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Polarographic vs. Galvanic Dissolved Oxygen Sensors Discussion on Differences

We often get asked; "What is the difference between a Polarographic and Galvanic Dissolved Oxygen sensor"? This technical bulletin will give a brief overview of the differences and what inherently makes one better than the other.

Alternatively, if the sensor manufacturer selects specific electrode materials, oxygen will spontaneously trigger the cell reaction and produce an accompanying electric current whenever oxygen is present. Cell voltage is self-generated by selecting a suitable electrode system, so the sensor does not need to be polarized by the analyzer. This type of cell has been termed "Galvanic".⁽²⁾ Another way to look at the galvanic sensor is to view it as a fuel cell powered by oxygen.

The Major Difference. In a sensor requiring polarization, you must first very carefully control the polarizing voltage from the parent analyzer. Then you must carefully measure and compensate for the resulting current flowing when no oxygen is present. However, as the sensor ages the zero offset changes, and errors of over 2 ppm have been reported. When one considers the D.O. in bioreactors is normally 1.8ppm, this offset makes the sensor useless. Even more disconcerting is that these sensors will calibrate OK in air yet be 100% inaccurate at 2ppm.

But the ROYCE Galvanic sensor is a true "Zero" based galvanic sensor. When there is no oxygen present, all cell reaction ceases and the output is zero voltage. Also, and equally important, the output of the sensor is linearly proportional to the amount of oxygen throughout its range at a fixed temperature. In other words - at "Y" oxygen you get "Y" output, and at "2Y" oxygen you get "2Y" output. It does not matter where you start or what thickness membrane, the result is always the same.

The selection of electrode materials is critical to avoid the potential for generating a current from reducing elements other than oxygen. In building a Royce DO sensor extreme care is taken to ensure we do not introduce a possible stray current. For instance, the specification for Royce DO sensor materials is as follows:

The cathode platinum is specified to be 99.9998% pure Platinum. The anode lead is specified to be 99.98% pure Lead. The electrolyte is manufactured from USDA food grade chemicals and triple distilled water. Careful manufacturing procedures are incorporated to ensure no other

materials, especially any other noble metals, come in contact with the sensor components.

The selection of sensor electrode materials is critical for another very important reason - possible contamination. There is a very real potential for other gases such as Hydrogen Sulfide to permeate the membrane of any DO sensor. Also in the event of a membrane failure raw sewage or mixed liquor can get in the sensor. If one of the sensor electrodes is made from materials such as silver or copper, degradation will occur rapidly rendering the sensor useless and most often irreparable. The fact is, you could fill a ROYCE DO sensor with mixed liquor, let it set for six months and then clean it, and reassemble it. You could have it operating perfectly in about ten minutes at the nominal cost of a membrane and electrolyte solution.

Finally, the old adage *A you get what you pay for* definitely holds true when purchasing DO sensors. Polarographic sensors are usually less expensive than galvanic sensors, primarily because of the lower cost of anode/cathode materials used. But lower priced noble metals are easily attacked and degrade quickly, so it is common to have up to 6 polarographic sensors for each analyzer. Our experience is that many galvanic DO sensors made in the 1970s are still in operation, and still reliable.

References

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