Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Dissolved Oxygen Measurement

Sensors, assemblies and transmitters for all applications

Endress+Hauser

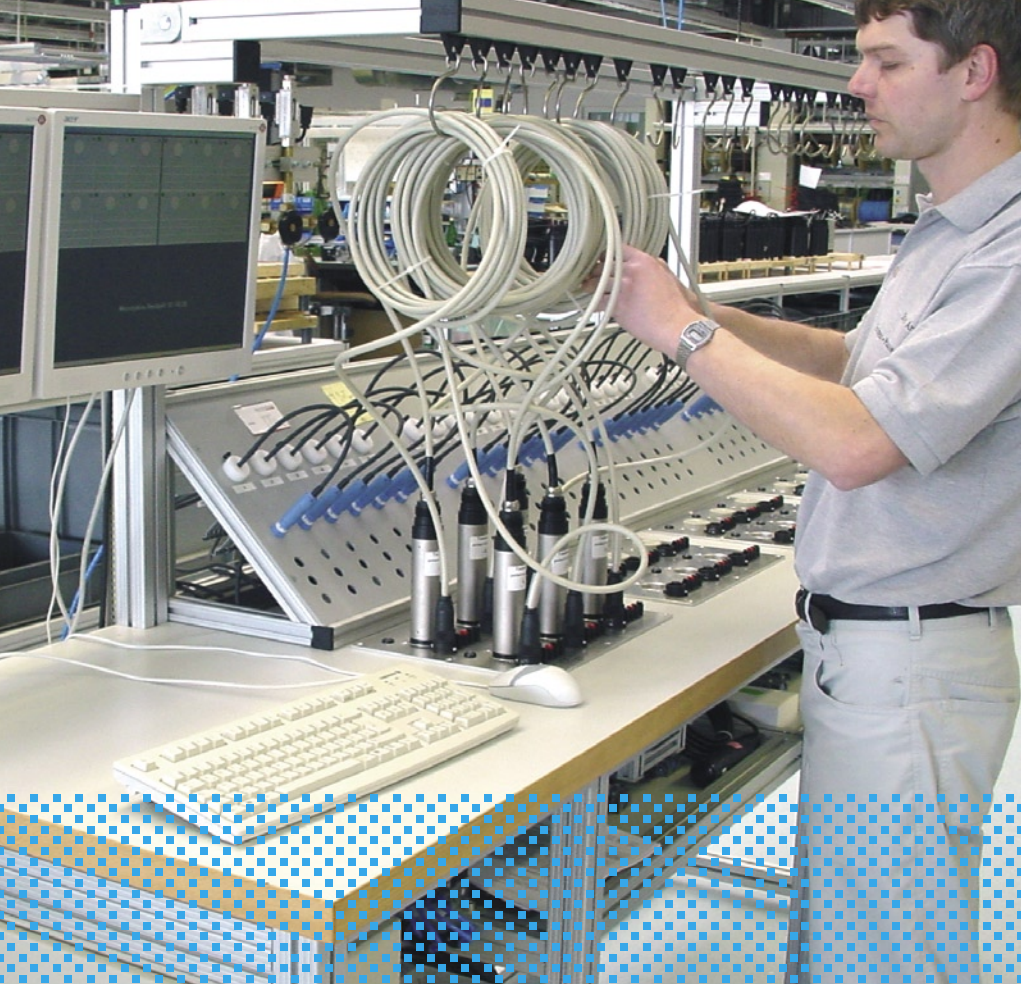
People for Process Automation

Solutions for liquid analysis

Endress+Hauser is a global provider of solutions for process automation. For production and logistics, the company develops sensors and systems which retrieve, transmit and process information from the processes. Future-oriented services, and products excelling both in terms of price and performance, support the competitiveness of clients thanks to the highest degree of quality, safety and efficiency.
Endress+Hauser has been a specialist in analysis measuring technology for the environment and process industry for over 30 years. The extraordinarily high number of research and development resources guarantees the efficiency, performance and high quality of the products. The latest technology for safe processes can be made permanently available to the user.
By mastering all technically demanding processing steps, in conjunction with a high degree of automation in almost every production area, Endress+Hauser has achieved a great vertical range of production. As a result, the client receives high and constant product quality as well as excellent delivery reliability for all standard products and for individual products tailored to suit special applications. Measuring technology from Endress+Hauser stands for reliable measured values, a high degree of availability and long operating times.

Competence in dissolved oxygen measurement

A solution for every industry – this is dissolved oxygen measurement from Endress+Hauser. The range spans from controlling the aeration of activated sludge basins in wastewater treatment and residual oxygen measurement in power station boiler feedwater, to controlling fermentation in food processing and optimizing color and taste in the production of red wine. Two types of technology are deployed in sensory measuring technology: the well-known and tried-and-tested amperometry – here oxygen concentrations are converted to electric currents – and the optical method of fluorescence quenching which is relatively new in process measuring technology. Here, the fluorescing light of an oxygen-sensitive molecule is used to determine the concentration. In the transmitter, the signals are processed further for the desired display.
How does the medium get to the sensor? In immersion operation, such as in open basins or channels, the sensor is suspended in the medium from an immersion assembly and the medium flows around it. In closed pipe systems, a flow assembly is often used in bypass operation while tanks are accessed via stationary-mounted retractable assemblies. The latter allow the sensor to be removed even if the tank is full.

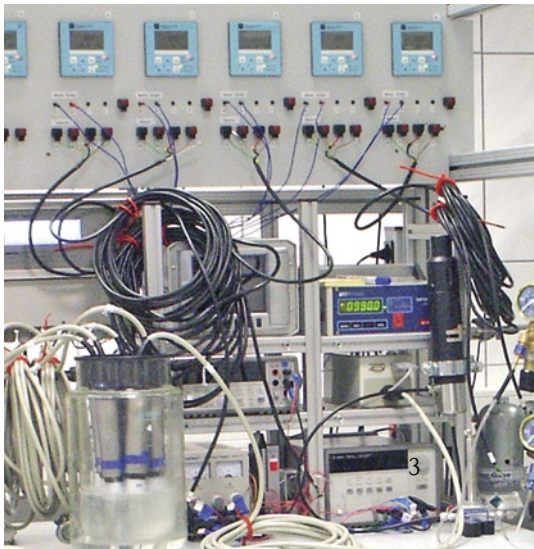


Research and development

Membrane-covered oxygen sensors are state of the art. The future will see an increase in the use of optical methods, such as fluorescence quenching, to determine oxygen concentration in plants and systems. At Endress+Hauser, optical sensors are developed and brought to fruition in technical applications. Product development is one side of the coin but the development of associated production techniques is just as important. Many stages of production are automated to ensure a consistently high quality. Testing also takes place on a fully automated test stand: here the sensors are tested for zero point, slope and constancy and the results are documented. Ensuring a high level of product quality is our paramount goal.

Flexible measuring point concept

Channels, pipes, tanks – not a problem. With the flexible measuring point concept, every task is mastered. Oxygen sensors from Endress+Hauser are designed both for use in channels and basins as well as for installation in pipes and tanks. The wide range of assemblies on offer safely positions this sensor at the place of application – these assemblies include the CYA611 immersion assembly, the COA250 flow assembly or the COA451 retractable assembly. The Liquisys M COM2x3 transmitter is available as panel or field housing. The transparent operating concept corresponds to the Liquisys transmitters for the parameters oxygen, chlorine, pH or conductivity.



Working principle

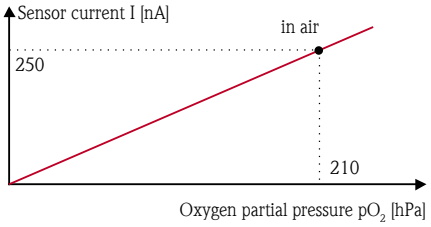
From the technical possibilities available, two solutions for measuring dissolved oxygen have become established: amperometric oxygen measurement and measuring oxygen using fluorescence quenching.

While amperometric measurement offers higher accuracy, optical measurement offers impressively short response times.

Amperometric sensor:
In the simplest version of the two-electrode system, the sensor comprises a working electrode and a counter electrode. Both are surrounded by an electrolytic liquid in a common chamber. A membrane provides the link to the medium or process: oxygen permeates from the medium into the electrolyte through the membrane and is converted to a current at the working electrode. The counter electrode keeps the system running by means of a chemical equivalence reaction. The resulting current response is in direct proportion to the oxygen partial pressure.
The current is converted in the downstream transmitter and made available to the user in the familiar units of oxygen saturation, concentration (in mg/l or ppm) and oxygen partial pressure.

In more complex three-electrode systems, an extra electrode is used (the reference electrode) to accurately control and regulate the internal status of the sensor. This type of sensor demonstrates a high level of long-term stability.

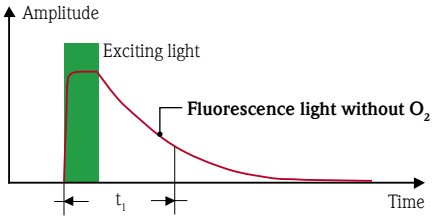
Fluorescence quenching:
With this method, a layer that is permeable to oxygen also forms the junction with the process. This layer contains just as many oxygen molecules as the medium (the partial pressure of the oxygen is just as high in the medium as in the layer). It is separated from the optics at the sensor by means of a substrate permeable to light. The layer contains marker molecules that are optically excited with a green light and respond with a red fluorescence light. Oxygen molecules adapt to these marker molecules and decrease (quench) the fluorescence light emitted. The reduction in fluorescence light is connected to the oxygen partial pressure, both in terms of the amplitude and the duration. The light signal is converted in the downstream transmitter and made available to the user in the familiar units of oxygen saturation, concentration (in mg/l or ppm) and oxygen partial pressure, just as with the amperometric sensor.



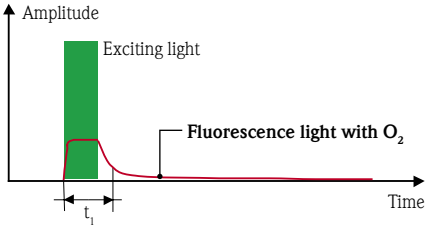
The linear characteristic curve of the amperometric sensor begins at the origin 0.

Working principle of the amperometric sensor

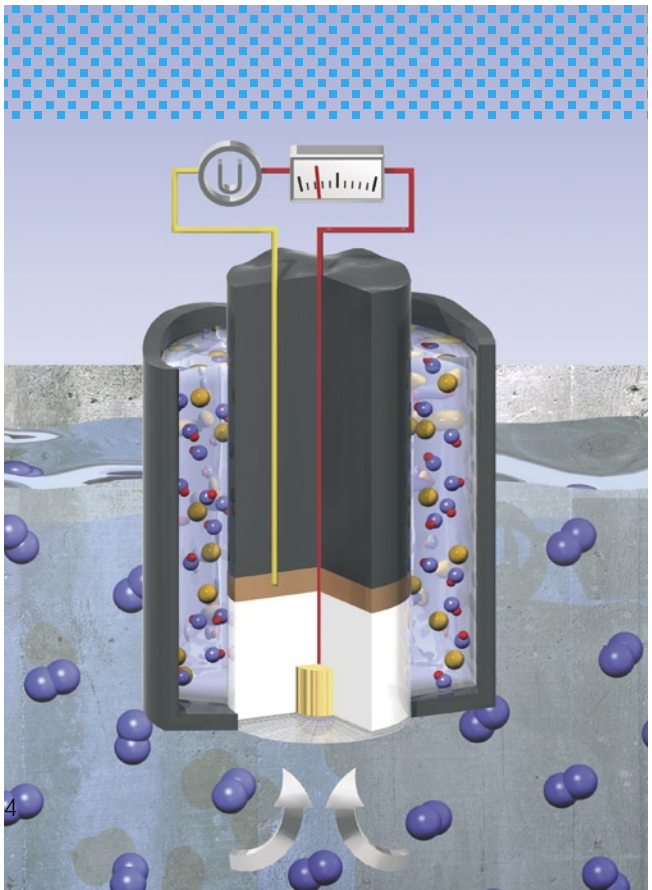
Without oxygen:
The amplitude of the fluorescence light is high, the duration long.

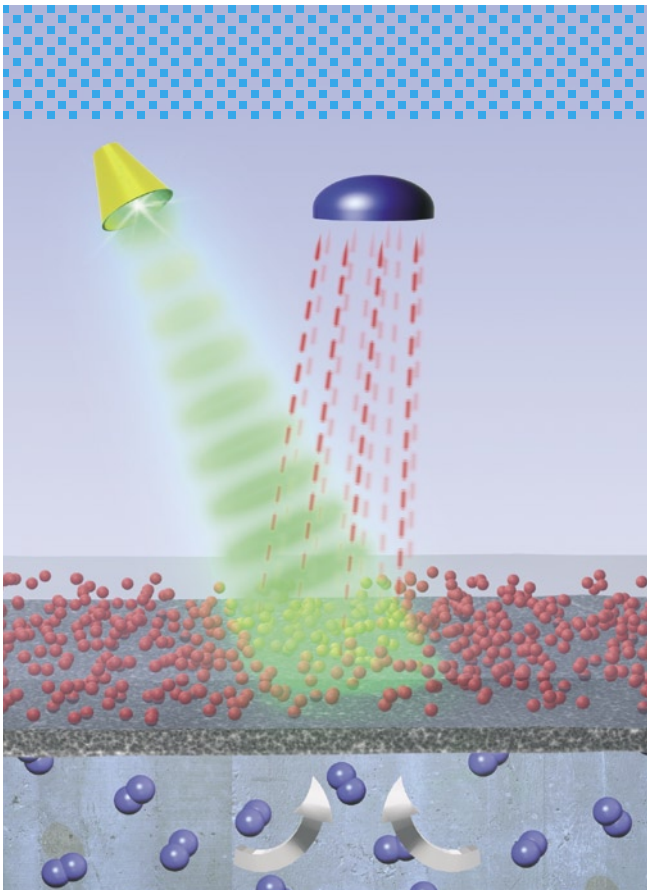


With oxygen: The amplitude of the fluorescence light is small, the duration short.



Working principle of fluorescence quenching





Oxygen in the activated sludge basin

One of the most well known applications of oxygen measuring technology in liquids can be found in the activated sludge basin in wastewater treatment. Here oxygenation in the basin must be regulated – too little oxygen means too little degradation, too much oxygen means high energy costs.

Channels and open basins are the domain of the oxygen sensor mounted in the immersion assembly. The immersion assembly means that the sensor can be installed in such a way that only the sensing part is in contact with the medium. Modules such as the cable gland are protected and dry within the assembly pipe. The assembly itself can be immersed into the medium using a chain and boom or mounted directly on the edge of the basin in the event of high fluid velocities. The transmitter is mounted under the weather protection cover at the upright post, which also forms the boom for the assembly chain – all in one place.

Liquisys M COM223/253 | Oxymax W COS41 | Oxymax W COS31/61 | Dipfit CYA611 | CYH101 assembly holder

Liquisys M COM223/253 transmitter
- Modes of operation: mg/l, ppm, hPa, % SAT
- Two-line display
- Optionally with 2/4 contacts (limit contacts, P(ID) controller, timer)
- Optionally with Profibus-PA/-DP or HART®

CYA611 Dipfit immersion tube
- Immersion assembly in PVC version
- For open basins and channels
- Length 1630 mm

Oxymax W COS31 oxygen sensor
- Measuring range 0 to 60 mg/l
- Digital sensor

Oxymax W COS41
- Measuring range 0 to 20 mg/l

Oxymax W COS61
- Measuring range 0 to 20 mg/l
- Digital optical sensor

CYH101 universal suspended assembly holder
- Stainless steel column for securing transmitter and immersion tube
- Fixed and oscillating method of securing immersion tube

Oxygen in power plants

Hot boiler feedwater in conjunction with dissolved residual oxygen – this means corrosion for the plant units from the pipe to the turbine on the one hand and high maintenance and repair costs on the other hand.
To prevent this, oxygen-consuming chemicals are added to the boiler feedwater. The effectiveness of these chemicals must be monitored. A leak in the pipes and tanks also results in oxygen penetration and increased corrosion.

The basic conditions of high pressure and high temperature demand a sensor suitable for daily use, with associated reliable sample conditioning, to safely display the residual oxygen contents in the ppb range. This task is solved by the Endress+Hauser COS71 sensor in the COA260 flow assembly specially designed for this purpose. The Liquiline with the COS21D sensor is available as a two-wire version. Both sensors measure as trace sensors in the ppb range right up to oxygen concentrations in the air and, in this way, allow easy calibration. With their technical designs, the flow assemblies make central flow possible and prevent any dead volume that could interfere with the measurement.

Oxymax W
COS71

Liquisys M
COM223/253

Liquiline M
CM42

Oxymax W
COS71

Flowfit W
COA260

Oxymax H
COS21D-C

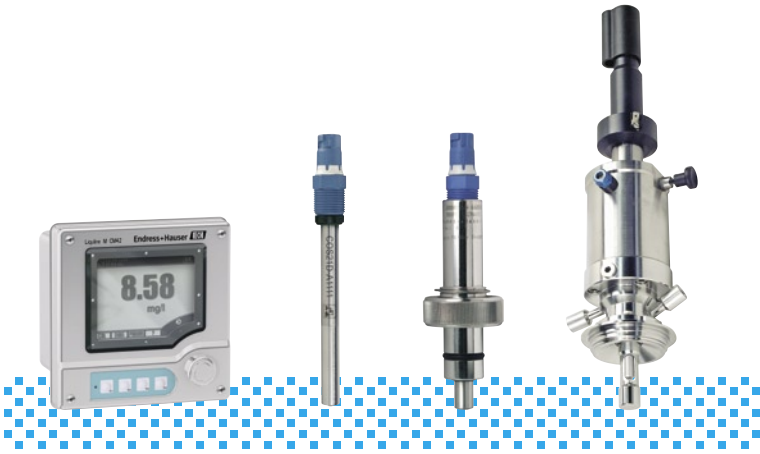
Liquisys M COM223/253 transmitter
- Modes of operation: mg/l, ppm, ppb, hPa, % SAT
- Two-line display
- Optionally with 2/4 contacts (limit contacts, P(ID) controller, timer)
- Optionally with Profibus-PA/ -DP or HART®
- Oxymax W COS71

Flowfit W COA260 flow assembly
- Minimum sample volume
- Fluid velocity 200 to 600 ml/min
- Oxymax W COS71

Oxymax W/H COS71/ COS21D-C oxygen sensor
- Trace sensor
- Resolution 1 ppb
- COS71: Ø 40 mm
  COS21D-C : Ø 12 mm

Liquiline M CM42
- Two-wire transmitter for easy installation with large display and alarm LED
- Simple, intuitive operation due to Navigator, plain text menu and online help
- Second current output
- Oxymax H COS21D-C

Oxygen in the food and pharmaceutical industry



Liquiline M CM42 | Oxymax H COS21D | Unifit H CPA442 | Cleanfit H CPA475

Oxygen and foodstuffs – a contradiction in terms?

Yes! Everywhere where oxygen can have an oxidizing effect (fresh drinks, fresh oil, fresh meat) or in places where oxygen creates the breeding ground for unwanted microbes, such as bacteria, causing food to perish.
No! Everywhere where oxygen is needed for treating and producing the foodstuffs (fermentation, vinegar production, production of pharmaceuticals).
Two applications are characteristic of oxygen measurement in the food and pharmaceutical industry:

- Measuring the absence of oxygen e.g. in beverage bottling, inerting systems, high-purity water, etc. (trace oxygen measurement).
- Measuring the oxygen contents to check and regulate fermentation systems (operating oxygen measurement).

Major importance is attached to the surfaces and materials used. Potential areas where buildup can take place and material incompatibility must be avoided. High-quality stainless steel and minimum surface roughness are essential here. With COS21D as the sensing element, essential requirements in the food and pharmaceutical industry are met. Supported by the suitable assembly family – CPA442 as an installation assembly, CPA475 as a retractable assembly - the entire measuring point is designed as required and meets 3A and EHEDG guidelines and directives.

Liquiline M CM42

- Two-wire transmitter for easy installation with large display and alarm LED
- Simple, intuitive operation due to Navigator, plain text menu and online help
- Second current output

Fixed installation assembly Unifit H CPA442

- Material: stainless steel 1.4435 (AISI 316L)
- For the process, food and pharmaceutical industry
- Certification: 3A, EHEDG, EN 10204, 3.1

Oxymax H COS21D oxygen sensor

- Measuring range 0 to 20 mg/l
- Autoclavable/sterilizable up to 130 °C
- Standard process connection PG13.5

Cleanfit H CPA475 retractable assembly

- Material: stainless steel 1.4435 (AISI 316L)
- For the process, food and pharmaceutical industry
- Certification: 3A, EN 10204, 3.1
- Manual or pneumatic operation
- Diverse process connections

Selection aid

Specification	COS21D	COS31	COS41	COS61	COS71
Method	Amperometric, 2-electrode sensor	Amperometric, 3-electrode sensor	Amperometric, 2-electrode sensor	Optical, fluorescence quenching	Amperometric, 3-electrode sensor
Application	Food and pharmaceutical industry, power plants	Water and wastewater	Water and wastewater	Water and wastewater	Power plant
Version	CIP, SIP	All-rounder	Standard	Optical	Trace sensor
Diameter	12 mm	40 mm	40 mm	40 mm	40 mm
Length	120 mm	186 mm	144 mm	186 mm	186 mm
Process connection	PG13.5	G1	G1, NPT3/4	G1	G1
Measuring range [mg/l]	0 to 20	0 to 60	0 to 20	0 to 20	0 to 20
Resolution [mg/l]	0.01/0.001	0.01	0.01	0.01	0.001
Communication	Memosens	digital	analog	digital	digital

Further documentation

Technical Information

TI 402C Oxymax H COS21D
TI 285C Oxymax W COS31
TI 284C Oxymax W COS41
TI 387C Oxymax W COS61
TI 286C Oxymax W COS71
TI 199C Liquisys M COM2x3
TI 381C Liquiline CM42
TI 306C Unifit H CPA442
TI 240C Cleanfit H CPA475
TI 111C Flowfit W COA250
TI 310C Flowfit W COA260
TI 368C Cleanfit COA451
TI 166C Dipfit W CYA611
TI 092C CYH101
TI 046C Chemoclean CYR10/CYR20

04.06/MSC

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