PASTEURIZATION OF FOOD PRODUCTS

HEAT PROCESSING: Use of high temperatures to destroy enzymes and microorganisms that could reduce quality and/or safety of food

1. **BLANCHING** - A mild heat treatment that primarily destroys enzymes and reduces microbial load (does not necessarily kill pathogens), further preservation methods needed to extend shelf life.

   Example: Vegetables, frozen, canned

2. **PASTEURIZATION** - A mild heat treatment used primarily to destroy pathogenic organisms but it also destroys enzymes and reduces microbial load. Requires an addition preservation method to extend shelf life (example: refrigeration, drying).

3. **COMMERCIAL STERILIZATION** –
   A severe heat treatment that destroys pathogenic and many microorganisms that could spoil food. Extends shelf life, room temperature stable. (canned foods)

4. **STERILIZATION** - A very severe heat treatment that destroys all microorganisms.

History

- **PASTEURIZATION**
- The process of pasteurization was named after Louis Pasteur (1960S) who discovered that spoilage organisms could be inactivated in wine by applying heat at temperatures below its boiling point. The process was later applied to milk and remains the most important operation in the processing of milk.

- Common milk borne illnesses during that time were:
- Typhoid fever
- Scarlet fever
- Septic sore throat
- Diphtheria
- Consumption
- Diarrheal diseases.

What is Pasteurization ?

- Pasteurization involves heating food to a temperature that kills disease causing microorganism and substantially reduces the levels of spoilage organisms.
- Pasteurization is not intended to kill all micro-organisms in the food. Instead pasteurization aims to reduce the number of viable pathogens so they are unlikely to cause disease (assuming the pasteurized product is stored as indicated and consumed before its expiration date).
- Heat also destroy enzymes that make milk spoil, so pasteurized milk is drinkable for longer time.
- Thus it increases the shelf life of the product.

PASTEURIZATION

- Used for milk, liquid eggs, fruit juices and beer.
- Destroy pathogens
- Reduce microbial load (numbers)
- Inactivate enzymes
- Extend shelf life

PASTEURIZATION IS USED FOR;

- 1.When more rigorous heat treatments might harm the quality of products
- 2.When one aim is to kill pathogens, as with market milk
- 3.When the main spoilage organisms are not very heat resistant, such as the yeasts in fruit juices
- 4.When any spoilage organisms will be taken care of by additional preservative methods to be employed
- When competing organisms are to be killed

Objectives of milk pasteurization

- The chief objective of milk pasteurization is to destroy pathogenic bacteria that could have a public health concern. By destroying these microorganisms, the product becomes safe for public consumption.
- Secondly, pasteurization eliminates destructive bacteria and enzymes that could cause spoilage of the product. This leads to a prolonged shelf life of the milk.
- Pasteurized milk is commercially sterile, which means that they are not entirely rid of bacteria. One should compound their preservation with another method (usually refrigeration).

Methods of pasteurization

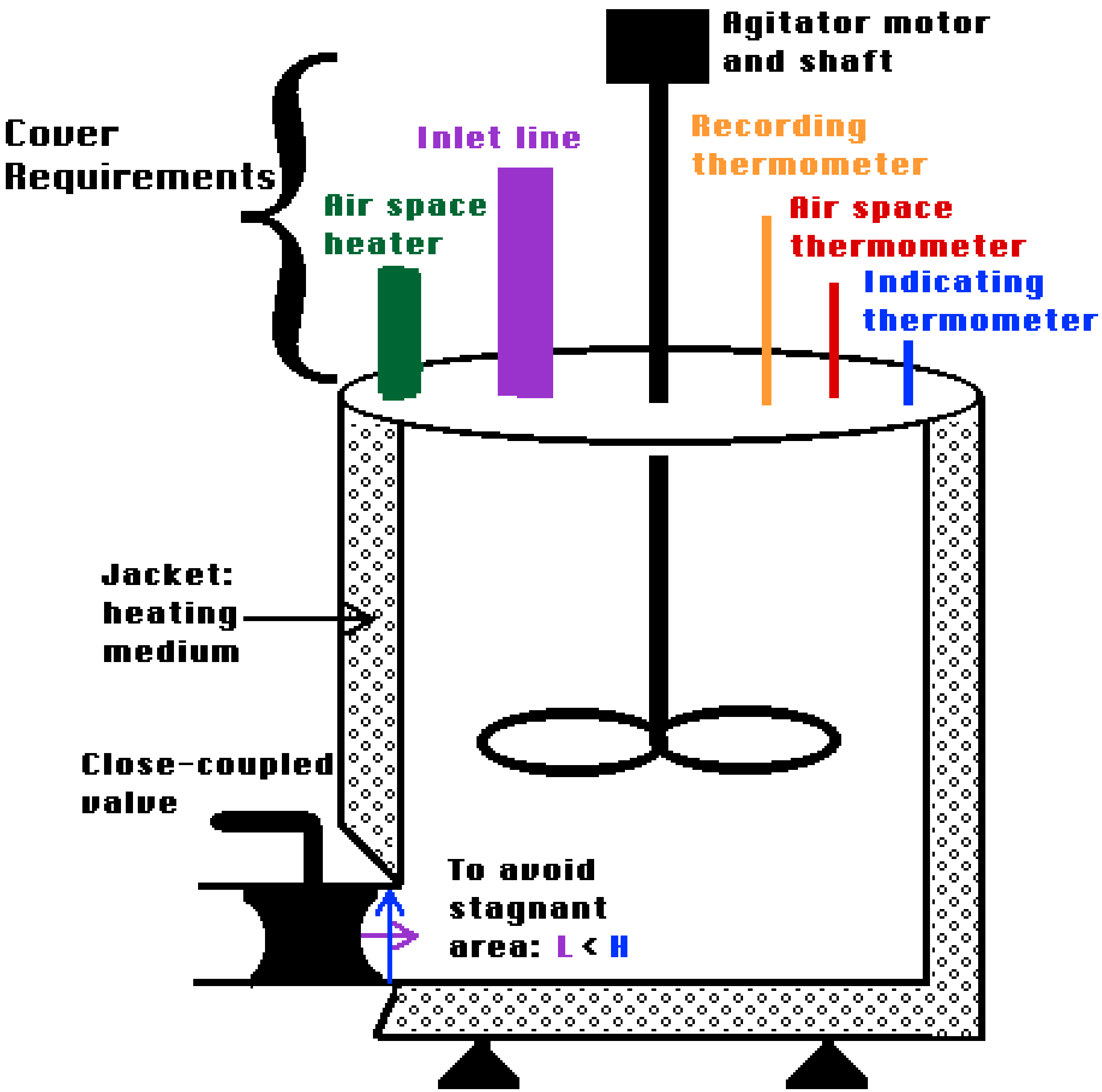
- Low temperature holding pasteurisation (LTH) Low Temperature Long Time (LTLT), or Batch/Vat Pasteurization
- High-temperature, short time (HTST) or continuous flow or Flash Pasteurization
- Ultra heat treatment or ultrahigh temperature (UHT)

Batch pasteurization:

- Also known as low temperature long time (LTLT) pasteurization.
- Heat the milk to 62.8°C for 30 minutes and rapidly cooled to 10°C.
- The extendend holding time causes alteration in the milk protein structure and taste.

- In the vat the milk is heated and held throughout the holding period while being agitated. The milk may be cooled in the vat or removed hot after the holding time is completed for every particle.
- As a modification, the milk may be partially heated in tubular or plate heater before entering the vat. This method has very little use for milk but some use for milk by-products (e.g. creams, chocolate) and special batches.

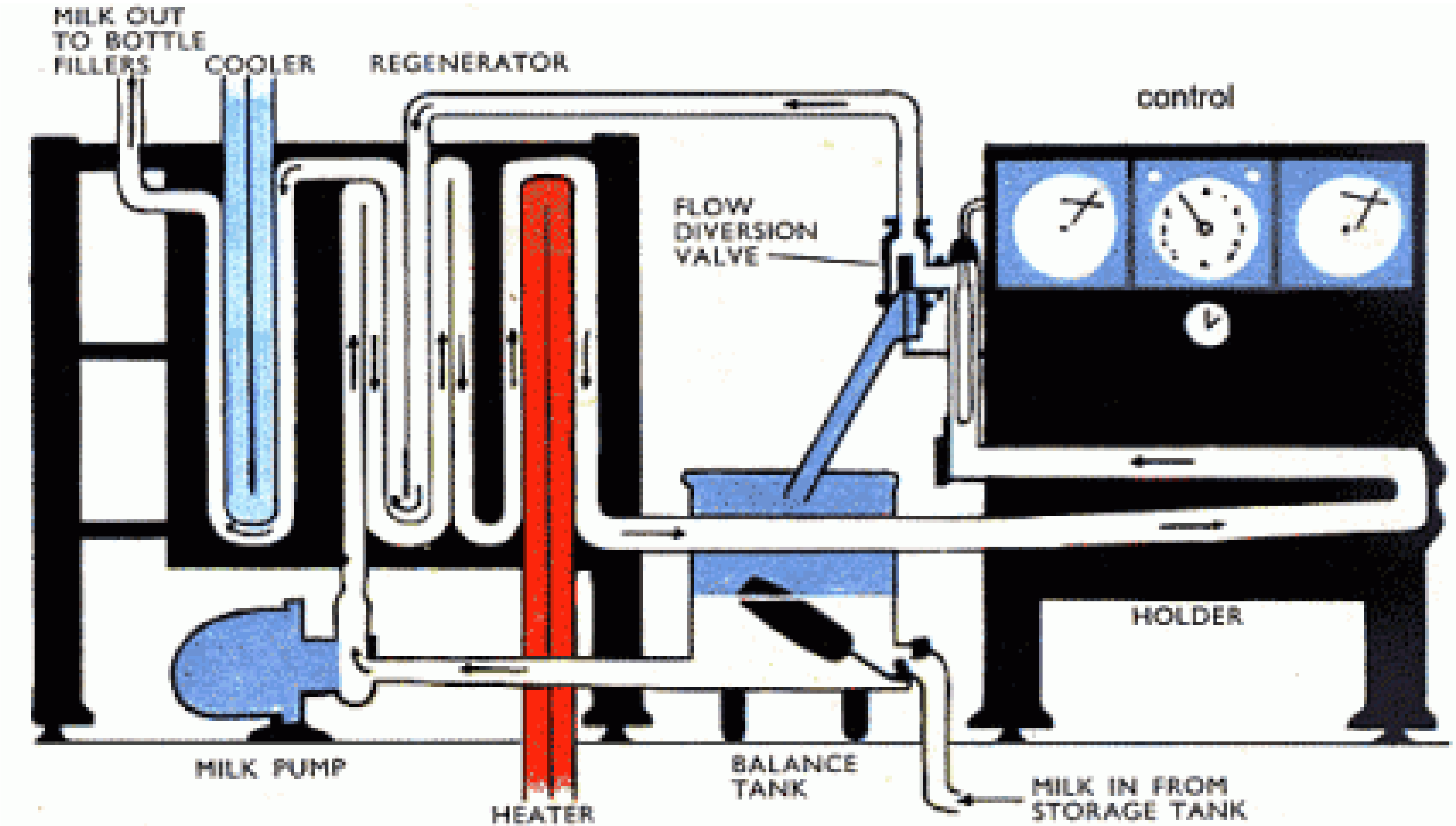
Batch Pasteurizer



HTST Method: (Flash Pasteurization)

- Heat the milk to between 71.7°C (72°C to 74°C) for 15 (to 20) seconds and then rapidly cooled to 4°C.

HTST pasteurization Unit



PROCESS

1) cold raw milk is fed into the pasteurization plant and passes into the regeneration heating system of the plate heat exchanger
2) The plate heat exchanger is basically a series of stainless steel plates stacked together with some space in between forming chambers to hold the milk as it passes through
3) In the regeneration section cold milk is pumped through the A chambers, while milk that already been heated and pasteurized is pumped through the B chamber
4) The heat from the hot milk passes to the cold milk through the steel plates

5) This warms the milk to 57-68˚C
6) Next the milk is passes into the heating section of plate heat exchange. Here hot water in the B chamber heats the milk at least 72˚C which is the goal temperature for HTST
7) Hot milk is then passed though a holding tubes, it takes milk about 15 sec to pass through the tube
8) Milk is officially pasteurized once its passes through the holding tube
9) Now the pasteurized milk is sent back through the regenerative section, where it warms the incoming cold milk
10) This cools the pasteurized milk to about 32˚C

- The warm milk passes through the cooling section where it is cooled to 4° C or below by coolant on the opposite sides of the thin, stainless steel plates.
- The cold, pasteurized milk passes through a **vacuum breaker** at least 12 inches above the highest raw milk in the HTST system then on to a storage tank filler for packaging.

HTST Pasteurization plant

HTST Pasteurization plant

Ultra High Temperature (UHT) Pasteurization

- This is a completely closed pasteurization method. The product is never exposed even for a fraction of a second during the entire process.
- It involves heating milk or cream to between 135°C to 150°C for one to two seconds, then chilling it immediately and aseptically packaging it in a hermetic (air-tight) container for storage.

Steam injection technique

steam is injected into milk

UHT SYSTEM

Steam infusion technique

milk is injected into steam

- **Disadvantages of high temperature pasteurization**
- There is a possibility of alteration of milk proteins. This can affect the properties of such milk when used to make other food products.
- High temperatures inactivate the enzymes that protect the product increasing the risk of spoilage.
- High temperatures alter the protein structure and imparts a cooked flavor to the milk.

Phoaphatase test

- **Alkaline Phosphatase** is an enzyme which is naturally present in **milk**, but is destroyed at a temperature just near to the **pasteurization** temperature. **Alkaline Phosphatase test** is used to indicate whether **milk** has been adequately **pasteurised** or whether it has been contaminated with raw **milk** after pasteurisation.

- Alkaline phosphatase is a monesterase that catalyzes the hydrolysis of monoesters.
- Alkaline phosphatase is associated with the fat globule of milk, i.e., it is adsorbed to the fat globule membrane surface.
- Alkaline phosphatase (EC 3.1.3.1) is a membrane- bound glycoprotein with sialic acid as sugar moiety. It is a phospho- monoesterase enzyme that catalyzes the hydrolysis of monoesters of phosphoric acid (at alkaline pH), yielding phosphate and the corresponding alco- hol.

- Assays employed to detect ALP activity can be broadly classified into 4 types: colorimetric, fluorometric, chemiluminescent, and immunochemical methods.
- These methods have been adopted for use over many years; however, only the colorimetric, fluorometric, and chemiluminescent types have been recognized as validated methods for pasteurization verification in the dairy industry.

- **Phosphatase tests** is based on the principle that the alkaline phosphatase enzyme in raw milk liberates phenol from a disodium phenyl phosphate substrate (Scharer Method) or phenolphthalein from a phenolphthalein monophosphate substrate (Rutgers Method) or para nitro phenol from p- nitrophenyl phosphate disodium salt (Aschaffenburg and Mullen method), when tests are conducted at suitable temperature and pH.

- The amount of phenol or phenolphthalein or p-nitro phenol liberated from the substrate is proportional to the activity of the enzyme. Phenol is measured calorimetrically after its reaction with 2,6 dichloroquinone-chloroimide (CQC) to form indophenol. Phenolphthalein is detected by addition of sodium hydroxide.

Aschaffenburg and Mullen method for detecting ALP

Milk Sample

+

Phosphatase reagent (Carbonate buffer + p- nitro phenol phosphte disodium salt)

Incubate at ↓ 37 °C / 2 hours

Check for development of yellow colour.

Errors in the test result

Coloured dairy products, such as strawberry milk, pose an obvious interference challenge with colorimetric ALP assays

Other non pigmented food additives with reac- tive phenolic groups, such as vanillin (when oxidized to vanillic acid), ρ-hydroxybenzoic acid, and salicylic acid, can interfere with the ALP assay substrate yielding false positive results.

Antibiotic residues of oxytetracycline and penicillin with phenolic moieties have been shown to give false positive results with colorimetric tests

- Microbial Alkaline Phosphatase, Alkaline phosphatase is produced by many bacterial strains and, in many cases, exhibits a higher thermal stability than bovine ALP, potentially increasing the incidence of false positive results.
- Reactivation of ALP. It has been reported that pasteurized milk could test positive for ALP activity when stored at temperatures ranging from 22 to 37°C, even when a negative ALP result was obtained for the same pasteurized milk following processing.