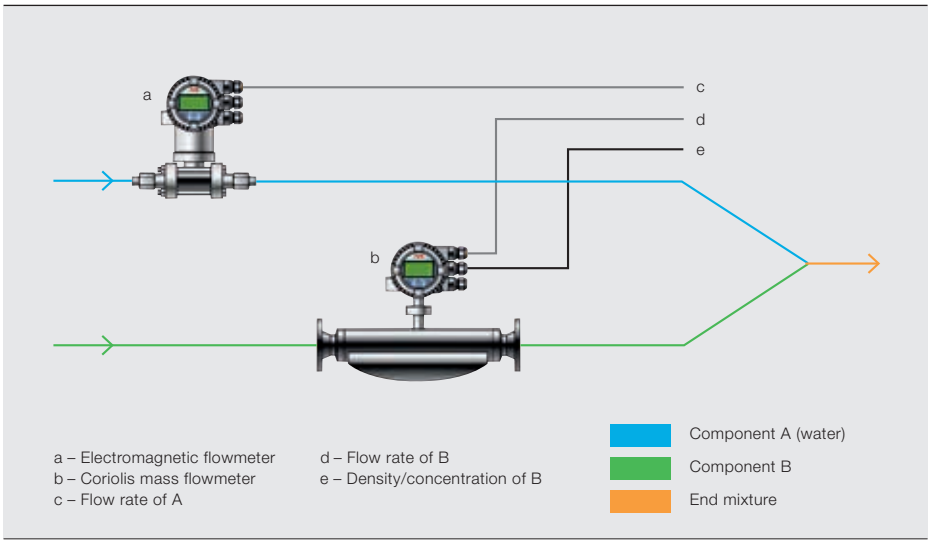
Recipe for success

Simultaneous mass flow rate and density measurement for the food and beverage industry

FRANK FRENZEL – Makers of food and drink like to have consistency in their products. For a consistent taste or texture to be achieved, the concentrations of a product's constituent components have to be kept constant so that the proportions in the final mixture are exactly correct. This is relatively straightforward to achieve using volumetric, gravimetric or simple mass flow measurements if the individual components have stable concentrations. However, nature does not always play ball and often the concentrations of the individual components themselves vary. These variations must be detected and volume adjustments performed as early as possible in the mixing process in order to avoid subsequent analyses, calculations and corrections. ABB's mass flowmeters CoriolisMaster FCB/FCH 150 and FCB/FCH 450 supply accurate density measurements that make them ideal for dosing tasks of this kind.

1 Mixture of two components with different concentrations



Makers of foods and beverages strive to maintain consistency of taste, texture, appearance, etc., in their products. If, for example, a brand of orange juice tastes different from month to month, consumers may switch to a rival product.

In some cases, the components that are mixed to make food and drink products may display concentration deviations, such as slight variations in water content. However, density measurements can be used to calculate concentrations so that concentration discrepancies can be corrected during the manufacturing process.

Title picture
Consistency is the watchword in the food and beverage industry. ABB's Coriolis mass flowmeters help correct for variability in the components of a product. Shown is ABB's new FCB400 Coriolis meter.

CoriolisMaster FCB/FCH150 and FCB/FCH450

ABB's CoriolisMaster FCB/FCH150 and FCB/FCH450 are ideally suited to online concentration correction applications in the food and beverage industry. As well as accurately measuring mass flow by exploiting the Coriolis effect, these devices also make an independent density measurement using the resonant frequency of the meter at the given fluid density.

The CoriolisMaster FCB/FCH150 and FCB/FCH450 – which can operate with media up to 205 °C – have a flow rate measurement accuracy of 0.1 percent. Accuracy of density measurements for liquids is 0.002 kg/l and 0.001 kg/l, with 0.0005 kg/l possible with field adjustment.

Maintaining concentration

In → 1, two components (A and B) are to be blended. The concentration of component A (which we can assume is water) is constant. Component B itself contains water and this water fraction can vary slightly. So that the final product has the correct proportions according to the recipe, the variation in the proportion of water in component B has to be corrected for. This is done by measuring the component B concentration and adjusting the quantity of component A added.

Solution solution

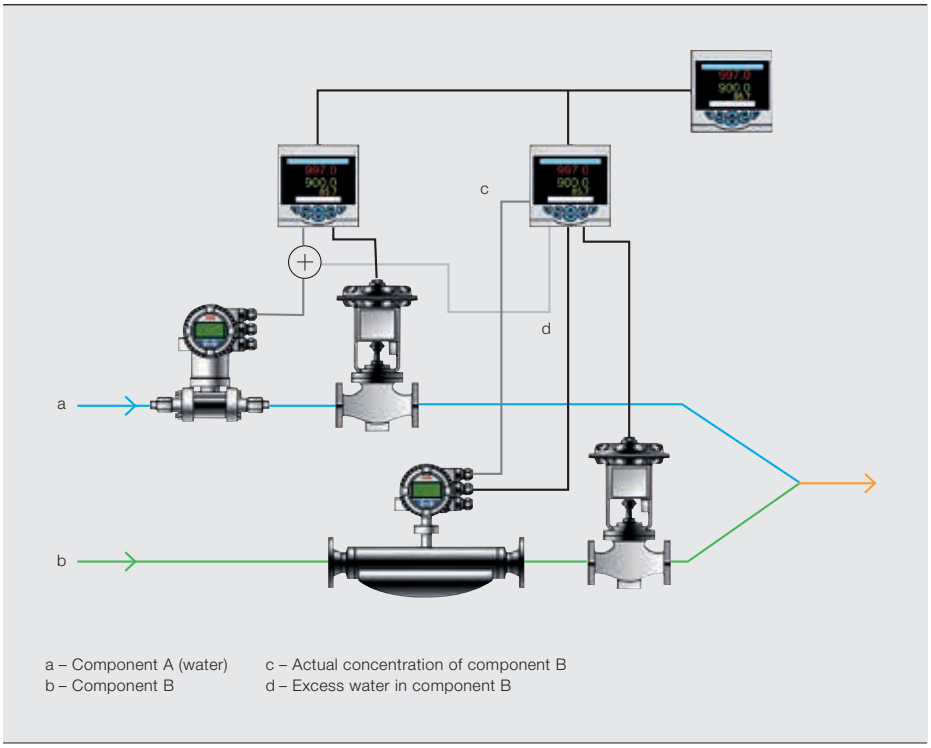
The stable concentration of component A can be measured using an electromagnetic flowmeter. The slightly varying concentration of component B is measured using a Coriolis mass flowmeter. This is achieved by measuring the mass flow and converting it into an equivalent volume flow. At the same time, the Coriolis mass flowmeter records the actual density of component B and, by combining this measurement with the equivalent volume flow value, produces a result for the concentration. Temperature compensation is performed using a table stored in the transponder. This measurement procedure generally results in an exact concentration value. If slight disparities arise for process-related reasons, adjustments can be made to the table.

ABB's CoriolisMaster measures mass flow using the Coriolis effect and makes an independent density measurement using the resonant frequency of the filled system.

The measurement characteristic curves may shift slightly when the device is used in a normal operating environment instead of in a testing/laboratory setting because the medium may contain small amounts of gases, for example, or there may be a slight variation in density in concentrates

Temperature compensation is performed using a table stored in the transponder.

2 Possible control circuit with correction. As C varies, the signal D is used to vary the quantity of component A to be added as compensation.



a – Component A (water)
b – Component B
c – Actual concentration of component B
d – Excess water in component B

The concentration is transmitted to the process control system and compared with the value in the recipe so that the appropriate corrective measures can be taken.

for the same Brix content (Brix is the percentage of sucrose by weight in a solution). Such discrepancies can be easily corrected for by comparing field and laboratory density measurements.

The concentration can then be transmitted to the process control system and compared with the value in the recipe so that the appropriate corrective measures can be taken.

A control diagram involving the calculation of excess water quantities and the compensation thereof is shown in ➔ 2. At the same time as recording the concentration of the relevant components, the mass flowmeter also records the mass or volume flow of the medium in which they flow. This negates the need for an additional flowmeter. All of the calculations are performed by the controllers without any add-on components. The level of accuracy can be substantially increased by using a blend line control method with error storage and subsequent compensation of transient deviations.

With margins in the food and beverage industry constantly tightening, consumer expectations rising and legislative control increasing, manufacturers are becoming ever more reliant on technology to support their production lines. ABB's CoriolisMaster mass flowmeters provide a key tool for food and drink producers to maintain the consistency and quality in their brands upon which their business success depends.

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