Cleaning, Sanitation & Hygiene Maintenance of Dairy Processing Equipment

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Presentation outline

- ✓ **Introduction**
- ✓ **Cleaning**
  - **Why?**
  - **Agents**
  - **Methods**
- ✓ **Sanitization**
  - **Why?**
  - **Dairy sanitizers**
- ✓ **Hygiene control**
- ✓ **Conclusion**

Introduction

- Raw milk get contaminated with environment, milking persons and utensils

- **Milk is a highly perishable food item-** contamination starts from its production, collection, conveying, processing and storage from plant personnel, packaging material and environmental factors

- Safe milk and milk products → **Right of consumers** → can only be produced through the applicability and maintenance of efficient cleaning, sanitization and hygiene practices


MILKMER


air vent
agitator
inlet
manhole
control box
leg
cooling system
outlet
clean in place system


On/Off switch
Supply can
Regulating cover, float inside
Cream Spout
Bowl chamber
Skim milk spout
Disc washer
Bowl

Cleaning

- ✓Cleaning is the process in which complete removal of food soil (unwanted matter on food-contact surfaces) is accomplished using appropriate detergent chemicals under recommended conditions from the internal and external surface of the equipment

- ✓Some of the precipitates remains intact to equipment after cleaning and forms a film over equipment surface called water stone→ white or grayish film

- ✓Heat denaturation of protein present on the equipment surface or absorbed by other components forms milkstone quickly over heated surfaces

This soil of two types:

Water soluble (sugar, starches and salts easily cleaned by water)

Water insoluble which is further divided in organic and inorganic/ mineral soil

Type of Soil	*Soil Subclass*	*Deposit Examples*
Inorganic soil	Hard-water deposits	Calcium and magnesium carbonates
	Metallic deposits	Common rust, other oxides
	Alkaline deposits	Films left by improper rinsing after use of an alkaline cleaner
Organic soil	Food deposits	Food residues
	Petroleum deposits	Lubrication oils, grease, and other lubrication products
	Nonpetroleum deposits	Animal fats and vegetable oils

- Source :
  - Food product handled
  - Minerals from water residues
  - Residues from cleaning compounds
- Vary widely in composition and solubility properties
- Single detergent not capable of removing different type of soil

- **Biofilm:→**Organism attached to surface with nutrients deposit, grows and multiply
- Entrap organic/inorganic debris, nutrients & other organisms.
- **Results in frictional resistant to flow, impend heat flow across surface**

Milk Stone Composition

- **Accumulation of dried milk solids.**
- **Salts from hot water & cleaning solution.**
- **Ppted./coagulated Milk protein ; Cal.Po4**

Moisture	**2.68 – 8.75 %**
Fat	**3.63 – 17.66 %**
Protein	**4.40 – 43.83 %**
Ash	**42.03 – 67.33 %**

Properties of various food soils

Surface Deposit	Solubility	Ease of Removal	Heat-Induced Reactions
Sugar	Water soluble	Easy	Carmelization
Fat	Alkali soluble	Difficult	Polymerization
Protein	Alkali soluble	Very Difficult	Denaturation
Starch	Water soluble, Alkali soluble	Easy to Moderately Easy	Interactions with other constituents
Monovalent Salts	Water soluble; Acid soluble	Easy to Difficult	Generally not significant
+Polyvalent Salts	Acid soluble	Difficult	Interaction with other constituents

(Schmidt, 2012)

Cleaning: Why?

- Proper cleaning of dairy equipment
  - ✓**Reduces the chance of product contamination at each step by reducing the high initial load of micro-organism through removal of their available nutrients**
  - ✓**Promotes clean and tidy environment that improves operator's moral/confidence and helps to maintain safe work place, creates cleaner production area, prevent/avoid accidents**
  - ✓**Increases the life of equipment by increasing plant efficiency, improves process economy thus profit of the organization**
    - E.g. Efficiency of milk pasteurizer reduces with increase in process time due to scale deposition on its heat exchanger plates and the same can be regained after its adequate cleaning, also true with **Separator**

Cleaning agents

- Cleaning agents are mixture of several chemical compounds employed for a particular function to perform like washing of floors and walls, used in cleaning modes → Manual, COP , CIP

- Mainly used to reduce surface tension of water that results in dislodging and loosening of soil followed by flushing away of the suspend soil particles

- Classified as strong, heavy duty and mild alkaline and acids, employed for a particular use

- Usually, fats, oils, greases, and proteins can be removed with alkaline cleaners at pH ≥11

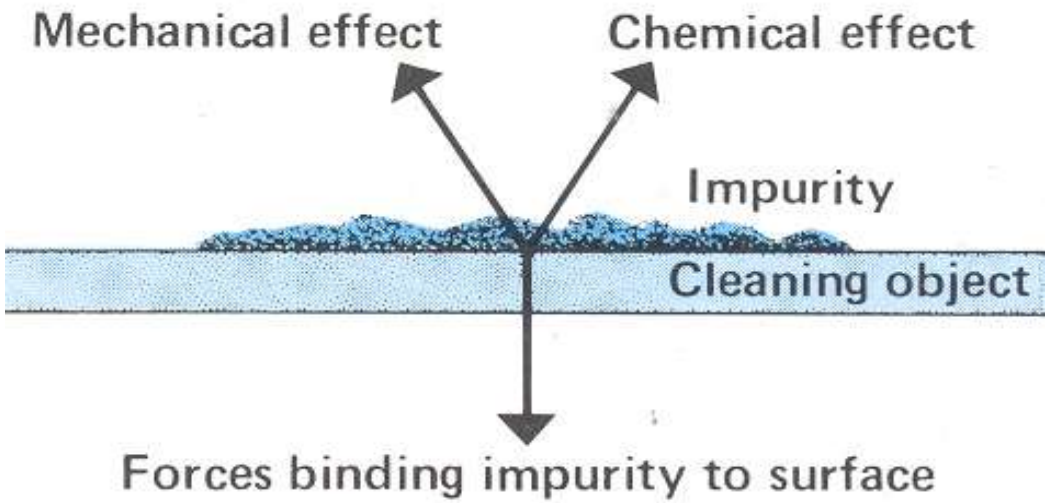
- Sodium hydroxide (caustic soda) potassium hydroxide (caustic potash) →strong alkali →corrosion and tissue damage

- Sodium carbonate (soda ash, mild), and sodium silicates, Trisodium phosphate (TSP)

- Acid based cleaning agents are the blend of phosphoric, nitric, sulfuric and sulfamic acid used to remove encrusted (having a hardened crust as a covering) surface materials and dissolve mineral scale deposits
  - Strong (hydrochloric, hydrofluoric, sulfamic, sulfuric & phosphoric acids)
  - Mild (hydroxyl acetic, acetic, gluconic acid, levulinic)

Basics of Cleaning

- Cleaning is reversal of soiling and requires supply of energy usually in the form of mechanical and chemical energy.



- To overcome the **forces binding** the soil to the surface both mechanical and chemical effect must be provided by cleaning system

EXPRESSION OF CLEANING RESULTS

Degree of cleaning results are expressed in terms of :

- ✓ **Physical cleanliness –**removal of all visible dirt from cleaned surface
- ✓ **Chemical cleanliness –** removal of both visible and microscopic residues not detected by naked eye but by taste or smell only.
- ✓ **Bacteriological cleanliness –** attained by disinfection
- ✓ **Sterile cleanliness –** destruction of all micro organisms.

MECHANISM OF CLEANING

✓ **Cleaning mechanism consists of :**

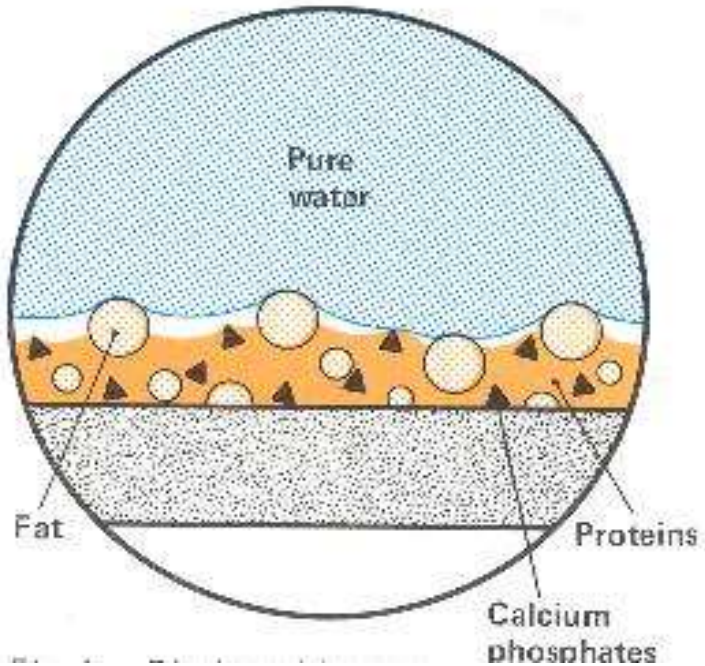
- **Wetting of soiled surface i.e. bringing the cleaning solution into intimate contact with the soil to be removed. For this the solution should have adequate wetting and penetrating properties.**

- **Displacement of the soil from the surface by emulsification, saponification and / or mechanical action.**

- **Dispersion of soil removed from the surface in the cleaning solution by dispersion, de-flocculation.**

- **Rinsing to prevent re-deposition of the dispersed soil on the cleaned surface.**

ACTION OF BLENDED DETERDENTS



Rinsing with water

The water just runs off without wetting the surface –the fat present in the soil prevents contact. Hot water achieves somewhat better result by melting fat.

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Water with wetting agent (surfactant) added.

To obtain contact between the detergent solution and the film of dirt it is necessary to add a wetting agent (surfactant) to lower the surface tension of liquid.

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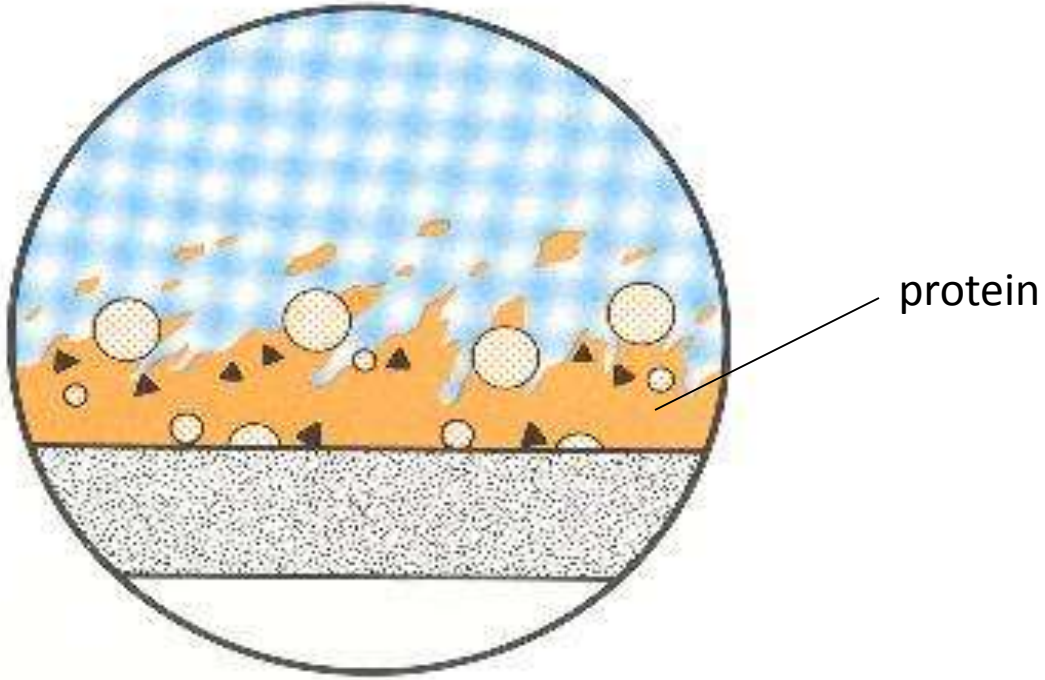

Alkaline detergent in water dissolves protein

The continuous protein phase swells somewhat when it absorbs water. Alkalis reinforce the swelling and dissolves the protein and release other constituents.

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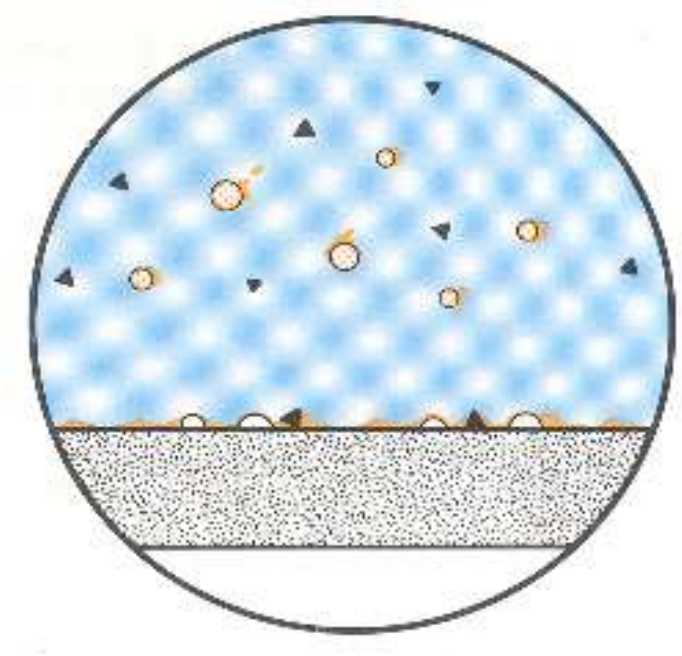

Chelating agent added

Deposits of calcium salts on the surface are loosened and collected by chelating agents in the detergent.

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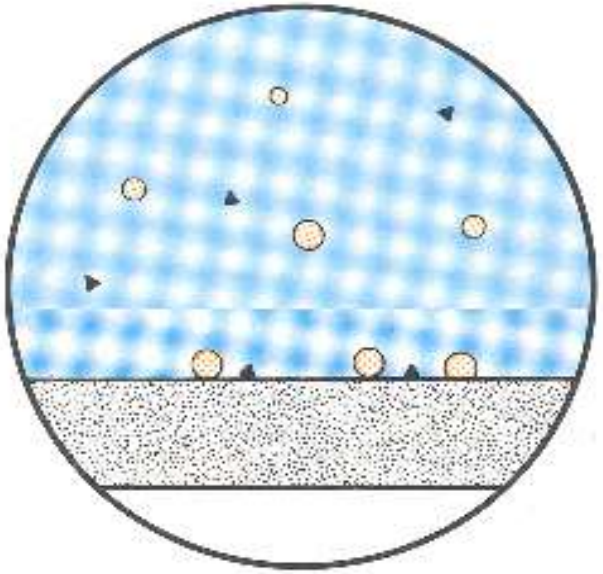

The residual film is now easily flushed away

The dirt deposit now requires only mild mechanical force to flush away remaining deposits of dirt.

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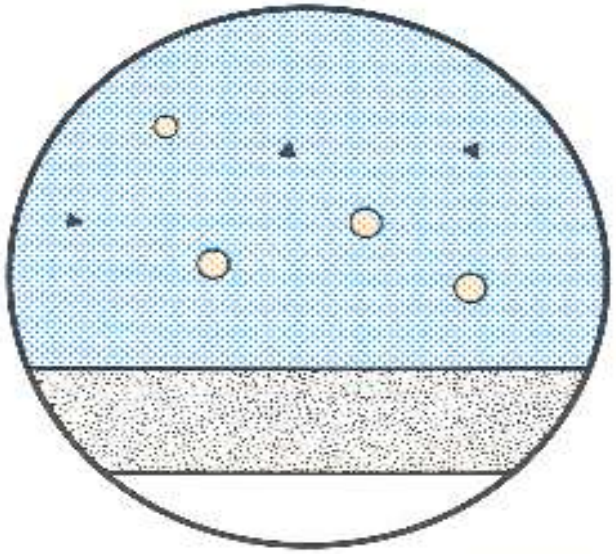


Dust particles are prevented from resettling on the surface

The film of detergent clinging on the surface gets diluted with rinse water. If the detergent lacks the ability to hold the entrained dirt in solution even when diluted, the dirt tend to flocculate and redeposit on clean surface. Detergent must, therefore, be capable of dispersing the suspended particles to prevent flocculation.

PROPERTIES OF DAIRY DETERGENT

An **effective and fast-acting detergent** should have:

- **Ability to dislodge dirt from the equipment surface**
- **High wetting effect to enable the detergent to penetrate dirt deposits.**
- **Ability to break up the deposits and keep them dispersed so that they are not re-deposited.**
- **Ability to dissolve calcium salt deposit from the equipment surface.**
- **Ability to hold calcium salts in solution so that no scale deposits are left after cleaning.**
- **Moderate to low foam generation capacity.**
- **Non- corrosive.**

BIO-DETERGENTS

- Alternative to synthetic detergents
- Fast emerging
- Low toxicity
- Non-corrosive
- Environmental friendly
- Enhanced cleaning properties

ENZYME BASED DETERGENT

Type	Substrate	Reaction
Protease	Protein / polypeptide	Hydrolysis of amide/peptide bond
Lipase	Mono /di /tri glycerides	Easter bond
Amylase	Amylose / amylopectin	A-1,4 glycisidic linkage
Cellulase	cellulose	B-1,4 glycosidic linkage

Branded bio-detregents

- **Proteases - Alcalase, Durazyme, Esperase, Maxatase, Optimase**
- **Lipases – Lipolase, Lipomax, Lumafest**
- **Amylases – Maxamyl, Optiamyl**

✓Firms – Gist-Brocade, Nova-Nordisk,Genecor, Solvay enzymes

Cleaning cycle

Steps	Purpose
1. Recovery of product residue (flushing, scraping, blowing etc)	•Minimizes product loss •Reduces load on sewage system •Saving in sewage treatment cost
2. Pre-rinse (warm water)	•Removes visible soil, Melt fats •Prevent protein adherence •Prevent thermal shock
3. Wash (detergent)	•Removes remaining soil •Chemicals lift biofilms that bind to equipment surfaces
4. Post-rinse	•Removes suspended soils and chemical residues •Prepares surface for sanitization
5. Sanitization	•Kills bacteria that remain on equipment surface •Must be in contact with surfaces for sufficient time

Cleaning methods

- Equipment cleaning can be accomplished in various ways

1. **Mechanical Cleaning**: **Often referred to as clean-in-place (CIP), requires no disassembly or partial disassembly- choice of modern automatic plants**

2. **Clean-out-of-Place (COP):can be partially disassembled and cleaned in specialized COP pressure tanks**

3. **Manual Cleaning**: **requires total disassembly for cleaning and inspection**

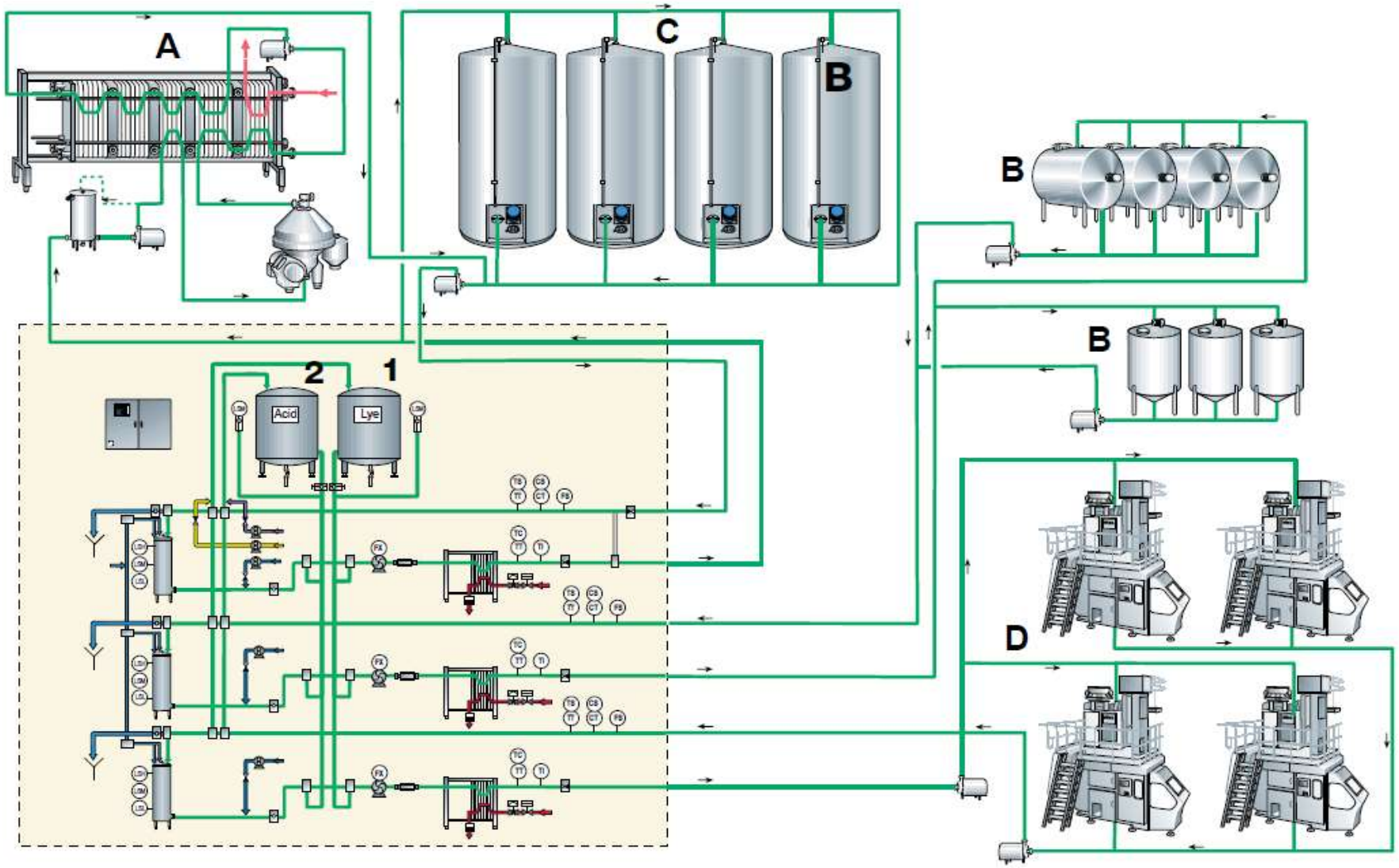
Cont…

- **A CIP program for a pasteurizer circuit can consist of the following stages**
  - i. **Rinsing with warm water for about 10 minutes**
  - ii. **Circulation of an alkaline detergent solution (0.5 – 1.5%) for about 30 minutes at 75°C**
  - iii. **Rinsing out alkaline detergent with warm water for about 5 minutes**
  - iv. **Circulation of (nitric) acid solution (0.5 – 1.0 %) for about 20 minutes at 70°C**
  - v. **Post-rinsing with cold water**
  - vi. **Gradual cooling with cold water for about 8 minutes**
  - vii. **Disinfection by circulating hot water at 90 – 95°C for 10 –15 minutes after the returning temperature is at least 85°C**

(Tetra Pak handbook)

CIP PROGRAM FOR COLD COMPONENTS

- Rinse with water for 3 min.
- Circulation of alkaline detergent at 70-75^{0}C for 6 min
- Rinsing with hot water at 90^{0}C for 3 min



Cleaning unit (with in broken lines)

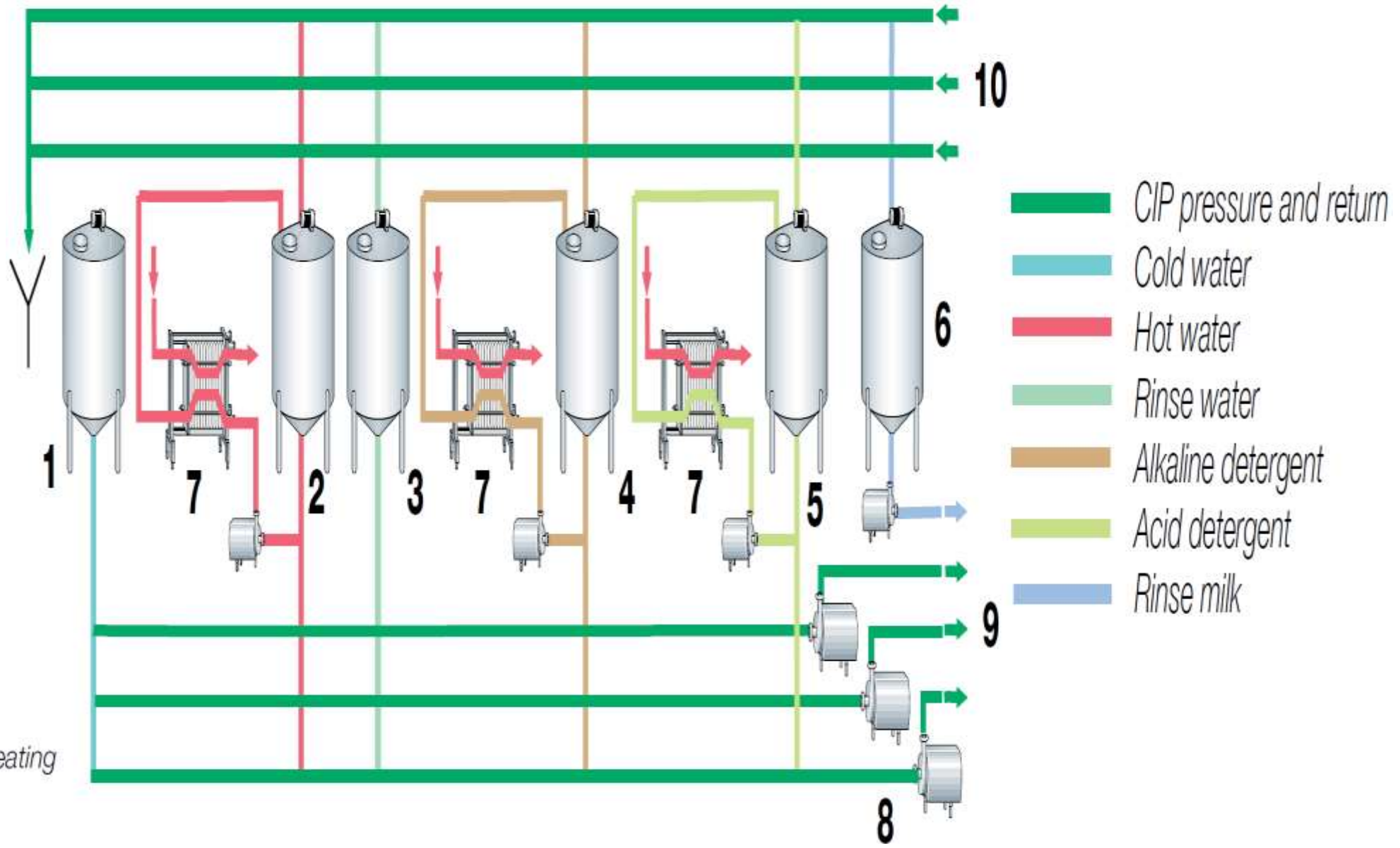
1. Tank of alkaline detergent
2. Tank of acid detergent

Objects to be cleaned

A. Milk pasteurizer
B. Tanks
C. Silo tanks
D. Filling Machines

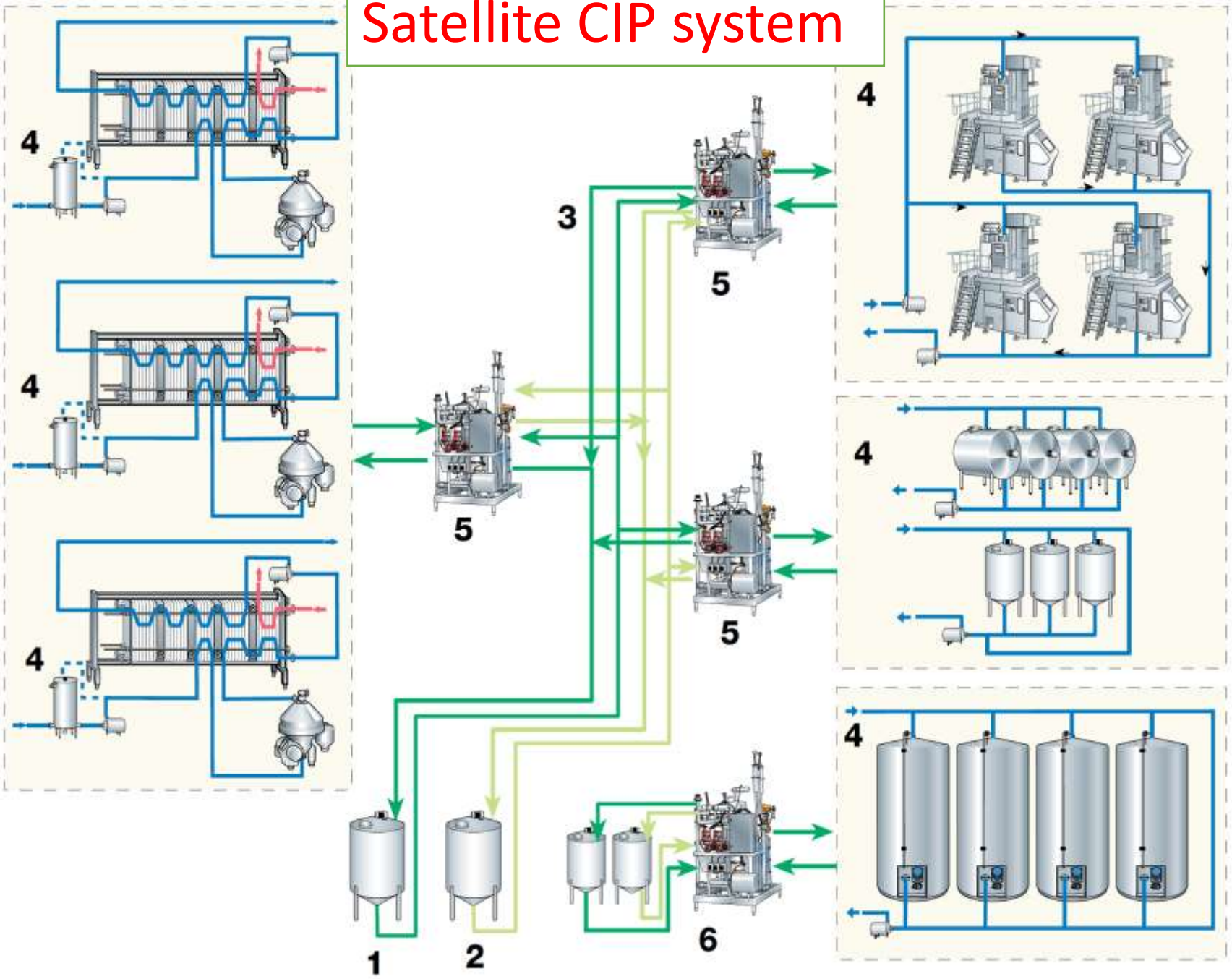
Centralized CIP System

General design of Central CIP system



1 Cold water tank
2 Hot water tank
3 Rinse water tank
4 Alkaline detergent tank
5 Acid detergent tank
6 Rinse milk tank
7 Plate heat exchanger for heating
8 CIP pressure pumps
9 CIP pressure lines
10 CIP return lines

Satellite CIP system



1 Storage tank for alkaline detergent
2 Storage tank for acid detergent
3 Ring lines for detergents
4 Objects to be cleaned
5 Satellite CIP unit
6 Decentralised CIP system with its own detergent tanks

Cleaning of Membrane systems

- Governed by membrane material
- Strictly follow manufacturer instructions
- Very less scope for deviation
- Based on Membrane resistance cleaning chemicals are selected
- Enzyme cleaning: efficient tool in absence of harsh cleaning solutions

Sanitation

- Sanitation was originated from ***Sanitas*** (Latin word) having meaning "health" but the same word has another meaning "creation and maintenance of hygienic and healthful conditions" in food industry

- It is considered as a **joint venture of principles of design, development, execution, maintenance, restoration, improvement of hygienic practices and conditions**

- Applied for the **creation of hygienic practices intended to continue a clean and healthy environment** from food production to storage

- Usually applied after cleaning operation for the **complete elimination of all types of bacteria**

Why sanitation?

- Product can get **contaminated with in new and well-designed plants** if proper sanitary practices are not adopted

- Its main focus is to **prevent the major food based safety incidents to happen in future**

Major Food Safety Incidents

Agent	Food	Effect
S. enteritidis	Ice cream	~224,000 ill
***E. coli* 0157:H7**	Hamburgers	732 ill, 4 deaths
Benzene	Mineral water	Worldwide recall of 160 million bottles
L. monocytogenes	Hot dogs	101 ill, 21 deaths
Allergens	Many foods	35–40% of U.S. population have food allergies; 150–200 people die each year
Glass	Bottled beer	15.4 million bottles were recalled, destroyed, and replaced

(Marriott and Gravani, 2006)

Dairy Sanitizers

- ✓Most frequently used dairy sanitizers includes steam, hot water and chemical sanitizers
- ✓In steam sanitizing, steam is subjected and maintained on the equipment surfaces for desired time duration
    - •The International Dairy Federation (IDF) recommends circulation of hot water 85°C for 15 minutes for milk pasteurizer sanitization
    - •For enclosed system, minimum circulation of hot water (77°C) for 15 minutes or >5 minutes circulation at 94°C recommended by Food and Drug Administration (FDA)
- ✓In chemical (chlorine, iodine etc.) sanitization, sanitizing solution of **desired concentration is kept in the contact (circulation) of equipment surface for 2-5 minutes with slight back pressure in the pipe lines**
- ✓Also be applied as fogging, spraying and with help of brushes

Characteristics of commonly used sanitizers and application of chemical sanitizers

Characteristics	Steam	Iodophors	Chlorine	Acid	Quats
Germicidal efficiency	Good	Vegetative cells	Good	Good	Somewhat selective
Yeast destruction	Good	Good	Good	Good	Good
Mold destruction	Good	Good	Good	Good	Good
Shelf strength	—	Yes	Yes	Yes	Yes
Stability stock	—	Varies with temperature	Low	Excellent	Excellent
Use	—	Varies with temperature	Varies with temperature	Excellent	Excellent
Speed	Fast	Fast	Fast	Fast	Fast
Penetration	Poor	Good	Poor	Good	Excellent
Film forming	No	None to slight	None	None	Yes
Affected by organic matters	None	Moderate	High	Low	Low
Affected by other water constituents	No	High pH	Low pH and iron	High pH	Yes

Cont...

Characteristics	Steam	Iodophors	Chlorine	Acid	Quats
Ease of measurement	Poor	Excellent	Excellent	Excellent	Excellent
Ease of use	Poor	Excellent	Excellent	High foam	High foam
Odor	None	Iodine	Chlorine	Some	None
Taste	None	Iodine	Chlorine	None	None
Effect on skin	Burns	None	Some	None	None
Corrosive	No	Not to SS	Extensive on mild steel	Bad on mild steel	None
Cost	High	Moderate	Low	Moderate	Moderate

Chemical Sanitizer Applications

Sanitizer	Application
Chlorine	All food-contact surfaces, spray, CIP, fogging
Iodine	All food-contact surfaces, approach as a hand dip
Peracetic acid	All food-contact surfaces, CIP, especially cold temperature and carbon dioxide environments
Quaternary ammonium compounds	All food-contact surfaces, mostly used for environmental control; walls, drains, tiles

(Marriott and Gravani, 2006)

Table: General summary of activities of commonly found disinfectants in the dairy& food industry

Type of disinfectant	Type of micro-organisms							
	Gram +ve	Gram −ve	*Mycobacterium* spp.	*Pseudomonas* spp.	Yeasts	Moulds	Spores	Viruses
Halogens[a]	++	++	++	++	++	+	+	++
QAC[b]	++	+	−	+/−	++	+	−	+/−
QACs + chelator	++	+	−	+	++	+	−	+/−
Peracetic acid	++	++	++	++	+	+	+	++
Amphoterics	++	++	−	+/−	++	+	−	+/−
Amphoterics + chelator	++	++	−	+	++	+	−	+/−
Alcohols (60−70 g 100 mL^{-1})	++	++	−	++	+	+	−	+/−
Acid anionic	+	++	−	+/−	+/−	+/−	−	−
Acid biguanides	++	++	−	+	+	+	−	+/−

[a]Some examples are chlorine, iodine and chlorine dioxide.

[b]Quaternary ammonium compounds.

Note: ++, very active; +, slightly active; −, not effective; +/−, doubtful.

- Amphoteric: not much pH dependent like QACs or acid anionic disinfectants; blended with them surface-active agents→, under certain circumstances, can exist as –Ve, +Ve or zwitterionic species
- Chlorhexidine and polymeric biguanides have a wide spectrum of antibacterial activity against both Gram +ve and Gram-ve bacteria; Biguanides (guanidine derivatives) naturally found in certain vegetables and cereals

Water attributes important to cleaning and disinfection

- *Sanitary quality*. Water used in food plant sanitation must be potable – that is, fit for human consumption
- *Microbiological standards*. The following are the main microbial specifi cations for water, measured in colony forming units (cfu) mL^{-1}: total bacterial count < 100, coliforms absent in 100 mL, and *Escherichia coli* absent in 100 mL.
- *Taste, odour and colour*. Objectionable tastes, odours and colours are usually acquired from rotting vegetation and algae, and are best removed by activated carbon filtration

Suspended matter comprises clay, silt and other organic materials; suspension of more than 1 ppm causes visible turbidity, and is best removed by sedimentation/filtration

- ***Total dissolved solids (TDS).*** This is a measure of all the chemicals dissolved in the water, and is generally not problematic for cleaning and disinfection.
- ***Dissolved gases.*** Some, such as carbon dioxide, can form weak acids, resulting in the need for additional alkali, or in some cases may cause corrosion.
- ***pH.*** This should ideally be between 6.5 and 7.5. Below pH 6.5 corrosion problems will occur. The maximum alkaline pH value allowed is 10.

- ***Alkalinity.*** High bicarbonate alkalinity may contribute to scale formation.
- *Silica.* This is generally not significant in cleaning and disinfection, but on stainless steel surfaces it can form dull layers that are diffi cult to remove.

Sulphides/sulphates. allowable level is 250 µg SO4 L^{-1}

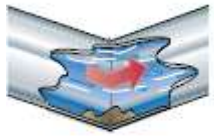
- *Chlorides.* These should not be more than 250 µg mL^{-1} (maximum), but preferably should be below 50 µg mL−1 because of the possibility of corrosion, especially in acidic conditions.
- *Iron*. The maximum is 200 µg Fe L^{-1}; staining will be the main issue here.
- *Manganese.* The maximum is 50 µg Mn L^{-1}
- *Total hardness*. This is the total of all dissolved calcium and magnesium salts, usually expressed as equivalent CaCO3.

Hygiene control

- Main objective of dairy equipment hygiene to **ensure that the quality of dairy products is consistent and keeping quality of such products being preserved** →to **enhance consumer's faith** in these products
- Affected by- **D & L of dairy building, material and construction of the equipment, personnel, water quality, cleaning practices and laboratory control**
- Based on hardness water divided in four groups → **crucial role in scale formation**

Very hard (>180 ppm or mg/L) Moderately hard (60-120 ppm)

Hard (120-180 ppm) Soft (0-60 ppm)



- **For proper cleaning and sanitization→ sanitary piping and fitting → 3-A sanitary standards →to overcome the specific cleaning problem**
- **Personnel hygiene** is mandatory which can be maintained by **proper training, education and written instructions**

Conclusion

- ✓ **Plant design and layout, construction material and equipment surface, quality of air and water and hygiene of dairy workers affect microbial contamination and end product quality of the product**

- ✓ **To provide microbiologically safe, nutritionally rich, sensorially acceptable dairy products with naturally fresh like attributes to the end users, proper cleaning, sanitization and hygiene practices must be strictly applied at each step of production, processing, storage and distribution**

Suggested readings

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Thank You!

Dairy Processing Utility Equipment:

Refrigeration System & Boiler

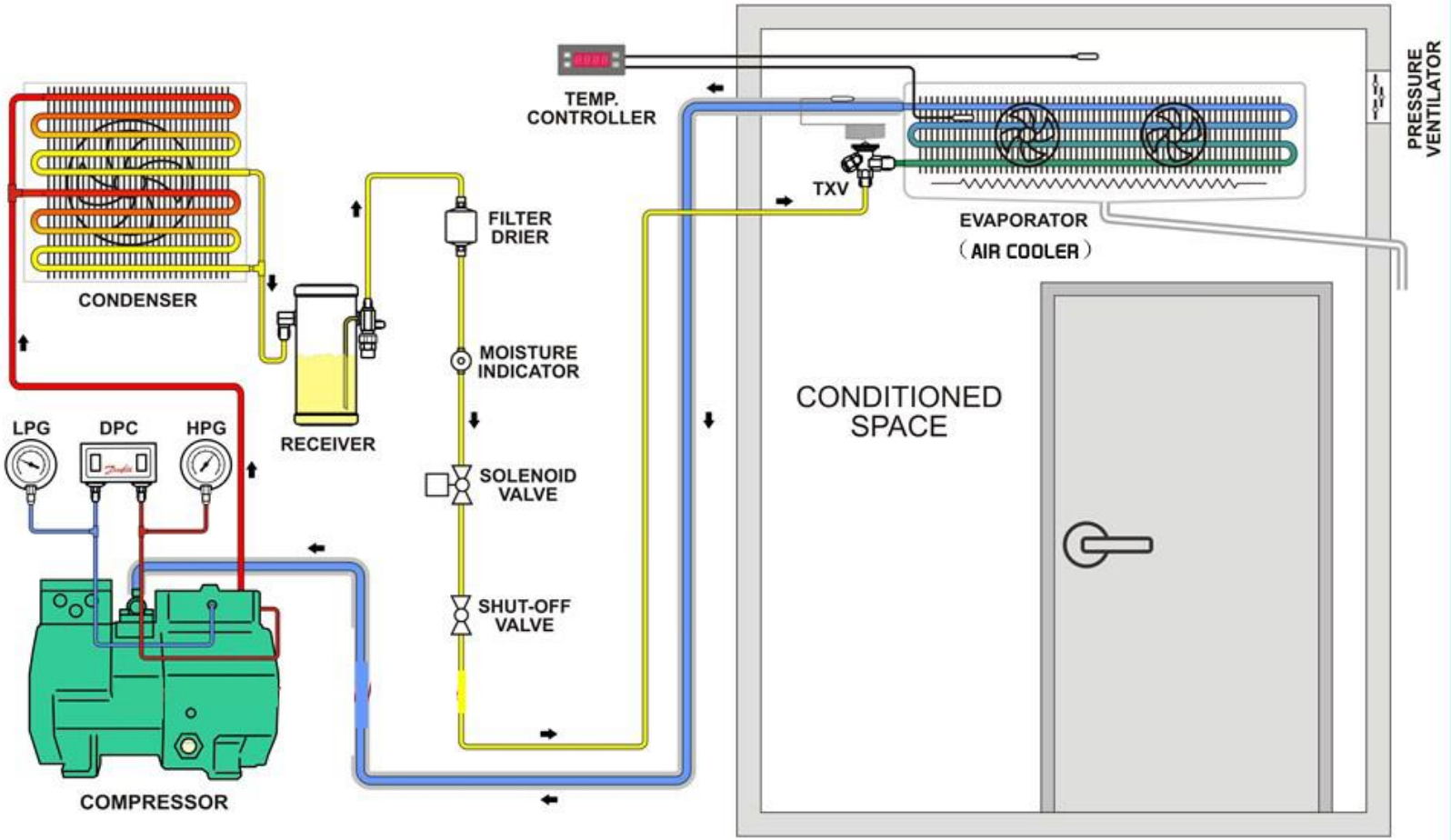
Selection, Specifications and Installation

REFRIGERATION SYSTEM AND COLD STORAGE

- **Refrigeration (Cooling):** The process of lowering down the temperature of an enclosed space.
- **Refrigeration System:** The complete machinery involved in producing Refrigeration
- **Cold Storage:** The insulated room where refrigeration is produced and perishable dairy/ food products are stored.

  Cold storage increases the life span of perishable dairy products
- **Refrigeration Utility:** An important and essential utility of a Dairy Processing Unit. *Required not only for Storage but for processing as well.*

COLD STORAGE REFRIGERATION SYSTEM



Cold Chain in Dairy Sector

- **Cold Chain:**

  It means maintenance of refrigerated conditions throughout the supply chain.

- It makes possible the commercial production, processing, distribution and marketing of milk and milk products

- It makes available fresh dairy products even if produced and processed days before and at a distant place

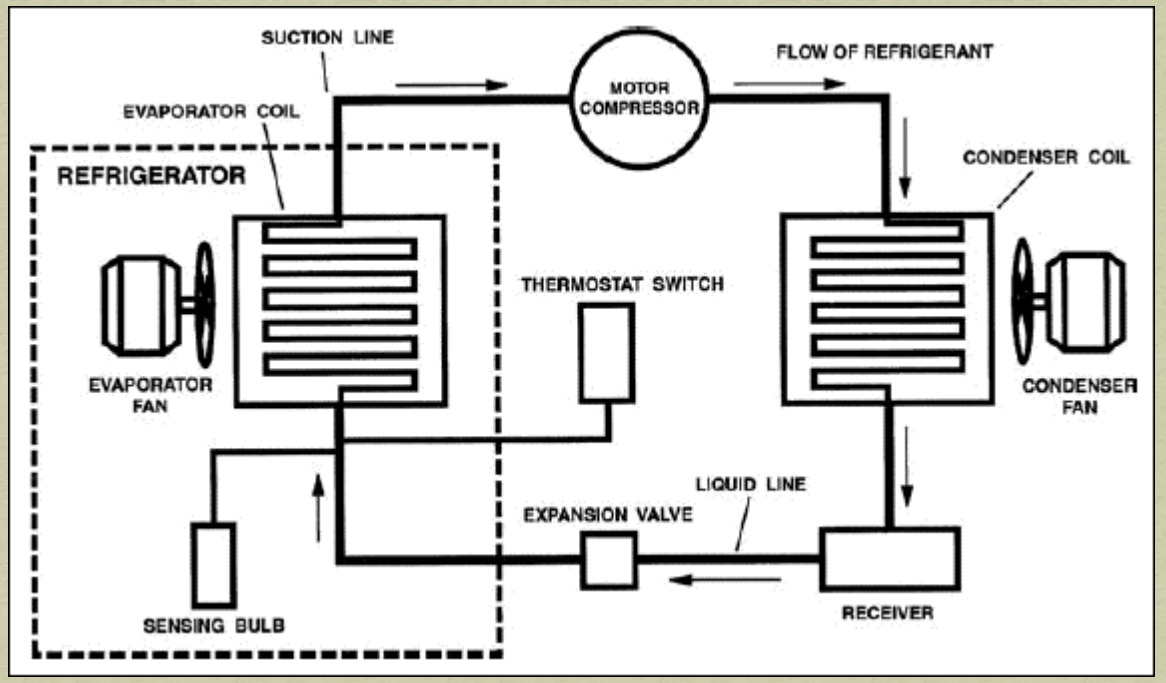
Refrigeration System Components and Working

Major Components:

- **Compressor**
- **Condenser**
- **Expansion Valve**
- **Evaporator**

Other Parts

- Receiver
- Filter/ Drier
- Piping & Control Valves
- Refrigerant
- Cold Room/ Cabinet
- Insulation
- Controls



Principle of Working:

Vapour Compression Refrigeration Cycle

Capacity & Performance of Refrigeration System

- **Refrigeration Capacity:**

  The rate of heat extraction by the evaporator unit of refrigeration system from the refrigeration space. It can be expressed in Kcal/ min or KJ/ min or KJ/ S (KW). However, its commercial unit is Tons of Refrigeration (TR).

- **Tons of Refrigeration (TR):**

  One TR is equal to the heat extraction rate which would be capable of converting one US Ton (908 Kg) of water at 0ºC into ice at 0 ºC in 24 hours. Mathematically, it is expressed as:

  1 TR = 50 Kcal / min

  Or 1 TR = 211 KJ / min

  Or 1 TR = 3.51 KW

- **Power Consumption:**

  The power input of Refrigeration system is mainly the power consumption by compressor. However, some auxiliary equipment like condenser and evaporator fans or circulation pumps of condenser & cooling tower etc. also consumes a considerable power.

- **COP /EER**

  It is defined as the ratio of Refrigeration capacity to the Power Consumption. Higher COP/ EER valve means better performance. It is always looked into while selecting a Refrigeration System.

Refrigerant Compressor

Most important component driven by electric motor and responsible for the overall working by compressing and pumping the refrigerant throughout the closed refrigeration system

- Rotary Compressor (Used in small refrigeration equipment like Domestic Refrigerator and ACs) https://www.youtube.com/watch?v=fxDEK3Ymx30
- Reciprocating Compressor (Used in small to medium refrigeration application)
- https://www.youtube.com/watch?v=kFQu9uoZWKg
- Screw Compressor (Used in large refrigeration application)
- Scroll Compressor (Used in small to medium refrigeration application)
- Centrifugal Compressor (Used in medium to large refrigeration application)

Further sub-types based on position of electric motor and drive are:

- Hermetically sealed (Motor and Compressor in one sealed casing: used in small equipment like Refrigerator Compressor)
- Semi-Hermetic (Motor and compressor are sealed together in one casing but more ease of access for maintenance purpose) https://www.youtube.com/watch?v=W6VR9nXPAmo
- Open type (Motor and compressor are separate and can be maintained separately)

Refrigerant Condenser

It is a type of heat exchanger, where the refrigerant flows on one side and air or water on the other. Its different types are:

- Air Cooled (Naturally cooled or fan cooled)
- Water Cooled
- Evaporator Type

Further Sub types are:

- Tubular heat exchanger with wire fins (Air cooled condenser of a domestic refrigerator)
- Plate fins type tubular heat exchanger (Air cooled condenser of small or medium systems)
- Shell and tube heat exchanger (Water cooled condenser of large refrigeration plants
- Plate heat exchanger (Water cooled condenser of medium size system)
- Bare tube condenser (Evaporative condenser of medium to large applications)

Refrigerant Evaporator

It is also a type of heat exchanger where refrigerant flow through the inside of tubes and outside is refrigerated space or any heat carrying fluid named as secondary refrigerant. Its different types are:

- Dry Expansion Evaporator (Used in case of Freon Refrigerants)
- Flooded Evaporator (Used in case of Ammonia Refrigerant)

Further Sub-types are

- Bare tube bundle (As in case of domestic refrigerator the refrigerant tubes are wrapped around freezer box)
- Corrugated Plate Evaporators (In case of modern refrigerator)
- Dimple Jacket Evaporator (Generally used in BMC)
- Brazed tubes on Plate (Water Cooler)
- Plate Finned Tubular Evaporator (Used in medium to large applications)
- Bare tube submerged Evaporator (Used in Ice Bank Tank)

Expansion Valve

It offers flow resistance while passing the refrigerant through a narrow restriction thus decreasing its pressure and temperature. Its different types are:

- Capillary Tube (Simple narrow diameter copper tube used in small rating refrigeration systems like domestic refrigerator or AC's etc.)
- Thermostatic Expansion Valve (Used with dry expansion evaporator as in case of Freon Refrigerants)
- Float Valve (Used with flooded evaporator as in case of Ammonia in large size refrigeration plant)
- Manual or Electronically Controlled Valve (Also used in large capacity Ammonia refrigeration plants)

Refrigerant

- The fluid which flows through each component and undergoes thermodynamic changes and absorbs heat through evaporator thus produces refrigeration effect.
- Its properties not only affect the performance of system but it also has influence on our environment and safety in case of leakage or end of life cycle of system.
- Its selection is vital while designing a new refrigeration system as it should fulfill the following requirement.
  - Good performance in terms of power consumption per ton of refrigerator capacity
  - It should be safe, non-flammable and non-toxic and non-reacting to human, material and environment
  - It should not be in the category of phased out refrigerants or to be phased out refrigerants in near future due to environmental reasons like high global warming potential (GWP) and or high ozone depletion potential (ODP)
  - It should be cheap and easily available.

Insulated Refrigerated Space (Cold Room)

- It is an insulated cabinet or chamber or tank or small to large size cold storage where the evaporator of refrigeration system is installed and the products which are to be cooled or refrigerated are stored inside.
- Insulation material layers are provided on all the sides including door so that the coldness of inside space is maintained and natural heat flow from hot ambient conditions outside to cold refrigerated condition inside is prevented.
- Insulation materials are those materials which have very low thermal conductivity value or very high thermal resistance due to their porous nature and air space in between. Some commonly used insulation materials are glass wool, thermocol, PUF, XPS, EPS etc.
- Nowadays PUF panels of various thickness and sizes are very commonly used either directly to form insulated cabinet or fixed as insulation on the inside surface of brick-cement walls of cold storage. There panels have all the required characteristics like high thermal resistance (R-value), moisture resistant, non-flammability, excellent building strength and easy to use or install.
- The selection of right kind of insulation material, its optimum thickness depending upon temperature deference between inside and outside, required compressive strength and cost are very important while designing a cold room or refrigeration facility.
- Undersize insulation would result in continuous loss of cooling and increased operational cost. Over sized insulation would lead to high initial cost.

Design Conditions of Cold Storage

- Cold Room Size (based on type of products)
- Cold room temperature (chilling/ freezing)
- Ambient temperature (Year round climate)
- Drop down period (Type of refrigeration requirement)
- Product loading & unloading cycle
- R-value of Insulation in m^2K/W (Type & thickness of insulation material)
- Cold room humidity
- Product incoming & outgoing temperature
- Freezing point of product
- Specific heat above and below freezing point
- Latent heat of freezing
- Compressor runtime with safety factor
- Compressor rating on designed conditions

Various Heat Loads in Cold Room

- Product Load
- Transmission load (Walls, Ceiling and Floor)
- Respiration Load
- Air Change Load
- Lights Load
- Fan Motor Load
- Occupancy Load
- Door/ peripheral / tray heaters load

Design/ Selection/ Installation of Refrigeration Utility

- Identification of different kinds of cooling requirements.
- Correct estimation of cooling load in TR for each of the cooling requirements
- Choice between separate compact refrigeration units or centralized plant.
- Cooling load variation during 24 hrs and also between different seasons throughout the year needs to be assessed correctly to decide the maximum refrigeration capacity and type & amount of refrigeration capacity control requirement
- Cooling storage in terms of ice bank tank is an option commonly used in dairy plants. *With storage options, refrigeration system need not to be selected on the basis of peak requirement at a particular time*.

Design/ Selection/ Installation of Refrigeration Utility

- Insulation is designed based on its characteristics and the requirement regarding R-value, compressive strength, moisture resistance, non-flammability etc.
- Type of Refrigerant is the primary parameter to be decided keeping in mind the performance, safety, its environmental restrictions, cost & availability etc.
- Type of compressor, condenser & evaporator and expansion valve. *Selection of type of compressor is most important in terms of performance characteristics matching with requirement, maintenance issues, initial and operational cost, reliability & life cycle etc.*

Design/ Selection/ Installation of Refrigeration Utility

- Proper location of cold storages in the processing plant and each of the refrigeration components is also very important. *Cold storage is located within the plant to avoid direct sun exposure of the walls or roof as far as possible and taking care of easiness in loading and unloading of products.*
- Condensing unit also called as outdoor unit is located outside the cold room in open. It should be located in the airy space and should not be in the direct exposure of Sun.
- Likewise the evaporator units are located inside the cold room keeping in mind the uniform distribution of cold air in all the space without flow restrictions. *In larger cold rooms however air ducts are used for this purpose.*

Design/ Selection/ Installation of Refrigeration Utility

- As far as possible the condensing unit and evaporator unit should not be far from each other. Otherwise the performance will decrease and the piping & refrigerant cost would increase.
- Intelligent control of the refrigeration system through modern instrumentation is very important. Various automatic controls options are available like: precise temperature control, on-off control, defrosts control, compressor capacity control, evaporator fan speed control etc.
- The automatic controls enhance the performance, safety and life of system. However extra cost is involved but still a well controlled system always offers better overall economy.

STEAM GENERATION, SUPPLY & SELECTION OF BOILERS

Introduction of Boiler and Steam Distribution System

- Boiler is a combination of fuel furnace/ burner, heat exchanger and insulated high pressure steam vessel.
- Burns fuel to produce heat and generates steam to be used as heating medium.
- Meets all the heating requirements of processing unit by supplying steam through insulated steam pipe/ fittings
- Heating by steam is a hygienic method as polluting exhaust gases produced by burning of fuel are kept away from the processing unit.
- Easy handling and automatic control over heating process
- Selection is important due to high initial cost and operational cost

Types of Boiler

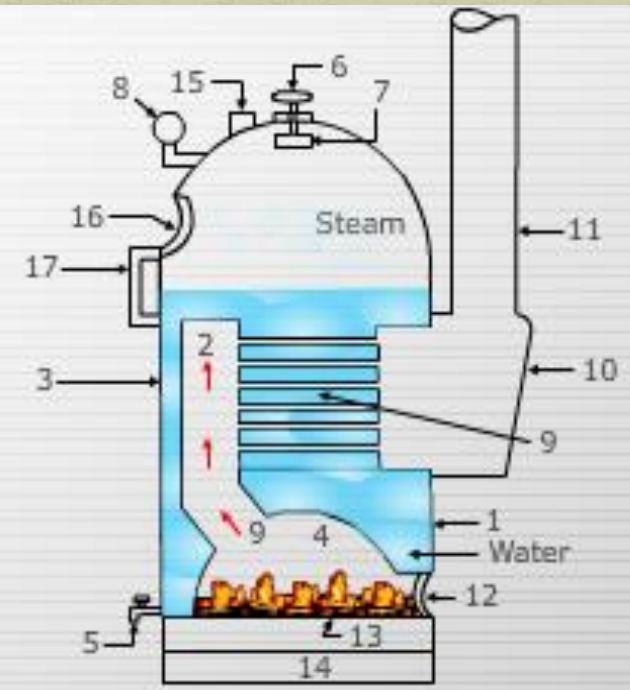
- Fire tube Boiler/ Water Tube Boiler
- Low Pressure Boiler/ High Pressure Boiler
- Process Steam/ Power Steam Boiler
- Coal fired/ Oil fired/ Gas fired Boilers

Many other sub-types based on type of heat exchanger, number of passes, type of draught, type of boiler accessories and type of control

Type of Boiler mostly used in Dairy Processing Units:

Fire tube, Low pressure, Insulated Shell type with any of the fuel options and forced draught(FD) fan

Working of Fire tube Boiler



1 → Cylindrical shell
2 → Combustion chamber
3 → Firbrick lining
4 → Furnace(dome shaped)
5 → Blow off cock
6 → Steam stop valve
7 → Antipriming pipe
8 → Pressure gauge
9 → Fire tube
10 → Smoke box
11 → Chimney
12 → Fire hole
13 → Grate
14 → Ash pit
15 → Safty valve
16 → Man hole
17 → Water level gauge

Cochran boiler

Boiler Mountings

Fittings essentially required for safe and efficient operation:

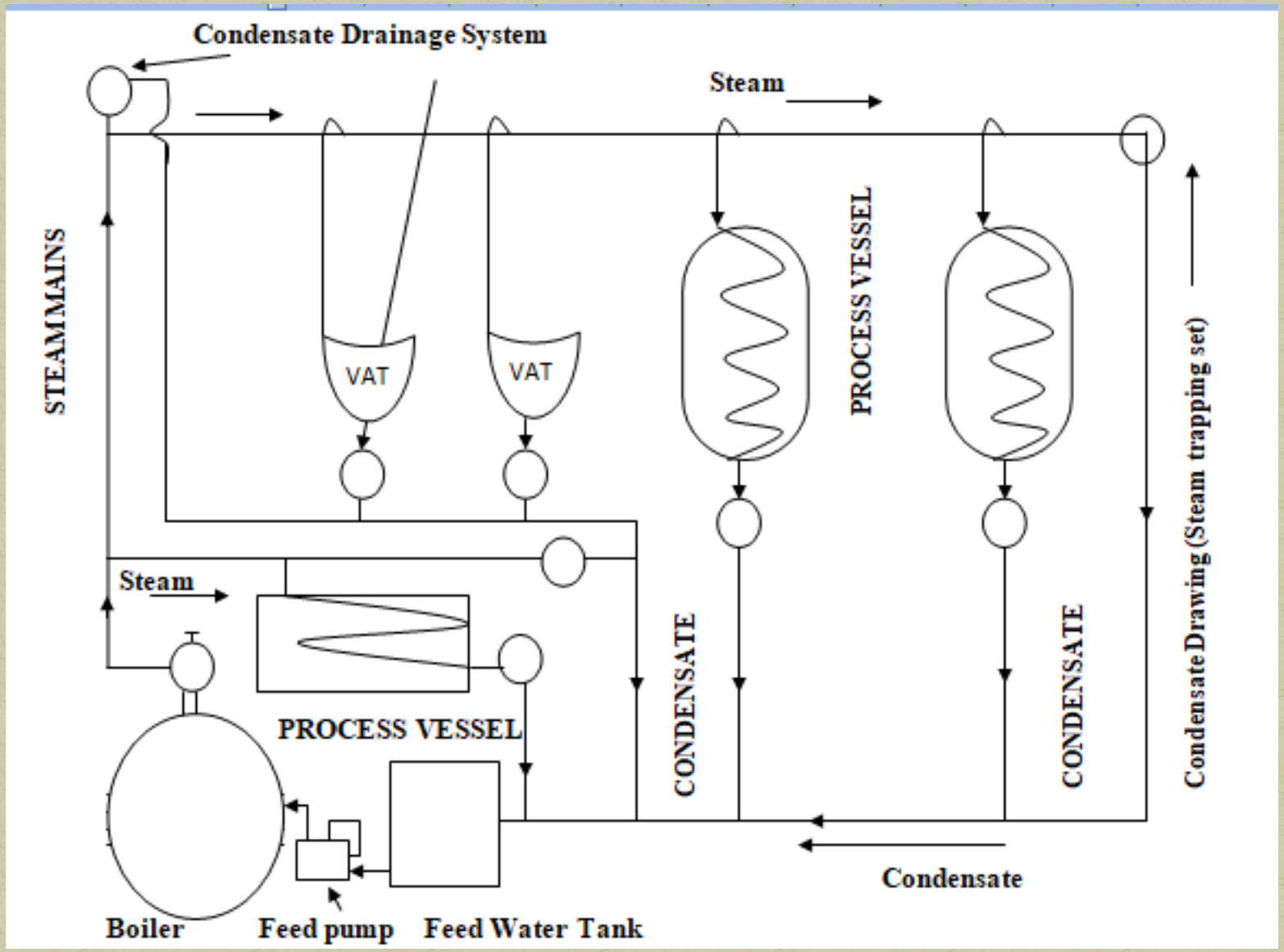
- Water Level Indicator (To check the water level in the boiler shell manually)
- Pressure gauge (To indicate pressure of steam in the boiler)
- Safety Valve (To release steam automatically in case steam pressure exceeds the limit for the safety of boiler)
- Fusible Plug (Located inside the boiler and melts itself in case the tubes are overheated due to low level of water in the boiler)
- Blow off Cock (To blow down some of the water from boiler intermittently to keep control over TDS and safety of the boiler)
- Feed Check Valve (Type of non return valve fitted at the feed water inlet. It allow water to go inside the boiler but prevent steam to come out)
- Steam Stop Valve (Fitted at the steam outlet for flow control of steam)

Boiler Accessories

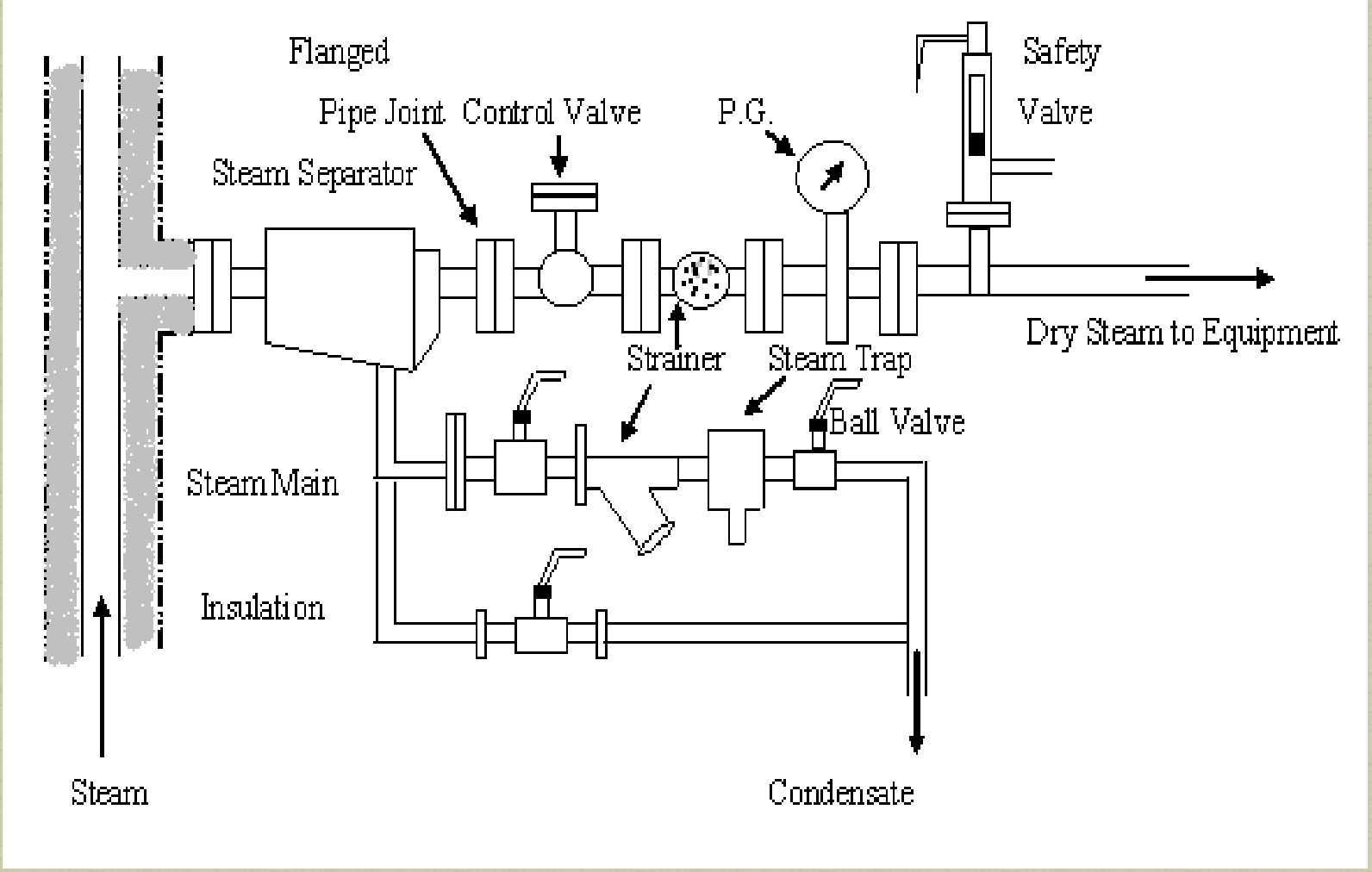
The integral parts of boiler, required to enhance its efficiency or the overall performance

- Feed Pump (A high pressure pump to pump feed water against high pressure inside the boiler vessel)
- Economizer/ Water pre-heater (preheats the feed water by outgoing flue gases thus increases the boiler efficiency)
- Air Pre-heater (preheats the incoming air used in fuel combustion by outgoing flue gases thus increases the combustion efficiency)

Steam Distribution System



Steam Pipe line fittings



Performance of Boiler

- **Boiler Capacity in terms of Equivalent evaporation**

  The weight of saturated water at 100°C evaporated to dry and saturated steam at 100°C by utilizing heat at the same rate as would have been used under the actual working conditions.

  It is generally expressed in terms of tons/hr. For example One ton boiler means its equivalent evaporation at full capacity is 1000 kg of steam per hour.

- **Factor of evaporation**

  It is a quantity which when multiplied by the actual amount of steam generated at a given pressure from water at given temperature, gives the equivalent evaporation.

  Equivalent Evaporation = F x Actual Evaporation

  *Thus factor of evapo*ration may also be defined as ratio of Equivalent Evaporation to actual Evaporation.

- **Boiler efficiency**

  It is the ratio of heat utilized in generation of a given quantity of steam to the heat supplied by fuel burnt to produce this steam.

  $$\text{Boiler Efficiency, } \eta_b = \frac{W_a(H - H_{w1})}{W_f . C}$$

  Boiler efficiency is always less than 100% because of some loss of heat through hot gases escaping to atmosphere and also directly to atmosphere by conduction convection and radiation.

Indian Boiler Regulation Act

- The boiler being pressure vessel is required to be operated within safe pressure limits with regular checkup and maintenance, because the failure of a boiler may prove extremely disastrous.
- To ensure full safety, some standard rules and regulations have been enforced through legislation, all over the country. This is known as Indian Boiler Act 1923. All boilers owners are required to follow this legislation in a strict sense.
- Indian Boiler Regulation act is made to encompass the following
  - Provide for the safety of life, limb and property.
  - Create a board for boiler rules to serve the society.
  - Formulate rules and regulations for the safe and proper construction, installation, repair, use and operation of boilers and unfired pressure vessel.
  - Provide for the examination and appointment of boiler inspectors.
  - Provide for the inspection of boiler and unfired pressure vessel, the fees to be charged and the reports to be made thereof.
  - Provide for the enforcement of the rules and regulations promulgated by the board of boiler rules.
  - Provide for inspection certificate.
  - Provide for appeals.
  - Provide a penalty for the violation of the provisions of the act.

Design/ Selection/ Installation of Boiler

- Identification of different kinds of heating requirements in the Dairy Processing Unit.

- Correct estimation of total rate of heating required and temperature to be maintained in all the vats, process vessels/ equipment, CIP etc. based on the amount of products their sensible/ latent heat and temperature/ concentration change and possible losses.

- Correct estimation of steam consumption rate and steam pressure throughout the day based on total heating rate and all kinds of steam distribution losses and pressure losses through steam distribution system.

Design/ Selection/ Installation of Boiler

- The maximum steam consumption rate multiplied by factor of evaporation should not be more than 80 % of the Boiler steam generation capacity

- The maximum pressure requirement should be well below the safe working pressure of the boiler. *Little overcapacity of the Boiler may be selected keeping in mind the future requirement.*

- To meet the excessively varying load, two or more boilers may be selected so that when all working simultaneously meet the peak steam requirement and only one can be run at reduced steam load.

Design/ Selection/ Installation of Boiler

- A boiler is primarily specified by the type of fuel used i.e. coal fired, oil fired or gas boiler etc. The selection is based on various aspects like fuel cost per unit of steam production, it's easy availability in a given location, environmental/ pollution restrictions, fuel storage space and handling facility available in the processing plant.

- Boiler efficiency is also an important parameter to be looked into while selecting a boiler and its accessories responsible for efficiency improvement like air pre-heater, economizer, super-heater.

Design/ Selection/ Installation of Boiler

- PLC control of the working of Boiler system further ensures best thermal efficiency by improved combustion efficiency, improved safety, life and reliability of boiler and hence decreased operational cost and fulfillment of environmental norms by effectively controlling various operational parameters such as excess air through speed control of FD fan, outgoing flue gas temperature, concentration of CO, O2 and other polluting gases in the outgoing flue gases, TDS of boiler water through automatic blow down control, steam pressure, water level etc.

- However decision is taken on the basis of overall economy. Any additional expenditure on the improved efficiency is done on the basis of payback period.

THANK YOU

Dairy Processing Equipment Selection, Specifications and Installation

By

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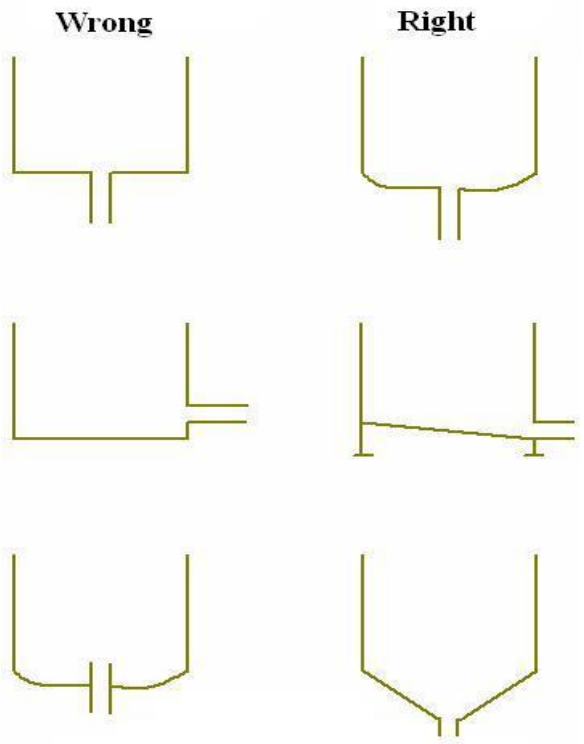
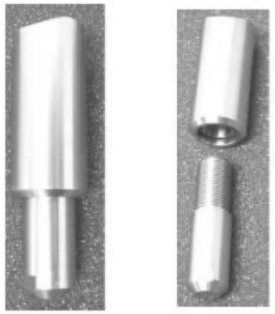
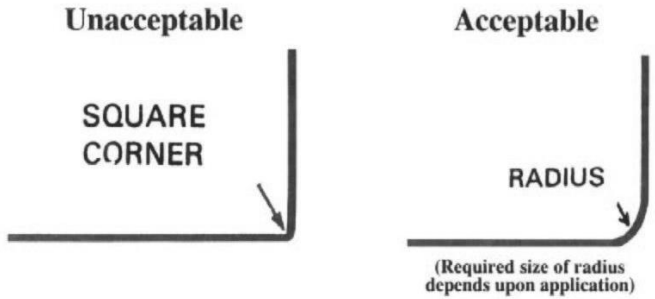
General aspects of equipment selection

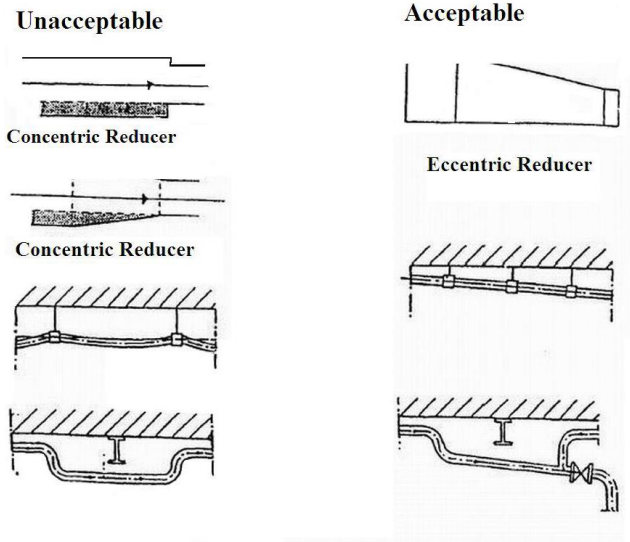
- Milk: the most perishable
- Chilled and processed with least time delay
- Equipment also needs to maintain high standards of hygiene
- Cleanable with suitable acid and alkali, immediately after use
- Equipment meet the requirement of maximum seasonal handling of milk and milk products
- Compatible to the other related equipment, upstream or downstream of the processing sequence (capacity, size, fittings, threaded joints etc.
- Should be self- draining
- Product contact surfaces must be of grade SS 304 or SS 316
- Smooth surface finish of at least 150 grit (0.4 Ra)
- Pacified by suitable chemical treatment
- Strictly follow the manufacturer’s instructions

Examples of Sanitary Design









Bulk Milk Coolers

- Bulk Milk Coolers : popular because of easy installation
- Follow the standards of ISO 5708-1983, with variations in types of reception quantities and rate of cooling.
- Example: ISO 5708 – 2 A II means, BMC is designed to receive milk to the rated capacity 2 times in a day; A means ambient temperature of 38 ^{o}C and ; II means milking in morning is cooled in 3 hr and evening addition is cooled in 1.5 hr
- Cooling capacities with differing milk reception quantities to be actually checked, as some manufacturers claim
- Equal milking is a western concept, as in India it varies from 60:40 or even 70:30
- Growth of psychrotrops is a problem

DX Open Cylindrical

300-1800

IBT Semi Cylindrical

DX Semi Cylindrical

500-3500

Open IBT

1100-2000

DX Closed

5000

Ice Bank Tank system an option

The IBT is a system in which evaporator of refrigeration is surrounded by water and this is located below or around the milk holding tank itself.

The chilled water from IBT is circulated around the outer surface of the milk holding tank.

Another system : Small PHE is attached, where milk and chilled water flow in alternate plates. The chilled milk and chilled water flow back to tank to the respective places

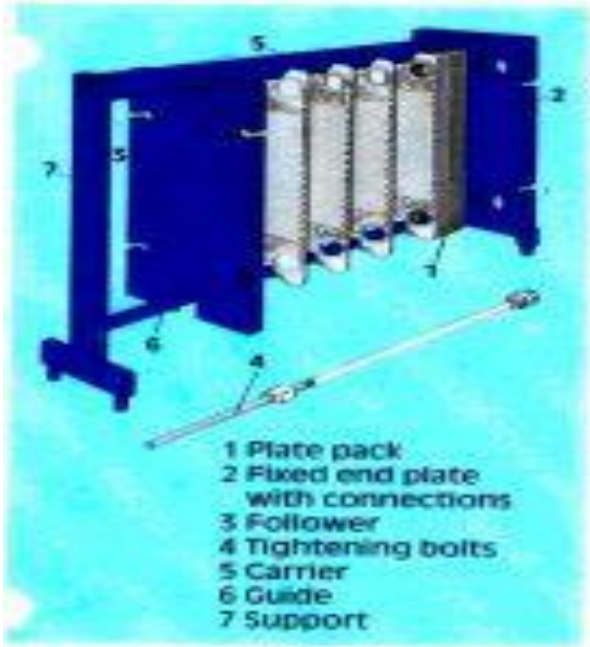
Chiller of Plate Heat Exchanger type

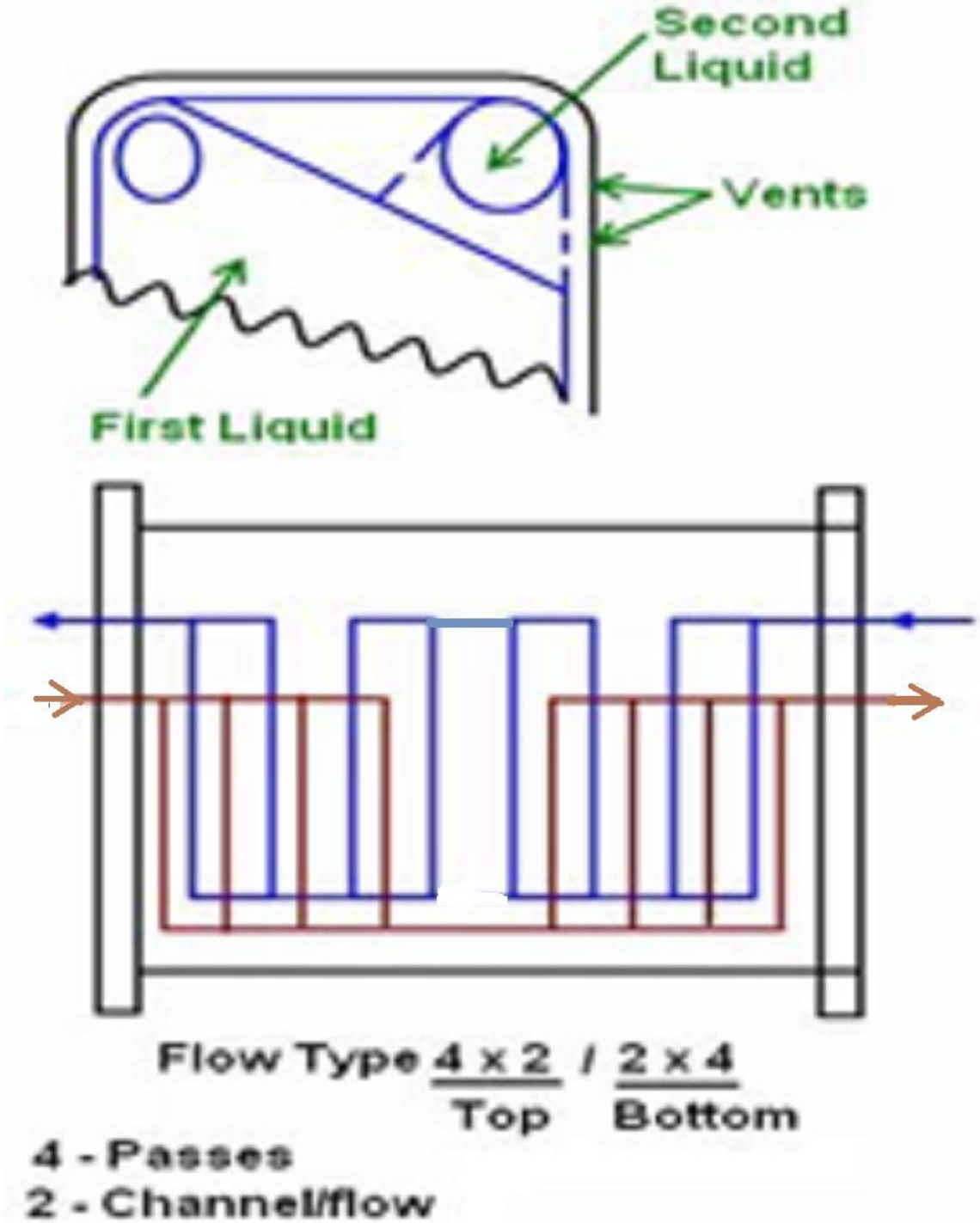
Plate chiller :SS corrugated plates hang to a frame, with gaskets in between, to maintain a narrow gap

The milk flows in alternate gaps, and the chilled water flows in the adjacent gaps

Chilled water available at 1 to 1.5^{o}C, with facility to recirculate at required flow rate and bring the temperature back to the required temperature

Plates and corrugations depend on the product to be processed, whether heating, cooling, evaporation or condensing,

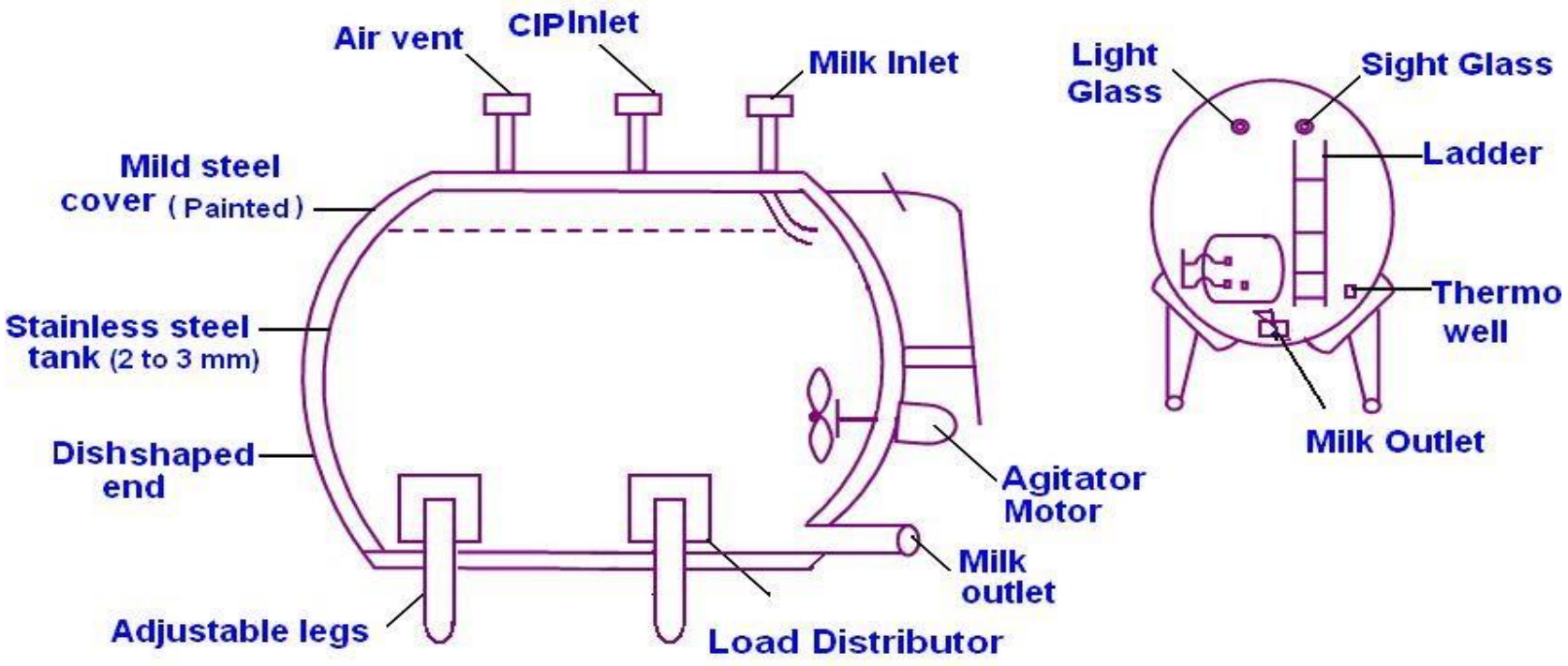



Second
Liquid
Vents
First Liquid
Flow Type 4 x 2 / 2 x 4
Top Bottom
4 - Passes
2 - Channel/flow

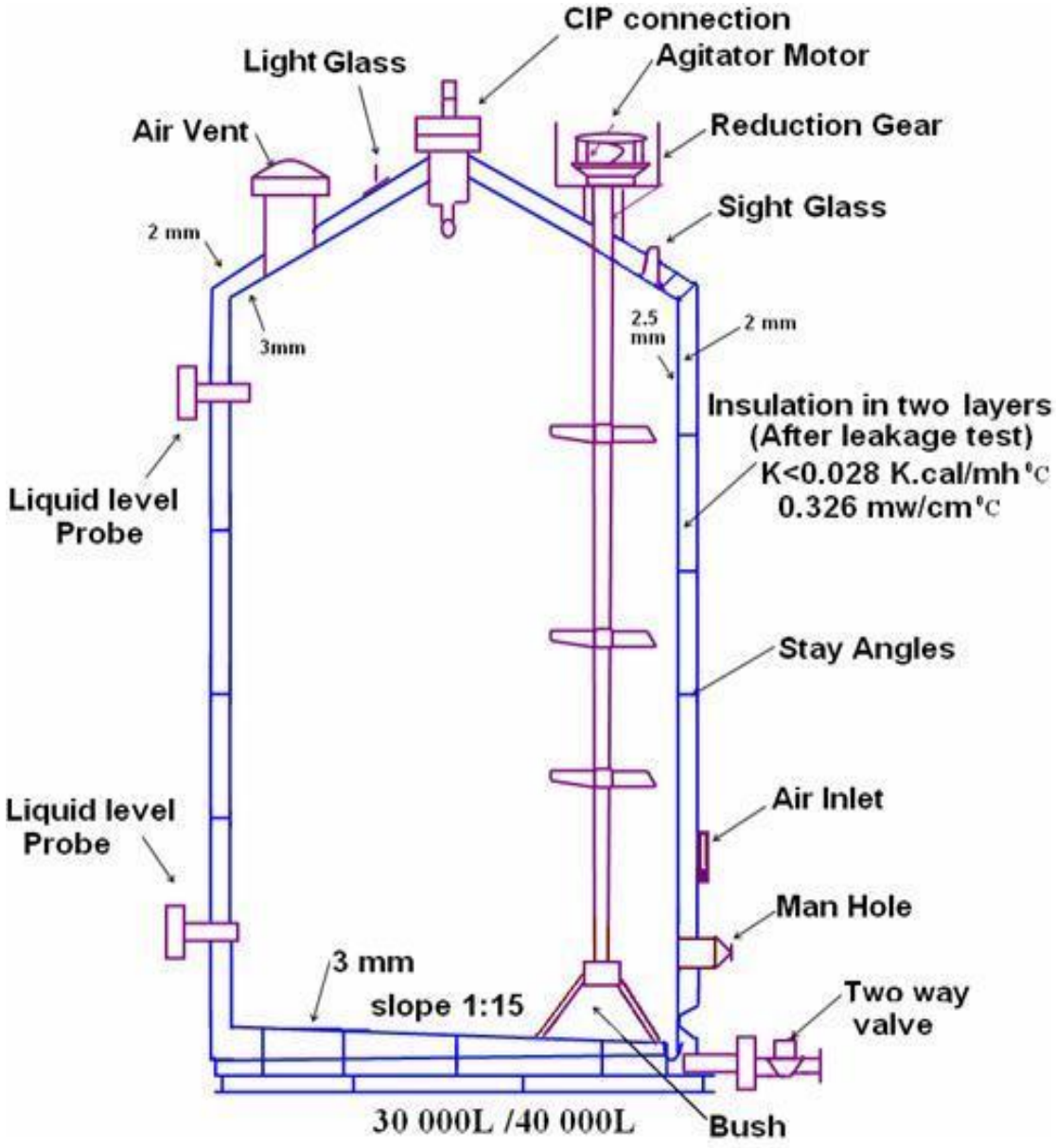
Milk Storage Tanks

Insulated tank , to maintain the milk in chilled condition for sufficiently longer time till it is further processed (<2^{o}C in 18 h)

To be installed simultaneously, while the civil works of the dairy plant is taking place, with fittings fixed later on



Vertical storage tanks and silos



Batch Pasteurizer

For small capacity processing

Vertical Cylindrical with double jacketed vessel

Arrangements to pass heating and cooling liquids in the jacket

Provisions for agitation, temperature measurement and controls (option)

HTST Pasteurizer

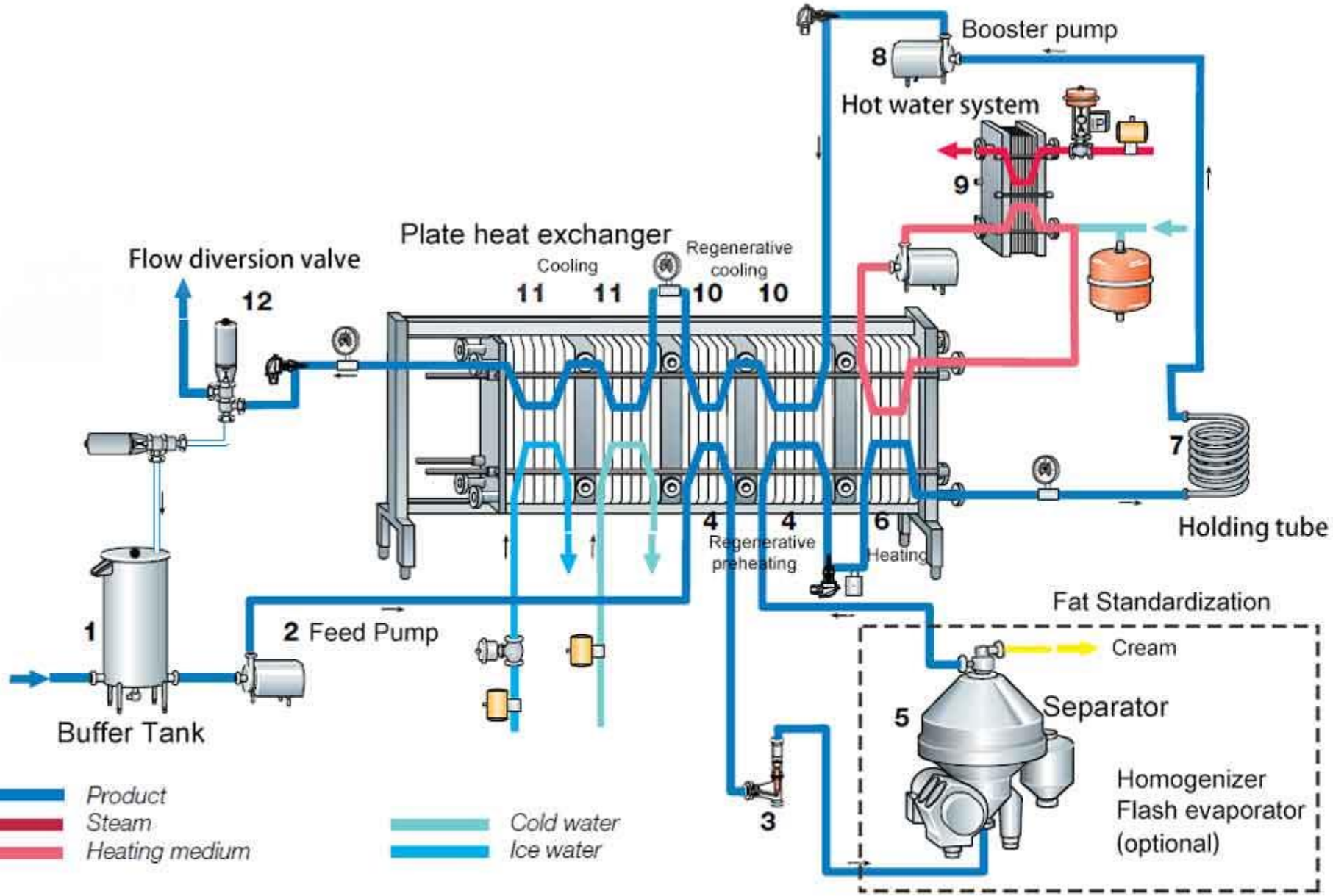
Heat treated to temperatures of at least 72^{o}C for 16 seconds (High Temperature Short Time).

Under Indian conditions of poor initial quality of milk, however, the heating up to 78 ^{o}C, is now common, which can only be brought down, if the quality of raw milk is improved considerably

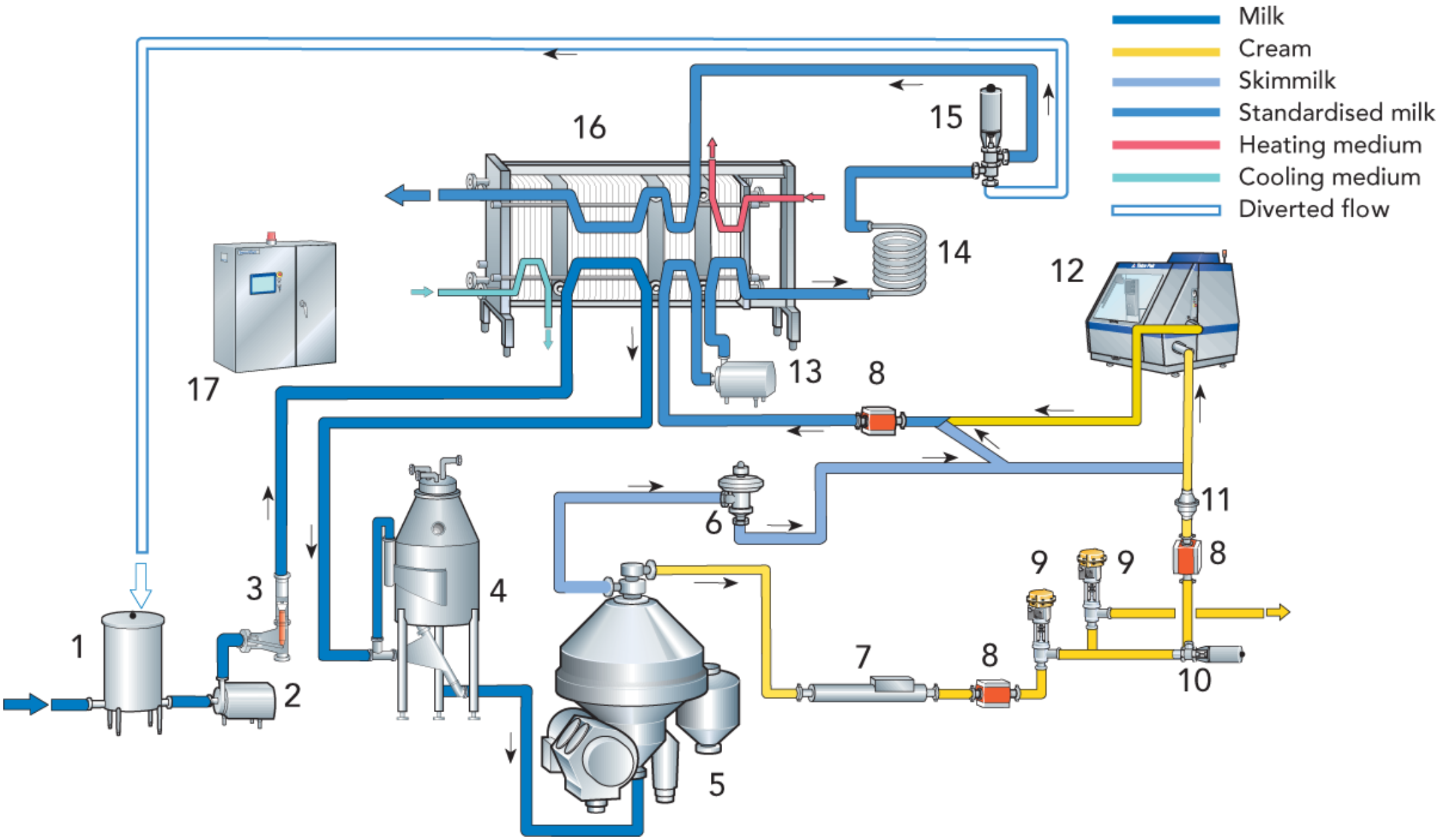
Cooling immediately below 4 ^{o}C is essential

Skid mounted units for smaller capacities up to 500 lph

HTST Pasteurizer with other processing equipment



HTST Pasteurizer with other processing equipment (contd.)

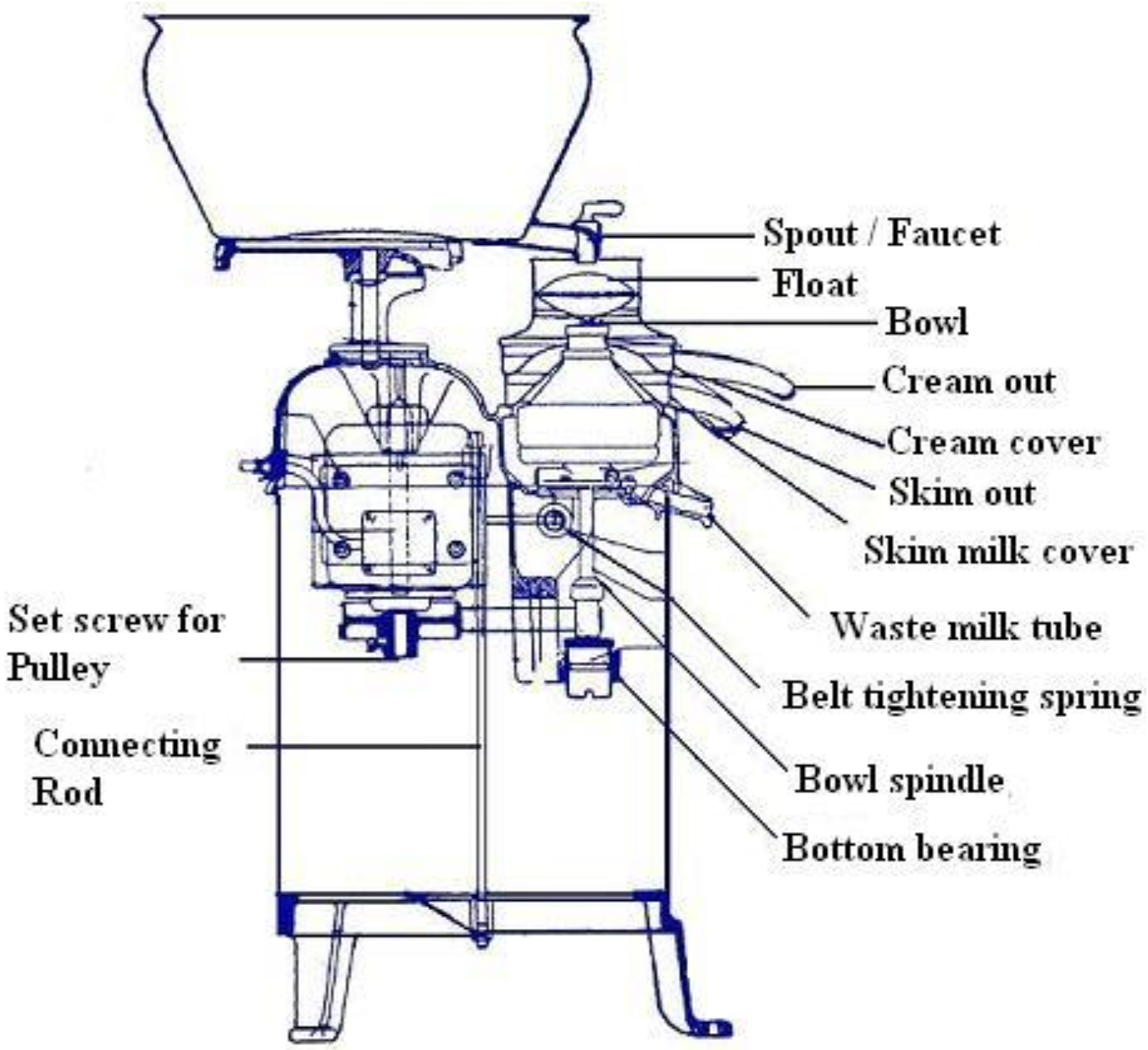


Cream Separators

For production of toned milk (which has 3.0% fat), fat is partially removed quickly from raw milk, which can vary from 3.5% (cow milk) to 7.0% (for buffalo milk)

Centrifugal Cream separators are used, which has number of angular discs mounted on a shaft, that is rotated manually (for smaller capacities of 60 lph) or with electric motor drive (for larger capacities 10,000 lph or more)

Milk must be around 40 ^{o}C for efficient separation

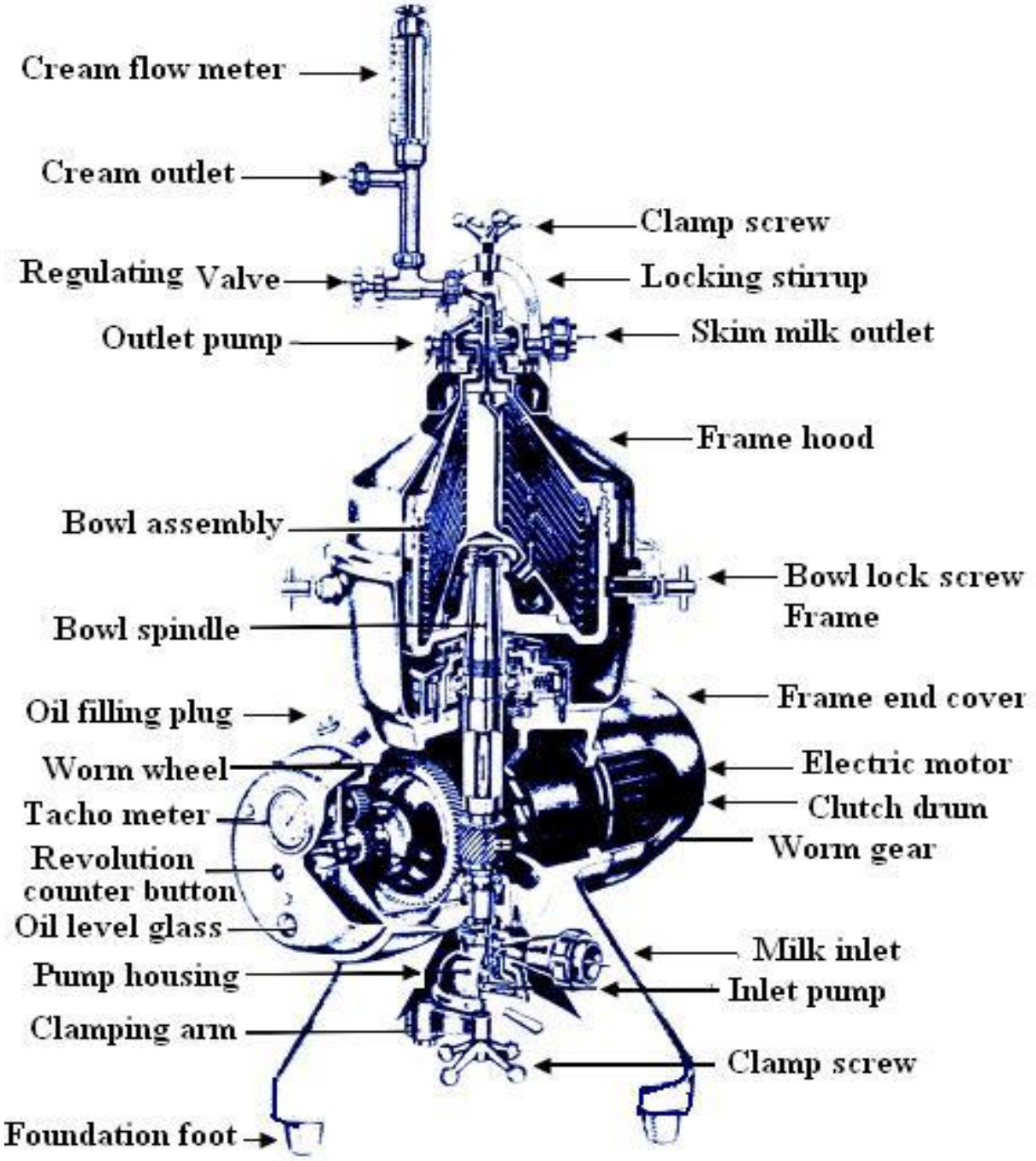


Hermetically cream separator

Can be used for 1) Clarification (just to remove dirt and extraneous material not in solution) 2) To separate fat completely and obtain cream and skim milk or 3) To standardize the outcoming milk to a suitable fat percentage

Self-desludging types are available, which automatically remove the dirt without stopping the equipment for cleaning

Centrifugal separation to remove bacteria present in milk, as a step towards, better quality milk to be used for manufacture of Ultra High Temperature (UHT)

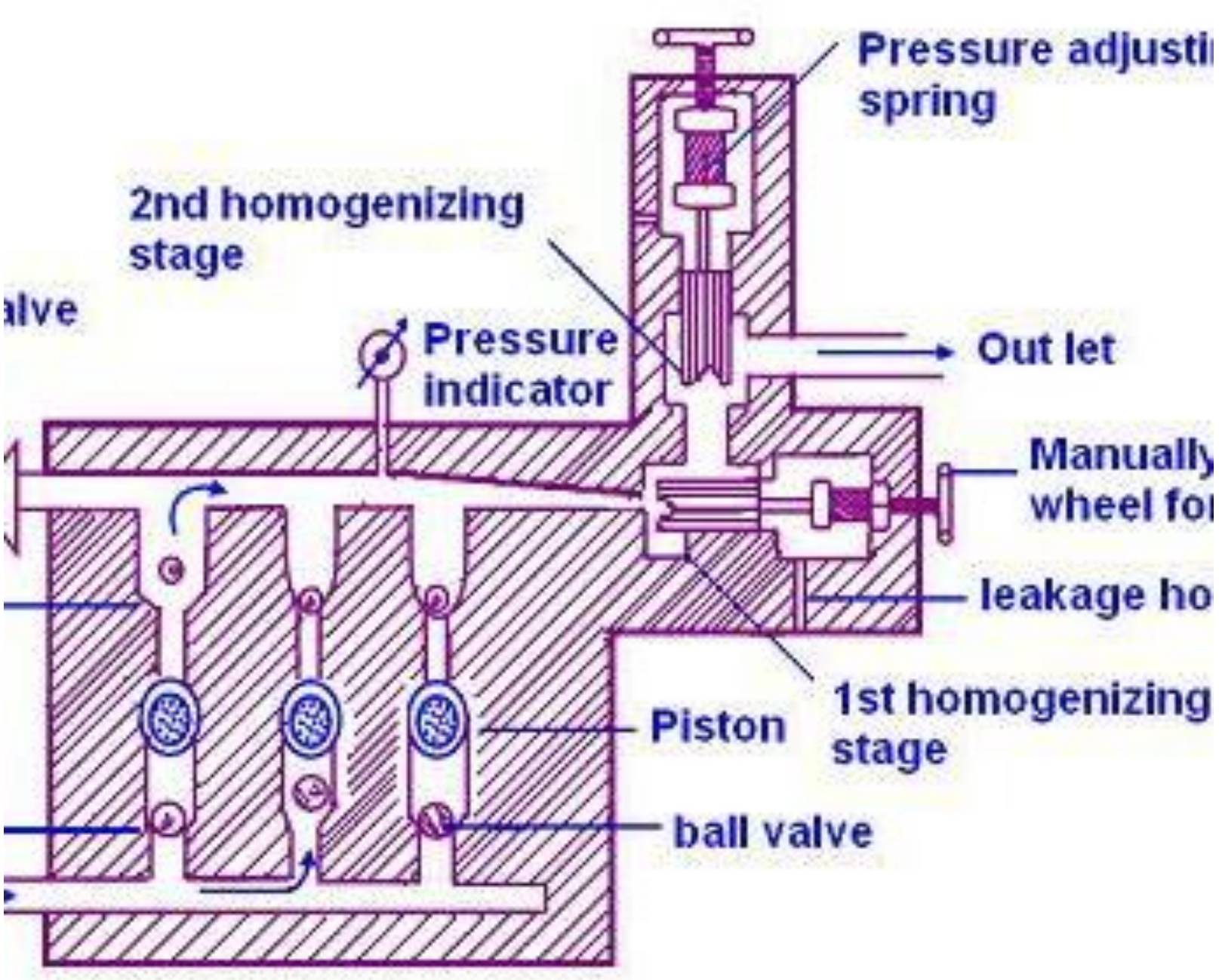


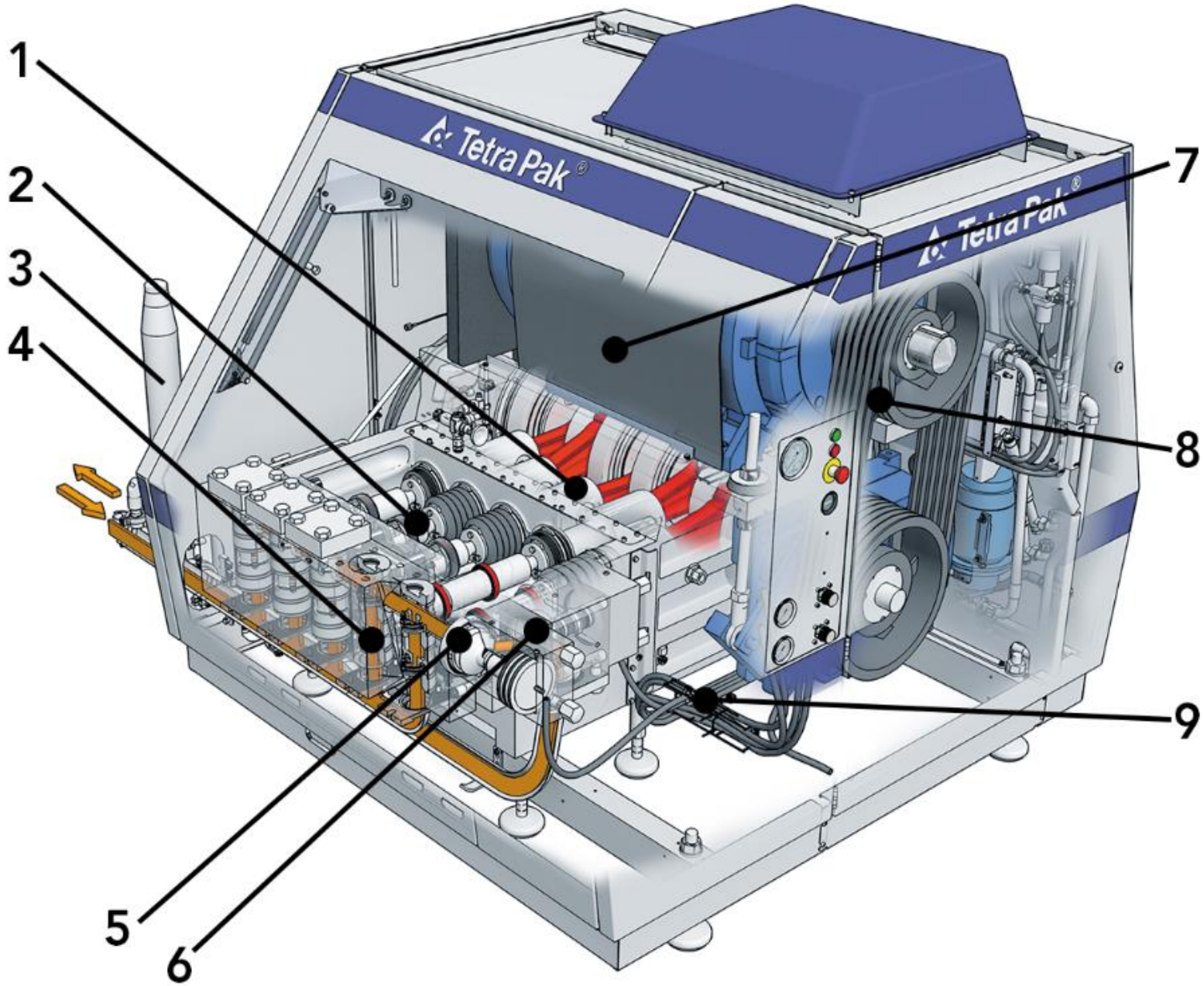
Homogenizers

Long time storage, transportation and distribution of milk, there is a need of uniform distribution of fat in milk

Reducing the fat globule size from 15 micron to less than 2 microns

Forcing milk through a narrow gap (called Homogenizer valve) under great pressure of around 175 kg/ cm^2 (nearly 2500 psi) and second stage of 35 kg/cm^2




1
2
3
4
5
6
7
8
9
Tetra Pak
Tetra Pak

Evaporators

- The dairy industry a balancing wheel between the times of plenty to times when milk is scarce
- First, the milk is concentrated using evaporator, to about 50% total solids concentration. Then, the concentrated milk is made into powder using spray drier
- Evaporator, removes moisture in the milk, under vacuum, so that the temperature of boiling is low
- Evaporator may be batch (Vacuum Pan) or continuous type (Multiple effect type)
- Vacuum pan essentially has a semi-cylindrical double jacketed vessel, vacuum device, agitator, pipe connections for loading milk and unload the concentrated milk.
- Controls will be provided to control the steam supply to the jacket and the degree of vacuum in the vessel. Provision is there for drawing sample from time to time to know concentration

Multiple effect evaporators

For larger capacity of production

Evaporator system has tall bundle of pipelines

Milk is fed uniformly into the tube bundle from top

As it flows down, it picks up heat from the steam surrounding the tubes, and vapours are formed

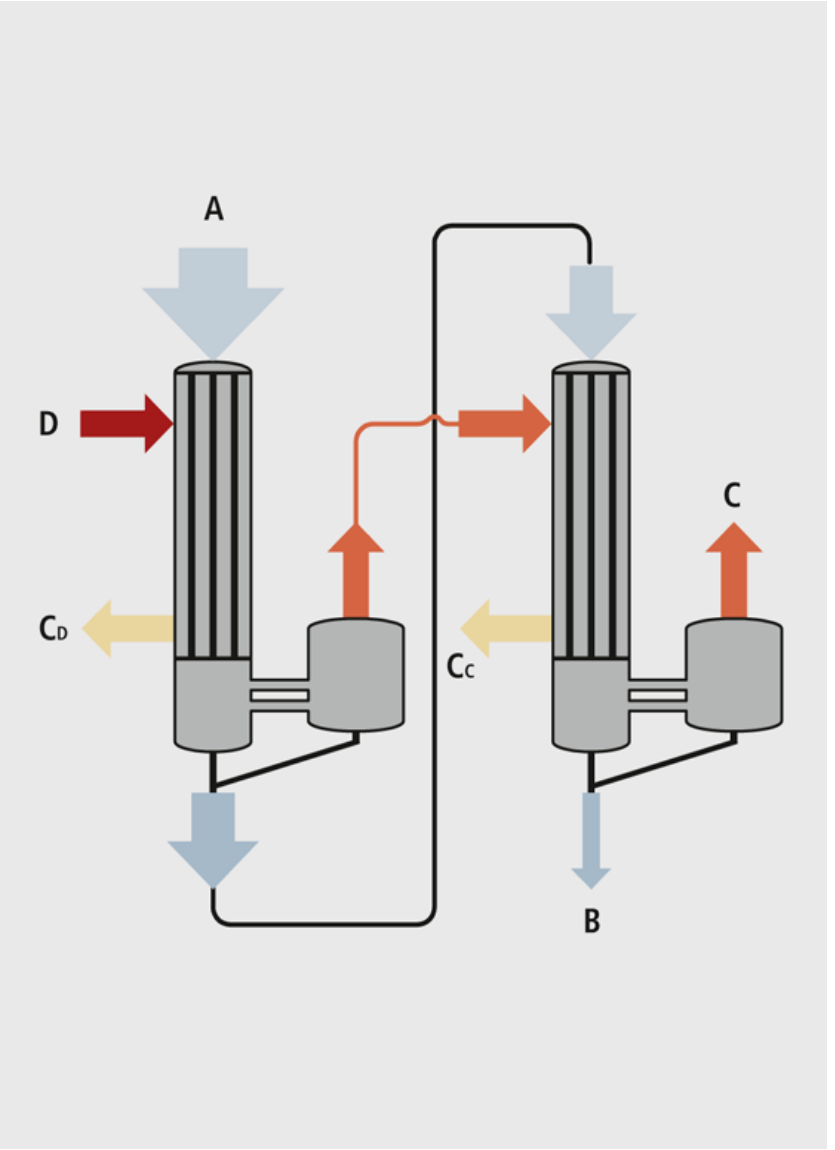
Vapours are separated by Vapour separator chamber at the bottom

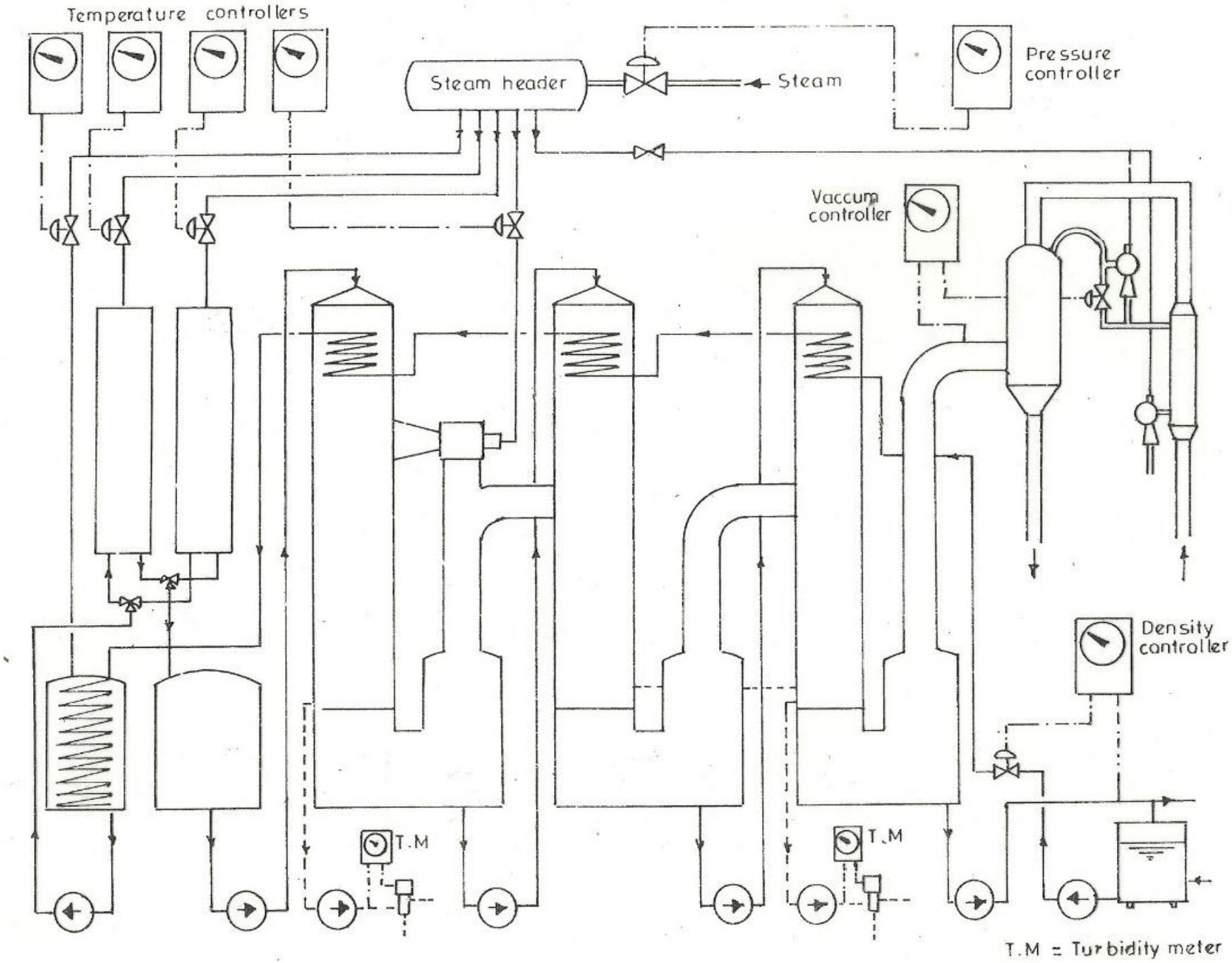
Vapours from the vapour separator, is drawn to the shell side of the next set of calandria, which is being operated at lower pressure

In practice, 3 or more sets of calendria are operated in sequence (between 70^{o}C to 45^{o}C)

Rate of evaporation in each calandria are carefully monitored for a continuous operation

Milk is initially brought to a high temperature of about 85^{o}C (held for few seconds), through a series of heat exchangers.




Temperature controllers
Steam header
Steam
Pressure controller
Vaccum controller
Density controller
T.M
T.M
T.M = Turbidity meter

General aspects of installation of equipment

- Follow the manufacturer’s instructions
- Manufacturer may sometimes exclude some of the required items
- These have to be taken care of in time, so that installation is not delayed or incomplete
- Sometime are legally time bound, in which case, the delay in provision for the installation should not be on promoter
- Installation also includes trial runs and final testing to prove that equipment meet the performance parameters and if it doesn’t, then the agreed penalties to be imposed, in extreme cases
- Important drawings of installation, manuals etc provided by manufacturer (made in duplicate)
- Copies must be easily available while installation as well as regular operation of the equipment
- Installation must follow the general principles of plant layout
- Installation may some time depend on the actual conditions at the site
- Training of the personnel who are going to operate it
- The installation of a particular equipment or group of equipment must be coordinated with the Project development and Project management

Khoa Pan

Khoa pan

Batch Sterilizer

Hot water/Steam generator

Pouch filling m/c

Chilled water equipment

Pre-fabricated cold store

Some of the costs

- Khoa Pan: Steam operated – 40 Lit , about 1.0 L to 0.6L (available 10 L to 100L)
- Gas operated: 0.5L
- Cream Separator: 500 lph – 0.5 L
- Batch Pasteurizer: 500 lit – 0.5 L
- HTST Pasteurizer: 100 lph -4.5 to 6.0 L
- Boiler : 150 Kg/h – 4.0L
- Sterilizer: 500 bottles/batch – 4.0 L
- Pouch filling m/c 1000 pks/h – 2.5 L
- Cold Store: 4.0 L to 11.0L

Training to farmers to use surplus milk

శిక్షణ ఇస్తున్న అధ్యాపకులు

Food Package Labelling Requirements

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भारत का राजपत्र
The Gazette of India

FOOD SAFETY AND STANDARDS AUTHORITY OF INDIA

NOTIFICATION

New Delhi, the 17th November, 2020

F. No. 1-94/FSSAI/SP(Labelling)/2014(Pt-2).—Whereas the draft of certain regulations, namely, the Food Safety and Standards (Labelling and Display) Regulations, 2019 vide notification number F. No 1-94/FSSAI/SP(Labelling)/2014(Pt-2), dated the 25th June, 2019 was published as required under Sub-section (1) of section 92 of Food Safety and Standards Act, 2006 (34 of 2006) in Gazette of India, Extraordinary, Part III, section 4, inviting objections and suggestions from the person likely to be affected thereby, before the expiry of a period of thirty days from date on which the copies of Gazette containing the said notification was made available to the public;

And whereas, the Food Safety and Standards Authority of India made the Food Safety and Standards (Packaging and Labelling) Regulations, 2011, but now the Food Authority has decided to divide these regulations into two regulations,-

(i) the Food Safety and Standards (Packaging) Regulations, 2018; and

(ii) the Food Safety and Standards (Labelling and Display) Regulations, 2019,

(3) They shall come into force on the date of their publication in the Official Gazette and Food Business Operator shall comply with all the provisions of these regulations after one year from the date of their publication in the Official Gazette except chapter-3 of these regulations, to which Food Business Operator shall comply by 1st January, 2022.

Food Package Labelling Requirements: *Outlines*

- ***Terms used in food package labelling & their Regulatory definition***
- ***Food Safety and Standards (Labelling & Display) Regulation 2020- Labelling: General Requirements***
- ***Specific Requirements or Restrictions***

Food Safety and Standards
(Packaging and Labelling)
Regulations, 2011

Food Safety and Standards
(**Packaging**) Regulations, 2018

Food Safety and Standards
(**Labelling & Display**) Regulations, 2020

Labelling of Packaged Foods: General Requirements

Labelling: *General Requirements*

1. **Every pre-packaged food shall carry a label**
2. When a food product is ***sold through e-commerce or any other direct selling*** means, ***the mandatory requirements of the label*** as given in the regulations ***shall be provided to the consumer*** through appropriate means before sale except batch number / lot number, best before, use-by-date, expiry date, date of manufacturing / packing.
3. Pre-packaged food ***shall not*** be described or presented on any food 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. ***Any information or pictorial device written, printed or graphic matter may be displayed*** on the label provided that it is not in conflict with the requirements of the regulations.
5. Particulars of declaration required shall be in ***English or Hindi or Devanagri*** script & nothing prevent the use of other language in addition

General Requirements …

6. The label on the pre-packaged foods shall be applied in such a manner that they ***will not become separated from the container***
7. The contents on the ***label shall be clear, prominent, indelible (cannot be removed) and readily legible*** by the consumer under normal conditions of purchase and use.
8. Where a package is provided with ***an outside container or wrapper*** and such container or wrapper is displayed ***for retail sale***, it ***shall also contain all the declarations which are required to appear on the package*** except where such container or wrapper itself is transparent and the declarations on the package(s) are easily readable through such outside container or wrapper.

Labelling of Packaged Foods: Labelling Requirements

Labelling of Pre-Packaged Foods

1. **The name of the food**
   - ✓ The name of the food shall carry the name of the food which indicate the true nature of the food contained in the package; additionally contain "coined", "fanciful", "brand" or "trade name" subject to compliance of FSS(A&C) Regulations (2018)
2. **List of ingredients**
   - ✓ Except for single ingredient foods, a list of ingredients shall be declared on the label in the following manner:
     - ✓ The list of ingredients ***shall contain an appropriate title***, such as the term **"Ingredients"**
     - ✓ The name of Ingredients used in the product ***shall be listed in descending order of their composition by weight or volume***, as the case may be, at the time of its manufacture

Labelling of Pre-Packaged Foods …

- ✓ ***A specific name shall be used for ingredients*** in the list of Ingredients; provided that ***for ingredients falling in the respective classes, the class titles may be used***.
  - ✓ In case of edible vegetable oils, name of the ***specific edible oil;*** while in case of edible vegetable fat, ***type of vegetable fat*** (interesterified vegetable fat, hydrogenated oils, partially hydrogenated oils, margarine, fat spreads, etc.)*;* In case of animal fat / oil other than milk fat, source of fat (Pork fat, lard; beef fat or extracts thereof)*;* ***Starch*** *(*starches, other than chemically modified starches; ***Fish*** (all species of fish); ***Poultry meat*** (all types of poultry meat); ***Cheese*** (all types of cheese where cheese or mixture of cheese constitutes an ingredient); ***Spices and condiments or mixed spices/condiments*** (all spices and condiments and their extracts); ***Gum base*** (all types of gums); ***Dextrose or Glucose*** (anhydrous dextrose and dextrose monohydrate); ***Caseinates*** (all types of caseinates); ***Cocoa butter*** (press, expeller or refined cocoa butter); ***Crystallized fruit*** (all candied, crystallized and glazed fruit or vegetable or rhizome or fruit peel); ***Milk Solids*** (all milk and milk products derived solely from milk); ***Cocoa solids*** (coca bean, coco nib, cocoa mass, cocoa press cake, cocoa powder (fine/dust)).

Labelling of Pre-Packaged Foods …

- ✓ ***Where an ingredient itself is the product of two or more ingredients, such a compound ingredients shall be declared*** in the list of ingredients
- ✓ ***Added water shall be declared in the list of ingredients except in cases where water forms part of an ingredient***, such as brine, syrup or both used in the compound food and so declared in the list of ingredients
- ✓ ***In case of dehydrated or condensed food***, which are intended to be reconstituted by addition of water, ***the ingredients in such reconstituted food shall be declared in descending order of weight or volume as the case may be***, and shall contain a statement such as "***Ingredients of the product when prepared in accordance with the directions on the label***"

Labelling of Pre-Packaged Foods …

3. Nutritional information

- ✓ Nutritional information or ***nutritional facts per 100 g or 100 mL or per serving*** of the product shall be given on the label containing the following:
  - ✓ ***energy value*** in "kcal"
  - ✓ the ***amounts of protein, carbohydrate (specify quantity of sugar)*** and ***fat*** in "g" or "mL"
  - ✓ the ***amount of any other nutrient for which a nutrition or health claim is made***
  - ✓ Where a claim is made regarding ***the amount or type of fatty acids or the amount of cholesterol***, the amount of saturated fatty acids, monounsaturated fatty acids and polyunsaturated ***fatty acids in grams*** (g) and ***cholesterol in milligrams*** (mg) shall be declared

Labelling of Pre-Packaged Foods …

- ✓ wherever, ***numerical information on vitamins and minerals*** is declared, it ***shall be expressed in metric units***
- ✓ ***where the nutrition declaration is made per serving***, ***the amount in grams (g) or milliliter (mL) shall be declared***

✓ ***A health claim of "trans fat free"*** may be made in cases where the trans fat is less than ***0.2 g per serving of food*** and ***the claim "saturated fat free"*** may be made in cases ***where the saturated fat does not exceed 0.1 g per 100 g or 100 mL of food***.

✓ ***The following foods are exempted from mandatory nutritional labelling***:

a) Unprocessed products that comprise a single ingredient

b) Processed products in which the only processing they have been subjected to is maturing and that comprise a single ingredient

Labelling of Pre-Packaged Foods …

c) Waters intent for human consumption, including those where the only added ingredients are CO_2

d) A herb, a spice o mixtures thereof (masalas) meant for direct consumption

e) Salt and salt substitute

f) Table top sweeteners

g) Coffee extracts and chicory extracts, whole or milled coffee beans and whole and milled decaffeinated coffee, soluble coffee powder, coffee-chicory mixture

h) Herbal and fruit infusions, tea, decaffeinated tea, instant or soluble tea or tea extract;

i) Fermented vinegars and substitutes for vinegar

Labelling of Pre-Packaged Foods …

j) Flavourings, food additives, processing aids, food enzymes, gelatine, yeast;

k) Chewing-gums;

l) Alcoholic beverages; and

m) Foods for Special Dietary Uses (FSDU), Foods for Special Medical Purposes (FSMP) subject to compliance of requirements specified in the Food Safety and Standards (HS, N, FSDU, FSMP, FF and NF) Regulations (2016).

Labelling of Pre-Packaged Foods …

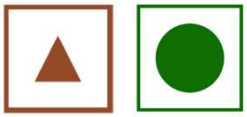
4. Declaration regarding Veg or Non-Veg

✓ Every package of "Non-Vegetarian" food and "Vegetarian" food shall bear a declaration to this effect made by a symbol and colour code as stipulated below to indicate

✓ Symbol shall be prominently displayed on principal display panel

Size of Logo

Area of the principal display panel	Minimum size of diameter of circle (in mm)	Minimum size of each side of Triangle (in mm)	Minimum size of each side of square (in mm)
Up to 100 cm^2	3	2.5	6
Above 100 cm^2 upto 500 cm^2	4	3.5	8
Above 500 cm^2 upto 2500 cm^2	6	5	12
Above 2500 cm^2	8	7	16



Labelling of Pre-Packaged Foods …

5. Declaration regarding food additives

- ✓ For food additives falling in the respective classes and appearing in lists of food additives permitted for use in food generally, the class titles shall be used together with specific names or recognized international numerical identifications
- ✓ Specific format for declaring "Addition of colours and /or flavours"; "Addition of both colours and flavours"
- ✓ Every package of synthetic food colour preparation and mixture shall bear a label upon which is printed a declaration giving the percentage of total dye content

List of food classes listed under permitted food additives

Food Class	Example	Identification Number
Acidity regulator	Citric acid	INS 330
Anticaking agent	Calcium carbonate	INS 170
Antifoaming agent	Methylphenylpolysiloxane	INS 900 b
Antioxidant	Ascorbic acid	INS 300
Bulking agent	Polydextroses A and N	INS 1200
Colour	Sunset Yellow FCF	INS 110
Colour retention agent	Ferrous gluconate	INS 579
Emulsifier	Sorbitan monostearate	INS 491
Emulsifying salt	Trisodium citrate	INS 331 (ii)
Firming agent	Qulillaia extracts	INS 999
Flour treatment agent	Potassium bromate	INS 924 a
Flavour enhancer	Monosodium glutamate	INS 621
Gelling agent	Carrageenan and its salts	INS 407
Glazing agent	Shellac	INS 904
Humectant	Sorbitol and sorbitol syrup	INS 420
Preservative	Sodium benzoate	INS 211
Propellant	Propane	INS 944
Raising agent	Sodium hydrogen carbonate	INS 500 (ii)
Stabilizer	Sodim alginate	INS 401
Sweetener	Sucralose	INS 955
Thickener	Xanthan gum	INS 415

(1) CONTAINS PERMITTED NATURAL COLOUR(S)
OR
CONTAINS PERMITTED SYNTHETIC FOOD COLOUR(S)
OR
CONTAINS PERMITTED NATURAL AND SYNTHETIC FOOD COLOUR(S)

(2) CONTAINS ADDED FLAVOUR

(3) CONTAINS PERMITTED NATURAL COLOUR(S) AND ADDED FLAVOUR(S)
OR
CONTAINS PERMITTED SYNTHETIC FOOD COLOUR(S) AND ADDED FLAVOUR(S)
OR
CONTAINS PERMITTED NATURAL AND SYNTHETIC FOOD COLOUR(S) AND ADDED FLAVOUR(S)

Labelling of Pre-Packaged Foods …

6. Name and complete address of the manufacturer

- ✓ The name and complete address of the manufacturer and the manufacturing unit if these are located at different places
- ✓ In case the manufacturer is not the packer or bottler, the name and complete address of the packing or bottling unit as the case may be shall be declared on every package of food
- ✓ Where an article of food is manufactured or packed or bottled by a person or a company under the written authority of some other manufacturer or company, under his or its brand name, the label shall carry the name and complete details of such company
- ✓ Where an article is imported into India, the package of food shall also carry the name and complete address of the importer in India

General Requirements …

7. ***FSSAI Logo and License number*** shall be displayed on the principal display panel in the following format

fssai

Lic. No. XXXXXXXXXXXXX

Further, ***fortified and organic food*** shall be marked with logo as specified in the regulations

Fortified with….
SAMPOORNA POSHAN
SWASTHA JEEVAN

Jaivik Bharat

Labelling of Pre-Packaged Foods …

8. **Net quantity,Retail Sale Price and Consumer Care Details**
   - ✓ Every package label shall carry the net weight or volume or number of the product, as the case may be.
   - ✓ In addition, a food packed in a "liquid medium" shall carry a declaration of the drained weight of the food
   - ✓ Liquid medium includes water, aqueous solutions of sugar and salt, fruit and vegetable juices or vinegar, either singly or in combination. Further, the declarations shall be as provided in Legal Metrology Act (2009) and Rules made there under.

Labelling of Pre-Packaged Foods …

9. Lot / Code / Batch identification

- ✓ A batch number or code number or lot number which is a mark of identification by which the food can be traced in the manufacture and identified in the distribution, shall be given on the label
- ✓ In case of packages containing bread and milk including sterilized milk, particulars under this clause shall not be required to be given on the label

Labelling of Pre-Packaged Foods …

10. Date marking

- ✓ "***Date of manufacture or packing***", and ***"Expiry / Use by"*** shall be declared on the label. However, expression "***Best before" may also be used as optional*** or additional information.
- ✓ The ***manner of declaration*** of date of manufacture or packing / Expiry / Use-by / Best Before shall be as the date, month and year using **the DD/MM/YY format for products with a short shelf life of up to 3 months**; **the month and the year for products with a shelf life of more than three months,** shall be declared in un-coded numerical sequence except that the month shall be indicated by capital letters and abbreviations (at least first three letters of the month) may be used.
- ✓ **Any special conditions for the storage of the food shall be declared on the label if the validity of the date depends** thereon. If required, **storage conditions after opening the pack may also be specified**.

Labelling of Pre-Packaged Foods …

- Notwithstanding anything contained in this regulation, an indication of the "***Expiry" shall not be required for***:
  - ✓ Fresh fruits and vegetables, including potatoes which have not been peeled, cut or similarly treated.
  - ✓ All types of wine
  - ✓ Alcoholic beverages containing 10% or more by volume of alcohol
  - ✓ Vinegar
  - ✓ Sugar boiled confectionery
  - ✓ Food grade salt for industrial use
  - ✓ Solid sugars
- **"Date and time of manufacture" shall be declared on packed meals served in airlines / railways / mobile catering units.**

Labelling of Pre-Packaged Foods …

11. Labelling of Imported Foods:

- ✓ In addition to the requirements mentioned in these regulations, labelling requirements of imported foods **shall be governed by the Food Safety and Standards (Import) Regulations (2017)**.

12. Country of Origin for imported foods

- ✓ Country of origin of the food shall be declared on the label of food imported into India
- ✓ When a food undergoes processing in a second country which changes its nature, the country in which the processing is performed resulting in change in HS Code (Harmonized System Code) at the 6 digit level shall be considered to be the country shall be considered to be the country of origin for the purposes of labelling.

Labelling of Pre-Packaged Foods …

13. Instructions for use

- ✓ Instructions for use, including reconstitution, where applicable, shall be given on the label, if necessary, to ensure correct utilization of the food, or where such **food requires directions for reasons for health and safety** ("Refrigerate after opening")

Labelling of Pre-Packaged Foods …

14. Declaration regarding Food Allergen

- ✓ The following foods and food ingredients which are known to cause allergy shall be declared separately as **Contains** _____ (Name of allergy causing ingredients).
  - ✓ Cereals containing gluten (To be declared as name of the **Cereal**)
  - ✓ Crustacean and their products (To be declared as **Crustacean**)
  - ✓ Milk and milk products (To be declared as **Milk**)
  - ✓ Egg and egg products (To be declared as **Egg**)
  - ✓ Fish and fish products (To be declared as **Fish**)
  - ✓ Peanuts, tree nuts (e.g. almonds, walnuts, pistachio, cashew nuts) and their products (To be declared as **Nut**)
  - ✓ Soybeans and their products (To be declared as **Soy**)
  - ✓ Sulphite in concentrations of 10 mg/kg or more (To be declared as **Sulphite**)

Labelling of Pre-Packaged Foods …

- ✓ Provided that in case presence of ingredients due to cross contamination which are known to cause allergy may be declared separately as "**May Contain _____**" (Name of allergy causing ingredients).
- ✓ **Raw agricultural commodities are exempted from the allergen labelling requirements**.

Labelling of Pre-Packaged Foods …

13. Every package of ***food material sold in retail but which is not meant for human consumption*** example Pooja water, Ghee for diya, Oil for Pooja, etc. shall bear a declaration to this effect by a symbol as stipulated below.

The symbol shall consist of a black colour cross inside a square with black outline having sides of square not less than the minimum size specified in the Table mentioned in the regulation.

Exemptions from certain Labelling Requirements

a) **Where the surface area of the package is not more than 100 cm^2**, 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; labelling of irradiated food, declaration of food additives; license number and logo and complete address of the importer and instructions for use, but this information shall be given on the multi-unit packages.

b) **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 shall be given.

c) **In case of food products 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 "Expiry/Use by" shall be mentioned on the label by the manufacturer or packer.

Exemptions from certain Labelling Requirements

f) In case of prepared food served for immediate consumption such as in hotels or by food service vendors or caterers or halwais or hospitals or at religious gathering or food served in airline/railway/passenger vehicle or any mobile unit shall accompany or display the minimum information as mentioned in the regulations at the point of sale/serve of the food.

g) The following labelling requirements are exempted if they are provided in a Barcode / Global Trade Identification Number (GTIN):
   - ✓ Address of the brand owner whether or not, he himself is the manufacturer, marketer, packer or bottler, as the case may be.
   - ✓ The license number of the manufacturer or marketer or packer or bottler, as the case may be, if different from the brand owner.

f) **For assorted packs**, ***shelf life declared on assorted pack should be that of the product having the earliest shelf life declared amongst the different pre-packaged food packed inside.***

Specific Requirements / Restrictions on Manner of Labelling

- *Labelling of Infant Milk Substitute and Infant Food*
- *Labelling of edible oils and fats*
- *Labelling of permitted food colours*
- *Specific labelling requirements of other products*

Thank You

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