

Staying in Control

Monitoring the milling process improves performance.

Maintaining balance in the milling process is a vital part of producing a consistent, high-quality product and maximizing the flour extraction rate. Staying in control of the process is essential

to maintaining this balance.

With the implementation of automation, programmable logic controllers (PLCs), and flow measurement devices such as process scales and flow meters, flour millers can better monitor and utilize statistical process control (SPC) to evaluate mill performance.

Monitoring the Process

Statistical process control or SPC refers to the use of statistical analysis to monitor and control a process and to validate that it runs within control limits. By using SPC, a milling process

can be evaluated to minimize variation and improve consistency of the flour produced.

A fundamental tool for SPC is the use of control charts. Control charts are simply the tracking and statistical analysis of process data to determine if the process is running efficiently.

In flour milling, the most common data analyzed is both quality data such as flour and wheat moisture and protein, as well as flow rates. A common

control chart would be one for monitoring flour extraction.

This basic control chart would include:

- Scale data for wheat, flour, and other mill byproducts measured continuously over a period of time.

- The average or mean extraction calculated and represented by a center line on a graph.

- Upper and lower control limits that designate the point at which the process is considered statistically out of control.

This occurs most commonly at three standard deviations from the center line.

In many cases, the control chart will have upper and lower warning lines—commonly two standard deviations above and below the center line (see **Figure 1**, page 47).

The use of a flour extraction or yield control chart should be seen as only part of a comprehensive plan incorporating traditional methods of monitoring milling perfor-

Management



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Fig. 1. This is a sample flour yield control chart that shows the typical upper and lower deviation or warning lines in relation to the mean center line.

mance such as break releases to enable millers to make better decisions to produce greater consistency in flour quality characteristics.

When true SPC is applied, process conditions are not adjusted when the process stays within the control boundaries. Whereas, a flour mill operates best when monitored closely by a trained miller who knows when to make the necessary adjustments before the trend lines reach the warning boundaries.

Making the necessary adjustments, before the process is out of control, improves milling yields and product consistency.

Measuring the Process

Using a complete scale package to measure the state of the milling process continuously is becoming a standard in an industry that not long ago used very few process scales.

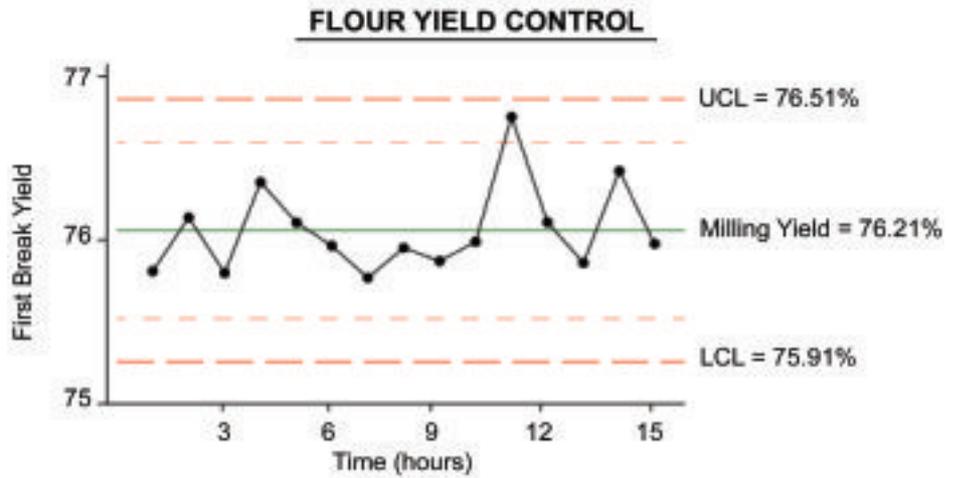
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- Mark Fowler, associate director, IGP, KSU

Rising wheat costs coupled with lower-cost, reliable technology have proven that the milling industry can and will adapt quickly and accept change, especially when it translates into improved profitability. There are millers who continue to question what advantages scales provide to the milling process.

To begin with, I do not remember where I first heard it stated, "We cannot improve or control what we cannot measure," but I do believe it to be true.

A scale package in the mill consisting of a wheat-to-first-break scale, a flour scale for each grade of flour produced, and byproduct scales for bran, shorts, or a combination thereof, gives the miller ▶



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a continuous view of the milling process.

We can accept that the control charts will not be a perfectly straight line, since there is constant variation in the flour yield.

However, by constantly monitoring the process, the miller can identify more quickly when the mill begins to get out of control and address the issues before they become quality or production concerns.

With the current price of wheat, whether the mill is large or small, if the benefit of greater process control is simply 0.25%, it is significant.

Likewise, in the cleaning house, a scale package including mass-flow meters instead of volumetric meters to provide more uniform, consistent wheat blends improves flour quality, as well as provides better inventory control.

Using a scale to measure the quantity of screenings removed from the cleaning process continuously can help in identifying when screens may be worn allowing good quality wheat to be lost



Here, milling students at Kansas State University, Manhattan, are learning how to use monitoring equipment properly from Mark Fowler (left), associate director, International Grains Program.

during the process.

Cleaning house scales also are very useful in monitoring the amount of screenings in wheat from different suppliers or origins, which allows the mill to evaluate wheat quality better.

Maximizing Moisture

Continuing with the applications of SPC, the effectiveness of an automated water addition system as part of the tem-

pering process has been proven repeatedly.

The value of a little water can be measured in thousands of dollars a month in the direct cost of not optimizing flour moisture for the customer. The indirect value of a little moisture is more difficult to measure, but it still remains significant when considering its influence on improving the consistency of the grinding process.

Most of automated water addition controllers monitor the incoming wheat moisture and flow rate continuously and then calculate the appropriate amount of water to add to the mixer according to the predetermined target temper moisture.

Using SPC methodology to determine when to make small adjustments to the amount of water added maximizes the consistency of the final tempered wheat moisture content. Delivering a consistent, well-tempered blend of wheat to the mill is an important first step to maintain a well-balanced milling process.

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Safety First

When addressing the importance of automation, it is important to understand the employee and plant safety advantages, as well. An integral part to any automated control system includes numerous safety devices.

Speed monitors and belt alignment monitors for bucket elevators help to prevent chokes and potential explosions by reducing or stopping product flow to equipment not operating at the right speed.

Monitoring bearing temperature levels in fans, motors, and conveyors also works to prevent explosions, and it helps to uncover trouble areas before they become an operational problem.

Using motion detectors on everything from airlock benches to screw conveyors can identify when a choke or equipment failure has caused a coupling to come apart.

Proximity switches can prevent employee injury by stopping equipment, when inspection doors or lids are opened, when the equipment is still running. Explosion suppression systems for filters can prevent small incidents from becoming large disasters.

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- Mark Fowler

Maintaining Control

The benefit of any automated process is only as good as the information it receives.

The continuous monitoring and calibration of the process scales and other monitoring devices are critical. Just like any other piece of equipment, the moving parts of the process scales wear out and must be maintained.

Many of the scales used in the mill rely on a clean, dry, reliable supply of compressed air in order to work properly.

Proper maintenance of the air compressor and dryer that supply the process air to the mill is important to assure the devices are in proper working condition.

The implementation and utilization of automation in the mill is still, at best, only a tool or source of information.

The miller is still the one responsible for maintaining control of the process. The miller must be well-trained and understand how to interpret data, to make the proper decisions and adjustments to maximize mill performance.

Whether determining the correct set point for the automatic water addition system for the tempering mixer or making the necessary adjustments to the grinding rolls, the most important calculations and decisions are made by the miller. The most complex automated mills still can be optimized by the proper human interface.

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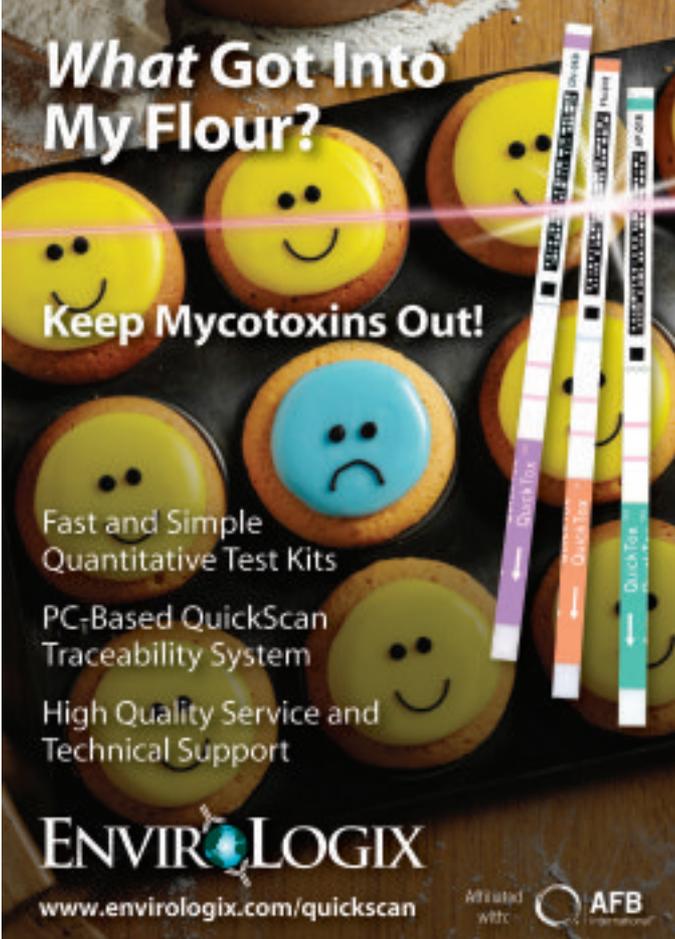
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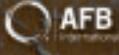
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