Baking Management

Improve oven efficiencies

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Installing a new tunnel oven was probably on the wish lists of many high-volume bakeries this holiday season. Unfortunately, tunnel ovens cost money and require significant capital investments. For those bakeries unable to splurge on a new tunnel oven, a variety of data loggers allow bakeries to achieve maximum performance out of their aged tunnel oven.

It is easy to overlook the performance of a tunnel oven. Most bakeries concede that their first batch is going to be slightly over baked or under baked. However, why does this train of thought have to hold true when technological advancements have enabled ovens to run properly from the first bake to the final bake of the day?

According to one manufacturer of oven-enhancing systems, some bakers have the necessary tools to improve oven efficiencies, but they misuse them or don't use them at all. However, by understanding and using the data derived from a data logger, bakeries can gain countless efficiencies out of their tunnel ovens.

Is temperature enough?

Measuring the temperature inside of a tunnel oven is a crucial aspect of optimizing performance. However, is it enough? According to manufacturers of data logger systems, no. "When you're looking at thermometers and gauges on an oven, all you're looking at is the air temperature somewhere in that oven chamber at a specific point," one manufacturer of data loggers says. "It's not telling you what type of temperatures and heat the product is seeing."

Bakeries can use data loggers to track and record various measurements throughout an oven's baking chamber. Data loggers have been used in the baking industry since the early 1990s, but advancements in new oven technology and a growing number of aging ovens have thrust this technology into the forefront of oven enhancements.

Data loggers are relatively small, usually no larger than a square foot, and operate by traveling through a tunnel oven and recording various measurements. According to one manufacturer of data loggers, the systems use an analog to digital converter to digitize measurements so that they can be displayed on a computer.

Unlike standard thermometers, data loggers track multiple measurements, including temperature, air velocity, humidity and heat flux.

To measure temperature, one manufacturer's data logger uses sensor bars that stretch from the data logger across the width of the oven. This aluminum sensor bar has thermocouples that are spaced evenly across the sensor bar, both above and below the bar. Besides allowing the data logger to take measurements across the width of the oven, instead of just down the middle, this feature also allows the unit to measure both air temperature and the temperature of the baking surface. This proves beneficial to bakers that are recording an uneven bake across the width of their baking surface.

To measure baking surface temperature, one manufacturer's data logger contains spring-loaded contact sensors on the bottom of the sensor bars. These sensors rest on the baking surface and can measure as many as ten surface temperatures and ten air temperatures across the width of the baking surface.

Data loggers distinguish themselves from standard temperature gauges because they go far beyond the measurement of temperature. "It's helpful to measure temperature, but when you try to solve detailed problems, it's not enough," one manufacturer of data loggers says.

To help bakers improve their oven's performance, data loggers also measure air velocity. To measure air velocity, one manufacturer's data logger contains air-velocity sensors that are spaced evenly across the width of the baking surface. These sensors measure air flow from all different directions in the baking chamber.

Besides measuring air velocity and temperature, data loggers also measure heat flux, which gauges the three types of heat in the baking process: convective, radiant and conductive. "The heat flux measurement gives you the amount and what kind of heat transfer the product is receiving," one manufacturer of data loggers says.

For example, many of today's new tunnel ovens use multiple zones and different types of heat to bake products. By measuring heat flux, bakeries can ensure that the proper heat type and temperature is being applied at the right time. Data loggers also measure the moisture in the various zones of an oven.

Analyzing data

The most important aspect of a data logger is its ability to provide a complete profile of an oven's baking process by measuring different variables that affect the baking of the product. However, a data logger's ability to collect data does not automatically ensure that an oven's performance will be improved.

It's one thing to collect data on temperature, air velocity, heat flux and moisture, but it's another thing to analyze this data and improve the process through the findings.

As a data logger traverses through a tunnel oven, it collects information on a number of variables. This information is then transferred to a computer. Many manufacturers of data logger systems provide bakers with software packages that analyze this data and provide a multitude of charts and graphs to help bakers understand how their ovens are performing, and where improvements can be made. One manufacturer of data loggers also conducts a training program to teach bakers how to properly use the system and analyze the data it provides.

Proven benefits

For bakeries using data loggers properly, the benefits are invaluable, says one manufacturer of data logger systems. According to the manufacturer, the most common performance issue in tunnel ovens is temperature variations from one side of the oven to the other. By using a data logger, bakeries can measure where and when the oven is failing, and correct the problem without scrapping multiple batches.

Perhaps the biggest benefit of data loggers is their ability to gauge an oven's performance level before products travel through the oven. For example, one manufacturer of data loggers relates a story about how a bakery's use of data loggers saved it significant money on wasted products. According to the manufacturer, the bakery's tunnel oven was shut down for a weekend to conduct various preventive maintenance measures. When the oven was fired up after the idle weekend, the bakery noticed huge spikes in the air velocity inside the oven after running the data logger through the oven. After identifying where the velocity spike occurred, the bakery realized that one of the oven's new exhaust blowers was wired backwards. "Instead of exhausting, it was blowing air into the oven," the manufacturer of the data logger system says. "They found the problem before they put products through the oven."

Return to the Stone Age

Some of the nation's most well respected high-volume artisan bakers are blending old world traditions with new world technologies to bake upscale artisan breads. The return to the Stone Age marks a movement in the baking industry to high-volume tunnel ovens with stone baking surfaces.

In the past couple of years, several bakeries have purchased stone-surface tunnel ovens, and that number is expected to increase as artisan breads gain popularity and advances in technology lead to less expensive stone-surface tunnel ovens from a wider variety of suppliers.
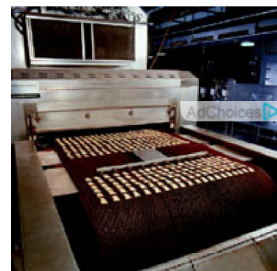
A data logger passes through a tunnel oven taking various measurements, including temperature, air velocity, heat flux and humidity.

Data loggers can help improve the efficiencies of any tunnel oven by continually mapping oven performance and detailing any potential problem areas.

Turano Baking Co. installs stone tunnel oven

The benefits of a stone-surface tunnel oven are irreplaceable, according to a several bakers that use stone-surface tunnel ovens. "With the granite plates, you get a lot better bake because you build bottom heat on your products very quickly, and it bakes the products thoroughly and a lot better than your standard steel or mesh hearth," Paul Sousa, Portuguese Baking's director of manufacturing told Baking Management.

Portuguese Baking uses its stone-surface tunnel oven to bake an assortment of artisan breads, including its Portuguese breads and rolls, which are "crusty on the outside with a very light texture inside," Sousa says.

Most bakers agree that the main benefit of baking on a stone surface is the quality of crust the stone produces as a result of the baking surface. "Because bottom heat is very important in bread baking, we used volcanic baking stones from Volvic, France, because they offer the best heat retention," Joe Mancini, Ecce Panis' director of production, says. Ecce Panis installed a stone-surface tunnel oven in its new plant in East Brunswick, N.J.

The variety of stone-surface tunnel ovens is increasing as technology advances in automating this ancient baking form. At the iba2003 show in DÉsseldorf, Germany, several companies exhibited stone-surface tunnel ovens. One manufacturer's stone-surface tunnel oven uses a combination of conduction/radiation heat from the hot stones and thermal exchange from convection heating to produce a high-quality and consistent crust.

Another manufacturer's stone-surfaced tunnel oven moves artisan bread and roll products via an 'S' configuration transport system. According to the company, this process allows bakers to achieve high yields with a smaller footprint.

Giancarlo Turano, Turano Baking Co.'s executive vice president, showcases the company's new stone tunnel oven at its Berwyn, Ill., facility. According to the company, the 130-ft. oven uses a slow-bake process that involves the gradual movement of bread on heated stones.