HACH ULTRA

EXCELLENCE IN PROCESS ANALYTICS

Application Note

Beverage No. 09

Increase customer satisfaction and loyalty by ensuring consistent CO_2 levels in soft drinks

- CO_2 measurements independent of other dissolved gases
- Solid-state thermal conductivity sensor with no moving parts and low drift

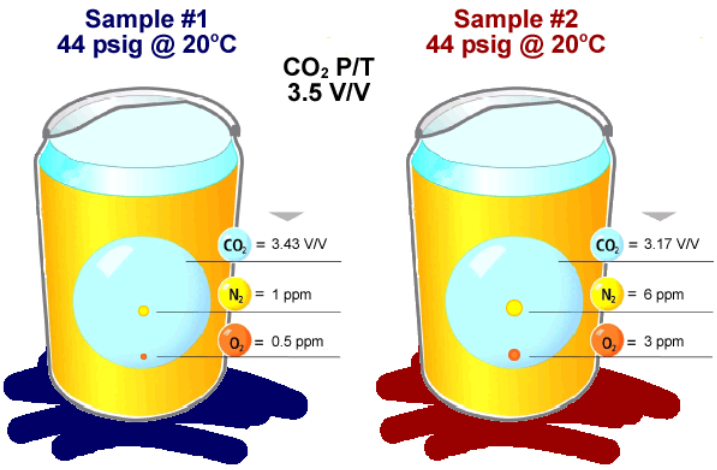
Application description

Consistency of carbonation ensures customer satisfaction and loyalty. Many soft drink bottlers determine carbonation by measuring the total pressure and temperature of a beverage. This method to calculate the amount of CO_2 is risky because it assumes the only gas present in the drink is CO_2, which is often not the case. Air, in varying amounts, is always present in a typical soft drink. The amount of air changes depending on several factors, including source water temperature, incomplete de-aeration and air contamination during production, filtering, and filling.

Measuring the total pressure and temperature is a quick and easy method for determining carbonation. The error in using this method is that it results in an overestimation of CO_2 due to the influence of air. Since air is entrained in the water, introduced during syrup agitation and is picked up at the filler, it adds to the total pressure. As the level of air changes over time, so will the measurement of CO_2 using a total pressure and temperature method. This causes an inconsistent CO2 result which means soft drink bottlers are not able to precisely control carbonation levels.

Air is made up of oxygen and nitrogen. Oxygen and nitrogen dissolved in a beverage do not have the same texture and feel effect as CO_2. Therefore, the measurement of CO_2 pressure specifically is a more accurate parameter for the carbonation level, final product quality, and product consistency.

Consider the two cans in the following diagram. Both the total pressure (P_{total}) and temperature of each can is identical. A CO_2 result using only pressure and temperature would calculate these two cans as being identical. However, the amounts of CO_2, O_2 and N_2 are completely different. In this case, a customer would experience different tastes, textures, and levels of carbonation from each beverage. At best, customers might consider this just a bad can or two. At worst, customers might find the beverage too unpredictable to purchase again.



$$P_{total} = PCO_2 + PO_2 + PN_2 + P_{water\ vapor}$$

A sensor capable of specifically detecting CO_2 does not overestimate carbonation levels, unlike the total pressure/temperature method. One approach is to use a thermal conductivity sensor. Since each gas has its own specific thermal conductivity, a thermal conductivity sensor is not affected by the presence of other gases.

The practice of measuring gases using the thermal conductivity method is well-established in many industries. Hach Ultra offers solid-state thermal conductivity sensors with no moving parts and low drift. Both these features contribute to increased uptime by minimizing the need for calibration and maintenance. Most importantly, thermal conductivity sensors offer the advantage of preventing low carbonation complaints by ensuring consistent product quality.

Installation recommendations

The Orbisphere ProBrix+ inline beverage analyzer is best suited for measuring the specific CO_2 in soft drinks. Using additional sensors, this system also measures O_2, Brix/Diet and temperature. Refer to Application Note 2.03 for more information about the ProBrix+ Beverage Analyzer.

Recommended systems components

Model	Description
3624/4631	CO_2, O_2, Brix/Diet and temperature measuring system
32109	Sampling module, including: Brix/Diet sensor, pump, liquid level sensor
31460	CO_2 sensor, thermal conductivity, with nitrogen purge, including protection cap, with external temperature sensor socket
31110	O_2 sensor, all PEEK, high sensitivity execution, with silver guard ring, ceramic valve seat, EPDM O-ring, and protection cap
32695	ProBrix Plus Windows® software, including statistical analysis program
32907	RS-485 communications port board, with two inputs
29662.mm	Cable for RS-485 communication (mm = length in meters)