MARLEN
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OPTIMIZING OVEN PROCESS REPEATABILITY: BREAKPOINT

Breakpoint is everything.

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INTRODUCTION

Forced convection in a commercial oven is only of value if stratification of the heat transfer media (air) can be avoided. Stratification in this application relates to the strata or layers of air that physically conform to the space being pressurized and the often non-uniform shape of the products being processed. Without some means of disturbing the strata, the classical "hot spot/cold spot" phenomenon can be expected.

This white paper is a supplement to "Optimizing Oven Process Repeatability" and addresses "breakpoint" – one of the key factors of airflow management during the cooking process.

THE PROBLEM

As the physical size of commercial ovens continued to grow, hot spots and cold spots became more challenging to overcome. Processors actually found it necessary to unload and rotate product carriers to avoid undercooked or overcooked product.

HISTORY

Most post WWII oven designs divided process airflow to delivery points at the upper-right and upper-left corners of the oven cabinet. As air arrived at the upper corners of the oven cabinet it needed to be collected in a vessel that would aid in its distribution over the length of the cabinet. Various designs of supply ducts or plenums served this purpose.

A means of disturbing or agitating process air in an orderly and repeatable way was understood to be necessary. The simplest means seems to have been a single damper "blade". Placed at the discharge point of the oven's single fan, this damper moved alternatively right and left to divide airflow to the oven supply ducts. The damper would restrict airflow to one side of the oven while allowing unimpeded flow to the other.

Rather than simply switch from fully closed to fully open, the drive mechanism set the damper in constant motion, so that the relationship of closed to open varied from theoretical volumes of 0% (closed-right) to 100% (fully open-left) and then to the opposite (100% right, 0% left), with volumes and velocities varying as the damper blade made its swing. This action created agitation of process air within the oven cabinet that helped avoid stratification.

Breakpoint: The key to processing oven repeatability

How well this phenomena was initially understood is hard to say, but it can be assumed that the benefit derived from alternating the airflow with the earliest of crude damper designs was an on again, off again affair resulting in poor repeatability of oven processes. Later designs placed separate damper blades, rotating 90° opposed, within ducts that transported process air to the oven cabinet's supply ducts. Reliability improved somewhat, or at least enough to begin measurement of the benefit of alternating airflow.

An understanding of the importance of accurately alternating airflow in measurable terms brought us the term "break-point" or the physical point at which the high velocity air mass collides with the low velocity air mass. By measurement of air velocity, the physical location of this collision point gave oven designers and processors something that they could measure, monitor and tune for most uniform and repeatable results.

Breakpoint: The key to processing oven repeatability (continued)

Breakpoint, in constant motion as is the damper(s) that creates the effect, was now understood for its value to uniform processing. But the benefit was still elusive at times due to wear factors of damper drive components and the torque effect of high velocity process air on the damper blades themselves. During rotation, damper blades pass through a period of random oscillation which creates some drift of the breakpoint made worse by worn damper drive components. When this is the case, the location of the breakpoint, and therefore the balance of the oven, are only theoretical. Uniformity and repeatability likely suffer.

SOLUTION

A US manufacturer has seen the need to deal with the issue of breakpoint and recognizes that it is the key to processing oven repeatability. Marlen greatly improved the reliability of the alternating damper drive with stainless steel shafting and gearboxes replacing chains and sprockets. An equally important Marlen invention is a damper brake that eliminates the random oscillation or “chatter” of damper blades. The result was the ‘locking down’ of that important breakpoint location without any necessity for adjustment. No longer just a theoretical setting, processing personnel now know what to expect from their oven, cycle after cycle.

SUMMARY

Innovation is worthless if the equipment doesn’t work. It’s important to source a food processing oven that has been designed with your operational and application needs in mind and to gain a full understanding of the oven’s key components that contribute to and deliver optimal repeatability.

About Faivre Technical LLC
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About Marlen
Recognized as a global manufacturer of highly engineered food processing equipment and systems, Marlen designs and builds innovative solutions for the food processing industry. Our premium products have long set the standard for quality and performance in vacuum stuffing and pumping, portioning, size reduction, thermal processing, and food handling. Marlen is a Duravant Company.