Anton Paar

Instruments for Measurement of Dissolved Carbon Dioxide and Oxygen in Beverages

Lab and At-line

::: Unique Density & Concentration Meters

Wherever You Are:
Measurement of Dissolved CO_2 and O_2 in Beverages

In the production of **alcoholic and non-alcoholic beverages**, it is essential to check and control the CO_2 and O_2 content of the product both during the production process and after bottling.

The CO_2 content strongly influences the taste of beverages and is a considerable cost factor in beverage production. Precise measurement of the carbon dioxide ensures **consistent taste** and **cost-efficient dosing**.

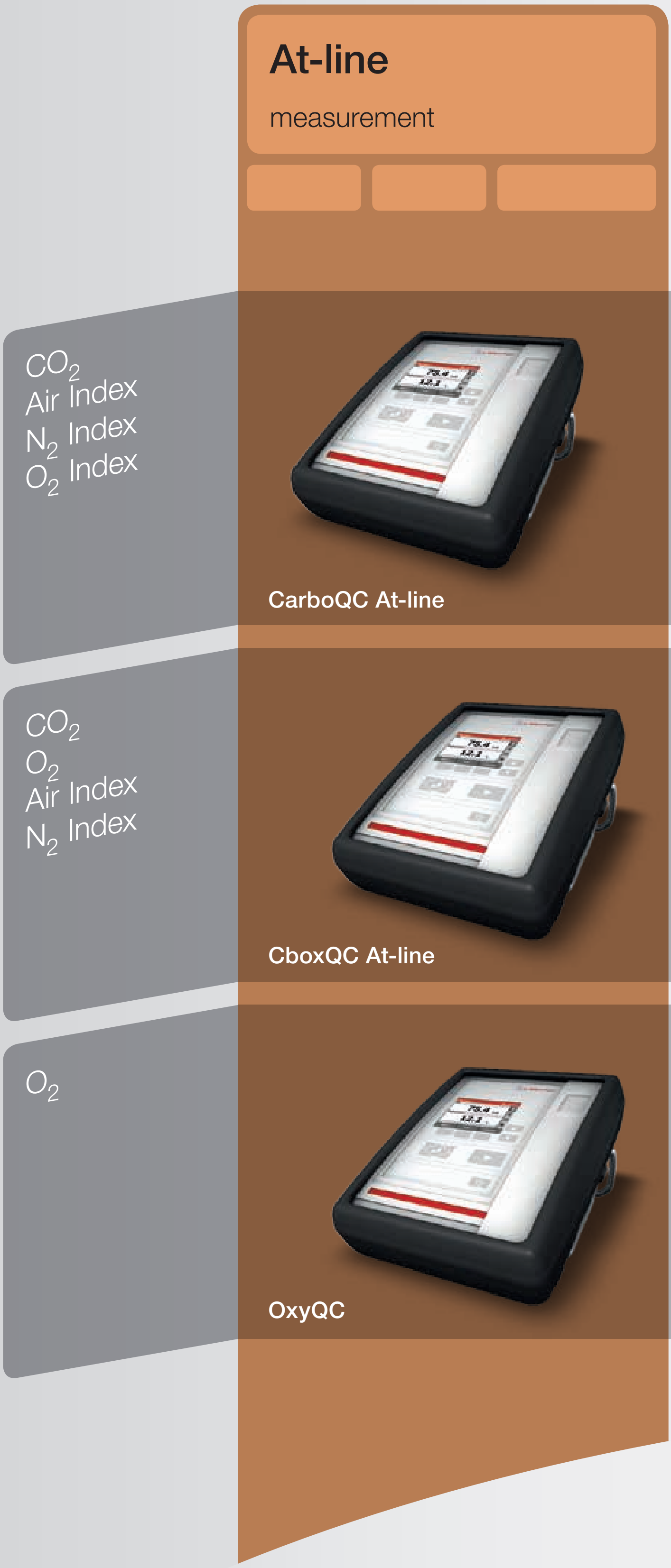
A high level of dissolved O_2 in beverages has a negative impact on the taste and shelf life of the beverage. The continuous monitoring of the oxygen content ensures **product safety** and consistent **beverage quality**.

The best instrument for your application

Whether directly at the production line, in the laboratory or as part of a larger beverage analyzing system, Anton Paar provides the **best instrument for your measurement** application. The range includes instruments for measuring dissolved oxygen and dissolved carbon dioxide without being influenced by other dissolved gases such as air or nitrogen.

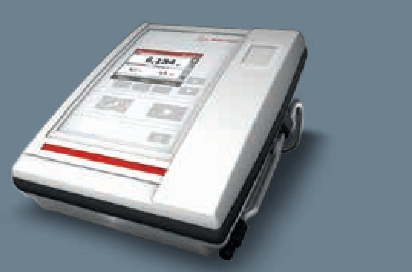
Have it all: CO_2 and O_2 combined

Anton Paar's new instrument, **CboxQC**, combines the fast measurement of CO_2 and O_2 in one measuring cycle – available for portable use at-line as well as in a stand-alone version for the laboratory.
For the utmost flexibility, the instruments' new and **robust design** is **small**, **compact and lightweight**.



Laboratory

measurement



CarboQC

CboxQC

OxyQC

System modules

integrated in PBA Gen. M measuring systems

CarboQC ME

CarboQC ME with Option O_2

The inventor of true CO_2 measurement

Anton Paar is the inventor of the Multiple Volume Expansion method, which is the most accurate way of selectively measuring dissolved CO_2 in beverages. This patented method provides the most reliable CO_2 results and avoids the shortcomings of other conventional methods of CO_2 measurement. Maximum precision is ensured with the MVE method.

Measuring dissolved oxygen using a new optical O_2 sensor via luminescence quenching provides precise results within seconds based on a proven technology.

World leader in analytical measuring instruments

Besides years of experience in the field of dissolved CO_2 and O_2 determination, Anton Paar is also the leader in density and concentration measurement, providing complete beverage analysis systems for the laboratory and production process.

Close to you

With a global network of subsidiaries and sales partners, Anton Paar is always close to your site. Local Anton Paar specialists are on call to give quick and competent after-sales support, regular maintenance and service.

At-line Instruments from the Measurement Experts

At-line measurements - whether from process lines, tanks, kegs or casks - provide the assurance that your production process is under control. At-line instruments are used to adjust process instruments.

Fully protected for harsh environments

Anton Paar's at-line series of instruments are built to operate for years under rough conditions. The robust and leakproof housings keep humidity out of the electronics and stop any spills from entering the instrument.

Quick to finish: saves you time and money

By measuring CO_2 and O_2 in only 90 seconds, Anton Paar's CboxQC At-line saves you valuable working time and therefore money.

Portable measurement: 10 hours on the go

CarboQC At-line and CboxQC At-line are portable and provide a battery life of up to ten hours. The battery is quickly recharged for continued operation. For the utmost flexibility, the instruments' new design is small, compact and lightweight.

Low-carbonated beverages? No problem!

With a measuring range from 0 to 20 g/L, Anton Paar's CO_2 meters not only measure highly carbonated beverages, but also samples with low CO_2 levels with outstanding accuracy.

Continuous control of CO_2 and/or O_2? Data Logger!

Using the CO_2 and O_2 Data Logger function you define the interval for continuous measurements from the line or tank. With a memory capacity of 500 measurement results, including timestamp and sample ID, Anton Paar's at-line instruments are prepared for a long working day.

O_2 determination: simple, accurate and ready for measurement anywhere!

The highly accurate determination of dissolved oxygen is based on the optochemical sensor's very fast response time and ideal temperature behavior. This leads to stable and precise results in less than 50 seconds. Durability and minimal maintenance are the prominent features that make the long-lasting optical sensor stand out.

Easy to use, easy to read

The color display makes sure you see your measuring results clearly, even in dark surroundings. Due to the intuitive user interface standard operations can be performed easily. The eight large keys enable operation of the instrument even when wearing protective gloves.

Get started fast with RFID

Equipped with an RFID interface option, the instruments enable you to quickly and conveniently change the method and sample ID automatically, by just reading an RFID tag. Whether using RFID or manual settings, the instruments ensure full traceability.

Teams up with process instrumentation

The at-line instruments are the ideal complement to Anton Paar's process instrumentation, such as the Carbo 510 online CO_2 analyzer and Cobrix 5 inline beverage analysis system for °Brix, Diet and CO_2 monitoring.

Your Longstanding Partner for Laboratory Measurements

Using Anton Paar's laboratory solutions for dissolved gas measurement allows you to perform reliable QC on finished packages and run measurements for product development with the highest accuracy.

High accuracy, more benefit

The patented CO_2 measuring method is not influenced by other dissolved gases such as oxygen and nitrogen, is rapid, and needs only minimum sample volume. Together with a new reliable optochemical oxygen sensor the results achieve the highest level of repeatability:

- ➔ **CO_2 repeatability s.d.: up to 0.005 vol.**
- ➔ **O_2 repeatability s.d.: ±2 ppb**

Low sample amount? No problem!

The very low required sample volume of around 100 mL allows reliable CO_2 and O_2 results, even out of very small packages.

PFD filling device - the perfect complement

Using Anton Paar's CO_2 and O_2 instruments in combination with a piercing and filling device means easy handling. Just press 'Start' and the sample is transferred to the measuring chamber without any loss of CO_2 and O_2. Reliable results can therefore be guaranteed.

TPO quick check? For sure!

Determination of the Total Package Oxygen is in great demand. By measuring dissolved oxygen the TPO value can be calculated via Anton Paar's free software AP-SoftPrint or by connecting to a DMA Generation M system.

Fast and wireless

For fast and simple printouts, Anton Paar's dissolved gas meters send the data to the optional Bluetooth printer.

Easy checks – reliable results

Anton Paar's CO_2 and O_2 meters are supplied factory-adjusted and can be used right from the start. The periodical recommended system check implemented in the instruments' quick access area guides you through the CO_2, O_2 and tightness check carried out with deionized water and nitrogen.

Correct filling for correct results

Correct results strongly depend on the right filling under pressure: the new series' integrated FillingCheck™ feature automatically detects filling errors.

Talks the same language

The user interface is clearly arranged and you intuitively find your way through the menu. Preprogrammed methods and measuring units, automatic service reminders and numerous wizard features help you in your everyday work.

Works through power outages

Voltage fluctuations or power outages are no threat for the new series of instruments. They automatically switch to battery-operated mode for up to 10 hours. You can continue your measurements as planned without losing any data, time or money.

Modular options for the future

With the stand-alone instruments you have the option to connect an Anton Paar DMA Generation M density meter in the future and therefore build your own measuring system for complete beverage analysis such as PBA-B, PBA-S/SI and PBA-SD.

Built to Work in a Team

Which beverage parameters do you need to determine? Combine a CarboQC ME module with a wide range of Anton Paar instruments to get the beverage analysis you need in one measuring cycle, with minimum sample preparation required. This teamwork brings quick and efficient results and saves space in the lab.

Accuracy that speaks for itself

CarboQC ME provides fast and accurate information on the selective amount of CO_2 dissolved in a beverage sample using Anton Paar's patented Multiple Volume Expansion method.

Option O_2 completes the team

Option O_2 with CarboQC ME allows the simultaneous determination of the dissolved O_2 and dissolved CO_2 contents in beverages within one measuring cycle. Option O_2 is the perfect complement for Anton Paar's beverage analysis systems such as PBA-S/SI/SD and PBA-B Generation M.

A strong partner

Parameters such as density are influenced by dissolved CO_2. Knowledge of the true CO_2 content can be used to fully compensate the influence. This means that no more degassing is required!

Stability for years

As the measuring module is permanently connected to the density meter and does not have to be disconnected or moved, it has a high level of system stability. This gives you reliable results over a long working life.

Fit for the future

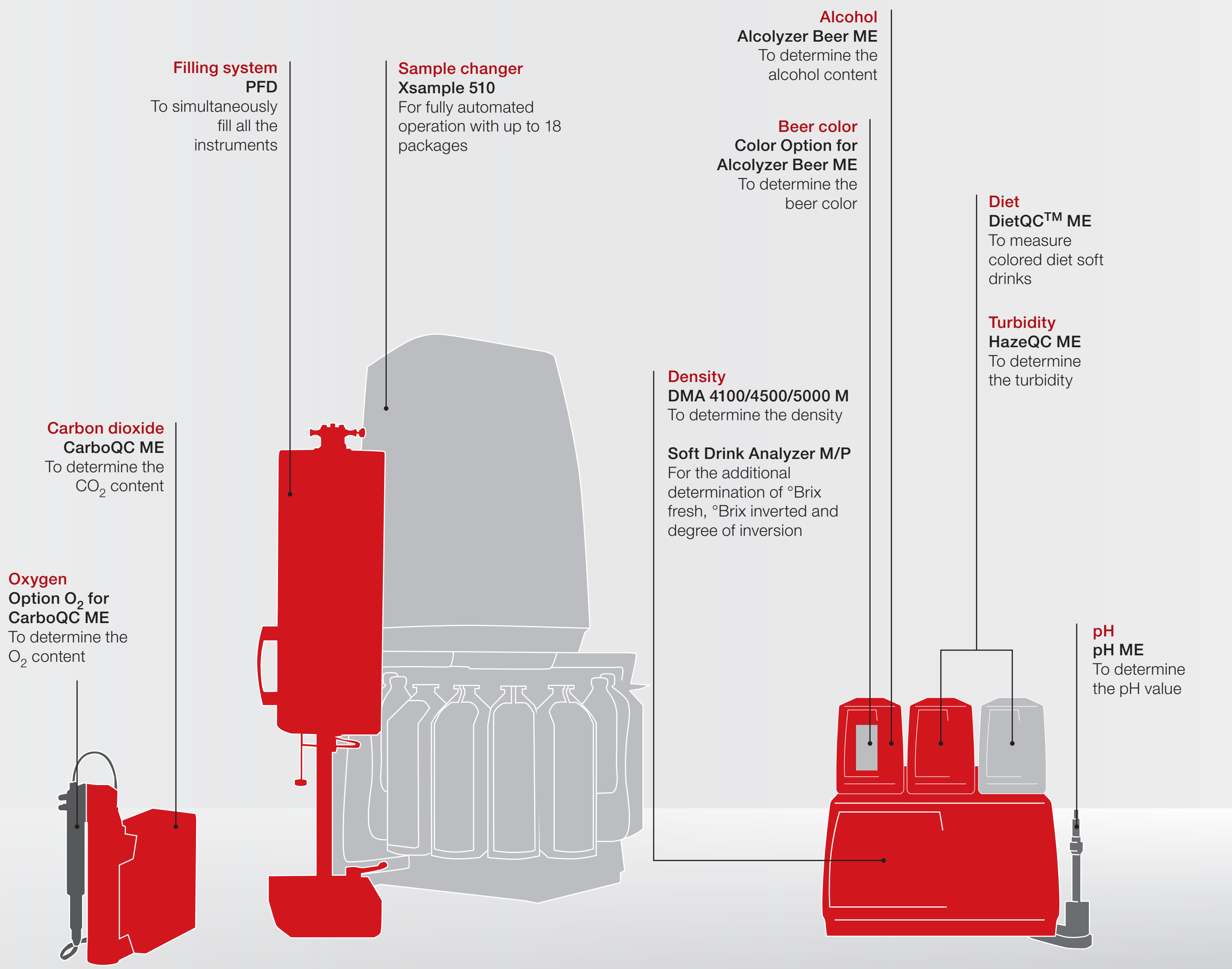
Combining a CarboQC ME module with a DMA Generation M density meter and PFD is a secure investment which allows you to add further modules in the future. Whether you require an Alcolyzer, the Option O_2, automatic sample changer or other modules at a later date, Anton Paar's modular concept allows you to create a measuring system to exactly suit your requirements.

	PBA-B	PBA-S	PBA-SI	PBA-SD
Standard configuration				
Master instrument	DMA M	DMA M	SDA M/P	DMA M/ SDA M/P
CarboQC ME	●	●	●	●
Alcolyzer Beer ME	●	○	○	○
DietQC^{TM} ME (not with DMA 4100 M)	○	○	○	●
PFD	●	●	●	●
Options				
pH ME	●	●	●	●
Option O_2	●	●	●	●
Options for the corresponding system				
Color Option for Alcolyzer Beer ME	●	○	○	○
HazeQC ME	●	○	○	○
Xsample 510 instead of PFD	●	●	●	○

● available for the configuration ○ not available for the configuration

All results at a glance

The combined system provides the utmost convenience: The CO_2 and O_2 values are automatically transferred to the master instrument. Measured data are displayed on the DMA M density meter screen along with all other measured parameters. Just press a button to print these results as one report.

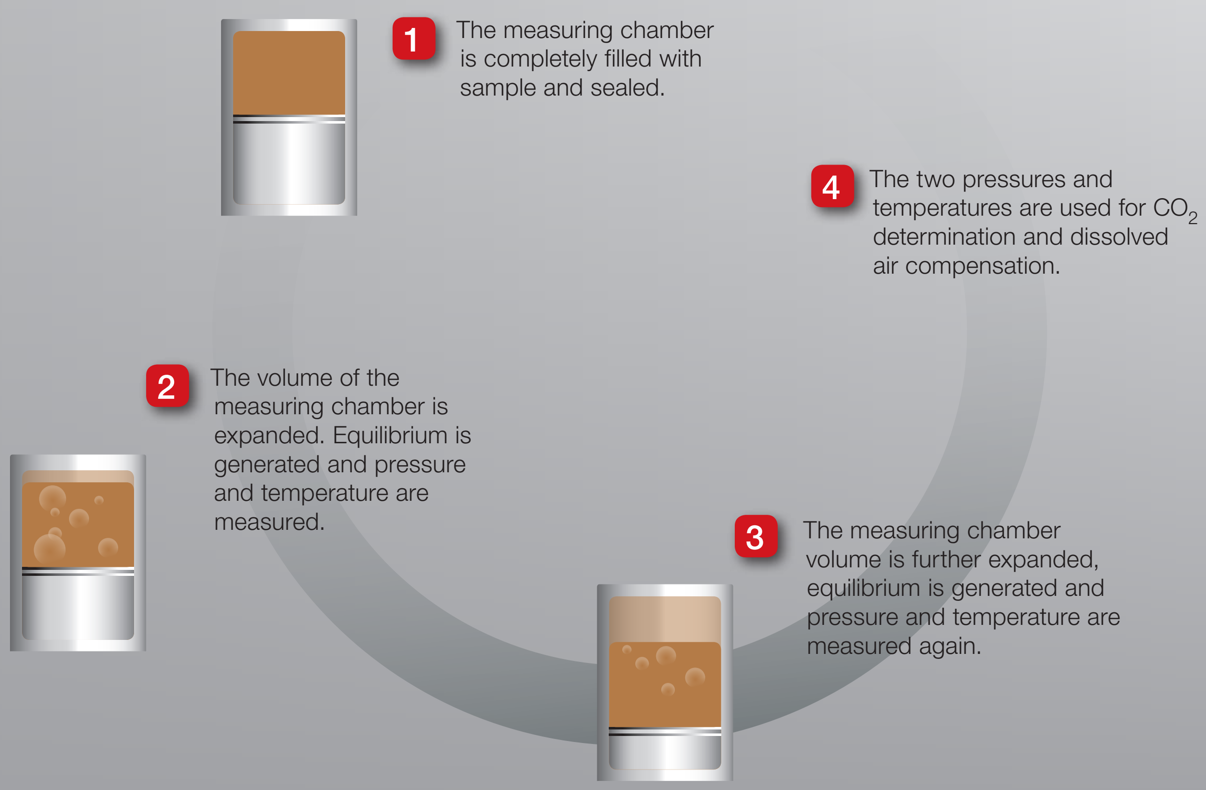


Unique:
Multiple Volume Expansion Method

The Multiple Volume Expansion (MVE) method was invented and patented by Anton Paar (AT 409673, GB 237 3584, US 6,874,351). It determines the true dissolved CO_2 content in beverages.

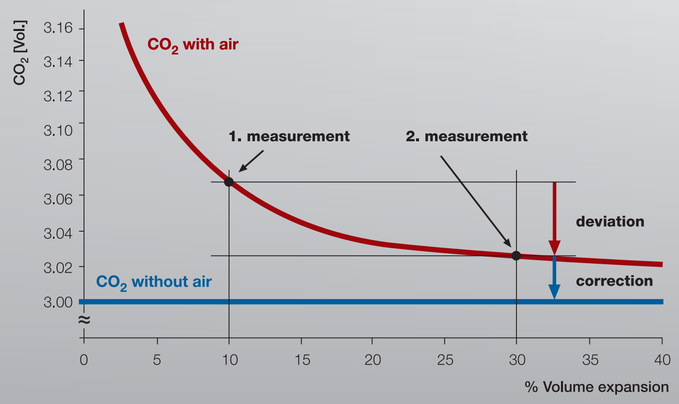
How does it work?

The short answer is: MVE is a selective method. By expanding the measuring chamber twice, only the CO_2 content is determined and the effect of other gases - such as air or nitrogen - is eliminated. In more detail the method works as follows:



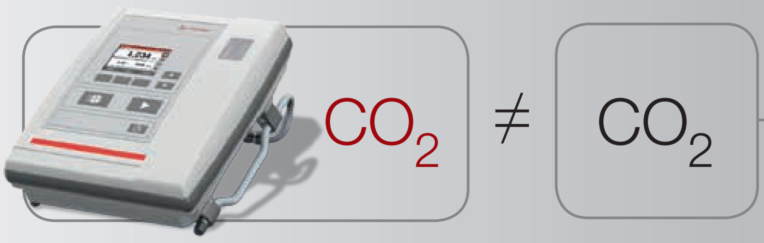
Why does it work?

The patented Multiple Volume Expansion method makes use of the fact that the solubility of air in beverages is much lower than that of CO_2. Due to the difference in solubility, when expanding the volume of the measuring chamber, the partial pressure of air decreases much more than that of CO_2. The difference between the equilibrium pressure and temperature results measured at the first and second volume expansions of the measuring chamber is used to determine the amount of dissolved air and mathematically calculate and compensate for this amount. The result is the true CO_2 concentration in the beverage.



Why do CO_2 results differ depending on the measuring method used?

The answer lies in the way the measurement is influenced by the following factors:



- External environmental influences
  - Altitude & weather
- Method-dependent influences
  - Snifting
  - Compensation tables
  - Incomplete equilibration
- Sample-dependent influences
  - Dissolved air in the sample
  - Package size

Altitude & weather

Environmental factors affect CO_2 measuring instruments. Anton Paar's CO_2 meters have an integrated absolute pressure sensor for accurate correction.

Snifting

Snifting is generally performed with traditional pressure/temperature (p/T) methods for compensating dissolved air when measuring CO_2 in bottles or cans. Snifting means briefly opening and closing the package in order to release the overpressure in the headspace to the ambience. During snifting, some carbon dioxide is also lost from the beverage which may lead to falsified results. With Anton Paar's CO_2 meters no snifting is required due to the used Multiple Volume Expansion method.

Compensation tables

Tables are used to compensate the effects of snifting. However, as snifting is affected by many external factors, it is impossible to know whether the tables are compensating too much, not enough or correctly for the snifting effects. With Anton Paar's CO_2 meters neither snifting nor compensation tables are required.

Incomplete equilibration

Incomplete equilibration, which is an unequal CO_2 distribution between gas phase and liquid phase, causes the CO_2 measurement to deliver results which are different than the actual CO_2 content.

Dissolved air in the sample

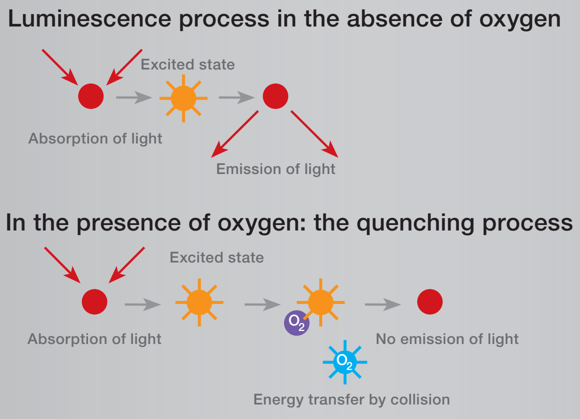
Traditional pressure/temperature (p/T) methods do not differentiate between the partial pressure of air and the partial pressure of CO_2 measured in the beverage. Pressure measurement is assumed to be a one-to-one measure of carbon dioxide alone, which is incorrect. This effect is also seen when using instruments which apply single expansion of the measuring chamber.

Package size

Traditional p/T methods determine the CO_2 content indirectly by measuring temperature and pressure right out of the gas phase in the headspace. Depending on the type of package, the headspace sizes vary, which affects the amount of CO_2 measured. Anton Paar's CO_2 meters directly determine the CO_2 content out of the liquid phase and this therefore guarantees the true CO_2 values.

Precise:
O_2 Measuring Method

The continuous monitoring of the oxygen content with an instrument that remains unaffected by other dissolved gases is indispensable for beverage analysis. Anton Paar presents a new dimension of measuring dissolved oxygen in beverages.



Measuring principle of dissolved oxygen

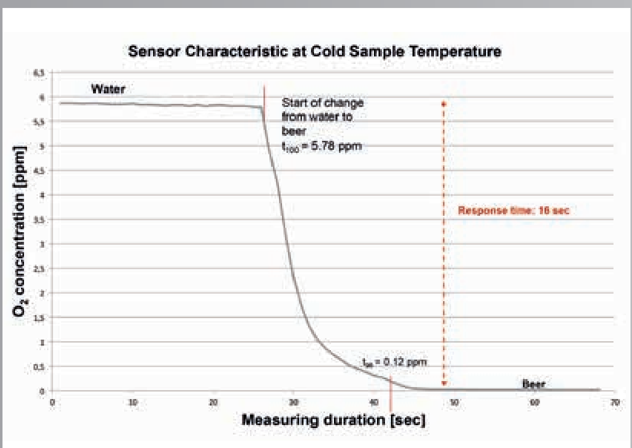
How does it work?

Anton Paar's oxygen meter uses an optochemical sensor for fast and highly accurate determination of dissolved oxygen. The principle of measurement is based on the effect of dynamic luminescence quenching by molecular oxygen. The new way of measurement in this sensor allows measuring while liquids are flowing through the cell. It is not a stationary measurement.

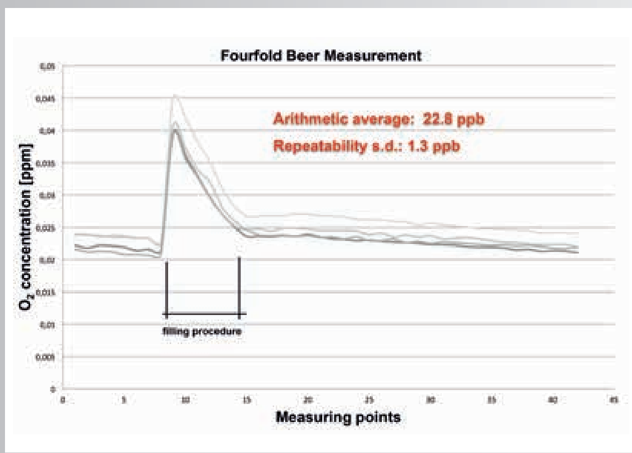
What makes Anton Paar's measurement of oxygen unique?

The pressure-resistant, high-resolution optical oxygen sensor correctly measures all kinds of beverages. The fast response time and ideal temperature behavior of the sensor allow excellent measurement stability within a few seconds, even when measuring cold samples.

The measuring principle guarantees results based on the repeatability of ± 2 ppb and reproducibility of ± 4 ppb as well as multiple measurements even out of small sample packages. The sensor has a long working life and requires minimal maintenance.



The sensor characteristic shows a response time of less than 20 seconds when changing from water to beer at 4 °C to 7 °C.



Measurement conditions:
Sample package: 0.5 L beer can
Temperature: 6 °C to 11 °C
Rinsing volume before starting measurement: 240 mL
Rinsing volume between each measurement: 50 mL

Oxygen determination – simple, accurate and ready for measurement anywhere!

Filling Directly from Closed Packages

Filling CarboQC, CboxQC and OxyQC in the laboratory

PFD Piercing and Filling Device

Fill samples reliably and safely directly out of closed PET bottles, glass bottles or cans into the measuring chamber using the PFD. No sample preparation, such as degassing or filtering, is needed. PFD pierces the bottle closure or the base of the can and transfers sample from the package using compressed gas. No dissolved CO_2 or O_2 is lost.

- gas spring for safety shield ensures operator safety
- easy cleaning due to removable safety shield
- robustness guaranteed by clever design and high-quality materials

SFD Sparkling Wine Filling Device

For transferring sample from wine and sparkling wine bottles closed with corks, the SFD filling device is available. SFD pierces the cork and inserts a sample tube. The sample is transferred under pressure without loss of CO_2. The SFD Filling Device can be used with most plastic and traditional corks.

- full operator protection
- for all sizes, from small bottles to magnum bottles
- sample transfer directly from the bottle

Filling CarboQC ME or CarboQC ME and Option O_2 in a modular system

To fill a modular system including a CarboQC ME (e.g. Anton Paar's PBA systems), you can connect a PFD or SFD for single samples or use an Xsample 510 package sampler.

Xsample 510 Package Sampler

The Xsample 510 fills samples from up to 18 different types of bottles or cans automatically and cleans the measuring cells between measurements.

- high sample throughput – optional bar code reader
- fully automatic filling and cleaning
- easy handling - high safety standard - robust design

Specifications

		At-line		
		CarboQC At-line	CboxQC™ At-line	OxyQC
Measuring range	CO_2	0 g/L to 12 g/L (0 vol. to 6 vol.) at 30 °C (86 °F) 0 g/L to 20 g/L (0 vol. to 10 vol.) < 15 °C (59 °F)		--
	O_2	--	0 ppm to 4 ppm	
	Temperature			
	Pressure	0 bar to 10 bar absolute (0 psi to 145 psi)		
Repeatability s.d.	CO_2	0.04 g/L (0.02 vol.)		--
	O_2	--	± 2 ppb[a]	
	Pressure	0.01 bar		--
Reproducibility s.d.	CO_2	0.1 g/L (0.05 vol.)		--
	O_2	--	± 4 ppb[b], ± 10 ppb[c], ± 20 ppb[d]	
	Pressure	0.08 bar		--
Resolution	CO_2	0.01 g/L		--
	O_2	--	0.1 ppb < 100 ppb	
O_2 response time t_{98}%		--	less than 20 seconds at 25 °C, from air to nitrogen	
Measuring units		CO_2: g/L, vol., kg/m^3 Temperature: °C, °F, K Air/O_2/N_2 Index: ppm, mg/L Package pressure: bar, psi, mbar, kPa	CO_2: g/L, vol., kg/m^3 O_2: mg/L, ppm, ppb, % sat., µg/L Temperature: °C, °F, K Air/N_2 Index: ppm, mg/L Package pressure: bar, psi, mbar, kPa	O_2: mg/L, ppm, ppb, % sat., µg/L Temperature: °C, °F, K Package pressure: bar, psi, mbar, kPa
Sample volume		150 mL	150 mL	100 mL
Measuring time per sample		55 seconds	90 seconds	50 seconds
Power supply		AC 100-240 V, 50/60 Hz, 1.5 A; DC 12 V, 3.0 A		
Rechargeable battery type		Li-Ion 11.1 V, 2.25 Ah (optional: Li-Ion 11.25 V, 2.6 Ah)		
Maximum at-line operation		up to 10 hours		
Interfaces		1 x USB for PC, 1x RS 232 for printer/AP-SoftPrint optional: 1 x RFID, 1 x Bluetooth		
Data memory		500 measured results		
Options		High-performance battery, RFID/Bluetooth option		
Available accessories		Portable thermal printer with Bluetooth interface, RFID tags, carrying strap		
Protection class		IP 67		
Dimensions (L x W x H)		262 mm x 209 mm x 176 mm (10.3 in x 8.2 in x 6.9 in)		
Weight		2.1 kg (4.6 lbs)	2.7 kg (6 lbs)	1.7 kg (3.7 lbs)

[a] Valid for measuring range < 200 ppb
[b] Valid for measuring range < 1000 ppb
[c] Valid for measuring range < 1000 to 2000 ppb
[d] Valid for measuring range < 2000 to 4000 ppb

	Sample filling	
	PFD piercing and filling device	SFD piercing and filling device for sparkling wine and wine bottles
Filling mode	Pressurized filling from closed packages	Pressurized filling from closed and open packages
Compressed gas supply	6 ± 0.5 bar (87 psi ± 7 psi) relative	7.5 bar relative ±0.5 bar (109 psi ±7 psi) for sparkling wine 3 bar relative ± 0.5 bar (44 psi ± 7 psi) for wine
Package types and maximum allowed volume of packages to be measured	Glass bottles: 1 L Cans: 0.5 L PET bottles: 3 L	Glass bottles: 0.2 L to 1.5 L
Maximum height with piercing head in highest position	1020 mm (40.2 in)	690 mm (27.2 in)
Ambient temperature for operation	0 °C to +40 °C (+32 °F to +104 °F)	0 °C to +40 °C (+32 °F to +104 °F)
Dimensions (L x W x H)	190 mm x 270 mm x 670 mm (7.5 in x 10.6 in x 26.4 in)	320 mm x 370 mm x 550 mm (12.6 in x 14.6 in x 21.7 in)
Weight	10.1 kg (22.3 lbs)	12.3 kg (27.1 lbs)
Power supply	--	--
Interfaces	--	--

[e] Depending on the diameter of the package

Laboratory		System	
CarboQC	CboxQC^{TM}	CarboQC ME	CarboQC ME + Option O_2
0 g/L to 12 g/L (0 vol. to 6 vol.) at 30 °C (86 °F) 0 g/L to 20 g/L (0 vol. to 10 vol.) < 15 °C (59 °F)		0 g/L to 12 g/L (0 vol. to 6 vol.) at 30 °C (86 °F) 0 g/L to 20 g/L (0 vol. to 10 vol.) < 15 °C (59 °F)	
--	0 ppm to 4 ppm	--	0 ppm to 4 ppm
-3 °C to 40 °C (27 °F to 104 °F), acc. ± 0.2 °C			
		0 bar to 6 bar relative (0 psi to 87 psi)	
0.01 g/L (0.005 vol.)		0.01 g/L (0.005 vol.)	
--	± 2 ppb[a]	--	± 2 ppb[a]
0.005 bar		--	--
0.05 g/L (0.025 vol.)		0.05 g/L (0.025 vol.)	
--	± 4 ppb[b], ± 10 ppb[c], ± 20 ppb[d]	--	± 4 ppb[b], ± 10 ppb[c], ± 20 ppb[d]
0.04 bar		--	--
0.001 g/L		--	--
--	0.1 ppb < 100 ppb	--	--
--	less than 20 seconds at 25 °C, from air to nitrogen	--	less than 20 seconds at 25 °C, from air to nitrogen
CO_2: g/L, vol., kg/m^3 Temperature: °C, °F, K Air/O_2/N_2 Index: ppm, mg/L Package pressure: bar, psi, mbar, kPa	CO_2: g/L, vol., kg/m^3 O_2: mg/L, ppm, ppb, % sat., µg/L Temperature: °C, °F, K Air/N_2 Index: ppm, mg/L Package pressure: bar, psi, mbar, kPa	CO_2: g/L, vol., kg/m^3 Temperature: °C, °F, K Air/O_2/N_2 Index: ppm, mg/L Package pressure: bar, psi, mbar, kPa	CO_2: g/L, vol., kg/m^3 O_2: mg/L, ppm, ppb, % sat., µg/L Temperature: °C, °F, K Air/N_2 Index: ppm, mg/L Package pressure: bar, psi, mbar, kPa
100 mL	100 mL	approx. 150 mL	min. 150 mL (when filling similar samples)
55 seconds	90 seconds	approx. 90 seconds	approx. 2 minutes
		--	--
		--	--
		--	--
1 x USB for PC, 1 x RS 232 for printer/AP-SoftPrint/DMA Generation M optional: 1 x RFID, 1 x Bluetooth		2 x CAN	2 x CAN
		1000 measured results	
High-performance battery, PFD, SFD, Xsample 510, RFID/Bluetooth option		Module with DMA M or Soft Drink Analyzer M/P as a master instrument; pH ME, DietQC ME, HazeQC ME, Alcolyzer Beer ME + Color Option, PFD, Xsample 510	
Portable thermal printer with Bluetooth interface, RFID tags, carrying strap, rubber protection		--	--
		--	--
258 mm x 201 mm x 170 mm (10.2 in x 7.9 in x 6.7 in)		305 mm x 85 mm x 275 mm (12.0 in x 3.3 in x 10.8 in)	320 mm x 120 mm x 330 mm (12.6 in x 4.7 in x 13.0 in)
2.0 kg (4.4 lbs)	2.6 kg (5.7 lbs)	approx. 3.0 kg (6.6 lbs)	approx. 3.7 kg (8.2 lbs)

Xsample 510 automatic package sampler
Automatic pressurized filling from up to 18[e] closed packages
6 bar (87 psi) relative
Glass bottles: from 0.33 L Cans: from 0.25 L to 0.5 L PET bottles: from 0.5 L to 3 L
--
0 °C to +35 °C (+32 °F to +95 °F)
900 mm x 750 mm x 1200 mm (35.4 in x 29.5 in x 47.2 in)
75 kg (165.3 lbs)
AC 100-240 V, 50/60 Hz
1 x RS-232, 1 x S-BUS , 1 x CANopen in, 1 x CANopen out

Specifications subject to change without notice.
01/14 D35IP001EN-C

www.anton-paar.com