Smart Notes

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Water Purification

Should the pH level of dispensed ultrapure water be a neutral 7.0?

No. This is a common myth of ultrapure water. The pH level of ultrapure water can quickly decrease after being dispensed from a lab water system. Fresh ultrapure water can read anywhere between pH 5.0 and 8.0. As time passes, the CO_2 absorption in the water creates carbonic acid, which causes the pH level to drop.

pH measurements of ultrapure water tend to be unstable and can be inaccurate due to its low ionic strength and low buffering capacity; therefore, pH is not considered a measurement of ultrapure water quality. The ASTM Standard Specification for Reagent Water, D1193*, which establishes water quality standards for laboratory use, does not list pH readings for Type I, II or III water.

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FAQ's

Understanding pH, CO_2 and water purity

There are many questions about the relationship between pH, conductivity, CO_2 and the purity of water. The following are frequently asked questions related to this topic:

QUESTION	ANSWER
Ultrapure water absorbs CO_2 from the air. Does this affect the purity of the pure water?	**Ultrapure water immediately picks up carbon dioxide and conductivity upon dispensing.** Due to this volatility, the conductivity level of the ultrapure water, once dispensed, will not match what is on the display. However, the CO_2 can be accounted for in the water as described in USP Method <645> Water Conductivity.
Should I worry about a pH between 5 and 8 if I decide to test my ultrapure water?	**Probably not. Fresh ultrapure water can read anywhere between pH 5.0 and 8.0.** A pH between 5 and 8 can be attributed to innocuous exposure to CO_2 in the air. In addition, pH is not considered a useful indicator of ultrapure water quality, because of the expected CO_2 absorption. More important is consistent maintenance of the water system to avoid the possibility of contaminants such as ions, organics or bacteria interfering with the application.
If it is necessary to test the pH of my ultrapure water, how can I obtain an accurate reading?	**pH measurements of ultrapure water tend to be unstable and can be inaccurate due to the low ionic strength and low buffering capacity of ultrapure water.** The addition of a neutral salt (KCl) will increase the ionic strength, and minimize drift and bias in the pH measurement. For example, the addition of 0.3 mL of saturated KCl to 100 mL of ultrapure water will stabilize the reading without significantly impacting the pH. A high-quality pH electrode will reduce noise and drift, and help increase accuracy.
If the pH is low, is it considered an acidic solution?	**Low pH and a high acidity are two different things.** The acidity and buffer capacity of low pH pure water is minimal. Once reagents are added to the pure water, the effect of the CO_2 on the pH will often be negligible. For example, the pH of ultrapure water and an acetate buffer are very similar, but the acidity and buffer capacity of the pure water is about 1000 times less than the acetate buffer. It is minimal.

Will CO_2 absorption affect the pH of a solution prepared with ultrapure water?

CO_2 will be in any solution that is prepared in an air atmosphere. It has always been there and does not lead to high acidity or alkalinity. In most cases, we don't expect there to be a significant effect. In general, it may be more useful to monitor and/or control the pH of the prepared solution instead of the pH of the ultrapure water used to make the solution. The exception to this would be a recipe that calls for CO_2-free water.

Summary

Avoid unnecessary troubleshooting by understanding what parameters are important when testing the ultrapure water in the lab.

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*ASTM D1193-06(2011), Standard Specification for Reagent Water, ASTM International, West Conshohocken, PA, 2011, www.astm.org

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