AMS

High-end dosing of additives in food production

Nowadays, consumers are increasingly critical when it comes to healthy food and because of this, usage of natural products and ingredients is coming more and more into the consumer's focus. Therefore, food and beverage producers worldwide have to react to fulfill the consumer and market needs.

Additive dosing

Unfortunately, natural ingredients are more expensive and harder to obtain in comparison to artificial or nature identical ingredients. So besides higher costs, important features for quality control must be taken into account. Reliability and reproducibility of the dosing method are very important and very often FDA certified materials have to be used.

For most manufacturers a variation in taste and colour is not acceptable. Just have a look at the candy from the well known brands; all candy bags in your supermarket have exactly the same colour and taste.

This results in high requirements for guaranteeing the same product composition for every batch they produce.

To fulfill the customer- and quality control requirements, as well as cost efficiency issues, it is necessary to re-define production processes. Bronkhorst has developed a batch dosing technology for fast and precise batch dosing applications like additive dosing for confectionery applications.

Batch dosing technology

The batch dosing technology, called CORI-FILL, is firmware that is integrated in all Bronkhorst Coriolis and ultrasonic flow meters and controllers. The technology features an integrated batch counter function with functionality to directly control shut-off valves, proportional valves or (gear) pumps. It's a time and cost efficient alternative to the more traditional gravimetric method.

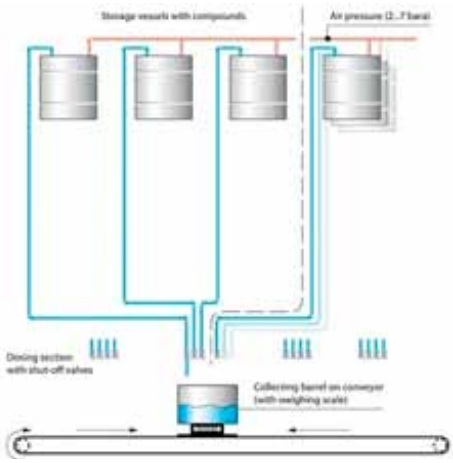
This dosing technology allows dosing of small amounts of liquid additives with only a minimum of tolerance. The firmware is equipped with a "learning function" to correct even the smallest tolerances automatically (e.g. during start-up of the instrument or change of supply batches). The setup is customized to fulfill all requirements of the production; it can easily be integrated in already existing production sites.

Additive dosing with a Coriolis flow meter

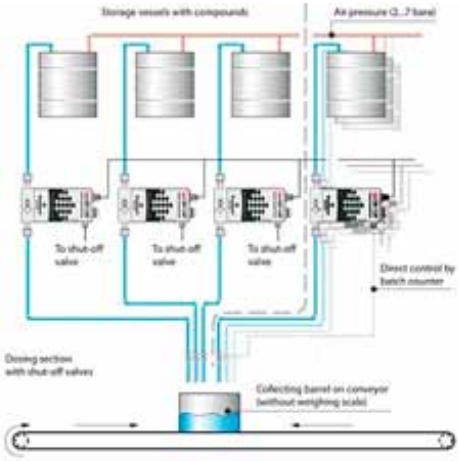
Besides the integrated batch dosing technology, all Bronkhorst Coriolis mass flow meters are equipped with an on-board PID-control for the direct activation of additional actuators - like valves and pumps - enabling a very fast communication and

Product group Coriolis products

Filling process using multiple Coriolis flow meters



Traditional Gravimetric method



CORI-FILL method

Traditional Gravimetric method

Traditionally, dosage of mass/volume is achieved by using a shut-off valve with a weighing scale/balance. The weighing scale is located under a valve outlet nozzle and, after a zeroing procedure, the valve will open. The weighing scale will send a signal to PLC or control unit and when the batch has been reached the valve will close. Thereafter the next ingredient can be dosed, etc.

CORI-FILL™ method

The CORI-FILL technology has integrated batch counters and the facility to directly operate connected shut-off valves. The used Coriolis mass flow meter is capable of dosing the exact desired amount of compound into the collecting vessel. All ingredients can be dosed in one go, meaning a faster, and therefore more efficient (in time and money) method.

therefore enhances speed and quality of the control significantly. The dosing speed is kept absolutely stable, also in long-term usage.

With a Coriolis instrument, the direct mass flow is measured (e.g. kg/h, g/h, g/min etc.). Furthermore, next to flow and temperature, the density can be measured as well. This can be monitored as an extra quality parameter.

Additive dosing with an ultrasonic volume flow meter

Besides the Coriolis mass flow meter, another product in the Bronkhorst product portfolio fits perfectly for dosing applications: the ES-FLOW ultrasonic flow meter for measuring low volume flows of liquids.

Similar to the Coriolis instruments, these flow meters comprise the batch dosing firmware and on-board PID control. The hygienic design, viz. a self-drainable straight sensor tube, an adequate surface roughness and the absence of any dead volume, make it very much suitable for the food industry.

This volume flow meter uses an innovative ultrasonic wave technology to measure the flow.

Due to the integrated dosing technology in the ultrasonic or Coriolis flow meters it is possible to dose expensive liquids like natural flavours, fragrances, colourings or acidifiers with a great reproducibility and accuracy to avoid production fails and unwanted waste of ingredients.

ES-FLOW ultrasonic flow meter in application

5 Reasons why additive dosing with Bronkhorst instruments supports process efficiency for food manufacturers

1. One sensor for multiple liquids: Many companies have changing process conditions and make use of various liquids like additives or solvents. As the Coriolis and ES-FLOW ultrasonic technologies are fluid independent, re-calibration is not required with liquid changes. Also non-conductive liquids as demi water can be measured and/or controlled.

2. Multi parameter. The Coriolis instruments can measure: flow, temperature and density; the ultrasonic instruments flow and temperature. Furthermore, there are a lot of parameters available (batch counter, alarms etc.) that can be logged.

3. Integrated PID controller and fast response: The on-board PID controller can be used to drive a control valve or pump, enabling users to establish a complete, compact control loop with fast response time.

4. Fast return on investment: Because of the high accuracy and reproducibility the investment made during procurement is earned back relatively fast. The more expensive the ingredient, the shorter this time will be since waste and production time are often reduced considerably with this method of dosing.

5. Low cost of ownership. Since there are no moving parts in the ultrasonic and Coriolis flow meters, maintenance costs are low. Factory re-calibration is hardly required; usually an annual calibration check in the customer's installation will be sufficient.

Both the Coriolis and ultrasonic instruments have their own specific characteristics. The Coriolis instruments are more accurate (0.2% of reading against 1.0% of reading of the ultrasonic) but the ultrasonic has a more hygienic design (straight sensor tube, better surface roughness, no dead volume and therefore easier to clean).

Free software tools available for Bronkhorst Coriolis and Ultrasonic flow meters

Various software tools are available to support the operation of these instruments. These software tools are suitable for operation by personal computers and available free of charge. Typical functions of this software:

- **Re-ranging the instruments:** Coriolis and ultrasonic instruments are very linear, hence the instruments can be rescaled at any desired value within the specifications of the instrument.

- **Optimizing (PID) controller settings:** The Coriolis- and Ultrasonic flow meters & controllers have an integrated PID controller. Therefore it is possible to control valves and pumps directly. With the software it is possible to optimize control settings to your personal preferences and save them as well. This can be very useful if you would like to use the same instrument for multiple processes.

- **Printing a hardcopy of graphs:** Share your results with colleagues and/or customers.

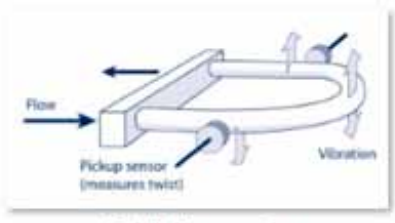
- **Data logging to comma separated files:** All parameters can be logged; therefore you will have an excellent traceability of your process. This is very useful when it comes to quality assurance.

• **Batch counter settings:** The Coriolis- and ultrasonic instruments are equipped with high performance batch dosing technology. The counter function ensures that the actuator will react as soon as the batch has been reached. Normally several components would be needed to achieve this. The integrated batch technology offers this functionality in one assembly without the need of additional hardware or complex programming.

Coriolis mass flow measuring principle

The operating principle of a Coriolis flow meter is basic but very effective. A Coriolis flow meter contains a tube which is energized by a fixed vibration. When a fluid (gas or liquid) passes through this tube the mass flow momentum will cause a change in the tube vibration, the tube will twist resulting in a phase shift. This phase shift can be measured and a linear output derived proportional to flow.

As this principle measures mass flow independent of what is within the tube, it can be directly applied to any fluid flowing through it - LIQUID or GAS - whereas thermal mass flow meters are dependent of the physical properties of the fluid. Furthermore, in parallel with the phase shift in frequency between inlet and outlet, it is also possible to measure the actual change in natural frequency. This change in frequency is in direct proportion to the density of the fluid – and a further signal output can be derived. Having measured both the mass flow rate and the density it is possible to derive the volume flow rate.



Coriolis flow sensor

Watch the video:

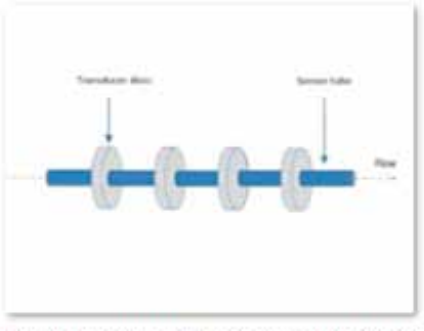
https://youtu.be/z5utL9Cy6b4

Ultrasonic liquid flow measurement principle

The operation of Bronkhorst® ES-FLOW™ flow meters is based on the propagation of ultrasound waves inside a very small, straight sensor tube with an inner diameter of 1.3mm, without obstructions or dead spaces. At the outer surface of the sensor tube multiple transducer discs are located which create ultrasonic sound waves by radial oscillation. Every transducer can send and receive, therefore all up- and down-stream combinations are recorded and processed. By accurately measuring the time difference between the recordings (nanosecond range) the flow velocity and speed of sound is calculated.

Knowing these parameters and the exact tube cross-section, the ES-FLOW ultrasonic flow meter is able to measure liquid volume flows.

The distinctive character of this flow meter is that it is capable to measure the actual speed of sound, meaning that the technology is liquid independent and calibration per fluid is not necessary. Next to that the speed of sound can be used as an indicator of the type of fluid present in the flow meter.



Transducer discs and sensor tube in ES-FLOW ultrasonic flow meter

Watch the video:

https://youtu.be/li7Jv_FY4g4

Bronkhorst®

Bronkhorst High-Tech B.V. is an expert in low flow fluidics handling technology, experienced in designing and manufacturing precise and reliable measurement and control equipment. We are a worldwide organisation with our Head Office located in the Netherlands, offering the widest range of mass flow and pressure meters and controllers available on the market for many different applications in a wide variety of markets.

At many companies in the food production industry, our Coriolis- and ultrasonic flow meters/ controllers are used to accurately measure or control liquid additives.

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