

# How FTIR Technology Can Enhance Carbonated Beverage Quality



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**F**OOD ENGINEERING recently spoke to Daniel Tabrizi, product manager, FTIR Gas Analyzers, Thermo Fisher Scientific, about the role Fourier Transform Infrared (FTIR) technology can play in producing safe, high-quality carbonated beverages.

**FE:** Can you describe the challenges beverage companies face in maintaining consistency and quality in their products?

**Daniel Tabrizi:** Beverage companies encounter various challenges in ensuring consistency and quality across their products. One of the primary issues is the variability of raw materials — especially ingredients such as water and CO<sub>2</sub> — which can directly impact the taste and overall consistency of the final product.

Additionally, optimizing every stage of the production process — from temperature and pressure control to mixing and blending — plays a critical role in maintaining high-quality standards. Even slight deviations in these parameters can lead to inconsistencies in the finished product, making it essential for companies to monitor and control these factors meticulously throughout the production line. Human error in manual testing and measurements can lead to further inconsistencies.

Meeting industry regulations, such as those set by the International Society of Beverage Technologists (ISBT) and the European Industrial Gases Association (EIGA) for beverage-grade CO<sub>2</sub>, introduces another layer of complexity. Companies also face the challenge of managing consumer expectations for consistent taste, appearance and carbonation levels in every bottle produced. As production scales across multiple facilities, maintaining high quality becomes even more challenging, further underscoring the need for effective quality control throughout the entire process.

**FE:** How has the integration of FTIR technology transformed the quality assurance process in bottling facilities?

**DT:** The integration of Fourier Transform Infrared (FTIR) technology has significantly transformed the CO<sub>2</sub> carbonation quality assurance process in bottling facilities. By using an infrared spectrum to collect a molecular “fingerprint” of the sample, each chemical structure produces a unique pattern that enables the identification and analysis of various compounds. This capability supports precise quality control, offering valuable structural insights that are essential for ensuring product safety and consistency throughout the bottling process. In beverage testing, FTIR plays a crucial role in verifying ingredient

composition, confirming flavor profiles and detecting contaminants, making it an indispensable tool for maintaining high-quality standards.

A major advantage of FTIR is its ability to simultaneously analyze a range of impurities, including absolute CO<sub>2</sub> levels, as well as critical components like total sulfur and benzene. Its broad dynamic range allows for rapid and precise detection of these compounds, which are vital for meeting industry standards and ensuring product quality. By enabling real-time, continuous analysis, FTIR enhances the ability to identify contaminants early, minimizing the risk of quality issues and ensuring that each product meets the highest standards before reaching consumers. Moreover, FTIR has streamlined beverage manufacturers' quality control processes, reducing the need for manual testing and improving overall efficiency in our facilities.

**FE: What advantages does FTIR technology offer over manual testing methods?**

**DT:** FTIR technology provides numerous advantages over traditional manual testing methods, particularly in terms of accuracy, efficiency, and versatility. One of its key strengths is its high sensitivity and precision, which allows for the detection of even trace amounts of compounds or contaminants. This capability significantly reduces human error, which is often an issue with manual testing that relies on operator judgment. As a result, FTIR ensures more reliable and consistent results, contributing to better quality control.

In addition to its accuracy, FTIR offers versatile analysis capabilities that make it a comprehensive testing solution. Unlike manual methods that may require multiple tests to identify different compounds, FTIR can simultaneously analyze a wide range of substances in a single test. For detecting gas impurities in CO<sub>2</sub>, FTIR streamlines the process, saving time and reducing the need for additional equipment or tests.

FTIR also enables rapid, non-destructive testing, providing results quickly without altering or damaging the sample. This makes it particularly valuable for real-time analysis during production. In contrast, manual testing methods often involve sample preparation or destruction, which can delay results and affect the sample's integrity. FTIR's ability to continuously monitor without compromising the sample allows for immediate identification and resolution of potential issues.

Finally, FTIR technology improves overall efficiency by automating measurements and providing real-time data. This allows businesses to track trends and monitor performance through dashboards, eliminating the need for manual data collection, which can be prone to errors. Additionally, FTIR automates the generation of certificates of analysis (COA), reducing

the need for manual documentation and further enhancing the efficiency and accuracy of the testing process.

**FE: How do these technological advancements align with the industry standards set by the ISBT for beverage-grade CO<sub>2</sub>?**

**DT:** ISBT specifies that beverage-grade CO<sub>2</sub> must meet stringent purity standards to ensure product safety and consistency. By providing a direct CO<sub>2</sub> measurement, the MAX FTIR technology exceeds the sensitivity requirements outlined by the ISBT standard. This system, driven by precise system calibrations, allows for more sensitive analysis than traditional methods, offering a level of accuracy and reliability that is difficult to achieve with conventional manual testing techniques like the Zahm-Nagel test. Unlike current industry practices that rely on indirect measurements and are susceptible to external factors, FTIR provides a more straightforward and robust approach.

By aligning with ISBT standards, this technology not only guarantees beverage-grade CO<sub>2</sub> quality but also enhances product safety and compliance, helping companies meet regulatory requirements while streamlining their quality control processes.

**FE: What were some initial hurdles in implementing FTIR technology in production lines, and how can bottlers overcome them?**

**DT:** One of the primary hurdles in implementing FTIR technology — like any new system — is overcoming the resistance to adopting new technology over the previously established systems. Personnel are often accustomed to older methods and initially may be hesitant to embrace a new analytical approach. Additionally, training staff to fully understand the operation and maintenance of the FTIR system presents a challenge until the benefits are fully realized.

Fortunately, these challenges can be addressed through comprehensive training programs that emphasize both the functionality and the advantages of the FTIR system. By providing hands-on experience and ongoing support, users can gain confidence in operating the technology. Over time, as teams become more familiar with the system, they embrace its benefits, such as increased accuracy, real-time data and automation.

**FE: Can you share an example in which FTIR technology improved the bottling process and product outcome?**

**DT:** At a Coca-Cola plant in Londonderry, N.H., the implementation of the MAX-BEV FTIR system was driven by a need to improve CO<sub>2</sub> quality control and streamline the CO<sub>2</sub>

receiving process. Prior to adopting the system, the plant faced challenges with inconsistent CO<sub>2</sub> testing. Without continuous monitoring, each CO<sub>2</sub> delivery required additional testing, and lab technicians often spent up to an hour receiving a truck, with the potential for errors that led to repeated tests. These delays created inefficiencies and increased the workload for lab techs, drivers and plant staff.

FTIR technology, specifically the Thermo Scientific™ MAX-Bev CO<sub>2</sub> Purity Monitoring system, proved to be an ideal solution by providing real-time, continuous monitoring of incoming CO<sub>2</sub>. This allowed for quicker, more accurate detection of impurities in the gas, ensuring that only the highest quality CO<sub>2</sub> was used in production. As a result, the system significantly reduced human error, minimized delays, and streamlined the process. The time saved from fewer re-tests and smoother operations not only improved efficiency but also enhanced product consistency and safety, making the entire CO<sub>2</sub> receiving process more reliable and less stressful for all involved.

**FE: How do you foresee the role of technologies like FTIR evolving in the beverage industry over the next decade?**

**DT:** Over the next decade, optical technologies, including FTIR, will continue to advance, further improving detection limits and response times. As these technologies evolve, instru-

ment manufacturers will play a key role in enhancing both performance and cost-efficiency, enabling them to offer even greater value to customers. The ongoing innovation in this field will likely lead to more precise and faster analyses, helping the beverage industry maintain high standards of product quality and safety while improving operational efficiency.

**FE: What should other companies consider when looking to adopt similar technologies in their production processes?**

**DT:** When adopting technologies like FTIR in production processes, companies should focus on the long-term value and operational benefits that these innovations bring. While it's important to evaluate the total cost of ownership and maintenance requirements, many advanced technologies, including FTIR, offer significant advantages beyond the initial investment. For example, FTIR systems are designed for high reliability, minimizing downtime and enhancing productivity. With proper maintenance and calibration, these systems can maintain peak performance and support continuous production.

It's also crucial to consider the level of vendor support and availability of spare parts, as these factors ensure smooth operations and help avoid disruptions. By prioritizing performance, ease of maintenance and ongoing support, businesses can achieve greater operational efficiency and long-term value, ultimately improving their overall production processes.