



Optical Oxygen Measurement

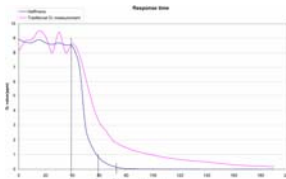
Optical oxygen (O_2) measurement was used in breweries for the first time in 2004. Today, the whole process from the brewing room to bottled product, including all relevant gases and liquids, can be covered with in-line and/or portable optical measurement systems. Optical measurement is much more effective in minimizing both product and quality loss than using traditional methods for determining O_2 , thus raising a brewery's overall performance. The credo for up-to-date O_2 management is therefore 'always optical'.

Benefits of Optical O_2 Measurement

Optical O_2 measurement offers breweries many benefits and outperforms the traditional Clark cell O_2 measurement. Optical measurement requires no maintenance and less calibration and provides a stability and a faster response time.

Rapid response time

The optical sensor's very quick response time, up to 3 times faster than traditional methods, results in less product loss. With the traditional Clark cell, the O_2 must diffuse through a membrane, go into a solution in the electrolyte, and establish equilibrium. An electrode is placed in the electrolyte to measure the O_2 concentration based on an electrical current through the electrolyte. This analysis is a slow process, compared to the optical O_2 measurement.



Costs saving with Optical technology compared to the Membrane method

Parameters	Membrane	Optical
Measurements per year	5,000	5,000
Frequency of maintenance	12	4
Savings on measurement		60%
Savings on maintenance		75%
Overall savings*		61%

Low operating costs

The optical O_2 does not require any maintenance and only requires minimal calibration. It is empirically guaranteed that after one million illuminations, deviation from the zero point is max. 5 ppb and at higher O_2 values no significant deviation is recorded. Assuming 500 illuminations per day, seven days per week, 52 weeks per year, the sensor would, from a purely technical perspective, only need to be calibrated or replaced once every 5 years.

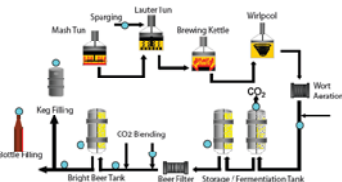
O_2 Management, Where it Matters

Oxygen is one of the most important parameters that affects beer shelf life and flavor stability. It is very important to avoid any O_2 pick-up and to ensure low dissolved oxygen (DO) levels during the entire production process. In order to get the DO profile under control, an accurate and reliable O_2 measurement system is necessary.

Comparing apples with apples is the key to a trustworthy O_2 management system. All Pentair Haffmans instruments that measure O_2 use identical optical measurement systems that can be used on all relevant gases – carbon dioxide (CO_2) and nitrogen (N_2) – and liquids including water, wort, yeast, deaerated water, beer, and other beverages.

	Lab / package	At-line	In-line
O_2			
Combined O_2/CO_2			

Currently, the most important areas of use within the context of seamless O_2 management are the brew house, cold block and packaging.



O_2 in the Brew House

In the brew house, the degassed water that is used for **sparging at the lauter tun** is monitored. A high O_2 value can lead to undesirable coloration of the wort.

For **wort aeration**, DO is measured to monitor for high quantities of O_2 dissolved in the wort so that aeration can be controlled for optimal fermentation.

Yeast propagation can also be controlled with an in-line solution or monitored by the use of a portable O_2 meter.



O_2 in the Cold Block

Applications in the cold block include measuring the O_2 content in the **fermentation, storage and bright beer tanks**. Here combined meters for O_2 and CO_2 are often used as both parameters can be detected by taking a single sample, which means that product loss is reduced and working time saved.

On **centrifuges and filters** the O_2 values are measured on the inlet and outlet to monitor any O_2 pick-up.

In “**high gravity**” brewing, measure whether the deaerated blending water and CO_2 added during carbonation do not cause any additional O_2 pick-up.



Installed at the **inlet of the filler** provides shorter changeover time and prevents inadequate product quality ending up in the package. In-line O_2 meters for gas are installed to monitor the removal of CO_2 from a tank before it is cleaned-in-place with caustics, to minimize the risk of the tank to implode.

Differentiated O_2 in Packaging

Using the traditional Z-method, the Total Packaged Oxygen (TPO) value is obtained by measuring DO in a package that is shaken to equilibrium. **A novel method enables measuring TPO** from a single package, meaning as well as the O_2 in the head space and the DO. This makes it possible to directly pinpoint the source of the O_2 and packaging performance with regard to:

- Package preparation
- Liquid handling and
- Head space air retention

With this novel method of TPO measurement and use of the optical O_2 measurement, breweries and beverage companies are able to improve the efficiency of the filler and reduce product losses or rework.



O_2 and Utilities

The optical O_2 measurement has even been applied in the utilities at breweries and beverage plants to, for example, monitor the O_2 content of CO_2 gas from fermentation to provide key parameters in an efficient and economical operation of a CO_2 recovery system.

In other areas, including wastewater treatment, O_2 content in steam boiler water and in highly pure CO_2 such as treated fermentation CO_2 can be monitored.

Conclusion

The innovative optical O_2 measurement technology makes it possible to map the O_2 management throughout the whole brewing or beverage production process. Quicker response times, lower production losses and reduced OPEX as results.

Pentair Haffmans' **Total O_2 Management solutions**, based on the innovative optical O_2 technology, keep all your products fresh!