pH Application Note

pH Measurement of Cream

InLab Solids Pro-ISM Sensor

In diary industry, cream as a sample possess various challenges during pH measurements. Being high in protein and fat content, it can easily lead to clogging of a conventional sensor. Inefficient cleaning of the sensor leads to sluggish response resulting in delayed and inaccurate pH results. InLab Solids Pro-ISM is a specialized pH sensor from METTLER TOLEDO, recommended to overcome these pain points in pH measurements of cream samples. Thanks to ARGENTHAL™, the reference system in InLab pH sensors that takes care of the precipitation or clogging, that normally occurs in such proteinaceous samples. The spear shaped sensor membrane is easy to insert in a semi-solid sample and also easy to clean. The open junction of the pH sensor does not clog easily.

Find out all the benefits that this sensor provides while ensuring best practices to measure the pH of cream products in diary industry.

METTLER TOLEDO

Introduction

Cream as a dairy product has numerous uses in areas of the food industry. Cream gives soft texture and adds flavor to fresh dairy products like ice-cream and cheese spread. It is widely used in chocolate and biscuit manufacturing industries. Bakery and pastry industries rely on cream for its taste and emulsifying capacities. There are numerous varieties of creams based on heat treatments, pasteurisation, fat content, and viscosity.

Cream manufacturing process involves five basic steps. It starts with skimming the milk in a centrifugal cream separator. The next step is fat standardization to achieve the expected fat content, followed by homogenization. The product is then subjected to heat treatment in order to destroy the pathogenic microbes without damaging essential qualities of cream. Finally, the cream is put through a maturing process that enhances its ultimate taste and provides protection against lactic acid production.

Importance of pH Measurement

pH is an important quality parameter in the dairy industry during the manufacturing of cream. Right from the beginning of measurement of milk through the different stages, up until the final processing of cream. For generating sweet butter from the pasteurized cream, the pH has to be strictly controlled between 6.70 and 6.85. For preparation of sour butter, the cream is acidified to a pH of 4.6 to 5.0. pH analysis is vital during the cream maturation stage.

pH Measurement Challenges

The semi-solid nature of a cream sample makes it challenging to measure the pH using a conventional sensor. 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 on the top right outlines the challenges and impacts on pH measurement results during the analysis of cream samples.

Sample Challenge	Sample Impact
Reading fluctuations	Inaccurate results
Semi-solid sample nature	Difficulty in sample measurement; junction clogging
High protein sample content	Proteins can lead to precipitation of reference electrolytes and junction clogging
High fat sample content	Insufficient miscibility of aqueous reference electrolyte with sample, which results in high response time.
Cleaning of sensor after measurement	Sensor fouling due to inefficient cleaning leads to deposition on the glass membrane, causing sluggish response.

InLab Solids Pro-ISM for Reliable pH

The InLab Solids Pro-ISM (51344155) is a specialized sensor for measuring the pH of cream with precision and accuracy. It is an easy clean pH sensor specially designed for semi-solid and solid dairy products. The pH sensing membrane of this sensor is spear shaped so 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. Since the refilling of electrolyte is not required these sensors are maintenance free. InLab pH sensors have an 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 dairy samples can now freely interact with the electrolyte without causing precipitation.

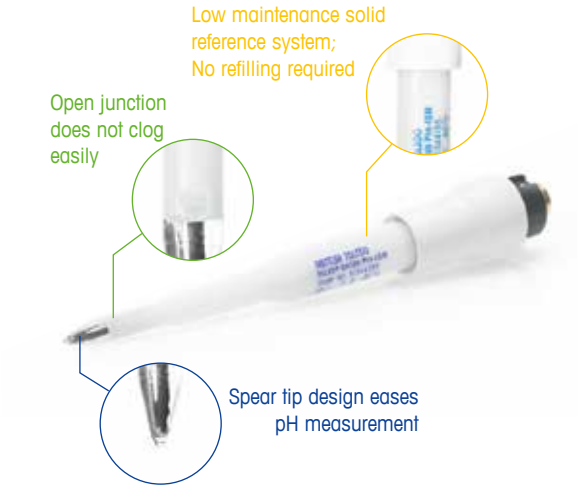

Figure 1: InLab Solids Pro-ISM pH sensor

The sensor has Intelligent Sensor Management (ISM) technology that offers data security, stores calibration history, and monitors maximum temperature exposure of the sensor. 'Pro' stands for a built-in temperature probe sensor that helps to capture the sample temperature accurately and supports the ATC (automatic temperature compensation) functionality.

Procedure and Method

Calibrate the sensor using MT technical buffers that bracket the pH values of cream sample (usually, 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 2: Measurement of whipped cream sample using InLab Solids Pro-ISM pH sensor

Perform sample measurements 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. Use of Pepsin/HCl solution (51350100) is recommended for cleaning the protein built up from the sensor membrane. Ethanol solvent can also be helpful to remove the protein contaminations on the sensor. However, to protect the pH membrane from dehydration, such cleaning should be followed by rinsing with deionized water. Further, soak 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

Various milk cream samples were analyzed for pH at an ambient temperature of 25 ± 2 °C. Average pH values for the samples (performed in triplicates) using InLab Solids Pro-ISM pH sensor are given in the table below.

Cream Sample	Mean pH value	Std.Dev.	Avg. time (s)
Fresh Cream	6.66	0.02	06
Sweet cream	6.48	0.02	20
Sour Cream	4.39	0.01	06

Table: pH values of cream samples measured with InLab Solids Pro-ISM 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. This is ideal for removing protein contamination. Rinse and then recalibrate the sensor.
- Regular maintenance is very important for prolonging the lifetime of the pH electrode. In case there are inaccuracies in the pH measurements, reconditioning of the electrode in 0.01 M HCl is recommended.
- For quick and consistent measurement, ensure that the junction of the pH sensor is completely immersed in the sample.
- Clean the electrode regularly to remove accumulated fat and protein using deionized water followed by ethanol solvent and finally again with deionized water.
- Do not let the sample dry over the sensor, this will obstruct the junction of the sensor making it difficult to clean and might even damage the pH-sensitive glass membrane.
- 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 values of samples changes with temperature, hence pH values of the samples should be measured at the same temperature for a fair comparison.
- In-between measurements or when the electrode is not being used for brief periods, it is best to keep the electrode in the wetting cap filled with InLab Storage Solution (30111142).
- Ensure usage of buffers in the correct sequence, use fresh buffers, and always check the expiry date before using.

Further Information

- Electrode handling movies on:

  YouTube

- Comprehensive range of pH meters, electrodes, solutions, and accessories:
  www.mt.com/pH

References

- Code of Federal Regulations. 21, Chapter 1 (4-1-12 ed.), part 131 – Milk and Cream. U.S. Printing Office, Washington, D.C
- Robinson, R.K. ed., 2005. Dairy microbiology handbook: the microbiology of milk and milk products. John Wiley & Sons.

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