery
- Combustion for volume reduction
- Landfill
- Save money
- Help the environment

## 3.3.2.1 Purpose of Food Waste Management

1. **Save Money**

   Waste reduction allows you to save money on commodities, labour, energy and disposal costs. Consider that if 4–10 % of the food you purchase will become pre-consumer waste before ever reaching a guest, it becomes clear that waste reduction should be one of the first and easiest ways to control costs (and hedge food cost inflation).

2. **Help the Environment**

   Waste leads to significant carbon emissions. In the case of food waste, farm inputs, transportation and storage each requires petroleum inputs. And landfill disposal often leads to the production of methane gas, a greenhouse gas that is over 20 times more potent than carbon dioxide. Reducing foodservice waste can make a real environmental difference.

3. **Community Engagement**

   Engage staff, guests and community members by showing that waste reduction is achievable and makes a positive difference for all.

## 3.3.2.2 Waste Management Hierarchy in Food Service

Most foodservice operators are familiar with the phrase “Reduce, Reuse, Recycle” which has been used for many years to describe waste control options other than straight disposal, what many people do not realize is that this phrase represents a hierarchy of activities, starting with the most beneficial and moving to the least attractive.


*Fig 3.3.1: The waste management hierarchy in foodservice*

1. **Reduce**

   Source reduction is the most powerful and effective thing that could manage waste. By designing systems and policies to prevent, minimize, or avoid waste in the first place, humans have an opportunity to save food and labour dollars while making the largest positive impact on the environment. When preventing waste, money is not spent on raw materials that would otherwise go in the garbage. At the same time, money will be saved on labour costs associated with handling or processing these materials. It is also avoided, hauling and landfill fees (and carbon emissions) associated with recycling, composting or disposing of the waste.

2. **Reuse**

   Reuse is the next best option after source reduction. With reuse, it could find a secondary way to obtain value from an item that would otherwise be wasted. In foodservice, the most common reuse opportunities involve - (a) redeploying overproduced food elsewhere on the menu and (b) donating to a food recovery program that will provide it to those in need. In certain jurisdictions, food can also be donated to feed animals provided it is handled and treated correctly.

3. **Recycle/Compost**

   It is the final good option prior to disposal. Recycling or composting, can divert the waste from the landfill or elsewhere in the solid waste stream and ensure ongoing value when the item is converted into something useful, such as a soil amendment with composting. Some of the common wastes in the food packaging industry were discussed in this chapter.

## 3.3.2.3 Plastic Use in Packaging Application

Plastic is the major source used in the packaging of foods. The thermoplastic materials used for packaging purposes are qualified based on the code as 1–7 and the various applications of the different quality of the plastic materials are given in Table below.

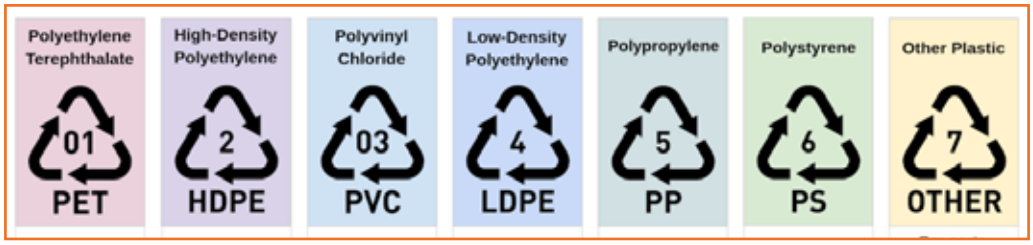



*Fig 3.3.2: Codes of thermoplastic*

| S. No. | Thermoplastic Materials | Packaging Application |
|---|---|---|
| 1 | **Polyethene terephthalate (PET)** | Drinking bottles<br>Microwavable packaging<br>Soft-drink bottles<br>Food jar for butter<br>Jelly and<br>Plastic films |
| 2 | **Polypropylene (PP)** | Drinking bottles<br>Bottles for milk and juice |
| 3 | **Polyvinyl acetate (PVA)** | Common food packaging |

| S. No. | Thermoplastic Materials | Packaging Application |
|---|---|---|
| 4 | **Polyvinyl chloride (PVC)** | Plastic bags<br>Frozen foods stretch films<br>Container lid |
| 5 | **Polystyrene (PS)** | Food container<br>Bottle caps<br>Medicine bottles<br>Straws |
| 6 | **Low-density polyethene** | Disposal cups<br>Glasses<br>Plates<br>Spoon |
| 7 | **High-density polyethene** | Custom packaging |

*Table 3.3.1: Thermoplastics and their use in food packaging*

**Methods of Plastic Recycling**

Steps involved in the recycling process are:

- **selection:** The recyclers/reprocessorshave to select the waste/scrap which is suitable for recycling/reprocessing
- **segregation:** The plastics waste shall be segregated as per the codes 1-7 mentioned in the BIS guidelines and
- **processing:** After selection and segregation of the pre-consumer waste (factory waste) shall be directly recycled. The post-consumer waste (used plastic waste) shall be washed, shredded, agglomerated and extruded.

**Environmentally Sound Manner**

Recycling plastics should be carried out in such a manner to enhance the efficiency of the process and conserve energy. Plastic recycling technologies have been historically divided into four general types- primary, secondary, tertiary and quaternary.

- Primary recycling involves processing of a waste/scrap into a product with characteristics similar to those of original product.
- Secondary recycling involves the processing of waste/scrap plastics into materials that have characteristics different from those of original plastics products.

- Tertiary recycling involves the production of basic chemicals and fuels from plastics waste/scrap as part of the municipal waste stream or as a segregated waste. Quaternary recycling retrieves the energy content of waste/scrap plastics by burning/incineration.

## 3.3.2.4 Glass Recycling

The recycling process of glass depends entirely on the type of glass that will be produced. The main advantage is energy saving. Glass cullet requires less temperature for melting than raw material. Saved energy = 0.25 × % of recycled glass cullet used. There are some basic rules to be followed during glass recycling, so glass should be free from metal tops, ceramics and stones and be sorted according to colour. There should be a thorough removal of foreign materials; otherwise, the produced glass might be defective. The quantity of ceramics left on the cullet should not be more than 25 g per tonne, while the metal particles should be less than 5 g per tonne. Therefore, the basic container glass recycling process steps are:

- Initial rinsing, cap and lid removal
- Colour separation
- Volume reduction by breaking or crushing
- Packaging and shipping
- Final treatment.

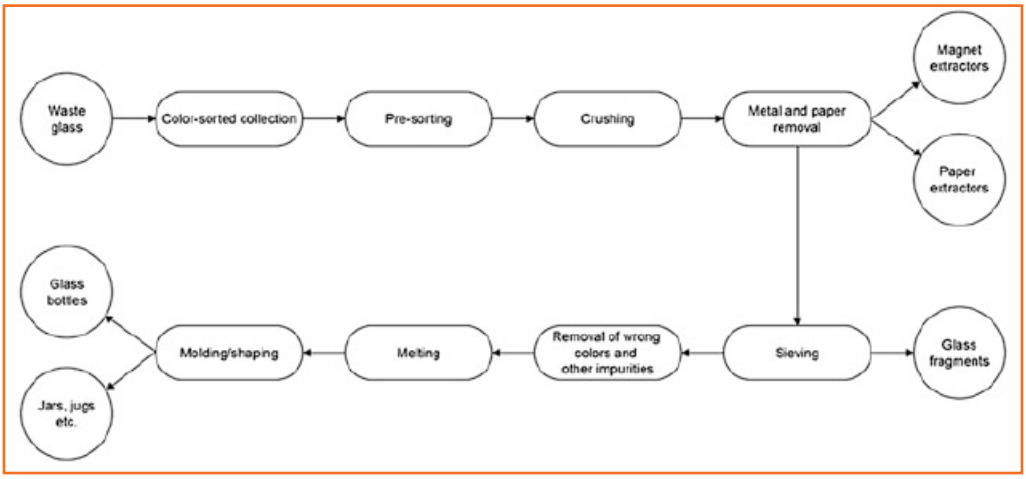



*Fig 3.3.3: Glass recycling process*

## 3.3.2.5 Aluminum Recycling

In contrast to many other materials, in the recycling of metal, there are no quality losses. Compared to primary metal extraction, a 95 % savings in energy can be achieved with recycling. The economic value of aluminium has always been the main reason for bringing the material into the loop of metal extraction, processing, use and recovery. Aluminium has been recycled since the days it was first commercially produced and today recycled aluminium accounts for one-third of global aluminium consumption worldwide.

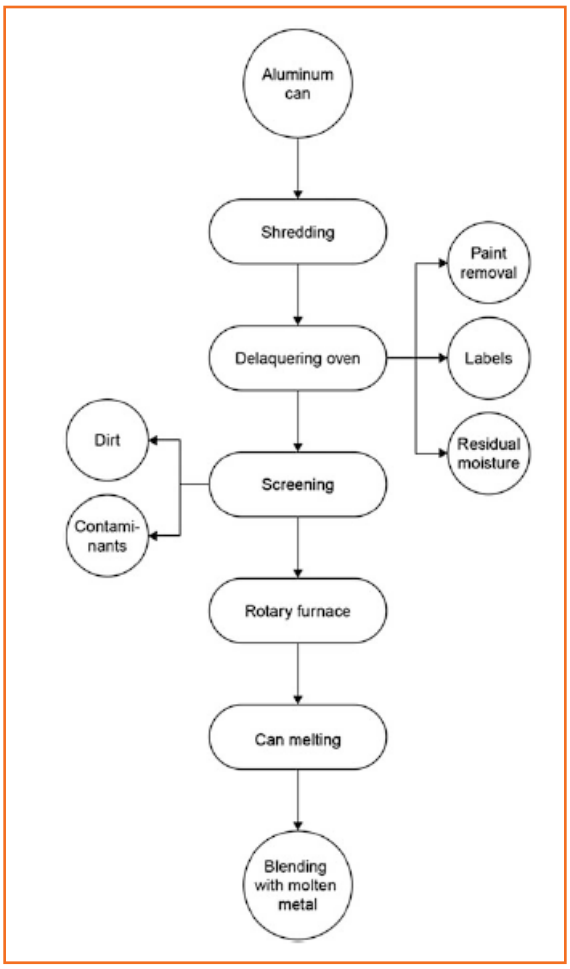



*Fig 3.3.4: Flow diagram formetal recycling*

## 3.3.2.6 Paper/Carton Recycling

Despite synthetic packaging materials and electronic media, internationally paper and board consumption is increasing steadily. While in 1950, about 50 million tonnes of paper were produced worldwide, in 2010, approximately 400 million tonnes were produced. To make this increase in paper production possible and for saving resources at the same time, paper recycling has been intensified steadily in the last decades and has now reached a high technical level.

Most of the products made of paper only have a life span of a few days (e.g. newspapers) or a few weeks (e.g. packaging). The increase of recovered paper use in industrialized countries is determined by

problems of disposal. Thus, recovered paper is today the most important raw material for the production of paper, paperboard and corrugated board.

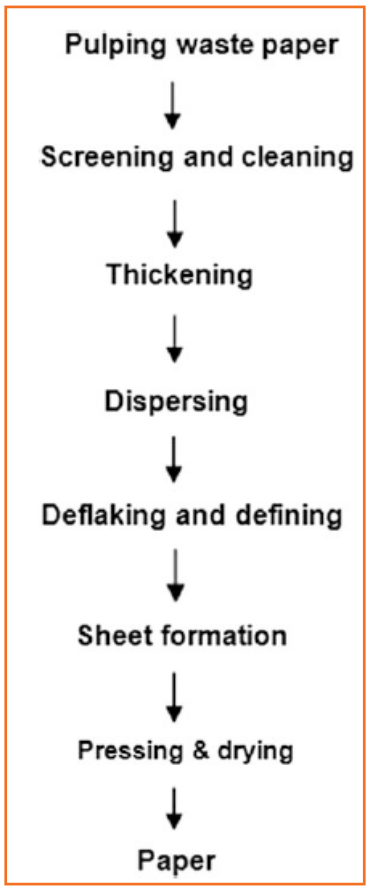



*Fig 3.3.5: Process of waste paper recycling*

Scan the QR code or click on the link to watch related videos

www.youtube.com/watch?v=JGeZFPnIQbI
Testing of Packaging Materials

www.youtube.com/watch?v=n8xbfS6-SxE
Quality evaluation of packaging materials

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

FICSI
Food Industry Capacity and Skill Initiative

# 4. Basic Food Safety Standards

Unit 4.1 - Food Hazards and Contamination - Causes and Preventation

Unit 4.2 - Food Safety – Standard Operating Procedures

Unit 4.3 - Food Safety Audits– Measures & Management

Unit 4.4 - Food Production Process - Records and Documentation

FIC/N9904

## Key Learning Outcomes

**At the end of this module, the trainee will be able to:**

1. Describe the various hazards and contaminations and present in food procssing industry
2. Explain the various food safety standards to be followed during the produc
3. Prepare sample reports regarding food safety regulations, inspections, faults objervation, etc.
4. Discuss the importance of workplace food safety audits

# Unit 4.1 Food Hazards and Contamination- Causes and Prevention

## Unit Objectives

**At the end of this unit, the trainee will be able to:**

1. List the types of biological, chemical, and physical hazards present in the food processing industry
2. Discuss various types of food contaminations, their causes, and ways to prevent them
3. State the importance of ensuring that the materials (such as raw materials, processed materials, finished goods, etc.) are adequately isolated to prevent them from contamination
4. Discuss various types of allergens and their management at the workplace

## 4.1.1 Food Safety Hazards

A food safety hazard can be defined as anything that could contaminate the food and has the potential to cause adverse health consequences to consumers. Hazards may be introduced into the food product at any time during harvesting, formulation and processing, packaging and labelling, transportation, storage, preparation, and serving. Food hazards can be categorized into the following types:

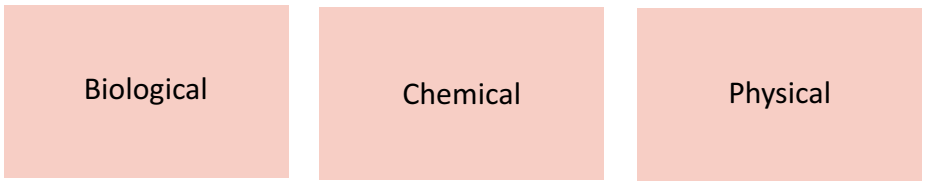



Fig 4.1 Types of Food Safety Hazards

**Biological Hazards**

Biological hazards occur when hazardous or pathogenic organisms are introduced to food and thus pose a food safety concern to consumers. For example, when microorganisms infect the food, it results in biological or microbiological risks. Microorganisms are tiny living organisms that can only be seen under a microscope. These microscopic organisms can be found in the air, soil, water, animals, and humans.

As a result, they have an effortless time infiltrating and contaminating the food along the entire supply chain. In addition, pests, such as rodents, flies, and other insects, can transport hazardous bacteria, making them biological hazards.

**Chemical Hazards**

A chemical hazard in food is when food gets contaminated with pathogens or toxic chemicals found in nature or created by humans. Chemical hazards can be introduced from various sources at different food production and preparation stages. For example, fruits, vegetables, root crops, and grains are usually treated with pesticides and fertilizers. Although these foods are washed during the harvesting process, some contaminants may remain.

Here are some examples of hazardous chemicals that can contaminate food:

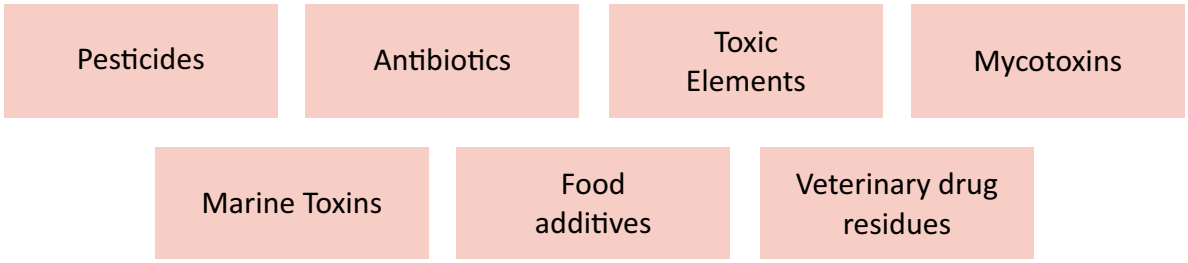



Fig 4.2 Examples of hazardous chemicals

**Physical Hazards**

Physical hazards are foreign materials unintentionally introduced to food products, such as metal fragments in ground meat or naturally occurring objects like bones in fish, hazardous to the consumer. A physical hazard may contaminate a food product at any stage of production. The extraneous substance is another term for this. Physical risks, such as rodent droppings and plastic, can also be biological and chemical pollutants. At any level of the manufacturing process, unnatural physical dangers might arise from various causes—for example – Plastic, stones and pebbles, glass, wood, metal, etc.

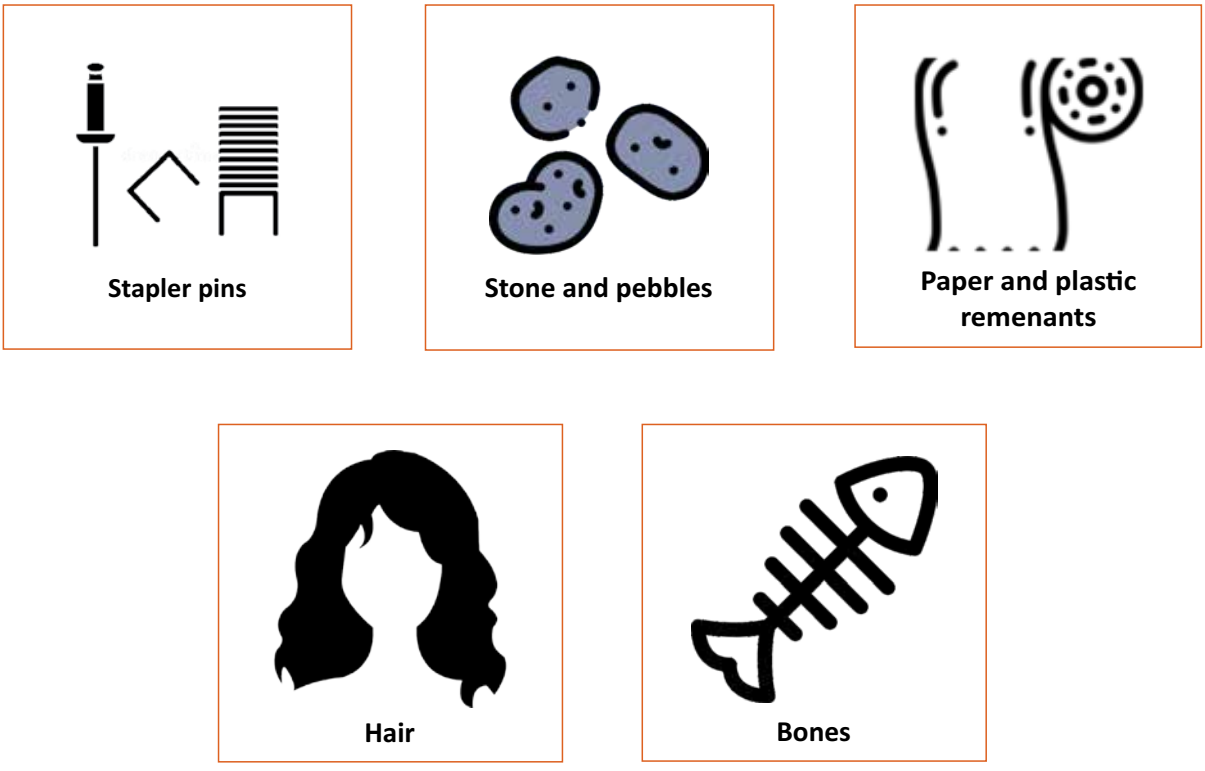



Fig 4.3 Sources of Physical Hazards

## 4.1.2 Food Contamination

Food contamination is generally defined as spoiled foods because they either contain microorganisms, such as bacteria or parasites, or toxic substances. The parasites that cause sickness create poisons that can cause food poisoning. Additionally, herbicides and specific cleaning agents can also contaminate the food. Therefore, it is crucial to know how food can become infected so that food product developers can take necessary safety measures.

The following are some of the most common causes of food contamination:

1. Improper food storage, handling, and preparation
2. Utensils that are not adequately cleaned or sanitized
3. Flies, cockroaches, insects, and pests contaminate the environment

## 4.1.3 Types of Food Contaminations

Food contamination can have severe consequences for both consumers and food producers. A variety of factors can cause food contamination.

There are four main types of contamination:

| Chemical Contamination | Biological Contamination | Physical Contamination | Cross Contamination |
|---|---|---|---|

Fig 4.4 Types of Food Contamination

**Chemical Contamination**

Chemical contamination happens when a chemical substance pollutes food. Chemicals are often used in the workplace for cleaning and disinfection, so, understandably, they could contaminate food. Contamination can occur when food is prepared on a surface that still has chemical residue on it, or when cleaning chemicals are sprayed near unprotected food. Furthermore, pesticides can affect food even before it reaches the kitchen. Fertilizers and pesticides, for example, may have been sprayed near food when it was growing.

## Notes

Anyone who prepares or handles food must ensure that the food is not contaminated with chemicals. They should do the following to ensure this:

- Always store chemicals in the designated area
- Follow the manufacturers' instructions when using chemicals
- Procure raw material from approved who can guarantee the safety of the food they provide
- Adhere to SOP while cleaning and sanitation of workplace and equipment

Fig 4.5 Prevention from Chemical Contamination

**Biological Contamination**

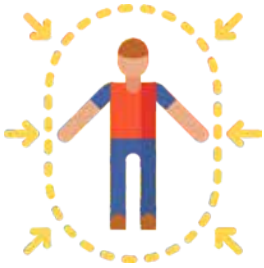
One of the most common causes of food-borne illness is biological contamination. Biological food contamination refers to the contamination of food by other living creatures. The hazardous germs spread on the foods during biological contamination. Even a single bacterium can multiply quickly when proper growth circumstances are found. Biological contamination may happen from different sources. Some of them are:

**Dust**

**Raw Meat**

**Air**

**Continued...**



**Human body**

**Pets and pests**

**PPE**

**Equipment**

Fig 4.6 Sources of Biological Contamination

It is essential to follow strict, high-standard food hygiene measures to avoid this form of contamination. Some of them are as follows:

- Separating raw material and ready-to-eat food at all stages of the food handling process, from delivery to transport
- Always washing raw fruit and vegetables
- Controlling pests and ensuring they are not on the premises

Fig 4.7 Prevention from Biological Contamination

**Physical Contamination**

When a foreign object contaminates food, it is called physical contamination. It can happen at any point during the delivery and preparation of food. Physical contamination can result in catastrophic consequences for consumers, such as fractured teeth or choking. Jewelry, hair, plastic, bones, stones, insect corpses, and cloth are examples of physical contaminants detected in food. Furthermore, if there are issues with the food premises or equipment, such as flaking paint or loose screws in a piece of equipment, these can go into the food. Physical impurities may transmit hazardous microorganisms, putting you at even more risk.

Physical contamination can be prevented through the following practices:

- Replacing any damaged equipment immediately
- Reporting any faults with equipment and premises without delay
- Having a thorough pest control system in place
- Following dress code principles, such as removing jewellery when handling food and wearing a hairnet

Fig 4.8 Prevention from Physical Contamination

**Cross-Contamination**

Cross-contamination refers to the contamination of a food product from some other sources. There are three main ways cross-contamination can occur:

**Food-to-food**

- Food can become contaminated by bacteria from other foods. This type of cross-contamination is especially dangerous if raw foods come into contact with cooked foods. Here are some examples of food-to-food cross-contamination:
  - In a refrigerator, meat drippings from raw meat stored on a top shelf might drip onto cooked vegetables placed on lower shelf.

**Continued...**

### People-to-food

- People can also be a source of cross-contamination to foods. Some examples are:
  - Handling foods after using the toilet without first properly washing hands.
  - Touching raw meats and then preparing vegetables without washing hands between tasks.
  - Using an apron to wipe hands between handling different foods, or wiping a counter with a towel and then using it to dry hands.

### Equipment-to-food

- Contamination can also be passed from processing equipment and utensils to food. This type of contamination occurs because the equipment or utensils were not properly cleaned and sanitized between each use. Some examples are:
  - Using unclean equipment, such as slicers, can openers, and utensils, to prepare food.
  - The food processing equipment handling a batch of raw meat was not thoroughly cleaned before the processing of the next batch leading to the growth of microorganisms.
  - Storing a cooked product, such as a sauce, in an unsanitized container that previously stored raw meat.

Fig 4.9 Cross-Contamination

## Notes

The safety measures that can be implemented to prevent cross-contamination are as follows:

- Use separate utensils to prepare different types of foods.
- Avoid using the same processing equipment for ready to eat foods.
- Make sure raw foods don't come in contact with ready to eat foods.
- Cover and store raw foods below cooked foods to prevent cross-contamination.
- Store and seal garbage correctly to prevent cross-contamination.
- Clean and sanitize the waste bins to prevent infestation risk.

Fig 4.10 Prevention from Cross-Contamination

## 4.1.4 Importance of Isolating Materials to Prevent Contamination

Food product developers usually segregate factories to protect the product from the environment. For example, raw material is segregated from the finished product, and wet and dry materials are segregated. Ready-to-eat (RTE) food product developers further segregate or zone production areas for food safety or hygiene reasons.

Furthermore, a series of higher hygiene zones are created to protect the product from microbiological cross-contamination events after it has been heat-treated or decontaminated.

## 4.1.5 Allergen Management

Allergens are still the primary reason for product recalls in the food industry across the globe. Hence it is crucial to give proper attention to all the aspects involved in the management and prevention of allergens during the food production process.

Like many other concepts, allergen prevention and management will only work properly if each and every aspect of food production is properly controlled at all times.

A food allergy is an immune system reaction to a food that the body perceives as unfamiliar and harmful to it. For example, people might be allergic to an item as a whole or ingredients, for the most part, proteins, contained in an item. Depending on the individual, responses can go from high fevers, rashes, and influenza-like side effects to more extreme conditions like anaphylactic shock leading to death.

Some of the common symptoms of food allergy are as follows:


Fig 4.11 Symptoms of Allergen

Allergen management practices are crucial for good hygiene practices (GHPs), and, HACCP systems, in manufacturing, retail, and food administration. Therefore, allergens should be overseen through the supply chain and production process.

The steps of Allergen management are as follows:

1. **Cross Contact Prevention during processing:**

   In this step,

   a. Allergenic and non-allergenic production areas to be segregated

   b. The traffic of raw material supplies, employees, and packaging materials to be limited during the manufacturing of allergenic products

   c. Dedicated equipment and tools to be used for allergenic products

   d. Reuse of products like oil, and water to be avoided

   e. Allergenic products should be easily identifiable using tags or colour codes, etc. while on the processing line

**2. Validated and verified allergen cleaning**

In this step,

a. Appropriate cleaning and sanitizing of equipment

b. Written protocols to be maintained

c. No dead spots should be present in the production

d. Cleaning validation and verification procedures should be present with their records

e. Identification of the effectiveness of the allergen control plan to be done through internal and external audits

**3. Review of product label /packaging usage and control**

In this step,

a. The product should be labeled appropriately as per standards and adhere to the Food Allergen Labeling and Consumer Protection Act of 2004

b. Labels should be reviewed prior to their receipt for their accuracy

**4. Personnel training**

In this step,

a. Training to be provided to personnel at all levels for allergen awareness and control

b. Specific documented training for jobs of greater responsibilities

c. Consequences to be highlighted if the plan is not followed during training and the reasons for the protocols followed

## Notes

# Unit 4.2 Food Safety – Standard Operating Procedures

## Unit Objectives

**At the end of this unit, the trainee will be able to:**

1. Outline the standard regulations to be followed for ensuring food safety as listed in 'The Food Safety and Standards Act, 2006 that need to be followed during production.
2. Discuss the importance of following the standard procedures for ensuring food safety.
3. Discuss the role of HACCP, VACCP and TACCP as well as procedures to implement these in the food industry
4. State the significance of training the team members regarding various food safety procedures such as GMP, HACCP, etc.

## 4.2.1 The Food Safety and Standards Act-2006

The Act covers all kinds of food that is consumed by human beings including unprocessed/semi-processed/processed foods, genetically engineered foods, all kinds of substances, and water used in the preparation of food.

Packaged juices, drinking water, infant food, alcohol-based drinks, chewing gums, and all other primary foods are also covered by the FSSAI Act.

Furthermore, the Act considers live animals or products of agriculture, horticulture, or animal husbandry as food items when it has already been passed on from the hands of a farmer.

This Act is applicable to all persons who are manufacturing, producing, selling or handling food meant for human consumption. The Act does not discriminate between a small hawker or a huge Food Business Operator and makes it mandatory for everyone handling food to keep it safe and fit for human consumption. Be it an Individual seller or a small business, everyone is considered a Food Business Operator under this Act. Therefore, this Act applies to every person in the food business.

The basic safety standards are as follows:

**1. Regulation on Food Additive**

Food shall not contain any food additive or processing aid unless it is in accordance with the provisions of this Act and regulations.

**2. Regulation on Contaminants or Toxic Substances**

Food shall not contain any contaminant, naturally occurring toxic substances or toxins, or hormones in excess of such quantities as may be specified by regulations.

**3. Regulation on Pesticides, Veterinary Drugs, Antibiotic Residue, Microbiological Counts**

Food shall not contain insecticides or pesticide residues, veterinary drug residues, antibiotic residues, solvent residues, pharmacologically active substances, and microbiological counts above such tolerance limit as may be specified by regulations.

**4. Regulation on Genetically Modified Foods, Organic Foods, and Functional Foods**

No person shall manufacture, distribute, sell or import any genetically modified articles of food, irradiated food, organic foods, foods for particular dietary uses, functional foods, health supplements, proprietary foods, and such other articles of food that the Central Government may notify in this behalf.

**5. Packaging and Labelling of Foods**

The labelling and presentation of food, including their shape, appearance, or packaging, the packaging materials used, the manner in which they are arranged and the information which is made available about them through whatever medium, should not mislead consumers.

The labelling and presentation of food should not mislead consumers, including:

- shape
- appearance or packaging
- packaging materials used
- manner in which they are arranged
- information which is made available about them through whatever medium

No person shall manufacture, distribute, sell or deliver to any agent or broker any packaged food products that are not marked and labelled in the manner as specified by regulations.

**6. Regulation on Advertisement and Prohibition as to unfair trade practices**

- No advertisement shall be made which is misleading or deceiving or in contradiction to the provisions of this Act, the rules and regulations made thereunder.
- No person shall engage in any unfair trade practice for the purpose of promoting the sale, supply, use, and consumption of articles of food
- No unfair practice should be adopted that falsely represents that the foods are of a particular standard, quality, quantity, or grade composition.

Furthermore, there are 10 golden rules on hygiene laid down by FSSAI to ensure food safety

## Notes

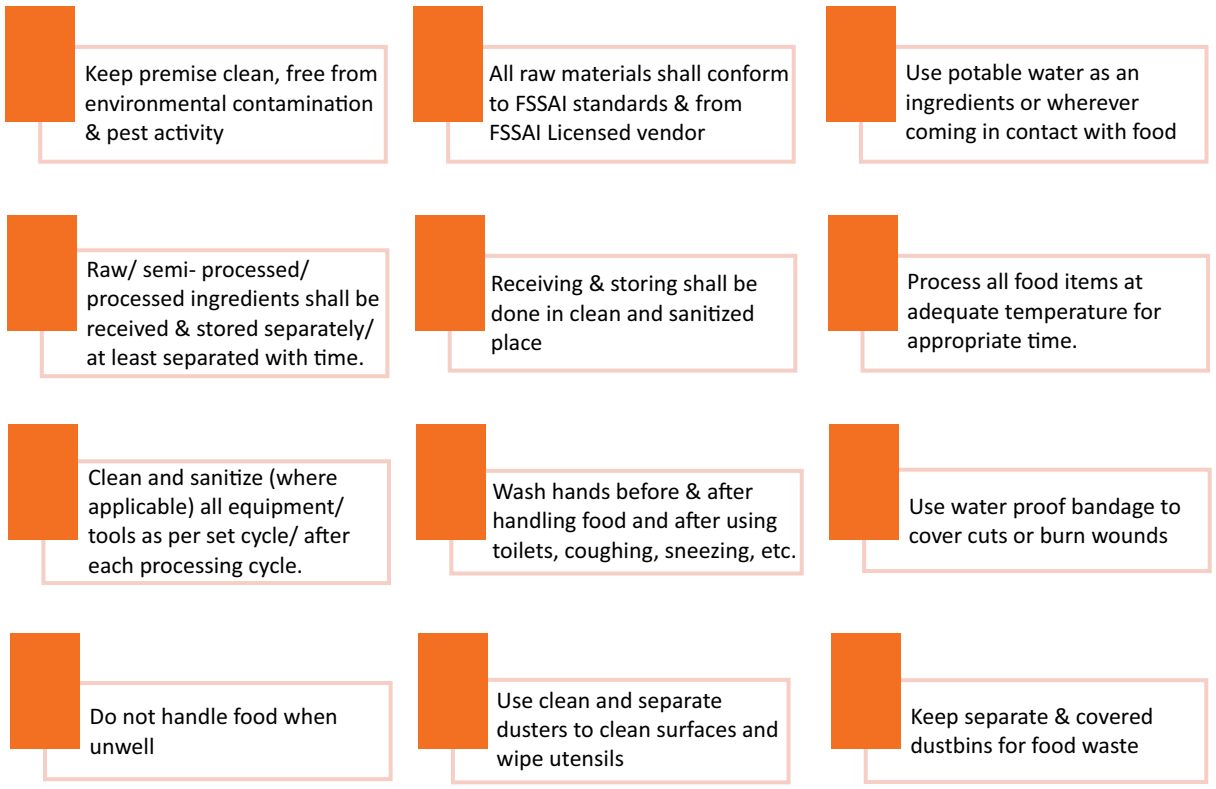



Fig 4.12 Golden Rules on Hygiene by FSSSAI

## 4.2.2 Importance of Food Safety- Standard Operating Procedure

Food safety refers to the handling, preparation, and storage of food in such a way that prevents the consumers from foodborne illness. It includes several standards to be followed to avoid any hazards affecting food. Food safety procedures are crucial to protect consumers from health risks related to common allergens and food-borne illnesses. Safe food products prevent companies and stakeholders from costly penalties and legal action. Fines and legal consequences could result in the closing down of a facility or may lead to bankruptcy.

So, we can say that following food safety procedures is highly critical both financially and ethically. The outcomes of failing to comply with food safety standards are multifarious. In addition to being extremely costly for organizations that must recall their products, revamp their processes, and manage the public relations crisis, inadequate food safety in manufacturing involves a significant human cost.

**The cost of food recalls for companies**

The failure in implementing an effective food safety protocol may lead to contaminated products entering the food chain. Once a defective product is noticed, food businesses are subject to dramatic disruptions in their operations as they manage and assume the cost of product recalls.

Food recalls can cost huge amounts to the companies, immediately measurable costs. In addition, the long-term effect that a product recall can have on consumer trust is conceivably even more damaging.

**The human cost of unsafe food**

The significance of food safety to human life is difficult to understate. Food safety problems are a prominent cause of several preventable diseases across the world. Each year, one in ten people will suffer from foodborne illness or injury. An estimated 420,000 people die every year because of eating contaminated food.

In addition to the human cost, unsatisfactory food safety comes with a greater ripple effect that obstructs socio-economic growth, especially in the developing world. The World Health Organisation states that food safety, nutrition, and food security are inextricably linked. A lack of safe food generates a "vicious cycle of disease and malnutrition" which overburdens public health services, disrupts social and economic progress, and detracts from the quality of life.

Food Product Developers can attain sufficient food safety measures by training and educating everyone who handles ingredients in a food business.

## 4.2.3 HACCP (Hazard Analysis and Critical Control Points)

Hazard Analysis and Critical Control Point (HACCP) is primarily an international food safety regulation followed to reduce the risk of hazards in a food-processing unit. It is a systemic and risk-based approach that aims to prevent the biological, chemical, and physical contamination of food in production, packaging, and distribution environments. The HACCP concept is designed to deal with health hazards by identifying potential food safety problems before they happen, rather than inspecting food products for hazards after the fact. The HACCP implies controlling for contaminants at several key stages in the food production process and strict adherence to hygiene practices throughout.

HACCP principles form the basis of Food Safety Plans across the globe. HACCP is applied to every stage of the food supply chain, such as production, preparation, packaging, and distribution, and is used to manage food safety across many types of food businesses. HACCP follows seven basic principles, which are as follows:

## Notes

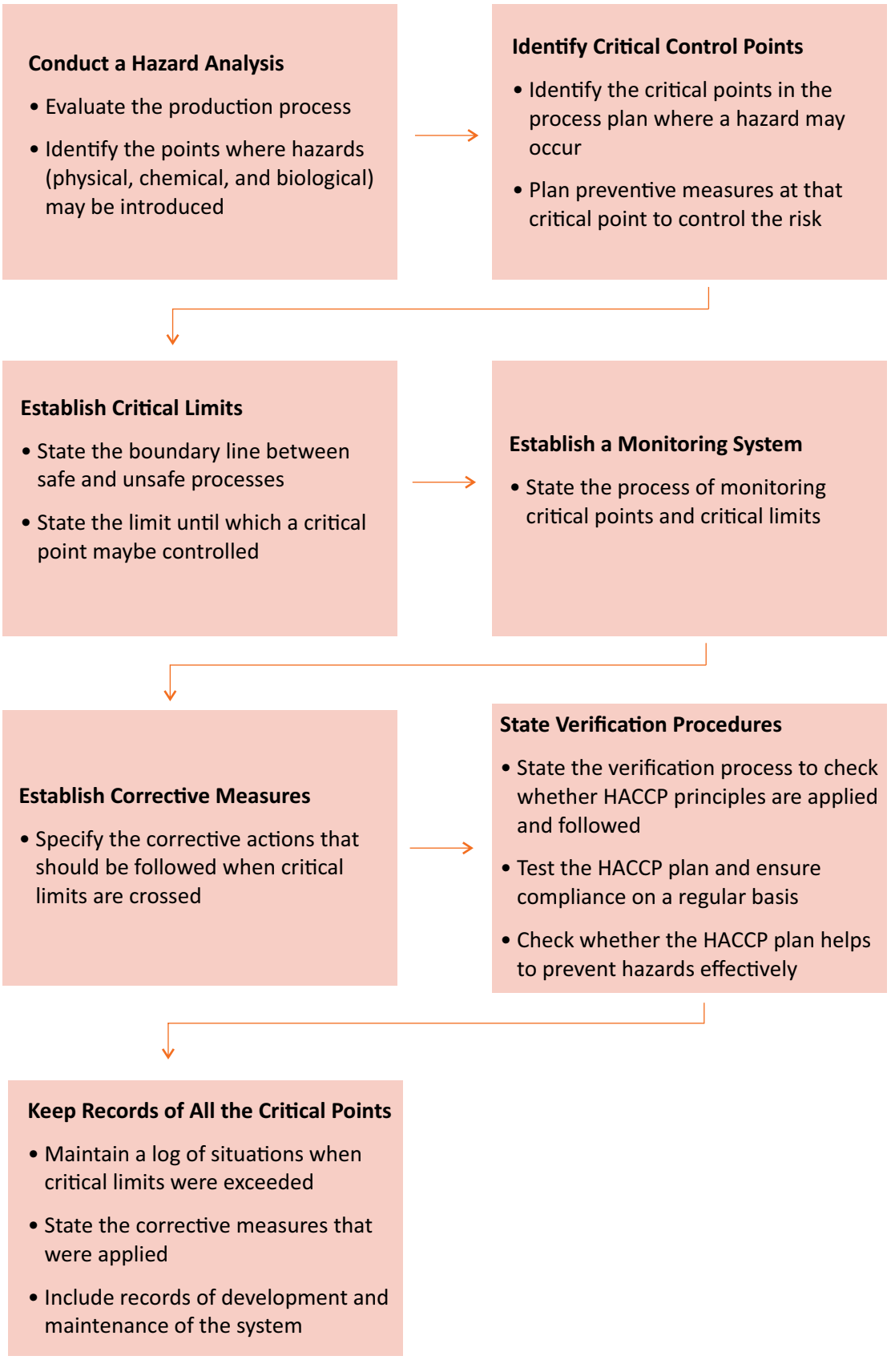



Fig 4.13 HACCP Principles

## 4.2.4 VACCP (Vulnerability Assessment Critical Control Points)

VACCP stands for 'Vulnerability Assessment Critical Control Points.' The VACCP examination is a tool to assess vulnerability in a critical control point. It is used to identify any potential weaknesses in the system and develop a plan to address them. The examination is based on a risk assessment. It considers the likelihood of an incident and the impact of that incident.

The assessment includes a review of the process, its controls, and the resources needed to implement those controls. It also includes a review of the management structure and how it supports the control process. Generally, a thorough VACCP analysis includes:

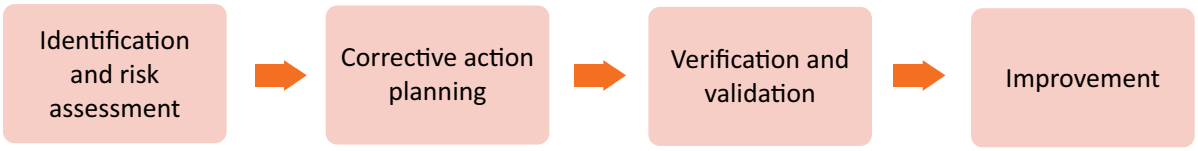



Fig 4.14 Steps of VACCP Analysis

The structure of VACCP is similar to the classic HACCP analysis as it also focuses on the safety of the facility. However, this approach enables the control of fake food by ensuring the quality of products and the safety of the production process.

Though, it is not a comprehensive food fraud control strategy but can be an effective tool to identify the risks in food product 'developers' supply chain.

This is not the only aspect to ensure product integrity. The implementation of several control measures along with VACCP can increase the effectiveness of preventing food fraud and other forms of food crime.

## 4.2.5 TACCP (Threat Assessment Critical Control Point)

With regards to food safety across the entire food manufacturing industry, food defense has been the most important element that comprises protecting businesses and consumers from internal and external threats. It encompasses a range of potential threats, like intentional contamination of food products, disruption of the supply chain, and using food or drink items for terrorism or criminal purposes

TACCP is a management process and a systematic strategy for protecting a food supply chain from deliberate contamination. Contamination is motivated by behavioral or ideological motives with the desire to damage individuals.

The key steps for an organization to follow while developing TACCP include:

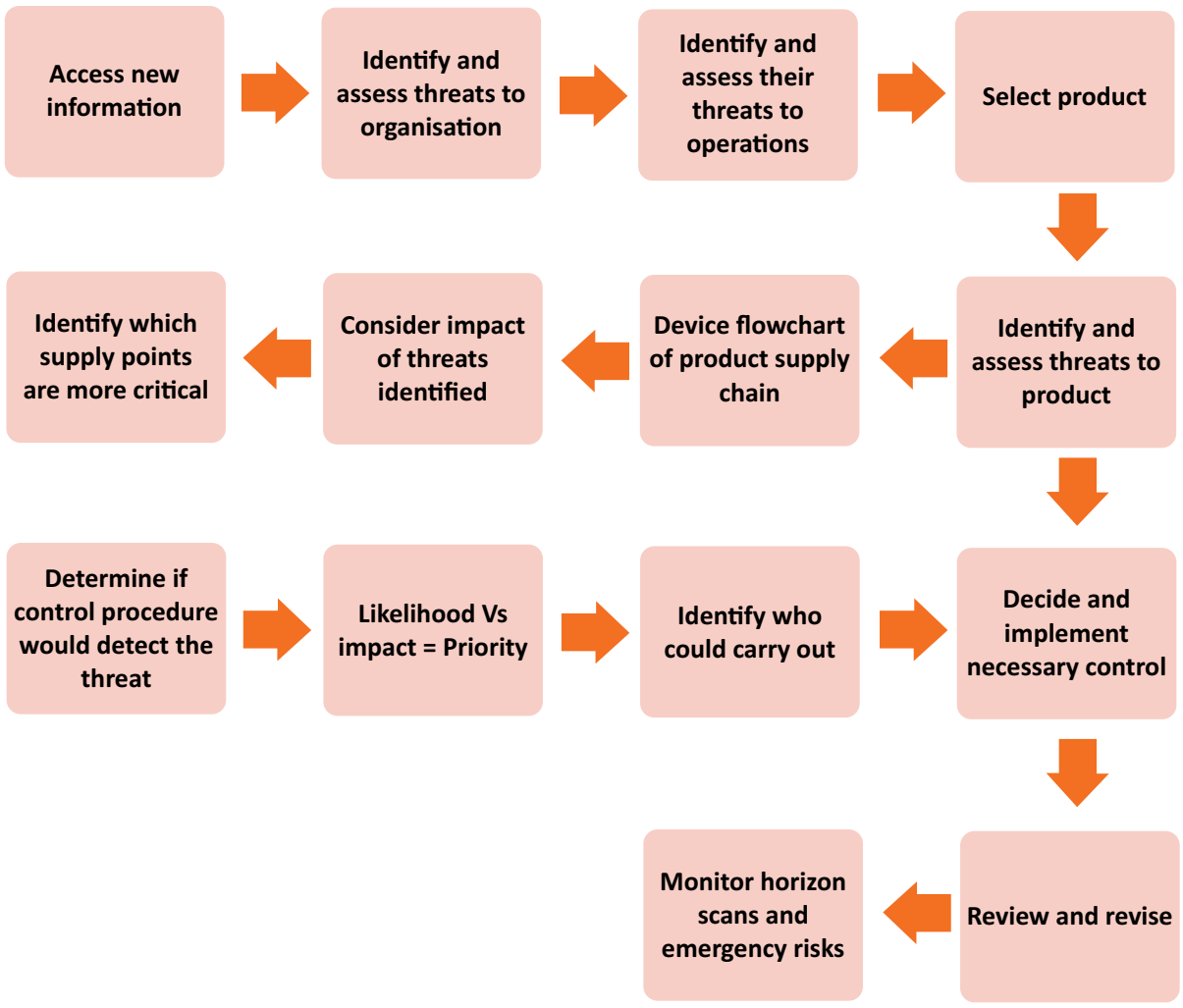



Fig 4.15 Steps of Developing TACCP

## Notes

## 4.2.6 Significance of Training the Team on Food Safety Procedures

Training staff on methods to ensure food safety will help reduce the risk of contamination. Regulations require that food handlers are supervised and well-trained in food hygiene practices suitable for their work activity.

Certain areas which staff should be trained about are:

- Safe food storage practices
- Safe food handling practices
- Good hygiene practices
- Cleaning for food safety
- Pest control
- Good manufacturing practices

Food Safety measures are crucial because foodborne illnesses and allergic reactions may cause severe health issues.

Where bacteria in contaminated food are allowed to multiply and ultimately enter a ' 'person's body, it can cause problems ranging from causing mild discomfort to a life-threatening illness. The best possible way to prevent this is by ensuring that bacteria is killed and not able to reproduce in large enough numbers and that it cannot easily be transferred between foodstuffs. Similarly, allergic reactions are life-threatening and can only be prevented if people know exactly what ' 'they're eating. And this can only be known if food producers and preparers ensure that foodstuffs 'don't come into contact or mix when they shouldn't.

This is one of the core functions and most important elements of food safety procedures and can only be learned through proper training.

## Notes

# Unit 4.3 Food Safety Audits– Measures & Management

## Unit Objectives

**At the end of this unit, the trainee will be able to:**

1. Explain the procedure to conduct workplace food safety audits
2. List various issues that can arise during food production and other processes
3. Discuss the procedure of performing root cause analysis and taking corrective and preventive actions against workplace problems
4. Discuss the corrective measures to be applied to ensure food safety

## 4.3.1 Food Safety Audits

There are several stages during the food production process when the food product may get contaminated. A food safety audit gives food product developers confidence that safety and hygienic practices in food processing have been followed throughout the supply chain.

A food safety audit process performs a detailed inspection of the food processing facility to evaluate its compliance with established food hygiene and safety standards. Food safety audit provides food product developers with multiple benefits. Some of them are as follows:

| | | | |
|---|---|---|---|
| Mitigate Risk | Save Time and Money | Inspire Confidence | Enhanced quality and productivity |

Fig 4.16 Benefits of Food Safety Audit

## Notes

Based on the type of food safety audit being performed, it includes a comprehensive assessment of:

| | | | |
|---|---|---|---|
| Building structure | Documentation, records and monitoring | Cleaning and hygiene schedule | Facilities and equipment |
| Personnel hygiene | Emergency procedures | Storage areas | Product handling and food display |
| Temperature control | Supply chain | Pest control | Training, supervision and instruction |
| Product and process audits | Audit of equipment maintenance and hygiene | Supplier or contractor audit | |

Fig 4.17 Aspects of Food Safety Audit

## 4.3.2 Steps to Conduct Food Safety and Hygiene Audit

Discussed here are the key steps to performing comprehensive food safety and hygiene audit:

i. **Planning:** This is the initial stage of the food safety audit which consists of setting a clear objective and determining the audit scope, i.e., which areas need to be targeted. This stage also includes cost and resource considerations while planning for a food safety audit.

ii. **Execution:** Audit assesses the status of the quality management system and operations in real-time. It helps identify the problems that may arise now and encourages to take a proactive approach rather than a reactive one. Identifying areas where preventive strategies can be implemented based on audit findings can help improve operational efficiency and prevent problems in the future.

iii. **Preventive and Corrective Actions:** The gathered audit information along with problem descriptions and proper documentation can provide valuable data with actionable insights.

iv. **Verification:** In this phase, it is crucial to evaluate how efficient are the preventive and corrective actions and whether they follow regulatory standards.

v. **Audit Evaluation:** It is one of the most crucial steps of a food safety and hygiene audit – evaluating and validating the success of the audit process. Even the audit process should comply with the food developer's business objectives and statutory audit schedule.

**Types of audits in food processing units:**

The two types of audits carried out in food processing units are internal and external audits.

Internal audits are carried out by employees or staff from within the organisation. The employees can be from a different department or another unit of the same organisation. These audits are carried out to identify problem areas and rectify them. They can also be carried out as a pre-audit prior to the audit by external agencies to ensure that all the standard operating procedures and guidelines as per governing bodies are followed and compliant with the industry standards. Along with helping to improve processes, they also help to find deficiencies before the external audit and take corrective actions. All the findings and actions taken to resolve them are documented.

External or third-party audits are carried out by auditors from outside the organisation. They are often used to get a certification. The regulatory bodies carry out these audits to ensure compliance with the regulatory requirements. If the organisation is found to be non-compliant, then the external auditor may issue a warning letter, cancel the registration of the company, or stop the production of products/services.

## 4.3.3 Root Cause Analysis

Root cause analysis often referred to as RCA, is a method to analyse serious problems before trying to solve them. The main root cause of a problem is isolated and identified. It is considered one of the core building blocks in an ' 'organization's continuous improvement efforts. However, it is important to note that root cause analysis will not produce any results; it must be made part of a larger problem-solving effort for quality improvement.

Root cause analysis could be done using multiple tools and methods, including the following:

- Events and causal factor analysis
- Change analysis
- Barrier analysis
- Management oversight and risk tree analysis
- Kepner- Tregoe Problem Solving and Decision Making

Fig 4.18 Tools of RCA

When carrying out root cause analysis methods and processes, it's crucial to note:

- Though root cause analysis tools can be used by a single person, the output is better when a group of people works together to find the causes of the problem.
- Prominent members of the analysis team should be responsible for removing the identified root cause(s).

A typical design of a root cause analysis in an organization might follow these steps:

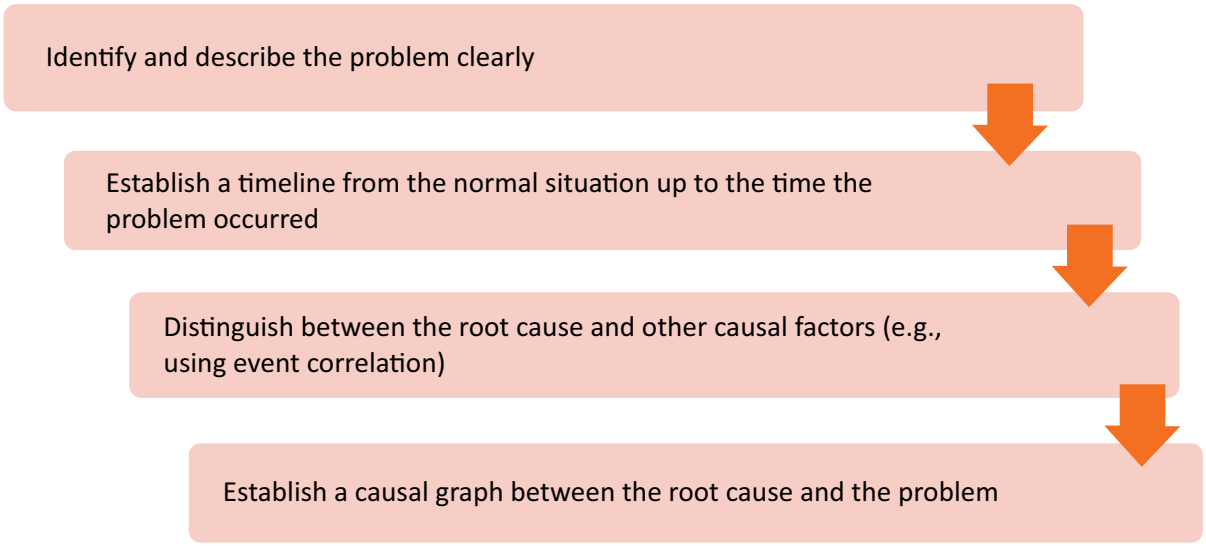



Fig 4.19 Design of RCA

1. A small team is formed to conduct the root cause analysis.
2. Team members are selected from the business process/area of the organization that experiences the problem.
3. During the analysis, equal emphasis is placed on defining and describing the problem, brainstorming its possible causes, analyzing causes and effects, and formulating a solution to the problem.
4. Weekly team meetings are conducted during the analysis period, sometimes two or three times a week. The meetings are always kept for a maximum of two hours, and since they are meant to be creative in nature, the agenda is quite loose.
5. One team member is assigned the role of making sure the analysis progresses, or tasks are assigned to various team members.
6. Once the solution has been designed, and the decision to implement it has been taken, it can take anywhere from a day to several months before the change is complete.

## 4.3.4 Corrective and Preventive Action (CAPA)

Corrective Action and Preventive Actions are derived from the 5 Whys consist of tools that can be used to address a systemic issue, and control processes to help prevent a costly food safety or quality incident.

CAPA procedure can be based on PDCA(Planned Do Check Act) philosophy as determined by Deming-Shewhart Cycle.

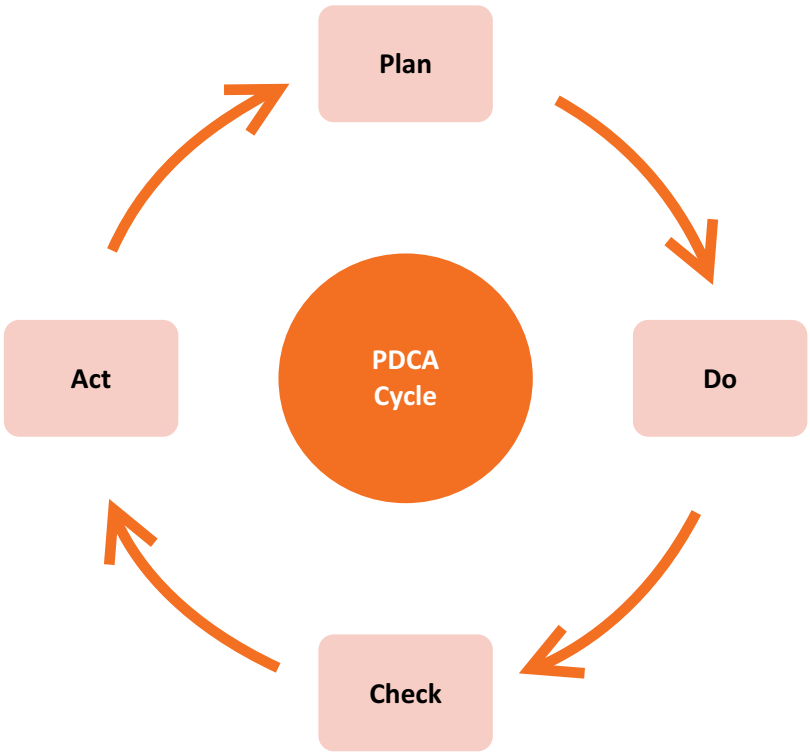



Fig 4.20 PDCA

The steps involved in CAPA are as follows:

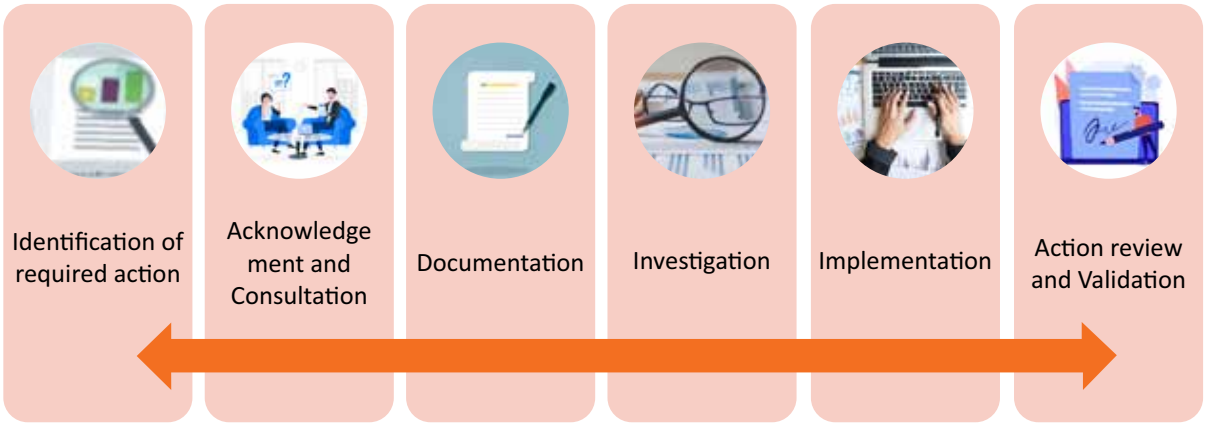



Fig 4.21 Steps of CAPA

A thorough and effective CAPA provides a lot of benefits. A few of them are as follows:

1. It eliminates detected conformities
2. It provides a framework for eliminating the cause of a detected non-conformance or other undesirable situation
3. It provides ways to recognize exact steps to be taken when a defect or process issue arises
4. It also helps in determining:
    - Documents or forms need to be completed
    - Who needs to be contacted?
    - Exact procedure to be followed

## 4.3.5 Common Issues during Food Production

Sometimes the foods that are counted on for good health are contaminated with germs that cause sickness and can even be deadly. More progress is needed to protect people and reduce food borne illnesses. New challenges to food safety will continue to emerge, largely because of:

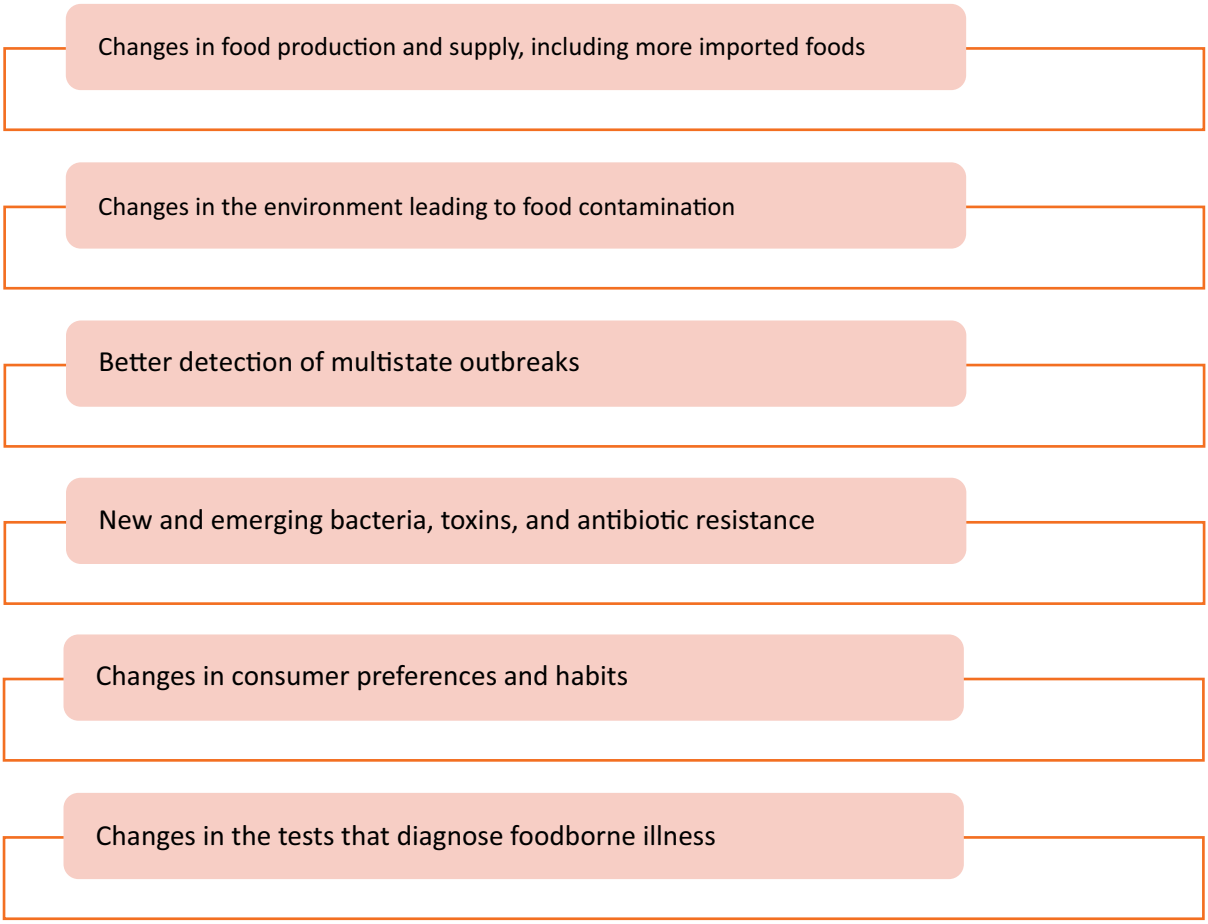



Fig 4.22 Reasons for Common Issues during Food Production

Some of the common issues during the food production processes are listed below:

| | |
|---|---|
| Condensation on Pipes and other Equipment | Occurs when humid air contacts cold pipes in a food processing plant and resulting condensation can then drip from the pipes into the food product, causing contamination. |
| Contamination by Reworked Product | Using product from one product line in another product line (reworking) can cause food contamination. |
| Contamination During Processing | Caused when food is contaminated during processing such as not having an adequate glass cleanup policy. |
| Raw Material Contamination | This includes the following:<br>1. cases in which the raw materials arrive at the facility already contaminated and<br>2. cases in which the contamination occurs at the food-processing plant. |
| Inadequate Training of Employees | Can led to a variety of food safety problems. Food processing plants must train new employees on the minimum training requirements. |
| Equipment that's Hard to Clean | Some equipment is difficult to clean, either because of its own intrinsic design or because of the way it was installed at the food-processing plant. |
| Insufficient Cooling | It's important to keep food ingredients and products at proper, cool temperatures during processing or storage or risk contaminationThis is especially true of foods that are refrigerated or frozen. |
| Food Products that are Labeled or Packaged Incorrectly | Products may in some cases (wrongly) be packaged in old packages or placed in the wrong packages. In other cases, a label may not identify the presence of an allergen when it should be labeled. |
| Failure to Develop a Crisis Management Protocol | The lack of written procedures for how to manage a crisis at the facility, or poor training on how to carry out those procedures, can lead to food safety problems. |
| Inadequate Equipment Knowledge by Employees | This could be considered part of the poor training category, and it includes employees who don't know how to keep equipment clean and employees who don't know how to prevent routine equipment maintenance tasks (such as lubrication of a machine) from causing food contamination. |
| Failure to Reconcile Equipment Parts after Repairs | After repair to equipment in a food processing plant, it's important to reconcile equipment parts to make sure they're all accounted for when the repair is complete. |

**Continued...**

| | |
|---|---|
| Absence of a Protocol for Product Recovery | Not having a product recovery protocol, including no coding, traceability, or recall systems, can lead to food safety problems. |
| Failure to Perform Preventive Maintenance | When a machine breaks down or performs improperly, that can be a cause of food safety problems. Therefore, it's better for a food processing plant to routinely perform preventive maintenance instead of simply reacting to maintenance problems. |
| Poor Employee Hygiene | If employees at a food processing facility have poor hygiene, that can cause contamination in the food products. |
| Inadequate Pest Control | It's essential for a food processing facility to have a comprehensive and detailed pest management policy & program and to ensure it's carried out properly (be sure to document this). |
| Inadequate Sanitation of Plant and/or Equipment | Poor sanitation may result from poor (or absent) sanitation policies, poor sanitation procedures, and/or poor monitoring and verification that those policies and procedures are being enacted. |
| Improper Plant Design and Construction | Plant design and construction can have a good or bad effect on food safety within a food processing facility, and some design and construction issues make food safety problems more likely. For example, floors with poor drainage and/or cross-over between the process flows of raw and finished products. |
| Post-Process Contamination at Manufacturing Plant | In some cases, a finished food product can be contaminated after it's been processed. This can occur between the lethality treatment and packaging or post-packaging. |
| Dead-Ends in Plumbing Leading to Accumulation of Stagnant Water | Plumbing connections that don't drain into other areas and therefore result in sitting water may harbor contaminants that ultimately create food safety problems. |
| Using Unpotable Water During Food Processing | It's always important to use fresh, clean, sanitary, potable water for food processing. |

Fig 4.23 Common Issues during Food Production

## 4.3.6 Food Safety and Corrective Actions

There are many factors that food processing businesses need to consider when ensuring food safety for consumers. A few of them are listed below:


Fig 4.24 Factors for Ensuring Food Safety.

Food product developers often define critical limits to ensure food safety.

Critical limits represent the minimum or maximum acceptable level of a food safety hazard at each Critical Control Point (CCP). Corrective action is taken when the critical limit is exceeded at any step of food production (e.g., delivery, storage, preparation, etc.).

There are two types of corrective action:

- Immediate
- Preventative

Immediate corrective actions are reactive, but preventative actions are proactive.

**Examples of immediate corrective actions**

An immediate corrective action resolves an existing problem or any deviation from a critical limit. It prevents a food safety breach that is happening at present.

Some examples of immediate corrective actions are:

- A food delivery with bite marks on the packaging (or other signs of pest infestation) being rejected
- Unrefrigerated, perishable food items being transferred into cold storage (5° C or below)
- Food items in the temperature danger zone for more than four hours are being disposed of.
- Food items that show signs of spoilage (e.g., bad smell or slimy skin) are being thrown away.
- An employee being asked to go home if they are experiencing symptoms of illness (e.g., fever, nausea, or diarrhoea)

**Examples of preventative actions**

A preventative, action prevents a potential problem from happening. It stops a breach from occurring in the future.

Some examples of preventative actions are:

- Broken, cracked, or chipped equipment, dishware, or glassware being repaired.
- Food preparation surfaces (e.g., chopping boards or countertops) with cracks or deep scratches being replaced.
- Change work procedures to improve food safety.
- A food safety supervisor appointed to manage food safety risks in the business

## Notes

# Unit 4.4 Food Production Process– Record and Documentation

## Unit Objectives

**At the end of this unit, the trainee will be able to:**

1. List the information to be recorded in the work process such as product traceability and recall
2. Discuss about product information and consumer awareness, product recall and withdrawal, and traceability

## 4.4.1 Product Specification

In Quality Management, several documents and certificates related to the purchased products and raw materials are required by the buyers. One of the most important product-related documents is the product specification. This document contains a detailed description of the product, all the requirements related to the production process as well as technical and functional aspects of the product. A product specification document can be released for any kind of product, from the raw materials (raw material specifications) to the machine parts or the packaging goods.

The specification documents are useful at all stages of the production process, on the suppliers and producer sides as well as on the buying company side which can use this document as a quality standard required at the delivery.

In some industries, such as the food industry, the number of protocols and documents required during the production process can quickly skyrocket to guarantee food safety and higher food quality. To meet this goal and standard, the food product and raw material specifications sheets primarily inform about the ingredients of each product and its condition of production.

## 4.4.2 Product Recall and Traceability

**Traceability** or product tracing is defined as the ability to follow the movement of a food through specified stage(s) of production, processing, and distribution. Traceability within food control systems is applied as a tool to control food hazards, provide reliable product information, and guarantee product authenticity. Traceability systems should be capable of documenting a product's history and/or locating it in the food chain. The traceability exercise is part of the recall procedure. Traceability has two components:

| Tracing : Backward | Tracking : Forward |
|---|---|
| • Tracing is the ability to reconstruct the history of a product in the food chain and identify the origin, movement patterns, and relevant associated information of a specific unit and/or batch of product located within the supply chain by referencing records held upstream. | • Tracking is the ability to trace the final destination of a product in a food chain and to follow the path of a specified unit and/or batch of product through the supply as it moves from organizations to the final point of the process, point of sale, point of service, or point of consumption. |

Fig 4.25 Backward and Forward Traceability

In a food traceability exercise, records and documents are prepared for the following areas.

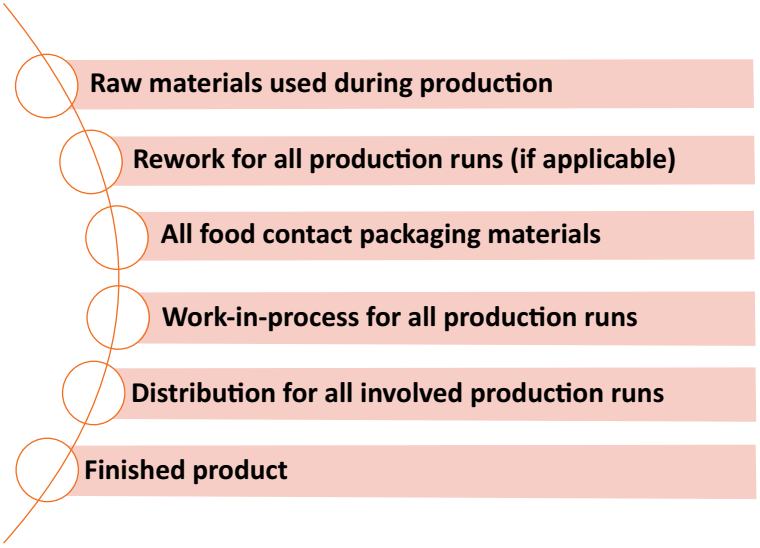



Fig 4.26 Document and Record Details for Traceability Exercise

The following figure below demonstrates the steps in the traceability exercise process.

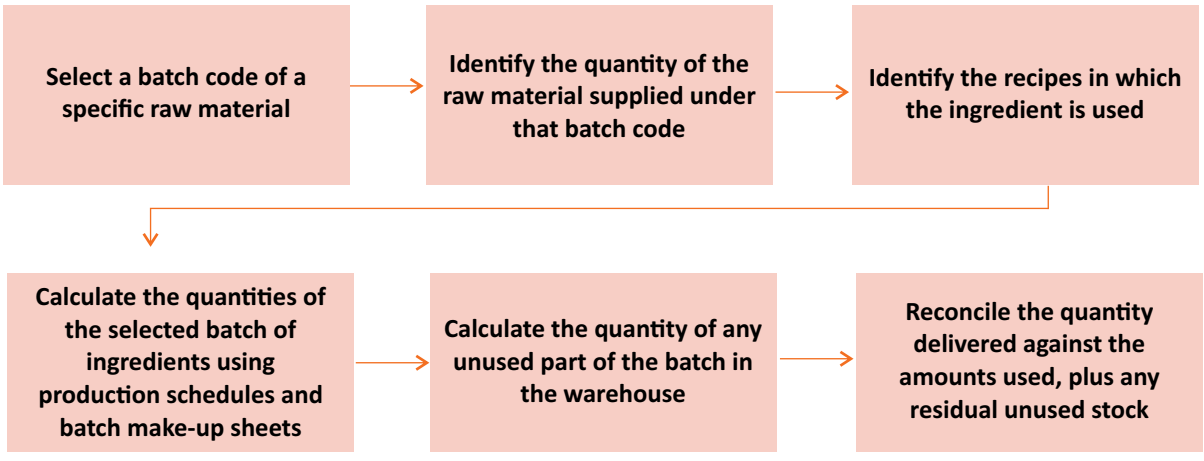



Fig 4.27 Traceability Process

**Recall** or **Product Recall** is defined as the action to remove food from the market at any stage of the food chain, including that possessed by consumers. A food recall is a fundamental tool in the management of risks in response to food safety events and emergencies. Traceability and recalls are essential components of a national food control system.

A mock product recall is an internal exercise designed to assess a company's ability to track down and remove unsafe products or ingredients from the market. The following are the goals of food recall:

1. To develop a written recall strategy
2. To conduct a food recall
3. To ensure the effectiveness of the action and to prevent a recurrence.

This is the procedure that an FBO (food business operator) must follow to remove unsafe or illegal products from the market. The goal of a food recall is to direct FBO:

1. Stop delivering and selling the product in question
2. Notify the appropriate regulatory bodies
3. Product removal from the market in a proper and timely manner

The following are the reasons for food recalls in the food industry:

**Adulteration**


**Ambiguous allergy information**


**Misbranding**

**Missing Labels**

Fig 4.28 Reasons for Food Recalls

The scope and benefits of food recall are as follows:

1. Trace a product's journey through the supply chain to evaluate the company's traceability system
2. Check the communication systems (contact information of recall personnel, suppliers, and consumers)
3. Determine and modify aspects of the recall plan that are problematic or difficult
4. Whose quality does not comply with the Act and the Rules and Regulations promulgated thereunder
5. All food businesses regulated by the Food Authority that engage in the wholesale supply, manufacture, or importation of food must have an up-to-date recall plan

The following are included in the Mock Recall Plan and Procedure:

1. Designated recall team
2. Random product for mock recall and traceability exercise
3. Tracking of the products using traceability procedures
4. Reconciling the affected product with current inventory
5. Rapid Recall Exchange to simulate the communication of the event
6. Assessment of mock recall results

The designated recall team includes:

**Recall coordinator**

- Oversees all activities relating to the recall and manage other team members

**Quality assurance specialist**

- Identifies the root causes and issues that led to the recall

**Communications expert**

- Handle public relations (press releases and media statements)

**Sales/Customer representatives**

- Communicates with consumers

**Legal counsel**

- Advise on the legal requirements for a recall

Fig 4.29 Recall Team

The following figure explains the standard procedure of food recall exercise in the food industry.

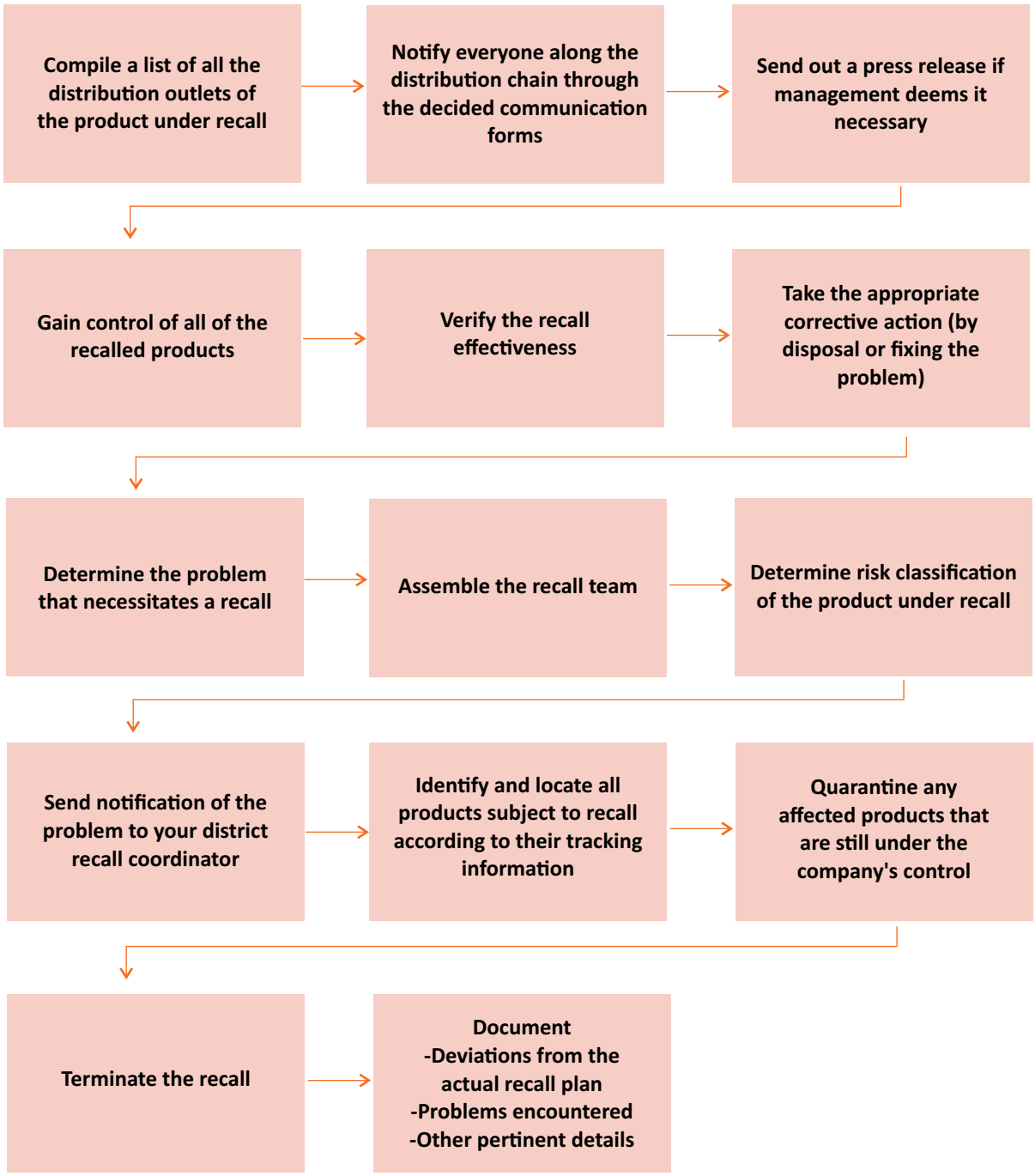



Fig 4.30 Standard Process for Food Recall

After the food recall process, it is essential to conduct a proper Key Assessment. The figure below explains the steps to be taken following the food recall exercise.

**Key questions to ask after the recall:**

- Was the recall team able to convene quickly and reach a decision regarding the recall?
- Was the contact information of all stakeholders (recall team members, suppliers, retailers, consumers) available and up-to-date?
- How difficult was it to:
  - Trace the recalled product?
  - Gather the information necessary to activate the recall?
  - Contact regulatory agencies?
  - Prepare documents for media correspondence (press releases and media statements)?
  - Maintain a log of activities?

Fig 4.31 Key Assessment for Recall Process

## Notes

## Summary

- Types of biological, chemical, and physical hazards present in the food processing industry
- Various types of food contaminations, their causes, and ways to prevent them
- Importance of ensuring that the materials (such as raw materials, processed materials, finished goods, etc.) are adequately isolated to prevent them from contamination
- Various types of allergens and their management at the workplace
- The standard regulations to ensure food safety are listed in 'The Food Safety and Standards Act, 2006' that need to be followed during production.
- The importance of following the standard procedures for ensuring food safety.
- The role of HACCP, VACCP, and TACCP, as well as procedures to implement these in the food industry
- The significance of training the team members regarding various food safety procedures such as GMP, HACCP, etc.
- The procedure to conduct workplace food safety audits
- The procedure of performing root cause analysis and taking corrective and preventive actions against workplace problems
- Corrective measures to be applied to ensure food safety
- Information to be recorded in the work process
- Product information and consumer awareness, product recall and withdrawal, and traceability

Scan the QR code or click on the link to watch related videos

www.youtube.com/watch?v=d5kn5ns0zWM
General Requirement on Hygiene and sanitation

www.youtube.com/watch?v=KBvU4Bmu5O0
Food Safety

## Exercise

**I. Answer the following questions:**

1. List the types of different hazards in the Food Processing Industry.

_____
_____

2. List down different types of Food Contamination.

_____
_____

3. What are the steps involved in CAPA?

_____
_____

4. What are the symptoms of Allergen?

_____
_____

5. Write down the key steps for an organization to follow while developing TACCP.

_____
_____

6. What is backward traceability?

_____
_____

7. Explain the food recall process.

_____
_____

8. List the steps for traceability exercise.

_____
_____

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Food Industry Capacity and Skill Initiative

# 5. Follow Preventive Measures to avoid Accidents

Unit 5.1 - Workplace Hazards and Risks

Unit 5.2 - Safety Signs

Unit 5.3 - Health and Safety Practices

FIC/N9903

## Key Learning Outcomes

**At the end of this module, the trainee will be able to:**

1. Explain the standard procedure to be followed for dealing with workplace hazards safely
2. Describe how to minimize potential risks and accidents at the workplace
3. Demonstrate how to train the workforce on accident prevention techniques effectively

# Unit5.1 Workplace Hazards and Risks

## Unit Objectives

**At the end of this unit, the trainee will be able to:**

1. Explain the standard procedure to be followed for dealing with workplace hazards safely
2. Describe how to minimize potential risks and accidents at the workplace
3. Demonstrate how to train the workforce on accident prevention techniques effectively

## 5.1.1 Hazards and Risks

A hazard can be defined as a potential source of harm, damage, or adverse health effect on a person, persons, or equipment. It can cause injury or ill-health to people and damage to the environment, equipment, and/or property.

A risk can be defined as the likelihood that a person or equipment may be harmed, damaged, or suffer an adverse health effect if exposed to a hazard.

Though these two terms are associated with one another, they are distinct entities with entirely different meanings. Hazard could be an agent which can cause undesirable effects, whereas, risk refers to the likelihood that the effect will occur.

Occupational hazards are risks associated with working in specific occupations. There are six categories of occupational hazards as shown in the figure below:

## Notes


Fig. 5.1 Occupational Hazards and Risks

## 5.1.2 Hazards and Risks in Food Industry

Hazards may result from different aspects of the workplace, including equipment, dangerous materials, unsafe working practices, and behaviour of individuals. Workers in food manufacturing and processing industries face numerous hazards and risks. The following are some of the common hazards and risks:

| | | |
|---|---|---|
| Many raw materials require thorough washing, as a result workers keep their hands constantly in water, which affect the nerves in their hands gradually. | Meat, seafood and poultry has to be processed in low temperatures; hence workers need to work in refrigerated rooms for long hours. This could lead to respiratory disorders, rheumatic disorders and frostbites. Along with the risk of exposure to infectious diseases. | Workers carrying out activities like baking, roasting, boiling, etc. are constantly exposed to high temperatures causing dehydration and also exposing to risk of burns. |
| Workers carrying out processes like grinding, mixing of grains and spices are exposed to dust in the air causing respiratory disorders and allergies. | Overexertion due to lifting, pushing, pulling heavy objects and repetitive motions can cause injuries to back, neck, hands, wrists, arms and shoulders. | Working on machines exposes workers to moving parts, conveyors, collapsing structures, pressurized equipment, falling objects, hot surfaces, etc. causing injuries and even death in some instances. |
| Ammonia is a common refrigerant used in food processing and manufacturing units, exposure to ammonia can cause damage to eyes, skin and lungs. As it is flammable, it can cause an explosion if released in enclosed spaces with a source of ignition. | Usage of high volumes of liquids (water, oil, sticky substances) in food industry leads to exposure of workers to wet surfaces. This increases the risk of slips, trips and falls. | Processes and equipment employed in operations like grinding and milling can cause loud noise, that can cause long term hearing problems in workers. |

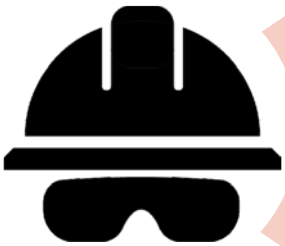
Fig. 5.2 Hazards and Risks in Food Industry

## 5.1.3 Causes for Workplace Hazards and Risks

The factors that cause workplace hazards and risks are as follows:

**Men**

Men are the first factor that can create a working hazard. Employees carelessness, ignorance and/or lack of training can be a threat in the workplace.

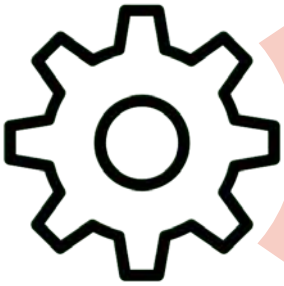


**Machines**

Machine, tools and equipment are part and parcel of every manufacturing unit. Improper usage of tools and poor maintenance of equipment can be a potential threat in the workplace.

**Material**

Food industry deals with a wide variety of materials ranging from cold to hot, solid to liquid, perishable to non-perishable, combustible to non-combustible. Wrong handling improper processing, storage and disposable of these materials can be a threat to people as well as property and equipment.



**Method**

The term method refers to the way things are done in the workplace as a whole. To carry out a method all the above four elements - men, machines, materials and environment are required. A fault in any one of them can be a cause for a hazard during the process.

**Environment**

The term environment covers all aspects of a workplace. Situations like overcrowding, inadequate ventilation, poor lighting, extreme temperatures, noise, slippery floors, blocked entries and exits, poor housekeeping can all lead to a hazardous environment.

Fig. 5.3 Causes for Workplace Hazards and Risks

## 5.1.4 Preventive Measures for Workplace Hazards and Risks

Every workplace has hazards and almost all workplaces have an appointed person for conducting formal risk assessments but still, it is every individual's responsibility to be conscious of hazards in the workplace and minimize the risk of harm. Not all hazards are obvious and they are distinctive to a workplace. It is also not always possible to identify and protect employees from such hazards. Therefore, it is crucial for both employers and employees to understand these factors, and build and participate in activities to minimize hazards and prevent accidents.

The following steps can be taken to identify and assess hazards:

| Identify the probability of a hazard | Assess the severity of the hazard | Determine the risk level |
|---|---|---|
| • Frequent- occurs continously<br>• Likely- occurs several times in a period of time<br>• Occasional- occurs rarely<br>• Remote- occurs very rarely<br>• Unlikely- almost impossible | • Catastrophic- cause death, total disability or damage to equipment and property<br>• Critical- partial permanent disability or significant damage to equipment and property<br>• Marginal- minor wound or minor damage to equipment and property<br>• Negligible- a very small wound or damage to property | • Extremely high- loss of ability to perform task<br>• High- significantly degrades ability to perform task<br>• Moderate- degrades the ability to perfrom task<br>• Low- little or no impact on ability to perform task |

Fig. 5.4 Steps to Identify and Assess Hazards

### 5.1.4.1 Steps to Prevent Hazards

Control measures include actions that can be taken to reduce the potential of exposure to the hazard, or the control measure could be to remove the hazard. Control measures can be adopted in different ways at different levels, it can range from the usage of personal protective equipment to the complete elimination of the source of hazard as shown below:

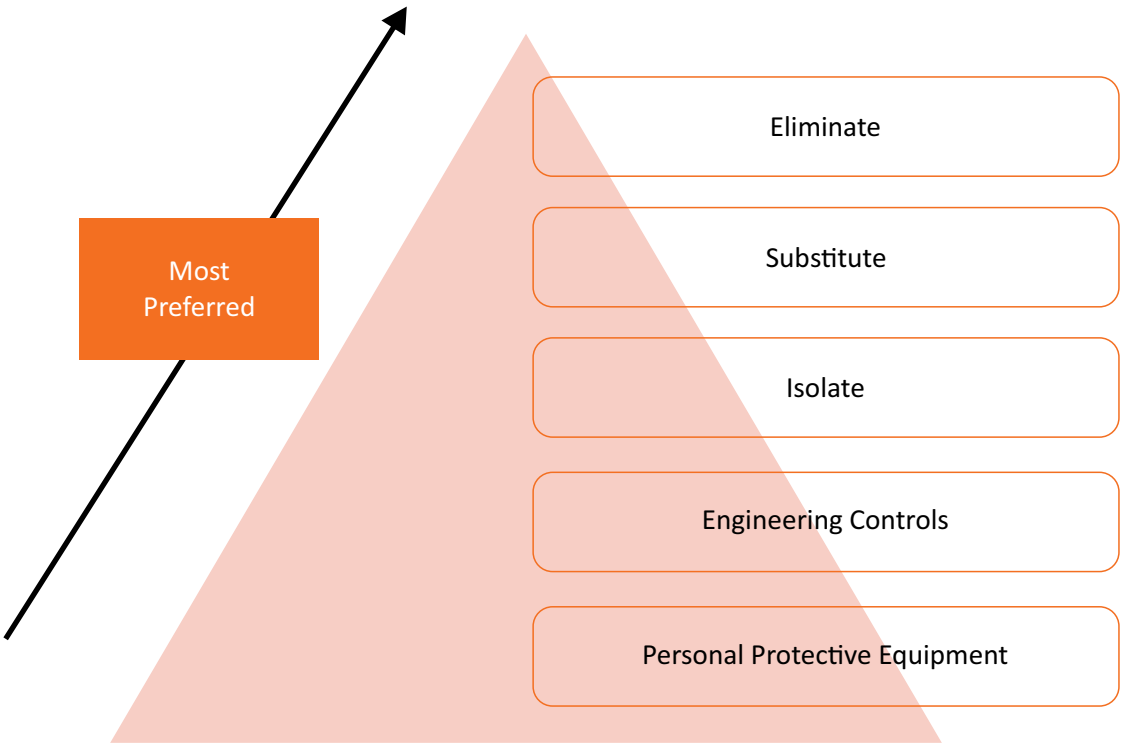



Fig. 5.5 Steps to Prevent Hazards

1. **Eliminate the hazard**

   Elimination of the danger is not always feasible, but it does totally eliminate the hazard and hence the risk of exposure.

2. **Substitute the hazard with a lesser risk**

   Although substituting the hazard may not eliminate all of the risks associated with the process or activity, it may pose lesser risks, and the overall harm or health effects will be reduced.

3. **Isolate the hazard**

   Isolating the hazard is managed by restricting access to plant and equipment, or, in the case of substances, locking them away under severe restrictions.

4. **Use engineering controls**

   Engineering controls, such as machinery monitoring, proximity guarding, extraction systems, or shifting the operator to a remote location away from the hazard, include redesigning a process to create a barrier between both the person and the hazard or separate the hazard from the person.

5. **Use administrative controls**

   Adopting standard operating procedures or safe work practices, as well as providing adequate training, education, or information to limit the risk of injury or ill-health impacts to people, are examples of administrative controls. Administrative controls include isolation and permit-to-work processes.

6. **Use personal protective equipment**

   Personal protective equipment (PPE) mainly includes gloves, safety footwear, glasses, aprons, earmuffs, and dust masks which are designed to reduce exposure to the hazard. PPE is typically considered the last line of defense, and it is typically employed along with one or more additional control measures.

## 5.1.5 Standard Practices to Control and Prevent Hazards, Risks, and Accidents

Workplace accidents can be detrimental to the organisation. It can cause injury to workers, damage to equipment and property, loss of production, etc. All these can reduce the morale of workers and may lead to financial losses as well. Safe work practices can be adapted to control, manage and prevent hazards, risks and accidents. These practices help in performing the tasks with minimum risk to people, equipment, materials, environment, and processes. Some of the safe practices to follow are:

1. Follow good housekeeping practices.
2. Use proper tools, equipment, and machinery to perform tasks.
3. Follow all safety procedures while working on machinery.
4. Replace/repair malfunctioning equipment and machinery.
5. Maintain all tools, equipment, and machinery.
6. Discard all expired, spoilt and outdated ingredients and materials.
7. Maintain fire-fighting equipment and train people to operate fire extinguishers.
8. Maintain appropriate protocols while working in confined spaces and restrict entry into confined spaces.
9. Use appropriate equipment to lift, pull or push heavy objects to avoid overexertion.
10. Ensure safety guards and railings are installed around moving parts of machinery.
11. Ensure all electrical devices are inspected, repaired, and broken/exposed wires are replaced.
12. Ensure there are no chemical leakages, spills, or fumes in the work area.
13. Ensure that the workplace is well ventilated, illuminated, and free of obstacles.
14. Follow appropriate guidelines while handling raw meat, poultry, and seafood as they can be a source of infections.

15. Ensure that the work area is disinfected and sanitized to prevent contamination of food.
16. Follow appropriate procedures to dispose of wastes.
17. Ensure to wear personal protective equipment appropriate to the work being carried out.

## Notes

# Unit 5.2 Safety Signs

## Unit Objectives

**At the end of this unit, the trainee will be able to:**

1. State the importance of maintaining the equipment effectively
2. Discuss the various types of safety signs and their relevance at the workplace
3. State the significance of displaying the common hazard signages wherever required

## 5.2.1 Importance of Maintaining Equipment Effectively

Equipment in the food industry consists of a wide range of components, and processing machines used in cooking, handling, packaging, preparing, and storing food and food products along with vessels, utensils, and cutlery used in serving and consuming food. Equipment maintenance is the process of keeping tools, equipment, and machinery in good working condition to prevent them from malfunctioning, or stoppage during use. Unexpected equipment failure at a production unit can disrupt production and result in costly downtime, which can have a substantial impact on the bottom line. Preventing catastrophic equipment failure requires regular equipment maintenance.

The benefits of maintaining equipment effectively are as shown below:

- It ensures safe operations and reduces risk of accidents.
- It reduces machine breakdown and stoppage.
- It increases the life of the equipment.
- It prevents defective products.
- It ensures timely production.
- It increases efficiency.

Fig. 5.6 Benefits of Maintaining Equipment Effectively

Drawbacks of not maintaining equipment effectively:

- It may cause injury to workers.
- It may cause damage to machine parts.
- It may slowdown the equipment due to wear and tear.
- It may reduce the quality of product.
- It may cause breakdown of the equipment.

Fig. 5.7 Drawbacks of not Maintaining Equipment Effectively

## Notes

## 5.2.1.1 Types of Maintenance

| | |
|---|---|
| **Routine** | • It is also known as periodic maintenance and is carried out on a daily, weekly, or monthly basis.<br>• It is mostly carried out by the equipment user or operator.<br>• It involves simple cleaning, washing, wiping, and oiling operations. It helps in stopping equipment due to the accumulation of dirt. |
| **Preventive** | • It is carried out by conducting routine checks and inspections or when the user feels that there is a problem.<br>• It helps in reducing downtime and surprise repairs.<br>• For example; excessive vibrations, unusual noise or heating up of the equipment, etc. if the problem is minor, then the operator can carry out minor repairs otherwise maintenance personnel should carry out the repairs. |
| **Predictive** | • The performance of the equipment is tested using gauges and meters and if there are any variations, then, the maintenance personnel carry out the remedial procedures. |
| **Breakdown** | • It is carried out when the equipment stops working and the repairs are carried out by maintenance personnel. |

Fig. 5.8 Types of Maintenance

### 5.2.1.2 Steps for Equipment Maintenance Plan in Food Industry

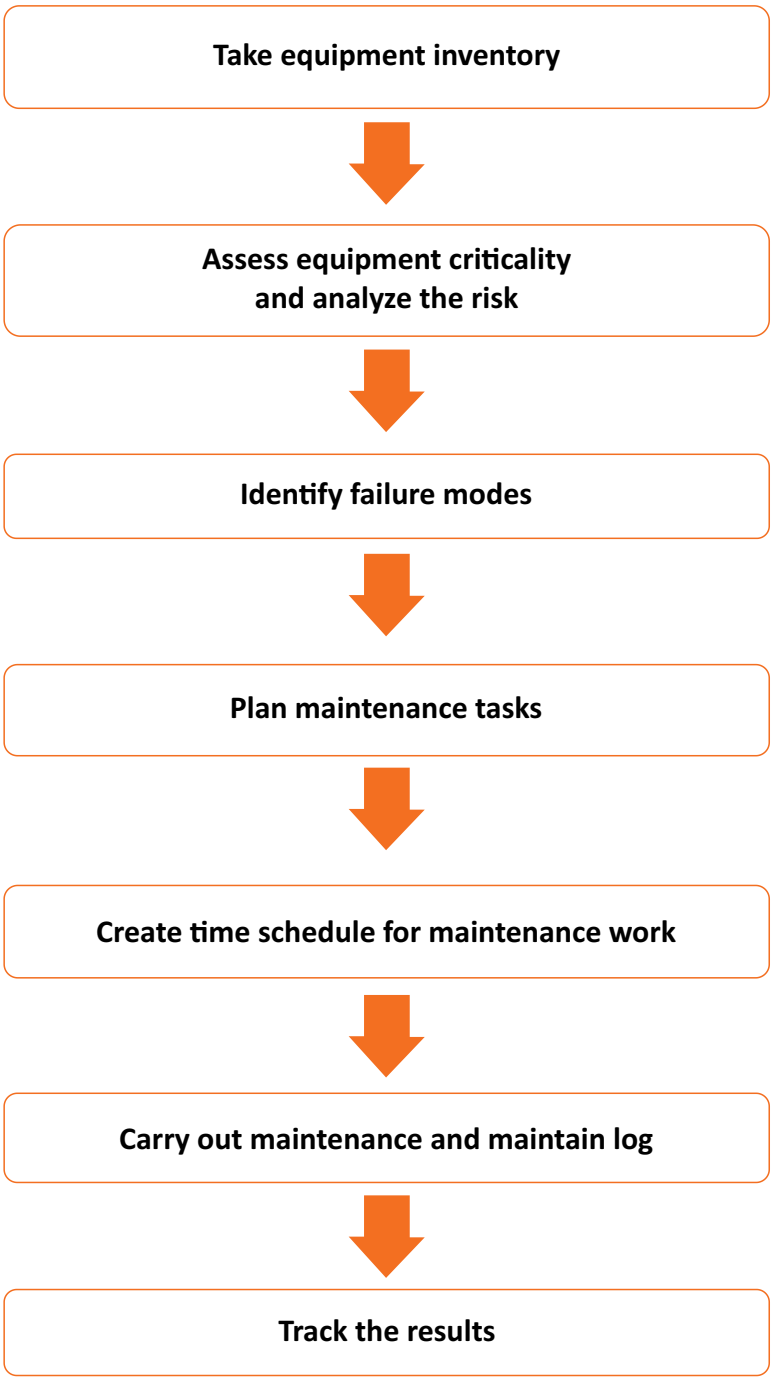



Fig. 5.9 Steps for Equipment Maintenance Plan in Food Industry

## 5.2.2 Safety Signs

It is necessary to have safety signs in the workplace. A visible warning from a safety sign provides a clear indication and reduces the risk of accidents for both employees and non-employees, resulting in a safer working environment. Employers are legally obligated to implement safety procedures and display several types of basic safety signage to protect people and equipment from potential hazards. Safety signs should be clear, easily recognizable, and require no explanation so that it is easy for everyone to follow without language barriers and even for illiterate people. They should be placed or displayed prominently in the required areas. The different categories of safety signs are as shown below:

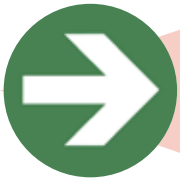
Prohibition signs
Indicates an action or behaviour that is not permitted, shown as a red circle with a red slash over a black icon of the action.

Mandatory signs
Provides specific instuctions that must be carried out, shown with white icons on a blue background

Danger signs
Communicates a hazard or a life-threatning situation, shown in red or black background and icons

Warning signs
Indicates hazards or conditions that can be harmful but not life-threatening, shown on a black triangle and icon on a yellow background


Fire safety signs
Indicates the location of fire fighting equipment and fire alarms, shown as white symbols on a red background



Emergency signs
Indicates the directions or location to emergency facilities, shown with white symbols on a green background

Information signs
it communicates general information regarding house-keeping, company practices, etc.

Fig. 5.10 Categories of Safety Signs

The following table represents some of the common workplace safety signs:

| Sl. No. | Signage | Message |
|---|---|---|
| 1. |  | No entry |
| 2. |  | No smoking |
| 3. |  | Hot surface |
| 4. |  | Fire exit |
| 5. |  | First aid |
| 6. |  | Fire alarm |
| 7. |  | Danger flammable material |

| Sl. No. | Signage | Message |
|---|---|---|
| 8. |  | Wet floor warning |
| 9. |  | Wear protective gloves |
| 10. |  | Food processing area |
| 11. |  | Wear PPE before entering |
| 12. |  | Wash hands before starting work |
| 13. |  | Keep aisles clear |
| 14. |  | Stack correctly |

Table 5.11 Common Workplace Safety Signs
Image source: www.creative safetysupply.com and freepik.com

## 5.2.2.1 Significance of Safety Signs

The main purpose of workplace safety signage is to warn people of possible exposure to various hazards. It helps to constantly communicate important instructions and reinforce safety messages. Organisations and workplaces that lack or do not have the necessary safety signage will be booked for violating safety regulations and regulatory action and legal fines by the auditing legal authorities. If appropriate safety signs are not displayed and an accident occurs, then the employer and other responsible people may face legal consequences. The main highlights of safety signs can be summarized as shown below:

- Provides instant visual communication of key safety messages
- Highlights safe methods of work as well as hazards
- Fulfils legal requirements
- Helps in warning and protecting employees and the public alike
- Provides better safety benefits for everyone

Fig. 5.12 Significance of Safety Signs

## 5.2.2.2 Safety Signs in Food Industry

In the food industry, along with the safety of the workers, food safety, hygiene, and contamination prevention play an important role. Employees have to be constantly reminded of the proper procedures to follow in the workplace. This can be achieved by displaying signage at all the strategic points. Some of the commonly seen safety signage in the food industry are shown below:


Fig. 5.13 Safety Signs in Food Industry
Image source: www.creative safetysupply.com

## Notes

# Unit 5.3 Health and Safety Practices

## Unit Objectives

**At the end of this unit, the trainee will be able to:**

1. Outline the importance of ensuring the availability of general health and safety equipment at all times
2. Describe the causes of fire, ways to prevent them and rescue techniques to be followed at times of fire at the workplace
3. Outline the purpose and usage of various Personal Protective Equipment (PPE) required at the workplace

## 5.3.1 Health and Safety Protocols

Health and Safety laws place the duty of care on employers for ensuring the safety of their employees and others. It is a huge task for a single person to be responsible for workplace health and safety regulations. Therefore, in an organisation various people including workers, supervisors, managers, business owners' legal advisors and health and safety executives are equally responsible. Employers bear more responsibility than employees because they are accountable for the safety of not only employees but also visitors to the workplace, customers, contract, and temporary workers.

Companies have to perform the following tasks to maintain health and safety requirements:

- Carry out risk assessments
- Consult employees about health and safety
- Create written health and safety policies
- Display health and safety posters
- Provide effective health and safety training to all employees
- Provide PPE and other safety equipment

Fig. 5.14 Tasks to Maintain Health and Safety Requirements

## 5.3.1.1 Importance of Health and Safety Equipment

The risk of injuries can to some extent be minimized by the use of health and safety equipment. Health and safety equipment or commonly known as personal protective equipment (PPE) protects the user against health and/or safety risks at work. Some of the common items include protective eyewear, gloves, face masks, hairnets, boots, aprons, etc. they are designed to protect the wearers. They are designed to protect employees from serious workplace injuries and illnesses resulting from biological, chemical, physical, radiological, electrical, or mechanical hazards. Every organisation should maintain a PPE manual that helps both employers and employees in understanding the various types of PPE.

Fig. 5.15 A Food Product Developer with Safety Equipment
Image source: www.freepik.com

## 5.3.1.2 Personal Protective Equipment

Personal protective equipment refers to accessories designed to protect the employees in the workplace from occupational hazards. It should be ensured that PPE used are well maintained and free of defects. Workers should be informed to wear and use PPE that are damage free and of the appropriate size. Workers should also be trained to clean and maintain them after use. In case of disposable PPEs, worker have to trained in safe disposable techniques to prevent contamination.

The following are examples of basic personal protective equipment (PPE) that can assist protect employees:

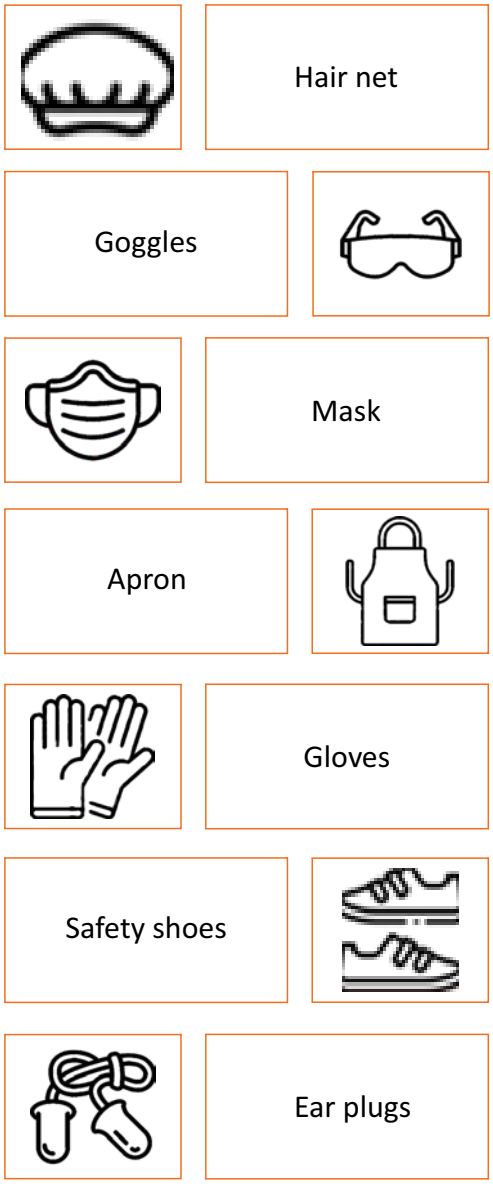



Fig. 5.16 Personal Protective Equipment
Image source:www.flaticon.com

**Hair nets**

Disposable hairnets should be worn to prevent hair from falling into food products.

**Safety Suggestions**

- Ensure that the hair nets cover the entire head and hair.
- People with long hair should first tie their hair into a bun and insert it into the hair net.
- Disposable hair nets should be replaced after each usage.
- If the hair net is damaged or soiled, replace it right away.

**Face and Eye Protection**

PPE, such as safety goggles and face shields, should be worn for tasks that could result in eye damage or loss of vision, such as liquid sprays, splashes, or burns.

**Safety Suggestions**

- Check to see if the safety glasses meet the standard eye protection requirement.
- Make sure the lenses are free of fractures and abnormalities.
- Check that the strap is in good functioning order and that it is securely fastened to the cheek and forehead.
- After each use, clean and disinfect.

**Face mask**

Face masks are worn when performing an activity that could result in the inhalation of fumes, gases, and chemicals. It also protects against the contamination of food from germs and viruses in case the food product developer is carrying any infection.

**Safety Suggestions**

- Before wearing any equipment, be sure it has been fit-tested.
- Ensure that the mask covers the nose and mouth adequately.
- Replace masks as recommended.
- Disposable masks should be replaced after each usage.
- Avoid sharing masks with others.
- If the mask is broken or soiled, replace it right away.

**Body Protection**

PPE for body protection includes aprons, safety vests, and suits for tasks that expose workers to extreme temperatures, flames, sparks, hazardous chemicals, etc.

**Safety Suggestions**

- Make sure they are clean and not damaged.
- Washable and reusable aprons should be washed after each usage.
- Disposable aprons should be replaced after each usage.

**Hand Protection**

PPE, such as safety gloves, should be worn when performing tasks that could result in hand and skin burns, absorption of hazardous substances, wounds, or cuts.

**Safety Suggestions**

- Check that the hand protection fits well and is free of cuts and damages.
- If there is any sign of contamination, replace them immediately.
- When dealing with heat and electricity, wear rubber gloves to prevent the danger of burns or electrical shock.

- Wear metal mesh gloves while chopping meat.

**Foot Protection**

Knee pads and safety boots are examples of personal protective equipment (PPE) that should be worn for tasks that could result in catastrophic foot and leg injuries due to falling or rolling objects, hot liquids, electrical hazards, or slippery surfaces.

**Safety Suggestions**

- Check that the boots have slip-resistant soles that can withstand compression and impact.
- Check that the sole plate is in good working order.

**Ear plugs**

Ear plugs should be worn when performing noisy operations like grinding to avoid hearing loss.

**Safety Suggestions**

- Make sure the equipment fits snugly in the ear canal.
- It is recommended that formable earplugs be used to fit various ear canal sizes.
- Use noise-reducing protectors to create a space for communication.
- Check that the earplugs are clean and in good working order.

## 5.3.2 Fire Safety

Personal protective equipment refers to accessories designed to protect the employees in the workplace from occupational hazards. It should be ensured that PPE used are well maintained and free of defects. Workers should be informed to wear and use PPE that are damage free and of the appropriate size. Workers should also be trained to clean and maintain them after use. In case of disposable PPEs, worker have to trained in safe disposable techniques to prevent contamination.

The following are examples of basic personal protective equipment (PPE) that can assist protect employees:

Fig. 5.17 Fire Safety
Image source: www.freepik.com

Fires and explosions are the leading causes of death and property loss in industries across the globe. Fire safety refers to a set of protocols to be followed to reduce the devastation caused by fire. The following figure shows the different classes of fires, causes, and extinguishers that can be used:

**Class of Fire - A**

- Type of Fire - Ordinary Combustible : wood, paper, rubber, fabrics and many plastics.
- Type of Extinguisher- Water, dry powder, halon

**Class of Fire - B**

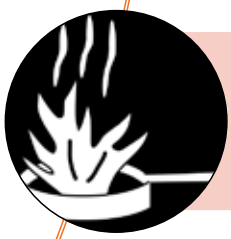
- Type of Fire - Flammable liquids and Gases: Gasoline, Oils, paint, lacquer and tar.
- Type of Extinguisher- Carbon Dioxide, dry powder, halon

**Class of Fire - C**

- Type of Fire - Fires involves live electrical equipment .
- Type of Extinguisher- Carbon Dioxide, dry powder, halon

**Class of Fire - D**

- Type of Fire -Combustible metals or combustible metal alloys
- Type of Extinguisher- Special Agents



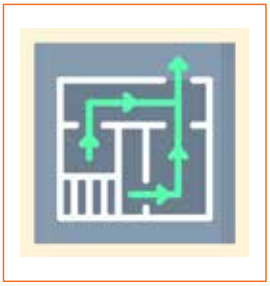
**Class of Fire - K**

- Type of Fire - Fires in cooking appliances that involve combustible cooking media: vegetable or animal oils and fats.
- Type of Extinguisher - Wet Chemical

Fig. 5.18 Types of Fires
Image source: www.flaticon.com

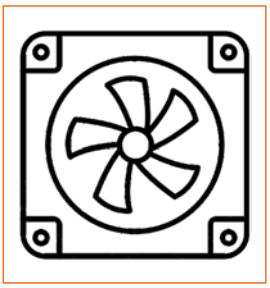
**Fire safety checklist:**

Are all the employees trained in fire safety procedures?



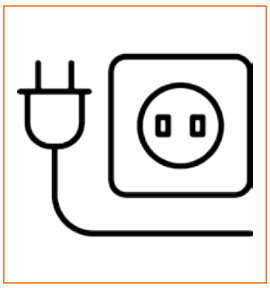
Are fire evacuation plans with emergency contact numbers displayed on all floors?

Is the fire fighting equipment maintined in good working condition?



Are the exhaust systems clear and maintained well?

Are all the safe assembly points identified and marked?



Are all the electrical gadgets and other proccessing equipment maintained and checked regularly?

Are there 'no smoking' signage posted?

Are there location signage of 'fire' alarm posted?

Are flammable items stored appropriately?

Fig. 5.19 Fire safety checklist
Image source: www.flaticon.com

## 5.3.2.1 Ways to Prevent Fire

The proverb 'Prevention is better than cure' can be aptly applied in the case of workplaces to prevent fires. Even a small fire can be disruptive causing injury to workers, damage to equipment, wastage of material, loss of time, productivity, and output. Therefore, the following ways can be implemented to prevent fires at the workplace:

1. Follow good housekeeping practices to keep the workplace clean and safe.
2. Create employee awareness through training programmes.
3. Store combustible and flammable materials properly.
4. Keep inventory of combustible and flammable materials as low as possible.
5. Take adequate precautions around ignition sources.
6. Ensure all electrical devices are grounded well.
7. Replace all exposed electrical wires.
8. Follow a good equipment maintenance programme.
9. Avoid electrical overload.
10. Conduct fire safety audits regularly.
11. Dispose of waste properly.
12. Report unsafe conditions that may cause a fire.

## 5.3.2.2 Precautionary measures to handle fire emergencies

In spite of taking all measures to prevent, there could be a possible fire incident in the workplace. In the food industry even a small error or carelessness can lead to a fire. Therefore, the management has to take adequate measures to tackle the situation by planning the infrastructure and training the staff. The precautionary measures to handle fire emergencies are:

be taken are:

1. There should be enough exit gates for people to come out from the premises to safe assembly point.
2. All exit gates should be indicated properly.
3. Floor layout should be displayed on every floor.
4. There should be sufficient fire extinguishers to extinguish different classes of fire in the premises.
5. Workers need to be trained for the following roles to handle fire emergencies:
   a. **Fire alarm box runners-** workers trained to break alarm boxes and inform the fire department
   b. **Fire brigade-** workers trained to extinguish small fires
   c. **Fire wardens-** workers trained to coordinate evacuation of workers

d. **Searchers-** workers trained to search for people in restrooms, shop-floors, canteen and elsewhere in the premises to ensure that nobody is left behind during evacuation

e. **Door holders-** workers trained to hold doors open when people are being evacuated and close the door when all people are out

6. All employees should be trained in emergency evacuation procedures.

7. Fire drills should be conducted as per the organizational and government guidelines.

## Notes

## 5.3.2.3 Fire Evacuation Process

In case of a fire emergency, people should be evacuated in the initial stages of a fire. Fire brigade should be informed immediately. The first priority is to save people, next fire containment and lastly property protection.

Some of the important points to follow during a fire evacuation process:

- Follow emergency evacuation instructions
- Raise a fire alarm
- Fight only small fires
- Use a fire extinguisher on the type of fire that it is labelled for
- Switch off electrical devices
- Do not carry any personal belongings or equipment
- Give preference to elderly, expectant mothers, specially-abled persons, children, if any
- If it is smoky, try to cover nose and mouth with a wet cloth to prevent inhaling smoke and crawl to the nearest exit
- Give preference to elderly, expectant mothers, specially-abled persons, children, if any
- If it is smoky, try to cover nose and mouth with a wet cloth to prevent inhaling smoke and crawl to the nearest exit

Fig. 5.20 Points to follow during Fire Evacuation Process

## Summary

- A hazard can be defined as a potential source of harm, damage, or adverse health effect on a person, persons, or equipment.
- A risk can be defined as the likelihood that a person or equipment may be harmed, damaged, or suffer an adverse health effect if exposed to a hazard.
- The various types of occupational hazards are safety, chemical, biological, physical, ergonomic, and psychological hazards.
- The factors that cause workplace hazards and risks are men, machines, materials, environment, and methods.
- The first step in preventing hazards is to identify and assess hazards by identifying the probability of a hazard, assessing the severity of the hazard, and determining the risk level.
- The preventive measures for workplace hazards and risks are elimination, substitute, isolation, engineering controls, administrative controls, and personal protective equipment.
- Safe work practices can be adapted to control, manage and prevent hazards, risks and accidents. These practices help in performing the tasks with minimum risk to people, equipment, materials, environment, and processes.
- Equipment maintenance is the process of keeping tools, equipment, and machinery in good working condition to prevent them from malfunctioning or stop during use. Preventing catastrophic equipment failure requires regular equipment maintenance.
- A well-defined maintenance plan is of most importance in the food industry because of the high cleanliness standards required, wet environment, complex equipment, perishable products, continuous processes, stringent quality control, etc.
- The steps for equipment maintenance plan in the food industry are taking equipment inventory, assessing equipment criticality and analyzing the risk, identifying failure modes, planning maintenance tasks, creating a time schedule for maintenance work, carrying out maintenance, and maintaining a log and track the results.
- Maintenance planning is not a one-time job, it needs to be dynamic.
- A visible warning from a safety sign provides a clear indication and reduces the risk of accidents for both employees and non-employees, resulting in a safer working environment.
- Safety signs should be clear, easily recognizable, and require no explanation so that it is easy for everyone to follow without language barriers and even for illiterate people.
- The different categories of safety signs are prohibition signs, mandatory signs, danger signs, warning signs, fire safety signs, emergency signs, and information signs.
- The main purpose of workplace safety signage is to warn people of possible exposure to various hazards. It helps to constantly communicate important instructions and reinforce safety messages.
- If appropriate safety signs are not displayed and an accident occurs, then the employer and other responsible people may face legal consequences.
- In the food industry, along with the safety of the workers, food safety, hygiene, and contamination prevention play an important role. Employees have to be constantly reminded of the proper procedures to follow in the workplace. This can be achieved by displaying signage at all the strategic points.

- Health and Safety laws place the duty of care on employers for ensuring the safety of their employees and others. In an organisation various people including workers, supervisors, managers, business owners, legal advisors, and health and safety executives are equally responsible.
- The risk of injuries can to some extent be minimized by the use of health and safety equipment.
- Some of the common items include protective eyewear, gloves, face masks, helmets, boots, aprons, etc. They are designed to protect employees from serious workplace injuries and illnesses resulting from biological, chemical, physical, radiological, electrical, or mechanical hazards.
- Personal protective equipment refers to accessories designed to protect the employees in the workplace from occupational hazards. Workers should be informed to wear and use PPE that is damage-free and of the appropriate size. Workers should also be trained to clean and maintain them after use.
- Fires and explosions are the leading causes of death and property loss in industries across the globe. Fire safety refers to a set of protocols to be followed to reduce the devastation caused by fire.
- The different types of fires are classified as Class A, B, C, D, and K based on the cause and each class of fire can be extinguished by a particular type of extinguisher.
- Companies should take adequate measures to prevent a fire like following good-housekeeping practices, storing combustible materials safely, providing training to staff, maintaining equipment, conducting fire safety audits, etc.
- Organisations should take all precautionary measures to handle fire emergencies including regular fire drills.
- In the event of a fire emergency, proper evacuation process should be followed.

## Notes

## Exercise

**Answer the following questions:**

1. Define the terms 'Hazard' and 'Risk'.

   _____

   _____

2. Write a note on hazards and risks in the food industry.

   _____

   _____

3. Explain the importance of the maintenance of equipment in the food industry.

   _____

   _____

4. List any five personal protective equipment that workers in the food industry need to wear.

   _____

   _____

**Fill in the blanks:**

1. _____ hazard is caused by exposure to unsafe work environment.
2. _____ is a common refrigerant used in food processing units.
3. _____ type of fire is caused by cooking oils and fats.
4. _____ type of gloves should be worn by workers while

**Multiple-choice Questions:**

1. Choose the correct answers (MCQ)
   a. Which one of the following is an example for an ergonomic hazard?
      1. Contaminated poultry
      2. Electrical devices
      3. Flammable materials
      4. Repetitive motion
   b. Which type of maintenance is performed when equipment stops working?
      1. Periodic maintenance
      2. Preventive maintenance
      3. Predictive maintenance
      4. Breakdown maintenance

c. Which one of the following signs indicate an action or behaviour that is not permitted?

1. Danger sign
2. Prohibition sign
3. Warning sign
4. Mandatory sign

d. Which type of fire can be extinguished with water?

1. Class A
2. Class B
3. Class C
4. Class D

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# 6. Manage Workplace Emergencies

FICSI
Food Industry Capacity and Skill Initiative

Unit 6.1 - Workplace Emergency

Unit 6.2 - First Aid

Unit 6.3 - Health, Safety and security breaches

FIC/N9903

## Key Learning Outcomes

**At the end of this module, the trainee will be able to:**

1. Explain the standard procedure to be followed for dealing with workplace hazards safely
2. Describe how to minimize potential risks and accidents at the workplace
3. Demonstrate how to train the workforce on accident prevention techniques effectively

# Unit 6.1 Workplace Emergency and Evacuation Procedures

## Unit Objectives

**At the end of this unit, the trainee will be able to:**

1. Discuss workplace emergency and evacuation procedures and the importance of following them

## 6.1.1 Workplace Emergency

A workplace emergency is an event that causes disruption of workplace operations by posing an immediate risk of significant harm to the health and life of people, equipment, property, or the environment. Preparing for emergencies is not only important for the health and safety of the workplace, it is a legal requirement as well.

## 6.1.2 Types of Workplace Emergency

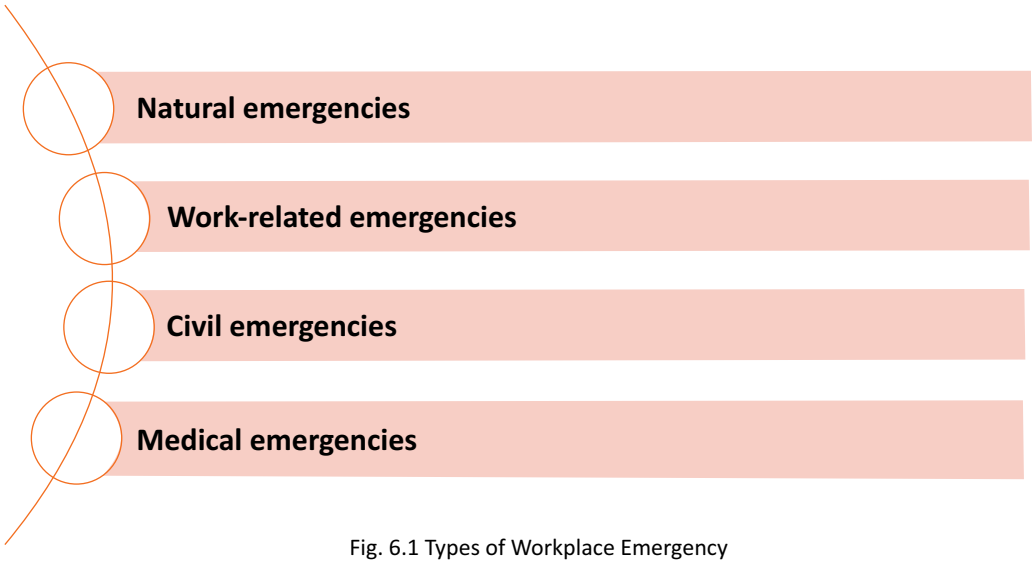


Fig. 6.1 Types of Workplace Emergency

**Natural emergencies** are the hardest to predict and plan for. Natural emergencies can occur due to floods, earthquakes, hurricanes, tornadoes, forest fires, etc. Most often it will not be limited only to the workplace. Hence it can affect the logistics as the whole neighborhood would be affected.

**Work-related emergencies** are caused by factors relating to the workplace like explosions, machinery malfunction, power outages, chemical spills, dangerous gas releases, etc.

**Civil emergencies** are caused by civil unrest like strikes, protests, employee-employer conflict, workplace harassment or violence, terrorism, etc.

**Medical emergencies** commonly seen at the workplace are heart attack, electrocution, accident, burns, choking, etc.

## 6.1.3 Emergency Situations in the Food Industry

Emergency situations not only cause temporary damage immediately after the incident, but they can also lead to a permanent closure of the business. The occurrence of an emergency situation leads to costs associated with loss of material, damage to equipment and property, loss of staff, cost of paying staff that is idle, loss of business, customer confidence, and loyalty. Therefore, it is always good to prevent such a situation. It is not always possible to prevent an emergency, hence the next best thing is to be prepared for it so as to reduce or minimize the damage. Every food production facility should have a Food Safety Manager who will be responsible to ensure consistent compliance with food safety requirements.

Some of the emergency situations in the food industry are:

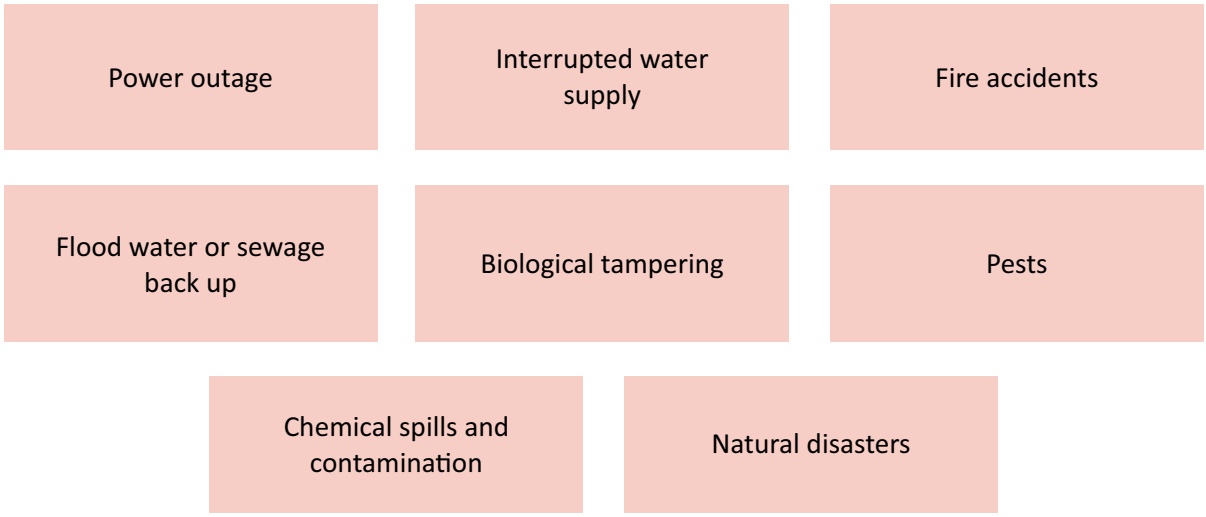


Fig. 6.2 Emergency Situations in the Food Industry

**Power outage:** The food industry is dependent on the power supply for the functioning of refrigeration and freezer units, hot water heaters, lighting, etc. if there is a power outage for a long duration, it can lead to the spoiling of food leading to staleness and contamination. This can pose a food safety threat and loss of material as well as production.

**Interrupted water supply:** Water is the most common ingredient in cooking. It is also required for drinking, cleaning, and sanitization purposes. If there is not enough water available it can lead to loss of production and wastage. If water is sourced from external agencies, then it needs to be checked for quality to prevent contamination.

**Fire accidents:** The food industry is prone to combustible dust, electrical fires, and explosions compared to other industries. This is because of the presence of materials like flour, grains, spices, cooking oils, etc. When oil is heated for cooking at high temperatures, it degrades and becomes combustible. Processing, cooking, and other production equipment are operated using electricity or gas, both of these have a high potential for fire accidents. Poor housekeeping and maintenance can also lead to fire accidents due to oil and grease buildups clogging exhaust systems and ductwork.

**Flood water or sewage back up:** Flood water or sewage can enter the premises and damage raw material and equipment. Flood water can contain chemicals, feces, disease-causing microorganisms, pests, insects, etc. If the flood water or sewage cannot be contained immediately, then the facility has to be closed be prevent contamination.

**Biological tampering:** It involves the deliberate use of biological contaminants and toxins in food and water. They can be in the form of powder or liquids. Food safety managers and supervisors have to be watchful to prevent or minimize these kinds of threats.

**Pests:** Pests often pose a huge threat to the food industry, they can damage food, raw materials, equipment, and buildings. Pests like rodents and insects like cockroaches and flies are a common problem in most food production units. Stagnant water becomes a breeding site for mosquitoes and other insects. Sewage and floods can also bring pests into the facility. Poor housekeeping and improper handling and disposal of garbage can further aggravate the problem.

**Chemical spills and contamination:** Chemical spills, the release of fumes and gases into the air can cause damage to workers' health and contaminate food and water.

**Natural disasters:** Natural disasters like earthquakes, hurricanes, tornadoes, floods, heat waves, etc. are striking more and more often. Some regions are more prone to certain natural disasters; therefore, the organisation has to be well prepared to tackle the situation. These disasters can often cause irreversible damage to the facility, destroy buildings and equipment and also harm people leading to disruption in production capacity.

## 6.1.4 Emergency Management Plan

The objectives of an emergency management plan are:

**Prevention:** Create policies and procedures to minimize the occurrence of emergencies.

**Preparation:** Carry out activities, procedures and training to make sure the workplace is ready to respond effectively.

**Response:** Determine the action to be taken in the event of an emergency situation.

**Recovery:** Prepare to resume normal work operations.

Fig. 6.3 Emergency Management Plan

## 6.1.5 Planning for Emergencies

Irrespective of the type of emergency, it is important to be prepared to tackle emergencies to keep the employees and other people free from harm and life-threatening situations, minimize damage to the equipment, machinery, tools, etc. minimize damage to the environment, minimize downtime. This can be achieved by devising an emergency plan. The emergency plan should have a clear outline of the steps and actions to be taken, as making decisions during a crisis can be tough.

The first step is to create a plan assuming the worst-case scenarios that can happen. Different types of emergency situations call for different steps to be taken. Each workplace will have different kinds of emergency situations arising. A list of the most likely emergency situations that can arise based on the location and size of the organisation, the kind of processes carried out, and the kind of people on the premises like employees, visitors, customers, etc. has to be made. For example:

- Some locations can be prone to frequent natural calamities like earthquakes, hurricanes, floods, etc.
- Food industries can be prone to fires, biological hazards, chemical spills, fumes, etc.
- Food cooking and serving places like restaurants will have employees, visitors, and customers, who may or may not have the training to deal with emergency situations.

In most cases, the likelihood of workplace emergencies is high compared to other types of emergencies. Therefore, a good way to start is by evaluating emergencies that may result from factors directly related to the work. This can be done by using a previous risk assessment that identifies the risks and ways to alleviate them. Along with those other emergencies that may befall should be accounted for. A single plan will not suit every workplace.

## Notes

## 6.1.6 Emergency Response Plan

A written document of the emergency response plan should be made available to the emergency response team consisting of the following details:

- Scope and outline potential emergencies
- Site-specific response procedures
- Details and location of emergency equipment
- Alarms, alerts and other announcements of initiating a response
- Emergency response team members, their roles and responsibilities
- Procedures for shutting down power, water, equipment and machinery
- Evacuation and assembly procedures
- Procedures for first-aid and medical help
- Emergency contact lists
- Resource lists

Fig. 6.4 Documentation guideline for Emergency Response Plan

The response plan should include:

**Emergency response team-** The emergency response team should have people appointed at various levels along with backup personnel, in case the primary appointees are not available. The team should consist of a coordinator and a few emergency response personnel.

- Coordinator should be a responsible person who can help prevent any confusion during an emergency. The person should be able to oversee the emergency response, communicate and mediate with internal and external emergency response teams, ensure that all the at-risk personnel is informed and evacuated, and ensure that operations are shut down and secured.
- Emergency response team should consist of people who can be responsible for dedicated tasks like fire safety, medical assistance, safe evacuation of people, handling, control, cleanup of hazardous or toxic material, etc.

**Emergency equipment-** Immediate response in case of emergencies is very crucial in limiting damage. A list consisting of the details and location of all the emergency equipment should be prepared and made available for both internal and external emergency personnel.

Some examples of emergency equipment are fire extinguishers, chemical containment equipment, automatic external defibrillators (AED), machinery controls, electricity mains, water main access points, first-aid kits, etc. Personal protective equipment may include safety glasses, goggles, face shields, head protection gear, safety shoes, chemical suits, gloves, and special protective clothing for combating emergencies.

**Training and practice drills-** Regular training and drills should be conducted so that every employee knows the procedures to be followed during different kinds of emergencies. Employees should be made aware of their responsibilities during an emergency like responding to an alarm system, following the announcements, knowing the place to gather during an emergency, knowing whom to approach, reporting an emergency, action to be followed for specific emergencies, being aware of when to re-enter the premises after emergency and the using of emergency equipment if trained/authorized to. Some of the key features of employee training are:

- Individual roles and responsibilities
- Risks, hazards and protective actions
- Notification, warning and communications procedures
- Methodologies for locating missing members in an emergency
- Emergency response procedures- evacuation and assembly procedures
- Location and use of common emergency equipment
- Emergency shutdown procedures

Fig. 6.5 Key features of Employee Training

**Evacuation procedures-** A detailed plan should be drawn for the actions to be taken for different emergencies including personnel in charge of the evacuation, location of various shelter and meeting places inside and outside the premises, evacuation routes and map, alert or alarm systems, procedure to follow if someone is injured and employee responsibilities.

- Personnel: People in-charge of evacuation should be able to evacuate workers safely, hold doors and assist people with special needs, aged people, expecting mothers, etc., and look for people in washrooms, canteens, shop-floor, and elsewhere on the premises to ensure that nobody is left behind during an evacuation.
- Shelters and meeting places: In places where hurricanes and tornadoes are a possibility, safe shelter places inside the building should be identified. For incidents like fire emergencies, safe outside assembly or meeting points should be designated so that employees can assemble. After complete evacuation, a roll call can be taken in these places to see if all the employees have been safely evacuated from the building.
- Exit and evacuation routes: There should be a sufficient number of wide, well-lit, and easily accessible exits so that all employees can be evacuated rapidly. All exits should be free from any kind of blockage.
- Alarm systems: Alarm systems should be such that they are easily visible, heard, and understood by all personnel.
- Procedures to follow if someone is injured: First-aid kits should be provided, and a few personnel should be trained to provide first aid and Cardiopulmonary Resuscitation (CPR) and assess when to call for medical help. Employees should be informed whom to approach if medical attention is required.

Following an evacuation plan is very critical to keep control of all employees. Confusion in the assembly areas can cause a delay in rescuing anyone trapped within the building, as well as unnecessary and dangerous search-and-rescue operations.

## Notes

## 6.1.7 Measures to be taken after Evacuation of People

- Ensure that all the evacuated people have gathered in the designated assembly areas.
- Perform a headcount after the evacuation.
- Identify all the people rescued and make a list.
- Establish a method for accounting all visitors, contract workers, suppliers and customers.
- Prepare and establish procedures for further evacuation in the case the incident expands.
- If required send all the empoyees home.

Fig. 6.6 Measures to be taken after Evacuation of People

## Notes

# Unit 6.2 First Aid

## Unit Objectives

**At the end of this unit, the trainee will be able to:**

1. Explain the procedure to be followed for administering immediate first aid to victims in case of cuts, bleeding, burns, choking, electric shock, poisoning, etc.
2. Discuss the procedure to be followed for providing artificial respiration and cardio-pulmonary resuscitation (CPR) to the affected person and highlight its significance

## 6.2.1 Objectives of First Aid

First Aid is the emergency care given to an injured person as soon as the injury occurs and at the location where it occurred. It often consists of a short one-time treatment given by a first aider until proper medical help can be provided. Every kind of injury does not require treatment at a medical centre, some minor injuries can be treated with only first aid.

First aid can include treating a minor burn, a minor cut, applying bandages and dressing, administering non-prescription medicine, etc. All workplaces have to provide at least some level of first aid. The type of first aid, equipment, and training depends on the type of hazards present in the workplace, the number of employees, and the distance to the nearest hospital or medical facility. Provision for first-aid is also a legal requirement as per the law.

Objectives of first aid:

- To minimize injury and future complications, disability, or in some cases prevent death.
- To make the person as comfortable as possible to conserve strength until medical help comes by.

## Notes

Points to remember while providing first aid:

Obtain medical help immediately. Call the doctor and ambulance to take the person to the medical centre.

Always remember to treat the most dangerous first, for example: take measures to prevent bleeding before attending to bruises.

Avoid moving a seriously injured person from lying position, unless absolutely required. If it is inevitable, then handle very gently.

Make sure that the person is stable and comfortable.

Do not give any food, water or any fluids orally to an unconscious person.

Observe if the person is breathing normally and check pulse periodically.

Cover any open wound with a sterile gauze bandage or clean cloth.

In case the victim vomits, then gently lower the head and turn to a side to ensure the fluids do not choke the victim and enter the lungs.

Fig. 6.7 Points to remember while providing First Aid

## 6.2.2 First Aider

| | | |
|---|---|---|
| Be a good observer and be able to act quickly. | Be self-confident, calm and composed. | Be able to control the crowd, lead and take from onlookers, if required. |
| Be able to judge the extent of injury, communicate the same to paramedics. | Be able to understand the severity of the injuries and treat the most dangerous one first. | Be able to counsel the victim, reassure and make the victim feel calm and comfortable. |

Fig. 6.8 Qualities of a First Aider

## 6.2.3 First Aid Kit

Every workplace should have at least one first aid kit. The contents of the first aid kits should be based on the risks the workplace poses and the kind of injuries it can cause. First aid kits should have the following features:

- It should be large enough to hold all the required items.
- It should have the first-aid signage (white cross on a green background) displayed.
- It should be able to protect the contents from dust, moisture, heat and contamination.
- It should have the list of contents for that kit.
- It should have all tools and other materials required to give first aid.
- It should have medicines within the expiry date.
- It should be periodically checked expired medicines, damaged tools and contaminated material and replaced.

Fig. 6.9 Features of First Aid Kit


Fig. 6.10 Items in a First Aid Kit

- First aid manual
- Tools- torch, scissors, magnifiers, thermometer, safety pins, forceps, syringes, needles, etc.
- Materials- cotton rolls, alcohol swabs, sterile gauze dressing, crepe bandage, medicated bandages of different sizes, plasters, tape, disposable gloves, disposable face masks, N95 masks, tissue papers, soaps, sanitizers, etc.
- Non-prescription medicines- anti-septic creams and ointments, anti-septic solution, paracetamol, painkillers, anti-histamines, eye-wash, etc.

## 6.2.6 First Aid Procedures for Various Injuries

Safety precautions to be followed before, during, and after administration of first aid:

- Always wash, dry, and sanitize hands before and after performing first-aid.
- Wear disposable gloves while dressing wounds, and avoid contact with blood and other body fluids.
- Use alcohol swabs to wipe tools.
- Sterilize reusable tools after every use.

**Bleeding:**

The colour of blood and the way it bleeds from the wound indicates the severity of the injury. Bleeding from capillaries, which are small blood vessels, comes out as a trickle and stops on its own. Blood bleeding from veins is darker in colour than capillary blood and exhibits a consistent flow, the flow intensity can be from mild to severe. Blood coming out of arteries carry oxygen and is bright red in colour and the flow intensity is typically severe, leading to severe blood loss quickly. All types of bleeding can be arrested with quick intervention and care. If bleeding is allowed to continue for a long time it can end in shock and eventually death.

Fig. 6.11 Bleeding from a cut

The following first aid steps should be taken to stop bleeding:

| Severe bleeding | Minor cuts and scratches |
|---|---|
| • Do not pull out or remove large and deeply embedded objects.<br>• Stop the bleeding by placing a sterile gauze bandage or clean cloth on the wound and apply constant pressure until bleeding stops.<br>• Secure the bandage and if the bleeding is in the hands or legs, then keep them at an elevated position.<br>• Keep the injured person in a lying position and immobilize the injured body part as much as possible.<br>• Call an ambulance and seek medical help | • Clean the cut with clean water, raise the injured area above the heart and cover the cut with a sterile gauze dressing or bandage. |

Fig. 6.12 First Aid steps to Stop Bleeding

**Burns:**


Fig. 6.13 Burn injury

Burns are caused due to direct contact with fire or flame, by touching very hot surfaces, spilling hot fluids on the body, or due to electric shock. The general precaution to be taken for burns is to not put ice directly on the burn and not to break blisters. Burn injuries can be categorised as follow:

| First-degree burn | | |
|---|---|---|
| **Impact**<br>The outer-most layer of the skin is affected | **Symptoms**<br>Skin redness Swelling<br>Pain | **Treatment**<br>Cool the burn<br>Cover with a sterile bandage<br>Administer a pian killer if required |

| Second-degree burn | | |
|---|---|---|
| **Impact**<br>The first and second layers of the skin are affected | **Symptoms**<br>Blisters Swelling<br>Severe pain | **Treatment**<br>Cool the burn<br>Cover with a sterile bandage<br>Administer a pian killer if required |

| Third-degree burn | | |
|---|---|---|
| **Impact**<br>All layers of skin, fat, muscle and bone are affected | **Symptoms**<br>Dry white/black areas Sign of shock<br>Severe pain | **Treatment**<br>Remove contact with smoldering material Check for circulation Cover with sterile bandage Seek medical help |

Fig. 6.14 Categories of burns

**Electrocution:**

When a person comes in contact with a live wire or faulty electric equipment, the person gets a shock (electrocution). It may cause burns or it may not leave any visible mark on the skin. In both cases, it can cause cardiac arrest, internal damage, or other injuries. In some circumstances, even a small amount of electricity can be fatal. A person injured by contact with electricity should be thoroughly examined by a doctor. Medical help should be sought immediately if the victim experiences: severe burns, difficulty in breathing, confusion, heart rhythm problems, seizures, muscle pain cardiac arrest, or loss of consciousness.

**Shock due to trauma, severe infection, or an allergic reaction:**

When a person is suffering from any kind of severe infection, allergic reaction, or trauma it can lead to a shock. The symptoms of shock are cold and clammy skin, shallow breathing, low blood pressure, yawning, staring eyes, yawning, delirium, or unconsciousness. In such situations, the person has to be immediately taken to a medical care facility.

**Choking:**

Choking occurs when an external object gets stuck in the throat or windpipe blocking the flow of air. It cuts off oxygen to the brain, therefore first aid has to be given immediately. The common symptoms of choking are coughing, inability to talk, heavy and noisy breathing, skin, nails, and lips turning blue, and loss of consciousness. If the person is finding it difficult to breathe and has fallen unconscious seek medical help immediately.

**Poisoning:**

Poisoning can cause injury or death due to inhaling, swallowing, touching or injecting various gases, chemicals, drugs, venom, etc. Some substances are poisonous only in high dosages or concentrations. The symptoms of poisoning are vomiting, drowsiness, difficulty in breathing, confusion, seizures, etc. Depending on the severity of the effect of the poisoning the person has to be taken to a medical facility or can be given first-aid by a trained first-aider.

## 6.2.8 Artificial Respiration and Cardiopulmonary Resuscitation (CPR)

Artificial respiration is breathing induced when natural respiration has stopped. It can be performed manually by providing air to a person who is not breathing or with the help of mechanical ventilators. One of the manual methods of providing artificial respiration is Cardiopulmonary Resuscitation (CPR).

CPR is a life-saving technique in many emergencies like heart attacks or when a person has stopped breathing because of various reasons like trauma, choking, shock, etc. CPR keeps the oxygen-rich blood flowing to the brain and other organs until medical treatment can restore the heart rhythm. CPR has to be performed only by a trained person. An untrained person can perform hands-only CPR. Hands-only CPR consists of giving uninterrupted chest compressions of about 120 per minute until medical help arrives.

# Unit6.3 Health, Safety, and Security Breaches

## Unit Objectives

**At the end of this unit, the trainee will be able to:**

1. State the impact of health, safety and security breaches on self, team, and work process

## 6.3.1 Health, Safety, and Security Breaches

The term breach can be defined as 'an act of breaking or failing to observe a law, agreement or code of conduct.' The responsibility of following health, safety, and security procedures are on both the employers and employees at the workplace.

Responsibilities of employers:

- Carry out periodic inspections and risk assessment.
- Provide a safe working environment.
- Provide safety signage to warn workers of potential hazards.
- Provide information about risks and hazards.
- Implement health and safety procedures.
- Provide training related health and safety.
- Provide adequate training to safely use tools and equipment.
- Keep log of all work-related injuries, accidents and incidents.
- Comply to all organizational rules and regulation.

Fig. 6.15 Responsibilities of Employer

Responsibilities of employees:

- Follow all the guidelines relating to health and safety
- Wear proper personal protective equipment
- Operate equipment and machinery after adequate training
- Cooperate with fellow employees at workplace
- Report any possible risk or hazard observed at workplace
- Report all work related injuries, accidents, diseases or occurrences

Fig. 6.16 Responsibilities of Employees

The management can be booked for breach:

- If any action that exposes a person to the risk of injury, illness or death in the workplace.
- If adequate steps are not taken to prevent a risky situation from occurring.
- If the organisation does not comply with regulatory requirements.

The organisation may face financial penalties, industry disqualification, withdrawal of sanctions, and benefits by the authorities.

The employers may face the following consequences for breach:

- Warning from management.
- Loss of benefits like bonuses, promotions, and incentives.
- Loss of employment.

## Summary

- A workplace emergency is an event that causes disruption of workplace operations by posing an immediate risk of significant harm to the health and life of people, equipment, property, or the environment.
- The different types of workplace emergencies are natural, work-related, civil, and medical emergencies.
- Some of the emergency situations in the food industry are power outage, interrupted water supply, fire accidents, flood water or sewage backup, biological tampering, pests, chemical spills and contamination, and natural disasters.
- The objectives of an emergency management plan are prevention, preparation, response, and recovery.
- Irrespective of the type of emergency, it is important to be prepared to tackle emergencies to keep the employees and other people free from harm and life-threatening situations, minimize damage to the equipment, machinery, tools, etc. minimize damage to the environment, minimize downtime.
- A list of the most likely emergency situation that can arise based on the location and size of the organisation, the kind of processes carried out, and the kind of people on the premises like employees, visitors, customers, etc. have to be made.
- In most cases, the likelihood of workplace emergencies is high compared to other types of emergencies.
- A written document of the emergency response plan should be made available to the emergency response team.
- The response plan should include an emergency response team, emergency equipment, training and practice drills, and evacuation procedures.
- Following an evacuation plan is very critical to keep control of all employees. Confusion in the assembly areas can cause a delay in rescuing anyone trapped within the building, as well as unnecessary and dangerous search-and-rescue operations.
- First Aid is the emergency care given to an injured person as soon as the injury occurs and at the location where it occurred. It often consists of a short one-time treatment given by a first aider until proper medical help can be provided.
- First aid can include treating a minor burn, a minor cut, applying bandages and dressing, administering non-prescription medicine, etc. All workplaces have to provide at least some level of first aid.
- A first aider is a person trained to identify the problem and provide emergency care until medical help arrives.
- Every workplace should have at least one first aid kit. The contents of the first aid kits should be based on the risks the workplace poses and the kind of injuries it can cause.
- Employees should be trained to create awareness of first aid.
- Safety precautions to be followed before, during and after administration of first-aid.
- When a person comes in contact with a live wire or faulty electric equipment, the person gets a shock. It may cause burns or it may not leave any visible mark on the skin. In both cases, it can cause cardiac arrest, internal damage, or other injuries.

- When bleeding is caused by an injury, the colour of blood and the way it bleeds from the wound indicates the severity of the injury. All types of bleeding can be arrested with quick intervention and care. If bleeding is allowed to continue for a long time it can end in shock and eventually death.
- Burns are caused due to direct contact with fire or flame, by touching very hot surfaces, spilling hot fluids on the body, or due to electric shock. The general precaution to be taken for burns is to not put ice directly on the burn and not to break blisters.
- When a person comes in contact with a live wire or faulty electric equipment, the person gets a shock (electrocution). It may cause burns or it may not leave any visible mark on the skin. In both cases, it can cause cardiac arrest, internal damage, or other injuries. In some circumstances, even a small amount of electricity can be fatal.
- When a person is suffering from any kind of severe infection, allergic reaction, or trauma it can lead to a shock. The symptoms of shock are cold and clammy skin, shallow breathing, low blood pressure, yawning, staring eyes, yawning, delirium, or unconsciousness.
- Choking occurs when an external object gets stuck in the throat or windpipe blocking the flow of air. It cuts off oxygen to the brain, therefore first aid has to be given immediately.

Scan the QR code or click on the link to watch related videos

https://www.youtube.com/watch?v=DaYwcH1GMEg

Emergency Procedures

## Exercise

**Answer the following questions:**

1. What is the importance of workplace emergency?

   _____

   _____

2. Write a brief note on first aid.

   _____

   _____

3. What is meant by health, safety and security breach?

   _____

   _____

**Fill in the blanks:**

1. _____ is an example of natural emergency.
2. _____ is a person trained to perform first aid.
3. _____is an act of breaking or failing to observe a law, agreement or code of conduct.

**Choose the correct answers (MCQ)**

a. Which one of the following is most likely to affect the functioning of a refrigerator?

   1. Biological tampering
   2. Chemical spills
   3. Power outage
   4. Interrupted water supply

b. In which of the following types of burns, only the outer-most layer of the skin is affected?

   1. First-degree burn
   2. Second-degree burn
   3. Third-degree burn
   4. Fourth-degree burn

c. Which one of the following is breach by employee at the workplace?

   1. Wearing PPE
   2. Reporting a hazard
   3. Following safety guidelines
   4. Operating machines without training

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# 7. Manage Infection Control

Unit 7.1 - Infection and Control Measures

Unit 7.2 - Effective Infection Control Practices

FIC/N9903

## Key Learning Outcomes

**At the end of this module, the trainee will be able to:**

1. Describe the various steps to be followed for managing infections at the workplace
2. Perform various tasks to train the workforce on infection control practices effectively

# Unit 7.1 Infection and Control Measures

## Unit Objectives

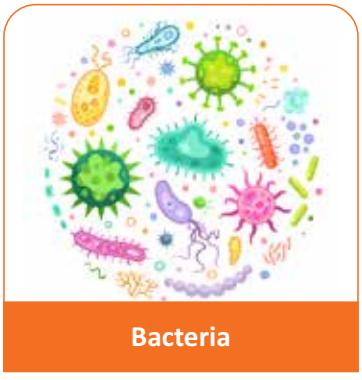
**At the end of this unit, the trainee will be able to:**

1. List the general sources of infections
2. Discuss various types of potential infections along with the precautionary measures to be taken, and safety protocols to be followed at the workplace
3. Discuss the procedures to be followed to tackle infection spread and the importance of carrying out the sanitization of the work area, equipment and related facilities as per standards
4. Explain various ways to store the sanitization materials appropriately

## 7.1.1 Infection

Infection refers to the process of a micro-organism entering a person's body and causing harm. We can also say that the invasion and multiplication of micro-organisms such as viruses, bacteria, and parasites that are generally not present within the body are called infections. It may be asymptomatic and subclinical or cause symptoms and be clinically evident. Also, it may remain localized or spread through the blood or lymphatic vessels to become body wide. There are numerous micro-organisms that live naturally in the body, and they are not considered infections. For example, bacteria that usually live within the mouth and intestine are not infections.

The micro-organism uses the human being's body to sustain itself, reproduce, and colonize. These infectious microscopic organisms are called pathogens, and they can multiply quickly. Few examples of pathogens include:


Bacteria


Virus


Fungus

Fig 7.1 Pathogens

## 7.1.2 Sources of Infection

Infection can spread in various ways like:

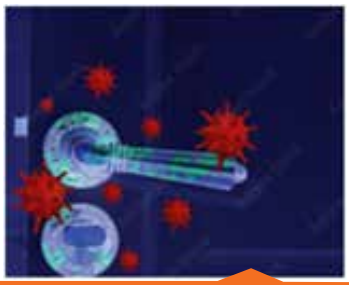
Skin contact

Transfer of bodily fluids

Contact with feces

Ingesting contaminated food or water

Inhaling airborne particles or droplets



Touching an object that a person carrying the pathogen has also touched

Figure 7.2 Sources of Infection Spread
Image source: www.stock.adobe.com

The significant sources of infection at the workplace are:

- Blood and other body fluids (e.g. saliva) and
- Sources of blood/body fluids such as human bodies, animal carcases and raw meat
- Human or animal waste products such as faeces, urine and vomit
- Respiratory discharges such as coughs and sneezes
- Direct skin contact

Fig 7.3 Sources of Infection at the Workplace

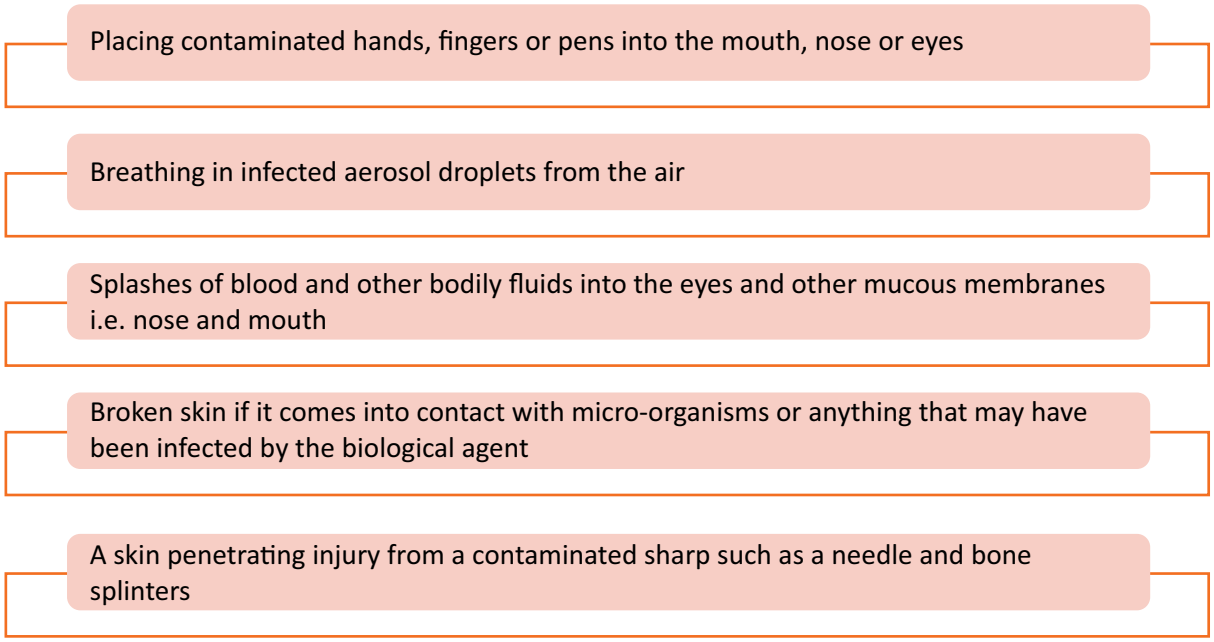



Fig 7.4 Transmission of Infection

## 7.1.3 Potential Infections

The spread of infection and its effects on the human body depends on the pathogen type. The immune system is an efficient barrier against infectious agents. However, pathogens may sometimes overpower the ability of the immune system to fight them off. At this stage, an infection can become harmful.

Some pathogens can have little effect, while others can produce toxins or inflammatory substances that trigger negative responses from the body. We can also say that some infections are mild and barely noticeable, while others can be severe and life-threatening.

There are different pathogens like viruses, bacteria, fungi, and parasites. They vary in several ways, including:

- Size
- Shape
- Function
- Genetic content
- Effect on the body

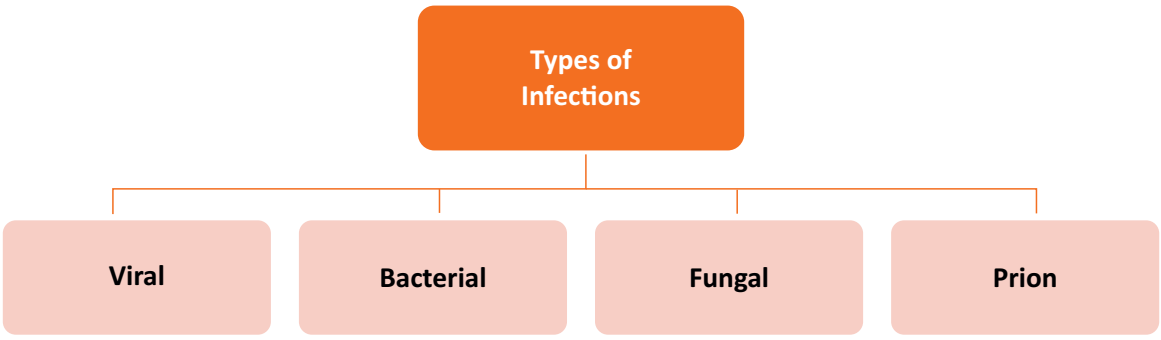



Fig 7.5 Major Types of Infections

The entrance of a particular type of organism into the body is the cause of that specific infection. For example, a particular virus will be the cause of a viral infection. Similarly, any particular bacterial will be a cause of bacterial infection. Sometimes, swelling and running nose can be seen due to an infection. This happens as a result of the attempt of the immune system to get rid of the invading organism.

1. Viral Infection

An infection caused by a virus is known as a viral infection. There are millions of different viruses, but researchers have only identified approximately 5,000 types. Viruses have a small piece of genetic code and are protected by a coat of protein and lipid (fat) molecules.

Viruses attack a host body and attach themselves to a cell. They release their genetic material upon entering the cell. Then, this material forces the cell to reproduce the virus, and it multiplies. After that, when the cell dies, it further releases new viruses, which infect the other cells.

However, all viruses do not destroy their host cell. Some of the viruses:

- change the function of the cell
- replicate in an uncontrolled way which leads to cancer

Viruses might remain inactive for some time before multiplying again. The person with the viral infection can seem to have fully recovered, but they might get sick again when the virus re-activates.

Viral infections can include the following:

| Common Cold | Encephalitis and meningitis | Warts and skin infections, | Gastroenteritis | COVID-19 |
|---|---|---|---|---|
| • Occurs due to rhinovirus, cor onavirus, and adenovirus | • Results from enteroviruses and the herpes si mplex virus (HSV), as well as West Nile Virus | • HPV and HSV are responsible | • Caused by norovirus | • Respiratory disease that develops after a novel coronavirus infection that is currently causing a global pandemic |

Fig 7.6 Major Viral Infections and their Causes

Other viral conditions include:

| | | | |
|---|---|---|---|
| Zika virus | HIV | Hepatitis C | Polio |
| Influenza (flu), including H1N1 swine flu | Dengue fever | Ebola | Middle East respiratory syndrome (MERS-CoV) |

Fig 7.7 Other Viral Conditions

Symptoms:

Viruses target specific cells, like those in the genitals or upper respiratory tract. For example, the rabies virus targets the nervous system. Some viruses may target skin cells and can cause warts. Some others might target a broader range of cells, which leads to several other symptoms. A flu virus might cause muscle aches, upset stomach, or a runny nose.

Medication:

While the disease passes, **antiviral medications** can help relieve the symptoms. They work in either of the following ways:

- prevent reproduction of the virus, or
- boost the immune system of the host to deal with the impact of the virus

**1. Bacterial Infection**

When bacteria get into a body, grow there in number, and cause a reaction, it causes bacterial infection. Bacteria are single-celled micro-organisms that can enter the body through an opening in the skin like a cut or a surgical wound or through the airway.

Symptoms:

Common symptoms of bacterial infection are redness, heat, swelling, fever, and pain at the site of infection, as well as swollen lymph glands.

Medication:

Bacterial infections can be treated with antibiotics though some stains become resistant and can survive the treatment.

**2. Fungal infection**

A fungus is usually a multicellular parasite that decomposes and absorbs organic matter with the help of an enzyme, but some types are single-celled like yeasts. Some fungal infections develop in the upper layers of the skin, while some get into the deeper layers. Inhaled yeast or mold spores could also lead to fungal infections, like pneumonia, or infections throughout the body. The human body generally has a lot of good bacteria that aid in maintaining the balance of micro-organisms. People who have a weakened immune system (e.g. HIV or diabetes), have undergone a transplant (take medication to prevent the body from rejecting the new organ), or have used antibiotics for a long time are more prone to fungal infection.

Symptoms:

A rash on the body can indicate a fungal infection of the skin. However, bacteria and viruses too can cause skin conditions and rashes.

**3. Prion Disease**

A prion is basically a protein containing no genetic material and is generally harmless. Scientists have not yet classified prions as living micro-organisms, but if a prion folds into an abnormal shape, it can become a rogue agent and cause infection. Prions can affect the brain's structure or other parts of the nervous system.

Symptoms:

Some of the common symptoms of prion diseases are rapid onset of brain damage, cognitive difficulties, and memory loss.

## 7.1.4 Infection Spread Control at the Workplace

Infectious disease risks often cause serious problems in the workplace. Be it seasonal flu or respiratory diseases, a lot of infectious diseases are responsible for worker illnesses which in turn have a considerable effect on workplaces through absenteeism and disruption of services. So, controlling the infection spread in the workplace is very crucial. Infection control is very similar to any other element of health and safety and can be handled simply with common sense, i.e.

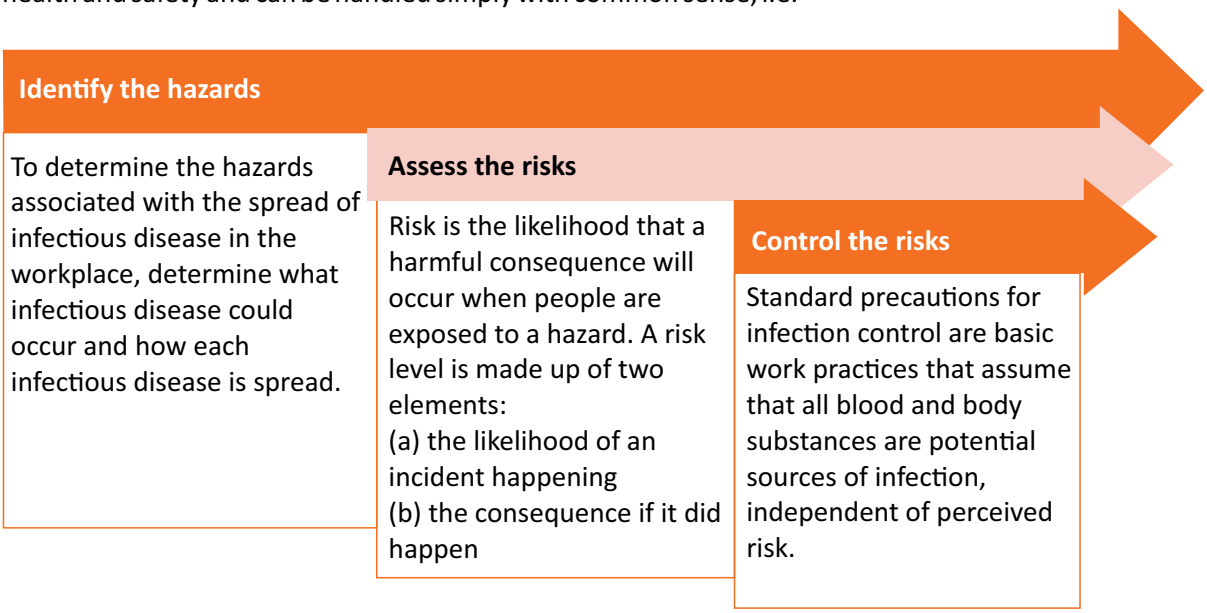



Fig 7.8 Infection Control Process

Infection can be represented as a chain and if one of the links is broken in the chain at any point, the risk of infection can be controlled. Once the hazard has been identified, these links should be identified, and then the best way to break it should be incorporated to control the risk.

To ensure good infection control in the workplace, it should be assumed that everybody is potentially infectious. Following proper procedures at all times is the key to infection spread and control. The workplace should have an appropriate first aid kit. Personal protective equipment like gowns, gloves, eye goggles, and face shields should be provided, if necessary.

It is advisable to check employees prior to them starting work and ensure that they are effectively protected. On the other hand, some people might be naturally immune to disease because they have had the illness as a child or immunisation.

Thus, it is crucial to ensure that the workplace is kept clean and tidy and the areas that are likely to be contaminated with any infection-causing micro-organism are deep cleaned thoroughly on a regular basis. It is also essential to make sure that all employees are trained to complete the cleaning tasks satisfactorily using the appropriate cleaning agents.

All employees should regularly wash their hands after blowing their nose, visiting the toilet, touching raw food, bodily fluids, etc, with appropriate soap. It is not always possible for employees to thoroughly wash their hands, especially if they are away from the premises. Thus, it is vital to ensure that suitable personal protective equipment is provided for them to wear as well as a supply of alcohol-based sanitizer which can reduce the number of micro-organisms being transferred by individuals' hands.

## 7.1.5 Standard Procedures for Infection Control

The infection spread can be controlled by following the standard procedures:

**i. Personal Hygiene Practices:**

- Washing Hands: Regular hand washing can avoid the spread of many pathogens. Hands should be washed thoroughly with water and soap for a minimum of fifteen seconds post visiting the toilet, prior to developing any food product, and after touching somebody else or equipment.
- Unbroken Skin: Intact and healthy skin is a major hindrance to pathogens. Any cuts or abrasions shall be covered with a waterproof dressing.
- Gloves: Gloves should be worn while handling raw material or performing other food-related procedures.
- Personal items: Don't share personal things with anybody else.

**ii. Food Preparation:**

- Hands should be adequately washed prior to and after handling food.
- Touching the hair, nose or mouth should be avoided.
- Store hot food and cold food separately at the required temperature.
- Separate storage, utensils, and preparation surfaces should be kept for cooked or uncooked foods.
- After use, all utensils, equipment, and preparation surfaces should be washed thoroughly with hot water and detergent.

**iii. Workplace Cleanliness:**

- Wash the floors, bathrooms, and surfaces (such as tables and benchtops) and equipment regularly with hot water and appropriate detergent.
- The walls and ceilings should be washed periodically.

- Wash and dry brushes, mops, and clothes after every use. Drying clothes and mops is essential, as many pathogens rely on moisture to grow.
- Use specified disinfectants to clean up spills.
- Always wear gloves while using disinfectants. Clean the surfaces before using the disinfectant and follow the manufacturer's instructions.
- Perform spot cleaning when necessary.

## 7.1.6 Importance of Sanitization

Maintaining a clean work environment at the workplace is critical in preventing infections. Bacteria can quickly grow on unsanitary surfaces and can contaminate food. A work surface that looks clean does not mean that it is sanitary. It must be ensured that the work area is cleaned and sanitized before starting to prepare food.

Cleaning the surfaces with soap and appropriate detergents is just one step of the cleaning procedure. It is equally necessary to sanitize. Cleaning can remove any dirt or grease but will not kill any bacteria or other pathogens. Only a prescribed sanitizer can kill bacteria and ensure that the area is safe for food preparation. Most commonly used sanitizers in the foodservice industry are chlorine solutions (bleach), quaternary solutions (quats), and iodine. These materials should be used according to the instructions of the manufacturer using the appropriate personal protective equipment.

Let's understand the most commonly used processes for keeping the equipment and premises clean and disinfected.

**Cleaning:** It is the removal of "soil" or debris and the reduction of the number of germs from a surface. Cleaning is usually sufficient for most areas and surfaces and should be carried out using warm water and detergent, followed by rinsing and thorough drying.

**Sanitizing:** It is the reduction in the number or slowing of the growth of bacteria. Sanitizers are appropriate for food contact surface sanitizing (e.g. dishes, utensils, cutting, boards, high chair trays, tables).

**Disinfection:** It is the inactivation of bacteria, viruses, and fungi and can be achieved by heat or chemical means e.g., autoclaving, boiling, and bleaching. It is important to clean surfaces thoroughly prior to disinfection to remove organic matter present in blood and body substances.

Fig 7.9 Processes for keeping equipment and premises clean and disinfected

**Steps for Cleaning and Sanitizing**

**Step 1: Remove any debris or dirt from the food contact surface**

- Remove any debris or dirt from the food contact surface using a brush to sweep the surface, air to blow off the dirt or debris, or water to rinse off.
- Applying the right pressure is crucial.
- High-pressure washers or air compressors can spread the debris or pathogens over a large area.
- Overly low-pressure water or air do not essentially remove soil and debris from the surfaces.
- Use appropriate pressure to remove the dirt or debris.
- A designated area shall be provided for using the tools. Color-coding is an effective way to achieve this. For example, blue handles can designate use on food contact surfaces such as conveyor belts, and black handles can designate use on floors.

**Step 2: Apply a detergent and scrub the surface**

- Ensure using an appropriate detergent as per the type of soil that needs to be removed. For example, some detergents effectively eliminate fats (e.g., from animal slaughter) while others are efficient at eliminating carbohydrates (e.g., sugars from fruit) or proteins.
- Appropriate detergents should be used on food contact surfaces.
- Apply the detergent at the recommended level as per the label and physically scratch the surface to remove any soil or debris.
- Removing the soil and other organic build-up helps in minimizing the formation of biofilms.

**Step 3: Rinse the surface using clean water to remove the detergent and soil**

- Rinse out the surface with clean water. Ensure all the detergent and soil are removed
- Avoid rinsing with high-pressure washers. This can spread the pathogens over a large area which can recontaminate an area that has already been cleaned.
- Minimize the splashing or aerosolizing to avoid contamination from one surface (e.g., floors, floor drains) to another using high volume and low spray water.

**Step 4: Apply a sanitizer approved for use on food contact surfaces**

Note: All materials cannot be sanitized.

- A sanitizer is basically a substance that lowers the number of micro-organisms to an acceptable level. Sanitizers are usually considered to be part of a broader group of substances known as antimicrobial pesticides. The label describes the approved uses, such as for water or for food contact surfaces, as well as the appropriate concentrations.
- Apply a sanitizer that is approved for use on food contact surfaces. Make sure the product being used has proper concentration per the instructions.
- Use the sanitizers as per the label instructions.
- There might be a 5th step if the sanitizer requires a final rinse.

- Allow the surface to air dry.
- The application of a sanitizer needs to be followed by a potable water rinse in organic operations. The requirements of the certifier for application and residue management on food contact surfaces shall be followed.

## 7.1.7 Storage of Sanitization Material

We have already discussed the importance of sanitization at the workplace to avoid the spread of infectious diseases. It is equally important to store the cleaning and sanitization material appropriately. If the material is not stored correctly, it might lead to inefficiency as well as can introduce another hazard.

- A list of standard cleaning and disinfecting materials should be maintained
- Efficacy of these materials should be checked for meeting the requirements of disinfection for specified areas or as per specific use like disinfection of the surface areas and for cleaning and disinfection of equipment
- It must be ensured that all the disinfectants, cleaning materials, and sanitizers are approved by an appropriate authority to ensure the efficacy of these agents and materials
- A chart mentioning the name of the chemicals, dilutions to be used, areas where it is permitted for use, and the intended application (for what to use - floor/equipment/blood spill cleaning, etc.) should be prepared and placed in the storage room
- It is to be ensured that separate equipment is used for cleaning general and critical areas
- All the cleaners, sanitizers and disinfectants, and prepared solutions should be clearly labelled
- All cleaners, sanitizers, and disinfectant chemicals should be stored at the designated location
- All the inflammable should be stored on lower shelves
- The storage should be at or above adult shoulder height
- Preferably, use a closed cupboard with a lock, in a cool place away from direct sunlight and heat sources
- While storing more than one bottle of the same chemical, use the one with the earliest expiry first (first-in-first-out principle)
- There should be a biohazard label on the cupboard and the chemical containers
- Keep bottles and cans tightly closed when not in use
- Discarded chemicals should be disposed of as per the manufacturer's instructions

# Unit 7.2 Effective Infection Control Practices

## Unit Objectives

**At the end of this unit, the trainee will be able to:**

1. Discuss appropriate actions to be taken during illness to self and others at the workplace
2. State the importance of undergoing preventive health checkups organized by the organisation in compliance with FSSAI guidelines
3. Describe the parameters to be assessed during health and safety audits, their acceptability levels of appropriateness and the procedure to conducting these audits
4. Discuss various parameters to be assessed and compliance issues to be addressed during the review of SOPs and the ways to improve them as per required quality and safety standards
5. List various types of documents and records to be maintained in the work process

## 7.2.1 Handling Illness at the Workplace

The employees who are not feeling well should be allowed and encouraged to stay at. If any employee is showing any symptoms, allow them to go or remain at home. In case of doubt, if a person is sick, they should stay at home until they feel good and are able to return to their regular activities.

For instance, if a person becomes ill at work, they should report to first aid or ask for medical attention. If the employee is severely ill (such as difficulty breathing or chest pain), call medical help immediately. If not, they should:

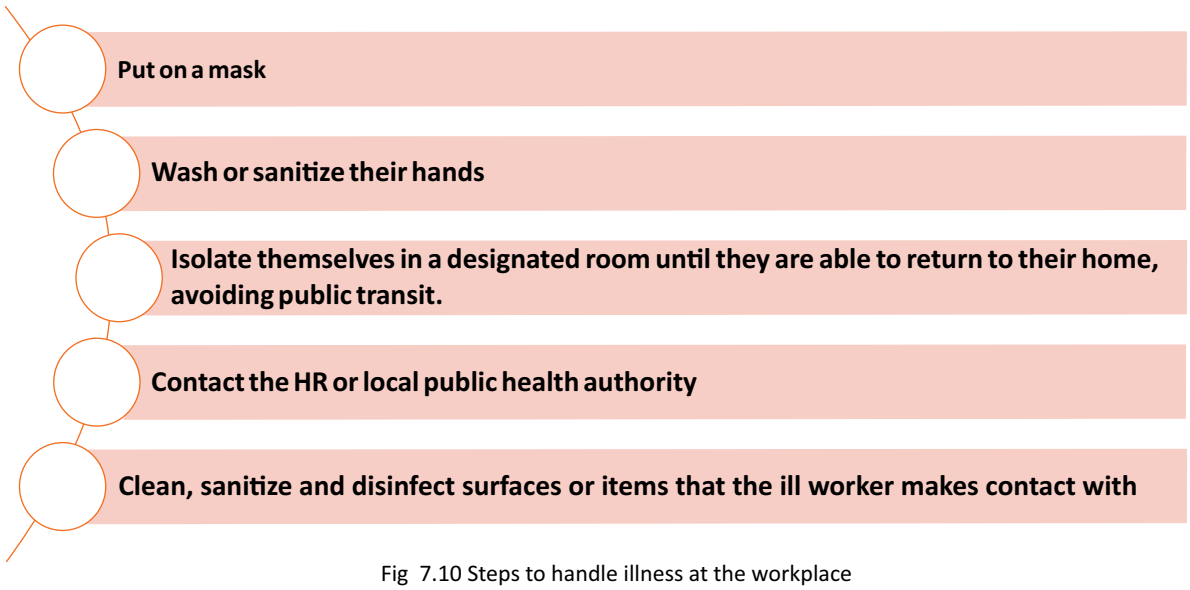



Fig 7.10 Steps to handle illness at the workplace

## 7.2.2 Preventive Health Check-ups

The Food Safety and Standards Act of India (FSSAI) has an established bill associated with food safety and regulation in the country. The importance of food safety has been raised due to the increase in diseases and illnesses in India. FSSAI is accountable for protecting and promoting public health by maintaining the regulation and supervision of food safety.

FSSAI has issued a set of rules and regulations on food safety norms and keeps updating these rules frequently. These rules are applicable from food development to street food and online food delivery. It is essential for these companies to guarantee and demonstrate their employees' fitness, especially those who come under direct contact with food. As per the FSSAI guidelines for food handlers, annual health check-ups for employees should be organized in order to confirm their physical fitness to pursue their trade. A medical examination of food handlers defines them as a verified and authenticated food production or service brand.

As per FSSAI, "General hygienic and sanitary practices to be followed by food business operators applying for a license- Manufacturing/ processing/ packaging/storage/distribution".

It also states that "arrangement shall be made to get the food handlers/employees of the establishment medically examined once in a year to ensure that they are free from any infectious, contagious and other communicable diseases. A record of these examinations signed by a registered medical practitioner shall be maintained for inspection purpose".

Therefore, it is mandatory for companies to provide a preventive health care plan for the betterment of employees and consumers.

## 7.2.3 Health and Safety Audits

To analyse an organization's Workplace Health and Safety (WHS) performance, audits are essential. But they are not always taken this way. If the word 'audit' raises a montage of clipboards, inspections, and interrogations, one would have terrible experiences or expect the worst.

Safety audits should never be a policing activity. They are crucial to find out where the safety performance is and where it needs to be as per the specified parameters. So, these should be taken as a positive learning opportunity to improve the safety of the employees.

Health and safety auditors can be an organization's internal employees or someone from outside. It depends on the organization's preference. Some choose to conduct their audits in-house, as they know the areas they want to emphasize, while others might prefer to hire someone externally to develop a fresh set of eyes and perception. Some organizations even choose both and conduct an internal audit as a predecessor to the external audit.

**Importance of Health and Safety Audits**

The task of the audit is to compare what's happening on the ground with what is written in the safety management system or the prescribed rules and regulations. Apart from identifying the gaps, health and safety audits are crucial to challenge the benchmarks set out in the safety management system.

They are really beneficial for coming up with actionable steps to be taken to improve the safety of the business and can be used to:


Fig 7.11 Importance of Health and Safety Audits

Workplace Health and Safety Audit Process

Generally, the following steps are followed to conduct a workplace health and safety audit.

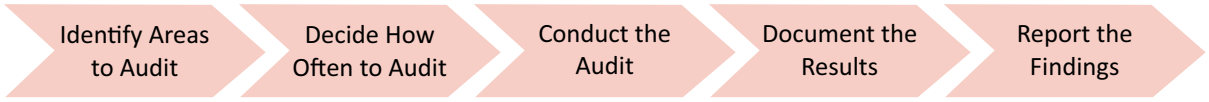



Fig 7.12 Steps of Health and Safety Audits

**STEP 1: Identify Areas to Audit**

A note of each part of the business that should be audited should be made first. Some may have simple processes, while others may have more complex ones. It is imperative to understand that an internal audit should not try to do everything at once. Whatever the focus area, a 'systematic and disciplined approach to work' should be used according to the relevant norms. Benchmarks and standards should also be set, and it should be made sure that everybody agrees on them before the audit is conducted.

**STEP 2: Decide How Often to Audit**

The size of the business decides how often the audit should take place. However, some timings are already chosen, for example, HACCP audits must be completed every quarter. It is possible that some areas of the business might need auditing more frequently than others as they carry greater health and safety risks.

The organizational safety management system should clearly outline how often it is required to audit different areas. Still, the frequency might be changed, like from quarterly to monthly or monthly to weekly – depending on the risk factors. Once the frequency of the audit of each area is decided, it should be put on the calendar. It is pretty common that the months roll past and internal audits do not happen, so these should be scheduled for the year ahead. A copy of the calendar should be sent out so an upcoming audit never comes as a surprise to the employees.

**STEP 3: Conduct the Audit**

The audit process will differ depending on the organization and the area to be audited.

1. **Kick-off meeting:** The audit should start with a kick-off meeting. It is a decent opportunity to introduce the team that will conduct the audit and the key participants, describe the audit's purpose and approach, and determine the required communication protocol.
2. **In-field observations and interviews:** Post the kick-off meeting, observations and interviews should be carried out. In-field observations surely do not mean hiding behind some equipment with the camera to snap somebody being non-compliant. A casual and inclusive approach should be taken to understand how the processes work in actuality. Similarly, interviews should not seem like interrogations. They should be conducted in the field among people who are really familiar with the processes.
3. **Collect evidence:** This is very important as it facilitates demonstrating the outcome of the audit and can help improve the system for the future or celebrate the success of the standards achieved. Evidence can be completed documents, interview statements or photos, etc.
4. **Result Documentation:** Notes should be taken throughout the audit process, which further helps write the report. The collected documents and notes should be reviewed, and the findings should be written comprehensively. Any gaps in compliance should be documented to ensure they appear in the report.
5. **Report the Findings:** The findings should be reported in a tabular format with graphs, diagrams, and photos to make the information more straightforward to find and understand. All the positive notes about things that are going well should be covered. Lessons should be learned from the findings and applied to gaps in other business areas. Determining the reason and discussing the best actions to be taken with management can lead to the best outcome. The report is crucial to highlight how to improve the safety of the business.

## 7.2.4 Reviewing SOPs

A Standard Operating Procedure (commonly known as an SOP) is basically a written plan of a process that assesses potential hazards and explains how they have been eliminated or minimized. The SOP is prepared to assure maximum safety at work. As a written document, the SOP permits the management to review and approve a somewhat detailed plan of a process based on the assessment of the associated risks. It also enables Hazards Control Division specialists to review the plan and suggest modifications to control possible health and safety hazards better.

SOPs are developed as a measure for controlling risks:

- if suggested from the conclusions of a risk assessment which is carried out in agreement with the procedure to manage workplace health and safety risks
- when new work practices are introduced
- when new technology is introduced
- when SOP development is recommended following some incident investigation

SOPs must be written in detail to make sure that anybody with limited understanding or knowledge of the procedure can effectively carry out the procedure in a safe manner even when unsupervised. They should be written in a logical, easy-to-read, step-by-step, and concise format.

SOPs should be reviewed periodically, for example, every two years, depending on the risk level, to make sure that the procedure remains current and appropriate. The next review date should be mentioned in each SOP reviewed. If an SOP explains a process that is no longer required to be followed, it should be withdrawn and archived immediately.

The health and safety system of an organization should never sleep. In fact, it should evolve and keep changing as per the legislation, market requirements, new products, machinery, and other internal as well as external factors. All this can impact the quality, personnel, health and safety, and other business systems.

The health and safety processes can change even daily, and any change can impact the process descriptions, for example, implementing new machinery.

The following parameters should be checked while reviewing the SOPs:

1. Hazard and risk assessment on the equipment
2. Development and implementation of hazard plan
3. Development of safe work method for the equipment or process
4. Training of the employees using the SOP or safe work method
5. Records of training
6. Establishment date to understand if the SOP was effective and to decide if tweaking is required

The health and safety document should be particularly reviewed when:

1. An employee has reported an idea for continuous improvement
2. An accident or near-miss report is filed, and as part of the incident, corrective actions
3. Non-conformance of any product or service

Document management and reviews generally do not happen and are sometimes not even considered. But, these documents are often the keystone to a business, especially if any evidence of compliance in a WorkSafe investigation or prosecution is to be submitted. Therefore, the organizations must ensure that the SOPs are still relevant and updated with the business operations.

## 7.2.5 Documentation and Record Management

Any procedure or system in an organization has documentation requirements because if something is not documented, then there is no evidence that it was done. Documentation not only provides proof that the system is in place but the review and understanding of the documentation also facilitates the continual improvement of the system.

To ensure proper documentation and record management, the following shall be well documented in any organization:

i. Policy: The policy statement must be written and kept current.

ii. Regulations: A review of the legal applicability of regulations should be documented.

iii. Structure and Responsibilities: Responsibilities and Authority for managing the overall program for the organization and any individual area programs, procedures, or work instructions should be documented.

iv. Objectives and Goals: Meaningful and attainable goals should be set for the safety management system and should be documented.

v. Activities: The measurements are taken, including baseline data, should be well documented. It assists in determining (i.e., evidence) if there is progress toward achieving the goal or not

vi. Data and Measurements: Audits, inspection results, and findings should be documented for safety and health management.

vii. Changes and Corrective Actions: Changes to equipment and procedures should be documented, including the reasons for change.

viii. Procedures and Records: Instructions or procedures outlining the specific steps that must be taken by the employees should be documented to assure that their tasks or activities remain compliant with the regulations. Records to be documented include training records, established safety and health goals, results of measurements (ventilation readings, noise readings, air quality measurements, etc.), audit and inspection results, corrective actions taken, communication with authorities (OSHA, etc.), injury logs and/or incident reporting data should be maintained.

ix. Emergency Response Information: Emergency Evacuation and Response procedures should be clearly written and communicated to employees.

## Summary

- Infection and sources of infection spread
- Types of infections and their treatment
- Infection Control Methods
- Cleaning and sanitization process
- Appropriate methods of storing the sanitizing material
- Responsibility for self in case of any illness
- Importance of health audits
- SOPs and their review process
- Document and Record Management

## Exercise

**Answer the following questions:**

1. What do you understand by the term "Infection"?

   _____

   _____

2. What are the various sources of infection transmission?

   _____

   _____

3. Explain the procedure to clean, sanitize and disinfect the workplace.

   _____

   _____

4. What precautions shall be taken to prevent the spread of infection?

   _____

   _____

5. What steps should you follow if you feel ill at the workplace?

   _____

   _____

6. What do you understand by preventive health check-ups?

   _____

   _____

7. Explain the process of conducting a health and safety audit?

   _____

   _____

8. What records should be maintained for a process in an organization?

   _____

   _____

9. State True/False:

   i. Alcohol-based hand rub is the preferred method of hand hygiene. (True)

   ii. Allow hands to dry before applying gloves to ensure the full antiseptic effect. (True)

   iii. It is not necessary to wash your hands after removing gloves because the gloves protect your hands. (False)

   iv. Removing all the soap from your wrists and hands is essential, keeping your hands up and your elbows down to rinse away the micro-organisms. (False)

10. Fill in the blanks:

i. _____ is the first step while conducting an audit.

ii. FSSAI stands for _____.

iii. _____, _____, _____ are the basic and mandatory health-checks every organization should organize for their employees

iv. A written plan of a process that assesses its potential hazards and explains how the hazards have been eliminated or minimized is called _____.

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# 8. Employability Skills (30 Hours)

DGT/VSQ/N0101

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# 9. Annexure

Lists of QR Codes used in the PH

## ANNEXURE - Lists of QR Codes used in the PH

| S.No. | Chapter No. | Unit No. | Topic Name | Page No. | QR code(s) | URL |
|---|---|---|---|---|---|---|
| 1 | Chapter 1: Introduction to food processing sector and the job of a "Food Packaging Developer" | Unit 1.2 - Introduction to the Food Processing Industry | Scope of food processing in India with National and International perspective | 9 | | https://www.youtube.com/watch?v=5VlYw38hCxU |
| 2 | | Unit 1.2 - Introduction to the Food Processing Industry | Overview of Food Processing Industry | 9 | | https://www.youtube.com/watch?v=J-2EiMVNtpM |
| 3 | Chapter 2: Prepare for Developig Packaging Material | Unit 2.3 - Prepare for Testing | Food Packaging and labelling | 52 | | https://www.youtube.com/watch?v=UhDRNXLIvTA |
| 4 | | Unit 2.3 - Prepare for Testing | Food Packaging | 52 | | https://www.youtube.com/watch?v=osA74cAqMLc |
| 5 | | Unit 2.3 - Prepare for Testing | Packaging Techniques | 52 | | https://www.youtube.com/watch?v=TZONvx4eDyA |
| 6 | Chapter 3: Perform Tasks for Testing Packaging Material | Unit 3.3 – Post-trial activities | Testing of Packaging Materials | 108 | | https://www.youtube.com/watch?v=JGeZFPnIQbI |
| 7 | | Unit 3.3 – Post-trial activities | Quality evaluation of packaging materials | 108 | | https://www.youtube.com/watch?v=n8xbfS6-SxE |

| S.No. | Chapter No. | Unit No. | Topic Name | Page No. | QR code(s) | URL |
|---|---|---|---|---|---|---|
| 8 | Chapter 4: Basic Food Safety Standards | Unit 4.4 - Food Production Process - Records and Documentation | General requirement on hygiene and sanitation | 145 | | https://www.youtube.com/watch?v=d-5kn5ns0zWM |
| 9 | | Unit 4.4 - Food Production Process - Records and Documentation | Food safety | 145 | | https://www.youtube.com/watch?v=KBvU4B-mu5O0 |
| 10 | Chapter 6: Manage Workplace Emergencies | Unit 6.3 - Health, Safety and Security Breaches | Emergency Procedures | 201 | | https://www.youtube.com/watch?v=DaYwcH-1GMEg |
| 11 | Employability skills (30 hours) | Employability skills (30 hours) | Employability skills (30 hours) | 224 | | https://www.skillindiadigital.gov.in/content/list |

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