



Engineering Process Control Solutions for Over 50 years

Balancing Bakery Ovens: A Recipe for Success

Oven Balancing Helps Correct Sub-Par Heat Flow
to Deliver Consistent Results

Overview

Consumers like predictability, especially when it comes to food. Baked goods are part of people's life routines – they like certain bread varieties, specific flavors and textures, and expect consistent quality from their favorite brands. Repeatable results undoubtedly help satisfy consumers, but also provide multiple benefits to the bakery, including:

- ✓ Improved margins and profitability from efficient energy use and high-yield product output
- ✓ Consistent product quality, day in and day out
- ✓ Consumer brand loyalty
- ✓ Reduced oven maintenance downtime and costs over the equipment life

There are many aspects to producing high-quality baked goods, and part of the recipe must include in-spec and balanced oven performance. Oven balancing is recommended for any bakery, providing preventative maintenance and diagnostics, predictable quality outcomes, and out-of-spec troubleshooting.



What is a Balanced Oven?

Thermal profiling of products such as cakes and breads is standard practice at bakeries worldwide. This method measures the thermal transformation of products in-process to help optimize settings, ingredients, temperature, and time spent in each process phase. Product profiling is a given (or it should be!).

Oven profiling to verify consistency across the oven should also be part of a bakery's operational protocol, not just when something goes wrong. In a perfect world, an oven – either rotating rack or tunnel – should bake products equally regardless of the pan position in the oven. Whether left to right in a conveyor or high to low in rotational rack ovens, every cake, bun, cookie, and loaf coming off the line and between multiple lines should be of equal quality, color, and consistency. This is what a balanced oven delivers and why oven profiling is imperative.

Out-of-Balance Clues: When Ovens Operate at Sub-Par Performance

For bakeries that haven't been regularly verifying oven performance, the first indication of a potential issue with the oven is usually visual. Product exterior color that is not even from loaf to loaf, or from row to row in the case of buns and cookies, suggests that adjustments to recirculatory speed, air distribution, or air direction/angle (local distribution) may be required. However, baking operations that traditionally run oven profiles can clearly see where the **oven balance** may break from the charted data. In the **Figure 1** example below, the oven is balanced throughout Zones 1 to 3, but falls off in Zone 4. In this case, Zone 4 contained two different burners (different brands), each with its own ways of modifying burner heat distribution. Running the oven profile and visually seeing the SPC data helped to pinpoint the problematic area and led to corrective action.

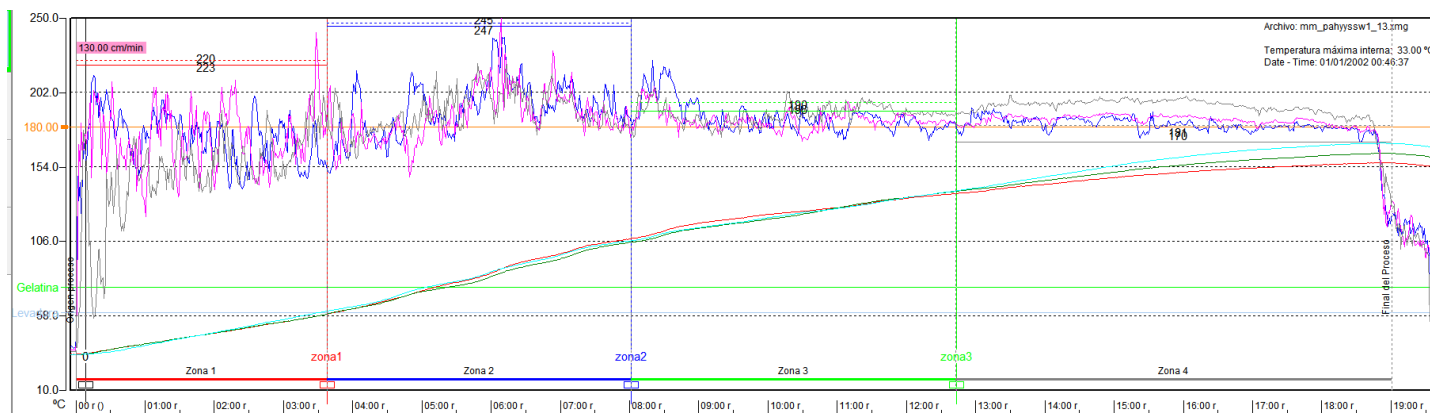


Figure 1: Oven performance (in the upper portion of the profile) combines with convective data by zone to provide a visual analysis of declines and gains in performance along the tunnel oven via thermal profiling. Here, balance is achieved in Zones 1-3, but falls off in Zone 4, indicating a need for corrective action.



How to use Thermal Profiling to Verify Oven Optimization

Obtaining detailed SPC data like that shown in Figure 1 using a mass puck sensor technology – like the OvenBALANCER™ device – combined with a thermal profiling data logger such as a [M.O.L.E.™ EV6](#), allows air flow consistency to be evaluated and fine-tuned. This method optimizes oven settings by comparing ambient and convective or radiant heat flow uniformity. Each panel contains an ambient and a process sensor, and magnetically attaches to the belt, pan, or tray. The ambient sensor detects burner imbalances and incorrect oven zone settings. The process sensors have enough mass to measure the effect of heat exposure/flow to introduce heat evenly into baked goods. Zone deltas, as measured by the process sensors, verify lateral convection controls balance (in the case of tunnel ovens) to detect incorrect fan, baffle, damper, and colorador settings. The lateral measurements indicate how uniformly the oven (s) can bake a specific product.

In tunnel convection ovens (which are becoming more standard) and after obtaining lateral data using OvenBALANCER, it is recommended to use the technique of an “air shield” – covering the bottom, then top of each damper opening -- to obtain information about the heat the product will receive from the top and bottom, the vertical balance. The data produced will show individual zone slopes and temperature at the end of each zone, and combine to reveal where damper adjustments should be made for even product baking. This should be repeated in all ovens. For rack ovens, each tray or pan should bake evenly regardless of its position in the oven (top, center, or bottom), and the three OvenBALANCER sensors effectively measure heat exposure at each location to determine consistent oven performance.

Oven Balancing in Practice: Application Case

Recently, a bakery producing a toast product was experiencing quality inconsistencies across its three tunnel oven toast lines. Each oven is different in terms of the number of burners, and one transfers heat radiantly instead of convectively. Despite the equipment differences, the objective – for any bakery using multiple lines for the same product -- is to obtain equal outcomes from each line. In this case, to understand the root causes for the product quality differences, the company hired an [oven analysis expert](#) to evaluate the tuning and combustion of each oven.

Utilizing a portable M.O.L.E. six-channel thermal profiler in combination with an [OvenBALANCER](#) baking oven sensor system (**Figure 2**), the process and equipment consultant measured convection and radiant reflow heat transfer consistency and burner outputs at three positions across the tunnel oven; left, center, and right. Supported by M.O.L.E. MAP software, the thermal profiler and sensor precisely measure and display what is occurring inside the oven. This helps identify locations that are delivering sub-par performance, which may diminish product quality. Measurements were obtained both laterally and vertically to analyze and validate oven balance.

After obtaining profiles for the three ovens using the M.O.L.E.™ data recorder via the OvenBALANCER sensors, data revealed that the oven zone setpoints between the three toast ovens varied between 240° C and 290° C. Ovens that were deemed within specification (two of the ovens) were compared to the one oven line that was producing lower-quality products. This was evaluated using the OvenBALANCER data.



Figure 2: OvenBALANCER sensors are placed in loaf pans and a M.O.L.E. EV6 (inside the center barrier) collects in-process temperature data.



It was determined that adjustments to the oven dampeners on the problematic oven would correct the issues. Using the OvenBALANCER measurements for guidance, the consultant was able to establish the process role of each dampener position and its impact on the toast product. Once the corrections and adjustments were made, OvenBALANCER was used again to compare the corrected oven to the in-spec ovens in the two other lines. All the data points revealed consistent oven performance and resulted in improved and equal product quality across all three toast lines. This plant now routinely verifies all ovens using a M.O.L.E. thermal profiler and OvenBALANCER sensor kit monthly (at a minimum) and after any oven maintenance is performed. This confirms aligned heat distribution across all the ovens, preemptively ensuring consistent product results.

Recommended Oven Balancing Intervals

Every baking operation is unique, so the frequency of running an oven balancing check is bakery-dependent. However, a good rule of thumb minimum is monthly (but ideally every two weeks), and after every maintenance event. Of course, if product quality shows signs of decline, running an oven check is highly advised.

What is thermal profiling?

While there is definitely an art to producing delicious baked goods, baking is most assuredly a science underpinned by chemistry, process control and temperature accuracy. As a pioneer in measurement devices for thermal processes, ECD has perfected the science of thermal profiling for baking. We have developed an entire suite of easy-to-use tools that ensures every phase of product transformation is measured, in control, in compliance and of highest quality.

[Want to know more about improving precision and control in your baking operation?](#)



Notes:



ECD WORLD HEADQUARTERS
(North America - US, Canada)
4287-B SE International Way
Milwaukie, Oregon 97222 U.S.A.
Tel: +1 800 323 4548
E-Mail: sales@ecd.com
Web: www.ecd.com

APAC
(Asia-Pacific, China, India)
Singapore Office
Mobile: +65 9692 6822
E-Mail: ecd.asia@ecd.com

EMEA
(Europe, Middle East, Africa)
UK Office
Mobile: +44 (0) 7903 252560
E-Mail: ecd.europe@ecd.com

LATAM
(Mexico, Central, South America)
Houston, TX U.S.A. Office
Phone: +1 503 659 6100 x 250
Mobile: +1 832 533 0046
E-Mail: ecd.latam@ecd.com

• Award winning products, service & software • No-cost ECD Online Training •

Accredited Labs



Member of



Awards



Social Networks



60 Years of Excellence, and Still
Growing Strong- www.ecd.com