

pH Measurement of Milk

InLab Dairy Sensor

Fluctuating pH reading and inaccurate results will no more hamper the routine pH measurements of your milk samples. Reliable and fast pH measurement is possible with InLab Dairy pH sensor from METTLER TOLEDO. Normally, high protein and fat content of milk leads to precipitation and junction clogging in conventional pH sensors. Thanks to ARGENTHAL™, the reference system in InLab pH sensors that takes care of this challenge. Inefficient cleaning of sensor leads to fouling of the pH membrane and are responsible for sluggish response of a conventional pH sensor. InLab Dairy pH sensor is specially designed to overcome these pain points. Moreover, the triple junction ensures fast pH measurements.

Read this document to find out various features of InLab pH sensors that can combat common challenges faced during the pH analysis of milk. Tips and tricks section provides guidance for proper maintenance of these pH sensors to ensure accurate results every time.



Introduction

Milk is a perfect nutrient for all age groups due to its high nutritious value. It is also a starting material for many dairy products such as cheese, yogurt, cream, etc. The quality of raw milk as well as the finished product essentially, need to be maintained and monitored at a typical dairy industry. pH is an important quality parameter in a dairy industry, be it during packaging for human consumption or further processing for other dairy products.

Importance of pH Measurement

pH value for fresh raw milk is normally in the range of 6.4 to 6.8 and depends on the source of milk. Microbial activity in fresh milk leads to production of lactic acid as a byproduct. Presence of excess lactic acid results in curdling or coagulation of milk proteins, developing a characteristic smell and sour taste. This is not desirable and deteriorates the quality of the products processed from such milk.



Figure 1 : Raw milk for quality testing

Testing of pH value in raw milk also helps in detecting signs of infection in lactating cattle. The pH value deviates from the normal range in such cases. Sterilization process is found to be faster if the pH is lower. Hence, pH parameters are recorded for efficiency in quality and process steps. During the manufacturing of different dairy products, pH plays a vital role. For example, pH value decides the cheese quality in terms of hardness or softness. In the butter manufacturing process, the milk cream is maintained at a particular pH to generate sweet butter. For sour butter, this cream is acidified further to a pH of 4.6 to 5.0 range. Lower pH value in dairy products also enhances the shelf life of the products.

Measurement Challenges

Milk industry needs a pH sensor that is easy to clean and robust to handle. Sensitive and fast response of the pH sensor is needed for a reliable and quick analysis. Inaccurate results lead to inconsistencies in quality and taste.

The table below outlines the challenges and impacts on pH measurement results during the analysis of milk samples.

Sample Challenge	Sample Impact
Reading fluctuations	Inaccurate results
High protein sample content	Proteins can lead to precipitation of reference electrolytes and junction clogging
Cleaning of sensor after measurement	Sensor fouling due to inefficient cleaning leads to deposition on the glass membrane, causing sluggish response.
Outdoor or at-line measurements	Requires sensor that gives reliable results, yet economical and easy to handle

Low maintenance and easy to clean

InLab Dairy (59904591) is a low maintenance and easy to clean pH sensor specially designed for milk samples. It has a triple ceramic junction, which ensures optimum outflow of reference electrolyte. InLab pH sensors has improved reference system, ARGENTHAL™ that helps to avoid junction clogging caused by sulfides or proteins. The silver ion trap in it takes care of silver ions from migrating into the electrolyte. The proteins from the milk sample can now freely interact with the electrolyte without causing precipitation. The sensor has FRISCOLYT-B reference electrolyte that makes it suitable for pH analysis in emulsion natured samples and cold environments. Its hemispherical pH glass membrane is easy to clean after repetitive milk sample measurements.

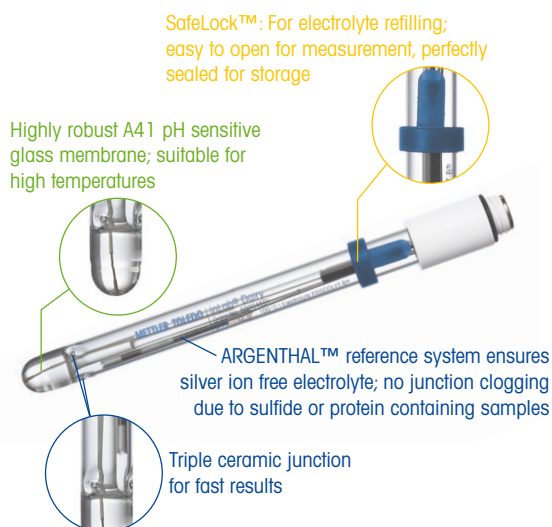


Figure 2: InLab Dairy pH sensor

It is a specially designed sensor for robust and fast pH measurements in different workplaces, which include laboratory's, at-line and outdoor environments. Temperature of the sample can be measured using an external temperature probe along with the pH sensor for an automatic (ATC) or can be manually entered in the pH meter for manual temperature compensation (MTC).

For a pH sensor with an integrated temperature probe for milk samples, InLab Power Pro-ISM (51344211) or InLab Solids Pro-ISM (51344155) pH sensor can be used. 'Pro' stands for built-in temperature probe and ISM (Intelligent Sensor Management) feature allows users to accurately capture all critical measurement parameters like calibration history. Since refilling of electrolyte is not required, these are maintenance free sensors. InLab Power Pro-ISM sensor has Steady-Force™ reference system. The pressurized electrolyte prevents the junction from clogging, and guarantees extremely reliable and reproducible results due to the steady flow of electrolyte, even in dense sample fluids. InLab Solids Pro-ISM sensor has an open junction and hence is clog-free. This sensor can also be used to measure semi-solid and solid dairy products like yogurt, cheese, butter. The pH sensing membrane of this sensor is spear shaped such that it can be easily inserted into semi-solid samples. The solid XEROLYT®EXTRA polymer reference system offers a clog-free open junction, making it easy to clean and a low maintenance sensor.

Procedure and Method

Calibrate the sensor using buffers that bracket the the pH values of milk sample (in this case pH 4.01 and 7.00). Record the calibration slope and offset value for the sensor. A slope value of 95 -105 % and an offset of 0 ± 30 mV ensures reliable measurement.



Figure 3: Measurement of milk using InLab Dairy pH sensor

Perform sample measurement in triplicates. A standard deviation within ± 0.05 pH units indicates fair variance in pH values of the sample. After pH measurement, rinse it thoroughly using deionized water. To prevent any accumulation of fat and protein on the pH sensor and to ensure a systematic cleaning, a mild soapy solution wash is recommended, followed by rinsing with deionized water. Occasional rinsing with ethanol helps to remove the protein built up if any. Such cleaning should be followed by rinsing with deionized water and then soaking the pH sensor in InLab storage solution (30111142) or 3 mol/L KCl (51350072) solution for 5 -10 minutes before proceeding to the next sample.

Results and Discussion

Samples of various raw and processed milk were analyzed for pH at an ambient temperature of 25 ± 2 °C. Average pH values for the samples (performed in triplicates) using InLab Dairy pH sensor are given in below table.

Milk Sample	Mean pH value	Std.Dev.	Avg. time (s)
Raw Cow milk	6.62	0.02	06
Raw Buffalo milk	6.76	0.03	20
Flavored Toned Milk (Almond)	6.53	0.01	09

Table: pH values of milk samples measured with InLab Dairy Sensor.

Standard deviation was noted to be less than ± 0.05 pH units and the response time was within 30 seconds.

Expert Tips

- If there is excessive clogging at the junction of the pH sensor, soak the sensor in a pepsin/HCl solution (51350100) for one hour. It is ideal for removing protein contamination. Rinse and then recalibrate the sensor.
- Clean the electrode regularly to remove accumulated fat and protein using deionized water followed by ethanol and finally again with deionized water.
- Do not leave milk samples to dry over the sensor, this will clog the junction making it difficult to clean and might damage the pH-sensitive glass membrane.
- Regular maintenance is very important for prolonging the lifetime of pH electrode. In case there are inaccuracies in pH measurements reconditioning of the electrode in 0.1 M HCl is recommended. InLab Solids Pro-ISM sensor should be reconditioned in 0.01M HCl solution.
- The pH measuring range for InLab Solids Pro-ISM sensor is 1 to 11 pH units and hence should not be exposed to harsh acidic (below pH 1.00) or alkaline (above pH 11.00) solutions.
- Maintain calibration buffers, samples and sensors at the same temperature for accurate pH measurement. pH value of sample changes with temperature, hence pH values of the samples should be measured at the same temperature for a fair comparison.
- For quick and consistent measurement, ensure that the junction of the pH sensor is completely immersed in the sample.
- In between measurements or when the electrode is not being used for brief periods, it is best to keep the electrode in a wetting cap filled with InLab Storage Solution (30111142)

Further Information

- Good Electrochemistry Practice (GEP) for maintenance and proper handling of pH sensors and buffers:

► www.mt.com/GEP



- Electrode handling movies on:



- Comprehensive range of pH meters, electrodes, solutions, and accessories:

► www.mt.com/pH

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Subject to technical changes

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