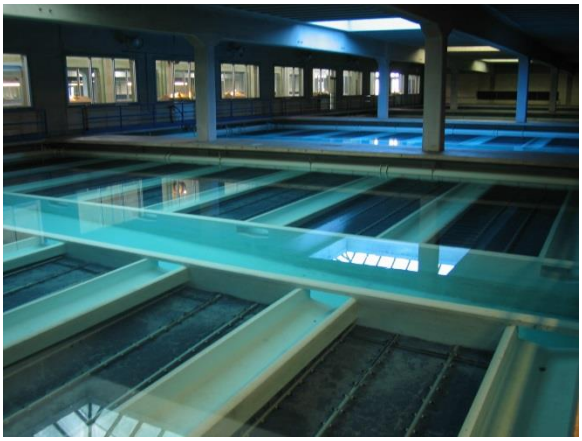
ELECTRO-CHEMICAL DEVICES

White Paper: Smart Diagnostic Data Monitoring Provides Predictive Maintenance for Analyzer Sensors & Systems

SENTINEL Pre-pHAULT Technology Detects Sensor Wear and Provides Just-In-Time Alert To Replace Electrodes

Overview—Predictive Maintenance for Analyzer Sensors & Systems

Today's municipal and industrial water and wastewater treatment processes are today under continuous pressure to provide 24-x-7 up-time, an excellent quality product and deliver it at the lowest possible cost. At the same time, the environmental quality standards for clean water, water treatment and water re-use continue to tighten in order to provide the best product possible in terms of water cleanliness, quality and conservation.



Process, instrument and plant engineers are now tasked with ever-increasing regulatory and reporting requirements at the local, state, federal and international levels. Every aspect of municipal water treatment and industrial plant water treatment is now and will continue to be under review for continuous process improvements, including analyzer systems and sensors that provide measurement of pH, ORP, resistivity, conductivity and specific ions (p-Ion).

The Problems of Continuous Measurement and Maintenance

The measurement of these parameters depends on electro-chemical sensors that are designed with electrodes, which are placed in water and water-based solutions. Over time all electrodes placed in any liquid naturally tend to wear due to exposure to the liquids and their performance begins to degrade. Replacement of the electrode is eventually necessary.

The problem for the technicians responsible for maintaining municipal water and industrial treatment systems is knowing exactly when to replace the analyzer sensor electrode? There are many factors that affect the electrode degradation process, including the composition of the liquid, temperature, pressure and more.

Two options are typically taken by the maintenance staff: (1) premature replacement of the electrode or (2) waiting too long until measurement is affected. Neither option is the most intelligent or best maintenance solution.

Premature replacement of sensor electrodes can be costly in terms of purchasing too many electrodes over time as well as the labor time it takes a technician to replace each electrode. Waiting too long for replacement affects the quality of the water and may cause harm to other equipment, which then requires extra or heavier maintenance or early replacement.

The Solution—Pre-pHault Indication of Measurement Lifetime

The best solution to minimizing the cost of maintaining analyzer sensor electrodes is a predictive maintenance solution . . . a technology that alerts maintenance technicians to sensor electrode wear. Sensor electrodes are replaced only as necessary so replacement costs and labor costs are optimizes while water quality never diminishes and there is no impact on other equipment or systems that might affect their performance, maintenance or useful lifetime.

ECD's SENTINEL technology allows the combination of Model T80 transmitter and S80 sensors to provide Pre-pHault diagnostic information about the lifetime of a pH, ORP or pIon measurement. The SENTINEL graphically displays a filled triangular gauge that decreases proportionally to the degradation of the reference electrode. A filled gauge indicates a new electrode that is functioning properly while an empty gauge indicates an electrode near the end of its useable life. In addition to the graphics, the SENTINEL information is also remotely transmitted by various user selected outputs giving an alert that the sensor electrode is nearing its useful life and will need replacement in the near future to avoid down time.

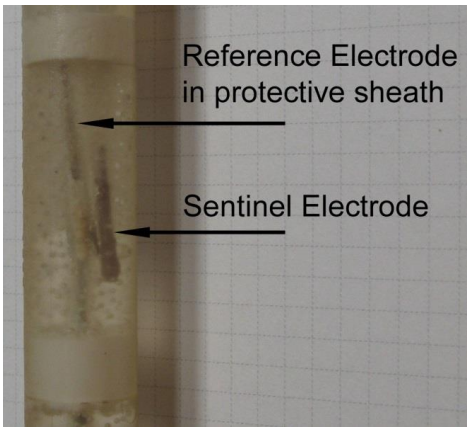
Electrode Sensors for Measuring pH, ORP and Specific pIons

Model S80 sensors for the measurement of pH, ORP and the various pIons use replaceable electrode cartridges specific for the measured parameter. These electrode cartridges have a measurement cell (pH glass, platinum ring or ion selective membrane) and a reference cell. The reference cell is designed to produce a standard potential independent of the solution it is immersed in. The highly conductive potassium chloride electrolyte in the reference cell diffuses through the liquid junction making the electrical contact between the internal silver/silver chloride wire and the process solution. The concentration of potassium chloride electrolyte also determines the potential of the silver/silver chloride electrode, the reference potential.

While these electrodes are typically trouble free, they do have a life span and there are conditions that lead to failure. Diffusion through the porous liquid junction decreases the concentration of the potassium chloride inside the electrode as the electrode ages. The decreasing concentration of potassium chloride changes the potential of the cell which shows up as a drift in the measured value and eventually leads to a noisy erratic

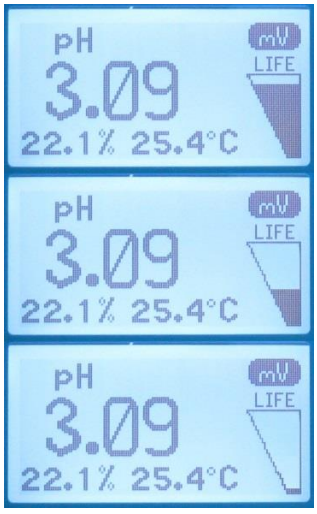
reading. Diffusion also allows chemicals in the process to infiltrate into the electrode. If these chemicals can react with the silver electrode then the electrode will become poisoned and a large offset voltage will be generated destroying the accuracy of the measurement and effectively killing the electrode.

The SENTINEL addresses these issues by including an additional silver/silver chloride element into the reference cell. The primary reference is sleeved in a glass tube while the SENTINEL element is immersed in the potassium chloride electrolyte. When the electrode cartridge is new, both silver elements are at the same potential but as the electrode ages or becomes poisoned the SENTINEL element changes its potential in response to the electrolyte depletion or poisoning. The analyzer monitors the potential difference between the two elements and displays the value on the SENTINEL gauge as a representation of the electrodes remaining life. The protected silver element is still producing the correct potential but it is in danger of failing due to the changing environment inside the reference cell. This Pre-pHault indication notifies the user of the potential electrode failure before the measurement actually fails.



An Example of Sentinel Predictive Maintenance

A large resin manufacturer used multiple pH electrodes on each step of their manufacturing process. Each measurement point used redundant electrodes. When one pH electrode would fail, all of the electrodes on that reactor would be replaced assuming that if one failed the others were probably near failure. Monitoring the pH is critical to the quality of the resin. If the pH is not controlled within a defined range the batch could be lost. After retrofitting the unit with SENTINEL transmitters and sensors, the electrodes were only replaced when the SENTINEL indicated most of their life had been used. This dramatically reduced their electrode usage and maintenance time used for replacing the electrodes.



SENTINEL Predictive Maintenance Facilitates JIT Manufacturing

Several companies use the SENTINEL to facilitate their JIT manufacturing, only ordering replacement pH electrodes as needed. Electrodes typically drift and die in a fairly predictable manner, rarely is their demise due to some catastrophic failure. So electrode life and the consequential replacement can be predicted in most of the cases if you have the Sentinel Pre-pHault diagnostic. When the SENTINEL is down to 10% of the expected lifetime there is probably a month or so of life left in the sensor. Place the order and the new electrode will arrive shortly before the electrode should be replaced.

The Pre-pHault diagnostic is displayed on one of the Model T80s main screens along with the process variable, % 4-20 mA output and temperature. The diagnostic value can be assigned to an optional alarm relay and/or a secondary 4-20 mA output. The mV limit value for the diagnostic is user configurable with a default setting of 60 mV.

The Model T80 transmitter only displays the SENTINEL functions when a Model S80 SENTINEL sensor is connected. The Model S80 SENTINEL sensor uses Diagnostic electrodes designated by Part#'s 20053XX, these electrodes use a triaxial connector with a, PV connection (pH, ORP, Ion), Reference connection and Diagnostic connection.