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Tip Log # 86

Applications Tip of the Week

Temperature Compensation for pH – A Simplified Approach

Question: Can I turn off pH temperature compensation and measure pH and temperature without compensation?
Answer: Not really, but there are ways to minimize the effects of temperature on the pH measurement.

Let's face it. Temperature compensation for pH can be a little mysterious. Picture the user who asked the question above. He or she might be thinking "What's the meter doing to my pH reading anyway? Maybe it's doing something to my results that I don't want to happen."

Since temperature affects the pH electrode slope, the pH standard buffer values, and sample pH, it is not possible to eliminate temperature compensation altogether. However, there are simple approaches to minimize temperature compensation corrections and to maximize the accuracy and confidence level of your pH readings.

The key to simplifying pH temperature compensation is to bring the samples and the standards to the same temperature and to know what that temperature is. Read on.

Approach Number 1: store standard buffers at room temperature; bring samples to room temperature

1. Measure temperature of standard buffers, which are stored at room temperature.
2. Bring samples to the same temperature as the standard buffers (room temperature). See Note 1.
3. Enter the measured room temperature into the meter either manually or automatically (see Note 2).
4. At room temperature, calibrate the electrode and measure the sample pH.

Approach Number 2: cool or warm standard buffers to the sample temperature

1. Measure temperature of the sample at the point of pH sampling and testing
2. Bring the pH buffer standards to the same temperature as the sample. See Note 3.
3. Enter the sample temperature into the meter either manually or automatically (see Note 2).
4. At sample temperature, calibrate the electrode and measure the sample pH.

Why does this work?

- Knowing the temperature of the standard buffers is necessary for assigning the correct pH value to the standard. When the correct temperature is input (manually or automatically), Orion Star meters will do this automatically through the Autocal function.
- Keeping the temperature of the samples close to the standard buffer temperatures will minimize the temperature compensation correction applied.
- Measuring the temperature of the samples and standards allows them to be adjusted to match each other.

Be aware that temperature compensation correction does <u>not</u> account for sample pH changes that result from the effects of temperature on the nature of the sample itself. These effects are unknown for most samples and can not be corrected for. For this reason, it is common to see methods which suggest that pH and temperature are measured and reported together. Other methods may specify that the pH must be measured at sample temperature.

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If it is necessary to measure pH at a temperature that is different from the calibration temperature, be aware that the applied temperature compensation correction becomes larger as the temperature and pH of the standards and samples become further apart. The temperature compensation correction applied to a sample pH reading is approximately 0.003 pH /degree C/pH units difference from pH 7 (Note 4).

> For example, if calibration is at 20 C, but a sample is measured at 38C and reads near pH 8.5, the temperature compensation correction applied will be approximately 0.003 pH x (38-20C) x (8.5-7.0 units) = 0.08 pH.

Note 1: Measure the sample temperatures to be sure they match the standard buffer temperature. Depending on the level of accuracy desired, standard and sample temperatures that agree within 1 deg C are usually satisfactory.
Note 2: Automatic temperature measurement may be done by an Orion pH triode or automatic temperature compensation (ATC) probe connected to the meter.
Note 3: Measure the standard buffer temperatures to be sure they match the sample temperature. Depending on the level of accuracy desired, standard and sample temperatures that agree within 1 deg C are usually satisfactory.
Note 4: The pH electrode slope changes by 0.2 mV/deg C or ~ 0.003 pH units/deg C. See Fig. A-5. The pH at which the reading for the electrode does not vary with temperature is known as the isopotential point. For an ideal glass pH electrode, the isopotential point is pH 7. The further the sample pH is from pH 7, the more the reading changes when temperature changes and the larger the temperature compensation correction applied.

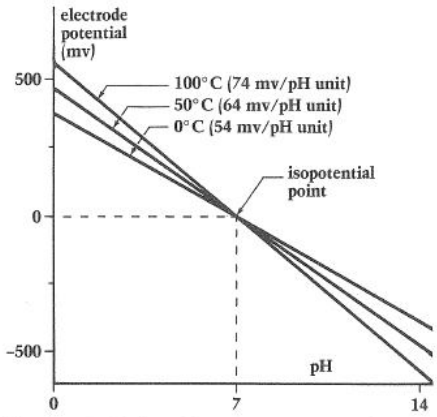

Fig. A-5: Typical pH electrode response as a function of temperature.

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