Breakthrough flow-control technology reduces waste due to shrink

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Over the past few decades, mass flow control technology has made several important advances that improve the ability of manufacturers to more accurately measure the amount of liquid flowing through their supply lines.

Analog devices that are slower to measure flow and activate the valves of filling machines have been replaced by devices using digital signal processors. Digital signal processing (DSP) is the current state of the art in mass flow control technology used in such industries as food and beverage, dairy, pharmaceuticals.

Unfortunately, even some of the most advanced DSP devices in use still present two difficult challenges: measurement delays at the start of a filling cycle, and the inability to completely empty the supply tanks because of inaccurate measurements.

The lag in response time upon start-up can result in inaccurate measurement of flow and either overfilling or under-filling the product container. In the case of longer filling cycles, a delay of 1 or 2 seconds at the start does not cause a significant loss of accuracy. But when an entire filling cycle takes only 2 to 3 seconds to complete, as is the case with many food and beverage packaged products, a delay of even a second can cause costly inaccuracy.

The second, and perhaps more important challenge to processors, is the inability of most of today's flow control devices to completely empty the storage tanks supplying these filling lines. The product left behind due to incomplete emptying, or "shrink" as it is known, can result in anywhere from 5%-10% loss of usable product.

Shrink occurs because as a supply tank empties, the amount of air inside the tank increases. This air begins to infiltrate the liquid as the tank continues to empty, and the liquid begins swirling on its way out of the supply valve. More and more gas gets into the liquid, creating a two-phase (liquid and gas) flow condition. This two-phase flow condition defeats the ability of most current mass flow measuring devices (even those operating with digital signal processors) to accurately measure the amount of product flowing through the pipeline. Production must stop due to this lack of accuracy; and the unused, unrecoverable, and unrecyclable product left in the tank is lost. That's as much as 10 gallons of product that goes to waste in a 100-gallon supply vessel.

In addition to losing product, the filling line must be shut down, and valuable production time is lost due to this rework and restart.

For years, this loss of product and productivity due to shrink has been considered "just the cost of doing business."

Today, however, a technology has been developed that offers the promise of bringing an end to these losses due to shrink in the liquid processing industry.

Masterleo is a technical resource consulting firm located in Westerville, Ohio. The company works with customers in the dairy, food, and beverage industries to maximize the productivity and cost-efficiency of their customers' production and processing operations—especially in the area of mass flow control technology.

Recently, Masterleo approached a Midwestern beverage company about the possibility of testing a flow control device they had previously placed with a dairy customer. The device, a Foxboro Digital Coriolis CFT51 mass flowmeter, was being used in a dairy filling application that Masterleo thought might be beneficial to the beverage company (see Image 1).

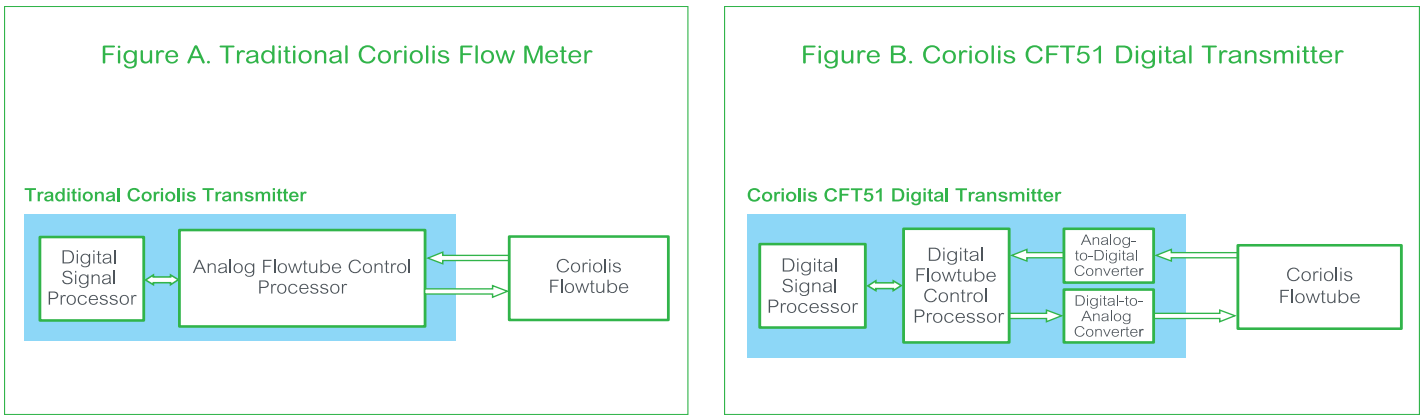

Image 1: In a traditional Coriolis Flowmeter (Figure A), the Signal Processor is digital but the Flowtube Controller is analog. The response time of the Signal Processor is subject to the response time limitation of analog circuitry. In the Coriolis CFT 51 Transmitter, (Figure. B) both the Signal Processor and the Flowtube Control Processor are digital; and along with the signal converters, provide significantly faster response time with the CFT51.

The beverage processing application involved a high-speed, bulk-packaging operation filling 5-gallon "bag-in-a-box" plastic containers with syrup to be used by restaurants, theaters, and other food service operations to dispense fountain drinks.

The beverage company's production facility operated 28 filling lines for 2 shifts a day, 5 days a week. Each filling line was supplied by a 100-gallon supply tank. The filling cycle for each bag-in-a-box took only 2.5-3.2 seconds to send 5 gallons of syrup into each bag, close the supply line and seal the bag.

Naturally, a key consideration was the speed and accuracy of the filling cycle. But there were other equipment considerations as well. The closing of the supply valve and sealing of the bag with each filling cycle required two violent actions that produced significant vibration in the filling line. So flow control metering device had to be robust in its construction to remain accurate under the effects of such constant, heavy vibration. Each filling line produces 10-12 bags-in-a-box per minute.

The beverage company decided to install a Foxboro CFT51 metering device on one filling line to compare the Foxboro device against the existing equipment in three basic areas:

1. The speed and accuracy of the CFT51's filling cycle.
2. The ability of the CFT51 to maintain accuracy under the constant vibration of the filling line.
3. The CFT51's ability to more completely and accurately empty the supply tank because of its proprietary ability to handle two-phase flow conditions.

The test period was designed to last 60 to 120 days. But, after only a few weeks of head-to-head comparison, the beverage company suspended the test and installed the CFT51 as a permanent device in the filling line. It had dramatically outperformed their current metering devices (see Image 2).

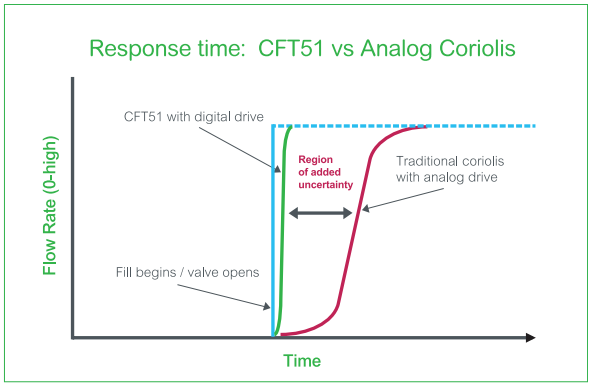

Image 2: Comparison of the batch response improvement with digital Coriolis

The Foxboro equipment:

1. Improved on the speed and accuracy of each filling cycle.
2. Maintained its measurement accuracy in spite of the constant vibration of the filling line.
3. Emptied the supply tank completely, virtually eliminating any product loss due to shrink, and providing a significant cost savings to the client when utilizing the Foxboro meter vs the competitive brand.

As a result of the test, the beverage company's maintenance manager is considering an upgrade of all 28 of their filling line flow control devices to the Foxboro CFT51 in the first quarter of 2016.

The benefits of the CFT51 to the production process went beyond its measurement and tank-emptying capabilities.

The company's bag-in-a-box product line featured dozens of different flavors. So the 28 filling lines must be emptied, flushed, and cleaned 5 to 20 times a day to accommodate multiple flavor change-overs. The CFT51 has been especially designed to make cleaning easy and flawless, as the CFT51 meter is often specified for use in 3-A applications in the pharmaceutical and food industries that must meet strict government standards for sanitation.

What are the potential financial benefits to the beverage company by upgrading their operations to include the CFT51? Because of the size of its operation, the financial loss to the beverage company due to shrink has been estimated to be several hundreds of thousands of dollars annually per line. So it is not surprising that the company is interested in replacing its current flow control equipment with Foxboro Coriolis CFT51 devices.

In addition to the impact that the CFT51 will have in applications like the one described above, the end-of-batch "shrink" problem is also encountered when unloading a railcar or tank truck. The requirement is to empty out the tank completely, which invariably introduces air as the level approaches bottom. This is exacerbated by the fact that in most cases unloading is done at as high a flowrate as possible. The high flowrate tends to suck air into the flowmeter. Where a convention meter would shut down in this situation, the CFT51 Coriolis meter will continue to provide a useful flow measurement, enable faster, more complete unloading of tank trucks and railcars.

The Foxboro Coriolis CFT51 by Schneider Electric is the latest advance in flow-control technology designed to improve productivity and cost-efficiency in a wide range of applications. It solves the problem of flow measurement with entrained air bubbles once and for all, and eliminates gas-induced interruptions, lost product, and below-spec batches.

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