## Application Note

# Measurement of gas volume and air content in carbonated fruit juice beverages by gas volume analyzer

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|---|---|
| Industry | Food & beverage |
| Instrument | Gas Volume and Air Content Analyzer |
| Measurement method | Gas volume measurement method |
| Standards | |

## 1. Scope

*Caution*

This instrument needs a 6 mol/L sodium hydroxide aqueous solution which may cause blindness when it contacts human eyes. Be sure to wear protective goggles during handling it.

The measurement of the gas volume, air content, and oxygen concentration of carbonated beverages is an important factor in determining the mouthfeel, taste and flavor, and best-by date. This Application Note introduces an example of measuring commercially available carbonated fruit juice beverages of two different products using a gas volume and air content analyzer. The gas volume is calculated by continuously rotating the sample container and measuring the equilibrium pressure of the gas and the sample temperature. Then, gas in the sample is transferred to the absorbent cylinder and the carbon dioxide gas is absorbed by an absorbent solution (sodium hydroxide solution) filled in the cylinder to measure the air content and oxygen concentration.

## 2. Precautions

- The instrument and samples should be sufficient temperature equilibration with the laboratory room temperature where is maintained at a constant temperature.
- Either the instrument air system or an independent air compressor, both of which can adjust in the pressure range between 0.5 and 0.7 MPaG, is required for piercing and rotating sample bottle/can.
- When measuring samples containing solids like the pulp of small fruits, wash the nozzle after every 5-10 measurements to prevent clogging of the tubing.

## 3. After measurement

- Samples should be disposed of properly after the measurement is complete, as they may be contaminated with the absorbent solution.
- The measurement instrument should be rinsed properly at the end of the day.
- When measuring samples containing solids such as pulp, clean the net filter of the instrument after measurement for the day is complete.

## 4. Apparatus

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| Equipment | Gas volume and air content analyzer |
| Option | Oxygen concentration measurement unit |

## 5. Reagents

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| Absorbent solution | 6 mol/L sodium hydroxide solution |
| Rinse solution | pure water |

## 6. Procedure

1) Select "gas volume/gas pressure + air content measurement (GV/P+AIR)" on the measurement mode, and enter the following parameters into the measurement conditions.

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|---|---|
| < Mode > | GV/P+AIR |
| GV/P Cal. | Soft |
| DISSOLVE | AUTO |
| O2 Meas. | ON |
| < Method > | |
| Start Time | 0 sec |
| Rot0 Time | 0 sec |
| Wait Time | 0 sec |
| Snift Press | .005 MPa |
| MAX Time | 180 sec |
| MIN Time | 10 sec |
| Error Press | .015 MPa |
| Rot1 Time | 70 sec |
| Trial Press | .010 MPa |
| max Time | 180 sec |
| Min Time | 10 sec |
| Trial Count | 5 times |
| Skip Press | .015 MPa |
| Rot2 Time | 20 sec |
| End Press | .015 MPa |

Note that the above measurement parameters are an example and optimizing these parameters might be necessary depending on the sample's property.

2) Set the sample bottle/can on the sample stage and press the Start button.

## 7. Example

Table 1 shows the measurement results of carbonated fruit juices.

Table 1. Measurement results list*

| Sample | n | TGAS [mL] | O2 conc. [%] | Air Volume [mL] | Gas Volume [V/V] | Gas Press [MPa] | Press [MPa] | Temp. [°C] |
|---|---|---|---|---|---|---|---|---|
| Sample A | n1 | 19.5 | 24.7 | 23.0 | 2.71 | 0.218 | 0.294 | 21.6 |
| | n2 | 20.7 | 24.5 | 24.3 | 2.72 | 0.220 | 0.291 | 21.4 |
| | n3 | 18.6 | 25.1 | 22.4 | 2.74 | 0.222 | 0.292 | 21.5 |
| | n4 | 19.2 | 24.8 | 22.8 | 2.75 | 0.223 | 0.293 | 21.3 |
| | n5 | 16.2 | 25.8 | 20.0 | 2.74 | 0.222 | 0.288 | 21.5 |
| | Avg. | 18.8 | 25.0 | 22.5 | 2.73 | 0.221 | 0.292 | 21.4 |
| | SD | 1.678 | 0.495 | 1.597 | 0.016 | 0.002 | 0.002 | 0.093 |
| | RSD | 8.9 | 2.0 | 7.1 | 0.6 | 0.9 | 0.8 | 0.4 |
| Sample B | n1 | 17.8 | 3.5 | 2.97 | 2.68 | 0.215 | 0.298 | 22.1 |
| | n2 | 19.0 | 3.6 | 3.26 | 2.66 | 0.212 | 0.297 | 22.1 |
| | n3 | 19.3 | 3.5 | 3.18 | 2.66 | 0.212 | 0.296 | 22.1 |
| | n4 | 17.5 | 3.6 | 3.00 | 2.67 | 0.214 | 0.293 | 22.1 |
| | n5 | 18.1 | 3.5 | 3.03 | 2.65 | 0.211 | 0.292 | 22.1 |
| | Avg. | 18.3 | 3.5 | 3.09 | 2.66 | 0.213 | 0.295 | 22.1 |
| | SD | 0.757 | 0.058 | 0.126 | 0.011 | 0.001 | 0.002 | 0.037 |
| | RSD | 4.1 | 1.6 | 4.1 | 0.4 | 0.6 | 0.8 | 0.2 |

* Measurement items

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|---|---|
| Gas Volume | Carbon dioxide volume (mL) of 1mL sample volume |
| Air Volume | Gas volume except carbon dioxide in sample bottle/can (mL) |
| Gas Press | Converted pressure in sample bottle/can at 20 ℃ (MPa) |
| Press | Measured pressure (MPa) |
| Temp. | Measured sample temperature (° C) |