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FICSI
FOOD INDUSTRY CAPACITY & SKILL INITIATIVE

Participant Handbook

Sector
Food Processing

Sub-Sector
Food Grain Milling

Occupation
Processing-Food Grain Milling

Reference ID: **FIC/Q1010, Version 1.0**
NSQF Level 4

Fortified Rice Technician

Published by

Food Industry Capacity and Skill Initiative

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Printed in India at

Food Industry Capacity & Skill Initiative

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

Shri Narendra Modi
Prime Minister of India

Certificate

COMPLIANCE TO QUALIFICATION PACK - NATIONAL OCCUPATIONAL STANDARDS

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SKILLING CONTENT : PARTICIPANT HANDBOOK

Complying to National Occupational Standards of

Job Role/ Qualification Pack: **"Fortified Rice Technician"** ' QP No. **FIC/Q1010, NSQF Level 4**

Date of Issuance: 31/03/2022

Valid up to*: 31/03/2025

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

Authorised Signatory

Food Industry Capacity & Skill Initiative

Acknowledgement

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

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

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

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

About this book

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

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

The Qualification pack of Fortified Rice Technician, Level 4 includes the following NOS's which have all been covered across the units

1. **FIC/N9026:** Prepare for production
2. **FIC/N1036:** Carry out production of fortified rice
3. **FIC/N9901:** Implement Health and Safety Practises at Workplace
4. **FIC/N9902:** Work effectively in an organisation
5. **SGJ/N1702:** Optimize resource utilization at workplace
6. **DGT/VSQ/N0101:** Employability Skills (30 Hours)

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

Symbols Used


Key Learning Outcomes


Steps


Exercise


Notes


Unit Objectives

Table of Contents

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सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
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1. Introduction to Food Processing Sector and the Job of "Fortified Rice Technician"

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Unit 1.1 – Food Grain Milling in Food processing Industry

Unit 1.2 – Role of Fortified Rice Technician in the Food Processing Industry

FIC/N1036

Key Learning Outcomes

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

1. Define food processing
2. List the various sectors of the food processing industry
3. Describe the food grain milling in food processing industry
4. State the roles and responsibilities of a Fortified Rice Technician

Unit 1.1: Food Grain Milling in Food Processing Industry

Unit Objectives

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

1. Define food processing
2. List the various sectors of the food processing industry
3. Describe the food grain milling in food processing industry

1.1.1 Food Processing

Agriculture is the backbone of the Indian economy. The produce from various agriculture-based occupations is primarily used for consumption within the country. It is exported to different parts of the world as well. Agricultural produce is also used as raw material in the food processing industry.

Food processing is the method used to convert raw materials into food products. They could be processed foods, ready-to-eat foods, food additives or foods used to prepare other food products. Besides food processing, the food industry also relies on food preservation as an important method to store food products for longer periods of time.

The food processing industry in India is divided into several sub-sectors. They are:

Fig 1.1.1 Sub-sector of food process industry

The Indian food industry is a star sector in India with bright prospects for growth and development. The Indian food and grocery market is the sixth-largest in the world. The food industry, particularly the food processing sector in India, has shown immense potential due to its quick-paced growth. Food processing ranks fifth in the country in terms of its production, growth, export, and consumption. Oneof the recent trends that is seen in this sector is the online ordering of food. Even though this segment is still in its early stages of development, it is growing at an increasingly fast pace.

The food industry is implementing stringent food safety and quality measures in order to attract more investors and ensure the safety of its existing consumers. All these factors will have a positive impact on the way the sector functions and also on the job market in the country.

1.1.2 Journey of Food from Harvest to Consumer

The following chart shows the journey that food material goes through to become a final, consumable product to various customers.

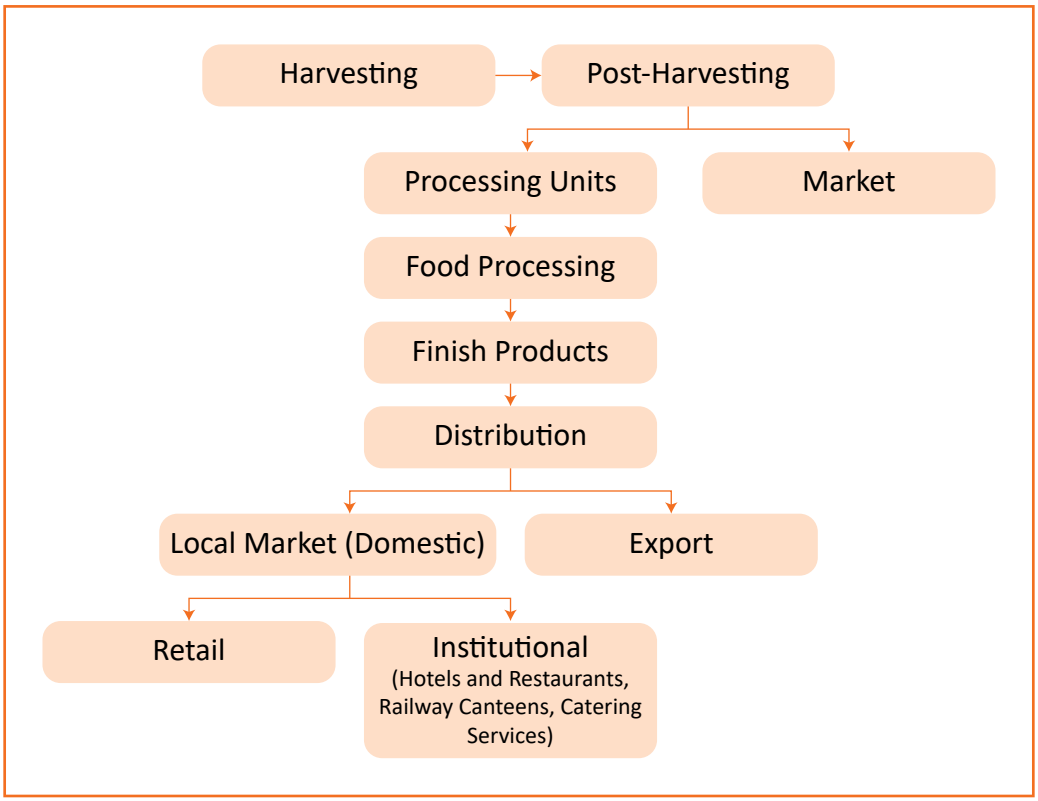

Fig 1.1.2 Sub-sector of food process industry

1.1.3 Indian Food Processing Industry Market

The food processing industry forms a major part of India's economy owing to the variety of food products that the country harvests and further processes for consumption. India is the largest producer of milk, bananas, mangoes, guavas, papaya, ginger, okra; second-largest producer of wheat, rice, fruits, vegetables, tea, sugarcane and cashew nuts and the third-largest producer of cereals, coconut, lettuce, chicory, nutmeg, mace, cardamom and pepper worldwide. Rising incomes and a growing demand for healthy, packaged food ensure that this industry is likely to sustain all seasons and never fear a recession. The industry also receives growing support from the government.

Market Stats

- India's food processing sector is one of the largest in the world and its output is expected to reach US$ 535 billion by 2025-26.
- This sector is expected to generate 9 million jobs by 2024.
- The Indian food industry is expanding at a CAGR of 11% and the food processing sector accounts for 32% of the total food industry.
- India's food sector attracted US$ 4.18 billion in foreign direct investments between April 2014 and March 2020.
- By 2030, Indian annual household consumption is expected to triple, making India the fifth-largest consumer in the world.

Key growth drivers & trends

- There is growth in the organised food retail sector and increase in urbanisation.
- MSME's are playing a vital role in India's food processing chain through various advancements in skills and technology.
- The online food ordering business in India is witnessing an exponential growth.
- There is high demand for packaged, healthy and immunity booster snacks such as roasted nuts, popcorns, and roasted pulses.
- There is a shift in focus from loose to branded packaging.
- The government's 'Atmanirbhar Bharat' initiative places priority on this sector and offers support through various policies.

The Indian Government, in the 'Make in India' campaign, has prioritised the food processing sector and promotes investments in the sector. In addition, the government has established 18 mega food parks and 134 cold chain projects to develop the food processing supply chain. These initiatives are likely to boost food processing companies. Also, the recent government initiatives—such as Rs. 10,000 crore scheme rolled out by the Finance Minister, Mrs. Nirmala Sitharaman, to support this industry—have placed the food processing sector on a high growth trajectory.

1.1.4 Ministry of Food Processing Industries

The Ministry was set up in 1998 and the industry segments that come under its purview are:

- Fruit and Vegetable processing (including freezing and dehydration)
- Grain Processing
- Processing of Fish (including canning and freezing)
- Processing and refrigeration of certain agricultural products, dairy products, poultry and eggs, meat and meat products
- Industries related to bread, oilseeds, meals (edible), breakfast foods, biscuits, confectionery, maltextract, protein isolate, high protein food, weaning food and extruded food products (including other ready-to-eat foods)
- Beer, including non-alcoholic beer
- Alcoholic drinks from non-molasses base
- Aerated water and soft drinks
- Specialised packaging for food processing industries.

1.1.5 Food Grain Milling

Milling is the process of cleaning, tempering, and grinding cereal grains into flour and other milled grain products. Milling of foodstuffs is an ancient craft, dating back thousands of years to the dawn of civilization. The first food materials to be ground were probably cereal grains. By reducing the average particle size of foods, humans were able to enjoy more palatable forms of meals, access different nutritious components, make food preparations easier to chew and create different products from the same source or raw material.

Fig 1.1.3 Food grain milling

In the food industry, raw materials, flours and intermediate products must often undergo milling or

grinding for size reduction. Various types of mills are available, including:

- Hammer mills
- Pin mills
- Roller mills
- Ball mills

Examples of size reduction in the food industry include -

- Milling of cereal grains to obtain flour
- Wet milling of corn for manufacturing starch
- Wet milling of wheat for manufacturing vital wheat gluten
- Fine grinding (refining or conching) of chocolate mass
- Flaking of oilseeds (e.g. soybeans) prior to solvent extraction

How does milling work?

Grain milling is essentially a process of separating the grain into its constituents, i.e. germ, bran and endosperm. It serves three main purposes - the breaking and opening of kernels, purification of endosperm and further particle size reduction. Various classes of products can be produced from milling wheat, corn, oats and other grains ranging from fine flour to semolina, grits and flakes.

Steps involved in wheat milling:

The wheat milling process involves separating the wheat grain into three constituents - germ, bran, and endosperm. It is a complex and intricate process. Once the wheat is prepared it is weighed, inspected, and graded. Then, the grain is separated by size, shape, and weight.

1. Cleaning
2. Tempering and conditioning
3. Gristing
4. Separating
5. Milling
6. Blending

Choosing adequate systems and conditions depends greatly on the type of wheat and target product among other factors. In hard wheats, for example, the starch and protein components of the endosperm are very tightly bound, thus requiring longer tempering times and more mills and reduction systems compared to soft wheats with soft endosperms. Milling of soft wheats produces fine particles with narrow size distribution. These flours tend to agglomerate and are very difficult to sift.

Unit 1.2: Role of Fortified Rice Technician in the Food Processing Industry

Unit Objectives

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

1. State the roles and responsibilities of a Fortified Rice Technician

1.2.1 Roles and Responsibilities

A fortified rice technician is responsible for producing fortified rice through extrusion method by operating extruder in synchronization with various tools and equipment as per the standard operating procedures of the organization to achieve uniform quality product with consistent output.

The roles and responsibilities of a Fortified Rice Technician:

- Perform and monitor various activities for rice fortification
- Prepare samples to plan and prioritize work schedules
- Estimate the resources as per the requirement (raw materials, packaging materials, machineries, and manpower
- Plan capacity utilization of machineries
- Perform cleaning of machines and tools and sanitize them following the organization's specifications and standards.
- Inspect the tools, equipment and machinery to ascertain suitability for use.
- Report information such as faulty tools and equipment to the concerned authority.
- Organize production materials appropriately.
- identify various raw materials such as broken rice, vitamin premixes, minerals and other ingredients
- Verify obtained ingredients meets the organisational standards as well as the standards laid down by FSSAI
- Arrange and segregate the raw material based on inspection
- Perform process of grinding and sieving of normal rice
- Perform process of mixing vitamin and mineral premix into the ground rice flour
- Perform extrusion process to produce extruded fortified rice kernels
- Perform process of blending the mixture to produce fortified rice
- Identify different losses during the production of fortified rice
- Perform process of butt drop and flat drop test on suitable packaging material
- Arrange a proper storage area for Fortified rice
- Monitor packing of fortified rice in suitable packaging material

- Ensure properly labelling of package according to FSSAI guidelines
- Facilitate cleaning and regular maintenance of equipment at the workplace

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

https://www.youtube.com/watch?v=J-2EiMVNtpM&t=11s

Overview of Food processing industry

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3. Prepare for Production

Unit 3.1 – Fortification of Rice

Unit 3.2 – Preparation for Fortification of Rice

FIC/N9026

Key Learning Outcomes

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

1. Describe fortification of rice
2. List Indian government schemes and initiatives related to rice fortification
3. Describe process of rice fortification
4. List requirements for fortification of rice

Unit 3.1: Fortification of Rice

Unit Objectives

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

1. Describe fortification of rice
2. List Indian government schemes and initiatives related to rice fortification

3.1.1 Fortification

Fortification is the addition of minute quantities of key vitamins and minerals such as iron, iodine, zinc, Vitamin A & D to commonly consumed staples such as rice, wheat flour, salt, milk and oil to improve their nutritional content. These nutrients may or may not have been originally present in the food before processing.

Fortification is the practice of deliberately increasing the content of one or more micronutrients (i.e., vitamins and minerals) in a food or condiment to improve the nutritional quality of the food supply and provide a public health benefit with minimal risk to health. As well as increasing the nutritional content of staple foods, the addition of micronutrients can help to restore the micronutrient content lost during processing.

Most fortified foods are processed and packaged. Common ones include:

- Breakfast cereals
- Bread
- Eggs
- Fruit juice
- Soy milk and other milk alternatives
- Milk
- Yogurt
- Salt

Nutrients added to fortified foods include:

- Folic acid
- Vitamin A
- Vitamin B6
- Vitamin B12
- Calcium
- Vitamin D
- Vitamin E

- Iron
- Iodine

Benefits of food fortification

- Removes malnutrition and nutritional deficiencies.
- Provides extra nutrition at affordable costs.
- The essential characteristics of the food remain the same. This means that the original taste, texture, and appearance are unchanged.
- Wide scale production of fortified foods can help improve the overall nutritional problem of a country, by catering to both, the poor and the wealthy.
- The process of fortification is cost effective.

Limits of fortified foods

Fortified foods have limits to how much they can improve and protect your health.

- Fortified product doesn't mean it's healthy, they are heavily processed foods. They're often high in sugars, fats, sodium, and other ingredients that can lead to problems like obesity.
- You might get too many vitamins and minerals in your diet, which can be harmful.

3.1.2 Fortification of Rice

Fortifying rice makes it more nutritious by adding vitamins and minerals in the post - harvest phase; many of which are lost during the milling and polishing process. Rice fortification may be considered as having the highest potential to fill the gap in current staple food fortification programs as it is the staple food of 65 percent of the Indian population and reaches the most vulnerable and poorer section - with the highest uptake in the government safety net programmes.

Need of rice fortification:

- Rice is a staple food for more than half of the global population, providing more than 20% of the world's calorie intake.
- The deficiency of micronutrients or micronutrient malnutrition, also known as "hidden hunger", is a serious health risk. Rice is widely consumed in many developing countries, where 'hidden hunger' is an issue. This offers a unique opportunity for nutrition improvement in the form of rice fortification.
- India has very high levels of malnutrition among women and children. According to the Food Ministry, every second woman in the country is anaemic and every third child is stunted.
- There are multiple factors to consider when developing sustainable and effective rice fortification programs, which have a positive impact on public health, including which vitamins and nutrients to include and at which level, the how to integrate fortification into the rice supply chain, and ensuring it meets all regulatory requirements.

According to FSSAI norms, 1 kg fortified rice will contain iron (28 mg-42.5 mg), folic acid (75-125 microgram) and Vitamin B-12 (0.75-1.25 microgram). In addition, rice may also be fortified with micronutrients, singly or in combination, with zinc, Vitamin A, Vitamin B1, Vitamin B2, Vitamin B3 and Vitamin B6.

3.1.3 Government Initiatives for Fortification of Rice

Initiatives related to fortification:

1. **FSSAI Regulations:** In October 2016, FSSAI operationalized the Food Safety and Standards (Fortification of Foods) Regulations, 2016 for fortifying staples namely Wheat Flour and Rice (with Iron, Vitamin B12 and Folic Acid), Milk and Edible Oil (with Vitamins A and D) and Double Fortified Salt (with Iodine and Iron) to reduce the high burden of micronutrient malnutrition in India.
2. **Nutritional Strategy:** India's National Nutritional strategy, 2017, had listed food fortification as one of the interventions to address anaemia, vitamin A and iodine deficiencies apart from supplementation and dietary diversification.
3. **BIS Standards:** The Bureau of Indian Standards (BIS) has finalised standards for Fortified Rice Kernnels (FRK), fortified rice and machineries. Around 55 NABL laboratories are capable of testing fortified rice, said department of food distribution.

The main purpose of fortified rice is to meet nutritional goals for the end consumer, but in order to reach their full benefit, fortification programs need to meet certain requirements -

- Rice fortification improves the nutritional quality of the food supply and provide a public health benefit with minimal risk to health.
- Rice is a widely used staple food, it is simple to replace standard rice with fortified rice to boost the nutritional profile of a simple diet.
- Rice fortification costs are small compared to the wide-reaching benefits.
- It looks, cooks, and tastes the same as non-fortified rice.
- It presents a solution for health-conscious consumers.

To address anaemia and micro-nutrient deficiency among large sections of the population, the Centrally Sponsored Pilot Scheme on "Fortification of Rice and its Distribution under Public Distribution System" was implemented for a period of 3 years beginning from 2019-20. Eleven (11) States- Andhra Pradesh, Gujarat, Maharashtra, Tamil Nadu, Chhattisgarh, Uttar Pradesh, Odisha, Telangana, Madhya Pradesh, Uttarakhand and Jharkhand successfully distributed the fortified rice in their identified districts (one district per State) under the pilot scheme.

The key objectives of the Pilot Scheme are:

- Distribution of Fortified Rice through Public Distribution System, to cater 15 Districts in the country - preferably one district per State in the initial phase of Implementation.

- Coverage of NFSA (National Food Security Act), beneficiaries under PDS with Fortified Rice in the selected Districts.
- Facilitate cross learning and sharing of best practices among States/UTs and DoF&PD (Department of Food and Public Distribution).
- To evaluate the provision, coverage and Utilization of Fortified Rice by the target population as well as the efficiency/effectiveness of the consumption of fortified rice in reducing the targeted micronutrient deficiencies in different age and gender groups.

Now, the Cabinet Committee on Economic Affairs approved supply of fortified rice throughout the Targeted Public Distribution System (TPDS) under the National Food Security Act (NFSA), Integrated Child Development Services (ICDS), Pradhan Mantri Poshan Shakti Nirman-PM POSHAN [onetime Mid-Day Meal Scheme (MDM)] and Other Welfare Schemes (OWS) of Government of India in all States and Union Territories (UTs) by 2024 in a phased manner.

The entire cost of rice fortification (around Rs. 2,700 crore per annum) would be borne by the Govt. of India as part of food subsidy till its full implementation upto June, 2024.

The following three phases are envisaged for full implementation of the initiative:

1. **Phase-I:** Covering ICDS and PM POSHAN in India all over by March, 2022 which is under implementation.
2. **Phase-II:** Phase I above plus TPDS and OWS in all Aspirational and High Burden Districts on stunting (total 291 districts) by March 2023.
3. **Phase-III:** Phase II above plus covering the remaining districts of the country by March 2024.

Fortification of rice helps increase vitamin and mineral content in diets and helps achieving nutritional security. The government annually spends more than Rs 2 trillion for implementing NFSA.

According to a recent statement by ministry of food and public distribution in the Parliament, at present around 3,400 rice millers in the country have monthly blending capacity of around 2.8 mt. Food ministry officials said that the pilot scheme has helped create ecosystem for fortified rice. The food ministry has also formulated standard operating procedure for the quality management protocol for fortified rice kernels.

The decision on providing fortified rice comes after the government decided to extend the free ration scheme — Pradhan Mantri Garib Kalyan Anna Yojana (PMGKAY) — by six months to September-end 2022, at an additional cost of Rs 80,000 crore to the exchequer. The government has so far spent about Rs 2.6 trillion under PMGKAY, which was launched in April 2020.

“Under the extended PMGKAY, each beneficiary will get additional 5 kg free ration per person per month in addition to his normal quota of food grains under NFSA”, according to a statement issued by the department of food and public distribution after the Cabinet meeting.

Unit 3.2: Preparation for Fortification of Rice

Unit Objectives

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

1. Describe process of rice fortification
2. List requirements for fortification of rice

3.2.1 Process of Rice Fortification

Rice Fortification is the process of addition of vitamins and minerals such as iron, iodine, zinc, vitamin A & D in the regular rice to improve its nutritional content. These nutrients may or may not have been originally present in the food before processing.

Rice fortification is a two-step procedure:

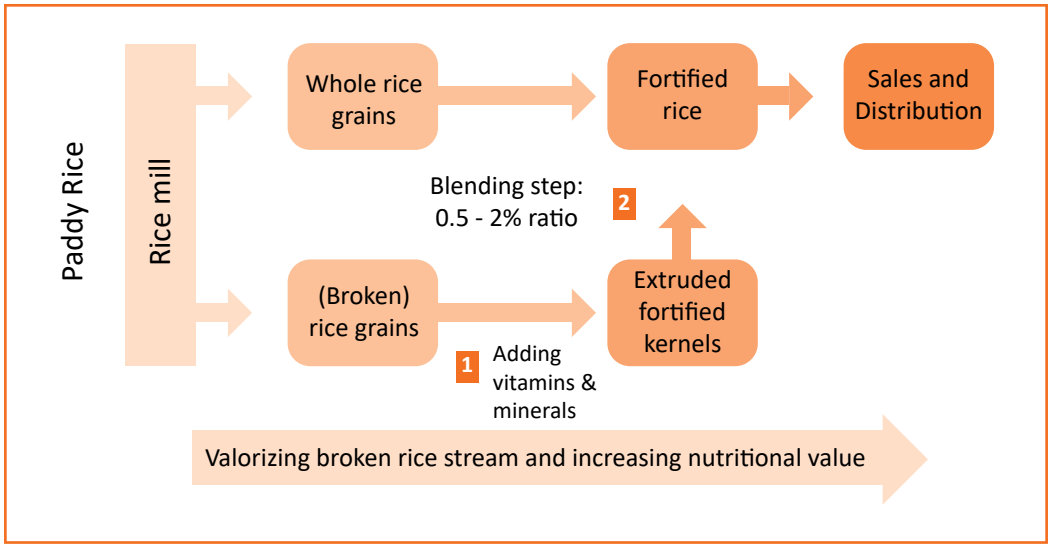

Fig 3.2.1 Rice fortification procedure

1. Sourcing/ Production of Fortified Rice Kernels (FRK)
2. Blending of FRK (generally 1-100) with raw milled rice (polished or parboiled rice).

Rice can be made more nutritious by adding vitamins, minerals and other nutrients to replenish micronutrients lost in the milling process and reinforce its nutritional value. Fortified rice can be adjusted based on the nutritional needs and can be made to resemble the different rice varieties.

Selecting an appropriate method, technology and fortificant forms to fortify rice post-harvest is crucial to successfully improve micronutrient health.

Rice fortification terminology (post-harvest)

Term	Definition
Fortificant / micro-nutrient	Selected vitamin or mineral in a specific form suitable to fortify the rice
Fortificant mix / premix	Blend that contains several fortificants (vitamins and minerals)
Rice-premix / fortified kernels	Rice (shaped) grains fortified with the fortificant mix
Fortified rice	Regular rice blended with the fortified kernels (rice premix), typically in 0.5-2% ratio

3.2.2 Requirements for Rice Fortification Process

Raw Material:

The first decisive step in making good fortified rice is the availability of appropriate raw material. Raw material required for rice fortification process are -

1. Rice flour
2. Food grade Vitamin and Mineral premix
3. FSSAI approved Acid regulators and emulsifiers (Pentasodium Triphosphate – INS 451 (I), Citric Acid INS 330 etc.)
4. Potable Water (IS 10500 : 2012)

We will discuss about selection criteria of raw material later in Unit 4

Machineries required

1. Pulverizer
2. Mixer
3. Extruder
4. Dryer
5. Blender

We will discuss about selection criteria and operation of machineries later in Unit 5.

3.2.3 Capacity Utilization of Machineries

Machine capacity utilization plays major role in any industry. Capacity utilization is one of most crucial part of production planning. Several parameters such as speed, feed, material, process, loading & unloading time, tool setup, preventive maintenance etc. influence the utilization. Each machine could have different parameters influencing its non or low utilization.

Apart from these factors, machine utilization could be low because of several other factors - labor issue, tool breakage, higher setup times, man machine relationships, manual programs, production planning etc.

Machine capacity utilization planning impacts many costs within a company i.e.

- **Operating Costs** – If product demand is out of sync with capacity, a company need to schedule overtime or add shift or reduce labor and idle facilities quickly. Miscalculating either can drive up operational costs and increase cost per unit.
- **Fixed Costs** – Misjudging capacity will force companies to carry increased fixed costs when they are not being utilized.
- **CapEx Costs** – If a company does not understand the capacity required for specific demand levels, they may underbuy capital equipment needed to produce, forcing them to utilize overtime or to subcontract production.

The capacity planning process can vary from company to company, but there are a few core steps that happen in every process -

Fig 3.2.2 Capacity planning process

1. **Forecast expected demand:** First make an estimate on what work needs to be done production. This will give an idea of the capacity that need to meet the expected demand.
2. **Determine required capacity:** Based on estimates, approximate the capacity need to

meet the demand.

3. **Calculate the resource capacity:** Check the capacity of available machinery, see how much capacity they have in a week by subtracting their current workload in hours from the average 30.
4. **Measure the capacity gap:** Based on the capacity needed, measure how your current resources compare to the anticipated demand.
5. **Align capacity with demand:** Look at the previous gap in capacity and optimize current and available capacity so they are balanced.

Improving machine utilization

First identify the machine utilization levels and non-value-activities (NVA), then you need to reduce the non-utilization percentage by reducing the NVA's.

NVA's are classified into various categories for applying different methodologies.

- **Repetitive NVA's:** These NVA's takes the major portion of non-utilization. RCA and establishing QC and Kaizen teams against these NVA's would help improving machine utilization
- **Repetitive NVAR:** These types of NVA are hard to resist or minimize for example initial tool sharpening etc. This category should not be focused.
- **Setup:** Setup is major time taking process, when it comes job shop production, setup takes much time 40-50% of machining time reduces the machine utilization drastically.
- **Occasional NVA's:** These types of NVA are not in anybody's control, these occur very rarely so we should not much focus on this.
- **Non-Repetitive:** Non repetitive are type of activities occurs after certain activities or after any incident. These are mostly manual errors which can be reduced by implementing SOPs and following it properly.
- **Breakdown:** This is due to maintenance issue. Preventive maintenance needs to be implemented for reducing it.

3.2.4 Production Planning

Production planning is a very critical decision which is necessarily required to ensure an efficient and economical production. Planned production is an important feature of any manufacturing industry. Production planning and control is a tool to coordinate and integrate the entire manufacturing activities in a production system. This essentially comprises of planning production before actual production activities start and then exercising control over those activities to ensure that the planned production is realized in terms of quantity, quality, delivery schedule and cost of production.

The various activities involved in production planning are designing the product, determining the equipment and capacity requirement, designing the layout of physical facilities and material and material handling system, determining the sequence of operations and the nature of the operations to be performed along with time requirements and specifying certain production and quantity and quality levels.

Production planning also includes the plans of routing, scheduling, dispatching inspection, and coordination, control of materials, methods machines, tools and operating times. Its ultimate objective is the to plan and control the supply and movement of materials and labour, machines utilization and related activities, in order to bring about the desired manufacturing results in terms of quality, quantity, time and place. This provides a physical system together with a set of operating guidelines for efficient conversion of raw materials, human skills and other inputs to finished product.

The Production Planning and Control (PPC) consists of the following steps.

- Forecasting the demands of the customers for the products and services.
- In advance preparing the production budget.
- Design the facility layout.
- Specify the types of machines and equipment.
- Appropriate production requirements of the raw materials, labour, and machinery.
- Drawing the apt schedule of the production.
- Confirming the shortage or any excess of the end product.
- Future plans are drawn for any sudden surge in the demand for the product.
- The rate and scale of production is setup, which needs to be broken into realistic time periods and scheduling. The specified job needs to be done in the amount of time provided so that the production can move to next step.

Elements of Production Planning

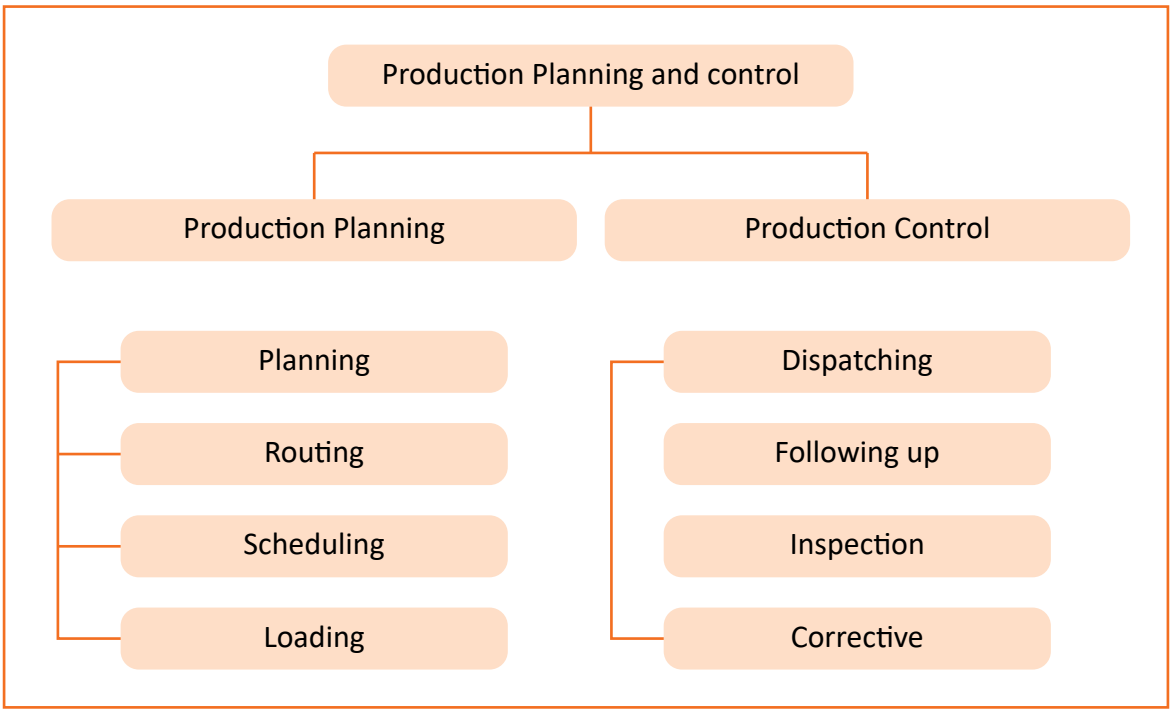

Fig 3.2.3 Elements of production planning

1. **Materials:** planning for procurement of raw material, component and spare parts in the right

quantities and specifications at the right time from the right source at the right place. Purchasing, storage, inventory control, standardization, variety reduction, value analysis and inspection are the other activities associated with material.

2. **Method:** choosing the best method of processing form several alternatives. It also includes determining the best sequence of operations (process plan) and planning for tooling, jigs and fixtures etc.
3. **Machines and equipment:** manufacturing methods are related to production facilities available in production systems. It involves facilities planning, capacity planning, allocations, and utilization of plant and equipment, machines etc.
4. **Manpower:** planning for manpower (labour and managerial levels) having appropriate skills and expertise.
5. **Routing:** determining the flow of work material handling in the plant, and sequence of operations or processing steps. This is related to consideration of appropriate shop layout plant layout, temporary storage location for raw materials, component and semi-finished goods, and of materials handling system.
6. **Estimating:** Establishing operation times leading to fixations of performance standards both for worker and machines. Estimating involves deciding the quantity of the product which needs to be produced and cost involved in it on the basis of sale forecast.
7. **Loading:** machine loading is the process of converting operation schedule into practices in conjunctions with routing. Machine loading is the process assigning specific jobs to machines, men, or work centers based on relative priorities and capacity utilization. Loading ensures maximum possible utilization of productive facilities and avoid bottleneck in production.
8. **Scheduling:** Scheduling ensure that parts and sub-assemblies and finished goods are completed as per required delivery dates. It provides a timetable for manufacturing activities.
9. **Dispatching:** This is concerned with the execution of the planning functions. Dispatching is release of orders and instructions for starting of production in accordance with routing sheet and scheduling charts.
10. **Inspection:** This function is related to maintenance of quality in production and of evaluating the efficiency of the processes, methods and labours so that improvement can be made to achieve the quality standard set by product design.
11. **Evaluating:** The objective of evaluating is to improve performance. Performance of machines, processes and labour is evaluated to improve the same.

Selection of appropriate production system also make impact on the production planning

There are 4 different types of productions which are most commonly used. Which type of production should be used by the company depends on the type of product being manufactured, the demand of the product as well as the supply of raw materials.

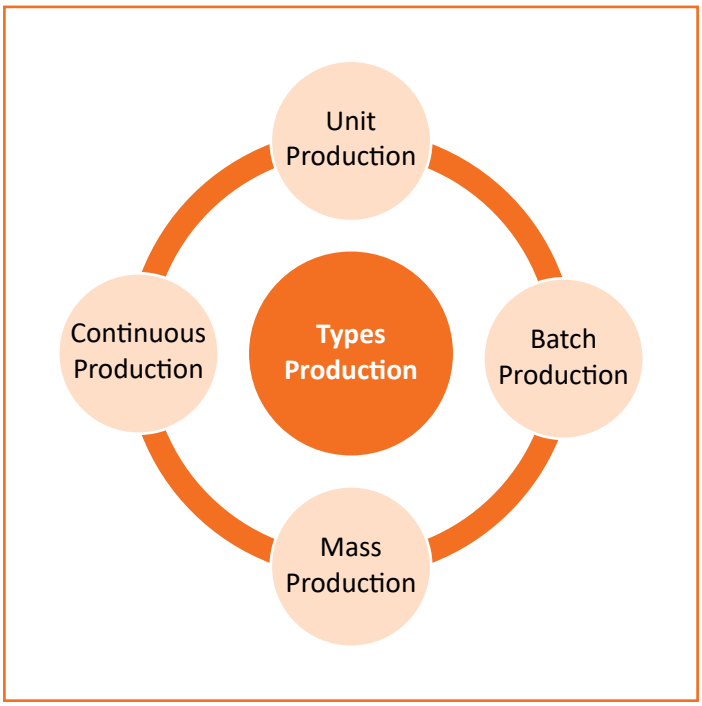

Fig 3.2.4 Types of production

- **Unit production**, where items are made individually and each item is finished before the next one is started.
- **Batch production**, where groups of items are made together. Each batch is finished before starting the next block of goods.
- **Mass production**, where identical, standardised items are produced on an assembly line. Mostly product is mass-produced in large factories using conveyor belts and expensive machinery.
- **Continuous production or Process production:** There is a lot of confusion between mass production and continuous production. It can be differentiated by a single element. The amount of mechanical work involved. In Mass production, both machines and humans work in tandem. However, in continuous production, most of the work is done by machines rather than humans. In continuous production, the production is continuous,24×7 hours, all days in a year.

3.2.5 Documentation and Records Requirements

Every organisation has to maintain records of raw material procurement, production processes, and sales. The purpose is to assist in determining whether anything has happened to the food or been done to the food that would render it unsafe (i.e., adulterated). Accordingly, firms must maintain records and government authorities may access the records.

Listed below are some reasons why there is a need for documentation:

- It gives detailed knowledge about running of the business.
- It helps to control product quality.

- It helps to keep track of the money invested in the business.
- It helps to identify the separate costs of raw material or product ingredients.
- It helps to identify the production cost of a particular process.
- It helps to ensure that quality assurance procedures are followed.
- It helps to ensure that the production unit is running smoothly/effectively.
- It works as evidence for legal procedures.
- It helps to set an appropriate product price.
- It helps to take corrective measures at the right time.

List of documents need to maintain in industry

- The HACCP plan
- List of hazards and details of the hazard analysis
- CCP determination
- Critical limit determination
- Training needs analysis
- Procedures – e.g. standard operating procedures, corrective action procedure
- Work Instructions
- BOM
- Purchase and sale invoice

List of records need to maintain in industry

- CCP monitoring activities
- Deviations and associated corrective actions
- Verification procedures performed
- Modification to the HACCP plan
- Training undertaken
- Daily records (raw material check)
- Visual inspection reports
- Team meeting records
- Processing records
- Vendor records
- Sale and purchase records

Every food processing organization follows a more or less similar way of keeping records. Production records keep a log of -

- Quantity and type of raw materials
- Quantity and type of ingredients used

- Processing conditions in which production took place (e.g. the temperature set or the air pressure applied)
- Product quality

Product quality can be maintained only when:

- Same quantity and quality of ingredients and raw materials are mixed in every batch
- Standard formulation is used for every batch
- Standard process parameters are applied for every batch

Every batch of production is given a batch number. This number is recorded in:

- Stock control books (where raw material procurement is noted)
- Processing logbooks (where production process is noted)
- Product sales records (where sales and distribution is noted)

The batch number must correlate with the product code number, which is printed on labels. This helps the processor to trace any fault found in a batch back to the raw material used or the production process.

Example of a stock control book:

Product Name			Batch Name	
Raw Material	Supplier	Result of inspection for:		
		A	B	C

Table 3.2.1 Stock control book

There are two main ways in which records can be kept: manual record keeping and computerized (or automated) record keeping.

Manual record keeping

You can also opt for a manual record-keeping system. Manual records are beneficial as long as they are accurate and can be understood or explained if questioned.

There are a few traditional ways to manually keep records:

- **Preformatted record books:** Inexpensive, preformatted record books are available at most office supply stores.
- **Ledger sheets:** Ledger sheets (also available at office supply stores) are columnar pads of paper, usually light green in color.

Either way, you must keep a record of each expense -- jotting down a brief description of the business expense, the date incurred, the amount, and to whom it was paid. On the profit side of the equation, you must also keep similar records of any income your business receives.

Advantages of manual record keeping systems include:

- Low cost
- Ease of use

Disadvantages of manual record-keeping systems include:

- They are often “single entry” systems, meaning you enter each transaction only once.
- You must manually tally up expenses or income by category or by month -- which can be time consuming.

Computerized Record Keeping

Keeping records on a computer follows the same principles as a manual system, except the computer automates the process so it’s faster and more accurate. A simple-to-use software program eliminates the need for a handwritten set of books.

By using a software program for record keeping, you can:

- Eliminate math errors
- Instantly see your income and expenses by category
- Get profit and loss statements and other financial summaries quickly, and
- Interface with compatible tax software programs -- so you don’t need to re-input data come tax time.

Disadvantages of software programs for business record keeping include:

- They are slightly more expensive than manual record keeping supplies.
- You must have a computer and be comfortable using it on a regular basis.

Exercise

1. Which of the following are benefits and advantages of Fortification of Food?

   i. Doesn't change existing food patterns

   ii. Alters the characteristics of the food

   iii. Safe and cost effective

   a. 2, 3 b. 1, 2

   c. 1, 3 d. All of the above

2. What is Fortification of food?

   a. Purposely increasing the content of an essential micronutrient in food

   b. Providing tablets containing vitamins and minerals along with food

   c. Proper cooking and storage of food to avoid loss of nutrients

   d. Ensuring minimum amount of nutrients in food

3. Staple foods, such as cereal grains and rice might get fortified with this nutrient to prevent visual impairment?

   a. Vitamin D

   b. Folic Acid

   c. Vitamin A

   d. Iron

4. Does fortification affect the color, flavor and shelf life of food?

   a. Yes

   b. No

   c. Partially

   d. I don't know

5. Which of the following vitamin is presented fortified rice?

   1) Vitamin A

   2) Vitamin B1

   3) Vitamin B12

   a. Only 1 and 2 b. Only 1 and 3

   c. Only 3 d All of the above

6. Does fortified rice improve people's health and nutritional status?

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7. Can any variety of rice be fortified?

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4. Select Quality Raw Material to Produce Fortified Rice

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FOOD INDUSTRY CAPACITY & SKILL INITIATIVE

Unit 4.1 – Selection of Raw Material for Fortification of Rice

FIC/N1036

Key Learning Outcomes

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

1. List raw material required for fortification of rice
2. Describe selection parameters for selecting the raw material

Unit 4.1: Selection of Raw Material for Fortification of Rice

Unit Objectives

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

1. List raw material required for fortification of rice
2. Describe selection parameters for selecting the raw material

4.1.1 Raw Material for Production of FRKs

Raw materials

- **Rice flour:** The main ingredient used to produce FRKs is rice flour, which is usually made from broken rice, a by-product of rice milling and in some cases of parboiling. Various factors influence rice flour behaviour throughout the manufacturing process and affect the appearance of the FRK:

  - ❑ Rice varieties vary greatly in protein, fat, starch content and starch composition.
  - ❑ The purity of the rice flour compared to bran, other grains or components must be taken into consideration. These different components influence rice flour behaviour.
  - ❑ Pre-extrusion processes, such as parboiling, affect a considerable portion of the starch content, and require significant adjustments in processing.
  - ❑ Using mixed flours (i.e. blending other grain flours with rice) could lead to deviations in FRK appearance and function.

  The choice of ingredients will have an impact on the final FRK characteristics and processing performance and must therefore be tested.

- Fortificant mix (also referred to as premix) – is the other main component. The nutrients included in the premix may have an effect on the appearance of the FRK due to the type and level of added vitamins and minerals. For example, the type of iron used in a premix could lead to changes in appearance that vary from neutral to light grey or rust-like brown. The addition of riboflavin may produce a yellow FRK. In some cases, premixes also include flowing agents added to improve the mixing abilities of individual components and prevent clumping.

  The most commonly used micro-nutrients and their fortificants are:

  - ❑ **Iron:** Different forms of iron offer trade-offs between bioavailability and properties impacting consumer acceptance. The iron fortificants recommended for wheat and maize flour fortification (e.g. ferrous sulphate, ferrous fumarate or sodium iron EDTA) are nearly unnoticeable to the consumer because the relevant iron fortificant is equally distributed throughout the fortified flour.

    However, when concentrated in a fortified kernel, color and taste may be affected.

- **Zinc:** Adding zinc to rice is relatively easy. Zinc oxide is suitable for the technical needs of fortification and has high bioavailability, with virtually no negative impact on taste, color, or stability for the other micronutrients.
- **Selenium:** Selenium is an essential trace mineral important to human health. Even if the precise biological activity of selenium in humans is still under investigation, this mineral constitutes a key component of various selenoproteins involved in enzymatic activities and particularly in redox homeostasis and in thyroid hormone metabolism. A poor selenium status has been associated with increased risk of several chronic diseases, such as cardiovascular diseases and cancer.
- **Vitamins:** Similar to wheat and maize flour fortification, the water-soluble vitamins B_1 (thiamin), B_3 (niacin), B_6 (pyridoxine), B_9 (folic acid), and vitamin B_{12} (cobalamin) are frequently used to fortify rice without affecting acceptability. However, there are some stability concerns with respect to vitamin B_1 when fortified rice is stored at elevated temperatures. Vitamin B_2 (riboflavin) changes the color of the fortified kernels, which reduces consumer acceptability.

- **Emulsifier:** In addition to rice flour and premix as the most basic ingredients, an emulsifier can optionally be used to influence the processing properties of rice flour. An emulsifier can change the dough texture, reduce its adhesiveness and could help retain final product shape after hydration or cooking. The most commonly used emulsifiers are mono- and/or diglycerides of fatty acids. However, any emulsifier should be tested throughout the process to choose the best functional and cost-effective option.
- **Water:** Water is used in manufacturing of Fortified rice as a solute which penetrates the starch structure of the flour and helps in gelatinization of starch.

4.1.2 Quality Factors for Selection of Raw Material

FRK quality depends on many factors:

- One important factor is the type of rice flour used, as flours behave differently during the process.
- Additionally, the type of equipment used has an impact on the final characteristics.
- Finally, the settings of the extrusion parameters are as decisive to FK quality as the raw material and equipment.

Some of these quality parameters must be checked regularly during production on site, for example the moisture content, cooking behaviour, size and bulk density, shelf life and size distribution (related to the equipment used) etc.

Quality parameter	Descriptor
"Rice-like appearance" and size	FRK should look as much as possible like the unfortified rice that it will be blended with. Appearance varies greatly by region, and is defined in terms of length, width, diameter, whiteness and translucency.
Moisture content	Moisture content should be between 10 – 14%. If the content is higher, there is a risk of mould. If the content is lower, the kernels can crack.
Micronutrient content and other ingredients	Due to losses during the energy input in the production phase and during storage, micronutrient content and other ingredients should be overdosed during mixing, so that their final amount in the FRK meets contractual obligations.
Shelf life	Shelf life is highly influenced by the packaging material, moisture content and degree of cooking (highly cooked starch will increase shelf life).
Cooking behaviour	Cooking behaviour refers to the stability of the kernels during cooking. During cooking, part of the kernels may dissolve. If rice is cooked using excess water (i.e. cooking water is poured off prior to serving), these micronutrients are lost. Therefore, producers should aim for less than 10% of the FRK to dissolve during cooking.
Size distribution of FRK	The difference in size between the largest and smallest FRK should be within the same range that naturally occurs in the rice to be blended with FRKs. If this is not the case, a disaggregation can occur in the bags during transportation of fortified rice. This will cause differences in FRK consumption levels.

Table 4.1.1 Quality factors for raw material selection

A list of FSSAI verified premix suppliers who supply quality assured micronutrient premixes is available on below link

Source: https://ffrc.fssai.gov.in/assets/file/premix_supplier_list_website.pdf

4.1.3 Verification of Raw Material

Raw material samples should be manually tested for quality conformity to specifications before it is permitted for production and manufacture use. The raw material and packaging material should be examined and cross checked for their conformity to specifications.

The quality of a food material is judged in terms of its nutritional value, purity, wholesomeness and palatability. If any of these properties is not optimal, the food quality is affected. Raw material examinations include test for genuineness and composition, freedom from contaminant, and conformity with official or factory standards.

Steps to inspect the raw material

1. **Pre-inspection:** Verify and record the quantity received, the referencing purchase order number, and whether or not the material order is complete.
2. **Photos:** Capture photos or videos upon receipt of materials.
3. **Pulling random samples for inspection:** Create a sampling process where you randomly pull materials and check their physical condition. Without pulling samples randomly, you risk getting a report that doesn't fairly represent the quality of the entire shipment.
4. **Checking the material against specifications:** Check the material with other reference materials to clarify product specifications.

   A QC checklist typically covers product specifications such as:

   - ❑ Item weight and dimensions
   - ❑ Material and construction
   - ❑ Item color
   - ❑ Item marking and labeling, and
   - ❑ General appearance

5. **Make & Manufacturer:** Confirm that what you received is from the confirmed manufacturer or trademark holder.

Conduct raw materials inspections on an as-needed basis. After all parameters of raw materials are met, a sample batch of raw materials is put through a trial run to get a preview of the end product. The equipment is examined for any sign of corrosion due to the acidity or alcohol content of the materials used. Approval for processing is given only after all quality specifications on the sample run have been met.

After inspection process, material needs to be sorted into defective and approve categories.

Sorting is the separation of foods into categories on the basis of results of quality check. Every organisation has their own procedure of segregating correct and defective material. This process can vary from organisation to organisation.

Mostly followed segregation process followed in industries is separating the correct and defective material into different color code bins as specified in their SOP. Mostly utilised colors are -

Fig 4.1.1 Segregation of material

- Blue for approved material
- Red for defective material

4.2.4 Quality Check of Premix

The vitamins and minerals used in fortification are combined in a powdery blend called a premix. This is added to flour in the milling process or used to make fortified rice kernels. Premix does not affect the taste, smell, texture, or baking qualities.

1. **Inspect premix upon delivery:** Mild damage to the outer cardboard container is acceptable, but water damage to the premix or tears in the inner plastic bag are not acceptable. Check the content of one box to be sure the premix has no lumps, spots, or odor.
2. **Confirm the nutritional content:** Each lot of premix should include a certificate of analysis. Confirm that the vitamins and minerals listed meet your country's specifications.
3. **Keep accurate records of premix use:** Unusual increases or decreases in the amount of premix used indicate problems in fortification procedures.
4. **Store premix well:** Keep premix away from sunlight, excessive heat, and potential water damage.

Exercise

1. What is a Micronutrient Premix?
   a. Blend of vitamins & minerals
   b. Blend of several foods
   c. Nutritious Food
   d. Special food for children
2. Which of these factors affect the stability of premix?
   a. Moisture
   b. Oxygen
   c. Temperature
   d. All of the above
3. Which equipment, is used for adding premix for fortifying rice?
   a. Break Rolls
   b. Doser
   c. Reduction Rolls
   d. Sifter
4. Fortified Rice Kernels (FRK) are made up of_____?
   a. Rice Flour
   b. Vitamins
   c. Minerals
   d. All of the above
5. Describe process of quality check of premix?

   .....

   .....

   .....

   .....

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5. Ensure Processing of Fortified Rice Kernel and Blended Fortified Rice

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Unit 5.1 – Machine Parameters for Fortification of Rice

Unit 5.2 – Production of Fortified Rice Kernel (FRK)

Unit 5.3 – Production of Blended Fortified Rice

FIC/N1036

Key Learning Outcomes

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

1. List various operational parameters need to maintain during extrusion process.
2. Describe impact of operational parameters on final product.
3. Describe production process of FRK.
4. Demonstrate production process of FRK.
5. Describe blending process of fortified rice.
6. Demonstrate various methods of blending of fortified rice.

Unit 5.1: Machine Parameters for Fortification of Rice

Unit Objectives

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

1. List various operational parameters need to maintain during extrusion process.
2. Describe impact of operational parameters on final product.

5.1.1 Machine Operation Parameters

Extrusion is a complex operation. Changes in one process parameter, such as the screw speed, affect multiple product properties and other parameters. It is very important for the operator of an extrusion line to understand the correlations between changes in process parameters and their effects on product properties. These correlations and impacts are discussed below:

<table>
<tr>
<td>Process Parameter
Fixed parameters
• Machine type, machine size, machine L/D
• Screw configuration
• Quantity of die holes, die opening diameter
• Preconditioning</td>
<td>System Parameter
Heat and mechanical history
• Dissipation of energy (SME profile)
• Temperature profile
• Residence time
• Pressure on mass before the die</td>
</tr>
<tr>
<td rowspan="2">Variable parameters
• Throughput
• Feed temperature
• Water/Steam addition
• Screw rpm (provides material shear rate and degree of screw filling)
• Temperature profile of barrel
• Venting
• Cutter speed
• Preconditionning
❑ Temperature
❑ Retention time
❑ Addition of Water, Steam, other Liquids</td>
<td>Structure Parameter
• Starch: Gelatinization
Degradation
• Protein: Texturization
Denaturation
• Ingredients (vitamins, minerals. fat, emulsifier):
Reaction, denaturation
Encapsulation
Complexation</td>
</tr>
<tr>
<td>Product Parameter
• Quality: Shape
Density
Color
Texture
Taste
Cracks
Water content</td>
</tr>
<tr>
<td colspan="2">Material properties
• Rice flour, type, amylose/amylopectin ratio
• Fat, moisture, protein, bran content
• Add. Components: vitamins/ minerals/ emulsifier
• Quality and homogeneity</td>
</tr>
</table>

Table 5.1.1 Machine operating parameters

Screw Speed – dynamic response in the hot extrusion process

An increase in screw speed results in an increase in the shear energy input, represented as Specific Mechanical Energy (SME), and the dough temperature. This reduces the dough viscosity in the extruder. As a result, the pressure of the dough on the die plate decreases and the resulting torque of the screw also decreases. Thus, increased screw speed could be used to increase the degree of starch gelatinization, which will affect final product appearance by making the grain more crystalline. This could influence cooking properties and prevent disintegration of the cooked FRK.

Throughput can also be increased if the energy input is sufficiently high before the increase in screw speed. However, the increased energy input due to the higher screw speed can also lead to high temperatures (above 100°C), which can then cause FRK to expand. Hence, a thermometer close to the exit is needed to measure temperature and control expansion.

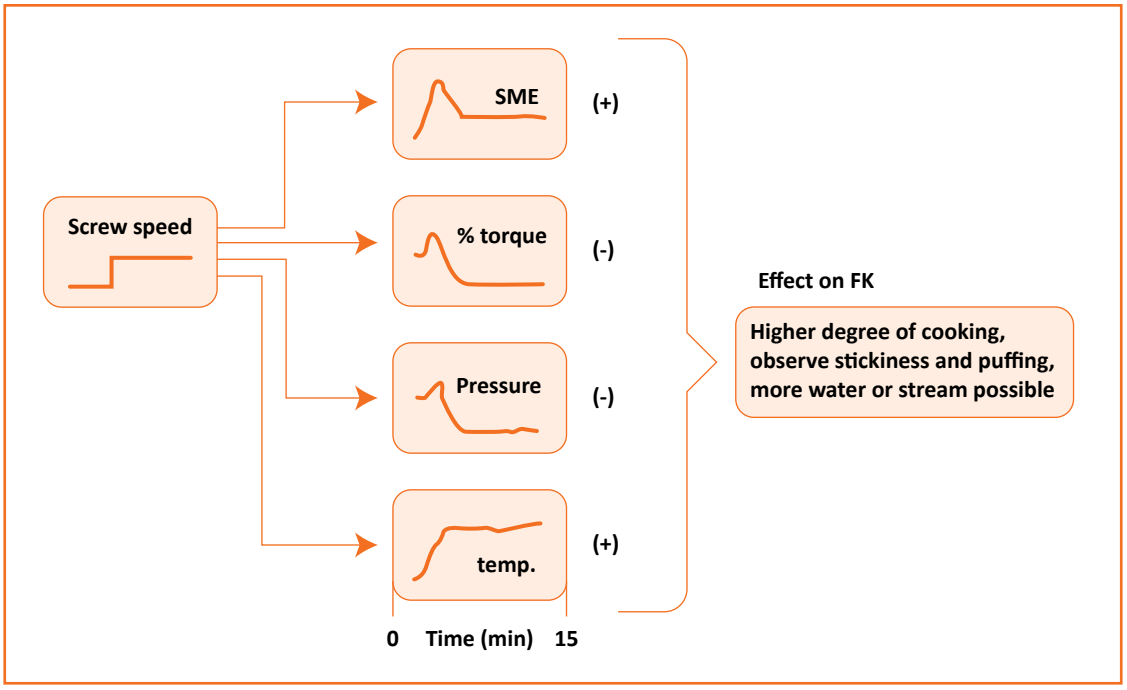


Fig 5.1.1 Screw speed

Moisture Content – dynamic response in the hot extrusion process

An increase in the moisture content of the mass in the extruder reduces the input of SME and thus the input of thermal energy. This lowers the degree to which starch is cooked, as well as the product temperature of the mass.

Additionally, the pressure in front of the die and the resulting torque of the screw is reduced. This could result in a product that is less cooked. To overcome this, the addition of water must be optimized to ensure starch gelatinization (65-78°C) and allow the backpressure of the mass inputs enough shear to cook the starch.

However, it must be kept in mind that the addition of water to the preconditioner during the hot extrusion process increases the degree of starch gelatinization. This could result in stickiness if steam is added simultaneously and block the preconditioner.

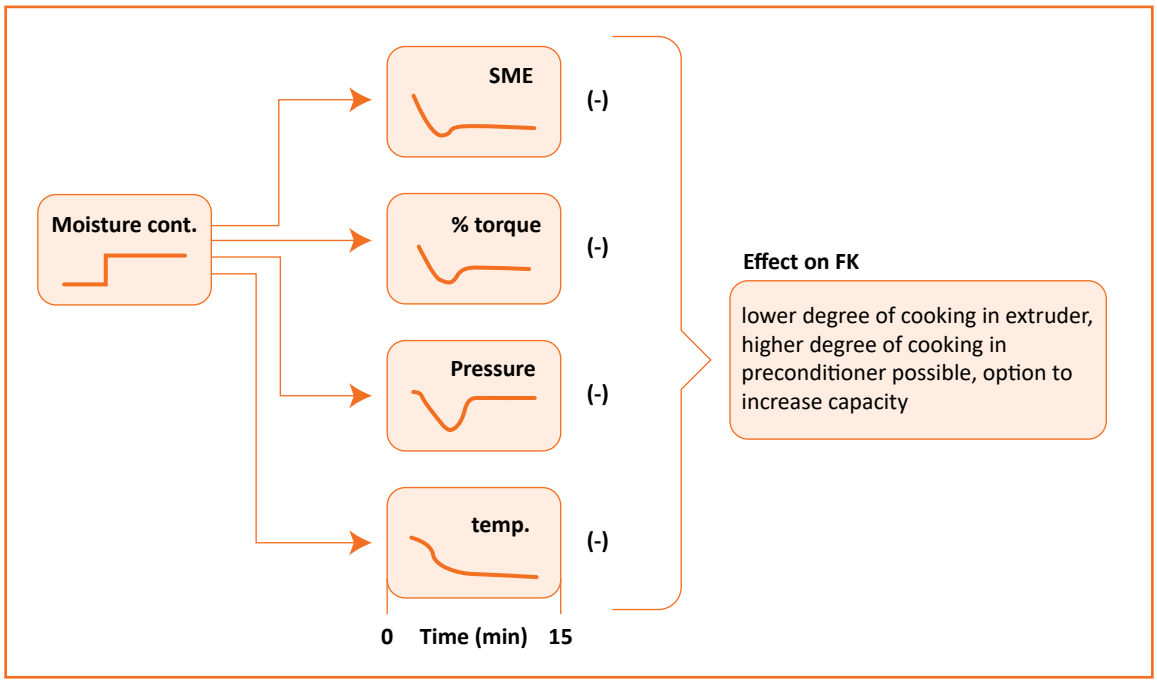


Fig 5.1.2 Moisture content

Feed rate – dynamic response in the hot extrusion process

Each production process should aim to run at the highest possible feed rate. However, an increased flow of flour or throughput, reduces the input of SME. This means the dough will be less processed, and the starch less cooked, triggering a higher pressure of the dough against the die plate. This increase in pressure also increases product temperature, which forces the motor to use more energy to push the dough through the die. This results in a dough with a lower energy intake and less gelatinized starch.

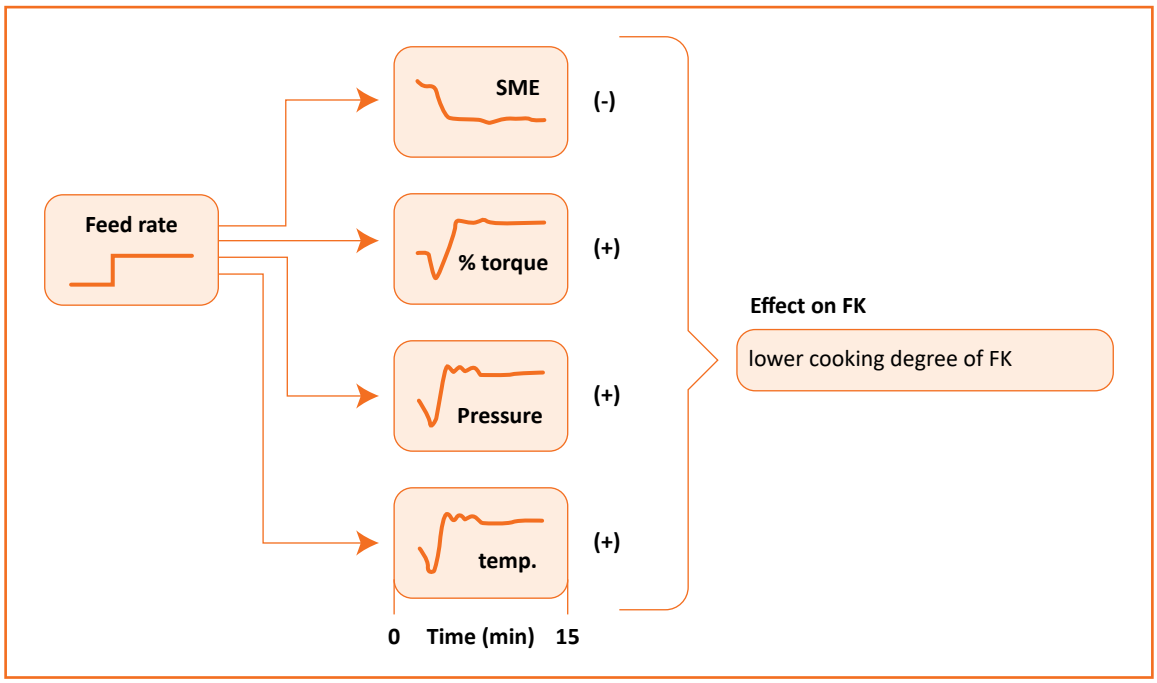


Fig 5.1.3 Feed rate

Steam addition – dynamic response in the hot extrusion process

The amount of steam added should be such that the dough in the preconditioner reaches a temperature of 90°C or more. Increasing the flow of steam to the preconditioner increases the degree of starch gelatinization. This reduces the entry of SME in the extruder because the mass gives less resistance. Consequently, the product temperature, the pressure of the mass at the die plate and the resulting torque of the screw are also reduced. The addition of steam is dependent upon the functional capacity of the flour to absorb the additional moisture from the steam and by the structural properties of the preconditioner. Excessive steam could block the preconditioner.

In warm extrusion systems, steam addition results in FRK with variable degrees of cooking. Therefore, steam should be considered exclusively for hot extrusion systems, where more starch gelatinization can be achieved, and a more visually appealing FRK can be processed.

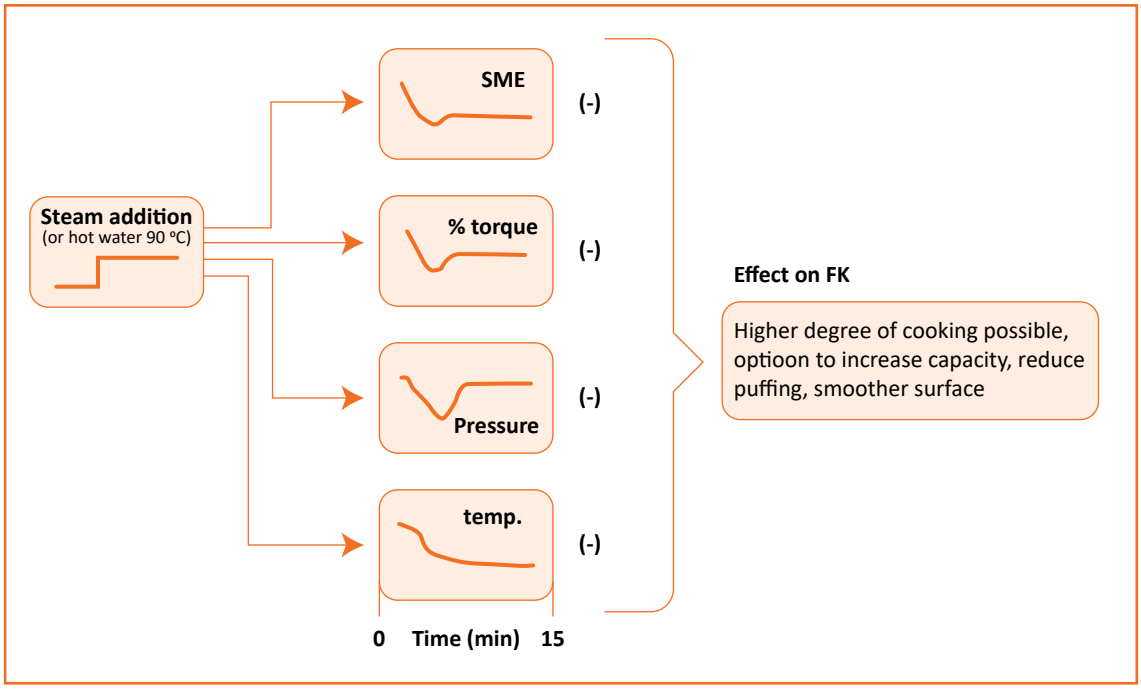


Fig 5.1.4 Steam addition

Emulsifier proportion– dynamic response in the hot extrusion process

Increasing the emulsifier proportion reduces the input of SME into the mass in the extruder, as the mass gives less resistance. As a result, the product temperature, the pressure of the mass on the die plate and the resulting torque of the screw are also reduced. The effect on product properties means a lower degree of starch degradation. Under process conditions where the stickiness of the product is limiting the cutting step, an increase of the emulsifier proportion may be helpful.

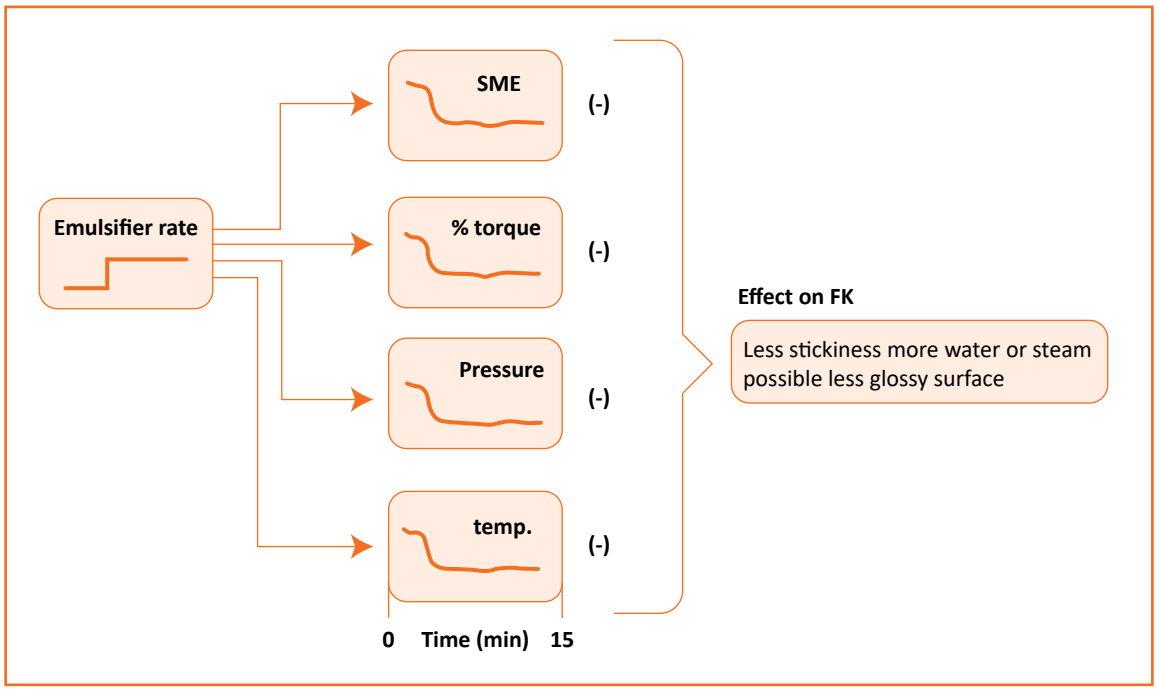


Fig 5.1.5 Emulsifier addition

Unit 5.2: Production of Fortified Rice Kernel (FRK)

Unit Objectives

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

1. Describe production process of FRK
2. Demonstrate production process of FRK

5.2.1 Fortified Rice Kernels (FRK)

Fortified Rice Kernels (FRK) are prepared with a mix of vitamins and minerals. Fortified kernels can be made by a number of ways, including -

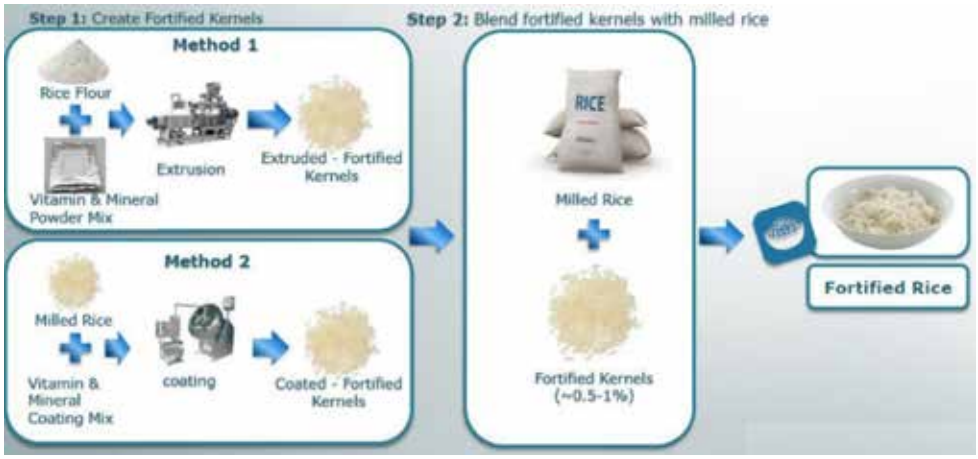


Fig 5.2.1 Methods of producing fortified rice

1. **Extrusion:** In extrusion cooking, raw materials are mixed, compressed into a dough, and finally shaped. The technology is based on a screw system which compresses the dough within a tube or barrel, heats it, and then pushes it through small openings called die holes. These rice-shaped die holes are the first step in shaping the fortified kernel dough into a shape resembling milled rice grains. When leaving the die hole, strands of dough are cut into individual kernels by rotating knives. The rotational speed of the blades, together with the dimensions of the die holes and the throughput per die hole, define the thickness of the RKs. The high temperature causes changes in the structure of components such as starch (gelatinization) and protein (denaturation). FRKs produced in this way must be transferred to the downstream process for drying.

   During extrusion, raw materials are fed in at a constant rate, while the machinery maintains a steady-state equilibrium. This is achieved by balancing the forward flow produced by the screws against the pressure at the die.

2. **Coating:** It is one of the oldest ways to prevent micronutrient losses through washing is to add high concentrations of micronutrients to a fraction of the rice and to subsequently coat the rice

kernels with water resistant edible coatings, and then mix the coated kernels with normal rice in ratios ranging from 1:50 to 1:200. Several coating layers, usually alternated with layers of coating material alone, are added by spraying the suspension through nozzles into a rotating drum containing the rice kernels to be fortified. The same drum is generally used during drying of the kernels by means of a hot air current.

The major problems encountered with coating technologies are related to color, taste, and a loss of micronutrients during washing, as well as during cooking. High variability is reported among technologies and in many of them, consumers are easily able to distinguish the fortified kernels, which will most likely be discarded during rice cleaning.

3. **Dusting:** Rice is dusted with a powdery mix of vitamins and minerals. This is not appropriate in cultures where rice is rinsed or cooked in excess water. These preparations will wash off the added nutrients.

In this unit we will discuss about production of FRK's through extrusion process

5.2.2 FRK Production Process

Before the extrusion begins, several components must be in place to ensure sufficient, clean and homogeneous raw material with the desired formulation for continuous, reliable production of FRK.

Processes to handle raw materials need to be in place before the extrusion system begins. The main raw materials are rice flour, the premix, and emulsifier. Polished rice must be ground to a fine flour before mixing with the other ingredients.

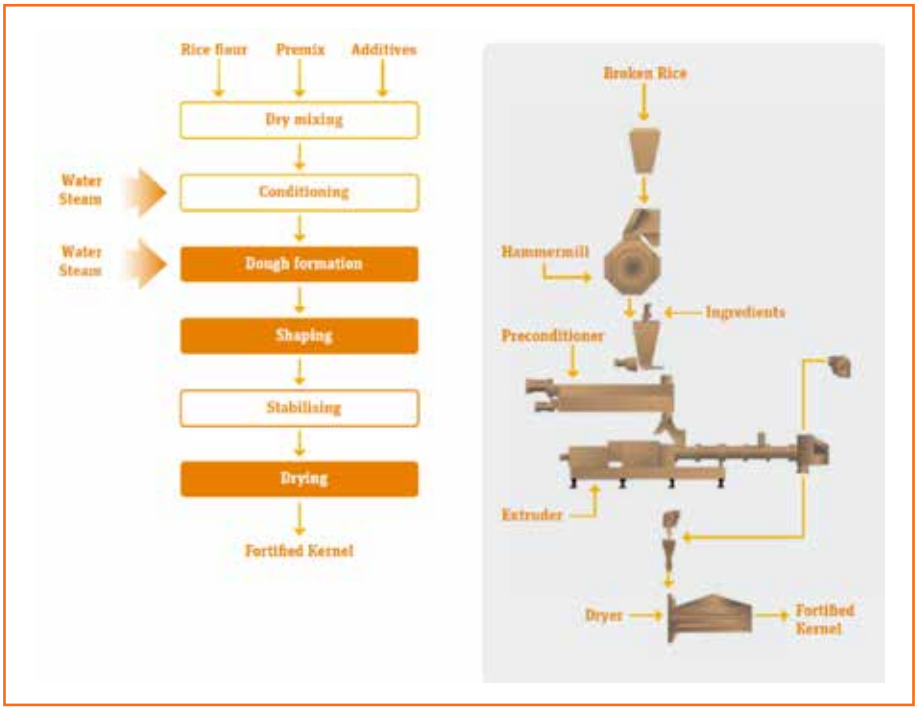


Fig 5.2.2 FRK production process

5.2.2.1 Milling of Broken Rice

A fine homogeneous rice flour will give the best result for FRK appearance. Processing capacity can also be increased by using fine rice flour.

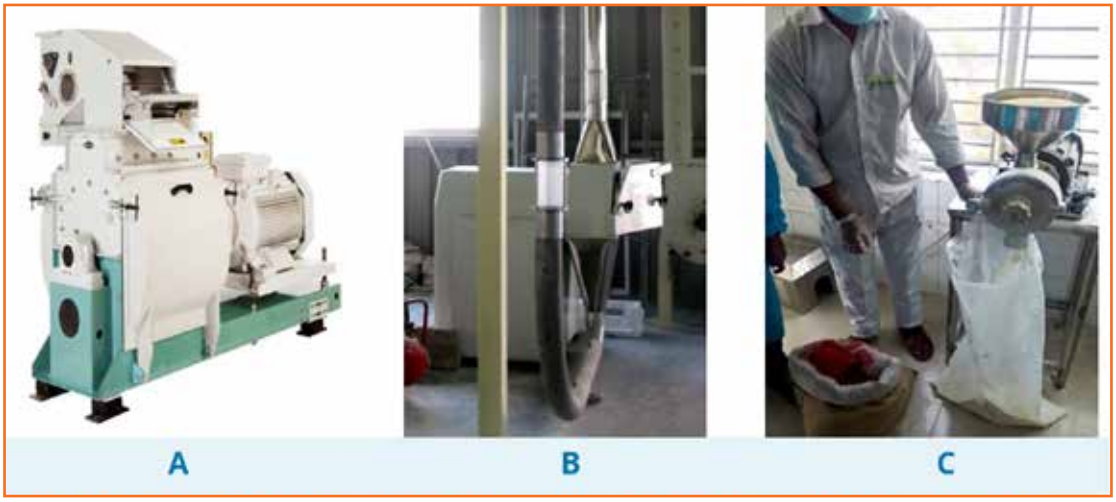


Fig 5.2.3 Diffrent tyoes of mills. (A) Hammermill with up to 2000kg/h, (B) Hammermill with up to 300kg/h in automated production, (C) Small Diskmill with manual operation

A hammer mill can produce optimum results for continuous cost-effective production. The sieve in a hammer mill determines the granulation of the flour. Such mills can be designed considering the mesh size of the screen, the open area of the screen and the installed engine power.

The expected capacity of the rice flour mill should be at least twice that of the subsequent extrusion process, so that the supply of rice flour does not represent a bottleneck for the continuous extrusion process.

To make rice flour, whole or broken polished rice is usually fed with a screw conveyor or pneumatic transport to the mill. The speed of the conveyor (screw or pneumatic) determines the amount of rice grains that are conveyed into the grinding chamber. In an automated production line, the conveying speed is optimized by monitoring the mill's energy consumption.

Note: *If broken rice is procured externally, a detector and/or separator for magnetic and non-magnetic metals should be installed in front of the mill to avoid damage, and to prevent or control mechanical hazards.*

The milling process of rice flour is very important for the entire production of FRK. The granulation of flour influences different aspects of the process. Grinding and sieving impact the granulation or particle size of the flour, which in turn affects FK quality. Although grinding a very fine flour means greater investment and a higher use of energy, it also brings pivotal advantages that improve FRK quality. The finer the flour granulation, the lower the energy requirement for the production of a homogeneous dough in the preconditioning and extrusion processes.

5.2.2.2 Raw Material Mixing and Feeding into Extruder

Mixing

Proper mixing of appropriate quantity of raw material in the mixer is very important to attain desired quality of the FRK. This can be achieved by mixing the components before the FRK manufacturing process.

Due to lower costs, premixing raw materials is usually preferred. Paddle mixers are efficient in premixing. The mixing chamber is filled in batches – either automatically or manually – or with a combination technique whereby the main component (the rice flour) is automatically added, and additional ingredients (premix, emulsifiers if used) are incorporated manually.

1. **Automated Mixing:** Automation has the advantage that the weight of each component can be documented in every batch. The mixer is the most important unit in ensuring an even distribution of the ingredients with the flour.

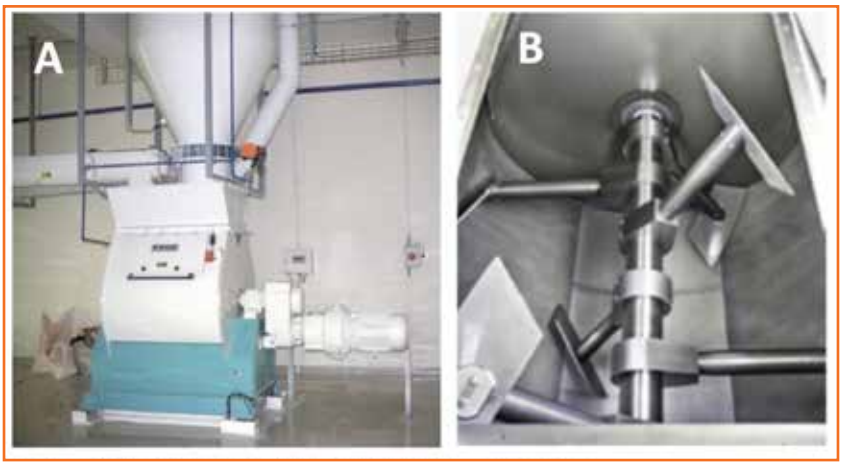


Fig 5.2.4 Automated mixing of material

2. **Manual mixing:** Vertical batch mixers are usually used in warm extrusion lines. Hot water (~90°C) is added to the flour and micronutrient premix in an excess of up to 33% and mixed until the ingredients are homogeneously distributed to simulate pre-cooking inside the preconditioner. Screw conveyors transfer the prepared mixture into the hopper and then the extruder.

   If the mixer is filled manually, it is important that all ingredients are added in correct amounts as per the required formulation. This should be monitored and documented.

Fig 5.2.5 Manual mixing of material

Note: *Manual mixers must be operated very carefully due to open access to the mixing chamber's high-speed rotor blades, which can be hazardous. The use of covers, safety switches and warnings are recommended. Insulation of the screw conveyor and hopper, as well as a cover, also helps maintain temperature control while the dough is being moved to the extruder, which improves the effect of hot water addition to the starch.*

Feeding to the extruder

When the mixture of rice flour, premix, emulsifier, etc. is ready for use, it is conveyed from mixer to the hopper for the next stage of FRK processing. Therefore, rapid emptying of the mixer is important. Most mixers have a large opening at the bottom of the mixing chamber to achieve rapid emptying and ensure the mixer is ready for the next batch.

The hopper under the mixer should be equipped with a screw conveyor. The screw conveyor moves the correct amount of mixture to the hopper for extrusion process.

5.2.2.3 FRK Production by Extrusion Process

To produce FRKs by extrusion, fortified flour is converted into dough using a rotating screw. This requires energy, which increases the temperature of the dough. This limits the capacity of the FRK process, as the dough at the outlet of the die plate must not be allowed to expand. Such expansion occurs when the temperature of the water in the dough is so high (~100°C) that the pressure difference at the exit point converts the liquid water into steam. Steam has a higher volume than liquid water and so causes the dough to expand. While expansion is desired for some puffed products (e.g. breakfast cereals, snacks), it must be avoided in case of FRK.

Warm and hot extrusion process for FRKs

The terms warm and hot extrusion are used to differentiate the extrusion lines' characteristics that affect the process and, subsequently, the product quality. Regardless of the process, FRKs are of optimal characteristics if all starch granules are fully gelatinized. This occurs only if the dough is completely cooked. Rice flour that is not cooked thoroughly by the extrusion process results in partly gelatinized starch granules. As a result, FRKs disintegrate during cooking by the consumer, which will cause micronutrient loss if rice is cooked in excess water.

In hot extrusion, the dough in the extruder reaches temperatures slightly above 100°C. This gives flexibility to modify ingredients such as rice flour to improve processing capacities and end-product properties. The patent describes the production of FRK in detail using twin-screw hot extrusion with a preconditioning step with the addition of steam and drying process. Together with the actual extrusion process, these steps are decisive in the production of a high-quality FRK.

In the warm extrusion process, the temperature of the dough in the extruder should never exceed 100°C. Warm extrusion systems have some deviations from the method described in the patent despite their similar production systems.

Starch changes in the FRK process

The desired rice-like appearance in FRKs is achieved by processing rice flour with enough water, heat and shear. The starch in the flour, as the main and most important structural component in the FK, should be cooked and forced so that most of the starch granules are fully gelatinized and dissolved into a homogeneous mass. Such a mass gives the desired matrix for the vitamins and minerals.

During preconditioning, starch can gelatinize by absorbing water at temperatures above the gelatinization temperature, but the granular shape remains. The necessary dissolution of the granular shape takes place in the extruder by introducing shear energy via the screw elements. If temperatures are exceeded, the dough needs sufficient cooling at the end of the extruder to prevent expansion. To achieve this, venting and cooling of the last extruder section can be used.

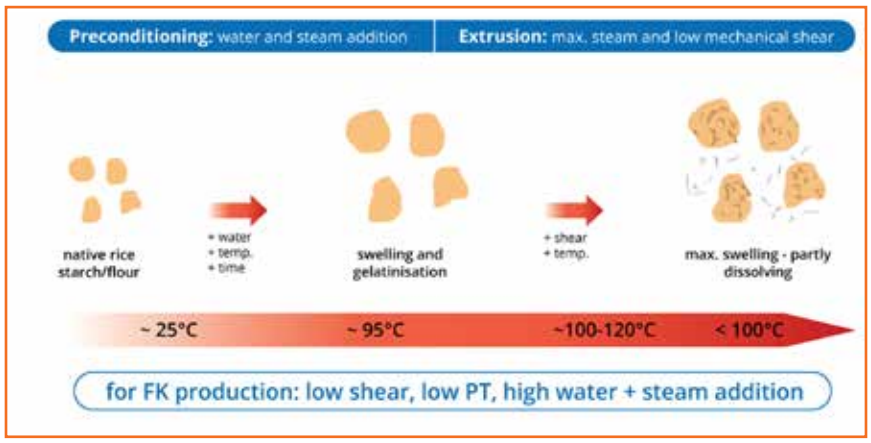


Fig 5.2.6 Schematic description of starch transition in the hot extrusion process

Hot extrusion

Preconditioning, usually observed only in hot extrusion lines, prepares the flour, subjecting it to steam so that the extruder can convert it into a cooked dense mass with minimal energy input. During the preconditioning step, it is possible to vent or degas the process chamber by vacuum suctioning. This option is especially useful if the raw material is not very fine. A coarser material needs more shear to get a good surface appearance. More shear, however, leads to higher temperatures. Venting removes a significant amount of water in the form of steam from the dough inside the extruder. When using a vacuum, this effect is further enhanced. The removal of water and steam simultaneously causes the mass to be significantly cooled. The investment in degassing is therefore very worthwhile if high throughputs from the extrusion process are needed.

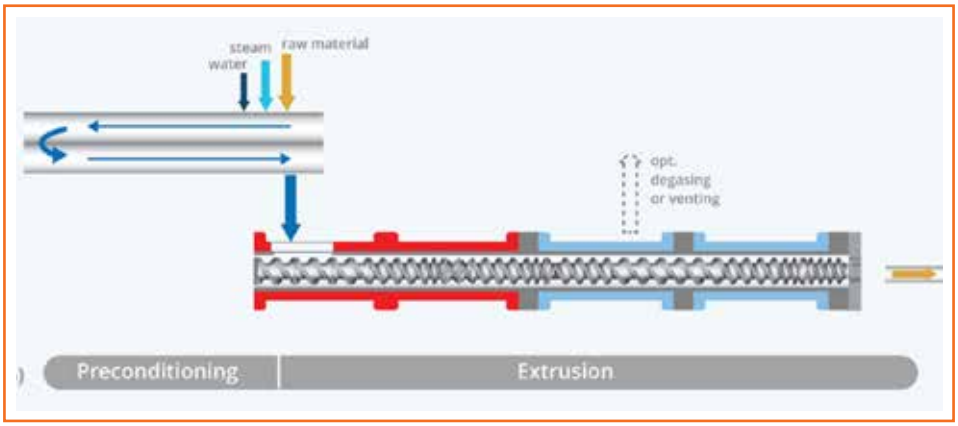


Fig 5.2.7 Hot extrusion

Fig 5.2.8 Extruder machine

Warm extrusion

In warm extrusion, hot water (~90°C) is added to the flour and micronutrient premix in an excess of up to 33% and mixed until the ingredients are homogeneously distributed (10 minute maximum) to simulate pre-cooking inside the preconditioner. After mixing, dough temperatures reach 60-62°C; however, rice starch gelatinization temperature occurs between 65 and 78°C. This is resolved by a sharp rise in temperature as the dough is transferred towards the die plate, due to shear input.

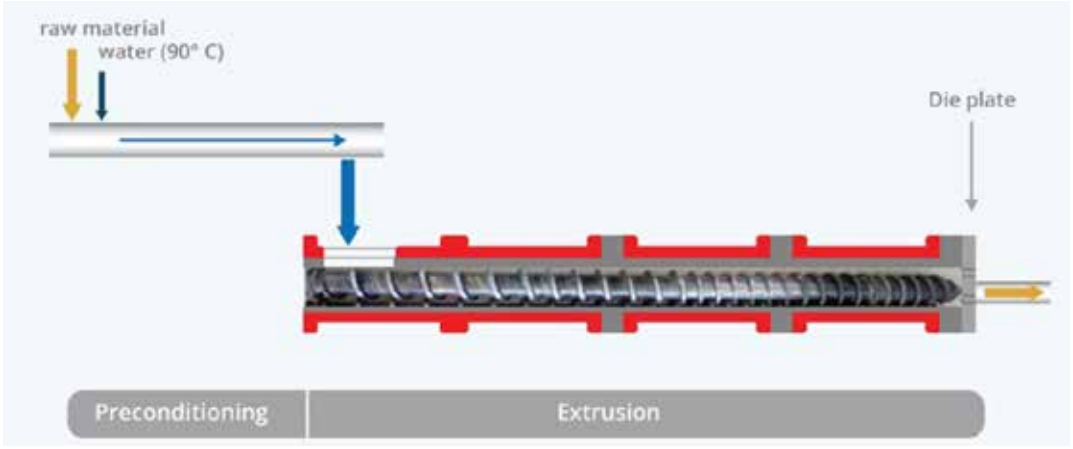


Fig 5.2.9 Warm extrusion

The temperature at the die plate must remain below the temperature at which FRKs begin to expand (< 100°C) to allow gelatinization but prevent puffing. The installation of a thermocouple in front of the die allows product temperature to be measured, and action to be taken if necessary. Cooling or venting mechanisms in the last section of the extruder are highly recommended to prevent dough temperatures reaching 100°C.

Operation of Extrusion System machineries

The heart of the FRK production plant is the extrusion system. This is made up of different components, containing addons specific to each particular process. The extruder itself is also assembled per specific requirements in terms of throughput and conditions of the current application, namely FRK.

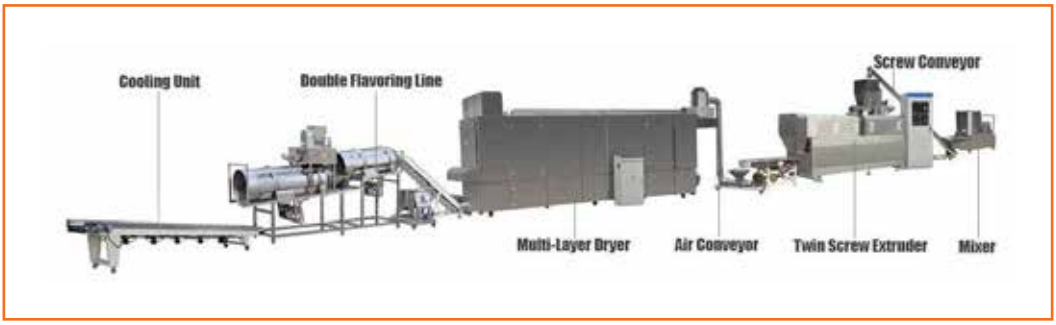


Fig 5.2.10 Extrusion process system

This system consists of the following components:

- Dosifier/feeder,
- Preconditioner,
- Water and steam addition devices,
- Extruder,
- Heating/cooling for extruder barrels,
- Control cabinet, and
- An optional degassing device.

Each component is selected according to the desired throughput, the process, final desired attributes, and budget. They are then activated and adjusted by the extruder control during production.

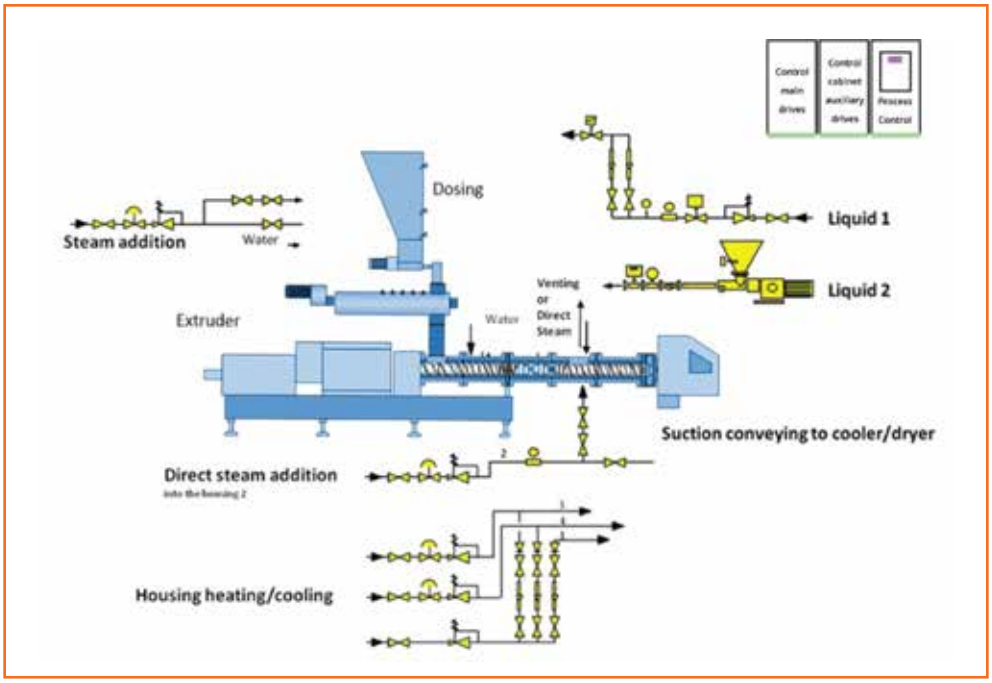


Fig 5.2.11 Extrusion machine operation

Dosing

The two ways to feed the flour blend into the extrusion process - volumetric and gravimetric - both consist of a premix hopper and a dosing screw. The screw continuously feeds the flour from the hopper into the extruder. Since these two systems function very differently and require very different investment, it is important to describe them in detail.

- **Volumetric dosing:** This system works by changing the speed of the dosing screw. It does not consider the density of the material, or the degree to which the hopper is filled. It simply promotes a filling of the screw chambers per revolution forward. The mass throughput of the dosing screw differs with different bulk densities of the material and the bulk weight of the material in the hopper. Furthermore, the fill level in the hopper affects flow rate due to the pressure exerted by gravity. This effect can be reduced with a large container and a high frequency of refilling. With a volumetric dosing system, the actual throughput for the respective premix must be determined manually in advance. For this purpose, the mass flow at different speeds must be collected and weighed for a certain time. Based on these measurements, a metering curve can then be calculated to determine the mass flow of the premix for each screw speed, which is specified by the control unit.
- **Gravimetric dosing:** This system is much more complex but also much more accurate. Here, the hopper is on load cells that continuously measure the weight of the material in the hopper. This allows the system to accurately calculate the output of the feeder at any time. Thus, the system constantly changes the speed of the metering screw to the desired rate. In addition to the very accurate continuous feeding rate, the system generates data that may be retained as a record of the production process.

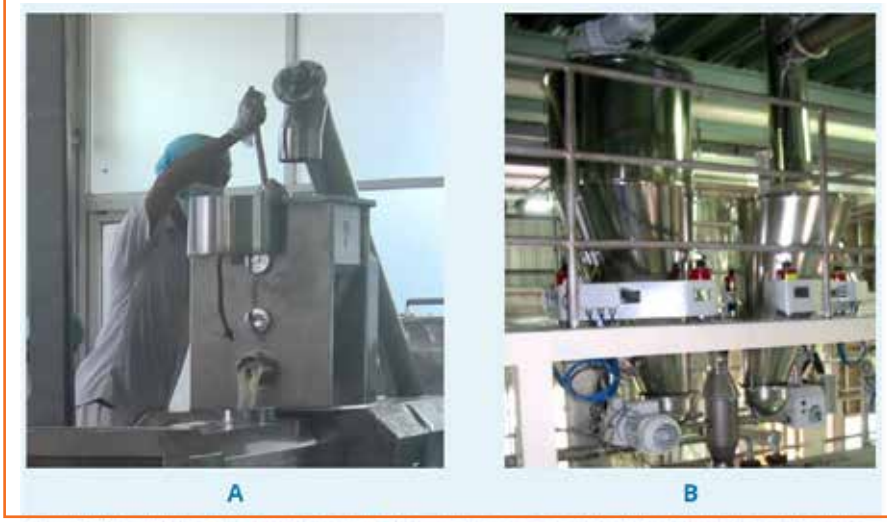


Fig 5.2.12 (A) Volumetric dosing with a single screw, (B) Gravimetric dosing units, one for rice flour and the smaller one foor the vitamin, mineral and emusifier premix

Preconditioner

A preconditioner homogeneously mixes the blended rice flour and fortificant mix with steam and water. The aim is to obtain moistened rice flour particles and to gelatinize the rice starch within these flour particles. Maximum amounts of both water and steam should be added to the preconditioner, and the ingredients must stay in the conditioner for as long as possible at the highest possible temperature. Settings for water and steam addition rate as well as throughput depend on the design properties of the preconditioner, the rice type and the recipe. During start-up of the extrusion line, these parameters are usually set with the equipment manufacturer during validation of the product.

Fig 5.2.13 Preconditioner

Extruder

An extruder consists of the following components: motor, gearbox, barrels, screw, die plate and cutter. These components are further described below.

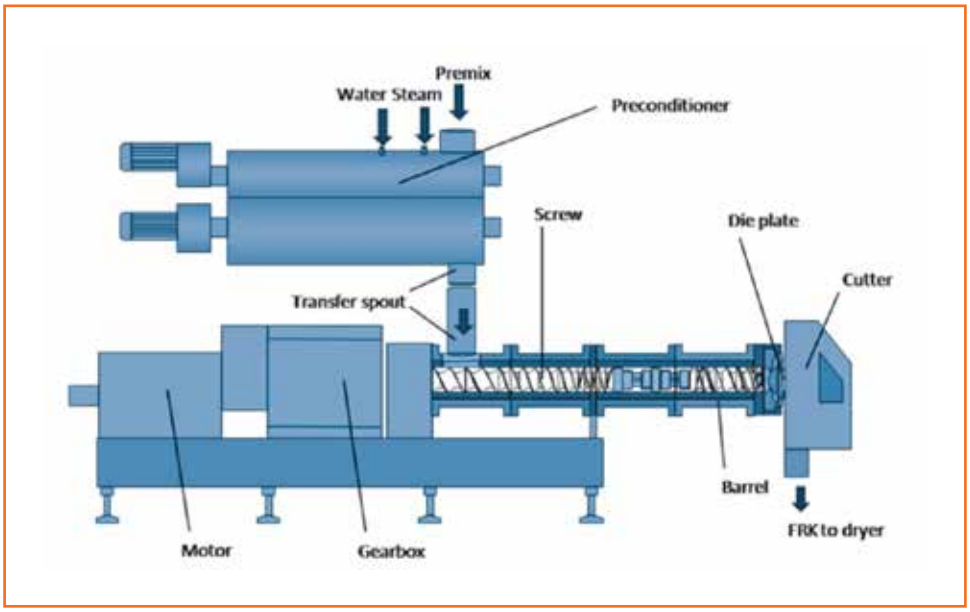


Fig 5.2.14 Parts of an extruder machine

Screw: The most important component of the hot extrusion process is the configuration of the screw and the arrangement of the individual screw elements. Rice flour that has been gelatinized in the preconditioner will still have a granular floury texture upon entry to the extruder. This powdery state must be converted in the extruder into a homogeneous dough without any granular appearance through shear.

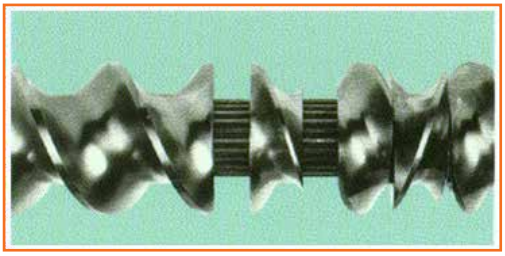


Fig 5.2.15 Screw

A flexible screw configuration is always preferable because the flexible screw elements can be used to create internal shear. Thus, the introduction of mechanical energy can be forced at different points other than the die plate. This enables the dough in the extruder to be cooked independently of the limited temperature transfer of the housing elements.

Die plate: The dimensions and arrangement of the holes in the plate and the head space between screw and die plate determine the FRK shape and uniformity. The width, length and depth of the holes in the die plate are the major factor affecting FRK final shape. The length and width of the kernels can be adjusted by the extrusion parameters only to a small extent. The dough in the extruder must be homogeneously distributed over the entire die plate to force the same amount of material through each die hole.

Fig 5.2.16 Die plate

Cutter: The dough exits the extruder through the die holes as a continuous strand. This strand must be cut with rotating knives to obtain the characteristic rice-like kernels. The number of knife blades and the speed of the knife shaft determine how often the strand is cut off. This it is what gives the third dimension, or height, to the kernel.

It is necessary to specify and vary the speed of the blade shaft. Furthermore, if the distance from the knife blades to the die plate can be adjusted during the process, it is possible to optimize the cut. This can minimize rough edges, cut corners, smears and stickiness to the knife blades.

Fig 5.2.17 Cutter

Heating /cooling options in the extrusion process: Temperature is a key parameter for FK process, capacity and quality. It is helpful to be able to measure the product temperature in the process, and important to be able to change the product temperature within the zones of the extruder. Measuring the temperature of the housing gives no reliable indication of the actual product temperature due to the limited heat transfer from the housing, even if the housing elements are actively heated or cooled. Therefore, to measure product temperature, a sensor must extend into the actual product inside the housing.

Since the housing units cannot be cooled, overheating can occur –especially in front of the die plate, where heat is generated by the backpressure against it. In warm extrusion systems, the backup at the die plate is the only way to cook the flour premix into an amorphous dough. To support this, the barrel temperatures of the first sections should be set as high as possible, to transfer as much thermal energy into the dough as early as possible. The goal is to achieve starch gelatinization in the conveying section, so the temperature increase can be limited at the die plate.

Fig 5.2.18 Heating/cooling section in extruder machine

The most common option for temperature control is external heating devices which pump a tempered medium (i.e. water, oil or glycerine) through the cylinder. Thermocouples control the operation of these external devices and ensure production at set points. Alternatively, electrical jackets can be used for heating, and water (chilled or at room temperature) for cooling. Thermocouples monitor the energy output through the shells, or the opening time of the cooling water valves, to bring the extruder barrels to the temperature set point. Another possibility is the use of steam. Again, thermocouples monitor the valves to heat the extruder barrels with steam or to cool them with water.

The selection of the tempering medium defines the possible temperature range. Hence, the tempering medium should be selected according to the requirements of the process and operating cost related to electricity or steam in collaboration with the equipment manufacturer.

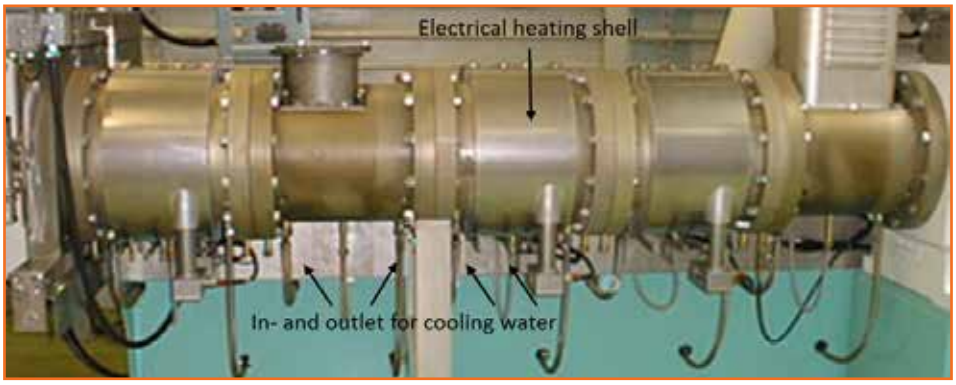


Fig 5.2.19 Heating/cooling section in extruder machine

5.2.2.4 Drying

The cut kernels from the warm extrusion process can be transported to the dryer with a non-stick conveyor belt or vibratory conveyor. Kernels from the hot extrusion process should be transported through a pneumatic conveyor due to their stickiness at this stage. Also, pneumatic transport is a good way to dry the surface of the hot extruded kernels, thereby reducing the formation of lumps in the subsequent dryer.

Fig 5.2.20 Conveyor

For warm extruded FRKs, a long-term belt dryer may be the best option. This is because the kernels are normally produced with lower moisture content, and so they are less sticky at the end of the extrusion process.

For hot-extruded kernels, it is best to use a two-stage drying process:

1. **Phase 1:** The rapid initial water loss suggests that the FRK drying process is initially determined by air exchange (quantity and temperature).
2. **Phase 2:** This is followed by slow water loss, as the drying process is limited by the diffusion of water from inner layers of the kernel.

It is preferable to divide the drying process into two machines: one with a high air throughput, like a fluid bed dryer, and a second one with a long residence time, such as a belt dryer.

Fig 5.2.21 Dryer

- In phase 1, a fluid bed dryer is recommended as it actively moves the kernels through the air stream, preventing sticking. Due to the high airflow, a large amount of water can be removed in a very short time.
- In phase 2, a long-term belt dryer can complete the drying at moderate temperatures. This should be carried out at as moderate as possible temperatures to prevent excessive drying of the outer layers, which will result in cracks. These cracks can lead to the breakage of the kernels during handling, which is a significant quality loss.

Fig 5.2.22 Condensation section

After drying, it is very important that FRKs are cooled to near ambient temperature so that condensation does not occur during packaging. Condensation can lead to moulding during storage. Also, unevenly or overly dried kernels crack, which leads to breakage and lower acceptability.

5.2.2.5 Storage and Packing

While the final moisture content of the kernels is the most important factor for FRK shelf life and its micronutrient content, it is equally important that FRKs are stored and packaged under the best possible conditions, namely at room temperature (approximately 23°C), away from direct sunlight and in a well-ventilated area.

It is recommended that storage time in tanks is minimized, and that FRKs are packed in 5 - 25 kg bags as soon as possible. The best storage conditions for bagged FRK can be created by excluding oxygen, moisture and direct light exposure. Therefore, packaging specifications should be very clear about barrier properties related to moisture, oxygen, light barriers and other characteristics that must be followed by the FRK producers unconditionally. This is especially critical if FRKs contain micro-nutrients whose stability is sensitive to direct light, moisture or prolonged storage.

5.2.3 Monitoring and Documenting Production for Process Control

Understanding the process model of FK extrusion is the basis for good process control and standardized production, since this is the only way to determine critical parameters and thus be able to monitor them. Accurate process control and documentation is only possible if the crucial parameters can be measured and recorded. Process data recording is an integral part of traceability of products and their manufacturing conditions.

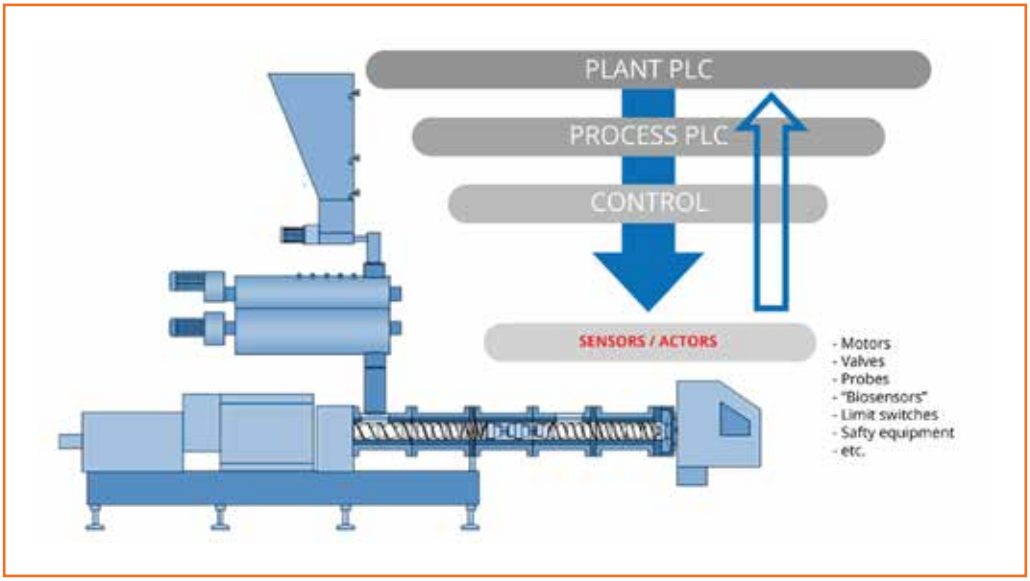


Fig 5.2.23 Sensors and devices in extruder

In modern extrusion plants with a high degree of automation, all relevant parameters are detected and recorded. These include drying temperatures, belt speed, air volumes, engine power, amount of air, and the temperature in the mill. These records are especially important on the extruder. Depending on the degree of automation, all variable process parameters can be set and changed.

A Plant PLC facilitates compliance with a well-defined standard operation procedure (SOP). With a high degree of automation, the parts of the plant which must be started, and the parameters needed to carry out the desired FRK production, can be precisely specified. If an important production parameter (e.g. steam addition rate) is outside defined safety ranges, this is then immediately signalled and recorded. A light or sound associated with the parameter notifies the need to check and correct production. This allows the operator to react immediately and decide whether the products can be used, or the production must be stopped.

With a low degree of automation, or in the case of manual operation, the SOP can only be based on parameters that can be monitored. Therefore, the stability and reproducibility of the process is entirely dependent on the accuracy of the adjustable parameters. Compliance with the SOP is only possible if the parameters relevant to product quality are known and can be measured, changed and documented.

Fig 5.2.24 Control panel of extruder

For government office orders, gazetted standards, protocols and guidelines for production and QA/QC of fortified rice

1. Food Safety and Standards (Fortification of Foods) by FSSAI

   Source: https://www.fssai.gov.in/upload/uploadfiles/files/Compendium_Food_Fortification_Regulations_30_09_2021.pdf

2. Draft operational guidelines for QC of food fortification by Ministry of Consumer Affairs

   Source: https://dfpd.gov.in/LwB3AHIAaQB0AGUAcgBlAGEAZABkAGEAdABhAC8AUABvAHIAdABhAGwALwBOAGUAdwBzAC8A583_1_Draft_Operational_Guidelines.pdf

3. Office order by Food Corporation of India

   Source: http://fci.gov.in/app/webroot/upload/Quality/SOP%20FRK%20FR.pdf

UNIT 5.3: Production of Blended Fortified Rice

Unit Objectives

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

1. Describe blending process of fortified rice
2. Demonstrate various methods of blending of fortified rice

5.3.1 Blending of Fortified Rice

After production of FRK, now regular rice (any variety) can be blended with FRK to obtain fortified rice as per the regulatory and market requirements. Blender and dozer combination is applied to get uniform blending of FRK and polished raw or parboiled rice in ratios ranging from 2-100 to 2-100.

Methods of blending:

There are two methods of blending -

1. Batch blending
2. Continuous blending

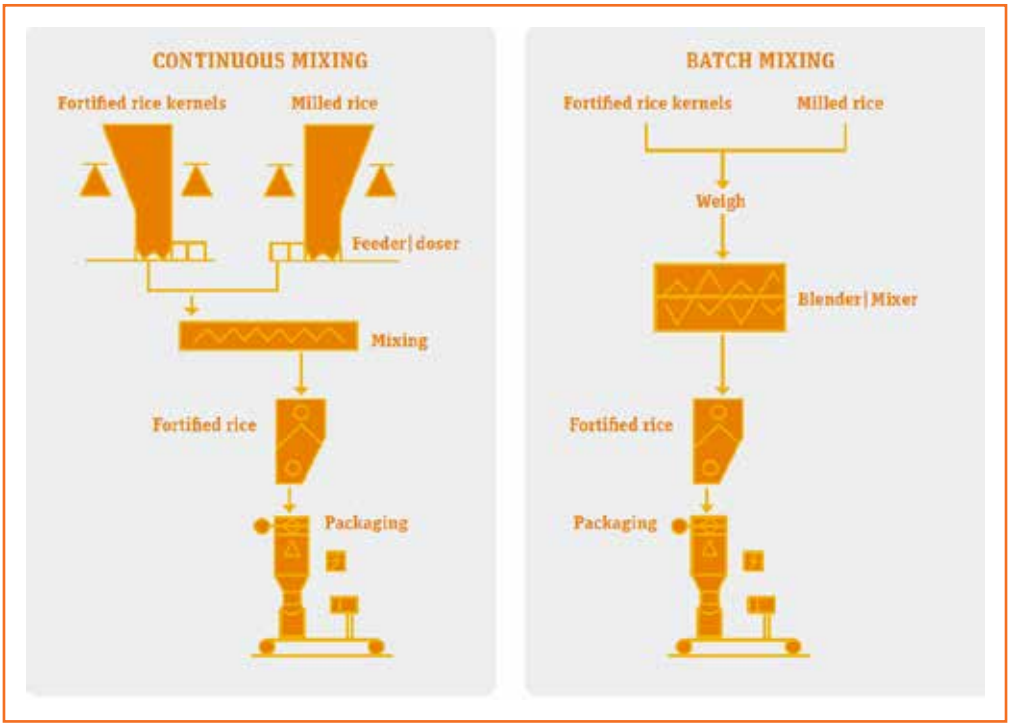


Fig 5.3.1 Methods of blending

Selection of blending mechanism: The choice of continuous and batch blending depends on several factors. Continuous blending requires less handling operations than batch blending and can handle larger volume as required in a conventional rice milling environment. A continuous mixing system operates

simultaneously at three stages:

- Material proportioning or metering
- Blending
- Discharge

Batch versus continuous mixing should be carefully evaluated in the context of the capacity, economics and technological feasibility. In some cases, batch mixing might be more advantageous for reasons mentioned below -

1. More flexibility in the process and possibly greater blending homogeneity at various blending time periods
2. Ability to control feeder and blender individually to attain various speeds and time periods
3. Batch mixing can handle smaller volumes and can reduce cost for a lower capacity operation

Selection of blenders: When selecting the blenders, available blenders should be evaluated based on several criteria, including existing set-up of the operations, current throughput of the line where the fortification needs to be integrated:

1. Choice of continuous/batch blending depends on the ease to integrate the equipment to current settings and choice of operations
2. Rice mill capacity/ through put
3. Cost of equipment and its operational cost
4. Operational ease
5. Effectiveness of blend (homogeneity achieved), precision mixing; time of blending
6. Gentle mixing (low broken percentage);
7. Suitability to grain blending (potential damage to kernel or product loss)
8. Maintenance and operational costs

5.3.2 Batch Blending of Fortified Rice

The batch mixing mechanism requires a blender, a dosing system, pneumatic controls, a PLC board and supporting structures to arrange the systems in order (frames, gate valves etc).

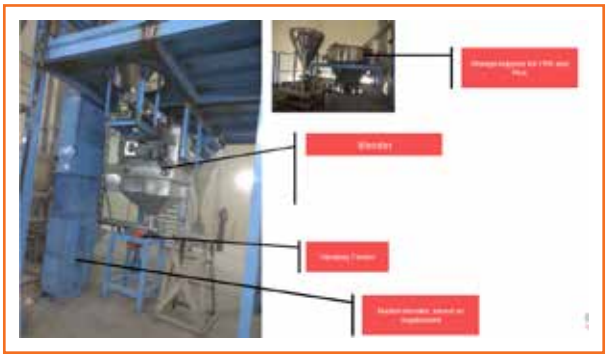


Fig 5.3.2 Parts of a blender

Batch blending process consists of two hoppers of which one is filled with FRK and the other is with regular rice. These two hoppers will be connected to a dosing system which will be controlling the grain flow and feeding to the blender. The dosing system feeds the rice in 1:100 w/w ratio to the blender. Blender blends the mixture to produce a homogenous 'Fortified Rice'.

Fig 5.3.3 Batch blending

After blending, the blended Fortified rice will be taken out for packing from the outlet which is controlled by a gate valve. The entire system can be controlled using a Programmable Logic Controller (PLC) making the process an automatic one.

5.3.3 Continuous Blending of Fortified Rice

Where rice mills have large cylindrical graders, Graders can be used as blenders. The system can be integrated using a dosing system to dose the FRK in required quantities before the regular rice enters into the graders.

FRK is fed before the rice goes to grading cylinder using a pre-calibrated vibratory feeder (dozer) to the same rate of the flow of regular rice that is flowing to the length grader, the mixture of rice and FRK stirs inside the length grader a number of times to properly intrude the fortified rice kernel in the rice mass.

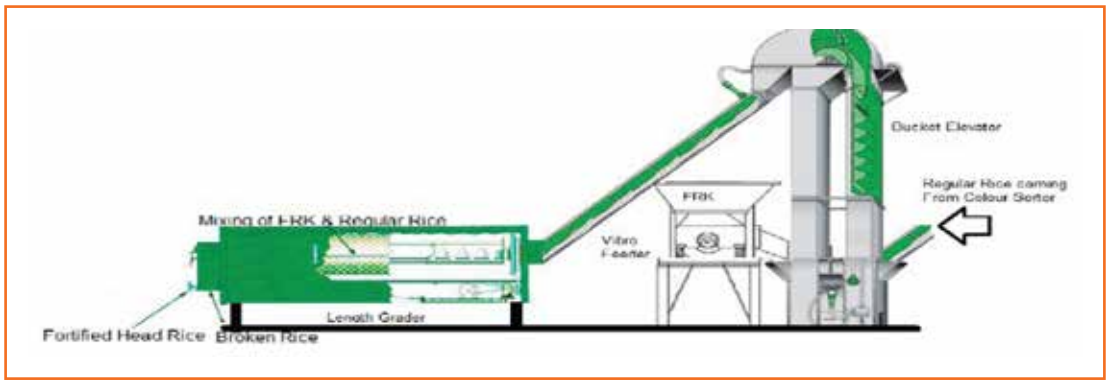


Fig 5.3.4 Continuous blending system

This method is a continuous feeding method and can help to increase the productivity while maintaining the uniformity of the blend. The mixing mechanism makes this blending process the most economical and effective as well. Vibratory dozer/feeder needs to be calibrated to match the desired flow capacity of the regular rice. The outlet of vibratory feeder (FRK) is attached to one inlet of the bucket elevator. To obtain the uniform blending, the vibratory feeder should discharge the fortified grain to match the flow of regular rice in the rice grading cylinder.

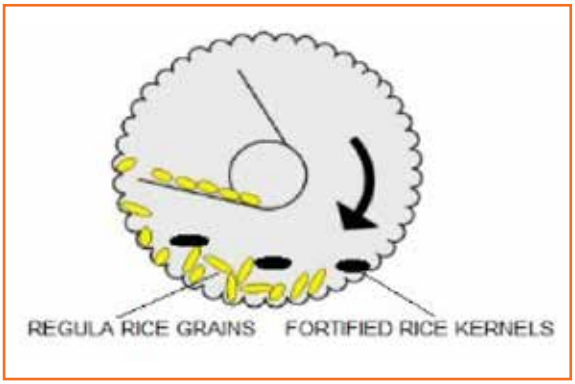


Fig 5.3.5 Mixing of fortified grain

FRK added through the vibratory feeder are mixed with regular rice flowing into the bucket elevator from the colour sorter, and the mix goes to the length grader. The length grader, by virtue of its grading mechanism, churns out the mix separating the broken grains from the mix, and this churning helps in the uniform distribution of FRK in the final fortified rice obtained at the head rice outlet of the length grader.

The second type of system that allows a high degree of blending homogeneity and is capable to handle extensively large quantities in a rice mill setting is continuous plow shear mixer. The stainless steel construction allows a rotating shaft fitted with a number of plow assemblies. The regular rice is fed through the rice bin and FRK through a vibratory feeder mounted below a FRK hopper. The operation is carried out for a specified time. The blended fortified rice will flow out of the blending system through an outlet at the other section of the equipment.

Fig 5.3.6 Zig-zag blender

The other type of blending equipment is the zig-zag blender that allows a continuous mixing of fortified rice along with highest level of homogeneity. The said blender is under development stage and soon to be installed at various locations.

5.3.4 Safety and Hygiene During the Manufacturing of Blended Fortified Rice

Several factors are involved in the processing of safe and hygienic food. The process involves all activities and responsibilities for preventing product adulteration, as well as the implementation of actions to prevent the occurrence of some of the hazards that can harm consumers. Providing a clean and sanitized environment and equipment for food processing is essential for producing safe foods. Personnel practices, plant facilities, equipment and operations designed to prevent contamination, pest control and warehousing practices are all equally important. It is imperative that all of these considerations be addressed in the design of a comprehensive sanitation programme and a subsequent HACCP system.

GMPs are intended to provide criteria for complying with the provisions of the government regulations requiring that all human foods be safe and free from adulteration.

In order to ensure high-quality production of FR, the standard food-safety guidelines will need to be followed stringently. The most commonly reported food preparation practices that contributed to food borne disease are -

- Improper holding temperatures
- Poor personal hygiene
- Inadequate cooking
- Contaminated equipment
- Food from an unsafe source

Contamination: Food becomes hazardous by contamination. Contamination is the unintended presence of harmful substances or microorganisms in food. Food can become contaminated from chemical, physical or biological sources. Regular testing, of final produce and raw material is important to keep contamination away.

- **Microbiological hazards:** Biological hazards come mainly from microorganisms including bacteria, viruses and parasites.
- **Chemical hazards:** Chemical hazards include substances such as cleaning solutions and sanitizers.
- **Physical hazards:** Physical hazards are foreign particles, like glass or metal.

Cross Contamination: Cross contamination is one of the most common causes of food poisoning. It happens when harmful germs are spread onto food from other food, surfaces, hands or equipment. It's very important to prepare food safely, to help stop harmful germs from spreading and growing. Cross-contamination of food may be due to,

- Hands that touch raw foods, such as chicken, then touch food that will not be cooked, like salad ingredients.
- Surfaces, like cutting boards or cleaning cloths, that touch raw foods, are not cleaned and sanitized, then touch ready-to-eat food.
- Raw or contaminated foods that touch or drip fluids on cooked or ready-to-eat foods.

The most important tool to prevent food borne illness is good personal hygiene. Personal hygiene is the way people maintain their health, appearance and cleanliness. Not only one can become the victim of illness, but one can also be the carrier. A cough or sneeze can transmit thousands of microorganisms that may cause disease.

Fig 5.3.7 Safrty signs

Food safety includes handling, preparation, and storage of food in ways that prevent foodborne illness. This includes several practices that should be followed to avoid potentially severe health hazards. Food can transmit disease from person to person as well as serve as a growth medium for bacteria that can cause food poisoning.

The five key principles of food hygiene, according to WHO, are:

- Prevent contaminating food with pathogens spreading from people, pets, and pests.
- Separate raw and cooked foods to prevent contaminating the cooked foods.
- Cook foods for the appropriate length of time and at the appropriate temperature to kill pathogens.
- Store food at the proper temperature.
- Use safe (RO) water.

Government of India has set up Food Safety & Standards Authority of India (FSSAI) to take care of the regulatory guidelines on food safety.

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

www.youtube.com/watch?v=T71bw2C4aNQ
Rice Fortification

www.youtube.com/watch?v=NYvxUNhOGUU
Understanding Micronutrient Food Fortification

https://www.youtube.com/watch?v=8aHCALd2l-g
FORTIFIED RICE KERNEL (FRK) PROCESSING PLANT

Exercise

1. How much Premix is added for fortifying 1000 kg rice?

   a. 10 kg
   b. 100 g
   c. 200 g
   d. 2 g

2. Rice can be fortified using which of these technologies?

   a. Extrusion
   b. Dusting
   c. Coating
   d. All of the above

3. At which stage of processing is the micronutrient premix added for fortifying rice?

   a. Beginning of milling process
   b. During milling process
   c. After milling process
   d. None of the above

4. What is the shelf life of fortified rice?

   a. 3 months
   b. 6 months
   c. 9 months
   d. 12 months

5. What are the different types of extrusion technology available for fortification of rice?

   .....

   .....

6. What is the equipment required for the production of fortified rice kernels through extrusion technology?

   .....

   .....

7. How are FRKs blended with normal rice?

   .....

   .....

8. How is fortified rice produced?

   .....

   .....

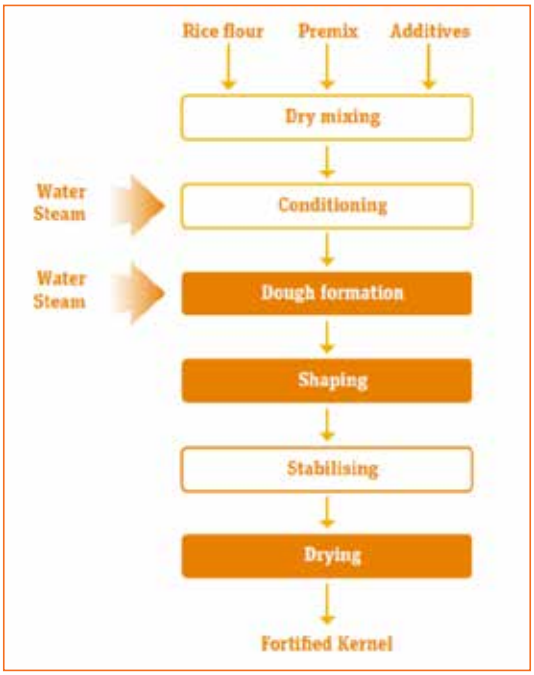
Practical

1. Perform production of Fortified Rice Kernel (FRK)

Pre-requisite knowledge:

- ❑ Production of Fortified Rice Kernel (FRK)

Method:



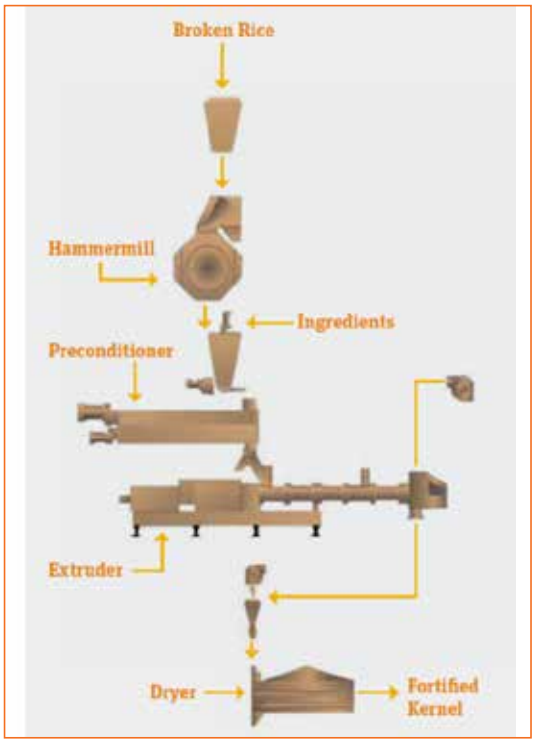
Refer to the process flow given in PH

2. Perform production of Blended Fortified Rice

Pre-requisite knowledge:

- ❑ Production of Blended Fortified Rice

Method:



Refer to the process flow given in PH

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Corporation
Transforming the skill landscape

6. Ensure Stability and Proper Storage of Packed Fortified Rice

FICSI
FOOD INDUSTRY CAPACITY & SKILL INITIATIVE

Unit 6.1 – Quality Assurance of Fortified Kernels and Fortified Rice

Unit 6.2 – Post-production Activities

FIC/N1036

Key Learning Outcomes

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

1. Describe need of QA/QC plan for production of fortified rice.
2. Describe ways for maintaining the quality of production process.
3. Describe various post-production activities need to done after production of fortified rice.
4. Demonstrate post-production activities.

Unit 6.1: Quality Assurance of Fortified Kernels and Fortified Rice

Unit Objectives

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

1. Describe need of QA/QC plan for production of fortified rice.
2. Describe ways for maintaining the quality of production process.

6.1.1 Quality Assurance and Quality Control of Fortified Kernels and Fortified Rice

In order to ensure quality production of Fortified rice, the standard food safety guidelines will need to be followed stringently. The staff will need to know and learn the following in relation to food safety. The major food preparation practices that are contributing to major food borne disease are improper holding temperatures, poor personal hygiene, inadequate cooking, contaminated equipment, and food from an unsafe source. To check these practices at every stage an ideal QA plan is required.

Quality Control (QC) refers to a process by which entities review the quality of all factors involved in production. This approach places an emphasis on three aspects -

1. Elements such as controls, job management, defined and well managed processes, performance and integrity criteria, and identification of records;
2. Competence, such as knowledge, skills, experience, and qualifications; and
3. Soft elements, such as personnel, integrity, confidence, organizational culture, motivation, team spirit, and quality relationships.

Quality Assurance (QA) refers to the systematic activities implemented in a quality system so that quality requirements for a product or service will be fulfilled. It is the systematic measurement, comparison with a standard, monitoring of processes, and an associated feedback loop that confers error prevention. This can be contrasted with QC, which is focused on process outputs.

Fortified rice should be regularly checked at a defined frequency and should be inspected at all levels. To ensure the quality of the fortified rice, controls need to be applied at various levels. It is also imperative to inspect the quality of the fortified rice throughout the supply chain.

1. Food Safety and Quality Management at the mill
2. External testing - Lab empanelment

6.1.2 Food Safety and Quality Management at the Mill

Incoming raw material and finished goods storage:

Fig 6.1.1 Quality management process at mill

- All the incoming raw materials should be visually examined for any kind of abnormalities or deviation from the FAQ/FSSAI specification. It needs to be ensured that the FRK which is proposed to be mixed with the regular rice exactly looks like a sound grain in size, shape, colour and texture so that during analysis they are treated as sound grains.
- At present the regular rice is procured at up to 15% moisture content and its issuable limit is upto 16%. It therefore needs to be ensured that, the FRK remains stable/ does not disintegrate and does not absorb moisture at this moisture level. Since some of such fortified rice may be stored at areas having high rainfall or high humidity it also needs to be ensured that the FRK remains stable and does not become soft/ powdered at such atmospheric moisture.
- During procurement of regular rice, the rice grains having more than 2.5 length - breadth ratio is treated as Grade A rice and grains having less than 2.5 ratio is treated as common rice. In case of Grade A rice as per uniform specification, a mixture of lower class of rice kernel (common rice) of more than 6% is not allowed and such stocks are treated as BRL (beyond rejection limit). To prevent such a situation, it is suggested that the length breadth ratio of FRK is kept at more than 2.5 in case of such FRK is to be mixed with Grade A CMR.
- Certificate of Analysis (CoA) of FRK, quality of FCI rice should be checked. The food material should not be stored directly over the floor, but it should be stored over the pallets or tarpaulin sheet. The material should be stacked away from the wall.
- Good Manufacturing Practices (GMP) and Good Hygiene Practices (GHP) must be followed.

Blending Efficiency Test (BET)

To validate the effective mixing of FRK and raw rice, blending efficiency test should be performed every hour by preparing a composite sample. The composite sample should be collected from 10-15 bags randomly every hour during production and blending efficiency test should then be performed. BET is performed by segregating and counting the FRK from 100g of fortified rice.

BET = No. of FRK per 100g of Fortified rice

Note: *Sample should always be taken before the weighment and stitching.*

Material required for BET

1. 250 ml beaker
2. 50 ml beaker calibrated to measure 50 grams of rice depending on the variety being used for blending

3. 100 ml bottle of Chemical Reagent (Povidone Iodine solution)
4. Dropper
5. Tray
6. QC method instruction manual
7. Standard Operating Procedures
8. Bag

Procedure of BET

1. Collect a sample of 200-500 grams from 10% of the blended fortified rice consignment using the BIS method.
2. Take 50 grams of rice from the collected sample using standard sample reduction techniques
3. Spread the 50g rice sample onto the tray.
4. Prepare a 1% chemical reagent (Povidone Iodine solution) in water using these steps -
   - ❑ Fill 250 ml beaker with 100 ml of water
   - ❑ Add approximately 1 ml of the chemical reagent (Povidone Iodine solution) to the water, using the dropper.
   - ❑ Stir until the solution turns bright orange in colour.
5. Pour the 1% chemical reagent (Povidone Iodine solution) into the tray and mix with the rice sample by tilting the tray or mixing with the dropper. Break-up any lumps that form.
6. Mix the sample until the solution turns from orange to violet-blue (10-15 seconds).
7. Carefully drain most of the chemical solution into the 250ml beaker. Keep the kernels in the tray.
8. Fill 50 ml beaker with water and add it to the kernels in the tray.
9. Count all of the discolored fortified rice kernels and document the findings. Re-count to confirm findings.
10. Discard the tested sample and wash hands.

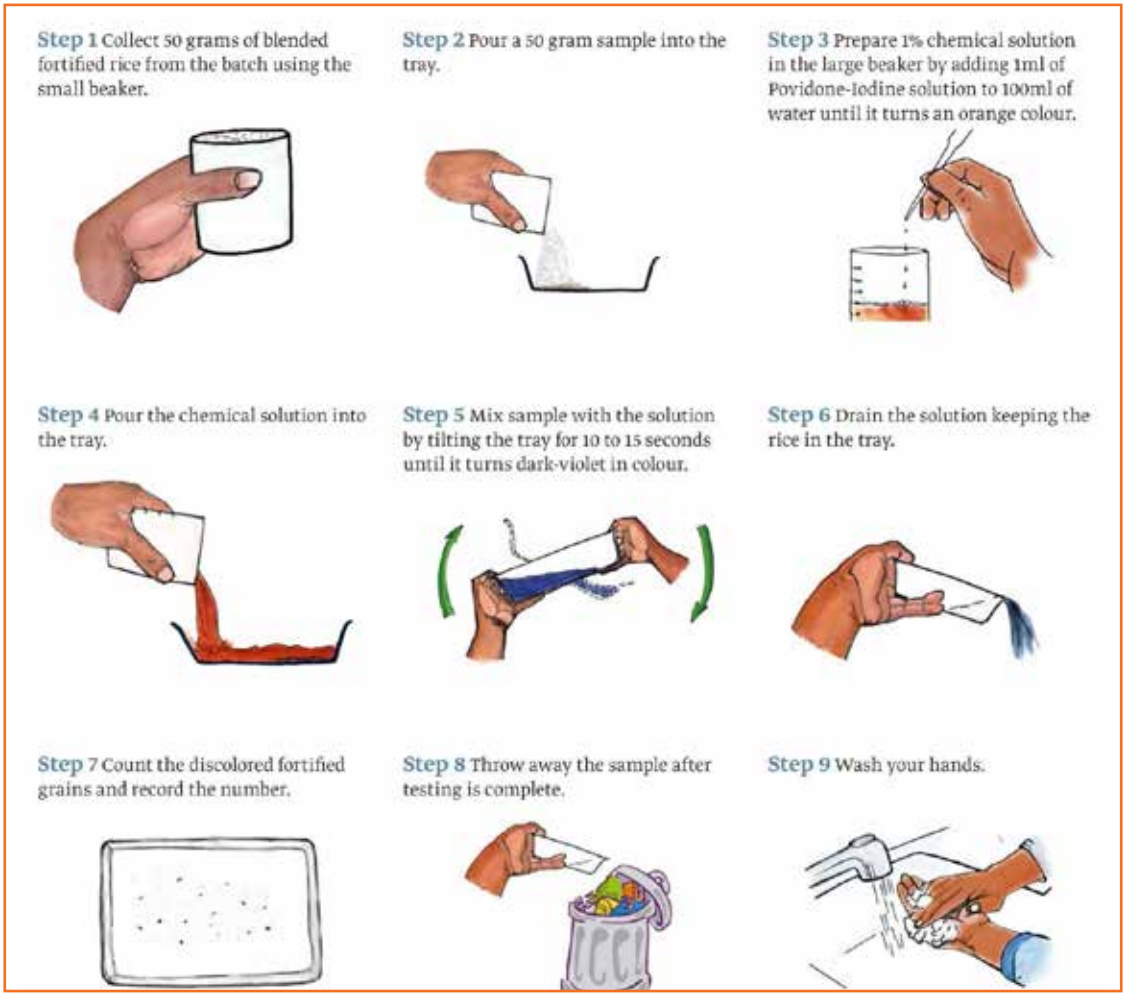

Fig 6.1.2 Blending efficienct test procedure

Iron Spot Test

Mill should have an in-house facility and availability of "Spot-testing" kits to perform test parameters and record daily data. In-house test such as iron spot test to be conducted on regular frequency to further validate the blending efficiency.

Material required for Iron Spot Test

1. H2O2 - 3%: Add 9 ml concentrated H2O2 (30%) to 81 ml distilled water
2. Thiocyanate reagent - Dissolve 10 g KSCN in 100 ml water. Mix with equal volume 2N HCl just prior to use

Procedure of Iron Spot Test

1. Place at least 50 grams of fortified rice in a plastic cup, tray, or similar container.
2. Pour Reagent 1 (2N HCl) on the rice until all the rice kernels are wet.
3. Pour a similar amount of Reagent 2 (10% KSCN) on the wet rice sample.
4. Immediately, fortified kernels will turn red to dark red (black upon drying) indicating the presence of iron fortified kernels.

If added iron compounds are present, they will show up as red spots on the surface. Reduced iron shows up as small dots that take time to appear. Ferrous sulphate shows up as larger spots that 5 appear more quickly. The density of the spots provides an estimate of how much iron was added, which is best done by comparison to flours having known levels of added iron.

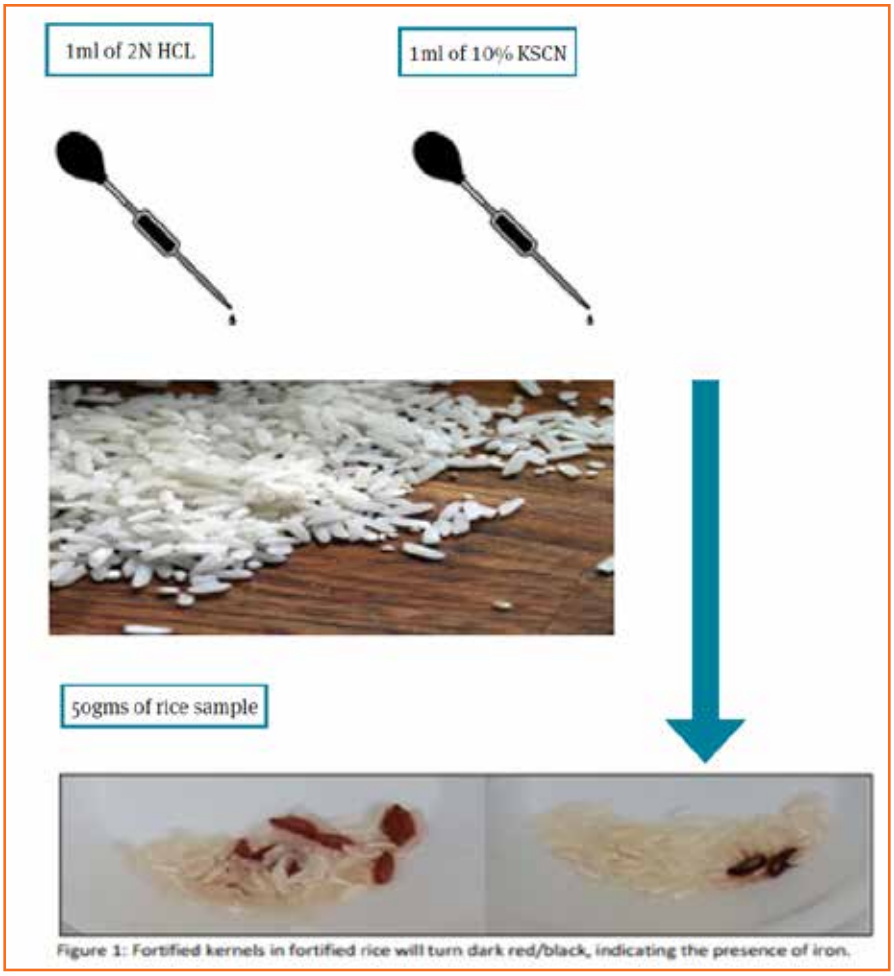

Fig 6.1.3 Iron spot test procedure

Regulatory compliance: The miller should comply to all the regulatory requirements for manufacturing and storing fortified rice. License should carry appropriate category. The package should contain +F logo and miller is required to get their product endorsed by +F logo through FSSAI's website. All the aspects regarding the food fortification standards should be met.

Documentation management:

- Log books should be well maintained to build a robust and transparent system. All records of incoming raw material and outgoing finished products should be maintained which includes lab reports of FRK manufacturer.
- Test results of in-house lab and of external laboratory should also be documented and examined.
- CAPA (Cause and Prevention Action) document format should be maintained and recorded whenever there is a deviation in finished product and root cause analysis should be identified and mentioned.

Food Safety Audits: Provision for internal audit on yearly basis will aid in maintaining the quality management system. The Food Safety Officer (FSO) should pick random samples from the mill and from fair price shops to ensure the quality of fortified rice.

6.1.2.1 Significance of +F logo and FFRC

+F logo

To promote fortified food and distinguish them from the regular products available in the market, a +F logo has been developed to be used on the packs of fortified food products. This will help increase consumer awareness and assist consumers in making healthier choices.

The fortification logo (+F) indicates that the food has been fortified with micronutrients as per standards mandated by FSSAI. It is surrounded by a square which represents completeness. The half ring below the +F sign symbolizes good health, protection for an active and healthy life. FSSAI has clarified that the +F logo must be displayed on all labels of fortified foods together with the statement that a particular food is 'Fortified with ……(Name of the fortificant)'.

Fortified rice will be packed in jute bags with the logo ('+F') and the line "Fortified with Iron, Folic Acid, and Vitamin B12".

Fig 6.1.4 +F logo

Fig 6.1.5 +F logo on package

FFRC

The Food Fortification Resource Centre (FFRC) is established under India's government department that regulates food, known as The Food Safety and Standards Authority of India (FSSAI) in collaboration with TATA Trusts. The FFRC works dedicatedly to provide essential support to stakeholders like relevant government ministries, food businesses, development partners etc., promoting and supporting food fortification efforts across India.

6.1.3 External Testing

External testing of fortified rice

- Vitamin and mineral content of the fortified rice for defined parameters in FSSAI should be tested monthly from an external NABL accredited laboratory.
- On quarterly basis pathogenic microbial parameters should also be sent to NABL accredited laboratory to ensure the safety of the fortified rice.
- Miller would also be required to get the fortified rice tested for complete FSSAI parameters

applicable to fortified rice half-yearly.

Criteria for empanelment of external testing lab

For selection of an external testing lab for parameters related to food safety and quality, following criteria should be met -

- The lab should hold a valid NABL license
- Should be listed in FSSAI approved laboratories
- Iron, folic acid and vitamin B12 should be covered under the NABL scope of the lab
- Should have trained personnel for sample collection

Unit 6.2: Post-production Activities

Unit Objectives

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

1. Describe various post-production activities need to done after production of fortified rice.
2. Demonstrate post-production activities.

6.2.1 Packaging of Fortified Rice

Testing of packaging

Drop test: Drop test standards are designed to test the protective capabilities of a package or container to withstand the sudden shock resulting from a free fall, or to test a package's ability to protect its contents during the sudden shock resulting from a free-fall impact.

The damages caused on the goods by drops, which are common during shipping & handling, perforations or other signs, such as tears and breakages, among others.

In order to foresee and prevent the consequences of this problem, a drop test performs the simulation of drops and rotational impacts that may affect packages and products during handling and distribution. These tests can simulate flat, edge, as well as corner drops.

Drop testing consists of dropping a sample (generally, the chosen packaging containing the load) in different ways (on its corners and edges, and on its different sides).

Therefore, a drop test allows for the analysis of the protective ability of your packaging when facing this kind of event, providing companies with reliable information to design the most suitable product + packaging system to withstand the distribution cycle.

Fig 6.2.1 Drop test

The bags of finished product must pass the drop test (after each drop, there shall be no rupture or loss of contents) following the principles of the drop test standard (EN 277, ISO 7965-2 or equivalent) with following sequence -

- **Butt dropping:** Bag is dropped from a height of 1.20 m on the bottom and the top of the bag.
- **Flat dropping:** Bag is dropped from a height of 1.60 m twice on one flat face and twice on the opposite flat face.

The required minimum number of units to be checked with drop test is 3 units/lot (one lot is max 500 tons).

Marking of Packaging

The following information should be available on the packaging of the product covered by the provisions of this specification:

- Name of the commodity
- Net content
- Name and address of the supplier (including country of origin)
- Crop year (when applicable)
- Details of ingredients
- Manufacturing date
- Lot number
- License No.
- +F logo
- Not for sale

Fortifted rice meant for supply under Public Disribullon System only
(No 1 for Sale In the Open Market)

STORAGE PROCEDURE

Unopened bags of fortified rice should be kept in a cool and dry place, away from direct sunlight. Fortified rice bags once opened should be stored in same bags after tying close with a string

COOKING DIRECTION

Cooking of fortified rice do not require any special cooking procedures. The regular steps of cleaning and washing to be followed. Rice should be cooked strictly using water tight method of cooking

Ingredients: regular rice kernels and fortified rice kernels

Each 1 00g of Fortif ied Rice contains:

Iron	= 4.25 mg
Folic Acid	= 12.5 mcg
Vitamin B-12	=0.125mcg

Net weight -50Kg
Batch no.
Date of Packaging:
BEST BEFORE X MONTHS FROM DATE OF PACKAGING
Note: Use fortified rice within Y days of opening of bag
Manufactured by:
FSSAI License no.

Fig 6.2.2 Information on packaging

6.2.2 Storage of Fortified Rice

Guidelines for storing rice properly in storage area:

- Store the grains at ambient temperature and Humidity <60% in dedicated area. Do not store in open, humid or moist area.
- Do not store the injured or broken grains.
- Use plastic or wooden pallets to store the grains. Do not store the grains directly on the floor.
- Stacking must be done in a way to facilitate maximum air flow and maintain aeration.
- Use rodent traps and other means like pest-o flash to control rodent, insect and pests
- Storage container must be free from large and small openings to prevent insect, pest and foreign matter to gain access to stored grains.
- The material should be regularly inspected for development of any pest and efficient remedial measures must be employed immediately to keep them under control.
- Make the storage area free from cracks and holes on floor and walls to avoid entry of water by seepage from ground or walls. The godown should provide maximum possible protection from moisture, rain, insects, pests, moulds, rodents, birds, fire etc.
- The godown where the material has to be kept should be clean, dry and properly aerated.
- The stacks are built in the form of domes. As protection against rains and sun the stacks should be covered with thick (600 to 1000gauge) black polyethylene sheets and the cover should be tied to the stack with the help of plastic ropes.

Fig 6.1.3 Storage of bags

Fig 6.1.4 Tips for storing material

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

https://www.youtube.com/watch?v=25zVA51CCac&list=PL_mT5DU_smK1eFsOmpTGQauReVFB72sGi&index=14

Packaging & Storage

Exercise

1. +F logo stands for?
   a. Organic food
   b. Vegetarian food
   c. Fortified food
   d. Genetically modified food
2. What is the color of +F logo?
   a. Red and white
   b. Brown and white
   c. Blue and white
   d. Green and white
3. Which test is performed to check the presence of iron in wheat flour and rice?
   a. Ring Test
   b. Iron Spot Test
   c. Iodine spot test
   d. All of the above
4. What color dots appear in rice when we test it for the presence of added iron?
   a. Green color
   b. Black color
   c. Dark red color
   d. Orange color
5. Which of these is the fortification logo as per approved by FSSAI?

   a. 

   b. 

   c. 

   d. 

6. What does FIFO stand for?
   a. First - in First Out
   b. Fresh - in fresh out
   c. Frozen - in frozen out
   d. Fresh - in frozen out
7. Is it mandatory to declare the micronutrients levels in Nutritional Information? Yes/No
8. List steps of Blending Efficiency Test (BET)

Practical

1. Perform Blending Efficiency Test (BET)

   Material required for BET

   i. 250 ml beaker
   ii. 50 ml beaker calibrated to measure 50 grams of rice depending on the variety being used for blending
   iii. 100 ml bottle of Chemical Reagent (Povidone Iodine solution)
   iv. Dropper
   v. Tray
   vi. QC method instruction manual
   vii. Standard Operating Procedures
   viii. Bag

   Procedure of BET

   i. Collect a sample of 200-500 grams from 10% of the blended fortified rice consignment using the BIS method.
   ii. Take 50 grams of rice from the collected sample using standard sample reduction techniques
   iii. Spread the 50g rice sample onto the tray.
   iv. **Prepare a 1% chemical reagent (Povidone Iodine solution) in water using these steps:**
      - ❑ Fill 250 ml beaker with 100 ml of water
      - ❑ Add approximately 1 ml of the chemical reagent (Povidone Iodine solution) to the water, using the dropper.
      - ❑ Stir until the solution turns bright orange in colour.
   v. Pour the 1% chemical reagent (Povidone Iodine solution) into the tray and mix with the rice

sample by tilting the tray or mixing with the dropper. Break-up any lumps that form.

vi. Mix the sample until the solution turns from orange to violet-blue (10-15 seconds).

vii. Carefully drain most of the chemical solution into the 250ml beaker. Keep the kernels in the tray.

viii. Fill 50 ml beaker with water and add it to the kernels in the tray.

ix. Count all of the discolored fortified rice kernels and document the findings. Re-count to confirm findings.

x. Discard the tested sample and wash hands.

Precautions:

- ❑ Follow the testing procedure as specified.
- ❑ Wear PPE

Observation:

Sr No	Sample No.	No. of grains	Test result
1			
2			
3			
4			
5			

Conclusion:

Write your conclusion here.

Sr No	Conclusion
1	
2	
3	
4	
5	

2. Perform Spot Iron Test

Material required for Iron Spot Test

iii. **H_2O_2 - 3%:** Add 9 ml concentrated H_2O_2 (30%) to 81 ml distilled water

iv. Thiocyanate reagent - Dissolve 10 g KSCN in 100 ml water. Mix with equal volume 2N HCl just prior to use

Procedure of Iron Spot Test

i. Place at least 50 grams of fortified rice in a plastic cup, tray, or similar container.
ii. Pour Reagent 1 (2N HCl) on the rice until all the rice kernels are wet.
iii. Pour a similar amount of Reagent 2 (10% KSCN) on the wet rice sample.
iv. Immediately, fortified kernels will turn red to dark red (black upon drying) indicating the presence of iron fortified kernels

Precautions:

- ❑ Follow the testing procedure as specified.
- ❑ Wear PPE

Observation:

Sr No	Sample No.	No. of grains	Test result
1			
2			
3			
4			
5			

Conclusion:

Write your conclusion here.

Sr No	Conclusion
1	
2	
3	
4	
5	

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7. Ensuring Food Safety and Personal Hygiene

Unit 7.1 - Introduction to Food Safety
Unit 7.2 - Schedule IV requirements of FSSAI
Unit 7.3 - Personal Hygiene
Unit 7.4 - Health Safety

FIC/N9901

Key Learning Outcomes

By the end of this module, the participants 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 7.1: Introduction to Food Safety

Unit Objectives

By the end of this unit, the participants will be able to:

1. Identify types of hazards and risks at work place

7.1.1 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.

7.1.2 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.

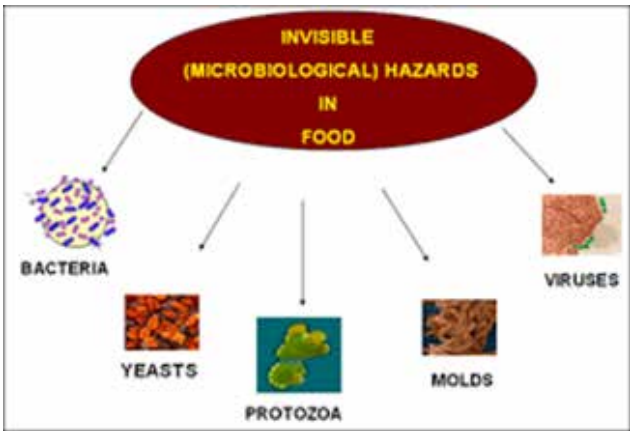

Fig. 7.1.1: Microbiological Hazards

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. 7.1.2: 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.

Fig. 7.1.3: 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. 7.1.4: 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)

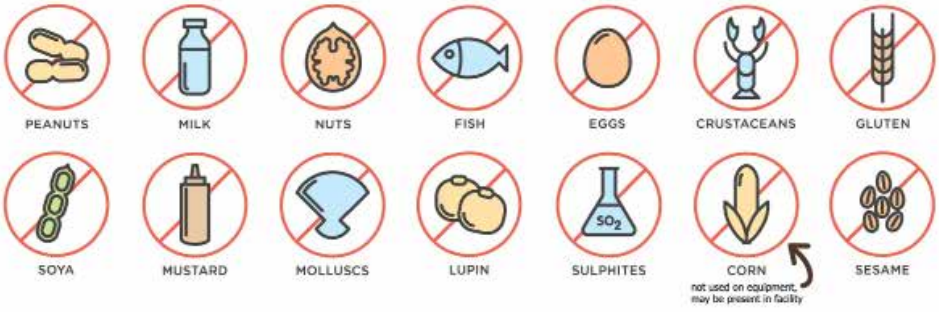

Fig. 7.1.5: Allergens

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 shelfish (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' diarrhe' itchy, wateru, or swollen eyes; red spots; swelling, a dropi in blood pressure and is capable of happening because a person can't digest a substance, such as lactose.

Handling of Allergenic Foods:

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

7.1.3 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

7.1.4 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 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.

13.1.5 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. 7.1.6: 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 and of temperature ranges.

7.1.6 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 7.2: Schedule IV requirements of FSSAI

Unit Objectives

By the end of this unit, the participants will be able to:

1. Identify requirements in Schedule IV in FSSAI

7.2.1 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 7.2.1: 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. 7.2.1: 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 ¼ 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. 7.2.2: 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. 7.2.3: 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

Colour coding of water pipes to avoid contamination

Fig. 7.2.4: 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. 7.2.5: Waste Disposal

Fig. 7.2.6: 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

Fig. 7.2.7: Personal facilities

- **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. 7.2.8: 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. 13.2.9: 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. 7.2.10: 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. 7.2.11: 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. 7.2.12: Maintenance

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

Fig. 7.2.13: 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. 7.2.14: 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:

Fig. 7.2.15: 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

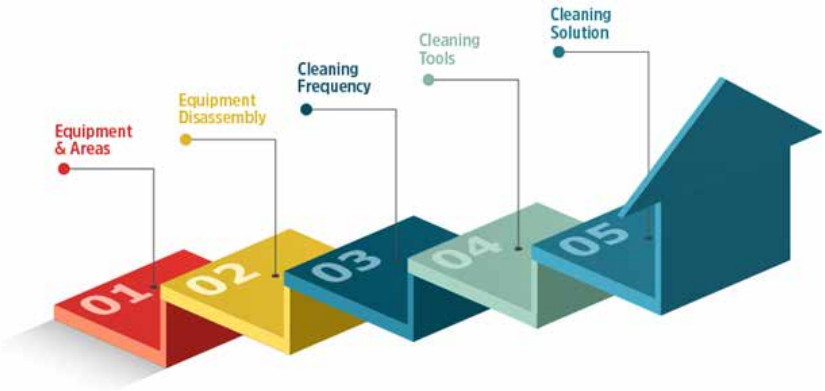

Fig. 7.2.16: Storage of sanitizing materials

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. 7.2.17: 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. 7.2.18: 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 7.3: Personal Hygiene

Unit Objectives

By the end of this unit, the participants will be able to:

1. Identify types of health and safety policies and procedures

7.3.1 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.

7.3.2 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.

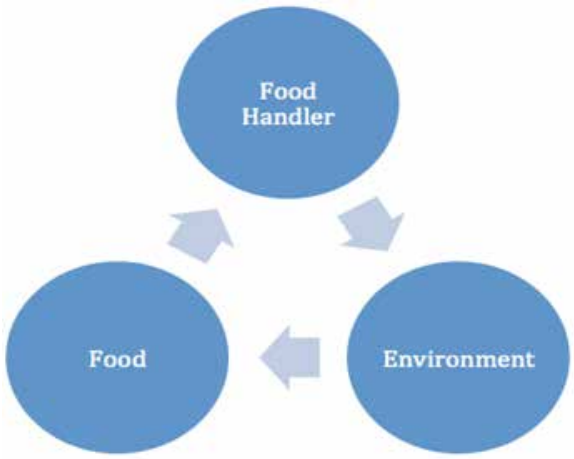

Fig. 7.3.1: Importance of Personal Hygiene

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. 7.3.2: Personal hygiene

7.3.3 Hand Washing

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

Fig. 7.3.3: Methods of washing hand

How to Use Sanitizer?

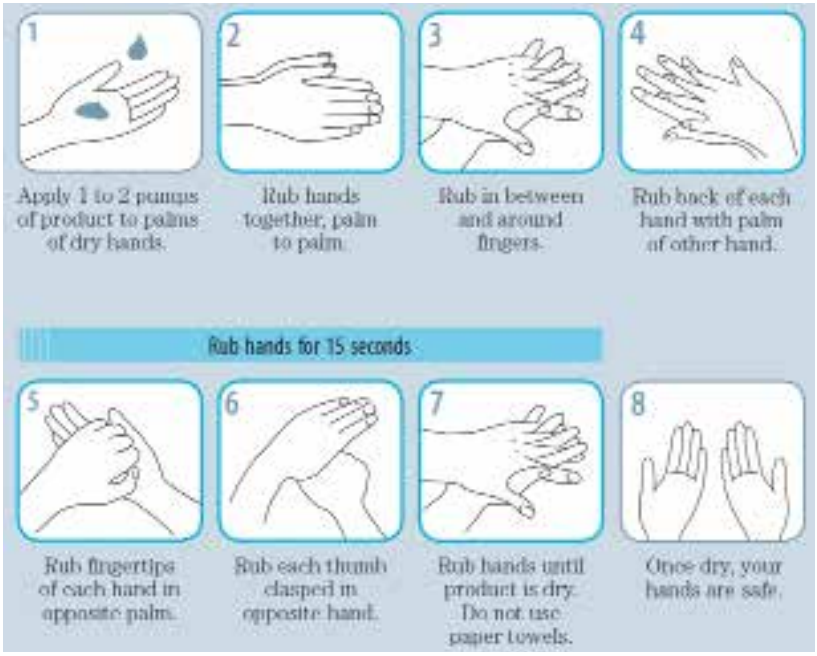

Fig. 7.3.4: Usage of Sanitizer

When to Wash and Sanitize Hand?

Fig. 7.3.5: 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.

7.3.4 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

UNIT 7.4: Health Safety

Unit Objectives

By the end of this unit, the participants 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

7.4.1 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.

7.4.2 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 that can cause injury, illness, or death.

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

  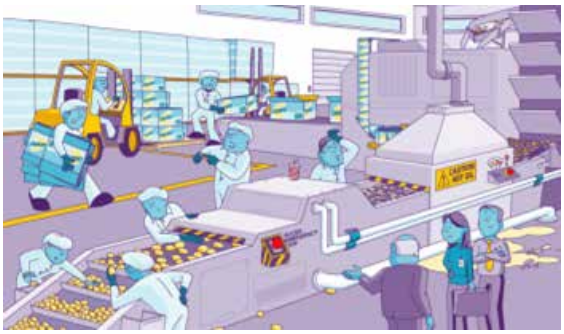

  Fig. 7.4.1: Safety hazards

  - 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

- **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. 7.4.2: 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

7.4.3 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.

7.4.4 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.

7.4.5 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. 7.4.3: 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. 7.4.4: 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

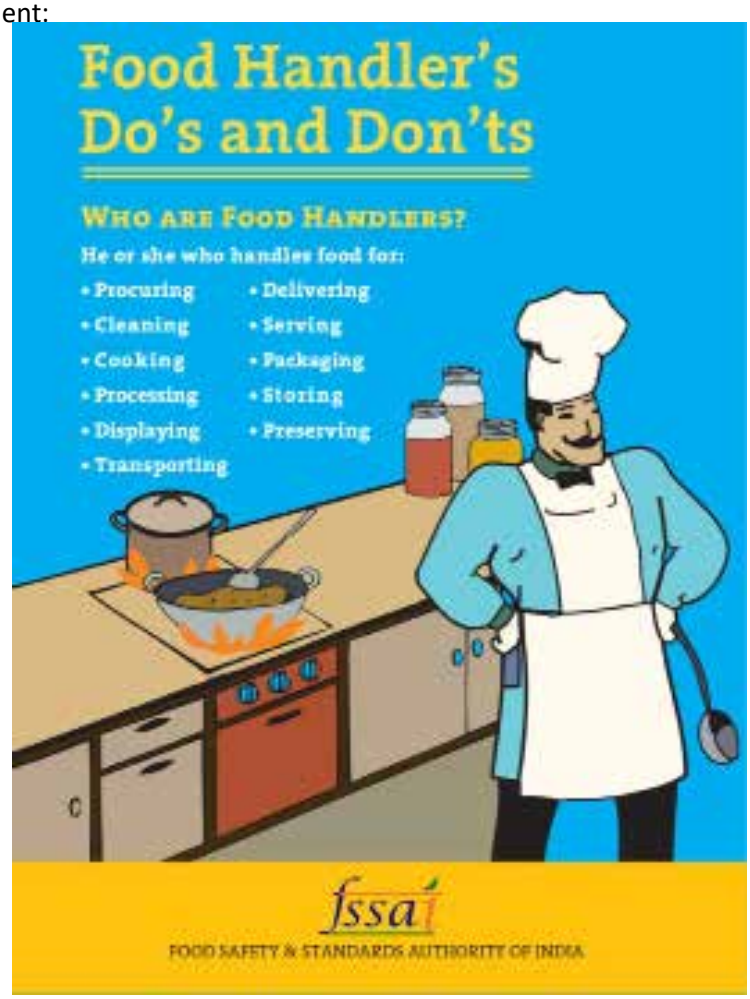

Fig. 7.4.5: FSSAI dos and don'ts for food handlers

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.

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. 7.4.6: 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 or click on the link to watch related videos

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Personnel Hygiene & Employee Facilities

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Hygiene and sanitation

www.youtube.com/watch?v=WYosZ4zru5Y
Introduction to Food Safety

Exercise

A. Answer the following questions briefly.

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.
   c. Threat
   d. Hazard
5. 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.
   e. Storage temperature
   f. Hazard temperature
5. Selling fresh and _____ produce is essential in groceries and retail food businesses.
   f. low-quality
   g. high- quality

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

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

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

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

FICSI
FOOD INDUSTRY CAPACITY & SKILL INITIATIVE

8. Managing Accidents and Emergencies

FIC/N9901

Key Learning Outcomes

By the end of this module, the participants 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 8.1: Hazard, Risk and Accidents

Unit Objectives

By the end of this unit, the participants will be able to:

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

8.1.1 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.

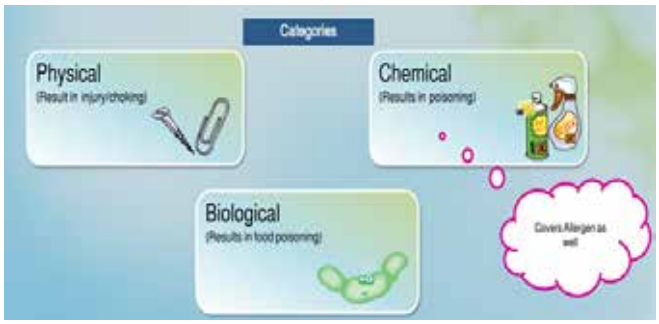

Fig. 8.1.1: Examples of physical, Chemical, Biological hazards

- **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.

  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. 8.1.2: Sources of different types of hazards

8.1.2 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 8.2: Standard Practices and Precautions

Unit Objectives

By the end of this unit, the participants will be able to:

1. Categorize the standard precautions and practices

8.2.2 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 8.3: Uses of Electrical Equipment

Unit Objectives

By the end of this unit, the participants will be able to:

1. Examine the utilization of the electrical equipment

8.3.1 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. 8.3.1: 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. 8.3.2: Electrical hazard symbols

UNIT 8.4: Usage of Personal Protective Equipment

Unit Objectives

By the end of this unit, the participants will be able to:

1. Explore the usage of personal protective equipment

8.4.1 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:

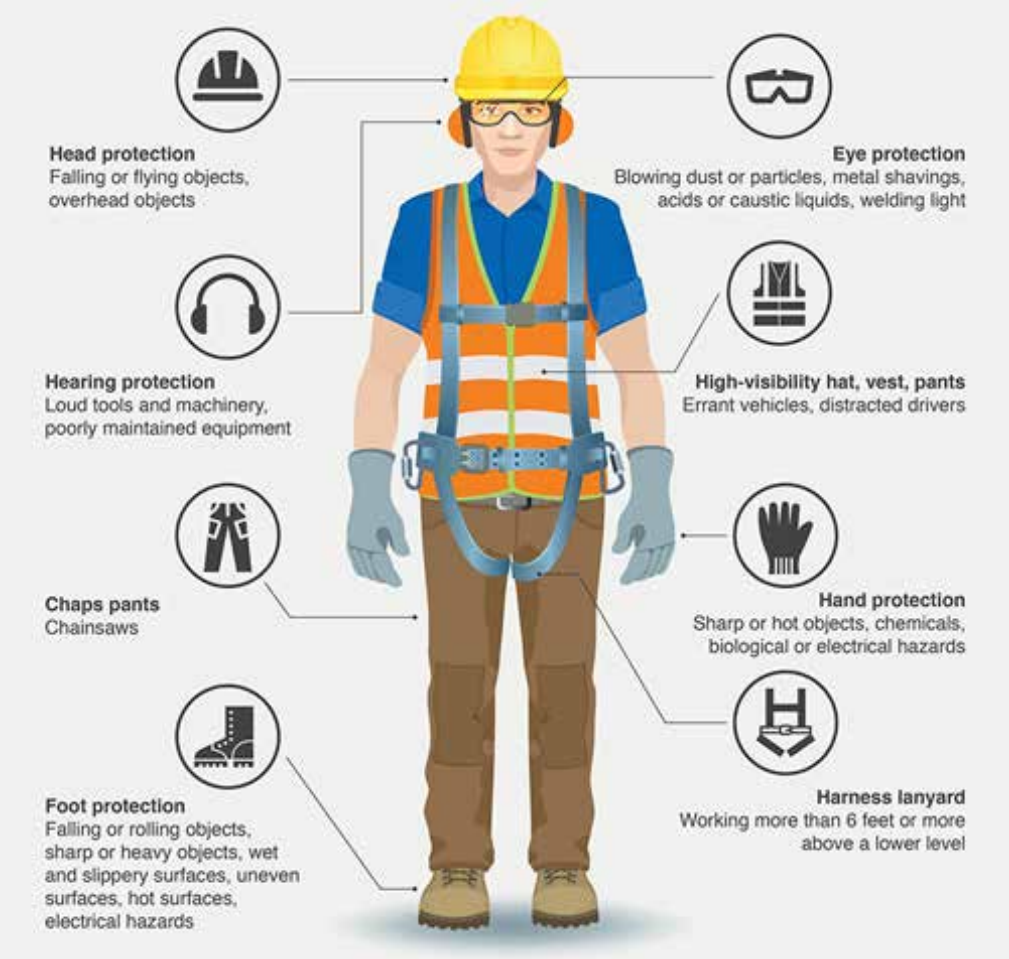

Fig. 8.4.1: The usage of personal protective equipment

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 8.5: Organisational Protocols

Unit Objectives

By the end of this unit, the participants will be able to:

1. Recognizing the organizational protocols

8.5.1 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 8.6: Dealing with Toxics

Unit Objectives

By the end of this unit, the participants will be able to:

1. Monitor the ways to handle the toxics

8.6.1 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. 8.6.1: Waste disposal process for a different type of waste

UNIT 8.7: Fire Prevention and Fire Extinguishers

Unit Objectives

By the end of this unit, the participants will be able to:

1. Identify fire prevention and fire extinguisher

8.7.1 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.
  - Class A extinguishers would be capable of putting out fires in ordinary combustibles such as wood and paper.
  - Class B extinguishers are utilized for flammable liquids like grease, gasoline and oil.
  - Class C extinguishers are used only for electrically energized fires.
  - Class D extinguishers are used on flammable metals.

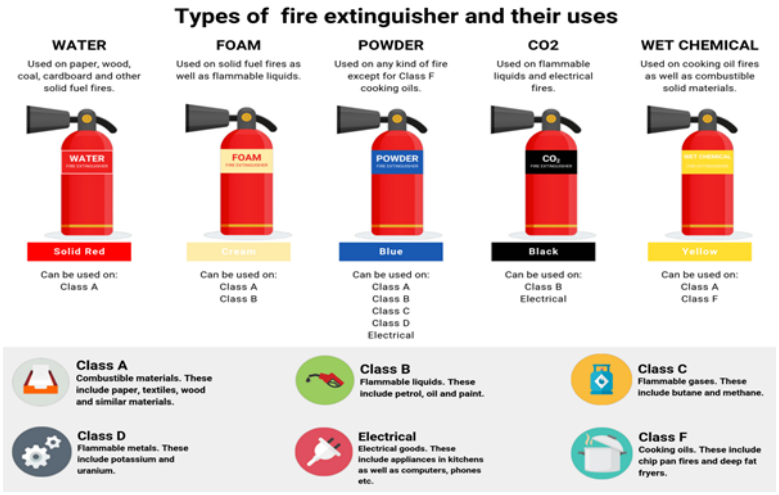

Fig. 2.7.1: Types of fire extinguishers

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. 8.7.2: 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 8.8: Artificial Respiration and CPR

Unit Objectives

By the end of this unit, the participants will be able to:

1. Evaluate CPR as well as the artificial respiration

8.8.1 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:

		
Position your hand	Interlock fingers	Give chest compressions

		
Open the airway	Give rescue breaths	Watch chest fall
		
Repeat chest compressions and rescue breaths		

Table 8.8.1: 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.

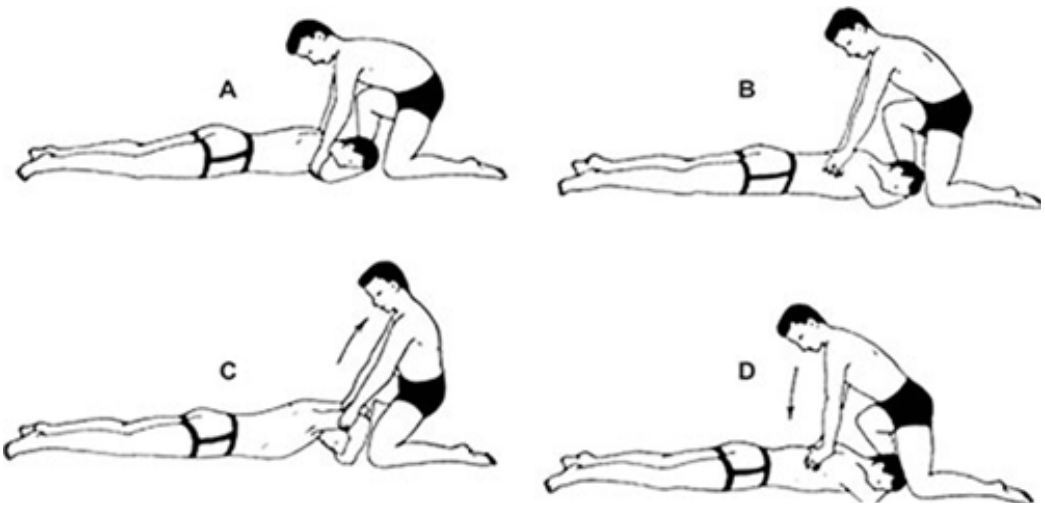

Fig. 8.8.1: Back Pressure Arm-Lift

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.

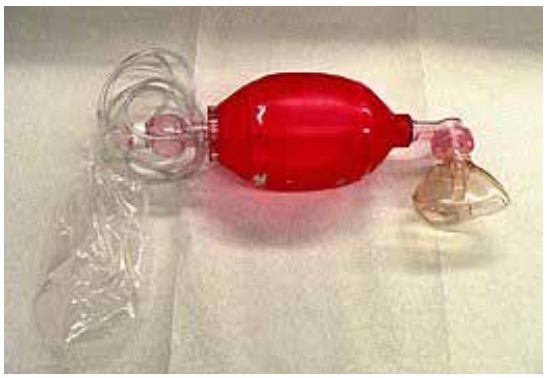

Fig. 8.8.2: Big Valve mask

Fig. 8.8.3: Ventilator

UNIT 8.9: Rescue and Evacuation In Case Of Fire

Unit Objectives

By the end of this unit, the participants will be able to:

1. Discuss the evacuation and rescue during a fire incident

8.9.1 The Evacuation and Rescue during a Fire Incident

A "Fire Emergency Evacuation Plan (FEEP)" 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 inidviduals requires to be nominated inidviduals in order to conducr 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:

Fig. 8.9.1: 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 responsing 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 indivdiuals 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 fires 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. 8.9.2: Fire evacuation process

UNIT 8.10: First Aid

Unit Objectives

By the end of this unit, the participants will be able to:

1. Cataloguing the first aids

8.10.1 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. 8.10.1: First Aid Kit

UNIT 8.11: Potential Injuries and Ill Health

Unit Objectives

By the end of this unit, the participants will be able to:

1. Understanding the ill health as well as potential injuries

8.11.1 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 8.12: Precautions in Mobility

Unit Objectives

By the end of this unit, the participants will be able to:

1. Demonstration of the precautions in mobility

8.12.1 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 8.13: Significance of various types of hazard and safety signs

Unit Objectives

By the end of this unit, the participants will be able to:

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

8.13.1 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. 8.13.1: 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. 8.13.2: 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.

Fig. 8.13.3: Biological hazard safety signs

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.

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. 8.13.4: 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.

Exercise

A. Answer the following questions briefly.

1. Is Covid -19 a biological hazard?
   A True B False
2. Which of the following is included in Personal Protective equipment?
   A Spectacles or clear goggles B Earmuffs
   C Hard hat D All of them.
3. Can toxic substances spillage be wiped off with a normal cloth and with bare hands?
   A True B No
4. A simple technique for using fire extinguisher_____.
   A. PASS method B Installation on telephonic desk
5. Which is not a part of potential injury at the workplace?
   A Muscle strain B Cuts
   C Slip or fall D Drowning

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

1. Explain the golden rule of “First Aid”.
2. Why is Organisational Protocol necessary for an organisation?
3. Describe any two types of electrical equipment?
4. Explain why hand hygiene is necessary for oneself.
5. Describe the various types of hazards involved while handling or dealing with toxic?

Notes

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

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

FICSI
FOOD INDUSTRY CAPACITY & SKILL INITIATIVE

9. Working Effectively in an Organization

FIC/N9902

Key Learning Outcomes

By the end of this module, the participants 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 9.1: Organizational Policies

Unit Objectives

By the end of this unit, the participants will be able to:

1. Categorize the organizational policies

9.1.1 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 9.2: Legislations, standard, policies, and procedures

Unit Objectives

By the end of this unit, the participants will be able to:

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

9.2.1 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:

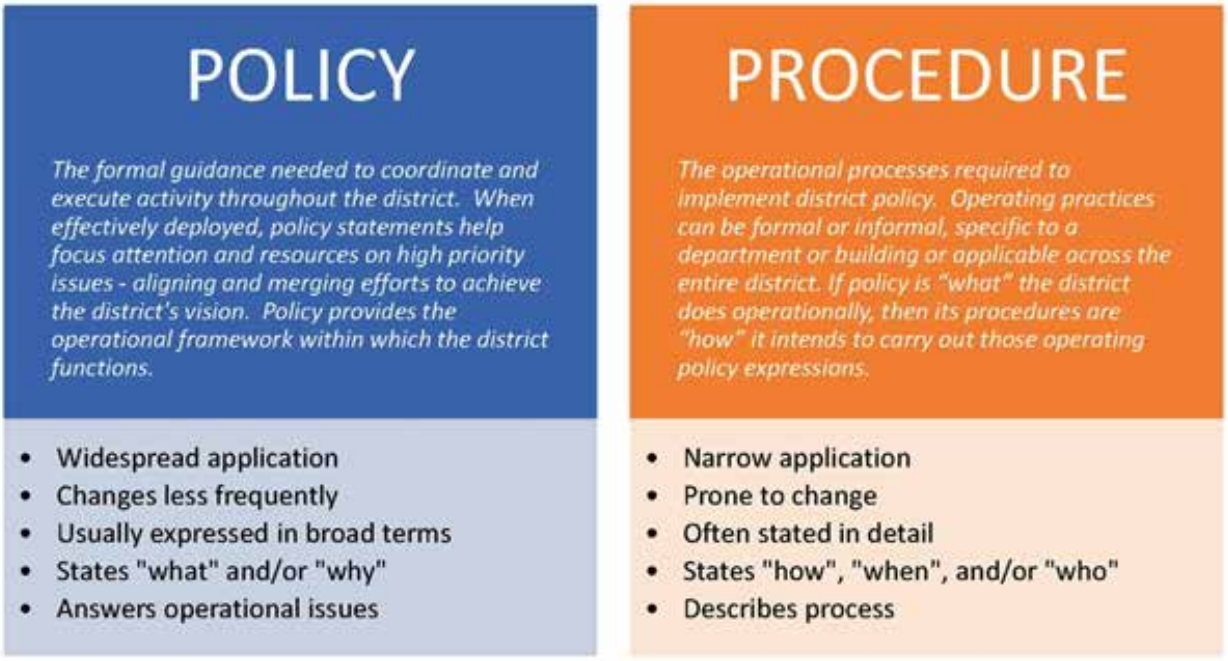

Fig. 9.2.1: Difference between Policy and Procedure

UNIT 9.3: Reporting Structure

Unit Objectives

By the end of this unit, the participants will be able to:

1. Analyse the reporting structure

9.3.1 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. 9.3.1: Company's Reporting Structure

UNIT 9.4: Inter-Dependent Functions

Unit Objectives

By the end of this unit, the participants will be able to:

1. List the inter-dependent functions

9.4.1 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.

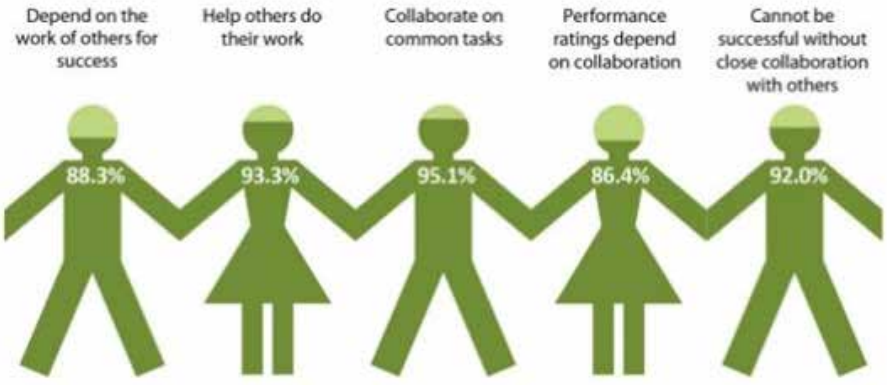

Fig. 9.4.1: Process of the concept of Inter-dependence

UNIT 9.5: Harassment and Discrimination

Unit Objectives

By the end of this unit, the participants will be able to:

1. Discuss the impact of harassment and discrimination

9.5.1 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.

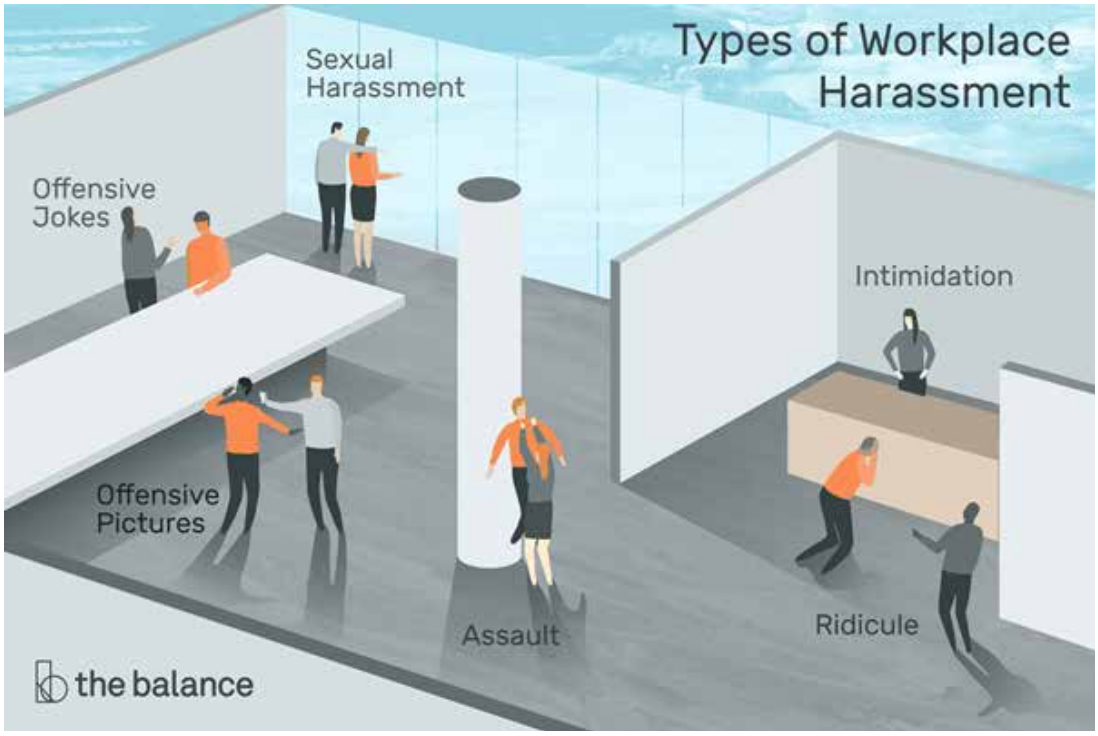

Fig. 9.5.1: Types of Workplace Harassment

UNIT 9.6: Prioritising Tasks

Unit Objectives

By the end of this unit, the participants will be able to:

1. Monitor the ways of prioritising the task

9.6.1 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 9.7: Communication Skills

Unit Objectives

By the end of this unit, the participants will be able to:

1. Record the types of communication skills

9.7.1 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.

Fig. 9.7.1: Essential Communication Skills

- **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.

Fig. 9.7.2: 7 Key Active Listening Skills

- **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.

- **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 9.8: Teamwork

Unit Objectives

By the end of this unit, the participants will be able to:

1. Evaluate the ways of carrying out a teamwork

9.8.1 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 9.9: Ethics and Discipline

Unit Objectives

By the end of this unit, the participants will be able to:

1. Highlight the ethics and discipline

9.9.1 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 9.10: Grievances Solution

Unit Objectives

By the end of this unit, the participants will be able to:

1. Illustration of the grievance's solution

9.10.1 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 tackledwith 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 9.11: Interpersonal Conflicts

Unit Objectives

By the end of this unit, the participants will be able to:

1. Recognize the interpersonal conflicts

9.11.1 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 9.12: Disabilities and Challenges

Unit Objectives

By the end of this unit, the participants will be able to:

1. Identify the disabilities and challenges

9.12.1 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 authorizethem 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 9.13: Gender Sensitivity and Discrimination

Unit Objectives

By the end of this unit, the participants will be able to:

1. Identify the disabilities and challenges

9.13.1 The Disabilities and Challenges

Gender sensitivity has also been an ongoing dialogue inside the workplace. The workplace has frequantly 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 otherscould 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 9.14: Applicable Legislation, Grievance Redressal Mechanisms

Unit Objectives

By the end of this unit, the participants will be able to:

1. Discuss the applicable legislations, grievance redressal mechanisms

9.14.1 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 9.15: Transacting With Others without Personal Bias

Unit Objectives

By the end of this unit, the participants will be able to:

1. To administer with others without personal bias

9.15.1 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 givingas well asreceiving 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 inone'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.

Exercise

A. Answer the following questions briefly.

1. Which policy stands to be the workplace or organizational policy?
   A. Social Media Policy B. Environment Protection Policy
2. _____ at workplace lays a strong foundation of trust between the employer and its employees/
   A. Communication B. Discipline
3. _____ can prove to be quite harmful if not dealt in time.
   A. Actions B. Grievance
4. The employment barriers might include:

A. Communication barriers B. Disciplinary barriers

5. _____ requires employers to pay equal remuneration to the workers.

A. Equal Remuneration Act, 1976 B. Republic Act No. 9710

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

1. List down the importance of having the company policies in force.
2. State the differences between policies and procedures.
3. What do you understand by communication skills?
4. What are policy barriers?
5. What are some of the central and state-specific labour laws in India for focusing on the grievance redressal mechanism?

Notes

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

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

FICSI
FOOD INDUSTRY CAPACITY & SKILL INITIATIVE

10. Material Conservation

Unit 10.1 - Material Handling

Unit 10.2 - Workstation Layout, Electrical and Thermal Equipment

Unit 10.3 - Organisational Procedures for Minimising Waste

Unit 10.4 - Practices of Efficient and Inefficient Management

Unit 10.5 - Material and Water Usage

SGJ/N1702

Key Learning Outcomes

By the end of this module, the participants 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 10.1: Material Handling

Unit Objectives

By the end of this unit, the participants will be able to:

1. Identify the ways to handle materials

10.1.1 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.

10.1.2 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 establish for 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 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).
- Pallet used to store materials can cause different hazards. For example- Damage pallets can result into product damage or fall down of the product; Protruded nails can product damage or injury.
- Loading strength and design should be based on Health and safety risk assessment. Major accidents can happen due to excessive product storage on each rack or improper design of 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 10.2: Workstation Layout, Electrical and Thermal Equipment

Unit Objectives

By the end of this unit, the participants will be able to:

1. Categorize the workstation layouts, electrical and thermal equipment

10.2.1 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
- Tools 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 10.3: Organisational Procedures for Minimising Waste

Unit Objectives

By the end of this unit, the participants will be able to:

1. List the organizational procedures for minimising waste.

10.3.1 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. 10.3.1: 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 10.4: Practices of Efficient and Inefficient Management

Unit Objectives

By the end of this unit, the participants will be able to:

1. Analyse the practices of efficient and inefficient management

10.4.1 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 10.5: Material and Water Usage

Unit Objectives

By the end of this unit, the participants will be able to:

1. Discuss the material and water usage.

10.5.1 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.

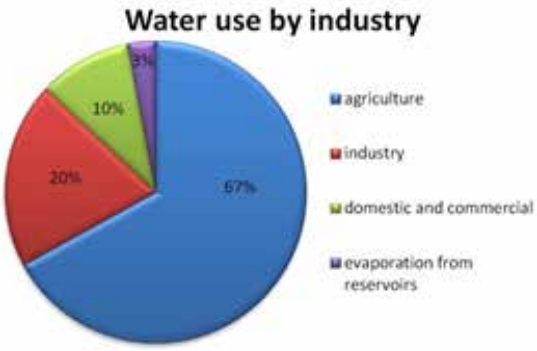

Fig. 4.5.1: Industry-wise water consumption

Industrial usage of water:

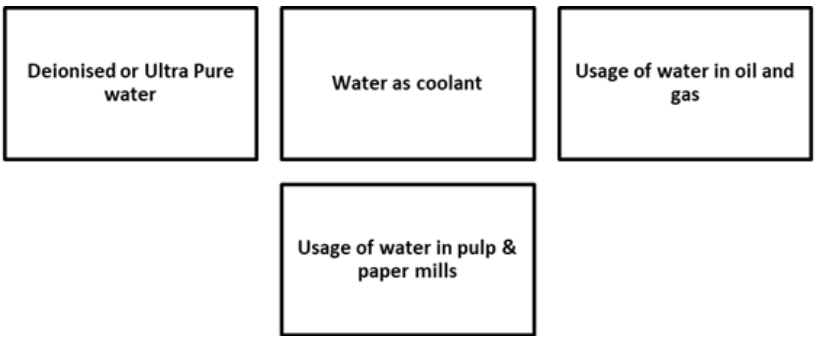

Fig. 10.5.2: Industrial wastage of water

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 briefly.

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

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

1. What are the key indicators of inefficient management?
2. What are the four ways to control the defects types of waste?
3. What are the points required to consider while designing an electrical workstation?
4. What are the important aspects which need to be considered while designing the workplace?
5. What are the requirements for a storage space?

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Material Conservation

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11. Energy and Electricity Conservation

Unit 11.1 - Define Electricity
Unit 11.2 - Basics of electricity
Unit 11.3 - Energy efficient devices
Unit 11.4 - Standard Practices for Conserving Electricity

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Key Learning Outcomes

By the end of this module, the participants 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 11.1: Define Electricity

Unit Objectives

By the end of this unit, the participants will be able to:

1. Define electricity

11.1.1 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:

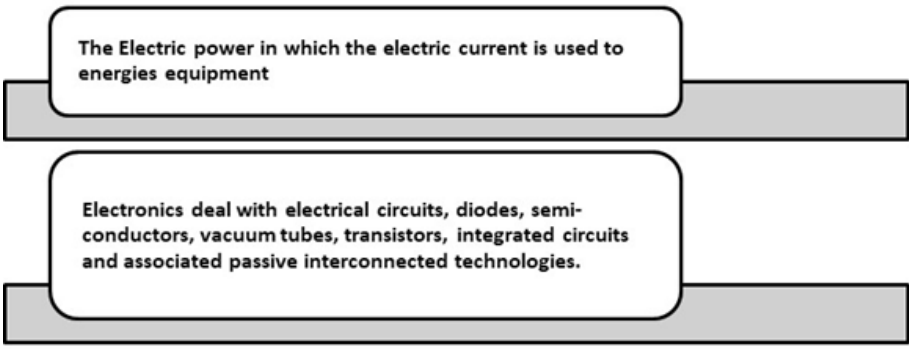

Fig. 11.1.1: Electricity utilization

UNIT 11.2: Basics of electricity

Unit Objectives

By the end of this unit, the participants will be able to:

1. State the basics of electricity

11.2.1 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 104 to 107-ohm m. For example, Iron, Copper, etc.
- **Semi-conductors –** Materials whose conductivity lies between 10-6 to 104-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.

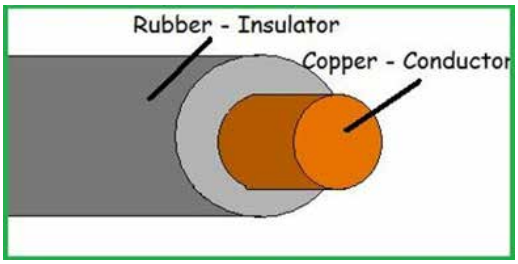

Fig. 11.2.1: Conductor of Electricity

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 11.3: Energy efficient devices

Unit Objectives

By the end of this unit, the participants will be able to:

1. Identify the energy-efficient devices

11.3.1 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. 11.3.1: 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.

11.3.2 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 indivdiuals 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 11.4: Standard Practices for Conserving Electricity

Unit Objectives

By the end of this unit, the participants will be able to:

1. Explain the standard practices for conserving electricity

11.4.1 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 briefly.

1. On the basis of conductivity, conductors possess:

   A. Materials whose conductivity lies between 10-6 to 104-ohm m

   B. Materials whose conductivity lies between 104 to 107-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

4. Energy _____ is broader in comparison to energy efficiency in including active efforts to decrease energy consumption.

   A. Release

   B. Emission

   C. Conservation

   D. Deletion

5. Modern energy efficiency refrigerators use _____ less energy than their conventional models did in 2001.

   a. 50%

   b. 40%

   c. 60%

   d. 90%

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

1. What are the classifications for the materials of electricity?
2. What are the three primary electrical parameters?
3. What are the components of electrical equipment?
4. What are the categories of appliances?

Notes

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12. Waste Management and Recycling

Unit 12.1 - Types of waste

Unit 12.2 - Waste Management and Disposal Solutions

Unit 12.3 - Pollution and Remedies

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Key Learning Outcomes

By the end of this module, the participants will be able to:

1. List the types of wastes
2. Describe waste management and disposal solutions
3. Explain pollution and its remedies

UNIT 12.1: Types of waste

Unit Objectives

By the end of this unit, the participants will be able to:

1. List the different types of waste

12.1.1 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 2. Steel 3. Aluminium 4. Plastic (PET) 5. Newspapers 6. Corrugated Cardboard 7. Plastics (HDPE) 8. Glass 9. Mixed Papers 10. Used Motor Oil 11. Used oil from food industry	1. Garbage. Mixture of different of garbage makes it hard to recycle. 2. Food-tainted items (such as: used paper plates or boxes, paper towels, or paper napkins) 3. Ceramics and kitchenware. 4. Windows and mirrors. 5. Plastic wrap. 6. Packing peanuts and bubble wrap. 7. Wax boxes. 8. Photographs 9. Medical waste 10. Polystyrene or Styrofoam 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 12.1.1: 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. 12.1.1: 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)

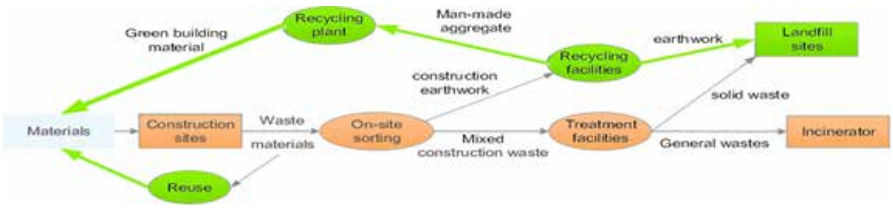

Fig. 12.1.2: Ways to process industrial and biomedical wastes

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, TSIIC 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. 12.1.3 : Examples of waste collecting vendors

UNIT 12.2: Waste Management and Disposal Solutions

Unit Objectives

By the end of this unit, the participants will be able to:

1. Describe waste management and disposal solutions

12.2.1 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.

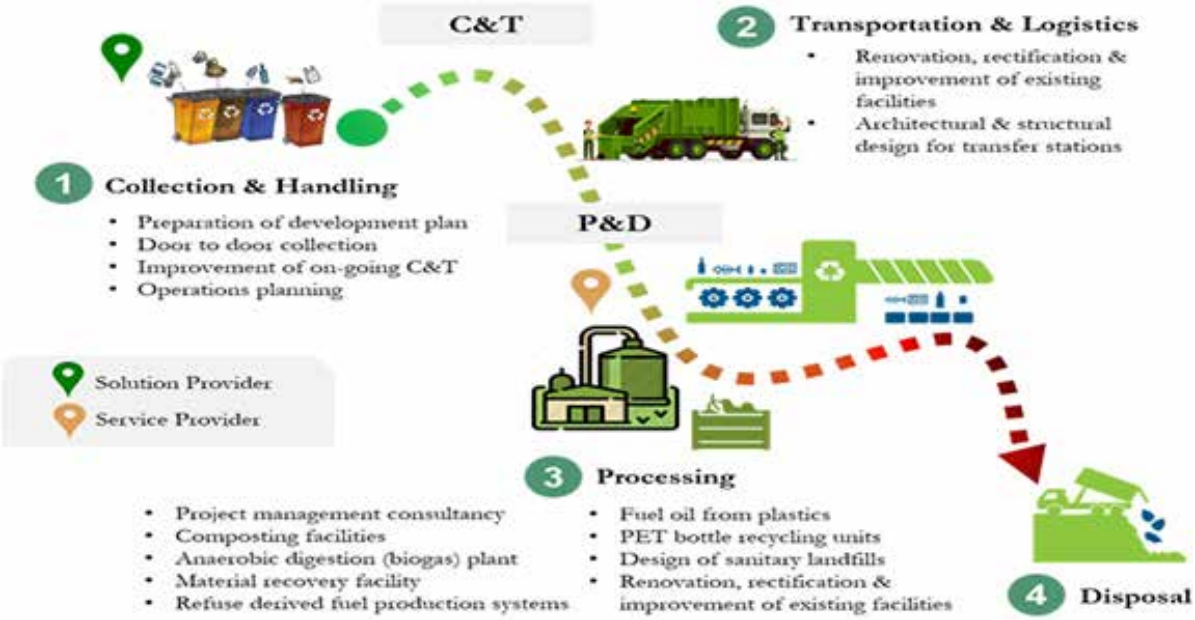

Fig. 12.2.1: Waste management and disposal solutions

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. 12.2.2: 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 12.3: Pollution and Remedies

Unit Objectives

By the end of this unit, the participants will be able to:

1. Explain pollution and its remedies

12.3.1 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 in-ception to its end disposal.
- Proper management of waste is significant for building sustainable and liveable cities, yet it re-mains 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 re-leased into the environment.

Exercise

A. Answer the following questions briefly.

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 by choosing the correct option:

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?

Notes

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14. Annexure

Lists of QR Codes used in the PH

ANNEXURE - Lists of QR Codes used in the PH

S.No.	Chapter No.	Unit No.	Topic Name	Page No.	QR code(s)	URL
1	Chapter 1: Introduction to Food Processing Sector and the Job of "Fortified Rice Technician"	Unit 1.2 - Role of Fortified Rice Technician in the Food Processing Industry	Overview of the Food Processing Industry	9		https://www.youtube.com/watch?v=J-2EiM-VNtpM&t=11s
2	Chapter 3: Prepare for Production	Unit 3.2 - Preparation for Fortification of Rice	Food Fortification	28		https://www.youtube.com/watch?v=akU4xetG32A
3		Unit 3.2 - Preparation for Fortification of Rice	National programmes to improve food security and nutritional status of India	28		https://www.youtube.com/watch?v=X1U9SJhIOXg
4	Chapter 5: Ensure Processing of Fortified Rice Kernel and Blended Fortified Rice	Unit 5.3 - Production of Blended Fortified Rice	Rice Fortification	66		https://www.youtube.com/watch?v=T71bw2C4aNQ
5		Unit 5.3 - Production of Blended Fortified Rice	Understanding Micronutrient Food Fortification	66		https://www.youtube.com/watch?v=NYvxUNhOGUU
6		Unit 5.3 - Production of Blended Fortified Rice	FORTIFIED RICE KERNEL (FRK) PROCESSING PLANT	66		https://www.youtube.com/watch?v=8aHCALd2l-g

S.No.	Chapter No.	Unit No.	Topic Name	Page No.	QR code(s)	URL
7	Chapter 6: Ensure Stability and Proper Storage of Packed Fortified Rice	Unit 6.2 - Post-production Activities	Packaging & Storage	81		https://www.youtube.com/watch?v=25zVA51C-Cac&list=PL_mT5DU_smK1eFsOmpTGQau-ReVFB72sGi&index=14
8	Chapter 7: Ensuring Food Safety and Personal Hygiene	Unit 7.4 - Health Safety	GHP, GMP & HACCP	118		https://www.youtube.com/watch?v=R-S4A-uczS6E&t=554s
9		Unit 7.4 - Health Safety	Personnel Hygiene & Employee Facilities	118		https://www.youtube.com/watch?v=daNjRoP_I0c&t=87s
10		Unit 7.4 - Health Safety	Hygiene and sanitation	118		https://www.youtube.com/watch?v=daNjRoP_I0c&t=83s
11		Unit 7.4 - Health Safety	Introduction to Food Safety	118		https://www.youtube.com/watch?v=WYosZ4z-ru5Y
12	Chapter 10: Material Conservation	Unit 10.5 - Material and Water Usage	Material Conservation	188		https://www.youtube.com/watch?v=abuousx-wRe4
13	Employability skills (30 hours)	Employability skills (30 hours)	Employability skills (30 hours)	210		https://www.skillindiadigital.gov.in/content/list

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