

Reading Material for
ICE CREAM PRODUCTION
Under PMFME Scheme



AATMANIRBHAR BHARAT

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Chapter – 1

Raw Material

1.1 Introduction

Milk, liquid secreted by the mammary glands of female mammals to nourish their young for a period beginning immediately after birth. The milk of domesticated animals is also an important food source for humans, either as a fresh fluid or processed into a number of dairy products such as butter and cheese (<https://www.britannica.com>). Milk is a nutritious choice as it provides nine essential nutrients our body needs. Milk contains essential nutrients like high-quality protein, calcium, vitamin D and more. These nutrients help our bodies function properly. For example: Protein helps build and repair muscle tissue Calcium and vitamin D helps build and maintain strong bones and teeth Milk also contains B vitamins, which can help your body convert food into energy.

1.2 Dairy Industry in India

India is leading milk producing country in the world, accounting for 19 percent of the global market share and expected to grow at compound annual growth rate (CAGR) of 14.8% between FY 2018 – 2023. As per fiscal year 2019, milk production in India amounted to about 187 million metric tons. As per FY – 2018, around 81% of the Indian dairy and milk processing market comes under unorganized sector, where milk is processed in unhygienic infrastructure, which affects the overall quality of milk and milk-based products. Consumption patterns of liquid milk at the farm level and less infrastructure for processing is the main reason for low value addition of milk. The demand for value added products especially traditional dairy products is increasing day by day and the dairy industry of the country is trying to meet the present demand.

Uttar Pradesh, Rajasthan and Gujarat are the major milk producing states in India. Uttar Pradesh is the largest milk-producing state, as it has the highest buffalo population and the second-highest cattle population in the country. Majority of the rural population in this state is engaged in livestock nurture and dairy farming. Gujarat holds several cooperative dairy unions, milk cooperative societies and private dairy plants, which play vital roles in the production of milk and milk-based products in the state.

1.3 Insight on value-added product

Apart from processed liquid milk, Indian dairy and milk processing industry generates revenue from several value-added products such as butter, curd, paneer, ghee, whey, flavoured milk, ultra-high temperature (UHT) milk, cheese, yogurt, dairy whitener and milk powder. During the FY 2016 – 2020, the market size of dairy ingredients is expected to grow by around 14%.

1.4 Export-import opportunities

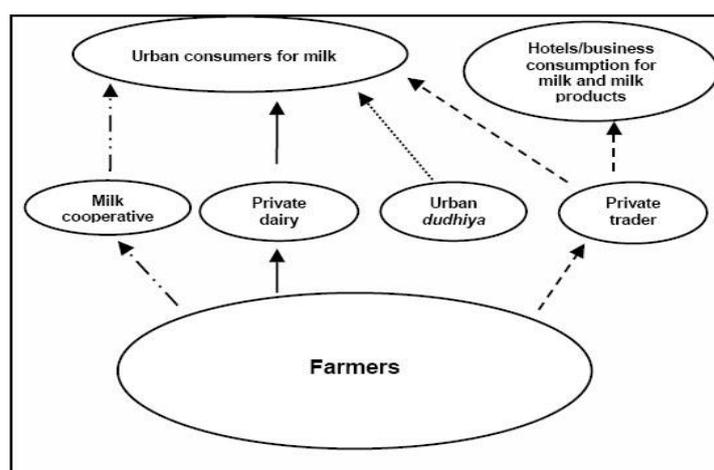
The export of dairy products from India has increased to countries like Bhutan, Afghanistan, Canada, Egypt, and the United Arab Emirates. India has also imported a significant number of dairy products from countries like France, New Zealand, Ireland, France, Ukraine, and Italy.

1.5 Key deterrents to the growth of the market

Despite having a significant livestock base of milch animals, India lacks in terms of good processing facility and availability of cold storages which results in wastage of dairy output. Lack of sufficient storage facilities and inefficient distribution channels are hampering the growth of the Indian dairy and milk processing industry.

Sufficient quantity and good quality of feed and fodder are required for proper animal rearing and milk production. Improper droughts and flood management affect the production of fodder in India. Deficiency of proper feed and fodder for milch animals, due to high usage of agricultural crop residues by producers of fibreboard, paper, and liquid fuels, affect its availability for dairy production and milk processing.

Dairy marketing channels in India



Reference: FAO

1.6 Need for Processing Milk

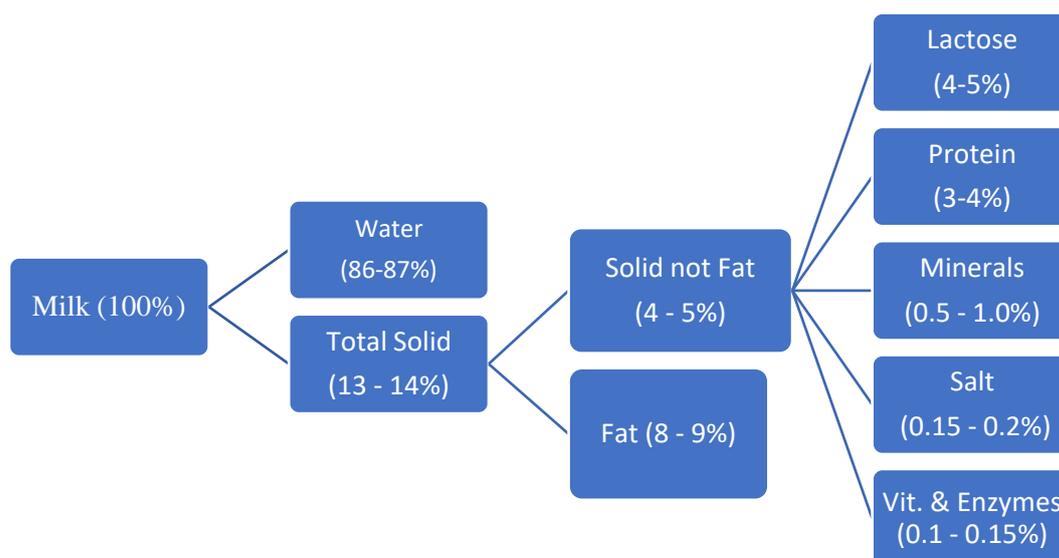
Milk is considered wholesome food mainly because of its high nutritive value. It has to be processed to;

- Increase the shelf life, because it is highly perishable.
- Prepare value added products like peda, dahi, cheese, paneer, butter, ghee, AMF, flavoured milk, cheese, and yogurt, dairy whitener, milk powder etc. and many more dairy based products, for a good health.
- Make business out of it, create job opportunities, consequently building financially strong Nation.

1.7 Composition of Milk

Milk composition varies with species, breed (Holstein, Jersey), feed, and the stage of lactation. As per FSSAI, “Milk is a whole, fresh, clean lacteal secretion obtained by complete milking of one or more healthy milch animals excluding that obtained within 15 days before calving or 5 days after calving. Market milk must possess the pre-determined percentage of milk fat and SNF (Solid Not Fat).”

Milk of different classes and types must conform to the standards laid down by FSSAI. Mixed milk means a combination of the milk from cow and buffalo or any other milch animal. The combination also should at par with FSSAI standards.



1.8 Nutritional Value of Milk

Table: Nutritional values of milk

Nutritional Factor	Description	Energy Value
Protein	Milk protein is casein, a high-quality protein. All essential amino acids are present in Milk.	4.1 kCal/g
Minerals	Milk contains phosphorus and calcium.	
Vitamins	Milk contains vitamins A, D, thiamine, and riboflavin.	
Fat	Milk fat is responsible of good flavor and physical properties. The fat content in cow milk is generally from 3.5 to 4.5 %	9.3 kCal/g
Lactose	Lactose is the sugar component of milk and it supply energy.	4.1 kCal/g

Chapter – 2

Processing and Machinery

2.1 Introduction

Ice cream is a sweetened frozen food typically eaten as a snack or dessert. It may be made from dairy milk or cream and is flavoured with a sweetener, either sugar or an alternative, and any spice, such as cocoa or vanilla. Ice cream may be served in dishes, for eating with a spoon, or licked from edible cones. Ice cream may be served with other desserts, such as apple pie, or as an ingredient in ice cream floats, sundaes, milkshakes, ice cream cakes and even baked items, such as Baked Alaska.

Ice cream is a frozen dairy product made by suitable blending and processing of cream and other milk products, together with sugar and flavour, with or without stabilizer or color, and with the incorporation of air during the freezing process. The exploding popularity of ice cream has led to a number of ice-cream variations including frozen custard, frozen yogurt, and even non-dairy versions made with ingredients like coconut milk.

The development of ice harvesting and the invention of the insulated icehouse in the nineteenth century made ice more accessible to the general public. In 1846, Nancy Johnson designed a hand-cranked ice cream freezer that improved production slightly. The first documented fulltime manufacturing of ice cream took place in Baltimore, Maryland, in 1851 when a milk dealer named Jacob Fussell found himself with a surplus of fresh cream. Working quickly before the cream soured, Fussell made an abundance of ice cream and sold it at a discount. The popular demand soon convinced him that selling ice cream was more profitable than selling milk.

However, production was still cumbersome, and the industry grew slowly until the industrialization movement of the early twentieth century brought electric power, steam power, and mechanical refrigeration.

2.2 Market Potential of Ice cream

India's ice cream market, one of the fastest growing markets in the Asia Pacific (APAC) region, is forecast to grow from INR121. 4bn (US\$1.8bn) in 2018 to INR 213. 6bn (US\$2.9bn) in 2023, registering a compound annual growth rate (CAGR) of 12%. The healthy growth of the market can be attributed to numerous forces. Population growth, rising disposable incomes, urbanization rates, changing consumer preferences, improved cold supply chain and growing

deep freezer penetration are some of the factors that are broadening the growth aspects of the market. The overall ice cream market is estimated at over 250 mn litre valued at around Rs. 17 bn. Nearly a fourth of the market by volume at 50 mn litres is in the organized sector with players like Amul, Hindustan Unilever, Mother Dairy, Vadilal having a major share. In value terms, the organized sector has an overall market of over Rs. 10 bn.

2.3 Difference Between Frozen Dessert and Ice-Cream

According to Food Safety and Standard Regulations 2011, Ice Cream, Kulfi, Chocolate Ice Cream or Softy Ice Cream (hereafter referred to as the said product) means the product obtained by freezing a pasteurized mix prepared from milk and /or other products derived from milk with or without the addition of nutritive sweetening agents, fruit and fruit products, eggs, etc. The product shall conform to the compositional specifications provided in the table below:

Requirement	Ice cream	Medium Fat Ice cream	Low Fat Ice cream
Total Solid	Not less than 36%	Not less than 30%	Not less than 26%
Weight/volume (g/l)	Not less than 52%	Not less than 47%	Not less than 47%
Milk Fat	Not less than 10%	More than 2.5% but less than 10%	Not more than 2.5%
Total Protein	Not less than 3.5%	Not less than 3.5%	Not less than 3%

Frozen Dessert or Frozen Confection means the product obtained by freezing a pasteurized mix prepared with edible vegetable oils or fats, having a melting point of not more than 37 °C or vegetable protein products, or both. It may also contain milk fat and other milk solids with the addition of nutritive sweeteners and other permitted non-dairy ingredients. The said product may contain incorporated air and may be frozen hard or frozen to a soft consistency.

Therefore, as per regulations Ice Creams do not contain edible vegetable oils or fats or vegetable proteins but Frozen Desserts do.

2.4 Type of Ice Cream

a) Hard Ice Creams: This is the traditional type of ice cream which is made using milk, sweeteners, cream, eggs, sugar, and stabilizers. These ice creams are found in shops, cafes and ice cream parlours in different ice cream flavours list.

b) French Ice Creams: These ice creams are made using custard base along with milk, cream, egg yolks, etc. These ice creams are also popularly known as custard ice creams.

c) Light Ice Creams: These are just like the regular easy ice creams with only one minute difference. The milk that is used for preparing these ice creams contains 25% less fat.

d) Organic Ice Creams: This type of ice cream contains the ice cream names that are made using only the natural and organic ingredients. These ice creams are generally considered as good ice cream as they have no side effects on the body.

e) No Sugar Ice Creams: As the name indicates, these ice creams are made by either using artificial sweeteners or sugar substitutes. Some of the latest ice creams are being made using this recipe so as to help the people taste the flavors of ice cream along with taking care of their daily diet. These ice creams can also be termed as sugar-free ice creams.

f) Soft Ice Creams: These soft ice creams are prepared at higher temperatures than the regular ice creams. The production process conducted at a higher temperature helps the ice cream mixtures to be soft, smooth and creamy for the maximum amount of time.

g) Lactose-Free Ice Creams: Lactose is a kind of sugar that is generally found in milk and most of the dairy products. There are many people who have lactose intolerance, which means that they have a problem with digesting lactose.

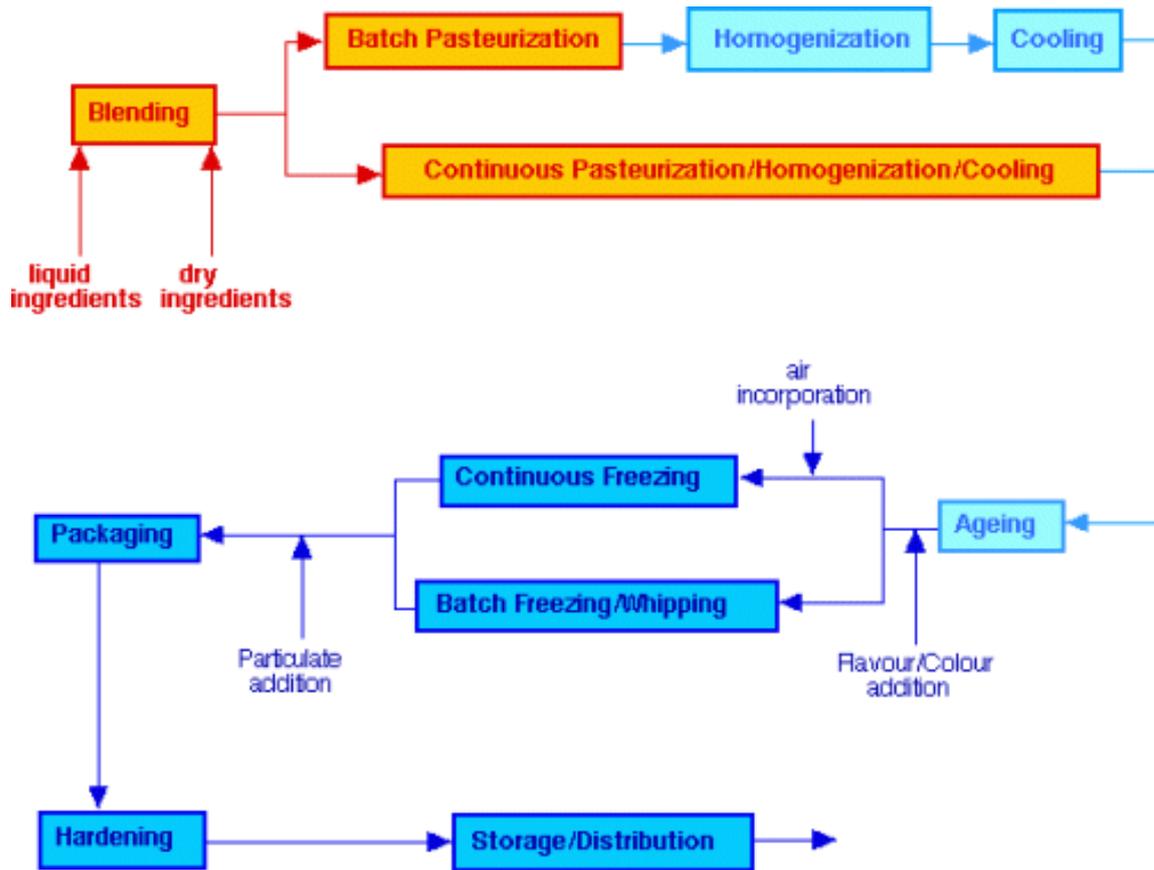
h) Gluten-Free Ice Creams: Gluten-free ice creams are for people who have celiac disease or people suffering from gluten sensitivity. The celiac diseases are hard to inspect and thus special care should be taken for these people.

2.5 Ice Cream Processing Flow Chart

The basic steps in the manufacturing of ice cream are generally as follows:

- blending of the mix ingredients
- pasteurization
- homogenization
- aging the mix
- freezing
- packaging
- hardening
- storage

Process flow diagram for ice cream manufacturing is presented below.



2.6 Ingredients Required for Producing Ice-Cream

Ingredients used for the production of Ice-Cream lies under two categories:

- 1) Dairy Products
- 2) Non-dairy products

The dairy products used for the preparations of ice cream is listed below:

- a. Sweet cream
- b. Unsalted butter
- c. Whole milk
- d. Skim milk
- e. Skim milk powder

Non-Dairy Products: Several types of non-dairy products are used for the preparations of ice cream. In FSSAI has restricted the use of the role

Non-dairy product	Function
Sweetening agents like Sucrose	<ul style="list-style-type: none"> ✓ Sweetens ice-cream ✓ Improves taste ✓ Smoothens body and texture

	✓ Gives ice-cream faster melting quality
Stabilizers	<ul style="list-style-type: none"> ✓ Helps preserve emulsion ✓ Helps reduce growth of ice crystals during storage ✓ Provides uniformity to ice-cream mix ✓ Helps delay melting
Added flavours	✓ Improves appearance, texture, and taste
Added colours	✓ Improves appearance of ice-cream
Fruits and nuts	✓ Enhances flavour of ice-cream

2.7 Step wise for Ice Cream manufacturing

2.7.1 Preparation of Ice-Cream Mix: The most important process while producing ice-cream for the determination of the following:

- ❖ composition of the mix
- ❖ amount of ice-cream to be made
- ❖ composition of ingredients to be used

Ingredients for Frozen Dessert Mix is different from the ingredients for Plain Ice-Cream Mix or Premium Ice-Cream Mix. Skim milk is used for Frozen Dessert Mix while full fat milk is used for Premium Ice-Cream Mix. A total solid of 36.0 % to 40.0 % results into organoleptically acceptable ice-cream. Premium ice-cream (high fat) will have lower SNF than average (moderate fat) ice-cream. Thus, 16 % fat ice-cream should ideally have 17 % sugar as against 15 % sugar for ice-creams with 10 % fat.

All the ingredients (like Milk, Butter, SMP, Sugar, Stabilizer and Emulsifier) were weighed as per mix calculations and put in the steam jacketed blender for dissolving and blending. Blending is the initial step for operation of the ice-cream manufacturing process. In this step, all the ingredients are added to milk at different temperatures as per the process.

Pearson square method is generally used for the calculation of product mix. The other important consideration is a correct total solid to water ratio. If the ratio is too high, it results in sandiness and rough texture of the ice cream. If the ratio is too low, it results in the ice-cream having glassy or icy texture along with weak body.

2.7.2 Pre-Heating Ice-Cream Mix: The objective of pre-heating the mix is to increase the temperature of the mix for appropriate mixing of all ingredients. It helps to avoid lumpiness of dry ingredients. It also increases the efficiency of pasteurization and homogenization of the mix. Usually, pre-heating is conducted at a temperature between 20 to 25°C.

2.7.3 Homogenization of the Ice-Cream Mix: The main purpose of homogenization is to make a permanent and uniform suspension of fat. This is done by reducing the size of the fat globule to a very small diameter preferably not more than 2 microns. Homogenization of mix is carried out at 63–77°C with the help of a 2-stage homogenizer (pressure at the 1st stage: 2500 psi and at the 2nd stage: 500 psi respectively)

The benefits of the homogenization are:

- Prevents fat separation during ageing
- Produces more uniform ice-cream with a smoother texture
- Improves whipping ability
- Shortens ageing period
- Decreases the risk of churning occurring in the freezer
- Helps in the process of stabilization

2.7.4 Pasteurization of the Ice-Cream Mix: An ice-cream mix may contain various types of microorganisms, especially pathogens. Hence, it is important to pasteurize the ice-cream mix. The general standards for pasteurizing the ice-cream mix are:

- ✓ LTLT method – 68.5⁰ C for not less than 30 minutes
- ✓ HTST method – 80⁰ C for not less than 25 seconds

A continuous type pasteurization method is employed in most of the dairies where the mix is pasteurized at 82 to 86⁰ C for 25 seconds.

The advantages of pasteurization are:

- Renders the mix completely free of pathogenic bacteria, without disturbing the nutritive and acceptable quality of the mix
- Dissolves and helps to blend the ingredients of the mix
- Improves the flavour of the mix
- Improves the ice-cream's keeping quality
- Helps to maintain uniformity in production

2.7.5 Cooling and Ageing of the Ice-Cream Mix: After heating/pasteurizing, the mix is sent to the cooling section. In this section, temperature is reduced from 82° C/84° C to 6 °C. This is done to facilitate the process of ageing the ice-cream mix. Ageing refers to the process of holding the mix at a low temperature for a definite time before freezing. The

ageing temperature has to be maintained at 5° C. The ageing time under average commercial conditions may be 3-4 hours.

Ageing is used to:

- Improve body and texture of ice-cream
- Improve whipping capacity of mix
- Increase maximum overrun
- Increase resistance to melting

2.7.6 Freezing the Ice-Cream Mix and Overrun: After ageing, the mix is ready for freezing. Freezing is important as it helps to ensure the quality, palatability, and satisfactory overrun in the finished product. The freezing time for continuous ice-cream freezers is 24 seconds for temperatures between -6 to -5 °C. The function of the freezing process is to freeze a portion of the water of the mix and to incorporate air into the mix. This process takes less than 2 minutes.

This is done by:

- Lowering the temperature of the mix from ageing temperature to the freezing point
- Freezing a portion of the water in the mix
- Incorporating air into the mix
- Cooling ice-cream from the temperature at which it is drawn from the freezer
- Hardening the ice-cream till room temperature while sensible heat is being removed and before any ice crystal formed

Overrun is the volume of ice-cream obtained in excess of the volume of the mix. It is expressed in percentage. This increased volume is due to the air incorporated during the freezing into the ice-cream.

It mainly depends upon:

- The composition of the mix
- The method of processing

Overrun gives the body of ice-cream mix proper texture and palatability necessary to a good quality product. Too much of overrun produces snowy, fluffy, unpalatable ice-cream. Too little overrun produces soggy, heavy products.

2.7.7 Packaging of Ice-Cream:

After drawing the ice-cream from the freezer, it is usually collected in containers to give it desired shape or size for convenient handling during the hardening and marketing processes.

The main requirements for packaging of ice-cream are:

- Protection against contamination
- Attractive appearance
- Ease of opening and re-closure
- Ease of disposal
- Protection against moisture loss
- Ability to withstand temperature fluctuation

The packaging materials generally used are:

- Wax coated fibre board cartons
- Polythene wax blends for protection against moisture and oxygen
- Plastic cylinder containers
- Polycups
- Sticks
- Bars

2.7.8 Hardening and Storage of Ice-Cream: For hardening, ice-cream is put into trays and placed in hardening tunnels. At this point, ice-cream has a semi-fluid consistency and is not stiff enough to hold its shape. During the process of hardening, ice-cream is brought to a temperature between -25 to -35⁰C or below. In the freezer, quick hardening is desirable since slow hardening favours large ice crystals and coarseness. The factors affecting hardening time are:

- Size and shape of the ice-cream package
- Speed of air circulation
- Temperature of cooling air
- Sections of hardening room
- Temperature of ice-cream drawn from the freezer
- Composition of mix
- % overrun in the ice-cream being hardened

Chapter – 3

Packaging

3.1 Selection of packing material for Ice cream packing

When ice cream is drawn from the freezer, it is put into containers that give it the desired form and size for convenient handling during the hardening, shipping and marketing processes. The type of package can be cups, tubs, cones, wrappers, etc. Following factors need to be considered for the selection of ice cream container

- a. Cost
- b. Protection against moisture loss, temperature loss and contamination.
- c. Ease of handling and disposal (i.e. ease of opening and reclosure, if required)
- d. Effect upon the quality of ice cream
- e. Neatness of appearance
- f. Advertising that package may carry.
- g. Storage problem.
- h. Point of consumption in relation to the location of the factory.
- i. Size of unit desired
- j. Bulk containers

The three types of packaging materials used for Bulk containers for ice cream include:

- Fiber board containers
- Metal containers
- Plastic (Polyethylene) containers

Wrappers: These may be composed of vegetable parchment or foil laminate.

Containers can be made up of fiberboard, either paper or card board which has been treated to make it impervious to moisture. Plastic (polystyrene) or wax-coated paperboard cartons may also be used.

3.2 Shelf life of ice cream

The most frequently occurring textural defect in ice cream is the development of a coarse, icy texture. Iciness is also the primary limitation to the shelf life of ice cream and probably also accounts for countless lost sales through customer dissatisfaction with quality. The

shelf-life of ice cream depends entirely on its conditions of storage. It might be one year, or it might be two weeks or less.

3.3 Storage Conditions:

The optimum temperature of safe storage is 0°F (-18°C) or colder. The temperature in the retail market store's freezer case should not be above 10°F (-12°C). If kept at a proper temperature, ice cream will be thoroughly frozen and will feel hard to the touch.

Chapter – 4

Food Safety Regulations and Standards

4.1 Registration and Licensing of Food Business

All Food Business Operators in the country will be registered or licensed in accordance with the procedures laid down

Registration of Petty Food Business

- a. Every petty Food Business Operator shall register themselves with the Registering Authority by submitting
- b. An application for registration in Form A under Schedule 2 of these Regulations along with a fee as provided in Schedule 3.
- c. The petty food manufacturer shall follow the basic hygiene and safety requirements provided in Part I of Schedule 4 of these Regulations and provide a self-attested declaration of adherence to these requirements with the application in the format provided in Annexure-1 under Schedule 2.
- d. The Registering Authority shall consider the application and may either grant registration or reject it with reasons to be recorded in writing or issue notice for inspection, within 7 days of receipt of an application for registration.
- e. In the event of an inspection being ordered, the registration shall be granted by the Registering Authority after being satisfied with the safety, hygiene and sanitary conditions of the premises as contained in Part II of Schedule 4 within a period of 30days.
- f. If registration is not granted, or denied, or inspection not ordered within 7 days as provided in above sub regulation (3) or no decision is communicated within 30 days as provided in above sub regulation (4), the petty food manufacturer may start its business, provided that it will be incumbent on the Food Business Operator to comply with any improvement suggested by the Registering Authority even later.
- g. Provided that registration shall not be refused without giving the applicant an opportunity of being heard and for reasons to be recorded in writing.
- h. The Registering Authority shall issue a registration certificate and a photo identity card, which shall be displayed at a prominent place at all times within the premises or vehicle or cart or any other place where the person carries on sale/manufacture of food in case of Petty Food Business.

- i. The Registering Authority or any officer or agency specifically authorized for this purpose shall carry out food safety inspection of the registered establishments at least once in a year. Provided that a producer of milk who is a registered member of a dairy Cooperative Society registered under Cooperative Societies Act and supplies or sells the entire milk to the Society shall be exempted from this provision for registration.

4.2 Hygienic, Sanitary and Good Manufacturing Practices (GMP/GHP)

In addition to Part-II, the dairy establishment in which dairy based food is being handled, processed, manufactured, stored, distributed and ultimately sold by the food business operator, and the persons handling them should conform to the sanitary and hygienic requirement, food safety measures and other standard as specified below.

1. Sanitary requirements
 - a. Facilities for the hygienic handling and protection of raw materials and of non-packed or non-wrapped dairy products during loading and unloading, transport & storing including Bulk Milk cooling facilities.
 - b. Special watertight, non-corrodible containers to put raw materials or dairy products intended for human consumption. Where such raw materials or dairy products are removed through conduits, these shall be constructed and installed in such a way so as to avoid any risk of contamination of other raw materials or dairy products;
 - c. A waste water disposal system which is hygienic and approved;
 - d. Facilities for cleaning & disinfecting of tanks used for transporting dairy products and raw milk. These containers have to be cleaned after every use.
 - e. The occupier of a dairy establishment shall take appropriate measures to avoid cross-contamination of dairy products in accordance with the cleaning program as specified in point 9.1 of Part II.
 - f. Where a dairy establishment produces food stuffs containing dairy products together with other ingredients, which have not undergone heat treatment or any other treatment having equivalent effect, such dairy products and ingredients, shall be stored separately to prevent cross-contamination.
 - g. The production of heat-treated milk or the manufacture of milk-based products, which might pose a risk of contamination to other dairy products, shall be carried out in a clearly separated working area.

- h. Equipment, containers and installations which come into contact with dairy products or perishable raw materials used during production shall be cleaned and if necessary disinfected according to a verified and documented cleaning programme.
- i. Equipment, containers, instruments and installations which come in contact with microbiologically stable dairy products and the rooms in which they are stored shall be cleaned and disinfected according to a verified and documented. Food Safety management programme drawn up by the owner/occupier of the dairy establishment.
- j. Disinfectants and similar substances used shall be used in such a way that they do not have any adverse effects on the machinery, equipment, raw materials and dairy products kept at the dairy establishment. They shall be in clearly identifiable containers bearing labels with instructions for their use and their use shall be followed by thorough rinsing of such instruments and working equipment with potable water, unless supplier's instructions indicate otherwise.

2. Personal hygiene requirements

- a. 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.
- b. Persons working directly with and handling raw materials or dairy products shall maintain the highest standards of personal cleanliness at all times. In particular they shall
 - wear suitable, clean working clothes and headgear which completely encloses their hair;
 - Wash their hands at least each time work is resumed and whenever contamination of their hands has occurred; e.g. after coughing / sneezing, visiting toilet, using telephone, smoking etc.
 - (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.
 - 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 before resuming work after such actions

3. Sanitary requirements for storage

- a. Immediately after procuring, raw milk shall be placed in a clean place, which is suitably equipped so as to prevent any kind of contamination.
- b. 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.
- c. If raw milk is brought to the dairy plant by a producer or farmer then it shall be ensured 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 that temperature until processed.
- d. Where raw milk is collected daily from a producer, it shall be cooled immediately to a temperature of 4°C to 6°C or lower and maintained at that temperature until processed;
- e. When the pasteurization process is completed, pasteurized milk shall be cooled immediately to a temperature of 4°C or lower. Subject to Paragraph 7 below, any dairy product not intended to be stored at ambient temperature shall be cooled as quickly as possible to the temperature established by the manufacturer of that product as suitable to ensure its durability and thereafter stored at that temperature.
- f. Where 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.
- g. The maximum temperature at which pasteurized milk may be stored until it leaves the treatment establishment shall not exceed 5°C.

4. Wrapping and packaging

- a. The wrapping and packaging of dairy products shall take place under satisfactory hygienic conditions and in rooms provided for that purpose.
- b. The manufacture of dairy products and packaging operations may take place in the same room if the following conditions are satisfied:
 - The room shall be sufficiently large and equipped to ensure the hygiene of the operations;
 - the wrapping and packaging shall have been brought to the treatment or processing establishment in protective cover in which they were placed immediately after manufacture and which protects the wrapping or packaging from any damage during

transport to the dairy establishment, and they shall have been stored there under hygienic conditions in a room intended for that purpose;

- The rooms for storing the 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 products. Packaging shall not be placed directly on the floor;
 - packaging shall be assembled under hygienic conditions before being brought into the room, except in the case of automatic assembly or packaging, provided that there is no risk of contamination of the products;
 - packaging shall be done without delay. It shall be handled by separate group of staff having experience in handling and product wrapping and
 - immediately after packaging, the dairy products shall be placed in the designated rooms provided for storage under required temperature.
- c. Bottling or filling of containers with heat-treated milk and milk product shall be carried out hygienically.
- 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 milk or liquid milk-based products have 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.

4.3 Packaging and Labelling

The packaging design and materials shall provide protection for products in order to prevent contamination, damage and accommodate required labelling as laid down under the FSS Act and the Regulations there under. Only food grade packaging materials shall be used as primary packaging material. Packaging materials like aluminium, tin and plastic shall conform to the Indian standards as mentioned under the FSS Regulations from time to time. The food packaging materials shall be inspected before use to avoid using damaged, defective or contaminated packaging, which may lead to contamination of the product.

- The wrapping and packaging of dairy products shall take place under satisfactory hygienic conditions and in rooms provided for that purpose.

- The rooms for storing the 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 products. Packaging shall not be placed directly on the floor.
- Packaging shall be done without delay followed by labelling. If it is not the case, appropriate procedure shall be applied to ensure that no mix-ups or mislabelling could occur. It shall be handled by separate group of staff having experience in handling and product wrapping and immediately after packaging; the dairy products shall be placed in the designated rooms provided for storage under required temperature.
- Packaging material/wrapping materials shall be protected from external environment/contamination during transport and storage. Facilities shall be established for safe and hygienic storage of packing materials at the dairy plant.”
- 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.
- “Packaging of milk and milk products shall be carried after processing. The packages should be designed so as to ensure they are tamper proof and are not easily damaged during general handling /operation. Once the packages are opened it should be easily identifiable and cannot be duplicated against a fresh/unopened package”.
- The ink used for printing of primary food packaging should be of food grade quality. This should comply with **IS 15495** standards or other international standards for use in food packaging and printing.

4.4 Coding and Labelling of Packaging Material

Fluid milk: The caps of the milk bottles /pouch/aseptic pack 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

4.5 Exemptions from labelling requirements

Where the surface area of the package is not more than 100 square centimetres, the label of such package shall be exempted from the requirements of list of ingredients, Lot Number or Batch Number or Code Number, nutritional information and instructions for use, but this information shall be given on the wholesale packages or multi piece packages, as the case may be.

1. The 'date of manufacture' or 'best before date' or 'expiry date' may not be required to be mentioned on the package having surface area of less than 30 square centimetres but this information shall be given on the wholesale packages or multi piece packages, as the case may be;
2. In case of liquid products marketed in bottles, if such bottle is intended to be reused for refilling, the requirement of list of ingredients shall be exempted, but the nutritional information specified in regulation 2.2.2 (4) these regulations shall be given on the label. Provided that in case of such glass bottles manufactured after March 19, 2009, the list of ingredients and nutritional information shall be given on the bottle.
3. “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”.
4. In case of food with shelf-life of not more than seven days, the 'date of manufacture' may not be required to be mentioned on the label of packaged food articles, but the 'use by date' shall be mentioned on the label by the manufacturer or packer.
5. In case of multi piece packages the particulars regarding list of ingredients, nutritional information, Date of manufacture/ packing, best before, expiry date labelling of irradiated food and, vegetarian logo/non vegetarian logo, may not be specified.

4.6 Date of manufacture or packing

The date, month and year in which the commodity is manufactured, packed or pre-packed, shall be given on the label:

Provided that the month and the year of manufacture, packing or pre-packing shall be given if the “Best Before Date” of the products is more than three months:

Provided further that in case any package contains commodity which has a short shelf life of less than three months, the date, month and year in which the commodity is manufactured or prepared or pre-packed shall be mentioned on the label.

Best Before and Use By Date

- i) the month and year in capital letters upto which the product is best for consumption, in the following manner, namely:

“BEST BEFORE MONTHS AND YEAR

OR

“BEST BEFORE MONTHS FROM PACKAGING

OR

“BEST BEFOREMONTHS FROM MANUFACTURE

(Note: — blank be filled up)

- ii) In case of package or bottle containing sterilised or Ultra High Temperature treated milk, soya milk, flavoured milk, any package containing bread, dhokla, bhelpuri, pizza, doughnuts, khoa, paneer, or any uncanned package of fruits, vegetable, meat, fish or any other like commodity, the declaration be made as follows

“BEST BEFOREDATE/MONTH/YEAR”

OR

“BEST BEFORE.....DAYS FROM PACKAGING”

OR

“BEST BEFOREDAYS FROM MANUFACTURE”

Note:

(a) blanks be filled up

(b) Month and year may be used in numerals (c) Year may be given in two digits

(iii) On packages of Aspartame, instead of Best Before date, Use by date/recommended last consumption date/expiry date shall be given, which shall not be more than three years from the date of packing;

(iv) In case of infant milk substitute and infant foods instead of Best Before date, Use by date/recommended last consumption date/expiry date shall be given, Provided further that the declaration of best before date for consumption shall not be applicable

4.7 Documentation and Record Keeping

Every organization has to maintain records of raw material procurement, production processes, and sales. This is to ensure that the business runs effectively and is profitable. Listed below are some reasons why there is a need for documentation:

1. It gives detailed knowledge about running the business.
2. It helps to control product quality.
3. It helps to keep track of the money invested in the business.
4. It helps to identify the separate costs of raw material or product ingredients.
5. It helps to identify the production cost of a particular process.
6. It helps to make sure that all the quality assurance practices were followed during the production.
7. It helps to make sure that the production equipment is running smoothly/effectively.
8. It works as an evidence for legal procedures.
9. It helps to set an appropriate product price.
10. It helps to take corrective measures at the right time.

4.8 How to Keep Records?

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

- The quantity and type of raw materials received
- The quantity and type of ingredients used during processing

- The processing conditions in which production took place (e.g. the temperature set or the air pressure applied)
- The product quality produced

Product quality can be maintained only when:

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

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

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

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

Chapter – 5

Cleaning and CIP

5.1 Tanker Washing

The main objective of this unit is to clean the tankers properly after unloading or before uploading milk or any other dairy ingredients to avoid microbial and bacterial growth.

Stepwise washing operation:

- Circulate Caustic solution for 15min. (1 – 1.5%) at 70 – 75⁰C.
- Flush out Caustic with water.
- Circulate with hot water for 15min. (80 – 85⁰C)
- Allow temperature to cool down
- Get QA clearance

5.2 Crate Washing:

Normally a semi-automatic crate washer is used for cleaning the crates. The washer cleans the crates in stages

Solid waste removal – Manually

1. Pre-rinse
2. Hot water and caustic solution
3. Final rinsing

5.3 CIP of raw milk tank, multipurpose tank etc.

- Flush Silo with necessary water
- Clean (by brushing) the door of the manhole and sampling point with soap oil and water.
- Circulate Caustic solution for 20min. (1 – 1.5%) at 70 – 75⁰C.
- Flush out Caustic with water.
- Circulate with acid for 20min. (0.6 – 1.0%) at 60 – 65⁰
- Circulate with hot water for 20min. (80 – 85⁰C)
- Allow temperature to cool down

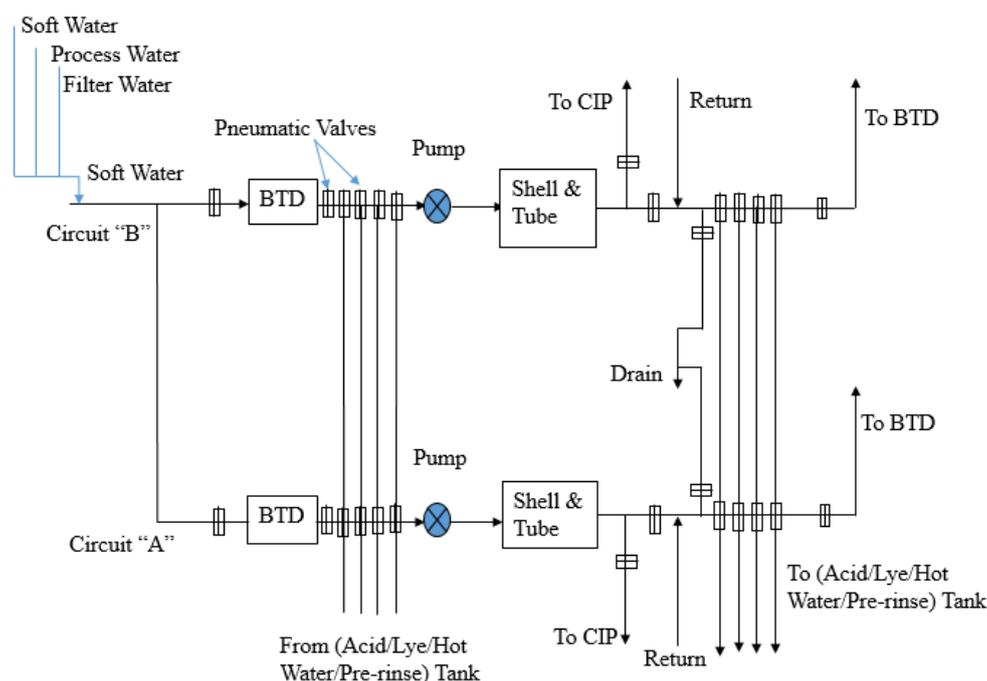


Fig: A two station CIP Circuit(model)

5.4 Effluent Treatment Plant (ETP)

ETP is a 24 hrs. continuous process. It takes hazardous outlet from all the process as inlet, treat it in three stages (Primary, Secondary and Tertiary stage) to reach the environmental standard. The outlets of the plant namely solid waste and treated water are respectively disposed in field and used for irrigation purpose in plant to develop green belt.

Effluent Sources:

1. CIP: Caustic and Nitric Acid
2. Backwash: Water
3. Tanker wash: Caustic and Nitric Acid
4. Boiler: Water
5. Caret wash: Caustic

Stepwise description of ETP functioning:

- 1) Screen chamber: Raw effluent from the plant is received by screen chamber and suspended particles are removed here.

- 2) Collection and equalization tank: After the screening the effluent enters the collection and equalization tank, where it is neutralized with hydrochloric acid and the effluent is made homogeneous.
- 3) Holding tank: It only meant for storage when excess amount of effluent is discharged from plant during CIP
- 4) Dissolved Air Flootation (DAF): The neutralized effluent from collection and equalization tank is received here and aluminum sulphate (a non-ferric alum) is added. The suspended and emulsified solids are separated here.
- 5) Buffer tank: It is an over flow storage tank
- 6) Up blow Anaerobic Suspended Sludge Blanket (UASSB) Reactor (I&II): 12% to 15% of the total volume of this tank is filled with biomass. It receives the effluent from DAF from the bottom of the tank. There are two type of bacteria present here.
 - a. Acetogenesis: - It converts the large chain molecule to small chain molecule and produces amino acid.
 - b. Methenogenesis: - It converts to methane gas, and hence organic load decreases
- 7) Hopper bottom tank: It is just a tank to control the escaped microbes from UASSBR and again recirculate it.
- 8) Aeration tank: In this tank aerobic microbes are developed
- 9) Lamella clarifier: It is used for solid settling purpose i.e. the solid liquid separation takes place here
- 10) Secondary clarifier: Here the aerobic culture is settled and again circulated to aeration tank to maintain the amount.
- 11) Treated water tank: Here the treated water from secondary clarifier or lamella clarifier is collected.

5.5 Plant Performance and Monitoring:

- Carryout regular monitoring program involving maintenance of record and analysis of effluent sample.
- ETP assistants have to collect samples at different stages of treatment system in presence of ETP in-charge for analysis.
- ETP in-charge has to do the analysis and record the result also report the result to EHS-engineer and EHS-officer. EHS-engineer and EHS-officer both will assess the performance of the plant based on laboratory analysis report and instruct the ETP in-charge and assistants about the action to be taken in case of any deviation from normal.

- The treated effluent has to be analyzed on daily basis and the results are recorded

5.6 Environmental Management System (EMS): Implementation and operation:

- 2. Level-1:** EMS manual; describes the core elements of the EMS and their interactions. It outlines the structure of the document used in the EMS in line with-ISO 14001-2004 manual also describe the procedures elaborately how various requirements of ISO 14001-2004 are implemented.
- 3. Level-2:** Documents; the filled formats which conveys the data that affects the environment. Ex – Operational control process, environmental management programs, emergency procedures, monitoring and management plans, training plan etc.
- 4. Level-3:** Formats; used for recording and conveying data effecting the environment