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BREWING AND BEVERAGE INDUSTRY INTERNATIONAL

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FINAL PACKAGE ANALYSIS
TOTAL PACKAGE ANALYSER
ORBISPHERE 6110

NEW
RAPID PROCESS CONTROL
ORBISPHERE 6110

ORBISPHERE 6110

The ORBISPHERE 6110 total package analyser is the latest technology in final package analysis for O_2 and CO_2 measurements. Designed to meet the practical needs of the at-line brewery environment and to deliver a simple, high quality user interface.

- **At-line ergonomics – simple, effective, time saving**
- **Data confidence – protected, audited, validated**
- **Return on investment – low total cost of ownership**

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HACH LANGE

UNITED FOR WATER QUALITY

QUALITY CONTROL IN THE BREWERY

Innovative Technology for gas analysis in beer packages

Final package analysis is an important step for any brewery. Here, the bottle or can is controlled for the last time before being released to market. Among other parameters, O_2, TPO (Total Package Oxygen) and CO_2 are measured. New requirements have arisen for the next generation package analysis tool, including performance improvements like analysis time reduction, accurate, repeatable and stable measurements, and data integrity, plus a need to simplify operation and maintenance. This article presents a new, patented and innovative technology that delivers against today's high performance requirements.

Why measure gases?

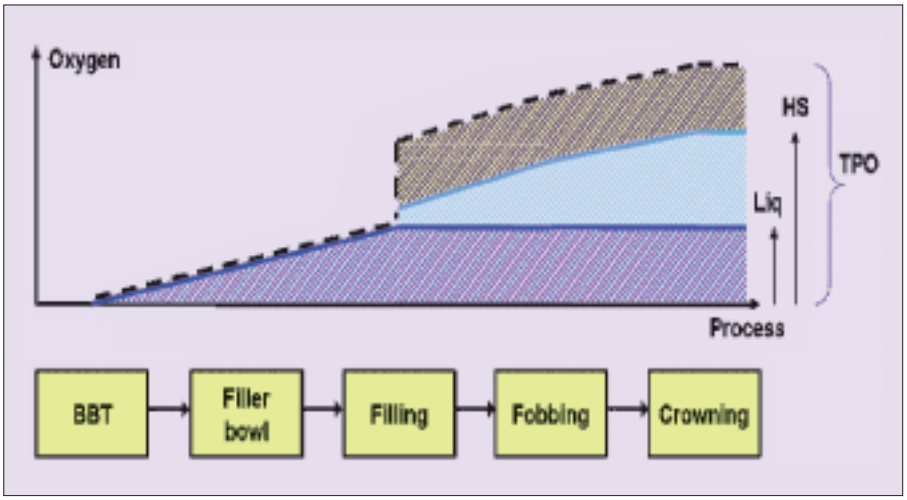
Although all precautions are taken to avoid air contamination and CO_2 losses in the process, the last steps of package filling and bottle crowning are the most critical when considering both gases. Oxygen from the air generates off-flavours and dramatically reduces shelf life.

CO_2 participates to the mouth-feel of the beverage and is complementary to other flavour specifications. For these reasons it is now common that both gases are measured right after the filling step.

What is TPO?

TPO is the amount of oxygen in a package that is available to react with the beverage in that package. It is a calculated value that combines the dissolved and headspace oxygen – the mass of the oxygen in the liquid plus the oxygen in the headspace divided by the volume of liquid in the package.

The normalisation to the total package volume allows easier comparisons between packages of different sizes and allows control limits or alarms to be set more easily.



Oxygen contamination steps in the liquid and in the headspace (HS).

Why measure TPO instead of Dissolved Oxygen (DO_2)?

Data gathered from several plants showed that two thirds of TPO "out-of-spec" conditions are generated by air contamination in the headspace occurring during and right after the filling process. The identification of the cause can only be done by measuring TPO. Measuring TPO and controlling the process can be done in several ways (see next section) and requires resources, time and money.

Due to these reasons, TPO control is sometimes neglected, assuming that line and filler operations are stable over time. This is a very uncertain assumption that can have strong, negative implications for final product quality and shelf life.

Today, flexible filling lines manufacturing different types of packages and beers require many, frequent parameter changes. This exposes the filler to non optimal working conditions, particularly during start up and shut down.

Georges Schmidt

Hach Lange Geneva,
Product Application Manager

The consequence is clear: measuring only DO_2 will not give a complete air contamination diagnostic of a package and basic Quality Control can not give the full picture of process performance.

Available techniques for TPO analysis

Available techniques can be divided in three groups following the evolution of chemical analysis tools dedicated to QC purposes.

Chemical: Zahm & Nagel

After shaking, the package CO_2 is absorbed with caustic soda. The remaining non absorbed volume gas is assumed to be air.

Instrumental: DO_2 and Z factor

Method known as the EBC 11.5. It requires a DO_2 analyser. Prior to measurement, equilibrium is achieved through shaking. The DO_2 is measured and a Z factor applied to find the TPO. The Z factor takes account of temperature and package volumes (HS and total).

Instrumental

The original Orbisphere analyser model 2740 measures the headspace using an appropriate sampler and a separate DO_2 measurement. The TPO is then calculated.

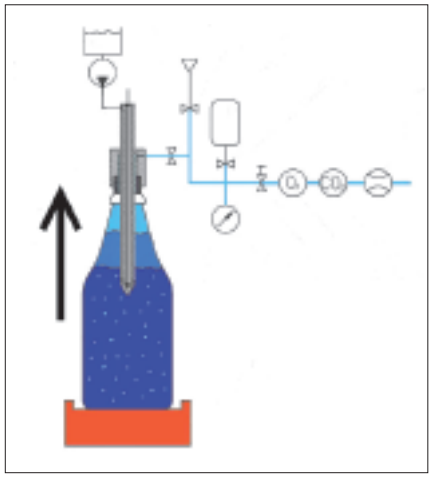
The model 3625 superseded this and performs the TPO in one step but still requires equilibrium of the package. In addition, it also measures the CO_2 but does not provide initial O_2 in liquid and headspace.

Discussion

Although very affordable, the first method does not comply with many of today's safety rules in the lab due to the corrosive reagent. The method is also operator dependent (shaking operation) and is not accurate enough for today's modern plant or where N_2 blanketing/injection is used.

The EBC method is cost effective but does not provide information of O_2 in the liquid and in the HS. It requires also time to equilibrate the package.

Instrumental analysis has provided the most consistent results for many years but as instrumentation tools evolve, improvements in analysis time, reliable performance, ease of use, and lower cost of ownership are possible.



All package gases are measured without extracting the liquid.

A new, patented, innovative technology

When discussing a new generation of TPO analyser, users and plant managers were asking for the following:

- It has to be very easy to use,
- The TPO analysis should be performed quickly
- It should provide data confidence with calibration/validation quickly performed. Data records should be secure,
- Robustness has to be insured in all circumstances with minimal maintenance,
- Cost of ownership should be as low as possible.

In order to exceed such requirements a new analyser, the Orbisphere 6110, has been developed that uses a gas sampling technique in cans or bottles. This patented technique uses ultra sound for sample preparation and pattern recognition in the algorithm calculation.

Principle of measurement

The new analyser includes sensors for six parameters: oxygen, CO_2, flow, pressure, temperature and barometric pressure. The TPO and CO_2 analysis is achieved in a fully automated five step process:

- Bottle or can piercing-temperature measurement in the liquid,
- O_2 measurement in headspace with a controlled gas extraction,
- Ultra sound exposure of the package and measurement of CO_2 with pressure and thermal conductivity sensor,
- Controlled extraction of CO_2 and measurement of the DO_2 by combination of flow and integration of the concentration over the time,
- Headspace volume determination.

The system reports O_2 and CO_2 in the liquid, in the headspace, in the whole package and also the HS volume. During the standby mode, a continuous high purity CO_2 purge is provided to the whole sample path. This keeps the system at low oxygen concentration, ready to measure low TPO in all packages.

The patented Controlled Gas Extraction

This process eliminates the need for liquid sampling. As a consequence, it minimises maintenance requirements and ensures consistent operation and results. It maximises the analyser "up time" and answers the users need for reliability. Gas sampling also allows for simple, reliable system calibration and validation.

An on-board pump is used to deliver a flow of air at a known temperature and pressure to the O_2 sensor for proper calibration or verification. Both operations can be activated manually or automatically. An additional gas inlet is available to connect an O_2 standard, for instance 100 ppmV in nitrogen, for verification at low levels if required.

The CO_2 sensor can also be manually or automatically calibrated or validated by knowing the purity of the CO_2 purge gas used. All the described features combined with automatic operation, reduced operator dependence and three security levels for system operation provide the answers for complete confidence in the data.

Ergonomics do matter

Because final package analysis can be performed tens of thousands of times per year, at line ergonomics and ease of use were

topics focused on during the development of the Orbisphere 6110.

Productivity and performance

The automatic anti-foam injection just after piercing reduces the time usually required for foam collapse in the bottle or can. In this way a high analysis throughput is achieved with total analysis time, from package pick up on the line, varying between 3-6 minutes from the very first sample. Analysis time is dependent on the size of the package and the oxygen content. Such performance and ease of use allows the analyser to be installed close to the filler for rapid information on plant performance as well as final QC reporting.

Ease of use

Three positioning aids allow quick and easy package positioning. The sample platform can be tilted for optimal can measurement, no additional devices are required. The symmetric design of the enclosure allows for easy operation by left or right hand users.

No PC is needed for the whole system operation and all menus are readily accessible via a touch screen positioned in front of the operator. No special operator skills are required due to the simple menu driven system for operation and maintenance.

A single button push starts the measurement sequence and at the end all data is sent to the internal memory for review or further transfer via a USB key or an intranet connection. An on-board wizard shows clear pictures on procedures for basic maintenance operations.

Safety

A shield protects the operator against possible bottle breakages. The package rim is automatically detected and an emergency button stops the measurement process if required by the operator.

Cost of ownership

Nowadays it is not only important to deliver a Quality Control tool with high performance but also to provide a reduced cost of ownership. This is achieved through the automatic measurement and calibration sequences and the removal of manual operations.

The new automatic multi parameter analyser Orbisphere 6110.

The gas sampling concept avoids liquid extraction and consequent, time consuming, system cleaning operations. It provides robustness and reliability of the analyser. Such features minimise downtime and operator involvement.

Short analysis time, samples taken straight after the filler and analysis performed by the line operator gives the plant management quick information on the filling process and allow rapid response to any out-of-spec operation. The rapid analysis also reduces product waste, when compared with traditional procedures that require up to 6 times more total time. With rapid out-of-spec reporting and low cost per analysis the 6110 analyser provides a pay back time of less than 2 years that can be even shorter depending on the specific operation of the brewery.

Conclusion

Data confidence, at line ergonomics and rapid return on investment are provided by the Orbisphere 6110 multi parameter analyser using an innovative sampling and measurement principle. It has been proven to be a highly valuable tool to increase filling and production performances in the brewery. □

Ten main sources of O_2 pick up:

1. Improper purge of the filler bowl
2. Incorrect settings for gas evacuation and CO_2 counter pressure, single instead of double purge
3. Displacement of in-package gases by turbulence
4. Short filling tube length resulting in higher risk of oxygen pick-up
5. Poor foam generation on the bottle neck between filler and crowner due to non optimal settings: water jet angle, pressure, etc. Foam does not reach the top of the neck just before crown application
6. Poor purging of crowns and crowner with inert gas
7. Inconsistent fill heights and headspace
8. No oxygen scavenger in the crown seal
9. Incorrect crimp on the crowner to avoid leakage/ingress
10. Frequent stops of the filler