

Measuring pH in surface water

Key words

pH, triode, electrode, ROSS, Orion, meter, surface water, rivers, streams, public water supply, mill pond, water quality.

Goal

The following application note describes how to reliably measure the pH of surface water using a portable pH meter and pH triode.

Introduction

The pH of surface water is a common field measurement. This measurement can be made using a Thermo Scientific™ Orion™ ROSS™ Ultra™ Triode™ which will measure both the temperature and pH of the sample with a single probe. The probe provides quick, reproducible results in both fresh and salt water samples.

Reference

USGS National Field Manual: pH Method, Chapter 6.4; Version 1.3, January 2006 and Version 2.0, February 2021 (online).

Recommended equipment

- Thermo Scientific Orion Portable pH Meter
- Thermo Scientific Orion ROSS Ultra Triode with built-in temperature sensor
- NIST calibrated thermometer — optional

Required solutions

- pH 4.01, 7.00, and 10.01 Buffer Pouches
- Filling Solution
- Thermo Scientific Orion ROSS™ Storage Solution
- Deionized Water (DI) or reagent grade water (RGW)

Solutions preparation

Buffers used for field calibration should be equilibrated to the temperature of the sample. This can be done by placing buffer pouches in large beaker of sample for 10 minutes prior to calibration.

Meter setup

Connect the electrode to the Thermo Scientific Orion Star™ or Star A meter. Set measurement mode to pH. In Setup mode of Star meter, set resolution to 0.01, Buffer Set to USA and read type to Auto. If all steps were followed correctly the meter display will show units of pH, a value with two decimal places, and the actual temperature (not 25.0 °C).

Electrode setup

See the electrode manual for preparation of the electrode.

Electrode performance check

These checks may be done in the lab. Check slope at least daily according to the electrode manual. Drift may be checked by comparing a one minute reading to a two minute reading. Results should agree with desired criteria. See troubleshooting section of manual if slope and/or drift are not acceptable. Be sure electrode is working properly before going out into the field to make measurements.

Electrode storage, soaking and rinsing

Store electrode in pH 4.01 or 7.00 buffer in between measurements. A buffer pouch in a beaker of sample is best to keep the electrodes as close to sample temperature as possible. Rinse the electrode with DI or RGW and gently shake off excess drops of liquid before measuring the next sample. Store electrode in small bottle with electrode storage solution when transporting probe.

Sample preparation and preservation

Since the sample is measured in the field, no preparation or preservation is required. Collect samples and measure without delay.

Calibration

Because pH readings are temperature dependent, it is good practice to bring the pH buffers to the same temperature as the sample before calibrating your pH electrode. Place unopened pH buffer pouches in a large beaker containing sample water for at least 10 minutes to allow for temperature of buffer to equilibrate. Perform a three point calibration using pH 4.01, 7.00 and 10.01 buffers. The meter automatically recognizes the buffers and displays the temperature-corrected pH value for each calibration point. The electrode slope should be between 92 and 102%. Read a fresh portion of pH 7.00 buffer to verify calibration. Reading will be temperature-adjusted, see the table for expected values, on the next page. If readings are not acceptable and/or slope is not within range, see troubleshooting section of your pH triode manual. In some cases, it may be desirable to calibrate the pH meter and electrode in a laboratory rather than in the field. In that case, once in the field, read of fresh pour or fresh pouch of pH 7.0 buffer to verify the calibration..

Analysis

Rinse electrode with DI or RGW. Collect a sample in a large container. Without delay, pour a portion of the sample into a smaller beaker. Insert the pH probe and briefly, gently stir the sample with the probe. Then press "measure." The pH value will be displayed. When a stable reading is achieved, the "pH" icon will stop flashing and screen will freeze with stable values displayed. Repeat this rinse and measure process until



successive sample readings are within 0.1 pH unit of each other. This should happen within one or two sample readings.

Quality Control (QC)

Recommended QC procedures include: calibration and calibration verification, sample duplicates, slope, and drift check.

A note about automatic temperature compensation (ATC) for pH readings:

Temperature sensors for ATC automatically adjust pH measurements for the change in the electrode calibration that happens when the temperature changes. Therefore, the ATC corrects for the effects of changing temperature on sensor response. No pH temperature compensation corrects a pH reading back to a value expected at 25°C (in the way of a conductivity temperature compensation). That is why the verification is done by comparing the measured buffer reading to the reading expected at the measurement temperature -- not to the 25°C value printed on the bottle or pouch. This is why recording the temperature for every pH measurement is important, as it has an impact on the pH reading.

Results

Lake (Public Water Supply)	pH	Temperature (°C)
Sample 1	7.64	26.6
Sample 2	7.56	26.8
Sample 3	7.60	26.8
Mean	7.60	26.7
Standard Deviation	0.04	0.12
Time per Sample	121 seconds	

Mill Pond	pH	Temperature (°C)
Sample 1	7.85	25.2
Sample 2	7.71	25.1
Sample 3	7.78	24.9
Mean	7.78	25.1
Standard Deviation	0.07	0.15
Time per Sample	85 seconds	

Ocean (Harbor)	pH	Temperature (°C)
Sample 1	8.12	20.2
Sample 2	8.15	20.2
Sample 3	8.12	20.0
Mean	8.13	20.1
Standard Deviation	0.02	0.12
Time per Sample	33 seconds	

Temperature vs. pH for pH 7.00 buffer

(°C)	0	10	20	30	40	50	60	70	80	90
pH	7.11	7.06	7.01	6.98	6.97	6.97	6.97	6.99	7.03	7.08



Thermo Scientific Orion pH Meters, Electrodes, and Solutions Ordering Information

Product	Description	Cat. No.
Meters	Thermo Scientific Orion Star A321 pH Portable Meter Kit	STARA3215
	Thermo Scientific Orion Star A221 pH Portable Meter Kit	STARA2215
	Thermo Scientific Orion Star A121 pH Portable Meter Kit	STARA2215
Electrodes	Thermo Scientific Orion ROSS Ultra Refillable pH/ATC Triode Combination Electrode	8157BNUMD/8157UWMMD**
	Thermo Scientific Orion ROSS Ultra pH/ATC Triode with Epoxy Body, Low Maintenance Gel	8107BNUMD/8107UWMMD**
Solutions	Orion pH 4.01 Buffer Individual Use Pouch, 25 × 15 mL	910425
	Orion pH 7.00 Buffer Individual Use Pouch, 25 × 15 mL	910725
	Orion pH 10.01 Buffer Individual Use Pouch, 25 × 15 mL	911025-WA
	Orion ROSS Ultra pH Electrode Filling Solution	810007
	Orion ROSS pH Electrode Storage Solution, 475 mL Bottle	810001
Reagent Grade Water	Barnstead Smart2Pure 12 UV Water Purification System	50129890*

*Please contact your local sales representative for support on ordering the best water purification system for your application. And visit our website at thermofisher.com/labwater.

** WMMD models come with choice of 3m or 6m cable lengths.

 Find out more at thermofisher.com/electrochemistry

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