A Novel Method for Measuring Oxygen in Processing Applications
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Pentair Haffmans

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Agenda

- Pentair and Pentair-Haffmans background
- Optical oxygen technology
- Why and where to measure oxygen
- What is TPO and new differentiated technology
- Optical oxygen management Tools Overview
- Conclusion

Pentair CPT

Pentair welcomes Clean Process Technologies!

As of May 12, the companies under Clean Process Technologies (CPT) – Filtrix, Haffmans, Nijhuis, Pentair Components & Services, Pentair Process Technology, Südmo and X-Flow – became part of Pentair's Filtration Solutions global business unit.

Pentair is a global diversified industrial company headquartered in Minneapolis. With revenues of about $3 billion, Pentair employs approximately 14,500 people worldwide.

Pentair CPT

- Pentair Filtrix
- Pentair Haffmans
- Pentair Nijhuis
- Pentair Process Technology
- Pentair Südmo
- Pentair X-Flow

Pentair CPT Companies

Pentair Südmo

Pentair Südmo offers an extensive range of sanitary and aseptic valves and fittings, complete manifolds, design review and superior customer service for the food, dairy, beverage, pharmaceutical and consumer products industries.

Pentair Haffmans

Pentair Haffmans develops and supplies quality control equipment and total CO2 and O2 management systems for the brewing and beverage industries.

Pentair X-Flow

Pentair X-Flow develops, manufactures and supplies membranes for municipal and industrial applications, including potable water, process water, wastewater treatment, water for re-use and desalination.

Pentair Filtrix

Pentair Filtrix develops and manufactures innovative point-of-use and point-of-entry water purification products based on membrane and activated carbon technologies.

Pentair Nijhuis

Pentair Nijhuis develops, manufactures and supplies centrifugal high performance pumps, and pumping systems for the water, wastewater, fire fighting, steel, paper, chemical, marine, and dredging industries.

Pentair Process Technology

Pentair Process Technology engineers and supplies Beer Membrane Filtration technology and state-of-the-art breweries.

Pentair Haffmans

Pentair Haffmans has 60 years of experience in providing CO_2 and O_2 management, quality control equipment and green CO_2 recovery systems.

Headquarters - Venlo, The Netherlands

Major Industries Served

- Brewing
- Beverage
- Wineries & Distilleries

Products

- Quality Control Instruments
- CO_2 Recovery
- CO_2 & O_2 Management

Did you know that …
… Pentair Haffmans can recover CO_2 in breweries and beverage plants, distilleries, wastewater treatment plants, and in biogas plants … and that the recovered green CO_2 is food-grade and suitable for use




Industries

Pentair Haffmans technologies are applied in more and more markets!

Breweries

Soft drink

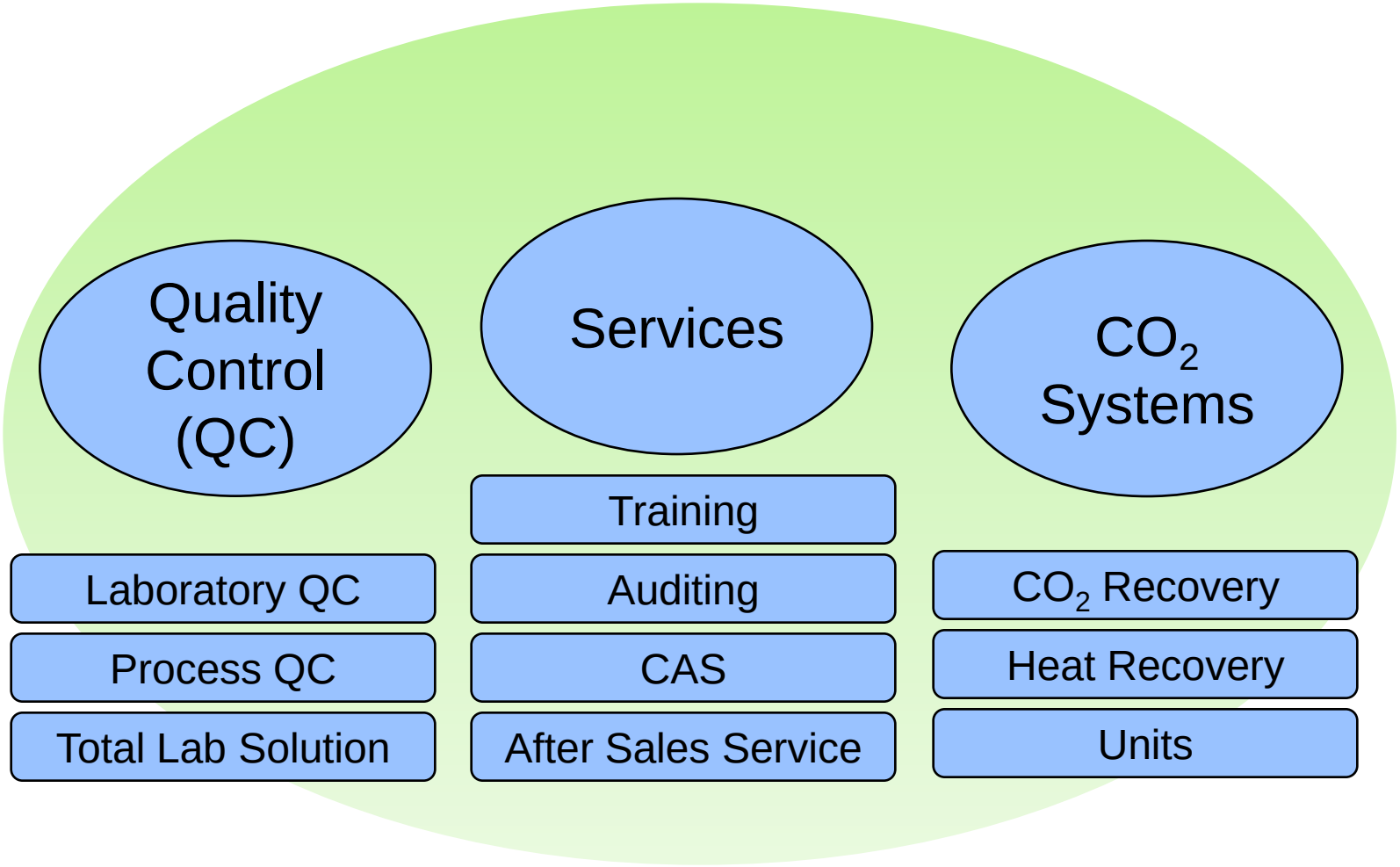
Wine & Cider

Mineral water

Desalination

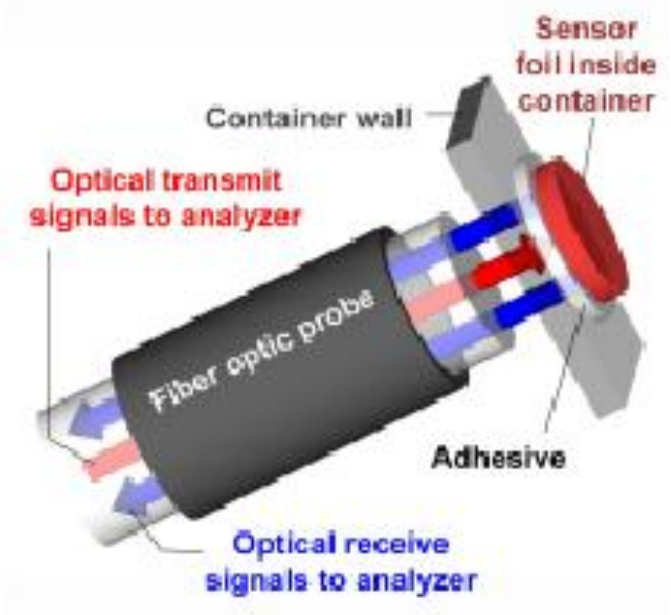
Bio-ethanol / Distilleries

Total Product Overview



O_2 Measurement Principle

To determine the O_2 content, an O_2 sensor(sensor spot) is put in contact with the medium to be measured.
For a short time the sensor spot is intensely illuminated by a light source.
Depending on the O_2 content in the medium the sensor spot will give a light signal.



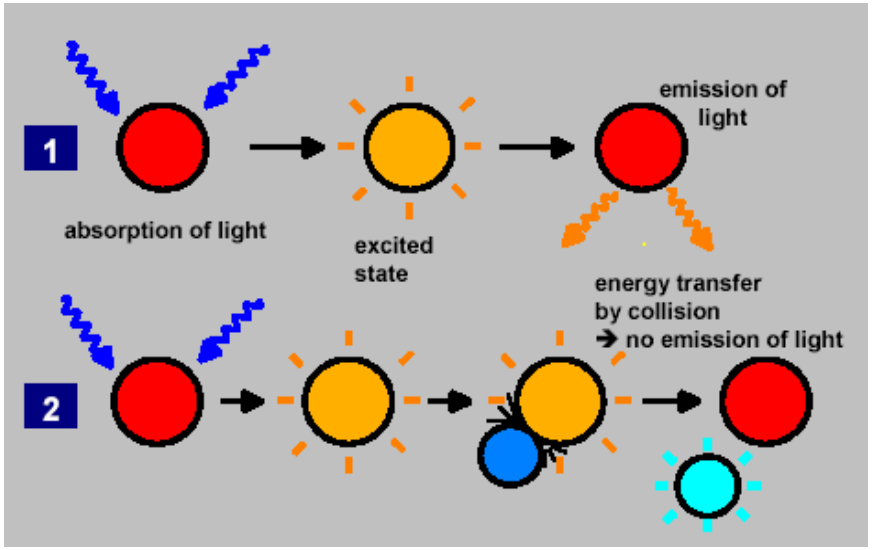
A photo detector measures this light signal and from the signal the O_2 content is calculated.

The sensor spot experiences wear with use and will need to be replaced. The frequency depends on the number of times that the O_2 content is measured by illuminating the sensor spot.

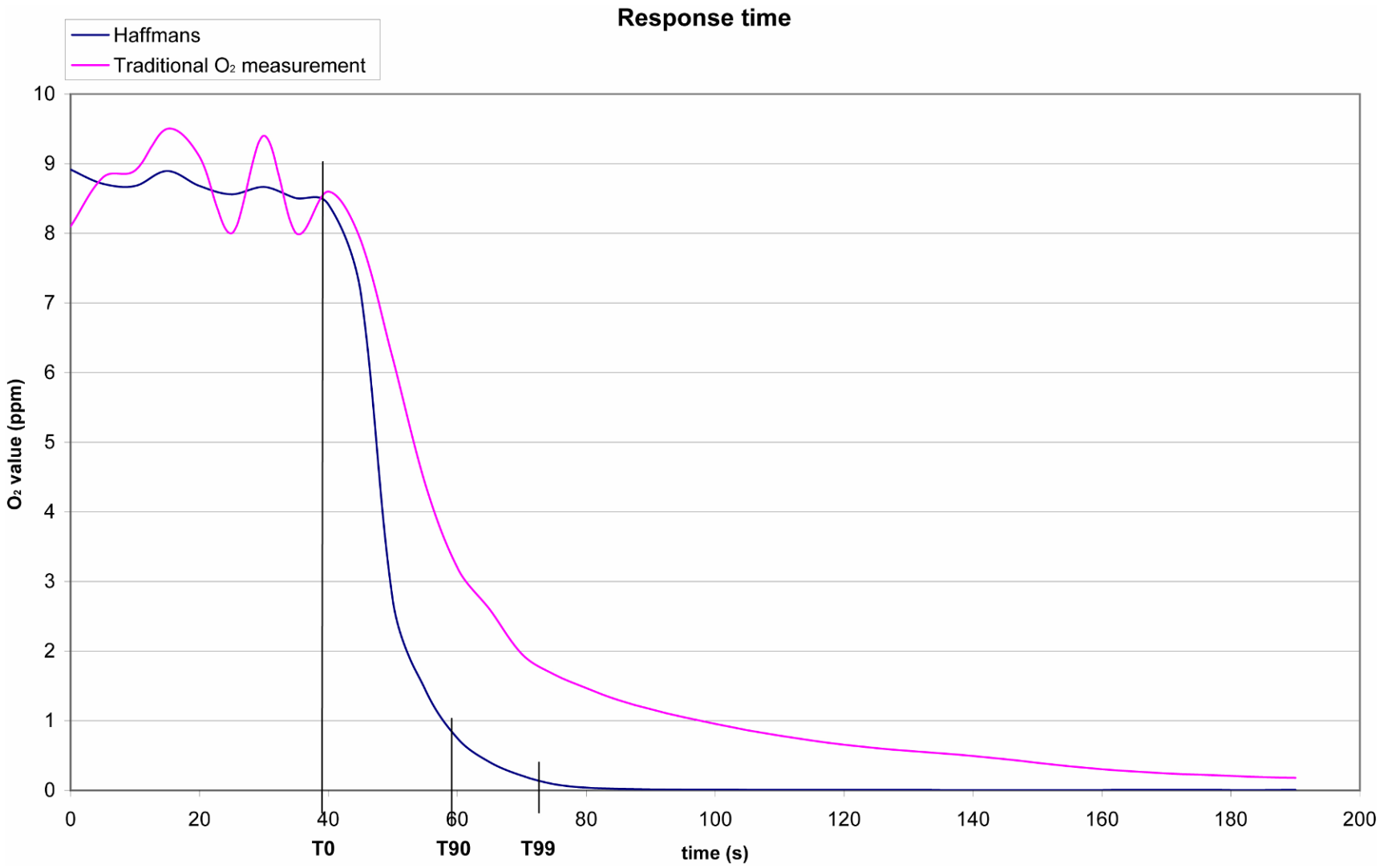
O_2 Measurement – How?

Optical O_2 Measurement Principle

- Optical O_2 sensor
- Based on the quenching of luminescence caused by collision between molecular oxygen and luminescent dye molecules in exited state
- The measurement is temperature compensated



Optical O_2 response time



O_2 Measurement – Why?

- Maintain quality during storage
- Shelf Life assured
- Guarantee content of nutritional components
- Prevent corrosion inside cans
- Enrich with O_2

Improved Sensory and Functional properties

Savings on flavorings and ingredients

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O_2 Measurement – Where?

- Deaeration
- Storage
- Filtration
- Filling
- Finished product
- Wastewater treatment

Laboratory & Analysis

In Process -> Improve efficiency

What is TPO?

TPO = Total Package Oxygen

A measurement of all O_2 within a packaged container, including:

- O_2 in the headspace (HS) – HSO and
- Dissolved Oxygen (DO)

Traditional method for measuring TPO

Preparations

- Acclimatize the sample to 20 ºC (68 ºF)
- Shake for 5 minutes to equilibrium of all gasses
- 3-5 minutes pause time

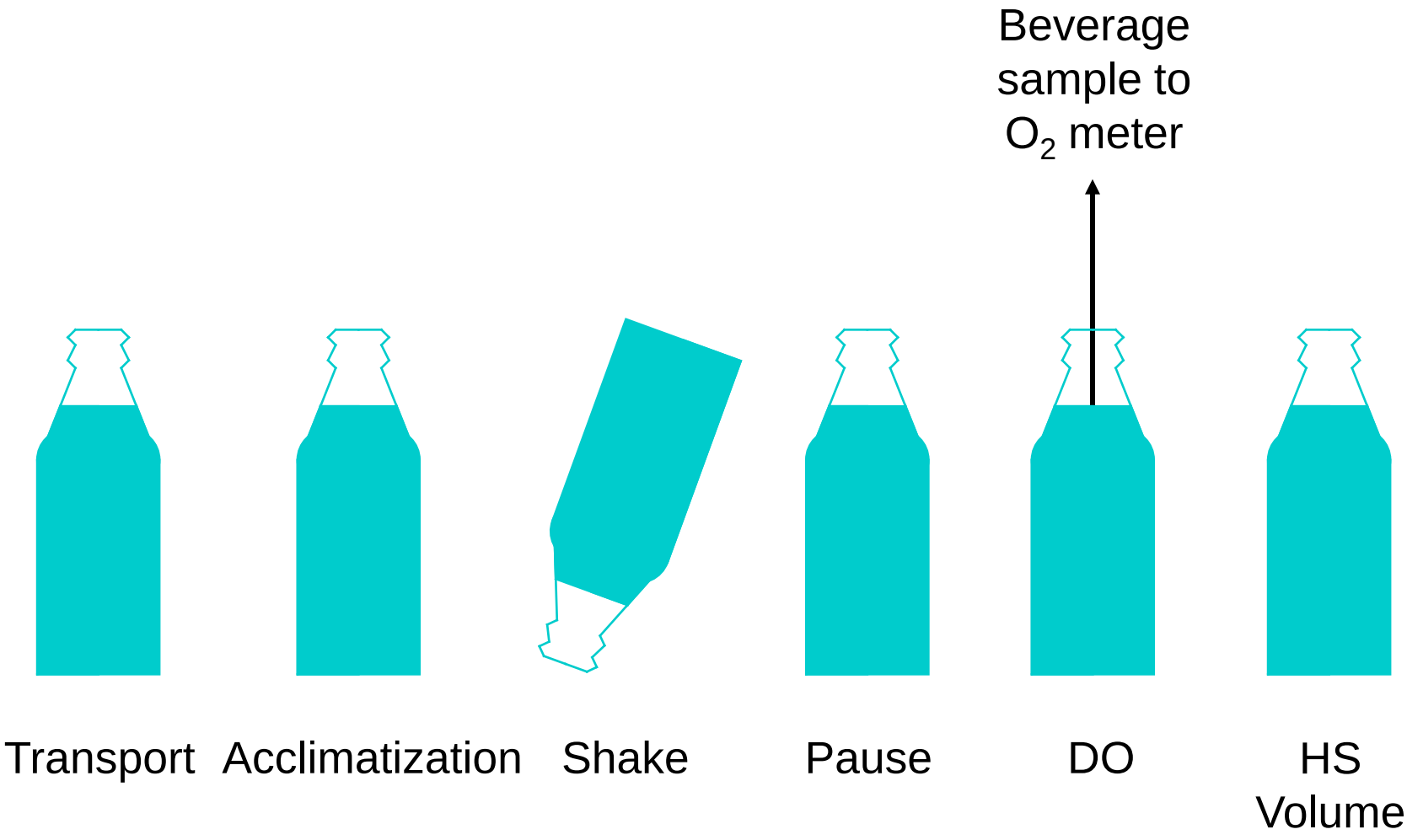
DO measurement

- Beverage sample is forwarded to DO Meter

TPO calculation

- DO x HS x Temperature factor (Z-factor method)

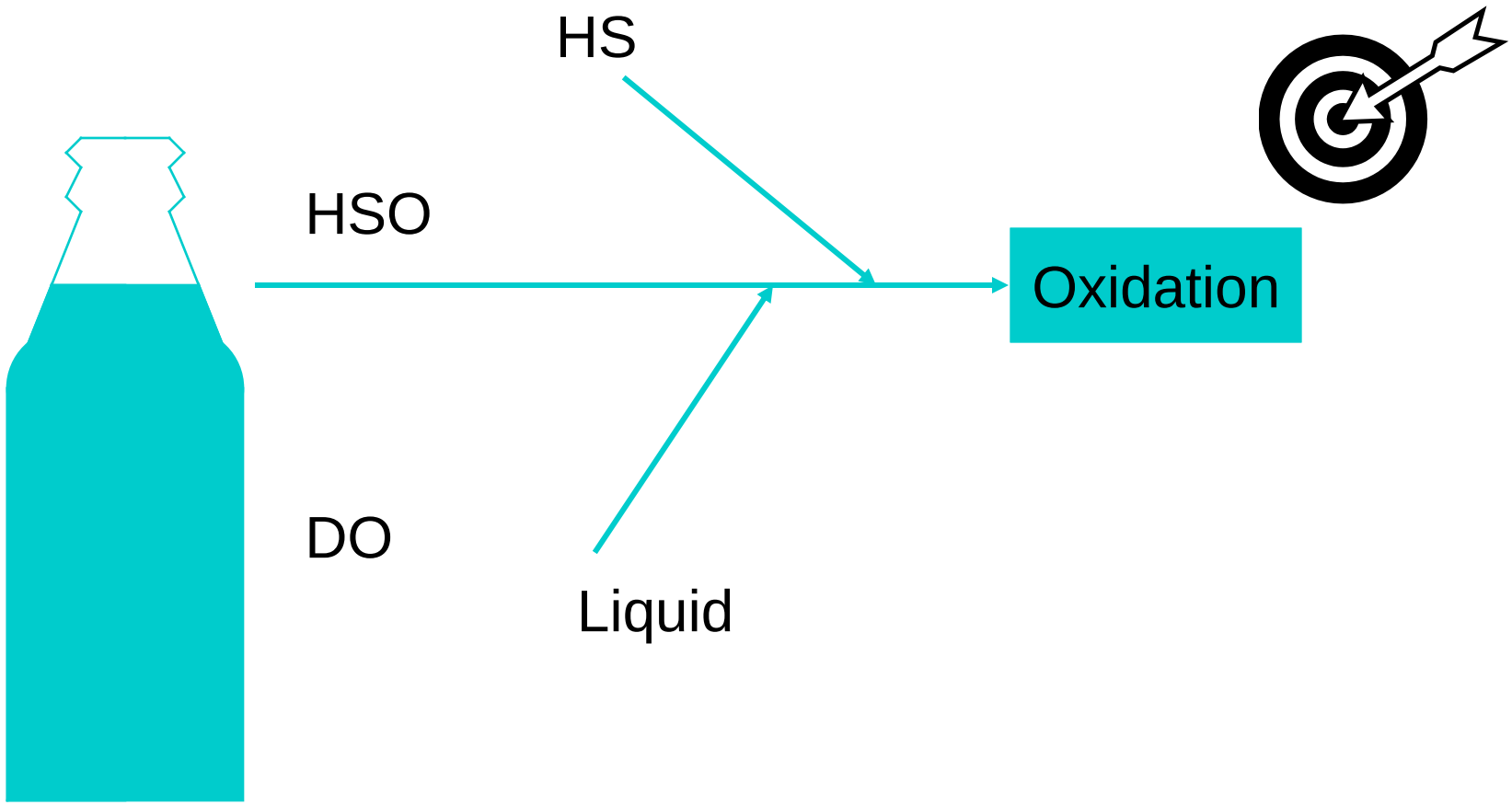
Traditional method for measuring TPO



Traditional method for measuring TPO

- Time: Sample preparation takes more than 10-15 minutes
- Sampling: Risk of O_2 contamination
- Origin of O_2: Not possible to discriminate the origin of O_2
  - HS or
  - DO
- Indirect method

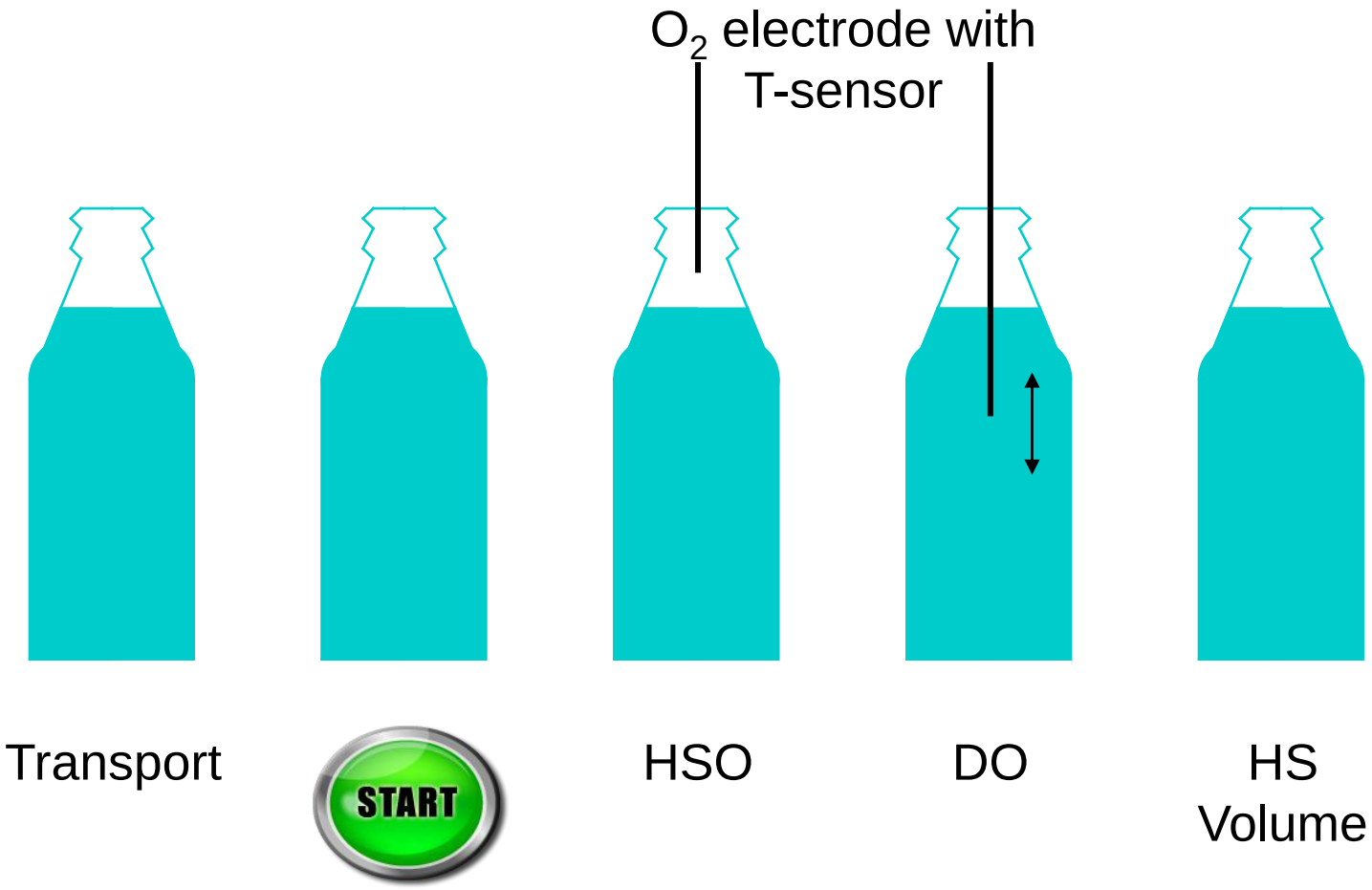
Differentiated measurement



Novel method for measuring TPO

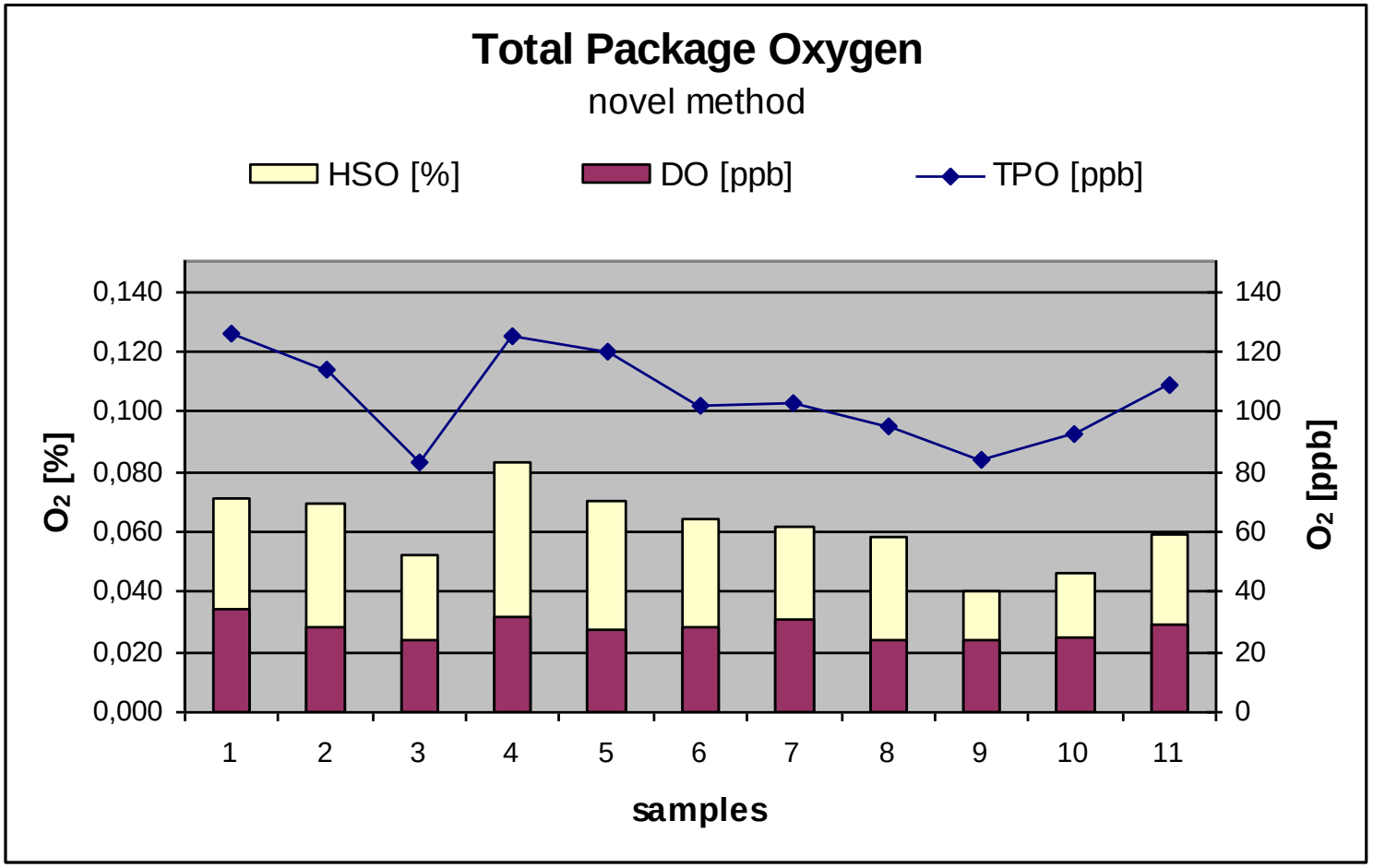
- No sample preparation required
- Sample remains in the package
  - less chance of O_2 contamination
  - able to measure beverages with pulp or fibers
- Origin of O_2: Differentiated measurement of
  - O_2 in HS and
  - DO
- Direct method

Novel method for measuring TPO

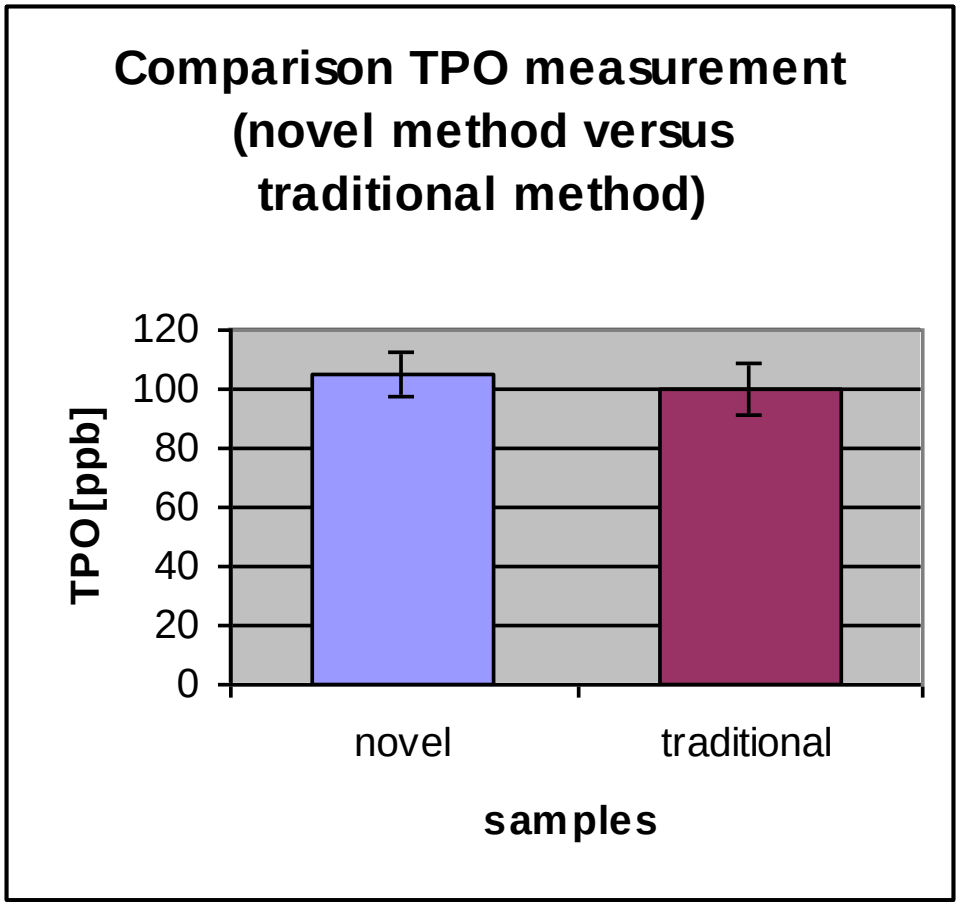


Product remains in the package

Novel method for measuring



Comparing traditional & novel methods



TPO measurements executed with Inpack TPO/CO_2 meter

Inpack TPO/CO_2 Meter, type c-TPO

- Differentiated measurement
  - DO
  - HSO
- Fully automated
- Operator independent
- No sample preparation required
- Beverage remains in package

- Optical O_2 Measurement
  - Reduced maintenance
  - Long stability
  - Quick response
  - No O_2 consumption

Portable O_2

MEASUREMENT

Portable O_2 Measurement

O_2 Gehaltmeter, o-DGM

Type o-DGM

Portable O_2 Measurement

O_2 GEHALTEMETER, RANGE OF USE

O_2 content of carbonated beverages

- in tanks
- in pipelines
- in kegs (pre-mix)
- on dispensing systems
- in bottle and cans (in combination with ISD)

Portable O_2 Measurement

O_2, TECHNICAL DATA O_2-MEASUREMENT

O_2 MEASUREMENT

Measuring Range	: 0.0-2,000 ppb
Accuracy	: 1 ppb +/- 2 % meas. value
Detect. limit	: 1 ppb
Response time (T99,9)	: < 1 minute
Temperature range	: -2 to 40 °C

Portable O_2 Measurement

O_2, USP O_2-MEASUREMENT

- Approved new optical O_2 meas. technology
- Excellent long term stability (no calibration required)
- High accuracy
- Quick response
- No electrolyte that needs to be replaced
- Small sensor size
- No O_2 consumption

In-line O_2 Measurement

O_2

In-line Measurement

In-line O_2 Measurement

IN-LINE O_2 GEHALTEMETER

Transmitter

Sensor

TYPE OGM

In-line O_2 Measurement

OGM, TECHNICAL DATA

O_2 Range	: 0 – 2,000 ppb
Accuracy O_2 Measurement	: 1 ppb (+2% of measured value)
Measuring frequency	: 10 s (adjustable from 2-999 s)
Process connection	: Varivent

Optical O_2 Management Tools

Transmitter

Sensor

Portable O_2/CO_2

Optical technology

Inpack &
Laboratory

Optical O_2 Management Tools

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

Conclusion

- Results of novel and traditional methods are in agreement with a comparable standard deviation
- Added value by differentiated O_2 measurement
- Easy to pinpoint source of O_2 in a package
- Added confidence with knowing sources of O2
- Assurance of ensuring product quality/shelf life

Novel TPO Measurement

A sustainable solution keeps this party going!