Foxboro® CFT50 Digital Coriolis Mass Flow Transmitter

Improving Molasses Production by Reducing Costly Material Loss

Summary

The Foxboro CFT50 digital Coriolis mass flow transmitter features a patented digital processing system and allows mass flowmeters to operate uninterrupted during difficult-to-measure applications, including problematic liquid/gas flow and is designed to control the Coriolis meter throughout all stages of gas void fraction for continuous, precise measurement.

Business Value

The Foxboro CFT50 digital Coriolis mass flow transmitter improves control with reliable measurement of molasses production – Molasses Production Digital Coriolis technology sweetens molasses production by reducing costly material loss.

Benefits

- Greater accuracy over conventional volumetric-based technologies
- Lower cost than batch-scale-based methods
- Faster response rate than non-digital Coriolis flowmeters
- Greater accuracy than non-digital Coriolis meters in interrupted processes

Technical Challenge

A sugar mill typically loses between one and two percent of its incoming sucrose to factors such as poor clarification, sugar crystal elongation, reduced crystal growth rates, filter cake loss, and loss to molasses. Of these, loss to molasses is most significant — and one of the most difficult to prevent. Loss to molasses results from inaccurate flow measurement that causes more than the required amount of sucrose to pass into the molasses recipe. Wasting valuable sucrose can directly affect profitability of molasses batch yields, so new strategies to control this loss are constantly being investigated.

Improved control begins with a reliable measurement of molasses production, but getting that is indeed a challenge. Estimating undetermined sugar loss to within 0.1 percent, for example, requires molasses loss measurement that is accurate to at least one percent.

(continued)

Technical Challenge (continued)

There are a number of methods that have been employed to measure molasses quantities in sugar mills around the world, each with distinct advantages and limitations. Measuring storage tank levels on a regular basis is probably the simplest method, but readings are inconsistent and unreliable. The error in the mass estimate affects the undetermined loss directly. Further complicating accuracy are chemical reactions that produce carbon dioxide, which affects both density and tank levels.

The Foxboro Solution

Another method is production tank dipping, which involves detecting changes in flow based on changes in torque at various measurement points. While this may be adequate for reporting on a volume basis, most molasses production balance is based on mass. Also, molasses is usually aerated, which creates two-phase flow conditions, further compromising density and accuracy.

Engineers at Raceland sugar mill compared measurements made by tank dipping and batch weighing to conventional and digital Coriolis measurements at various points over a three-year period. In 2002, they installed a competitor's conventional Coriolis meter. In 2003, they installed a Foxboro CFT50 digital Coriolis transmitter from Invensys Foxboro in series with the existing unit. The Foxboro meter uses digital flowtube control that overcomes flow interruption or stalling caused by two-phase flow. And finally, in 2004, as a benchmark for accuracy, they installed a set of molasses batch scales. Valve leaks notwithstanding, they assumed that the scales would provide the most faithful measure of flow.

Results

The measurements from tank dipping were ten to fifteen percent lower than estimates obtained from either of the Coriolis meters tested. Figure 1 shows a consistent discrepancy between the tank-dipping-based estimates and both of the Coriolis meters. The figure also shows that the conventional meter consistently estimated higher than the Foxboro meter.

In 2004, with the batch scales installed, both Coriolis meters recorded consistently higher estimates than the scales readings, as shown in Figure 2. On average, the Foxboro meter gave readings that were three percent higher, and the conventional meter read nine percent higher.

Comparing Figures 1 and 2, it is clear that the Coriolis meters followed the batch scales much more closely. This strongly indicates the unreli-ability of tank dipping measurements and suggests that the Coriolis meters are also more responsive to real changes in flow rate. An unanticipated result also indicated that the digital Coriolis meter might be the most responsive to sudden changes in flow rate.

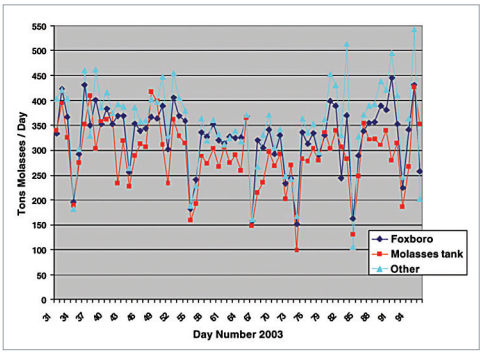

Figure 1. Coriolis meter recordings showing mass flow and density over a period of 14 minutes.

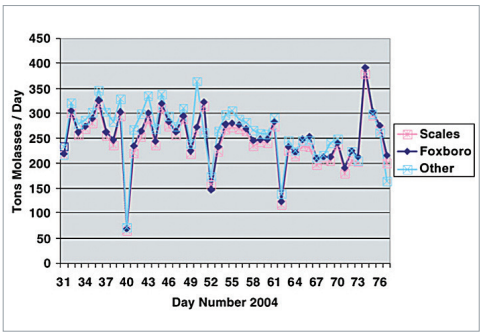

Figure 2. Comparison of measurement of molasses quantity by two Coriolis meters compared with batch molasses scales.

Results (continued)

Figure 3 shows that the Foxboro instrument, which is designed to handle multiphase flow conditions, had a much faster response. Even in the presence of entrained air and water, the Foxboro instrument output always returned to zero when the pump was not running. The conventional instrument was not always able to do this, however.

While acknowledging the need for additional study, the researchers concluded that Coriolis measurement is the only suitable alternative to batch scales for measuring sucrose loss to molasses. They found that the conventional Coriolis meter tended to estimate higher than the Foxboro Coriolis meter and that the Foxboro meter had a significantly faster response time in on/off applications. They believe the discrepancy may be due to the response time, and are doing additional testing to verify this more conclusively.

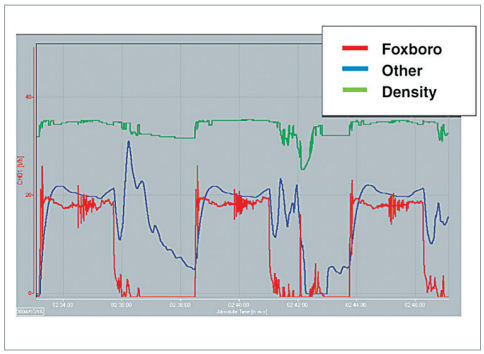

Figure 3. Coriolis meter recordings showing mass flow over a period of 14 minutes.

Ask about our next generation flow transmitter, Model CFT51 which offers all of these benefits and more!

Foxboro

38 Neponset Avenue
Foxboro, Massachusetts 02035 USA
Toll free within the USA 1-866-764-6477
Global +1-508-549-2424

www.fielddevices.foxboro.com

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