SYSTEMS

Oxygen Ingress Measurement

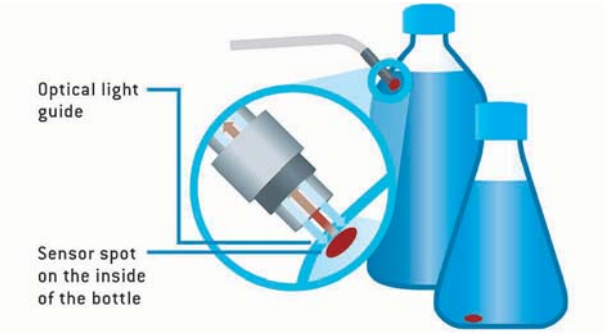
Non-invasive, non-destructive & real conditions: Determine the shelf-life of your product

- Determination of oxygen ingress in PET bottles
- Determination of scavenger capacity
- Determination of oxygen permeation through closures

PreSens
PRECISION SENSING

Systems

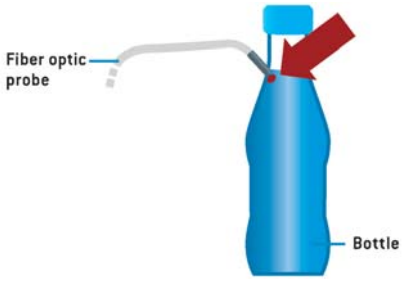
Oxygen Ingress Measurement



A new non-invasive and non-destructive fiber optic oxygen meter determines oxygen permeability of plastic bottles and containers. Trace oxygen concentrations inside the package are measured. Ideal for assurance, production and quality control, this system incorporates the latest state-of-the-art in optical-chemical sensor technology. Permeation rates can be confirmed without piercing the package or bottle.
The sensing principle is based on a fluorescence quenching method enabling oxygen measurements in a non-destructive way. A trace oxygen sensor spot is placed inside the transparent bottle or package and a fiber optic cable is positioned on the outside. The luminescence lifetime of the oxygen-sensitive spot changes with the oxygen concentration and is therefore acting as the oxygen dependent parameter.

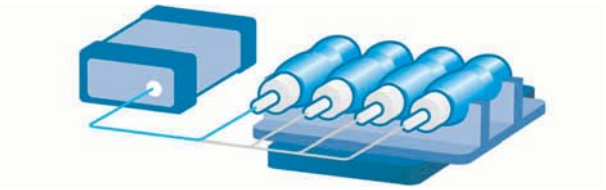
Features:

- Non-invasive & non-destructive
- Real-conditions & on-line monitoring
- Shelf-life determination
- Sensitivity down to 1 ppb dissolved oxygen
- Easy & precise measurement



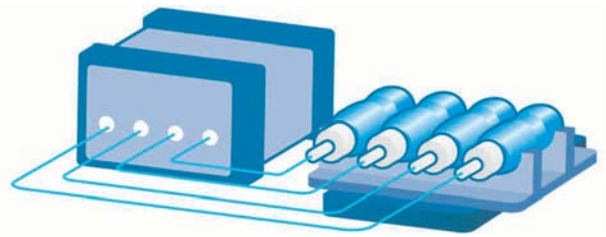
Single-channel set-up for subsequent measurement

The sensor spot can be glued into the PET bottle which then can be closed with a standard closure. For this direct coating, the bottles should be transparent but the measurement is even possible through slightly coloured (e. g. greenish or yellowish) or turbid bottles.



Measurement with an oxygen-sensitive cap in case of non-transparent bottles

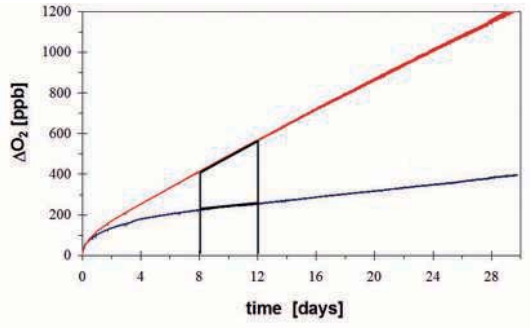
To determine the oxygen ingress in dark brown or non-transparent PET bottles, a direct coating of the PET bottle wall with a sensor spot is not possible. To enable non-invasive oxygen ingress measurement also for deeply coloured and non-transparent containers PreSens has developed an oxygen-sensitive cap (OSC) which can be used as closure.

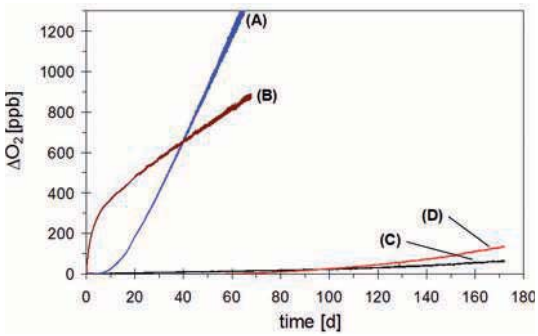


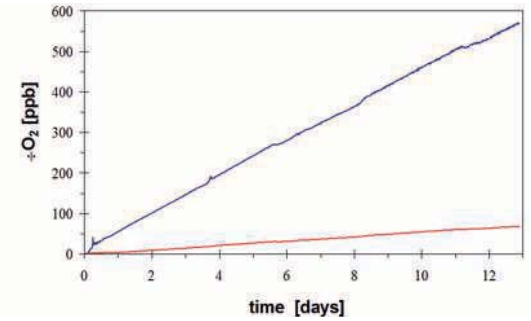
Multi-channel set-up for simultaneous measurements

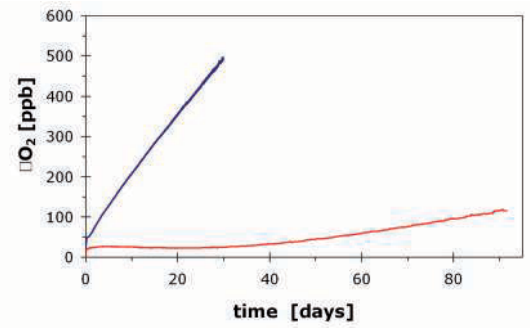
Transmitters for 4 and 10 oxygen sensors are offered. With this multi-channel set-up it is possible to monitor simultaneously up to 10 bottles.

Oxygen Ingress Measurement









Results

Bottle type 1: External coated PET bottles

The oxygen ingress into an external coated (blue line) and the respective reference PET bottle without coating (red line) are shown over a period of more than 25 days. In the first 48 hours the increase of the oxygen concentration in non-coated bottles and bottles with the external coating is non-linear due to the additional migration of oxygen out of the PET bottle wall. The external barrier coating reduces the rate of permeation, resulting in a significantly decreased slope compared to the slope observed for non-coated PET bottles.

Bottle type 2: PET bottles with external coating and / or different contents of oxygen scavanger

Oxygen ingress into differently treated PET bottles of the same type; (A) non-coated PET bottle with 2 % scavenger, (B) external coated PET bottle with no scavenger, (C) external coated PET bottle with 1 % scavenger, (D) external coated PET bottle with 0.5 % scavenger. The combination systems (C) and (D) hold oxygen ingress to less than 1 ppm over six months, which could not be accomplished with the active (scavenger (A)) or passive barrier (external coating (B)) alone.

Bottle type 3: Internal coated PET bottles

The inner coating provides an efficient barrier to oxygen (red line), and prevents oxygen desorption from the PET bottle wall into the product during the first few days of storage contrary to bottles coated externally.
In this case a thin layer of amorphous carbon, typically 100 to 200 nm thick, is applied to the inner surface of the bottle. This is deposited from high-energy plasma of acetylene gas within a high vacuum environment.

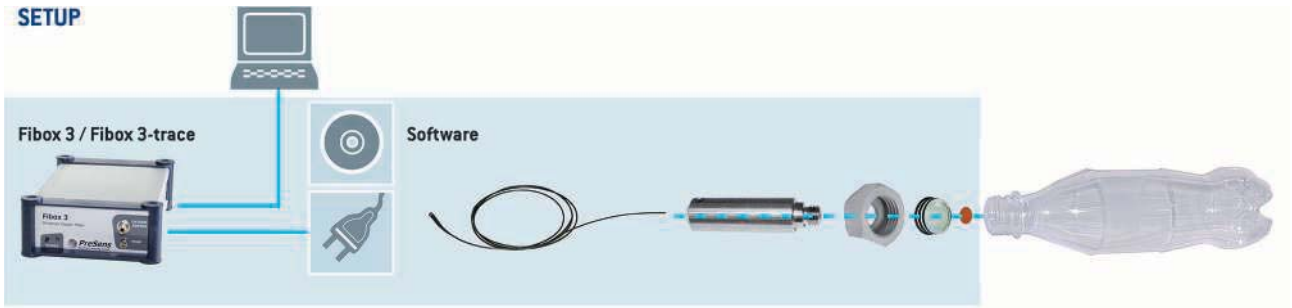
Bottle type 4: Multilayer bottles containing oxygen scavanger

Most common multilayer structures combine two layers of PET and a middle layer of Nylon MXD6 (metaxylylene diamine nylon) in three layer structures. The high barrier material is present in separate layers which are made by simultaneous or sequential co-injection (blue line). The combination of a multilayer structure adding an active barrier within the middle layer decreases oxygen ingress significantly, which could not be accomplished with a multilayer structure without an active barrier (red line).

Oxygen Ingress Measurement

	Sensor Type PSt3		Sensor Type PSt6	
Specifications	**Gaseous & Dissolved Oxygen**	**Dissolved Oxygen**	**Gaseous & Dissolved Oxygen**	**Dissolved Oxygen**
Measurement range	0 – 100% O_2 0 – 1000 hPa	0 – 45 mg/L 0 – 1400 µmol	0 – 4.2% O_2 0 – 41.4 hPa	0 – 1.8 mg/L 0 – 56.9 µmol
Limit of detection	0.03% oxygen	15 ppb	0.002% oxygen	1 ppb
Resolution	± 0.01% O_2 at 0.21% O_2 ± 0.1% O_2 at 20.9% O_2 ± 0.1 hPa at 2 hPa ± 1 hPa at 207 hPa	± 1.4 µmol at 283.1 µmol ± 0.14 µmol at 2.83 µmol	± 0.0007% O_2 at 0.002% O_2 ± 0.0015% O_2 at 0.2% O_2 ± 0.007 hPa at 0.023 hPa ± 0.015 hPa at 2.0 hPa	± 0.010 µmol at 0.03 µmol ± 0.020 µmol at 2.8 µmol
Accuracy	± 0.4% O_2 at 20.9% O_2; ± 0.05% O_2 at 0.2% O_2;		± 1 ppb or ± 3% of the respective concentration; whichever is higher	
Drift at 0% oxygen	< 0.03% O_2 within 30 days (sampling interval of 1 min)		< 2 ppb within 30 days (sampling interval of 1 min)	
Measurement temperature range	0 – 50°C		0 – 50°C	
Response time (t90)	< 6s	< 40 s	< 6s	< 40 s
PROPERTIES				
Compatibility	Aqueous solutions, ethanol, methanol			
No cross-sensitivity with	pH 1 – 14 CO_2, H_2S, SO_2 Ionic species			
Cross-sensitivity to	Organic solvents, such as acetone, toluene, chloroform or methylene chloride Chlorine gas			
Sterilization procedures	Steam sterilization Ethylene oxide (EtO) Gamma irradiation			
Cleaning procedures	Cleaning in place (CIP, 5% NaOH, 90°C, 194°F) 3% H_2O_2 Acidic agents (HCl, H_2SO_4), max. 4 – 5%			
Calibration	Two-point calibration with oxygen-free environment (nitrogen, sodium sulfite) and air-saturated environment		Two-point calibration in oxygen-free environment (nitrogen) and a second calibration value optimally between 1 and 2% oxygen	
Storage Stability	2 years provided the sensor material is stored in the dark (-10 – 60°C)			

The System



Option: 4-channel transmitter

Option: 10-channel transmitter

ACCESSORIES

Glove Box
The Glove box supports the filling process under oxygen free atmosphere.

ARC
The adapter for round containments (ARC) is used for measurements with standard closure.

Technical data can change without prior notice.

Bring to light what's inside. Ask our experts:

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