ABSTRACT

Traditional methods for measuring carbon dioxide both in the laboratory and online are based on Henry’s Law and use pressure and temperature to calculate dissolved CO2 concentration. These methods are not specific to carbon dioxide and measure all gases including oxygen and nitrogen. A novel sensor has been developed which measures only dissolved CO2 and is suitable for online applications. Based on infrared spectroscopy, the sensor uses the Attenuated Total Reflectance sampling technique to continuously analyze the beverage in flow and no flow applications. The sensor is compact and is designed to fit directly into the process. The operation and design of the sensor are discussed. The performance of the ATR-based sensor will be compared with traditional temperature-pressure based devices. The ATR-based sensor provides improved measurement accuracy which is not dependent on beer type, density or alcohol content, is not affected by pressure surges, and can operate during CIP cycles.

INTRODUCTION

There are many references to the topic of CO2 control in beer. CO2 levels are universally considered critical to final product quality from the supplier’s, as well as the consumer’s, perspective. Taste, presentation, drinkability and packaging of the final product depend on reliable control of this ingredient.

During processing of final beer dissolved carbon dioxide levels are measured along with other key parameters, including specific gravity, real extract, alcohol %, temperature, etc. Manufacturers require CO2 levels to be within the quality control standards set by their brewing chemists and process engineers. These levels in the U.S. may vary from lower levels of 1.5-2.0 Volume/Volume on (Ales) to higher levels of 2.5-2.8 Volume/Volume on (Lagers). To account for shelf loss in plastic packaging, these levels may be increased ~10%. The allowable ranges for the CO2 readings from a tank may be ±0.1 V/V, or ~5%.

Traditional methods for measuring carbon dioxide both in the laboratory and online are based on Henry’s Law which uses pressure and temperature measurements to calculate the dissolved CO2 concentration. These methods are not specific to carbon dioxide and measure all gases including oxygen (O2) and nitrogen (N2).

There is widespread industry understanding and acceptance of the Pressure - Temperature (P-T) measurement method and its limitations. Pressure / Temperature tables have been developed that obtain a good correlation to dissolved CO2 in “standard beer.” These relationships have further been integrated into “on-line” systems that determine temperature measurements to calculate the dissolved CO2 concentration. These methods are not specific to carbon dioxide and measure all gases including oxygen (O2) and nitrogen (N2).

There is a preponderance of evidence to show that the Mid IR ATR measurement method offers many advantages over temperature-pressure methods. CO2 specificity and elimination of errors due to alcohol and specific gravity of the beer, which affects the solubility of CO2 in beer, are key attributes. When used in a process stream for automated production management, further benefits are realized when compared to manual sampling including 24 x 7 operation, minimization of human error and the ability to see related quality parameters such as CIP cycles. All of the mentioned factors are interrelated and contribute to the cost and quality of the beer as impacted by rework costs, product waste, utility costs, engineering time, and throughput.

The selectivity of the Mid-IR ATR measurement method produces a “true CO2” measurement of dissolved CO2. In most cases, the true CO2 measurements will differ from traditional temperature-pressure derived measurements. The advantages of the true CO2 measurement include accuracy, repeatability and the subsequent relationship of these parameters to the production, shelf-life, drinkability and quality of the beer.

REFERENCES

1. The In-Line Determination of Carbon Dioxide in Beer by Infrared Analysis, P.Willkes, MBAA Technical Quarterly vol 25, No 4, pp.113-116