



Participant Handbook

Sector
Food Processing

Sub-Sector
Fruits & Vegetables

Occupation
Processing- Fruits and Vegetables

Reference ID: FIC/Q0106, Version-4.0
NSQF Level: 3



**Fruit Pulp Processing
Technician**



Shri Narendra Modi
Prime Minister of India

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



Certificate

COMPLIANCE TO QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

FOOD INDUSTRY CAPACITY AND SKILL INITIATIVE SECTOR SKILL COUNCIL

for Food Processing

SKILLING CONTENT - PARTICIPANT HANDBOOK

Complying to National Occupational Standards of

Job Role/Qualification Pack: **Fruit Pulp Processing Technician** QP Nos **FIC/Qo1o6 Level 3**

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Authorised Signatory
(Food Industry Capacity and Skill Initiative)

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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 Qualification Pack (QP) for Fruit Pulp Processing Technician with Reference ID: FIC/Q0106 published by Food Industry Capacity Industry and Skill Initiative (FICSI).

This course encompasses all National Occupational Standards (NOS) of the Qualification Pack, Fruit Pulp Processing, Reference ID: FIC/Q0106. Each NOS is covered across one unit/s. This book is designed for upgrading the knowledge and skills for working as a 'Fruit Pulp Processing Technician' in the Food Processing Industry. This book will provide the necessary knowledge and skill inputs for a Fruit Pulp Processing Technician to work in an organized and the disciplined manner and following safe working practices, effective communication, documentation, and work ethics as well as production work, ensuring preparation and maintenance of work area along with the required machinery. Upon successful completion of this course the participant will be able to:

1. FIC/N9026: Prepare for Production
2. FIC/N0122: Produce Fruit Pulp from Various Fruits
3. FIC/N9901: Implement health and safety practices at the workplace
4. FIC/N9902: Work effectively in an organization
5. SGJ/N1702: Optimize resource utilization at workplace
6. FIC/N0103: Produce squash and juices
7. FIC/N0111: Produce jam, jelly and ketchup
8. DGT/VSQ/N0101: Employability Skills

Symbols Used



Key Learning
Outcomes



Unit
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1. Introduction to Food Processing Sector and the Job of Fruit Pulp Processing Technician



Unit 1.1 - Introduction to Food Processing Industry

Unit 1.2 - Roles and Responsibilities of Fruit Pulp Processing Technician



Key Learning Objectives



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

1. Describe the food processing industry and its sub-sectors in brief
2. Discuss the roles and responsibilities of a Fruit Pulp Processing Technician

Unit 1.1 Introduction to Food Processing Industry

Unit Objective

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

1. Define food processing and fruits and vegetables processing
2. Discuss the food processing industry in brief
3. Explain the terminologies used in the process of food processing

1.1.1 Food Processing

Agriculture is India's mainstay industry. The majority of the products from various agricultural occupations are consumed within the country and exported to different countries around the world. Agriculture produce is also used as a raw in the food processing industry. Food processing is the process of transforming raw materials into finished goods. They could be processed foods, ready-to-eat foods, food additives, or ingredients used to make other foods. The following figure explains the different level of food processing.

Primary Food Processing

- Primary Processing relates to the conversion of raw agricultural produce, milk, meat, and fish into a commodity that is fit for human consumption
- It involves steps such as cleaning, grading, sorting, packing, etc.

Secondary Processing

- Secondary food processing is the conversion of ingredients into edible products -
- This involves combining foods in a particular way to change properties. E.g. - Preparing of orange juices from oranges

Tertiary Food Processing

- Tertiary food processing is the commercial production of what is commonly called processed food
- These are ready-to-eat (RTE) or heat-and-serve foods.

Fig 1.1 Level of Food Processing

1.1.2 Journey of Food from Harvest to Consumer

The flowchart below explains the process by which food material becomes a final, consumable product for various customers.

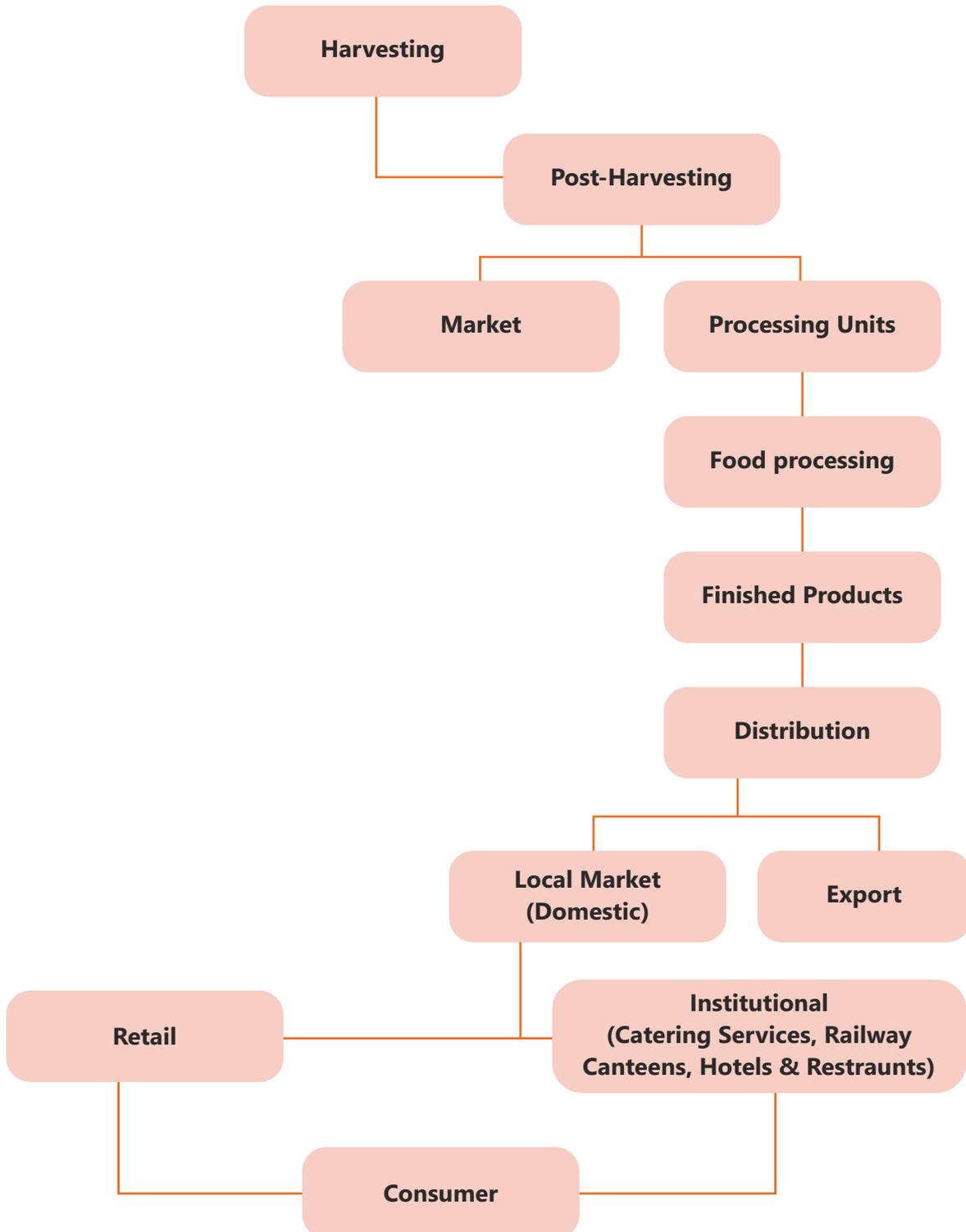


Fig.1.2 Journey of Foods from Farm to Consumer

1.1.3 India's Food Processing Industry

- The major segments in the Food Processing sector comprise of Fruits and Vegetables, Dairy, Edible Oils, Meat and Poultry, Non-alcoholic beverages, Grain-based products, Marine products, Sugar and sugar-based products, Alcoholic beverages, Pulses, Aerated beverages, Malted beverages, Spices, and Salt.
- In India, the food processing industry is divided into several sub-sectors.

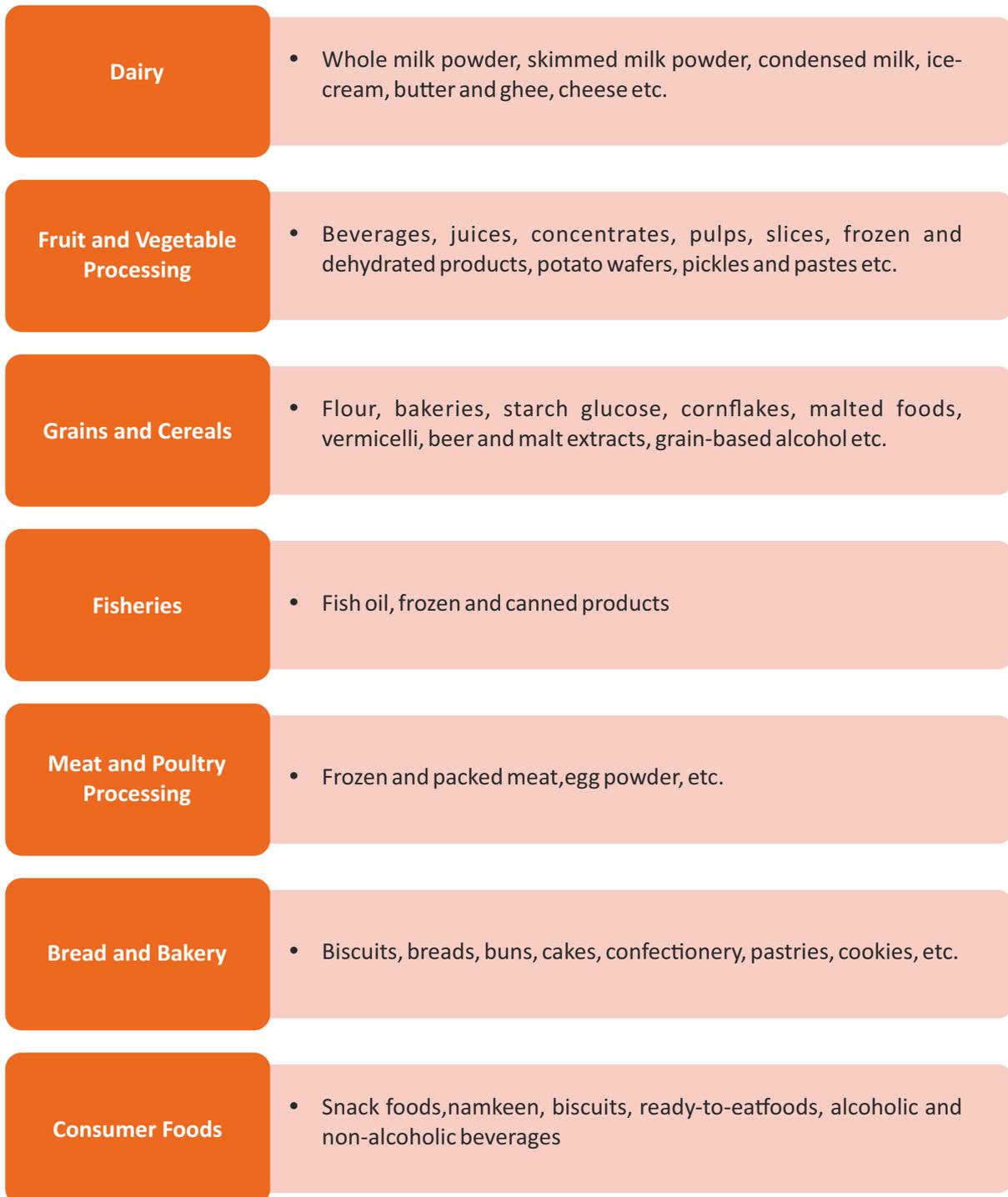


Fig.1.3 Sub-Sectors of the Food Processing Industry

1.1.4 Overview of the Fruit and Vegetable Processing Sector

The fruit and vegetable processing sub-sector deals with processed foods, semi-processed foods, and packaged foods that are made from fruits and vegetables. These includes:



Juices



Jellies



Pulps



Concentrated foods



Frozen foods



Confectionaries



Pickles



Jams

Fig.1.4 Various Processed and Semi-Processed Food Products

Certain parameters are important to consider when selecting a fruit/vegetable for processing. They are:

1. Demand for processed food made from that vegetable/fruit
2. High quality produce
3. Continuous supply

These parameters are critical for ensuring that raw materials can withstand the processing and preservation processes.

Notes



1.1.5 Methods of Processing Fruits and Vegetables

The following are some common methods of processing fruits and vegetables:



Drying



Concentration



Washing



Fermentation



Sterilization



Pasteurization



Blanching



Canning

Fig.1.5 Different Food Processing Methods

1.1.6 Various Terminologies used in the Process of Food Processing

The following table explains various terms used in food Processing:

Terminology	Meaning
Brix	Brix is a unit of measurement for the density of a solution. A solution's °Brix = the percent Sucrose of the solution at room temperature.
Ambient temperature	The temperature of the immediate surroundings. The temperature in the room ranges from 19 to 23°C (68 to 77°F).
Aseptic packaging	System in which the food product and container are sterilized separately before being packed and sealed in a sterile environment.
Blanching	Immersion in hot water or heating in steam at 95°C for 1-5 minutes to reduce enzyme activity.

Continued...

Terminology	Meaning
Centrifugation	The process of spinning liquid samples at high speeds in order to accelerate the settling of particles in suspension.
Contamination	The process by which harmful or unpleasant substances (such as metal or plastic, strong odours, bacteria, or poisons) enter or are absorbed by food.
Extraction	Removing one material from another; acid extracts pectin from apple pomace, making it soluble.
Filtration	The process of filtering a liquid to remove any solid particles.
Flavour enhancers	Used to enhance or bring out the flavour and/or odour of foods without imparting their own distinct flavour.
Grading	Sorting unlike quantities of the same product into uniform groups based on quality requirements.
Heat processing	Heat treatment of jars to allow food storage at normal home temperatures.
Hydrometer	Instrument that measures particular gravity of liquids, used to measure salt, sugar or alcohol concentration.
ISO	International Standards Organization
Ohmic heating	Ohmic heating is a novel sterilization technique that generates heat within a food product due to its inherent resistance.
Pasteurization	Process designed to reduce the population of pathogenic bacteria in a product to ensure product safety while having little impact on nutritional properties and flavour.
pH value	Measure of the acid/base properties of a substance.
Potable water	Water from an approved source which meets all drinking water quality standards.

Continued...

Terminology	Meaning
Refractometer	Instrument that measures the refractive index of a liquid, which is used to measure soluble solids in syrups, jams and marmalades, or salt in brines.
Shelf-life	Length of time between packaging and use that a food product remains of acceptable quality to the user.
Standard Operating Procedures (SOP)	Written procedures that will be followed in operating a food service system.
Sterilization	Process in which foods are treated to kill all forms of micro-organisms and spores.
Viscosity	Measure for the flow properties of a substance (expressed in mPa.s)
Workstation	Area and equipment used to do similar work (i.e. vegetable preparation) or a specific set of tasks
UHT	Ultra High Temperature.

Table 1.1 Common Terminologies used in Food Processing

Scan the QR Code to watch the related video



<https://www.youtube.com/watch?v=J-2EiMVNtpM&t=5s>

Overview of Food Processing Industry



<https://www.youtube.com/watch?v=hW10tq2fWfY>

Overview of Fruit and vegetables industry



<https://www.youtube.com/watch?v=TC1mGaWoyXk>

Orientation video of fruit pulp

Exercise

Answer the following questions:

1. Explain different levels of food processing.
2. List different methods of fruit and vegetable processing.
3. Give any two examples of processed food products.
4. Explain the terminologies below:
 - a. Refractometer
 - b. Shelf-life
 - c. Standard Operating Procedures (SOP)
 - d. Hydrometer
 - e. pH value

Choose the correct answers:

1. _____ have made inroads into the online grocery business, gaining significant popularity among urban consumers.
 - a. Flipkart
 - b. Amazon
 - c. Pharmeasy
2. _____ have made inroads into the online grocery business, gaining significant popularity among urban consumers.
 - a. Demand
 - b. High quality produce
 - c. Both a & b
3. _____ processing is related to the conversion of raw agricultural produce into a commodity that is fit for human consumption
 - a. Primary
 - b. Secondary
 - c. Tertiary

Unit 1.2 Career Opportunities for Fruit Pulp Processing Technician

Unit Objective

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

1. Discuss the standard business etiquette and code of conduct in the food processing industry
2. Discuss the career opportunities available to a Fruit Pulp Processing Technician in the food processing industry

1.2.1 Standard Business Etiquette & Code of Conduct

A professional code of ethics establishes ethical guidelines and best practices for an organization to maintain honesty, integrity, and professionalism. Members of an organization who violate the code of ethics may face sanctions, including termination. The figure below explains the standard practices and professional code of ethics that every food organization adheres to.



Be Punctual



Compliance with laws and regulations



Showcase professional behavior



Address seniors, assistants, and workers with respect



Follow the processes laid out in the manufacturing unit



Follow food safety norms at all times



Do not compromise with the quality of the product at any given cost



Perform your work with complete honesty



Perform your roles and responsibility with integrity



Be a team player



Avoid Conflicts of Interest



Keep accurate and complete records

Fig.1.6 Standard Code of Conduct

Work ethics are the morals or principles that govern a person's or group's behaviour, whereas etiquette is a set of rules indicating the proper and polite way to behave at work. Both contribute positive energy and influence an organization's growth. Workplace etiquettes promote honesty, integrity, and respect for one another in the workplace and encourage healthy and interactive communication among employees.

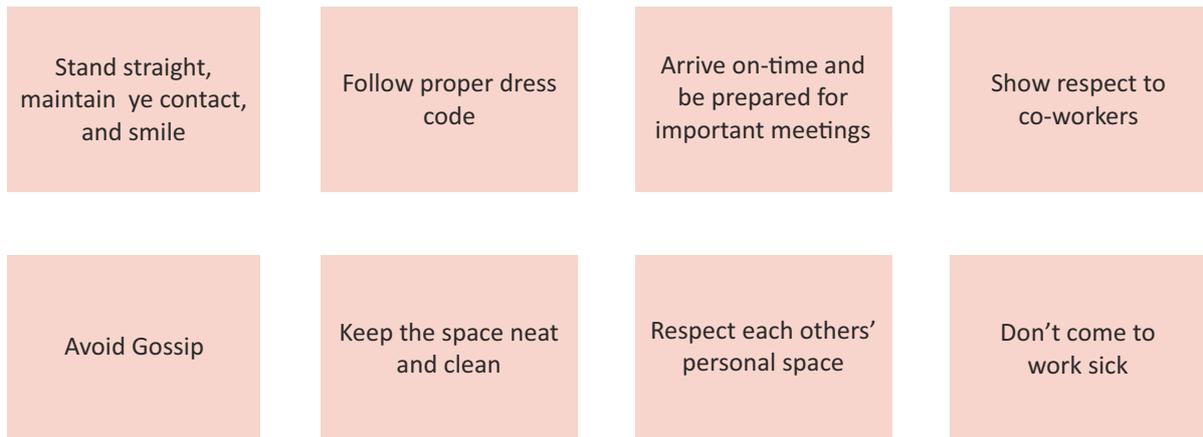


Fig.1.6 Standard Workplace/Business Etiquettes

1.2.2 Roles and responsibilities of Fruit Pulp Processing Technician

There are multiple future opportunities for fruit-pulp processing technicians in the food industry, including segments such as jam-jelly making, sauces and ketchup making, fruit juices and squash making, and so on. The following table explains the roles and responsibilities of Fruit Pulp Processing Technician

Roles	Responsibilities
Handle raw material from post-harvest storage to process line	<ul style="list-style-type: none"> • Check raw material for quality • Ensure fruits and vegetables are free from dirt, debris, foreign matter, glass and insects • Ensure minimum loss of material
Record-keeping and documentation	<ul style="list-style-type: none"> • Document and maintain records of production Schedule and process • Document and maintain records of finished Products
Hygiene and sanitation maintenance	<ul style="list-style-type: none"> • Adopt safety- and sanitation-related measures • Follow food safety norms and practices

Roles	Responsibilities
Inspect machines and troubleshoot issues or escalate them to the supervisor	<ul style="list-style-type: none"> • Ensure smooth operation of machinery to complete production line • Optimize the use of machinery • Attend to minor repairs of tools and machinery when required • Ensure that safety rules and regulations are observed • Prevent accidents
Plan and execute pickling process, examine products at different stages of pickling	<ul style="list-style-type: none"> • Adhere to Good Manufacturing Practice (GMP) • Ensure the products meet the quality standards set by the organization
Inspect intermediate as well as finished products	<ul style="list-style-type: none"> • Check cured fruits and vegetables, fermented pickles, and finished products for quantity, quality, and salt equilibrium • Ensure conformance of quality as per organizational
Follow storage and packaging norms	<ul style="list-style-type: none"> • Ensure safe and proper storage of raw material, packing material, and finished goods

Table 1.2 Roles and Responsibilities

Summary

- Food processing is the process of transforming raw materials into finished goods. They could be processed foods, ready-to-eat foods, food additives, or ingredients used to make other foods.
- There are three types of food processing – primary, secondary and tertiary processing.
- In India, the food processing industry is divided into several sub-sectors such as dairy fruit and vegetable processing, grains and cereals, fisheries, meat and poultry processing, bread and bakery and consumer foods.
- The fruit and vegetable processing sub-sector deals with processed foods, semi-processed foods, and packaged foods that are made from fruits and vegetables. For Example – juices, jellies, pulps, concentrated foods
- The important parameters to consider when selecting a fruit/vegetable for processing are demand for processed food made from that vegetable/fruit, high quality produce and continuous supply.
- A professional code of ethics establishes ethical guidelines and best practices for an organization to maintain honesty, integrity, and professionalism.
- Work ethics are the morals or principles that govern a person's or group's behavior, whereas etiquette is a set of rules indicating the proper and polite way to behave at work.
- There are multiple future opportunities for fruit-pulp processing technicians in the food industry, including segments such as jam-jelly making, sauces and ketchup making, fruit juices and squash making, and so on.

Exercise

Answer the following questions:

1. List the roles and responsibilities of Fruit Pulp Processing Technician.
2. Write a short note on:
 - a. Code of Conduct
 - b. Workplace Etiquettes

Fill in the Blanks:

1. _____ promote honesty, integrity, and respect for one another in the workplace and encourage healthy and interactive communication among employees.
2. _____ inspect intermediate as well as finished products.
3. Employee who violate the _____ may face sanctions, including termination.

Scan the QR Code to watch the related video



<https://www.youtube.com/watch?v=F4qEpblDaks>

Roles and responsibility of Pulp Making technician

2. Prepare for production



Unit2.1 - Production Planning process

Unit2.2 - Equipment types and its use

Unit2.3 - Cleaning and Maintenance



Key Learning Objectives



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

1. Discuss the standard practices to be followed for production
2. Demonstrate the tasks to be performed at the workplace for planning the production

Unit 2.1 - Production Planning process

Unit Objective

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

1. Elucidate production planning process
2. Discuss analysis and interpretation of various process charts, product flow charts, etc.
3. Discuss the procedure to allot work or responsibility to the team.
4. Explain the resource management process
5. Calculate procedure to estimate manpower and raw material.
6. Explain the capacity utilization calculation.

2.1.2 Planning and Prioritizing Production work

Production refers to the transformation of inputs into finished goods/ or the creation of services to satisfy the customer needs. Production involves applying processes by which the inputs can be transformed into the desired product (output) of potential utility while improving properties and adding economic value through the best method without compromising on quality. So it is that activity whereby resources, flowing within a defined system, are combined and transformed in a controlled manner to add value, following the policies communicated by management. A simplified production system is shown below:

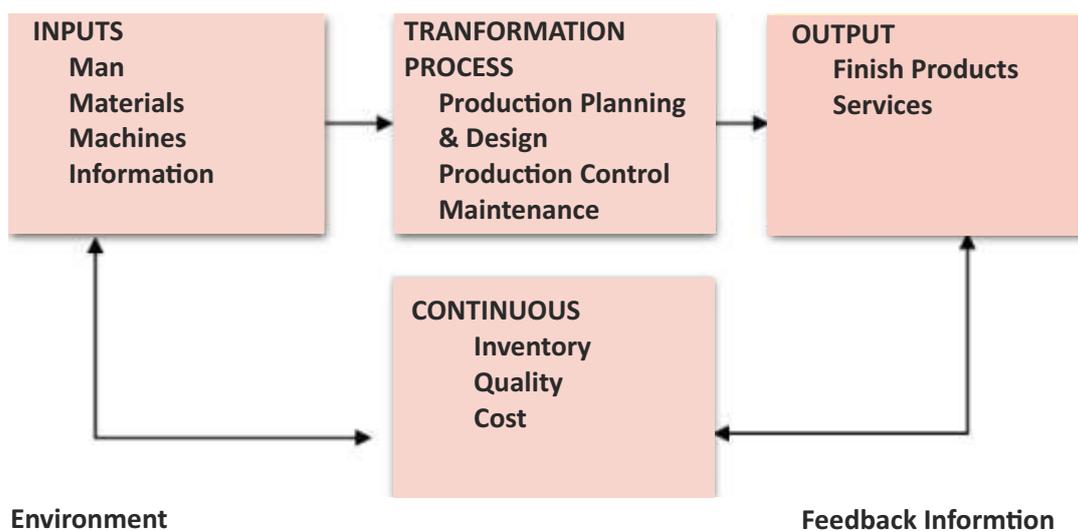


Fig.2.1 Schematic Production System

Production planning is a process that is necessarily required to ensure efficient and economical production. Therefore, planned production is an essential feature of the food processing industry. It is an instrument to coordinate and integrate the entire manufacturing activities in a production system. It develops the requirements for storage and production capacity needs based on food processing. The production planning for fruit and pulp processing industry consists of various plans related to routing, scheduling, dispatching, inspection and coordination, control of materials, machines, tools, and operating times.

2.1.2 Production Planning Analysis and Interpretation

The production process planning is rarely linear. Often new ideas and unforeseen possibilities surface. This creative problem-solving process may lead to considering a previously deemed unacceptable option, or it may reveal a solution that was not thought about in any previous plans. These back and forth developments ultimately lead to the best solution for expanding, refurbishing or constructing a new food plant.

The Production Plan for fruit and pulp processing begins with collecting data on any current or proposed food processing and storage operation. It consists of various charts, manuals, production budgets, etc., based on information received from management. These production plans and charts provide practical form by carrying different features under production control. Production planning is based on the following crucial elements:

Raw Material
Procurement of raw material, component and spare parts of machines or equipment in the right quantities and specifications at the right time from the right source at the right place.

Method of Processing
It includes determining the best sequence of operations (process plan) and planning for tooling, jigs and fixtures etc.

Machine & Equipment
It involves facilities planning, capacity planning, allocations, and utilization of plant and equipment, machines etc

Manpower
Planning for manpower (labour and managerial levels) having appropriate skills and expertise.

Routing
It determining the flow of work material handling in the plant, and sequence of operations or processing steps.

Estimation
It involves deciding the quantity of the product which needs to be produced and cost involved in it on the basis of sale forecast.

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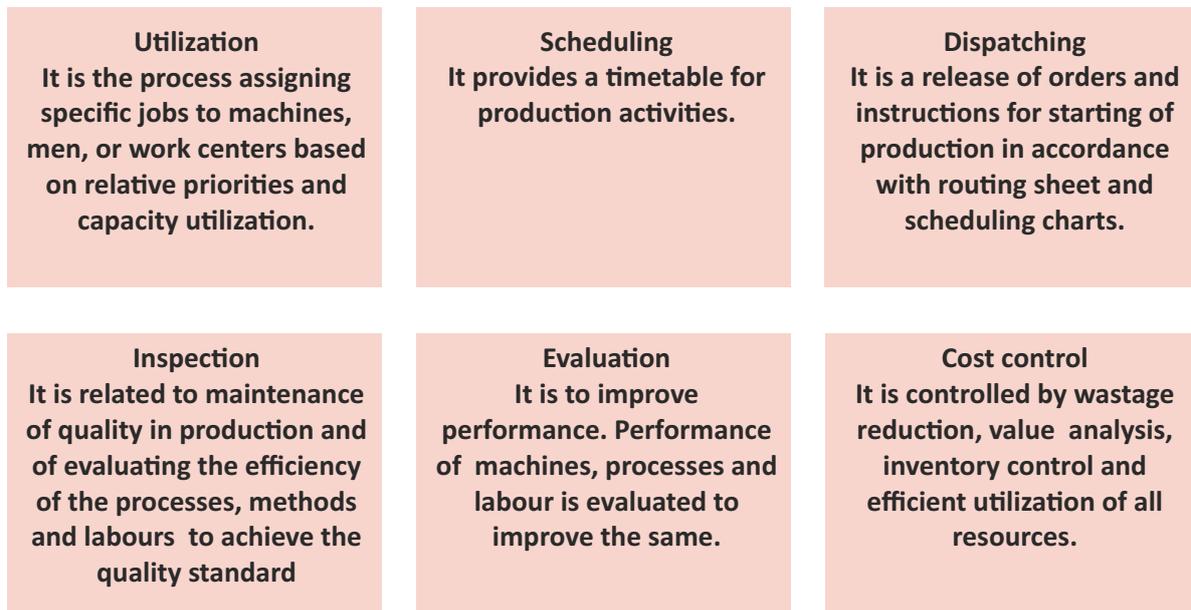


Fig.2.2 Elements of Production Planning

2.1.2.1 Prioritizing Workload

Prioritizing the production workload assist in taking control of time and ensures to meet important deadlines. Knowing daily priorities reduces stress, helps employees to focus, and improves their productivity. It also allows the employees to set better boundaries, eliminate distractions, and improve their work-life balance.



Fig.2.3 Significance of Prioritizing Production Workload

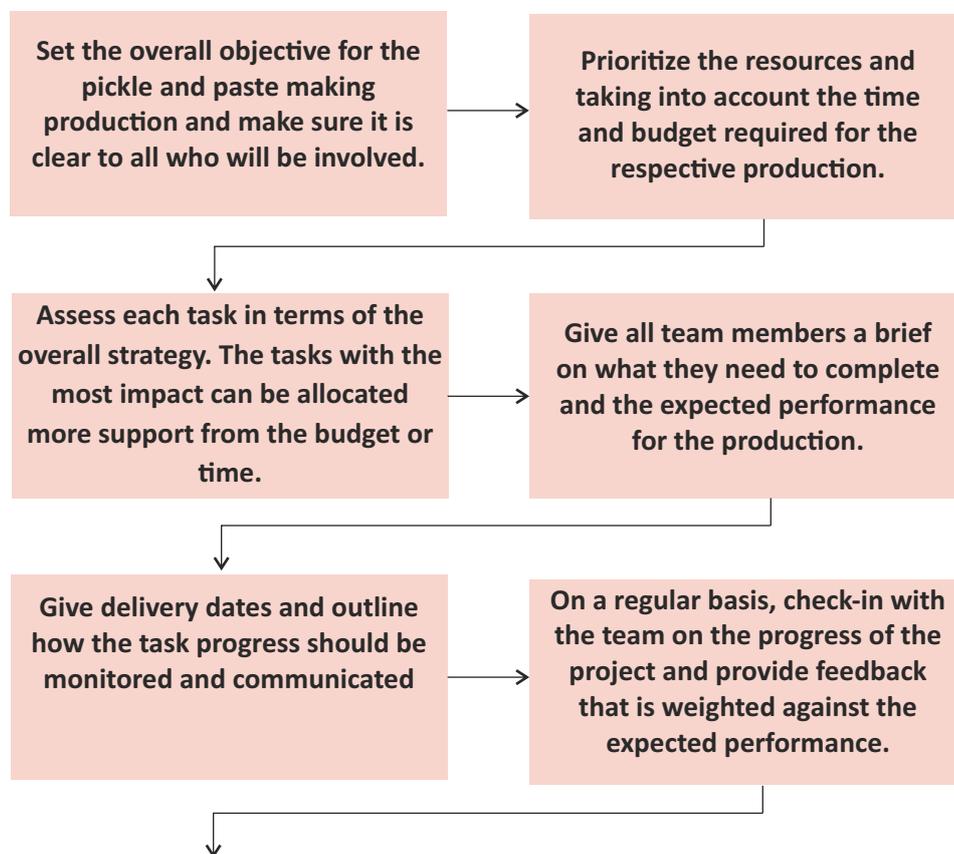
2.1.2.2 Allocation of Work or Responsibility to the Team

Work allocation needs to be done fairly to operate the team based on equality. The primary responsibility of a supervisor is to allocate tasks to each person in the team. This requires making decisions about who is capable of performing specific tasks for successful production. Following are the factors to keep in mind when distributing work:



Fig.2.4 Criteria for the Work Allocation

The following chart explains the planning and allocation of work:



Continued...

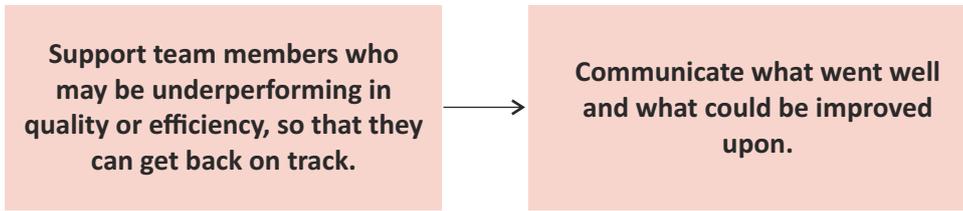


Fig.2.5 Planning and allocation of work for Pickle and Paste Making Production

2.1.3 Resource Management Process

Resource management is the process of pre-planning, scheduling, and allocating resources to maximize optimization and efficiency. It determines which resources are needed, in what quantities, and when to complete the production. This process not only helps to determine how the production process will be completed but also helps to estimate the costs and timeline associated with it.

Below are the steps for creating an effective resource management plan for pickle and paste making.

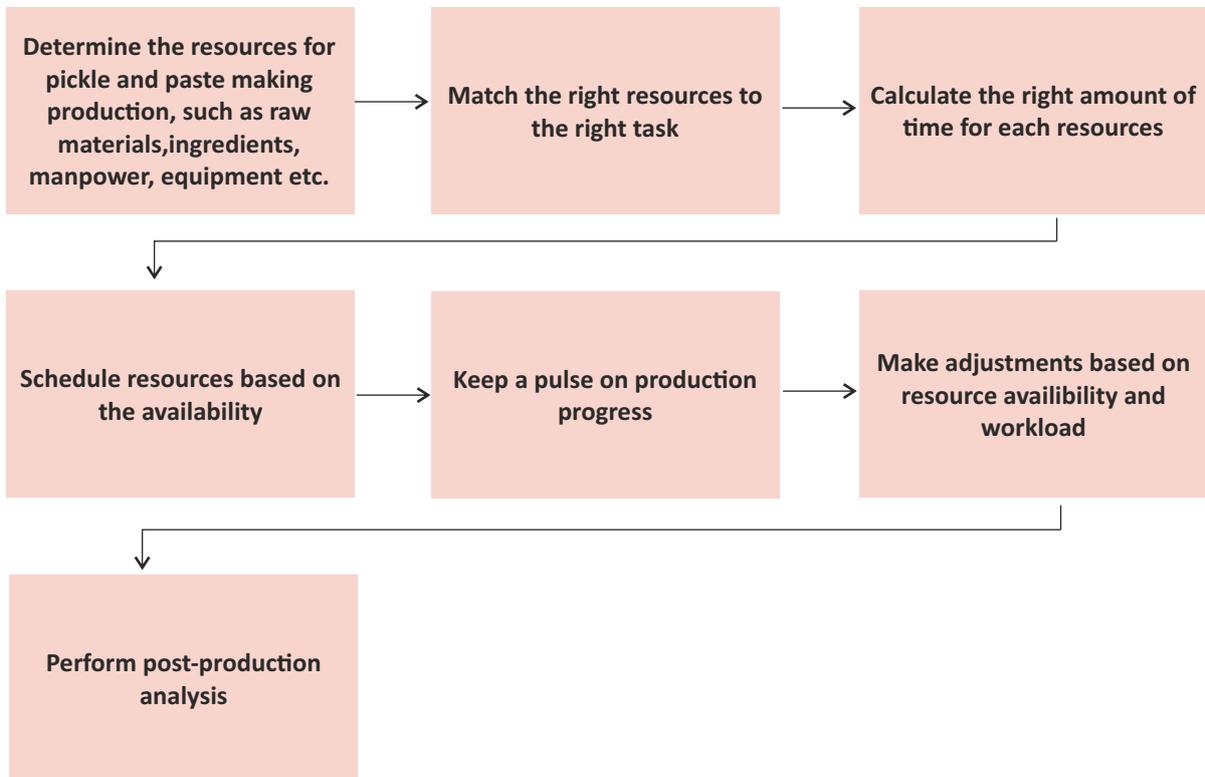


Fig.2.6 Process of Resource Planning for Pickle and Paste Making Production

2.1.3.1 Importance of Resource Planning

Wastage of resources can be fatal in production; therefore, every food production industry needs effective Planning. Here's why resource planning is vital for the pickle and paste making production process.

- The resource plan is prepared according to the product's delivery timelines and helps keep the production on track.
- Effective Resource planning lays the foundation of a successful production process.
- It set realistic expectations for the production deliverables among clients and other stakeholders.
- It helps to estimate production costs and profit margins accurately.
- Resource planning offers improved insight into actual costs and the overall profitability of the production.
- It prevents over-working or under-utilizing of the manpower ,which leads to increased employee satisfaction.
- It leads to optimal utilization of resources to prevent over-burdening and at the same time ensures that the food processing industry makes the most of the resources.
- Hiring decisions taken based on resource planning analysis are usually in the benefit to the production.
- A successful resource plan can be treated as a fool-proof formula for future production.

2.1.3.2 Raw Material and Manpower Estimation

The **raw material** is something that is used to produce a product. The availability of raw materials affects the production process which in turn affects the revenue of an organization. Raw material's availability assists manufacturing units in conducting production processes following the requests and wishes of the consumer. Raw material inventories are fundamental in pickle and paste making processing because the uncertain demand and availability of raw materials due to seasonal reasons can cause complications over costs incurred. Moreover, raw materials is an investment that affects the financial stability and listed as a current asset on a company's balance sheet. So, it is important to apply best practices for managing raw material inventory. There are two subdivisions of raw materials:

- a. **Direct Materials** are those resources that are part of or incorporated into the finished product. For example in pickle and paste industry vegetables, oil, spices etc
- b. **Indirect Materials** are those resources consumed during the manufacturing process but are not part of the finished product. For example disposable tools, protective equipment, cleaning supplies, fuel, light bulbs etc.

It is important to determine the value of opening and ending inventory for estimating raw materials for Fruit Pulp Processing as per production requirements. It is calculated as follows:

$$\text{Raw Materials Inventory} = \text{Beginning Inventory} + \text{Raw Materials Purchased} - \text{Cost Of Goods Sold}$$

1. **Beginning/opening inventory value** - The value is obtained from the previous accounting period balance sheet as the closing inventory.

$$\text{Opening Inventory} = (\text{Cost Of Goods Sold} + \text{Ending Raw Materials Inventory}) - \text{Raw Materials Purchased}$$

2. **Closing/ ending inventory value** – It is the inventory on hand at the close of an accounting period. The value is revealed on the balance sheet.

$$\text{Ending Inventory} = (\text{Raw Materials Purchased} + \text{Beginning Raw Materials Inventory}) - \text{Cost Of Goods Sold}$$

3. **Raw material Purchased** – it is calculated as:

$$\text{Raw Materials Purchased} = (\text{Ending Inventory} - \text{Beginning Inventory}) + \text{Cost Of Goods Sold}$$

4. **Cost of goods sold (COGS)** – It appears as an item in the income statement during the accounting period.

$$\text{Cost of goods sold} = \text{Beginning inventory} + \text{Purchases} - \text{ending inventory}$$

To calculate **manpower** requirements for pickle and paste production, divide the value of goods and services produced by the total hours worked by employees over a specified period. Here are the steps to estimate manpower for production.

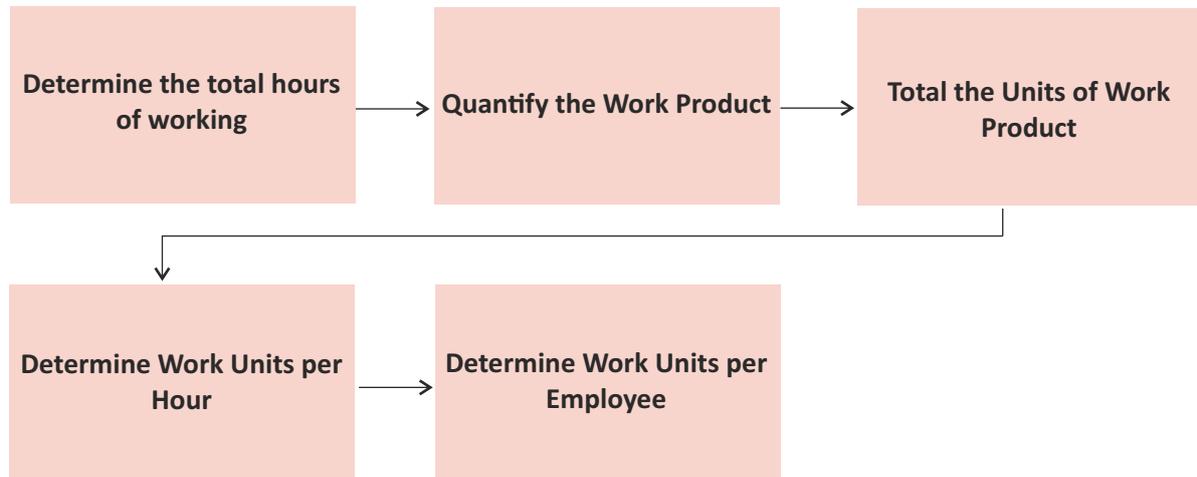


Fig.2.7 Steps to Calculate Manpower Estimation for Production

2.1.4 Capacity Utilization

Capacity utilization is a relationship between the actual and potential production output, using its capacity of machinery and available resources. The capacity utilization percentage provides an insight into a food processing industry's operational efficiency and can vary based on consumer and market demand.

1. Following are the steps to calculate the capacity utilization of production:

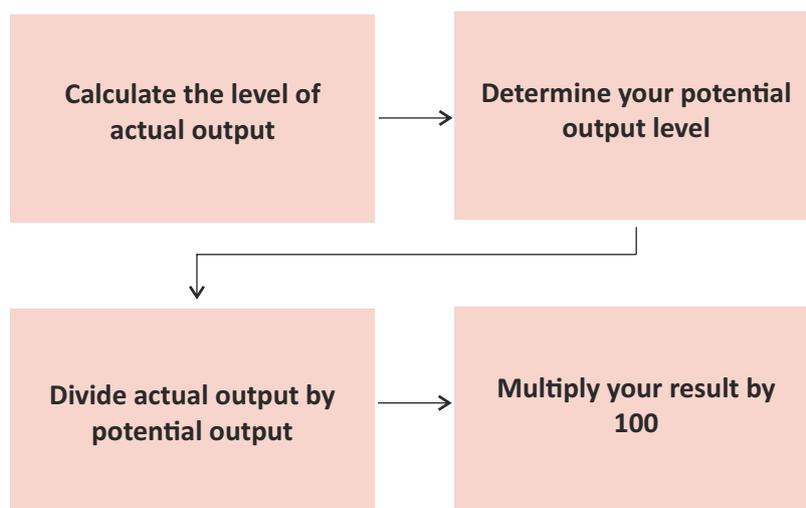


Fig.2.8 Steps to calculate Capacity utilization

The capacity utilization formula gives you the capacity utilization rate:

$$\text{Capacity utilization} = (\text{actual output level} / \text{potential output}) \times 100$$

In the above formula, the actual output level represents the number of units a manufacturing unit produces within a specific period. The potential output means the maximum capacity that companies and economies can operate at when they use all resources without incurring additional operational expenses.

2. Each machine in the production line operates at a particular cycle time. Therefore, the efficiencies of a production operation in a manufacturing system can be measured based on the utilization of production resources such as machines in a particular cycle.

$$\text{Machine capacity} = \text{operating hours} \times \text{operating rate} \times \text{the number of machines}$$

3. We can calculate the capacity of a process with respect to the batch size, using the following formula:

$$\text{Capacity} = (\text{batch size}) / (\text{set-up time} + \text{batch size} * \text{time per unit})$$

Unit 2.2 Equipment used in Fruit-pulp processing

Unit Objectives

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

1. List down equipment type and its use

2.2.1 Fruit-pulp processing Equipment and its uses

Food processing equipment is an umbrella term denoting to the components, processing machines, and systems used to handle, prepare, cook, store, and package food and food products. Although this equipment is primarily aimed toward the transformation, some pieces of equipment are also employed to perform preliminary or auxiliary functions, such as handling, preparation, and packaging.

The fruit pulp production line incorporates the following production equipment.

Equipment Name	Uses and operation
 <p>Sorting & Grading Machine https://www.amisyfoodmachine.com/vegetable-fruit-equipment/fruit-vegetable-sorting-machine.html</p>	Fruits and Vegetables are sorted and graded basis their size, color, dimension, quality, and other such physical parameters.
 <p>Washing line conveyer</p>	Wash and sanitize the fruits before moving forward to further processing.
 <p>Ripening Chamber</p>	The graded and sorted cleaned fruits/vegetables are moved to maturation or ripening chamber where the unripe or raw fruits are left for ripening

Continued...

Equipment Name	Uses and operation
 <p data-bbox="379 703 464 734">Peeler</p>	<p data-bbox="659 421 1278 488">Fruits/ vegetables are peeled into desired pieces, to facilitate the destoning and crushing process.</p>
 <p data-bbox="384 1039 453 1070">Corer</p>	<p data-bbox="659 768 1139 799">Seeds are removed from fruit/vegetable</p>
 <p data-bbox="379 1429 464 1460">Pulper</p>	<p data-bbox="659 1102 1251 1169">Extract the pulp by separating skin and fiber from fruit/vegetable</p>
 <p data-bbox="316 1659 523 1691">Filter/Cloth sieve</p>	<p data-bbox="659 1494 1382 1561">A sieve is used to separate the passage of granular materials according to particle size.</p>
 <p data-bbox="288 2002 552 2033">Sterilizer/ Pasteurizer</p>	<p data-bbox="659 1724 1385 1827">Sterilize the fruit pulp to destroy pathogenic microorganisms by heating the product to a moderately high temperature for a brief period.</p>

Continued...

Equipment Name	Uses and operation
 <p data-bbox="331 613 507 645">Refractometer</p>	Refractometer measures total soluble solids (TSS) as 0Brix, which corresponds to % sugar.
 <p data-bbox="309 1010 528 1041">Weighing balance</p>	Used to weigh small amounts of ingredients or laboratory chemicals, weighing of ingredients and products, and weighing of fruit and vegetables respectively.

Table. 2.1 Equipment and its uses

Unit 2.3 Cleaning and Maintenance

Unit Objectives

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

1. Discuss the organizational policies and SOP on cleanliness
2. List down the basic concept of food safety and hygiene
3. Describe the operating procedure and general maintenance of food production machinery
4. State waste management procedures
5. List down the methods to inspect tools, equipment, and machinery

2.3.1 Standard Procedures on Cleanliness

Good standard hygiene is the most reliable basis for infection control. In addition to hand hygiene, it comprises surface disinfection and cleaning, and the use of protective clothing. Installing the correct facilities for staff to ensure proper personal hygiene is met contributes towards meeting food safety requirements. Following factors are considered to ensure personal hygiene:



Fig.2.9 Standard Hygiene Practices

Food processing facilities rely on the use of potentially dangerous chemicals for sanitation and pest control. Because of this attention has to be applied to reduce the risk of accidental environmental contamination during the food processing cycle. Food safety practices need to be applied to ensure the chemicals stored and used on food processing premises do not contaminate the food products at any stage in production. Cleaning and sanitation in the food industry are critical for maintaining quality. The necessary steps to follow in the food processing industry are:

Engage all personnel

- Ensuring that sanitation teams have adequate resources to perform the work, including time, training, employees, equipment, sanitizers, and potable water.

Provide ongoing training

- All employees who work in a food processing facility should be trained in food safety, personal safety, and sanitation procedures. Training events should happen more frequently to reinforce new concepts.

Create a documented program

- Documented program that outlines what needs to be cleaned, how often it needs to happen, what sanitizing products should be used, and what procedures are in place to verify cleanliness.

Check your water quality

- Have the water quality in your facility analyzed once a year and, when necessary, condition the water to achieve the desired chemistry.

Follow sanitation standard operating procedures (SSOPs)

- How to dismantle equipment
- Application procedures for specific equipment
- Chemical concentrations for sanitizers
- Contact times for sanitizers
- Closely following SSOPs.

Clean the drains

- Clean drains to reduce the chances of cross-contamination during the cleaning and sanitation process. Implementing a weekly drain cleaning program can also help you avoid potential issues.

Verify sanitation processes

- Confirm that surfaces have been sanitized using the appropriate steps.

Use verification data to improve processes

- Gather data to validate the sanitation process, share it with the team so they can continually learn

Continued...

Protect sanitary spaces

- Use signs, barriers, and color-coding to physically indicate the areas of the plant that are clean and those that are dirty.

Color-code sanitation tools

- Color-code your equipment so that it's clear which items can be used for specific tasks to help avoid cross-contamination between sanitation and production equipment.

Fig.2.10 Steps Of Cleaning In the Food Processing Industry

2.3.1.1 Cleaning and Sanitizing Work Area and Machinery

The cleaning and sanitizing process are one of the most essential programs in the food processing industry. It has always been a critical element for ensuring food safety and quality. Food processing industries need to be kept spotlessly clean to ensure compliance with standard regulations and prevent contamination. Everything from random debris to flakes of rust and paint needs to be kept clear from foodstuff to make sure the product is entirely safe for consumption, so frequent cleaning is vital to food processing operations.

Though the entire process is quite tricky because of the complexity of the machinery and equipment used in the industry, it can also introduce additional difficulty by creating a wet environment. Equipment must be designed and built to withstand these environments, like using only food-grade stainless steel, but the complexity doesn't end there. High-pressure washers used to clean equipment can also strip the coatings on machines and cause injuries to employees, and the wet environment itself often poses a slip-and-fall hazard as well as food contamination.

Cleaning and sanitizing (disinfecting) are usually two separate processes. Effective cleaning must be carried out before sanitizing the work area and machinery, as sanitizers may not work as well if the work area or machinery has not had all visible contamination removed. Cleaning is often done using correct proportion of detergent and water. **Detergents** are chemicals that eliminate dirt and grease. However, it does not kill bacteria and other microorganisms. Microorganisms may be removed during the cleaning process but it can't be destroyed properly. Hence, sanitizing is required for this purpose.

The primary reasons for cleaning and sanitizing the work area and machinery are:



Fig. 2.11 Reasons for Cleaning and Sanitizing

The food processing industry follows standard procedures for cleaning the work area to ensure no bacterial growth due to the presence of leftover food particles. For cleaning purposes, the pickle and paste making work area are divided into two categories:

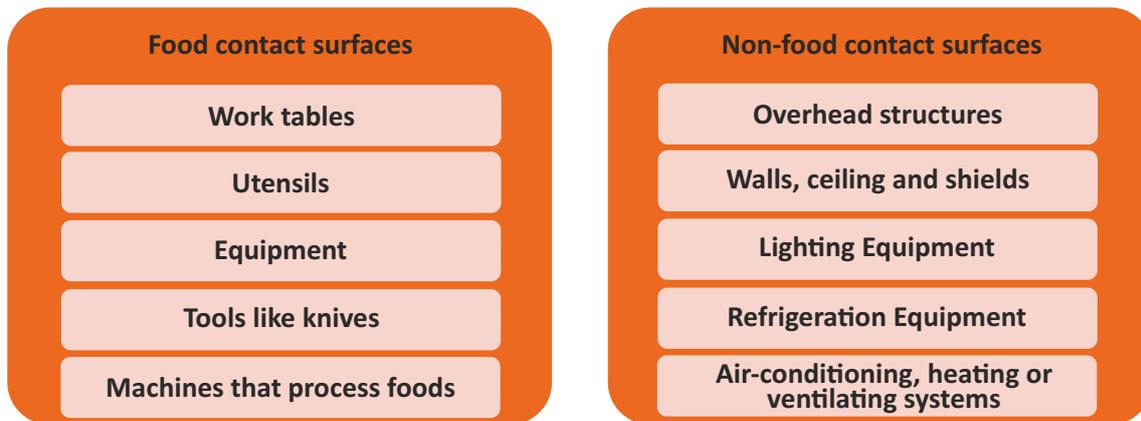


Fig. 2.12 Cleaning Work Area Categories

Proper and regular cleaning of the work areas protects food from any contamination. The cleanliness of the ambient air should also be controlled in the workplace, where contamination of any infectious material will be dangerous. The surfaces used for producing and storing Fruit Pulp products should always be dry and hygienic during use. When wet cleaning is required, these surfaces must be sanitized and thoroughly dried to use. The entire work area in wet applications must be cleaned and sanitized absolutely before use or at the risk of contamination. Fruit Pulp processing equipment and tools when not in usage should be stored properly to avoid any contamination risk.

2.3.1.2 Types of Cleaning Equipment & Materials for Work Area & Machinery

Cleaning equipment is divided into two sub-categories:

1. **Manual cleaning equipment** – Depends upon operation and energies of the employees and requisite the staff's maximum effort and techniques for cleaning.
2. **Automatic cleaning equipment** – Requires electricity or battery power for the operation. These cleaning machines ease labor and save a lot of time.



Microfiber Cloth



Abrasives



Different types of cleaning brushes - e.g. hard and soft floor brushes, scrubbing brushes.

Continued...



Brooms



Vaccum Cleaner



Polishing Machine



Floor Scrubber



Steam Vapour Machine



High Pressure Sprays

Fig. 2.13 List of Equipment and Materials for Cleaning Work Area

2.3.1.3 Cleaning Agents and Sanitizers Used for Cleaning

There are several common cleaning and sanitizing agents that can be used to clean the food-contact and non-food contact surfaces. Select the right kind of cleaning agent or sanitizer based on the variation of soils, water hardness, the temperature of the method, plant surfaces, machinery, equipment, and tools.

Detergent suppliers usually have a range of detergents to be employed in varying and specific circumstances. The range of products will include:

Alkalis:

- Caustic soda
- Caustic potash
- Coronate
- Silicate,
- Phosphate

Acids:

- Phosphoric
- Nitric
- Citric
- Glycolic

Chelates:

- EDTA
- NTA
- Gluconate
- Glucoheptonate, citrate
- Polymeric

Solvents:

- Isopropanol
- Propylene
- Butyl diglycol
- Ethers

Surfactants:

- Anionic
- Cationic
- Non-ionic
- Amphoteric

Inhibitors:

- Organic
- Inorganic

Enzymes:

- Protease
- Lipase
- Amylase

Oxidising agents:

- Hypochlorite
- Isocyanurates

Stabilisers

Viscosity modifiers

Fig. 2.14 Various Ranges of Detergents

There are three acceptable types of sanitizer solutions for use in the food processing industry.

Chlorine (Bleach)
Concentration:
50 to 100 ppm

- They are inexpensive and commonly used sanitizers that are effective against all bacteria.
- Bleach is less effective in hot water and works best at a temperature range of 12.78°C-23.89°C.
- Do not use splashless, scented or non-chlorine/color safe bleach.

Quaternary Ammonia (QUAT, QAC)
Concentration: As per manufacturer's instruction

- These come in diluted form and are odorless, colorless and nontoxic.
- They are stable at high temperatures, and are more effective in the presence of organic materials than chlorine.
- It takes longer time to sanitize against some common spoilage bacteria.

Iodine Concentration:
12.5 to 25 ppm

- Iodine compounds or iodophors are fast-acting and effective against all bacteria.
- They are relatively nontoxic, non-irritating to skin, and stable.

Fig. 2.15 List of Sanitizers for Work Area and Machineries

2.3.1.4 Effective Practices for Sanitization and Cleaning

It is compulsory to follow the manufacturer's instructions provided on the label for effective and safe use of a sanitizer.

- Some sanitizers are toxic to people, and the residue must be rinsed off, while other sanitizers are food-safe and do not require rinsing. So, the manufacturer's instructions shall always be followed for the sanitizer to ensure safe use.
- Sanitizers work best at the correct dilution. If they are too weak, they do not work effectively, and money is being wasted if they are too strong.
- Sanitizers need time to work. The contact time varies depending on the job.
- Check the dilution, contact time, safety precautions, shelf life, and storage of all chemicals before use.

Cleaning and sanitization take time and cost money. However, well-designed and organized food processing businesses can reduce the time needed for thorough cleaning with proper planning. In some cases, the combined operation of cleaning and sanitization are performed using a sanitizer which has the features of both a detergent and a sanitizer. Still, the two-stage approach is more consistent and effective than the single-stage sanitizer approach. In the pickle and paste-making processing industry, non-scented chemicals are used in operations due to the risk of taint. When cleaning and sanitizing work areas and equipments, the following practices must be followed:



Fig. 2.16 Standard Practices for Cleaning the work area and equipment

Cleaning and sanitization is a complex process. A defined and systematic approach should be followed to ensure it is conducted appropriately that considers several factors. This approach takes the form of a procedure, which is usually a legal and a fundamental requirement of global food standards. A collection of these cleaning procedures forms a Cleaning Plan or Program, which is plant-specific. The correct sequence of a general cleaning procedure for surfaces in a food plant is:



Fig.2.17 Steps for Cleaning Work Area

The following chart explains workflow process of cleaning and maintenance of Fruit Pulp processing machinery and equipment.

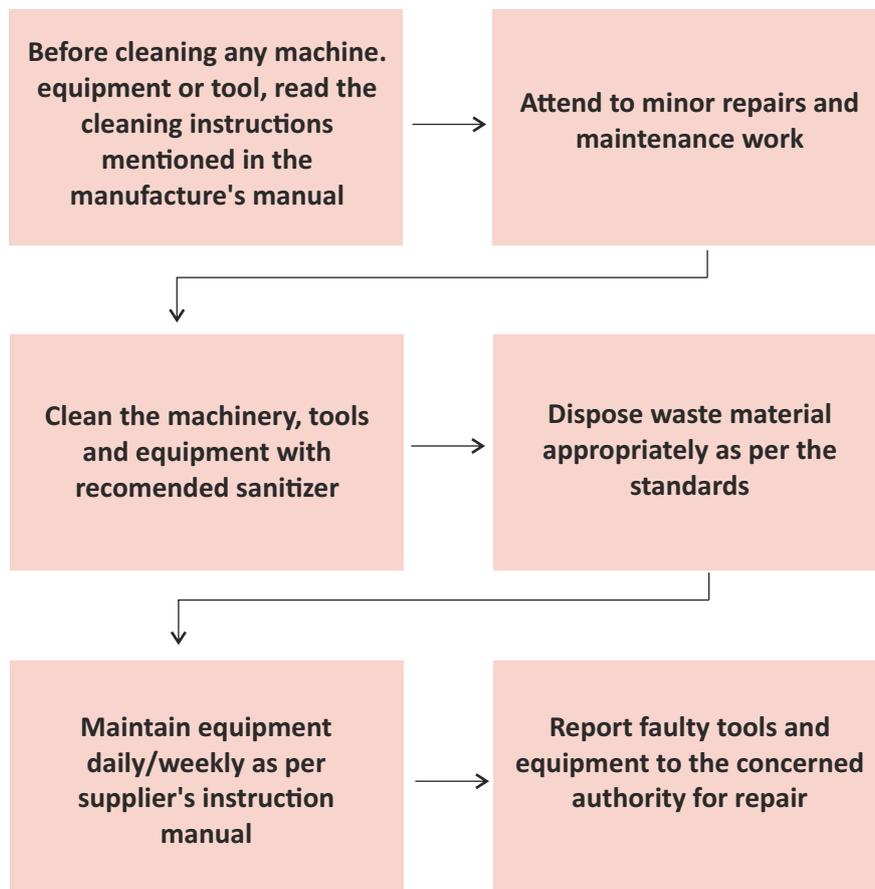


Fig.2.18 Cleaning Process for Fruit Pulp processing Machinery and Equipment

It is important to report faulty tools and equipment to the concerned authority, as it minimizes the possible risks and hazards related to equipment and prevents major failures and serious injuries or mishaps. The following figure explains the significance of reporting to the concerned authority:



Fig.2.19 Importance of Reporting Faulty Tools and Equipment

2.2.2 Maintenance and Check

In food manufacturing, maintenance supports various key objectives, many of which are unique to food production. Maintenance plays the following roles in food manufacturing:

1. It keeps the production running smoothly.
2. It helps to prevent any contamination and ensure food safety.
3. It reduces product losses.
4. It maintains regulatory compliance.

An effective maintenance routine ensures that operations are continued, repair costs are minimized, and downtime is reduced.

Following are the types of maintenance that are carried out in a food processing unit:

1. **Reactive Maintenance** is a method where machines run until they fail. It's a hands-off approach, and the significant benefit is that it keeps routine maintenance costs low.
2. **Predictive Maintenance** uses advanced technology such as infrared and ultrasound equipment during the routine inspection of machines. This process can stop unpredicted breakdowns, and using advanced technology and the industrial unit can reduce the amount of time needed to inspect equipment piece by piece. This type of maintenance is expensive, but this method accurately stays a step in front of faults.
3. **Proactive Maintenance** is a systemic issue-focused maintenance program. Rather than examining equipment, this approach considers how to control the problems that lead to machine wear and tear instead of the deterioration itself.

4. **Preventative Maintenance** is the checking of machines and equipment on a planned, regular basis. The purpose is to prevent costly downtime and minimize the probability of faults. It requires more planning and effort than other techniques. However, it has long and short-term benefits in cost-reduction and efficiency of machine performance. Preventative checks are done before a machine breakdowns and while it is still in running condition. Generally, the strategy leads to good food hygiene and prevents foreign materials from entering food produce.

It is essential to have a schedule for preventative maintenance of each piece of machinery and equipment used in the production. This consists of:

- Time schedule stating when and how frequently maintenance should be done
- Maintenance activities list for each item

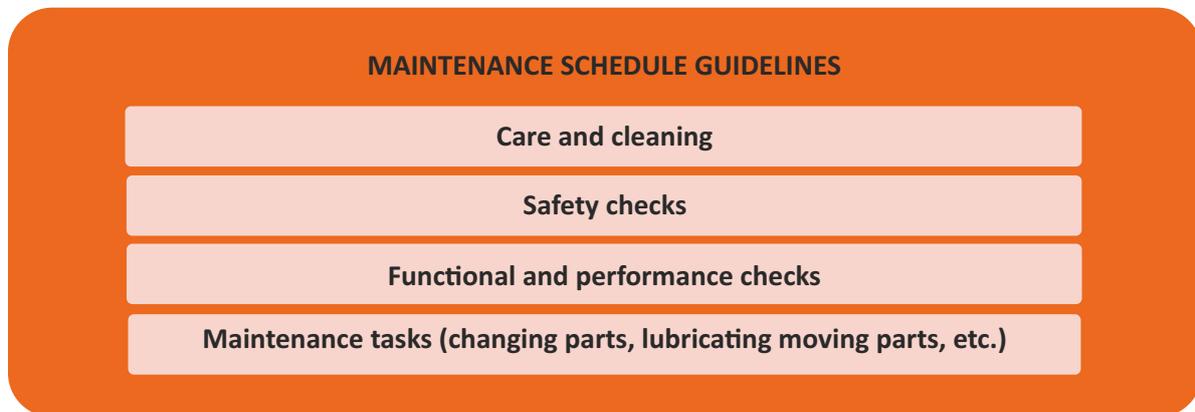


Fig.2.20 Maintenance Schedule Guidelines

Checklist for Planning Maintenance

- Identify the assets that require preventative maintenance.
- Distinguish what kind of safety checks the machine will need.
- Assess whether parts need replacing or cleaning.
- Decide how regularly assets need checking.
- Create a formal risk assessment process to help the person responsible for checks.
- Talk to employees who work closely with equipment to discover more about how the machines are operating at the time of the check.
- Find out if parts need cleaning, lubricating, or changing.

Fig.2.21 Maintenance Checklist

After completing any maintenance, the technician must keep a log for maintenance. This log entry should include a description of the work carried out, who carried it out, and the date and time it happened.

Document Maintenance Procedures. Every piece of equipment and machinery should have detailed descriptions, drawings, and photographs of how and when each machinery should be maintained or serviced. It includes:

- Maintenance procedures
- Lubrication procedures
- Tool reconciliation procedures
- Procedures for temporary repairs
- Procedures for emergency repairs
- Spare parts inventory program
- Training procedures
- Handover procedures
- Audit Procedures

2.3.3 Inspection Methods for Tools, Equipment, and Machinery

Regular inspections ensure the safety of your workers. The inspection occurrence should be determined through risk assessment and calculation, taking justification of the manufacturer's recommendations, industry advice, and your own experience. Machinery and equipment that is exposed to conditions causing deterioration, could result in a dangerous situation should be inspected at suitable intervals, and after every event, liable to jeopardize its safety.

Following are the inspection methods for tools, machinery, and equipment:

1. **Start-up Inspection:** An excellent countermeasure to avoid start-up risk is thorough and continuous inspection along with condition monitoring. Respect all potential areas of danger. Examine as many of these hazards as possible until operational stability is reinstated. These include:

- Temperature (all critical zones, components, and surfaces)
- Vibration
- Balance and alignment
- Gauge readings (based on temperature, pressure, vacuum, flow, speed, proximity, etc.)
- Differential filter pressure
- Magnetic plug collections
- Oil level, color, and clearness at all sight glasses
- Leak zones

2. **Stop Inspection:** Stop inspections allow accessing the hard-to-reach machine conditions and frictional surfaces. Also, avoid all unnecessary invasions that can introduce a root cause for failure.
3. **Repair inspection:** Repair inspections present a valuable opportunity that too often goes untapped. It is to assess what failed, why it failed and what can be observed while performing the inspection.

Checklist for inspection

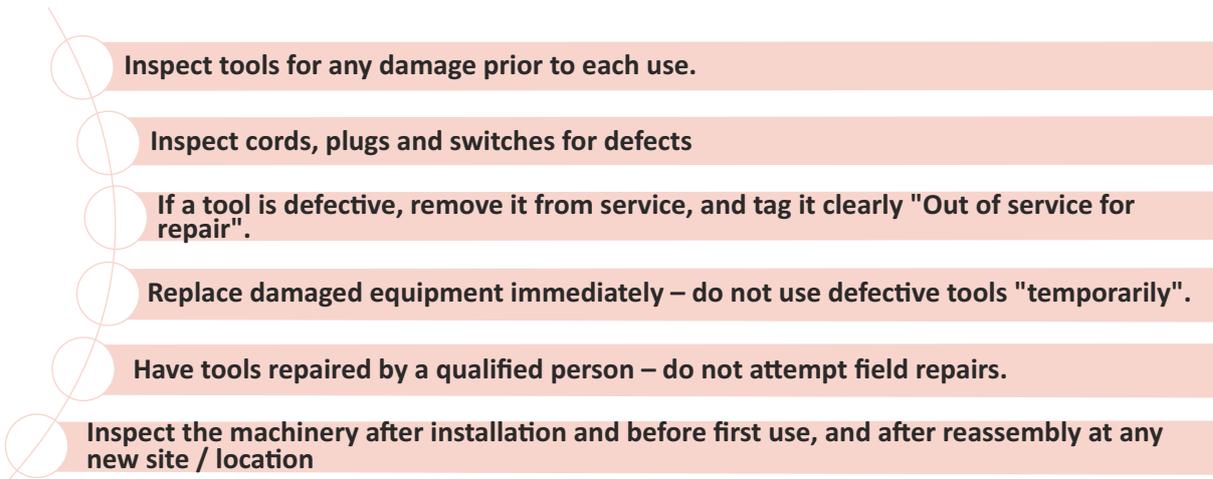
- 
- Inspect tools for any damage prior to each use.
 - Inspect cords, plugs and switches for defects
 - If a tool is defective, remove it from service, and tag it clearly "Out of service for repair".
 - Replace damaged equipment immediately – do not use defective tools "temporarily".
 - Have tools repaired by a qualified person – do not attempt field repairs.
 - Inspect the machinery after installation and before first use, and after reassembly at any new site / location

Fig.2.22 Inspection Checklists

Equipment inspection can be carried out by someone who has adequate knowledge and experience of it to enable them to know:

- **What to look at**
- **What to look for**
- **What action to be taken in case of a problem**

The inspection is varied according to the necessary level of equipment's competence and its types, and how / where it is used. The nature of these inspections does not have to be determined by the same individual who commences them, provided that person is competent. This can often be done in-house by an experienced team, taking into account of:

- **The manufacturer's recommendations**
- **Industry advice**
- **Experienced Staff who has sufficient knowledge of machine operations**

2.2.4 Waste Disposal

Waste generation is often a natural consequence of food processing plants. As environmental regulations become increasingly severe, appropriate management of food wastes has become a vital part of present food processing management. The amount of waste generation and the manageability of waste generated by a process have become benchmarks for assessing the applicability of the process. The most common wastes generated in Fruit Pulp industries are vegetable peel, wastewater, soil, etc. Various types of food waste are generated in many steps of the production process, packaging, and distribution.

1. Solid Waste - Plastic, Paper, Metals, Glass, etc.
2. Liquid Waste - Waste water, Organic liquids, Rainwater, etc.
3. Organic Waste - Food shells and residue, Spoil food products, etc.
4. Hazardous Waste - Chemical and toxic solutions, Filter oil, Flammable products

That is where the concept of waste minimization becomes a must for every employee to understand. There are several ways to explain waste minimization. In its broadest sense, waste minimization all practices including waste prevention, reuse, and recycling that reduce the amount of waste entering the environment.



Fig.2.23 Waste Minimization

Waste Segregation

In general, waste is segregated as **dry and wet waste**. Dry waste includes wood, paper, plastic, glass, etc., related products that can be recycled, and wet waste refers to organic and biodegradable waste. The waste can be segregated using color-coded dustbins.

1. Green Bin

The green-colored bin is used to dump biodegradable waste. In addition, this bin is used to dispose of wet/organic material, including cooked food/leftover food, vegetable/fruit peels, eggshell, rotten eggs, chicken/fish bones, tea bags/coffee grinds, coconut shells, and garden waste, including fallen leaves/twigs or the puja flowers/garlands.

2. Blue bin

The blue-colored bin is used for segregating dry or recyclable left over. This category includes waste like plastic covers, bottles, boxes, cups, toffee wrappers, soap or chocolate wrappers, and paper waste, including magazines, newspapers, tetra packs, cardboard cartons, pizza boxes, or paper cups/plates, metallic items like tins/cans, foil paper, and containers.



Fig 2.24 Dry & Wet Waste Bins

The most commonly used methods of waste disposal are:



Landfill



Incineration



Waste Compaction



Biogas Generation



Composting



Vermicomposting

Fig 2.25 Waste Disposal Methods

Scan the QR Code to watch the related video



<https://www.youtube.com/watch?v=nrEOtxjwKsQ&t=24s>

Waste Disposal



<https://www.youtube.com/watch?v=QWpU7DAfNcs&t=2s>

Cleaning and sanitation



<https://www.youtube.com/watch?v=CD0XLUutibk>

Cleaning facilities



<https://www.youtube.com/watch?v=tRAnusofqJ8&t=48s>

Maintenance

Exercise

1. Explain any two elements of the production planning process.

2. Write a note on

- A. Estimation of raw material.

- B. Capital utilization

- C. Allocation of Work

3. What is the process of resource planning?

4. List down any two checklists for inspecting equipment, machinery, and tools.

5. List down any five pieces of equipment and their uses.

6. What is Waste disposal.

3. Wash and Sort the Fruits for Processing



Unit 3.1 - Wash and Sort Fruits



Key Learning Objectives



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

1. Discuss the procedure to wash the fruits for fruit pulp processing
2. Perform the tasks to inspect the washed fruits manually and sort them for fruit pulp processing

Unit 3.1 Washing and Sorting Fruits

Unit Objective

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

1. Discuss the significance and procedure of receiving and checking fruits from supplier or vendor for quality and quantity
2. List the physical quality parameters of the fruits such as appearance, colour, texture, maturity, etc.
3. Discuss the methods to monitor the temperature of fruits to be cooled to the required temperature
4. Elaborate on the standard operating procedure of a ladder conveyor
5. Explain the Standard Operating Procedure (SOP) to wash fruits to start the process
6. Discuss the visual inspection procedure for manually washed fruits

3.1.1 Receiving Procedure

Receiving the fruits from the supplier is the first step of fruit pulp processing, and it holds great value. During this process, the quality and quantity of the fruits are checked. Both should match the requirement and specifications. In addition, the fruit received should match the fruits ordered or purchased from the vendor, which includes verifying that the fruits are in the correct quantity, fresh, and undamaged. Below are three steps of receiving the fruits:

Inspection of the quality and the quantity

- Checking of sanitary and freshness status
- Evaluation maturity degree and refractometric extract
- Check the colour, texture, appearance, taste, flavour of the fruits
- Maintain checklist of incoming raw material

Comparing with Purchase order and Recording the receipt

- Check the variety and number per kg as per purchase order
- Collection of data about quantities received in connection to the source of supply

Pre- Processing Storage of Raw/Unprocessed Fruit

- Keep the product away from direct sunlight.
- Store in a cool and dry place
- Avoid dust and any possible contamination
- Store in a place protected from possible attack by rodents, insects, etc.
- Store the fruits at ambient temperature, (preferably cold storage at 1.0°C -1.2°C temperature)
- Maintain checklist of incoming raw material

Fig 3.1 Fruit Receiving Process

Checklist of Incoming Raw Materials:

- Enter the purchase order number, material description, and quantity.
- Capture and save an unlimited number of photos of flaws or tagged materials.
- Send real-time notifications for scheduled incoming inspections.
- Assign actions to accepted, conditionally accepted, or rejected materials.
- Complete the incoming inspection with digital signatures.

3.1.2 Washing and Rinsing of Fruits With a High-Pressure Spraying System

Wash and Rinse -

"Fruits shall be thoroughly washed with potable water to remove the foreign matters like dust, dirt, in order to ensure there is no cross-contamination while storing fruits in the approved area".

There are different washing methods like soaking, agitating in water, washing with cold or hot water jets, high-pressure spraying system etc.

Steps for washing and Rinsing fruits

1. Wash hands properly.
2. Wash, Sanitize and dry all the direct food contact surfaces like utensils, equipments, tanks, containers, conveyor belts etc prior to the washing and rinsing of fruits.
3. Before and after preparing fresh produce, wash your hands for 20 seconds with warm water and soap.
4. Remove or separate any damaged or bruised fruit before washing.
5. Follow the instructions of the manufacturer for proper usage of chemicals.
6. Washing is done through the stages below:
 - a. Remove soil, dust, and other sticky material by dumping fruits in the washing tank.
 - b. Wash with high pressure spraying system and brush the surface (designated for this purpose) of firm fruits such as Guava.
 - c. Transfer fresh fruits from the washing tank to the washing line conveyor using a ladder conveyor with 25 litre cold water with 1 chlorine tablet. We can even use sodium metabisulphite (use 1g in 1 litre of water)
 - d. Rinse with cold water(jet spray/high spray system)
7. Pick the fruits from the tank, place them in the basket, and transfer those fruits on the ladder.



Fig.3.2 Washing Fruits & Vegetables

Dry - Drying entails heat and mass transfer operations. Drying removes moisture from the food, preventing bacteria, yeast, and mold from growing and spoiling it. Drying also slows but does not stop the action of enzymes (naturally occurring substances that cause foods to ripen).

3.1.3 Transfer & Storage of Fruits to Approved Area with Ladder Belt Conveyor

The ladder belt is a simple but effective conveyor commonly found in food manufacturing units. It helps to transport goods from one place to another place for production. Its open design provides efficient operation with minimum maintenance and facilitates easy and thorough cleaning. Ladder belting is a positively sprocket-driven belt used in straight running applications. A ladder belt is a conveyor, mechanically designed to convey fruits in order to ensure physical and manual sorting of fruits with having a lesser impact on the texture of the fruit. The ladder belt has a variation with a tapered rod pitch assembly that is beneficial for radial applications (90 and 180 degrees). Its lightweight and simple configuration functions make the equipment economical and cost-effective for many different environments.

Flat uniform surface for gentle product handling

High tensile rods which resist permanent distortion and reduce down-time

Positive drive to ensure there are no tracking issues

Smooth edges for easy movement around radial bends

U-bar filler rods available for increased product support

Easy belt assembly and disassembly due to its simple open construction.

Fig.3.3 Advantages of Ladder Belt Conveyor

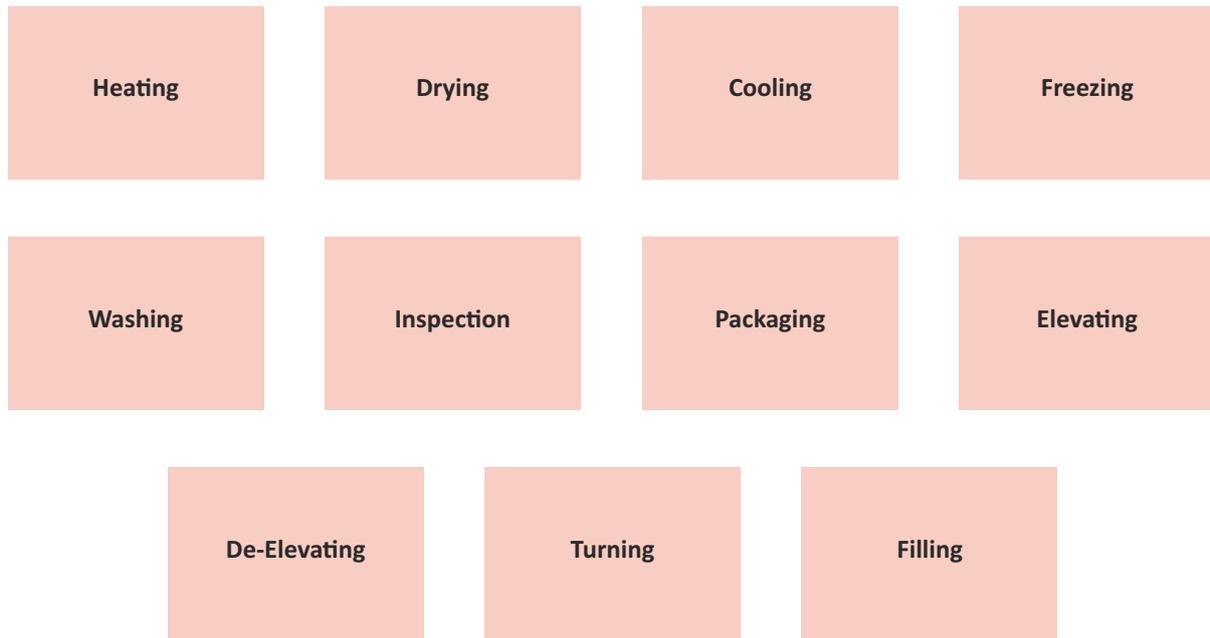


Fig.3.4 | Ladder Conveyor Belt Applications

The following flowchart explains the standard operating procedure of the ladder belt conveyor.

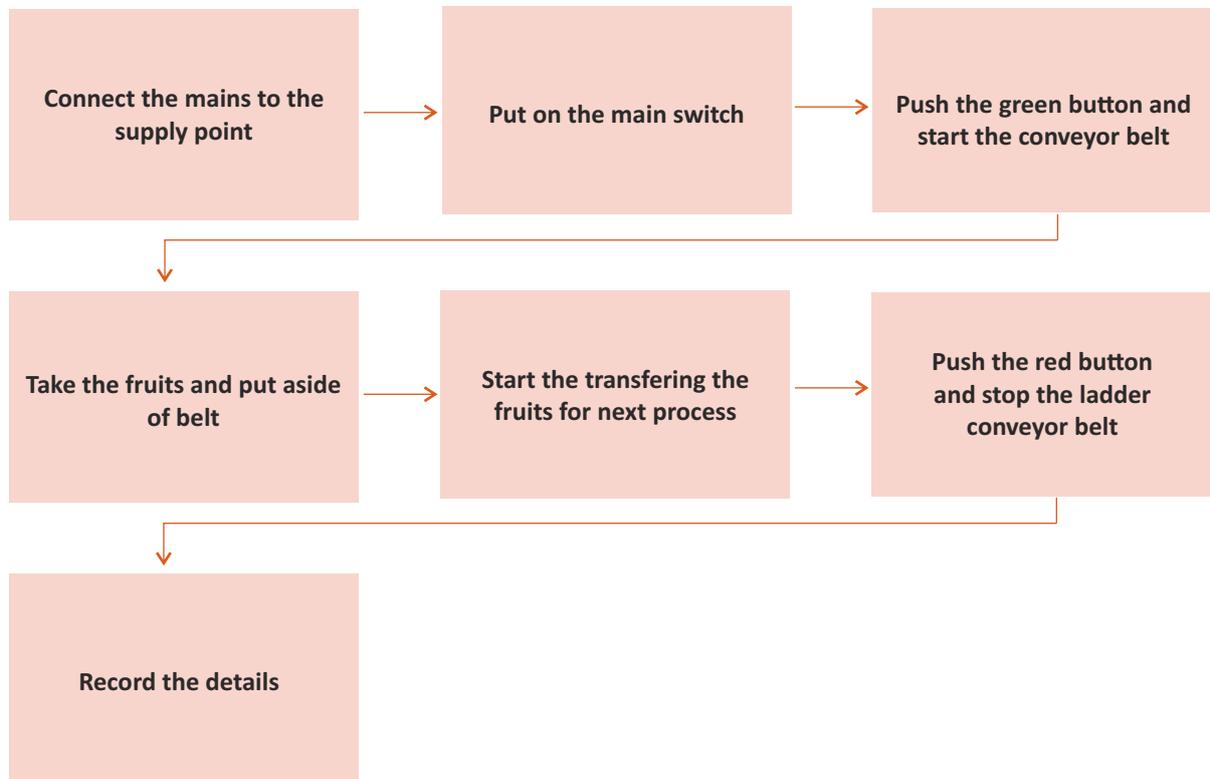


Fig.3.5 Standard Operatng Procedure for Ladder Belt Conveyor

3.1.4 Sorting of Washed Fruits

Sorting and grading ensure the removal of an inferior or damaged commodity. For sorting, an inspection belt can be used and trained personnel who detect poor quality produce unsuitable for fruit pulp processing. Automatic sorters can be used for sorting to reduce labour costs. After preliminary sorting, the fruit and vegetables are graded to get consistent quality for size, color, etc. Grading can be done either manually or with the help of grading machines. For mechanical grading, the fruit and vegetables are passed over screens with holes of different diameters.



Fig.3.6 Sorting Fruits & Vegetables

3.1.5 Visual inspection of fruits

Following are the parameters for Visual inspection of fruits in the sorting procedure:

1. **Colour**- Colour can be measured either visually or instrumentally, where you can choose the colour through a colorimeter. Colour helps decide whether the fruit is in good condition or not.
2. **Firmness**- This feature checks the degree of maturity of the fruit, which is done regularly with the penetrometer.
3. **Smell**- Smell refers to the aroma of a fruit that is present both on the skin and the pulp, especially citrus fruits. The aroma can be measured through gas chromatography with spectrometry.
4. **Morphology** The fruit's physical forms like size, weight, or curvature can be measured by the scale, tape measure, or sizing machine.

Check if fruits are cleaned properly or not

"Check for any damages occurred, while washing"

Check if chemical residue stays on fruits

Inspect fruit ripeness and maturity

Fig.3.7 Workflow Process of Inspecting Fruits

3.1.6 Identify Spoilage in Fruits and Vegetables

Fruits and vegetables, a part of fresh produce, contain high moisture, making them highly perishable foods and, hence, more prone to spoilage. Microorganisms gain entry into fruits/vegetables from various sources. These sources include:

1. Soil
2. Water
3. Diseased plant
4. Harvesting and processing equipment
5. Handles
6. Packaging and packing material
7. Contact with spoiled vegetables

Because of the spoilage, it becomes harmful and unsuitable for human consumption.



Fig. 3.8 Spoiled Fruits and Vegetables

Notes



The spoilage of fruits/ vegetables is predominating of following types:

Types of Spoilage	Description
Microbial Spoilage	
<p>Spoilage due to pathogens</p> 	<p>Infect stems, leaves, roots, flowers, and other parts of the fruit/vegetables themselves.</p>
<p>Spoilage due to saprophytes</p> 	<p>Under certain conditions, organisms grow on these fruits/vegetables and spoil them</p>
<p>Bacterial Soft Rot</p> 	<p>Breaks down pectin, giving rise to a soft, mushy consistency, sometimes a bad odour and water-soaked appearance.</p>
<p>Fungal Spoilage</p> 	<p>Caused by <i>Botrytis cinerea</i> in vegetables. Favoured by high humidity and warm temperature</p>
<p>Chemical Spoilage</p> 	<p>Caused by Pesticide residue, detergents, etc.</p>
<p>Physical Spoilage</p> 	<p>Bolts from machinery, stones, glass, etc.</p>

Table 3.1 Types of Spoilage

The following chart shows how fruits and vegetable spoilage take place:

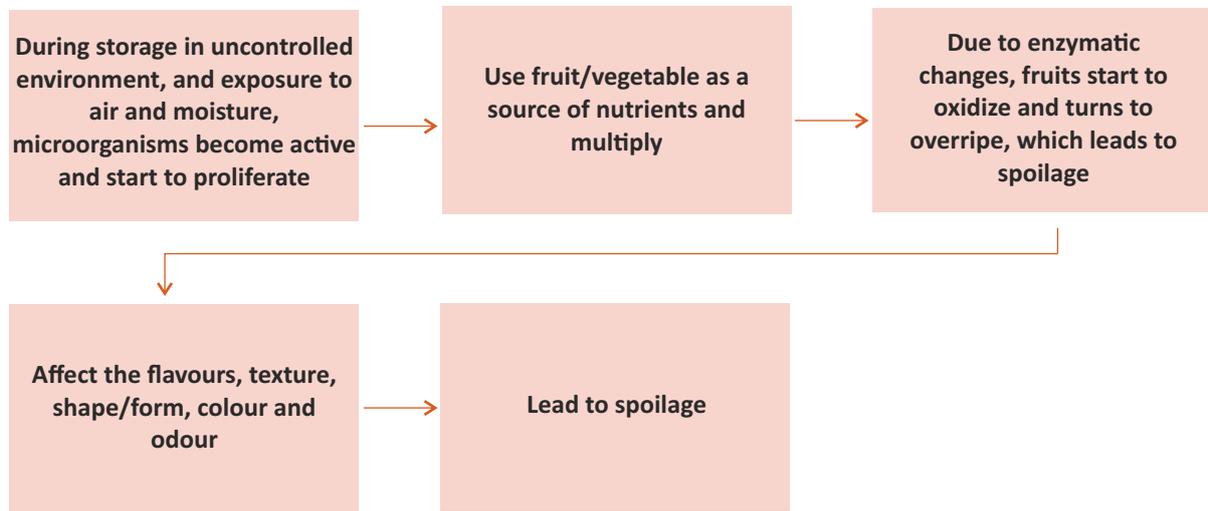


Fig. 3.9 Microbiological Spoilage in Fruits and Vegetable

The following chart shows the parameters to check the spoilage in fruits and vegetables:

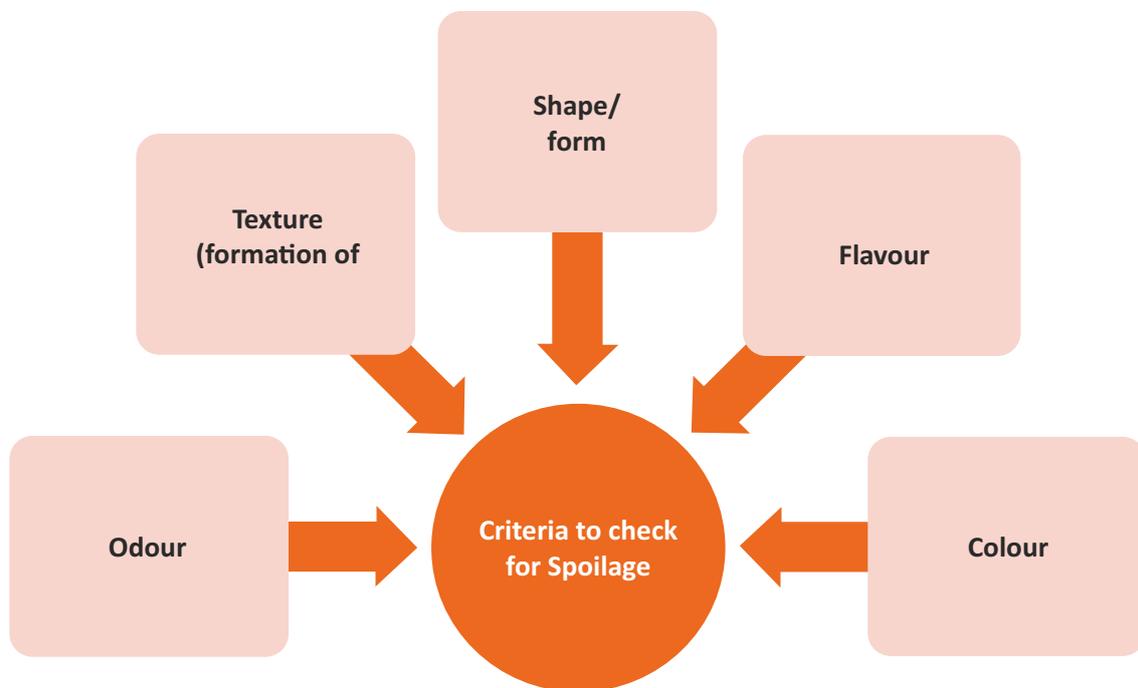


Fig. 3.10 Parameters to check Spoilage

3.1.7 Storage Conditions: Fruits

To increase the storage life and maintain the quality of fruits, proper storage conditions i.e., temperature and humidity, are needed. Fruits are living tissue. After harvesting, they keep on ripening and die after some time. Fresh fruits need low temperatures (32° to 55°F) to 0° celcius to 12.78° and high relative humidity (80 to 95 percent) for lower respiration and slow metabolic and transpiration rates. Water loss is decreased, and quality, food value, and energy reserves are maintained by slowing the process.

Relative humidity needs to be monitored and controlled in a storage area. A hygrometer or a sling psychrometer can be used to monitor humidity. Control can be accomplished by using a variety of methods:

1. Installing a Dehumidifier in the storage area.
2. Keeping refrigeration coil temperature within 2°C of the storage area air temperature.
3. Proper ventilation and regulating air movement.
4. Use moisture barriers in the insulation of the transport vehicle, storage room, and packing container lining.



Fig. 3.11 Hygrometer & Psychrometer

(Source: <https://www.instrumentchoice.com.au/news/how-does-a-sling-psychrometer-work>)

Temperature

Each product handled has unique temperature requirements. The time until cooling, temperature stability, and duration must all be taken into account. The following effects are achieved by lowering the produce temperature as soon as possible after harvest, usually within four hours:

- a. The rate of respiration is reduced
- b. Water loss is minimised
- c. Ethylene production has been reduced
- d. Ethylene sensitivity is reduced
- e. Microbial growth is slowed

Most leafy vegetables and "temperate" fruits, such as pome and citrus fruits, are not chill-sensitive and can be stored at temperatures ranging from 0°C to 2°C for extended periods without significant loss of visual quality. Fruit and vegetables from the tropics and subtropics, as well as some root vegetables, are chill-sensitive and may be damaged at low temperatures. They are typically stored at 13°C or higher, though some can be safely stored as low as 5°C if cooled quickly after harvest. The temperature must also be stable, as fluctuations can impair respiration and marketability.

Low temperature slows down respiration and hence slows the ripening and ageing process and increases the storage life. In addition, low temperature slows the growth of pathogenic fungus, which spoils the fruits. Too low and too high temperatures can damage fruits. Everything will start freezing below 0°C. Some fruits will be thawed without damage, and some will be ruined by the increase or decrease in temperature.

Most Susceptible

Fruits who will be injured by just one freezing

Example: Papaya, Mango

Moderately Susceptible

Fruits will take one or two freezings

Example: Apple

Least Susceptible

Fruits can survive several freezings without any damage

Example: Lemon, Avocado

Fig. 3.12 Freezing Conditions for Fruits

Notes



Damage or injury can be seen in the form of loss of rigidity, water soaking, and softening. Injured fruit should be checked immediately as freezing can reduce its life. In addition, fruits that require warm temperature (4.4 to 12.7°C) when subjected to freezing temp (0°C) can cause damage. Besides physical damage, frozen produce is often prone to disease infection.

Below are some of the examples of fruits storage with their temperature and humidity conditions:

Commodity	Temperature (°F)	Rel. humidity (percent)	Approximate storage life	Freezing point (°F)
Apples	30–40	90–95	1–12 months	29.3
Apricots	31–32	90–95	1–3 weeks	30.1
Berries				
— Blackberries	31–32	90–95	2–3 days	30.5
— Currants	31–32	90–95	1–4 weeks	30.2
— Elderberries	31–32	90–95	1–2 weeks	—
— Gooseberries	31–32	90–95	3–4 weeks	30.0
— Raspberries	31–32	90–95	2–3 days	30.0
— Strawberries	32	90–95	3–7 days	30.6
— Cherries, sour	32	90–95	3–7 days	29.0
Cherries, sweet	30–31	90–95	2–3 weeks	28.8
Grapes, American	31–32	85	2–8 weeks	29.7
Nectarines	31–32	90–95	2–4 weeks	30.4
Peaches	31–32	90–95	2–4 weeks	30.3
Pears	29–31	90–95	2–7 months	29.2
Plums and prunes	31–32	90–95	2–5 weeks	30.5

Table 3.2 Temperature and Humidity Conditions of Fruits

Exercise

I. Answer the following questions:

1. Explain the receiving procedure of fruits.

2. Explain the standard procedure for washing and rinsing fruits in the food industry.

3. What do you understand by sorting fruits?

4. Explain the types of spoilage in fruits or vegetables.

5. Describe the storage conditions for fruits.

ii. Fill in the blanks

1. In _____, fruit's physical forms like size, weight, or curvature can be measured by the scale, tape measure, or sizing machine.
2. Fruits which can survive several freezings without any damage are _____.
3. Fruits which will take one or two freezings are _____.

4. Peel, De-seed, and Destone the Fruits



Unit 4.1 Peeling, Coring, and Slicing of fruits



Key Learning Objectives



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

1. Perform the process to peel, de-seed, and cut the sorted fruits
2. Describe the ways to dispose of the peeling material or core of the fruits

Unit 4.1 Mechanism for Peeling, Coring, and Slicing of Fruits

Unit Objective

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

1. Elaborate on the standard operating procedure of the chopper/cutter/slicer machine
2. Explain the process of peeling or core removal of the fruits
3. State the significance of ensuring the removal of peel or core appropriately by monitoring the fruits emerging from the peeling or coring process
4. Discuss the SOP to cut fruits manually and dispose of the waste

4.1.1 Peeling, Coring of Fruits

After washing and sorting, fruits go through the peeling and coring process before extracting the pulp.

1. Peeling is a vital process in fruit pulp processing that removes the raw fruit's inedible or unwanted rind or skin. Peeling improves the physical shape and taste of the fruits. The food processing industry uses various peeling methods depending upon the types of fruits.
 - a. Hand Peeling is carried out with a hand peeler, consisting of a steel blade with a slot with a sharp edge attached to a handle, used to remove the outer layer of fruits such as apples and pears.



Fig. 4.1 Hand Peeling Tool

- b. Mechanical Peeling is carried out with a peeling machine or abrasive devices to remove the unwanted portion directly from raw fruits. Later, skin residues are removed using water. It causes minimum damage to the freshness and nutritional values of peeled fruits. Common examples of mechanically peeled fruits are citrus fruits, pears, pineapple, etc.



Fig. 4.2 Mechanical Peeling



Fig. 4.3 Fruit Peeling Machine

The following flow-chart shows the work-flow process of the peeling machine:

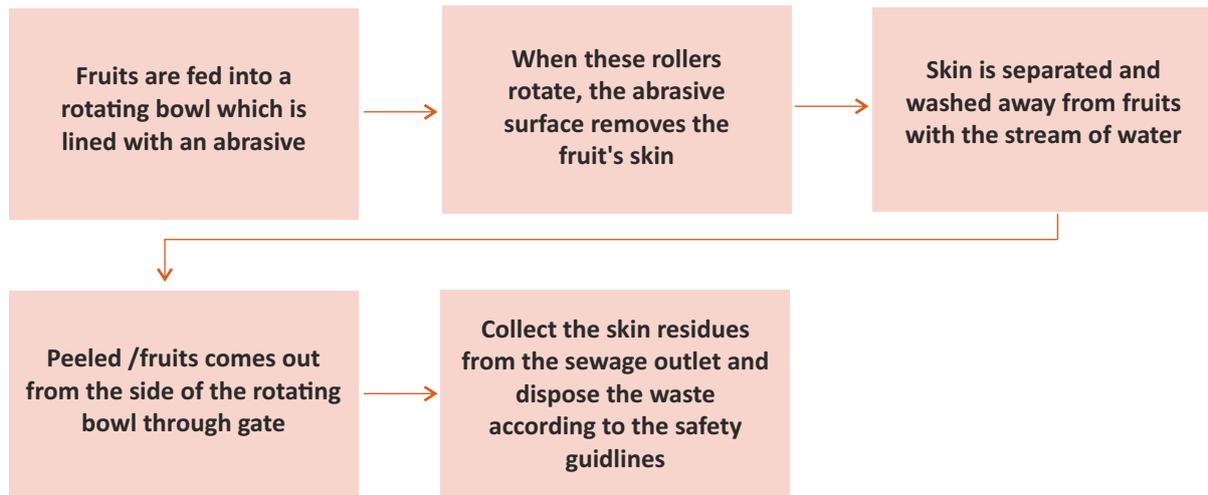


Fig. 4.4 Peeling Machine Operation

- c. **Caustic or Lye Peeling** is a chemical process for removing the peel or skin of thin-skinned fruits. In this process, fruits are immersed into a heated solution of 8 -25% containing sodium hydroxide or potassium hydroxide chemicals at a high temperature from 60- 100°C that softens the skin of the fruits. There after, the loosened skins are removed by a high-pressure water spray system. Lye peeling technique is applicable in various fruits like peaches, guava, pears, and apricots.



Fig. 4.5 Fruit Peeling Machine

- d. **Steam Peeling** process involves putting the raw fruits in a pressure container, on a high-pressure steam (180° to 200° C) for 15 -30 seconds. After which steam is released instantly, causing the peeling off the skin from fruits. Later, loosened skin is washed off by a pressurized water spray system. Steam peeling has been adopted increasingly by the food industry because of the chemical-free method.



Fig. 4.6 Steam Peeling

2. **Coring** refers to the process of removing the seed and the outer skin from the fruits. It plays an important role in fruit pulp processing as it deseed and removes tough and fibrous centers from the fruits. Many fruits with seeds may release sour or undesirable flavour to the fruit pulp at the time for pulp extraction. Coring of fruits can be done manually with a hand fruit corer or with a coring machine.
 - a. **Hand Fruit Corer** is a specialty knife with a V-shape or hollow cylindrical shape blade for scooping out the cores and seed of the fruits.



Fig. 4.7 Hand Fruit Corer

- b. **Coring machine** is an automatic electric machine made of stainless steel and food-graded materials. All the components in the machine are easily interchangeable based on a CNC (Computer numerical control) mechanism. The coring machine comes with multiple functions and easy maintenance features. Because of the labour-intensive and time-consuming operation of hand coring, most food processing companies rely on fruit coring machine, which removes the seeds and skin of the fruits with the help of cranks and levers.



Fig. 4.8 Coring Machine

4.1.2 Process of Cutting and Slicing of Fruits

Cutting/Slicing - For size reduction, fruits are cut or sliced into small pieces with the help of various equipment and tools. After coring, the fruits are halved manually with a hand knife or machines. However, peeled, cored, and sliced fruits should always be submerged in either water containing 1-2 % salt solution or acid to avoid enzymatic browning for storage.



Enzymatic Browning fruit



Fig. 4.9 Cutting and Slicing of Fruits

Wash and dry fruits and place them on a clean chopping board.

Remove the peel or skin of the fruits with the help of hand peeler.

Use hand knife to remove the damage or unwanted part like tip of the fruit and stem.

Remove the seeds with the help of hand corer.

Cut or slice the fruits into desired shape or pieces for further process.

Dip the sliced fruit pieces in water to avoid enzymatic browning.

Collect the waste and dispose them in allotted bins.

Fig. 4.10 Standard Practices for Manually Peeling, Coring and Cutting of Fruits



Fig. 4.11 Industrial Fruit Cutter/Slicer/Chopper

Cutting and slicing machines are widely used in the food processing industry because of their large quantity of production. These machines come with multiple functions like cutting, slicing, and chopping and can be used as per requirement.

The following flow-chart shows the standard operating procedure of the fruit cutter/slicing/chopping machine:

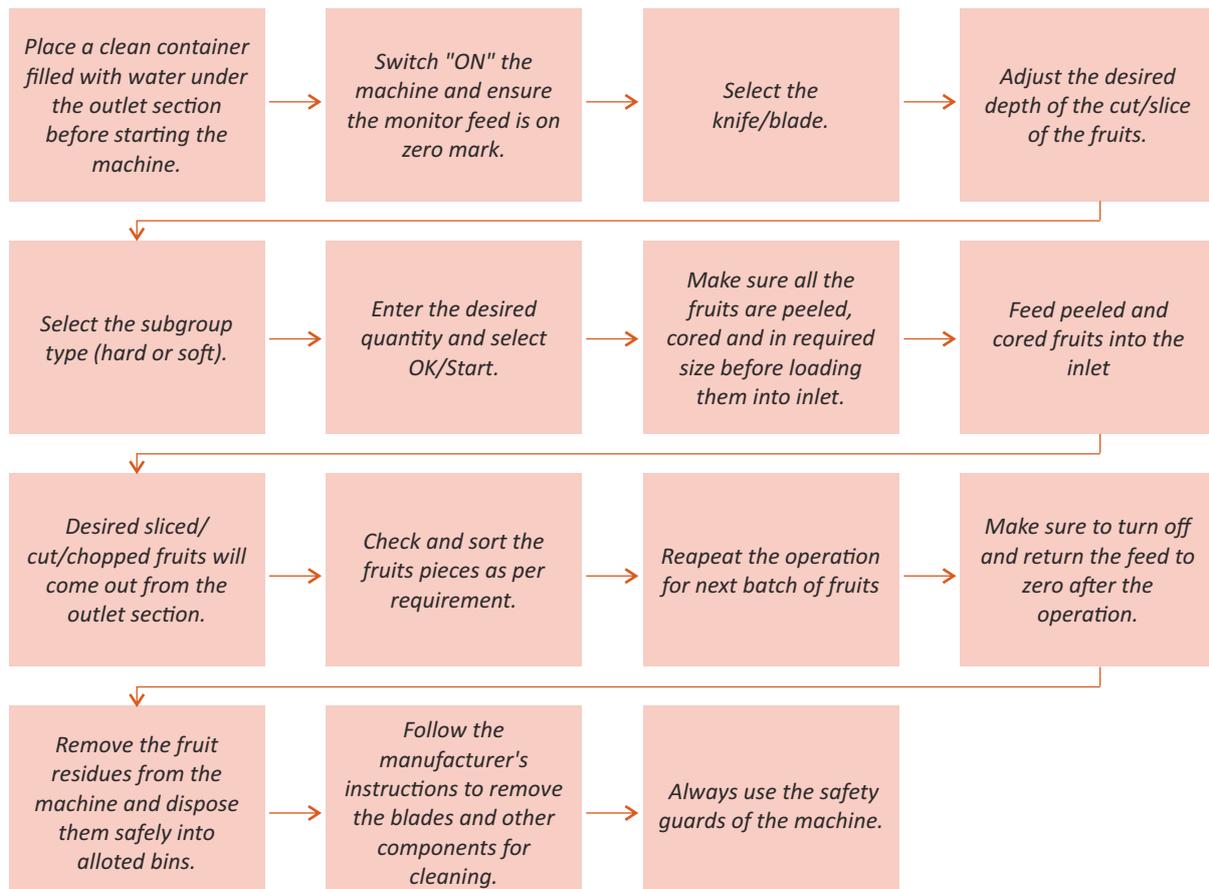


Fig. 4.12 Standard Operating Procedure of Fruit Cutter/Slicer/Chopper Machine

Exercise

I. Answer the following questions:

1. What is coring?

2. Differentiate between lye peeling and steam peeling.

3. Explain the operation of the fruit slicing/cutting machine.

4. Why peeling and coring are important in fruit-pulp processing?

II. Fill in the blanks:

1. _____ is a specialty knife having V-shape or hollow cylindrical shape blade for _____ and seed of the fruits.
2. _____ has been adopted increasingly by the food industry because of the chemical-free method.
3. _____ consisting of a steel blade with a slot with a sharp edge attached to a handle, used to remove the outer layer of fruits.

5. Fruit Pulp Extraction and Pre-cooking of the Pulp



Unit 5.1 Fruit Pulp Extraction Process



Key Learning Objectives



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

1. Discuss the tasks to be performed to extract the fruit pulp
2. Perform the activities to pre-cook the extracted fruit pulp

Unit 5.1 Fruit Pulp Extraction Process

Unit Objective

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

1. Discuss the fruit pulp extraction process
2. State the importance of ensuring that collected pulp is free from seeds and fiber
3. Discuss the standard procedure to replace damaged or clogged filter screen of pulper cum finisher/pulper refiner machine
4. Discuss the methods to examine pre-cooked fruits pulp
5. Explain the control parameters (Pressure, temperature, cooking time, stirrer speed, etc.) of cooking tank as per standards
6. Describe the procedure to transfer the sample of the pulp to the quality lab as per standards

5.1.1 Fruit-Pulp Extraction

Pulp is the edible part of the fruit, exclusive of its skin, seed, stones, etc., it is crushed and sliced but not filtered. Though sharing a similar process, fruit pulps are thicker than fruit juices. Various fruit-based products such as Jams, Jellies, Marmalades, Squashes, and Crushes and concentrates for beverages, prefer to use fruit pulp over the fruit juice, due to the high Total Soluble Solids (TSS) content. The more will be TSS of the fruit nectar, the less qty will be required in order to achieve the fruit percentage in the final product.

. It is extracted by squeezing and crushing the fruit flesh containing juices and then processed into a thick paste. Fruit pulp are not recommended for direct consumption. Following are the steps used for fruit pulp extraction.

Pressing

- In this process, the pulp is squeezed from fruits by external mechanical force. It applies to fruits with higher water content.

Pulping

- In this process, seeds and peel are removed from the fruit to obtain puree/pulp. Later, it is strained through the sieve to get the fineness. After that, the strained pulp is pre-cooked to stop the enzyme activity.

Continued...

Centrifugation/ Decanting

- In this process, the pulp is extracted by a centrifugal force when passing through the horizontal spiral filter centrifuge. Later, the pulp gets transferred into a revolving drum filter through a feed tube. Under high-speed centrifugal force, the pomace (dry or pulpy residue of material) is separated from the pulp to the one end of the drum by conveying screws, while the thick fruit pulp drains out of the other end outlet.

Clarification

- It is the process of ultrafiltration in which tartar cream is used in fruit pulp to remove certain specks that remains during decanting process. This process is carried out in two ways:
- Freezing - In this technique, the fruit pulp is refrigerated. The tartar crystals settle down, leaving clear liquid on top. Example: Apple pulp
- Heating - In this process, rapid heating is done up to about 180° C followed by sudden cooling in flash heaters to avoid oxidation. Later the liquid is passed through a filtering material. Example Pomegranate juice.

De-aeration

- It is the process of expelling air from the fruit pulp before the sterilization and filling process. Fruit pulp extract is subjected to a considerable amount of aeration when it goes through the process of crushing, pressing, and decanting. This inclusive oxygen can destroy the nutrition value, modify the flavour, lead to enzymatic browning, and damage the quality of fruit pulp. There are two methods for the de-aeration process:
- Rapid Heating of pulp and transferred into a vacuum chamber
- Inert gas bubbling

Concentration

- It is the process of cooking fruit pulp to remove the water content from the product. The fruit pulp is boiled in a cooking tank/kettle under controlled parameters (pulp flow, temperature, and time) until it becomes thick and excessive water is evaporated from the pulp. The cooking kettle operates at a maximum temperature of 50° C. The processed fruit pulp is called concentrate.

Fig.5.1 Fruit Pulp Extraction



Fig.5.2 De-aeration Tank (left) & Concentration Tank(right)

Importance of ensuring that collected pulp is free from seeds and fiber

1. To avoid sour off flavour in the fruit pulp which will be highly undesirable.
2. To sustain the natural taste and sweetness of the fruit.
3. To maintain the smooth texture and Fineness of the final product.
4. To preserve the natural colour of the fruit pulp as addition of seeds and fiber may change the colour of the fruit pulp.

5.1.2 Fruit Pulper Machine

Fruit Pulper is used for extracting pulp of most fruits & vegetables like mango, apple, tamarind, custard apple, plum, apricot, peach, kiwi, tomato, etc. In this process, fruits are transferred into the drum through a feed hopper. Later, the fruits are pushed towards the exit point along with the drum in a spiral motion. The fruits are crushed between the scraper and sieve, and pulp discharge through the screen mesh. Fruit peels or skins and seeds are discharged through the slag hole.

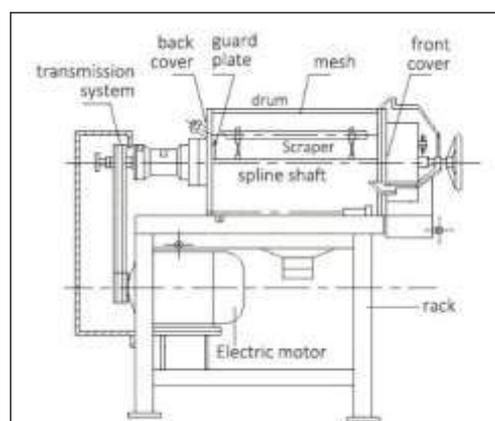
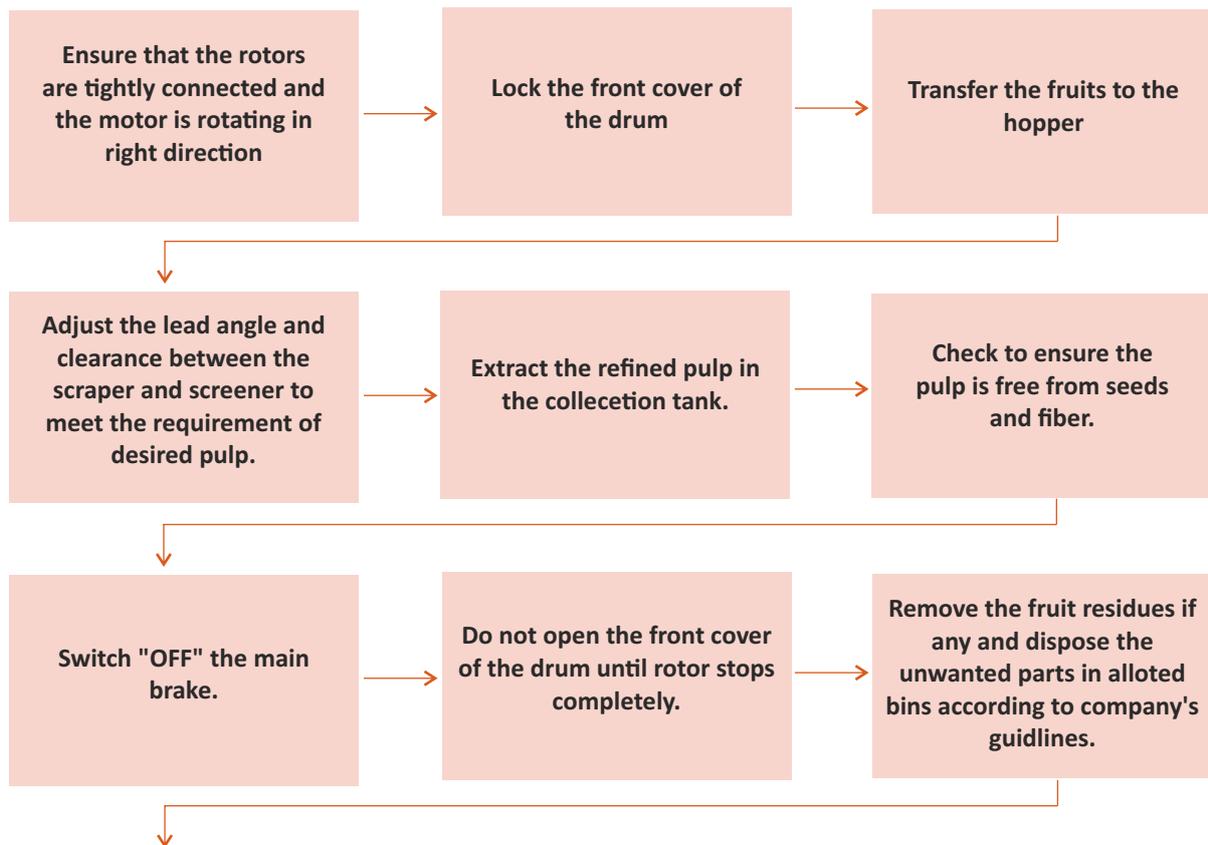


Fig.5.3 Parts of Fruit Pulper Machine



Fig.5.4 Fruit Pulper Machine

Following flow chart explains the standard operating procedure of extracting the fruit pulp using a fruit pulper machine.



Continued...

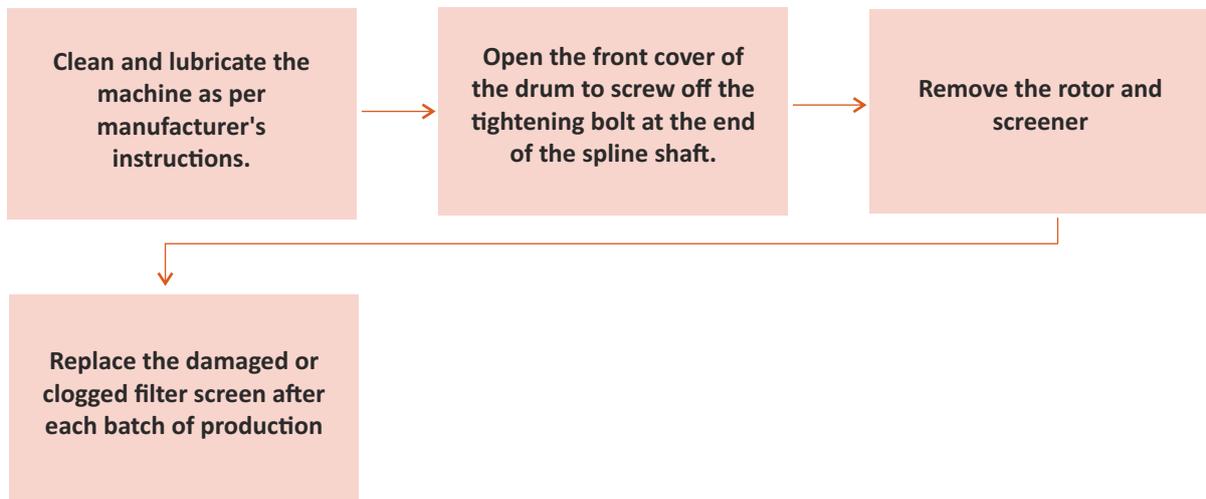


Fig.5.5 Process Flow of Fruit Pulper Machine

Standard procedure to replace damaged or clogged filter screen of pulper machine

1. Switch “off” the pulper machine.
2. Wait till the rotor stops completely.
3. Open the front cover of the drum.
4. Screw off the bolt at the end of the spline shaft.
5. Carefully remove the rotor and clogged filter screen and replace with a new one after each batch of production.
6. Clean the machine as per manual instruction.
7. Close and lock the front cover of drum immediately after cleaning to prevent contamination.

Notes



5.1.3 Pre-Cook the fruit-pulp

A steam jacket cooking kettle (also known as evaporating pan) are huge, deep kettles that stand on the floor. It is an all-purpose machine for making high-quality fruit-based products such as fruit pulp, jam, marmalade, and jellies. Various stirring and mixing processes can be carried out with this cooking kettle. These kettles have the advantages of a large heating area, high thermal efficiency, quick heating of materials, uniform heating, and easy control of heating temperature.

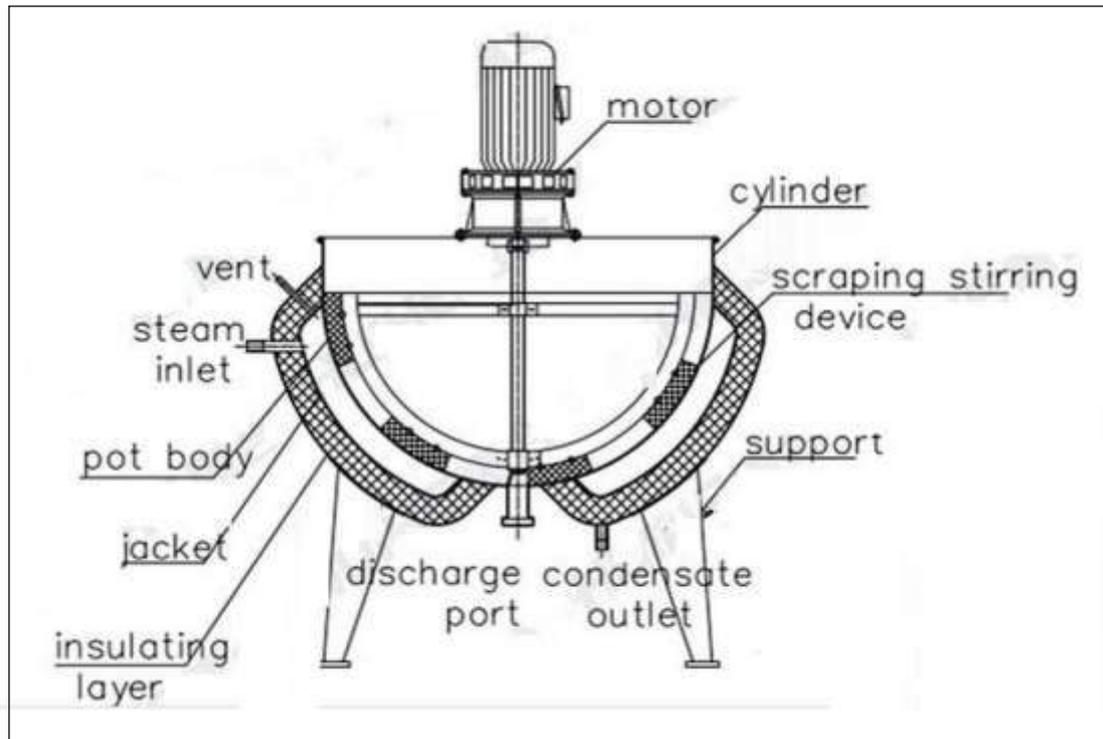


Fig.5.6 Parts of Steam Jacket Kettle



Fig.5.7 Steam Jacket Kettle

The following flow chart explains the cooking operation of pre-cooked pulp in a steam jacket kettle:

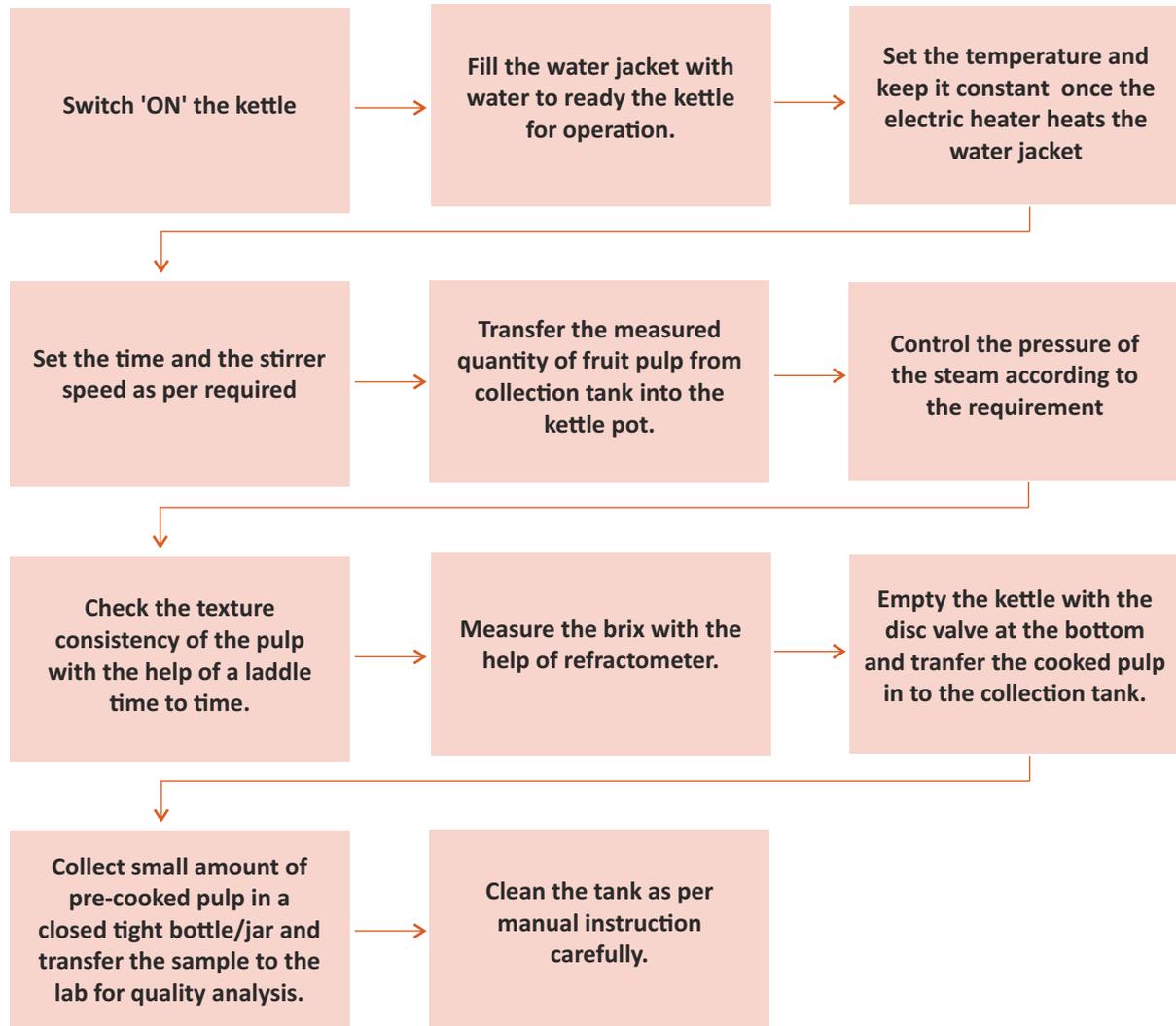


Fig.5.8 Process Flow of Pre-cooked Pulp in Steam Jacket Kettle

5.1.4 Lab Analysis for Sample Check of Fruit Pulp

Sample analysis is an optimum standard maintained continuously as per the company standard norms to produce a quality product and specific guidelines as per the government. On the other hand, processed food free from contamination will not cause any harm to the customers.

Every step involved in the process requires monitoring, including food safety and personal hygiene. For example, in fruit pulp processing, a quality lab check is done based on technical specification and organoleptic, which differ from fruit to fruit. After fruit pulp extraction process, the sample of pre-cooked fruit pulp is sent to the lab for quality analysis. Following are the parameters for quality check:

- **Taste/flavour, colour, and texture** - It is checked by Tasting the taste and flavour, whereas the colour and texture of the pulp goes through visual inspection.
- **pH** - A numeric scale to check acid levels in fruit pulp. Each fruit has its acidity level. The processing company maintains it as per their requirement.



Fig.5.9 pH Scale

- **TSS (Total Soluble Solids)** - It is the extracted mass of fruit, which contains fibers and fruit sugar. Each fruit has its own Brix ratio. It is maintained as per the company's requirement.
- **Brix** - It is a measure of the amount of dissolved solids in a liquid via its specific gravity, and is used especially to measure dissolved sugar. One degree Brix is 1 gram of sucrose in 100 grams of solution. Brix measurement is commonly used in the food industry for measuring the approximate amount of sugars in fruits, vegetables, juices, wine, and soft drinks. Brix is measured by Refractometer.
- **Titrateable Acidity** - It measures the total acid concentration in fruit and is determined by exhaustive titration of intrinsic acids with a standard base. Titrateable fruit acidity is expressed as g/100 mL of the predominant acid.
- **Viscosity** - Viscosity is a measure of a fluid's resistance to flow. It is measured by a viscometer as per the need.



Fig.5.10 Refractometer

- **Determination of drained weight** - The sample is drained on a standard mesh sieve. The weight of the material remaining on the sieve is expressed as a percentage of the packaging/ contents.



Fig.5.11 Sieve and Weighing Scale

Use of Refractometer:

1. Use the entire fruit or vegetable for small fruits or vegetables, but for larger ones, cut a representative wedge from the stem end to the blossom end and to the hub of the fruit.
2. Crush with a blender, mortar, pestle, or garlic press, or squeeze through cheesecloth.
3. Remove any pulp or seeds by filtering through a small piece of cheesecloth or filter paper.
4. Measurement Steps
 - a. Open the plastic cover and inspect the glass prism to ensure it is clean and free of scratches.
 - b. If the glass is not clean, place a few drops of distilled water on it, shake it off, and wipe the edge with a soft clean cloth to remove any remaining water.
 - c. Using a plastic pipette or spoon, place a few drops of sample on the glass measuring surface.
 - d. Replace the cover. If there is trapped air, gently press down on the cover.
 - e. Hold the refractometer up to a natural or incandescent light source and look through the eyepiece. By twisting the eyepiece, you can fine-tune the focus.
 - f. Inside, there is a scale that displays the percentage of sugar.
 - g. Determine where the shadow boundary or contrast line (the difference between blue and white areas) intersects the scale. Keep track of the percentage SSC or Brix value.
5. Clean between readings with distilled water that is 0 percent SSC at 20°C or 68°F.
6. Adjustment
 - a. Calibrate to 0 percent SSC with distilled water at the start of use and, depending on the number of samples measured, at regular intervals throughout measurements.
 - b. The contrast line should intersect the scale at zero. If not, the scale must be adjusted.
 - c. Follow the manufacturer's instructions, but there is a calibration screw to turn.

Materials Required:

- Refractometer
- Blender, mortar, and pestle, or garlic press
- Distilled water
- Plastic pipette or spoon to put a sample on a glass measuring surface.

Scan the QR Code to watch the related video



<https://www.youtube.com/watch?v=VEutWeSg23k>

Fruit pulp making process



<https://www.youtube.com/watch?v=ad1WZGA6ZBo>

Guava Pulp processing



<https://www.youtube.com/watch?v=supESo8qnjo>

Grape pulp processing

Exercise

I. Answer the following questions:

1. What is fruit pulp extraction?

2. How can you measure the brix?

3. Explain the process of pre-cooking of fruit pulp.

4. Explain the operation of the fruit pulper machine.

II. Fill in the blanks:

1. One-degree Brix is _____ gram of sucrose in _____ grams of solution.
2. TSS stands for _____.
3. _____ kettles have the advantages of a large _____ and high _____ efficiency.
4. _____ is the process of cooking fruit pulp to remove the water content from the product.
5. _____ the process of expelling air from the fruit pulp before the sterilization and filling process.

6. Aseptic Sterilization and Packing of Fruit Pulp



Unit 6.1 Aseptic Sterilization Process of Fruit Pulp



Key Learning Objectives



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

1. Discuss the procedure of aseptic sterilization of the fruit pulp
2. Perform the activities to pack and send the fruit pulp to the storage area

Unit 6.1 Aseptic Sterilization Process and Packing of Fruit Pulp

Unit Objective

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

1. Discuss the control parameters (such as temperature, pressure, time, etc.) of the sterilizer to be maintained for sterilizing the fruit pulp
2. Describe the procedure to monitor and maintain steam pressure
3. State the significance of maintaining the temperature of the product surge tank until the marked filling level
4. Discuss the operating procedure of aseptic packaging machineries, aseptic packaging process, and relevant parameters
5. Explain the SOP for sending the filled aseptic bags to the storage area, and storing raw materials, and packaging material

6.1.1 Aseptic Sterilization

Aseptic Sterilization of fruit pulp is the processing and packaging of sterile fruit pulp into sterilized containers followed by airtight sealing with a sterilized closure. This process prevents viable microbiological recontamination in the fruit pulp.

Sterilization of the fruit pulp is the next step after the process of de-aeration and concentration. It refers to the complete killing of all viable bacteria in the pre-cooked fruit pulp and permits the storage of the fruit pulp at ambient temperatures, with extended shelf life. It helps eradicate the poisonous toxins and food spoilage during fruit pulp's shelf life until it is consumed. There are four stages in the process of fruit pulp sterilization.

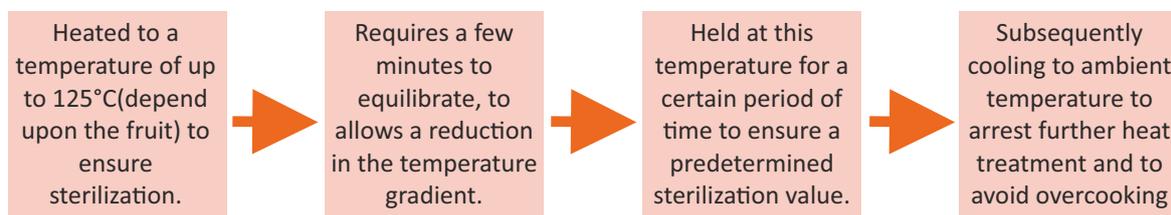


Fig. 6.1 Stages of Fruit-pulp Sterilization Process

As explained in Fig. 6.1, the process involves heating the fruit pulp to a fixed temperature and subsequently cooling to ambient temperature. This heating and cooling exempt the pulp from microbial

flora. The main parameters that influence the sterilization process of a fruit pulp as follows:



Fig. 6.2 Parameters of Aseptic Sterilization Process

Hence, it is vital to maintain these parameters when sterilizing the fruit pulp. The aseptic sterilizing system makes use of high-temperature short-time sterilization in the temperature range of 90°-110°C for acid products(pH 4.6). The aseptic sterilization process takes place in a continuous closed system and assists in producing the fruit pulp with better retention of nutrients and excellent sensory quality.

6.1.2 Aseptic Sterilizer and Filler Operation

An Aseptic Sterilizer machine is used for removing the number of live micro-organisms from fruit pulp and increasing the shelf life of the final product. It is an automatic machine made of stainless steel and food-grade materials. Below are the standard features of an aseptic sterilizer:

- a. Electric Heating with a tubular heat exchanger to produce saturated steam with automatic features for high energy efficiency
- b. Precise temperature control
- c. Pressure cooking system with digital and mechanical pressure gauges
- d. Saturated steam sterilization system to avoid heat stratification
- e. Automatic cooling system
- f. Automatic programming system
- g. Built-in CIP dosing system



Fig. 6.3 Aseptic Sterilizer Machine

The following flow chart illustrates the standard operating procedure for sterilizing the fruit pulp using an aseptic sterilizer machine.

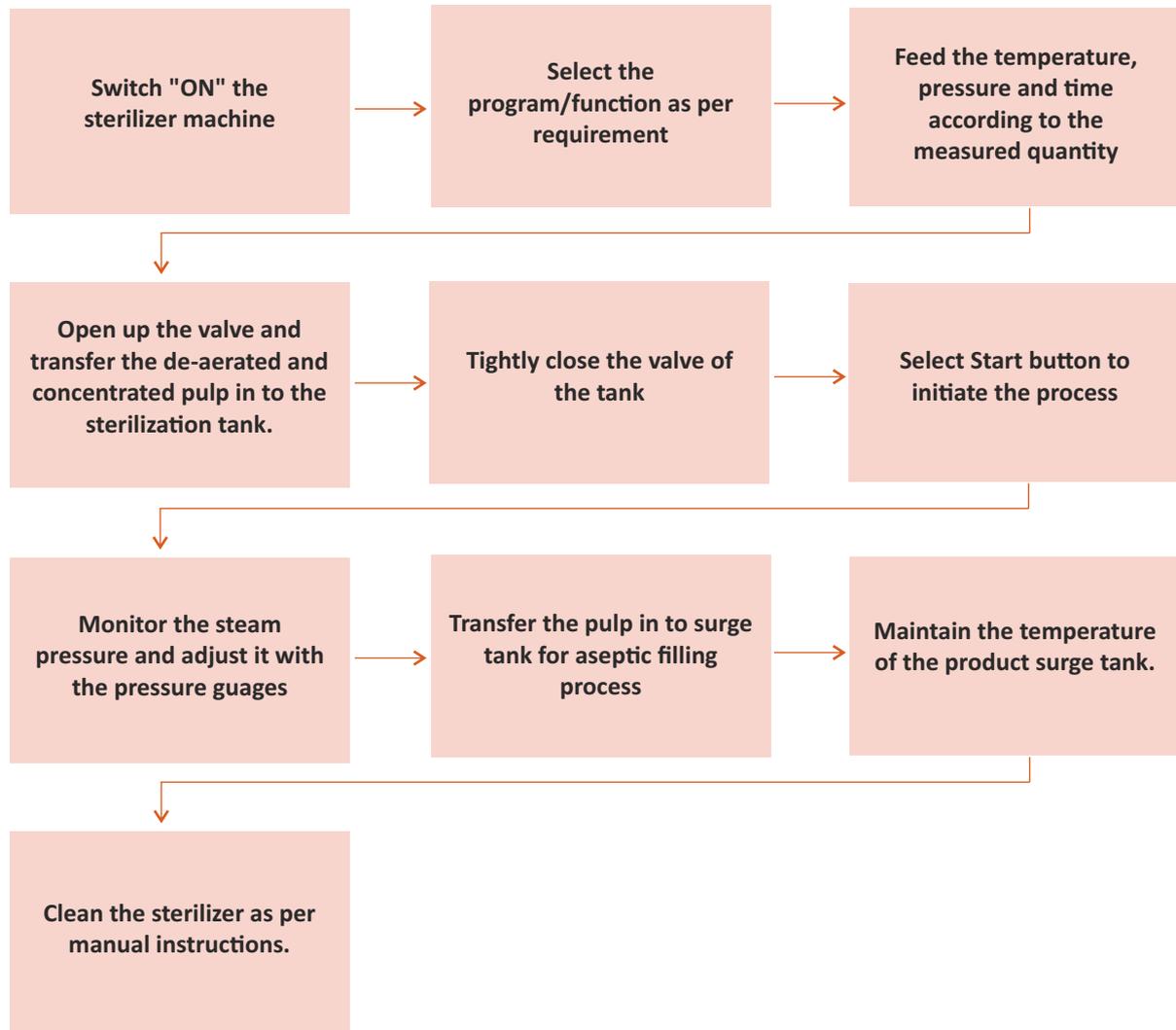


Fig. 6.4 Workflow Process of Aseptic Sterilizer Machine

It is important to maintain the temperature of the product surge tank after transferring the sterilized fruit pulp into the product surge tank because it –

1. maintains the commercial sterility condition until aseptic filling
2. prevent microbial recontamination of the fruit pulp
3. sustain the natural value and nutrition of the pulp
4. retain the quality of the fruit pulp



Fig. 6.5 Product Surge Tank

After the sterilization process, the fruit pulp is passed through a computerized aseptic filler and filled in pressurized aseptic bags of desired quantity in drums. Prior to the aseptic filling process, make sure to complete the following step:

- a. Put the aseptic bags and plastic liners in the drums
- b. Check the labelling details on the packaging material i.e., date of manufacture, date of expiry, batch code, and quantity
- c. Place all the drums near the machine, which passes through the conveyor to the filling nozzle of the machine.



Fig. 6.6 Aseptic Bags in Drums

Notes



The following flow chart explains the standard operating procedure for filling the fruit pulp in aseptic bags using an aseptic filler machine.

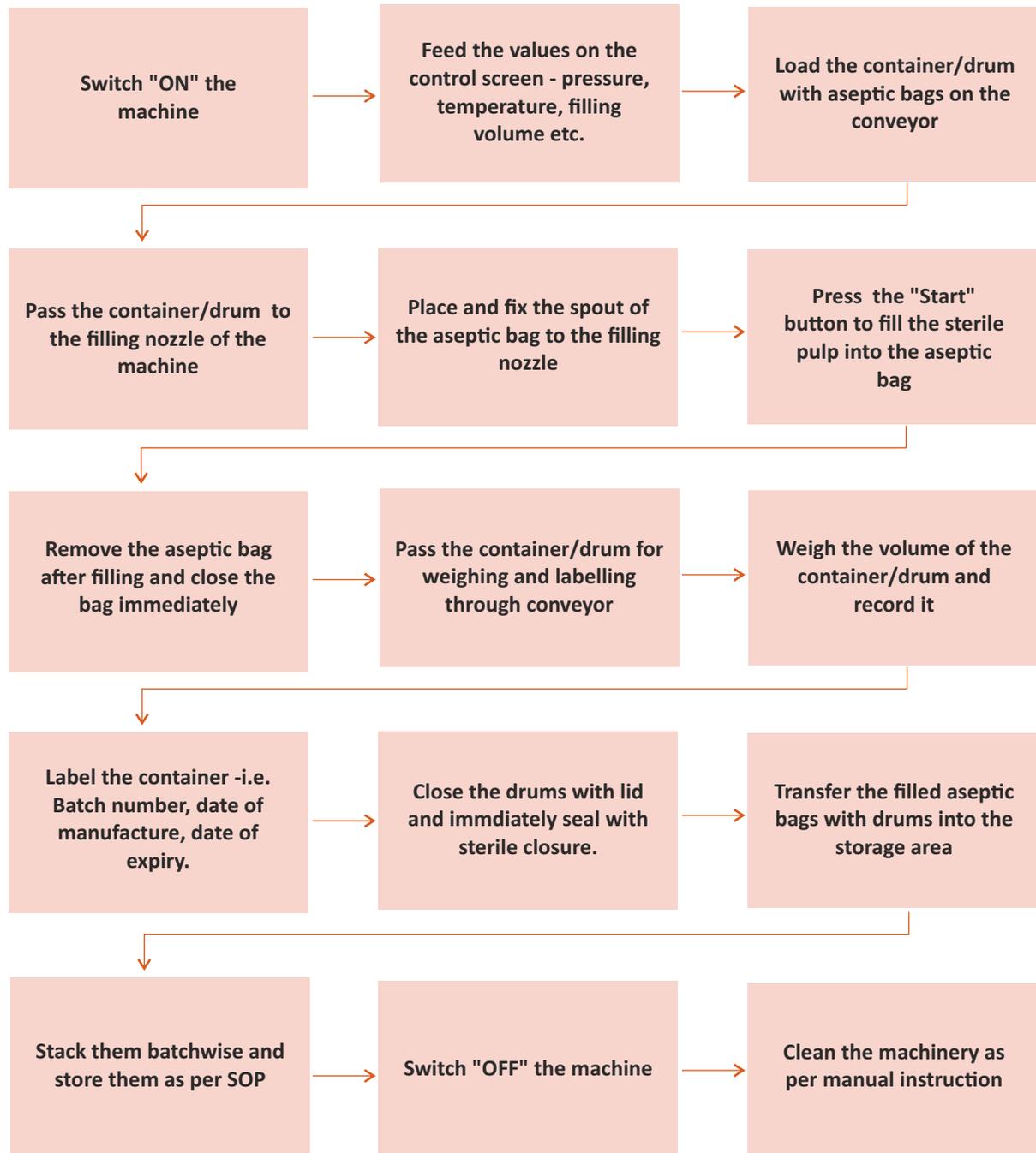


Fig. 6.7 Workflow Process of Aseptic Filler Machine

Condition and measures for aseptic drums storage

- a. Make sure the storage area is adequately cleaned and sanitized.
- b. Ensure that the storage area is free from pests and rodents.
- c. Ensure the storage area has a suitable temperature for sterilized fruit pulp.
- d. Stack and store the aseptic bag dumps batch wise.
- e. Maintain the temperature and humidity conditions of the storage area for any spoilage.
- f. Ensure the storage area has restricted entry to avoid the chances of recontamination.

Exercise 

I. Answer the following questions:

1. What do you understand by aseptic sterilization?

2. Explain the key features of the aseptic sterilizer.

3. What is the use of aseptic bags?

4. Explain the operation procedure of an aseptic filler machine.



7. Can the Fruit Pulp

Unit 7.1 Fruit Pulp Canning Process



Key Learning Objectives



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

1. Discuss the procedure to can the fruit pulp
2. Perform the tasks to report the discrepancy, if any

Unit 7.1 Fruit Pulp Canning Process and Packaging Activities

Unit Objective

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

1. Discuss the canning process of the fruit pulp and the parameters to be considered for the process
2. Discuss the operating procedure of canning machinery
3. Describe the procedure to fill pulp into the cans
4. Discuss the procedure to place a lid over the filled cans with a sealing machine or manually
5. Discuss various types of packaging materials, and packaging machinery for fruit pulp
6. Discuss standard quality parameters, basic food microbiology, and quality assessment of the fruit pulp based on physical parameters
7. Discuss the SOP on storing finished goods
8. State the importance of taking the canned fruit pulp samples for quality lab for analysis
9. Outline the scope of various standards as well as FSSAI laws and regulations on product, packaging, and labelling

7.1.1 Fruit Pulp Canning Process

Canning is the procedure of preserving fruit pulp from any damage or spoilage in a sealed and sterilized container or jar through heat. The heat destroys microorganisms and stops the activities of the enzymes in the fruit pulp, thus increasing the shelf life of the fruit pulp. The fruit pulp can be preserved in various types of sealed containers or jars, for example, metal, glass, thermostable plastic, or a multilayered flexible pouch. Here, heating is the source factor for eliminating all kinds of bacteria from the fruit pulp and permanently sealing them to prevent recontamination.

Also known as appertising, the canning process was invented by Nicolas Appert in 1809. He observed that food cooked and stored inside the jar did not spoil until the seal got broken or leaked. Later he developed a method of preserving and sealing food in the jars followed by heat sterilization. Hence, conventional canning is often known as appertising, as an honour to the originator of the modern canning process.

Long Shelf life	<ul style="list-style-type: none"> • High temperature and sterile containers in canning process destroys the microbes that would cause spoilage, ensuring longer storage.
Nutrition	<ul style="list-style-type: none"> • It preserve the nutrition value of the fruit, such as minerals, vitamins, protein, fat and carbohydrates etc.
Tamper Resistance	<ul style="list-style-type: none"> • Cans are tamper-resistant, which prevents rust, dents, bulges, or leakage in the content.
Food Safety	<ul style="list-style-type: none"> • Canning helps to protect the fruit pulp from recontamination and is thus safer for further usage and consumption.

Fig. 7.1 Advantages of Canning Fruit- pulp

The significant role of the canning process is that it is an effective way of preserving fruit pulp and other foodstuffs without the addition of any chemical preservatives. The **parameters considered during the canning process are pH level, water activity, oxygen level, and temperature**, which vary from fruit to fruit. The heat treatment is applied at a sufficiently high temperature to kill the majority of microorganisms such as bacteria, molds, and yeasts, followed by preventing their access to the food inside the container by sealing it hermetically. Hence, applying adequate processing time and temperature when canning the fruit pulp is essential. Following are the factors that affect the processing time in the canning process:

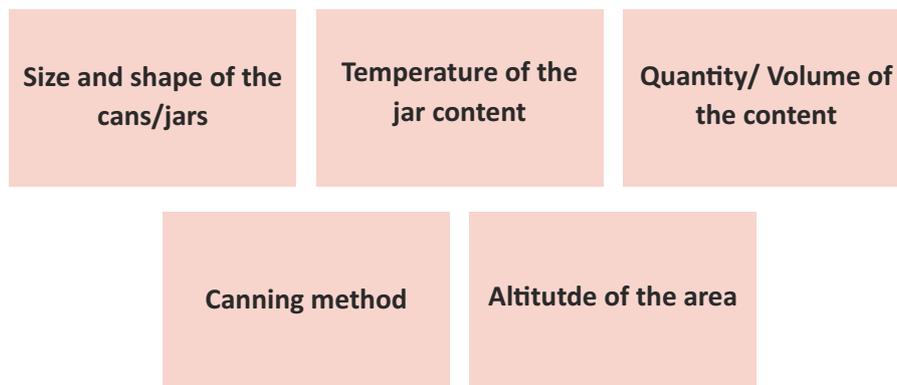


Fig. 7.2 Factors Affecting the Canning Processing Time

There are two canning methods that depend upon the acidity of the fruit pulp.

Boiling Water Bath Procedure

- High acidic fruits, with pH value of 4.6 or less

Pressure Canner Procedure

- Low-acidic fruits, with pH value higher than 4.6

Fig. 7.3 Methods of Canning Process

Notes



7.1.2 Canning Machinery and Equipment

Canning machinery or equipment are used for making cans at the production unit itself. Following are the machinery and equipment for making cans for canning process.

Canning Equipment	Description
 <p data-bbox="279 958 539 992">Can body Reformer</p>	<p data-bbox="639 533 1390 875">In most cases, can bodies get collapsed due to transportation from distant places. Hence, flattened can feeds are shaped into cylindrical form using can reformer equipment to reduce transportation and space. Then, the flattened cans are fed into the roller to form a cylindrical structure. It is widely used due to its low maintenance, solid construction, and corrosion resistance. It is available in multiple sizes, shapes, and finishes to fulfill the necessities of the food processing and packaging industry.</p> <p data-bbox="639 882 1390 954">Parts of Can body Reformer - 1 HP (1440 RPM) motor, starter, V-belt, and pulleys</p> <p data-bbox="639 960 1273 994">Machine Speed – 10-15 cans per minute (approx.)</p>
 <p data-bbox="268 1294 544 1328">Can Flanger Machine</p>	<p data-bbox="639 1032 1390 1256">Can Flanger machines are made up of stainless steel and works on worm gear & drive mechanism. It is widely used for seaming tops and bottoms to the can bodies. The cylindrical-shaped can bodies are flanged on other ends by Flanger. This equipment has two flanging dyes, including grooves.</p>
 <p data-bbox="263 1899 555 1933">Can Seaming Machine</p>	<p data-bbox="639 1368 1390 1592">Can seaming is used for closing the ends of the can. These machines are manufactured using superior quality of material and latest technology according to the international quality standards. These machines have corrosion resistance, tough construction, extended service life and high durability. The machine has two operations</p> <ol data-bbox="639 1599 1390 1749" style="list-style-type: none"> <li data-bbox="639 1599 1390 1671">i. It rolls the projection of the lid underneath the flange of the can body. <li data-bbox="639 1677 1390 1749">ii. It finishes off the seams by tightly pressing the can body and rolling up all five layers of the tin plates. <p data-bbox="639 1756 1390 1827">After the operations, the lid is seamed while the one end of the can is under vacuum.</p> <p data-bbox="639 1834 1390 1906">Parts of Can Seaming Machine - 1 HP 3 phase 440 volts' motor and starter.</p>

Canning Equipment	Description
 <p data-bbox="328 1240 491 1272">Exhaust box</p>	<p data-bbox="639 409 1393 1093">The procedure of removing air from cans is called exhausting. The exhausting process is vital after filling, kidding, or clinching cans. It is used for exhausting air from filled cans before the seaming process. Generally, these boxes are available in different sizes as per clients' specifications. Normally, it can pass two 2 ½ cans at a time. The exhaust box's bottom and cover are made of aluminum metal. Containers are exhausted either by heating or mechanically, but a heat treatment system is generally used. The cans are passed through a tank of hot water at 82-100°C for 5-10 minutes and at the end of the process, the center of the can shows a temperature of about 79°C. The duration of exhausting differs from 6-10 minutes relying upon the nature of the product. Instantly after exhausting, the cans are sealed hermetically from both ends with the help of a sealer machine. During the sealing process, the temperature should not fall below 74°C.</p> <p data-bbox="639 1111 1393 1173">Parts of Exhaust box - 18'ft long box, Operated by 1.5 H.P. motor</p> <p data-bbox="639 1191 1393 1254">Machine speed - Run in three Speeds - high, medium, and low.</p>
 <p data-bbox="304 1951 515 1982">Retort Machine</p>	<p data-bbox="639 1312 1393 1809">A retort is a cylindrical-shaped machine having a fixed dish at the end of the bottom. The top of the retort is openable. It is made up of mild steel. It has perforated steam/water connections built inside the machine. The metal carrying baskets/crates are also made of mild steel and are fully painted with rust-free solvent. The lid is fitted with a sealing gasket; hinges pivot arm, and balance weight for easy opening. There are locking bolts for locking lid. It is suitable for the sterilization of cans. The sealed cans are placed in retort keeping the level of water 2 to 3 inches above the top of the cans. The cover of the retort canner is then screwed down tightly, and the canner is heated to the desired temperature.</p> <p data-bbox="639 1827 1393 1926">Parts of Retort- Pressure gauge, safety valve, & metal clad thermometer and suitable cage Machine speed - 250 cans in one batch</p>

Canning Equipment	Description
 <p data-bbox="276 752 544 786">Embossing Machine</p>	<p data-bbox="639 405 1385 517">The embossing machine is used to imprint the code, which contains the name of the product, manufacture (code), and date of production.</p>

Table 7.1 Types of Canning Equipment

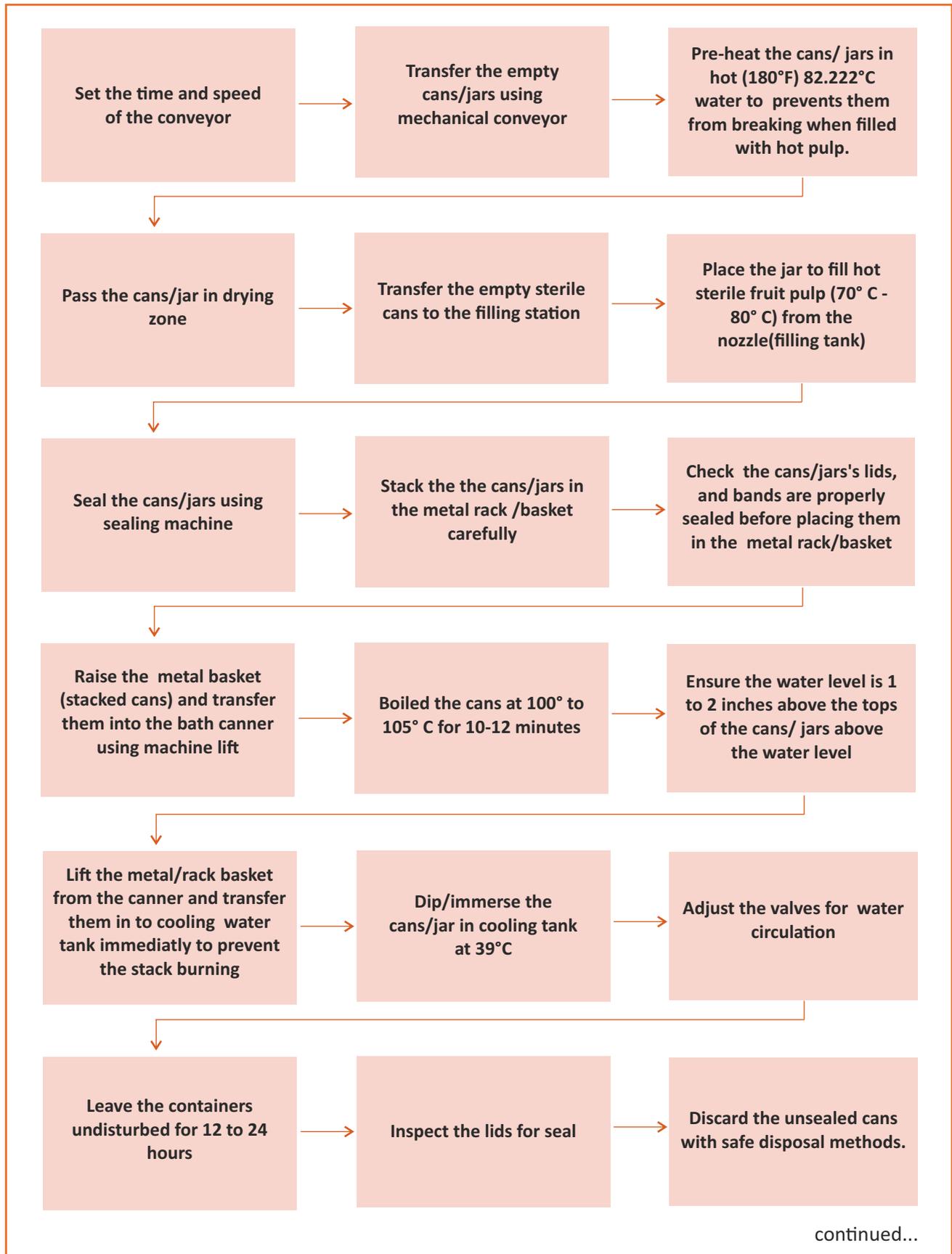
7.1.3 Canning Machine Operation

1. Boiling Water Bath Procedure (Pre-Operation) -

Fill water bath canner/galvanized iron tank at least half-full of potable water and maintain the temperature of 180° F (82.2°C)



Fig. 7.4 Water Bath Canner



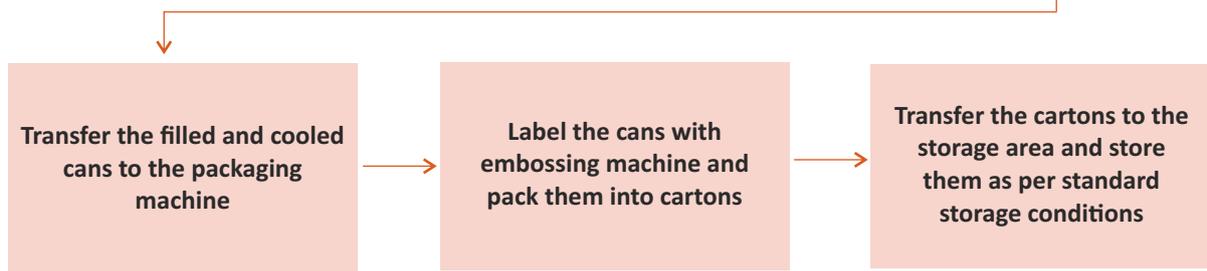


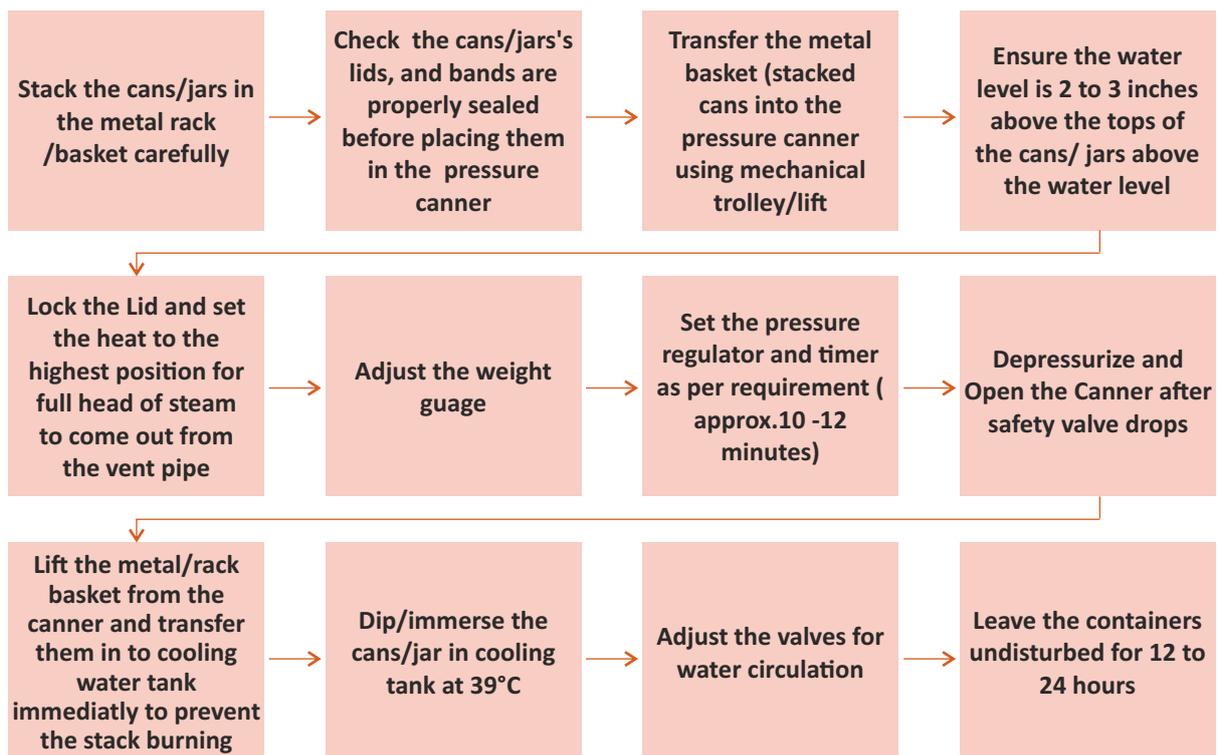
Fig. 7.5 Boiling Water Bath Method

1. Pressure Canner Procedure (Pre-Operation) -

Fill the pressure canner to three-inch depth with potable water and maintain the temperature of 240°F - 250°F (115.5 °C) temperature. The pressure canning procedure is the same until the containers are stacked, lifted, and then transferred into the pressure canner via mechanical lift or trolley.



Fig. 7.6 Pressure Canner



continued...



Fig. 7.7 Pressure Canner Method

7.1.4 Types of Packaging Materials

Types of packaging materials used for canning process are:



Glass Containers

- Glass bottles are preferred packaging medium for high quality fruit beverages. More care is required to avoid breakage of the containers.



Metal Containers

- Metal cans are made of low carbon mild steel of 99.75% purity, coated with tin with easy open ends are used. These tinplate containers are either 3 piece or 2-piece containers. They are lacquered internally to prevent corrosion.



Flexible Packaging

- Flexible packaging minimizes the permeability to oxygen. Flexible laminated pouches like metallized polyester/polyester/ polyethylene are used for hot fill packaging method without retorting for acidic fruit juices. These are used either as flat pouches or stand-up pouches.



HDPE Bottles

- HDPE bottles for fruit pulp are ethylene vinyl alcohol (EVOH) and polyamide (PA). These also provide an aroma barrier and can allow ambient storage for six months or longer, depending on the choice and thickness of the barrier layer.

continued...



Pet bottles

- Fruit pulp packaged in pet bottles is found in both the chilled and ambient segment. The bi-oriented material gives the bottle high tensile strength and an increased gas barrier, which allows for lightweight bottles.



Carton-based Packages

- The laminated carton material normally consists of layers of paperboard coated internally and externally with polyethylene, and a barrier layer.

Fig. 7.8 Types of Packaging Material for Canning Process

7.1.5 Microbial Analysis of Canned Food

Spoilage incidents in canned products are low, but it must be thoroughly checked and investigated adequately before it is sent for distribution. It is crucial to examine the samples of canned fruit pulp for quality lab analysis to detect any kind of spoilage, damage, or leakage. Usually, spoilage is caused by the growth of microorganisms following leakage of the can/jar. Often leakage occurs from defects, punctures, or rough handling of the cans/ jars. Sometimes, contaminated cooling water leaks inside the cans/jars and introduces bacteria which activates the spoilage. A practicable mixed microflora of bacterial rods and cocci is symptomatic of leakage, which can be confirmed by the sample can examination. If *Clostridium botulinum* (spores, toxin, or both) is found in the sample cans, it is dangerous and deadly. Hence it is vital for sample evaluation to check the cans are intact with acceptable seams with no micro leaks and other factors that may lead to under processing, such as drained weight and product formulation.

Following are the parameters for checking spoilage in canned products.

Spoilage due to physical and chemical changes

- Swelling includes flat swell, flipper, springer, soft swell, hard well
- Overfilling
- Faulty retort operation
- Under-exhausting
- Rust and Corrosion of cans
- Foreign flavours and undesirable texture
- Damages and leakage
- Discoloration

continued...

Spoilage due to microbial changes

- Flat sour
- Thermophilic acid (T.A) spoilage
- Sulphide spoilage

Fig. 7.9 Types of Spoilage in Sample Cans

The following equipment are used for the sample can analysis at the lab:

- Incubators, thermostatically controlled at 30, 35, and 55°C
- Ph meter, potentiometer
- Microscope, slides, and coverslips
- Can opener, bacteriological can opener, and can punch, all sterile
- Petri dishes and test tubes, sterile
- Serological pipets, cotton-plugged, sterile
- Indelible ink marking pen
- Diamond point pen for marking cans
- Examination pans

Scan the QR Code to watch the related video



<https://www.youtube.com/watch?v=qHgUc6rvm7c>

Packaging and storage of fruit pulp

7.1.5 FSSAI Laws and Regulations on Product, Packaging, And Labelling

According to FSSAI Standards (Food Products Standards and Food Additives) Regulations, 2011,) below are the regulations outlined for a product, packaging, and labeling.

1. In these regulations, unless the context otherwise requires -

- “Best before” means the date which signifies the end of the period
- “Date of manufacture” means The date on which the food becomes a product is referred to as the "date of manufacturing."
- “Date of packaging” means the date on which the food is placed in the immediate container in which it will be ultimately sold
- “Infant” means a child not more than twelve months of age
- “Lot number” or “code number” or “batch number”
- “Multipiece package” means a package containing two or more individually packaged or labelled pieces of the same commodity of identical quantity, intended for retail either in individual pieces or packages as a whole
- “Non-Vegetarian Food” means an article of food which contains whole or part of any animal including birds, fresh water or marine animals or eggs or products of any animal origin, but excluding milk or milk products, as an ingredient
- “Vegetarian Food” means any article of Food other than Non-Vegetarian Food as defined in regulation
- “Prepackaged” or “Pre-packed food”, means food, which is placed in a package of any nature, in such a manner that the contents cannot be changed without tampering it and which is ready for sale to the consumer.
- “Use – by date” or “Recommended last consumption date” or “Expiry date” means the date which signifies the end of the estimated period under any stated storage conditions, after which the food probably will not have the quality and safety attributes normally expected by the consumers and the food shall not be sold

continued...

Notes



2. Regulation 2.3.17 Concentrated Fruit/ / Puree with Preservatives for Industrial Use Only:

- Concentrated Fruit/Pulp/Puree with Preservatives for Industrial Use Only means, an unfermented product, which is capable of fermentation, obtained from the juice or pulp or puree of fruit(s) from which the water has been removed to the extent that the product has a soluble solids content of not less than double the content of the original juice, pulp, puree prescribed under Regulation 2.3.6 and Regulation 2.3.7. It may be pulpy, turbid, or clear.
- The product may contain food additives permitted in these regulations
- The container shall be well filled with the product and shall occupy not less than 90.0 percent of the water capacity of the container when packed in the rigid containers. The water capacity of the container is the volume of distilled water at 20°C, which the sealed container can hold when filled.

3. 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: —

- containers which are rusty;
- enameled containers which have become chipped and rusty;
- copper or brass containers that are not correctly tinned
- containers made of aluminum not conforming in chemical composition to IS:20 specifications for Cast Aluminium & Aluminium Alloy for utensils or IS:21 specifications for Wrought Aluminium and Aluminium Alloy for utensils.

4. Containers made of plastic materials should conform to the following Indian Standards Specification, used as appliances or receptacles for packing or storing whether partly or wholly, food articles namely: —

- IS: 10146 (Specification for Polyethylene in contact with foodstuffs);
- IS: 10142 (Specification for Styrene Polymers in contact with foodstuffs);
- IS: 10151 (Specification for Polyvinyl Chloride (PVC), in contact with foodstuffs);
- IS: 10910 (Specification for Polypropylene in contact with foodstuffs);
- IS: 11434 (Specification for Ionomer Resins in contact with foodstuffs);
- IS: 11704 Specification for Ethylene Acrylic Acid (EAA) copolymer.
- IS: 12252 - Specification for Poly alkaline terephthalates (PET).
- IS: 12247 - Specification for Nylon 6 Polymer;
- IS: 13601 - Ethylene Vinyl Acetate (EVA);
- IS: 13576 - Ethylene Metha Acrylic Acid (EMAA);

continued...

Labeling Requirements

- All food products sold in India that are pre-packaged are required to comply with the Food Safety and Standards (Packaging and labeling) Regulations, 2011. The Food Safety and Standards Regulation, 2011 is a notification issued by India's Food Safety and Standards Authority under the Ministry of Health and Family Welfare.

Applicability of Food Labelling Regulations

- The food labeling regulations require all “Pre-packaged” or “Pre-packed food” to comply with the labelling regulations in India. As per the rules, pre-packaged food means food, which is placed in a package of any nature, in such a manner that the contents cannot be changed without tampering it and which is ready for sale to the consumer.

Fig. 7.10 FSSAI Standards (Food Products Standards and Food Additives) Regulations

Exercise

Answer the following questions:

1. What is canning process?

2. What are the equipments use for analysis for sample can?

3. Explain the canning equipment and machinery.

4. List any two advantages of canning process.

5. Explain pressure canner process.

8. Ensuring Food Safety and Personal Hygiene



Unit 8.1 - Introduction to Food Safety

Unit 8.2 - Schedule IV requirements of FSSAI

Unit 8.3 - Personal Hygiene

Unit 8.4 - Health Safety



Key Learning Outcomes

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

1. Identify the hazards, types of hazards (Physical, chemical, biological and Allergenic) and risks at workplace
2. HACCP , TACCP, VACCP , Control measures , CCP, Critical limit
3. Explain the preventions of product contamination
4. Discuss the factors affecting food spoilage and food storage techniques
5. Describe Schedule IV requirements of FSSAI
6. Discuss cleaning and sanitization process, needs and importance and storage of sanitizing materials
7. Discuss health and safety policies and procedures
8. Discuss Employee health do's and don'ts, Food borne illness and preventive health checkups

UNIT 8.1: Introduction To Food Safety

Unit Objectives

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

1. Identify types of hazards and risks at workplace

8.1.1 Food Safety

Food safety refers to routines in the preparation, handling and storage of food meant to prevent food borne illness and making food safe for human consumption. Safe food handling practices and procedures are thus implemented at every stage of the food production life cycle in order to curb these risks and prevent harm to consumers.

8.1.2 Food Safety Hazard and Risk

Hazard is a factor or agent which may lead to undesirable effects like illness or injury in the absence of its control, whereas, risk refers to the probability that the effect will occur.

Hazard is that part of food which somehow entered in the food and which is non-consumable.

Types of hazards and risks at work place

There are two types of hazards: one is food safety hazard and second is health safety hazards.

Food Safety Hazard

There are four major hazards that may be introduced into the food supply any time during harvesting, processing, transporting, preparing, storing and serving food. These hazards may be microbiological, chemical, physical and allergens.

Microbiological hazards

When harmful microorganisms are found or grown on food it is called microbiological hazards. Food which contains harmful or pathogenic bacteria when eaten can make people ill.

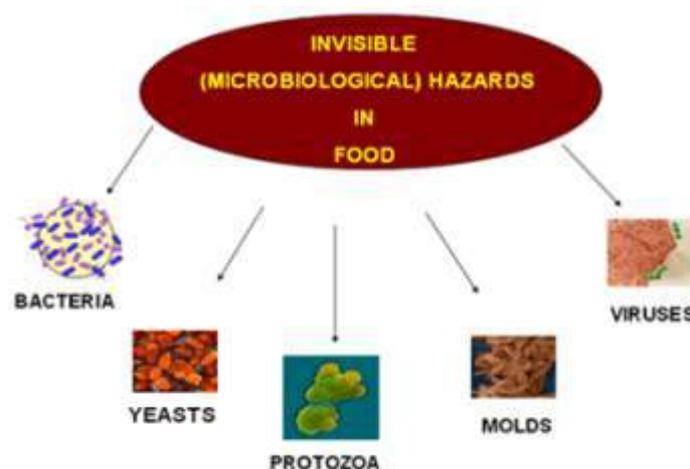


Fig. 8.1: Microbiological Hazards

Food spoilage and deterioration is no accident. It is a naturally occurring process. To understand how to maintain the quality of food and prevent spoilage, we need to know what can cause it.

Food spoilage: The microorganisms that can cause food-borne illness are called pathogenic microorganisms. These microorganisms grow best at room temperatures (25-30°C), but most do not grow well at refrigerator or freezer temperatures. Pathogenic microorganisms may grow in foods without any noticeable change in odor, appearance or taste. Spoilage microorganisms, including some kinds of bacteria, yeasts and molds, can grow well at temperatures as low as 4°C. When spoilage microorganisms are present, the food usually looks and/or smells awful.



Fig. 8.2: Food Spoilage

FAT TOM- This is a term used commonly in food industry to describe the six favorable conditions required for the growth of the food borne pathogens/micro-organisms.

FAT TOM - FOOD SAFETY

F **Food:** Microorganisms need a constant source of nutrients to survive, especially protein. Moist, protein-rich food (raw meat or seafood, cooked rice or pasta, eggs, and dairy products) are potentially hazardous.

A **Acidity:** Bacteria grow best in an environment that is slightly acidic or neutral (pH level of 4.6-7.5) and they flourish in a pH range between 6.6 and 7.5.

T **Time:** Food should not remain in the temperature danger zone (40°F - 140°F) for more than 2 hours, and either be cooled or heated.

T **Temperature:** Bacteria grow best at a temperature range of 40°F to 140°F - which is referred to as the "temperature danger zone".

O **Oxygen:** Almost all foodborne pathogens are aerobic, that is, requiring oxygen to survive and grow.

M **Moisture:** Water is essential to bacterial growth. Microorganisms grow faster in food with high water content (meats, produce, and soft cheeses).

FAT TOM is a mnemonic device used in the food service industry to describe the six aspects that contribute to the growth of foodborne pathogens. With the proper control of these aspects, the chance of food illness is reduced.

Fig. 8.3: FATTOM Food Safety

Physical Hazards

These include any foreign material, which you would not expect to find in your food. Hair, finger nails, pieces of wood, metal, plastic, glass and insect debris are examples of what can find their way into food as foreign matters.



Fig. 8.4: Physical Hazards

Chemical Hazards

Chemical hazards include, food contact materials, cleaning agents, pest control substances, contaminants (environmental, agricultural and process e.g. acrylamide), pesticides, biocides and food additives. They are naturally occurring, intentionally added or unintentionally added.

- Preservatives
- Colours and dyes
- Flavour enhancers
- Water additives
- Packaging materials
- Processing aids

Allergen

An allergen is any protein that is capable of producing an abnormal immune response in sensitive segments of the population.

A known component of food which causes physiological reactions due to an immunological response (e.g.- nuts, gluten, egg, ,milk etc, identified in legislation relevant to country of production or sale)

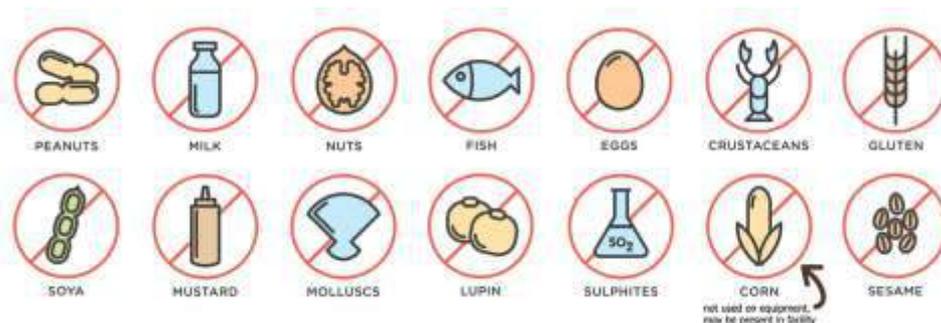


Fig. 8.5: Allergens

It is important to be aware of food allergens in food industry as this is the risk associated with the unintended presence of allergen due to cross contamination and should take this a matter of serious concern. Food allergies can cause serious and even deadly reactions.

What Are the Most Common Food Allergens?

There appears to be eight common allergens accounting for most food allergic reactions. They stand to be- milk, eggs, peanuts, soya, wheat, tree nuts (like walnuts and cashews), fish and shellfish (such as shrimp).

What Are the Signs & Symptoms of a Food Allergy?

The common sign and symptoms are: trouble breathing; coughing; hoarseness; throat tightness' belly pain' vomiting' diarrhea itchy, watery, or swollen eyes; red spots; swelling, a drop in blood pressure and is capable of happening because a person can't digest a substance, such as lactose.

Handling of Allergenic Foods:

1. Allergen-containing ingredients should be kept separate from non-allergen-containing products. Also, finished products containing that ingredient should be kept separate from non-allergenic products.
2. Allergen-containing products should be run at the end of the day or shift or isolated to a specific production line to avoid contact with non-allergen products.
3. Post-production, effective cleaning, and sanitizing must be performed to remove all allergen-containing products.
4. Sampling and testing of food products should be performed by the quality assurance staff or specially trained personnel to detect allergens in food products and on equipment surfaces.
5. Ensure that appropriate and correct information is provided in the labeled packaging of the food product.
6. Proper employee training should be given to to prevent allergen contamination.

8.1.3 Contamination, Cross Contamination and Prevention

Contamination: The presence of unwanted materials such as dust and particles during the manufacturing and transportation time is called contamination. The term contaminants include any unwanted matter that is found in the product. These contaminants affect the quality of the product or the process.

The most common types of contaminant include:

- Physical contaminant Examples: fiber material, particles, chips from your pill press tooling.
- Chemical contaminant. Examples: vapor, pesticides, grease. detergents, and so on.
- Biological contaminant Examples: fungus, bacteria, virus.

Cross contamination is possible when the unwanted matter is introduced or brought from one process to the next during manufacturing.

A leak in the holding containment would contaminate the product inside it; this would be an example of physical contamination.

Certain metals standing to be more advantageous to health, like iron, appearing to be globally added to some foods, involving infant formulas as well as breakfast cereals, to highlight their dietary advantages.

For biological contamination, bacteria may thrive if the container is not properly cleaned and dried. The contaminated container will then affect the product and microbes may thus be introduced to the batch.

Prevention of Contamination:

Determine the cause of the contamination

Anticipate the effect

Eliminate the source material

- To remove the contaminant carrier:
 - Reduce human involvement
 - Regulate the use of the equipment
 - Regulate the use of air
 - Regulate the use of water
- To reduce human carrier risk:
 - Ensure that proper attire is worn when coming and going from the production area
 - People frequently touch their eyes, nose, and mouth without even realizing it. Germs can get into the food through their contaminated unwashed hands.
- To reduce water as carrier:
 - As water is the number one source for cross contamination, it is important to reduce and prevent water contamination
 - Water borne contaminants: particulates (such as minerals) and pathogens (e. coli, salmonella, etc.)
 - Use of preventive measure such as filtration devices, distillation or reverse osmosis, UV treatments
- To reduce air as carrier:
 - Control air flow through AHUs (Air Handling Unit)
 - Use of air locks
 - Installation of HEPA (High Efficiency Particulate Absorbing Filters) filters
 - Ultra-Low Particulate Air

8.1.4 Storage (Importance of Storing Food at Specified Temperature)

Storage temperature is one of the most important factors in the preservation of food because microorganisms have been found to grow in almost all temperature.

Food storage is a major issue when keeping food safe. Food which is not correctly stored can spoil or become contaminated, which can make people sick. There are very specific rules regarding the temperatures that food must be stored at, cooked to and reheated to and if not followed, the risk of becoming ill as a result of contamination increases.

Room Temperature Food Storage

Keep dry storage areas clean with good ventilation to control humidity and prevent the growth of

Keep dry storage areas clean with good ventilation to control humidity and prevent the growth of mold and bacteria. 21°C is adequate for dry storage of most products. One of the first things to check regarding food which has been stored in the 'use-by' or 'best-before' dates printed on the packaging.

These dates will give you the most accurate indication of a food's shelf life, however, when a packet or can is opened, the expiry date almost always changes.

Refrigerating and Freezing Food

To reduce the risk of bacterial contamination, many foods must be stored in the refrigerator and thus kept below 5°C. These foods are often classified as 'high-risk foods' and include – meat, poultry, dairy, seafood, eggs, small goods and cooked rice and pasta. This also refers to ready-to-eat foods that have high-risk foods as ingredients and include – casseroles, quiche, pasta salad, pizza, sandwiches and many cakes.

By keeping these high-risk foods under 5°C it stops them from entering the 'danger-zone' – temperatures between 5°C and 60°C. The danger-zone is the temperature zone which provides bacteria with the perfect environment to rapidly grow and multiply to numbers that cause food poisoning.

By freezing food its longevity is increased because the water content of the food freezes – this prevents bacteria from multiplying and food spoiling. Food should be kept frozen at –18°C; when thawing, it should be stored in a refrigerator that reaches no more than 5°C until it is ready to be prepared.

8.1.5 Transportation

Selling fresh and high-quality produce is essential in groceries and retail food businesses. That's why the transport and storage of foods is so important, and refrigerated transport is essential to achieve this.

Refrigerated Transportation

Refrigerated transportation is a shipping cargo with advanced temperature adjustment features. It is built and designed mainly for climate-sensitive goods such as vegetables, fruits, meat, all-prep meals, bread, etc. in which the freight is loaded with ice and salt to maintain the food's quality at a particular temperature.



Fig. 8.6: Refrigerated Transportation

Ambient Temperature for Shipping

When it comes to cold chain logistics, maintaining ambient temperature tends to mean maintaining a temperature between 15°C to 25°C or 59°F to 77°F. These temperatures fall in the range of comfortable room temperature instead of being on one extreme end of temperature ranges.

8.1.6 HACCP, TACCP, VACCP, Control Measures, Critical Control Point, Critical Limit

HACCP (Hazard Analysis Critical control point): It is a systematic approach in identification, evaluation and control of food safety hazards and it's written documented plan based on HACCP principles known as HACCP Plan. It has 12 steps and 7 principles as:-

- Assembly of HACCP Team
- Describe Product
- Identify indent use
- Draw Flowchart / Diagram
- Verify Flowchart/ Diagram
- Conduct a hazard analysis (Principle 1)
- Determine critical control points (CCPs) (Principle 2)
- Establish critical limits (Principle 3)
- Establish monitoring procedures (Principle 4)
- Establish corrective actions (Principle 5)
- Establish verification procedures (Principle 6)
- Establish record-keeping and documentation procedures (Principle 7)

VACCP (Vulnerability Analysis Critical control points):

It focuses on food fraud as well, and widens the scope to include systematic prevention of any potential adulteration of food, whether intentional or not, by identifying the vulnerable points in a supply chain. It is especially concerned with economically motivated adulteration (EMA). Examples include product substitutions, unapproved product enhancements, counterfeiting, stolen goods and others.

TACCP (Threat Analysis Critical control points): generally requires a wider range of employee involvement than HACCP, as it covers issues such as manufacturing plant and transportation security, IT security, and employee background checks. Some points will overlap with HACCP, such as tamper-proof seals and various quality control checks.

Reduce the likelihood (chance) and consequence (impact) of a deliberate attack;

Protect organizational reputation;

Reassure customers and the public that proportionate steps are in place to protect food;

Demonstrate that reasonable precautions are taken and due diligence is exercised in protecting food.

Control: It is means to prevent, eliminate, or reduce hazard.

Control measures: It is means of any action or activity that is used to prevent, reduce to acceptable levels, or eliminate a hazard.

Critical limit: it is means a point, step, or procedure in a food process at which a control measure can be applied and at which control is essential to prevent, reduce to an acceptable level, or eliminate an identified food hazard.

UNIT 8.2: Schedule IV Requirements of FSSAI

Unit Objectives

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

1. Identify requirements in Schedule IV in FSSAI

8.2.1 Schedule IV Requirements of FSSAI

To provide assurance of food safety, Food businesses must implement an effective Food Safety Management System (FSMS) based on Hazard Analysis and Critical Control Point (HACCP) and suitable pre-requisite programmes by actively controlling hazards throughout the food chain starting from food production till final consumption.

As per the condition of license under FSS (Licensing & Registration of Food Businesses) Regulations 2011, every food business operator (FBO) applying for licensing must have a documented FSMS plan and comply with schedule 4 of this regulation. Schedule 4 introduces the concept of FSMS based on implementation of Good Manufacturing Practices (GMP) and Good Hygiene Practices (GHP) by food businesses and is divided into five parts as under:

Schedule 4	General Requirements
Part 1	General hygienic and sanitary practices to be followed by food business operators applying for registration - Petty food operators and Street food vendors
Part 2	General hygienic and sanitary practices to be followed by food business operators applying for license- Manufacturing/ processing/ packaging/storage/distribution
Part 3	General hygienic and sanitary practices to be followed by food business operators applying for license- Milk and milk products
Part 4	General hygienic and sanitary practices to be followed by food business operators applying for license- Slaughter house and meat processing
Part 5	General hygienic and sanitary practices to be followed by food business operators applying for license- Catering

Table 8.2.1: Five Parts of Good Manufacturing Practices (GMP) and Good Hygiene Practices (GHP)

Part II: General hygienic and sanitary practices to be followed by food business operators applying for license- Manufacturing/ processing/ packaging/storage/distribution

- **Location and Surroundings**
- Location shall be:
 - away from environmentally polluted areas
 - away from industrial activities which produce:
 - Disagreeable or obnoxious odor,
 - Fumes
 - Excessive Soot
 - Dust



Well Guarded Entrance of the Plant



Demarcation of the area

Fig. 8.7: Location and Surrounding factors

- Smoke
- Chemical or biological emissions
- Pollutants
- Layout and Design of Food Establishment Premises

Facility in good condition leads to clean, pest free environment

- Repaired or replaces holes, broken tiles missing ceiling panel etc.
- Sealed/grated sewer grids less than 1/4 inch

Hole free exterior walls

- Louvers in exterior wall fans that close tightly when turned off
- Screened pipes & windows
- Sealed outside pipe

Striped or sealed gaps around all doors

- Use of screen door, air curtains & other mechanisms
- Sealed cracks to prevent insect harborage

Fig. 8.8: Layout and Design factors

- **Equipment and Containers**

- made up of non-corrosive / rust free material
- smooth, free from any grooves
- easy to clean and maintain
- non-toxic and non-reactive
- of food grade quality



Fig. 8.9: Equipment and Container factors

- **Facilities**

- **Water supply**

- Only potable water meeting BIS (Bureau of Indian Standards) standards
- Appropriate facilities for storage and distribution of water
- Periodic cleaning of storage tanks and its record
- Non-potable water, if used, only for cooling of equipment, steam production, fire fighting
- Distinguished non-potable water pipes



Fig. 8.10: Water Supply

- Drainage and waste disposal
 - Disposal of sewage and effluent in conformance with the requirements of Factory
 - Designed and constructed to reduce risk of contamination to food and potable water
 - Separate waste storage area
 - Covered containers for waste storage
 - No accumulated waste in food handling, food storage or other working areas
 - Periodic disposal of waste/refuse
 - Pedal operated adequate size bins for waste collection
 - Waste bins emptied and washed daily with a disinfectant and dried before next use



Sr. No.	Material	Dustbin Colour	SYMBOL
1	Oily Cotton Waste	Red	
2	Paper	Green	
3	Plastic Jars, Sampling Bottles	Blue	
4	Plastic Bags	Yellow	
5	Polish Filter	Grey	
6	Food Waste	Orange	
7	Glass Bottles	Black	

Fig. 8.11: Waste Disposal



Fig. 8.12: Drainage System

- Personnel facilities and toilets
 - Facilities for washing and drying hands
 - Supply of hot and cold water
 - Separate lavatories of appropriate hygiene design for males and females separately
 - Suitably located Changing facilities for personnel
 - No direct opening of such facilities in food processing, service or storage area
- **Ventilation and Lighting**
 - Air quality and ventilation:
 - Natural / mechanical ventilation system including air filters, exhaust fans
 - Designed and constructed as such air does not flow from contaminated areas to clean areas
 - Lighting
 - Adequate Natural /artificial lighting
 - Protected lightings to avoid contamination by breakages



Fig. 8.13: Personal facilities



Fig. 8.14: Ventilation and Lighting

- **Food Operations And Controls**

- **Procurement of raw materials**

- Quality raw materials (free of parasites, micro-organisms, pesticides etc.)
- Raw material conforming to the regulations under the act
- Records of raw material as source of procurement



Fig. 8.15: Procurement of raw materials

- **Storage of raw materials and food**

- Adequate food storage facilities to protect food from contamination
- Cold storage facilities according to requirement
- Segregation of storage area for raw and processed food, recalled materials, packaging materials, stationary, cleaning materials/ chemicals
- Separate cold storage of raw food like meat/poultry/seafood product away from the area of WIP (Work in Progress), processed, cooked and packaged products.
- Monitoring of temperature and humidity
- FIFO First received (In) materials must move out first
- Non –toxic containers for food storage
- Stored on racks or pallets well above the floor and away from the wall



Fig. 8.16: Storage of raw materials and food

Review Of Product Label /Packaging Usage And Control

Labels should be reviewed allergens are mentioned don it prior to their receipt for their accuracy. Line Personnel should be trained to ensure labelling is changing when a changeover takes place.

Food Processing / Preparation, Packaging and Distribution / Service

- **Storing at appropriate temperature:** The Food Business shall develop and maintain the systems to ensure that time and temperatures are controlled effectively where it is critical to the safety and suitability of food. Such control shall include time and temperature of receiving, processing, cooking, cooling, storage, packaging, distribution and food service till it reaches the consumer, as applicable.
- **Food Packaging:** Packaging materials shall provide protection for all food products to prevent contamination, damage and shall accommodate required labelling as laid down under the FSS Act & the Regulations there under.
- **Transportation:** All critical links in the supply chain need to be identified and provided for to minimize food spoilage during transportation. Processed / packaged and / or ready-to-eat food shall be protected as per the required storage conditions during transportation and / or service.
- **Management and Supervision**
 - Provision of resources to implement & maintain Food Safety
 - Developing SOPs for processing, packing, dispatch & storage of food
 - Competent Technical Managers & Supervisors:
 - having skills on food hygiene principles & practice
 - taking appropriate preventive & corrective action
 - ensure effective monitoring and supervision.
- **Maintaining Process related records (e.g. production records)**
- **Sanitation And Maintenance of Establishment Premises**
 - Facilities should permit effective cleaning.
- **Cleaning Program**
 - areas to be cleaned,
 - cleaning frequency,
 - procedure,
 - equipment,
 - cleaning material and method



Visualizing for HK material



Kamishibai Board for maintaining HK



Hanging of Flexible pipes for ease of cleaning

Fig. 8.17: Cleaning Program

- **Maintenance**

- Preventive and Corrective Maintenance
- Lubricants and heat transfer fluids shall be food compatible Procedure for releasing maintained equipment back to production
- Maintenance personnel shall be trained in the product hazards associated with their activities



Fig. 8.18: Maintenance

- **Pest Control Systems**

- Report pest infestations immediately.
- Do not use pesticides/insecticides in food processing area.



Fig. 8.19: Fly Catcher and Rodent Traps

- **Personal Hygiene**

- Health Status
 - Personnel suffering from disease or illness shall not be allowed to enter in food handling area
 - System to report illness or symptoms of illness to management
 - Medical examination of food handlers/ employees once in a year
 - Records of medical examination
 - Factory shall be compulsorily inoculated against the entire group of diseases and recorded
 - In case of epidemic, all workers to be vaccinated irrespective of the yearly vaccination.

- **Personal Cleanliness**

- High degree of personal cleanliness by food handlers
- Food business shall provide to all food handlers;
- Protective clothing
- Head covering
- Face mask
- Gloves
- Foot wear



Fig. 8.20: Personal Cleanliness

- **Visitors Generally**
 - Generally visitors should be discouraged to go inside the food handling areas
 - The food business shall ensure visitors to its food manufacturing/ handling areas shall;
 - Wear protective clothing
 - Footwear
 - Adhere to personal hygiene provisions envisaged in the respective section
- **Product Information And Consumer Awareness**
 - Batch Identification
 - Identifies producer
 - Product recall
 - Effective stock rotation - FIFO
 - Product Information
 - Adequate information & enables other person in food chain to handle, display, store, prepare & use the product safely & correctly
 - Labeling
 - Should confirm to Legal Requirements
- **Consumer Education**
- **Training**
 - Awareness & responsibilities
 - Training Programmes
 - Nature of food
 - Control Spoilage
 - Handling of food
 - Storage
 - Training Records
 - Instruction & supervision
 - Periodic assessment of training & effectiveness
 - Refresher training
- **Good Manufacturing Practices For Whole Premise**

Good Manufacturing Practices* (GMPs) are the basic operational and environmental conditions required to produce safe foods. They ensure that ingredients, products and packaging materials are handled safely and that food products are processed in a suitable environment.

GMPs address the hazards associated with personnel and environment during food production. They provide a foundation for any food safety system. Once GMPs are in place, processors can implement a Hazard Analysis Critical Control Point (HACCP) system to control hazards that may affect the ingredients and packaging material during food processing.

GMPs Address:

- **Environmental control (premises):** Location, design and construction of the building and its interior, equipment, water supply.
- **Personnel practices:** Personal hygiene, hand washing, clothing/footwear/headwear, injuries and wounds, evidence of illness, access and traffic patterns, chemical use.
- **Shipping, receiving, handling, storage:** Inspection procedures for transport vehicles; loading, unloading and storage practices; inspection procedures for incoming products; shipping conditions; returned and defective products; allergen control; chemical storage; waste management.
- **Pest control:** Monitoring procedures for the exterior and interior of the building (ex: surveillance, fumigation) and the use of pesticides.
- **Sanitation:** Cleaning and sanitizing procedures and pre-operational assessment.
- **Equipment maintenance:** Procedures describing preventive maintenance and calibration of all the equipment and instruments that can affect food safety (ex: thermometers, thermocouples, metal detectors, scales, pH meters)
- **Recall and traceability:** Procedures that ensure final products are coded and labeled properly; incoming materials; in-process and outgoing materials are traceable; recall system is in place and tested for effectiveness (ex: procedures for mock recalls).
- **Water safety:** Water safety monitoring procedures for water, ice and steam, and water treatment procedures that ensure it is potable for use in food processing



Fig. 8.21: GMPs Address

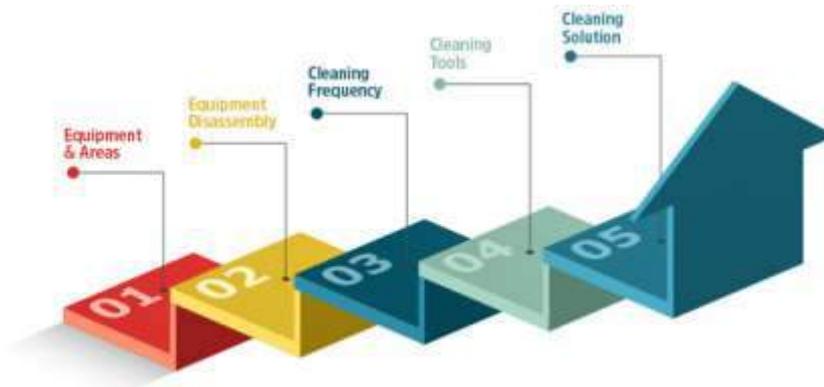


Fig. 8.22: Storage of sanitizing materials

Where and How to Store Your Cleaning Supplies

- **Clean, Cool, Dry:** Store your cleaning supplies in an area that is clean and free of debris. Make sure that there aren't any temperature extremes in the area where your cleaning supplies are stored. Another thing to make sure of is that the area is dry.
- **Original Containers:** Keep cleaning supplies in their original containers. If you mix your own cleaners, make sure you use new clean bottles and label them to avoid a mixup.
- **Safe Storage:** Be sure to keep your cleaning supplies stored in places where your children and/or pets will not be able to get to them. Consider higher storage or locked storage options to protect small children and pets.

Cleaning and Sanitization Process, Need and Importance

Workplace Sanitation: Maintaining a clean work environment is critical in preventing foodborne illness. Bacteria can grow on unsanitary surfaces and then contaminate food. Just because a work surface looks clean does not mean that it is sanitary. Always ensure that you clean and sanitize a work area before starting to prepare food.

Cleaning Procedures and Schedules: Cleaning with soap and other detergents is just one step of the cleaning procedure. It is also necessary to sanitize. Cleaning will remove any dirt or grease, but will not necessarily kill any bacteria or other pathogens. Only a sanitizer will kill bacteria and ensure the area is safe for food preparation. Leading sanitizers used in the food service industry are chlorine solutions (bleach), quaternary solutions (quarts), and iodine. Use these materials according to the manufacturer's instructions that accompany the product and that are found on the material safety data sheet (MSDS) using the appropriate personal protective equipment.

A sanitation plan is important in any food service preparation area. It ensures that all surfaces are cleaned on a regular basis and reduces the risks of transferring bacteria or other pathogens from an unclean surface to clean equipment such as cutting boards or tools. A sanitation plan has two components:

- A list of cleaning and sanitizing agents or supplies with instructions on their safe use and storage
- A cleaning schedule, outlining how each item needs to be cleaned, who is responsible, and how frequently it happens

Routine Equipment Maintenance

Refer to the manufacturer's instructions and training provided by your employer or instructor on how to do this safely. Some equipment is intended to be cleaned in place. This should be identified in your sanitation plan and cleaning schedule.

All equipment must be routinely cleaned and inspected. Older equipment may have nooks and crannies where dirt and bacteria can hide, which can be difficult to clean effectively. Proper cleaning procedures must be established and followed at all times with regular review to ensure that procedures are working. If equipment is replaced or cleaning materials change, the process may have to be adjusted. If you notice any safety concerns with the equipment while cleaning it, such as a frayed cord, missing guard or loose parts, let your supervisor know immediately.

• Good Food Hygiene Practices

- Cleaning
 - Food areas and equipment between different tasks, especially after handling raw food shall be cleaned.
 - The surface shall be thoroughly cleaned in case if somebody spills food / water / drink.
- Raw materials
 - Raw materials shall be purchased from reliable and known dealers and checked for visible deterioration & off-odour, physical hazards and foreign body contamination.



Fig. 8.23: 8 Principles based on eight quality management principles

- Cooking
 - The preparation/ processing/ cooking should be adequate to eliminate and reduce hazards to an acceptable level which might have been introduced at the raw food level.
 - The preparation/ processing/ cooking methods should ensure that the foods are not re-contaminated.
 - The preparation/ processing/ cooking of veg. & non-veg. products should be segregated.
 - Whenever cooking or reheating of food is done, it should be hot all the way through, it is especially important to make sure that food is cooked thoroughly.
 - Re-use of cooking oil should be avoided.
 - In case of reheating of oil use maximum three times to avoid the formation of Trans fat. It is ideal to use once if possible.
- Chilling
 - Semi cooked or cooked dishes and other ready-to-eat foods such as prepared salads and desserts having short shelf life should not be left standing at room temperature.
 - Chilled food intended for consumption should be cold enough.
 - Food items that need to be chilled should be put straight away into the fridge.
 - Cooked food should be cooled as quickly as possible and then put it in the fridge.
 - Chilled food should be processed in the shortest time possible.
 - Fridge and display units should be cold enough and as per requirement. In practice, fridge should be set at 5°C to make sure that food is kept in chilled condition. Also, fridge and display units should be maintained in good working condition to avoid food spoilage and contamination.
- Cross-contamination

Following should be done to avoid cross-contamination.

 - Separation of each crop/species and also processed and unprocessed foods.
 - Hands should be thoroughly washed after touching.
 - Work surfaces, chopping boards and equipment should be thoroughly cleaned before the preparing of food starts and after it has been used.
- **Personal Hygiene**
 - High standards of personal hygiene should be maintained.
 - All employees handling food should wash their hands properly:
 - before preparing food
 - after touching raw food or materials, specially meat/poultry or eggs
 - after breaks
 - after using the toilet after cleaning the raw materials or utensils / equipments
 - Street shoes inside the food preparation area should not be worn while handling & preparing food.
 - Food handlers should ensure careful food handling & protect food from environmental exposure.
- **Transportation and Handling Of Food**
 - Food shall be adequately covered during transportation to assure food safety.
 - Transportation vehicles
 - Vehicle inspection
 - Shall not contaminate foods & packaging
 - Should be easy to clean and maintain

- Provide effective protection from dust & dirt
- If required maintain temperature, humidity, atmosphere
- If required allow monitoring of temperature, humidity, etc.
- Should be used only for carrying food.
- Regular maintenance of vehicles is required.
- Appropriate supply chain to minimize food spoilage
- Non-toxic, clean, well maintained food containers during transportation
- Temperature and humidity control during transportation
- Dedicated vehicles for food transportation
- Effective cleaning and sanitation of vehicles between loads carrying high risk foods as fish, meat poultry to avoid cross contamination



Fig. 8.24: Transportation and handling of food

- **Storage**

- It is very important to store food properly for the purpose of food safety. Following things must be ensured:
 - Raw meat/poultry should be stored separately from other foods
 - Storage temperature of frozen food should be -18°C or below.
 - Storage instructions over food packaging should be followed.
 - Dried foods (such as grains and pulses) should be stored off the floor, ideally in sealable containers, to allow proper cleaning and protection from pests.
 - Store commercial ice cream at temperatures below 0°F .
 - Store biscuit, brownie, and muffin mixes at room temperature.

Stock rotation

The rule for stock rotation is FIFO (first in, first out) to make sure that older food is used first. This will help to prevent wastage. Older product will have nearer shelf life expiry, so older product should be moved out first, but new products will have time to move out since expiry is so far. That's why a rule of FEFO does also exist which means First Expiry First Out. It is called Good Distribution Practice.

UNIT 8.3: Personal Hygiene

Unit Objectives

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

1. Identify types of health and safety policies and procedures

8.3.1 Personal Hygiene

The expression “food hygiene” is often associated to personal hygiene. The concept of food hygiene really refers to the general cleanliness state of the food handlers’ body and clothes. Microorganisms can easily pass to food and reach the consumer if the handler comes into contact with any pathogenic microorganism by their clothes, hands, hair, nails, rings and then sets out to prepare food. As so, the personal hygiene of whoever contacts with food, as well as behaviors they assume during its processing, constitute an important preoccupation in the food business. The set of rules, conditions and practices that assure adequate personal hygiene make up the good practices for personal hygiene.

8.3.2 Importance of Personal Hygiene

It is imperative for safe food-handling outcomes for all workers to be familiar with standard sanitation and hygiene practices. Fig. 1.3.1 shows the cycles of transmission of micro-organisms. One of the basic principles is to break the cycle by avoiding cross-contamination, which can be achieved by ensuring personal hygiene practices are followed.

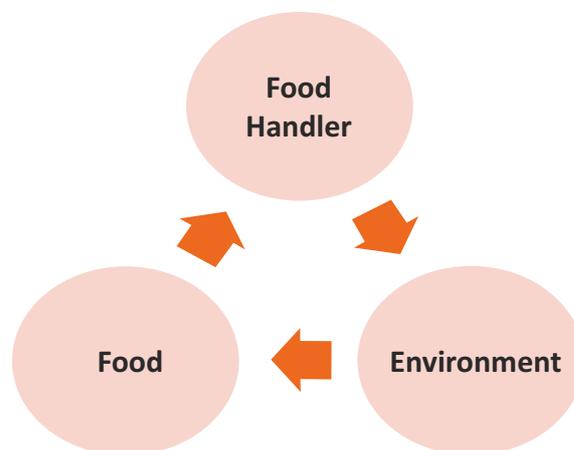


Fig. 8.25: Importance of Personal Hygiene

Proper personal hygiene is critical in any food service premise. Personal hygiene includes:

- Showering and bathing regularly
- Keeping hair clean hair and covered or tied back
- Keeping clean clothing and footwear that is used only at work
- Hand washing regularly



Fig. 8.26: Personal hygiene

8.3.3 Hand Washing

Proper and regular hand washing is a critical part of any food safety system.



Fig. 8.27: Methods of washing hand

How to Use Sanitizer?



Fig. 8.28: Usage of Sanitizer

When to Wash and Sanitize Hand?



Fig. 8.29: Times to wash and sanitize hand

We need to stop the spread of COVID-19 in food industry by washing hands regularly with soap and water for 20 seconds – especially after going to the bathroom, before eating, and after coughing, sneezing, or blowing our nose.

8.3.4 Good personal hygiene can prevent food poisoning.

Bacteria that cause food poisoning can be on everyone – even healthy people. You can spread bacteria from yourself to the food if you touch your nose, mouth, hair or your clothes, and then food.

Good personal hygiene also makes good business sense. Customers like to see food-handling staff who take hygiene seriously and practice safe food handling.

- Personal hygiene is important to prevent food poisoning.
- When handling food, wash your hands thoroughly and often.
- If you are sick, do not go to work, because you can contaminate food more easily.
- Food handlers should be properly trained in safe food handling.

Food handling businesses ensure the following factors are considered to ensure personal hygiene:

- **Hand Washing** — ensure effective hand washing techniques are followed at appropriate times
- **Minimise hand contact with food** — try to minimise direct hand contact with raw food by using appropriate utensils and safe use of disposable gloves
- **Personal cleanliness** — cover hair; do not sneeze or cough over food; cover cuts and sores; and do not wear jewellery
- **Wear protective clothing** — wear suitable clean protective clothing and handle appropriately to prevent cross contamination
- **Exclude ill staff** — staff must report illnesses; exclude staff with vomiting or diarrhoea

Scan the QR Code to watch the related video



<https://www.youtube.com/watch?v=9Vjyi0GhVGA>

Introduction to schedule 4 Part1



<https://www.youtube.com/watch?v=shAjoTniul0>

Introduction to schedule 4 Part2



<https://www.youtube.com/watch?v=GwGeTWYI0oY>
Basic storage and transportation



<https://www.youtube.com/watch?v=1tk145A3idl>
Internal structure and fittings



<https://www.youtube.com/watch?v=RS4A-uczS6E&t=432s>
GHP,GMP and FSMS

UNIT 8.4: Health Safety

Unit Objectives

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

1. Illustrate the concept of health safety
2. Understand the hazards of health safety
3. Explain the health and safety policies and procedures
4. Describe the personal protective equipment
5. Discuss the types of personal protective equipment

8.4.1 Health Safety

The term Health and Safety is generally used to describe Occupational Health and Safety, and relates to the prevention of accidents and ill health to employees and those who may be affected by their work.

8.4.2 Health Safety Hazards

Safety hazards exist in every workplace, but how do you know which ones have the most potential to harm workers? By identifying hazards at your workplace, you will be better prepared to control or eliminate them and prevent accidents, injuries, property damage, and downtime.

First of all, a key step in any safety protocol is to conduct a thorough safety hazard assessment of all work environments and equipment

In a safety hazard assessment, it is important to be as thorough as possible because after all, you can't protect your workers against hazards you are unaware of and unprepared for. Avoid blind spots in your workplace safety procedures by taking into consideration these 3 types of workplace hazards:

- **Safety hazards**

Safety hazards are number one on the list of 3 types of workplace hazards. These hazards play an effect on employees who work directly with machinery or in construction sites. Safety hazards are unsafe working conditions that can cause injury, illness, or death.

Safety hazards are the most common workplace risks. They include:

- Anything that can cause spills or trips such as cords running across the floor or ice
- Anything that can cause falls such as working from heights, including ladders, scaffolds, roofs, or any elevated work area.
- Unguarded and moving machinery parts that a worker can accidentally touch.
- Electrical hazards like frayed cords, missing ground pins and improper wiring
- Confined spaces



Fig. 8.30: Safety hazards

- **Ergonomic hazards**

Ergonomic safety hazards occur when the type of work, body positions, and working conditions put a strain on your body.

Ergonomic Hazards include:

- Improperly adjusted workstations and chairs
- Frequent lifting
- Poor posture
- Awkward movements, especially if they are repetitive
- Having to use too much force, especially if you have to do it frequently
- Excessive vibration



Fig. 8.31: Ergonomic Hazards

- **Work organization hazards**

Safety hazards or stressors that cause stress (short-term effects) and strain (long-term effects). These are hazards associated with workplace issues such as workload, lack of control and/or respect, etc.

Examples include:

- Workload demands
- Workplace violence
- High intensity and/or pace
- Respect (or lack thereof)
- Flexibility
- Control or say about things
- Social support or relations
- Sexual harassment

8.4.3 Health and Safety Policies and Procedures

Overview

The law says that every business must have a policy for managing health and safety.

A health and safety policy sets out your general approach to health and safety. It explains how you, as an employer, will manage health and safety in your business. It should clearly say who does what, when and how.

8.4.4 What is Personal Protective Equipment?

Personal protective equipment, commonly referred to as "PPE", is equipment worn to minimize exposure to hazards that cause serious workplace injuries and illnesses. These injuries and illnesses may result from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards. Personal protective equipment may include items such as gloves, safety glasses and shoes, earplugs or muffs, hard hats, respirators, or coveralls, vests and full body suits.

Employers are also required to train each worker required to use personal protective equipment to know:

- When it is necessary
- What kind is necessary
- How to properly put it on, adjust, wear and take it off
- The limitations of the equipment
- Proper care, maintenance, useful life, and disposal of the equipment

If PPE is to be used, a PPE program should be implemented. This program should address the hazards present; the selection, maintenance, and use of PPE; the training of employees; and monitoring of the program to ensure its ongoing effectiveness.

8.4.5 Types of PPE

Head protection

Examples of head protection equipment:

- Helmets
- Hard hats
- Hair nets

Hand protection

Examples of hand protection equipment

- Work gloves and gauntlets
- Wrist cuff arm nets

Eye and face protection

- Safety glasses and goggles
- Eye and face shields



Fig. 8.32: Eye and face protection

Respiratory Protection

This type of PPE must be present when being in contact with large amounts of gases, powders, dust and vapors.



Fig. 8.33: Types of Respirators

Hearing protection

Examples of hearing protection equipment:

- Earplugs and defenders
- Noise meters
- Communications sets
- Acoustic foam

Foot protection

As examples of foot protection equipment can be pointed out the following ones:

- Safety boots and shoes
- Anti-static and conductive footwear

Height and access protection

As examples of height and access protection equipment can be mentioned in the following ones:

- Fall-arrest systems
- Body harnesses
- Lowering harnesses
- Rescue lifting
- Energy absorbers and others

First aid kit

The kit should be kept in an accessible location and /or close to areas where there is a higher risk of injury or illness. The first aid kit should provide basic equipment for administering first aid.

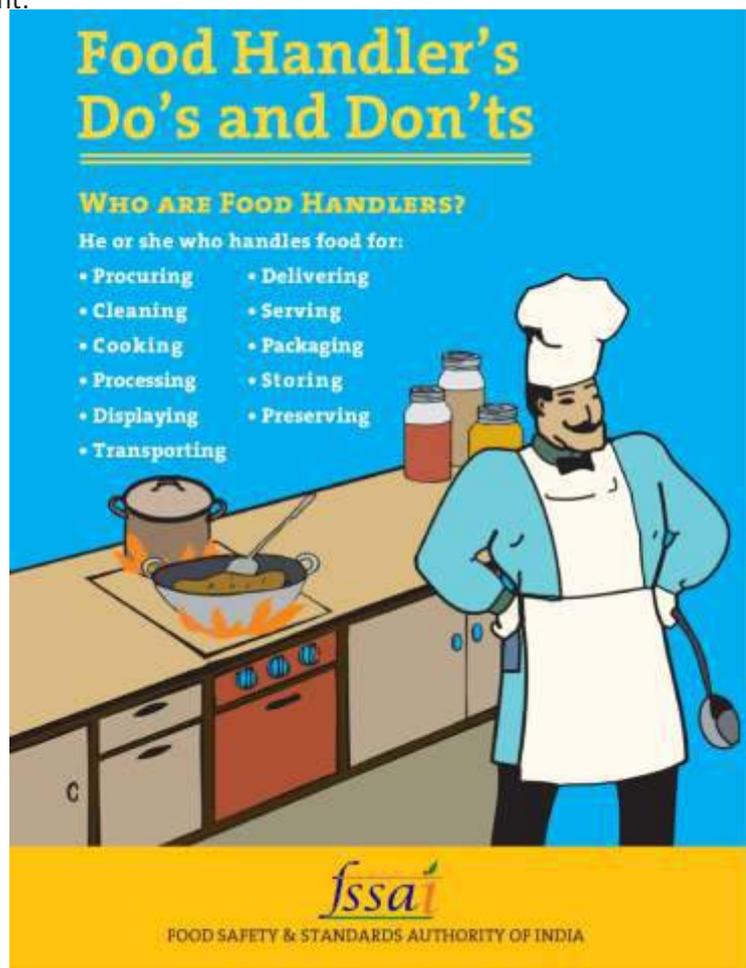


Fig. 8.34: FSSAI dos and don'ts for food handlers

Pictograms

Not only is preparing your workshop for accidents a smart thing to do, it is even smarter to organize your workshop in such a way that no serious accidents can take place. A simple way to make your workshop safer is to use pictograms: indicating flammable materials, the necessary use of hearing protection, indicating emergency exits.

Health and Safety Policy

FBO is committed to the goal of providing and maintaining a healthy and safe working environment, with a view to continuous improvement. This goal is only achievable by adherence to established objectives striving to exceed all obligations under applicable legislation, and by fostering an enthusiastic commitment to health, safety and the environment.

In particular:

Management, working in cooperation with the Joint Health and Safety Committee, will strive to take all reasonable steps to reduce workplace hazards to as low as reasonably achievable.

Supervisors and managers are held accountable for the health and safety of all employees under their supervision. This includes responsibility for applicable training and instruction, appropriate followup on reported health and safety concerns, and implementation of recommended corrective action.

FBO is committed to providing all necessary training and instruction to ensure that appropriate work practices are followed on the job, and to promote their use off the job.

Health, safety, the environment and loss control in the workplace are everyone's responsibility. Company expects that everyone will join in our efforts to provide a healthy and safe working environment on a continuous day to day basis.

Importance of Preventive Health Checkups

No matter what age group you are a part of, regular preventive health tests are essential for each one of us.

Whether one is feeling fit from within or is still in his early years of life, a preventive health checkup is an important practice that one must inculcate in his or her daily life.

- It can detect developing disease and prevent them
- Increase better chances for treatment and cure
- Can identify health issues early and prevent them
- It helps to improve lifestyle and increase productivity at work

FSSAI Format for health check up

PERFORMA FOR MEDICAL FITNESS CERTIFICATE FOR FOOD HANDLERS
(FOR THE YEAR)

(See Para No. 10.1.2, Part- II, Schedule - 4 of FSS Regulation, 2011)

It is certified that Shri/Smt./Miss.....
employed with M/s....., coming in direct
contact with food items has been carefully examined* by me on date
Based on the medical examination conducted, he/she is found free from any
infectious or communicable diseases and the person is fit to work in the above
mentioned food establishment.

Name and Signature with Seal
of Registered Medical Practitioner /
Civil Surgeon

***Medical Examination to be conducted:**

1. Physical Examination
2. Eye Test
3. Skin Examination
4. Compliance with schedule of Vaccine to be inoculated against enteric group of diseases
5. Any test required to confirm any communicable or infectious disease which the person suspected to be suffering from on clinical examination.

Fig. 8.35: Format for health check up

Medical examination to be concluded –

1. Physical examination
2. Eye Test
3. Skin examination
4. *Compliance with schedule of vaccine to be inoculated against enteric group of diseases
5. Any test required to confirm any communicable or infectious disease which the person suspected to be suffering from on clinical examination

* Vaccine to be inoculated against enteric group of diseases shall be decided by the medical practitioners in accord to remove the ping to the list as declared by the municipal corporation of that area.

Summary

- Food safety refers to routines in the preparation, handling and storage of food meant to prevent food borne illness and making food safe for human consumption. Safe food handling practices and procedures are thus implemented at every stage of the food production life cycle in order to curb these risks and prevent harm to consumers.
- It is important to be aware of food allergens in food industry as this is the risk associated with the unintended presence of allergen due to cross contamination and should take this a matter of serious concern. Food allergies can cause serious and even deadly reactions.
- The presence of unwanted materials such as dust and particles during the manufacturing and transportation time is called contamination. The term contaminants include any unwanted matter that is found in the product. These contaminants affect the quality of the product or the process.
- Refrigerated transportation is a shipping cargo with advanced temperature adjustment features. It is built and designed mainly for climate-sensitive goods such as vegetables, fruits, meat, all-prep meals, bread, etc. in which the freight is loaded with ice and salt to maintain the food's quality at a particular temperature.
- The retail food industry plays a significant role in assuring a safe food supply for its consumers. At the retail level, activities to control food safety risks can be divided into four key areas: the supplier and source of foods and food ingredients; in-store practices and procedures; education and training of employees and food handlers; and consumer engagement.
- Good Manufacturing Practices (GMPs) are the basic operational and environmental conditions required to produce safe foods. They ensure that ingredients, products and packaging materials are handled safely and that food products are processed in a suitable environment.
- Maintaining a clean work environment is critical in preventing foodborne illness. Bacteria can grow on unsanitary surfaces and then contaminate food. Just because a work surface looks clean does not mean that it is sanitary. Always ensure that you clean and sanitize a work area before starting to prepare food.
- The rule for stock rotation is FIFO (first in, first out) to make sure that older food is used first. This will help to prevent wastage. Older product will have nearer shelf life expiry, so older product should be moved out first, but new products will have time to move out since expiry is so far. That's why a rule of FEFO does also exist which means First Expiry First Out. It is called Good Distribution Practice.
- The expression "food hygiene" is often associated to personal hygiene, being many times limited to the care of washing hands. The concept of food hygiene really refers to the general cleanliness state of the food handlers' body and clothes.
- Health and Safety is a term that generally covers the legal requirements that fall under the Health and Safety at Work Act etc. 1974. The term Health and Safety is generally used to describe Occupational Health and Safety, and relates to the prevention of accidents and ill health to employees and those who may be affected by their work.

Scan the QR Code to watch the related video



<https://www.youtube.com/watch?v=gNEx8P9UqPA&t=35s>
Personnel Hygiene and personnel behaviour

Exercise

A. Answer the following questions by choosing the correct option:

1. _____ refers to routines in the preparation, handling and storage of food meant to prevent food borne illness and making food safe for human consumption.
 - a. Food Safety
 - b. Fire Safety
2. _____ is a factor or agent which may lead to undesirable effects like illness or injury in the absence of its control, whereas, risk refers to the probability that the effect will occur.
 - a. Threat
 - b. Hazard
3. The presence of _____ materials such as dust and particles during the manufacturing and transportation time is called contamination.
 - a. wanted
 - b. unwanted
4. _____ is one of the most important factors in the preservation of food because microorganisms have been found to grow in almost all temperature.
 - a. Storage temperature
 - b. Hazard temperature
5. Selling fresh and _____ produce is essential in groceries and retail food businesses.
 - a. low-quality
 - b. high- quality

B. Answer the following questions briefly.

1. What are the most common types of contaminant?
2. Outline the layout and design of food establishment premises.
3. Explain VACCP
4. What are the facilities provided by water supply?
5. What are the two components of the sanitation plan?

Notes

9. Managing Accidents and Emergencies



- Unit 9.1 - Hazard, Risk and Accidents
- Unit 9.2 - Standard Practices and Precautions
- Unit 9.3 - Uses of Electrical Equipment
- Unit 9.4 - Usage of Personal Protective Equipment
- Unit 9.5 - Organisational Protocols
- Unit 9.6 - Dealing with Toxics
- Unit 9.7 - Fire Prevention and Fire Extinguishers
- Unit 9.8 - Artificial Respiration and CPR
- Unit 9.9 - Rescue and Evacuation In Case Of Fire
- Unit 9.10 - First Aid
- Unit 9.11 - Potential Injuries and Ill Health
- Unit 9.12 - Precautions in Mobility
- Unit 9.13 - Significance of various types of hazard and safety signs



Key Learning Outcomes

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

1. Recognize the types of hazards, risks as well as accidents
2. Categorize the standard precautions and practices
3. Examine the utilization of the electrical equipment
4. Explore the usage of personal protective equipment
5. Recognize the organizational protocols
6. Monitor the ways to handle the toxics
7. Identify fire prevention and fire extinguisher
8. Evaluate CPR as well as the artificial respiration
9. Discuss the evacuation and rescue
10. Catalogue the first aids
11. Understand the ill health as well as potential injuries
12. Demonstrate the precautions in mobility
13. Discuss the significance of various types of hazard and safety signs

UNIT 9.1: Hazard, Risk and Accidents

Unit Objectives

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

1. Identify the types of hazards, risks as well as accidents

9.1.1 Types of hazards, risks and accidents

Hazard is considered a sort of incident or source that can fundamentally harm something, whether in a living or non-living state. It states to be significant to identify the hazard and the amount of risk or impact it would create on its surroundings. Thus, an individual must be prepared from the initial stages to manage such occurrences.

It is important to control workplace hazards by eliminating and identifying the capable risks. This is required as it is capable of causing accidents or hazards, along with finding the access based on the ways to isolate the risk which can lead to the hazard.

To ensure the safety of an individual and the workplace surrounding, an individual requires to regularly participating in the safety drill, which is conducted at their specific times.

Types of Hazards:

- **Safety Hazard:** A safety hazard is among the most common dangers found in every workplace. A safety hazard is capable of causing specific serious injuries or damage to the industrial workers. The safety hazards perform a practical part on the employees who have regularly contacted the heavy equipment or machinery throughout their working hours.

Some of the safety hazards which lead to accidents in the workplace tend to include:

- Anything capable of causing a fall, such as floor holes or opening walls, slippery surfaces, unprotected edges, and ladders which is unsafely situated.
- Heavy-duty mechanisms, which is seen to be usually present in every industry, such as construction, manufacturing, mining and so on, can sometimes be the cause behind the accident. It is due to loose machinery parts, sharp edges, hot surfaces causing severe cuts, burns and wounds.
- **Chemical Hazards:** Chemical substances are seen to include but are also not restricted to acidic substances, petroleum products, reagents, acids, flammable liquids and many more.
 - Acidic substances are firmly alkaline in their state as they tend to possess properties to damage the accidental arrival in contact with the other substances by forming a chemical reaction.
 - The petroleum products generate gasoline such as Butane, Propane, Kerosene, and LPG as they are incredibly flammable hazards and can damage on a larger scale.
 - Acids occur to be more hazardous, relying on their corrosive materials. The common acid includes Hydrochloric Acid, Sulphuric Acid, and Nitric Acid.
- **Biological Hazards:** Biological hazard is also known as the biohazard and is connected to the biological substances that lead to sickness and illness in humans during its occurrence in direct contact.

Sources through which the biological hazard might include are:

- Bacteria, viruses, insects, plants and humans are capable of being the hazard carrier that adversely impacts their health, causing skin irritation and can also lead to serious infections, like Tuberculosis, AIDS, and carcinogenic infection.

- Toxins from biological sources stand to be extensively poisonous in their state as they are manufactured by harmful animals and plants, such as snake venom toxins and botulinum toxins.
- The most recent example of the biological hazard is the outbreak of Covid-19.
- **Physical Hazard:** A physical hazard is the least common hazard at the workplace and is not limited only to physical presence. Extreme weather conditions or unfavourable working environments are the major causes of physical hazards.

Physical hazard has a prolonging effect on the health of the workers. These types of hazards are generally unrecognizable, like:

- The temperature can also be a cause of danger for the workers who attempt to work indoor as well as outdoors, having the factors such as overexposure to heat and cold leading to some serious illness like heat stroke, sweaty palm increasing the risk of accident, frostbit hypothermia which can eventually lead to death also.
- Harmful radiation like micro-waves, radio-waves, electro-magnetic waves, and so on.
- **Ergonomic Hazard:** An ergonomic hazard is a type of hazard that adversely affects the workers' physical health, having continuous work leading to lower back pain, joint pains, muscles ache, and ligaments pain.

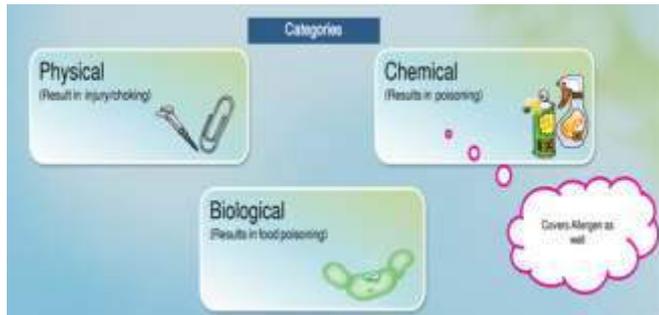


Fig. 9.1: Examples of physical, Chemical, Biological hazards

Ergonomic hazards may include:

- Poor sitting or standing postures.
- Improperly adjusted chairs and workstation height.
- Too much vibration or loud noise in the workplace.
- Frequent lifting of heavyweights.
- Prolong working conditions demanding physical force
- **Work Organization Hazard:** Work organization hazard usually defines the issues related to the workplace such as;
 - Excessive workload
 - Inappropriate behaviour of peers
 - Bullying
 - Lack of mental support
 - Work-related stress



Fig. 9.2: Sources of different types of hazards

9.1.2 Hazard Identification and Risk assessment

Risk Assessment (RA) and environment review (ER) were done for hazard and environmental impact. It is done from different stages, from evaluating a new operation, modification to the existing facilities, maintenance work and others.

RA identify all safety and health hazards – Including Operational, mechanical, electrical, chemical, biological and ergonomic for ER indicate the environmental aspects and impacts taken into consideration.

Review and update of R.A and ER to be done under following circumstances: -

- Amendments/addition in legal, corporate and other voluntary requirements.
- Change in process or product handled or new developments/ modifications in activities/ products/ services.
- Occurrence of the accident, emergency
- While initiating any corrective and preventive actions
- While purchasing and erecting any new equipment/ machinery/ building

UNIT 9.2: Standard Practices and Precautions

Unit Objectives

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

1. Categorize the standard precautions and practices

9.2.1 Standard Practices and Precautions

- Hand hygiene- Physical, Chemical or Biological hazard
 - Usage of personal protective equipment- Safety hazard
 - Respiratory hygiene/ Cough Etiquette- Biological hazard
 - Sharp Safety- Safety hazard
 - Safe injection practices- Biological or Physical hazard
 - Sterile instruments and Devices- Biological or Physical hazard
 - Avoiding ergonomic hazard
- **Hand hygiene:** Washing hands regularly is a significant step towards cleanliness, protecting us from various diseases and infections. Washing hands can keep us healthy well as it protects us from viruses capable of travelling from one person to another person. Germs and bacteria are the only host which comes from touching the nose, eyes with dirty hands, or eating/cooking food with smeary hands.
 - **Usage of Personal Protective Equipment**
 - Personal protective equipment, or PPE, protects its user against any physical harm or hazards that the workplace environment may present. It is important because it exists as a preventative measure for industries that are known to be more hazardous, like manufacturing and mining. Some of the personal protective equipment are: gloves, masks and eyewear.
 - **Respiratory Hygiene / Cough Etiquette:** One should follow the below guidelines to maintain respiratory hygiene.
 - Covering the mouth and nose with a cloth or elbow while coughing or sneezing.
 - Throw the used tissues in a separate bin.
 - Washing of the hands or sanitizing before touching the nose or mouth
 - **Sharp Safety:** Sharp objects such as needles, lancets, and surgical knives must be handled with utmost care to prevent injury or spread of infection.
 - **Avoiding ergonomic hazard:** Headsets, monitor stands, and adjustable chairs are just some devices that can be easily integrated into a workspace to diminish the risk of injury from repetitive motions. Awkward locating refers to positions in the body when a person deviates significantly from a neutral position while performing tasks.

UNIT 9.3: Uses of Electrical Equipment

Unit Objectives

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

1. Examine the utilization of the electrical equipment

9.3.1 The Utilization of the Electrical Equipment

Electrical equipment is generally that equipment that requires electrical supplies for their operations. It generally consists of several small components in an enclosed form and is controlled by a power switch. It tends to include:

- Electric switchboard
- Distribution board
- Circuit breakers and disconnects
- Electricity meter
- Transformer



Fig. 9.3: Different type of electrical equipment's

Hazards Related to Electrical Equipment's

The five hazards described here are very common and easily preventable.

- Working on live circuits
- Skipping Lockout/Tagout. It is also known as LOTO, which disconnects electricity and avoids electrical hazards.
- Forgetting PPE.
- Improper grounding.
- Damaged extension cords.



Fig. 9.4: Electrical hazard symbols

UNIT 9.4: Usage of Personal Protective Equipment

Unit Objectives

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

1. Explore the usage of personal protective equipment

9.4.1 The Usage of Personal Protective Equipment

Personal protective equipment is majorly used to protect oneself from serious accidents or illnesses originating from the workplace's physical, biological, chemical, and mechanical hazards.

Personal protective equipment includes:



Fig. 9.5: The usage of personal protective equipment

Importance of PPE in Food Industry

Protective Clothing Reduces Injury and Contamination Risks. In the food manufacturing units, workers are at a surprising risk of exposure to harsh and toxic chemicals, which can cause further contamination of the food product. Also, PPE importance can be identified during working at height to avoid slip, trip and fall.

UNIT 9.5: Organisational Protocols

Unit Objectives

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

1. Recognizing the organizational protocols

9.5.1 The Organizational Protocols

Accidents are unplanned experiences resulting in injuries, illness, death, and loss of property and/or production. While there is no way to avoid accidents, some actions, plans, and preparations are capable of being taken to diminish them.

Knowledge of the Hazards

- Be aware of the environment. Look around and recognize workplace risks that are capable of causing harm.
- Look for manners to diminish or eliminate hazards and implement them.
- Report unsafe areas or practices.
- Dress for the weather.
- Use the EHS (Environmental Health & Safety) Job Hazard Analysis devices to recognize hazards linked with job sorts.

Originate a Safe Work Sector

- Keep an orderly job place. Poor housekeeping is capable of causing safety hazards and serious health. The workplace's layout requires to have accurate egress routes as well as be debris' free.
- Take breaks as well as mobilize around regularly all through the day. Short breaks (moving around and standing up) can make a big distinction in combating the threats of residing in a static position all day long.
- Pay attention to workstation ergonomics.

Use Safe Lifting Techniques

- Follow the following safe lifting practices:
 - Lift from a position of power
 - Keep the load close
 - Use a staggered stance
 - Cable/Rope/Slings in good repair
 - Hoist chain/Rope free of kinks and twist
 - Hooks not deformed or damaged and safety latches intact
 - Display of testing date, capacity and safe working load
 - Do not attempt to twist while lifting
- Training in body mechanics can reduce strain injuries and keep employees safe during moving and lifting.
- Regular Interaction
 - Notify supervisors regarding the safety hazards
 - Speaking up as well as being included in safety strategizing.
 - Constantly cultivate a safety level
- Training as well as Education
 - Make sure for everyone who possesses the appropriate safety training linking to the job's

threats.

- Take benefit of Environmental Safety and Health online training events.
- Each employee's responsibility is to take an active role in maintaining safety.

Emergency Preparedness Plan

Nowadays, many organizations, including the food industry, also implement their emergency preparedness plan, which includes hazards identified during their past years of operation; possible weather or climatic condition; spillages during operational activities, etc. Hazards can be classified as low, moderate and significant impact on the organization based on the geolocation of the unit.

Incident Reporting and Investigation

Incident

It is an event that causes damage to equipment material or other property. It may or may not be accompanied by human injury. It can be categorized as: -

- **No Injury Incident / Dangerous Occurrences**
 - Fire**— An incident in which a fire broke out which has the potential of causing burn injury to humans or damage to property.
 - Near Miss**— An incident that has the potential for causing an injury to humans or damage to property but narrowly escapes
- **Industrial / Injury incident:** An incident is a sudden and unforeseen event, attributable to any cause, which happens to the person, arising out of or in this course of his or her work and resulting in an employment injury to that person.
- **Major Incident** An incident results in a human fatality, permanent disability or extensive loss of equipment or materials.
- **Lost Time Incident-** Human injury incident prevents the person from doing his work for more than 48 Hrs.
- **Minor Incident**— An incident that causes minor injury to a human which may prevent him from undertaking his work up to 48 Hrs.
- **First Aid Case**— An injury incident that requires a person to go to a dispensary for a one-time treatment and/or any follow-up visit for observation of minor scratches, cuts, burn, splinters or other minor industrial injuries which do not ordinarily require medical care.
- **Unsafe Act:** The violation of a commonly accepted safe procedure or practice which resulted in the incident or was against the safety guidelines. Examples are operating without authority, operating at an unsafe speed, making safety devices inoperative, posture or unsafe position, failure to use personal protective equipment. Etc
- **Unsafe condition:** The condition which has the potential to cause injury/harm & damage to property material/ environment or process, improper guarding, defective tools/ equipment, hazardous arrangement or process, Improper ventilation, high temperature/dust Noise.

Incident Investigation

- Persons investigating any incident should collect all information, evidence regarding the situation under which the incident; this shall also include the condition of the persons, physical and mental conditions.
- The investigation should be based on fact-finding, and immediate causes of incidents are listed in two groups (Unsafe Condition and Unsafe Act). The investigating team shall find out and note down. The investigation team shall attempt to list all unsafe conditions and all unsafe behaviours on personnel.

UNIT 9.6: Dealing with Toxics

Unit Objectives

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

1. Monitor the ways to handle the toxics

9.6.1 The Ways to Handle the Toxics

Toxics are chemical substances that can cause serious harm to the person if he/she comes directly in its contact. One should be extra careful while handling such substances and an organisation must have clear labelling, separate storage rooms and proper guidelines for its usage.

- **Exposure hazards:**
 - **Contact or Absorption:** It can cause when a person comes in direct contact with toxic substances. It can result in drying or defatting of skin, skin irritation, or redness.
 - **Inhalation** occurs when a person inhales the fumes or vapour of toxic substances. It can cause shortness of breath, sore throat, coughing, an effect on the nervous system, and irritation during the breath.
 - **Ingestion:** It occurs when people accidentally consume toxic material. It can result in diarrhoea, vomiting, indigestion, effect on the functioning of the liver and kidney.
- **Storage requirement:**
 - Toxic substances must be stored in designated storage compartments only.
 - It should be stored under the optimum condition as prescribed. Always take the material in desired quantity and never put the used or remaining material in the original container.
 - One should always look for an alternative before using the toxic agent.
 - Only authorised
 - Personnel should be given access to the storage compartment.
- **Labelling requirement:**
 - Toxic substances or materials should be labelled in clear and readable format and proper usage instructions.
 - Work areas should be labelled properly where toxic substances are used regularly or excessively.
 - Always label the emergency contact number near the storage and the work area.
- **Spill and accident procedures:**
 - In case of a spill or accident, immediately alert the people in that area and inform the supervisors.
 - Evacuate the area and seize the entry.
 - Inform the relevant authority in case of leakage or spillage in larger quantities.
 - The trained professional of designated staff should only perform cleaning of toxic spillage.
 - Usage of absorbent while cleaning the corrosive or other harmful liquid.
 - Usage of neutralizing agent while cleaning the acidic, toxic substances.
 - Never touch the toxic substance with naked hands.

- **Waste management:**

- Toxic waste must be segregated separately in accordance with its nature.
- It should be managed separately from other wastes.
- Flammable chemicals, acids should be disposed of carefully and separately in order to prevent any type of accident or injury.
- Never dispose of the toxic substance in an open area.
- It should always be disposed of in a leak-proof and airtight container.



Fig. 9.6: Waste disposal process for a different type of waste

UNIT 9.7: Fire Prevention and Fire Extinguishers

Unit Objectives

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

1. Identify fire prevention and fire extinguisher

9.7.1 Fire Prevention and Fire Extinguisher

Prevention from fire is necessary to avoid excessive damage. Their major goal remains to educate the workers on the ways to prevent the environment from fire.

To prevent the workplace from fire, we must enforce the following measures:

- Workers should be highly trained for the mock drill.
- No smoking signs around the highly flammable liquid and gases.

Causes of fire

- **Flammable and combustible liquids:** This requires proper storage and handling in order to prevent the occurrence of fire which must be stored under a well labelled and closed container to avoid any accident.
- **Liquified Petroleum Gases:** LPG gas has a low density and is heavier than air. It usually accumulates in low lying areas so that the workers are warned if they tend to find any leakage or hole in the cylinders. Moreover, they must not use fire; instead of that, they are capable of utilizing soapy water and finding out the bubbles.

Prevention of the Casualties from Fire

- **Fire Alarm Devices:** These are the devices used to warn people during fire and smoke or any other types of fire emergencies. These alarms are automatically activated once smoke and heat are detected. It should be installed on the telephone desk and the employer's entrance in order to evacuate promptly.
- **Fire Extinguisher:** It is a lifesaver device that is used to control small fires as well as in emergency situations. It should not be used in indented fire issues if it is reached to the walls, ceiling or where there is no route for escape.

Placement of fire extinguishers at workplace or organization must include.

- The fire extinguisher should always be placed or mounted on a wall and should be properly marked.
- Employees should be well trained with PASS methods or firefighting.
- The fire extinguisher should always be kept at the ease of location to all employees.
- Vehicles should also carry out one ABC rated extinguisher in case of emergency.
- All extinguishers should be well marked and labelled and should be clearly visible.
- All extinguishers should be inspected on a monthly basis, and their place it has not tampered with.
- For the point of safety, all extinguishers should be examined yearly or required to be refilled in order to ensure operability.
- A tag should also be attached to ensure its maintenance or refilling date and the signature of the authorized person.

Fire Extinguisher Classes:

There are four types/classes of fire extinguishers, which are most common, i.e., A, B, C and D, where every class is capable of putting out a varied sort of fire.

- o Class A extinguishers would be capable of putting out fires in ordinary combustibles such as wood and paper.
- o Class B extinguishers are utilized for flammable liquids like grease, gasoline and oil.
- o Class C extinguishers are used only for electrically energized fires.
- o Class D extinguishers are used on flammable metals.



Fig. 9.7: Types of fire extinguishers

Uses of Fire Extinguishers

Once it is installed in the workplace or industry, it is important for every employee to get familiar with the usage and the direction of fire extinguishers so as to be well prepared for the sudden occurrence of any hazardous incidents and accidents. Fire extinguishers are relatively easy to use in case of small fires by using some simple technique called PASS.

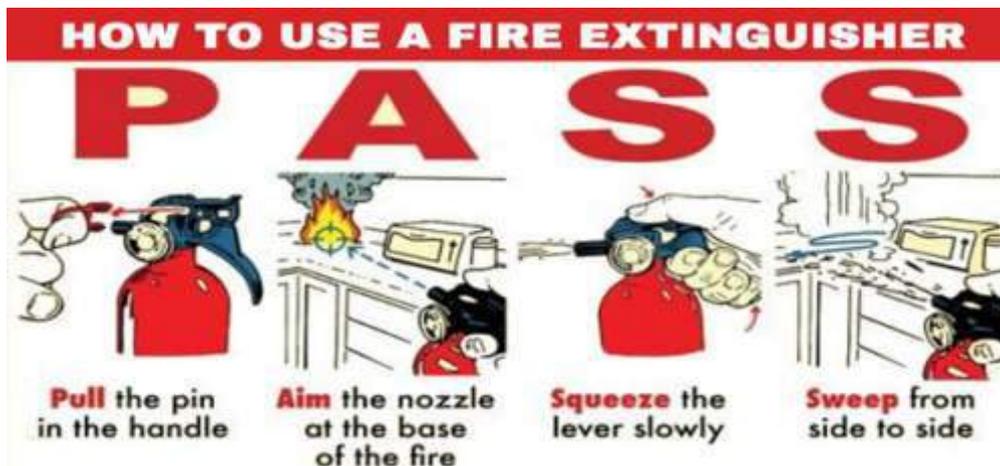


Fig. 9.8: Pass technique for Fire Extinguisher use

Fire Hydrant/ Fire Hydrant Pump

Fire hydrant consists of a system of pipework connected directly to the water supply mainly to water to every hydrant outlet as well as is attempted to present water for the firemen in order to fight a fire. The water is seen to be discharged into the fire engine, from which it is then pumped and sprayed over the fire. Where the water supply is not inadequate or reliable, hydrant pumps requires to be presented to pressurize the mains of the fire.

UNIT 9.8: Artificial Respiration and CPR

Unit Objectives

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

1. Evaluate CPR as well as the artificial respiration

9.8.1 CPR As Well As the Artificial Respiration

Artificial respiration and CPR is an act (or) technique used for stimulating respiration when there is a sudden stoppage of breathing or lung functioning.

Techniques used to provide artificial respiration are:

- Mouth-to-mouth breathing
- Prone-pressure method
- Cardiopulmonary resuscitation (CPR) or external chest compression

There are two types of ways to provide Artificial respiration. They are:

- Manual and,
- Mechanical

Manual ways consist of:

- Mouth-to-mouth breathing
- Prone Pressure Method
- Back Pressure Arm-Lift

Mouth-To-Mouth Breathing

The steps to perform in this specific process are:



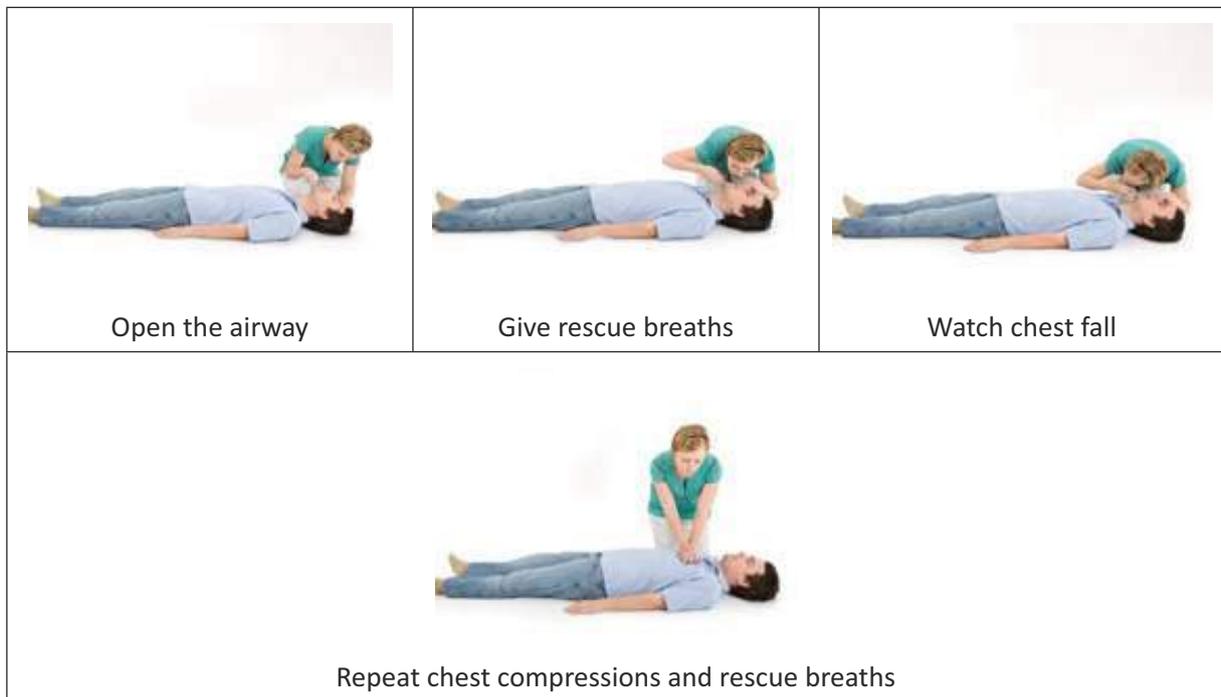


Table 9.1: CPR steps

Prone Pressure Method

This method, additionally known as the Schafer method, stands to be a type of artificial respiration which is used for a patient in case of drowning. In this, the patient is placed in a prone or placed in a face-down position allowing rhythmically pressure with the help of hand on the thorax by means of which the water present would get expelled from the lungs allowing air to enter by clearing the passage in order to breath.

Back Pressure Arm-Lift

This particular method is used as an alternative when other methods are not possible or are not working out.

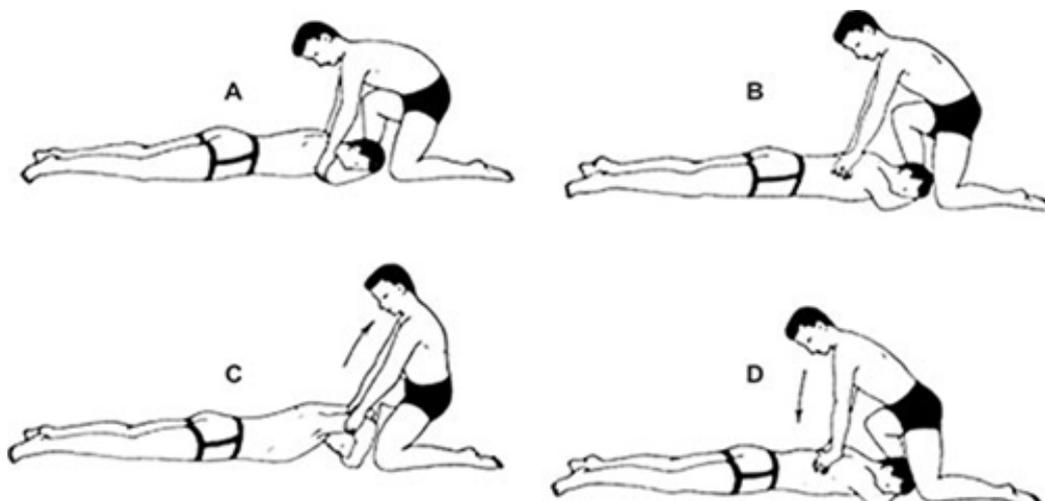


Fig. 9.9: Back Pressure Arm-Lift

A Mechanical Method of Artificial Respiration

These types of artificial respiration methods are generally performed by highly trained professionals such as a doctor, nurses, and paramedic forces. The mechanical method often uses machine-like ventilators. Another device that is used in the mechanical method is a bag valve mask. It has the self-inflate and deflates mechanism as well as has an air supply that is controlled by the valve.

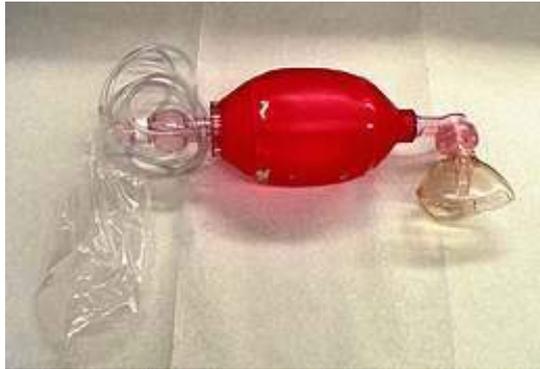


Fig. 9.10: Big Valve mask



Fig. 9.11: Ventilator

UNIT 9.9: Rescue and Evacuation In Case Of Fire

Unit Objectives

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

1. Discuss the evacuation and rescue during a fire incident

9.9.1 The Evacuation and Rescue during a Fire Incident

A "Fire Emergency Evacuation Plan (FEPP)" stands a scripted document that involves the activity to be adapted by all staff in the event of a fire and the sequences for calling the fire brigade.

Staff Fire Notice High fire threats or extensive premises that would be required a more illustrated emergency evacuation strategy which takes account of the findings of the assessment of fire risk, e.g. the staff importantly at threat and their spots. In addition, notices providing transparent and concise routine's instructions to be followed in the instance of fire that requires to be appropriately showcased.

In some instances, the individuals requires to be nominated individuals in order to conduct the fire action plan as well as provide them enough training in firefighting as well as procedures for evacuation. The following items require to be taken into consideration where appropriate:

Fire evacuation strategy	Action on discovering a fire	Action on hearing the fire alarm	Calling the fire brigade
Power/process isolation	Identification of key escape routes	Fire wardens/marshals	Places of assembly and roll call
Firefighting equipment provided	Training required	Personal Emergency Evacuation Plan	Liaison along with emergency services

Fig. 9.12: Staff Fire Notice

Fire Evacuation Plan

You require taking into consideration of how you would tend to arrange the premises' evacuation in the light of your risk evaluation as well as the other fire precautions that the individuals possesses or intended to put in spot.

Simultaneous Evacuation

In most premises, the evacuation in the instance of fire would easily be by means of each one responding to the warning signal given when a fire is discovered, then making their way, by regards of escape, to a spot of safety away from the boundaries. This is referred as a simultaneous evacuation and would generally be initiated by the sounding of the normal alarm over the system of fire warning.

Vertical Phased Evacuation

In certain larger complex premises, the emergency arrangements are designed to allow people who are not at immediate risk from fire to delay initiating their evacuation. It might be accurate to start the evacuation by initially performing the evacuation by only the sector closest to the fire as well as warning other individuals to stand by. This is generally done by suddenly evacuating the floor where the fire is spotted as well as the floor located above. The other floors are then evacuated among the individuals to neglect congestion on the escape paths. The rest of the individuals are then evacuated if it is important to do so. The fire warning system requires to be capable of providing two distinctly different signals (warning and evacuation) or giving accurate voice messages. Horizontal phased evacuation in hospitals as well as care homes: the floor may be divided into a number of fire-resisting compartments, and the occupants are moved from the compartment involved in the fire to the adjacent compartment as well as, if required, moved again. Depending on the fire situation, it might eventually be significant to take into consideration vertical evacuation.

Other Fire Precautions

- systems of voice alarm
- fire control points
- compartmentation of the premises using fire-resisting construction
- sprinklers in buildings where the top floor is 30 meters or more above ground standards

Staff Alarm Evacuation (Silent Alarm)

In certain instances, it might not be accurate for a normal alarm to start immediate evacuation (Cinemas and Theatres). This could be as of the number of members of the public provided and the requirement for the staff in order to put pre-arranged strategies for the safe evacuation of the premises into action. In the mentioned situations, a staff alarm is capable of being provided (by fire records, personal pagers, discreet sounders, or a coded phrase on a public address system etc.). Following the staff alarm, a more normal alarm signal is capable of being provided, as well as a phased or simultaneous evacuation initiated. The general alarm might be activated automatically if manual initiation has not taken place within a pre-determined time.

Defend in Place

This strategy might be taken into consideration in blocks of flats where each flat is a minimum 60-minute fire-resisting compartment. It might additionally be considered in hospitals or nursing homes where patients are connected to life-supporting equipment as well as is not capable of being moved. The concept authorises the occupants to stay put as well as authorise the fire facility to extinguish the fire. If the fire spreads as well as it is not capable of being controlled, then they would tend to initiate an entire evacuation. In the instance of patients connected to life-supporting equipment, a decision has to be made which choice stands to be the best, stay or move; in either manner, the patient would be at grave threat.

You should only strategise in order to utilise defend-in-place, phased evacuation schemes or a alarm system for the staff if the individuals have sought the suggestion of a competent individual as well as the fire and rescue service.

Action on Hearing the Fire Alarm

On discovering a fire, it is the duty of every person to sound the nearest fire alarm immediately. The plan should include the method of raising the alarm in the case of fire.

People, on hearing the alarm, should proceed to pre-determined positions to assist members of the public and staff in leaving the building by the nearest safe route.

Lifts and escalators should not be used due to possible electrical failure unless they are part of a Personal Emergency Evacuation Plan.

Calling the fire brigade

The Fire Service should also be informed to combat from fire.

Power/Process Isolation

Close Down Procedure – Adopt your own 'Close Down' procedure as appropriate.



Fig. 9.13: Fire evacuation process

UNIT 9.10: First Aid

Unit Objectives

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

1. Cataloguing the first aids

9.10.1 First Aids

First aid, as the name suggests, stands to be the first and immediate care or assistance provided to the person in case of either minor, serious injury or illness. First-aid provided on time can save the life in case of life and death kind of situation as well as additionally assists to control the condition from worsening further.

First aid is often controlled by the 3 P's principle:

- Prevent further injury
- Preserve life
- Promote recovery

It is necessary that each floor or manager should have the first aid box handy with them and can be easily accessed by the employees in case of emergency or need.



Fig. 9.14: First Aid Kit

UNIT 9.11: Potential Injuries and Ill Health

Unit Objectives

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

1. Understanding the ill health as well as potential injuries

9.11.1 The Ill Health As Well As Potential Injuries

The major role of work is based on enhancing self-esteem, wellbeing and social mobility. However, work-related accidents or illnesses can impact the employees' health in longer or shorter terms and may result in economic as well as social repercussions for the employer.

It is mandatory for an employer to have precautionary measures in place to avoid such incidents. A few common work-related injuries and illnesses are:

- **Slips, trips and falls:** One of the most common causes of injury are slippery surface, fall from ladder or height. It can be avoided through a safety grill or safety bars.
- **Muscle strains:** Muscle strain occurs at the workplace due to lifting heavy items regularly and long-standing or sitting hours. This can be prevented easily through exercise, training and guidance.
- **Being hit by falling objects:** Employees working in warehouses often encounter injuries caused by fall-ing objects. It can be controlled by providing adequate storage and encouraging staff to store the item safely.
- **Cuts and lacerations:** It generally occurs by inappropriately handling sharp objects and is capable of being controlled by delivering the proper training to the staff, wearing proper protection and providing safety equipment to the workers.
- **Inhaling toxic fumes:** Workers who are dealing with chemicals are more likely to become a victim of an injury caused by toxic materials like inhaling dangerous gases or fumes. It is mandatory for the em-ployer to provide adequate safety gear to its worker who regularly meets such kinds of substances.
- **Crashes and collisions:** It can happen in warehouses and construction sites due to vehicle movement, and prevention can be done through necessary safety measures such as PPE, sufficient light, safety alert etc.
- **Exposure to loud noise:** Industrial deafness can occur to employees working in loud noise areas, and it can be avoided by wearing earplugs or earmuffs.
- **Fights at work:** Disagreement or tension may lead to fighting at work. It is a must to have an employee grievance department in order to deal with such cases.

UNIT 9.12: Precautions in Mobility

Unit Objectives

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

1. Demonstration of the precautions in mobility

9.12.1 The Precautions in Mobility

For the safety of the workers or employees at the workplace or any industry, one should always take the necessary precautions.

All manufacturing owners need to comply with the legal requirements to order to ensure that their industry and workplace is safe to work for everyone, from the customers to employees, suppliers, visitors, contractors and others.

In order to provide better productivity for a workplace, the management of the organization:

- Should minimize illness and injury of employees.
- Should reduce the risk of accidents.
- Should maximize productivity.
- Should reduce the cost of injuries and workers compensation.
- Should meet their legal requirements and responsibilities.
- Should retain their staff for better performance.

Precautions at the workplace may include.

- Keep every corner organised, clean and clutter-free
- Usage of mats on slippery floors
- Properly stored combustible material
- Ensure proper training while handling equipment and machinery

It is very important to have medical facilities and proper first aid for the employees working with heavy equipment and machinery.

1. **Clothes for each different appropriate task:** The people who are working with tools or with machinery must have proper clothing while operating the machinery. They must wear the right size of gloves according to the type of work and must wear safety shoes as well as all protective equipment while handling the tools, machinery and chemicals.

Different industries have different types of personal protective equipment based on their mode of work. Those are:

- **The food processing industry:** In this particular industry, they do not require special types of uniforms unless they require antibacterial head caps, clothing or aprons in order to prevent bacterial contamination.
2. **Implementation of emergency procedures:** This procedure usually contains emergencies that do not announce themselves, and there can be the expectation of fire and accidents. For this, there is a need to be prepared beforehand for such emergencies in order to ensure the safety of the employees, workers, visitors as well for business.

3. Reduce workplace stress: The common cause of stress during work is working for long hours, insecurity of job and conflicts between employees, which can sometimes lead to depression, difficulties during work and affects the concentration of the employees. Employers must avoid excessive workload on their employees as it may lead to employee's frustration which will provide a direct impact on employee productivity.

In order to promote a healthy and stress-free environment at the workplace, it is the employers' duty to take care of both the physical and emotional well-being of its employees by conducting regular training on time management, outdoor activities, small group discussion and many more.

UNIT 9.13: Significance of Various Types of Hazard and Safety Signs

Unit Objectives

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

1. Understanding the impact of various types of hazard and safety signs

9.13.1 The Impact of Various Types of Hazard and Safety Signs

Safety Hazard Significance

A hazard is a process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation. Hazards may be natural, anthropogenic or socio-natural in origin.

Safety hazards are number one on the list of 6 types of workplace hazards. These hazards play an effect on employees who work directly with machinery or on construction sites. Safety hazards are the most common workplace risks. They include:

- Anything that can cause spills or trips such as cords running across the floor or ice
- Anything that can cause falls, such as working from heights, including ladders, scaffolds, roofs, or any elevated work area.
- Unguarded and moving machinery parts that a worker can accidentally touch.
- Electrical hazards like frayed cords, missing ground pins, and improper wiring
- Confined spaces.

Safety Hazards Symbol

Safety symbols, hazard symbols or safety labels are meaningful and recognizable graphical symbols that warn of or identify hazards associated with the location or item.



Fig. 9.15: Role of hazard in Risk assessment

Chemical Hazard Significance

A chemical hazard is a (non-biological) substance that has the potential to cause harm to life or health. Chemicals are widely used in the home and in many other places.[1] Exposure to chemicals can cause acute or long-term detrimental health effects. In the workplace, exposure to chemical hazards is a type of occupational hazard. The use of personal protective equipment (PPE) may substantially reduce the risk of damage from contact with hazardous materials.

Chemical Hazards Symbol

Hazard pictographs are a type of labelling system that alerts people at a glance that there are hazardous chemicals present. The symbols help identify whether the chemicals that are going to be in use may potentially cause physical harm or harm to the environment.

These pictographs are also subdivided into classes and categories for each classification. The assignment for each chemical depends on its type and severity.



Fig. 9.16: Chemical hazard safety signs

Biological Hazard Significance

Biological health hazards include bacteria, viruses, parasites and moulds or fungi. They can pose a threat to human health when they are inhaled, eaten or come in contact with skin.

Biological Hazards Symbol

The biohazard symbol is used or displayed only to signify the actual or potential presence of a biological hazard. Appropriate wording may be used in association with the symbol to indicate the nature or identity of the hazard, the name of the individual responsible for its control, precautionary information, etc., but never should this information be superimposed on the symbol.



Fig. 9.17: Biological hazard safety signs

Ergonomic Hazard Significance

Poor ergonomics contributes to muscle strain, muscle imbalances, and fatigue. Many muscle strains result from performing the same motion over and over again. These become repetitive stress injuries, which are some of the most common workplace injuries.

Ergonomics alone won't eliminate this type of injury. However, proper ergonomics will significantly reduce fatigue and strain.

Ergonomic Hazard Symptoms

Signs and symptoms of ergonomic injuries include pain which may be dull and aching, sharp and stabbing or a burning sensation—tingling or numbness; swelling, inflammation, stiffness. Muscle weakness or discomfort; extremities are turning white or cold.

Work Organization Hazard Significance

A few examples of work organization hazards and it is effective they are defined below.

- Falls and Falling Objects- It can result in serious injury or fatality
- Fire Hazards- It can result in loss, serious injury or fatality
- Electrical Hazards- It can result in loss, serious injury or fatality

Work Organization Hazard Symbol

There are multiple signs or symbols used in an organization to alert the people in their workstations.



Fig. 9.18: Work organization related hazard safety signs

Summary

- Hazard can be identified as an extended-term as it is capable of causing severe disruption to the environment or surroundings.
- Risk Assessment (RA) and environment review (ER) were done for hazard and environmental impact. It is done from different stages, from evaluating a new operation, modification to the existing facilities, maintenance work and others.
- Electrical equipment is generally that equipment that requires electrical supplies for their operations.
- Personal protective equipment is majorly used to protect oneself from serious accidents or illnesses originating from the workplace's physical, biological, chemical, and mechanical hazards.
- Accidents are unplanned experiences resulting in injuries, illness, death, and loss of property and/or production. While there is no way to avoid accidents, some actions, plans, and preparations are capable of being taken to diminish them.
- The "Occupational Safety and Health Administration (OSHA)" needs to implement the organization with a fire prevention event in order to prevent injuries and accidents from the occurrence of fire in the workplace. Prevention from fire is necessary to avoid excessive damage.
- Fire hydrant consists of a system of pipework connected directly to the water supply mainly to water to every hydrant outlet as well as is attempted to present water for the firemen in order to fight a fire. The water is seen to be discharged into the fire engine, from which it is then pumped and sprayed over the fire.
- Artificial respiration and CPR is an act (or) technique used for stimulating respiration when there is a sudden stoppage of breathing or lung functioning. It requires metabolic processes to exchange the gases which tend to be present in the body by external or pulmonary ventilation.
- Fire drills can be initiated with a defined frequency in a surprising manner to ensure employees are well aware of the fire evacuation process. Attendance can be taken in assembly points, and briefing also can be arranged to further train the staff.
- First aid, as the name suggests, stands to be the first and immediate care or assistance provided to the person in case of either minor, serious injury or illness. First-aid provided on time can save the life in case of life and death kind of situation as well as additionally assists to control the condition from worsening further.
- The major role of work is based on enhancing self-esteem, wellbeing and social mobility. However, work-related accidents or illnesses can impact the employees' health in longer or shorter terms and may result in economic as well as social repercussions for the employer.
- A hazard is a process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation. Hazards may be natural, anthropogenic or socio-natural in origin.
- Poor ergonomics contributes to muscle strain, muscle imbalances, and fatigue. Many muscle strains result from performing the same motion over and over again. These become repetitive stress injuries, which are some of the most common workplace injuries.

10. Working Effectively in an Organization



- Unit 10.1 - Organizational Policies
- Unit 10.2 - Legislations, standard, policies, and procedures
- Unit 10.3 - Reporting Structure
- Unit 10.4 - Inter-Dependent Functions
- Unit 10.5 - Harassment and Discrimination
- Unit 10.6 - Prioritising Tasks
- Unit 10.7 - Communication Skills
- Unit 10.8 - Teamwork
- Unit 10.9 - Ethics and Discipline
- Unit 10.10 - Grievances Solution
- Unit 10.11 - Interpersonal Conflicts
- Unit 10.12 - Disabilities and Challenges
- Unit 10.13 - Gender Sensitivity and Discrimination
- Unit 10.14 - Applicable Legislation, Grievance Redressal Mechanisms
- Unit 10.15 - Transacting With Others without Personal Bias



Key Learning Outcomes

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

1. Categorize the organizational policies
2. Catalogue the Legislations, standards, policies, and procedures
3. Analyse the reporting structure
4. List the inter-dependent functions
5. Discuss the impact of harassment and discrimination
6. Monitor the ways of prioritising the task
7. Record the types of communication skills
8. Evaluate the ways of carrying out teamwork
9. Highlight the ethics and discipline
10. Illustration of the grievance's solution
11. Recognize the interpersonal conflicts
12. Identify the disabilities and challenges
13. Outline the gender sensitivity and discrimination
14. Discuss the applicable legislations, grievance redressal mechanisms
15. Analyse the process of transacting with others without personal bias

UNIT 10.1: Organizational Policies

Unit Objectives

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

1. Categorize the organizational policies

10.1.1 The Organizational Policies

Organizational policy or work place policy is a type of statement which provides the outlining of any organization that practices out the procedures. This eventually leads to its business which covers and everything, starting from the operations to concerns and compliances along with the employee's legislation. It also protects the organization from risks and hazards. It consists of a group of statements that could showcase the purpose for one or more guidelines and actions that are required to be taken against it in order to achieve the goals. The statements are required to be written in simple formats for providing efficiency, depending on the type of issues in which the length of policy is stated.

Benefits of Organizational Policies:

- It stands to be in line with organizational values
- It tends to have the list of complaints with the employment and associated legal requirement
- It provides proper clarity on the roles and responsibilities
- It ensures that an organization operates efficiently and in the specified business manner
- It helps in strengthening the staff position during or in the legal situation
- It enforces consistency and uniformity in the operational procedure and in the processes of decision making
- It saves time for the employees while the problems can be resolved rapidly and effectively through the existing policy

Types of organizational or workplace policies:

- Workplace health and safety policy
- Non-discrimination and anti-harassment policies
- Equal opportunity policy
- Employee code of conduct policy
- Leave policy
- Employee time-stamping policy
- Employee disciplinary and termination policy
- Employee grievance policy
- Social media policy
- E-mail policy
- Mobile phone policy
- Temporary policy

- 1. Workplace health and safety policy:** It is very essential for a recruiter to provide safe and healthy work environments to their employees since the hazards might arrive without alarming anybody about the risks.
- 2. Non-discrimination and Anti-harassment policy:** The principle behind this policy highlights its providing of guarantees in which human rights are exercised without any discrimination. These discriminations stand to be against individuals on the basis of their race, colour, gender, age, language, national origin, religion, gender identity, sexual orientation, property, marital status, family status, and citizenship. The proposal of this policy is mainly to inhibit any kind of harassment, whether it could be verbal or nonverbal and any kind of physical conduct which is designed to threaten the co-workers and to intimidate the employees or any person working on behalf.
- 3. Equal opportunity policy:** This policy ensures that the employees are hired irrespective of their gender, religion, colour, age, caste, marital status, or physical ability.
- 4. Employee code of conduct policy:** The policy sets the guidelines for all the employees and various stakeholders in which they are expected to follow in their professional and personal behaviour at the workplace.
- 5. Leave policy:** This policy recognises that employees require time off from their works in order to maintain the work-life balance. It also understands the various other needs, like personal commitment, medical exigencies, relaxes time and so on of the employees.
- 6. Employee time-stamping policy:** This policy describes the rules and regulations related to the working hours of an employee. It additionally assists the guidelines related to their reporting time, work duration/hours and breaks time.
- 7. Employee disciplinary and termination policy:** The major objective of the mentioned policy is to define the procedures and protocols in case of any breach of the company's policy, employee misconduct or any in-disciplinary behaviour.
- 8. Employee grievance policy:** The aim of this policy is to make sure that every employee has a formal way to raise their concern or complaint to their senior management. It has a clear structure and point of contact details in a case in which the employee wants to raise a concern.
- 9. Social media policy:** It is expected from every employee who is engaged or involved in social media sites, like Facebook, Instagram, and Twitter, LinkedIn and several other similar platforms, to understand and follow the guidelines of the company's social media policy. This mainly stands to be the concern for the company if their action or engagement involves the company name. Failing to do so can put their employment with the company at risk.
- 10. E-mail policy:** This policy describes the guidelines and uses of corporate e-mails to meet business requirements. One should follow the corporate standards, including copyrights, logos and signatures, while sending the e-mail within or outside the organization.
- 11. Mobile phone policy:** This policy implies restrictions or limitations on the usage of mobile phones at the workplace.
- 12. Temporary Policies:** These policies are added to the main body of company's policy guides and could be changed or removed as needed example during the COVID-19 pandemic organization implemented policy to handle social distancing, masking, disinfecting and other safety procedures for keeping employee's and workplace safe for smooth running of organization or business.

UNIT 10.2: Legislations, Standard, Policies, and Procedures

Unit Objectives

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

1. Catalogue the Legislations, standards, policies, and procedures

10.2.1 The Legislations, Standards, Policies, and Procedures

It is the legal requirement of an organisation to comply with the local laws as well as regulations and keep them updated time-to-time. The HR department is mainly responsible for continuously updating the regulations and making sure that it is communicated across the organisation. It also states that the laws and regulations of local authorities take over the organisational policy when required.

Standard practices at a workplace must have:

- Employers to define clear expectations from their employees.
- Provide a chance to utilise one's skills to perform a task.
- Support one's employees
- Motivate employees to collaborate and participate in decision making
- Welcoming nature for the feedback from the organization's employees.
- Investment in the employees learning and development process.
- Feedback received from employees and attempts to make a great workplace.

Policies and procedures at the workplace:

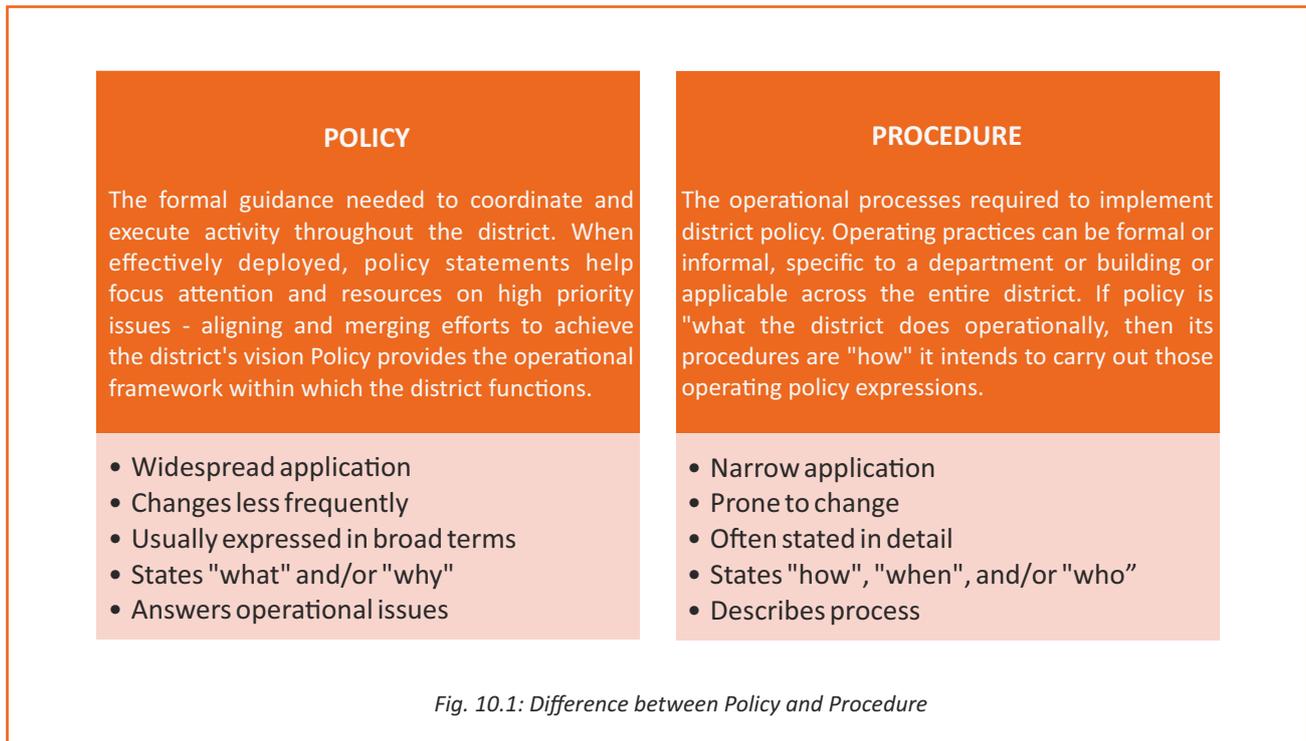
A policy is a general set of guidelines that are designed in line with the company's objective for dealing with an issue. Policies communicate the connection between the organization's vision and values.

A procedure sets out the specific task or action plan for implementing or carrying out a policy. Procedure tells employee's how to deal with a situation and when.

Importance of Policies and Procedure:

- It makes sure of the smooth functioning of the business and its day-to-day tasks.
- It clearly sets out the instruction for the employees which is expected from them.
- Having policy and procedure in place become handy at times while dealing with any kind of issue.
- It improves the overall image of an organisation in the market.
- It sends out a clear message to its external stakeholders and helps the organisation to build trust among its stakeholders.
- It enhances the goodwill of an organisation and, in turn, increases the market value.

The difference between policy and procedure is described below:



UNIT 10.3: Reporting Structure

Unit Objectives

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

1. Analyse the reporting structure

10.3.1 The Reporting Structure

Reporting structure refers to the relationship between the employees' position in terms of authority –“who reports to whom”. The reporting structure acts as a command it is hierarchal within every employee report to another employee who resides to be one level higher in their authority or position within the organisation including communication and decision channels.

Types of Reporting Structure

- **Vertical Structure:** The vertical organizational structure is a pyramid like top-down management structure. It creates a powerful hierarchical structure that emerges from top highest level of leadership CEO/owner followed by middle management then regular employees at bottom. Every employee has the authority to do their individual task or jobs. Every employee has to report to their supervisors in case of any issue. Here decision making often work from top to bottom, but work approval will work from bottom to top.
- **Horizontal Structure:** The flat structure or horizontal structure is an organizational structure having only a few layers of management into which the managers have a very wide span to control with one or more subordinates as it does not have many chains of command. The top layer of the structure is the owner of the business, whereas the second layer contains team leaders or managers who will report to the business owner. The third layer of team members is supervised by the team leaders or the managers of the second layer.

The company's reporting structure is generally prepared to keep the company's strategic goals and missions in mind. The authorities and work are delegated among the employees of the various departments according to various business functions.

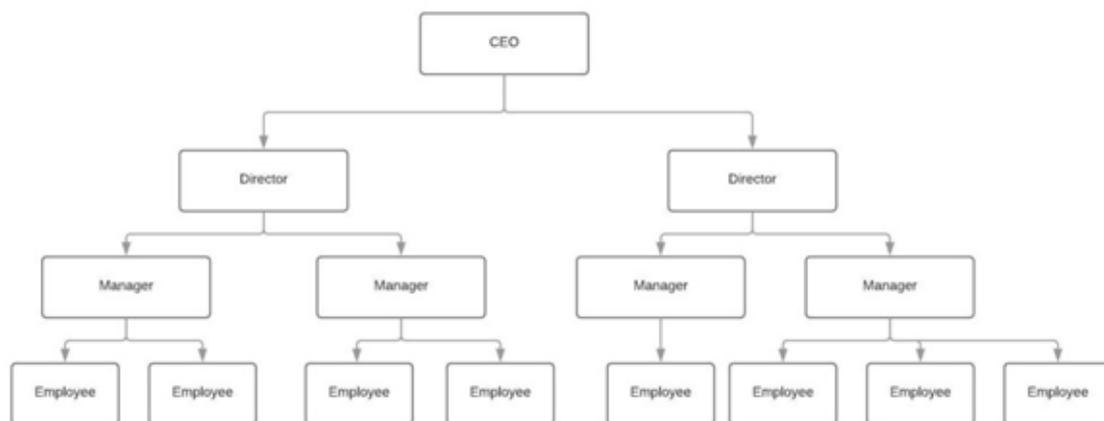


Fig. 10.2: Company's Reporting Structure

UNIT 10.4: Inter-Dependent Functions

Unit Objectives

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

1. List the inter-dependent functions

10.4.1 The Inter-Dependent Functions

Interdependence stands to be the key aspect of creating a healthy work environment and a sense of unity among the workers in order to achieve a common organizational goal. Teams of employees working together in hierarchy of organizational structure tend to demonstrate high chances of success rather than working individually. It also ensures the everyone is in line with the company's overall progress and are working towards the same objective.

The two main components of Inter-dependence are:

1. Collaboration
2. Delegation

Types of Inter-dependence:

- **Pooled inter-dependence:** In an organisation, each vertical or or horizontal department may not directly interact and do not directly depend on each other and perform completely separate functions having their own set of tasks, which stands to be different from each other, but they offer a contribution to the overall goal of an organisation as well. This type of inter-dependence is known as pooled inter-dependence. It means if any department fails to achieve its objective, the entire project or goal will collapse.
- **Sequential inter-dependence:** Sequential interdependence is a kind of inter-dependence when one department is witnessed to depend upon the functioning of the other department. As an instance, the procurement department must purchase the raw materials in order to ensure the proper functioning of the production department.
- **Reciprocal inter-dependence:** Similar to Sequential inter-dependence, Reciprocal inter-dependence also defines output of one department becomes input of other department in order to efficiently complete the task or project.

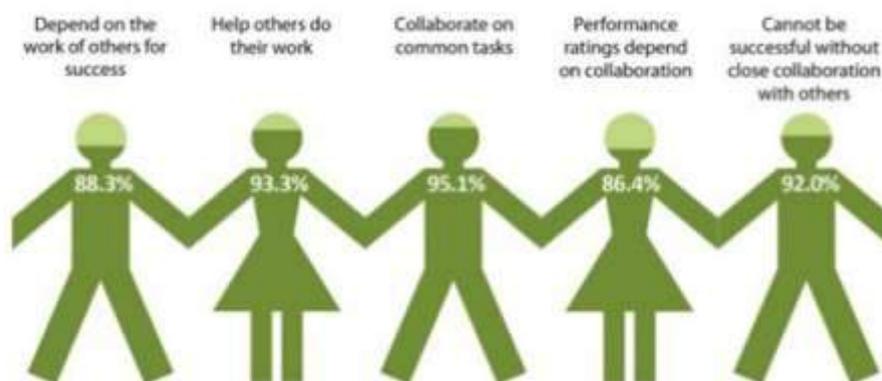


Fig. 10.3: Process of the concept of Inter-dependence

UNIT 10.5: Harassment and Discrimination

Unit Objectives

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

1. Discuss the impact of harassment and discrimination

10.5.1 The Impact of Harassment and Discrimination

Any objectionable behaviour of someone towards an individual during professional or personal communication, whether on verbal or non-verbal terms, is referred to as harassment.

Harassment can include behaviours, such as:

- Telling abusive jokes about a particular group of members.
- Forwarding obvious or sexually suggestive emails or texts.
- Making disrespectful comments or taunts about a person's appearance and disability.
- Asking unwanted questions about someone's life.
- Displaying ethnic offensive screen savers.

Discrimination refers to a treatment when one person or a group of members are treated unfairly based on the factors such as race, colour, gender, sexual orientation, age, religion, and disability.

Discrimination that occurs in the workplace is of different types:

It occurs when an individual is discriminated against a number of factors. In addition to the reasons, job applicants and workers are also discriminated against because of their relationship with any other person.

The different types of workplace discrimination are.

- Gender Discrimination
- Age Discrimination
- Race Discrimination
- Skin colour Discrimination
- Mental and physical disability
- Genetic information
- Religion Discrimination

Pregnancy and parenthood: Harassment and Discrimination at workplace is illegal and unethical. It is not only treating your employee's equally the right thing to do but also avoiding any type of harassment and discrimination can also improve company's reputation and will also improve working environment in organization.

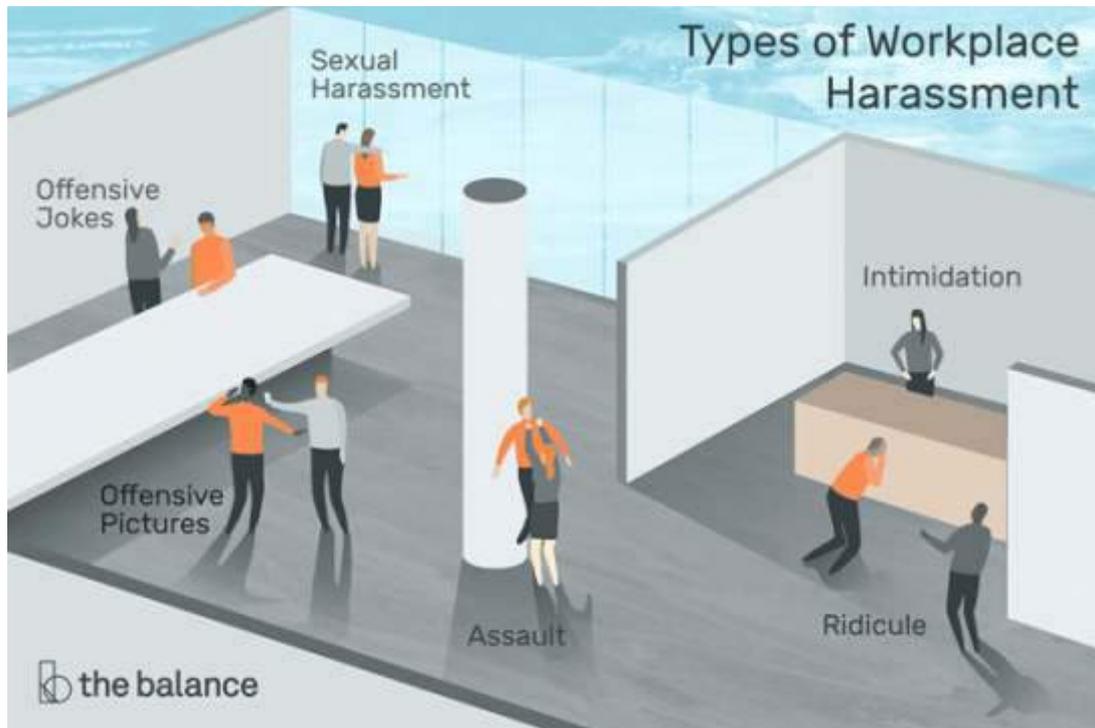


Fig.10.4: Types of Workplace Harassment

UNIT 10.6: Prioritising Tasks

Unit Objectives

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

1. Monitor the ways of prioritising the task

10.6.1 The Ways of Prioritising the Task

Prioritizing a task or work is a process of having an understanding of which task requires to be achieved first by determining the level of importance and urgency of task, thing or event. However, each task or work appears to be equally vital. Prioritization also helps the employees to attain more work or tasks in a less amount of time. It is very important for the employees and workers to prioritize their work in order to be productive rather than being reactive, which will indirectly decrease their efficiency of providing productive work.

How to Prioritize Task on Workplace When Everything's Important?

Seven strategies for prioritizing tasks at the workplace:

- Having a list that contains all tasks or works in one place
- Identify what's important
- Highlight what is necessary
- Prioritize based on importance
- Avoid competing with priorities
- Consideration of the efforts made in the tasks
- Constantly reviewing task and be realistic

UNIT 10.7: Communication Skills

Unit Objectives

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

1. Record the types of communication skills

10.7.1 The Types of Communication Skills

Communication skill mainly addresses to the ability of the ways in order to communicate effectively with managers, colleagues and staff. It is an essential part for every industry. Communication is the act of transferring information from one place to another. It may be vocally (using voice), written (using printed or digital media such as books, magazines, websites or emails, visually (using logos, maps, chats or graphs), nonverbally (using body language, gestures, tone and pitch of voice). In practice it is often a combination of several of these. Productive communication skills in the workplace can reduce conflicts, lower the risk of projects indirectly and thus would make the work more agreeable.

In today's scenario having technical skills is not only enough to get the work done in the workplace. Completing the task must require the support of the whole team, and without proper communication, things will remain stringent in order to get better communication in the workplace. Communication skills are absolutely necessary for successful communication both in the workplace and in private life.

- **Body Language (non-verbal):** When there is a discussion about body language, it refers to the ways by an individual presents themselves while interacting with someone. It includes body posture, hand movements or gestures, the type of eye contact that is made, and the voice tone.
- **Listening:** Communication in the workplace is not entirely about speaking; it mainly represents atwo-way channel. Onehas to pay close attention while talking, as this allows the team members to ask and clarify their doubts as well asinquiries to ensure that they are on the same page or track.
- **Clarity and Conciseness:** One of the major ingredients for effective communication in the workplace is clarity, which mainly stands to be responsible to expresses the attempt of conveying an individual's message in the simple way possible. Before you start a conversation, type an email or being a discussion, have in mind what the purpose of the communication is and what information you hope to obtain as a result.
- **Friendliness:** In order to engage with the team members in an open or honest discussion, a person needs a friendly tone, a personal question, or simply a smile. It is important because the team members would not hesitate to contact the individual as they would be easily approachable for the conversation.



Fig. 10.5: Essential Communication Skills



Fig. 10.6: 7 Key Active Listening Skills

- **Empathy:** Showing compassion or empathy even when the individual disagrees with an employer, co-worker, or employee state to be very important as it helps in understanding their point of view and also respects their decision.
- **Confidence:** It is an important step to be confident when an individual tends to interact with others. As in all interactions, confidence (but not overconfidence) is crucial part. Conveying with confidence will give you peoples, faith in your abilities and will take you seriously.
- **Respect:** The employee must respect their co-workers' roles, skill set and ideas in order to meet the company's overall goal as a team.

The team must communicate with each other in a respectful manner every time. Conveying them with respect through email by taking the time in order to edit their message is also required. If the individual would send them a sloppy written, confusing email, the recipient will think them to be disrespectful and also encourage them to think through the person's communication.

Summarizing the concept:

Effective and clear communication at the workplace ensures that the healthy work environment supports the overall team development, engagement of employees, innovative idea, which in turn help the overall company's growth, enhancing the goodwill and trust of its customers.

UNIT 10.8: Teamwork

Unit Objectives

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

1. Evaluate the ways of carrying out a teamwork

10.8.1 The Ways of Carrying Out Teamwork

Teamwork is a cumulative effort done by a team or a group of members in order to acquire a common goal or to complete a given work or task in the most effective and powerful way. Good teamwork helps in building a strong relationship as well as provides morale in the workplace, which makes the workers more productive, leading to an increased profit.

Tips to improve teamwork in the organization:

- **Encourage informal social events:** In an informal environment, employees feel free to communicate with each other, and they also try to understand the personal behaviour of everyone.
- **Clarify Roles:** In order to work efficiently at the workplace, every employee should have a proper understanding of their roles and responsibilities according to their work demand.
- **Specify long-term as well short-term goals:** Specifying goals help in streamlining the communication and makes the teamwork more purposeful.
- **Reward and recognition:** It is necessary for an employer to recognise the best performing employees as it will keep them motivated and also provide a sense of accomplishment.
- **Avoid micro-management:** One of the significant drawbacks of micromanagement is that the employee tends to focus on the small or less relevant thing which they think is required to please the immediate supervisor.
- **Establish Effective Communications:** It is not necessary that an employee needs to be friends with all the co-workers, but the thing which is necessary states the establishing and practising of effective/good communication.
- **Respect Individuality:** Every individual has their own personality, skill and preferential ways of working, which is a necessity of the employer in order to recognise these.
- **Seek feedback:** Seek feedback not only from the managerial staff but also from the ground level staff in order to gain the proper insights and scopes of improvement.

UNIT 10.9: Ethics and Discipline

Unit Objectives

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

1. Highlight the ethics and discipline

10.9.1 The Ethics and Discipline

Work ethics refers to the ways by which the employees govern themselves and their attitude towards their work. It also refers to morality in the workplace.

A person having a good work ethic tends to create a healthy workplace environment for him/her as well as for their fellow co-workers.

It is mandatory for an employer to develop strong work ethics among the employees. It can be done in various ways.

- Setting clear goals and objectives
- Mentoring
- Set example
- Need of right work environment
- Encourage professionalism
- Discipline
- Listen to your employees
- Feedback
- Rewards and recognition
- Remove obstacles
- Discipline at Workplace

UNIT 10.10: Grievances Solution

Unit Objectives

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

1. Illustration of the grievance's solution

10.10.1 The Grievance's Solution

Grievance's Solutions

A grievance can prove to be quite harmful if not dealt with in time. It may lead to frustration among the employees, and they can start losing their trust from the employers.

Work-related grievances and complaints from staff need to be tackled with proper care and are also known to be a time taking procedure.

It is the liability of the HR department that employee grievances are addressed quickly and in an effective manner.

There are five ways in order to address the grievances effectively:

- **Prompt and timely Action:** The staff or department expert in handling the grievances must be highly trained in managing the employee grievances effectively and in a time-bound manner.
- **Grievance acceptance:** The supervisor or expert must accept the employee grievance and also should respect their genuine feelings.
- **Collect information:** Management should not wait for the grievances to be reported. Instead, it should take preventive steps in order to avoid it. In order to curb it, the management must discuss, collect information, communicate regarding various issues at the workplace.
- **Cross verify the grievance cause:** Once the information and cause of grievance are collected about the reported incident, the information must be cross-checked from various other sources.
- **Decision making:** On successful identification of the causes, the management must develop a series of steps in order to resolve it along with the next course of action.
- **Review and implement:** The management should not wait for a longer time once they have a rational and effective resolution. It is necessary to involve the concerning employee(s) in confidence before implementing the decision.

UNIT 10.11: Interpersonal Conflicts

Unit Objectives

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

1. Recognize the interpersonal conflicts

10.11.1 The Interpersonal Conflicts

Interpersonal Conflicts

Interpersonal conflicts refer to any type of conflict among two or more people. The idea mainly refers to the situation when a person or group of employees try to interfere in some other employee's work.

Ways to Resolve Conflict at the Workplace

- Communicate
- Listen carefully
- Show empathy
- Never hold back any grudges
- Effective communication skill

UNIT 10.12: Disabilities and Challenges

Unit Objectives

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

1. Identify the disabilities and challenges

10.12.1 The Disabilities and Challenges

People with disabilities are far more impacted by personal and environmental barriers than normal people. By the end of this module, you will be able to get clarity on the rights of disabled people in the workplace.

These challenges to employment can range from a variety of physical and social ones. These can include:

- Physical barriers
- Nature of co-workers and stereotyping
- Communication barriers
- Policy barriers

Physical Barriers

They can take the form of structural issues in an environment that retrogrades the basic functioning of disabled people. As an instance, the lack of a wheelchair ramp or an elevator can hamper basic tasks for disabled people or not allow them access to modern equipment that would authorize them to perform tasks.

Nature of Co-Workers and Stereotyping

Judgements and assumptions against people with disabilities are pretty much the norms of our present-day society. They tend to prevent disabled people from getting hired or having a positive experience in the workplace. For example, a person might be denied useful resources because their employer believes that they don't tend to possess a learning ability. This is common for people suffering from autism, ADHD or several other 'invisible' disabilities.

Communication Barriers

Communication barriers can create an inefficacy to effectively write, speak, read or understand the necessary requirements for a job. Some examples would involve the inability to use a phone due to hearing disability, lack of braille prints for blind people, and usage of languages that are too technical for people with cognitive impairments.

Policy Barriers

Policy barriers can also be a defining factor for the challenged people to get a job in a cooperative workplace. These include giving people not enough time to complete their tasks.

UNIT 10.13: Gender Sensitivity and Discrimination

Unit Objectives

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

1. Identify the disabilities and challenges

10.13.1 The Disabilities and Challenges

Gender sensitivity has also been an ongoing dialogue inside the workplace. The workplace has frequently been referred to as an “inhospitable place” for women due to the multiple decisions taken by the HRs (i.e., policies, decisions and their enactment, training, wage).

Ways to Build Gender Sensitivity and Eliminate Discrimination

- Recognizing the workplace’s “Gender Equality Maker (GEM).”
- By being open and informative about it
- Altering existing policies to make room for gender diversity and equality
- Strict implementation of the policies

Recognize the Workplace’s Gender Equality Maker

Being gender-sensitive is just one of the many necessary steps to be taken in order to have a gender-fluid workplace. Recognizing your company's current status in its diversity can be helpful and would point you in the right direction.

By Being Open and Informative About It

An open atmosphere in a workplace would help a company and its employees to excel in all directions. Understanding their needs and fulfilling them accordingly would help the employers and workers in a similar manner to achieve a gender-balanced environment.

For example, having group discussions with men, women, and LGBTQ+ would help people to understand their needs and concerns.

Altering Existing Policies to Make Room for Gender Diversity and Equality

The “Equal Remuneration Act of 1976” of India has prohibited differential pay to men and women employees for conducting the same work or work of the same nature.

Strict Implementation

Rules and regulations are only followed up with when implemented strictly. There are lots of rules and policies that can be put in place in order to check inequality and help a workplace to go from being gender-sensitive to gender transformative. One example which can be taken under consideration is the ensuring of nearly everyone to be confident and open to a leadership role if offered, while the others could portray equal pay amongst colleagues in the same position. Lastly, for sexual harassment, implementing strict rules against this kind of behaviour is paramount and shows that a corporation is heading in the right direction. Companies must realise that employees are working in a safe environment and do not need to be anxious about a harassment encounter.

UNIT 10.14: Applicable Legislation, Grievance Redressal Mechanisms

Unit Objectives

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

1. Discuss the applicable legislations, grievance redressal mechanisms

10.14.1 The Applicable Legislations, Grievance Redressal Mechanisms

The Indian Constitution guarantees equality and prohibits discrimination on the grounds of religion, race, caste, sex, birthplace, and residence.

Discrimination against or profiling individuals can occur at two stages – pre-recruitment and post-recruitment. The former entails rejecting potential candidates on the basis of their gender, religion, caste, marital status, pregnancy etc. Post-recruitment discrimination manifests in lesser pay, fewer benefits and/or leave or even termination, based on the same grounds.

The Constitution guarantees equality of opportunity for every citizen in matters relating to employment or appointment to any office under the state.

“Equal Remuneration Act, 1976” needs the employers to pay equal remuneration to the employees for the same task or work of a similar nature without having any discrimination on the basis of sex.

Grievance Redressal Mechanism

A transparent, quick, robust and confidential grievance redressal system can effectively help in order to handle conflicts in the workplace and potentially go a long way in bringing harmony to the workplace. Some of the better places to work are identified to have an efficient worker-based grievance redressal mechanism.

In India, certain central and state-specific labour laws require the employer to adopt certain grievance redressal mechanisms at the workplace.

- **Internal Commite for Complaints:** According to the sexual harassment of women at workplace "(Prevention, Prohibition and Redressal) Act, 2013" of India (POSH Act), each workplace possessing at least ten employees is required to constitute an Internal Complaints Committee (IC). The IC is required to investigate complaints of sexual harassment of women at the workplace and also provide recommendations to the employers.
- **Grievance Redressal Committee:** According to section 9C of the Industrial Disputes Act, 1947 of India (IDA), each employer recruiting at least twenty workmen, is needed to structure a Grievance Redressal Committee (GRC) for resolution of the conflicts arising out of grievances of the people.
- **Works Committee:** The labour authorities might, under section 3 of the IDA, order an initiation possessing at least one hundred workmen to set up a Works Committee (WC).
- **Committee for Employee's Health and Safety:** Certain states in Indian like Maharashtra need employers to employ at least one hundred workers to structure a Health, Safety and Welfare Committee (HSW Committee). The responsibility of the HSW Committee includes surveying and identifying any accident-prone, hazardous objects or spots in the boundaries, rectifying such spots, conducting healthcare camps once a year.

UNIT 10.15: Transacting With Others Without Personal Bias

Unit Objectives

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

1. To administer with others without personal bias

10.15.1 Personal Bias

When it arrives at making choices at work, it's important to know they are not based on bias. It is essential for organizations to have concrete processes and procedures in place to curb unconscious bias. Nevertheless, there are many stages that can be adopted to check the biases and to create an inclusive environment for the team.

Recognizing an Individual's Own Biases

Recruitment is known to be an area where unconscious bias may come into play as it has been seen that people may unwittingly tend to favour applicants from their own familiar backgrounds.

Focusing on People

Many organizations are so focused on their processes that they lose sight of their own people. Of course, there is a requirement to find time, for example, to write reports, define job descriptions, and set up performance appraisals, but it's important that there is also the establishment of expectations communicate plans, and giving as well as receiving feedback from everyone involved in the team.

Increasing Exposure to Biases

Many organizations assume that their policies on avoiding discrimination are robust and work well, so perhaps they fail to weed out some subtle biases. Declaration of the intentions about valuing a diverse workforce is extensively required. Saying words out loud, or writing them down, sends a clear message to everyone with whom an individual is working, as well as is involved in one's own subconsciousness.

Summary

- Organizational policy or work place policy is a type of statement which provides the outlining of any organization that practices out the procedures. This eventually leads to its business which covers and everything, starting from the operations to concerns and compliances along with the employee's legislation.
- It is the legal requirement of an organisation to comply with the local laws as well as regulations and keep them updated time-to-time. The HR department is mainly responsible for continuously updating the regulations and making sure that it is communicated across the organisation.
- Policies communicate the connection between the organization's vision and values.
- The reporting structure acts as a command it is hierarchal within every employee report to another employee who resides to be one level higher in their authority or position within the organisation including communication and decision channels.
- Teams of employees working together in hierarchy of organizational structure tend to demonstrate high chances of success rather than working individually.
- Prioritizing a task or work is a process of having an understanding of which task requires to be achieved first by determining the level of importance and urgency of task, thing or event.
- Effective and clear communication at the workplace ensures that the healthy work environment supports the overall team development, engagement of employees, innovative idea, which in turn help the overall company's growth, enhancing the goodwill and trust of its customers.
- Discipline at the workplace lays a strong foundation of trust between the employer and its employees. It includes reporting on time, maintaining decorum during working hours and at the workplace, appropriate dressing, proper communication, etc.
- A grievance can prove to be quite harmful if not dealt with in time. It may lead to frustration among the employees, and they can start losing their trust from the employers. In order to handle grievances properly, one should have an adequate set of procedures that lays out a clear step by step process in order to deal with the grievances.
- Women have been witnessed to have fought for their rights and for their place in this world for hundreds of years. However, it's not just women now, and the LGBTQ+ communities are also fighting for their rights and their voices in order to be heard.
- The Indian Constitution guarantees equality and prohibits discrimination on the grounds of religion, race, caste, sex, birthplace, and residence.
- A transparent, quick, robust and confidential grievance redressal system can effectively help in order to handle conflicts in the workplace and potentially go a long way in bringing harmony to the workplace.
- Recruitment is known to be an area where unconscious bias may come into play as it has been seen that people may unwittingly tend to favour applicants from their own familiar backgrounds. But a person can take practical steps in order to reduce this bias.

11. Material Conservation



Unit 11.1 - Material Handling

Unit 11.2 - Workstation Layout, Electrical and Thermal Equipment

Unit 11.3 - Organisational Procedures for Minimising Waste

Unit 11.4 - Practices of Efficient and Inefficient Management

Unit 11.5 - Material and Water Usage



Key Learning Outcomes

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

1. Identify the ways to handle materials
2. Categorize the workstation layouts, electrical and thermal equipment
3. List the organizational procedures for minimising waste
4. Analyse the practices of efficient and inefficient management
5. Discuss the material and water usage

UNIT 11.1: Material Handling

Unit Objectives

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

1. Identify the ways to handle materials

11.1.1 The ways to handle materials

Material handling

Material handling is also known as the integrated system, which involves such activities of the movement, storage, protection and control of types of materials and products throughout the manufacturing, distribution, consumption and disposal. The major function involves the focus on methods, mechanical equipment, and related control systems to achieve the mentioned functions.

The fundamental objective of using material handling is to ensure that the material is in the right amount and is safely delivered to the desired place at the right time, along with minimum production cost. The cost of material handling has an estimated 20-25% of total manufacturing labour cost.

Principles of Material Handling

- **Planning:** The planning requires to be done in order to achieve the approach of the team with the input of consultants, suppliers and the end-users, from the management, engineering, operations, finance, sales and operations.
- **Standardization:** All the material handling equipment, methods, controls, and software requires to be standardized in such a way that it would be able to perform a wide range of tasks in a broad range of operations.
- **Work:** In material handling, the process requires to be clarified by reducing, shortening and eliminating in order to remove the unnecessary movement that would impact productivity.
- **Ergonomics:** Work and work-related conditions are being adapted to support the ability of a worker, which reduces the repetitive and difficult manual labour as well as safety.
- **Unit Load:** Due to the less use of effort and work required to move several individual items together as a single load (e.g., moving of many items one at a time), a unit load such as containers or pallets is required to be used.
- **Space Utilization:** In order to maximize the effective use of space within a facility, it is extensively crucial to keep the working stations organized and clutter-free to increase the density and availability of the storage area. 5S principle can be implemented for space utilization 5S stands for the 5 steps of this methodology: Sort, Set in Order, Shine, Standardize, Sustain.
- **System:** In material handling, the movement and the storage are required to be coordinated throughout the process in order to form or receive the inspection, storage, packaging, order selection, production, and shipping, return handling, as well as transportation.
- **Environment:** Energy, which is used in potential environmental impact, have been considered in designing the system with recycling and reusability processes implemented whenever possible, as well as for the establishment of practices for safe handling of hazardous materials.
- **Automation:** To develop operational efficiency and consistency, the automated material handling technologies need to be positioned whenever possible.

- **Life Cycle Cost:** For all the equipment used in material handling for a specified system, the analysis of a life cycle cost is required to be conducted. The areas of considerations require possessing the installations, programming, training, operation, maintenance and also repairing.

Material Handling Equipment

The simplest shelf to the most complex light out facilities, warehouse mechanization, is capable of being operated in the dark as it uses a lot of material handling equipment.

There are different kinds of material handling equipment, and they fall under four broad types. Material handling is the unloading and loading or movement of goods within a warehouse, especially with the help of mechanical devices. Thus, material handling equipment refers to the devices that are used in a warehouse's operation by storing and moving the goods.

Type 1: Storage and Handling Equipment

This stands to be usually the simplest type of material handling equipment which includes shelves and racks where an individual is capable of storing their material in the middle of shipping and receiving it. Drawers, bins, flow racks, cantilever racks and stacking frames are additionally included in this category.

Type 2: Bulk Material Handling Equipment

It is the process of storing, transportation and control of materials in loose bulk form. For instance, a silo, a large cylinder that is capable of holding stuff like grain. Other examples include:

- Reclaimers and Stackers:
- Hoppers
- Conveyor Belt
- Grain Elevators
- Dump Trucks
- Rotary Car Dumper
- Screw Conveyor
- Bucket Elevators
- Vacuum lifter

Type 3: Industrial Truck

These are the type of equipment or vehicles that is used to move materials. Sometimes it is run by workers, and sometimes they are automated. "Automated Guided Vehicles (AGVs)" fall under both industrial trucks and engineered systems. Other examples include:

- Forklifts
- Order Pickers
- Hand Trucks
- Pallet Trucks

Type 4: Engineered System

It is the type of material handling equipment that stands to be a more complicated system with multiple components, which are usually automatic. They include AGVs, conveyor belt or robotic delivery system that comes in different sizes and shapes or automated storage systems.

11.1.2 Hazards, Risks and Threats Associated with Handling Different Materials

There are multiple hazards, risks and threats can be identified during receiving, loading & unloading, storage, and transportation for handling different types of materials.

Receiving

Hazards, risks and threats can be identified during receiving of the material. Inspect incoming materials as soon as they are received to ensure established specifications such as product temperature, packaging conditions, etc. are met. A designated employee should verify and document:

- Incoming raw materials – Quality and other kinds of defects can occur during receiving of incoming materials. So, all kind of material should be from an approved supplier. Approved supplier can be verified through supplier visit, document verification and certification from legal bodies.
- Cleanliness of the truck – Foreign body, pest can be identified as a hazard. So, we must ensure that no foreign material, dirt, odours, rodents, insects or other pests are there in the vehicle.
- Temperature of the truck – Every different material requires different type of temperature requirements such as ambient (Normal temperature- 20-25°C), chilled (0-5°C), frozen (-16°C to -23°C) and dry items. Any deviation of temperature requirements can be considered as a hazard. Proper temperature needs to maintain for products according to specifications.
- Condition of door seals – Improper door closing, or door gaps of the vehicle can be one of the risk factors of material. So, it needs to ensure that close-fitting doors with no spaces at sides or bottom.
- General truck conditions or Material handling equipment's – Truck or material handling equipment's can be cause damage of product, infrastructure damage and injury of the person or even fatality.

Loading and Unloading

Loading and unloading process can be considered as hazard due to the potential risk involved to the product, property and person.

- Product damage and spillage can happen during loading and unloading process and it can be considered as a risk.
- Human error during loading or unloading process can cause damage to product, property or the employees. Employees responsible for loading and unloading materials should follow company standards for hygiene and sanitation practices.
- Proper product temperature must be maintained during loading and unloading as well. Movers should be aware of the product temperature requirements. Any kind of deviation regarding temperature can cause product damage. Document verification plays an important part for tracing shipments in case of a recall and should include: Time of receipt, type of product, ingredient and product packaging, labelling, lot number, pallet tag, quantity, size and weight.

Storage

Products should be stored adequately to maintain package/pallet integrity:

- Allow maximum air circulation and stock rotation. Air circulation is important to maintain the temperature, humidity inside the warehouse. Also, HEPA (High efficiency particulate air) filter can be installed to avoid biological hazard.
- Assign different storage areas for different products (ingredients, raw materials, finished products) to avoid cross contamination.

- Material should be used within the manufacturer's specified time period to maintain shelf-life requirements. Appropriate rotation of food and packing materials -- first in, first out (FIFO) -- helps minimize product contamination, damage and spoilage. Allergen control precautions need to be established for the food industry regarding raw materials purchasing, transportation and storage. Ensure suppliers have documented and implemented an allergen control plan. Check labels on incoming ingredients to ensure the supplier has not sent the wrong product, a substitute product or used the wrong label. Ensure vehicles and shipping containers are cleaned before shipping. Clearly label raw materials to indicate they contain food allergens (ex: color-coded containers, tags).
- Pallets used to store materials can cause different hazards. For example- Damaged pallets can result in product damage or fall down on the product; protruded nails can cause product damage or injury.
- Loading strength and design should be based on a health and safety risk assessment. Major accidents can happen due to excessive product storage on each rack or improper design of the racking system.

Transportation

Vehicles and containers that transport materials should be used only for the intended purpose and should have both sanitary design and pest control procedures in place. (Ex: truck's doors should be sealed to prevent entry of pests.) Refrigeration equipment in vehicles and temperature measuring devices should be calibrated and in good working order. Mechanical refrigeration should be provided for perishable food products such as meat, fish, poultry, milk and eggs.

Inspection of vehicles

Designated employees should evaluate and document the condition of trucks, containers and carriers of finished products before loading. The following should be verified before loading:

- Cleanliness of the truck should be maintained to avoid any physical, chemical or biological hazards.
- No odours or obvious dirt or debris.
- No evidence of chemical contamination such as fluids, powders, chemical residues
- Correct temperature in the truck.
- Temperature measuring devices will work properly during transportation. Documentation and maintain a log to verify inspection and cleaning tasks. Indicate type of loads, cleaning and sanitation procedures, inspections, etc.

UNIT 11.2: Workstation Layout, Electrical and Thermal Equipment

Unit Objectives

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

1. Categorize the workstation layouts, electrical and thermal equipment

11.2.1 The Workstation Layouts, Electrical and Thermal Equipment

Workstation Layout

Workstation or workplace is also known as the floor space occupied by the workers, as well as by the machines or a group of machines. An ergonomic workplace is a scientific discipline that is concerned with improving the productivity, health, comfort and safety of people in order to promote effective interactions among people, the environment and technology.

During the design of the workstation layout, the following space requirements are taken into considerations:

- Requires having spaces for racks, bins and conveyor stations that either contain the under processed work or receive the work after it has been completed by the machine.
- There should be a rectangular space occupied by the length and width of the machine or group of machines. They need to include the space for the travel of moving parts as well as the projected parts of machines which include shafts, levers, pulleys, handles and wheels.
- There requires being a proper workspace for the workers in order to efficiently complete their tasks.
- Requires having clearance space for feeding the work on and off the machine.
- There needs to be a space for tool racks, workbenches, etc., required by the individual machine, if any.
- There needs to be proper floor space for the power source, or if in case of any electric motor, it has to be placed on the floor or within the working area.

Storage Space Requirement

In any plant layout, the space for workstations allocation requires to be made for the storage of material and space essentially required inside the plants. Every department and area need to be designed in such a way so that they are capable of providing waiting, processing and moving facilities.

The storage space requirement depends on various factors such as:

- Quantitative use of raw material per hour
- Movement of semi-built parts between two machines depending upon the weight and volume.
- Movement of parts between the departments, depending upon the weight and volume.
- The dependence upon the scrap weight and volume
- Vertical heights of the building plants.
- Production capacity of the assembly.

- Floor load-bearing capacity.
- Storage practices.

Once the space requirement for all machines has been estimated, the employer needs to have the provision for the basic amenities like canteen, drinking water, first aid, restrooms, sales department, changing room (for factory worker like machine operators), refreshment place, etc.

Workplace Layout Design:

Employee productivity stands to be directly in proportion to workplace conditions. A good and comfortable workplace always results in high productivity per employee.

Some important aspects which need to be considered while designing the workplace are:

- Cleanliness
- Proper lighting
- Noise
- Tool Is and Material positioning
- Chairs and Workbench
- Machine design

Electrical and Thermal Equipment

In order to build an efficient workplace layout, one needs to consider the electrical and thermal requirements of the workers. Workstations that are well equipped with electrical supply takes care of the power source needs of employees in order to operate the required equipment and tools.

The following points require to be considered while designing an electrical workstation.

- Placement of electricity outlet or strips
- Power/voltage requirement of different equipment
- The number of power outlets required
- Alternative or emergency power source outlets

UNIT 11.3: Organisational Procedures for Minimising Waste

Unit Objectives

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

1. List the organizational procedures for minimising waste

11.3.1 The Organizational Procedures for Minimising Waste

Types of organisational waste and ways to minimise them:

- Transportation:** Transportation waste refers to the movement of tools, equipment, inventory, raw material, people etc., more than the actual requirement or consumption. Unnecessary or excessive movement of resources leads to unnecessary work, increased wear and tear, increased damaged and defects.

In order to curb this type of waste, the department which works closely needs to be designated next to each other. The materials required for production has to be placed in easy to reach locations as well as the multiple handling of material needs to be avoided.
- Inventory:** Inventory is often considered as an asset to any organisation; however, storing inventory stands to be more than the required leads to unnecessary damage, defects and increased lead time during the production process. The main cause of this is over-purchasing of raw material, increased WIP (work in progress) and over-production in comparison to the actual customer needs.

Measure to be taken in order to reduce such kind of waste involves the purchase of raw material as per the demand, avoid overproduction and reduce the work in progress.
- Motion:** This includes unnecessary movement of tools or equipment, machinery or people. It also includes repetitive movement that doesn't add value to the work or customer, reaching for raw material, unnecessary walking to fetch tools or equipment and readjusting of installed machinery.

Measures to be taken in order to reduce such kind of waste include a well-designed workplace, easy to reach location for tools or equipment, and efficient one-time installation of machinery.
- Waiting:** It includes equipment or machinery which are kept idle and also the workers waiting for material or equipment. It is majorly caused by unevenness among the various production lines.

This type of waste is capable of being curbed by streamlining the process for continuous workflow as well as training the workers on multiple skills set who are capable of easily adapting to the changing work demands and standardized workflow.
- Overproduction:** Overproduction means manufacturing a product or material in excessive quantity than the actual demand.

Measures to be taken in order to reduce such kind of waste include, even manufacturing rate between the station or production units and also manufacturing small batch size.



Fig. 11.1: Overproduction

- **Defects:** A defect usually refers to a specific product that is of no use. This results in either discarding the product or reworking on them and is capable of incurring the additional operational cost.

Tips

- For having an effective system of food processing implementation of automated statistical process control systems are extensively required
- Maintaining a high level of supply chain visibility is also considered to be important for efficient food processing

UNIT 11.4: Practices of Efficient and Inefficient Management

Unit Objectives

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

1. Analyse the practices of efficient and inefficient management

11.4.1 The Practices of Efficient and Inefficient Management

Inefficient Management Practices

Inefficiency at the workplace often refers to low productive and poor confidence. Inefficiency directly impacts the cost incurred by any organisation.

Following are the key indicators of inefficient management:

- Uneven prioritization of work
- Non-essential work
- Lack of resource planning
- Improper justification of resources
- Inefficient productivity management
- Lack of fruitful collaboration

An efficient manager must answer the below questions in order to identify the inefficient management practices.

1. Who is working on what?
2. Are they working on the highest priority projects?
3. Do they have the resources they need?
4. Do they have the information they need?
5. How is work coming along?
6. Will work be done on time?

Efficient Management Practices

An efficient management practice refers to those practices which can perform the task with minimal wastage of resources. It also refers to the appropriate utilisation of resources leading to profit maximisation. The basic rules of effective management are:

- Consistency
- Goal setting
- Delegation
- Task prioritization
- Effective communication
- Rewards and Recognition
- Training and development
- Management Commitment

UNIT 11.5: Material and Water Usage

Unit Objectives

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

1. Discuss the material and water usage.

11.5.1 The Material and Water Usage

Material Usage

Material refers to those components or raw goods which are used in producing hard goods like machines and equipment for another industry or end consumer as well as soft goods like food items, chemicals, medicines, apparel, etc.

Water Usage

In manufacturing units, water is used for various purposes like fabrication and processing of various materials, cleaning, diluting or as a coolant.

The need and demand for industrial water vary upon the product which is being manufactured. The other factors which need to be taken into consideration are water quality in the region, type of treatment required in order to make water usable.

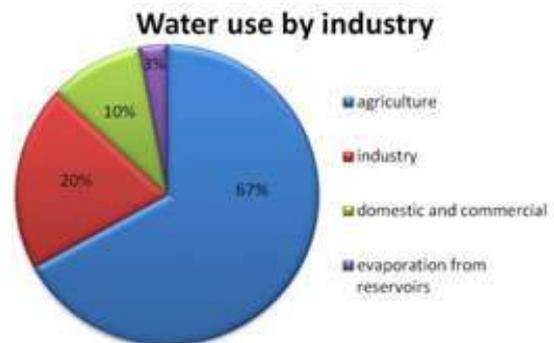


Fig. 11.2: Industry-wise water consumption

Industrial usage of water:



Fig. 11.3: Industrial wastage of water

Summary

- Material handling is also known as the integrated system, which involves such activities of the movement, storage, protection and control of types of materials and products throughout the manufacturing, distribution, consumption and disposal.
- Workstation or workplace is also known as the floor space occupied by the workers, as well as by the machines or a group of machines.
- Employee productivity stands to be directly in proportion to workplace conditions.
- An efficient management practice refers to those practices which can perform the task with minimal wastage of resources.

Exercise

A. Answer the following questions by choosing the correct option:

1. What is the manufacturing labour cost for material handling?
A. 20- 23% B. 20- 25% C. 20- 30% D. 20- 35%
2. What stands to be the full form of AGV?
A. Automated Guided Vehicle
B. Activated Guided Vehicle
C. Accurately Guided Vehicle
D. Action Guided Vehicle
3. _____ is the major component for manufacturing semiconductors and chips, which are widely used in mobile phones, computers and various other electronic goods.
A. Nitrogen B. Silicon C. Hydrogen D. Lithium
4. _____ directly affects the efficiency of the workers.
A. Proper lighting B. Noise C. Cleanliness D. Machine design
5. The appropriate temperature at the workplace usually requires being at _____ degrees Celsius.
A. 22
B. 30
C. 18
D. 16

12. Energy and Electricity Conservation



Unit 12.1 - Define Electricity

Unit 12.2 - Basics of electricity

Unit 12.3 - Energy efficient devices

Unit 12.4 - Standard Practices for Conserving Electricity



Key Learning Outcomes

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

1. Define electricity
2. State the basics of electricity
3. Identify the energy-efficient devices
4. Explain the standard practices to be followed for conserving electricity
5. Illustrate electrical equipment and appliances

UNIT 12.1: Define Electricity

Unit Objectives

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

1. Define electricity

12.1.1 Definition of Electricity

Electricity stands to be a general form of energy observable in a positive and negative form that takes place naturally (as in lightning) or is generated (as in a generator), as well as that is expressed in terms of movement and interaction of electrons.

The existence of an electric charge, which is capable of being either positive or negative, creates an electric field. The movement of electric charges leads to an electric current which further generates a magnetic field.

It is at the heart of many of our present era technologies, being utilized for:

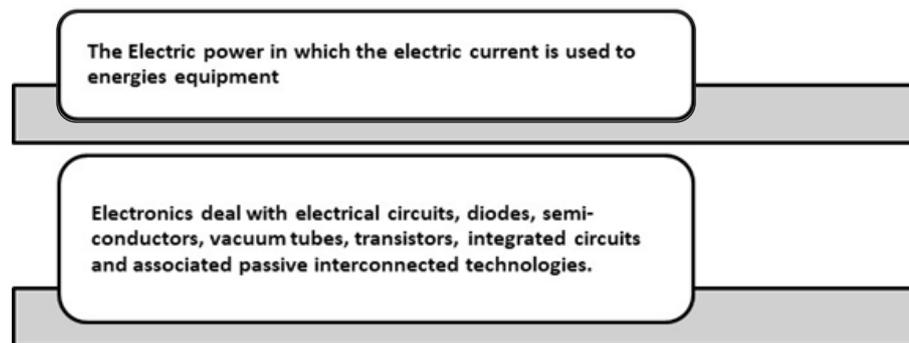


Fig. 12.1: Electricity utilization

UNIT 12.2: Basics of Electricity

Unit Objectives

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

1. State the basics of electricity

12.2.1 The Basics of Electricity

Electricity is easily put in the flow of electrons in a conductor. Electric current flows in the form of free electrons; thus, the greater the number of free electrons in a material, the better would stand to be its conductivity. On the basis of conductivity, these 'materials' can be classified into three categories:

- **Conductors** – Materials whose conductivity lies between 10^4 to 10^7 -ohm m. For example, Iron, Copper, etc.
- **Semi-conductors** – Materials whose conductivity lies between 10^{-6} to 10^4 -ohm m. For example, Graphite, Silicon, etc.
- **Insulators** – Materials whose conductivity lies between 10^{-20} -to- 10^{-10} -ohm m. For example, Paper, Glass, etc.

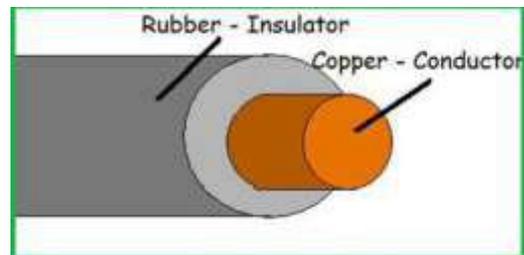


Fig. 12.2 : Conductor of Electricity

There are three primary electrical parameters:

- Volt
- Ampere
- Ohm

Volt: The amount of external force exerted on free electrons is known as "Electromotive Force (EMF)". Volt is the amount of EMF needed to push a current of one ampere through a conductor with the resistance of one ohm.

Ampere: Ampere defines the rate of flow of electric current. For example, when one coulomb of charge flows through a given point on a conductor in a second, it is defined as a current of one ampere.

Ohm: Ohm is the unit of resistivity of a conductor. Three factors determine the resistivity of a conductor:

- Size of conductor
- Composition of conductor
- Temperature of conductor

UNIT 12.3: Energy Efficient Devices

Unit Objectives

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

1. Identify the energy-efficient devices

12.3.1 Energy-Efficient Devices

The use of energy– efficient devices has proved to be an effective strategy for the economics and planet as a whole, as it cuts down on unnecessary power consumption while also being cost-effective.

From the viewpoint of an energy consumer, the main motivation for saving energy is frequently and simply saving money by decreasing the cost of purchasing energy. From an energy policy viewpoint, there has been a long trend in wider recognition of efficient energy as “first fuel” (meaning the ability to avoid consumption of fossil fuels for energy production).



Fig. 12.3 : Energy-efficient devices

Energy-Efficient Devices

Devices like LED bulbs, fluorescent lighting or natural skylights reduce the amount of energy required to attain the same amount of illumination compared to using traditional incandescent light bulbs. Modern appliances such as freezers, dishwashers, ovens, stoves, dryers use significantly less energy than their previous generation models and line-ups. For example, modern energy-efficient refrigerators use 40% less energy than their conventional models did in 2001.

Energy Conservation

Energy conservation is broader in comparison to energy efficiency in including active efforts to decrease energy consumption. For example, through behavioural change it has an addition to using energy effectively. Energy conservation is a challenge requiring stringent policy programmers, technological development and behaviour change to go hand in hand. Many energies intermediary organizations, government, non-government, regional, local or at the national level, are working in order to meet this challenge.

12.3.2 Common Ways to Identify Electrical Problems

Electricity appears to be something most of us understand it for granted. When the individuals need it, you turn to the nearest switch or outlet, and there it is, ready to serve you 24/7.

Yet that electric energy faithfully facilitating us is additionally a potential destruction's source.

Several electrical fire dangers are hidden within the walls of your house or offices or other workplaces. Nevertheless, if the individuals have the knowledge the ways to point the warning signs, the individuals are capable of making proactive — and less expensive — repairs that will also help protect your home in the long run. Here are certain manners to spot common issues and what to do about them.

- **Unknown odour:** When you detect an odd smell arriving from an electrical store, unplug anything linked to it, as well as don't utilise it again until a qualified electrician has tended to check it. In addition to this, if the individual's breaker panel or fuse box is emitting an odd odour, call an electrician immediately.
- **ARC faults:** Arc faults tend to take place when an electrical circuit veers off its intended path, frequently via a breach in the wiring. Arc faults stand to be preventable via the installation of a tool referred as an arc-fault circuit interrupter (AFCI).
- **Sparking or warm switches and outlets:** If the individual's light switches stand to be warm to the touch or an store is sparking, call a expertised the electrician immediately to see if your wiring needs repairs or the fixture should be replaced.
- **Buzzing sounds:** If you hear any buzzing, cracking or sizzling sounds when you flip a switch or plug into an outlet, turn off the power to that fixture immediately and consult a professional electrician.
- **Flickering lights:** Flickering lights usually indicate a power surge. These power surges don't necessarily have to come from a catastrophic event — more than likely, your appliances are making demands on the electrical system that it cannot handle.
- **Broken light switches and loose outlets:** If switches or outlets stop working or work only intermittently, it could be a sign of loose wiring — and another potential fire hazard. Loose outlets also create a potential for electrical shock.
- **Hot ceiling fixtures:** Occasionally check the area around your ceiling fixtures for warmth that could indicate a lack of sufficient insulation. Also, exceeding recommended bulb wattages can cause overheating. Either issue poses a potential fire hazard. Consider switching to compact fluorescent light (CFL) or light-emitting diode (LED) bulbs as these don't produce as much heat as incandescent bulbs.
- **Circuit breaker problems:** Circuit breakers are designed to trip when a circuit is overloaded. Tripping prevents overheating and eliminates fire hazards. Occasional tripping probably indicates a simple overload, but if it occurs repeatedly, you need to call in an electrician and have them evaluate your entire electrical system.

UNIT 12.4: Standard Practices for Conserving Electricity

Unit Objectives

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

1. Explain the standard practices for conserving electricity

12.4.1 Standard Practices for Conserving Electricity

Renewable energy sources have received plenty of attention in recent years, but the conservation of electricity is also important for sustainability. Nevertheless, the best results are acquired when clean power is combined with energy conservation, reducing the pressure to invest in newer infrastructure.

Environmental Reasons to Conserve Electricity

All systems of power generation have an environmental influence that must be taken into consideration before an investment decision. This is evident while dealing with fossil fuels since their combustion emits a constant stream of greenhouse gases in the atmosphere. The process of construction also has an environmental impact. Some waste materials are unavoidable, heavy machinery releases emissions and the ecosystem is seen to be disrupted.

Practices for Saving Electricity

For an average consumer, saving electricity can be good for the pocket and in turn, it reduces the increasing stress on the environment. Those savings can be diverted to alternative sources of energy like solar panel arrays, especially in a tropical country like India, where seasons are relatively moderate and 'timed'. Some practices and habits changes which would help in saving electricity are:

- Turning down the refrigerator
- Usage of energy-efficient LED bulbs
- Air drying the dishes and clothes
- Cooking under the right-sized burner
- Washing clothes with cold water
- Using window shades to alter sun rays entering the house
- Turning off electrical appliances, fans, lights when not in use
- Using low flow faucets and showerheads

Summary

- Electricity is a basic form of energy observable in a positive and negative form
- The main motivation for saving energy is frequently and simply saving money by decreasing the cost of purchasing energy.
- Energy conservation is broader in comparison to energy efficiency in including active efforts to decrease energy consumption.
- Renewable energy sources have received plenty of attention in recent years, but the conservation of electricity is also important for sustainability.
- All systems of power generation have an environmental influence that must be taken into consideration before an investment decision.
- Electrical equipment involves any machine powered by electricity.

Exercise

A. Answer the following questions by choosing the correct option:

1. On the basis of conductivity, conductors possess:

A. Materials whose conductivity lies between 10^{-6} to 10^4 -ohm m

B. Materials whose conductivity lies between 10^4 to 10^7 -ohm m

C. Materials whose conductivity lies between 10^{-20} to 10^{-10} -ohm m

D. None of the above

2. What is the full form of EMF?

A. Electromotive Force

B. Electromagnetic Force

C. Electro mobile Force

D. Electro massive Force

3. _____ energy sources have received plenty of attention in recent years, but the conservation of electricity is also important for sustainability.

A. Renewable

B. Non- renewable

C. Sustainable

D. Non-sustainable

13. Waste Management and Recycling



Unit 13.1 - Types of waste

Unit 13.2 - Waste Management and Disposal Solutions

Unit 13.3 - Pollution and Remedies



Key Learning Outcomes

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

1. List the types of wastes
2. Describe waste management and disposal solutions
3. Explain pollution and its remedies

UNIT 13.1: Types of Waste

Unit Objectives

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

1. List the different types of waste

13.1.1 The Different Types of Wastes

Unwanted, trash, rubbish, excess, superfluous, scrap, extra, rework, unused- there are so many synonyms for waste.

There are different types of waste which are recyclable or non-recyclable. Recycling of waste depends on the scientific progression as well knowledge about different kind of waste handling. Below are lists of different type of waste.

Recyclable waste	Non-recyclable waste
1. Concrete	1. Garbage. Mixture of different of garbage makes it hard to recycle.
2. Steel	2. Food-tainted items (such as: used paper plates or boxes, paper towels, or paper napkins)
3. Aluminium	3. Ceramics and kitchenware.
4. Plastic (PET)	4. Windows and mirrors.
5. Newspapers	5. Plastic wrap.
6. Corrugated Cardboard	6. Packing peanuts and bubble wrap.
7. Plastics (HDPE)	7. Wax boxes.
8. Glass	8. Photographs
9. Mixed Papers	9. Medical waste
10. Used Motor Oil	10. Polystyrene or Styrofoam
11. Used oil from food industry	11. Hazardous chemicals and chemical containers
	12. Plastic toys or sporting goods equipment
	13. Foam egg cartons
	14. Wood
	15. Light bulbs
	16. Yard waste or garden tools

Table 13.1: Lists of different types of waste

'Waste' is any unwanted material. These are objects that have been discarded, either because they do not function as intended or are simply not required anymore. Waste can come in many forms: solid, liquid or even gaseous (although it's mostly solid). There are many types of waste, but the two general ones are:

- Municipal Waste
- Hazardous Waste

Municipal Waste

It consists of everyday items discarded by the population. It includes clothes, wires, glass, unwanted food and a multitude of other things. It is further sub-divided into household, commercial and demolition waste.

- Household Waste – Materials like unused food, unwanted paper, empty batteries come under this category.
- Commercial Waste – Waste collected from establishments like businesses, trading factories, schools, etc., comes under this category.
- Demolition Waste – Evident from its name, this type of waste comes from the destruction of buildings or any structure made of concrete, bricks, wood, etc.

Hazardous Waste

It refers to solid, liquid or gaseous waste that has the properties of corrosiveness, ignitability, reactivity and toxicity. Proper disposal and treatment of this waste are necessary as it is unsafe for the well-being and the environment at large. It is further sub-divided into industrial and biomedical waste.



Fig. 13.1: Hazardous wastes

- Industrial Waste – Waste produced by industries such as chemicals, pigments, ashes, metals, etc., come under this category.
- Also cafeteria garbage, dirt and gravel, masonry and concrete, scrap metals, trash, oil, solvents.
- Biomedical Waste – Waste coming from medical facilities such as hospitals, medical colleges, research centres etc., come under this category.

PPE kits also consider as biochemical waste (specially now a days)



Fig. 13.2: Ways to process industrial and biomedical wastes

Significance of Different Coloured Dustbins

Colour coding of waste bin help us to understand which waste can be reuse or recycle and which waste need to dump. It also eliminates the amount waste through segregation process. Disposition process of waste can be defined based on different type of waste. Some waste can be dumped to land fill as it will not impact the soil quality such as food waste (onion, potato skin) as it act as fertilizer whereas industrial waste such as oil, batteries, chemical can't be dumped in land fill as it is hazardous to the soil property. It means if the wastes were separated in the 1st place then it will prevent or reduce any kind of negative impact to the environment due to waste disposition process.

Ideally every place where we discard waste should have three bins.

GREEN – for wet waste, which comes from the kitchen/cooking/food, goes to one bin.

BLUE – Dry recyclable waste such as newspapers, cardboard, packing plastics, bottles, cans, etc., should go to a different bin.

RED – Reject waste, which does not belong to the above two categories, including biowaste like diapers and bandages should go into a third bin.

All over the world, three-way segregation of waste is followed, and it is primarily instituted with some form of colour coding. It works just like the way traffic lights are coded in people's minds.

Govt authorised vendor details for different waste disposal solution-

There are many industries those are known for waste collection and disposal process approved by Indian govt. through registration process.

S No.	Registered PRO	Issued PRO Certificate
1	M/s. Attero Recycling Private Limited, H-59, Sector 63, Noida, UP-201301	11.10.2018
2	M/s. Auctus E Recycling Solutions Pvt. Ltd. A-58, Udyog Kendra-1, Ecotech-III, Village Habibpur, Noida-Dadri Road, Surajpur, Greater Noida (UP) 201306	12.11.2018
3	M/s Earth Sense Recycle Pvt. Ltd., Plot No:37, TSIIIC Industrial Park, Mankhal, Maheshwaram Mandal, Rangareddy Dist., Telangana-501359	11.10.2018
4	M/s EPR Compliance Pvt. Ltd., 422, The Summit Business Bay, Andheri Kurla Road, Near WEH Metro Station, Andheri (East), Mumbai-93	12.11.2018
5	M/s Hulladek Recycling Pvt. Ltd., 4 D.L. Khan Road, Block B, Flat-401, 4th Floor, Kolkata-700025	12.11.2018
6	M/s Karo Sambhav Private Limited, 408-409, Fourth Floor, Suncity Business Tower, Sector-54, Golf Course Road, Gurugram-122002, Haryana	29.08.2018
7	M/s Mahalaxmi Metalloys India Private Limited, Plot No. 87, 91/92, Sikhera Road Industrial Area, Modinagar, Dist. Ghaziabad (U.P.)201204	23.10.2018
8	M/s Pegasus Support System Pvt. Ltd, F- 6, 1st Floor, 4648/1, 21, Ansari Road, Daryaganj, New Delhi 110002	14.09.2018
9	M/s Pro Connect, G-7, New Market, Near Khasa Kothi Circle, Jaipur-302016 Rajasthan	12.11.2018
10	M/s R2 PRO Pvt. Ltd., B03-jain Height-Altura, Kalkondrahalli, Sarjapur Road, Banglore-560102	23.10.2018

Fig. 13.3 : Examples of waste collecting vendors

UNIT 13.2: Waste Management and Disposal Solutions

Unit Objectives

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

1. Describe waste management and disposal solutions

13.2.1 Waste Management and Disposal Solutions

Waste management includes the activities as well as actions required to manage waste from its inception to its end disposal. This involves the disposal, collection, transport, and treatment of waste, together with regulation and monitoring of the waste management procedure and waste-related laws, technologies, as well as economic mechanisms.

Proper management of waste is significant for building sustainable and liveable cities, yet it remains a challenge for many developing countries and cities. A large portion of the practices of waste management deal with municipal solid waste, which stands to be the bulk of the waste that is produced by household, industrial, and commercial activity.



Fig. 13.4: Waste management and disposal solutions

Turn Away from Single-Use Plastics

A few instances of these include plastic straws, sanitary napkins, take-out containers etc. There are plenty of reusable alternatives to them, like glass and metal straws.

One good manner of doing this is by shopping at bulk stores and zero-waste stores that provide products without packaging. A good practice is to carry around a reusable bag, metal straw and a stainless steel bottle to cut the dependencies on polluting stuff.



Fig. 13.5: Waste Management Hierarchy

Conventional Technologies

It is apparent that certain technologies are no longer applicable to modern waste reduction as well as recycling, but some organizations continue to rely on them because they appear to be cheap. However, more technologies are evolving or being created to solve waste management problems. These technologies can be used to recycle or up cycle waste, creates alternatives from products that normally produce more waste, or find a way to address the ever-growing problem of waste management.

There is seen to be plenty of this technology, including plastic-free shampoo pods and toothpaste pills, machines that sustainably remove waste from bodies of water.

UNIT 13.3: Pollution and Remedies

Unit Objectives

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

1. Explain pollution and its remedies

13.3.1 Pollution and Its Remedies

Today, the air is becoming foul, water is no longer clean, and forests are being cut down unscrupulously. Pollution in and of itself is difficult to define. The term is derived from the Latin word "polluere", which means 'to contaminate any feature of the environment. It may be broadly said to be 'adding to the environment a capably hazardous source or substance of energy faster than the environment can accommodate in it.

Methods to Counteract Pollution

Pollution prevention is considered as any action that reduces the number of contaminants released into the environment. Implementation of such processes reduces the severity and/or a number of hazards posed to both public health and the environment. If companies produce less waste, they do not have to worry about proper disposal. Some common methods for controlling pollution are:

- Reducing, Reusing, Recycling and Mitigating.
- Water pollution is capable of being controlled by using non-toxic soaps, detergents and cleaning products.
- Limiting the use of artificial fertilizers and pesticides helps in controlling soil and water pollution.
- Promoting and enforcing the use of biological methods for pest control.
- Chimneys should be longer in length so that polluting air is released high up in the atmosphere where it would not harm the surrounding environment.
- Automobiles should be installed with emission and pollution control systems.
- The timely servicing of automobiles also checks for air pollution.
- Carpooling and public transportation should be encouraged.
- Alternative sources of energy like wind, sun, water, geothermal should be harnessed and put to use.

Summary

- 'Waste' is any unwanted or un-useful material.
- Municipal wastes consist of everyday items discarded by the population.
- Hazardous waste refers to solid, liquid or gaseous waste that has the properties of corrosiveness, ignitability, reactivity and toxicity.
- Waste management includes the activities as well as actions required to manage waste from its inception to its end disposal.
- Proper management of waste is significant for building sustainable and liveable cities, yet it remains a challenge for many developing countries and cities.
- The biosphere and ecosystem are self-sustaining, and nature maintains a balance between the land, water, air and living organisms.
- The term "pollution" is derived from the Latin word "polluere", which means 'to contaminate any feature of the environment.
- Pollution prevention is considered as any action that reduces the number of contaminants released into the environment.

Exercise

A. Answer the following questions by choosing the correct option:

1. Which one stands to be a general type of waste?
 - A. Commercial waste
 - B. Hazardous waste
 - C. Household waste
 - D. Demolition waste

2. Which one is the type of hydrocarbon-eating bacteria that feed on oil?
 - A. Alcanivorax borkumensis
 - B. Bacillus
 - C. Spirillum
 - D. Vibrio

3. _____, reusing, recycling and mitigating helps in pollution reduction.
 - A. Reducing
 - B. Reinstalling
 - C. Redeeming
 - D. Reinvolving

4. The Latin term for pollution is _____

- A. pollueme
- B. polluese
- C. polluere
- D. polluete

5. _____ waste comes from medical facilities.

- A. Municipal
- B. Biomedical
- C. Industrial
- D. Commercial

B. Answer the following questions briefly.

1. What are the differences between recyclable waste and non- recyclable waste?

2. What are two general types of wastes?

3. What stand to be the significance of the different colored dustbins?

4. Outline the responsible waste management hierarchy.

5. What are the methods for controlling pollution?

14. Extraction of Fruit Juice for Making Squash



Unit 14.1 - Perform Fruit Juice Extraction Process



Key Learning Objectives

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

1. Perform the tasks to extract the fruit juice for producing the squash and juices
2. Discuss the procedures followed to extract fruit juice for making squash

Unit 14.1 Perform Fruit Juice Extraction Process

Unit Objective

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

1. State the significance and procedure of interpreting and analysing the process chart, product flow chart, and formulation chart for the production process
2. Discuss the fruit juice extraction process
3. Explain the standard procedure to dispose of the waste produced while extracting the juice
4. Describe the physical parameters (such appearance, colour, consistency, flavour, taste, etc.) for checking the quality of extracted juice
5. Discuss the standard procedure to take and send the samples of the extracted fruit juice to quality lab for analysis

14.1.1 Significance of Enzyme Activity

The enzymes are types of proteins that regulate the chemical reaction in food products. It has contributed to increasing the yield and production of various kinds of juices. Enzymes enhance transformation, such as flavour, colour, turbidity, and viscosity. Hence it is crucial to know the types of enzymes naturally present in a particular fruit. Enzymes can also remove the bitterness of citrus juice, extract pigments, among other applications, and have also had a great interest in juice production.

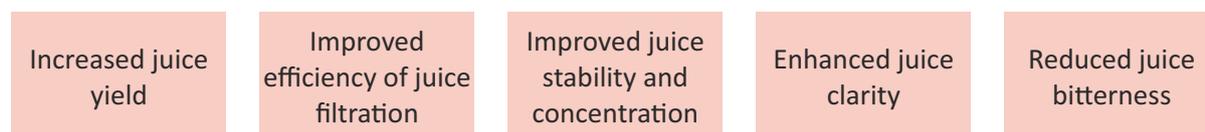


Fig. 14.1 Benefits of Enzyme Activity of Fruit Juices

Fruit juices extracted from ripe fruit contain a significant amount of pectin. Pectin imparts a cloudy appearance to the liquid and results in a presence and mouthfeel that many customers do not find appealing. Pectinases are naturally occurring enzymes that act on pectin yielding a crystal clear juice with the appearance, stability, mouth-feel, taste, and texture characteristics customers prefer.

Treating the juice with a pectin enzyme is the safest method to achieve pectin elimination without affecting color or flavor. The variable quality and quantity of the natural pectin in the liquid does not interfere when it is treated with the pectinase enzyme.

Pectinases, celluloses, and hemicelluloses are used to clarify fruit juices, which helps improve cloud stability, liquefaction, and maceration. These enzymes degrade structural polysaccharides that interfere with juice extraction, filtration, clarification, and concentration. These enzymes are termed “macerating or mash enzymes” that find application in the extraction of juice from citrus fruits and tropical fruits such as mango, banana and papaya, and pineapple. For Apple and Pears, pectin enzymes are used to facilitate pressing or juice extraction, to aid in separating the flocculent precipitate by sedimentation, filtration, or centrifugation. A combination of pectinolytic enzymes, is added to fruit and pressed fruit juice to reduce juice viscosity. Such viscosity reduction makes juice filtration, clarification, and concentration more efficient. In concentrated fruit systems, it improves the efficiency of spray drying.

14.1.2 Fruit Juice Extraction Process

There are various beverages available in the market. Still, fruit beverages are the most popular across the world. Being a tropical country, India has a vast market of various fruit beverages or drinks for consumers. These fruit beverages are produced using extracted fruit juice or fruit pulp as the base material. Almost all fruits can be used to make different fruit juices. The most popular ones are pineapple, orange, mango, grapefruit, and passion fruit. Many fruit beverages are consumed as pure juices without adding any other ingredients, whereas some are diluted with sugar syrup, acid, stabilizers, and preservatives. Commonly, sodium benzoate is used as a preservative to extend the shelf life of fruit juices and beverages. Below are the different types of fruit beverages or drinks as follows:

Juices

- In which one or more fruit juice(s) from the fruits used in the product which may be strained or filtered are the liquid packing medium.

Thermally Processed Fruit Nectar (TPFC)

- Unfermented but fermentable pulpy or non-pulpy, turbid or clear product intended for direct consumption made from fruit singly or in combination, obtained by blending the fruit juice / pulp/fruit juice concentrate and/ or edible part of sound, ripe fruit(s), concentrated or unconcentrated with water, nutritive sweeteners and any other ingredient appropriate to the product and processed by heat, in an appropriate manner, before or after being sealed in a container, so as to prevent spoilage.

Fruit syrup/ Squashes

- The product prepared from unfermented but fermentable fruit juice/puree (min 25% puree in the final product) or concentrate clear or cloudy, obtained from any suitable fruit or several fruits by blending it with nutritive sweeteners, water and with or without salt, aromatic herbs, peel oil and any other ingredients suitable to the products.

Cordials

- A clear product free from any cellular matter, obtained by blending unfermented but fermentable clarified fruit juice with nutritive sweeteners & water with or without salt and peel oil and any other ingredients suitable to the products.

Fig. 14.2 Classification of Fruit Beverages

Each fruit beverage is preserved by amalgamating natural acidity, pasteurization, and packaging in sealed containers. Fruit squashes and syrup also contain a high concentration of sugar, which helps to preserve them for more extended periods. The first stage of all the fruit-based beverages production is the extraction of juice or pulp from the fruit. Any fruit can be used to prepare fruit juice. For this, the fruit is prepared before the extraction process, later followed by clarification and pasteurization. Consequently, the finished beverage or drink is packed and preserved. **Fruit Juice extraction** is the process of eliminating fibrous and solid particles from the juice. The following are the key manufacturing stages in the fruit extraction process.

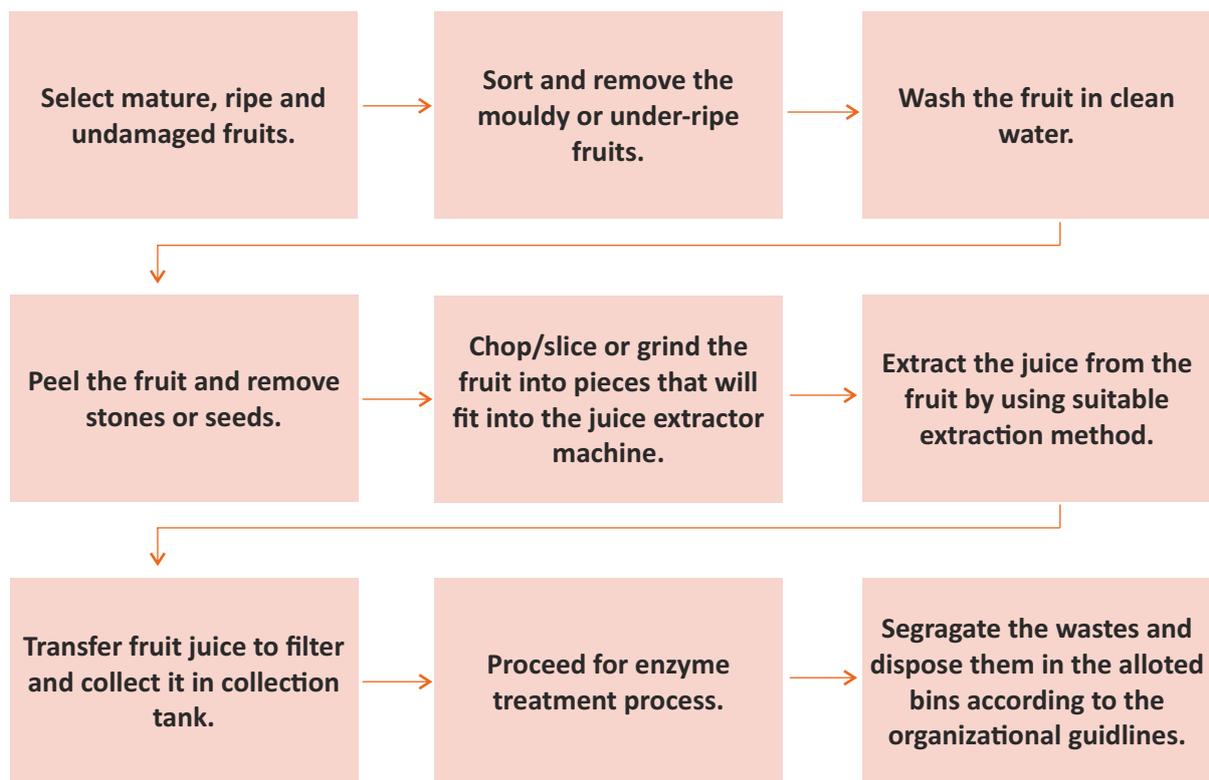


Fig. 14.3 Fruit-Juice Extraction Process

After the extraction of the juices, it is vital to check the quality of the juices as per appearance, colour, consistency, flavour, aroma, taste, etc. These are the critical factors for consumer acceptance of the final product.

A fruit juice extractor machine is used to extract juice from various kinds of fruits. In the food processing industry, fruit juice extractor machine is used to extract juice in bulk quantity, which is convenient and nutritional. All the fruits, such as apple, pineapple, pear, orange, grape, strawberry, watermelon, lemons, tomatoes, can be extracted by fruit juice extractor machine. The raw materials must be continuous; the non-rigid foreign matter must be fed into the hopper to avoid screen damage.



Fig. 14.4 Workflow Process of Fruit-Juice Extractor Machine

14.1.3 Methods of Fruit Juice Extraction

There are numerous ways to extract juice, depending on the fruit you use. Pressing or reaming are the best and suitable methods for citrus fruits. At the same time, some fruits such as melon and papaya are steamed to release the juice. Fruits such as mango, guava, pineapple, and strawberry are pulped to extract the fruit juice.

Pressing

- Fruit is cut in half and the individual halves reamed to extract both the juice and the inner fruit solids. Example - Citrus fruits like lemon, orange and grapes etc.

Solvent Extraction

- Solvent extraction is the process of transferring juice from fruits and vegetables to hot water. It applies to fruits that contain less water, such as wild jujube, dark plums, and red dates.

Pulping

- Pulping is the process in which we eliminate the seed and peel of fruits to obtain their juices. Example -Mango, strawberry, peach etc.

Continued...

Centrifugation

- Through horizontal spiral filter centrifuge, fruit juice are separated by centrifugal force. Slurries are transmitted to rotary drum filter through feed tube. Under high speed centrifugal force, the pomace is thrown to the drum wall and transmitted to the end of drum by conveying screws, while fruit juice drains out of screw gaps. Example - Apple, guava, Pineapple etc.

Rough Filtration

- Rough filtration is the process of removing larger particles or suspended particles dispersed in the juice. , The extracted juice or pulp is filtered through a muslin cloth or a stainless steel filter of the machine.

Fig. 14.5 Methods of Fruit-Juice Extraction

14.1.4 Standard Procedure for Lab Analysis

It is important to examine the sample after each process to maintain the quality of fruit juice. After extraction process, sample of juice is sent to laboratory for quality analysis. Following are the physical parameters for quality check:

Appearance

Colour

Consistency

Flavour

Taste

Fig. 14.6 Quality Parameters of Fruit Juices

Notes



Exercise

Answer the following questions:

1. Write a short note on:

a. Enzyme activity

b. Rough filtration

c. Classification of fruit beverages

2. Explain the fruit extraction process.

3. Explain the workflow process of fruit extractor machines.

15. Pasteurization and Clarification of the Extracted Juice



Unit 15.1 Pasteurize and Clarify the Extracted Juice



Key Learning Objectives

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

1. Perform the tasks to pasteurize and clarify the extracted juice
2. Discuss the process of pasteurization and clarification of extracted juice

Unit 15.1 Pasteurize and Clarify the Extracted Juice

Unit Objective

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

1. State the significance of ensuring pasteurization of the cloudy juice immediately after pressing
2. Discuss the pasteurization process of the extracted juice
3. State the importance of ensuring the uniform mixing of enzymes during the clarification process
4. State the significance of pasteurizing and clarifying the juice
5. Elaborate on basic food microbiology and quality assessment based on physical parameters

15.1.1 Pasteurization Process of the Extracted Juice

Pasteurization is a process in which the products are treated with mild heat, usually to less than 100 °C (212 °F), to eliminate pathogens and extend shelf life. The process is intended to destroy or deactivate organisms and enzymes that contribute to spoilage or risk of disease, including vegetative bacteria, but not bacterial spores. It eradicates microorganisms that can grow during storage and inactivates enzymes that cause **unwanted clarification or cloudy juice**. Hence, it is important to pasteurize the fruit juice immediately after the pressing to make them safer for consumption and prolong shelf life.

Pasteurization was initially developed to resolve the sourness of wine. This technology is named after French microbiologist **Louis Pasteur**, who discovered that microbes or pathogens (germs) that grow during the fermentation process could be eliminated by the heating treatment that ruins wines. He heated up the wines to 63.5°C for half an hour to **kill the lactobacillus (bacteria)** without damaging the wines. This technique saved the French wine industry. In the beginning, it was referred to as heating at a low temperature (60-70°C) for 30 min. Nowadays, it refers to various heat treatments for killing bacteria, including heating at high temperatures for a shorter time. The pasteurization process is widely used for fruit juice, pulp, milk, and wine production.

All the fruit juices go through the pasteurization process **at 80-95°C for 1-10 minutes** (depending on the fruit) before hot-filling into bottles. It eliminates the cloudiness in the juice by deactivating **pectin methyl esterase (PME)**, the enzyme that causes cloud loss or gelation and destroys the bacteria which may contaminate the juice. Also, the primary reason for pasteurizing fruit juices is to preserve the properties that make them attractive and enjoyable to customers, such as taste, appearance, and “mouthfeel”. The clarification of juice is usually referred to as cloud loss, which is the breakdown of pectin by enzymes. Practically, the tangible results of cloud loss are reductions in opacity and viscosity. This process prevents this undesirable process by deactivating PME.

Special attention is required during the production of the fruit juices due to heat resistant enzyme present in the liquid. These enzymes may harm the skin after prolonged contact, and hence all the employees dealing with this process must wear gloves to protect their hands. The juice must be heated to a higher temperature for a longer time to terminate the enzyme (e.g., boiling for 20 minutes). Fruit juices (low pH foods) are often pasteurized in their container due to the risk of cross-contamination. The main parameters that influence the pasteurization process of a fruit juice are as follows:

Temperature

Time

Acidity or pH
level of the fruit

Pressure

Flow rate

Fig. 15.1 Parameters of Pasteurization Process

15.1.2 Types of Pasteurization Process

The pasteurization process can be performed either by heating at a **low temperature for a long time (LTLT)** or **heating at a high temperature for a short time (HTST)**.

LTLT (low temperature long time) pasteurization process:

- In this process, juices are heated at 62.5°C for 20 - 30 minutes and cool down suddenly to 4-5°C, which cause the bacteria to die. It can achieve sterilization effects in short time and at low temperature, preserving the color, flavor, and taste of the fruit juice. This technique is known as Batch Pasteurization.

HTST (high temperature short time) pasteurization

- In this process, juices are heated up at high temperature of 72.0°C for short time (15 sec - 30 sec), eliminating all the bacterias without causing nutrition loss. It has more thorough sterilization effect and the pasteurized drinks can preserve longer. This technique is also known as Flash Pasteurization.

Fig. 15.2 Types of Pasteurization Process

Following figure explains different methods of pasteurization used in food processing industries.

Holding Process/ In-The Bottle

- Filtered juice filled in expandable sealed airtight bottles or containers with proper head space for pasteurization process
- Low temperature long time process is used for pasteurization of juice

Continued...

OverFlow

- Filtered juice is heated at high temperature (50° C and above) for pasteurization
- Heated liquid is filled in hot sterilized bottles upto brim and sealed
- Sealed bottles are pasteurized in boiling water for specific period of time and cooled leaving no space for air
- High temperature short time pasteurization process is used

Flash

- The fruit juice is heated at high temperature for 15-30 seconds
- Filled into the containers and sealed air tight under cover of a steam to sterilize the seal and then cooled at a room temperature
- It helps to minimize the loss of flavour, better retention of vitamins, keep juice uniformly cloudy and minimize the cooked taste of the juice
- High temperature short time pasteurization process is used

Fig. 15.3 Various Methods of Pasteurization

15.1.3 Workflow Operation of Pasteurization Machine

Currently, **manufacturers usually adopt HTLT technology** to heat up the juices to high temperature and keep them for a very short time. The Fruit Juice pasteurization machine is used to sterilize the fruit juice with high heat. It is carried out before juice filling and packing and after juice extraction, filtration, and concentrate processing.

Generally, there are three types of pasteurizer machines, plate pasteurizer, tubular pasteurizer, and steam pasteurizer. **Plate pasteurizer** is the most prevalently used in fruit juice processing production. It incorporates the function of preheating, sterilization, heat preservation, and cooling, which is suitable for fruit juices.

Notes



UHT (Ultra Heat Treated) technology.

Can operate under the temperature of 135° C - 140° C for 3-5 seconds

Short time protects the drinks from nutrition or flavor loss

Sterilization capacity is 1 -10t/h.

High heat-recovery efficiency, and automatic temperature control

Highly suited for thermal sensitive products due to short heating time

Compact structure and pretty appearance

Fig. 15.4 Features of Plate Pasteurizer

Plate pasteurizers consist of serial plates and gaskets (placed between the plates) that resist high temperature and prevent the mixing of the fluids which flow on the plates. These plates are made of stainless steel with 95-125 mm thickness. Patterns on the plates create turbulence, increase the heat transfer area and stretch out the time of heat transfer.

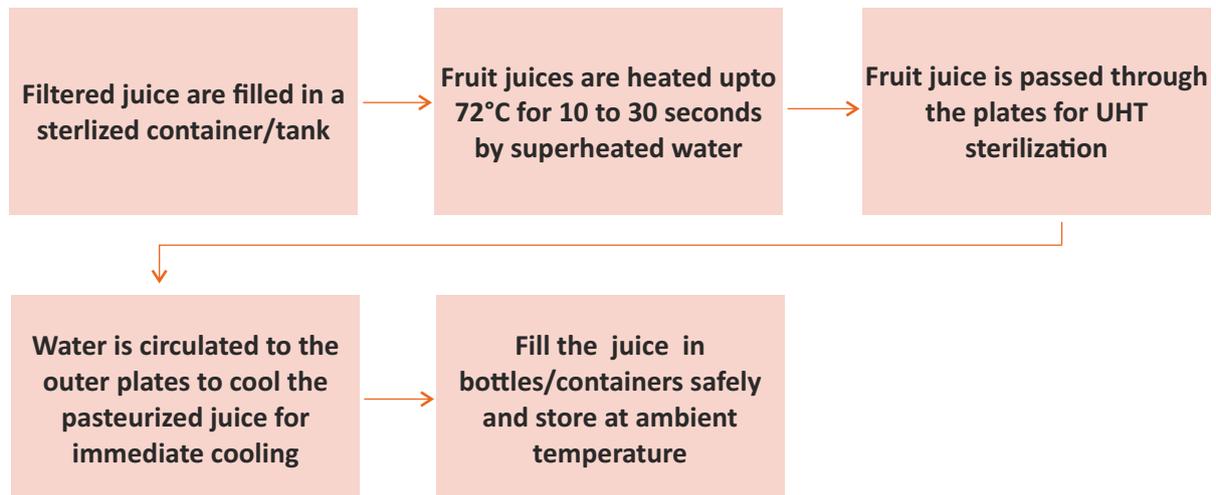


Fig. 15.5 Workflow Operation of Plate Pasteurizer Machine

15.1.4 Clarification Process of Fruit Juice

The clarification process of fruit juices can be done using different methods like straining or screening, settling or sedimentation, and filtration. Below are the common methods used in the clarification process of the fruit juices.

Straining or screening

- A process by which fruit juices are allowed to pass through a mesh/membrane either manually or by automatic process, which ensures to remove the coarse particles from the juice and thus leaving a clear juice without any bigger visible particles.

Finishing

- It is a process to separate the pulpy matter, rag, seeds etc. from the juice. The finisher separates the pulpy matter from the juice using a rotating auger inside a cylinder screen. The diameter of the screen holes varies depending on the condition and softness of the fruit. The pulp content of the fruit juice is used to determine completion.

Decantation

- Decantation is the process of separation of liquid from solid and other immiscible (non-mixing) liquids, by removing the liquid layer at the top from the layer of solid or liquid below. Decantation is the simplest method of clarification, in which the juice containing solids is allowed to settle down and then clear juice is decanted or siphoned out. The juice kept at low temperature for long period, helps in setting of solid to allow clarification.

Centrifugation

- Centrifugation is the process that uses centrifugal force for the separation of two liquids in a mixture. The clouding particles are separated by centrifugal action. The juice containing solids is fed into a basket or disc type centrifuge, where the centrifugal force separates the light and dense components in each layer. The clear juice is collected and unwanted solids are separated.

Continued...

Enzymes

- Enzymes are proteins that help speed up chemical reactions in fruits. The pectinol enzyme is used for clarification of fruit juices as it breaks pectin into soluble form thereby freeing the suspended particles which settle down and leaves the juice clear. Similarly, proteolytic and starch liquefying enzymes i.e. amylases are used to remove protein and starch from fruit juices. Pectinol is more effective in the case of acidic juices. Fruit juices can be clarified in about 1-2 hours at 40-50°C but requires 20 hrs at 20°C.

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Physical finings

- Physical fining agents, also known as filter aids like kaolin, diatomaceous earth, spanish clay, bentonite or china clay are mixed(0.5 to 0.1 percent earth) with fruit juice and then passed through the filter press. Physical finings are used in ultra filtration process that separates particles based on molecular weight and has better retention of the nutrients in the juice. It is necessary to degrade the pectin enzymatically before ultra-filtration, to reduce viscosity and allow a satisfactory juice.

Chemical finings

- Finings are substances that are usually added at or near the completion of the processing of brewing wine, beer, and various nonalcoholic juice beverages. They are used to remove organic compounds, either to improve clarity or adjust flavor or aroma. Depending on the tannin content of the fruit juice, gelatin or caesin solution is mixed in the juice and allowed to stand for 18 to 24 hrs to ensure that the precipitated matter clots together and settles down. The clarified juice is then siphoned off. Albumin (egg white) can also be used in clarification of juices.

Continued...

Clarification by freezing

- Freezing is the process in which a liquid changes to a solid. Cream of tartar or potassium hydrogen tartarate is mixed in the juice and refrigerated and later by thawing process, the clarified juice is separated from unwanted solids.

Clarification by heating

- The juice is heated to 80-85°C for few minutes and cooled immediately followed by filtration by passing the juice through a filter press.

Fig. 15.6 Various Methods of Clarification Process of Fruit Juice

15.1.5 Quality Assessment and Sample Analysis

It is important to assess the quality of pasteurized and clarified fruit juice before it is sent for further processing. Sample analysis is necessary for maintaining the quality of a product as per the company standard norms and specific guidelines mentioned by the government. If the quality standards are not maintained, it could lead to fatal consequences. On the other hand, contamination free processed food will not cause any harm to the customers.

Every step involved in the process requires monitoring, including food safety and personal hygiene. For example, in fruit juice processing, a quality lab check is done based on technical specification and organoleptic, which differ from fruit to fruit. After clarification of the fruit juice, the sample of clarified juice is sent to the lab for quality analysis. Following are the parameters for quality check:

- Taste/flavour, colour, and texture** – Fruit Juice is checked by testing the taste and flavour, whereas the colour and texture of the clarified fruit juice go through visual inspection.
- PH** – A numeric scale to check acid levels in fruit pulp. Each fruit has its acidity level. The processing company maintains it as per their requirement.

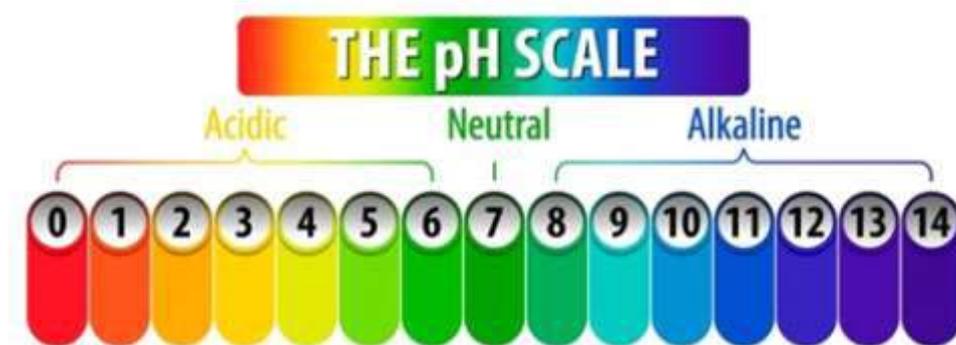


Fig. 15.7 PH Scale

TSS (Total Soluble Solids) - It is the extracted mass of fruit, which contains fibers and fruit sugar. Each fruit has its own Brix ratio. It is maintained as per the company's requirement.

Brix - It is a measure of the amount of dissolved solids in a liquid via its specific gravity, and is used specially to measure dissolved sugar. One-degree Brix is 1 gram of sucrose in 100 grams of solution. Brix measurement is commonly used in the food industry for measuring the approximate amount of sugars in fruits, vegetables, juices, wine, and soft drinks.

Titrateable Acidity - It measures the total acid concentration in fruit juice and is determined by exhaustive titration of intrinsic acids with a standard base. Titrateable fruit acidity is expressed as g/ 100 mL of the predominant acid.

Viscosity - Viscosity is a measure of a fluid's resistance to flow. It is measured by Viscometer as per the need.



Fig.15.8 Viscometer

Notes



Microbiological Standards for Fruit Products																
Product Description	Aerobic Plate Count	Yeast and Mold Count	Enterobacteriaceae	Staphylococcus aureus (Coagulase +ve)												
				Sampling Plan	Limit (cfu)	Sampling Plan	Limit (cfu)	Sampling Plan	Limit (cfu)	Sampling Plan	Limit (cfu)	Sampling Plan	Limit (cfu)	Sampling Plan	Limit (cfu)	
Minimally Processed or Packed Fruit Juices	5	2	1x10 ⁶ /g	1x10 ⁷ /g	5	1	1x10 ² /g	1x10 ⁴ /g	5	2	1x10 ² /g	1x10 ⁴ /g	5	1	1x10 ² /g	1x10 ³ /g
Pasteurized Juices	5	2														
Carbonated Fruit beverages	5	1	50/ml	5x10 ² /ml	5	0	<10/ml	5	0	Not detectable as per prescribed method	5	0	Absent/25g			
Thermally processed (other than pasteurization at less than 100°C)	5	1	1x10 ² /g	1x10 ³ /g	5	1	50/g	1x10 ² /g	5	0		5	0	Absent/25g		

Table.15.1 Microbiological Standards for Fruits and their Products
(Source: Table 4B, https://www.fssai.gov.in/upload/uploadfiles/files/Compendium_Food_Additives_Regulations_08_09_2020-compressed.pdf)

Exercise

Answer the following questions:

1. What do you understand by pasteurization of fruit juice? Why it is important?

2. Explain the pasteurization process of fruit juices.

3. Describe the workflow operation of pasteurizer.

4. Explain any two method of clarification of fruit juices.

5. How do you measure titrability acidity in fruit juice?

Fill in the Blanks:

1. _____ is used for clarification of fruit juices as it breaks pectin into soluble form thereby freeing the suspended particles which settle down and leaves the juice clear.
2. The clarification process of fruit juices can be done using different methods like _____, _____, and filtration.
3. The different methods of pasteurization used in food processing industries are _____, _____ and _____.
4. The main parameters that influence the pasteurization process of a fruit juice are _____.
5. Pasteurization technology is invented by French microbiologist _____.

16. Prepare the Squash



Unit 16.1 Production Process of Squash



Key Learning Objectives

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

1. Perform the tasks to produce the squash
2. Describe the methods required to prepare squash

Unit 16.1 Produce and Prepare Squash

Unit Objective

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

1. Discuss the usage of refractometer in the squash preparing process
2. Describe the procedure to measure the quantity of acids, preservatives, color, flavor, etc. to be mixed in a blending tank
3. State the importance of observing the mixing process and collecting a sample, and check physical parameters to ensure uniform mixing of the fruit juice
4. Describe the control parameters of pasteurizer or heat exchanger
5. Discuss the procedure to prepare and clarify fruit juice squash

16.1.1 Fruit Squash

Squash is a type of fruit beverage made by mixing of the calculated quantity of fruit juice with sugar, acid, and other ingredients. According to Indian food laws, squash must contain at least 25% fruit juice or pulp, and the total soluble solids content should not be less than 40% of brix in the finished product. The acidity of the squash should not exceed 3.5% as anhydrous citric acid. A variety of fruits, like mango, orange, lemon, pineapples, grape, and litchi, are used to commercially make squash. Squash are also prepared using the juice or pulp from fruits like bael, guava, pear, apricot, muskmelon, papaya, passion fruit, peach, plum, mulberry, raspberry, strawberry, grapefruit, etc. The maximum permissible limit of preservatives in squash is 350 ppm of sulphur dioxide or 600 ppm of benzoic acid. Potassium metabisulphite is not added in dark-coloured fruits as it may bleach the anthocyanin pigments. In such beverages, sodium benzoate is used. Commercially available squash contains 40 to 50 percent sugar and around 1.0 percent acid. They are diluted in the ratio of 1:4 before consumption.

List of ingredients used for the preparation of squash

Fruit Components	<ul style="list-style-type: none"> • It is in the form of fruit juice or pulp, the required amount should be more than 25% in the finished product.
Sugar Syrup	<ul style="list-style-type: none"> • Carbohydrate syrup is added in various forms like sucrose, glucose, or modified syrup. • Sugar syrup provides body and imparts sweetness to the squash. • Syrup also assists in the development of flavour, mild preservative effect, and is always added after the filtration and sterilization process.
Acid	<ul style="list-style-type: none"> • Citric acid is the most preferred acidulant, other than malic, lactic, and tartaric acid. • Balanced acid to sugar ratio helps impart flavour to the finished product.

Continued...

List of ingredients used for the preparation of squash

Preservatives	<ul style="list-style-type: none"> It is added to prevent the growth of fungi, yeast, and lactic acid bacteria in the finished product. Permitted preservatives in squash are sulphur dioxide, benzoic acid, and sorbic acid.
Flavourings	<ul style="list-style-type: none"> It is a highly concentrated flavor extracted from a combination of fruits. Mostly natural or natural identical flavouring is used to prepare squash that improves the taste/flavour without affecting other properties.
Colourings	<ul style="list-style-type: none"> A permitted food colour is used to enhance the aesthetic appeal of the squash. It may include natural, natural identical, or synthetic dyes with a maximum permissible limit as specified in IFC 14.1.4.3 of FSSAI (Food Additives Regulations).
Other Additives	<ul style="list-style-type: none"> Additives include stabilizers to keep the fruit solids in suspension and improve the mouthfeel of the beverage. Acidity regulators, emulsifiers, anti-oxidants, and clouding agents are used to enhance the acceptability of beverages.

Table 16.1 List of ingredients used for the preparation of squash

Preparation of Sugar Syrup - Sugar Syrup is usually prepared by mixing 1 part (volume) sugar to 3-6 parts (volume) water in stainless steel tanks fitted with top-driven agitators. Sugar syrup is passed through a plate heat exchanger to decrease the microbial load. The syrup is pre-prepared, tested and diverted to proportioned for mixing with water and carbonation. The refractometer is used for checking the specifications of the sugar syrup Brix. For squash making, it requires sugar syrup of 67° Brix strength. The syrup is dosed through a mass flow meter, and the water dosing is done volumetrically by using a magnetic induction flow meter.

16.1.2 Equipment used in Squash Making

To prepare squash at a commercial level, several equipment and processing machines are used. Some of the equipment and tools required for squash production are:

Basic equipment/ accessories

1. Cutting Knife (SS), coring knife, pitting knife, peeling knife
2. Working table
3. Buckets, Tubs, Jugs

4. Volumetric flask
5. Conical flask
6. pH meter
7. Heat production system
8. Blending Tank
9. Storage tank

Types of Equipment And Tools	Description
 <p style="text-align: center;">Cooking Kettle</p>	<p>A cooking kettle is an all-purpose machine for making high-quality products such as squash, jam, marmalade, and jellies. Various stirring and mixing processes can be carried out with a cooking kettle.</p> <p>Operation of Cooking Kettle</p> <p>After filling the water jacket with water, the kettle is ready to operate. The electric heater heats the water bath to the set temperature and keeps it constant. With the integrated mixer, the product is evenly heated and mixed. After the cooking process, the kettle can be easily emptied with the disc valve on the bottom. Cooking kettles mainly consists of: -</p> <ul style="list-style-type: none"> • a spherical tank • vapor-liquid separator • condenser • receiving tank, etc. <p>Cooking kettles have the advantages of a large heating area, high thermal efficiency, quick heating of materials, uniform heating, and easy control of heating temperature.</p>
 <p style="text-align: center;">Peeler</p>	<p>Peeler is used to peeling various ball-shaped fruits and vegetables, equipped with rotating soft and hard brushes that thoroughly clean and peel the vegetables.</p>

Continued...

Types of Equipment And Tools	Description
 <p data-bbox="316 792 517 824">Pulper machine</p>	<p data-bbox="647 450 1382 730">Pulper is used for extracting pulp of most fruits & vegetables like mango, apple, tamarind, custard apple, plum, apricot, peach, kiwi, tomato, etc. The fruits and vegetables are fed in the pulping chamber where due to blades and brushes the fruit is pressed against the sieve. The extracted pulp passes through the perforations in the sieve, and stone and skin are pushed forward and discharged from the other end., uniform heating, and easy control of heating temperature.</p>
 <p data-bbox="309 1115 517 1146">Filter cloth/sieve</p>	<p data-bbox="647 864 1382 931">A sieve is an equipment used to separate the passage of granular materials according to particle size.</p>
 <p data-bbox="316 1406 517 1438">Mixer/Agitator</p>	<p data-bbox="647 1184 1382 1319">An Agitator is a machine used in a tank for mixing various process media together. It consists of an impeller that rotates to impart energy to the media, which interact and mix the ingredients in the tank.</p>
 <p data-bbox="284 1890 545 1921">Sterilizer/Pasteurizer</p>	<p data-bbox="647 1480 1382 1648">A pasteurization machine sterilizes the squash to destroy pathogenic microorganisms by heating the product to a moderately high temperature for a brief period. The main parameters that influence the pasteurization process of a fruit squash are as follows:</p> <ol data-bbox="647 1671 1024 1917" style="list-style-type: none"> <li data-bbox="647 1671 839 1702">1. Temperature <li data-bbox="647 1724 743 1756">2. Time <li data-bbox="647 1778 1024 1809">3. Acidity or pH level of the fruit <li data-bbox="647 1832 791 1863">4. Pressure <li data-bbox="647 1886 791 1917">5. Flow rate

Continued...

Types of Equipment And Tools	Description
 <p data-bbox="325 792 502 824">Refractometer</p>	<p data-bbox="647 450 1385 517">Refractometer measures total soluble solids (TSS) as °Brix, which corresponds to % sugar.</p> <p data-bbox="647 539 1385 745">Usage: A refractometer is used for monitoring and controlling the quality of fruit juices, jams, ketchup, fruit extracts, syrups, chocolate, milk, and other products by measuring the total solids during processing. It is a well-known instrument for determining the water content of liquids. It measures the liquid's refractive index, which varies with moisture content.</p> <p data-bbox="647 768 751 799">Process:</p> <ol data-bbox="647 822 1385 1160" style="list-style-type: none"> 1. Place the deionized or distilled water (100 uL) on the sample well for full coverage of the prism. 2. Press the Zero button. 3. Remove the sample from the prism. 4. Place your squash sample on the sample well. 5. Take the refractometer reading. 6. Clean the prism and repeat for any other measurements
 <p data-bbox="213 1442 612 1473">Crown corking/capping machine</p>	<p data-bbox="647 1205 1385 1272">The crown corking/capping machine is used for sealing the caps/corks of the jars/bottles. ↕</p>

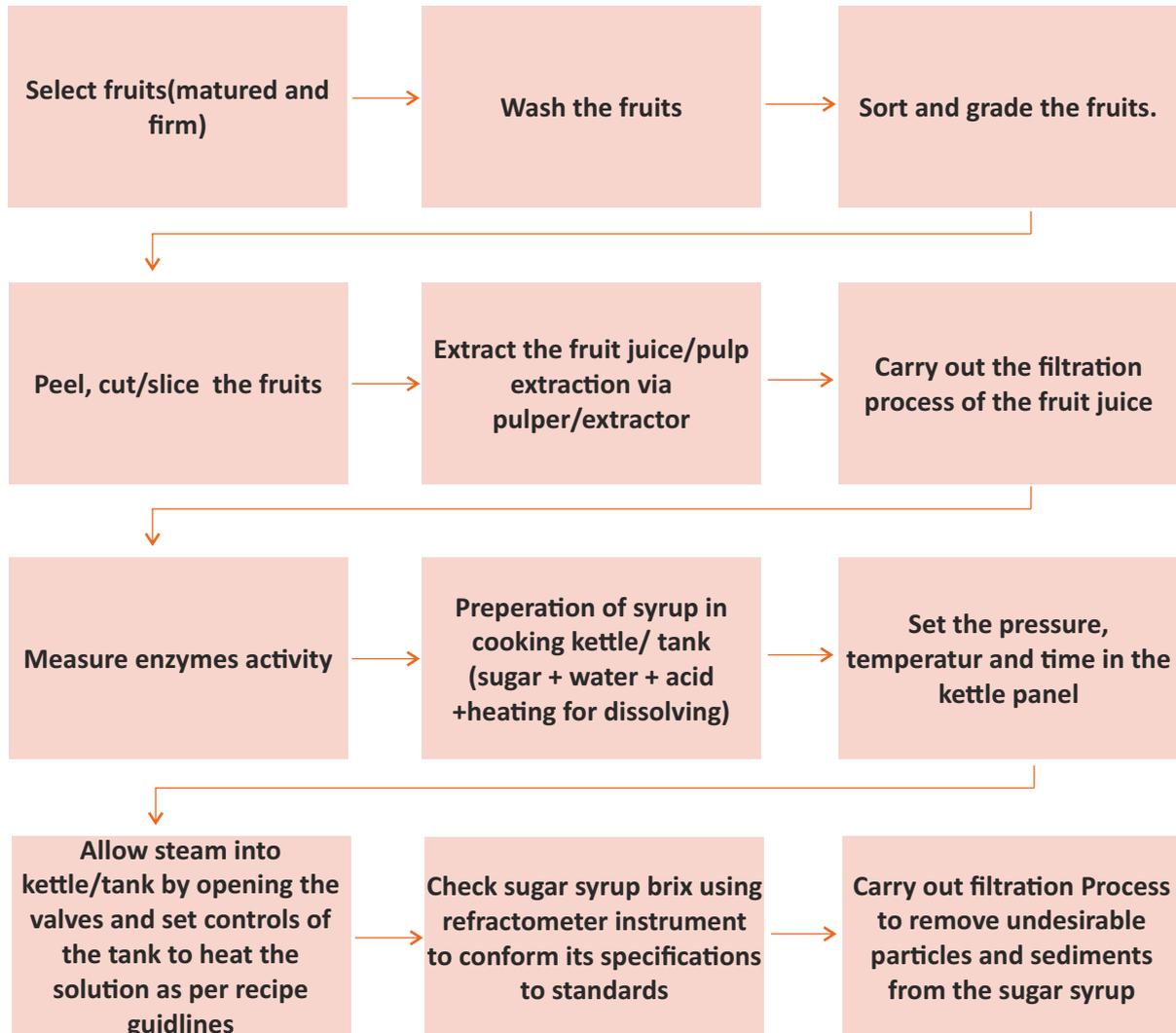
Table 16.2 List of Equipment and Tools for Squash Making

Notes



16.1.3 Process of Squash Making

The following workflow process chart explains the preparation of fruit squash:



Notes



Exercise

Answer the following questions:

1. List any two ingredients used for the preparation of squash making.

2. Explain the workflow process of squash making.

3. What is the operating procedure of the cooking kettle?

4. What is the purpose of the refractometer in squash making process?

Fill in the Blanks:

1. A _____ is used to sterilize the squash to destroy pathogenic microorganisms by _____ the product to a moderately high temperature for a brief period.
2. _____ is usually prepared by mixing 1 part of sugar to 3-6 parts of water in stainless steel tanks fitted with top driven agitators.
3. Permitted preservatives in squash are _____, and _____.

Scan the QR Code to watch the related video



https://www.youtube.com/watch?v=RliVo_wVFEQ

Lime squash processing

17. Fill, Pack and Store Juice and Squash



Unit 17.1 Filling, Packing and Storage of Juice and Squash



Key Learning Objectives

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

1. Perform the tasks to fill, pack and store the juice and squash
2. Describe the reporting procedure regarding the discrepancy

Unit 17.1 Filling, Packing and Storage of Juice and Squash

Unit Objective

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

1. Discuss the procedure to transfer the finished product into the filling tank
2. Elaborate the SOP to wash bottle/plastic containers to fill measured quantity of finished products
3. List the control parameters of the packaging machine, like filling volume, batch code details, date of manufacture, best before date, etc.

17.1.1 Introduction to Packaging

Food packaging is the most reliable process for preventing food contamination. This is the best way to safely control and protect the food against physical, chemical, biological, and environmental factors. Packaging provides many advantages such as protecting the contents in its containment from spoilage and leakage, more accessible transportation and storage, and better communications between the manufacturer and consumer. The most critical functions of packaging include:

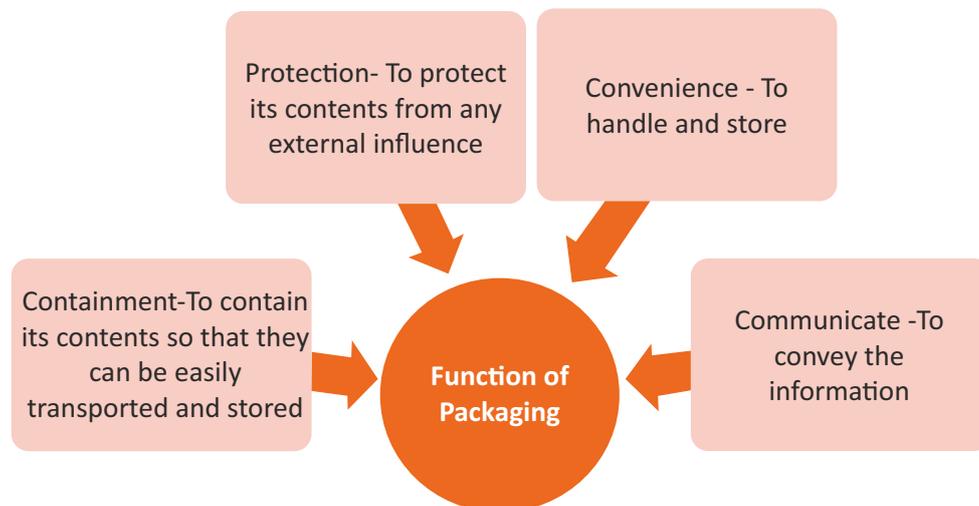


Fig. 17.1 Functions of packaging

The principal factors which affect the efficiency and utilization of a packaging line are as follows:

1. The suitability of the machine for the purpose
2. The output speed
3. The likelihood and frequency of stoppages and the time taken to overcome them

The following chart explains the benefits of packaging of squash and juices:

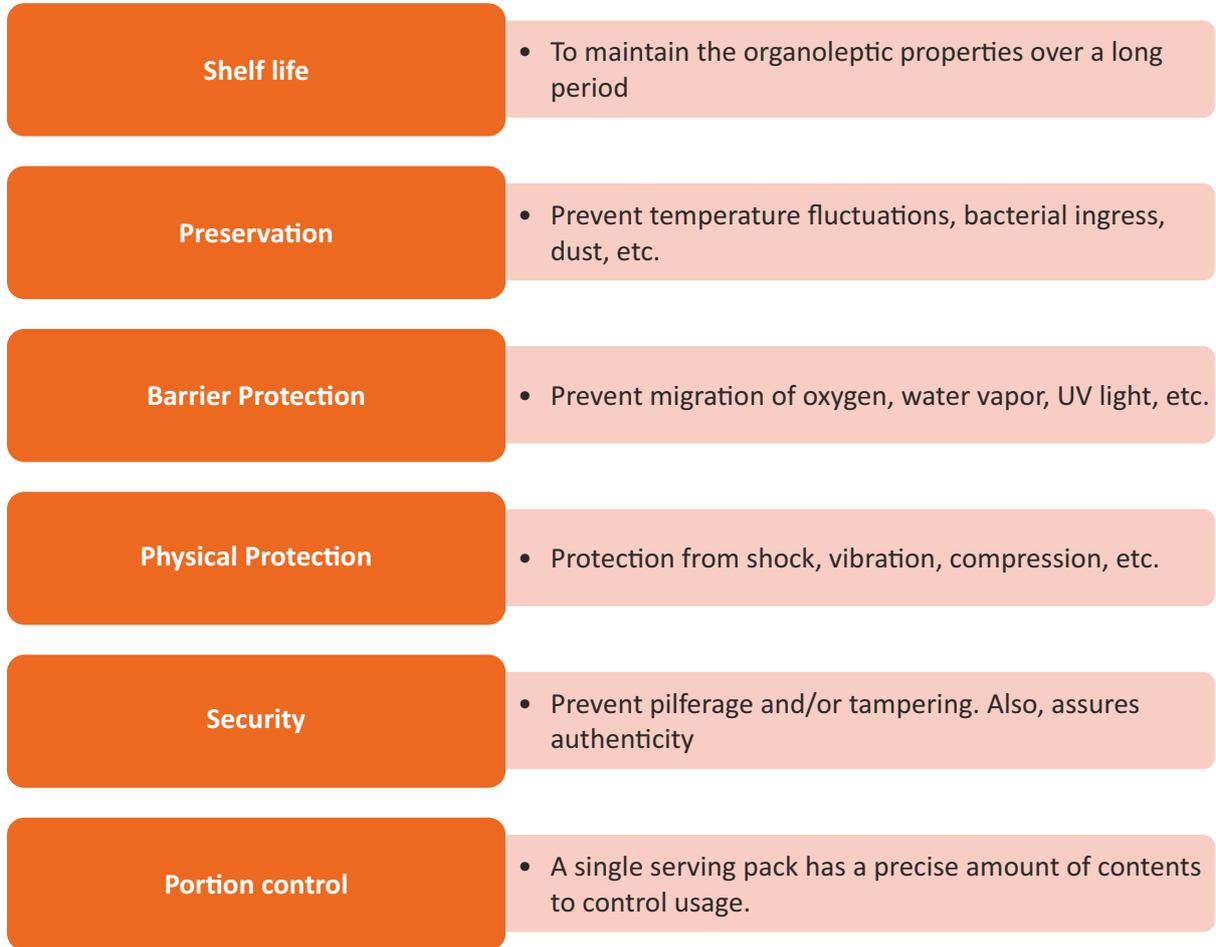


Fig. 17.2 Benefits of Packaging of Squash & Juices

17.1.2 Packaging Machinery

Some of the packaging machinery used in food processing industries are:

1. **Filling machines** are often but not exclusively used in the food packaging industry. Filling machines are used to fill liquids, grains, and other products into a container. The accuracy of the filling machine helps to maintain a consistent product for consumers efficiently.
2. **Form Fill Seal** is used in multiple forms of flexible packaging applications. Many industrial, retail, pharmaceutical, and food packaging products are sealed using a heat sealer. Sealers come in multiple sizes and specifications.
3. **Cartoning systems** are used in most packaging applications utilizing corrugated boxes. Tape guns are used in smaller operations, but higher volumes require case sealers for efficient packaging. Manual and automatic case sealers are used in retail, food, industrial, and pharmaceutical bulk packaging.

4. **A bottling system** is a collection of automatic machines connected by a conveyor belt or a group of highly specialized, fully automatic units that are completely integrated by a synchronized drive arrangement.
5. **Coding machines** apply a code (including bar codes), dates, and other variable or unique information to a package or transit container. These machines are usually attached to a larger packaging machine such as a cartoner, filler, or wrapper.
6. **Labelling Machines** apply labels and decoration onto all types of packaging containers, display, point-of-sale, and transit packs. Labels are used on every kind of product to brand, decorate or provide information for the consumer.
7. **Conveyors** are machines and equipment which carry ingredients, products, containers, packs, or packaging components from one place to another.

17.1.3 Filling and Bottling Operation of Squash

After the preparation and pasteurization process of squash, the products should be hot-filled into clean, sterilized bottles. A stainless steel bucket, drilled to accept a small outlet tap, is very effective bottle filler. After filling hot squash or juices from the tap/nozzle, the bottles are capped and laid in inverted position to cool before labelling. Hot filling offers a simpler means of ensuring microbial integrity of the nectars. The bulk product is heated to a pre-determined temperature, then filled hot (70°-85°C) in packs and sealed immediately. In case of glass bottle, it should be pre-heated to minimize thermal shock. The packs are inverted for proper mixing of the nectar and held at the desired temperature for a required time. Finally, they are cooled in a hydro-cooler to 25°C, the surface is then air-dried and labeled.

The filling station consist of:

Functions of Filling Machine	
Air jet Cleaner (Cleaning machine)	for empty containers with water and steam treatment
Bottle Unscrambler	for Container/bottle feeding
Linear piston filler	for filling dense and semi-dense products
Filling Area	where jars/bottles are placed
Cooling Conveyer	to cool the containers before moving to the capping machine
Automatic linear capping/corking machine with cap/cork feeder	for capping the containers

Continued...

Functions of Filling Machine	
Drying unit with air knives	to seal the caps of the container
Electronic Vacuum detector with the rejecting system	to reject the uncapped or cross capped containers

Table 17.1 Various Functions of Filling Machine

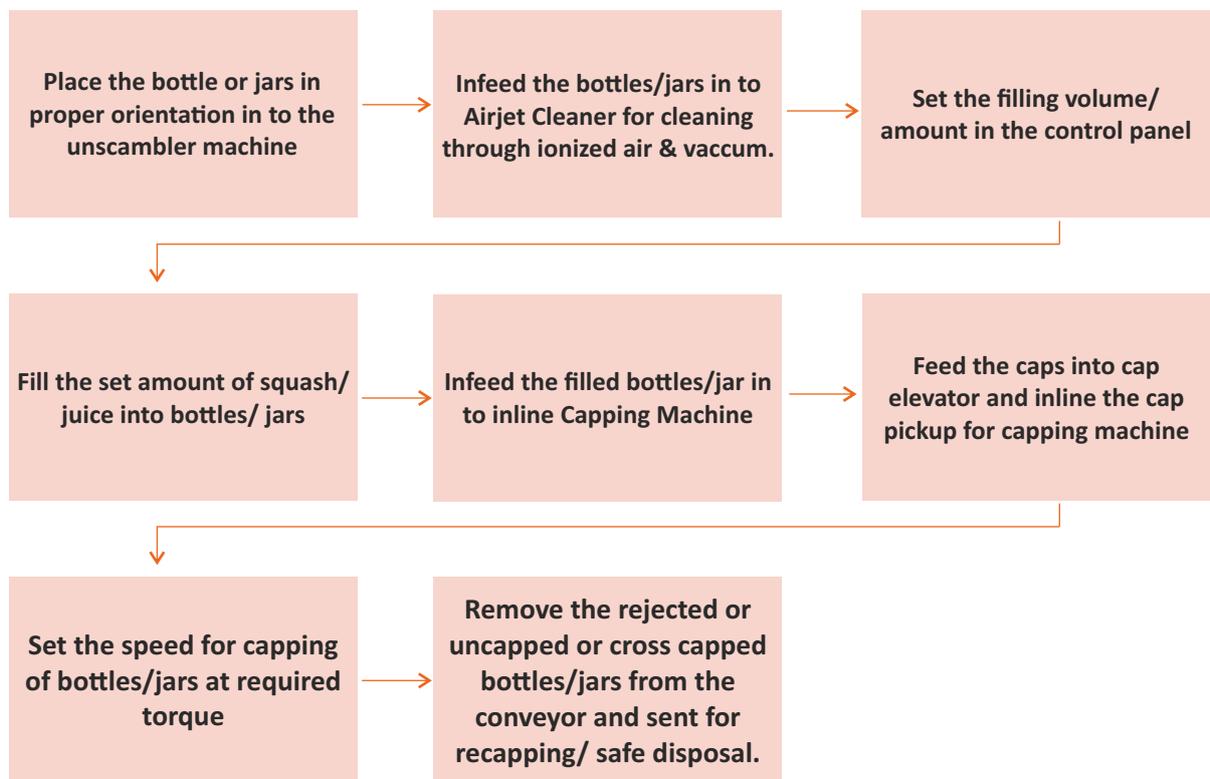


Fig. 17.3 Workflow Process of Filling Station

Below are the filling and packaging criteria for the squash and juices

1. Rinsing machines for jars or other containers should be used to remove dust and debris from the containers before filling, removing the possibility of producing contaminated products or reducing the shelf life of a batch.
2. Squash or juice should be filled hot at 70°-85°C to prevent browning and loss of vitamins during subsequent storage and distribution.
3. The liquid must be kept at a constant temperature throughout the process to ensure the product flow evenly, and the fill can be consistently and reliably repeated.
4. Packaging material should be heat-resistant, i.e., should have resistance towards high filling temperature.
5. It should be sturdy to prevent handling and storage hazards.

6. The package should not react with and change the product's properties over a given period of storage and preservation.
7. Containers/bottles should be cooled before applying the label to avoid wrinkles or peeling off of the label. It also helps the juice or squash to set in the container.
8. Packaged products should be stored under ambient temperature in a dry place.

17.1.4 Standard Procedure to Load Labels in Labeling Machine

The following chart explains the standard process for loading batch code details, date of manufacture, best before date, etc.) in a labelling machine:

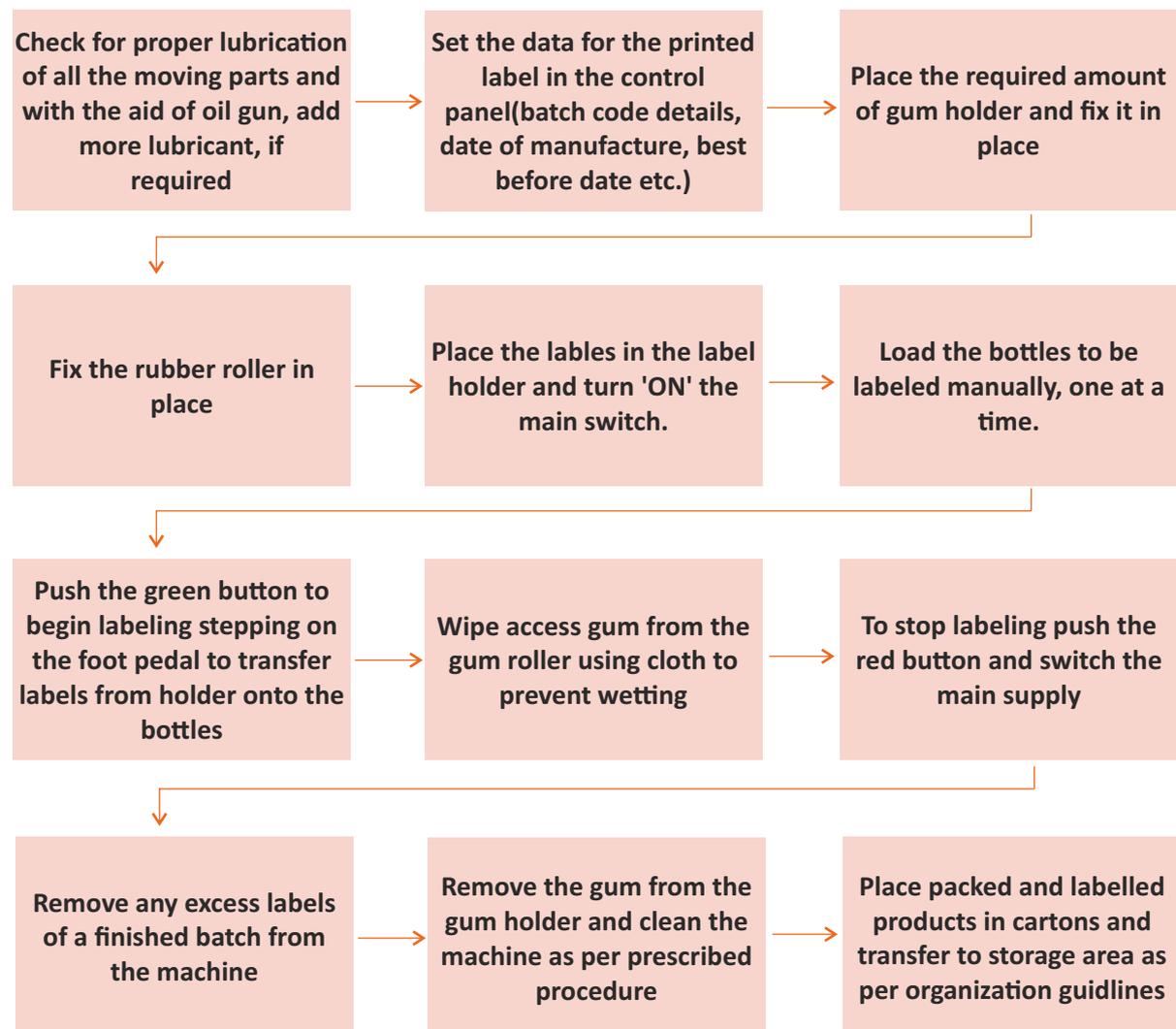


Fig. 17.4 Workflow Process of Labeling Fruit juice/Squash Bottles

Exercise

Answer the following questions:

1. Explain the operation of the filling station.

2. List any five types of packaging machines.

3. What are the benefits of packaging?

4. Explain the workflow process of labeling fruit juice/squash bottles.

Fill in the blanks:

1. _____ should be filled hot at _____ to prevent browning and loss of vitamins during subsequent storage and distribution.
2. _____ should be heat-resistant i.e., should have resistance towards high filling temperature.
3. _____ performs varied tasks such as protecting the contents in its containment from _____ and leakage, easier transportation and _____, and better communications between the manufacturer and consumer.

18. Perform Post-Production Cleaning and Regular Maintenance of Equipment



Unit 18.1 Post-Production Cleaning and Regular Maintenance of Equipment



Key Learning Objectives



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

1. Describe the post-production cleaning activities of required tools and equipment
2. Perform the tasks to maintain the tools and equipment regularly

Unit 18.1 Post-Production Cleaning and Regular Maintenance of Equipment

Unit Objective

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

1. List the appropriate cleaning agents and sanitizers to clean the work area, machinery, tools, and equipment after squash production
2. Discuss the standard procedure and importance of cleaning and maintenance of all machines and equipment

18.1.1 Cleaning & Sanitizing Work Area, Machinery, Tools, And Equipment

The cleaning and sanitizing process are one of the most essential programs in the food processing industry. It has always been a critical element for ensuring food safety and quality. Food processing industries need to be kept spotlessly clean to ensure compliance with standard regulations and prevent contamination. Everything from random debris to flakes of rust and paint needs to be kept clear from foodstuff to make sure the product is entirely safe for consumption, so frequent cleaning is vital to food processing operations.

Though the entire process is quite tricky because of the complexity of the machinery and equipment used in the industry, it can also introduce additional difficulty by creating a wet environment. Equipment must be designed and built to withstand these environments, like using only food-grade stainless steel, but the complexity doesn't end there. High-pressure washers used to clean equipment can also strip the coatings on machines and cause injuries to employees, and the wet environment itself often poses a slip-and-fall hazard as well as food contamination.

Cleaning and sanitizing (disinfecting) are usually two separate processes. Effective cleaning must be carried out before sanitizing the work area and machinery, as sanitizers may not work as well if the work area or machinery has not had all visible contamination removed. Cleaning is often done using correct proportion of detergent and water. Detergents are chemicals that eliminate dirt and grease. However, it does not kill bacteria and other microorganisms. Microorganisms may be removed during the cleaning process but it can't be destroyed properly. Hence, sanitizing is required for this purpose.

Notes

The primary reasons for cleaning and sanitizing the work area and machinery are:



Fig. 18.1 Reasons for Cleaning and Sanitizing

The food processing industry follows standard procedures for cleaning the work area to ensure no bacterial growth due to the presence of leftover food particles. For cleaning purposes, the work area is divided into two categories:

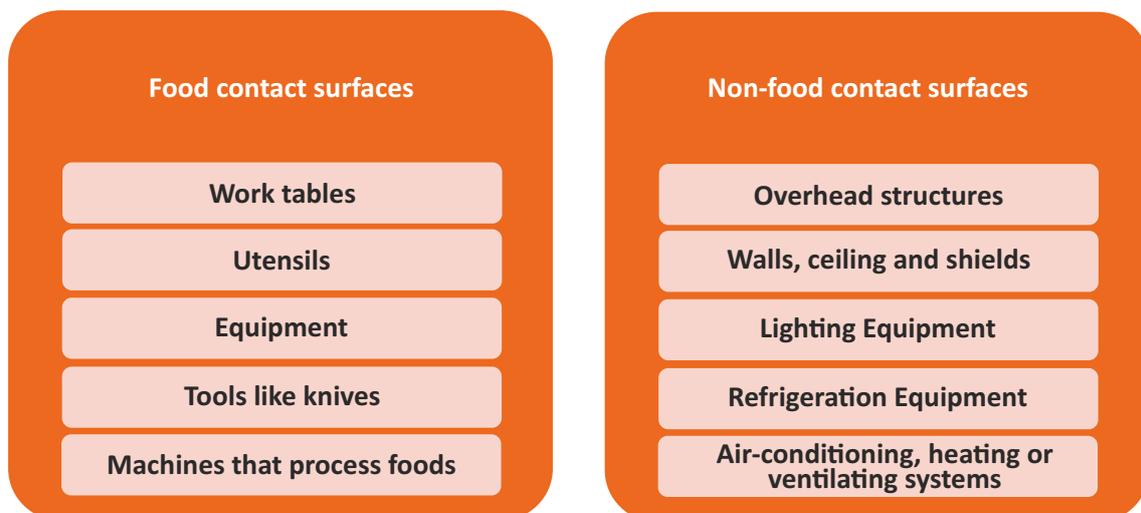


Fig. 18.2 Cleaning Work Area Categories

Proper and regular cleaning of the work areas protects food from any contamination. The cleanliness of the ambient air should also be controlled in the workplace, where contamination of any infectious material will be dangerous. The surfaces used for producing and storing foods with low moisture content should always be dry and hygienic during use. When wet cleaning is required, these surfaces must be sanitized and thoroughly dried to use. The entire work area in wet applications must be cleaned and sanitized absolutely before use or at the risk of contamination. Equipment and tools when not in usage should be stored properly to avoid any contamination risk.

18.1.2 Cleaning Agents and Sanitizers Used for Cleaning

There are several common cleaning and sanitizing agents that can be used to clean the food-contact and non-food contact surfaces. The nature and complexity of the detergent employed depend on the variation of soils, water hardness, and temperature of the method, plant surfaces, and safety. Detergent suppliers normally have a range of detergents to be employed in varying and specific circumstances. The range of products will include:

<p>Alkalis:</p> <ul style="list-style-type: none"> • Caustic soda • Caustic potash • Coronate • Silicate, • Phosphate 	<p>Acids:</p> <ul style="list-style-type: none"> • Phosphoric • Nitric • Citric • Glycolic 	<p>Chelates:</p> <ul style="list-style-type: none"> • EDTA • NTA • Gluconate • Glucoheptonate, citrate • Polymeric 	<p>Solvents:</p> <ul style="list-style-type: none"> • Isopropanol • Propylene • Butyl diglycol • Ethers 	<p>Surfactants:</p> <ul style="list-style-type: none"> • Anionic • Cationic • Non-ionic • Amphoteric
<p>Inhibitors:</p> <ul style="list-style-type: none"> • Organic • Inorganic 	<p>Enzymes:</p> <ul style="list-style-type: none"> • Protease • Lipase • Amylase 	<p>Oxidising agents:</p> <ul style="list-style-type: none"> • Hypochlorite • Isocyanurates 	<p>Stabilisers</p>	<p>Viscosity modifiers</p>

Fig. 18.3 Various Ranges of Detergents

The industry must use approved cleaning and sanitation chemical agents and the same must be prepared before use as per the instructions described on the product label. It is essential to identify the correct detergent for cleaning operation correctly. This will save money in the long term as cleaning will be more effective. The failure of a product to work is usually not due to a poor quality product but rather choosing the wrong one. Application and use are also important factors, and a good supplier will usually provide training in the correct use of the product. A 'detergent' is designed to remove soils. Another term used is 'sanitizer' and is often used to describe similar products. A 'disinfectant' is a product that kills microbes without employing a soil removal action.

The table below lists the typical cleaning agents and their appropriate usage, risks, and safety measures that should be taken while using these agents.

Notes



Cleaning agents	Used for	Risk	Safety measures
Hypochlorite like · potassium hypochlorite, · sodium hypochlorite, and · calcium hypochlorite	Cleaning stainless steel food contact surfaces	Leads to corrosion	Ensure pH and concentration levels are maintained
Liquid chlorine	Internal cleaning of stainless steel equipment and vessels	Leads to corrosion	Ensure concentration levels are maintained
Hydrogen peroxide	Killing bacterial spores, pathogens, spoilage organisms, and other microorganisms	Has a strong odor	Use in well-ventilated and open spaces
Ozone	Cleaning food-contact and on-food-contact surfaces like equipment, walls, doors, drains, conveyors, tanks, and other containers; Killing microbes	No risk involved since it leaves no residue	Safe to use

Table 18.1 Different types of cleaning agents, related risk factors, and safety measures

Cleaning and sanitization take time and cost money. However, well-designed and organized food processing businesses can reduce the time needed for thorough cleaning with proper planning.

Plan the cleaning sequence to avoid re-soiling the cleaned area

Implement and display a cleaning schedule so all staff know their cleaning and sanitizing responsibilities.

Wear personal protective equipment required for the cleaning methods and materials being used

All items must be stored off the floor. Allowing clearance from the floor gives plenty of room for cleaning beneath shelving and equipment.

All the machinery used for processing is "SWITCH OFF"

Keep only what you need at the food processing premises.

Continued...

Use the right materials for cleaning while considering risk, time, efficiency and type of stains

Wipe out the chemical spill properly in the work area, with care and caution

Use a high volume, low pressure hose for equipment and surfaces. High pressure hoses can splash and spray dirt onto surfaces and create aerosols that may contain and spread pathogens.

Use a vacuum cleaner or at least a damp cloth to clean the dust from surfaces around the work area

Remove the residues, coarse dirt, oily substances and scraps from the surface area

Undertake regular maintenance, for example filling holes and replacing damaged tiles.

Wipe down tools, equipment and surfaces as per specified standards

Dispose any waste or chemicals used in an appropriate manner

Fig. 18.4 Standard Practices for Cleaning the work area and equipment

The term sanitary refers to the state of a food contact surface or machinery where it does not contain microorganisms at a level that would permit the transmission of infectious disease or compromise food safety. Sanitizers are substances capable of destroying microorganisms, including those bacteria that cause food poisoning and other diseases. With appropriate use, they can reduce surface contamination by bacteria to a safe level. Therefore, it is essential to read and follow the directions on sanitizers carefully. Sanitizing is usually done using heat and water, or chemicals, or a combination of both methods.

Effective practices for sanitization

For effective and safe use of a sanitizer, follow the manufacturer's instructions provided on the label.

- Some sanitizers are toxic to people, and the residue must be rinsed off, while other sanitizers are food-safe and do not require rinsing. So, the manufacturer's instructions shall always be followed for the sanitizer to ensure safe use.
- Sanitizers work best at the correct dilution. If they are too weak, they do not work effectively, and money is being wasted if they are too strong.
- Sanitizers need time to work. The contact time varies and may be seconds to minutes depending on the job.
- Check the dilution, contact time, safety precautions, shelf life, and storage of all chemicals before use.

In some cases, cleaning and disinfection may be combined into one operation using a sanitizer which has the action of both a detergent and a disinfectant. However, it is believed that the two-stage approach is more consistent and effective than the single-stage sanitizer approach. It is important that non-scented chemicals are used in food operations due to the risk of taint.

18.1.3 Postproduction Cleaning of Work Area and Machinery

After the production cycle is complete, cleaning the area, machines, and equipment becomes imperative before starting the following process. Otherwise, the residuals from the previous cycle may cause contamination and other related quality problems in the upcoming production cycle. There are various methods of cleaning the work area and machinery that can be applied as per the requirement.

Manual Cleaning:

- This method of cleaning uses cloths, mops, brushes, pads, etc. It is usually used in small areas or non-waterproof equipment or machinery that requires dismantling or areas that are difficult to clean by other methods. It is a labor-intensive method and may limit the use of certain chemicals for safety reasons. The method must be clearly defined and staff trained to an appropriate level to ensure cleaning is effective.

Foam Cleaning:

- It is the common method for cleaning most food operations. A foam blanket that is created using a wide range of available equipment is projected from a nozzle and is allowed time to act on the soil. Then, it is rinsed off with the released deposits. Foam cleaning is ideal for cleaning large areas such as floors, walls, conveyors, tables, and well-designed production equipment. Foam is a carrier for detergent. The foam is applied in an even layer. Coverage rates are quick, and chemical usage is economical. The equipment for foam cleaning may be mobile, or centralized.

Spray:

- Spray cleaning uses a lance on a pressure washer with chemical induction by venturi. This should ideally be used where foaming properties are not essential for the cleaning action as this method can be wasteful of chemicals and can be slow to produce foam.

Fogging:

- This method uses compressed air or other equipment to generate a fine mist of disinfectant solution, which hangs in the air long enough to disinfect airborne organisms. It also settles on surfaces to produce a bactericidal effect. The system is available in both small portable devices and built-in automatic central systems. Fogging should never be used as a primary sanitizing method. This shall be used in conjunction with other methods. It is also vital to ensure that coverage and saturation are sufficient and the mist is acceptable to allow proper action.

Machine Washing:

- Machine washing is an automatic or semi-automatic washing process conducted within a purpose-built machine. Many machine designs are available depending on the application, e.g., crate washing or utensil washing. They represent a significant capital investment and need to have a clear business case before purchasing. In addition, they tend to consume a large number of chemicals and water. Failure to maintain them correctly can lead to a contamination risk to the product. Chemicals used in these machines should be low foaming. An effective system for controlling the dose of chemicals should be employed, and temperature control systems should be used where critical.

Fig.18.5 Various Methods of Cleaning the Work Area and Machinery

Cleaning and sanitization is a complex process. A defined and systematic approach should be followed to ensure it is conducted appropriately that considers several factors. This approach takes the form of a procedure, which is usually a legal and a fundamental requirement of global food standards. A collection of these cleaning procedures forms a Cleaning Plan or Program, which is plant-specific. The correct sequence of a general cleaning procedure for surfaces in a food plant is:



Fig.18.6 Steps for Cleaning Work Area

Notes



The following chart explains workflow process of cleaning and maintenance of fruit squash and juice processing machinery and equipment.

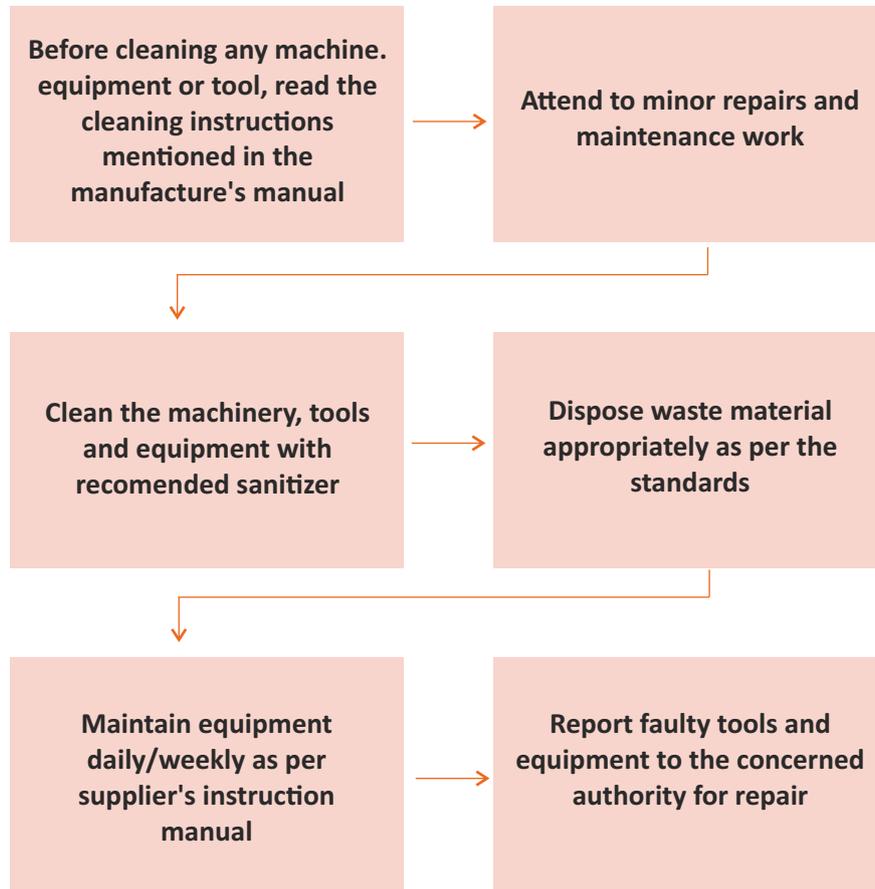


Fig.18.7 Cleaning and Maintenance Process for Fruit-pulp Machinery and Equipment

It is important to report faulty tools and equipment to the concerned authority, as it minimizes the possible risks and hazards related to equipment and prevents major failures and serious injuries or mishaps. The following figure explains the significance of reporting to the concerned authority:



Fig.18.8 Importance of Reporting Faulty Tools and Equipment

18.1.4 Maintenance and Check

In food manufacturing, maintenance supports various key objectives, many of which are unique to food production. Maintenance plays the following roles in food manufacturing:

1. It keeps the production running smoothly.
2. It helps to prevent any contamination and ensure food safety.
3. It reduces product losses.
4. It maintains regulatory compliance.

An effective maintenance routine ensures that operations are continued, repair costs are minimized, and downtime is reduced.

Following are the types of maintenance that are carried out in a food processing unit:

1. **Reactive Maintenance** is a method where machines run until they fail. It's a hands-off approach, and the significant benefit is that it keeps routine maintenance costs low.
2. **Predictive Maintenance** uses advanced technology such as infrared and ultrasound equipment during the routine inspection of machines. This process can stop unpredicted breakdowns, and using advanced technology and the industrial unit can reduce the amount of time needed to inspect equipment piece by piece. This type of maintenance is expensive, but this method accurately stays a step in front of faults.
3. **Proactive Maintenance** is a systemic issue-focused maintenance program. Rather than examining equipment, this approach considers how to control the problems that lead to machine wear and tear instead of the deterioration itself.
4. **Preventative Maintenance** is the checking of machines and equipment on a planned, regular basis. The purpose is to prevent costly downtime and minimize the probability of faults. It requires more planning and effort than other techniques. However, it has long and short-term benefits in cost-reduction and efficiency of machine performance. Preventative checks are done before a machine breakdowns and while it is still in running condition. Generally, the strategy leads to good food hygiene and prevents foreign materials from entering food produce.

It is essential to have a schedule for preventative maintenance of each piece of machinery and equipment used in the production. This consists of:

- **Time schedule** stating when and how frequently maintenance should be done
- **Maintenance activities list** for each item

These schedules provide simple guidelines for all types of equipment, covering the duties to be undertaken in the following areas:

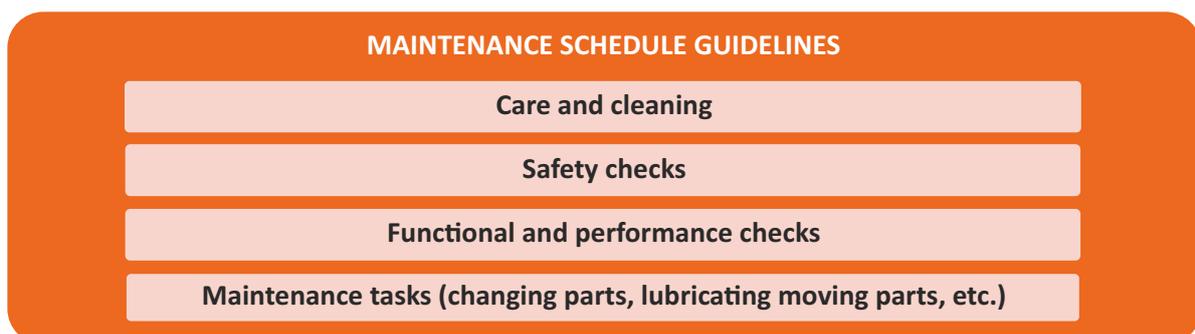


Fig.18.9 Maintenance Schedule Guidelines

Checklist for Planning Maintenance

-
- Identify the assets that require preventative maintenance.
 - Distinguish what kind of safety checks the machine will need.
 - Assess whether parts need replacing or cleaning.
 - Decide how regularly assets need checking.
 - Create a formal risk assessment process to help the person responsible for checks.
 - Talk to employees who work closely with equipment to discover more about how the machines are operating at the time of the check.
 - Find out if parts need cleaning, lubricating, or changing.

Fig.18.10 Maintenance Checklist

After completing any maintenance, the technician must keep a log for maintenance. This log entry should include a description of the work carried out, who carried it out, and the date and time it happened

Document Maintenance Procedures. Every piece of equipment and machinery should have detailed descriptions, drawings, and photographs of how and when each machinery should be maintained or serviced. It includes:

- Maintenance procedures
- Lubrication procedures
- Tool reconciliation procedures
- Procedures for temporary repairs
- Procedures for emergency repairs
- Spare parts inventory program
- Training procedures
- Handover procedures
- Audit Procedures

Exercise 

Answer the following questions:

1. List any two reasons for cleaning and sanitizing the work area.

2. What are the standard cleaning practices?

3. Name any two cleaning and sanitizing agents for cleaning work area and equipment.

4. Describe the importance of equipment maintenance and check.

19. Prepare Jam and Jelly



Unit 19.1 Production process of preparing Jam and Jelly



Key Learning Objectives



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

1. Perform the tasks to prepare jam and jelly
2. Discuss the process of preparing jam and jelly

Unit 19.1 Production process of Jam and Jelly

Unit Objective

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

1. Elaborate on the operating procedure of cooking kettle or tank
2. State the significance of stirring the pulp continuously during the heating process
3. State the importance of achieving specified pressure and temperature while cooking the fruit pulp or fruit juice
4. Discuss the procedure and significance to check the quality of cooked product through physical parameters such as colour, appearance, texture, taste, etc. and to send the sample finished product for quality lab analysis
5. Explain the procedure to transfer the finished product to the filling tank

19.1.1 Preparation of Jam and Jelly

Jam is made using pulp from a single fruit or a mixture of fruits. It gets produced by boiling the fruit pulp with an appropriate amount of sugar until it's a thick adequate consistency to hold the fruit tissues in position. Fruits like **Apple, sapota, papaya, plums, mango, grapes, jackfruit, pineapple, banana, guava, and pears** are used to prepare jam.

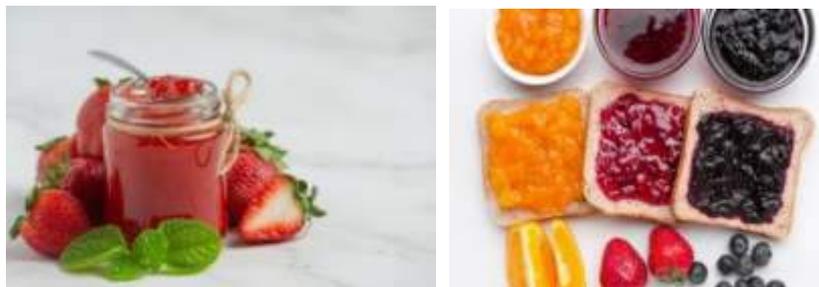


Fig. 19.1 Jam

Jelly is a semi-solid food product made by boiling a clear, strained solution of pectin-containing fruit extract, free from pulp, subsequently adding sugar and acid. A perfect jelly should be translucent, well set but not too stiff, and retain the fruit's original flavour. It should be of attractive color and preserve the shape of the mold. It should be firm enough to keep a sharp edge but adequately tender when squeezed from the mold. The jelly should not be gummy, sticky, syrupy, or have crystallized sugar. In fact, the product should be free from dullness with little (or) no syneresis (weeping) and neither tough nor rubbery. As per FSSAI regulation, the total soluble solids content, in the case of jams shall be not less than 65per cent. by weight and not less than 60 per cent. by weight in case of jellies.



Fig. 19.2 Jelly

Please Note:

As per FSSAI, under chapter 2.3.31 of FSSA (FOOD PRODUCTS STANDARDS AND FOOD ADDITIVES) REGULATIONS, 2011

1. **Jam** means the product prepared from a suitable fruit ingredient of one or two or more types which shall be—
 - (i) whole fruit, pieces of fruit, fruit pulp or fruit puree;
 - (ii) with or without fruit juice or concentrated fruit juice or dehydrated fruit as an optional
 - (iii) ingredient;
 - (iv) mixed with a nutritive sweetener, with or without water; and
 - (v) processed to a suitable consistency.

2. **Fruit jelly** means product prepared by boiling fruit juice or fruit(s) or aqueous extracts of one or more fruits of sound quality, with or without water, expressing and straining the juice, adding nutritive sweeteners, and concentrating to such a consistency that gel formation takes place on cooling. The product shall be clear, sparkling and translucent. It may also contain any other ingredient suitable to the products including derivatives like fibre, extracts, spices and condiments.

19.1.2 Material Specification for the Preparation of Jam and Jelly

The list of raw materials required for making jam is as below:

1. **Fruit** provides a specific color and flavor to the jams and jellies. It also provides some of the pectin and acid required for a gel. Therefore, the fruit should be just at the ripe stage to retain the best natural color and flavor. Fruit-pulp technicians can use irregular sizes and shapes of fruits for jam and jelly production as long as they are of good quality since they will be cut, mashed, or made into juice. The fruit can be used in the form of whole fruit, pieces of fruit, fruit pulp or fruit puree. With or without fruit juice or concentrated fruit juice or dehydrated fruit as an optional ingredient.

1. Pectin is the ingredient that causes the fruit to gel. Some types of fruits have sufficient natural pectin to make high-quality products. Others require added pectin, specifically when used for making jellies, which should be firm enough to hold their shape. The highest quality pectin is available in just-ripe fruit as pectin from under-ripe or over-ripe fruit will not form a gel.
2. Acid is required both for gel formation and flavor. The acid concentration varies with fruits and is higher in under-ripe fruits. Usually, when fruits are low in acid, lemon juice or citric acid can be added for jam and jelly production.
3. Sugar is an essential ingredient in a jam. It should be present in the right proportion with pectin and acid to make a good gel. Sugar acts as a preservative for the product that prevents the growth of microorganisms. It also adds to the taste of the product.

Fruits that have sufficient acid and pectin	Fruits that do not have enough acid or pectin	Fruits that do not have enough acid and pectin
<i>Unripe fruits: especially apple, quince, lemon, grapefruit, passion fruit, guava</i>	<i>Ripe fruits: especially apples, orange, mango</i>	<i>Ripe fruits: especially melon, banana, strawberry, pineapple</i>
Sugar: fruit juice ratio = 1:1	Sugar: fruit juice ratio = 0.6 to 0.75:1	Sugar: fruit juice ratio = 0.5:1

Table 19.1 Pectin and acid contents of fruits

19.1.3 Equipment used in making Jam and Jellies

Basic equipment/ accessories

- Cutting Knife (SS), coring knife, pitting knife, peeling knife
- Cutting and Chopping equipment
- Cooking Vessels/VAT
- Refractometer, pH meter
- Heat production system
- Other various machines

Types of Equipment And Tools	Description
<p data-bbox="296 405 544 432">Fig.19.3 Cooking Kettle</p> 	<p data-bbox="660 405 1388 506">A cooking kettle is an all-purpose machine for making high-quality products such as jam, marmalade, and jellies. With a cooking kettle, various stirring- and mixing processes can be carried out.</p> <p data-bbox="660 517 963 544">Operation of Cooking Kettle</p> <p data-bbox="660 555 1388 835">"The kettle is equipped with Jacketed system which contains hot water, so as to ensure the proper cooking of the jam solution in the cooking vessel/ VAT". The electric heater or kettle provided with the steam connections, heats the water bath to the desired temperature and keeps it constant. The product is evenly heated and blended because of the integrated mixer. After the cooking procedure, drain the kettle simply with the help of a disc valve on the bottom. Cooking kettles mainly consists of: -</p> <ul data-bbox="711 846 999 1010" style="list-style-type: none"> • a spherical tank • vapor-liquid separator • condenser • agitator • receiving tank, etc. <p data-bbox="660 1021 1388 1301">Cooking kettles have the advantages of a large heating area, high thermal efficiency, quick heating of materials, uniform heating, and easy control of heating temperature. Unlike conventional stockpot cooking, a steam kettle provides efficient heat transfer, uniform heating, and superior product handling, resulting in faster food service operations in your kitchen. These are just a few of the advantages of incorporating a steam kettle further into the jam jelly production process.</p>
<p data-bbox="339 1352 501 1379">Fig.19.4 Peeler</p> 	<p data-bbox="660 1352 1388 1453">Peeler is used for peeling various kinds of ball-shaped fruits and vegetables, equipped with rotating soft and hard brushes which thoroughly clean and peel the vegetables.</p>
<p data-bbox="336 1727 596 1753">Fig.19.5 Pulper machine</p> 	<p data-bbox="660 1727 1388 1973">Pulper is used for extracting pulp of most fruits & vegetables like mango, apple, tamarind, custard apple, plum, apricot, peach, kiwi, tomato, etc. The fruits and vegetables are fed into the pulping chamber, wherewith the help of blades and brushes gets pressed against the sieve. The extracted pulp goes through the perforations in the sieve and discharges the stone and skin by pushing forward from the other end.</p>

Types of Equipment And Tools	Description
<p>Fig.19.6 Filter/Sieve (Source: https://rdpf.co.in/ss-in-line-filter-supplier-in-mumbai-india/)</p> 	<p>A sieve is equipment used to separate the passage of granular materials according to particle size.</p>
<p>Fig.19.7 Plate Heat Exchanger/Pasteurizer</p> 	<p>A pasteurization machine is used to sterilize the jam/jelly/fruit pulp to destroy pathogenic microorganisms by heating the product to a moderately high temperature for a brief period. In commercial processing, the same is achieved through heat exchangers. In case of small production, the temp of pasteurization is normally achieved in the cooking vessel only.</p>
<p>Fig.19.8 Refractometer</p> 	<p>Refractometer measures total soluble solids (TSS) as °Brix, which corresponds to % sugar.</p>
<p>Fig.19.9 Weighing balance</p> 	<p>Weighing balance is used to weigh small amounts of ingredients or laboratory chemicals, ingredients and products, and fruit and vegetables, respectively.</p>
<p>Fig.19.10 Crown corking/capping machine</p> 	<p>The crown corking/capping machine is used for sealing the caps/corks of the jars/bottles.</p>

Table 19.2 Equipment used in Jams and Jellies

19.1.4 Processing of Jam

To achieve the desired quality of jam, the required and accurate amount of ingredients must be added. The following steps explain the preparation of jam in the food processing industry.

1. **Quality inspection of fruits:** The best quality fruits selected for jam making are loaded into the funnel-shaped hopper. The fruits are transported through this hopper for cleaning and crushing.
2. **Cleaning, crushing, and chopping:** The surface dirt from the fruits are removed using the gentle water spray. Some fruits like citrus and apples are subjected to manual peeling, slicing, and dicing.
3. **Pulping:** Fruits are pulped using a Pulper.
4. **Cooking:** The required pre-measured amount of fruits, sugar, and pectin are mixed in the cooking kettles. The mixture is slowly cooked with occasional stirring. The fruit pulp is crushed with a ladle during cooking. The cooking is continued till the temperature of the mass reaches 105.5°C. This mixture is then subjected to cooking and cooling three times. Cooking of the jam is stopped precisely at the setting time. The jam is not adequately set if this point is not reached. If the cooking process is carried out beyond this set point, the jam will undergo crystallization and darkening.

Please Note: -

- a. To ensure that everything is dissolved, give it a good stir. Once the jam is boiling, do not stir it; instead, use a wooden spoon to check that it is not sticking to the bottom of the pan. Stirring the fruit pulp continuously lowers the temperature and delays the setting point. It is wasteful to remove scum regularly.
 - b. If the sugar is still dry, keep stirring until the juices run and the sugar melts. Once all of the sugar has been melted, stir rarely or not at all. The less you stir, the faster everything heats up and evaporates the moisture.
 - c. To avoid scorching, stir your mixture frequently and constantly for 15 to 40 minutes, depending on the cooking time of the fruit. Scorching can ruin an otherwise delicious jam or preserve. Dip a cold metal spoon into the boiling mixture to see if it's ready.
 - d. It is important to maintain the specified pressure and temperature while cooking the fruit pulp or juice to avoid scorched flavor and undesirable color in the jam-making process. Temperature helps to determine the sugar-to-water ratio in a jam at this stage. Hence, monitor the pressure and temperature gauges and adjust the controls of the cooking kettle to achieve the specified temperature to cook the mixture for jam-making process.
5. **Sheet/Flake Test:** During the boiling process, a small portion of jam is taken out with a spoon or wooden ladle and let to cool slightly. After that, it's allowed to drop. If the product falls off in the form of a sheet/flakes rather than flowing in a continuous stream/syrup, the endpoint has reached, and the product is ready. Otherwise, boiling is required to continue till the sheet test is positive.



Fig.19.11 Inspection Table for Jam/Jelly Test

6. **Refractometer method Test:** Before placing a drop on the Refractometer glass, cool the jam immediately as the reading is calibrated at 20°C.
7. **Weighing method:** The weight of the jam made from pectin-rich fruits is one and half times the sugar. The disadvantage of jam making is that frequent weighing at the end of boiling is required, resulting in wastage of heat energy and practically time-consuming.
8. **Transporting the final product for filling:** The transportation of the finished product should be carried out under such conditions that will preclude the contamination with or development of pathogenic or toxigenic micro-organisms or infestation and protect the product against deterioration. The tabletop shall be of waterproof material, and other portions of the tables shall be free from corners, cracks, and cervices. There should be proper ventilation to prevent condensation and drippage.
9. **Filling:** Pasteurized jars are used to fill up the required amount of jam. The top of the jars is vacuum-sealed using metal caps. The process of filling and vacuum packaging of the jars removes all air, resulting in maintaining the product's sterility.
10. **Labeling and packaging:** The sealed jam jars are conveyed through the labeling machine. These labels must contain specific information about the ingredients used in the preparation of jam. The jars are later packed into cartons for shipment and further distribution.

Scan the QR Code to watch the related video



<https://www.youtube.com/watch?v=ZozA1gHNoDA>

Apple jam Processing

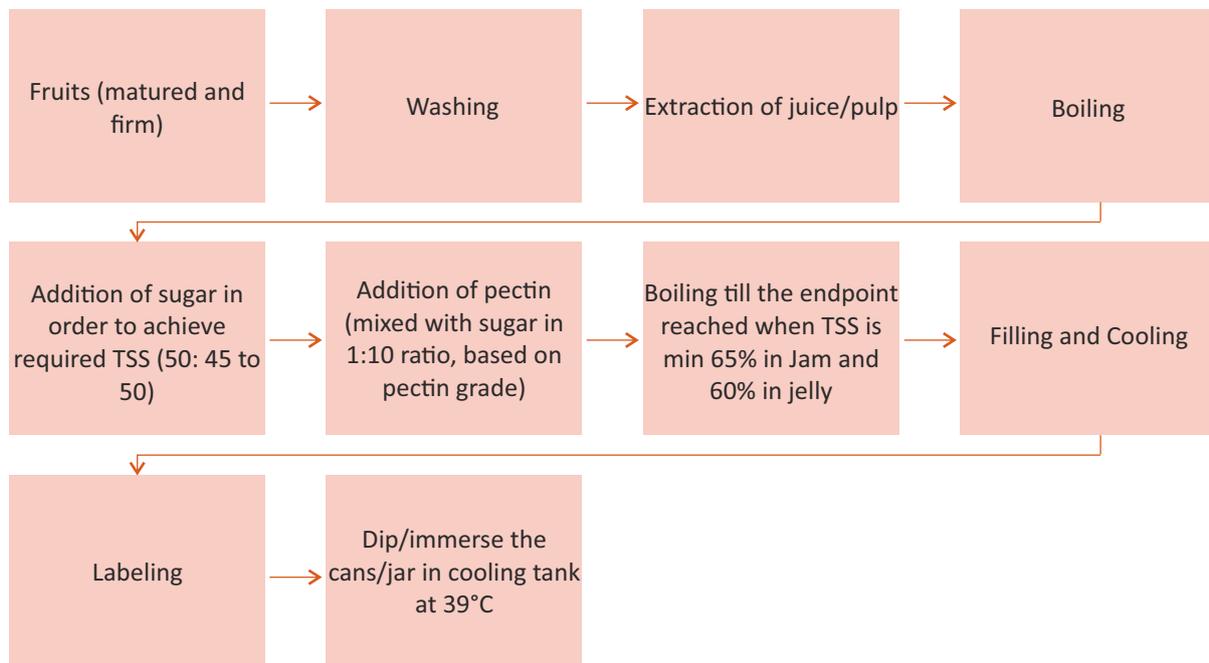


Fig.19.12 Process flowchart for preparation of jam

Problems in the jam production

- Crystallization:** In the jam invert sugar must be present in the concentration of 30–50%. If this concentration decreases below 30%, cane sugar may undergo crystallization upon storage. If the concentration of inverted sugar increases above 50%, the jam will form into a honey-like mass due to the formation of tiny glucose crystals. This crystallization can be prevented by adding corn syrup or glucose along with cane sugar in the jam preparation.
- Sticky or gummy jam:** High percentage of total soluble solids makes the jam sticky and gummy. This can be prevented by adding a sufficient amount of citric acid, pectin, or both.
- Premature setting:** This problem arises because of low total soluble solids and high pectin content. The addition of more amount of sugar is the best solution for it.
- Surface graining and shrinkage:** Jam must be stored in a cool place to prevent moisture loss due to evaporation. This moisture loss results in shrinkage and surface graining which affect the appearance of the product.
- Microbial spoilage:** During the storage, there may be mold growth in the jam, which can be prevented by storing jam in 80% humidity.
- Fermentation:** The occurrence is due to improper sealing of the jars. This problem can be solved by using the boiling water bath process.

19.1.5 Processing of Jelly

Jelly is prepared by boiling the fruit with or without water, straining, mixing the strained and clear juice extract with sugar, and boiling the mixture until it forms a clear gel. Guava, apple, plum are the fruits generally used for the preparation of jelly. Jelly shall have minimum TSS of 60% by weight. The permitted additives as defined in relevant Indian Food Standardization Code (IFC) shall only be added. Please refer to the IFC 4.1.2.5 of the FSSA, 2011 regulation.

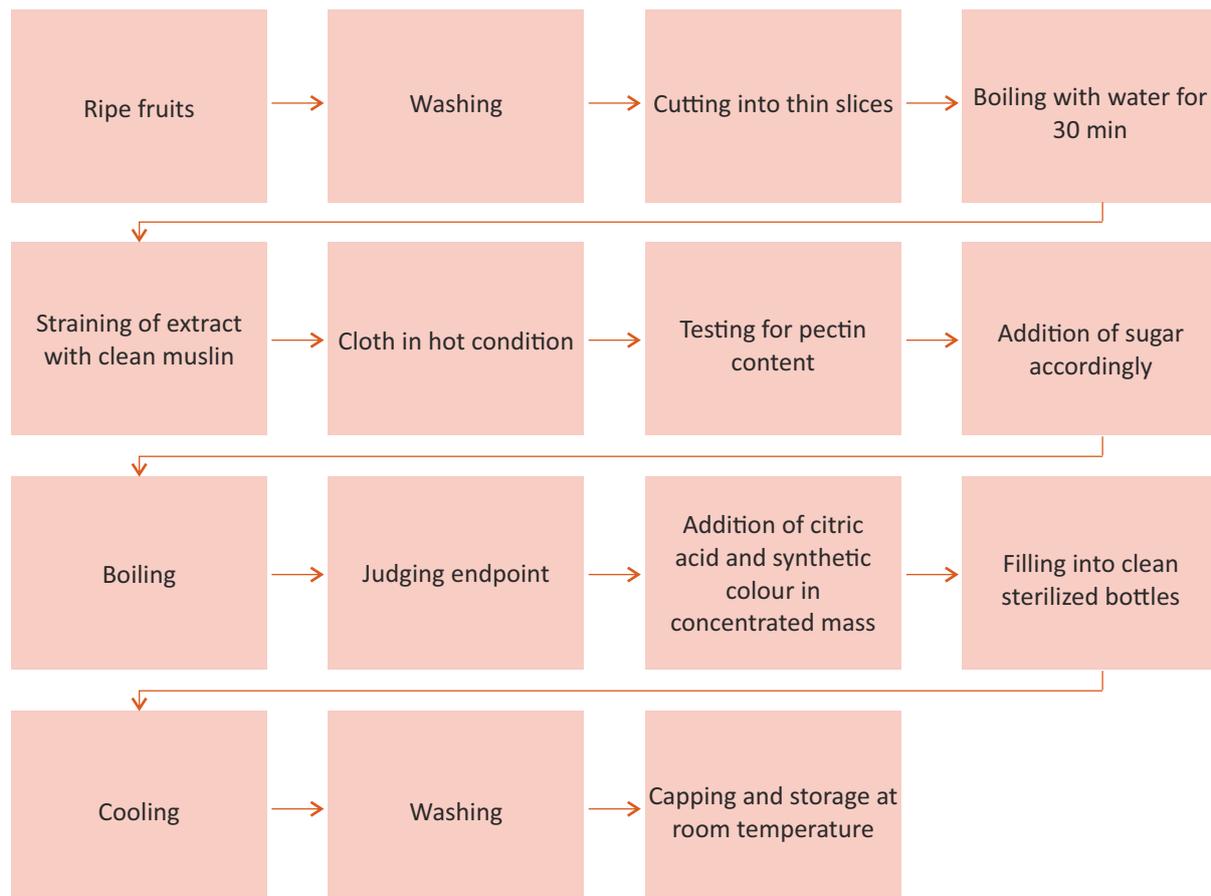


Fig.19.13 Process flowchart of preparing jelly

Testing of pectin quality

Two different methods usually determine the pectin quality in strained fruit juice or pulp:

- a. **Alcohol test:** One part of extracted fruit juice or filtered pulp is mixed with three parts of 95% alcohol and is allowed to stand for few minutes. A single translucent lump or clot will be formed in the case of an extract rich in pectin. In that case, an equal amount of sugar is to be added. The presence of a moderate amount of pectin suggests the formation of a less firm and fragmented clot. Therefore, three-fourths of the amount of sugar is to be added. The formation of numerous small granular clots, on the other hand, indicates the poor content of pectin in the extract in which half the quantity of sugar is ought to be added.
- b. **Jelmeter test:** The jelmeter is held in the left hand using thumb and forefinger. The little finger is applied to close the bottom of the jelmeter tube. The strained extract is poured into the jelmeter using a spoon and held in the right hand until it gets filled to the brim. The little finger from the bottom is withdrawn, where the extract is allowed to drip for one minute, replacing the finger at the end. The jelmeter's reading of the extract level in the jelmeter gets recorded to indicate how many parts of sugar need to add to one portion of juice.
- c. **jelly test:**
 - Temperature test: The temperature of the jelly with a candy or jelly thermometer is taken. It should be 220°F.
 - Spoon or sheet test: A cool metal spoon is dipped into the boiling jelly mixture and lifted out. When the mixture starts to boil, the drops will be light, and syrupy begins to boil. The drops will become heavier as the syrup continues to boil. Once two drops form together and sheet off the spoon it indicates that the jelling point is reached.
 - Refractometer test: The endpoint is determined with the refractometer to 68 Brix.

Problems in jelly making:

- a. **Failure of jelly to set:** It is due to an improper balance between various constituents of jelly e.g. lack of acid or pectin, too much addition of sugar, inaccuracy of measurement, inadequate cooking, overcooking, and slow cooking preventing the pectin from building a proper network of gel.
- b. **Cloudy jelly:** Unclarified juice or pectin extract, under-ripe fruit, non-removal of scum, premature gelation, over-cooking, or pouring so slowly into containers can result in a cloudy jelly.
- c. **Colour changes:** Darkening at the top of the jars can be caused by storing them in warm a place or an imperfect jar seal.
- d. **Colour fading:** Fading can occur with red fruits if stored in too warm and too bright areas or stored too long as the natural colorants are highly susceptible to high temperature and light. Another possible cause of colour fading could be the insufficient processing to destroy the enzymes affecting colour on the elevated processing temperature might cause destruction. The chemical changes caused by oxidation can also be aided by trapped air bubbles.
- e. **Crystal formation:** Excess sugar can "Seed" the jelly when high methoxyl pectin is used. Excess sugar is caused by overcooking, a lack of acid, or undercooking. Tartarate crystals can be formed in grape jelly if the juice is left to stand in the cold for several hours before being used.

- f. **Gummy and Excess softness jelly:** Gummy jelly is caused by prolonged or overcooking in which more than the desired inversion of sugar occurs. Excess softness can be caused by an imbalance of the proportions of sugar, juice or fruit, acid, and pectin used. It can be solved by selecting fully ripened fruits.
- g. **Weeping jelly:** Synergetic refers to the spontaneous exudation of fluid from a gel, also known as weeping jelly. It can be due to over-cooking, the accumulation of too low sugar or premature gelation, insufficient pectin, and storing in a warm place. "Weeping" arises during quick-setting and is due to disproportion of acid and pectin in the fruit mixture or the pectin quality of the fruit.
- h. **Presence of mold and bubbles:** The appearance of mold can result from imperfectly sealed jars and air-borne contamination if insufficient sugar is used. Water availability makes a favourable environment for contamination from the jars if they are not adequately sterilized or left under processed. Mold is noticeable before the taste is affected. Bubbles are usually caused when the jelly is not brought to the correct temperature before it is filled in the jar. This can be rectified by filling them in a boiling water canner.
- i. **Stiff and Tough jelly:** Overcooking or using too much pectin makes too tough jelly which fails to spread when applied on bread. Toughness happens because of the excess natural pectin content of the fruit. It can be solved by choosing fully ripened fruit rather than unripened ones.

19.1.5 Lab Analysis for Quality Check

It is an optimum standard maintained continuously as per the company standard norms to produce a quality product and specific guidelines as specific requirements stated in FSSAI Regulations, 2011 under chapter 2.3.31. Every step involved in the process requires monitoring, inclusive of food safety and personal hygiene. For example, in jam and jelly, a quality check is done based on technical specification and organoleptic, which differ from fruit to fruit. Following are the parameters for quality check:

1. **pH**— a numeric scale to check acid levels in fruits. Each fruit has its own acidity level. The processing company maintains it as per their requirement.

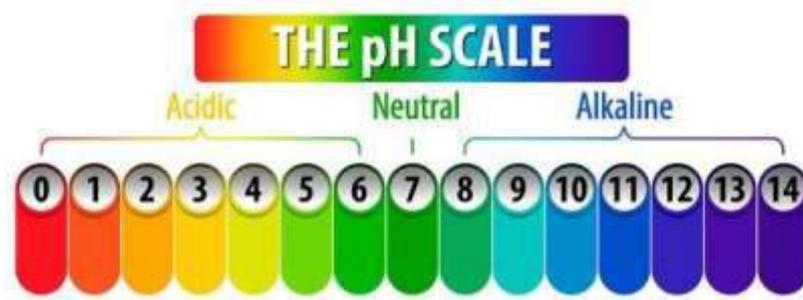


Fig.2.14 pH Scale

2. **Viscosity** - Viscosity is a measure of a fluid's resistance to flow. It is measured by viscometer as per the need.
3. **Taste/flavour, colour, and texture**– it is checked by tasting the product.
4. **Determination of pectin** - It is determined by placing 1 ml of boiled fruit extract in a test tube with the addition of 3 ml alcohol (90%) and leaving for a few minutes until clotting occurs.



Fig.2.15 Pectin in Fruit

5. **Titrateable Acidity** - It measures the total acid concentration in fruit and is determined by exhaustive titration of intrinsic acids with a standard base. Titrateable fruit acidity is expressed as g/100 mL of the predominant acid.
6. **Determination of total soluble solids** – It is the extracted mass of fruit, which contains fibers and fruit sugar. Each fruit or vegetable has its own Brix ratio. It is maintained as per company's requirement.

Scan the QR Code to watch the related video



<https://www.youtube.com/watch?v=zThmD6nrrRA>

Orange jelly processing

Exercise

I. Answer the following questions:

1. Explain the operation of the cooking kettle.

2. List the ingredients of jam and jelly.

3. What is pectin?

4. List any three problems in making jelly.

5. Explain the procedure to check the quality of the jam.

6. What are the problems that occur in the procedure of jelly making?

20. Prepare the Ketchup



Unit 20.1 Process of Preparing Ketchup



Key Learning Objectives



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

1. Perform the tasks to prepare ketchup
2. Explain the procedure of preparing ketchup

Unit 20.1 Production Process of Preparing Ketchup

Unit Objective

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

1. List the ingredients used in preparing ketchup such as sugar, salt, spice powder, vinegar, etc.
2. Elaborate the procedure to prepare ketchup from the fruit pulp
3. Explain the method to test the viscosity of the ketchup using viscometer

20.1.1 Preparation of Ketchup

Ketchup is made from strained tomato juice or pulp with the addition of spices, salt, sugar, and vinegar (onion and garlic are added optionally). As per FSSAI, chapter 2.3.27, it states the requirement of TSS of tomato which shall not be less than 25% (m/m). Ketchup is made from more or less the same ingredients and methods as chutney, with the exception that the fruit pulp or juice is sieved after cooking to remove the skin, seeds, and stalks of fruits/vegetables and spices added to give a smooth consistency to the finished product. However, cooking takes longer because fine pulp/ juice is used. High-quality ketchup is prepared by maceration of spices, herbs, fruits, and vegetables in cold vinegar or by boiling them in vinegar. Thickening agents are also added to the sauce to prevent the sedimentation of solid particles. Ketchup should be cooked to such a consistency that it can be freely poured without the fruit tissues separating out in the bottle. The colour of the ketchup should be bright. Ketchup usually thickens slightly on cooling. The container shall be well filled with the product and shall occupy not less than 90% of the water capacity of the container, when packed in the rigid containers. The water capacity of the container is the volume of distilled water at 20°C which the sealed container is capable of holding when completely filled.



Fig 20.1 Ketchup

20.1.2 List of ingredients used in preparing Ketchup

Spices: The spices should be of excellent quality and added in the correct proportions to give the product a pleasing taste and flavour. The natural tomato flavour is not dominated by any particular spice. The spices preferred in ketchup manufacture include **red chili, black pepper, nutmeg, clove, cinnamon, cardamom, mace, and cumin**. Besides these spices, seasonings like onion, ginger, and garlic may also be used in ketchup recipes. Certain specific measures are recommended for adding spice to make excellent quality ketchup or sauce.

- Red chili powder, spices, onion, and ginger should be tied loosely in the bag for better diffusion of flavoring principles in ketchup.
- The head portion of the clove should always be removed before it is grinded as it may lead to a black neck defect in ketchup.
- Usually, garlic is not the preferred seasoning in ketchup or sauce manufacture as its flavour may predominate over other spices.

The essence of clove, cinnamon, and cardamom is preferred in place of using coarsely ground powder because of the convenience of use and better flavour note in the finished product.

Methods of using ingredients for the production of Ketchup

Bag method	The coarsely ground spices are tied loosely in a muslin cloth bag, and the bag is placed in the tomato juice during boiling. The bag is pressed intermittently to release the flavouring component during processing. The proportion of these spices should be standardized so that they should not affect the color of the resultant product and do not impart bitterness. This bag can be used for the second batch also.
Use of oleoresins	Oleoresins are pure and natural extracts of spices obtained by solvent extraction. These concentrated extracts contain all the flavour components, be it volatile oils or non-volatile resinous fractions. These are the resins of active flavouring components in some solvents. The active flavouring molecule is extracted with a suitable solvent, and it can provide the complete flavour profile of the raw spice with the quick release of the flavour. Oleoresins are added few minutes before the final boiling during the manufacture of ketchup.
Use of extracts	Spice extract is prepared on a large scale by steeping or boiling spices in vinegar. The aroma component of the spices gets extracted in vinegar, and vinegary extract may be used in place of whole spice. It assists in maintaining the same taste and aroma and standardizes the proportion of spices in the recipe.
Sugar	Sugar is mainly used to adjust the sugar-to-acid ratio of the ketchup or sauce. Sugar may be added in the form of granular sugar, corn syrup, and other sweetening syrups. However, granular sugar is the most preferred one. About 1/3rd of sugar is added in the initial stage of boiling. This helps in preserving the natural colour of the product. The rest of the sugar is added a minute before the final concentration is reached. Initial addition of sugar will adversely affect the colour of the product as cooking of the product with higher amount of sugar under acidic conditions flavour brown coloured, Furfural, commercial level, sugar level varies between 10-26%. A higher amount of sugar may impart higher sweetness which is not liked by consumers.

Methods of using ingredients for the production of Ketchup

Common salt	Salt bleaches the colour of the tomato and also dissolves to some extent, copper from the processing equipment. It is, therefore, desirable to add towards the endpoint of the process. The range of common salt varies between 1.5 to 3.5%, and salt is added to enhance the flavour of the product and exert preservative action to a lesser extent. Salt of very high purity is preferred for ketchup manufacture. Salt also counteracts the highly acidic flavour of tomato pulp.
Vinegar	Vinegar is always added towards the end of the process in ketchup or sauce manufacture. Since it is a volatile product, most of the acid will lose during cooking. Tomato Ketchup" shall comply to the requirement of Acidity as acetic acid which shall not be less than 0.2%. In addition, vinegar contributes to the flavour as well as microbial stability of the ketchup.
Thickening agent	Pectin may also be added @ 0.1-0.2 percent by weight of finished product in clear juice or pulp to check the problem of serum separation and to also increase viscosity.

Table 20.1 List of ingredients used in the following way during the production of ketchup

Notes



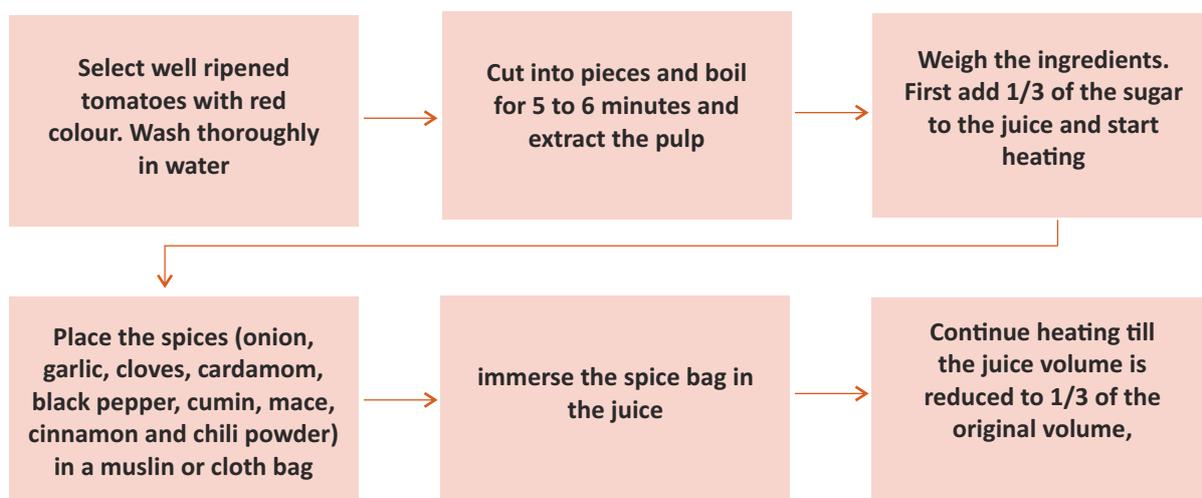
20.1.3 Procedure to prepare ketchup

- The steps of processing ketchup are given below in the table:

Cooking & Concentration	The tomatoes juice, and other ingredients are cooked and concentrated to get the desired flavour, uniform taste, and fine thickness or body. The cooking continues till the concentration reached 25 percent TSS. However, a concentration of 28-30 percent total solid is ideal as further increase may adversely affect the flavour of the product. However, to improve ketchup's stability, a slightly higher amount of sugar, salt and vinegar are added.
Bottling & Packaging	After attaining the desired total solid level and consistency, the ketchup is finally passed through a finisher to remove any tomato fiber, seeds, and any other suspended solids. After cooking, the Ketchup or sauce should be bottled hot at 85-88°C to prevent browning and loss of vitamins during subsequent storage and distribution. Hot filling of the bottle also assists in the creation of a vacuum in the headspace during the cooling of ketchup. The crown cork used for the ketchup bottle should be lined with polyvinyl chloride (PVC) to prevent the contact of ketchup with the metallic portion to avoid black neck formation. However, nowadays, sauce and ketchup are also packed in laminated flexible packaging materials consisted of polyethylene (PE), polyester (PET), and aluminum. Moreover, certain squeezable bottles are also used for the packaging of these products. Bottled and packaged products are stored under ambient temperature (30-35°C) under dry places.
Pasteurization	The hot-filled bottles are pasteurized in hot water (85-88°C) for 30-35 minutes. Care must be taken to cool the bottle immediately after pasteurization to avoid the degradation of nutrients and over-processing. Shelf-life is also enhanced by using preservatives.

Table 20.2 Processing of ketchup

- The following flow-chart shows the process of making tomato ketchup in brief:



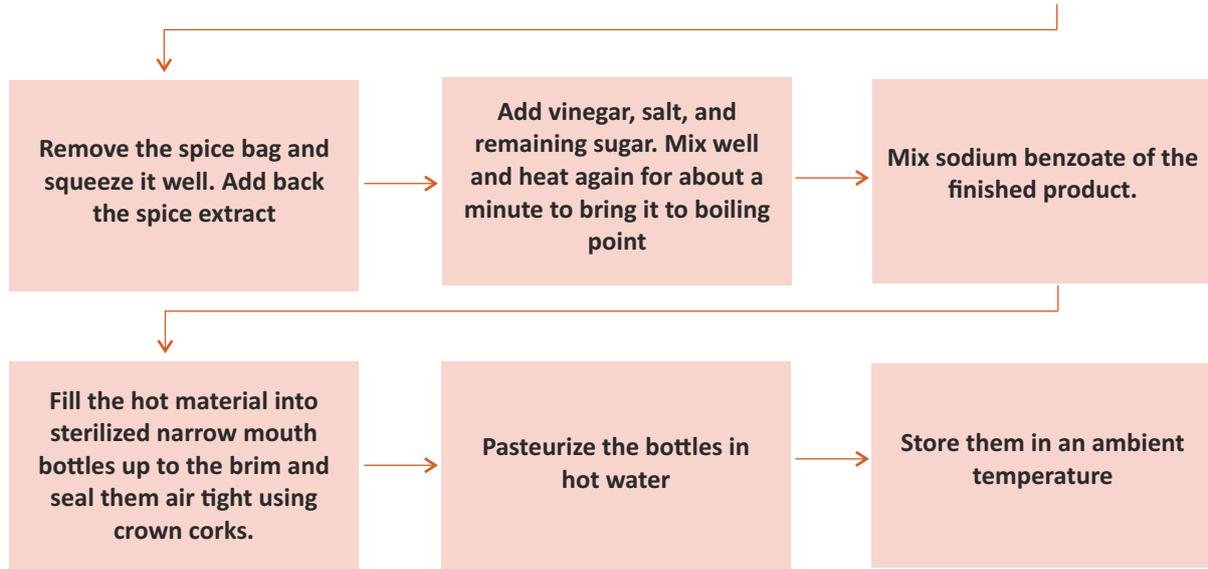


Fig. 20.2 Processing of ketchup



Fig 20.3 Storage Tank for Ketchup Making

- **Problem during the preparation of Ketchup**
- **Black neck:** It is a formation of the black ring in the neck of the bottles. It is caused by the iron which gets into the product from equipment metal or cap/crown cork. This iron when comes in contact with tannins in spice forms ferrous tannate, which on oxidation changes to black colour.
- **Prevention of black neck**
 1. Fill hot sauce at a temperature not less than 85°C.
 2. Leave less headspace in bottles (more air in bottles will result in more blackening).
 3. Reduce the chances of iron contamination.
 4. Partial replacement of sugar by corn syrup or glucose may prevent blackening.
 5. Store bottles in a horizontal or inverted position to diffuse the entrapped air/oxygen.

20.1.4 Method to test the viscosity of Ketchup using Viscometer

Viscosity is the measure of a substance's resistance to flow (under certain conditions). A **viscometer** is a measuring instrument used to determine a fluid's internal flow resistance or viscosity. The **Pascal-second** (Pa s) is the SI physical unit of dynamic viscosity (η), which is equivalent to $1 \text{ kg m}^{-1} \text{ s}^{-1}$. Fluids that have a constant viscosity autonomous from stress are called **Newtonian**. For example, water is a Newtonian fluid. Irrespective of whether you shake the cup of water, the viscosity/thickness or rate of flow doesn't change. In ketchup, viscosity corresponds to thickness. Ketchup is a non-Newtonian fluid because, unlike water, its viscosity is dependent on the shear rate. Therefore, it requires measuring its resistance to gradual deformation by stress (either shear stress or tensile stress).

- Various instruments are available to measure viscosity for quality control to the food processing industry and thus ensure that products made are of consistent quality. A common instrument that is used in the food industry is the **Bostwick consistometer**, which determines the consistency of food by measuring the distance it flows under its own weight. Typical food products measured include



Fig 20.4 Bostwick Consistometer

(Source: <https://www.cscscientific.com/consistometer/bostwick-consistometer>)

- Other common methods to test the viscosity of ketchup are listed below:

Methods to test the Viscosity Of Ketchup	
Capillary Viscometer:	One of the oldest methods of measuring viscosity, the capillary viscometer, measures the time between the volume of sample to pass through the length of the capillary tubes.
Rotational Viscometer	Measures the torque required to revolve an object within the volume of liquid
Viscosity Cup Method	Measures by observing the time it take the volume of liquid to empty the cup through a small hole in the bottom of a container/cup.
Vibrational Viscometer	By measuring the vibrational waves using a vibrating rod submerged in fluid, viscosity is calculated by analyzing the dampening of the vibration.
Falling ball viscometers	A falling ball viscometer measures the viscosity of fluids, and some units can also measure the viscosity of gases.

Table 20.3 Methods to test the Viscosity of Ketchup

Scan the QR Code to watch the related video



https://www.youtube.com/watch?v=elqc7aqx_IA
Tomato ketchup processing

Exercise

I. Answer the following questions:

1. How does sugar play an important role in the process of making ketchup?

2. Explain the bag method way of spices used during the manufacturing of ketchup.

3. What is a black neck?

4. What is a viscometer?

5. Explain the process flow of ketchup making.

21. Fill and Pack Jam, Jelly, and Ketchup



Unit 21.1 Operating packaging machine

Unit 21.2 Labelling and Coding



Key Learning Objectives



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

1. Perform the tasks to fill, pack and store the jam, jelly, and ketchup
2. Describe the reporting procedure regarding any discrepancy in the packing of jam, jelly, and ketchup

Unit 21.1 Operating Packaging Machine

Unit Objective

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

1. Discuss the procedure to load and operate the packaging machine
2. State the importance of setting packaging machine for filling volume, speed, size, etc.
3. Elaborate the standard procedure to wash bottle/plastic containers to fill measured quantity of finished products
4. State the significance of spraying water on containers to cool and set product (setting in case of jam and jelly) or arrange filled jam/jelly containers in the rack for a specified time as per the standards

21.1.1 Introduction

Food packaging is the most reliable process of food containment. This is the best way to safely control and protect the food against physical, chemical, biological, and environmental factors.

- Packaging performs varied tasks such as protecting the contents in its containment from spoilage and leakage, easier transportation and storage, and better communications between the manufacturer and consumer.
- The most important four functions of packaging include:

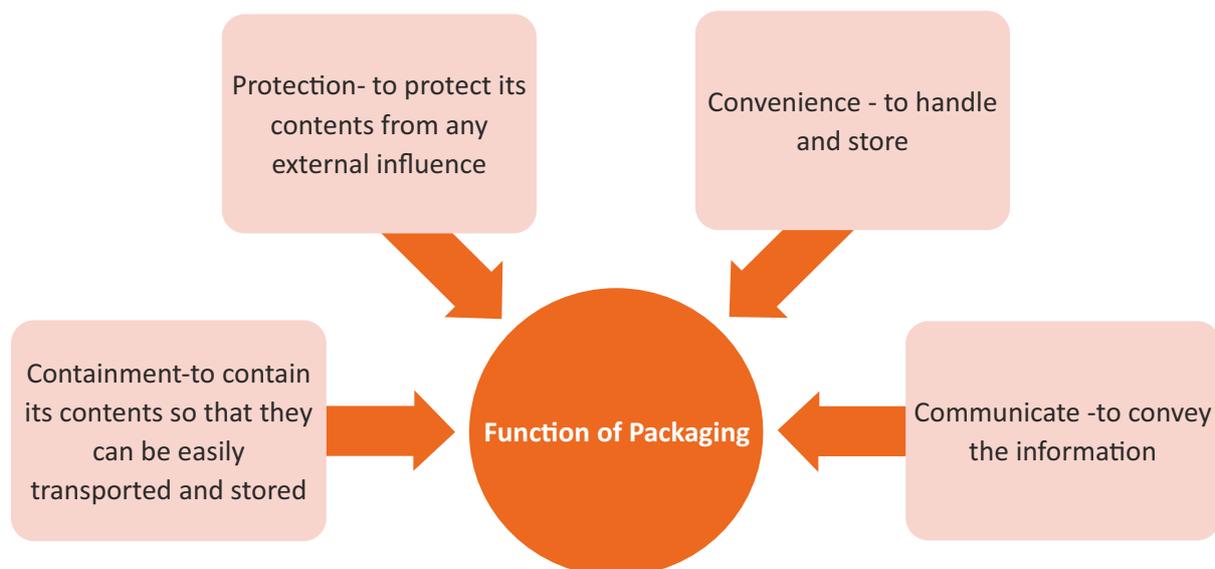


Fig. 21.1 Functions of packaging

The principal factors which affect the efficiency and utilization of a packaging line are as follows:

1. The suitability of the machine for the purpose
2. The output speed required
3. The likelihood and frequency of stoppages and the time is taken to clear them

Purpose of Packaging –

Shelf life	To maintain the organoleptic properties over a long period
Preservation	Prevent temperature fluctuations, bacterial ingress, dust, etc.
Barrier Protection	Prevent migration of oxygen, water vapor, UV light, etc.
Physical Protection	Protection from shock, vibration, compression, etc.
Security	Prevent pilferage and/or tampering. Also, assures authenticity
Portion control	A single serving pack has a precise amount of contents to control usage.

Table 21.1 Purpose of packaging

Some of the packaging machinery used in food processing industries are:

1. **Filling machines** are most often but not exclusively used in the food packaging industry. Filling machines are used to fill liquids, grains, and other products into a container. The accuracy of the filling machine helps to maintain a consistent product for consumers efficiently.
2. **Form Fill Seal or FFS** is a kind of packaging machine, where the laminates are fitted inside the equipment and thus, the machine itself first forms a package by sealing the lower half of the pack, and then fills the product as FFS contains a filling hopper and once the product is filled, the top is sealed and cut into proper packets. Form Fill Seal is used in multiple forms of flexible packaging applications. Many products within industrial, retail, pharmaceutical, and food packaging are sealed using a heat sealer. Sealers come in multiple sizes and specifications.
3. **Cartoning systems** are used in most packaging applications utilizing corrugated boxes. Tape guns are used in smaller operations, but higher volumes require case sealers for efficient packaging. Manual and automatic case sealers are used in retail, food, industrial, and pharmaceutical bulk packaging.
4. **A bottling system** is a collection of automatic machines connected by a conveyor belt or a group of highly specialized, fully automatic units that are completely integrated by a synchronized drive arrangement.

5. **Coding machines** apply a code (including bar codes), dates, and other variable or unique information to a package or transit container. These machines are usually attached to a larger packaging machine such as a cartoner, filler, or wrapper.
6. **Labelling Machines** apply labels and decoration onto all types of packaging containers, display, point-of-sale, and transit packs. Labels are used on every kind of product to brand, decorate or provide information for the consumer.
7. **Conveyors** are machines and equipment which carry ingredients, products, containers, packs, or packaging components from one place to another.

21.1.2 Workflow process of Jam, Jelly, and Packaging Machine

- Packaging machines for jams, jellies, and ketchup consists of an Unscrambler that orientates the bottles towards - the Airjet Cleaner where the bottles get cleansed with the filtered air purging & direct the bottles toward the filling station where the bottles get filled with jams, jellies, and sauce, then goes towards the Capping Station - where the filled bottles get capped at required torque & the caps are supplied with an elevator mechanism to get the capping done to the bottle.
- The packaging line consists of
 1. Cleaning Machine - for empty containers with water and steam treatment



Fig. 21.2 Cleaning and Sterilizing Machine

2. Bottle Unscrambler - for Container/bottle feeding
3. Linear piston filler - for filling dense and semi-dense products
4. Filling Area – where jars/bottles are placed



Fig. 21.3 Filling Machine

5. Cooling Conveyer- to cool the containers before moving to the capping machine



Fig. 21.4 Cooling Machine(left) & Capping Machine(Right)

6. Automatic linear capping/corking machine with cap/cork feeder- for capping the containers
7. Drying unit with air knives – to seal the caps of the container
8. Electronic Vacuum detector with the rejecting system – to reject the uncapped or cross capped containers

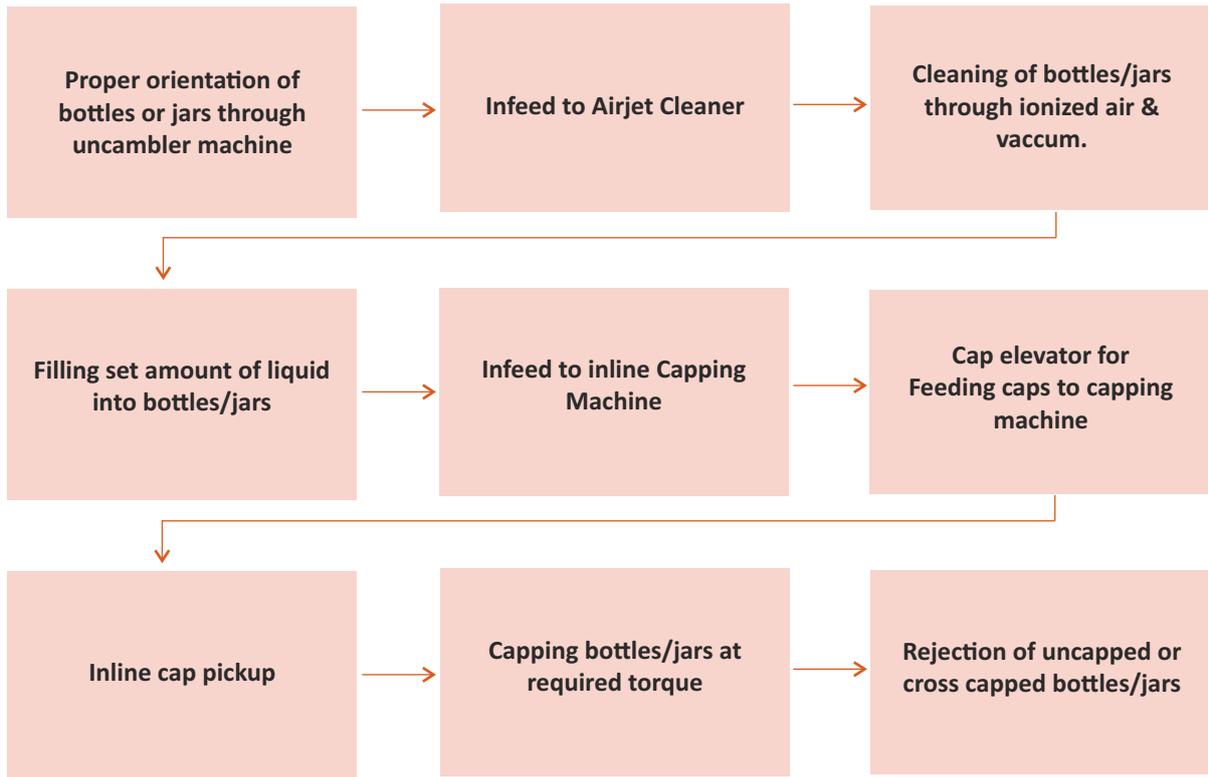


Fig. 21.5 Workflow process of Jam, Jelly and Ketchup packaging line

Notes



- Packaging criteria
- Rinsing machines for jars or other containers should be used to remove dust and debris from the containers before filling, removing the possibility of producing contaminated products or reducing the shelf life of a batch.
- Jam, jelly, or ketchup should be filled hot at 85-80 degrees C to prevent browning and loss of vitamins during subsequent storage and distribution.
- The liquid must be kept at a constant temperature throughout the process to ensure the product flow evenly and the fill can be consistently and reliably repeated.
- Packaging material should be heat-resistant i.e., should have resistance towards high filling temperature.
- It should be sturdy to prevent handling and storage hazards.
- The package should not react with and change the product's properties over a given period of storage and preservation.
- Containers should be cooled before applying the label to avoid wrinkles or peeling off of the label. It will also help the jam/jelly/ketchup to set in the container.
- Packaged products should be stored under ambient temperature in a dry place.

Unit 21.2 Labelling and Coding

Unit Objective

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

1. Elaborate the standard procedure to load labels in the labelling machine
2. Discuss the procedure to set date coding machine for a batch number, date of manufacture, date of expiry, etc.

21.2.1 Standard procedure to load labels in labeling machine

The following chart explains the standard procedure to load labels in a labelling machine.

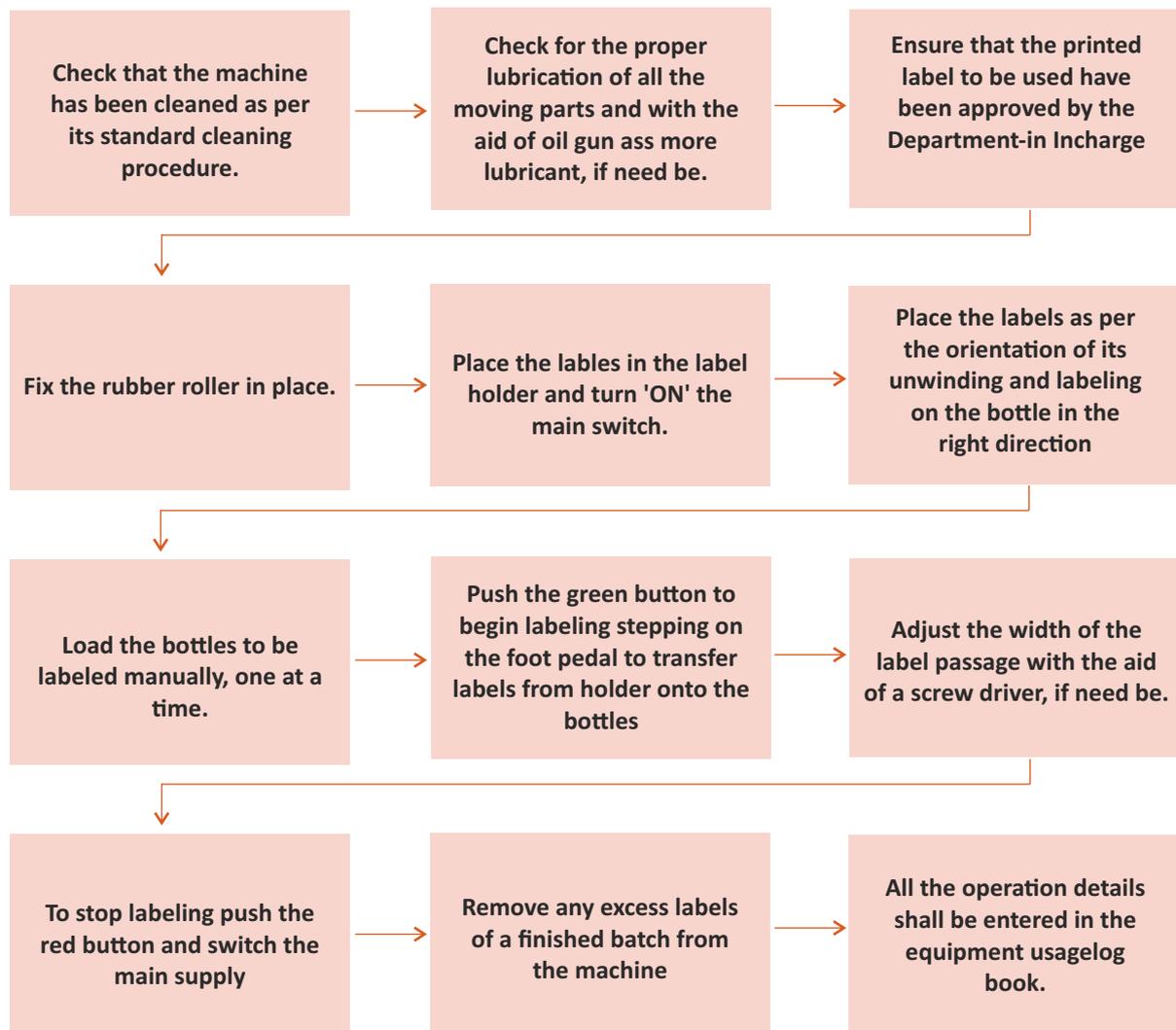


Fig.21.6 Standard Procedure to load labels in labelling machine.



Fig.21.7 Labelling Machine

(Source: <https://foodscienceuniverse.com/tomato-ketchup-production-process/>)

21.2.2 Standard procedure to proceed to set date coding machine

Following are the procedure to set date coding machine: -

Pre-start-up

- Check the status of the machine for its operation.
- Visually check the machine and surrounding area for cleanliness.
- Take the line clearance from the in-process quality assurance officer before starting the coding operation and enter the line in Batch Production Record.
- Write the Batch No., Product Name, Date, and Signature on the machine status tag.
- Get the coding details such as Batch No., Mfg. Date, Exp. Date & MRP of the bottle from the production officer.
- Take the packaging material already issued from the production officer as per the secondary packing material requisition from the store.

Startup:

Note: Batch coding should be done in a separate room with restricted admission to only a coding operator and production employee.

- Ensure that one coding operation of the product is carried out at one time. Switch “ON” the machine from the main panel.
- Switch on the machine and adjust the coding materials for alignment of impression.
- Set the rubber stereotypes on coding muster.
- Put ink on ink roller and run machine till ink spreads uniformly.
- Get the first coded material and specimen sample attached in batch production record, approved by the in-process quality assurance officer.
- Start coding operation only after getting approval from the in-process quality assurance officer.
- Store the coded material in plastic crates, put a status tag, store the crates under lock and key in storage rack after completion of day’s work.
- Collect and count the rejected coded materials in poly bags and do the entries in Batch Production Record.
- Get the last coded material approved by the In-process quality assurance officer and attached in batch production record.
- Record the operation time in the equipment logbook as per SOP
- After completing the batch, rubber stereotypes are to be destroyed as per SOP and Enter in Batch Production Record.
- After completion of the operation switch off the coding machine.
- Remove the coded /encoded packaging units from the machine and store them under lock and key.
- Collect and count the rejected packaging unit from the machine, keep it in polybags, and enter the quantity in BPR.
- Destroy and dispose of the collected packaging units.
- Switch off the main electric supply. Record the operation, cleaning & Maintenance details in the equipment logbook as per SOP and get it checked by the production officer.



Fig.21.8 Coding Machine

Exercise

Answer the following questions:

1. What is the function of a labelling machine?

2. List any two functions of the jam, jelly, and ketchup packaging machine.

3. Explain the standard procedure to set dates in a coding machine.

4. List any two examples of the packaging machine.

22. Post Production Cleaning and Regular Maintenance



Unit 22.1 Cleaning Activities and Maintenance Check



Key Learning Objectives



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

1. Describe the post-production cleaning activities of tools and equipment required
2. Perform the tasks to maintain the tools and equipment regularly

Unit 22.1 Cleaning Activities and Maintenance Check

Unit Objective

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

1. List the appropriate cleaning agents and sanitizers to clean the work area, machinery, tools, and equipment after jam, jelly, ketchup production and their uses
2. Discuss the standard procedure and importance of cleaning and maintenance of all machines and equipment

22.1.1 Cleaning and Sanitizing Work area, machinery, tools, and equipment

The cleaning and sanitizing process are one of the most essential programs in the food processing industry. It has always been a critical element for ensuring food safety and quality. Food processing industries need to be kept spotlessly clean to ensure compliance with standard regulations and prevent contamination. Everything from random debris to flakes of rust and paint needs to be kept clear from foodstuffs to make sure the product is entirely safe for consumption, so frequent cleaning is vital to food processing operations.

Though the entire process is quite tricky because of the complexity of the machinery and equipment used for jam, jelly and ketchup making, it can also introduce additional difficulty by creating a wet environment. The equipment for jam, jelly and ketchup making must be designed and built to withstand these environments, like using only food-grade stainless steel, but the complexity doesn't end there. High-pressure washers used to clean equipment can also strip the coatings on machines and cause injuries to employees, and the wet environment itself often poses a slip-and-fall hazard as well as food contamination.

Cleaning and sanitizing (disinfecting) are usually two separate processes. Effective cleaning must be carried out before sanitizing the work area and machinery, as sanitizers may not work as well if the work area or machinery has not had all visible contamination removed. Cleaning is often done using the correct proportion of detergent and water. **Detergents** are chemicals that eliminate dirt and grease. However, it does not kill bacteria and other microorganisms. Microorganisms may be removed during the cleaning process but they can't be destroyed properly. Hence, sanitizing is required for this purpose.

The primary reasons for cleaning and sanitizing the work area and machinery used for pickle and paste making are:



Fig. 22.1 Reasons for Cleaning and Sanitizing

The food processing industry follows standard procedures for cleaning the work area to ensure no bacterial growth due to the presence of leftover food particles. For cleaning purposes, the work area is divided into two categories:

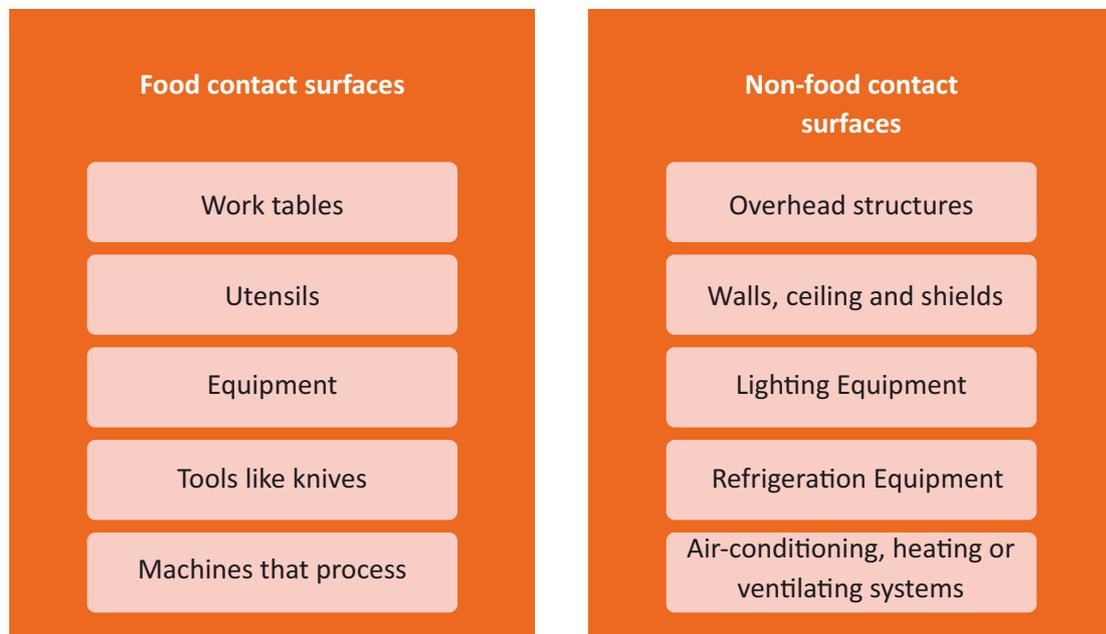


Fig. 22.2 Cleaning Work Area Categories

Proper and regular cleaning of the work areas protects food from any contamination. The cleanliness of the ambient air should also be controlled in the workplace, where contamination of any infectious material will be dangerous. The surfaces used for producing and storing jam, jelly and ketchup products with low moisture content should always be dry and hygienic during use. When wet cleaning is required, these surfaces must be sanitized and thoroughly dried to use. The entire work area in wet applications must be cleaned and sanitized absolutely before use or at the risk of contamination. Pickle and paste-making equipment and tools when not in usage should be stored properly to avoid any contamination risk.

22.1.2 Cleaning Agents and Sanitizers Used for Cleaning

There are several common cleaning and sanitizing agents that can be used to clean the food-contact and non-food contact surfaces. Select the right kind of cleaning agent or sanitizer based on the variation of soils, water hardness, the temperature of the method, plant surfaces, machinery, equipment, and tools.

Detergent suppliers usually have a range of detergents to be employed in varying and specific circumstances. The range of products will include:

Alkalis: <ul style="list-style-type: none"> • Caustic soda • Caustic potash • Coronate • Silicate, • Phosphate 	Acids: <ul style="list-style-type: none"> • Phosphoric • Nitric • Citric • Glycolic 	Chelates: <ul style="list-style-type: none"> • EDTA • NTA • Gluconate • Glucoheptonate, citrate • Polymeric 	Solvents: <ul style="list-style-type: none"> • Isopropanol • Propylene • Butyl diglycol • Ethers 	Surfactants: <ul style="list-style-type: none"> • Anionic • Cationic • Non-ionic • Amphoteric
Inhibitors: <ul style="list-style-type: none"> • Organic • Inorganic 	Enzymes: <ul style="list-style-type: none"> • Protease • Lipase • Amylase 	Oxidising agents: <ul style="list-style-type: none"> • Hypochlorite • Isocyanurates 	Stabilisers	Viscosity modifiers

Fig. 22.3 Various Ranges of Detergents

A detergent solution may contain between 2 to 15 components, which are blended carefully as per the specification. It is essential to identify the correct detergent for cleaning operation correctly. This will save money in the long term as cleaning will be more effective. The failure of a product to work is usually not due to a poor quality product but rather choosing the wrong one. Application and use are also important factors, and a good supplier will usually provide training in the correct use of the product. A 'detergent' is designed to remove soils. Another term used is 'sanitizer' and is often used to describe similar products. However, a 'sanitizer' refers to a product containing both a detergent and disinfectant. A 'disinfectant' is a product that kills microbes without employing a soil removal action.

The table below lists the typical cleaning agents and their appropriate usage, risks, and safety measures that should be taken while using these agents.

Cleaning agents	Used for	Risk	Safety measures
Hypochlorite like <ul style="list-style-type: none"> potassium hypochlorite, sodium hypochlorite, and calcium hypochlorite 	Cleaning stainless steel food contact surfaces	Leads to corrosion	Ensure pH and concentration levels are maintained
Liquid chlorine	Internal cleaning of stainless steel equipment and vessels	Leads to corrosion	Ensure concentration levels are maintained
Hydrogen peroxide	Killing bacterial spores, pathogens, spoilage organisms, and other microorganisms	Has a strong odor	Use in well-ventilated and open spaces
Ozone	Cleaning food-contact and on-food-contact surfaces like equipment, walls, doors, drains, conveyors, tanks, and other containers; Killing microbes	No risk involved since it leaves no residue	Safe to use

Table 22.1 Different types of cleaning agents, related risk factors, and safety measures

Cleaning and sanitization take time and cost money. However, with proper planning, well-designed and organized food processing businesses can reduce the time required for thorough cleaning.

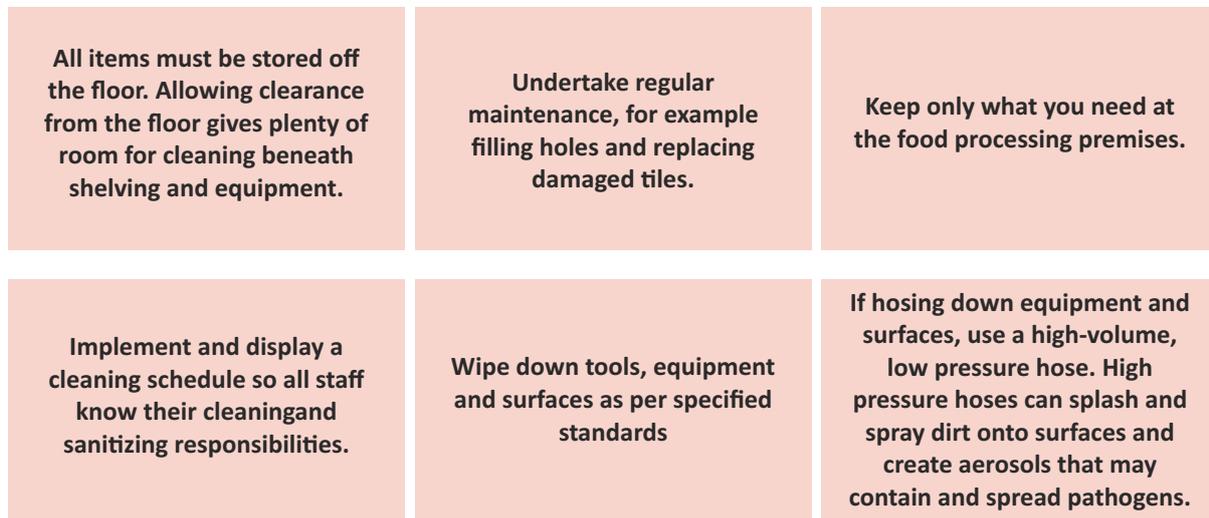


Fig. 22.4 Procedure for Cleaning and Sanitization

The term sanitary refers to the state of a food contact surface or machinery where it does not contain microorganisms at a level that would permit the transmission of infectious disease or compromise food safety. Sanitizers are substances capable of destroying microorganisms, including those bacteria that cause food poisoning and other diseases. With appropriate use, they can reduce surface contamination by bacteria to a safe level. Therefore, it is essential to read and follow the directions on sanitizers carefully. Sanitizing is usually done using heat and water, or chemicals, or a combination of both methods.

Effective practices for sanitization

For effective and safe use of a sanitizer, follow the manufacturer's instructions provided on the label.

- Some sanitizers are toxic to people, and the residue must be rinsed off, while other sanitizers are food-safe and do not require rinsing. So, the manufacturer's instructions shall always be followed for the sanitizer to ensure safe use.
- Sanitizers work best at the correct dilution. If they are too weak, they do not work effectively, and money is being wasted if they are too strong.
- Sanitizers need time to work. The contact time varies and may be seconds or minutes depending on the job.
- Check the dilution, contact time, safety precautions, shelf life, and storage of all chemicals before use.

In some cases, cleaning and disinfection may be combined into one operation using a sanitizer which has the action of both a detergent and a disinfectant. However, it is believed that the two-stage approach is more consistent and effective than the single-stage sanitizer approach. It is important that non-scented chemicals are used in food operations due to the risk of taint.

22.1.3 Postproduction Cleaning of Work Area and Machinery

After the production cycle is complete, cleaning the area, machines, and equipment becomes imperative before starting the following process. Otherwise, the residuals from the previous cycle may cause contamination and other related quality problems in the upcoming production cycle. There are various methods of cleaning the work area and machinery that can be applied as per the requirement.

i. Manual Cleaning:

This method of cleaning uses cloths, mops, brushes, pads, etc. It is usually used in small areas or non-waterproof equipment or machinery that requires dismantling or areas that are difficult to clean by other methods. It is a labor-intensive method and may limit the use of certain chemicals for safety reasons. The method must be clearly defined and staff trained to an appropriate level to ensure cleaning is effective.

ii. Foam Cleaning:

It is the common method for cleaning most food operations. A foam blanket that is created using a wide range of available equipment is projected from a nozzle and is allowed time to act on the soil. Then, it is rinsed off with the released deposits. Foam cleaning is ideal for cleaning large areas such as floors, walls, conveyors, tables, and well-designed production equipment. Foam is a carrier for detergent. The foam is applied in an even layer. Coverage rates are quick, and chemical usage is economical. The equipment for foam cleaning may be mobile, or centralized.

iii. Spray:

Spray cleaning uses a lance on a pressure washer with chemical induction by venturi. This should ideally be used where foaming properties are not essential for the cleaning action as this method can be wasteful of chemicals and can be slow to produce foam.

iv. Fogging:

This method uses compressed air or other equipment to generate a fine mist of disinfectant solution, which hangs in the air long enough to disinfect airborne organisms. It also settles on surfaces to produce a bactericidal effect. The system is available in both small portable devices and built-in automatic central systems. Fogging should never be used as a primary sanitizing method. This shall be used in conjunction with other methods. It is also vital to ensure that coverage and saturation are sufficient and the mist is acceptable to allow proper action.

v. Machine Washing:

Machine washing is an automatic or semi-automatic washing process conducted within a purpose-built machine. Many machine designs are available depending on the application, e.g., crate washing or utensil washing. They represent a significant capital investment and need to have a clear business case before purchasing. In addition, they tend to consume a large number of chemicals and water. Failure to maintain them correctly can lead to a contamination risk to the product. Chemicals used in these machines should be low foaming. An effective system for controlling the dose of chemicals should be employed, and temperature control systems should be used where critical.

When cleaning and disinfecting work areas and equipment, the following practices must be followed:



Fig.22.5 Standard Practices for Cleaning the work area and equipment

22.1.4 Workflow Process for Cleaning Machinery and Equipment

Cleaning is a complex process. A defined and systematic approach should be followed to ensure it is conducted appropriately that considers several factors. This approach takes the form of a Procedure, and this is usually a legal requirement in addition to a fundamental requirement of global food standards. A collection of these cleaning procedures forms a Cleaning Plan or Program, which is plant-specific. The correct sequence of a general cleaning procedure for surfaces in a food plant is:

Cleaning Preparation

- A poor cleaning preparation is the single biggest reason for poor or inconsistent bacterial counts on surfaces and for high bacterial contamination in aerosols caused by rinsing.
- A well designed cleaning procedure will provide for the removal of all food pieces greater than a fingernail before applying detergent.
- Ideally this should be done dry by hand, scrapping or other physical method.
- The collected material should be placed in waste receptacles and removed from the area.
- All ingredients, food and packaging materials should also be removed from the area prior to cleaning preparation.

Pre-rinsing

- This step aims to remove deposits that cannot be easily removed by picking, scrapping, or other manual forms of gross cleaning.
- Excess water should be removed following pre-rinsing to avoid dilution of the detergent in the following step.

Pre-rinsing

- The purpose of the detergent is to remove the layers of proteins, greases, and other food deposits that remain on surfaces.
- Detergents are not designed to remove large pieces of food deposits or thick layers of fat. In these layers, bacteria can survive and grow and make the use of a disinfectant pointless.
- The foam should be conducted carefully and methodically, and there should be a check to ensure that all surfaces have been covered.
- Detergents should be made up and used according to the supplier's instructions, and appropriate time should be allowed for the detergent to work.

Post-Rinsing

- The purpose of post rinsing is to remove the remaining food deposits.
- Care should be taken to minimise the amount of splash and aerosol formed which may re-contaminate surfaces.
- After post rinsing, the surface should be free of all visible deposits, layers of soiling, and detergent residues
- Any residues of detergent may neutralise the action of any subsequent disinfectant.
- Any pools or accumulations of water should be removed following post rinse.

Disinfection

- Disinfection should only be carried out on a visually clean, well-rinsed surface, with minimal water.
- Direct food contact surfaces should be disinfected at least daily, with other surfaces disinfected regularly.
- Disinfectants should be used safely according to the supplier's instructions.

Terminal Rinsing

- Most disinfectants are safe to leave on non-food contact surfaces without final rinsing.
- However, there is a requirement to rinse food contact surfaces with water after disinfection in some sections of the food industry.
- The standard of the water is important to ensure that the disinfected surface is not re-contaminated.

Fig.22.6 Sequence for Cleaning Machinery and Equipment

The following chart explains the process of cleaning machinery and equipment after the production cycle is over.

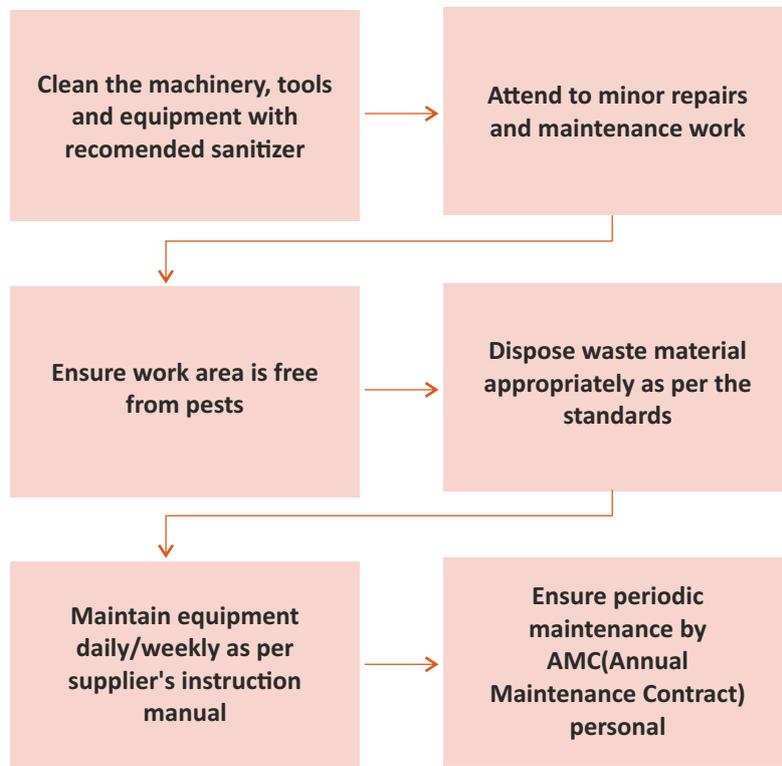


Fig.22.7 Sequence for Cleaning Machinery and Equipment

22.1.5 Types of Maintenance and Checks

In food manufacturing, maintenance supports various key objectives, many of which are unique to food production. Maintenance plays the following roles in food manufacturing:

1. It keeps the production running smoothly
2. It helps to prevent any contamination and ensure food safety
3. It reduces product losses
4. Maintain regulatory compliance

An effective maintenance routine ensures that operations are continued, repair costs are minimized, and downtime is reduced.

Following are the types of maintenance that are carried out in a food processing unit:

1. Reactive Maintenance is a method where machines run until they fail. It's a hands-off approach, and the significant benefit is that it keeps routine maintenance costs low.
2. Predictive Maintenance uses advanced technology such as infrared and ultrasound equipment during the routine inspection of machines. This process can stop unpredicted breakdowns, and using advanced technology and the industrial unit can reduce the amount of time needed to inspect equipment piece by piece. This type of maintenance is expensive, but this method accurately stays a step in front of faults.
3. Proactive Maintenance is a systemic issue-focused maintenance program. Rather than examining equipment, this approach considers how to control the problems that lead to machine wear and tear instead of the deterioration itself.
4. Preventative Maintenance is the checking of machines and equipment on a planned, regular basis. The purpose is to prevent costly downtime and minimize the probability of faults. It requires more planning and effort than other techniques. However, it has long and short-term benefits in cost-reduction and efficiency of machine performance. Preventative checks are done before a machine breakdowns and while it is still in running condition. Generally, the strategy leads to good food hygiene and prevents foreign materials from entering food produce.

It is essential to have a schedule for preventative maintenance of each piece of machinery and equipment used in the production. This consists of:

- Time schedule stating when and how frequently maintenance should be done
- Maintenance activities list for each item

These schedules provide simple guidelines for all types of equipment, covering the duties to be undertaken in the following areas:

MAINTENANCE SCHEDULE GUIDELINES
Care and cleaning
Safety checks
Functional and performance checks
Maintenance tasks (changing bulbs, lubricating moving parts,

Fig.22.8 Maintenance Schedule Guidelines

Checklist for Planning Maintenance

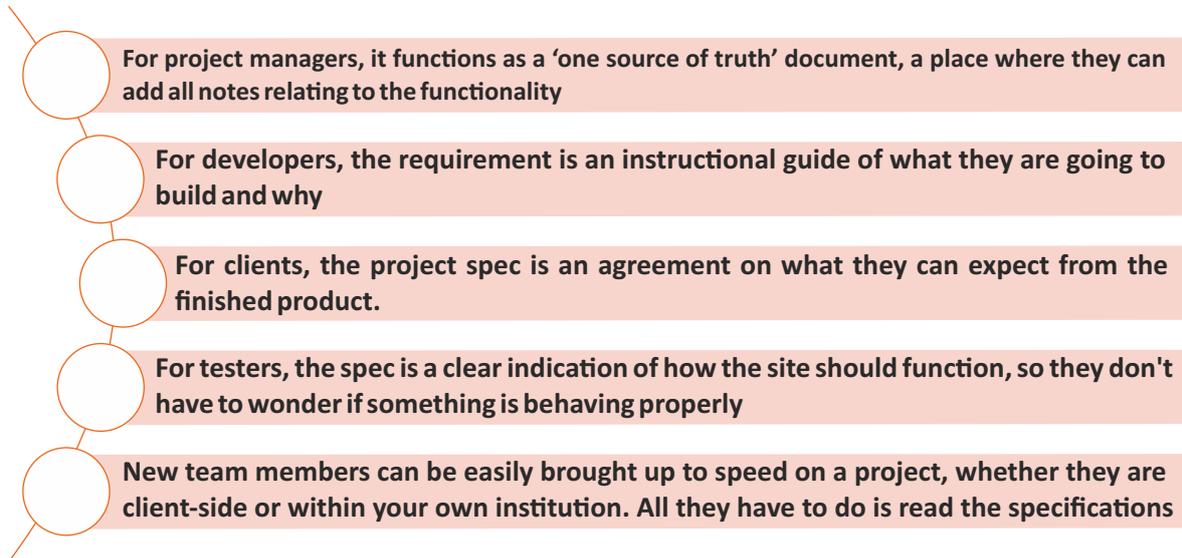


Fig.22.9 Maintenance Checklist

After completing any maintenance, the technician must keep a log for maintenance. This log entry should include a description of the work carried out, who carried it out, and the date and time it happened.

Exercise

Answer the following questions:

1. List any two reasons for cleaning and sanitizing the work area.

2. What are the standard cleaning practices?

3. Name any two cleaning and sanitizing agents for cleaning work area and equipment.

4. Describe the importance of equipment maintenance and check.



23. Employability Skills



Scan the QR code below to access the eBook
<https://www.skillindiadigital.gov.in/content/list>



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24. Annexures

Annexure I : QR Codes



Annexure I - QR Code

Serial No.	Module No.	Unit Number	Topic Name	Page No.	URL	QR Code
1.	Module-1 Introduction to Food Processing Sector and the Job of Fruit Pulp Processing Technicia	Unit 1.1 Introduction to Food Processing Industry	Overview of Food Processing Industry	9	https://www.youtube.com/watch?v=-J-2EiMVNtpM&t=5s	
2.			Overview of Fruit and vegetables industry	9	https://www.youtube.com/watch?v=hW10tq2fWfY	
3.			Orientation video of fruit pulp	9	https://www.youtube.com/watch?v=TC1mGaWoyXk	
4.		Unit 1.2 Career Opportunities for Fruit Pulp Processing Technician	Roles and responsibility of Pulp Making technician	14	https://www.youtube.com/watch?v=F4qEpblDaks	
5.		Module-2 Prepare for production	Unit2.3 - Cleaning and Maintenance	Waste Disposal	43	https://www.youtube.com/watch?v=nrEOtxjwKsQ&t=24s

Serial No.	Module No.	Unit Number	Topic Name	Page No.	URL	QR Code
6.			Cleaning and sanitation	43	https://www.youtube.com/watch?v=QWpU7DAfNcs&t=2s	
7.			Cleaning facilities	43	https://www.youtube.com/watch?v=CD0XLUutibk	
8.			Maintenance	43	https://www.youtube.com/watch?v=tRAnusofqJ8&t=48s	
9.			Fruit pulp making process	79	https://www.youtube.com/watch?v=VEutWeSg23k	
10.	Module-5 Fruit Pulp Extraction and Pre-cooking of the Pulp	Unit 5.1 Fruit Pulp Extraction Process	Guava Pulp processing	79	https://www.youtube.com/watch?v=ad1WZGA6ZBo	
11.			Grape pulp processing	79	https://www.youtube.com/watch?v=supESo8qnpj0	

Serial No.	Module No.	Unit Number	Topic Name	Page No.	URL	QR Code
18.		Unit 8.4 - Health Safety	Personnel Hygiene and personnel behaviour	134	https://www.youtube.com/watch?v=gNEx8P9UqPA&t=35s	
19.	Module-16 Prepare the Squash	Unit 16.1 Production Process of Squash	Lime squash processing	249	https://www.youtube.com/watch?v=RliVo_wVFEQ	
20.	Module-19 Prepare Jam and Jelly	Unit 19.1 Production process of preparing Jam and Jelly	Apple jam Processing	280	https://www.youtube.com/watch?v=ZozA1gHN0DA	
21.			Orange jelly processing	285	https://www.youtube.com/watch?v=zThmD6nrrRA	
22.	Module-20 Prepare the Ketchup	Unit 20.1 Process of Preparing Ketchup	Tomato ketchup processing	295	https://www.youtube.com/watch?v=elqc7aqx_lA	
23.	Employability Skills		Employability Skills - 30 Hours	324	https://www.skillindia.digital.gov.in/content/list	



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