Heat distribution studies in batch retorts for in-pack thermal processing

Identification

Key words
thermal processing, sterilisation, pasteurisation, in-pack, batch retort, heat distribution, heat penetration, process design, lowest lethality zone, coldest point

Latest version
2010/12/14

Completed by
KU Leuven LFT

How does it work?

Primary objective
Heat distribution studies are performed to identify the zone within the retort receiving the lowest lethality.

Working principle
Establishment of a safe in-pack thermal process in normally based on two factors: the position in the retort that results in lowest lethality (heat distribution) and the heating characteristics of the food product (heat penetration).

It is a common food industry practice to limit heat distribution studies to the measurement of temperature distribution in the heating medium. The slowest heating zone of the retort is often identified by conducting a temperature distribution test. A temperature distribution test is preformed by locating temperature sensors throughout a loaded retort. A temperature distribution test performed with 15 to 30 temperature sensors should result in a reasonable accuracy if the temperature sensor layout is properly chosen. At least two identical tests should be performed to confirm results. The heat distribution should be evaluated under ‘worst case’ (i.e. lowest lethality) conditions; this means under conditions with greatest challenge to the operational performance of the retort as can be expected for the specific production. Factors that should be considered as trial variables are: container size, container shape, container material, container content, container placement, baskets and layer pads, initial product temperature, come up time, rotational speed, ... IFTPS (Institute for Thermal Processing Specialists) developed some useful protocols that can be used when performing heat distribution trials:

• Nomenclature for Studies in Thermal Processing
• Temperature Distribution Protocol for Processing in Steam Still Retorts, excluding Crateless Retorts
• Temperature Distribution Protocol for Processing in Still, Water Immersion Retorts, including Agitating Systems Operated in a Still Mode
• Protocol for Conducting Temperature Distribution Studies in Water-Cascade and Water-Spray Retorts Operated in a Still Mode, including Agitating Systems Operated in a Still Mode

Images

Additional effects
Temperature distribution studies also enable evaluation of the operational capabilities of the equipment and identification of technical shortcomings of the system.

Important process parameters
• Accuracy of the temperature data-logging equipment
• Availability of enough temperature sensors
Important product parameters

What can it be used for?

**Products**
Food/feed products heat-treated in batch retort systems (water cascading, water spray, water immersion, steam), both in static and rotary mode

**Operations**
Design of a thermal process for pasteurisation/sterilisation of packaged foods in batch retort systems (in combination with heat penetration data)

**Solutions for shortcomings**
Insight in heat/temperature non-uniformity in conventional heating technologies.

What can it NOT be used for?

**Products**
Continuous retort systems

**Operations**
No information available

**Other limitations**
No information available

**Risks or hazards**
No risks/hazards

Implementation

**Maturity**
Procedures are well established (see references)

**Modularity**
Heat distribution studies should be performed (i) at the time of installation of the retort, (ii) if at a later time one of the factors related to heat distribution changes and (iii) regularly (e.g. once per year) to check the functioning of the equipment.

**Consumer aspects**
Proper process design in the point of lowest impact of the retort will result in products with optimal quality for the given processing technology, which is of interest to the consumer.

**Legal aspects**

**Environmental aspects**
Proper process design in the point of lowest impact of the retort will reduce the overcooking of products and thus reduce the energy needs for the process

Facilities that might be interesting for you

<table>
<thead>
<tr>
<th>Title</th>
<th>Institute/company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microwave heating lab-scale</td>
<td>KU Leuven LFT</td>
</tr>
<tr>
<td>KU Leuven</td>
<td></td>
</tr>
<tr>
<td>Retort pilot-scale KU Leuven</td>
<td>KU Leuven LFT</td>
</tr>
</tbody>
</table>

Further Information

<table>
<thead>
<tr>
<th>Institutes</th>
<th>KU Leuven LFT, Campden BRI, IFTPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Companies</td>
<td>Ellab</td>
</tr>
</tbody>
</table>
References


2. IFTPS (Institute for Thermal Processing Specialists) developed some useful protocols that can be used when performing heat distribution trials.

Source: