Training Manual
Food Safety Supervisor Course
Special – (Level 3) – Manufacturing Milk and Milk Product
PREFACE

Training of food handlers is a pre-requisite for ensuring food safety and the same is also mandated in the FSS Act, 2006. Food Safety and Standards Authority of India (FSSAI) has set up Food Safety Training & Certification (FoSTaC) ecosystem to ensure widespread and effective delivery of training to food businesses across the value chain. This ecosystem will train and certify the Food Safety Supervisor from each Food Establishment as it is envisaged to make this a regulatory requirement.

The manual is designed to train the personnel that can be designated as Food Safety Supervisors in the manufacturing sector. This manual details the requirements on food safety & hygienic practices to be followed by Food Business Operators engaged in the manufacturing sector. It is based on the Schedule 4 requirements of FSS (Licensing & Regulation of Food Businesses) Regulation, 2011 along with the industry best practices. It has been designed according to the flow of operation in the manufacturing industry for ease of understanding of the Food Safety Supervisors. This one-in-all manual is supplemented by a Tutor Guide along with the visuals, specific to the food industry for facilitating the trainers.

It is hoped that this manual will serve a wider purpose of training to the Food Safety Supervisors and will also be useful to the food handlers in implementing the hygiene requirements in the food production premises.

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**Disclaimer:** The content of this handbook/ manual is only for training and capacity building purpose, and is not intended to substitute applicable law, which may be referred separately.
Welcome to the manual –

The manual is designed for small, medium and large scale milk & milk products processors, manufacturers and packers. This manual explains General Requirements on Hygienic and Sanitary Practices to be followed by all Food Business Operators engaged in Food service establishments, as per Food Safety & Standard Act, 2006. This manual presents bare minimum requirements of Food Safety and Hygiene to be followed by Food Business Operators along with Industry best practices.

Learning Outcome –

The objective of this manual is to train the personal that can be designated as Food Safety Supervisors in the Milk Processing & Milk Products manufacturing units, about food safety and hygiene requirements which are to be followed in their businesses. The Food Safety Supervisors (FSS) may interpret these requirements according to the size and type of their establishment. The desired outcome of this manual is better understanding of food safety and hygiene requirements and high standards of food safety in the Dairy industry.

What the law says –

The establishment in which food is handled, processed & packed, by the food business operator and the persons handling them should conform to the sanitary and hygienic requirement, food safety measures and other standards as specified below. It shall also be deemed to be the responsibility of the food business operator to ensure adherence to necessary requirements.

In addition to standards requirements by FSSAI, the food business operator shall identify steps in the activities of Food businesses, which are critical to ensure food safety, and ensure that safety procedures are identified, implemented, maintained and reviewed periodically.

In India, the mandatory sanitary & hygiene requirements for food business operators are –

For the ease of understanding, the relevant sections from Part II & Part V of Schedule 4 of Food Safety & Standards (Licensing & Registration of Food Businesses) Regulation, 2011 has been segregated as per flow of operations in Dairy Sector –

1. **LOCATION, LAYOUT & FACILITIES**

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Part 1

Introduction to Food Safety

Milk Safety Hazard

Allergen

Food Quality
1. Food Safety and Food Safety Hazards

Dairy industry has the largest share in Food based industry. For young mammals, including human infants, milk is the first food ingested and in most cases, it continues to be the sole constituent of the diet for considerable period of time. Milk is a complex biological fluid and highly perishable commodity.

Milk is a high-risk food product as it is an excellent growth medium for many microorganisms, which have multiple growth range based on surrounding temperature. Many types of bacteria survive and thrive in milk because of its good nutritional quality and it may result in higher bacterial counts and amount of toxins produced by pathogenic organisms, making it unsafe for human consumption.

1.1 Factors influencing milk hazards

Production of safe and quality milk is a primary requirement for consumers. Milk safety must be controlled at each step from beginning of production to final consumption. Once it is found that any milk is unfit or unsafe for consumption, whether from chemical or physical contamination or microbiological testing, it should be removed from the market. Removal of chemical hazards and impurity is impossible or very difficult through processing and at the ambient temperature pathogens and spoilage organism can grow faster and affect the consumers, once it is consumed.

1.2 Milk Safety Hazard:

There are mainly three types of Hazard in Food, Physical, Chemical and Microbiological Hazard and in similar way Milk hazards are also divided in the same categories and these may remain in milk through various processes, which carried out for milk processing. Sources of initial milk hazards may come at primary stage of milk secretion/ milking process from milk giving animal, through interior of udder, udder and teat surfaces. Second source of hazard could be from process of milking, reception, storage etc., through milking equipment, milk transport line and storage tank. Other source of hazard could be milking environment, air, water and personal hygiene. In addition to these, chemical hazards might be come through cleaning and sanitising stages. Presence of any of these food hazards shows poor results of milk processing and hygienic practices.

Fig 1 Food Safety Hazards
1.2.1 Physical Hazard:

In milk production system, chances of contamination of milk with various types of foreign material or other particle could be hazardous and result as physical hazard to milk consumers.

Common physical hazard includes:
- Broken pieces of glass or tiny metals
- Chipped pieces from equipment
- Metal shavings from cans and foils
- Plastic or chipped pieces of disposables
- Lint and threads
- Hair
- Finger nails

These types of impurities have greater chance for milk, which is neither processed nor passed through screening and filtration process. Severity of these particles noted greater in raw and unprocessed milk.

1.2.2 Chemical Hazard:

Usage of chemicals in milk farms and Dairy plants leads to chemical hazards. Chemical were found in milk samples because of poor milk handling practices and fraudulent practices done at the farm.

Chemicals have been added severely to deteriorate milk quality. Common added Chemical contaminants include:
- Detergents
- Urea
- Starch
- Sugars
- Vegetable fats
- Neutralizer
- Hydrogen peroxide

Chemical hazards are not limited to added substances but also include certain process-induced contamination, which includes
- Pesticides, Colourants
- Antimicrobial Drugs
- Antibiotic Residue
- Hormones
- Sanitizers and Disinfectants
- Heavy Metals
- Mycotoxins
- Equipment Lubricants
- Food Additives and Preservatives
- Packaging materials-migration of residues from packaging material to milk
1.2.3 Biological Hazards

Microbiological hazards are a major food safety concern in the Dairy sector because milk is an ideal medium for the growth of bacteria. These can be introduced into the milk from the environment or from the dairy animals themselves. Milk can contain harmful microorganisms such as Salmonella, Escherichia coli, Listeria monocytogenes, Staphylococcus aureus, Yersinia enterocolitica, Bacillus cereus, Clostridium botulinum, Mycobacterium bovis, Brucella abortus and Brucella melitensis.

Chances of growth and survival of these pathogens are mostly temperature and time dependent, for which milk been handled as unprocessed during supply chain.

Sources of Bacteria in Raw Milk:

- Bacteria from teats
- Flora of mastitis animals
- Exterior of animal
- Dairy barn environment
- Milk contact surfaces
- Dirty equipment
- Inappropriate milk storage time/temperature

1.2.3.1 Biological Hazards causes -

a. Food Borne Infections– This result when a person consumes food containing pathogens; which grow in the human intestine and cause discomfort or disease. Typical symptoms of a ‘food borne Infections’ do not appear immediately.

b. Food Borne Intoxications - This result when a person consumes food containing toxins in it; that cause discomfort or disease. Typical symptoms of a ‘food borne Intoxication’ appear quickly. Food Borne toxins are mediated infections, that result when a person consumes food containing toxins produced by the pathogens in it; which grow in the human intestine and produce toxins that cause discomfort or disease.

1.2.3.2 Conditions favouring growth of Microorganisms – Milk is the most suitable medium that favours the growth of microorganisms.

**FAT TOM**

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<th>Conditions</th>
<th>Definition</th>
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<td>Food</td>
<td>Food borne Microorganisms draw nutrients from Potentially hazardous foods</td>
</tr>
<tr>
<td>Acidity</td>
<td>Food borne Microorganisms grow well between the pH range of most foods</td>
</tr>
<tr>
<td>Temperature</td>
<td>Microorganisms grow well between the temperature range of 5°C – 60°C, most commonly known as the ‘Danger Zone’</td>
</tr>
<tr>
<td>Time</td>
<td>Microorganisms need sufficient time to grow; when exposed to the ‘Danger Zone’</td>
</tr>
<tr>
<td>Oxygen</td>
<td>Microorganisms require oxygen in free or combined state; to favor</td>
</tr>
</tbody>
</table>
Moisture | Microorganisms require moisture to grow and is measured in the form of ‘Water Activity (Aw)’
---|---

1.4 Allergens

An allergen is normally, any harmless substance that causes an immediate allergic reaction in a susceptible person. Food allergens are usually proteins although other food constituents, such as certain additives, are known to have allergenic (allergy-causing) properties.

1.4.1 The following foods and ingredients are known to cause hypersensitivity and shall always be declared:

- ✔ Cereals containing gluten; i.e., wheat, rye, barley, oats, spelt or their hybridized strains and products of these;
- ✔ Crustacea and products of these;
- ✔ Eggs and egg products;
- ✔ Fish and fish products;
- ✔ Peanuts, soybeans and products of these;
- ✔ **Milk and milk products (lactose included)**
- ✔ Tree nuts and nut products; and
- ✔ Sulphite in concentrations of 10 mg/kg or more.
1.4.2 A **milk allergy** is an immune reaction to one of the many proteins in animal milk.

Most common milk allergies are:

- a. alpha S1-casein protein
- b. Lactose

1.5 **Food Quality**

Food quality is a complex concept that can be assessed only in relation to food safety. The relation between quality and safety is intricate and although safety cannot be viewed as a very independent aspect from quality, recognising the complexity of both concepts brought the need of managing them separately. In fact the reason behind separating food safety from quality was the need to place the concept of safety first and above all the other quality aspects.

**Quality** is a measure of the degree of excellence by degree of acceptability of the consumer. Further, Quality can be classified as

1. Quality Control
2. Quality Assurance

1.5.1 **Quality control** is an essential component of any milk processing industry whether small, medium or large scale. It is the evaluation of final product prior to its marketing.

Milk quality control is the use of various tests to ensure that milk and milk products are safe, healthy, and meet the standards for chemical composition, purity, and types and number of micro-organisms.

1.5.1.1 **Functions of Milk quality control programme are**

- ✓ Physical and chemical evaluation of raw materials and processed products.
- ✓ Control of
  - o Raw material, ingredients, packaging, and supplies
  - o Processing parameters
  - o Finished products
- ✓ Microbiological analysis
- ✓ Control of storage and handling condition.
- ✓ Sanitation and waste products controls.
- ✓ Assurance with final products is within the legal marketing standards established.

1.5.2 **Quality Assurance** is implementation of quality checks and procedures to immediately correct any failure and mistake, which may reduce the quality of the interim products at any production step.

It seeks to generate confidence both within the organization and externally, among its customer, that their requirements will be fulfilled.
1.5.2.1 Functions of quality assurance are

1. To define quality policy and its objective
2. Development of quality manual
3. Ensuring competency of personnel
4. Conducting periodic internal audits
5. Elimination of the root cause of the problems found
6. Periodic review of the system by top management

Thus, desired high quality of the final product is planned & obtained by conducting

1. Standard Operating Procedures (SOP’s)
2. Good Manufacturing Practices
3. Total Quality Management
Part II

Location and Layout
2. Location, Layout and Facilities

Dairy industry in India is growing at fast rate and as such, there is need for scientific Layout and Planning with a view to have model studies by Dairy designers and engineers.

The Dairy Plant Layout and design means designing a layout plan for Dairy factory, i.e.

- layout of various sections in Dairy building
- equipment layout
- laying of Dairy Machines in each section for economical and efficient movement of men and material in the plant

Milk and Milk Products, however, impose certain requirements, which do not occur elsewhere in food or other industries. These special requirements affect the structure and the layout of the building, the provision and distribution of services and the choice of site.

There is need for highest standard of hygiene. Milk is most suitable medium for the growth of microorganism. Therefore, every possible measure should be taken to reduce the possibility of contamination, especially after processing. A good layout design and use of proper materials and technique make great contribution towards hygiene.

To sum up, Dairy plant layout needs careful thought and planning keeping in view manufacture of the products and their Quality & Safety aspects.

2.1 Classification of Dairy Plants

![Dairy Plant Diagram]
2.2 Location of Dairy Plant

A few points mentioned below will help in determining the location of Dairy Plant:

- Availability of Transport Facility (Road & Rail Connectivity)
  - Provide easy transport of Raw material to the plant and dispatch of finished products
- Dairy should be situated close to consumption area
  - Bulk transport of Pasteurised Milk leads to contamination – Bulk transport may be avoided
- Availability of necessary facilities such as electricity, water, waste disposal at reasonable cost
- Free from atmospheric pollution/Hazard prone site
- Availability of adequate labour

2.2.1 Planning consideration of location of Dairy Plant

2.2.1.1 SITE LOCATION

The criterion, which has foremost operational important is minimum cost for procurement, production and distribution.

Essential factors for location includes

- Topography
- Shape and size of site
- Availability of water, power and fuel
- Climatic conditions

However, due to increased pollution and industrialization, all sites are not permitted for industrial work. Some states or central government gives incentive for development of certain industry on specified locations. Therefore, all such points to be analysed judiciously for finding out the best location.

2.3 Planning consideration of layout of Dairy Plant

Successful design of Dairy plant largely depends on selection of facilities and equipment for appropriate handling of the various resources involved in the product manufacturing. Therefore, one of the foremost steps would be to estimate the capacity of a Dairy and earmark production of various products with capacity. Other requirements like equipment, utilities, structure and work force will be function of the estimated capacity of Dairy.
Fig. 2.1 – Layout of Dairy Plant
2.3.1 Checklist for planning consideration of Dairy layout

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<th>Sr. No.</th>
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<td>1</td>
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<tr>
<td>2</td>
<td>Future possibility of expansion</td>
<td>2</td>
<td>Number of equipment with their capacities</td>
</tr>
<tr>
<td>3</td>
<td>Nearby Dairy plant, its distance and expansion possibilities</td>
<td>3</td>
<td>Milk processing Production line</td>
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<td></td>
<td></td>
<td></td>
<td>Milk Product Production line</td>
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<td>4</td>
<td>Productivity of animals and future aspects of affecting milk production</td>
<td>4</td>
<td>Cleaning and sanitary provision to low maintenance, cleaning, disinfection, monitoring and inspection</td>
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<tr>
<td>5</td>
<td>Connectivity of villages, possibilities for milk procurement and expected development</td>
<td>5</td>
<td>- Plant equipment material should be non-reactive, non-toxic and food grade quality specially that coming in the direct contact of milk.</td>
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<td>- Withstand heat treatment processes like heating and cooling.</td>
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<td>- Materials of heat transferring equipment should be good heat conductors.</td>
</tr>
<tr>
<td>6</td>
<td>Social tendencies for milk business</td>
<td>6</td>
<td>Provision for controlling and monitoring of temperatures, humidity, airflow and other parameters – as these parameters are detrimental to food safety</td>
</tr>
<tr>
<td>7</td>
<td>Allied occupation of farmers and extent of their sustainability</td>
<td>7</td>
<td>Space requirement for equipment should be analysed</td>
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<tr>
<td>8</td>
<td>Government policies for augmenting milk production</td>
<td>8</td>
<td>Utility requirements associated with the product and equipment</td>
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<td>9</td>
<td>Change in life style, purchasing power of consumers and nutritional awareness among people</td>
<td>9</td>
<td>Spacing between adjacent equipment and service pipelines to facilitate maintenance</td>
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<tr>
<td>10</td>
<td></td>
<td></td>
<td>Develop flow diagram to identify sequence of operations and flow of materials</td>
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<tr>
<td>11</td>
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<td></td>
<td>- Housing requirement for each product and equipment.</td>
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<tr>
<td></td>
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<td></td>
<td>- Few product needs to be manufactured in controlled atmosphere and need proper building.</td>
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<td></td>
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<td>- Few manufactured within the equipment kept in open.</td>
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<td>- some of the equipment requires proper housing.</td>
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<td>- Few needs open air for their efficient operation.</td>
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### 2.3.2 Principles of Dairy Layout

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<td>Minimize the cost of pipe length and save the cleaning time</td>
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<td>Method of Milk collection and optimum rate of intake</td>
<td>Contamination is minimized to safe level</td>
</tr>
<tr>
<td>Dispatch of Pasteurised Milk</td>
<td>Choice between cold storage at Dairy or immediate distribution to local depots</td>
</tr>
<tr>
<td>Method of Distribution to consumers</td>
<td>Prevention of Post Production Contamination</td>
</tr>
<tr>
<td>Electricity, Water Supply and Waste Water Disposal</td>
<td>Where appropriate, suitable facilities to be available for temperature, humidity and other controls</td>
</tr>
<tr>
<td>Choice of Fuel for steam production</td>
<td>To minimize production cost and air pollution</td>
</tr>
<tr>
<td>Provision for subsequent future expansion</td>
<td>For easy plant handling and maintenance</td>
</tr>
<tr>
<td>Approach to main road</td>
<td>Convenient Transportation</td>
</tr>
<tr>
<td>Single point entry/exit</td>
<td>Permits appropriate maintenance, cleaning and disinfections and minimize air borne contamination</td>
</tr>
</tbody>
</table>

Fig. 2.2 – Single point entry/exit in Dairy Plant premises including well-guarded entrance

### 2.4 DESIGN OF ESTABLISHMENT

Attention to good hygienic design and construction, appropriate location, and the provision of adequate facilities, are necessary to enable hazards to be effectively controlled. In this context, each aspect of Dairy is discussed below:

**2.4.1 Location** - Suitable location for the establishment and equipment should include following considerations:

**a) Establishments**

- To prevent potential sources of contamination to food
- No food establishment should be located in the hazard prone site
Location should be away from environmentally polluted area that can contaminate food, such as, flooded waste and infestations of pest prone area

b) Equipment
- Equipment should be properly located to permit adequate maintenance and cleaning
- The location facilitates good hygienic practices and effective monitoring

2.4.2 Premises and Rooms

Suitable consideration should be given depending upon requirement and nature of equipment:

a. Design and Layout: Where appropriate/applicable, the internal design and layout of Dairy establishment should permit hygienic practices including protection against cross-contamination during manufacturing and storage.

b. Internal Structure and Fittings: Structure within Dairy establishment should be soundly built of durable materials and easy to maintain, clean and/or disinfect. To achieve this, the surfaces of wall, ceiling and floor should be impervious and of non-toxic materials. The surfaces should be smooth and allow proper removing of water, dirt and germs. The material of facilities or fittings coming in the direct contact of milk should be non-reactive type.

c. Temporary/Mobile premises and vending machines: Premises and structures like stalls, mobile sales and street vending points as temporary housing should be sited, designed and constructed to avoid, as far as reasonably practicable, contaminating food and harbouring pests.

2.4.3 Equipment and Containers
- The contact surfaces should be made of materials with no toxic effect in the intended use of food.

Fig. 2.3 – Layout of Milk Pasteurization Plant
Design of equipment should facilitate easy movement and capability of disassembling to allow maintenance, cleaning, disinfecting, monitoring and inspecting pest.

- Withstand processing condition without affecting food safety aspect.
- Provision and capability for monitoring and control of process parameters.
- Specific identification, safe design and placement at appropriate location for waste, by-products and non-edible or dangerous substances containers
- Required safeguard should be made to prevent cross contamination from these containers or their contents.

### 2.4.1 Process & Storage Equipment

Equipment used in the receiving, processing, manufacturing, packaging, storing, dispensing, transporting or marketing of a dairy products shall be of an approved type or where applicable be based on Food Grade Standards.

The equipment must not be defective, unsuitable or unsanitary.

Fig. 2.4 Process & Storage Equipment

Fig. 2.5 Process & Storage Equipment
During receiving / handling / processing / storage of milk or intermediate product or finished milk products, certain equipment e.g. tanks, silos, hoppers, pipes, heat exchangers, packaging machines, filters, etc. come into contact with food. All these food contact surfaces shall be:

- Made up of non-corrosive / rust free material
- Smooth, free from any grooves
- Easy to clean and maintain
- Non-toxic and non-reactive
- Food grade quality

All processing equipment used during receiving, processing and packaging shall be designed, located and fabricated to facilitate easy cleaning and shall be kept away from contaminated air and dust.

Every processing and storing equipment shall at all times be either provided with a properly fitted cover/lid or other material of texture sufficiently fine to protect the milk and milk products completely free from dust, dirt and flies and other insects.

All equipment shall be kept clean, repaired and maintained in sound condition all the time.

2.5. Design of Facilities

Dairy plant has to be provided with required facilities for water supply, drainage/waste disposal, cleaning system, personal hygiene, toilets, humidity, air and temperature control, lighting and storage of various materials. These are discussed below:

a. Water Supply: Treatment of water occupies the predominant place in the modern Dairy industry.

- An adequate and potable water supply with appropriate storage, distribution and temperature control, should be available whenever necessary to ensure the safety and suitability of food.
Supply and storage line for non-potable water should be separate with proper identification.

Complete details of the water supply pertaining to the source and proposed treatment (when necessary) must be known.

Professionally engineered water systems may be required depending on source and type of Dairy products being processed.

An adequate supply of hot and cold water under pressure shall be provided in all plants.

The operator must assure that the water is bacteriologically and chemically safe.

Water Quality for Dairy processes

Treatment of water implicitly means changing its physical & mainly its chemical properties by removing undesirable suspended & dissolved impurities of organic, inorganic as well as biological in nature. The level of chemical dosing involved & method adopted for treatment are according to the end use requirement as well as the nature of composition of raw water sources; which are mainly from surface wells, lakes, rivers or from underground sources such as deep-wells & in some places from sea.

The specific method adopted for conventional treatment such as flocculation / coagulation, filtration and disinfection, lime soda softening process, electrodialysis, demineralization and reverse osmosis depending upon product quality requirement.

Treated water quality parameters for use in Dairy processes:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDS</td>
<td>&lt; 50.0 mg/ltr</td>
</tr>
<tr>
<td>pH</td>
<td>6.5 – 7</td>
</tr>
<tr>
<td>Chloride</td>
<td>&lt; 30.0 mg/ltr</td>
</tr>
<tr>
<td>Turbidity</td>
<td>&lt; 1 NTU</td>
</tr>
<tr>
<td>Total Hardness</td>
<td>&lt; 8 mg/ltr</td>
</tr>
</tbody>
</table>
Apart from process requirement, water is also required for **steam generation** and **cooling water for condenser in refrigeration plant**. For these requirements, Water hardness - below 5 ppm. Many modern dairy industries where raw water hardness is in excess of 500 ppm and TDS is more than 2000 ppm, utilize RO water for steam generation and cooling water in condensers.

- Use of RO water improves efficiency by reducing blow-down in boilers and bleeding in condensers. Equipment life expectancy is also improved.
- Water used in cleaning of equipment should be potable.
- The water used for processing of Milk & Milk products should be free from contaminants and preferably pasteurized.
- Water used for steam generation to process milk and manufacture milk product shall be generated from soft/DM/RO water.
- Wherever steam is mixed with the product as in DSI (Direct Steam Injection) heater, it should be of culinary grade.

If non-potable water is used anywhere in the plant for cleaning purpose then the concerned pipeline shall be identified as such or differentiated from potable/processed water.
b. **Drainage and disposal system:**

Adequate sanitary condition in and around plant can be maintained by proper arrangement for types of drains with cleaning and disinfection arrangement. Slope of floor and drains is of equal importance to let-out the spillage and washings.

![Fig. 2.9. Hygienic designed Drainage](image)

Properly trapped and covered floor drains with removable covers are essential in all areas of the plant. The drains must be of an adequate size and cleaned regularly.

![Fig. 2.10. Floors to be sloped to ensure easy drainage](image)

c. **Cleaning:**

Cleaning of plant premises and equipment should have provision in the planning stage itself. Proper clearance and facilities need to be considered. When manual cleaning is either not possible or less effective, then alternative methods like cleaning-in place (CIP) should be employed.

d. **Personnel facilities & toilets:**

In order to prevent cross contamination from machine and materials to man and vice versa, required arrangement should be thought for necessary equipment, space and water supply.

- Employee’s facilities shall include a suitably designed dressing room and lunchroom. Conveniently, located sanitary toilets for male and female
employees shall be provided exclusively for the use of Dairy plant personnel and shall not open directly into an area used for the processing or packaging of Dairy products.

Adequate and conveniently located facilities for hand washing and drying must be provided wherever the process demands. Where appropriate, facilities for hand disinfection should also be provided.

**f. Temperature Control:**

Most of the Dairy operations are temperature dependent. Heating, cooling or holding at certain temperature are required to obtain product with good microbiological quality, flavour and texture. For this steam supply unit, refrigeration unit and temperature recording, monitoring and controlling mechanism are provided.

**g. Air Supply System:**

Adequate air supply system should include compressor, inter-cooler, oil separator, air filters and drier/humidity controller. Air pipeline is provided to meet operation requirements of agitation, oxidation, control and/or conveying function. If air comes in direct contact of product, then its proper hygienic quality should be ensured.
Air Quality
Usage of air in dairy industry

- Dairy industry utilizes compressed air for pneumatic valves and instruments.
- Production of powder
- Conveying of powder produced into storage silos.
- Culinary grade of Air for mixing with product like Ice-cream and powder.

Note: Care has to be taken wherever compressed air comes into contact with food because compressed air is not clean by nature. On the contrary, solids and particles in various concentrations are present almost everywhere in the form of dust.

Water, in the form of natural humidity, is released in large quantities when the compressed air cools down. Thus, compressed air quality in accordance with the requirements of the application provides the best possible safety for food consumers and food producers.

Standards-compliant Compressed air preparation
Extremely strict demands are made of the compressed air quality in food industry. International standards are helpful in this respect. ISO 8573-1, for example, represents the key quality requirements for compressed air and specifies the maximum amount of contaminants and particle sizes that can be present in each class.

Compressed Air Quality classes to ISO 85731:2010

<table>
<thead>
<tr>
<th>ISO 8573-1:2010</th>
<th>Solid particles</th>
<th>Water</th>
<th>Oil</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum number of particles per m³</td>
<td>Mass concentration</td>
<td>Pressure dew point</td>
</tr>
<tr>
<td>0</td>
<td>In accordance with specification by the device user, stricter requirements than Class 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>≤20,000</td>
<td>≤400</td>
<td>≤10</td>
</tr>
<tr>
<td>2</td>
<td>≤400,000</td>
<td>≤6000</td>
<td>≤100</td>
</tr>
<tr>
<td>3</td>
<td>≤90,000</td>
<td>≤1,000</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>≤10,000</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>-</td>
<td>≤100,000</td>
</tr>
<tr>
<td>6</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>-</td>
<td>-</td>
<td>&gt;10</td>
</tr>
</tbody>
</table>

Adherence to the above standard is important in order to ensure the best possible food safety, and thus reduce the risks for consumers as well.
h. Lighting
While designing the lighting in a Dairy plant, following factors been taken into consideration:

- Availability of natural light
- Provision of artificial light needs to be made according to the requirement of operation.
- All plants shall be provided with adequate lighting and shielded with shatterproof coverings to ensure clean and efficient plant operation.
- In humid operating conditions e.g. CIP room and processing plants, light fixtures should be moisture proof.
- The colour rendering property of lighting should be such that Milk & Milk products exhibit their true and natural colours.

A minimum illumination requirement (Lux) at different section of Dairy units is as follows:

- Reception, processing and cleaning section - approximately 500 to 600 (250-300).
- Monitoring places like weighing, equipment with gauges, filling & inspection, laboratory and accounting is approximately 1000 (500-750).
- Corridor and utility section is 200 to 300 (100-120)
- Recommended illumination level for Milk premises (common areas like internal roads, corridors etc.) is 100 Lux. (As per IS 3646 Part-I 1992)
I. Storage

Adequate facilities should be provided for the storage of food, ingredients and non-food chemicals (e.g. cleaning materials, lubricant fuels).

- Appropriate food storage facilities should be designed and constructed to permit adequate cleaning and maintenance.
- Avoid pest access and harbourage, enable food to be effectively protected from contamination.
- Provide proper environment that minimizes the deterioration.
- Storage of edible, non-edible and hazardous materials should be separate.

Fig. 2.17 Stacking of Milk product

- A separate dry storage area shall be provided in Dairy plants for sugar, powder, salt, packaging materials etc.
- The storage area will depend upon the volumes of the milk and milk products handled by the Dairy.
- Now-a-days, in modern Dairy plants, ASRS (Automatic Storage & Retrieval System) is also used for automatic storage and distribution of finished goods.

Fig. 2.17 Staking of Milk Product

2.6 DESIGN OF DAIRY ESTABLISHMENT PREMISES

A building plan showing cross sections of the plant, floor plan of each level, the purpose for which each room is intended, location of walls, partitions, windows, doors, posts, conveyors and all equipment. The floor plan must indicate location of floor drains, process water and sewer lines, and plumbing fixtures including hand sinks and slope of floors to drains.
Fig. 2.18 Premises with tar road and RCC hard park to minimize entry of dirt/dust in Production area

Fig. 2.19 -Well-defined pathways

Fig. 2.20 Hygienic Plant entrance
2.7 Plant Construction Standards

Dairy processing sections require stringent hygienic construction standards with special attention paid to non-stagnation of water, clean drains, good ventilation and well-illuminated areas.

For ready reference, key requirements are listed below:

a. Floors:

- Sealed concrete or other impervious material with a smooth surface and adequate slope to drains
- The floor/wall joints are to be covered for ease of cleaning and maintenance

Fig. 2.21 Unwanted Vegetarian growth surrounding Dairy plant

Fig. 2.22 Stagnant water near Dairy premises

Fig. 2.23 Epoxy Flooring
b. Wall and Ceilings

- Floor surface in production areas should be acid and alkali proof - to resist the chemical action of the cleaning chemicals (e.g. Red Mandana, Epoxy flooring etc)

- Walls and ceiling of rooms in which Dairy products are processed, manufactured, packaged or stored shall be
  - Smooth
  - light coloured
  - impervious to moisture
  - Should be fungus free.

Fig. 2.24 Tiled floor to resist chemical action

Fig. 2.25 Cracked Ceiling

Fig. 2.26 Fungus infected Ceiling
c. Doors and Windows

The doors and windows in the Dairy plant shall be made of smooth and non-absorbent surfaces and they shall be easy to clean and disinfectant. Doors can be fitted with automatic closing spring, PVC strip or air curtain to stop entry of dust, insects etc.

d. Ventilation

Adequate ventilation is required in all plants to prevent
- excessive heat,
- dust accumulation,
- odours
- condensation
- to provide proper environment for processing and conducive working conditions for employees.

The direction of airflow should be from the processing area to outside the building.
e. Overhead Utility Lines:

- All overhead utility lines should be installed in such a manner to avoid contamination of products below by condensation droplets, dust falling off during cleaning/maintenance.
- They must be easy to clean.

Fig. 2.30 Standard colour code for utility lines

Fig. 2.31 Screw Compressor Refrigeration Plant

- Chilled water and product lines should be insulated where necessary
- Designed to prevent the accumulation of dirt, minimize mould development and flaking
- Painted with specific colours as per IS 2379 for easy identification of type of Utility pipes
2.8 Effluent Treatment Plant

- An Effluent treatment plant is mandatory by Central Pollution Control Board/State Pollution Control Board for Dairy plant operations and consequent effluent and waste disposal.
- Waste water disposal facilities (either municipal or private systems) must be provided at all dairy plants and must be hygienic and approved. These systems are subject to provincial and PCB requirements and
- Effluent is generated in any Dairy industry during the processing, cleaning, spillages, leakages and spoilage of milk & milk products.
- The effluent cannot be drained into water bodies and land areas without proper treatment as it can cause environmental pollution and irreparable damage to ecology.

![Fig. 2.31 Effluent Treatment Plant](image)

- **a. Usage of clarified water generated from ETP**
  - Gardening purpose
  - Cleaning floors of Dairy dock and toilets
  - Surplus treated water from ETP can be channelized into other natural water bodies.

- **b. ETP plant also generates solid waste in form of sludge**
  - Sludge can be dried and used as manure for gardening
✓ Bio-gases can be used as cooking gas or as a fuel for generation of electricity/steam.
✓ Fat separated initially is sold to soap industry.

Fig. 2.32 Effluent Treatment Plant

**c. Typical wastewater effluent & treated water characteristics from ETP at 27°C are as under:**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>pH</th>
<th>BOD</th>
<th>COD</th>
<th>TSS</th>
<th>TDS</th>
<th>Oil &amp; Grease</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unit</td>
<td>(mg/liter)</td>
<td>(mg/liter)</td>
<td>(mg/liter)</td>
<td>(mg/liter)</td>
<td>(mg/liter)</td>
</tr>
<tr>
<td>Effluent</td>
<td>5.9 to 7.5</td>
<td>1200-1600</td>
<td>3500-4500</td>
<td>300-600</td>
<td>800-1200</td>
<td>150-400</td>
</tr>
<tr>
<td>Treated water</td>
<td>6.5-8.5</td>
<td>&lt;30</td>
<td>&lt;100</td>
<td>&lt;100</td>
<td>&lt;800</td>
<td>&lt;10</td>
</tr>
<tr>
<td>Efficiency (%)</td>
<td>-</td>
<td>97.85</td>
<td>97.5</td>
<td>77.8</td>
<td>-</td>
<td>93.3</td>
</tr>
</tbody>
</table>

**d. Eco-friendly Effluent Treatment Plant in Dairy**

Fig. 2.33 Purification through Vacuum Pressure Swing Adsorption System

Fig. 2.34 flaring Biogas into the atmosphere
Fig. 2.35 Purified gas filled into the cylinders

Fig. 2.36 Double Membrane Balloon for Purified Biogas

Fig. 2.36 Double Membrane Balloon for Purified Biogas

Fig. 2.38 Raw Biogas Purification System

Fig. 2.39 Biogas Filling Station

Fig. 2.40 Trolley for cascade
Activity 2

1. A good layout design and use of proper materials and technique make great contribution towards hygiene.  ☐ True  ☐ False

2. Dairy Layout should have approach to main road for ________________.

3. Dairy Plant must be provided with __________Facilities.
   a. Water Supply  b. Air Supply  c. Drainage & Disposal System  d. All of These

4. Milk contact surfaces shall be made up of ______________material.

5. There is no use of clarified water generated from ETP
   ☐ True ☐ False
PART III

MILK PROCESSING & PACKAGING

- Clean Milk Production at Farm and DCS level
- Raw milk Reception at Dairy Plant
  - Chilling & Storage of raw milk
- Processing
  - Clarification
  - Bactofugation
  - Cream Separation
  - Standardization
  - Homogenization
  - Pasteurization

- Packaging (Sachet)

- Different types of Milk & Milk Products
- Packaging requirements for Milk and Milk Products
3 Clean Milk Production at Farm and DCS level

Milk is normal mammary secretion of a healthy animal. Hence, animal health is an important aspect in the production of clean milk. Good hygiene and sanitation practices would keep it free from bacterial contamination. Thus, both these aspects discussed mainly from the point of Clean Milk Production. If raw milk is brought to dairy plant by a producer or farmer, then it shall be ensure that he brings it within four hours of milking and it shall be cooled as soon as practicable to a temperature of 4°C or lower and maintained at the temperature until processed.

3.1 Necessary Steps to be taken care for Clean Milk Production

a. Cattle
   - Give sufficient quantity of feed and drinking water to cattle prior to milking.
   - Remove accumulated cow dung.
   - Cattle shall be bathed and if bath is not possible dry cleaning by broom / duster should be done.
   - Maintain the cattle clean and healthy.
   - In case animal is under treatment, discard the milk during the withdrawal period of the treatment.
   - Clean the udder and teats of the cattle by clean (potable) water and wipe using a dry & clean cloth.
   - Teats should be cleaned after sucking, if cattle is letting down the milk by calf sucking.
   - It is good to keep the animals standing for at least half an hour after milking. Feed may be provided to encourage this.

b. Cattle Shed
   - Clean the cattle shed floor either by washing with water or dry cleaning 10 – 15 minutes before milking.
   - The floor should not be slippery. It should be firm and dry so as to provide a proper foothold to the animal while rising or standing.

c. Utensils
   - Clean thoroughly the milk collection vessel preferably with detergent and hot water etc. and keep it inverted to dry before milking.
   - Avoid use of measures, tumbler etc. in the milking vessel for removing or to transfer milk from milking pail.
   - The utensils and the storage vessels should be of SS 304 construction and free from sharp edges.
   - A suitable size lid should always be used to cover the utensils and the vessel.
   - They should be cleaned and sanitized before and after their use and kept dry.
   - They should be exclusively used for milking.
   - The milk should be filtered before pouring into the vessel.
   - The utensils should be the same in which the milking is done to avoid contaminations due to multiplicity of vessel etc.

d. Milk Handler
Milker should wash his/her hands with soap to make them clean and germ free.
Milker should wear clean clothes.
Milker should avoid contact between milk and his body parts, clothes and other belongings.
Chewing and spitting with tobacco and smoking should be avoided during milking.
Sneezing/ coughing towards udder/vessel during milking should be avoided.
Milker should not be suffering from any respiratory ailment or contagious disease.
Milker should not have any open sores or cuts.

e. Miscellaneous
- Use separate vessel for washing of udder and teats & for milking.
- Discard the initial milk from all the four teats to minimize the bacterial load.
- Flies, hay, husk, dry cow dung cake or other extraneous matter should not get into the milking vessel.
- After milking rinsing of teats in a disinfective solution (with water, iodophor etc.) shall be done to avoid post milking infection.

3.2 Delivery of milk to DCS (Dairy Cooperative Society) / MCC (Milk Collection Centre)

Milk producers come together and form a village dairy cooperative society (DCS) with the support of Milk Union and start supplying the surplus milk to the DCS, after retaining milk for their household consumption.

Raw milk is collected daily from a producer, and it shall be cooled immediately to the temperature of 4-6°C or lower and maintained at the temperature until processed.

Fig 3.1 – Dairy Cooperative Society

The major operations of a DCS are hygienic milk collection and providing input services.

- Milk collection involves reception, testing, local and sample milk sale, dispatch of milk to the Milk Union, payment and accounts keeping.
- Input services include animal health coverage, artificial insemination, supply of cattle feed, mineral mixture and other feed supplements, fodder seeds, providing extension services to producer members including propagation of Clean milk production practices.
Milk should be carried in SS utensils/ SS Cans. Milk should be brought to DCS/MCC as quickly as possible after milking to avoid multiplication of harmful bacteria.

3.2.1 CLEANING OPERATIONS AND HYGIENE MAINTENANCE

Bulk tanks must be properly cleaned and sanitized. An improperly cleaned tank would be a major source of bacterial contamination in milk, thereby causing its deterioration and mitigating the advantages of chilling milk at farm level. Prevailing low temperatures of milk in an improperly cleaned tank favour rapid multiplication of psychrophilic bacteria (microorganisms capable of rapid growth at temperatures of 2 to 10°C) and cause serious flavour defects in milk.

3.2.1.1 Cleaning procedure: Tanks may be cleaned manually or with CIP. A typical example of cleaning cycle for bulk milk tanks is provided below:

a. Manual Cleaning of Bulk Milk Tanks

Pre-rinse

Rinse the tank manually and flush pipeline with lukewarm (38-43°C) water immediately after use to remove remaining milk residues.

- Disassemble all parts that must be hand-washed. Before carrying out routine cleaning of the tank, the thermometer probe and dipstick should also be removed and put aside carefully.

Detergent Wash

Alkaline cleaning solution (usually containing basic alkali, phosphates, wetting agent, and chelating agent) or as specified in manufacturer’s recommendations and based on water quality tests.

- All detachable parts like tank covers, gaskets, calibration rod etc. should be cleaned manually after disassembling.
- For hand washing of disassembled parts:
  - Soak all parts at 49-57°C for at least 5 minutes.
  - Brush all parts thoroughly.
  - Drain.

b. CIP of Bulk Milk Tanks:

Pre Rinse

Rinse the tank manually and flush pipeline with lukewarm (38-43°C) water immediately after use to remove remaining milk residues.

Detergent Rinse

- Start with detergent solution and circulate it at 77°C for 6-10 min.
- Brush all parts, including outside of tank and outlet valve, not designed for cleaning by circulation of cleaning solution.
- Drain.
- Clean the outlet connection and outlet valve manually.

**Rinse**
- Rinse off the detergent solution with tap water before the acid rinse, if required.
- Rinse tank thoroughly (inside and outside).
- Rinse tank outlet valve.

**Acid-rinse (Occasional)**
- Occasionally, rinsing with an appropriate acid (nitric acid) solution (55°C-60°C) is required to remove inorganic soils that build over a period of time.
- Circulate for 2-3 minutes and drain.
- Visually inspect line, receiver jar, etc., for proper cleaning.

c. **Check Points to follow in CIP**
- Check that all solutions drain completely between cycles.
- Check that the pump has sufficient pressure to reach all areas.
- Consider an acid wash if no softener is being used in hard water.
- Check outlet valve, gasket and manhole area for cleanliness.
- Check inlet area to cooler and inlet pipe.
- The outside of the bulk milk cooler needs to be kept clean at all times.

![Fig 3.2 – Closed Type Bulk Milk Cooler](image-url)
3.3 Milk Transportation from DCS to Dairy Plant

Milk from Dairy cooperative society/Milk collection Centre is transferred to Dairy plant through Cans/Road Milk Tankers.

3.4 Milk Reception at Dairy

Dairies have reception bays most commonly known as Raw Milk Reception Dock to receive the milk brought from the Dairy Cooperative Societies / Farms in cans as well as milk tankers. The first thing done at reception is to determine the quality of milk. The quantity is recorded and entered into the weighing system that the Dairy uses to weigh the gross and net weight.

3.4.1 Steps of Can reception

a. The cans arrive from the lorry on a conveyor. In automatic can reception, the lids are automatically removed and emptied into a weighing bowl, which indicates the quantity.
b. Cans are also unloaded manually and placed on the conveyors for emptying it
c. Drip Saver is provided to collect milk which is left while dumping into the weighing bowl.
d. Each can is subjected to rapid sensory evaluation and some preliminary tests to decide the acceptance or rejection of the milk.
e. The weighing-in system is programmed so that the operator enters the society identification on a keyboard before weighing all the cans from that route.
f. The weighing equipment must be well maintained and checked every day to ensure accuracy.
g. From weighing-in, the raw milk is pumped to storage tanks through milk chiller and line filter.
3.4.1.1 Can Washer
The empty cans are conveyed to a Can washer, where they are washed with water and detergent to remove all traces of milk.

Two types of Can washers are used in Dairy industry:

1) Rotary Can washer
2) Straight through Can washer
** Rotary Can Washer

These are semi-automatic or automatic can washing machines, in which cans are rinsed, cleaned and sterilized very effectively.

**Design and Operation:**

The cans are carried on a large rotating table or carrier. This type of washer is very simple in construction. De-shaped cans are also cleaned without any problem of falling. These are built in various sizes for handling low to medium number of cans and are very compact machines.

![Schematic Diagram of Rotary Can Washer](image)

**Precaution and Maintenance for Rotary Washer**

<table>
<thead>
<tr>
<th>Precaution</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check the effectiveness of cleaning. In case of dented cans or heavy soiled can, scrub the can in the can scrubber before loading in the rotary can washer.</td>
<td>Pumps and nozzles are to be checked timely</td>
</tr>
<tr>
<td></td>
<td>Lubricate the moving parts daily or as per the manufacturer's instructions.</td>
</tr>
<tr>
<td></td>
<td>Check and attend the gland/oil seal/water seal</td>
</tr>
<tr>
<td></td>
<td>Keep all the doors closed except entry and exit</td>
</tr>
</tbody>
</table>
**Straight-through Can Washer**

The washer has rinsing, detergent spraying, hot water rinsing, steaming and air-drying sections.

**Design and Operation:**

- The cans are moving from entry door over the steel or plastic chains of special design to hold the can and carry towards the exit door.
- In other type of moving arrangements cans are carried forward through a ratchet from one position to the next.
- Can moves forward from entry door in inverted position to rinsing section, where warm water is injected from bottom and other sides removing loosen soils and some part of dirt.
- Then these cans move to detergent section, in which hot detergent solution of 0.5 to 1% concentration is sprayed inside and outside surface of cans to remove the soil completely.
- These cans move to hot water rinsing section where the traces of detergent and soils are removed.
- Now, the cans are effectively clean and move to steaming section for sterilization.
- Finally, the hot cans are dried into the air-drying section. Before reaching to exit door, by suitable attachment, inverted cans are brought to the normal position with mouth upside.

**Precaution and Maintenance**

<table>
<thead>
<tr>
<th>Precaution</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam jets should be cleaned regularly for proper injection of steam.</td>
<td>Check the steam nozzle before and after the washing operation. Clean the blocked nozzle.</td>
</tr>
<tr>
<td>Damaged cans should not be used, as they often fall inside the washer and interrupt the washing operation.</td>
<td>Can conveying chain should be checked, loose link should be repaired/ replaced.</td>
</tr>
</tbody>
</table>
**Can Scrubber**

*Fig 3.7 – Schematic Diagram of Can Scrubber*

### Design and Operation:

These are very simple type of Can washing machines. As shown in the Fig. one nylon fibre hard brush “A” of cylindrical shape revolves about its axis which is driven by small rating (usually 0.5 to 0.75 HP) electrical motor. Another brush “B” is driven with the connected gear. One stationary brush “C” to suit the shape of can is fitted at one sidewall of the scrubbing machine. The arrangement of these brushes are shown in the schematic diagram

Following procedure is usually employed for washing cans in the scrubber:

- Fill the washer and put the required quantity of detergent.
- Heat the solution up to 45 to 50 degree centigrade.
- Now start the motor of can scrubber to rotate the brushes.
- Collect can from drip saver and insert it into the scrubber brush “A” from the free end side.
- Hold the can for enough time to loose the deposited materials.
- The brush “A” will scrub the inside surface of can, and rotating brush “B” and, stationary side brush “C” of special shape will scrub the external surface of can.
- Take out the cans and rinse with cold water.

<table>
<thead>
<tr>
<th>Precaution</th>
<th>Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proper temperature, concentration of solution and enough holding/scrubbing time</td>
<td>Draining of dirty detergent solution and washing properly to keep thorough cleaning</td>
</tr>
<tr>
<td>Operators should be provided with</td>
<td>Checking all the brushes for proper</td>
</tr>
</tbody>
</table>
protective hand gloves | alignment, tightening and condition of fibres. If found not proper set right properly. Change worn out brushes.
--- | ---
Regular monitoring of the condition of Brush | Checking motor and motion/power transmission system including chain/belt and sprocket/pulley for wear - tear and alignment.
Clean and Soft Water to be filled up to required level | Providing grease/oiling over the chain/gears
Concentration of the detergent solution is checked at desired interval of operation | Checking the drain plug to prevent leakage through it.
The solution is drained after every 150 can washing and then recharged freshly | Interval could be changed after observing the practical requirements

---

**Fig 3.8 – Can Scrubber**

### 3.4.2 Tanker Reception

Tankers arriving at the Dairy drive straight into a reception bay, often large enough to accommodate several vehicles.

The milk is measured either by volume or by weight.

1) Measuring by volume

This method uses a mass flow meter. To avoid error in the readings of mass flow meter, a deaerator which eliminates the air in the milk being unloaded from the tanker is installed.
2) Measuring by weight

Bulk-collected milk can be weighed in as following procedure:

- By weighing the tanker before and after unloading and then subtracting the empty tanker weight from the gross weighment value.

The tanker is driven onto a weighbridge at the Dairy. Operation may be manual or automatic.

- If manual, the operator records the weight against the driver’s code number.
- If automatic, the necessary data are recorded when the driver places a card in a card scanner.
3.5 Process flow-diagram of milk reception & processing:

Raw chilled milk in tankers (Cap-7.5 KL to 20 KL) → Sampling

- De-aeration tank
- SS Disc Filter
- Milk Chiller
- Buffer tank
- Milk clarifier
- Raw milk silo (4-5°C)
- Balance tank of Pasteurizer
- 1st Regeneration section of milk Pasteurizer (50-55°C)
- Bacteria removing clarifier (52-55°C)
- Cream separator

Skim milk → Milk Standardization

Cream → Cream chiller

- Buffer tank
- Cream pasteurizer (min. 85°C)
- Cream Silo
- Milk Standardization
- Standardized milk
- Regeneration-2 (65-70°C)
- Homogenizer
  (1st stage-2500 psi, 2nd stage-500 psi)
- Heating (min. 72°C)
- Holing (min. 15 sec)
- Chilling (Below 4°C)
- Store in Pasteurized milk silo
- Packaging → Crating and Dispatch
3.5.1 Chilling of incoming milk

Normally a temperature increase to slightly above 4°C is unavoidable during transportation. The milk is therefore usually cooled to below 4°C in a plate heat exchanger before being stored in a silo tank to await processing.

3.5.2 Raw milk storage

- The untreated chilled raw milk as received at RMRD is stored in large vertical tanks or silos which have capacities ranging from 50 KL to 150 KL.
- Smaller tanks can be located indoors while the larger capacity tanks are placed outdoors to reduce building costs.
- Material Of Construction (MOC) of silos is SS-304 and they are insulated with EPS or polyurethane foam sheets of sufficient thickness to prevent temperature rise.
- The outer cladding is also of SS-304 sheet in modern silos.
- The inner tank is of stainless steel with minimum 150 grit finish.
- There is an agitator mounted on top or inclined near the bottom of the silos for agitating the milk to keep it homogenous and also to cool it uniformly.
- The agitator with mechanical seal that prevents oil from dripping and also to avoid leaking into the milk inside the silo.

3.5.3 Clarifier

- Function of the clarifier
  - Remove undesirable milk solids like dirt, dust, hay, manure, bacteria, somatic cells and pulverized hair by the application of centrifugal force.
3.5.4 Bacteria Removing Clarifier

![Bacteria removing Clarifier](image1)

**Function of the Bacteria removing clarifier**

- Remove bacterial spores present in milk by the application of centrifugal force.
- 2-stage Bactofugation can remove 99.9% bacterial spores and 90% bacteria from milk.

3.5.5 Cream Separator

![Cream Separator](image2)

**Centrifugal equipment that separates milk into cream and skimmed milk.**

3.5.6 Milk Standardization

The separated cream and skim milk are remixed in certain proportions to make standardized milk as per further process/market requirement. Different types of milk like Toned, Double toned, Standardized, Full cream etc. have different standards of Fat & SNF as prescribed by the FSSAI. For certain specific product, even protein content may be adjusted.
3.5.7 Homogenizer

Homogenization is the process of reducing the fat globule size below 2 microns so that they float suspended evenly throughout the entire milk solution.

Homogenization is done in two stages. In first stage, the milk is passed through small openings with applied pressure of 2500 PSI followed by 500 PSI in 2nd stage to prevent fat globule clumps.

3.5.8 Pasteurizer

Pasteurization (LTLT/HTST) is a process that kills pathogens in milk. Pasteurizer (Plate Heat Exchanger) is the equipment used for HTST Pasteurization.

This is achieved by heating the milk in the pasteurizer to a temperature of minimum 72°C, holding it at that temperature for 15 seconds and then rapidly cooling it below 4°C.

**Standardization of Milk for Fat:**
This can be made by simple Pearson’s square method. Only Fat or SNF can be standardized by this method.

**Standardization of Milk for Fat & SNF:** This can be made by Algebraic method.

**On line milk standardization:** This is achieved by using combination of online Density-meter and Flowmeter instruments.
3.5.8.1 Requirements for successful operation of Pasteurization Plant

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Process Parameter</th>
<th>Required Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Application of correct thermal Process</td>
<td>a. Use of thermostatic control to ensure heating medium at correct temperature</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Use of Positive control to ensure flow rate through holding tube correct</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c. Use of long, thin holding tube to minimize short holding time due to turbulent flow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>d. Fitting of automatic flow diversion device to return under heated milk to raw milk buffer tank</td>
</tr>
<tr>
<td>2</td>
<td>Prevention of cross-contamination within pasteurizer</td>
<td>a. Vent inter space between seals to atmosphere to provide an immediate visual indication of gasket failure.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Maintain a positive pressure balance between pasteurized milk and raw milk in the regeneration section.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c. Ensure correct positioning of flow diverter and associated pipework to avoid contamination of pasteurized milk when through-flow resumes after diversion.</td>
</tr>
<tr>
<td>3</td>
<td>Cleanability</td>
<td>a. Fabricate milk contact surfaces from high-grade stainless steel finished, preferably by electropolishing to avoid crevices and consequent entrapment of soil.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Welds, joins, etc., should be finished to the highest possible standard.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c. All materials used in construction should withstand contact with cleaning fluids.</td>
</tr>
<tr>
<td>4</td>
<td>Limitation of heat damage</td>
<td>a. Minimize temperature difference (1°C is desirable) between heating medium and milk.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Minimize milk residence time in ‘hot’ section of pasteurizer.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c. Ensure efficacy of cooling section</td>
</tr>
<tr>
<td>5</td>
<td>Economic operation</td>
<td>a. Ensure efficacy of regeneration section</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Employ maximum possible ratio of heating surface to volume.</td>
</tr>
</tbody>
</table>

3.5.9 Milk Packaging

Processed milk is pumped to the packaging plant where milk is packed in various sizes of polypacks for final distribution to the end user.

Modern trend is to use mechanical pouch packing machines instead of pneumatic type packaging machines.
3.5.10 Crating and dispatch

Poly packs are arranged in plastic crates systematically and loaded on to trucks for dispatch to different milk sales outlets.

3.5.10.1 Crate washer

Effective cleaning of crates before transport of milk pouches at Dairy plant level decreases contamination. This could also lead to improvements in product quality, transportation and storage. Clean crate meets the hygiene requirement of your customers. To achieve that, you need high quality at flexible crate washers.

A typical crate washer consists of a washing section(s) and a rinsing section. In these sections, the nozzles that are mounted on the spraying racks will produce the Mechanical Action of the Temperature Controlled and Chemical Dosed water. Each washing section has its own reservoir for re-use of the washing water and for the rinsing section, fresh water will be used. A transport chain or transport belt will be used to transport the crates through the machine with a certain (controllable) speed to meet the Washing Time for a certain crate/pollution.

![Three Compartment Washing System](image1)

**Fig 3.16 – Three Compartment Washing System**

![High Pressure Jet cleaning in Crate Washer](image2)

**Fig 3.17 – High Pressure Jet cleaning in Crate Washer**

3.5.10.2 Advantages of High Pressure Jet cleaning

- Reduction in plant down time
- Saves labour cost and space
Environment friendly as it saves water, reduces noise pollution & air pollution as there is no generation of gas, smoke and heat
Safe to use: Effective cleaning without/less use of hazardous chemicals with no damage to the underlying surface

### 3.6 Precautions against re-contamination of pasteurized milk

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Source</th>
<th>Pathway</th>
<th>Precautions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Raw Milk</td>
<td>a. Direct</td>
<td>a. Correct design- Correct operation and maintenance of pasteurizer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Indirect via contamination of plant environment, passive transfer on hands of personnel, etc</td>
<td>b. Correct plant layout- Control of personnel movement and avoidance of ‘hands-on’ operations involving milk or milk-contact surface</td>
</tr>
<tr>
<td></td>
<td></td>
<td>a. Usually indirect via contamination of equipment</td>
<td>a. Prevent contamination of plant environment from outer environment including animals and birds, soil and water</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Also via personnel and packaging</td>
<td>b. Eliminate contamination of pasteurized milk side of plant by correct environmental sanitation.</td>
</tr>
<tr>
<td>2</td>
<td>Plant Environment</td>
<td>a. Direct due to personnel suffering with clinical illness or being convalescent or chronic carrier of pathogens.</td>
<td>a. Apply appropriate medical and exclusion policies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Indirect due to introduction to plant of contamination from outside environment, etc.</td>
<td>b. Ensure good personnel hygiene and correct use of protective clothing and footwear</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A particular hazard can exist in some rural areas where personnel are also small holders.</td>
<td>c. Prohibit raw produce such as eggs being brought into the plant by part time farmers for sale to follow workers</td>
</tr>
<tr>
<td></td>
<td>Personnel</td>
<td>a. Contamination of equipment by raw milk</td>
<td>Utilize suitable cleaning and sanitization programmes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Development of biofilms and colonization of milk contact surfaces by</td>
<td></td>
</tr>
</tbody>
</table>


3.7 Milk and Milk Products

In recent years, there has been considerable diversification of the types of milk available. Type of Milk is as follows:

<table>
<thead>
<tr>
<th>Raw Milk</th>
<th>Double Toned Milk</th>
<th>Condensed Milk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pasteurised Milk</td>
<td>Reduced Lactose Milk/Lactose Free Milk</td>
<td>Vitaminized/Irradiated Milk</td>
</tr>
<tr>
<td>Standardized Milk</td>
<td>Full Cream Milk</td>
<td>Condensed Milk</td>
</tr>
<tr>
<td>Homogenized Milk</td>
<td>Frozen Concentrated Milk</td>
<td>Flavoured Milk</td>
</tr>
<tr>
<td>Sterilized Milk</td>
<td>Reconstituted Milk</td>
<td>Soft Curd Milk</td>
</tr>
<tr>
<td>Toned Milk</td>
<td>Evaporated Milk</td>
<td>Fermented Milk</td>
</tr>
</tbody>
</table>

**Indian Milk Products**

- Desiccated Milk Based Products
- Heat - Acid Coagulated Products
- Fermented Products
- Fat Rich Products
- Milk Based Puddings/Desserts

**Desiccated Milk Based Products**
- Khoa/ Mava
- Gulabjamun
- Kalajamun
- Pantua
- Lalmohan
- Barfi
- Milk Cake
- Peda
- Thirattupal

**Fermented Products**
- Rabri
- Khurcan
- Basundi
- Kulfi
- Frozen Desserts
- Malai ka Barf
- Falooda

**Regional Products**
- Kunda
- Bal Mithai

**Fat Rich Products**

**Milk Based Puddings/Desserts**
Milk Based Puddings/Desserts
- Kheer
- Payasam
- Phirni
- Sevian
- Sabodana Kheer
- Lauki Kheer
- Sohan Halwa
- Gajar ka Halwa
- Kaju Barfi

Regional Products
- Ghever
- Lauki Halwa
- Padusha
- Jilli
- Mohandas

Western Dairy Products
- Cream
- Butter
- Butter Oil/AMF
- Ice-Cream
- Milk Powder
- Cheese
- Yoghurt
3.8 Packaging requirements for milk and milk products

(a) The rooms for storing packaging material shall be free from vermin and from dust which could constitute an unacceptable risk of contamination of the product and shall be separated from rooms containing substances which might contaminate the product. Packaging material shall not be place directly at the floor.

(b) Packaging shall be done without delay and shall be handled by separate group of staff having experience in product packaging.

(c) Bottling or filling of containers with heat-treated milk and milk product shall be carried out mechanically and the sealing of the containers shall be carried out automatically.

(d) Wrapping or packaging may not be re-used for Dairy products, except where the containers are of a type, which may be re-used after thorough cleaning and disinfecting.

(e) Sealing shall be carried out in the establishment in which the last heat-treatment of drinking milk or liquid milk-base products has been carried out, immediately after filling, by means of a sealing device which ensures that the milk is protected from any adverse effects of external origin on its characteristic. The sealing device shall be so designed that once the container has been opened, the evidence of opening remains clear and easy to check.

Packaging Material for different Milk and Milk Product

<table>
<thead>
<tr>
<th>Product</th>
<th>Packaging Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid Milk/Flavoured Milk</td>
<td>o Glass Bottle</td>
</tr>
<tr>
<td></td>
<td>o Tetrapack</td>
</tr>
<tr>
<td></td>
<td>o Flexible LDPE Pouch</td>
</tr>
<tr>
<td></td>
<td>o Flexible laminated Pouch</td>
</tr>
<tr>
<td></td>
<td>o PET Bottle</td>
</tr>
<tr>
<td>Milk Powder</td>
<td>o Tin Container</td>
</tr>
<tr>
<td></td>
<td>o Metalized Aluminium Foil</td>
</tr>
<tr>
<td></td>
<td>o Lined Cartoon</td>
</tr>
<tr>
<td></td>
<td>o Bag in Box: Powder filled in laminate</td>
</tr>
<tr>
<td>Butter (Table/White)</td>
<td>o Card Board with vegetable parchment paper</td>
</tr>
<tr>
<td></td>
<td>o Tin Container</td>
</tr>
<tr>
<td></td>
<td>o Tub/ Chiplet</td>
</tr>
<tr>
<td>Cheese/Cheese Spread</td>
<td>o Tin Containers</td>
</tr>
<tr>
<td></td>
<td>o Aluminium Foil in carton board</td>
</tr>
<tr>
<td></td>
<td>o PET Cup</td>
</tr>
<tr>
<td>Ghee</td>
<td>o Tin Container</td>
</tr>
<tr>
<td></td>
<td>o Flexible HDPE Pouch</td>
</tr>
<tr>
<td></td>
<td>o PET Bottle</td>
</tr>
<tr>
<td>Icecream</td>
<td>o Plastic Container</td>
</tr>
<tr>
<td></td>
<td>o Cartons board</td>
</tr>
<tr>
<td></td>
<td>o Laminate</td>
</tr>
<tr>
<td>Paneer</td>
<td>o Laminated Poly Pack</td>
</tr>
<tr>
<td></td>
<td>o Tin Container</td>
</tr>
</tbody>
</table>
Activity 3

1. The utensils and the storage vessels should be of _________ material of construction and free from__________.

2. Raw milk is collected daily from a producer, and it shall be cooled immediately to the _________temperature
   a. 4-6°C  b. 7-8°C  c. 1-2°C  d. 8-10°C

3. Rinsing with an appropriate acid solution is required to remove inorganic soils.
   ☐ True ☐ False

4. 2-stage Bactofugation can remove _________bacterial spores and _________bacteria from milk.

5. Effective cleaning of crates before transport of milk pouches at Dairy plant level decreases contamination.
   ☐ True ☐ False
PART IV

CLEANING & SANITATION

And

EQUIPMENT MAINTENANCE

- Cleaning & Sanitation
- Food Soils & their removal
- Cleaning-In-Place (CIP)
- Sanitation/Disinfection
- Checks for Cleaning Efficiency
- Hygiene station
- Equipment Maintenance
- Instrumentation in Dairy Sector
4 Cleaning & Sanitation and Equipment Maintenance

4.1 Cleaning and sanitation

Milk is a perfect media for growth of microorganisms at ambient conditions and gets easily contaminated once it comes in contact with uncleaned equipment and vessels. It is, therefore, essential to clean & sanitize the equipment in which milk is held during processing.

There are different methods for cleaning:

- Manual
- Semi-automatic
- Automatic

Before we deliberate further it will be prudent to understand some of the basic terms commonly used in Cleaning & Sanitation.

4.1.1 Some of the definitions regarding Cleaning & Sanitation:

- **Soil:** Primarily milk/milk product residues, may be more or less modified by processing treatment or by interaction with water or cleaning materials previously used, or by dust, dirt or other foreign matters

- **Cleaning / Washing:** Process of removal of soil from the surface of equipment

- **Sanitization:** Destruction of all pathogenic and almost all non-pathogenic microorganisms from equipment surface

- **Detergent:** A substance or mixture of substances, which when added to water helps to remove dirt and grease

- **Sanitizer:** Any chemical/hot water/steam used for sanitization or disinfection capable of 100% destruction of pathogens

4.1.2 Food Soil and their removal

<table>
<thead>
<tr>
<th>Components on Surface</th>
<th>Solubility</th>
<th>Ease of Removal</th>
<th>Change on Heating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar</td>
<td>Water and Acid Soluble</td>
<td>Easy</td>
<td>Caramelization more difficult to clean</td>
</tr>
<tr>
<td>Fat</td>
<td>Water in-soluble, alkali soluble</td>
<td>Difficult</td>
<td>Polymerization – more difficult to clean</td>
</tr>
<tr>
<td>Protein</td>
<td>Water insoluble, alkali soluble, slightly acid-soluble</td>
<td>Very Difficult</td>
<td>Denaturation – much more difficult to clean</td>
</tr>
<tr>
<td>Mineral Salts</td>
<td>Variable Water solubility, mostly acid soluble</td>
<td>Easy to difficult</td>
<td>Generally easy to clean</td>
</tr>
</tbody>
</table>
4.2 Cleaning In Place (CIP)

CIP is the cleaning of Dairy plants without dismantling equipment/pipes and without altering the production process configuration.

There are two types of CIP:

a. Manual
b. Automatic

Cleaning solution contacts all of the production food-contact surfaces by:

– Spraying on vessel surfaces
– Recirculation through pipes and flooded equipment

**CIP reduces cleaning costs by controlling the consumption of:**

![Cleaning chemicals](image)

![Time](image)

The *cleaning result* is considered constant. since anything less than completely clean is unacceptable
Modern CIP units are designed to effectively clean and quickly sanitize the equipment and minimize production downtime.

**4.2.1 Advantages of CIP**

- CIP assures the repeatable application of all cleaning and disinfecting parameters (time, temperature, detergent, and mechanical action), thus saving of cost and time.
- Increased economy in use of cleaning detergents, which helps in cutting the operational costs.
- Automated systems clean better than manual systems due to their consistency.
- Automated cleaning increases the level of equipment/storage space utilization.
- CIP systems enhance safety at the processing plant since people do not come into direct contact with the cleaning detergents.
- Enhanced efficiency will definitely improve productivity at the plant. There will be efficient use of water and detergents.

**4.2.2 Manual CIP vs Automatic CIP**

Manual CIP depends on the knowledge, skill, training, and dedication of the operator and hence can be inconsistent.
4.2.3 Designing of CIP Cycle

Dairy CIP programs differ according to whether the circuit to be cleaned contains heated surfaces or not. We distinguish between:

- CIP programs for circuits with pasteurisers and other equipment with heated surfaces (UHT, Condensing plant etc.).
- CIP programs for circuits with pipe systems, tanks and other process equipment with no heated surfaces

The main difference between the two types is that acid circulation must always be included in the first type (heated surfaces) to remove encrusted protein and salts from the surfaces of heat-treatment equipment.

4.2.3.1 A CIP program for a pasteuriser, "hot components", circuit can consist of the following stages:

- Rinsing with warm water – 10 Mins
- Circulation of an alkaline detergent solution (0.5-1.5%) – 30 Mins at 75°C
- Rinsing out alkaline detergent with warm water – 5 Mins
- Circulation of (nitric) acid solution (0.5 – 1.0 %) – 20 Mins at 65-70°C
- Rinse with warm water
- In Some Plant, Low strength caustic solution (0.3-0.5 %) (for neutralizing acid solution in pipe lines)
- Final Rinse with Warm Water
Note:

- The pasteuriser is usually disinfected in the morning, before production starts. This is done by circulating hot water at 90 – 95°C for 10 – 15 minutes after the returning temperature is at least 85°C.
- CIP is repeated depending on the reduction in flow-rate due to formation of soil.

4.2.3.2 A CIP program for a circuit with pipes, tanks and other “cold components” can comprise the following stages:

- Rinsing with warm water for 3 minutes.
- Circulation of a 0.5 – 1.5% alkaline detergent at 75°C - 10 minutes.
- Rinsing with warm water - 3 minutes.
- Disinfection with hot water 90 – 95°C - 5 minutes.

4.2.4 Design of CIP systems

In practice, there is no limitation to satisfy stringent individual demands as to the size and complexity of CIP plants. The CIP station in a Dairy consists of all necessary equipment for storage, monitoring and distribution of cleaning fluids to the various CIP circuits.

The exact design of the station is determined by many factors, such as:

- How many individual CIP circuits are to be served from the station? How many are “hot” and how many are “cold”?  
- Are the milk rinses to be collected? Are they to be processed?  
- What method of disinfection is to be used? Chemical, steam or hot water?  
- Will the detergent solutions be used only once or recovered for reuse?  
- What is the estimated steam demand, momentary and total, for cleaning and sterilisation?

Looking back over the history of CIP, we find two schools of thought:

1) Centralised cleaning

2) Decentralised cleaning
Until the end of the fifties, cleaning was decentralised. The cleaning equipment was located in the Dairy, close to the process equipment. Detergents were mixed by hand to the required concentration – an unpleasant and hazardous procedure for the personnel involved. Detergent consumption was high, which made cleaning expensive.

The centralised CIP system was developed during the sixties and seventies. A central CIP station was installed in the Dairy. Rinsing water, heated detergent solutions and hot water were supplied from this unit by a network of pipes to all the CIP circuits in the Dairy. The used solutions were then pumped back to the central station, and from there to the respective collecting tanks. Detergents recovered in this way could be topped up to the correct concentration and reused until they were too dirty and had to be discarded.

Note:

Centralised CIP works well in many Dairies, but in large Dairies, the communication lines between the central CIP station and the peripheral CIP circuits have grown excessively long. The CIP pipe systems contain large volumes of liquids, even when they are “drained”. The water remaining in the pipes after pre-rinsing dilutes the detergent solution, which means that large amounts of concentrated detergent must be added to maintain the correct concentration. The greater the distance, the greater the cleaning cost. A move back towards decentralised CIP stations therefore began in large Dairies at the end of the seventies. Each department had its own CIP station.

### 4.2.4.1 Tanker Cleaning

Tankers are cleaned every day, as a rule at the end of a collection round. If the tanker makes several rounds a day, cleaning should take place after each round. Cleaning can be carried out by connecting the tanker to a cleaning system while in the reception area or by driving it to a special cleaning station.

The CIP steps for tanker cleaning are as under:

1) Rinse with normal water for 2 mins
2) Caustic solution (0.5-0.8%) circulation for 5 mins
3) Final Rinse with normal water for 5 mins

<table>
<thead>
<tr>
<th>Decentralised cleaning</th>
<th>Centralised cleaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Until the end of the fifties, cleaning was decentralised</td>
<td>The centralised CIP system was developed during the sixties and seventies.</td>
</tr>
<tr>
<td>The cleaning equipment was located in the Dairy, close to the process equipment</td>
<td>A central CIP station was installed in the Dairy.</td>
</tr>
<tr>
<td>Detergents were mixed by hand to the required concentration – an unpleasant and hazardous procedure for the personnel involved.</td>
<td>Rinsing water, heated detergent solutions and hot water were supplied from this unit by a network of pipes to all the CIP circuits in the Dairy.</td>
</tr>
<tr>
<td>Detergent consumption was high, which made cleaning expensive.</td>
<td>The used solutions were then pumped back to the central station, and from there to the respective collecting tanks.</td>
</tr>
<tr>
<td>Detergents recovered in this way could be topped up to the correct concentration and reused until they were too dirty and had to be discarded.</td>
<td></td>
</tr>
</tbody>
</table>

**Fig. 4.3 Milk Tanker**
4.3 Sanitation/Disinfection

Why is Sanitation necessary?

- Cleaning may not be 100% effective.
- Microorganisms remain on surfaces after cleaning.
- Some of these organisms may be pathogens or spoilage organisms.

4.3.1 Effective sanitation depends on

- Concentration
- Temperature
- Contact time
- Degree of soiling
- Water hardness
- pH
4.3.2 Types of Sanitation/Disinfection

4.3.2.1 Chemical sanitation kills by affecting the metabolism and/or structure of the microorganism.

e.g.

1. Proteins oxidised by hypochlorites and peracids.

2. Disruption of active transport across the cell membrane by quaternary ammonium compounds and amphoterics.

There are number of Sanitizers available but factors that affect choice of sanitizer are as follows:

<table>
<thead>
<tr>
<th>Sanitizers</th>
<th>Factors affecting Sanitizer choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorine (Hypochlorite)</td>
<td>Microbiological performance required</td>
</tr>
<tr>
<td>Quaternary Ammonium Compounds (QAC’s)</td>
<td>Manual or C.I.P. System</td>
</tr>
<tr>
<td>Peracetic acid</td>
<td>Production Plant</td>
</tr>
<tr>
<td>Amphoterics</td>
<td>Toxicity</td>
</tr>
<tr>
<td>Aldehydes</td>
<td>Effect on product</td>
</tr>
<tr>
<td>Alcohol</td>
<td>Health and Safety</td>
</tr>
<tr>
<td>Chlorine Dioxide</td>
<td>Temperature</td>
</tr>
<tr>
<td>Iodophor</td>
<td>Foam characteristics</td>
</tr>
<tr>
<td>Phenolics</td>
<td>Time available for sanitation</td>
</tr>
<tr>
<td>Biguanide</td>
<td>Water hardness</td>
</tr>
<tr>
<td>Preservatives</td>
<td>Storage</td>
</tr>
<tr>
<td>Bacteriocines</td>
<td>Cost</td>
</tr>
<tr>
<td></td>
<td>Concentration</td>
</tr>
<tr>
<td></td>
<td>Residues</td>
</tr>
</tbody>
</table>
4.3.2.2 Summary of Sanitizers Activity

<table>
<thead>
<tr>
<th>Type of Disinfectant</th>
<th>Gram +ve bacteria</th>
<th>Gram -ve bacteria</th>
<th>Mycobacteria (e.g., Tuberculosis)</th>
<th>Pseudomonas species</th>
<th>Yeasts</th>
<th>Mould</th>
<th>Spores</th>
<th>Viruses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Halogens (e.g., Chlorine, Iodine, Chlorine Dioxide)</td>
<td>+ +</td>
<td>+ +</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+ / +</td>
</tr>
</tbody>
</table>
| Q.A.C. | + | + | | + | + | + | + | | /
| Q.A.C. + chelator | + | + | | + | + | + | + | | / -
| Peroxidating acids | + | + | | + | + | + | + | | + | -
| Amphoterics | + | + | | + | + | + | + | | + | -
| Amphoterics + chelator | + | + | | + | + | + | + | | + | -
| Aldehydes | + | + | | + | + | + | + | | + | +
| Alcohols (60–70%) | + | + | | + | + | + | + | | + | +
| Phenolics | + | + | | + | + | + | + | | + | +
| Acid Biguanides | + | + | | + | + | + | + | | + | + / + |

+ += Good Activity  
+ / - = Limited & Selective Activity  
+ = Moderate Activity  
- = No Practical Activity

4.3.2.3 Summary of Sanitizers Properties

<table>
<thead>
<tr>
<th>Disinfectant Type</th>
<th>Possibility of Taint</th>
<th>Relative Toxicity</th>
<th>Corrosion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypochlorite</td>
<td>MEDIUM</td>
<td>MEDIUM</td>
<td>MEDIUM / HIGH</td>
</tr>
<tr>
<td>Q.A.C.</td>
<td>LOW</td>
<td>LOW</td>
<td>LOW</td>
</tr>
<tr>
<td>Peroxidating acid</td>
<td>LOW</td>
<td>LOW</td>
<td>LOW / MEDIUM</td>
</tr>
<tr>
<td>Amphoterics</td>
<td>LOW</td>
<td>LOW</td>
<td>LOW</td>
</tr>
<tr>
<td>Iodophor</td>
<td>MEDIUM / HIGH</td>
<td>MEDIUM / HIGH</td>
<td>MEDIUM / HIGH</td>
</tr>
<tr>
<td>Biguanide</td>
<td>LOW</td>
<td>LOW</td>
<td>LOW</td>
</tr>
</tbody>
</table>

4.4 Checks for Cleaning Efficiency

1) **Swab test**


2) **Rinse test**
3) ATP Bioluminescence technique

Adenosine Triphosphate, or ATP, is the energy molecule found in all living cells making it a perfect indicator when trying to determine if a surface is clean or not.

Food processors use ATP systems to rapidly verify surfaces have been cleaned thoroughly so that new product runs are not contaminated by prior product runs, and to ensure biofilms are not developing on the surface that could affect quality.

4.5 Hygiene station for monitoring hygiene for workforce

Hygiene station is designed for the controlled passage of the workforce in and out of the work environment.

Hygiene station combines functions of hand and sole disinfection at the entry and sole cleaning at the exit from the work environment.
4.6 Equipment Maintenance

Maintenance plays very important role for getting optimal efficiency of machine in Dairy plant.

There are three types of maintenance:

- Corrective/Break-down maintenance
- Preventive maintenance
- Predictive maintenance

This type of Hygiene station is designed for larger production plants.

This double lane station enables the passage, in both the entry and exit direction.
<table>
<thead>
<tr>
<th>Corrective/ Break-down maintenance</th>
<th>Preventive maintenance</th>
<th>Predictive maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance of equipment after equipment break down or malfunction is often most Expensive</td>
<td>Maintenance performed with the intent of avoiding failures, safety violations, unnecessary production losses, and to conserve original materials of fabrication</td>
<td>Advances in sensing and computing technology have given rise to ‘predictive maintenance’</td>
</tr>
<tr>
<td>The worn out equipment part can damage other parts and lead to multiple damage and increase repair/replacement costs.</td>
<td>The effectiveness of a preventive maintenance schedule depends on the Root Cause Analysis</td>
<td>It uses sensors to monitor key parameters within a machine or system and uses this data in conjunction with analysed historical trends to continuously evaluate the system health and predict a breakdown before it happens e.g. on-line monitoring of bowl speed, motor current, flow-rate etc. during operation of Clarifier / Cream separator / Bacteria removing clarifier.</td>
</tr>
<tr>
<td>Higher Machine downtime and Production loss</td>
<td>The history sheet maintained also helps in early detection of problems and increased equipment life.</td>
<td>The continuous temperature monitoring of say bearings or internal motor / transformer windings would enable the operator to take appropriate action even before the equipment is due for preventive maintenance.</td>
</tr>
</tbody>
</table>

### 4.6.1 List of processing plant equipment are as follows:

- Chiller
- Clarifier
- Milk Pasteurizer
- Bactria Removing Clarifier
- Cream Separator
- On-Line Milk Standardization Unit
- Cream Pasteurizer
- Homogenizer
- Valves & Pumps

#### 4.6.1.1 Pasteurizer maintenance

- Periodic inspection of Pasteurizer for leakages and opening of Pasteurizer once in 6 months/1 Year.
- Checking of rubber gaskets i.e. corner gasket, channel plate gasket and end plate gasket when the Pasteurizer is opened every six months/year. In case leakages are observed before six months, it needs to be checked immediately.
- Checking of pin holes in PHE plates, block and tie-rod after every 10 years of interval.
4.6.1.2 Self-desludging Clarifier / Cream Separator / Bacteria Removing Clarifier

Two types of maintenance are required

i) Intermediate maintenance- after every 2000 hour of machine run for parts above bowl and oil change in gear box

ii) Major maintenance- after every 8000 hour of machine run in which all parts i.e mechanical seals, bearings, O-rings and gaskets have to be changed

4.6.1.3 Homogenizer maintenance

<table>
<thead>
<tr>
<th>Homogenizer</th>
<th>1</th>
<th>Homogenizing head</th>
<th>Valve Seat</th>
<th>Quarterly</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Forcer</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Impact Ring</td>
<td></td>
</tr>
<tr>
<td>2 Oil Changing</td>
<td>After 5000 running hours</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.6.1.4 Valves maintenance

Sanitary Remote Butterfly Valve/Sanitary Remote Seat Valve/ Sanitary Mix proof Valve

<table>
<thead>
<tr>
<th>Sanitary Remote Butterfly Valve</th>
<th>Maintenance of Valves</th>
<th>Two Years</th>
<th>Service Kit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Changing of Valve seat</td>
<td></td>
<td>Valve Seat</td>
</tr>
<tr>
<td></td>
<td>Changing of Air pipe</td>
<td></td>
<td>PU Air Pipe</td>
</tr>
<tr>
<td></td>
<td>Maintenance of Control Unit</td>
<td></td>
<td>Solenoid Valve</td>
</tr>
</tbody>
</table>

4.7 Instrumentation in Dairy sector

In the modern Dairies, considering the complex operations and scale of production, automation is unavoidable and inevitable. The basic dictum is if we can measure, we can control. The first step is, therefore, to measure the field parameters and then cross-check with standard values /parameters. The controlling and integration into the automation system comes thereafter.

Fig: Multi-parameter measurement, i.e. mass, temperature, density and viscosity
For measurements to be accurate, high precision instruments should be used. The instruments should also measure and provide accurate readings throughout its lifecycle. This requires calibration of the instruments at regular intervals. Why is Validation & Calibration necessary?

4.7.1 Validation It ensures that the instrument works correctly and provides accurate and reliable data/results.

4.7.2 Calibration Ensures on an on-going basis that the instrument is performing accurately.

The word calibration is defined as “a test during which known values of measured and are applied to the transducer and corresponding output readings are recorded under specified conditions.” The definition includes the capability to adjust the instrument to zero and to set the desired span.

Calibration is a comparison of measuring equipment against a standard instrument of higher accuracy to detect, correlate, adjust, rectify & document accuracy of instrument being compared.

Rugged system must be in place to ensure that all instruments are calibrated.

The instruments, which are generally used in the dairy plant, are listed as under with their calibration schedule:

<table>
<thead>
<tr>
<th>Instrument</th>
<th>Calibration Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature sensor</td>
<td>CCP temperature sensor- Quarterly</td>
</tr>
<tr>
<td></td>
<td>CP temperature sensor- Once in sixth month</td>
</tr>
<tr>
<td></td>
<td>General temperature sensor- Yearly</td>
</tr>
<tr>
<td>Level indicator / transmitter</td>
<td>Yearly</td>
</tr>
<tr>
<td>Pressure gauge / transmitter</td>
<td>Yearly</td>
</tr>
<tr>
<td>Vortex and Mass Flow meter</td>
<td>Yearly</td>
</tr>
<tr>
<td>Conductivity meter</td>
<td>Yearly</td>
</tr>
<tr>
<td>Turbidity meter</td>
<td>Yearly</td>
</tr>
<tr>
<td>Load cells</td>
<td>Yearly</td>
</tr>
</tbody>
</table>
Activity 4

1. Important parameters for effective CIP are:
   a. __________  b. __________
   c. __________  d. __________

2. CIP systems enhance __________ at the processing plant since people do not come into direct contact with the cleaning detergents.

3. What is the Strength of alkaline detergent solution for CIP of Pasteurizer?

4. Effective sanitation depends on
   a. Temperature  b. Degree of Soiling
   c. Water Hardness  d. All of These

5. Calibration ensures on an on-going basis that the instrument is performing accurately  True  False
PART-V
PERSONAL HYGIENE

➢ Health status, Behavioural & Personal cleanliness of Plant operators & Visitors

➢ Safety Systems for Dairy industry
5. PERSONAL HYGIENE

5.1 Health Status

Personnel known, or believed, to be suffering from, or to be a carrier of a disease or illness likely to transmitted through food, shall not be allowed to enter into any food handling area.

The Food Business shall develop system, whereby any person so affected, shall immediately report illness or symptoms of illness to the management and medical examination of a food handler shall be carried out apart from the periodic check-ups, if clinically or epidemiologically indicated.

Arrangements shall be made to get the food handlers / employees of the establishment medically examined once in a year to ensure that they are free from any infectious, contagious and other communicable diseases.

A record of these examinations signed by a registered medical practitioner shall be maintained for inspection purpose.

The factory staff shall be compulsorily inoculated against the enteric group of diseases as per recommended schedule of the vaccine and a record shall be kept for inspection.

In case of an epidemic, all workers are to be vaccinated irrespective of the scheduled vaccination.

The Food Business Operator shall employ those persons only in such an establishment to work directly with and handle raw materials or Dairy products if those persons have proved to the occupier's satisfaction by means of a medical certificate, on recruitment, that there is no medical impediment to their employment in that capacity.
SAFE & NUTRITIOUS FOOD HANDBOOK FOR DAIRY SECTOR

An illustrative Performa is shown below and it can be downloaded from www.fssai.gov.in

---

**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.

---

5.2 **Behavioural & personal cleanliness**

5.2.1 **Behavioural Hygiene Requirement**

Persons working directly with and handling milk & milk products shall maintain the highest standards of personal cleanliness at all times. In particular, they shall

- Avoid certain hand habits - e.g. scratching nose, running finger through hair, rubbing eyes, ears and mouth, scratching beard, scratching parts of bodies etc. that are potentially hazardous when associated with handling Dairy products, and might lead to food contamination through the transfer of bacteria from the employee to product during its preparation. When unavoidable, hands should be effectively washed and sanitized before resuming work after such actions.

- Food handlers engaged in food handling activities shall refrain from smoking, spitting, chewing, sneezing or coughing over any food whether protected or unprotected and eating in food preparation and food service areas.

- The food handlers should trim their nails and hair periodically, do not encourage or practice unhygienic habits while handling food.
A. General Hygiene practices for food handlers

Food handlers should **NOT EAT OR TASTE FOOD** in food handling area

Food handlers should **NOT EAT CHEWING GUM OR PAN MASALA** in food handling area

Staff with cough and sneezes must **NOT HANDLE FOOD**, alternatively must wear a face mask

**SPITTING** is prohibited in food handling area

**DO NOT SMOKE**

B. Good Behavioural Practices for food handler

Food handlers shall avoid certain hand habits such as scratching nose, running finger through hair, rubbing eyes, ears and mouth, scratching beard, scratching parts of bodies etc.
5.2.2 PERSONAL CLEANLINESS

Food handlers shall maintain a high degree of personal cleanliness. The food business shall provide to all food handlers adequate and suitable clean protective clothing, head covering, face mask, gloves and footwear and the food business shall ensure that the food handlers at work wear only clean protective clothes, head covering and footwear every day.

Food handlers shall always wash their hands with soap and clean potable water, disinfect their hands and then dry with hand drier or clean cloth towel or disposable paper at the beginning of food handling activities immediately after handling raw food or any contaminated material, tools, equipment or work surface, where this could result in contamination of other food items or after using the toilet.

Cover wounds to the skin with a suitable waterproof dressing. No person with injury on hand, even with dressing, shall be placed in any product making/handling section.
A. Hand Washing Step

B. How to wash hand
C. When to wash your hands
D. Basic Requirements for Personal Hygiene

Do (क्या करें)
- Hair should be properly tucked inside the cap
- No earrings or necklace/chains
- No outer pockets
- Wear neat and clean clothes
- No wrist watch/rings
- Cover all wounds
- Nails should be short and clean
- Torn clothes should be repaired or replaced
- Wear clogs and safety shoes

Don't (क्या न करें)
- Hair coming outside the cap
- Earring and necklace/Chains
- Outer pockets and contents
- Dirty clothes
- Wrist watch/Rings
- Open and bleeding wounds
- Long and painted nails
- Torn clothes
- Bare feet/slippers
5.3 Visitors

- Generally, visitors should be avoided from going inside the food handling areas. Proper care has to be taken to ensure that food safety & hygiene is not being compromised due to visitors in the floor area.

- The Food Business shall ensure that visitors to its food manufacturing, storage or handling areas must wherever appropriate, wear protective clothing, footwear and adhere to the other personal hygiene provisions envisaged in this section.

5.4 HEALTH AND SAFETY POLICY

5.4.1 Health and safety policy is mandatory for all industries. Safety policy of Dairy industry is as follows:

- To provide a safe work environment for all employees working in Dairy premises.
- To provide the same safe and healthful environment for the company visitors.
- Safety policy shall be a cooperative effort between labour and management in order to prevent hazards, work related causes and minimize losses of property damage.
- The safety policy should have the first of management level. The occupier shall prepare as often as may be appropriate, revise a written statement of his general policy in respect of Health & Safety of workers.
Policy should contain:

✓ Assigning work responsibility related to particular safety hazard to each level in the unit
✓ Arrangement for involving the workers at different work of health and safety issues
✓ Relevant techniques and method (such as safety audits and risk assessment) for periodical interval at least once in every two years on the status of Dairy employees health and safety
✓ Arrangements for informing, educating and retraining own employees at different levels and the visitor

5.4.2 Safety systems for Dairy industry

Dairy industry involves several hazards. To handle these hazardous environments following safety systems are very essential:

A. Fire fighting systems:
✓ Fire hydrant
✓ Fire Extinguishers for different types of Fires- A, B, C or combination
✓ Fire Sand Buckets
✓ Sprinkler systems

B. Emergency alerting system
✓ Smoke Detectors of optical and heat sensing type
✓ Ammonia Detector

C. Emergency Declaring systems
✓ Emergency Siren
✓ Manual Call Points

D. Emergency Indicating systems - Cold room bells

E. Escape routes

F. Assembly point

G. Wind sack

H. First Aid systems
✓ Ambu bag
✓ First Aid box

I. Personal Protective Equipment’s (PPEs)

J. Emergency Control Room

The Appropriate personal protective equipment are very essential for a Dairy industry.
✓ Safety helmets
✓ Goggles
✓ Ear muffs
✓ Ear plugs
✓ Ammonia half Face mask
✓ Self-Confined Breathing Apparatus
✓ Gloves
✓ Gum boots / shoes
✓ Aprons
✓ Safety belts
✓ Supplied Air Line Mask
5.4.3 Health and Safety Training

- Need of health and safety standards training of Dairy employees to work safely and without risks to health:
  - Develop a health and safety standards
  - Emergency plans after the incident of Bhopal gas disaster, the Factories Act 1948 has been amended and a new chapter. Preparation of On-site Emergency Plan by the occupier is mandatory. The occupier shall ensure a mock drill of the onsite emergency plan is conducted at least one in every six months.

- Identification of possible emergency situations in Dairy industry
  - The following emergency situations might be arise in the Dairy industry
    a. Ammonia leakage
    b. Fire in Raw Material Stock Yard (Viz. Coal, PNG, LPG, and Furnace oil etc.)
    c. Powder burning in Spray dryer
    d. Explosion in boiler

- Teams
  - The following teams comprising members ranging from two in each have been nominated to discharge duties assigned to them.
    a. Fire Fighting Team - to extinguish the fire
    b. Repair & Task force Team – to keep rest of the plant in safe condition
    c. Transport Team - to arrange transport for casualties
    d. Medical Team - to arrange for aid, stretches, medicines
    e. Safety Team - to arrange required safety equipment
    f. Evacuation Team - to rescue the casualties on priority basis.
Activity 5

1. Medical examination of the employees must be conducted __________ to ensure that they are free from any infectious, contagious and other communicable diseases.
   a. Half Yearly  
   b. Once in a Year  
   c. Once in a 2 Year  
   d. Once at the time of employment

2. Write any four good behavioural practices for Milk Handler in Dairy industry
   a. __________  
   b. __________  
   c. __________  
   d. __________

3. Food handlers shall maintain a high degree of personal cleanliness
   [ ] True   [ ] False

4. Visitors shall adhere to the personal hygiene provisions as mandate for food handlers
   [ ] True   [ ] False

5. All food handlers shall wear suitable clean protective clothing, head covering, facemask, gloves and footwear.
   [ ] True   [ ] False
PART-VI

MILK & MILK PRODUCTS TRANSPORTATION, STORAGE & DISTRIBUTION
6. Milk & Milk Products Transportation, Storage and Distribution

6.1 Storage & Transportation –

- The vehicles used to transport milk and milk products must be maintained in good condition and kept clean. Ensure that as much as possible the required temperature shall be maintained throughout the supply chain from the place of procurement or sourcing till it reaches the end consumer including chilling, transportation, storage etc.

- The cans/containers made up of mild steel metal and plastic material used for storage and transportation of milk and milk products shall not be allowed.

- Immediately after packaging the Dairy products shall be placed in designated rooms provided for storage under required temperature.

- Dairy products other than raw milk are stored under cooled conditions, their storage temperatures shall be registered and the cooling rate shall be such that the products reach the required temperature as quickly as possible.

- The maximum temperature at which pasteurized milk may be stored until it leaves the Dairy plant shall not exceed 5°C and must be transported in insulated vans.

![Fig: 6.1 Road Tanker](image)
• Milk and milk products while in transport in packaged form or in containers shall maintain the required temperature.

• Whenever frozen food / raw materials are being used / handled / transported, proper care should be taken so that defrosted / thawed material are not stored back after opening for future use.

• All critical links in the supply chain need to be identified and provided 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.

• Temperatures and humidity which are necessary for sustaining food safety and quality shall be maintained.

• The conveyance and /or containers shall be designed, constructed and maintained in such manner that they can effectively maintain the requisite temperature, humidity, atmosphere and other conditions necessary to protect food conveyances and / or containers used for transporting / serving foodstuffs shall be nontoxic, kept clean and maintained in good condition in order to protect Dairy Products from any contamination.

• Receptacles in vehicles and / or containers shall not be used for transporting anything other than Dairy products where this may result in contamination.
• Same conveyance or container is used for transportation of different Milk and Milk Products or high risk foods, effective cleaning and disinfections shall be carried out between loads to avoid the risk of cross-contamination.

• For bulk transport of food, containers and conveyances shall be designated and marked for food use only and be used only for that purpose.

6.2 GPS (Global Positioning System) for Monitoring of Tanker moment/Refrigerated Vans

90% of the milk produced in India is collected from individual farmers by milk collection centre. Collected milk is then transported to a nearby chilling centre/Dairy Plant owned by a specific Milk Union, if milk is received through Bulk Milk Cooler.

From processing and product manufacturing plant, packaged milk and milk products are then transported to Sales office/Regions in Insulated/Refrigerated Trucks. Again, at Sales Office/Region Milk is then distributed to the different route in the region in smaller trucks or autos to milk sales agents. On top of intensive transportation operations, timing and efficiency very important for a Dairy for effective sales and customer service.

Any discrepancy in the transportation operation will cost Dairies a lot and also their reputation in the market will be at stake. Most of the Dairies will operate by outsourcing entire or part of the transportation vehicles so that they can concentrate on their core business than to worry about fleet management. So to avoid any discrepancy during transportation of milk and milk products, GPS System helps in effective and controlled transportation.

6.2.1 GPS will give Alert when Tanker/Van:

• Reached to destination
• Divert from route
• Tanker Stoppage more than specified time on unidentified location
• Over speed
• Device tempered/ power cable disconnected
• Engine On/off alert
• Tanker out of service alert
• Tanker not update from last one hour
6.2.2 Benefits of GPS System

1. Track the location of theft and tempering activity
2. Continuous monitoring of milk tanker while it is in transit so that one can monitor the route which milk tanker is following
3. Accurate planning of product manufacturing
4. Prevention of adulteration in milk and hence maintains the quality of milk
5. Automation in data collection and accurate data of milk procurement
6. Saving the cost of milk theft and adulteration
Activity 6

1. Which type of cans/containers shall not be allowed to use for storage and Transportation of milk and milk products
   a. mild steel metal
   b. plastic crates
   c. plastic material
   d. both a and c

2. The maximum temperature for storing pasteurized milk until it leaves the Dairy plant shall not exceed __________°C

3. Food Safety and quality of milk can be maintained by temperature and Humidity
   [ ] True  [ ] False

4. Write four benefits of using GPS (Global Positioning System) in dairy industry.
   a._____________________
   b._____________________
   c._____________________
   d._____________________
PART-VII

MANAGEMENT & SUPERVISION

- Standard Operating Procedure (SOP)
- Cold Chain Management
- Supply chain of Indian Dairy Industry
7. Management and Supervision

7.1 Standard Operating Procedure

A detailed Standard Operating Procedure (SOP) for the processing of food as well as its packaging, despatch and storage will be developed. A standard operating procedure, or SOP, is a living document showing technical instructions of how to perform a routine or repetitive task.

SOP aim to achieve efficiency, quality output and uniformity of performance, while reducing miscommunication and failure to comply with establishment requirements. The SOP should be based on 5W’s & 1H (i.e. why, when, what, where, who & how)

A good standard operating procedure –

- Should provide all information necessary to perform a task
- Should usually specific to the equipment used for the procedure
- Should be meticulous
- Should be standalone
- Should provide quality information
- Should provide references

The technical managers and supervisors shall have appropriate qualifications, knowledge and skills on food hygiene principles and practices.

Condition of FSSAI license – The Food Business Operator shall employ at least one Technical person to supervise the production process.

Technical Qualification of the supervisor - at least a degree in science with Chemistry/ Bio-chemistry/ Food and nutrition/ Microbiology or a degree or diploma in Food Technology/ Dairy Technology/ Dairy Microbiology/ Dairy chemistry/ Dairy engineering or any degree or diploma in any other discipline related to the specific requirement of the business from a recognized university or institute or equivalent.

7.2 Supply chain of Indian Dairy Industry

- Supply of inputs for Dairying in form of fodder, cattle feed plant, veterinary aids for the cattle.
- Milk is taken out from the healthy milch animal on the daily basis by the Dairy farmers (large, medium and small scale farmers).
- Collection of milk by collection centres (various milk collection centre and milk cooperatives societies).
- Milk collected by the cooperative societies/Milk Collection Centre are sent to the Dairy plants where chilling of milk, processing and packaging of milk and milk products.
- The transportation of chilled/frozen milk and milk products from one place to another is done through the means of refrigerated vans, or insulated milk tankers/vans.
Milk and milk products are transported to various retail outlets, supermarkets, and to retail markets from where the processed milk and milk products finally reach to their end consumers.

### 7.3 Cold Chain Management

Cold chain is a logistic system that provides a series of facilities for maintaining ideal storage conditions for perishables from the point of origin to the point of consumption.

The cold chain market can be divided into two types mainly:

a. Refrigerated storage  
b. Refrigerated transport

The products and industries that rely on effective and efficient cold chain management include fresh fruits and vegetables, bakery and confectionery, chemicals and pharmaceuticals, dairy and frozen desserts, and fresh meats, fish, and seafood.

The ultimate goal for cold chain management is to deliver perishable Milk and Milk Products in a timely fashion while maintaining the quality of the products and increasing their shelf life.

#### 7.3.1 Important aspects of Cold chain management in Dairy

- It extends and ensures the shelf life of Milk and Milk Products  
- Retains the longevity of Milk products characteristics, active ingredients, freshness, nutritive value
Major infrastructure components of cold chain supply management:

- Refrigerated storage facilities
- Refrigerated transport options
- Packaging
- Information System
Activity 7

1. Good standard operating procedure
   a. Should provide all information necessary to perform a task
   b. Should usually specific to the equipment used for the procedure
   c. Should be meticulous
   d. All the above

2. The Food Business Operator shall employ at least ____________ Technical person to supervise the production process

3. The cold chain market can be divided into two types, one is Refrigerated Storage and the other is Refrigerated transport
   True □    False □

4. Important aspects of Cold chain management For the shelf life of Milk and Milk Products and Retaining the longevity of Milk products, what are the characteristics require
   a. Active ingredients, freshness
   b. Nutritive value
   c. Both a and b
   d. Only a
PART-VIII
MILK & MILK PRODUCTS TESTING

➢ Sampling
➢ Quality Testing Parameters
➢ Microbiological standards for Milk & Milk Products
➢ Safety Testing Parameters
8. Milk and Milk Product Testing

All products manufactured by Dairy must comply with the legal standard and should be acceptable by the consumers. The product must be safe for the consumers and comply FSSAI, BIS and AGMARK standards.

In laboratory all the raw material, ingredients, products in progress, finished products are tested for their physical as well as chemical & microbiological requirements. Packaging material is also tested for required strength & leakage and graded accordingly.

**Manual for analysis of Milk and Milk products published by FSSAI is available on website as under:**

http://old.fssai.gov.in/Portals/0/Pdf/Draft_Manuals/MILK_AND_MILK_PRODUCTS.pdf

8.1 Equipment for Rapid analysis of Milk and Milk Products

**A. Milk Analyser:**

![Milk Analyser](image1)

For analysis of Fat, Protein, Lactose, TS, SNF, Total Acidity, Density, FFA, Casein, and adulterants

**B. Rapid Bacteria Counting Machine for Raw milk:**

![Rapid Bacteria Counting Machine](image2)

Analyse the individual bacterial count in raw milk for checking microbiological quality of Milk handled at Farmer and Dairy Cooperative Society/Milk Collection Centre.

Modern Dairies are also providing extra incentive for pouring low bacterial count milk to Dairy to encourage clean milk production.
C. Rapid Somatic Cell Counter for Raw Milk

Count somatic cells in to milk, which gives the indication of mastitis disease in animal.

D. Butter/Cheese/Paneer Analyser

Accurately measures different parameters i.e. Fat, Moisture, Salt, TS, SNF.

E. Milk Powder Analyser

Accurately measures variety of parameters i.e. Moisture, Fat, Protein, Lactose, Acidity, Ash, Sucrose

Note:

The above shown equipment is for rapid analysis, still these equipment needs to be calibrated and results must be compared with results of conventional method of testing.
### 8.2 Safety Parameters for Contaminants

It is provided under the conditions of license as per FSSR licensing and registration regulations that every FBO shall ensure that his food product is tested for relevant chemical and microbiological contaminants through FSSA notified / NABL accredited at least once in six months.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Parameter</th>
<th>Type of Product</th>
<th>Limit (ppm/weight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Urea</td>
<td>Milk</td>
<td>700</td>
</tr>
<tr>
<td>2</td>
<td>Lead</td>
<td>Ice-cream, iced lollies and similar frozen confections</td>
<td>1.0</td>
</tr>
<tr>
<td>3</td>
<td>Arsenic</td>
<td>Milk</td>
<td>0.1</td>
</tr>
<tr>
<td>4</td>
<td>Aflatoxin M1</td>
<td>Milk</td>
<td>0.5 μg/kg</td>
</tr>
<tr>
<td>5</td>
<td>Aldrin, Dieldrin</td>
<td>Milk and Milk products</td>
<td>0.15 (on a fat basis)</td>
</tr>
<tr>
<td>6</td>
<td>Chlordane</td>
<td>Milk and Milk products</td>
<td>0.05 (on a fat basis)</td>
</tr>
<tr>
<td>7</td>
<td>D.D.T.</td>
<td>Milk and Milk products</td>
<td>1.25 (on a fat basis)</td>
</tr>
<tr>
<td>8</td>
<td>Fenitrothion</td>
<td>Milk and Milk products</td>
<td>0.05 (on a fat basis)</td>
</tr>
<tr>
<td>9</td>
<td>Heptachlor</td>
<td>Milk and Milk products</td>
<td>0.15 (on a fat basis)</td>
</tr>
<tr>
<td>10</td>
<td>Hexachlorocyclohexane and its Isomers Alfa (α) Isomer: (b) Beta (β) Isomer: Gamma (γ) Isomer (Known as Lindane) Delta (δ) Isomer:</td>
<td>Milk (whole)</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Milk (whole)</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Milk</td>
<td>0.01 (on whole basis)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Milk products (having less than 2 per cent fat)</td>
<td>0.20 (on whole basis)</td>
</tr>
<tr>
<td>11</td>
<td>Chlorienvinphos</td>
<td>Milk and Milk Products</td>
<td>0.2 (fat basis)</td>
</tr>
<tr>
<td>12</td>
<td>Chlorpyrifos</td>
<td>Milk and Milk Products</td>
<td>0.01 (fat basis)</td>
</tr>
<tr>
<td>13</td>
<td>2,4D</td>
<td>Milk and Milk Products</td>
<td>0.05</td>
</tr>
<tr>
<td>14</td>
<td>Ethion</td>
<td>Milk and Milk Products</td>
<td>0.5 (fat basis)</td>
</tr>
<tr>
<td>15</td>
<td>Monocrotophos</td>
<td>Milk and Milk Products</td>
<td>0.02</td>
</tr>
<tr>
<td>16</td>
<td>Paraquat Dichloride</td>
<td>Milk (whole)</td>
<td>0.01</td>
</tr>
<tr>
<td>17</td>
<td>Trichlorfon</td>
<td>Milk (whole)</td>
<td>0.05</td>
</tr>
<tr>
<td>18</td>
<td>Carbendazim</td>
<td>Milk &amp; Milk Products</td>
<td>0.10 (fat basis)</td>
</tr>
<tr>
<td>19</td>
<td>Benomyl</td>
<td>Milk &amp; Milk Products</td>
<td>0.10 (fat basis)</td>
</tr>
<tr>
<td>20</td>
<td>Carbofuran</td>
<td>Milk &amp; Milk Products</td>
<td>0.05 (fat basis)</td>
</tr>
<tr>
<td>21</td>
<td>Cypermethrin (sum of isomers)</td>
<td>Milk &amp; Milk Products</td>
<td>0.01 (fat basis)</td>
</tr>
<tr>
<td>No.</td>
<td>Chemical</td>
<td>Category</td>
<td>Level (fat basis)</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------</td>
<td>------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>22</td>
<td>Edifenphos</td>
<td>Milk &amp; Milk Products</td>
<td>0.01</td>
</tr>
<tr>
<td>23</td>
<td>Fenthion</td>
<td>Milk &amp; Milk Products</td>
<td>0.05</td>
</tr>
<tr>
<td>24</td>
<td>Fenvalerate</td>
<td>Milk &amp; Milk Products</td>
<td>0.01</td>
</tr>
<tr>
<td>25</td>
<td>Phenthoate</td>
<td>Milk &amp; Milk Products</td>
<td>0.01</td>
</tr>
<tr>
<td>26</td>
<td>Phorate</td>
<td>Milk &amp; Milk Products</td>
<td>0.05</td>
</tr>
<tr>
<td>27</td>
<td>Pirimiphos-methyl</td>
<td>Milk &amp; Milk Products</td>
<td>0.05</td>
</tr>
</tbody>
</table>

**Other Toxic substances**

<table>
<thead>
<tr>
<th>No.</th>
<th>Chemical</th>
<th>Category</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>Agaric acid</td>
<td>All Milk &amp; Milk Products</td>
<td>100</td>
</tr>
<tr>
<td>29</td>
<td>Hydrocyanic acid</td>
<td>All Milk &amp; Milk Products</td>
<td>5</td>
</tr>
<tr>
<td>30</td>
<td>Hypericine</td>
<td>All Milk &amp; Milk Products</td>
<td>1</td>
</tr>
<tr>
<td>31</td>
<td>Saffrole</td>
<td>All Milk &amp; Milk Products</td>
<td>10</td>
</tr>
</tbody>
</table>
Activity 8

1. FBO should test food products for chemical and microbiological contaminants through NABL at least ___________________________.

2. The urea limit in milk is
   a. 750ppm/weight
   b. 650ppm/weight
   c. 700ppm/weight
   d. None

3. Ice cream, iced lollies and similar frozen confections should contain lead ___________ ppm/weight

4. D.D.T limit present in milk and milk products is 1.24 ppm/weight (on a fat Basis)
   True ☐   False ☐

5. Packaging material for milk is tested for
   a. Durability
   b. Strength & leakage
   c. Heat resistance
   d. Corrosion resistance
PART-IX

TRAINING
9. Training

- All food handlers shall be aware of their role and responsibility in protecting food from contamination.

- Food handlers shall have the necessary knowledge and skills which are relevant to food processing / manufacturing, packaging, storing and serving.

- All food handlers shall be trained in food hygiene and food safety aspects along with personal hygiene requirements.

- Periodic assessments of the effectiveness of training, awareness of safety requirements and competency level shall be made.

- Training programmes shall be routinely reviewed and updated wherever necessary.
PART-X

AUDIT, DOCUMENTATION & RECORDS
A periodic audit of the whole system according to the SOP shall be done.

Appropriate records of Milk tanker receipt, raw materials, production, storage, distribution, service, laboratory test results, cleaning and sanitation, pest control and product recall shall be kept.

The records shall be retained for a period of one year or the shelf-life of the product, whichever is more.

List of records as mandated under Part 2 of Schedule 4 of Food Safety & Standards (Licensing & Registration of Food Businesses) Regulation, 2011

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Section Name</th>
<th>Clause</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Facilities</td>
<td>4.1.3</td>
<td>Water storage tanks shall be cleaned periodically and records of the same shall be maintained in a register.</td>
</tr>
<tr>
<td>2</td>
<td>Food Operations and controls</td>
<td>5.1.3</td>
<td>Records of raw materials, food additives and ingredients as well as their source of procurement shall be maintained in a register for inspection.</td>
</tr>
<tr>
<td>4</td>
<td>Pest Control</td>
<td>7.02</td>
<td>The pest control measures adopted by the owner of shop should be kept as a record in the premises to be shown to any officer of the concerned Panchayats / Municipalities responsible for local administration / Corporation at the time of inspection.</td>
</tr>
<tr>
<td>5</td>
<td>Medical fitness certificate</td>
<td>8.02</td>
<td>A certificate / records of medical fitness of all workers handling milk &amp; milk products should be kept as a record in the premises to be shown to any officer of the concerned Panchayats / Municipalities responsible for local administration / Corporation at the time of inspection.</td>
</tr>
<tr>
<td>6</td>
<td>Audit, documentation and records</td>
<td>8.1</td>
<td>A periodic audit of the whole system according to the SOP shall be done to find out any fault / gap in the GMP / GHP system.</td>
</tr>
<tr>
<td>Part</td>
<td>Section</td>
<td>Topic</td>
<td>Subsection</td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
<td>--------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>Audit, documentation and records</td>
<td>8.2</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>Sanitation and maintenance of establishment premises</td>
<td>9.1.1</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
<td>Sanitation and maintenance of establishment premises</td>
<td>9.2.3</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
<td>Personal Hygiene</td>
<td>10.1.2</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>Personal Hygiene</td>
<td>10.1.2</td>
</tr>
<tr>
<td></td>
<td>FSS Regulation</td>
<td>Condition of licence</td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>----------------</td>
<td>----------------------</td>
<td>---</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>13</td>
<td>FSS Regulation</td>
<td>Condition of licence</td>
<td>14</td>
</tr>
</tbody>
</table>
PART-XI

PRODUCT INFORMATION & CONSUMER AWARENESS

Labelling
Manner of Declaration
Specific Requirements/ Restrictions on manner of labelling
Exemptions from labelling requirements
Notice of addition, admixture or deficiency in food
11. PRODUCT INFORMATION & CONSUMER AWARENESS

All packaged food products shall carry a label and requisite information as per provisions of FSS Act, 2006 and Regulations made there under. (Please refer http://www.fssai.gov.in/home/fsslegislation/fss_regulations.html)

11.1 General Requirements of Labelling of Milk and Milk product

1. Every pre-packaged food shall carry a label containing information as required here under unless otherwise provided, namely,—

2. The particulars of declaration required under these Regulations to be specified on the label shall be in English or Hindi in Devnagri script: Provided that nothing herein contained shall prevent the use of any other language in addition to the language required under this regulation.

3. Pre-packaged food shall not be described or presented on any label or in any labelling manner that is false, misleading or deceptive or is likely to create an erroneous impression regarding its character in any respect;

4. Label in pre-packaged foods shall be applied in such a manner that they will not become separated from the container;

5. Contents on the label shall be clear, prominent, indelible and readily legible by the consumer under normal conditions of purchase and use;

6. Where the container is covered by a wrapper, the wrapper shall carry the necessary information or the label on the container shall be readily legible through the outer wrapper and not obscured by it;

7. License number shall be displayed on the principal display panel in the following format

![fssai]

LIC No. XXXXXXXXXXXXXX

11.2 Specific Requirements/ Restrictions on manner of labelling of Milk and Milk product

11.2.1 Labelling of infant milk substitute and infant food

1. An article of infant milk substitutes /infant foods, whose standards are not prescribed under Food Safety and Standards (Food Products standards and Food Additives) Regulations, 2011 shall be manufactured for sale, exhibited for sale or stored for sale only after obtaining the approval of such articles of food and its label from the Authority.
2. Without prejudice to any other provisions relating to labelling requirements contained in these regulations, every container of infant milk substitute or infant food or any label affixed thereto shall indicate in a clear, conspicuous and in an easily readable manner, the words “IMPORTANT NOTICE” in capital letters and indicating there under the following particulars, namely:

(i) a statement “MOTHER’S MILK IS BEST FOR YOUR BABY” in capital letters. The types of letters used shall not be less than five millimeters and the text of such statement shall be in the Central Panel of every container of infant milk substitute or infant food or any label affixed thereto. The colour of the text printed or used shall be different from that of the background of the label, container as the case may be. In case of infant food, a statement indicating “infant food shall be introduced only (after the age of six months and upto the age of two years)” shall also be given;

(ii) a statement that infant milk substitute or infant food should be used only on the advice of a health worker as to the need for its use and the proper method of its use;

(iii) a warning that infant milk substitute or infant food is not the sole source of nourishment of an infant;

(iv) a statement indicating the process of manufacture (e.g spray dried) except in case of infant foods, instruction for appropriate and hygienic preparation including cleaning of utensils, bottles and teats and warning against health hazards of inappropriate preparations, as under;

“Warning/ caution-Careful and hygienic preparation of infant foods/infant milk substitute is most essential for health. Do not use fewer scoops than directed since diluted feeding will not provide adequate nutrients needed by your infant. Do not use more scoops than directed since concentrated feed will not provide the water needed by your infant”.

(v) the approximate composition of nutrients per 100 gm of the product including its energy value in Kilo Calories/Joules;

(vi) the storage condition specifically stating “store in a cool and dry place in an air tight container” or the like (after opening use the contents within the period mentioned or the expiry date whichever is earlier);

(vi) the feeding chart and directions for use and instruction for discarding leftover feed;

(viii) Instruction for use of measuring scoop (level or heaped) and the quantity per scoop (scoop to be given with pack);

(ix) indicating the Batch No. Month and Year of its manufacture and expiry date.
(x) the protein efficiency ratio (PER) which shall be minimum 2.5 if the product other than infant milk substitute is claimed to have higher quality protein;

(xi) the specific name of the food additives, if permitted, shall be declared in addition to appropriate class names.

3. No containers or label referred relating to infant milk substitute or infant food shall have a picture of infant or women or both. It shall not have picture or other graphic materials or phrases designed to increase the saleability of the infant milk substitute or infant food. The terms “Humanised” or “Maternalised” or any other similar words shall not be used. The Package and/or any other label of infant milk substitute or infant food shall not exhibit the words, “Full Protein Food”, “energy Food”, “Complete food” or “Health Food” or any other similar expression.

4. The containers of infant milk substitute meant for (premature baby (born before 37 weeks)/low birth weight infant (less than 2500gm) or labels affixed thereto shall indicate the following additional information, namely:—

(i) the words [PREMATURE BABY (BORN BEFORE 37 WEEKS) LOW BIRTH WEIGHT (LESS THAN 2.5 KG] in capital letters along with the product name in central panel;  
(ii) a statement “the low birth weight infant milk substitute shall be withdrawn under medical advice as soon as the mother’s milk is sufficiently available”; and

(iii) a statement “TO BE TAKEN UNDER MEDICAL ADVICE” in capital letters.

5. The product which contains neither milk nor any milk derivatives shall be labelled “contains no milk or milk product” in conspicuous manner.

6. The container of infant milk substitute for lactose or lactose and sucrose intolerant infants or label affixed thereto shall indicate conspicuously “LACTOSE-FREE or SUCROSE-FREE or LACTOSE and SUCROSE-FREE” in capital letters and state statement “TO BE TAKEN UNDER MEDICAL ADVICE” and shall also bear the following statements, namely:—

“Lactose free Infant Milk Substitute should only be used in case of diarrhea due to lactose intolerance. The lactose free/sucrose free Infant Milk Substitute should be withdrawn if there is no improvement in symptoms of intolerance”.

7. The container of infant milk substitute meant for infants with allergy to cow’s /buffalo’s milk protein or soy protein or label affixed thereto shall indicate conspicuously “HYPOALLERGENIC FORMULA” in capital letters and statement “TO BE TAKEN UNDER MEDICAL ADVICE”.

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8. Declaration to be surrounded by line:
There shall be a surrounding line enclosing the declaration where the words “unsuitable for babies” are required to be used.

(i) Distance of surrounding line:
The distance between any part of the words “unsuitable for babies” surrounding the line enclosing these words shall not be less than 1.5 mm.

11.2.2 CONDENSED MILK OR DESICCATED (DRIED) MILK:

Every package containing condensed milk or desiccated (dried) milk shall bear a label upon which is printed such one of the following declarations as may be applicable or such other declaration substantially to the like effect as may be allowed by the State Government, namely,—

(i) In the case of condensed milk (unsweetened):

<table>
<thead>
<tr>
<th>CONDENSED MILK UNSWEETENED</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Evaporated Milk) (This tin contains the equivalent) of (x)........ litres of toned milk</td>
</tr>
</tbody>
</table>

(ii) In the case of condensed milk (sweetened):

<table>
<thead>
<tr>
<th>CONDENSED MILK SWEETENED</th>
</tr>
</thead>
<tbody>
<tr>
<td>This tin contains the equivalent of (x)........ litres of toned milk with sugar added</td>
</tr>
</tbody>
</table>

(iii) In the case of condensed skimmed milk (unsweetened):

<table>
<thead>
<tr>
<th>CONDENSED SKIMMED MILK UNSWEETENED</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Evaporated Skimmed Milk) This tin contains the equivalent of (x)........ litres of skimmed milk</td>
</tr>
</tbody>
</table>

(iv) In the case of condensed skimmed milk (sweetened):

<table>
<thead>
<tr>
<th>CONDENSED SKIMMED MILK SWEETENED</th>
</tr>
</thead>
<tbody>
<tr>
<td>This tin contains the equivalent of (x)........litres of skimmed milk with sugar added”</td>
</tr>
</tbody>
</table>

(v) In the case of condensed milk (sweetened and flavoured):

| This has been flavoured with............. |
| NOT TO BE USED FOR |
| INFANTS BELOW SIX MONTHS |
(vi) In the case of condensed milk/condensed Skimmed milk (unsweetened)
Sterilised by Ultra High Temperature (UHT) treatment:

This has been sterilised by UHT Process

(vii) In the case of milk powder:

**MILK POWDER**
This tin contains the equivalent of
(x)..... litres of toned milk

(viii) In the case of milk powder which contains lecithin:

**MILK POWDER IN THIS PACKAGE CONTAINS LECITHIN**

(ix) In the case of partly skimmed milk powder:

**PARTLY SKIMMED MILK POWDER**
This tin contains the equivalent of
(x)......... litres of partly skimmed milk
having......... per cent milk fat

(x) In the case of skimmed milk powder:

**SKIMMED MILK POWDER**
This tin contains the equivalent of (x)........ litres of skimmed milk

➢ The declaration shall in each case be completed by inserting at (x) the appropriate number in words and in figures, for example, “one and a half (1½)”, any fraction being expressed as eight quarters or a half, as the case may be.

➢ There shall not be placed on any package containing condensed milk or desiccated (dried) milk any comment on, explanation of, or reference to either the statement of equivalence, contained in the prescribed declaration or on the words “machine skimmed” “skimmed” or “unsuitable for babies” except instructions as to dilution as follows:

- “To make a fluid not below the composition of toned milk or skimmed milk (as the case may be) with the contents of this package, add (here insert the number of parts) of water by volume to one part by volume of this condensed milk or desiccated (dried) milk”.

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• Sweetened condensed milk and other similar products which are not suitable for infant feeding shall not contain any instruction of modifying them for infant feeding.

➢ Wherever the word “milk” appears on the label of a package of condensed skimmed milk or of desiccated (dried) skimmed milk as the description or part of the description of the contents, it shall be immediately preceded or followed by the word “machine skimmed” or “partly skimmed”, as the case may be.

➢ Fluid milk: — The caps of the milk bottles/pouch/tetrapak shall clearly indicate the nature of the milk contained in them. The indication may be either in full or by abbreviation shown below:

(i) Buffalo milk may be denoted by the letter ‘B’.
(ii) Cow milk may be denoted by the letter ‘C’
(iii) Goat milk may be denoted by the letter ‘G’
(iv) Standardized milk may be denoted by the letter ‘S’
(v) Toned milk may be denoted by the letter ‘T’
(vi) Double toned milk may be denoted by the letter ‘DT’
(vii) Skimmed milk may be denoted by the letter ‘K’
(viii) Pasteurised milk may be denoted by the letter ‘P’; followed by the class of milk. For example
         Pasteurised Buffalo milk shall bear the letters ‘PB’.
(ix) Alternatively suitable indicative colours of the packs/caps/bags shall be indicative of the nature of milk contained in them, the classification of colours being displayed at places where milk is sold/stored or exhibited for sale, provided that the same had been simultaneously intimated to the concerned Designated Officer, and information disseminated through the local media.

11.2.3 Ice-cream and Frozen Dessert/Low fat Paneer/Channa/Cheese

➢ Every dealer in ice-cream or mixed ice-cream who in the street or other place of public resort, sells or offers or exposes for sale, ice-cream or ice-candy, from a stall or from a cart, barrow or other vehicle or from a basket, phial, tray or other container used without a staff or a vehicle shall have his name and address along with the name and address of the manufacturer, if any, legibly and conspicuously ‘displayed’ on the stall, vehicle or container as the case may be.

➢ Every package of Frozen Desert / Frozen Confection shall bear the following label, namely,—

Frozen Desserts / Frozen Confection Contain ………………. Milk Fat* / Edible Vegetable Oil* / and Vegetable Fat*
Every package of food which is permitted to contain artificial sweetener mentioned in Food Safety and standards (Food Products standards and Food Additive) Regulations, 2011 and an advertisement for such food shall carry the following label, namely,—

(i) This contains ............... (Name of the artificial sweeteners).
(ii) Not recommended for children.
(iii) (a) *Quantity of sugar added ............. gm/100 gm.
     (b) No sugar added in the product.
(iv) *Not for Phenylketonurics (if Aspertame is added)

In addition to the declarations under regulation, every package of food which is permitted to contain artificial sweetener mentioned in table in regulation of Food Safety and Standards (Food Products standards and Food Additive) Regulations, 2011 and an advertisement for such food shall carry the following label, namely,—

CONTAINS ARTIFICIAL SWEETENER AND FOR CALORIE CONSCIOUS

Every package of Low Fat Paneer/ Chhana shall carry the following label, namely,—

LOW FAT PANEER / CHHANA

Every package of Cheese(s), if coated/packed in food grade waxes polyfilm/wrapping of cloth, shall bear the following label, namely,—

REMOVE THE OUTER PACKING BEFORE CONSUMPTION
Activity 11
PART-XII

FOOD SAFETY MANAGEMENT SYSTEM PLAN

Introduction
Structure of the FSMS Program
Flow chart
FSMS Plan
Conclusion
12. FOOD SAFETY MANAGEMENT SYSTEM PLAN

12.1 Introduction of FSMS:

Internationally and even in India, there are many Food Safety Certifications which meets these requirements. These are Hazard Analysis and Critical Control Point (HACCP), ISO 22000, Food Safety System Certification (FSSC) 22000 and many more. These are voluntary certifications to strengthen the food safety system.

A Food Safety Management System (FSMS) is a network of interrelated elements that combine to ensure that food does not cause adverse human health effects. These elements include programs, plans, policies, procedures, practices, processes, goals, objectives, methods, controls, roles, responsibilities, relationships, documents, records, and resources. The purpose of FSMS is to ensure the manufacture, storage, distribution and sale of safe food.

However, under current Indian regulation defined by the FSS Act 2006, Food Safety Management System (FSMS) means the adoption Good Manufacturing Practices, Good Hygienic Practices, Hazard Analysis and Critical Control Point and such other practices as may be specified by regulation, for the food business.

The Key elements of FSMS:

- Good Practices/ Pre Requisites Programmes
- Hazard Analysis /HACCP
- Management Element / System
- Statutory and regulatory requirements
- Communication
12.1.1 FSMS Documentation by FBO

FBO Seeking Fresh / Renewal of License

Submission of Mandatory Documents with Application:
1. Self-Inspection Checklist as per FSSA-CHK-R-01
2. Process Flowchart – As per guideline document
3. FSMS Plan specific to FBO as per FSSA-FSM-R-01

Guidance needed by FBO for preparing mandatory documents

Prepare Documents in prescribed format

Refer to FSSAI Guidance Documents:
1. Schedule IV Implementation Guidance and Tools
2. Conducting a Food Safety Assessment and Developing a FSMS Plan – Guidance.
3. Category Sample of FSMS Documents

Submit Application
12.1.2 Structure of the FSMS Program

FSMS Program will cover following documents

1. The FSMS Plan (samples are provided as guidance) and
2. Flow chart of for the Process
3. A self-inspection checklist, which is to be submitted as an annexure to the plan.

Note: These documents will need to be submitted by the FBO as part of application for new license or renewal of license. Also the FSSAI approved audit agency may inspect the FBOs on basis of this scope.
12.2 Flow chart  
Sample Flowchart for Pasteurised Milk

12.3 FSMS Plan  
Every manufacturing / processing unit should submit a Food Safety Management System Plan. It has to be developed based on Schedule – 4 of Food Safety and Standards Regulation, 2011 in which general hygienic and sanitary practices to be followed by food business operators have been elaborated. Along with sanitation and maintenance of establishment premises, personal hygiene of workers as well as personal cleanliness is also to be ensured by the FBO’s.
### 12.3.1 The food safety plan shows:

<table>
<thead>
<tr>
<th><strong>Hazard</strong></th>
<th>What problems could happen?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Control measures</strong></td>
<td>What you do to stop problems</td>
</tr>
<tr>
<td><strong>Critical Limits</strong></td>
<td>What are the critical limits set for each control measure</td>
</tr>
<tr>
<td><strong>Monitoring method</strong></td>
<td>How do you make sure that what you are doing stops the problem</td>
</tr>
<tr>
<td><strong>Corrective Action</strong></td>
<td>What you do if something goes wrong</td>
</tr>
<tr>
<td><strong>Records</strong></td>
<td>What records you keep</td>
</tr>
</tbody>
</table>
### 12.4 Sample FSMS Plan for Liquid Milk

<table>
<thead>
<tr>
<th>Operational Step</th>
<th>Hazard</th>
<th>Control Measure</th>
<th>Critical Limit</th>
<th>Monitoring Method</th>
<th>Corrective Action</th>
<th>Responsibility</th>
<th>Record</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Receiving</strong> – Materials shipped by bulk tanker, e.g. fluid milk and milk products</td>
<td>Contamination with vegetative pathogens</td>
<td>Truck unloading area should be constructed to protect the milk (at a minimum overhead protection and concrete or equivalent surface under the truck that is properly drained). Maintain the truck unloading area and equipment clean. Protect the milk that is being unloaded by closing in the unloading area or using filters over the vent/personnel access port area. Using equipment meeting sanitary design guidelines.</td>
<td>Company Specifications</td>
<td>Check Incoming MBRT time</td>
<td>Reject lots not complying with specifications or revalidate process requirements</td>
<td>QA/QC</td>
<td>Incoming Milk Quality Check Record</td>
</tr>
<tr>
<td><strong>Raw Milk Storage</strong></td>
<td>Growth of vegetative pathogene</td>
<td>Maintain the temperature sufficiently low to minimize the growth of pathogens. Clean the storage</td>
<td>Store below 4°C</td>
<td>Storage temperatures</td>
<td>Reject lots not complying with specifications</td>
<td>QA/QC</td>
<td>Temperature logs</td>
</tr>
<tr>
<td>ns</td>
<td>vessels and associated lines and valves at frequencies that do not allow for bacterial growth of pathogens in the product at the product temperature used</td>
<td>or revalidate process requirements</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Activity 12

1. Key elements of Food Safety Management System (FSMS) are
   a. Good Practices and HACCP
   b. Management Element and Statutory and regulatory requirements
   c. Communication
   d. All of These

2. Which Schedule of Food Safety and Standards Regulation, 2011 is to be develop for FSMS ______________ for every FBO

3. The purpose of FSMS is to ensure the manufacture, storage, distribution and sale of safe food
   True □ False □
PART-XIII
HACCP (Hazard Analysis and Critical Control Point)

Introduction
HACCP Principles
Purpose & Importance of Hazard Analysis
Hazard Analysis Process, Hazard Identification & Evaluation, Control Measures
Flow Diagram of Liquid Milk & UHT Milk processing
13. **HACCP (Hazard Analysis and Critical Control Point)**

Milk is highly perishable commodity and a nutritious food so there is high risk of hazard or food poisoning. Hazard analysis is the process used by the HACCP team to determine which potential hazards present a significant health risk to consumers. Only those hazards that pose significant risk to the health of consumers should be included in the HACCP plan.

### 13.1 HACCP Principles

<table>
<thead>
<tr>
<th>PRINCIPLE</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Conduct a hazard analysis</td>
</tr>
<tr>
<td>2</td>
<td>Determine Critical Control Points (CCP)</td>
</tr>
<tr>
<td>3</td>
<td>Establish critical limit(s).</td>
</tr>
<tr>
<td>4</td>
<td>Establish a system to monitor control of the CCP.</td>
</tr>
<tr>
<td>5</td>
<td>Establish corrective action to be taken when monitoring</td>
</tr>
<tr>
<td>6</td>
<td>Establish procedures for verification to Confirm that HACCP system is working effectively.</td>
</tr>
<tr>
<td>7</td>
<td>Establish documentation concerning all procedures &amp; records appropriate to these principles and their application</td>
</tr>
</tbody>
</table>

### 13.1.1 Purpose of the Hazard Analysis

- The purpose of the hazard analysis is to develop a list of hazards, which are of such significance that they are reasonably likely to cause injury or illness if not effectively controlled.
- Successful application of HACCP principles 2-7 depends on a high-quality hazard analysis

#### 13.1.1.1 Importance of Conducting a Thorough Hazard Analysis

- An improper hazard analysis may result in a HACCP plan that is not effective in protecting consumers regardless of how well it is followed.
- Plant operations may be modified based on a thorough hazard analysis.

### 13.1.2 Hazard Analysis Process

- Hazard Identification and Determination of Acceptable Levels
- List of potential hazards that may be associated with a milk and milk product.
- Determination of the acceptable level for each identified food safety hazard.

### 13.1.3 Hazard Identification

- HACCP team develops a list of potential biological, chemical, and physical hazards that may be introduced, increased, or controlled at each step described on the product flow diagram.
- The preliminary information collected while developing the product description
- Experience
External information including, when possible, epidemiological and other historical data
Information from the food chain on food safety hazards that may be of relevance for the safety of the end products, intermediate products and the food at consumption

13.1.4 Determination of Acceptable Levels
For each food safety hazard identified, its acceptable level in the end-product shall be determined whenever possible.
This determination shall consider:
- Regulatory requirements
- Customer requirements
- Intended use by the customer
- Other relevant data

Record the result of the determination and its justification.

13.1.5 Hazard Evaluation
Evaluation based on the likelihood of occurrence and the severity of effects of a particular hazard.
Identify which of the potential hazards pose a significant risk to the consumer.
The HACCP team decides which of the potential hazards listed during hazard identification stage present a significant risk to consumers.
Each potential hazard should be evaluated based on two factors:
- Severity (of the potential illness or injury)
- Likelihood of occurrence

A. Evaluating Severity
Will require consideration of various factors, including:
- Susceptibility of intended customers to foodborne illness (e.g. children versus adults)
- Possible impact of secondary problems
- Magnitude and duration of the illness or injury

B. Estimating Likelihood of Occurrence
Experience
Data from past foodborne illness outbreaks
Information in the scientific literature
Historical information gathered by the establishment
Factors Influencing Likelihood of Occurrence
- Effectiveness of prerequisite programs
- Frequency of association of the potential hazard with the food or ingredient
- Method of preparation
- Conditions during transportation
- Expected storage conditions
- Likely preparation steps before consumption

13.1.6 Evaluating Hazards

13.1.7 Hazards that Pose a Significant Risk
- Should be addressed in the HACCP plan
- Control measures must be described for each hazard that will prevent, eliminate, or reduce the hazard to an acceptable level.
- Significant hazards may be different for the same product produced at different facilities.

13.1.8 Control Measures
- Any action or activity that can be used to prevent or eliminate a food safety hazard, or reduce it to an acceptable level.
- Often termed “Preventive Measures” in earlier HACCP documents.
- More than one control measure may be required for a specific hazard.
- More than one hazard may be addressed by a specific control measure.

Examples of Control Measures
- Filtration
- Pasteurization
13.1.9 Selection and categorization of control measures shall include assessments with regard to:

- Its effect on identified food safety hazards
- Its feasibility for monitoring
- Its place in the system relative to other control measures
- The likelihood of failure of a control measure or significant processing variability
- The severity of consequences in case of a failure
- Whether the control measure is specifically established and applied to eliminate or significantly reduce the level of hazards
- Synergistic effects between control measures
- Summarize the Hazard Analysis
- Identify potential hazards for each step in the process flow diagram.
- Determine significance of identified hazards, and justify this decision.
- Identify control measures that can be applied at each step to control the identified hazards.
- Keep records of this analysis.
13.2 Flow Diagram of Liquid Milk processing

CCP: **Pasteurization** of Milk temperature minimum 72°C for 15 Sec and chilling below 4°C
13.3 Flow Diagram of UHT Milk processing

CCP: Milk Sterilization temperature minimum 137°C for 4 Sec.
<table>
<thead>
<tr>
<th>Section</th>
<th>Sr no</th>
<th>CCP No</th>
<th>Process Step</th>
<th>Critical Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquid Milk Processing</td>
<td>1</td>
<td>1</td>
<td>Pasteurization of milk</td>
<td>Pasteurization of Milk at (76±2 °C) for 15 sec and Chilling temp ≤4 °C For Cheese milk Pasteurization at (73±1 °C) for 15 sec and Chilling temp ≤4 °C</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2</td>
<td>Pasteurization of Cream</td>
<td>Pasteurization of Cream  85-90 °C , no hold and chilling temp 8 to 12 °C</td>
</tr>
<tr>
<td>Butter</td>
<td>3</td>
<td>1</td>
<td>Metal Detector</td>
<td>Minimum detection limit: Ferrous: 3.5 mm Non-ferrous: 4.0 mm SS 316: 4.5 mm</td>
</tr>
<tr>
<td>Ice cream</td>
<td>4</td>
<td>1</td>
<td>Pasteurization of mix</td>
<td>Pasteurization Heating Min. 82±2°C/40 Sec. Chilling 7±3 °C, FDV working.</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>2</td>
<td>Metal Detector</td>
<td>Minimum detection limit: Ferrous: 3.5 mm (FOR Box Ferrous: 2.5 mm) Non-ferrous: 4.0 mm SS 316: 5.0 mm</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>3</td>
<td>Pasteurization of Juicy water for candy</td>
<td>Pasteurization at Min. 82±2 °C for 40 seconds and chilling below 7± 3 °C.</td>
</tr>
<tr>
<td>UHT Milk</td>
<td>7</td>
<td>1</td>
<td>Sterilization of milk</td>
<td>Sterilization temp. 137±4 °C for 4 sec</td>
</tr>
<tr>
<td>Powder plant</td>
<td>8</td>
<td>1</td>
<td>DSI temperature during condensing</td>
<td>Dairy Whitener- 98-102°C for 15 Sec, Infant Milk Powder- 90-95 OC for 15 Sec, Skimmed Milk Powder- 80-95°C for 15 Sec, Whole Milk PowderOCfor15 Sec.</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>2</td>
<td>Metal Detector</td>
<td>Ferrous: 1.2 mm Non-ferrous: 1.5 mm SS 316: 2.5 mm</td>
</tr>
<tr>
<td>Cheese</td>
<td>10</td>
<td>1</td>
<td>Metal Detector</td>
<td>2.5 mm Fe , 2.5 mm Non Fe</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>1</td>
<td>Heat Treatment of Cheddar Cheese mix (Old, Medium and New)</td>
<td>Heating temp. 80 to 85 °C</td>
</tr>
<tr>
<td>Paneer</td>
<td>12</td>
<td>1</td>
<td>Sterilization</td>
<td>Sterilization of packed paneer at (90±5 °C) for 30 minutes</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>2</td>
<td>Metal Detector</td>
<td>Minimum detection limit: Ferrous: 3.5 mm Non-ferrous: 4.0 mm SS 316: 4.5 mm</td>
</tr>
<tr>
<td>Dahi</td>
<td>14</td>
<td>1</td>
<td>Heat treatment of Dahi milk</td>
<td>Heating temperature: 85-90°C, Holding time: 10 minutes minimum</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>2</td>
<td>Pasteurization of Milk</td>
<td>80±_2 °C/min 15 Sec ,Cooling and Storage 5-7 C</td>
</tr>
</tbody>
</table>
**Activity 13**

1. What is the full form of UHT______________________

2. Critical limit for Dairy Whitener is 98-102 °C for 15 Sec
   
   True [ ] False [ ]

3. Minimum temperature for milk sterilization is
   a. 137°C for 4sec
   b. 137°C for 2sec
   c. 127°C for 4sec
   d. none

4. Critical limit for Dairy Whitener
   a. 98-102 °C for 12 Sec
   b. 98-102 °C for 13 Sec
   c. only a
   d. only b

5. Each potential hazard should be evaluated based on Severity (of the potential illness or injury) and Likelihood of occurrence
   True [ ] False [ ]

6. HACCP has how many principles_______________

7. Each potential hazard should be evaluated based on Severity (of the potential illness or injury) and Likelihood of occurrence
   True [ ] False [ ]

8. HACCP has how many principles_______________
PART - XIV
PEST CONTROL
14. Pest Control

14.1 Pest Control in Dairy industry

A pest is an organism which cause injury / harm to humans, animals, desirable plants or products. This obviously results in losses.

In Dairy industry we deal with milk and milk products which are primary source of nutrition for millions. Milk is a perishable commodity and gets contaminated with slightest of hygiene lapse. We give hereunder a broad spectrum of prevention techniques for Pest control in Dairy industry.

The pests can:

- Cause Contamination of dairy products by their droppings which contain bacteria and other microorganisms.
- They can spoil products by eating part of it
- The disease causing germs are carried by them on various parts of their bodies and can lead to serious diseases to people who eat the products contaminated by them.

14.2 Various types of pests
14.3 **Pest control program** should effectively eradicate pest from the dairy premises. The steps involves are:

- Exclusion of pests → preventing their entry in the premises.
- Removing food sources by good practices → keeping the premises clean.
- Controlling pests with appropriate methods → different pests need different treatment for effective removal.
- Specific procedures / records → records to be maintained for future references as well as evolving more effective method to avoid recurrence.

### 14.3.1 Pest Exclusion:

- All doors should be kept tightly closed and fitting. The windows shall be 3 track type with mosquito /fly proof wire-mesh for preventing entry of insects but allowing cross ventilation.
- Minimize gaps in doors and windows or any open able space in production areas. Use of Air curtains on main doors/ entry points is quite effective.
- Door seals in the bottom of doors and self-closers is of utmost importance.
- The exhaust openings should be provided with gravity louvers lest insects enter when the exhaust fan is not operating.
- Production areas and cold stores shall be screened by using strip curtains.
- Netting and eliminate perches for birds is a sensible solution to avoid bird droppings contaminating the dairy products.
- All cracks and holes in walls should be properly plugged so that small insects do not have opportunity to thrive.

14.4 Checks should be performed from time to time for Pest infestation verification.

- Look for bird droppings or animal tracks. It will provide useful tips on the type of pests present and it can lead to their entry points and nests.
The type of pest will enable plant personnel to choose appropriate method for controlling them.

Notice the product or carton/container damage which will again indicate type of pest present and hence suitable method to control them.

Observe the presence of any dead pests and decide on the method to be adopted for its control and prevention. Baits can be effective only if those are target specific. Ideally pests have to be captured or destroyed.

14.5 Rodent control:

Apart from cockroaches, rats and mice are a common menace to milk and milk products in dairies. They can be effectively controlled by use of bait stations and mouse traps. In their case the traps have to be placed inside production areas. For small rodents, Sticky pads shall be provided. These baits shall be checked & emptied regularly lest the decomposition causes foul smell in the production areas. And milk being a sensitive product, it will catch on the foul odour.

14.6 Insect control:

In production area acquires major significance and can be controlled by

1. **Fly Catcher**

   The UV light in fly catcher attracts the pests like flies and mosquitoes and the charged electric grid kills them instantly. It shall be located prominently.

   It is recommended that only approved baits should be used. The baits should be sealed, locked or strapped securely.
and at an appropriate height. Nowadays, fly catcher come with a sticky pad to hold the insect. These pads are then periodically discarded and new pads are installed in place of the old ones. The charged electric grid spatters the insect body parts and they may fall in the product causing contamination and consequent rejection of the product. This results in commercial loss to milk union apart from bad name to brand value. The sticky pads are then a good alternative as they hold insects after impact.

2. Pest Control Chemicals

There are various chemicals available in the market for effective control of the pests. But the pesticides are to be handled with care. The chemicals should be of approved make and suitable to be used in Dairy industry. Their usage should not cause any harmful side effects to the operational staff and contaminate food by their odour etc. But the effect on the targeted pests should be maximum.

Notes:

- In spite of the best pest control methods, no programme will be successful without an active participation and whole-hearted support from the employees.
- Employees to be sensitized for any garbage around the production areas as they will be potential source for pest to thrive. The damaged traps must be removed at once. The employees should be encouraged to have their lunches in designated areas only.
- Employees should report any sighting / evidence of pests so that timely action could be taken for removing the pests and stop its multiplication.
**Activity 14**

1. Pest can cause contamination of dairy products by their ____________which contain bacteria and other microorganisms.

2. What are the pest control programme
   a. Exclusion of pests
   b. keeping the premises clean.
   c. Controlling pests with appropriate methods
   d. None of the above

3. The windows shall be of the following type with mosquito fly proof wire-mesh for preventing entry of insects but allowing cross ventilation
   a. 3 track
   b. 5 track
   c. 2 track
   d. 4 track

4. What type of baits be used
   a. Sealed
   b. Locked
   c. Strapped securely
   d. All the above

5. Production areas and cold stores shall be screened by using __________ curtains.