

STERILIZATION

Summing up (What and Why?)



Usually temperature more than 100°C.

No chilling is required. Excellent storage life at room temperature.

High operating pressure to prevent milk from boiling at the processing temperature.

Conventional method: Packaging before heat treatment

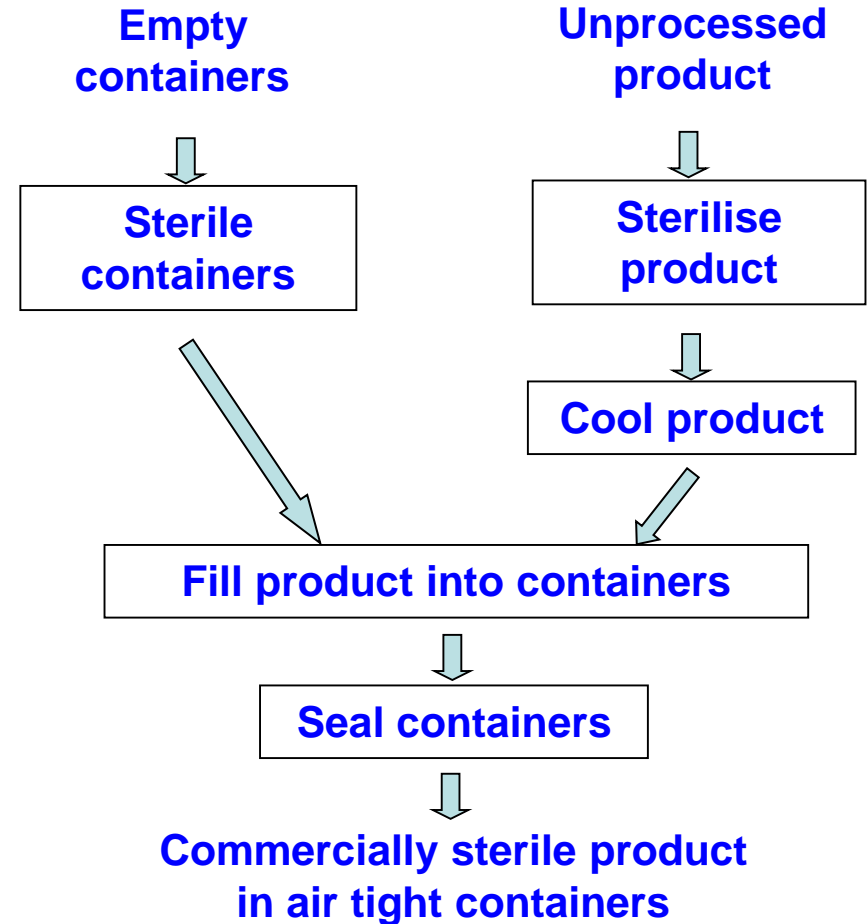
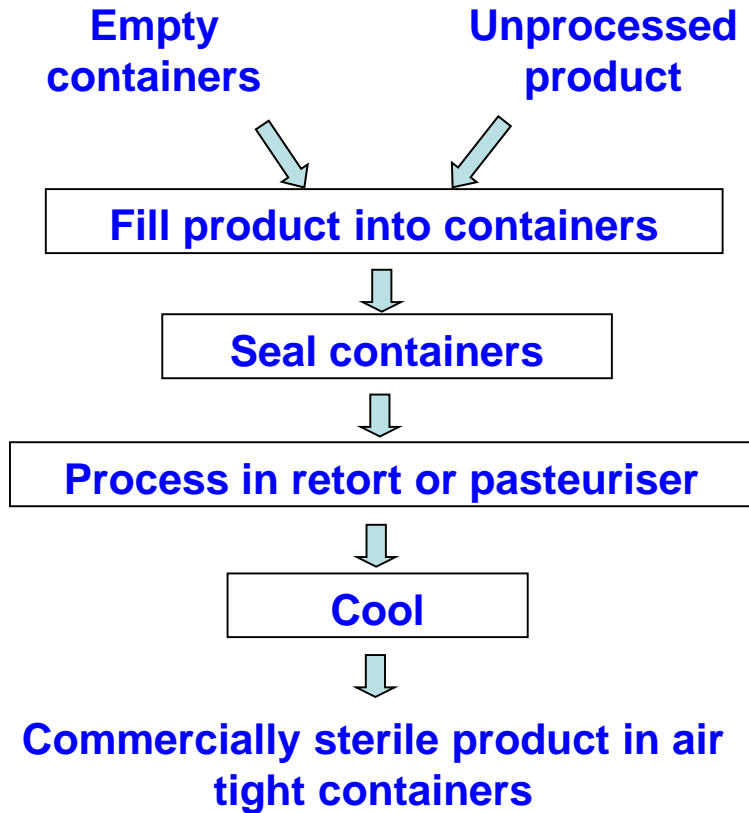
UHT or aseptic method: Packaging after heat treatment.

How?

Methods of sterilisation

- **In-bottle sterilisation : 105-110°C for 30-45 min**
- **UHTST or VHTST process : 135-150°C for 1-20 seconds (Then packed aseptically)**

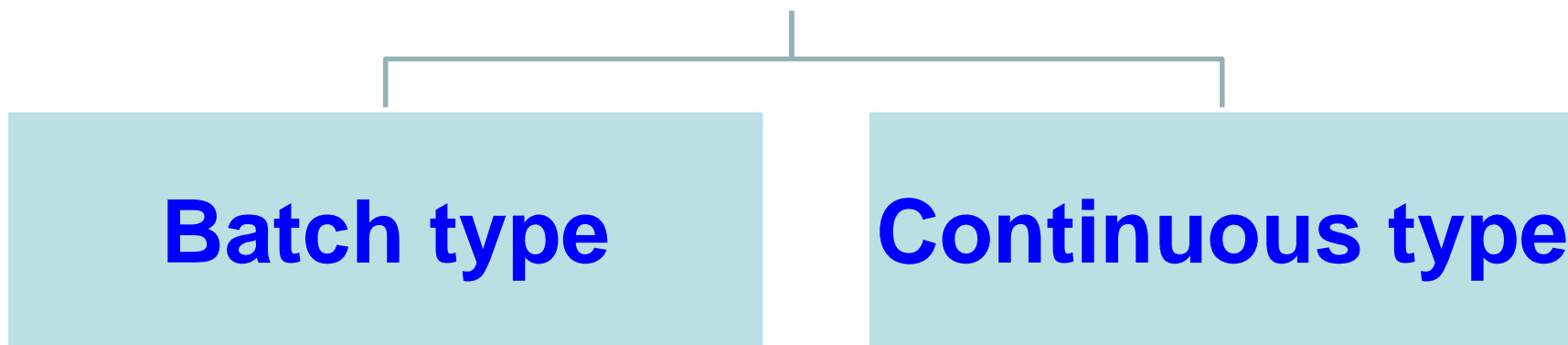
Conventional canning-vs- aseptic processing



Conventional canning

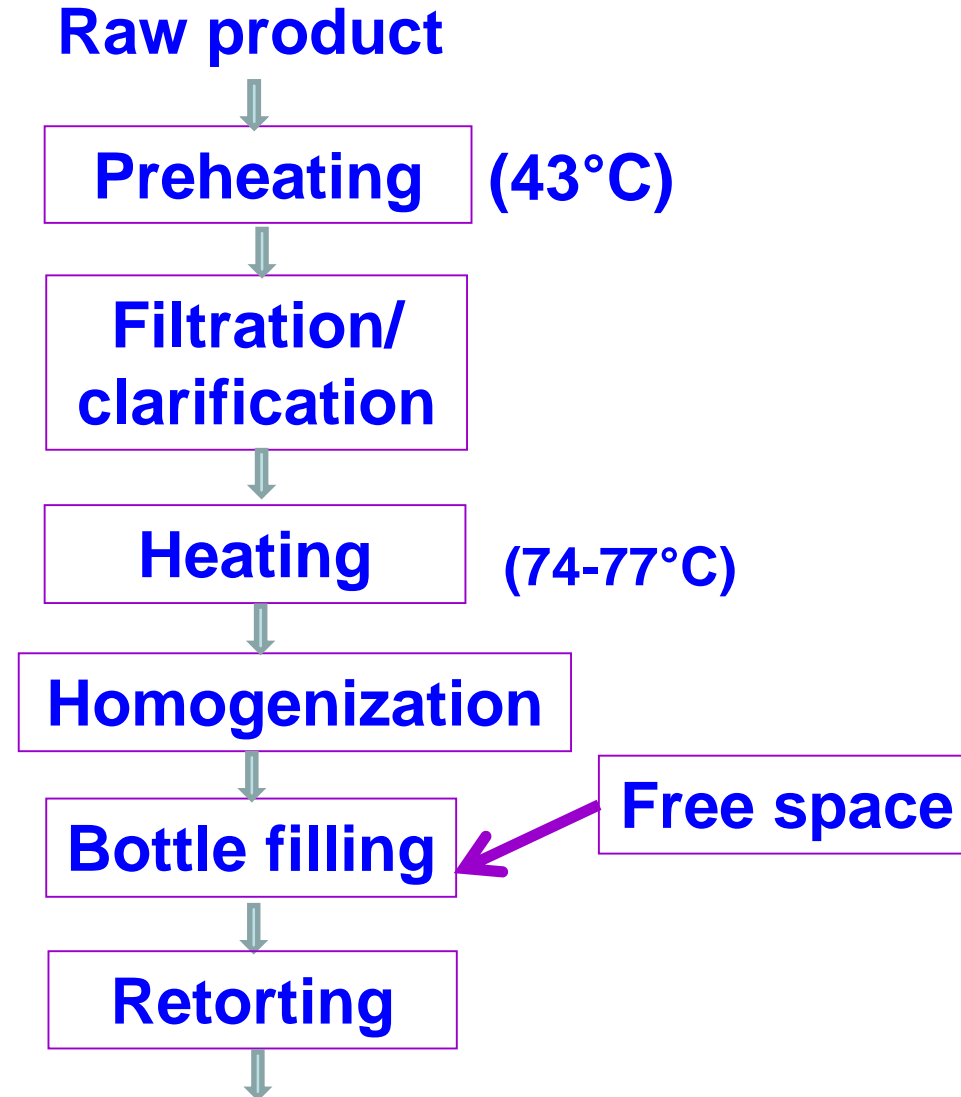
In-bottle sterilisation

In-bottle sterilisation

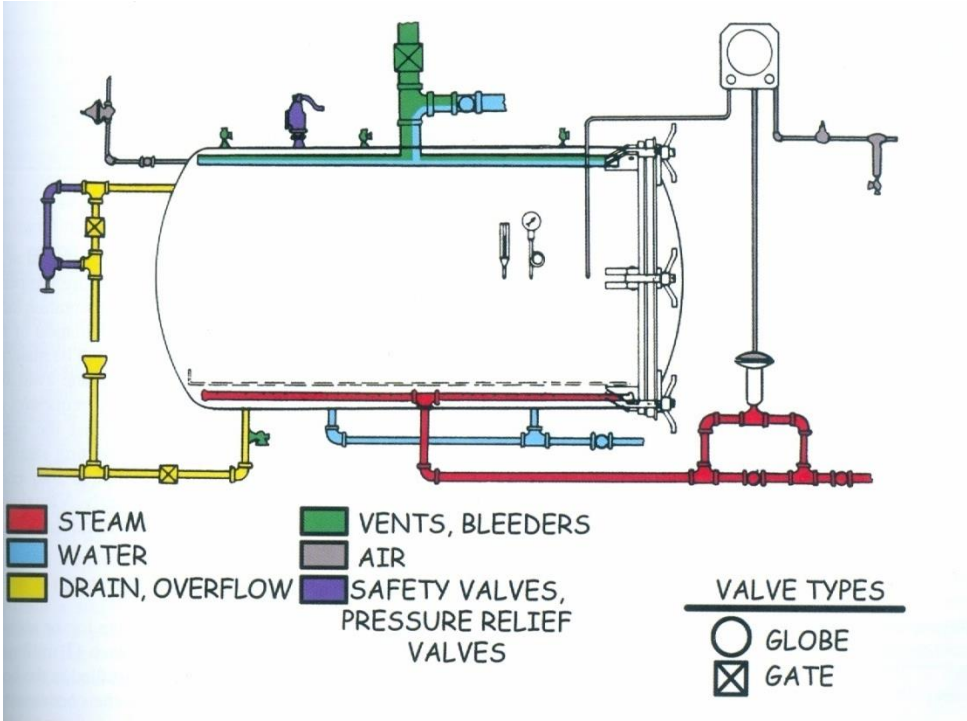


RETORTS

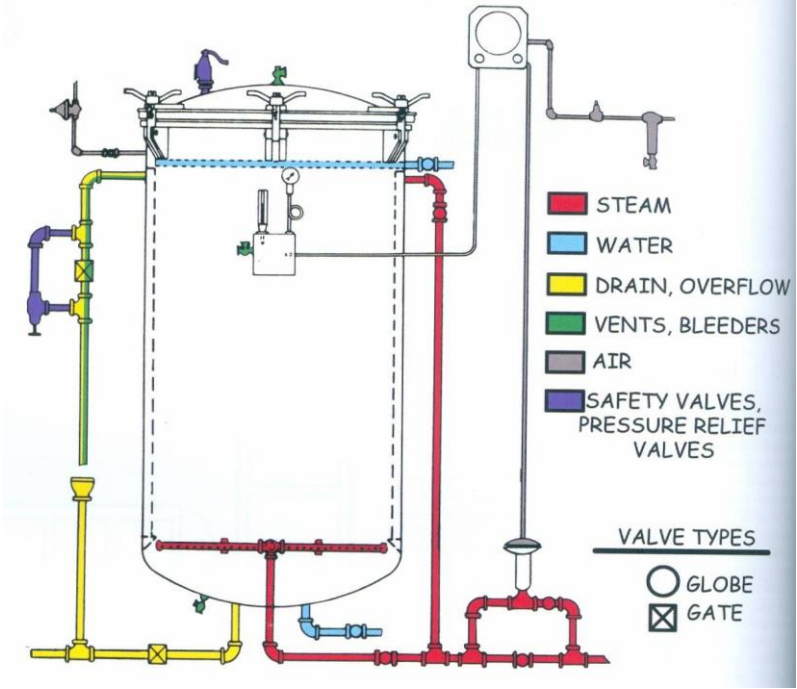
In-bottle sterilisation



In-bottle sterilisation

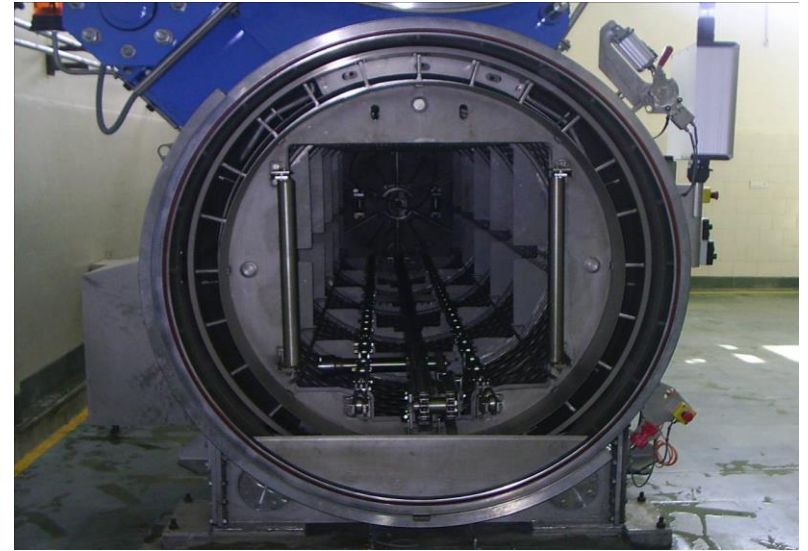


Horizontal retort



Vertical retort

In-bottle sterilisation



Horizontal retorts

In-bottle sterilisation

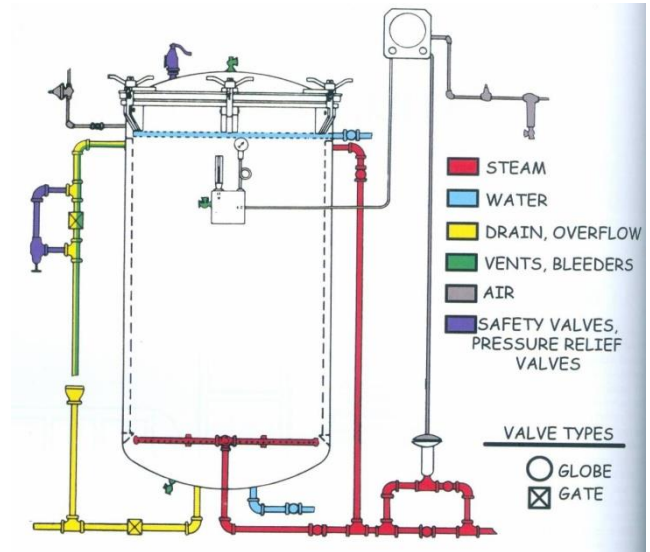


Horizontal retorts

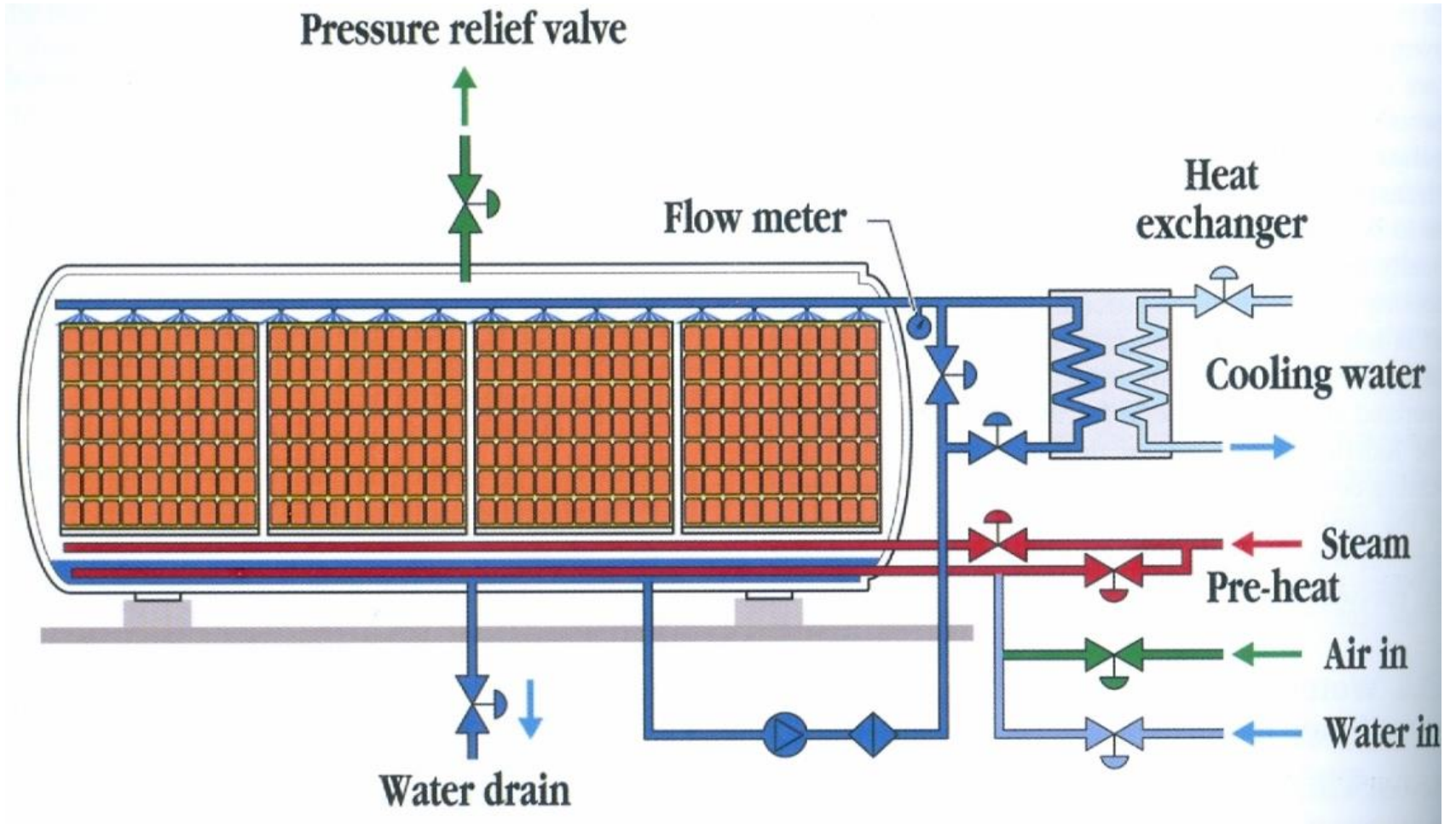
In-bottle sterilisation

Batch sterilisation

- **Pressure vessel**
 - Circular or rectangular**
 - Vertical / Horizontal**
- **Bottles into crates and then into steriliser**
- **Lid or door with good fastening**
- **Vessel is supplied with steam at required pressure**
- **After desired processing time, steam vented to atmosphere**
- **Controls to maintain processing time and pressure**
- **Cooling of crates by air (fans)**

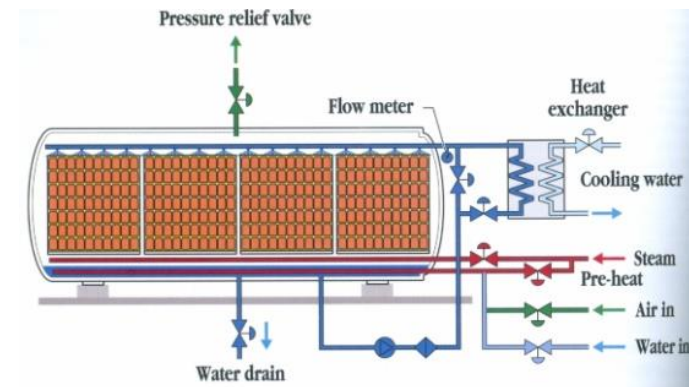


Water spray or cascading water retort



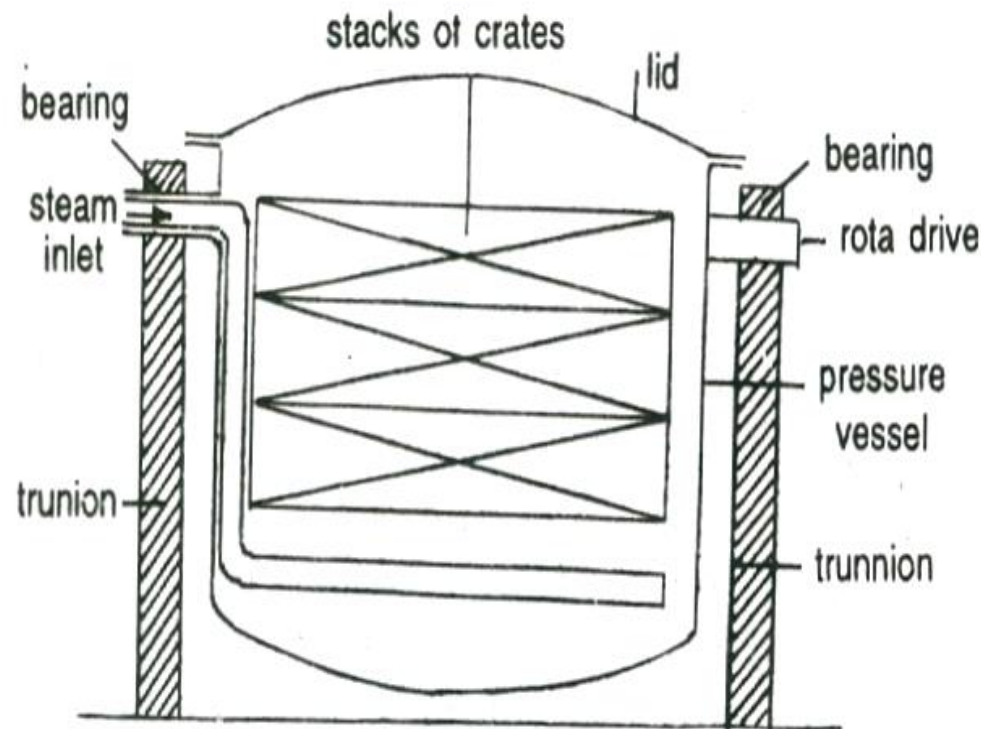
Water spray or cascading water retort

- Use a low volume of water
- Water does not completely cover the containers during processing, but instead sprays or cascades (showers) on the containers.
- The system collects (draws) water from the bottom and reintroduces through sprays from the top and mid-section of the vessel to heat or cool.
- Heating of water internally by steam spreaders
- Air is the source of overpressure to maintain container integrity during thermal processing..



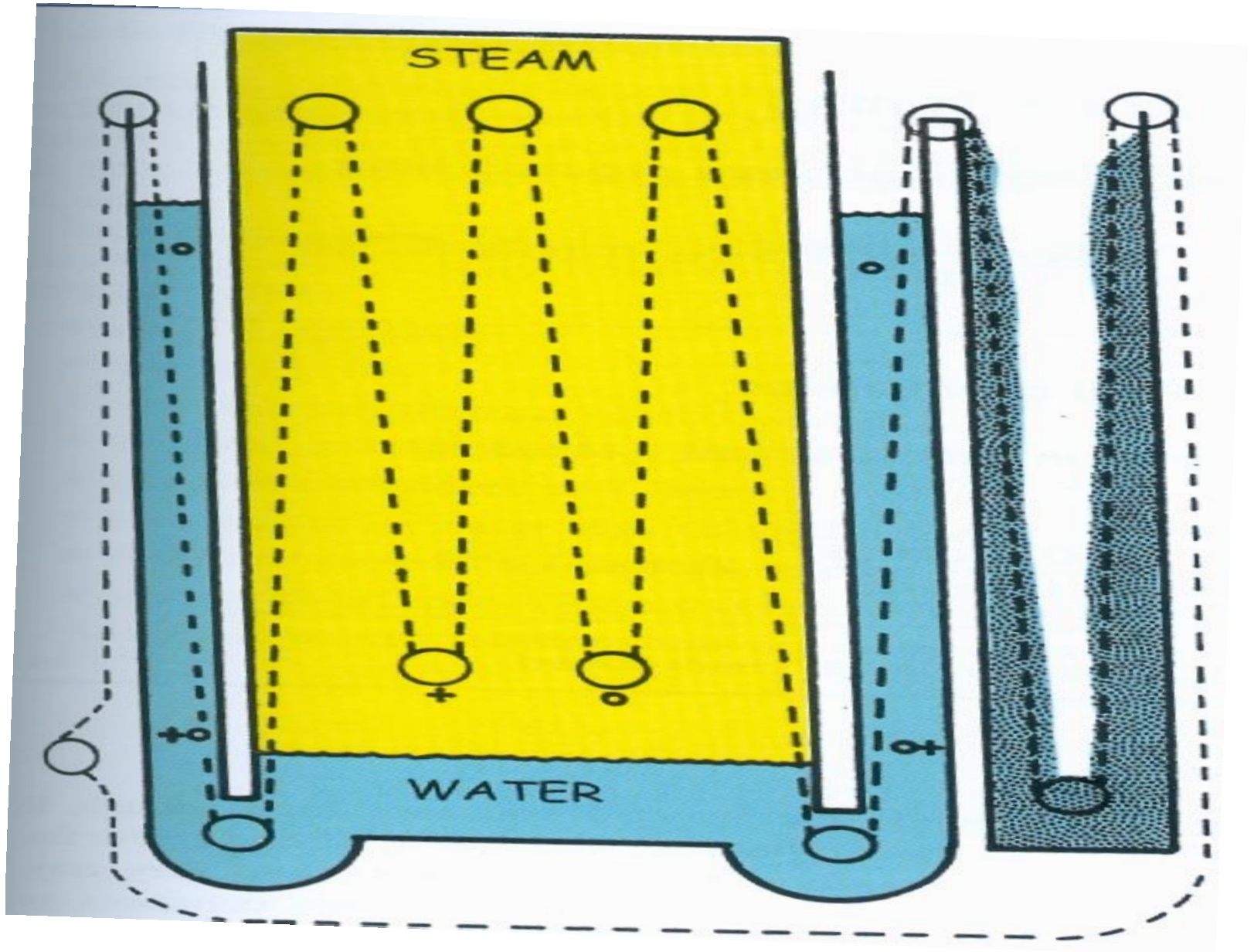
Rotary batch sterilisation

Rotary batch steriliser : Agitate milk during heating by rotating the load of bottles about a horizontal axis.



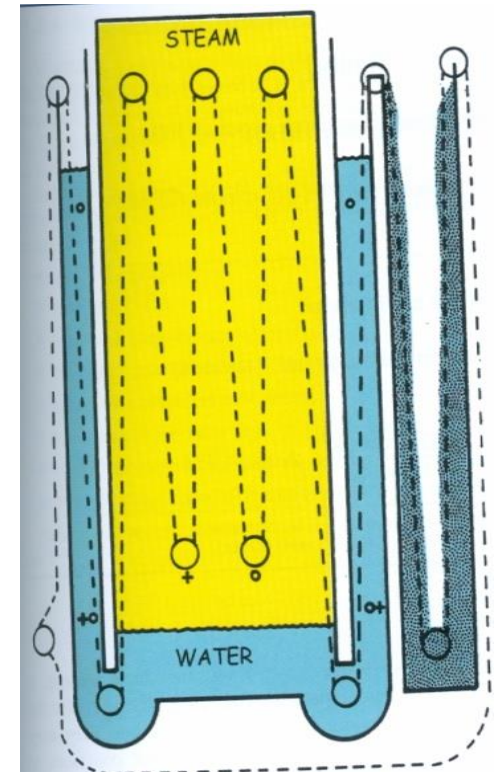
Rotary batch stabiliser

Hydrostatic retort



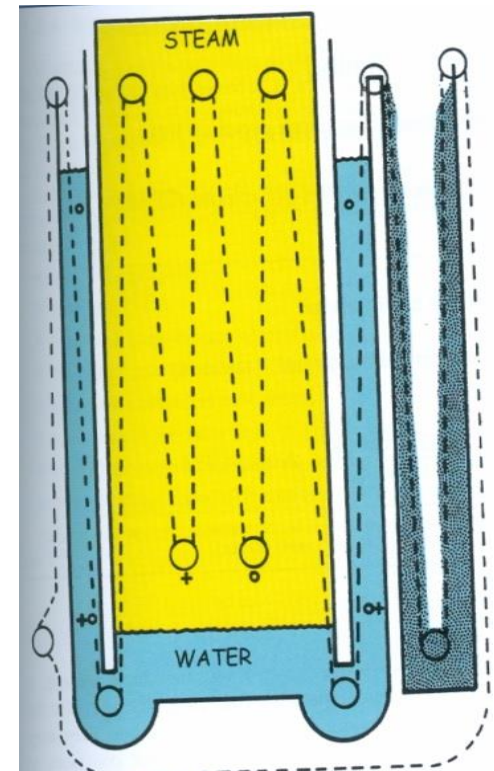
Hydrostatic retort

- Processing chamber (also known as **steam dome**) is maintained at constant temperature.
- Has a **continuous conveyor chain** that transports containers at a constant rate.
- Operates with steam as the processing medium.
- **Minimal container agitation** during processing.
(However, some use cascading water with over pressure as the processing medium and some provide container rotation or rocking during processing.)

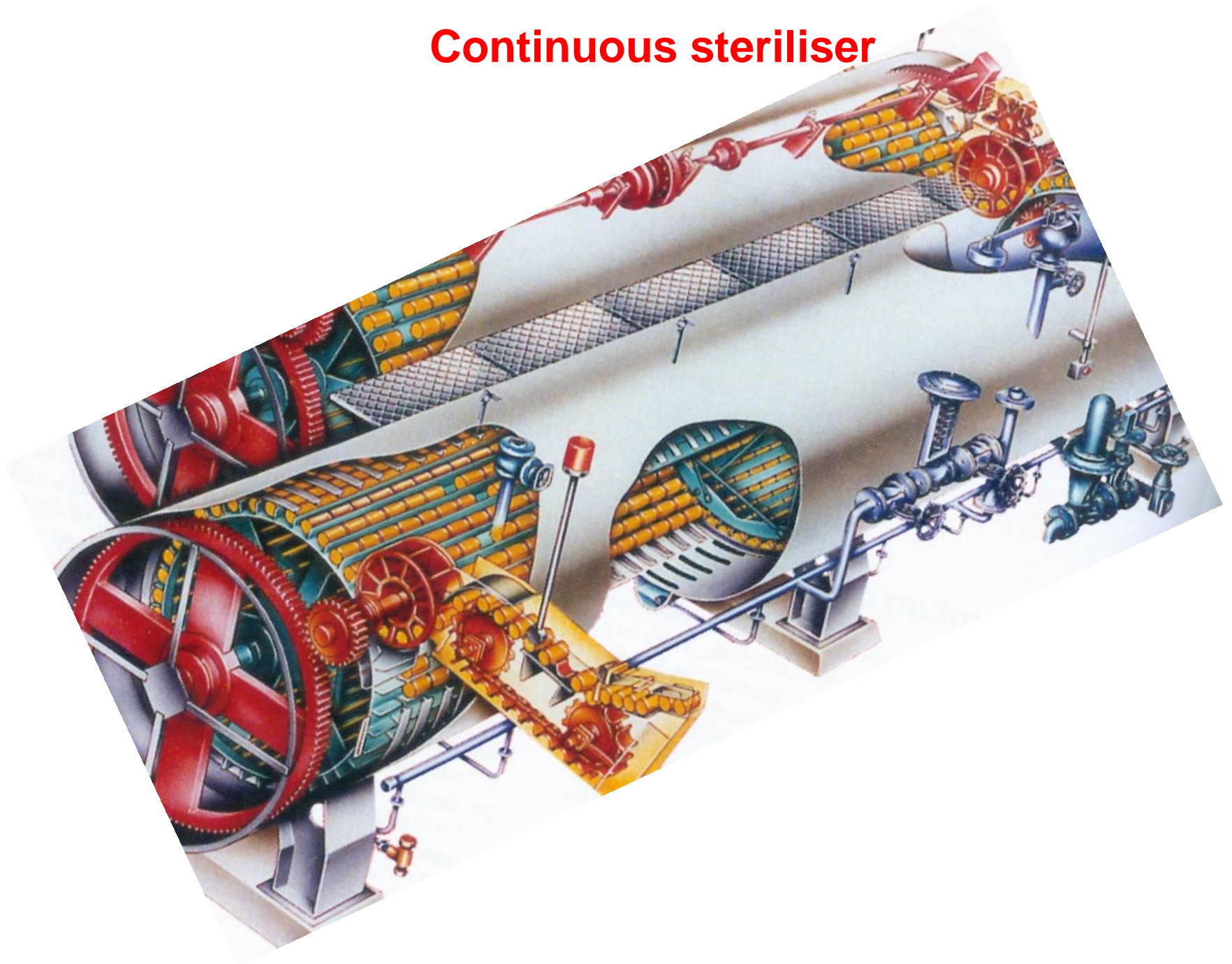


Hydrostatic retort

- 2,4,6, or 8 pass hydrostatic retorts are common.
- Pressure within the chamber is maintained and counterbalanced by the weight of water in the feed and discharge gates.
- To increase the temperature, the pressure must increase and thus height of water column must increase.
- For the processing chamber temperature as $121^{\circ}\text{C} \rightarrow 103.4 \text{ kPa}$ pressure in the chamber \rightarrow water column height in the feed and discharge legs must be 11.3m above the steam-water interface.



Continuous steriliser



Continuous rotary retort

- Continuous container handling and intermittent product agitation.
- The retort system is constructed of a series of cylindrical vessels called shells (typically 1.5 m dia).
- Processing and cooling in separate shells connected by transfer valves.
- To maintain the pressure in the shells, containers enter and exit through self-sealing inlet and discharge valves.
- Agitation occurs when the containers roll on the bottom of a shell.
- Product agitation increases rate of heat penetration, allows use of higher processing temperature (up to 137.8°C, i.e. 280°F), and improves product uniformity and quality.

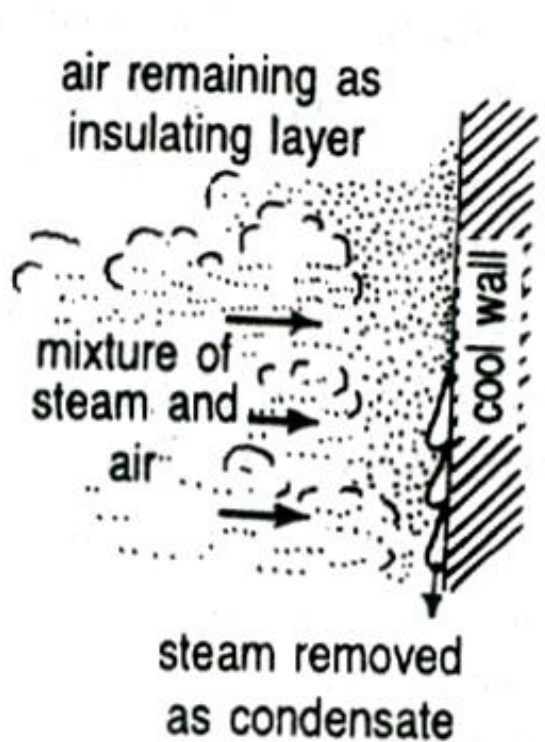
Continuous rotary retort

- Large initial investment and additional critical factors to monitor and control.
- Retorts will accommodate a limited range of both length and diameter of cylindrical container sizes due to the physical restrictions imposed by reel steps, spacing of the spiral and other factors.

In-bottle sterilisation

Two kinds of problems in heat treatment

1. Heat has to pass through the container first before it goes into the milk
2. Use of glass as container material



- A ring of white solids left on wall of the bottle at edge of milk surface.
- Could be due to excessive foam formed during bottle filling operation.
- Avoided by rotation or violent shaking of the bottle during heating and cooling cycle.

In-bottle sterilisation

Important accessories

- Air vent
- Temperature recorder/ thermometer
- Pressure gauge

Bottle cooling by natural air (to avoid thermal shock)

Controlled water cooling within the steriliser is practised in commercial canning, but not for glass bottles, as they may break.

In-bottle sterilisation

Usually steam capacity ranges between 0.2-0.6 kg of steam per litre of milk according to plant characteristics.

(Assuming that milk bottles are loaded at 70°C and sterilised at 113°C by steam with a heat capacity of 555 kcal/kg, the steam requirement is about 0.1 kg steam for each litre of milk.)

Thank You