High Purity Water pH Measurements Made Easy

What is pure water and why do we measure it?

Ultrapure water, UPW, high-purity water and deionized (DI) are all terms describing basically the same property. They refer to water which has been purified to the highest standards by removing all contaminants such as, organic and inorganic compounds; dissolved and particulate matter; volatile and non-volatile, reactive and inert; hydrophilic and hydrophobic; and dissolved gases. The purified water has very low conductivity which means it is high in resistance because all the conductive components have been removed. In low conductive solutions combined with its susceptibility to contamination and temperature effects makes accurate pH measurement very difficult.

Pure water is used in a variety of industrial processes and understanding why pH is being measured its level of importance in the overall process is key.

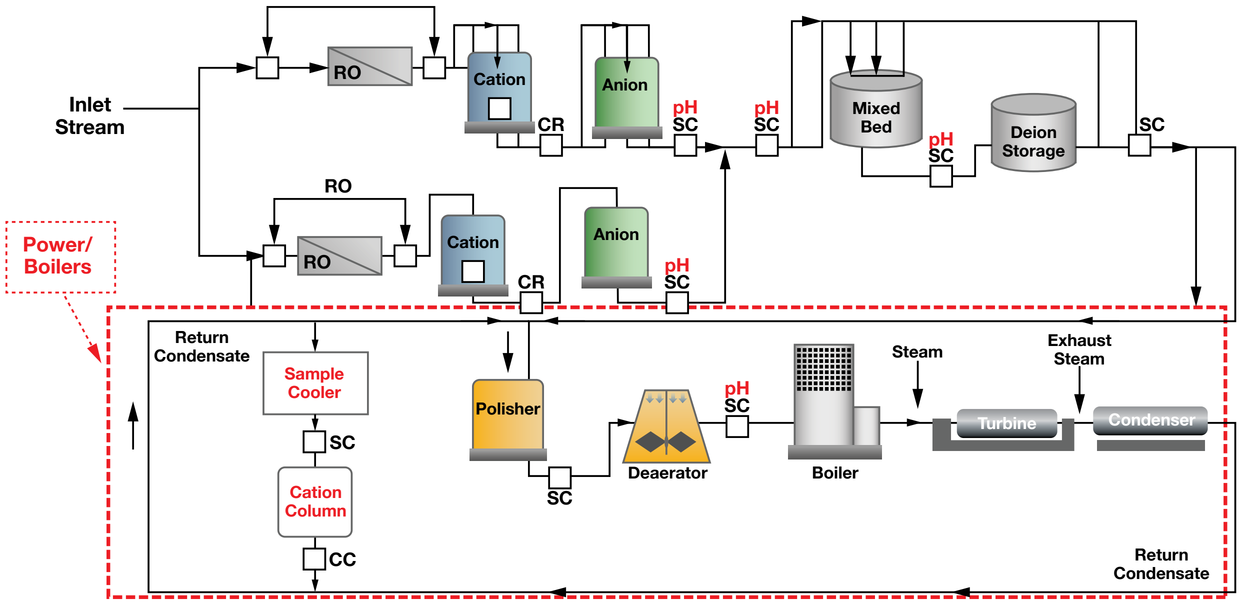
- A primary purpose of measuring pH is its quick response to the ingress process contamination during production and distribution of pure water. Gaseous contaminants like air or carbon di-oxide, or the exhaustion of resin beds are the main sources of the contamination.
- For Demineralization applications, the resin beds can be either cationic or anionic. An increase in pH results from cationic bed exhaustion whereas anionic bed exhaustion leads to a decrease in pH value.
- Most industrial plants use high pressure boilers to generate steam from pure water. Impurities in the water will increase scaling of boiler tubes and carryover of impurities in steam which will further reduce the boiler efficiency and damage the equipment.
- Pure water is an essential factor in the pharmaceutical industry as well. It is necessary for the production for a variety of products.
- Semiconductor manufactures also require pure water to insure highest product quality.

Where is pH measured?

In the production and use of pure water, pH must be measured at various points:

- Preparation point - pH measurement at this beginning point validates that the desired purity has been produced and in sufficient quantity.
- Distribution system - This confirms no impurities have been injected by the distribution system which could hamper the process.
- Usage Point - pH measurement here further confirms the water is of the required purity.
- Apart from these points, wherever steam is generated, other pH measurement points include; after water treatment; condensate pump discharge; after condensate polishing units; etc.

The schematic on the back page is an example of pure water within a power plant.



Factors and counter measures to ensure accurate pH measurement:

Static Charges:
Since the conductivity of high pure water is very low, it creates a static charge while passing through a nonconductive material that affects the pH reference sensor. This static charge will create stray currents resulting in erratic pH readings.

Counter Measure:
Using a pH sensor with a liquid earth electrode combined with dual amplifier pH transmitter is recommended. This configuration ensures the measuring and reference electrode signals are amplified separately against the liquid earth contact. This provides the best immunity to noise and stray currents and thus reliable, stable pH readings.

Process contamination and reference junction potential:
A potential is developed at the reference junction when two different solutions come in contact with each other. This is called diffusion gradient. The reason for this unwanted gradient is transfer of ions at different rates because of flow variations. This may cause unstable reference potential and anomalous pH measurement. Process contamination can also generate these errors in pH measurement.

Counter measure:
These anomalies can be minimized or removed by maintaining a steady flow across a “positive pressure” reference sensor such as the unique bellow system in the reference electrode. The build-in bellow ensures immediate interior pressure equalization to the outside pressure making the sensor virtually insensitive to external pressure/flow variations. A slight overpressure caused by the bellow tension, prevents fluid ingress and maintains a positive ion flow out of the sensor. This feature is of particular interest in pure water applications.

Conclusion:
Achieving accurate and reliable readings using a traditional pH analyzer is challenging, however with the right equipment stable and accurate pure water pH measurements can be accomplished. Yokogawa’s specialized bellomatic pH sensor is proven best solution for high purity water applications. For those individuals that do not like the maintenance of refilling sensors, then the FU24 which incorporates the successful patented bellow system in an All-in-one body is the ideal solution.

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