Observations of a pH Field Guy

After 40 plus years, here are some recollections of experiences troubleshooting pH sensors at customer sites.

By Fred Kohlmann, Midwest Analytical Product Marketing Manager, Endress+Hauser

Being employed in the analytical business for more than four decades—specifically repairing, designing and selling pH, conductivity, turbidity and other various sensors and transmitters used in industry—I've come across some wild and crazy, if not bizarre, field experiences. I'll share three of these with you, each of which will impart some practical knowledge, along with a bit of amusement.

The Light Bulb is Burnt Out!

Early in my career, I was a field service technician traveling to customer sites to do repairs. These were anything from component level repairs on circuit boards, to sensor replacement, cleaning and calibration.

One customer called and asked for service and training to be performed on his pH system including sensor cleaning and calibration. I arrived at the site with my usual toolboxes of spare parts, buffers and cleaning agents.

The customer directed me to the location of the pH sensor. He indicated it seemed to be working correctly, but the light bulb had burnt out. I assumed he meant the power or alarm light on the transmitter and so asked him to show me the transmitter location. He said "No, the light bulb in the sensor." He proceeded to pull the sensor up from the tank it was suspended in and showed me the measuring end of the sensor and pointed to the pH electrode and said "There, this! This light bulb is burnt out."

I said, "That's not a light bulb, it's the measuring electrode and does not light up." He argued that he had seen it lit up in the past and due to recent erroneous pH readings and the lack of light, it must be defective. A simple cleaning and recalibration got him back up and running. As I was leaving he grumbled that he was sure that "thing" lit up.

If there's a lesson to be learned here, it's that one needs some grounding in the basics before jumping to conclusions, whether it's a pH sensor or any other item in an industrial automation system.

Too Much Protection Can Be a Bad Thing

I was called out to see a customer who had a pH system that was maybe a year or two old and working fine, but he just wanted it checked because it was the final control for their wastewater outlet, and thus critical.

I got to the customer's plant and while walking to site, I asked the customer how often he cleaned or calibrated the pH sensor and to my surprise he said "Never." He said he didn't want to touch it as it had been working so well since it was installed, and he believed in the "if it ain't broke don't fix it" principal. I said "Well, that sure is a good track record, maybe we can use you as a success story for the robustness of our products."

We got to the installation point and I pulled the sensor out for inspection. To my amazement, I saw the protective cap still attached! These protective caps are affixed by the factory to the end of each pH sensor to keep the glass bulb wet and protect it from accidental damage during shipping and storage. It looked like the rest of the sensor body, dirty and crusty. I asked him if he had just put this on knowing I was coming out? He said, "Put what on?" I said, "The protective cap." He looked dumbfounded and replied, "What protective cap?"

Most manufacturers put a boot or cap on the measurement end of the pH sensor to keep it safe (Figure 1). In the cap is a wetting or storage solution of KCl or buffer or a mix of the two. In this case it was a pH 7.0 buffer. So that sensor read a perfect 7.0 pH for the many months he had it in use. He said it was strange, now that he was thinking about it, that the amounts of reagents he used to treat his wastewater had dramatically decreased since he installed this new pH system.

Figure 1: pH sensors are delivered with a protective cap.

Storage tip: Make sure the sensor is always kept in a storage solution of pH 4, pH 7 or tap water when not in use. Use the protective cap provided by the manufacturer, or place the sensor without the cap in a clear beaker and fill the beaker with the storage solution such that the bottom inch or two of the sensor is fully submersed. The clear beaker is used so that at any time one can easily see if the solution has evaporated.

Customers Complain: Your pH Sensors Drift!

This is an amalgamation of experiences over the years. Customers often contact manufacturers complaining that their pH sensors drift. Most often it is not the fault of the sensor itself, but is instead due to improper sensor installation, cleaning or calibration. Here are two examples.

Many pH installations are in line (Figure 2), with the sensor mounted into a pipe run, either in a main or bypass line. Depending on the physical layout of the piping, sensor location can be a tricky thing. Most often when a customer plans ahead, they put the sensor in a convenient location so it is easily accessible for maintenance and calibration.

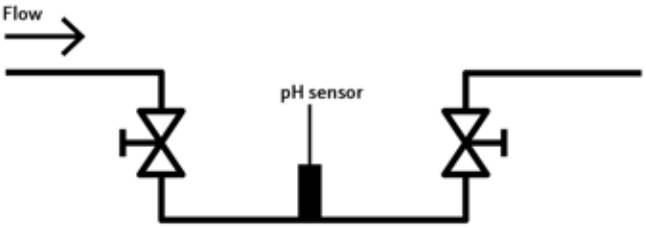

Figure 2: pH sensors should be mounted in the flow stream and remain wet at all times.

Sometimes that nice and accessible location is in the exact wrong spot for the sensor to remain wetted at all times by the process media being measured. A typical bad location is an installation with the sensor in the top of a pipe, at an elbow or in a tee in a downward-flowing line. Each of these examples allows air to be entrapped should the pipe not be full of process fluid.

Some customers will swear up and down that the pipe is full, and that the sensor is just not responsive to the changes in pH values. Many times, I have asked for the process to be stopped at the sensor location. Hopefully, the customer had the sensor in a slip stream and used blocking valves to isolate the sensor. When the flow was stopped and the sensor removed, it was often bone dry.

Sometimes we were able to unscrew the sensor as the process was running past it, in effect burping the sensor by letting some of the process media seep out, and then tightening down the sensor again. Magically, the sensor started reading correctly. It started to read correctly because the action of burping the sensor when it was partially removed bled air from the line, allowing the sensor to again become wet and read the pH. This will last until a slug of air comes down the pipe again isolating the sensor tip from the wet process.

Figures 3 and 4 depict some common installation mistakes to be avoided.

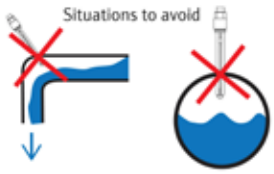

Figure 3: Avoid mounting where a sensor can become dry or sees air.

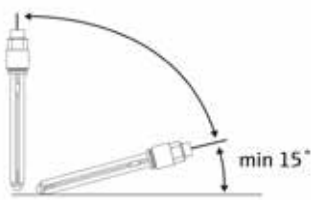

Figure 4: Never mount a pH sensor horizontally.

Clean and Then calibrate the pH sensor

A salesperson and I went to see a customer that was having some problems with our pH systems. When we arrived, the customer said, "I like everything your company makes except your pH equipment. Your sensors keep drifting." I said, "I'm sorry to hear that. Let's go take a look at the application."

The customer had six identical tanks with one pH sensor on each tank. We went to the first tank and observed the pH reading. The customer called down to the control room to verify what the pH value should be based on their recipe. The sensor read about one pH off. He said, “See, we calibrated yesterday, and it has drifted by one pH.” I said, “Will you please show me how you do a cleaning and calibration?”

They proceeded to pull the sensor out, rinse it with water and put it in buffers. In the 7 buffer it read 6. The customer looked at me with scornful eyes. They put it in the 4 buffer and it read 3. Again, scornful eyes.

They put the sensor back in the 7 buffer and were just ready to hit the calibrate button when I said, “Hold on, how are you going to clean the sensor?” He looked at me like I had two heads. He said “We just did! Didn’t you see that step?” I said, “Well you rinsed it off, but you didn’t really clean it.” Again, he looked at me quite strangely and he said, “I didn’t know you could clean it any other way.” I said “Well based on my experience of similar processes, yours probably has a lot of fats, oils and greases. Let’s pour a few drops of liquid dishwashing soap into a cup of warm water.”

We immersed the sensor in the soapy water, swirled it around a bit and dipped a paper towel into the soapy water to gently clean the electrode area. We then put it back into the 7-buffer solution. What did read now? Yep, 7 pH. He looked at me like I was a magician that just made his watch disappear.

We rinsed off the sensor and placed it in the 4 buffer and it read four. He said, “Wow, that’s really nice.” We went to tank number two and had the exact same scenario and exact same results. We want to tank number three, again same results. We were ready to go to tank four and he said, “I got it, thank you very much, we learned a lot today.”

It always makes me feel good when I leave a customer site after I was able to fix issues and get them back up and running. In most cases, many of these types of problems can be avoided by following manufacturer operating and installation information, and keeping the pH sensors clean and calibrated.

Figure 5: The first steps are to wipe away debris and rinse the sensor in soapy water.

About the Author

Fred Kohlmann joined Endress+Hauser in 2006 and is currently the Midwest Product Marketing Manager for Analytical products. Since 1976, Kohlmann has been involved in engineering, design, service, marketing and sales of online analytical water quality and process control instrumentation.

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WP01098C/24/EN/01.19
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