Top 10 Things to Consider When Measuring pH

By Frederick J. Kohlmann & Kareem Key

Tips to achieve reliable pH readings

One of the more complex and difficult measurements in many water and wastewater treatment plants is pH, but the following tips can help to ensure accurate and consistent readings.

① Watch flow rate, pressure & temperature.

For most applications, the flow velocity across the pH sensor should not exceed 10 ft per second. At elevated flow rates, metal salts leach from the glass surrounding the sensor, turning its membrane into ordinary high-impedance glass.

Excess pressure and/or temperature can negatively affect sensor life, which can be cut drastically when process temperatures rise above 80°C for prolonged periods. Newer types of glass and flowing references help, but this rule of thumb is a good one to adhere to.

Figure 1: Make sure line pressure and temperature are within manufacturer's specifications.

② Clean the sensor.

pH sensors get exposed to materials that can coat or foul the device. The first indication that a pH sensor needs cleaning is divergence from a field or lab calibration. Sensors should be cleaned regularly with soap and water. A weak acid can be used (4% to 5% W/V HCl) to remove scale from the measuring glass.

Knife blades or wire brushes should not be used to clean deposits left on the glass bulb, as they can scratch the glass or break off the bulb at the neck. A soft bristle brush should be used instead.

After cleaning, the sensor should sit in a bath of 50% 3.0-molar KCl/50% 4-buffer for one hour to recondition the sensor and bring the junction potential back to a neutral state.

③ Watch the temperature.

pH readings are only as relevant as the temperature to which they are referenced. pH sensors and transmitters often are equipped with temperature compensation routines. These software tools are designed to compensate for the effect of temperature on the sensor glass. Each process behaves differently, and the effects of temperature on the pH measurement should be examined independently for each solution.

Figure 2: A pH sensor being kept wet in tap water

④ Keep it wet.

pH sensors like to remain wet at all times. Individual plastic boots for the sensor tips or one large tub for communal soaking can be used. Sensors also must remain wet while installed in process lines and tanks.

Finding pH sensors left to dry out in empty lines is all too common during process unit start-ups and shutdowns. Good piping design (wet leg) can keep sensors wet, and close communications during non-routine operations among all plant personnel should be maintained to ensure proper procedures are followed.

Do not store sensors in deionized water. Ideally, a mixture of 3.0-molar KCl and 4-buffer should be used to maintain balance and help sensors last when they are not in use.

⑤ Consider redundancy.

Redundant installation of pH sensors often is required to ensure accurate measurement. A reliable redundant measurement is the best way to gain confidence in the online reading. Where possible, triple redundancy is the best bet, and these three readings should be sent to an automation system enabled with a two-out-of-three voting control scheme. If one sensor consistently disagrees with the other two, it probably needs to be cleaned and calibrated.

Figure 3: Store pH sensors with manufacturer's supplied boot/ shipping cap or in beakers with storage solution.

⑥ Monitor sensor life.

A pH sensor in a drinking water plant measuring effluent water at 25°C and 7.0 pH should last a year or more. Some may last for six years or more, but some may last only a day or two, depending on the applications. The best answer is, "it depends." Sensor life will depend on pressure, temperature and flow—as well as the pH and chemistry of the process.

A new sensor, properly stored with its protective shipping cap (Figure 3) and immersed in the solution it came with (usually 3.0-molar KCl), should be able to sit on the shelf for a year and still provide a standard lifetime of service. If left unattended and

dry, the sensor will have to be regenerated in a 3.0-molar KCl solution for one to three days to recover.

Figure 4: A pH sensor being readied for calibration.

⑦ Establish & follow QA/QC procedures.

A quality assurance or control procedure is essential. The frequency for cleaning and calibrating is best determined by checking sensor operation after an initial operating time in the process of 12 to 48 hours. Comparison should be made between the actual and expected pH value.

If there is unexpected divergence, remove the sensor from the process and rinse it in warm tap water. Check the sensor in calibration buffers and determine whether the values are consistent with the initial calibration. Determine how much time occurs before changes occur, and establish this as the cleaning/maintenance frequency in QA/QC procedures.

⑧ Handle sensors carefully.

A pH sensor is a delicate instrument and should be handled accordingly. We have seen sensors used by some as footsteps or handholds for gaining access to other systems in the plant. As most pH sensors are made of glass, or of plastic bodies with glass measuring ends, care must be taken so the glass is not broken by mishandling or abuse.

⑨ Use only as directed.

Many times, pH measurements are requested in hard-to-access locations. Make sure the sensor is accessible and easy to remove and re-install for cleaning and calibration. If outdoors, consider how winter freezing or summer heating will impact the sensor and the operator's ability to perform a calibration. Locate the sensor away from rain or snow conditions if possible.

Make sure the desired pH measurement is feasible. For example, products with insufficient liquid content will not provide meaningful pH readings.

Do not install a pH sensor in a tank without insertion and retraction hardware. This is more expensive than just threading a sensor through a nipple, but less expensive than having to drain the tank to remove the sensor.

If in a tank, mount the sensor away from the reagent addition so proper mixing can occur. If in-line, verify that proper mixing has occurred between the process and reagent through use of an inline mixer.

Mount pH sensors at a minimum angle of 12 degrees to the horizontal plane to ensure any air bubbles in the glass electrode are driven to the back end of the sensor and do not form in the glass bulb.

⑩ Select the correct sensor.

pH sensors are manufactured for specific uses. Specific pH sensors are made to withstand high/low temperatures and/or pressures and the effects of different types of media that tend to coat, plug or otherwise contaminate the reference electrode. It is important to work with the manufacturer to select the pH sensor best suited to your application. w&wd

Fred Kohlmann is U.S. business manager for analytical products and Kareem Key is process reliability group manager for Endress+Hauser.

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