



## **In-Situ Oxygen Measurement Solutions** Delivering Tangible Results for Your Process

**METTLER**  **TOLEDO**

# METTLER TOLEDO

## Commitment to Innovation and Quality

### METTLER TOLEDO Group

**Our organization specializes in providing precision instrument equipment and related services to industrial customers. In 2010, METTLER TOLEDO generated revenues of approx. US\$ 2 billion. The company's stock has been publicly traded on the New York Stock Exchange since 1997.**

#### Worldwide presence

METTLER TOLEDO has a worldwide distributor network and a workforce of more than 11,000 employees. We support our customers in industry by providing comprehensive solutions for each step of their manufacturing processes – extending from receipt of materials throughout all manufacturing stages with in-line process measurement through to final packaging control, logistics and shipping.

METTLER TOLEDO instruments are used in research and development, manufacturing process control and for quality control. The pharmaceutical, biotech, chemical, food and beverage, and cosmetic industries are among the principal users.

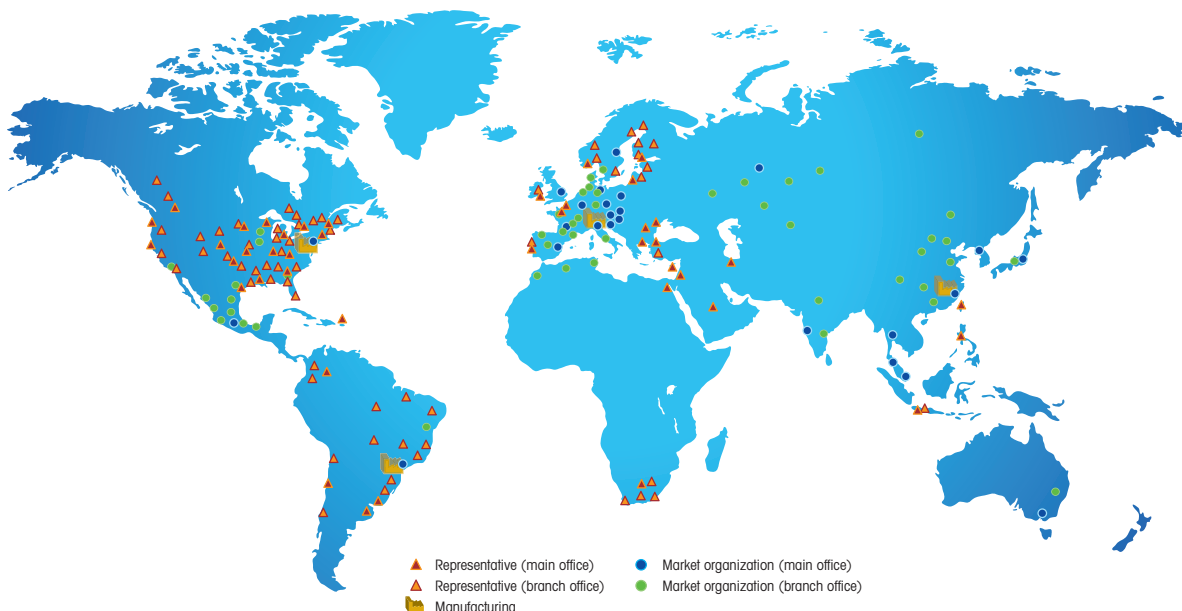
#### Innovation and quality

Our company enjoys an excellent reputation as an innovator demonstrated by R&D expenditures above the average for the industry. We make every effort to achieve the highest level of quality, by applying Total Quality Management at both product and process level, particu-

larly as part of the support we provide to our customers in complying with international guidelines.

#### Process Analytics Division

Within the METTLER TOLEDO Group, the Process Analytics Division concentrates on in-line analytical system solutions for industrial manufacturing processes. The Division consists of two business units, Ingold and Thornton, both internationally recognized leaders in their respective markets and technologies.



## Leading Process Analytics

**Ingold and Thornton have long track records for creating innovative high-quality solutions for demanding liquid process analytics applications.**

Ingold was founded in 1948 by Dr. Werner Ingold. Today, Ingold provides the broadest range available of in-line analytical measurement solutions for industrial processes in the biotechnology, pharmaceutical, chemical and beverage

industries. Ingold offers systems for the measurement parameters pH/ORP, dissolved oxygen (DO), dissolved CO<sub>2</sub>, conductivity and turbidity. Thornton Inc, founded in 1963 by Dr. Richard Thornton, an MIT professor, has been part of the

Process Analytics Division since 2001. Thornton is the market leader in ultrapure and pure water analytics, with technology complementing Ingold's process measurement systems.

## In-Situ Gas Analytics: Measure Where it Matters

Controlling the level of gaseous oxygen in your process is key to ensuring the safety of the environment, people and your assets. Equally important, processes involving oxygen as a reactant must be carefully controlled to remain within safety limits.

Based on our long-standing field experience in analytical solutions for liquid measurement, we have developed systems for the measurement of oxygen that convince through:

- **in-situ capability:** our systems are built to measure in-line, right there where you need to measure
- **low cost of ownership:** outstanding measurement performance without the drawback of heavy maintenance

- **ruggedness and long-term stability** for continuous use in the harshest environments.

With extensive know-how in process control and automation available throughout our team of application specialists worldwide, we can support you in:

- increasing process reliability,
- optimizing product yield,
- reducing maintenance costs and spare parts inventory.



M420



InPro 6850iG



M400



GPro™ 500



# Measure Oxygen In-Situ And Stop Worrying About the Weakest Link

**Extractive measurement is challenging without reliable process gas conditioning. METTLER TOLEDO offers sensors that can be installed in-line – bypassing all sampling and conditioning issues.**

## Extractive measurements ...

Your extractive oxygen analyzer can only be as good as the weakest link in the chain. In safety-critical processes, system dependability is a top priority.

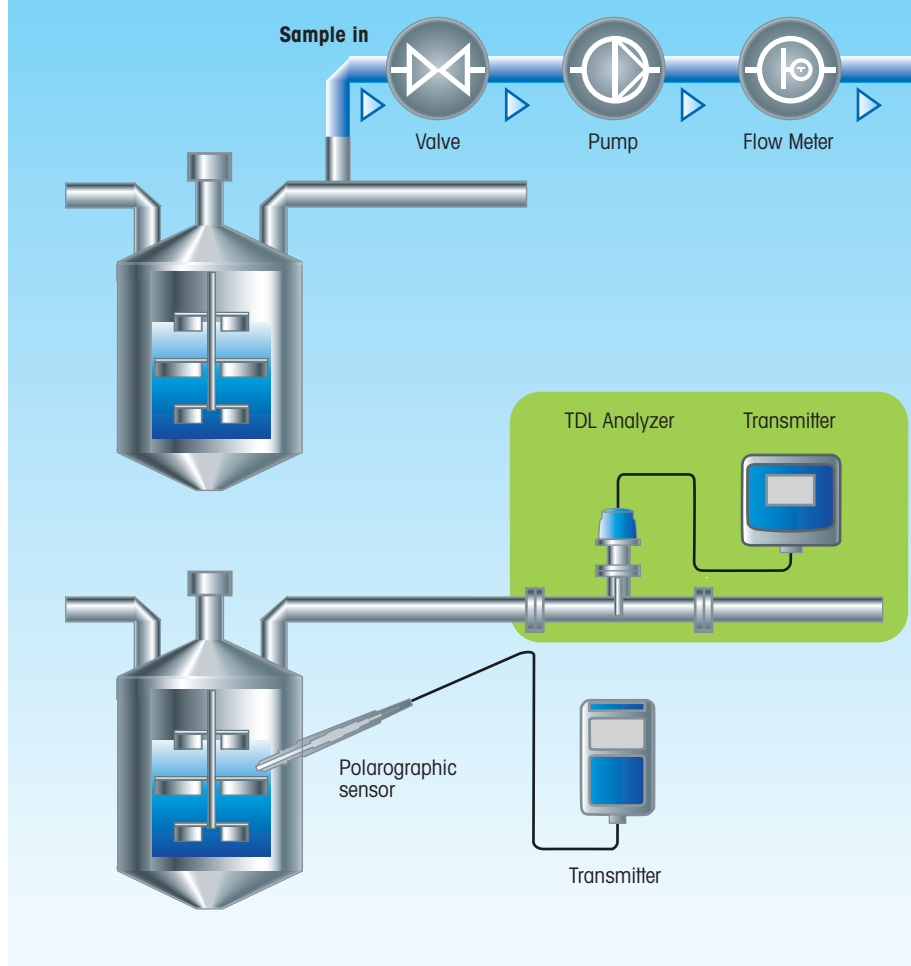
For processes that require continuous monitoring, every unscheduled downtime directly impacts productivity.

## ... that come at a cost

Extractive analyzers are complex systems that operate satisfactorily only if each component performs well. Issues to be dealt with on a regular basis are:

- component servicing and repair
- line clogging caused by condensation or dust
- slow response time due to long sampling lines

## Comparison: Extractive vs. In-Situ Measurement



## Top 10 Reasons for going In-Line

1

**No gas sampling or conditioning:**  
less parts, less breakdowns

2

**Measure directly in the gas stream:**  
more representative measurements

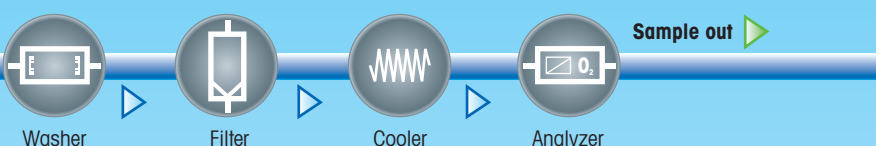
3

**No more cumbersome maintenance:**  
easy and fast calibration

4

**Fast payback:**  
ROI typically less than 6 months





### Extractive Measurement

Price/Performance ●●●●○  
Maintenance ●●●●○  
Reliability ●●●●○

#### Sampling and conditioning is not easy

- Typical drawbacks of extractive systems are:
- heavy pre-emptive system maintenance
  - wrongly selected conditioning components
  - lengthy process downtimes for maintenance

### In-Situ Measurement: Bring the Sensor to the Process

Price/Performance ●●●●●  
Maintenance ●●●●●  
Reliability ●●●●●

#### Reliability through simplicity

With an in-line oxygen analyzer mounted directly into the process, gas sampling and conditioning become obsolete. Representative oxygen values are obtained, leading to more accurate and reliable oxygen control.

## Measure Where it Matters

METTLER TOLEDO's choice of technologies for oxygen measurement all feature the ability to measure in-situ, without the need for gas sampling or conditioning.

- Membrane covered **polarographic sensors** are largely insensitive to moisture and dust: they are ideally suited for inerting and blanketing applications.
- **Tunable Diode Laser (TDL)** analyzers provide the highest level of reliability and fastest response time in process control and safety applications.



Visit the competence center

[www.mt.com/o2-gas](http://www.mt.com/o2-gas)

ance:

5

**Humidity-insensitive sensor:**  
wet gas streams welcome

7

**Predictive maintenance:**  
with the built-in ISM® technology

9

**Simple system setup:**  
approved for hazardous areas

6

**Rugged system design:**  
for harshest applications

8

**On-the-fly sensor verification:**  
without process interruption

10

**Easy maintenance:**  
no specialist know-how needed

# Laser-sharp View into Your Gas Stream For Cutting-Edge Process Control

**When it comes to controlling oxygen in tough process conditions with potentially harmful components, a scrutinized view of all performance factors of your oxygen analyzer is necessary.**

## Explosion prevention

The closer the analyzing instrument is to the process, the better. This becomes especially true when tight control is a must in order to ensure safety in potentially explosive processes.

Frequently, extractive oxygen analyzers with sophisticated sampling and conditioning systems fail to deliver reliable measurements if they are not maintained properly.

## TDL meets in-line sensors

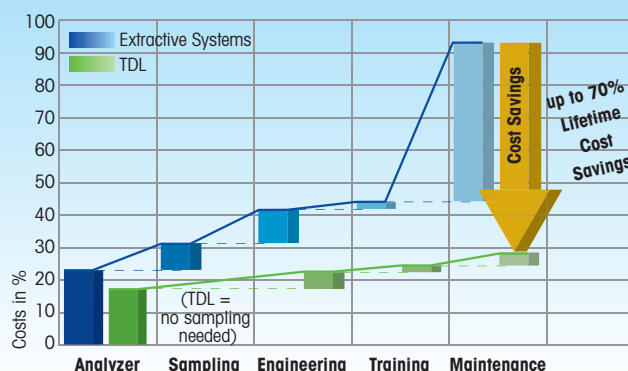
Tunable Diode Laser (TDL) Oxygen Analyzers from METTLER TOLEDO offer the best of two worlds: dependable, in-situ measurements with the power of a gas analyzer.

What's more, with METTLER TOLEDO's innovative probe design, installation and maintenance effort is reduced to an absolute minimum.

In fact, when compared with cross-stack type TDLs, such tedious operations as alignment become unnecessary, reducing installation costs by as much as 40 %.

## Decision Made Easy – Comparison Sheet

Lifetime Costs Extractive Systems vs. Tunable Diode Laser (TDL)



A Tunable Diode Laser solution reduces system lifetime costs significantly

## Applications

- Safety control
- Refineries
- Flares
- Oxychlorination in EDC plants
- VCM plant
- Vapor recovery systems
- FCC units

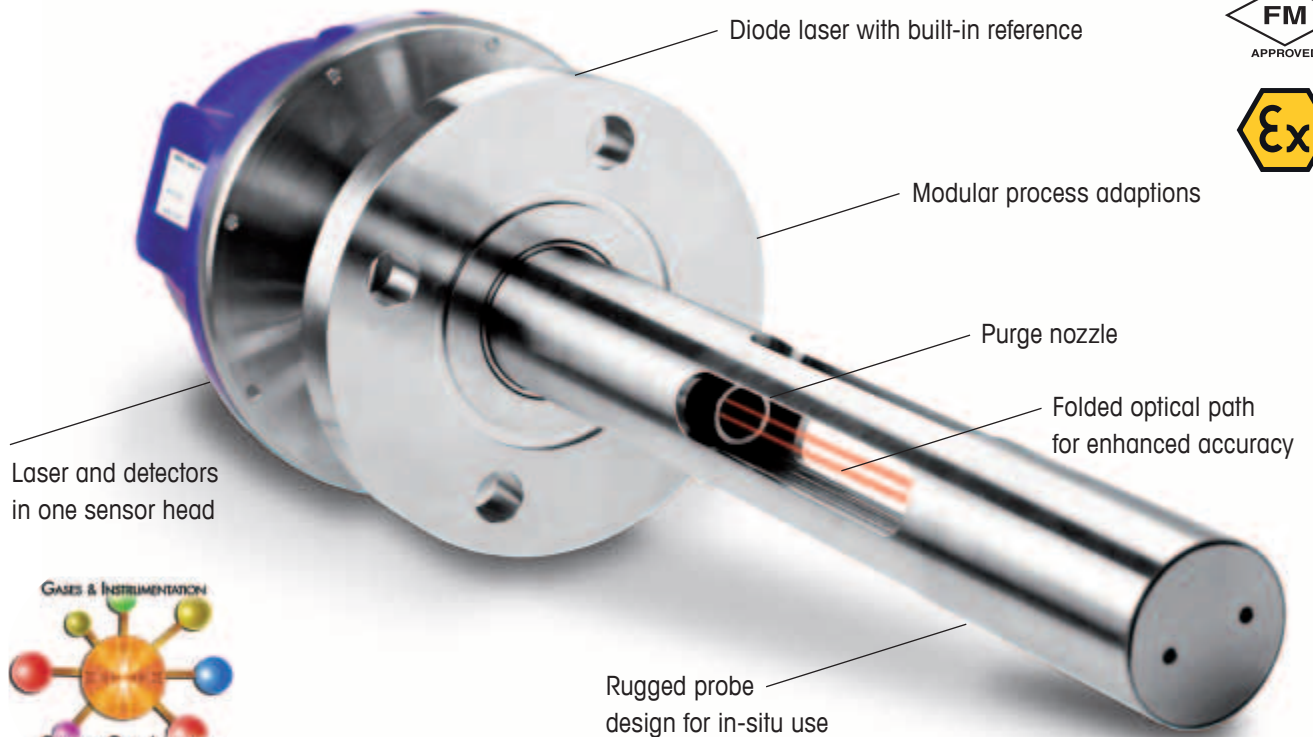
## Other gases

- CO (2013)
- H<sub>2</sub>O (2013)





## GPro™ 500 Series: In-situ sensor convenience, with analyzer performance



### Convenient user interface

The METTLER TOLEDO GPro 500 series uses the versatile M400 transmitter for easy system setup and advanced diagnostics.



**Time to Maintenance:** real-time assessment of optical path quality.

**Dynamic Lifetime Indicator:** diode laser's remaining expected lifetime.

### Benefits at a glance

- One-flange installation
- In-situ measurement
- Easy to install
- Low cost-of-ownership
- Compact design
- Virtually no maintenance
- Intuitive field user interface
- Low purge gas consumption

# In-Line Inerting Control

## No Sampling, Just Measuring

**Containing the risk of explosion in processes with flammable solvents and potentially explosive products is a top priority in all industries. Polarographic oxygen sensors offer superior insight into process oxygen levels, and at low cost of ownership.**

### Unwanted oxygen

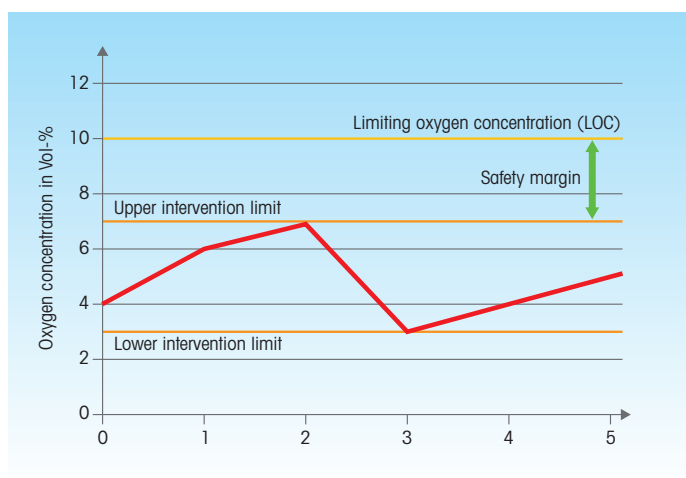
Inerting is all about avoiding potentially hazardous situations at any given time by keeping the oxygen level below the LOC (Limiting Oxygen Content), after deduction of a safety factor.

Typically, inert conditions are obtained by controlling flow and/or applying low overpressure to a tank. However, this method provides no information on oxygen concentration, knowledge of which is particularly important during tank filling and emptying. Further, a drop in ambient temperature can lead to tank "in-breathing" of air in order to avoid tank collapse.

### Know what's inside

Therefore, oxygen measurement is added to the inerting system. In practical terms, the measurement location for representative oxygen values is highly critical, because homogenous gas conditions within the volume to be inerted may not be present, and oxygen "hot spots" may exist.

With extractive measurement, such "hot spots" may not be identifiable. Additionally, long sampling lines cause unnecessary measurement delay.



Oxygen control ensures inert conditions

### Examples of successful applications:

- Monitoring of centrifuges and separators
- Milling systems
- Crystallizers
- Glove box inerting
- Spray tower atmosphere control







### The truth about oxygen in your process

In-line polarographic sensors are preferred to extractive systems because they allow the collection of oxygen readings from where explosion risk is present, without the problems of long sampling lines and unnecessarily long response times.

### New approach to inerting

The availability of reliable polarographic solutions opens new ways for improved, fast inerting control. Closed-loop systems with in-line sensor, analyzer with integrated PID controller and upper/lower limit open the way for field-level autonomous inerting systems.

### Benefits at a glance

- Measure oxygen where it matters: in the process
- 2-minute maintenance without process downtime
- No interference from many solvents
- Better process control through closed-loop oxygen control
- Digital technology for accurate signals and diagnostics

Moreover, oxygen measurement enables efficient management of inerting gas consumption.

When coupled with overpressure measurement, oxygen control delivers maximum safety of critical equipment.

**ISM**



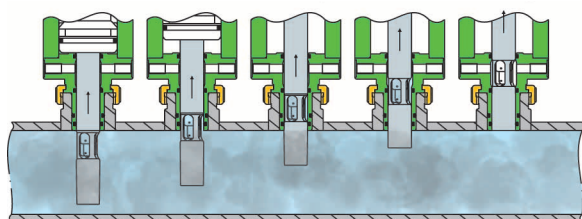
InPro 6850 i



InTrac 777 e



M420



With the patented Tri-Lock® system for InTrac® housings, the sensor can be safely removed from the process gas stream at any given time, without process interruption.

# Blanketing and Storage Solutions to Efficiently Protect Your Product

**Controlling the inert gas blanket in a vessel by pressure and flow only, can lead to a “blackbox” situation: the effective oxygen concentration is assumed, but never known. Extra nitrogen is injected to ensure sufficient blanketing. Oxygen measurement inside the vessel can change that.**

## Less oxygen, more yield

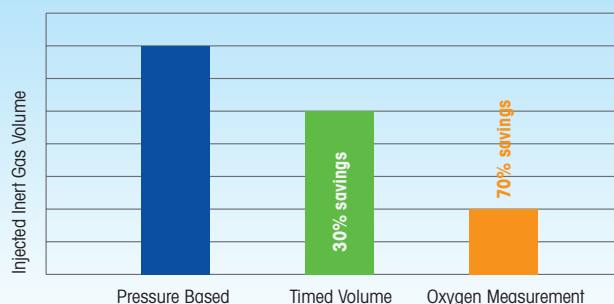
If oxidation is detrimental to the product, blanketing of tanks during intermediate process steps and final storage is necessary.

The conventional approach to solving this task involves the measurement of headspace overpressure and/or the measurement of the inert gas flow. Relying only on these indirect parameters for blanketing control, however, has significant drawbacks:

- The presence of oxygen in the tank is not quantified. This can lead to inconsistent product output.
- To be on the safe side, extra inert gas is pumped in to ensure correct blanketing. This leads to higher inert gas consumption.
- If you are not measuring the oxygen concentration in inert gases acquired from different sources, it is not safe to mix them (don't assume “pure nitrogen” is pure).

## Comparison of Inerting Methods

Consumption of inerting gas



On a typical inerting application, using in-line oxygen measurement can help you save up to 70% of inerting costs.



## Savings that we did not expect

“Identifying potentials for cost improvements is part of our daily activities. With amperometric oxygen measurement systems we not only uncovered substantial savings opportunities on our inerting bill, we also improved our process by taking control of blanketing. That turned out to be a key quality driver for us.”



Extract from an original customer testimonial.



### Blanketing made efficient

With oxygen measurement in-line, inert gas costs are minimized. Because polarographic sensors are insensitive to dust, moisture and many interfering gases, they can be inserted in-line to deliver reliable, accurate values.

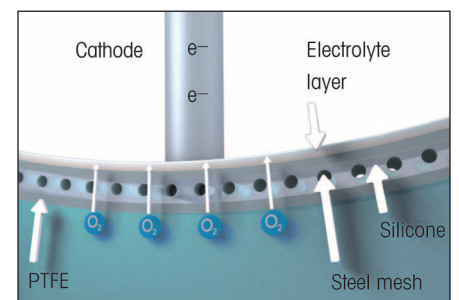
### Benefits at a glance

- Direct in-line installation
- High operational availability thanks to the 2-minute maintenance concept
- Calibration in air only, for low cost of ownership
- Wide application coverage thanks to broad configuration options
- High dynamic range from 50 ppm to air

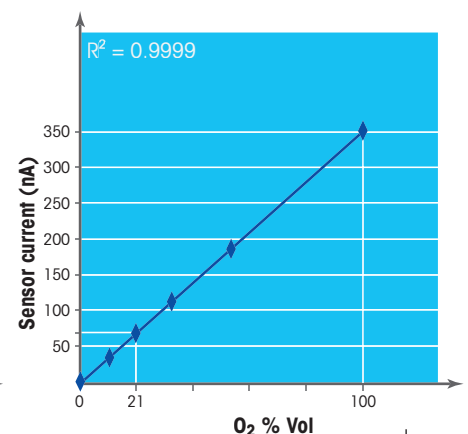
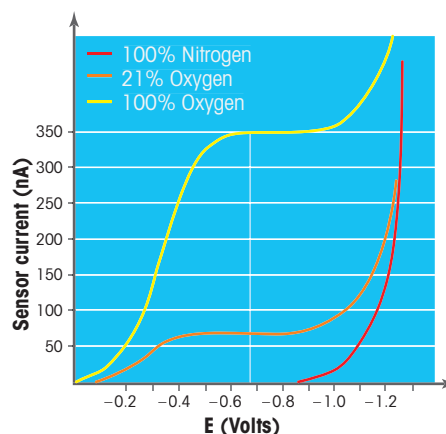


### Polarographic sensors: How they work

The oxygen sensor is separated from the sample gas by a membrane. This membrane is permeable to oxygen, but prevents detrimental components influencing the measurement. At the cathode, oxygen is electrochemically measured as a current to calculate the oxygen partial pressure.



The current output is proportional to the oxygen concentration (right). To obtain this fully linear relationship over the whole measurement range of 0 to 100 % oxygen, a polarization voltage of  $-675\text{ mV}$  is applied between anode and cathode (left).



# Oxygen Competence Center

## The Latest News on Applications and Products



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