

# RECORD and VERIFY

If your bakery doesn't already own a thermally hardened data logger, it will soon. Here's what you need to know.

by Laurie Gorton

So, how does a baker prove the oven to be a preventable control point as defined by pending Food Safety Modernization Act (FSMA) rules? Today's commercial baking ovens already come equipped with computers governing temperature settings, but more monitoring — and documenting — will need to be done. Not just once, but repeatedly.

"It's important to remember that the panel temperature is for control of the oven. It is not telling you what the product is actually seeing," said Richard Starke, director, Reading Thermal, Sinking Spring, PA.

Speaking as an oven manufacturer, Jerry Barnes, vice-president, engineering, Baker Thermal Solutions, Clayton, NC, confirmed this matter by saying, "Just measuring the air temperature doesn't give you all the information you need."

Performance criteria are about to force bakers into a higher order of data collection. "A single data point is not enough," said Ray Pearce, baking product manager, ECD BakeWATCH, Milwaukie, OR. The kill step that constitutes the preventable control stipulated by FSMA involves duration as well as temperature. "Multiple temperature sensors spread across the breadth or height of the oven [are needed to] ensure that all products meet the food safety spec," he explained.

Where you take the process' temperature makes a big difference. "Many commercial bakers still only measure a dough exit temperature," Mr. Pearce observed. "That's just a snapshot. A snapshot does not tell

them when arrival nor yeast kill occurred. In-transit time/temperature profiling is the solution."

## Different configurations

Today's ovens use proportional-integral-derivative (PID) loops with set-point limits. These feedback systems are designed to minimize temperature overs and unders by adjusting the oven's energy inputs.

Measurements are taken by thermocouples and sensors mounted throughout the oven, along its walls and in its crown. "But they're never right at product level," Mr. Starke observed. Because data loggers are designed to stand in for products by traveling the same path at the same level, they "help the baker understand exactly what the products are experiencing," he added, noting that temperature differentials could run as much as 100 F°.

Mr. Pearce explained, "The location of burner control thermocouples is typically not near enough to where the products travel to accurately represent the temperatures the baked goods are subjected to. Oven temperatures [as read from control panels] do not tell you the internal dough or baked good temperatures."

Data loggers, such as ECD's M.O.L.E. and Reading Thermal's Scorpion systems, measure more than one data point and record process parameters such as temperature against time traveled through a process.

The Scorpion Data Logging System measures the four key baking parameters, Mr. Starke explained. "First, there's the temperature of the environment, which

The data logger sits directly on the oven belt with probes inserted into cookie interiors to chart both the baking environment and internal product conditions.

Reading Thermal

consists of the temperature of both the air and the oven belt surface," he said. The system also records heat flux (energy transfer), humidity and air flow (velocity).

Mr. Pearce described the company's M.O.L.E. 3-, 6- and 20-channel systems as thermal profilers because

### Data loggers measure more than one data point and record process parameters against time traveled.

they are built to withstand the heat of the oven cycle. Insulated stainless steel enclosures protect the electronics from the hot surroundings. Rechargeable batteries power the unit.

The Scorpion evolved to fit hot environments, too. "This line was developed initially for use in cookie, cracker and baked snack ovens but has proved useful in bread, cake and meat processing," Mr. Starke said.

#### Kill step monitoring

Verifying internal product temperatures requires an-

other capability, one that also fits the more ordinary need to ensure that doughs are thoroughly baked. It's all about the bake cycle S curve, the core temperature of the baked item charted over time. Two important constants determine the curve: 140°F, when yeast activity stops, and 180°F, when starch gelatinizes and sets the structure.

There's also the matter of the kill step, which will become important as the baking industry moves into the FSMA era. Mr. Stark noted that the Scorpion can measure environmental and product core temperatures to understand their relationship under specific process conditions. Using proprietary SV8 software, the system uses that data to calculate and display the % Kill/pathogen reduction level.

With probes inserted into dough pieces or deposited batters, the baker can collect internal temperatures and relate those to the environmental temperature profile. The results are continuous-line graphs of the baking cycles, displaying times and temperatures, and the corresponding data tables. Mr. Pearce noted

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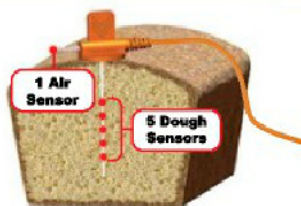
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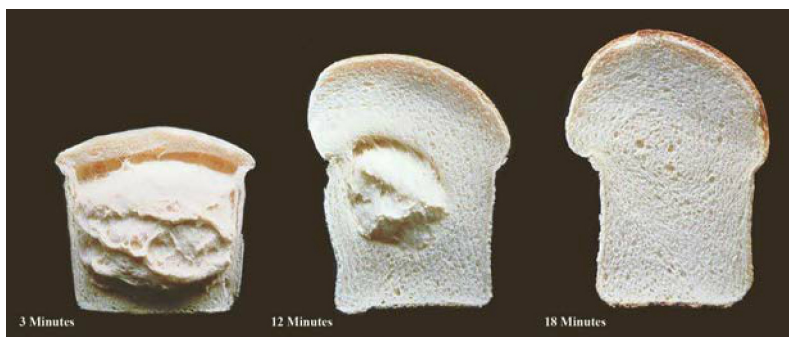
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Cross-sections of white pan-bread dough reveal the changes its interior undergoes after (from left) 3, 12 and 18 minutes of baking.  
Sluimer 2005

appropriate for oven balancing work as well as insertion temperature analysis.”

### All types of ovens

Although data loggers were first configured as thermal

that data communication can also be done with a radio frequency (RF) transceiver option that streams live data to the baker's computer for real-time display.

For pan-baked items, the Reading Thermal Scorpion system can be configured with a Pan+Dough probe. Mr. Starke described it as a dual system with a copper spade measuring the temperature at the interface of pan and dough and a stainless steel probe penetrating vertically to a fixed distance within the dough piece to measure the bake cycle S curve.

The ECD M.O.L.E. can employ the company's BakeWATCH thermal profiling tool: the patented Breadometer single-piece, 6-channel sensor that enables placement of five insertion thermocouples into yeast-raised bread doughs. The software controlling the system offers built-in set-point entry for kill temperature and arrival parameters.

“Dough viscosity and variety dimensions are the key variables here,” Mr. Pearce said about probes in general. “Many thermocouples are multipurpose, equally

profilers to monitor the performance of tunnel ovens, they suit the full range of commercial bakery styles. “There's nothing really different about using a data logger in any type of oven, except those that drop doughs from one conveyor to another within the oven or flip them during the process,” Mr. Starke said. “You can use them wherever the transfer mechanism is stable.”

To measure performance of a rack or traveling tray oven, the data logger is placed on the tray as dough pieces would be. The same is true for fixed- and free-pan styles of vertical and serpentine systems.

“Tunnel oven measurements at left, center and right across the belt become analogous to multiple rotating rack ovens' low-, mid- and high-level shelves,” Mr. Pearce said.

Data loggers find use in various departments at bakeries. Quality assurance operations employ them to check finished product against baking profiles. The maintenance group puts them to work during preventative maintenance. R&D finds them useful for product

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A probe inserted into the loaf before it enters the oven collects data throughout the bake cycle and cooling to document the product's temperature.

ECD BakeWATCH

development. Many commercial bakeries and ingredient suppliers use data loggers to optimize new formulations including clean-label and gluten-free products.

And it's not unusual for oven manufacturers themselves to employ data loggers.

For example, AMF Bakery Systems, Richmond, VA, uses a Reading Thermal Scorpion R&D unit fitted with a long array of probes for measuring wide oven profiles, according to Phil Domenicucci, EPM Thermal Solutions at AMF Bakery Systems. "It allows us to track top and bottom heat profiles, air flow profiles, radiant and convective heat profiles, and baking curves. This is a valuable tool in understanding exactly how the oven operates so we can work with the baker to achieve exact baking parameters."

When Franz Haas Machinery of America, Richmond, VA, commissions an oven, it relies on a validated baking profile generated by a data logger and established for the customer's products. It assists in making sure the baker's

goals are met on matters such as finished product color and weight.

"The logger is a tool and an indicator of the baseline. It's a powerful weapon in the arsenal of the installation engineer," said Kevin Knott, technical sales manager, Franz Haas Machinery of America, Richmond, VA.

The profiles are particularly valuable when a baker moves from one type of oven to another, noted Rick Parrish, director of sales and marketing, Franz Haas. "The baking profile of a direct-gas-fired system will be different from that of an indirect-fired oven, but the finished product must be the same."

Auto-Bake, Hornsby, Australia (represented by Dunbar Systems, Lemont, IL), constantly profiles the company's ovens to confirm their thermal computer modelling. It has employed data loggers for many years. Amanda Hicks, Auto-Bake's director and co-CEO, described them as a "verification tool to ensure all our systems are calibrated accurately."

Taking a big picture approach, it's better to know what your product is going through as it bakes than just to assume that a well-controlled oven is doing its job. As FSMA kicks in, critical control points will become preventative control points. And keeping that point — the kill step so important to producing food safe to eat — under control will be essential. Find the best tools for your operation and learn how to use them. •

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