ApplicationNOTE

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ENSURING SOFT DRINK CONSISTENCY AND QUALITY WITH HPLC

Soft Drinks – A Popular Beverage Choice

Around the world, multinational brands and local varieties of soft drinks are offered in an array of packaging options, through almost every distribution outlet. The National Soft Drink Association[1] states that: "one in every four beverages consumed in the United States" is a carbonated soft drink, resulting in "more than 56 gallons of soft drinks consumed per capita annually." While smaller, the corresponding usage in the European Union community is an impressive 19.5 gallons, according to the UNESDA-CISDA[2].

The Manufacturing Challenge

Hundreds of bottling plants around the world serve consumers in their local vicinity. The demands of maintaining standards and consistency from location to location and country to country are substantial. Manufacturing procedures are very tightly specified. Bottling is performed in highly-automated, sanitary facilities. Rigid quality standards are maintained by constantly monitoring a broad range of factors including ingredient content, water quality, gas pressure and uniformity of container fills.

The process begins with a proprietary concentrate that is supplied to bottlers by the parent corporation or franchise holder. Following very explicit recipes, the bottler combines this concentrate with sweeteners and other ingredients to produce syrup that is then mixed with purified water. (A widely used sweetener is 55% solids high fructose corn syrup (55 HFCS) for non-diet beverages. Various sweetener substitutes for diet beverages include saccharine, aspartame, sucralose and acesulfame K.) This sweetener/water solution is then carbonated by adding carbon dioxide under pressure and packaged. A typical modern, high-speed packaging line is capable of filling 1500 to 2000 cans per minute.

Conservatively, the value of the initial concentrate to the finished soft drink is increased by 300%. All possible steps need to be taken to preserve quality and consistency. High Performance Liquid Chromatography (HPLC) has emerged as an effective, easy–to-use analytical technique to monitor the fully-formulated beverage prior to carbonation and packaging. In a single analysis, HPLC can quickly measure the amount of caffeine, sweeteners and preservatives to ensure that the diluted syrup is within specifications prior to releasing the product.

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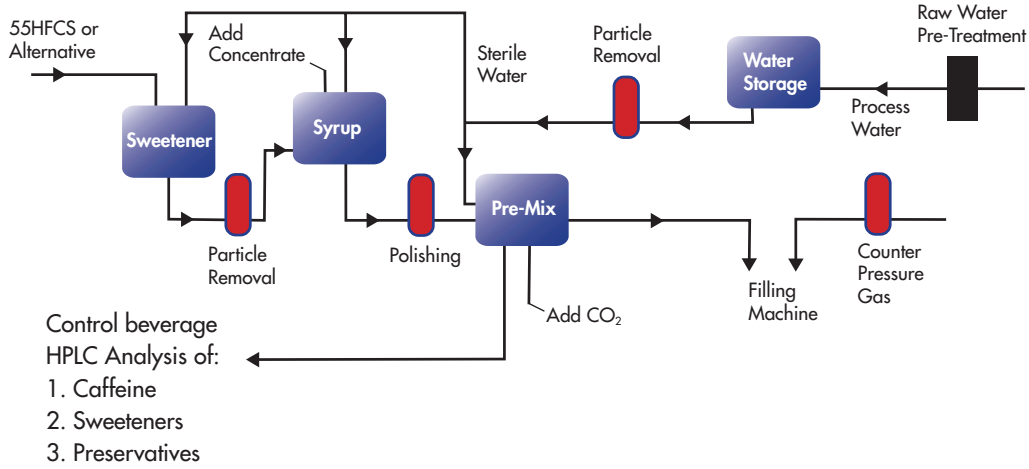
HPLC Ensures Consistency

Despite tight controls during the manufacturing operation, there are potential sources of variability that can lead to "off-spec" products, possibly altering perceived taste adversely. High fructose corn syrup, a commonly used soft drink sweetener, is a naturally derived product that can vary by approximately one percent solids within specification. Additionally, its viscosity changes sharply with temperature, dropping from 760 centipoises at 80°F (27°C) to 360 centipoises at 100°F (38°C) and only 160 centipoises at 120°F (49°C). Manufacturing systems using volumetric metering for combining ingredients may be susceptible to errors due to variability of solids content or slight temperature shifts in the ingredients.

The optimum point to monitor key ingredients is as a control beverage— immediately after the syrup has been produced, diluted and lightly carbonated. When using HPLC, the control beverage is degassed, filtered and analyzed. The process requires about 10 minutes and can confirm that the main ingredients—caffeine, sweetener, benzoate and sorbate—are all within specification and that there has not been any inter-reaction during syrup preparation.

In the event the control beverage is below specification, HPLC analysis can help to determine if the wrong amount of an ingredient was added or ingredients were added in the wrong order. Ingredient levels can be adjusted but if ingredients were added out of order, an insoluble reaction product may result, often involving some of the preservative. This usually cannot be corrected since the risk of spoilage or off taste renders the batch unusable. HPLC can also help determine the effectiveness of any corrective measures that are taken to bring the product back into specification. (Another use of HPLC is the evaluation of abused sales returns, especially monitoring heat-labile ingredients.)

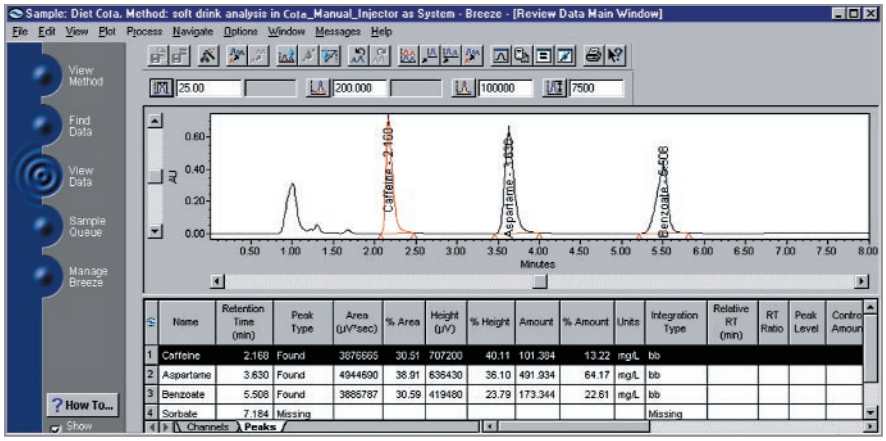
The Soft Drink Production Process



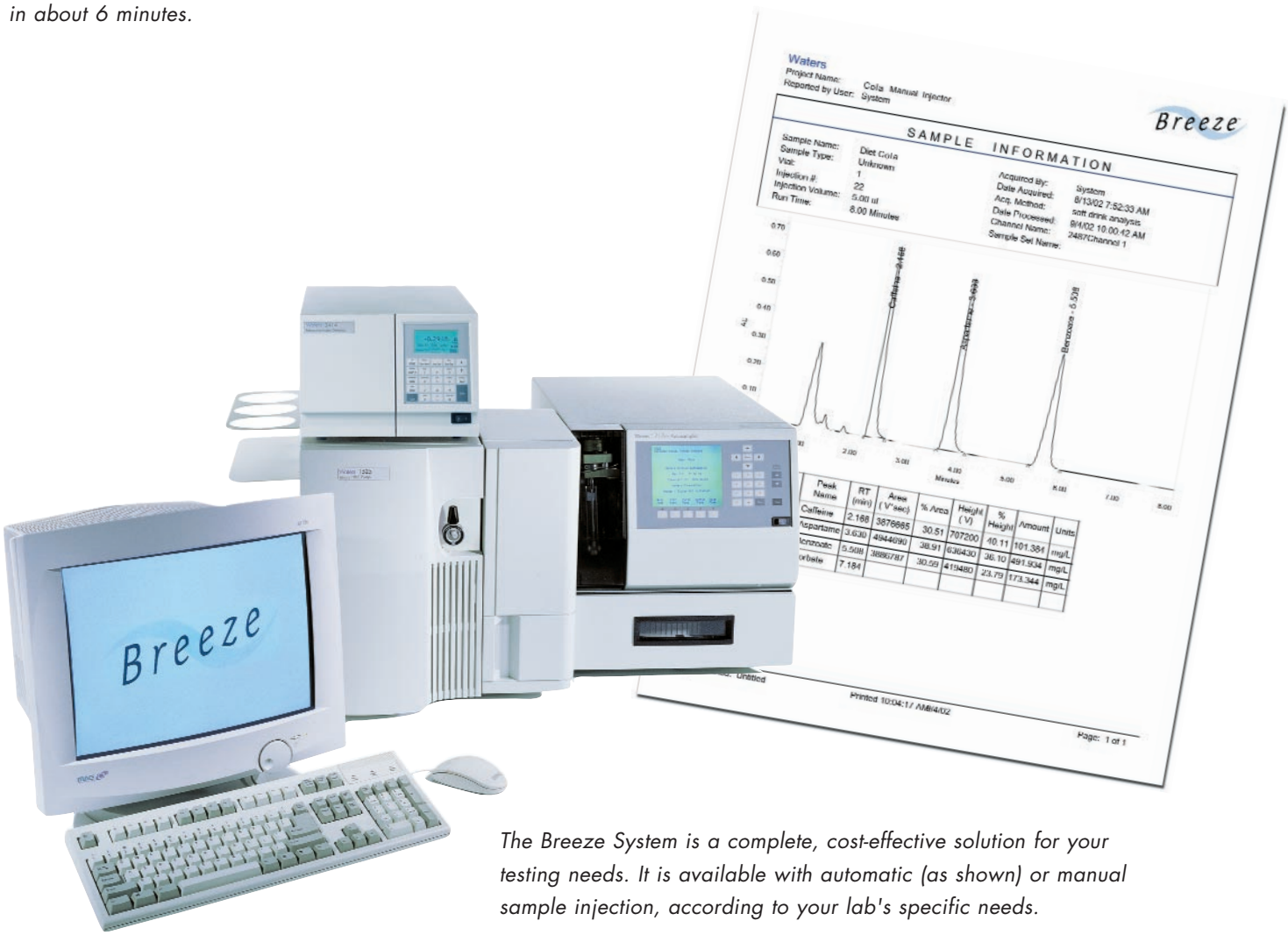
Complete Soft Drink Analysis Capability from Waters

The Waters Breeze™ HPLC System's robust features strike a balance of simplicity, performance and reliability, making it the perfect instrument for supporting production operations in organizations with minimal chromatography experience. Additionally the methodology, analytical column, standards and pre-formulated mobile phase, are all available from Waters in a virtually turnkey package. The Breeze System also comes with a tutorial CD for fast start-up and operation, making introduction into the process easy and effective. When working with the Breeze System, a single screen enables you to move easily and intuitively between instrument control, analysis and reporting.

Fast Analysis, Direct Display of Results



A portion of a screen capture on a Breeze System. The analysis of a diet cola shows the information that is produced together with the liquid chromatogram that the operator can examine, if desired. Note that this analysis is performed in about 6 minutes.



The Breeze System is a complete, cost-effective solution for your testing needs. It is available with automatic (as shown) or manual sample injection, according to your lab's specific needs.

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Waters Connections® — your link to world-renowned service and support

Waters Connections provides the services you need to maintain maximum uptime of your Waters Breeze System. Look to Waters Connections for:

- Analytical Instrumentation and Software Services including Total Assurance Plans that extend and enhance the original warranty you receive when you buy a Waters product. These plans minimize the level of insurance investment and deliver the value you need to avoid costly and time-consuming system downtime.
- Connections University, the center of our Educational Services, providing extensive HPLC and LC/MS training and education at your site, at our corporate headquarters or at our local offices around the world.
- Representatives of our global Customer Assurance Organization – trained and certified in all our products and current in HPLC and LC/MS applications – available in person, on the phone, via FAX or at www.waters.com to answer questions and provide you with support and information services.

1. National Soft Drink Association. www.nsda.org. 1999.

2. www.unesda-cisda.org

WATERS CORPORATION
34 Maple St.
Milford, MA 01757 U.S.A.
T: 508 478 2000
F: 508 872 1990
www.waters.com