Five Reasons

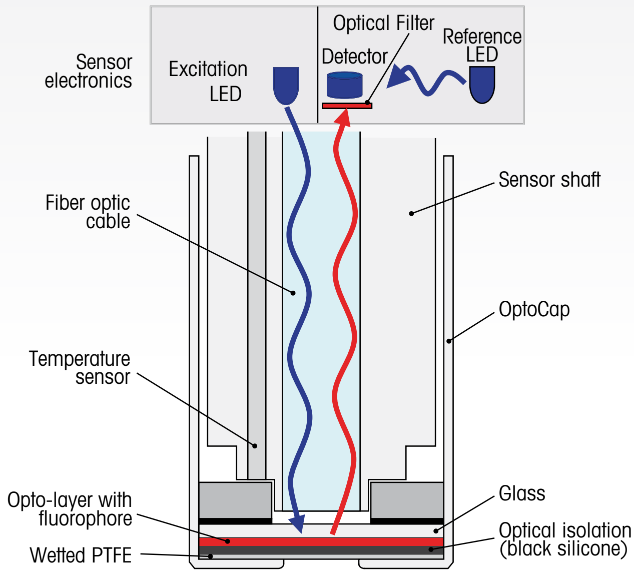
Switch to Optical DO Sensors

An Easier Way to Measure

For many years, the biotech industry has relied on polarographic technology for dissolved oxygen (DO) measurement. Handling and maintenance of polarographic sensors is well understood and such sensors can be relied on to provide accurate measurements if kept in good operating condition. However, they have some aspects which can be cumbersome for technicians and can delay operations.

Optical measurement of oxygen is a relatively recent development which is also highly accurate but additionally provides much easier handling. Here are five reasons why biotech companies are moving from polarographic to optical DO sensors.

1 Simpler technology



In polarographic Clark sensors, an anode / cathode electrode assembly is suspended in an electrolyte. A gas permeable membrane attached to a plastic body, separates the electrolyte from the measuring medium. Oxygen molecules dissolved in the medium traverse the membrane and enter the electrolyte. A voltage of around 700 mV is applied to the electrodes, which causes oxygen to be reduced at the cathode. The resulting generated current increases then plateaus when the reaction rate is determined by the ongoing oxygen diffusion rather than the voltage. This plateau correlates to the dissolved oxygen level in the media. The various parts of the sensor, anode / cathode assembly, membrane body and electrolyte must work well together in order to provide dependable readings. This means sensor assembly after any servicing must be conducted carefully to avoid issues that can negatively affect measurement (e.g. air bubbles or dirt trapped in the membrane body).

METTLER TOLEDO

In optical sensors, an oxygen-sensitive marker (fluorophore) is exposed to the measuring medium. An LED in the sensor illuminates the fluorophore causing it to absorb a portion of the light. The fluorophore then emits the light at a slightly different frequency. This fluorescence is quenched and its lifetime shortened if oxygen molecules are present. The more oxygen in the medium, the shorter is the fluorescence lifetime. The fluorescence lifetime, and hence oxygen level, is measured by a photodetector in the sensor. The only replaceable item on optical sensors is the part that houses the fluorophore.

2 No need for polarization

Polarographic sensors must be polarized (attached to a voltage supply) before being used. When a polarographic sensor is not connected to a voltage supply, oxygen molecules can collect in the electrolyte. When the sensor is put into service, the residual oxygen will result in readings higher than actually present in the medium. Therefore, sensors must be polarized to consume / reduce any residual oxygen molecules present in the electrolyte which do not represent the oxygen content in the measurement media. Six hours is required for full polarization to achieve dependable measurement results.

The need for polarization is particularly inconvenient when a polarographic sensor is to be installed on a bioreactor as the sensor must be polarized in situ; therefore, a minimum of six hours polarization time is required before sterilization can begin.

Optical sensors do not contain an electrolyte, so polarization is not required. METTLER TOLEDO optical DO sensors can be calibrated and stored until needed. This means they can be put into service in minutes rather than hours.

3 Easier maintenance

Polarographic sensors require a significant amount of maintenance. Over time, the electrolyte in the membrane body will be consumed and must be replenished. The membrane itself is subject to wear and needs periodic replacement. The anode / cathode assembly can become damaged due to mishandling and exposure to steam cleaning which can cause delamination. The need to maintain a polarographic sensor depends on the application it is used in, but monthly maintenance is common.

Optical sensors have only one consumable part: the oxygen-sensitive element. In METTLER TOLEDO optical oxygen sensors, this part (the OptoCap) needs replaced approximately only once a year.

4 Predictive diagnostics

Intelligent Sensor Management (ISM®) is a digital process analytics platform that uses the power of intelligent sensors to provide worry-free measurement points and maximum process confidence.

Among the benefits of ISM is a range of sensor diagnostic tools that continuously monitor sensor "health" and predict when maintenance should be performed. METTLER TOLEDO offers polarographic and optical dissolved oxygen sensors with ISM diagnostics that include the Dynamic Lifetime Indicator (DLI – days until polarographic inner body or OptoCap should be replaced) and the Adaptive Calibration Timer (ACT – days until sensor calibration should be performed).

With METTLER TOLEDO's polarographic sensors, the diagnostics are based on an advanced algorithm that takes into account stresses on the sensor from temperature in the process, and the number of sterilization or sanitization cycles the anode/cathode assembly has been exposed to.

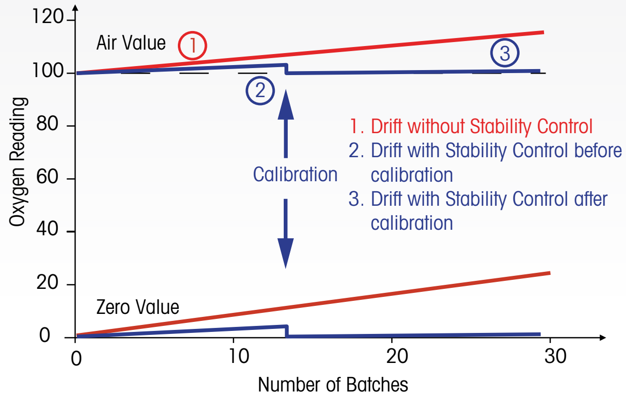
METTLER TOLEDO's optical sensors have comparable diagnostic algorithms implemented (DLI and ACT). But in addition to the above mentioned stresses, the consumption of the fluorophore is tracked as it is used up. Further, the algorithm uses the fluorophore consumption rate since the last calibration and adjusts itself appropriately. The diagnostics therefore becomes more reliable over time.

5

Greater measurement stability

Measurements from polarographic sensors drift from the true DO value over time. During short fermentations of a few days, this drift is negligible, but can become significant over longer batch runs.

Optical measurement technology drifts far less and METTLER TOLEDO has reduced it further still. Whenever the sensor is calibrated, the Automatic Stability Control compares sensor drift with a base level and adjusts the sensor accordingly. This results in a more reliable sensor signal and in a virtually non-drifting sensor.



Find out more about optical DO sensors

▶ **www.mt.com/InPro6860i**

ISM and OptoCap are trademarks of the METTLER TOLEDO Group.

Mettler-Toledo GmbH
Process Analytics
Im Hackacker 15
CH-8902 Urdorf
Switzerland

www.mt.com/pro

Visit for more information