ROYCE TECHNOLOGIES

TECHNICAL BULLETIN

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Why Do D.O. Meters Read Differently?

Many customers, consultants, integrators, commissioning engineers, representatives, and indeed competitors of Royce Technologies, are often at a loss to understand why D.O. analyzers read differently in the same biological reactor. Excuses like 'measuring at the surface as opposed to lower in the tank, oxygen stratification, bubble size, fluid dynamics' are used to explain the phenomena. But in fine bubble reactors, whether they are plug flow, complete mix, step aeration or whatever, the D.O. is more often than not constant in a particular section of the reactor. All D.O. analyzers, with the exception of the Zullig sensor, calibrate in air, so how come they then read differently in the process?

It is very common for a Royce D.O. analyzer to read lower than other measurement systems, especially those using polarographic sensors. In December 2001, a plant in Des Moines, Iowa reported 24 Royce systems reading between 1.0 and 1.5 ppm lower than the plant standard (a YSI portable analyzer calibrated every day). It was subsequently proven, beyond any doubt, all Royce systems were actually reading correctly. The Royce D.O. sensor is galvanic, while manufacturers like Danfoss, ABB, Endress & Hauser, GLI and YSI use polarographic sensors. Yet all calibrate in air or against a known sample, and all read the same (correct value) immediately after calibration.

Think about this. At 75^{O}F (approx 25^{O}C), the saturation value of oxygen in water is 8.4ppm, which is the calibration point. No manufacturer recommends checking the zero point during a standard calibration process, yet the process measurement is usually 1.6 to 2.0 ppm. Which is closer to the process reading, 8.4 ppm or 0.0 ppm? Let's first understand the major differences between a galvanic and polarographic sensor:

1. A galvanic sensor has zero output at zero D.O. A polarographic sensor has to be polarized via a voltage from the analyzer. Current flows through the sensors electrolyte due to this, so the sensor output is something other than zero at zero D.O. Polarographic sensor manufacturers either choose to ignore this or say it is insignificant, but is it?
2. A Polarographic sensor has to be polarized. This polarization can take up to a couple of hours to occur, and if interrupted (perhaps to perform a calibration), the zero point will shift. Further, as the sensor ages, it's zero offset changes.
3. Look at the difference in size of a Royce sensor versus any other. First, the Royce Platinum Cathode is huge by comparison to almost all D.O. sensors. This gives substantially higher output and therefore a better signal to noise ratio. It also provides inherent resistance to chemical interference for the same reasons laboratories have used platinum crucibles for years. Secondly, a larger anode means less drift and better stability, and that is one reason why the same Royce sensor is used in high purity water applications involving measurement below 5 ppb, and that is very close to zero. The other is the inherent ZERO output at ZERO D.O..

So how do you find out which analyzer is reading correctly? Simple, check the zero as well as performing an air calibration. Put the sensor or sensors in water saturated with sodium sulphite, a known and accepted oxygen scavenger. This solution contains zero dissolved oxygen within seconds of mixing the compound in the beaker. Wait 5 minutes, then see which sensor reads within 0.1ppm of zero. And remember, when a portable analyzer is used in the process, does the operator wait 5 minutes, or is it only a minute or two?

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