Intelligent Sensor Management
Intelligence Starts in the Head

Intelligent measuring systems for pH and oxygen sensors improve process safety

Stable product quality, process safety and cost reduction are essential success factors for chemical, pharmaceutical or biotechnology companies. Increased maintenance requirements for sensors and unplanned production downtimes resulting from the failure of measurement technology are substantial cost factors. Intelligent systems for pH and oxygen sensors reduce the maintenance cost and offer diagnostic tools that improve lifetime, performance and reliability of process analytical measurement technology.

Sensors with the Intelligent Sensor Management (ISM) functionality carry their own specific data on an integrated chip along with the calibration and existing process data, and exchange this with the connected transmitter. This technology improves the maintenance management and diagnostics, increases process safety and thus allows the operating costs to be reduced. The newest generation of analytical sensors for pH and oxygen measuring systems from METTLER TOLEDO has ISM technology and is easy and reliable to maintain.

Optimized calibration and maintenance

The need for a simple alternative for critical pH and oxygen measurements and for increased reliability of the measuring location has become a key issue. In order to meet these requirements, field devices must supply current information for the early detection of unexpected sensor loads on an ongoing basis. Thus maintenance work can be planned and implemented at an early stage at the measuring location to handle problems. In biotechnology processes the product yield can
be increased by up to 30% through efficient pH and oxygen measurement. At certain time intervals however the process analysis equipment has to be calibrated and maintained at a later date. Such work can result in a total failure of the measuring location and even to production standstill if it is not undertaken preemptively on a regular basis. At the same time maintenance and calibration are delicate tasks that are ideally implemented on site by qualified staff.

INGOLD pH and oxygen sensors are frequently found in the biotechnology, pharmaceutical, chemical, food and drink industries. They provide solutions wherever precise measurements are required under demanding operating conditions. The technological and application methods, for example, for oxygen sensors have resulted in patented membranes and internal bodies that are tailor-made for the application. For pH electrodes such features as silver ion trap, biocompatible electrolytes and platinum coated auxiliary electrodes (“solution ground”) are typical examples for sensor expertise. A complete ISM measuring point comprises of an application-specific sensor, an appropriate static or retractable housing and the modular M 700 transmitter that converts the measurement signal and enables predictive diagnostics with adaptive algorithms.

Plug and measure – simple measurement

ISM sensors for measuring pH and oxygen are already delivered with a data record stored on the chip. With this integrated data a brand new sensor can be used directly at the measuring location and take on measuring tasks without requiring calibration or initialisation. If a sensor is used in conjunction with a retractable housing and problems occur with the reference or glass electrode, a new sensor can be installed preemptively in under a minute, thus increasing production capacity substantially by avoiding longer interruptions. Used sensors can be collected from the complete operation and calibrated under ideal conditions in the laboratory before reuse.

Advanced diagnostics – Anticipate sensor problems

In ideal situations experienced employees are used to resolve measurement technology problems. The ISM technology is able to provide expert information that is tailor-made for each measuring point. Using the “advanced diagnostics” measurement technology function, the ISM saves all relevant sensor data and data on the ongoing process conditions. This information is available to the operating staff via the graphical interface on the M 700 transmitter in a detailed and yet clear manner, and allows the measurement point to be optimized on an ongoing basis and all critical situations to be predicted so that you can respond before production is interrupted.

Especially for pH monitoring the reference system is essential. ISM also provides online impedance monitoring and uses reference monitoring for unique dynamic lifetime monitoring. This data is summarised graphically in a sensor network diagram and displayed on the transmitter.

Use this sensor or discard it?

A new diagnostics parameter called the sensor wear is monitored on-line. The sensor wear, expressed in % gives the user an indication of how much the exposure of each sensor to the process conditions has altered the sensor’s condition. Sensors with high wear
can be replaced preemptively before they fail during operation, resulting in less frequent unscheduled downtimes. The level of maximum tolerable wear can be set by the user for each measurement loop individually, adapting to the level of confidence required for the process. As a result, the plant’s maintenance strategy can be changed from a passive, costly and unpredictable workflow to a fully proactive, safe and optimized procedure.

**How many CIP/SIP cycles left?**

Also critical to proper function of a pH or DO sensor in batch processes are the frequent SIP and CIP cycles found in pharmaceutical or food & beverages applications. These can be detrimental to the sensor’s slope and zero, and can lead to improper measurements and early-stage sensor failure. To overcome this, plant operators often turn to manual documentation of the sensor history, and rely on this documentation to schedule sensor replacement. Digital ISM sensors have a built-in CIP and SIP counter, which automatically detects when the sensor is exposed to heat cycles. The CIP/SIP counter data is stored in the sensor memory. When connected to an ISM-equipped transmitter, the sensor status data from the digital sensor is automatically loaded into the transmitter. When the maximum setpoint of cycles allowed at this particular measurement point is exceeded, an alarm condition is raised. As a result, a sensor that could potentially fail in the process cannot be utilized. Additionally, there is no need to manually record each sensor’s CIP/SIP history as all the cycles are stored on the probe itself.

When connecting an ISM sensor to an M 700 transmitter the diagnostic functions are visualised. The example shows the network diagram that immediately indicates the sensor status using several assessment criteria (see fig. on the previous page, top left), the wear monitor with the calculated sensor operating duration for a pH electrode (centre) and an oxygen probe (right). With these advanced functions the sensor behaviour during the operating time can be tracked precisely, maintenance activities started at an early stage and losses from unexpected downtimes avoided. In addition, the diagnostics also allow additional information to be collected via the measuring point. Experts can therefore use the yield, process duration and lifespan of the sensors to easily improve the process.

**The following digital sensors with ISM technology are available:**

<table>
<thead>
<tr>
<th>pH electrodes</th>
<th>DO sensors</th>
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<tbody>
<tr>
<td>InPro 3250i</td>
<td>InPro 6850i</td>
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<tr>
<td>InPro 4260i</td>
<td>InPro 6900i</td>
</tr>
<tr>
<td>InPro 4800i</td>
<td>InPro 6950i</td>
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<tr>
<td>InPro 2000i</td>
<td>InPro 3100i</td>
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**Feature overview for all digital ISM sensors:**

- Same sensor performance as analog electrodes
- Digital IP68 connector
- “Plug and Measure” functionality
- Advanced sensor diagnostics
- Predictive maintenance functions
- Wear monitor
- CIP/SIP counter
- ATEX, FM compatible (pending)
Digital ISM Measurement Solutions

**Highly modular transmitter**

The user-friendly and easily configurable interface of the M 700 offers highest functionality.

The M 700 multi-channel transmitter features exchangeable ISM digital and analog modules. Additional PROFIBUS and FOUNDATION fieldbus modules are used for system integration.

**M400 analog/digital transmitter**

The versatile M400 accepts all digital ISM sensors. As a unique diagnostics feature, the Dynamic Lifetime Indicator (DLI) continuously assesses the sensor remaining service life.

**iSense™ Asset Suite**

The ideal tool to manage your ISM sensors efficiently. Accurate pre-calibration in the lab yields better field performance. Every maintenance step is documented in PDF format and recorded in the sensor database.

For more information:

www.mt.com/ISM