Module 11. Retorts— Processing With Overpressure

Thermal Processing for Meat and Poultry Products Training
What is Overpressure?

Overpressure:

- Pressure supplied to a retort in excess of the normal pressure exerted by the heating medium at a given temperature.
Overpressure

- To maintain container integrity
- To permit adequate processing
Overpressure requirements vary:

- Too much at the start of the process could distort containers (crush containers) or damage seals.
- Too little during heating could lead to container rupture or seal damage, slow heat penetration, or interfere with water circulation patterns in the retort.
- Too little during cooling could lead to container rupture or seal damage.
Factors Affecting Overpressure Requirements

- Product fill temperature
- Container headspace
- Container vacuum
- Entrapped air
- Processing temperature
Overpressure Applications

- Plastic containers
- Flexible pouches
- Metal trays
- Glass jars
General Characteristics of Retorts that Provide Overpressure

- Introduced steam or air is the source of overpressure
- Batch processing, not continuous container handling
- Static (still), rotary (end-over-end), and back and forth (Shaka® process) agitation models
End-Over-End Agitation

- Containers are held in place in the basket
- Rotating framework holds baskets
- Variable rotational speed
- Custom racking system
End-Over-End Agitation

Rotating Reel

Lock Down Mechanism and Plate

Crate to Hold Containers
Back and Forth (Shaka® process) Agitation

- Containers are held in place in the basket
- Variable double reciprocating strokes
- Custom racking/basket system
Retorts that Provide Overpressure

- Processing medium:
  - water immersion,
  - cascading water,
  - water spray, or
  - steam/air mixture

Water Spray
Common Considerations:

- Installation, operation, and controls vary based on the processing medium
- Usually equipped with various alarms and warning devices to monitor critical operating procedures
Each retort must have a pressure recording device

Each retort should have pressure gauge
Each retort **must** have a means of providing uniform HD/TD during processing

The efficiency of the circulation system **must** be documented in HD/TD data or other documentation from a PA

HD/TD data **must** be on file at the establishment to support the retort operating procedures
Factors that may Affect Heat Distribution or Processing Medium Circulation

- Crate and rack design
- Loading configuration
- Container type, size, or position

Nested Pouches
Factors that may Affect Heat Distribution or Processing Medium Circulation

- Operating pressure
- Come-up procedures
- Partial loads
- Fan or pump off or not functioning properly
Full Water Immersion Retorts
Water Immersion Retort Characteristics

- Water is the heating/cooling medium which completely covers the containers
- Horizontal and vertical configurations
- Introduced air or steam provides overpressure
- Several manufacturers
Sensor (probe) located beneath water surface

Sensor (probe) must extend at least 2" into water

Vertical retorts – sensor (probe) may be located in thermometer pocket
- Horizontal retorts – sensor (probe) **must** be directly in shell for a retort using a steam spreader

- Horizontal retorts using a heat exchanger – sensor (probe) is located on the water return pipe before the entry to the exchanger
Instrumentation - Temperature/Time Recording Device

- Recorder sensor (probe) usually adjacent to temperature indicating device sensor
- May be combined with the steam controller to be a recorder-controller
- Vertical retort – sensor (probe) must be below lowest crate support where steam does not strike it directly
- Horizontal retort – sensor (probe) **must** be between water surface and center line in a retort using a steam spreader
- Horizontal retorts using a heat exchanger – sensor (probe) is located on the water return pipe before the entry to the exchanger
Each retort must be equipped with a water level indicator, e.g.,

- Water sight glass tube
- Water level alarm (visual and audible)
- Petcock valves
Instrumentation - Water Level Indicator

AIR

6 INCHES

SIGHT GLASS
Instrumentation - Water Level Indicator
Instrumentation - Drain Valves

- Water immersion retorts **must** be equipped with non-clogging, watertight drain valve to ensure minimum water level
- **Must** have screens over drain openings to prevent loose containers and debris from entering circulation system
For vertical water immersion retorts:

- Bottom crate supports are **required**
- Crate centering guides are recommended
- Bottom baffle plates prohibited
Vertical Retorts
Vertical Retorts - Water Circulation

- By compressed air or
- By mechanical means such as a pump
- Air is introduced with steam through bottom spreader
- Air bubbles agitate water as they rise upward
- During CUT, a greater volume of air is needed to prevent steam hammer (noise)
During processing, the air volume is reduced to recommended level

- The air in the retort headspace maintains the overpressure

- Two steam spreader designs
Vertical Retorts - Spreader Configurations
Horizontal Retorts - Design

AllPax

Stock Rotomat
Horizontal Retorts - Design

AllPax or Stock Rotomat

Steam pressure

H.E.
Horizontal retorts need a water recirculation system which is usually a pump.

- Suction manifold in the bottom of the retort
- Distribution system (spreader) along the top of the retort
- Suction outlets must be protected with screens
- Pump must be equipped with warning device to indicate when it is not functioning
- Racks designed to positively hold containers
- **Must** provide free movement of the water
- Adequacy **must** be documented in HD/TD data
Water Immersion Retort - Cooling Water Supply

- Should not strike jars directly
- Vertical retorts - introduced into process water about 4 inches above top layer of jars
- Horizontal retorts - introduced into suction side of water circulation system
Water level

Air circulation rate for vertical retorts

Water recirculation rate for retorts using pumps

Overpressure

Reel speed timing for agitating processes
Agitating Water Immersion Retorts - Rotational Speed

- **Must** be checked before process timing starts and, if needed, adjusted as specified in the process schedule
- **Must** be determined and recorded for each retort load
- Prevent unauthorized changes
  - Lock or Posted Sign
Crate Position Rotational Speed is Determined Electronically by Sensors on the Reel Shaft
Cascading Water Retorts
Cascading Water Retort Characteristics

- Water is the heating/cooling medium that rains (cascade) down over and through the containers
- Horizontal configuration
- Introduced air provides overpressure
- Several manufacturers
Exploded View of Cascading Water Retort

- Water Pump
- H.E.
- Water Distribution Manifold
- Water Level Sensor
- Screened Water Return
Water is Recirculated with a Pump

WATER PUMP - MUST INDICATE OPERATION
Cascading Water Retort Design

WATER RETURN TROUGH
Cascading Water Retort Design

Screen in Water Return Trough on Retort- 1.5 mm Holes
Cascading Water Retort Design

Rear View with Heat Exchanger and Water Return at Rear of Retort
Cascading Water Retort Design

Water Shower

Distribution Manifold
Cascading Water Retort Design

Separate Water Distribution Manifolds
Pressure Differential Sensor is used to Alert Operator to Changes in Pressure from One Side of Pump to the Other Side
Cascading Water Retort – Compressed Air Entry

AIR ENTRY
- **Must** provide free movement of the water and allow water to contact the containers
- Adequacy **must** be documented in HD/TD data
Mineral Scale Buildup
Water level must be maintained within the range specified by retort manufacturer or PA during come-up, thermal processing, and cooling periods.
Water recirculation (flow rate, e.g., gallons per minute) for maintaining uniform heat distribution in the retort must be documented by HD/TD data or other documentation from the PA.
Cascading Water Retort – Critical Operating Parameters

- Stepped come-up procedures
- Water recirculation (flow) rate
- Overpressure
- Reel speed timing for agitating processes
Water Spray Retorts
Water Spray Retort Characteristics

- Water is sprayed over the containers from several angles
- Direct and indirect steam heating of the process water
- Some inject steam into the retort
- When steam is injected, a steam/water mixture heats the containers
Water Spray Retort Characteristics

- Horizontal configuration
- Introduced air provides overpressure
- Several manufacturers
Water Spray Retort Design

Diagram showing the components of a water spray retort, including:

1. Process Water
2. Air Vent
3. Process Water
4. Level Probe
5. Compressed Air
6. Steam
7. Heat Exchanger
8. Flowmeter

Additional components include a basket and drain lines.
Water Spray Retort Design
Steam Spreaders and Spray Bars
Water Return Through Screened Exit Ports

WATER RETURNS

WATER LEVEL SENSOR
Like cascading water retorts, a stepped program with a temperature overshoot is used to bring the retort’s cold spot up to process temperature.
- **Must** provide free movement of the water and allow water to contact containers

- Adequacy **must** be documented in HD/TD data
Water level must be maintained within the range specified by retort manufacturer or PA during come-up, thermal processing, and cooling periods.
Water recirculation (flow rate, e.g., gallons per minute) for maintaining uniform heat distribution in the retort must be documented by HD/TD data or other documentation from the PA.
Water Spray Retort – Critical Operating Parameters

- Stepped come-up procedures
- Water recirculation (flow) rate
- Overpressure to maintain container integrity
- Reel speed timing for agitating processes
Steam/Air Retorts
Steam/Air Retort Characteristics

- A mixture of steam and air is the heating medium
- Steam/air ratios range from 75% steam/25% air to 95% steam/5% air
- A fan is used to maintain uniform steam/air circulation
- Introduced air provides overpressure
- Several manufacturers
Steam/Air Retorts

Baffle Plates

Plenum
- Temperature indicating device and recorder-controller probes are usually inserted directly into retort shell in such a position that steam does not strike them directly.

- The location of the probes on the retort may depend on the type of steam/air retort.
Like cascading water/water spray retorts, a stepped program with a temperature overshoot is used to bring the retort’s cold spot up to process temperature.
Steam/Air Circulation

- A method of circulating the steam/air mixture **must** be provided
- The circulation system, *usually a fan*, **must** be checked for proper functioning and **must** be equipped with device to warn the operator when it is not functioning
Steam/Air Retort - Critical Operating Parameters

- Stepped come-up procedures
- Percent steam/air mixture (e.g., 90%/10%), or maximum pressure (e.g., 25 PSIG)
- Steam/air mixture circulation and flow rate (e.g., 30 cubic feet/second)
- Reel speed timing for agitating processes
The steam/air mixture or the temperature and pressure (that represents a specific steam/air ratio) used to thermal process a product must be the same mixture or temperature and pressure documented in the heat penetration tests used to establish the product’s process schedule.
Questions?