pH Measurement
Control in Dairy Processes

Notes

pH non-glass electrode InPro®3300/ISFET:

The new standard for non-glass, in-line pH measurement for process control in yogurt production.

Process Analytics
Success Story

Yogurt, a best seller of the dairy industry, is available in a whole variety of product modifications.

In the food and beverage (F&B) industry, in particular in dairy applications, there is a continued trend towards in-line pH measurement using non-glass sensors. Several customers who produce yogurt, recently successfully finalized tests with METTLER TOLEDO's ISFET pH electrode, InPro 3300. Their common goal was to establish process control in yogurt production. One customer even utilized an ISFET system to find methods for the detection of infection with phages at an early stage of the production process.

When producing yogurt, in a first step all potential additives such as milk powder, protein, and sugar are added to the milk. After subsequent homogenization, the resulting mixture is pasteurized in order to avoid contamination with pathogenic microorganisms. It is then cooled down to approximately 40…45° C and inoculated with a culture of bacteria, most commonly a mixture of lactobacillus bulgaricus and streptococcus thermophilus. These are responsible for the fermentation of the milk sugar (lactose) and the formation of lactic acid, which results in a decrease of pH from 6.6 pH units to 4.4…4.6 pH units within the process time of three to six hours. When the desired final pH value has been reached, the product is stirred and cooled down in order to stop activity of the bacteria.

METTLER TOLEDO

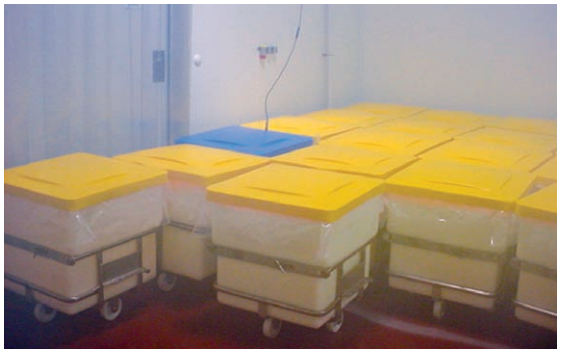
ISFET in yoghourt production control for tzatziki

Our customer, a dairy company in Australia, manufactures a large range of dips including tzatziki. With his old method, the customer had been taking samples for laboratory tests every few minutes when the yoghourt was about to reach a pH value of 4.4, this in order to know when to stop the process. He complained that this procedure was very time-consuming and costly, and last but not least not accurate enough. Namely, during transfer time to the laboratory, the yoghourt cooled down and bacteria stopped their activity, so that consequently the measured pH was not identical with the actual pH in the process.

In the light of this, John Goode from METTLER TOLEDO Australia was able to provide a solution, consisting of the InPro 3300 and a pH 2100 e transmitter. *"Initially I had to put in a significant time overhead to win the deal but it was worthwhile,"* admits John.

The InPro 3300 was directly placed into the top of the yogurt containers to measure the pH value, and when the target value was reached, a light was triggered, signaling the operator to remove the 200 l containers to the cooling room.

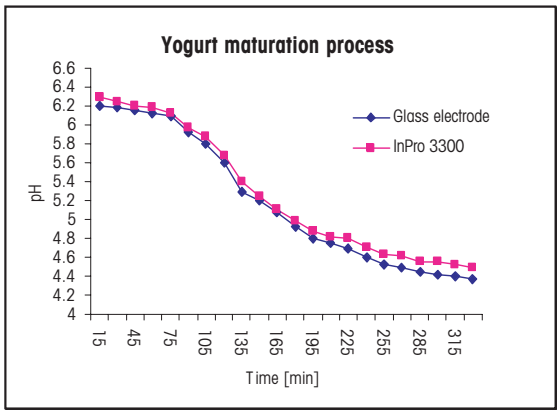
After a test phase of several weeks, the customer was completely satisfied with this solution. *"Not only do we save money and time, and gain accuracy"*, explains a representative of the customer, *"We are also sure not to contaminate our product through glass breakage"*. Consequently, the customer established this solution in his plant and purchased a further three ISFET loops.



Yogurt containers, in which an ISFET sensor directly is placed into in order to determine the end of the process

Research work on early detection of yogurt failures and infection with phages

Another key customer in the yogurt business in Switzerland produces yogurt on a larger scale, in 5000 l vessels. In this case, it was his wish to develop a method that would allow early detection of potential problems liable to affect yogurt quality. Such a problem is, for example, an infection with phages (viruses that infect yogurt culture bacteria). If these are detected early enough, quality can be maintained by taking special action against failures, or the entire batch can be discarded before more raw materials and time are wasted.



Characteristic curve of pH over time in a yogurt maturation process. An InPro 3300 ISFET sensor was compared to a laboratory glass electrode.

Currently, the customers R&D is investigating to which extent such potential problems can be anticipated from the profile of the pH-over-time curves. It is already clear that the accuracy of

METTLER TOLEDO's InPro 3300 ISFET sensor is very good compared to the laboratory glass electrode. Therefore, it also allows control of the yogurt maturation process in large-scale production.

The detected deviation of 0.1 pH units results from the fact that ISFET technology differs completely from conventional glass-electrode technology: In the ISFET sensor, a highly sophisticated semiconductor chip takes over the role of the glass membrane.

Advantages and benefits for the customer

- InPro 3300 eliminates the risk of glass breakage and subsequent contamination.
- This allows safe inline measurement for the customer and therefore saves time and money.
- InPro 3300 is compliant with existing (FDA) and possible future regulations.
- The InPro 3300 displays high accuracy in comparison with glass electrodes, and is superior to competitor ISFET products.
- Long lifetime of the electrodes saves customers money.
- The 45° design of the tip of the electrode prevents air bubble coverage of the sensor surface, assuring measurement reliability.
- FDA compliant materials facilitate process validation.
- VP connector IP68 makes cleaning of the electrode easier.

Non-glass pH electrode Inpro 3300/ISFET front view.

Technical specifications InPro®330

pH range	0…14
Temperature range	0…80 °C (130 °C)
Pressure range	0…6 bar
Reference system	gel electrolyte
Diaphragm	one ceramic diaphragm
Shaft	PEEK (FDA compliant)
Connector	VarioPin (VP), IP68
Insertion length	120 mm
Temperature sensor	Pt1000

pH transmitter 2100 e

Cable VP6-ST/ISFET

The pH electrode InPro 3300:
Successful application in the dairy industry in order to establish non-glass in-line pH measurement for quality monitoring.

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