# managing pH & ORP

**By Mike Ross**

*Demands for meeting and maintaining water quality standards from local, state and federal agencies are a continuing challenge for industrial plants and municipal water and wastewater treatment facilities. The accurate and reliable measurement of pH and oxidation-reduction potential (ORP) is an essential requirement in the successful treatment of water, and in avoiding costly citations and fines. New approaches to sensor technology are now helping process, plant and instrument engineers keep up with water quality demands for pH and ORP measurement while simultaneously meeting the challenge of shrinking staff levels and operational budgets.*

## Measurement and control of pH and ORP in water/ wastewater applications

Municipalities and water-intense process industries face a variety of regulatory and practical requirements when managing pH or ORP measurement and control with respect to water and wastewater. Not only is the cost of capital equipment a concern, but the ongoing cost of ownership in relation to maintenance, labor and replacement components is involved. The importance that sensor selection and versatility plays in overall system cost of ownership and performance often is overlooked.

At the heart of any pH or ORP measurement or control system is the sensor itself. The pH and ORP electrodes provide the data to analyze and control the measurement process effectively. System performance can be directly correlated to the performance of the sensors, available in a wide range of shapes and construction styles from multiple manufacturers. Sensor selection and mounting considerations are a vital part of the system design process and are too frequently an afterthought. The pH and ORP electrodes are similar to batteries: They have a finite use and shelf life. They will require some cleaning and calibration to maintain performance.

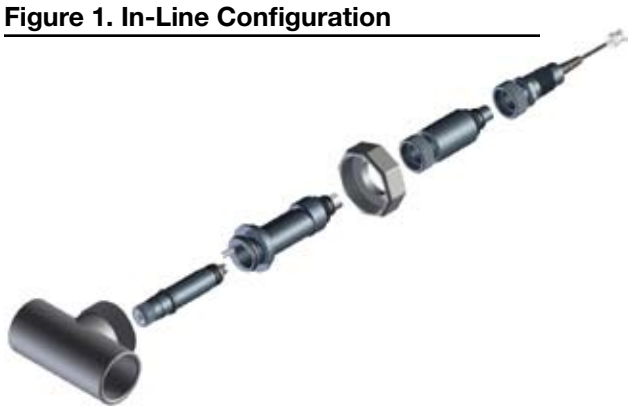

**Figure 1. In-Line Configuration**

**Figure 2. Submersion Installation**

**Figure 3. Retrofit Submersion Installation**

### Installation

Installation requirements for pH and ORP sensors need to be a primary consideration to ensure that a system is reliable, serviceable and operates at an optimum level of performance with minimal maintenance, costs and system downtime. Investing time up front by planning ahead for maintenance will pay off in the long term.

When—not if—a user has to calibrate the system, the following questions should be addressed when selecting or replacing a current sensor:

- Have provisions been made in advance to isolate the sensor for removal from pressurized flowing lines to avoid system shutdown?
- Can the user lift a sensor from a tank for calibration with having to maneuver a 10-ft-long assembly while standing atop an open tank?

A difficult situation will not improve unless a change is made.

The following are key installation considerations that can save users time, costs and labor:

***Location and mounting requirement.*** Will the sensors be installed in-line or submersed in an open vessel?

***Accessibility.*** The electrodes will require periodic cleaning, calibration or replacement. Can they be accessed easily?

***Distance.*** How far is the instrumentation from the sensor? Distance will dictate if additional signal transmission or amplification capabilities are needed.

***Location and mounting.*** As pH and ORP electrodes will require some cleaning and calibration, plus eventual replacement, the user should decide how and where to mount the sensor. A flat surface-style sensor can provide improved performance when used in areas with good flow or agitation. The flat measuring surface is easier to clean and very durable. It also can resist fouling and coatings to increase intervals between service. For multiple installations (e.g., in-line, submersion as well as a variety of instrument brands), the same electrode that can be used for in-line or submersion applications will reduce the number of on-hand spares required.

Mounting hardware, which allows sensor replacement without tools or having to reroute cables and retape threads, presents another opportunity to reduce costs through labor savings. Lastly, a cartridge-type sensor will save time and cost of ownership expense. Users can quickly change a nonfunctional electrode cartridge in seconds, or replace it to perform cleaning later at a more convenient time.

***Accessibility (Part 2).*** Having identified the best location and mounting installation, users must ensure that it can be accessed readily. If an individual has to crawl over pipes and needs tools, there are probably better options. A cartridge-style design of the electrode itself ensures that users can quickly and easily replace a sensor with no tools. If installed in-line, consider installing a bypass line with ball valves to facilitate sensor removal without system shutdown.

***Distance.*** The instrumentation package location to sensor distance is a consideration. Many instruments can accept a pH electrode input directly. Others require an amplified signal or 4-20 mA input. A modular system allows users to add the electronics required as needed. Additionally, long cable runs would not have to be disturbed with the modular approach. When sending a sensor signal more than 25 ft, even if an instrument is designed for direct sensor input, an amplifier is generally recommended to ensure signal integrity.

When selecting a pH or ORP electrode, these considerations can save time and substantial expenses while improving system performance.

## Case Study No. 1

***Problem.*** Scott Mann of Hawkins Associates in Georgia was challenged with an application for a wastewater treatment solution for Jim Lewis of Complete Water Services (CWS), Marietta, Ga. A primary concern was the serviceability and ownership costs relative to the pH and ORP sensors.

The sensors ideally would be provisioned for in-line as well as submersion installations to simplify inventory logistics. A differential amplifier also was required to ensure ground loop problems were avoided. The electrode signal needed to be sent 100 ft back to the control panel. The use of a front-end cartridge-style electrode was desirable, as it was not practical to re-run 100 ft of cable when sensor replacement was required.

***Solution.*** Hawkins Associates chose to offer CWS the Sensorex S8000 modular solution. The base cartridge-style flat-surface pH and ORP sensors were combined with a dual-use in-line or submersion mounting holder with solution ground and interconnect cap cables with 100 ft of cable. Flow cells were added for the in-line configurations, and the optional differential amplifier modules were plugged in between the cables and mounting holders. All parts are reuseable, and only the sensor cartridges periodically need to be replaced.

***Result.*** After the project installation, Lewis gave the following testimonial: "The installation was for the control of pH and ORP in industrial wastewater. The key item liked the most was having one style S8000 cartridge probe to use for both the submersion and in-line installations. This minimized the number of on-hand spares needed and reduced costs and the confusion factor for the customer when installing replacements. Also, the installation required the cable lengths to be 100 ft or longer. He was able to use the same parts and add the optional EM801 differential pre-amp on both the pH and ORP probes to boost the signal back to the controllers. Using the external optional EM801 pre-amp will help reduce probe replacement cost as compared to the probes with the amplifier built in, which cost substantially more."

## Case Study No. 2

***Problem.*** Danny Smith of NE Pump, Lunenburg, Mass., had a plating customer who was getting a service life of about five to six weeks from the sensors he was using. The installation was a basic simple submersion installation, but the application was aggressive toward the reference of the pH electrodes. The customer wanted to use the existing BNC cables and submersion pipes.

***Solution.*** NE Pump decided to retrofit the installation with a Sensorex S8000CD electrode. The electrode cartridge incorporates an ERP reference path to protect the electrode in the presence of aggressive solutions. The company provided a simple S8000-to-BNR mounting adapter to connect to the existing assembly and coax cabling.

***Result.*** NE Pump reported: "The customer is now getting eight to nine months out of the S8000CD electrode. He is extremely pleased with the results. The retrofit was quite simple, and the cartridge is a solid electrode holding up extremely well in the aggressive solutions. Choosing the right electrode made all the difference, and the versatility only required us to purchase minimal hardware."

## Case Study No. 3

***Problem.*** Bill Giglio of Facility Care outside of Cleveland, Ohio, faced the challenge of improving the service life of sensors and adapting them to multiple brands of instrumentation. His customer was a full-service wastewater system designer, fabricator and service company with a certified laboratory.

***Solution.*** Giglio chose to offer the Sensorex S8000 solution to his customer. By utilizing the modular design and offering the hardware as needed to retrofit each specific brand and installation, he was able to provide the customer a cost-effective electrode with dependability and dramatically simplify logistics of replacement electrodes for multiple brands of instrumentation.

***Result.*** Facility Care reported: "My customer is achieving outstanding performance and service life. They only have to deal with a single replacement pH electrode for all the different brands and mounting configurations, saving time, money and complexity. They have successfully retrofitted the S8000 to multiple brands of control instrumentation, and they now use the S8000 pH electrodes for all their new installations, replacements and conversions whenever needed. The flexibility of the S8000 platform made the retrofits simple. The ERP reference system makes the cartridge the right choice for simple and difficult applications. The plug-and-play feature allowed the addition of a 4-20 mA module for data logging."

## Plan Now, Save Later

A small amount of thought on the front end will save time and expenses over the life of a pH or ORP measurement/control installation. Operators of existing installations can make changes to improve the current system as required. One should not feel boxed in by an off-the-shelf solution if it does not fit the requirement. WWD

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