pH and beermaking

Fast and accurate pH testing is important throughout the brewing process

thermo scientific

Introduction

Accurate testing is the key to good beer. This includes testing water at the point of entry, testing various stages of production and packaging, and testing wastewater.

pH is one of the most important elements to get right—it affects how yeast, nutrients and other chemicals behave throughout every stage of beermaking. It's basic (no pun intended), but it's also the only consistent measurement parameter across all the different stages of brewing.

What is pH?

• pH compares the acidity or alkalinity of a solution at a given temperature. A pH of 7 describes a neutral solution because the activities of hydrogen and hydroxide ions are equal. When the pH is below 7, the solution is described as acidic—the hydrogen ion activity increases and the pH value decreases. When the pH is above 7, the solution is described as basic (or alkaline)—the activity of hydroxide ion is greater than that of hydrogen ion.

Why measuring with an electrode and meter is better

- pH electrode measurements are made by comparing the readings in a sample with the readings in standards whose pH has been defined (buffers). Thermo Scientific[™] Orion[™] pH Meters contain pH versus temperature values for commonly used buffers. This allows the meter to recognize a particular pH buffer and calibrate with the correct buffer value at the measured temperature.
- pH electrode measurements are very accurate, enable consistency over time, and automate data collection. For example, to support enzyme activity, mash pH should generally be controlled in the optimal range of pH 5.2–5.5. This level of precision is not possible with pH paper. The meter can log pH data wherever pH is measured and can be tracked to indicate trends and unusual activity.





pH and water

The chemical profile of the brewing water affects the beer.

A beer's flavor profile depends on the chemical profile of the water used for brewing. The Thermo Scientific[™] lab equipment and water analysis products described throughout are designed to be durable, low-maintenance and easy to use. Test your water and get your results quickly and easily so you can create the water profile you need to get on with your brewing.

pH and alkalinity

- During the brewing process, natural acids are released and the pH of the wort and beer becomes more acidic.
- The alkalinity of the incoming water balances these acids and keeps the pH from going too low.
- Breweries with multiple sites or multiple water sources test for calcium to match the mineral profile across all similar products. A common mineral salt that affects alkalinity and taste, calcium affects the mash pH, can impact fermentation and is a factor in final clarity.



Products for testing water at point of entry:

- <u>Thermo Scientific Orion Star</u>[™] <u>A214 Benchtop pH Meter Kit</u> with <u>Orion</u> <u>Calcium Electrodes</u>
 - Test pH throughout the brewing process.
 - Record accurate and reliable pH, ion concentration, mV, ORP and temperature.
 - Perform up to 5 point pH and ISE calibrations, log up to 2000 data point sets with time/date stamp and easily transfer calibration and data logs.
 - Add ion-selective electrode testing for parameters like calcium and ammonia; no separate reference electrode is needed.
- Orion Star T910 pH Titrator
 - Versatile titrator for dedicated acid-base titrations including titratable acidity of beer and alkalinity of waters.
 - Automate alkalinity testing of source water.
 - Perform acidity testing of finished beer.
 - Techniques include equivalence point titrations and preset pH endpoint titrations for versatile sample analysis.

pH during production

Fermentation, filtration and pasteurization impact flavor and quality, and each of these processes must be closely inspected and measured.

Mash, boil and fermentation all impact pH. For example, organic acids created during production affect the pH of the wort.

Getting the right flavor profile and maintaining consistent quality takes diligence. Incoming material monitoring, control of the brewing process and quality control on the finished product all contribute to beer profile consistency. Tracking pH is a simple way to confirm a batch is progressing to plan. The discovery of non-optimal pH levels may indicate the presence of undesired organisms.

To get the job done, you need high quality, reliable tools that are easy to use and maintain. Thermo Scientific laboratory instruments give you the feedback you need to ensure you get the consistent beer you want. Our laboratory equipment includes automated procedures and step-by-step instructions to enable testing at any step of the process.

Products for testing during production:

- Orion Star A326 pH/Dissolved Oxygen Portable
 <u>Multiparameter Meter</u>
 - Test the pH of the product as it moves through the brewery, from the brewhouse to the cellar to storage and final packaging.
 - Access high accuracy and premium performance everywhere you need it. This meter is designed for a wide range of pH, ORP (oxidation-reduction potential), dissolved oxygen (DO) and temperature testing and field applications.
 - Use the two meter-channels to measure pH and dissolved oxygen simultaneously or view each channel separately.
 - Log up to 5000 data point sets with time/date stamp and easily transfer calibration and data logs.

- Orion Star A214 pH/ISE Benchtop Meter Kit
- Record accurate and reliable pH, ion concentration, mV, ORP and temperature measurements.
- Ideal for a wide range of applications and advanced pH or ion analysis in the lab. Perform up to 5 point pH and ISE calibrations, log up to 2000 data point sets with time/date stamp and easily transfer calibration and data logs.
- Thermo Scientific Orion AquaMate[™] Vis and UV-Vis Spectrophotometers
 - With more than 260 preprogrammed analysis methods, these spectrophotometers incorporate advanced features and functions for ultimate flexibility in operation.
 - Mash pH and color are often related. Analyze for bitterness (IBU), color, FAN, diacetyl (VDK – vicinal diketones), polyphenols, and thiobarbituric acid index (TBI).

Titratable acidity vs. pH: What's the difference?

- pH measures only the free acid activity of the beer, while titratable acidity (TA) measures all the weak and strong acids in the beer.
- pH is a logarithmic scale, while TA gives the concentration in grams of acid per volume of beer.
- Beermakers measure both pH and TA. TA tends to be a better indicator of the taste.
 - Higher acid makes sour beers: Lambic, Gose, Berliner Weiss, etc.

pH during filtration and packaging

pH targets are set for the filtration phase as part of achieving overall clarity goals. For example, haze, foam and astringency perception are all strongly influenced by pH.

- Beer haze formation is greatest slightly above pH 4 and is much weaker at both higher and lower pH. [source]
- Studies with both beer and a model system showed greater foam formation with higher pH within the beer range. [ibid]

pH is also targeted throughout the packaging, cleaning and sanitization processes.

• As the final step before distribution and consumption, packaging is the last chance to ensure the product meets all standards for taste and quality. As such, pH continues to be closely monitored.

Products for testing during filtration and packaging phases:

- Orion Star A214 Benchtop pH/ISE Meter Kit
 - Record accurate and reliable pH, ion concentration, mV, ORP and temperature measurements throughout the brewing process.
 - Perform up to 5 point pH and ISE calibrations, log up to 2000 data point sets with time/date stamp and easily transfer calibration and data logs.
 - Includes sensing electrode, buffers or standards, and an attached electrode stand—everything you need to get started.
- Orion Star A221 pH Portable Meter Kit
 - Record accurate and reliable pH, mV, ORP and temperature measurements as the product moves through the brewery, from the brewhouse to the cellar to storage and final packaging.
 - Perform up to 5 point pH and ISE calibrations, log up to 1000 data point sets with time/date stamp and easily transfer calibration and data logs.
 - Waterproof and rugged for outdoor use.



pH and wastewater treatment

Wastewater plants are not equipped to treat high-strength waste like that from most breweries. <u>Best practices are well documented</u>, but testing is necessary to confirm regulatory expectations are met.



pH testing products for wastewater

- Orion Star A326 pH/Dissolved Oxygen Portable Multiparameter Meter
- Record accurate and reliable pH, mV, ORP, dissolved oxygen (DO) and temperature measurements on the go.
- Access high accuracy and premium performance everywhere you need it.

- Use the two meter-channels to measure pH and dissolved oxygen simultaneously or view each channel separately.
- Log up to 5000 data point sets with time/date stamp and easily transfer calibration and data logs.

A well-equipped lab makes the best featers of consistent quality

Thermo Fisher Scientific knows beermaking. Our water purification systems, benchtop and portable meters with electrodes, titrators and spectrophotometers are critical in brewery quality control labs and throughout the brewing process.

• While suitable for breweries of any size, our products are ideally suited to regional breweries with an annual production of 15–600 thousand barrels/year, as well as the labs that serve them.



The right tools and analyses can remedy complications and are the foundation of good brewing. We offer durable, high quality instrumentation and robust equipment that can help you analyze your starting ingredients, optimize your brewing process and quality check the final product.

On the production floor and in the lab, Thermo Scientific testing instruments and lab equipment support your incoming water analysis and wastewater monitoring, as well as key steps in the brewing process. Clear, accurate tests start with clean, well-kept samples. And clean, well-kept samples require the right equipment:

- Water purification systems
- Benchtop and portable meters for pH and other testing
- Titrators for alkalinity and acidity testing
- UV-Vis spectrophotometers for color, bitterness, and other tests
- Turbidity meters for stability and clarity tests
- Shakers and laminar flow hoods for culturing yeast
- Water baths for sample preparation
- Ovens for drying
- Beakers, bottles, pipettes, and all manner of collection and storage vessels

Design your own laboratory space to efficiently plan square footage based on specifications for your Thermo Scientific lab equipment. This <u>virtual lab tool</u> will help you visualize it all within your existing lab footprint.

Learn more



Smart Note #1:

How do I maintain my pH PDF electrode so that it is fast and reliable in mash, wort, and beer samples?

Smart Note #2:

PDF

When measuring the pH of beer mash or wort, how do I know that the reading is valid?



Haze in Beer **Application Note:**

How can I quickly measure the turbidity of my beer?

Beermakers checklist		
Point-of-entry		
pH & Calcium	Orion Star A214 Bench pH Meter Kit with Orion Calcium Electrode	
рН	Orion Star T910 pH Titrator	
Chlorine	Thermo Scientific Orion AQUAfast [™] AQ3710 Colorimeter	
Production		
pH & Oxygen	Orion Star A326 pH/Dissolved Oxygen Portable Meter Kit	
Moisture	Thermo Scientific Heratherm [™] General Protocol Oven	
IBU, color, etc.	AquaMate 8100 UV-Vis Spectrophotometer	
FAN	Orion Star A214 pH/ISE Benchtop Meter with Orion High Performance Ammonia Electrode	250
Filtration and Packaging		
Turbidity	AQUAfast AQ3010 Turbidity Meter Kit	
рН	Orion Star A214 Benchtop pH/ISE Meter Kit and Orion T910 pH Titrator	150
IBU, color, etc.	AquaMate 8100 UV-Vis Spectrophotometer	
Testing	Heratherm General Protocol Microbiological Incubator and Thermo Scientific Digital Mini Rotator	50
Wastewater		and the second secon
рН	Orion Star A211 pH Benchtop Meter Kit	
pH & Oxygen	Orion Star A326 pH/Dissolved Oxygen Portable Meter Kit	1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2 1 2
Turbidity	AQUAfast AQ3010 Turbidity Meter Kit	
Oxygen	Orion Star A213 Dissolved Oxygen Benchtop Meter Kit	
COD, Nitrogen & Phosphates	AQUAfast AQ3700 Colorimeter	

Find out more at **thermofisher.com/beer**

and discover more resources at thermofisher.com/beertesting

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