# Validating UHT and HTST Pasteurization Processes

## Background

UHT and HTST pasteurization are highly regulated, thermal processes that revolve around sterilizing liquid products (typically food) prior to packaging. The goal of the process is to sterilize foods and beverages like milk, juice, dressing and yogurt, while ensuring that they keep their sensory appeal and become shelf-stable products.

There are currently two continuous aseptic processes based on heat treatment being used in the food and dairy industries:

- UHT (Ultra-High Temperature) Pasteurization, where a product (particularly milk) is heated to 130-150 °C for 0.5-1.0 second.
- HTST (High Temperature/Short time) Pasteurization, where a product is heated to 72 °C for approx. 15 seconds.

A typical design of a processing plant setup includes:

- Heat exchanger – either plate type PHE (usually for low viscosity and non-particulate products) or tubular type THE
- Holding tube – sized to ensure that the correct treatment time is achieved
- Surge tank
- Control and monitoring system

The validation process is generally divided into 3 parts:

1. Qualifying the tanks with regard to the max. temperature and temperature uniformity
2. Validating the temperature/time profile obtained through the holding tube
3. Validating the possible temperature differences across the pipelines and holding tube

## Challenges

Validating a pasteurization process, such as UHT or HTST, includes several considerations, of which identifying the locations of the critical point is of most importance. Critical points are the slowest reacting part of the system, these are especially important to locate within the holding tube. The cold spot could be located in the center of a tube, or in other geometric locations, depending on the type of product. This therefore needs to be defined prior to validation by using mathematic modelling combined with actual measurements.

As the pasteurization processing equipment is rather large in size, one of the biggest challenges is the placement of measuring devices. Due to this issue, wireless data loggers are highly recommended as they pose no limitations to range.

Another challenge is the ability to measure the actual product temperature inside the system. To do this, it may be necessary to mount Smart Gaskets or special insertions valves (Janz valves), which are welded onto the piping at the critical points, allowing sensors to be inserted through a tightening membrane system. If this is not possible, another solution could be to measure the surface temperature on the outside of the pipe – and make temperature correlations to compensate for the differences.

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## Important Method Considerations

The importance of validating continuous heat treatment systems is to ensure that the parameters used for a product, aside from ensuring that they are adequate, produce a safe thermally-processed product that does not compromise the desired quality and sensory attributes of the product.

The results of the measurements should also be able to provide the following:

- Determine the spatial and temporal temperature distribution within the product, ensuring adequate treatment and food safety
- The temperature profile (temporally and spatially) should provide information used for calculating the lethality (F0/P0) value. As the process is not static, knowing the time/temperature history of the product through the plant (inlet/outlet), as well as the flowrate, is required.
- Provide a guide to mathematical modeling of the process and improved process control

## Best Practice for Surge Tanks

Using the E-Val™ Pro system is possible but not recommended, as managing large tanks with 7-meter cables may prove difficult when considering the need for sensors to be positioned strategically correct inside the tanks.

Using the wireless TrackSense® Pro system is the far better option in this case, as loggers can be placed anywhere. By attaching loggers tightly with e.g. a sanitized string, rope or by using a strong adhesive tape and the FixPro silicone logger holding system, they can be positioned at the appropriate locations inside the tanks.

## Best Practice for an Aseptic Line/Holding Tube

Much like with Surge Tanks, the TrackSense® Pro data loggers are highly recommended when compared to the wired thermocouple system. For pasteurization processing, it is far more efficient to use data loggers, due to the challenges of validating or measuring the critical areas of a widely-designed, continuous heat treatment system (which is common for HTST and Hot-Fill-Hold systems). This process can be optimized even further by using the SKY real-time data communication. When equipped with an appropriate Type T thermocouple cable, our newly improved TrackSense Pro Thermocouple Sensor is also highly capable of validating pasteurization processes.

## Data Evaluation & Analysis with Windows Authenticated Software

In order to validate the pasteurization processes according to the predefined acceptance criteria, using the ValSuite® software is ideal when using the following standard facilities and reports are required:

- ✓ F0 report: Calculation of the lethality value
- ✓ Comments: Specifications and photos of test equipment
- ✓ Limit Report: Temperature
- ✓ Unit: Mapping of measuring points - including pictures
- ✓ Time Event Markers: Heating zone, Heat treatment zone, Cooling zone (sub-zones)
- ✓ Advanced Validation Report: Temperature and P-Unit evaluation of the entire process criteria with pass/fail indicators
- ✓ Statistic Reports: Min., Max., Average and Delta values of all parameters
- ✓ Word Document: SOP presentation

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