

REFEX Technology Overview

Major pH measurement problems such as drift, sluggish response and measurement error are often associated with the porous reference junction or conductive salt bridge of conventional electrodes. Being porous, the reference junction is very sensitive to fouling, poisoning, temperature/pressure changes, and diffusion/dilution of the electrolyte within the reference half-cell and all these factors can have a significant impact on the measurement performance. Short operating life of conventional electrodes in aggressive applications is often experienced and besides the cost of replacement electrodes, many man hours are expended in maintenance activities. The cost of using conventional electrodes, even so called “long-life” and “rugged application” designs, is high and an area of great opportunity for cost reduction.

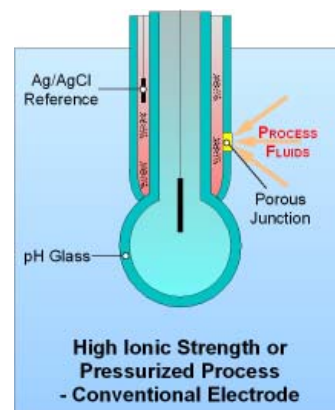
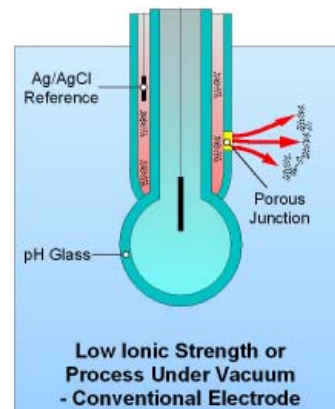
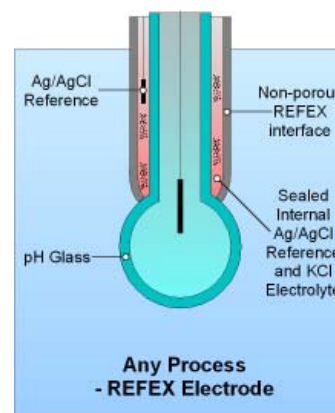
REFEX electrodes still rely upon an Ag/AgCl element in a 3 mol/l KCl electrolyte (just like conventional technology probes, so they work with many standard pH transmitters) but in addition use a patented conductive polymeric material as a barrier between the process and the reference electrode. Unlike conventional electrodes that use open channels, diaphragms or other means to connect the reference electrode to the process, this solid barrier is non-porous, so the problems caused by fouling, poisoning, temperature/pressure changes, and diffusion/dilution of the electrolyte are essentially mitigated.

Simply put, REFEX reference electrodes improve on conventional designs by eliminating the need to have a porous liquid junction in a pH (or ORP) measurement circuit.

The non-porous nature of REFEX:

1. Eliminates diffusion potential errors

As an example, raw water (Reservoir, Lake, and River) can be bitterly cold with low ionic strength and trace quantities of magnesium and iron. Conventional pH sensors with porous reference junctions can quickly foul because of the trace metals and require frequent cleaning and recalibration. Because of the difference in salt concentration between the reference electrolyte (typically KCl 3 mol/l) and the water being measured, diffusion occurs through the porous junction and the reference cell electrolyte becomes depleted. This causes a diffusion potential error - significant when a tight pH value has to be maintained. When conventional electrodes with porous junctions are installed in low ionic strength water applications, they often exhibit instability in the form of continuous drift.

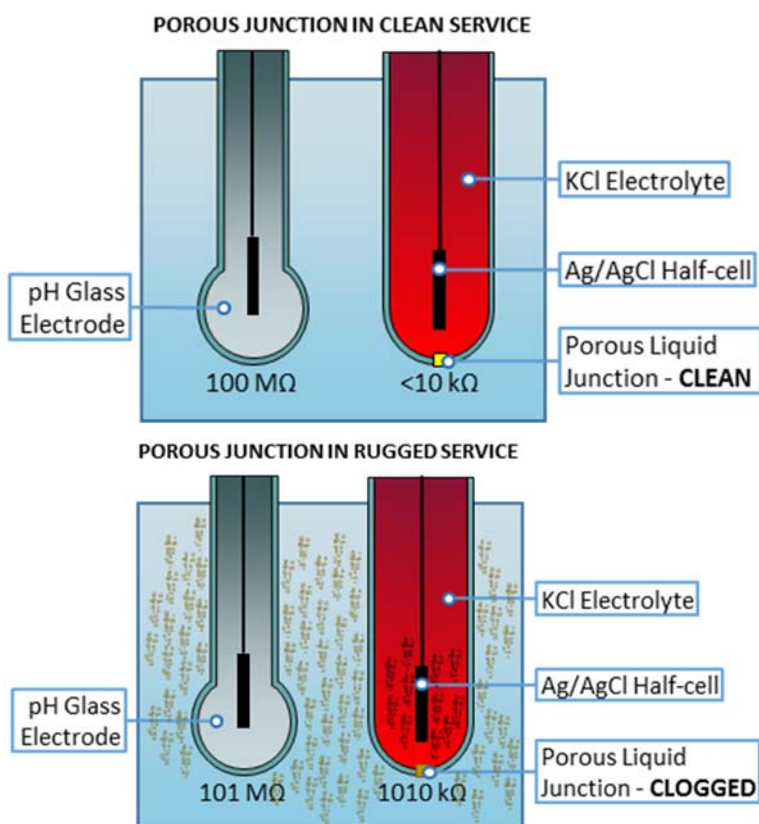


The opposite is true when working with process solutions with high ionic strength. Here, diffusion occurs in the opposite direction with a consequent change to the electrolyte properties.

REFEX, being non-porous, has eliminated measurement error caused by diffusion potential. There is no electrolyte loss or dilution while the electrode is in service and this provides an extremely stable reference output (drift < 1mV/month). Ingress of poisoning material is eliminated, greatly extending electrode life.

2. Is resistant to fouling and coating

Electrode fouling is one of the major problems requiring frequent electrode maintenance and recalibration. The problem in conventional electrodes is the porous liquid-junction for the reference electrode. This porous junction, whether ceramic, Teflon, paper, even wood and other materials can, over time become clogged by process medium, increasing impedance and effecting performance. This clogging can become so bad that the electrode stops responding at all. Lime scale, manganese, precipitation between hydrogen sulfides and AgCl and protein/fat build up in sewage and industrial effluents are all examples of material that can effect electrode performance in this way. Fine particle clogging - pigments and dye stuffs etc. – are particularly bad and have been known to shorten conventional electrode life considerably.

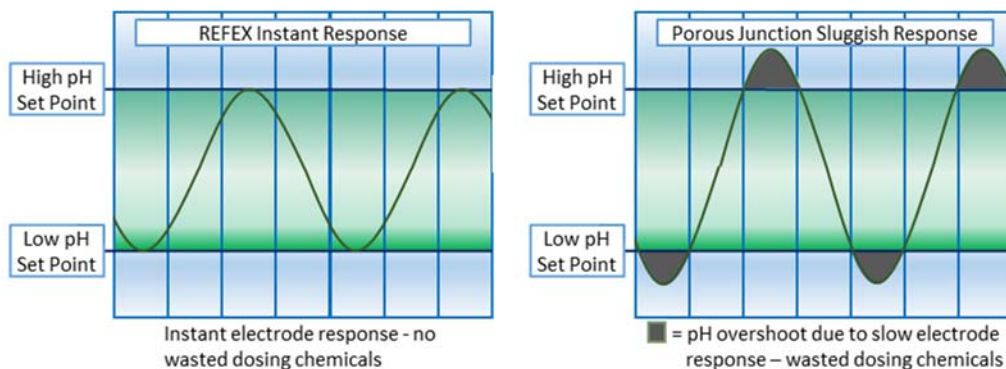


Reference electrodes are low impedance sensors (typically 10 kΩ) while the pH glass element is a high impedance sensor (typically 100 MΩ). Coating and deposits on sensors can increase impedance by 1 MΩ; this is not a major problem for the pH glass electrode - the impedance changes to 101 MΩ (1% increase) however this same effect on the reference side (across the porous junction) changes the impedance from 10 kΩ to 1010 kΩ – orders of magnitude of change and this is exactly where the problem lies. One solution to this problem has been to use a flowing junction electrode where liquid electrolyte is pressurized to create a positive KCl out-flow through the junction and keep it clear of contaminants. While this helps, it is maintenance and consumable intensive and still allows poisoning of the reference element with resultant precipitation within the sensor body. The pressurization and flow of the electrolyte then seals the electrodes' fate by blocking the junction from the inside!

REFEX is far more resilient to fouling and build up. Being non-porous, there is nothing to block and provided any coating on the electrode is conductive, it will continue to operate as if clean. Note that eventually, it will be necessary to clean off heavy build-up from the electrode – it is difficult to measure the process with the electrode buried in its own “micro-environment” of build-up.

3. Responds instantaneously to pH change

The REFEX solid state polymeric reference system allows sensors to respond instantaneously to pH change. This is a very important quality when titration and chemical dosing is required. The entire outside wetted surface of the REFEX reference electrode is electrochemically active without diffusion potential / flow errors and ensures rapid response to pH change, preventing dosing over-shoot and the unnecessary wastage of expensive dosing chemicals. This response characteristic can result in significant cost reduction through chemical savings.



Conventional electrodes respond far more slowly due to ion diffusion time through the porous junction. The use of tortuous paths and double junction techniques to extend electrode life only adds to the slowing of response, and as the porous junctions become obstructed, response time slows further. Slow response inevitably results in set point overshoot and the unnecessary wastage of expensive dosing chemicals.

REFEX is available in separate reference electrodes and combination pH/ORP sensors in a variety of lengths and styles.

Contact South Fork instruments for more information.

