



THERMAL PROCESSING OF FISHERY PRODUCTS



Exhausting



- Removing air from contents and headspace of filled can before sealing
 - Minimizes strain on can seam – expansion of air during heat processing
 - Removes oxygen – reduces internal can corrosion
 - Prevents fat oxidation – product deterioration and discolouration
 - Ensures proper vacuum –
 - ✦ Replaces air by steam – on cooling – vacuum
 - ✦ Can ends remain concave/flat – higher storage temperatures – high altitude area
 - ✦ Absence of vacuum – internal pressure – blown cans



- 3 methods:

1. Heat exhausting

- Can contents heated immediately before sealing
- Releases trapped air/gas – product expands – displaces air in headspace with water vapor – vacuum on cooling
- 2 ways –
 - ✦ Heating can contents immediately before filling and sealing quickly
 - ✦ Cold filling contents into can – passed through steam exhauster before sealing – cans heated in circulating steam
 - ✦ Automatic high speed machines – exhausted with clinched ends – can end partially secured to can body by a single seam – keeping end sufficiently loose – allows escape of air



2. Mechanical exhausting

- Can filled with cold contents – sealed in vacuum sealing machine
- Flexible pouches – heat exhausting
- Mechanical exhausting – partial vacuum in headspace – collapses pouch – prevents further escape of air
- 2 stages – first sealed leaving a small area in seam to draw vacuum – final sealing after drawing vacuum



3. Steam injection

- Blast of steam – injected into headspace – through ports around seaming head
 - Steam replaces air – condenses on cooling after sealing – creates vacuum
 - Suitable – products packed in liquids
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- Heat exhausting – commonly used for fish canning – simple, cheap and reliable
 - Heat exhausted cans – sealed hot – 60-70°C – favourable effect on further heat processing



- Mechanical exhausting and steam injection – rapid process – exhausting and seaming done simultaneously
- Disadvantage – air removed only from headspace – dissolved and trapped tissue gases not removed



- Clinching
 - Partial closing
 - Loose hooking between lid and can body
 - To prevent defects – scorching and falling of condensed steam
 - Better heat retention – better vacuum

Sealing the container



- Tight seal between cover/end/lid and body – prevent entry of microorganisms
- Sealing – immediately after or simultaneously with exhausting
- Delay between exhausting and seaming – loss of vacuum – bacterial spoilage
- Perfect sealing – critical operation – good quality tin plate, adequate sealing compound, efficient can closing machine – strong, hermetic double seam



- Flexible pouches – fusion of two thermoplastic materials – heated pressure plates/jaws
- Before sealing – can coding – date/year of production, producer's name – alphabets and numerals
- Coding – embossing machine – without damaging lacquer or tin coating

Washing the sealed container



- Cans leaving seaming machine – oil, brine, sauce, fish pieces adhering to surface
- Contaminate and clog retort – source of contamination of subsequent batches
- Removal after retorting – peels off surface lacquer – corrosion of can surface
- Contaminants – prevent label from sticking to can surface



- Can washing – hot detergent solution – sodium polyphosphate (1-1.5%) at 80 °C
- Traces of alkaline residue – surface corrosion
- Rinsed with hot water – remove detergent residue

Thermal Processing/Sterilization



- Most important operation
- Application of sufficient heat treatment for a definite time – destruction of pathogens and inactivation/destruction of spoilage organisms under ordinary conditions of storage and handling without affecting food qualities – **commercial sterility**



- Thermal processing –
 - Consumer safety
 - Non-spoilage under ordinary conditions
 - Proper cooking
 - Retaining organoleptic food qualities
- Safety from *C.botulinum* – elimination of spores



- Process ensuring destruction of spores of *C.botulinum* – kills other microorganisms spoiling canned fish under normal non-refrigerated conditions of handling and storage
- Time-temperature combinations – commercial sterility:
 - Acidity of foods – acid foods require less treatment compared to low acid and medium acid foods
 - Number and types of microorganisms present and their heat sensitivity – thermobacteriology
 - Consistency of foods – solid foods and thick liquids – longer periods of heat treatment



- Sealed cans – washed – heated for predetermined period at a predetermined temperature in steam
- Heating medium – steam – efficiency depends on type of steam
- Sterilizing action – transfer of heat to surface of cans on which it condenses
- Dry steam – not easily condensed – not efficient in transferring heat
- Saturated steam – efficient



- Heat processing – retorts
- Design and construction – influence efficiency of processing operations
- Retort – provide uniform distribution of steam inside
- Complete elimination of air - presence of air pockets cause non-uniform heating – under processing of cans
- Vent out air completely



- Presence of air reduces process efficiency –
 - Air reduces retort temperature unevenly – air settles down below steam since air is heavier
 - Mixture of air and steam – less efficient as saturated steam at that temperature – transfer of lower quantum of latent heat
 - Air cuts down penetration of steam
- No temperature fluctuations
- Retort parameters – pressure gauge and thermocouple

Retorts

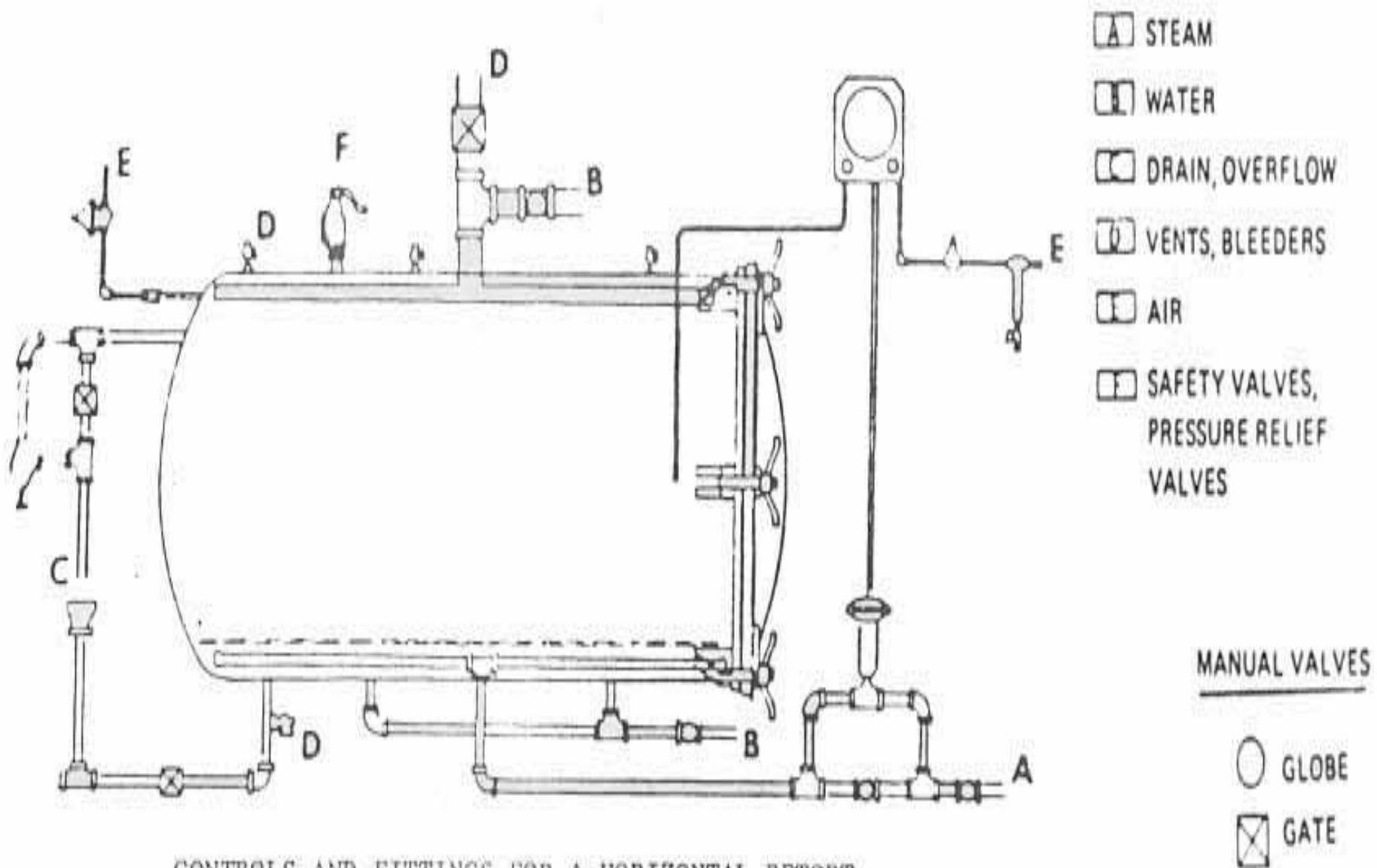


- Batch retorts – still or agitating type
- Still retorts – oldest and commonly used
- 2 types – vertical and horizontal
 - Vertical – door on top
 - Horizontal – door in front
- Batch operated – efficient when no. of cans is less



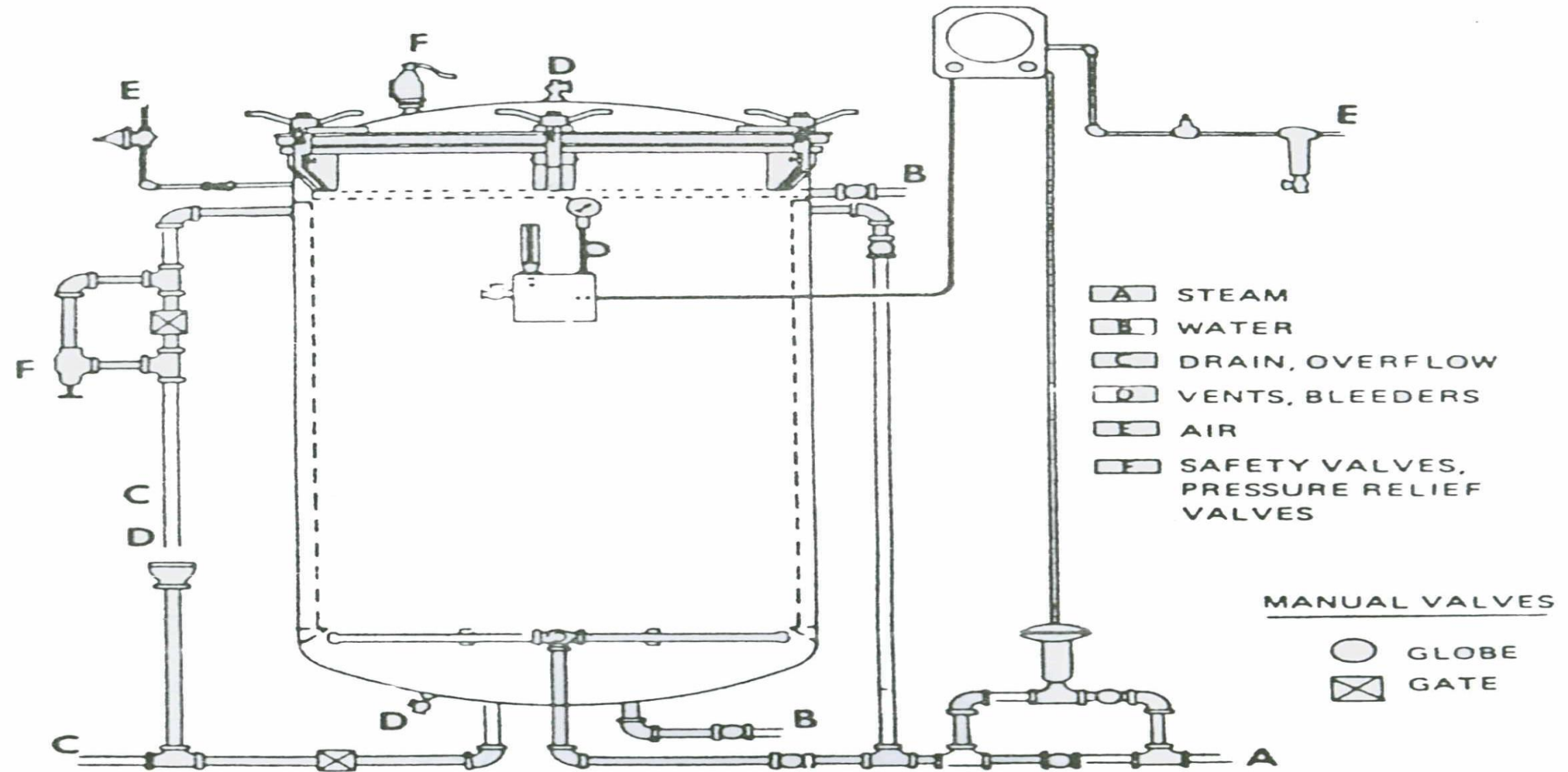
- Agitating retorts – baskets containing cans rotated during heating and cooling process
- Agitation – quicker heat penetration – higher processing temperature – reduced process time
- No over heating
- Less number of cans

Horizontal Retort



CONTROLS AND FITTINGS FOR A HORIZONTAL RETORT.

Vertical retort



CONTROLS AND FITTINGS FOR A VERTICAL RETORT

Operation



- Washing
- Pressure gauge and thermocouple/thermometer checked properly
- Steam should not leak through the gasket fixed to the retort at the door/closure of the retort
- Jumble stacking of cans – better spread of steam around cans
- After loading – door closed tightly – steam valve opened



- Time taken by retort to attain desired temperature and pressure (after the opening of steam valve) – **come up time (CUT)**
- CUT depends on
 - size of retort
 - Design
 - speed with which steam enters the retort
 - number of cans stacked in the retort etc
- Steam valve closed – air removed completely - pressure builds up – process time starts

Hydrostatic Continuous Sterilizer

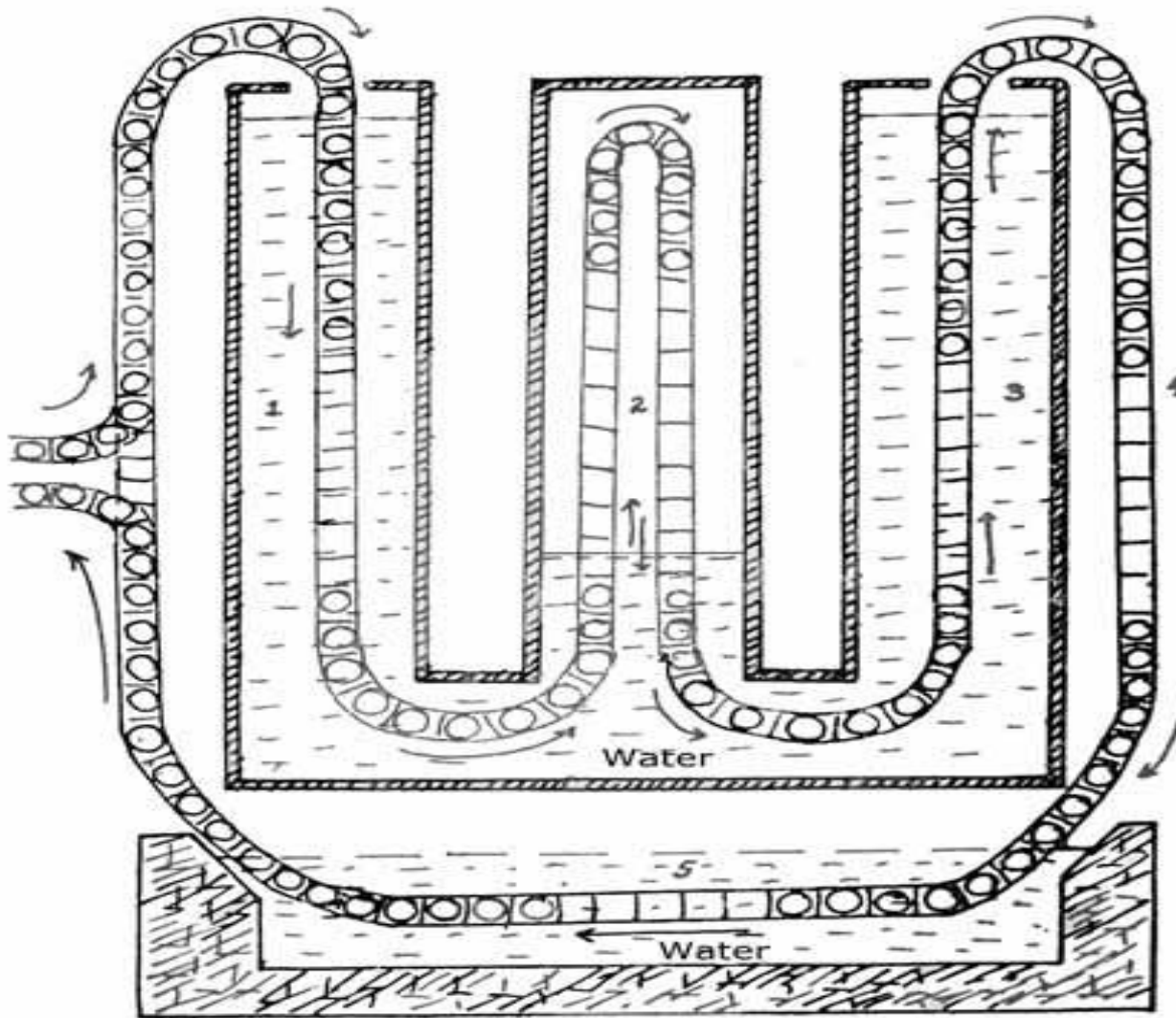


- Cans conveyed continuously by a chain conveyor through a 'W' shaped pressure vessel
- Cans enter and leave sterilizer through water column
- Steam pressure balanced by water head pressure in heating and cooling towers
- 3 inter-connected towers
- Conveyor belt carrying can enters from the top - comes down - enters middle tower - steam under pressure
- After required heat process - enters third tower - partially cooled



- Further cooled by air spray of water - finally in running cold water
- Speed of conveyor adjusted – constant rate – cans remain in steam chamber - required period of time

Hydrostatic Sterilizer



1, 2, 3 - Towers

2 - Steam under pressure

4 - Cooling of food cans in air

5 - Cooling in water



- Advantages:

- Cans after closing – enter sterilizer immediately whereas in batch type the first can has to wait till the basket is full - no delay in between can closing and sterilization.
- Cans - subjected to heat processing temperature as soon as it enters and till it leaves – batch type – wait till CUT ends
- Design - handle cans of different sizes without major change in equipment
- No sudden variation in pressure while the can enter and exit from it – reduces seam defects
- Convenient to use – requires small floor area



- Factors influencing thermal process for cans -
 - Small cans require shorter process than the one given for larger cans for the same product.
 - Solid food in the form of smaller piece surrounded by low viscosity liquid medium requires shorter process.
 - process required in agitation type retorts or cookers require shorter process compared to still retorts or cookers.
 - Acid foods such as fruits and their products require lower temperature and shorter process.

Can Cooling



- End of process schedule – steam cut off
- Temperature at can centre – continues rising even after cutting off steam – overcooking of can contents
- Immediate cooling to 35°C –
 - Prevents overcooking
 - Prevents germination of non-pathogenic thermophilic spores



- Pressure builds up during processing –
 - Expansion of can contents
 - Increase in water vapour pressure
 - Expansion of gases in headspace
- Maximum pressure at the end of heat processing – counterbalanced by steam pressure inside retort
- Steam pressure falls rapidly – pressure inside can remains higher – difference in pressure – permanent distortion of can ends - leakage



- Pressure cooling – Retort pressure maintained – steam replaced with compressed air - flooding with cold water
- Slow dropping of retort pressure to atmosphere Pressure – cans cooled in water
- Cooled to 35°C - sufficient heat retained by contents – evaporate moisture on can surface – prevent external rusting
- Rate of cooling – enhanced by adding ice



- Can seam and sealing compound after heating – softens and expands – microscopic openings – droplets sucked in
- Cooling water – bacteriologically safe – prevent contamination
- Chlorinated to 5 ppm
- TPC < 100 cfu/ml
- Coliform < 1/g or ml
- No pathogens
- Continuous use of same water – bacterial load – filtered and chlorinated

Labeling



- Labeling – after cooling and surface drying
- Display name of product, additives added, net weight and drained weight of contents, date of manufacture, batch number, licence no, manufacturer's address
- In accordance with food laws
- Adhesive –
 - non-hygroscopic – prevent rusting
 - Non corrosive and non toxic
- Coding - embossing machine – no damage to lacquer or tin coatings – prevent corrosion

Storage



- Cans stored for 1-3 months before marketing –
 - Contents mature
 - Equal distribution of salt, spices
 - Stabilizes taste and flavour
 - Show up any cases of leak – countercheck for soundness of can

- Storage temperature – shelf life



- Processed cans – should not be cased hot
 - Loss of heat by radiation – slow – stack burning – quality deterioration or corrosion due to retention of heat in stack of cans or carton for long periods
 - Favourable condition- development of thermophilic spores – survived heat processing
- Warehouse –
 - Clean, dry – presence of moisture – condensation on can surface – corrosion ; and cool
 - Well-ventilated
 - Minimum temperature fluctuations
 - Prevent entry of corrosive fumes and gases ; salty breeze from sea



- Cans – not stored near steam pipes / humid environments
- Cases should not be kept in floors – keep on wooden platforms
- Prevent direct sunlight from entering storage directly