Enzymatic pressure temperature time indicator

Identification

Key words
- pressure temperature time indicator, pTTI, uniformity, pressure, temperature, enzyme inactivation, enzyme activity, amylase, Bacillus, process impact, non-uniformity, heterogeneity, high pressure processing, high hydrostatic pressure, pasteurization, sterilization, heat transfer, adiabatic heating, kinetics, enzymatic sensor

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How does it work?

Primary objective
A pressure temperature time indicator (pTTI) allows detection of temperature non-uniformity in a high-pressure vessel, during high pressure processing (stabilizing operation). This temperature non-uniformity is caused by heat transfer of adiabatic heat during compression. This temperature non-uniformity can result in process impact non-uniformity. This tool allows detection of the point of lowest temperature or even lowest impact, in case the temperature dependence of its kinetics match that of the target attributes (quality or safety). (3,8)

Working principle
The enzyme shows a pressure and temperature sensitive inactivation. The isolated enzyme is positioned at different locations in the high pressure vessel. After the process, the residual activity of the enzyme is read out. The lower the residual activity, the higher the temperature at the given location.

Temperature and pressure dependence of the pTTI can be adapted to the window of processing conditions by
- selecting a different enzyme (for instance, enzymes originating from thermophilic micro-organisms are useful for detection of temperature non-uniformity in HP/HT conditions)
- selecting different solvent conditions for the enzyme = solvent engineering (pH, additives, type of buffer …)

Example: alpha-amylase from Bacillus species (1,5-7)

Images

Additional effects
Once the non-uniformity of the vessel is determined, process parameters can be changed to minimize this non-uniformity. The pTTI can be used to validate this optimization.

Important process parameters
pressure, temperature, time

Important product parameters
none, as the integrator is isolated from the product
What can it be used for?

**Products**
Packaged foods (meat, fish, shellfish, chicken, juices, ...)

**Operations**
Pasteurisation through high pressure processing

**Solutions for short comings**
Process non-uniformity in high pressure processing

What can it NOT be used for?

**Products**
Non-packed liquid products

**Operations**
High pressure thermal sterilisation (batch). No enzymatic pTTIs have been described yet that can be used under conditions of high pressure, high temperature (HPHT) processing.

**Other limitations**
To assess process impact, the kinetics of the pTTI should match that of the target attribute (safety or quality)

**Risks or hazards**
Integrators should be isolated. Food labelled with the integrator should not be used for consumption.

Implementation

**Maturity**
Lab scale

**Modularity /Implementation**
This tool can be placed between packed foods or in a labeled (not to be sold) packed food.

**Consumer aspects**
No information. No problems expected.

**Legal aspects**
This tool offers a solution for legislation with regard to process control, as direct temperature measurement is difficult in high pressure vessels.

**Environmental aspects**
No information. No problems expected.

Facilities that might be interesting for you

Further Information

**Institutes**
KU Leuven LFT

**Companies**
References


Source: