



LALLEMAND BAKING

Baking Update

Bake Time Reduction

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Energy Efficiency in Industrial Bakeries

SUSTAINABILITY has become one of the most pressing topics in recent years, as the consequences of climate change, resource depletion, and the impact of human activities on the environment are becoming increasingly apparent.

In times of significant energy price volatility, rising living costs, and regulatory pressure to limit gas emissions combined with the environmental responsibility of consumers and the industry alike, **optimizing energy consumption has become** necessary to remain competitive rather than a voluntary measure to meet internal sustainability goals. Improving the energy efficiency of an industrial bakery is challenging, and many factors come into play, such as the type of product, process, facilities, and internal policies and practices. But while there is no playbook to follow in this pursuit, many steps can improve energy savings, which come in several forms, such as good practices, energy-efficient equipment, and process optimizations.

In "Achieving Net Zero: A Handbook For The Food And Drink Sector," the Food & Drink Federation indicates that manufacturing has only a marginal contribution to

the total emissions in the food and drink value chain. Nevertheless, it represents a significant opportunity for emission reduction, especially by improving the energy efficiency of the process, as any positive action in this sense is quickly rewarded with lower energy bills. There is, therefore, a short-term economic incentive to achieve the long-term Net Zero emissions goal.

An essential step in improving the energy efficiency of the bakery is to identify which phases of the production process are the most energy-intensive. These may differ significantly based on the product manufactured and the equipment and practices employed in the production system. However, a study by the Ernest Orlando Lawrence Berkeley National Laboratory in 2012 identified baking and freezing as the critical steps for primary energy consumption **in industrial bakeries**. Indeed, for non-frozen products, the baking step consumes from 31% of the total energy for cake production to up to 78% for biscuits and crackers. In producing frozen baked goods, freezing becomes the most energy-intensive step, requiring up to 32% of the total process energy consumption.

One of the main practical steps to be considered is to upgrade the equipment. Ovens, proofers, and dryers are commonly found to be among the least

energy-efficient equipment used in bakeries. These devices often suffer significant heat loss to the surrounding environment. Upgrading to energy-efficient models can significantly reduce energy consumption; investing in ovens, proofers, and dryers equipped with efficient insulation materials, advanced heat recovery systems, and precise temperature control mechanisms. Upgraded equipment can minimize heat loss, optimize energy usage, and contribute to overall energy efficiency in the baking process. While this requires a significant capital investment, it offers a substantial incentive for energy savings.

Baking and freezing are the primary energy consumption steps in industrial bakeries

Process optimization plays a vital role in improving energy efficiency. Evaluate the production workflow to identify areas where energy usage can be optimized. Some key

considerations include:

- **Load optimization:** Efficiently utilize oven capacity by maximizing the number of baked goods in each batch. Proper load distribution can reduce the number of baking cycles, resulting in energy savings.
- **Temperature control:** Optimize temperature settings to ensure precise and consistent baking. Avoid excessive heating, as it leads to energy waste without significant benefits.

- **Shutdown management:** Establish effective shutdown procedures to avoid unnecessary energy consumption during inactivity. Ensure that equipment, such as ovens and proofers, is adequately powered off when not used.

Sound practices are critical in ensuring that efforts to improve energy efficiency are successful. Promote energy-saving

behaviors among bakery staff through comprehensive training programs. Educate employees about the importance of energy efficiency, guide best practices, and encourage them to actively contribute to reducing energy consumption. This can include adequately closing oven doors, minimizing openings, and promptly reporting equipment malfunctions or inefficiencies.

Finally, sustainability goals cannot be achieved through one-off actions. Continuous monitoring and improvement are crucial to aligning with the preset goals. Also consider implementing energy monitoring systems to track and analyze energy usage throughout baking. Real-time data can identify patterns, anomalies, and potential areas for improvement. Regularly review energy consumption reports and collaborate with energy management experts to identify further optimization opportunities.

Lallemand Sustainability Solutions

AS BAKING solutions partners, we have developed the Baking Time Reduction (BTR) solution in response to the growing demand for energy efficiency and sustainability in the baking industry. This clean-label enzymatic solution aims to support bakeries in achieving their sustainability goals while optimizing the production process and maintaining the quality of their baked products.

BTR is an enzymatic solution that modifies the water-holding capacity of the dough matrix, enabling it to obtain the same dough and final baked product characteristics while reducing the baking time. This innovative approach enhances operational flexibility and creates a range of opportunities to improve the energy efficiency of the baking process.

Below are some of the applications where Bake Time Reduction can be employed to improve the energy efficiency of industrial bakeries:

- **Reducing the baking time.** With the BTR solution, the baking time can be reduced by up to 33% compared to the standard. This allows bakeries to increase the throughput where the oven is the bottleneck of the process without requiring extra energy input and without affecting the quality of the product.

- **Reducing the baking temperature.** BTR facilitates energy savings by enabling bakeries to bake at lower oven temperatures. This advantage is especially beneficial for bakeries whose set-up and capacity do not allow increased throughput.
- **Standardizing the baking profile between different formulations.** While correct production planning is essential for optimal energy efficiency, downtime for heating or cooling is sometimes unavoidable when switching to another product. With BTR, different formulations can be baked at the same oven temperature, ensuring consistent baking results and optimizing energy efficiency.
- **Reducing the water content of dried baked products.** Water evaporation requires a significant amount of energy input in producing dried baked goods like breadcrumbs, croutons, and rusks. BTR offers the ability to reduce the initial humidity of the product before the drying step, thereby minimizing energy requirements to achieve the target final moisture of the product.
- **Water saving.** An efficient water management system is just as important to a sustainability plan as energy savings, considering that water scarcity is increasingly affecting the world. Water reduction in the formulations is an added benefit of BTR in addition to energy savings.

The BTR Background: Understanding How It Works

THE BAKE Time Reduction solution incorporates enzymes commonly used in baking solutions, conditioners, and improvers, carefully selected and dosed to achieve the conditions needed to maintain the product's desired characteristics while reducing the energy required for a fully baked product.

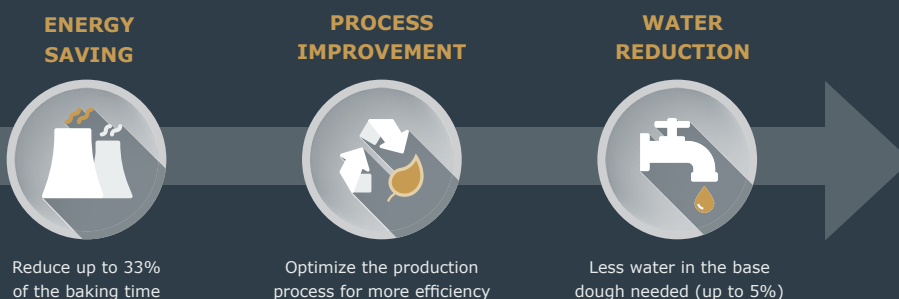
Decreasing Baking Time

REDUCING the amount of water in the formulation is essential in reducing baking time when using BTR. To obtain the same dough and baked product characteristics with less water, a range of enzymes, such as xylanases and amylases, are used to modify the ability of the dough to trap moisture.

Xylanases, enzymes acting on non-starch polysaccharides in flour, play a crucial role. These polysaccharides possess a significant water-holding capacity. By hydrolyzing the xylan backbone, xylanases facilitate the release of water, making it available for gluten development. As a result, even with a reduced total water content in the dough, its distribution between the molecular components allows for an ideal dough development and handling while reducing the heat needed for its evaporation during the baking process.

Crust Color

THE BAKING process does not end when the crumb is set. Another essential characteristic to consider is the crust's color. Therefore, one of the main concerns with reducing the baking time is not achieving the brown crust expected from a fully



baked loaf. The crust's color is formed due to molecules produced during a chemical reaction between reducing sugars (e.g. glucose, maltose, and fructose) and proteins at high temperatures, known as the Maillard reaction. To maintain the unaltered final characteristics of the baked product, the BTR solution includes amyloglucosidase, an enzyme that allows for a higher amount of reducing sugars to be released. By releasing glucose from the starch molecule, this enzyme enhances the Maillard reaction and the formation of crust color.

Dough Yield

THE WATER content of a formulation is directly correlated to the dough yield, and maximizing the dough yield is an essential rule in baking for maximizing profit. Removing water from a formulation seems counterproductive, as it would imply an economic loss. However, this is different with BTR. While less dough is obtained from the same amount of flour with the standard formulation when using BTR, smaller piecing is required to get the same scaling weight of the final baked loaf. A shorter baking time means less weight loss during baking, meaning the final yield is equal to or higher than the standard recipe.

Understanding the background of the BTR solution is crucial to grasp its mechanisms and discover how it can help you reach your sustainability goals. Based on your specific processes, setup, and needs, we can assist you in identifying the best approach to incorporate the BTR solution in your production system.

BTR Solution Case Study

Line Trial Application

TO EVALUATE the energy-saving potential of the Lallemand BTR solution, we have collected relevant data during trials conducted at the Mecatherm Demo Center to produce parbaked baguettes. Below are shown the recipes and average baking time and gas consumption.

Ingredients	Reference	BTR
	kg	kg
Flour (T550)	50	50
Water	28.5	26.5
Salt	1	1
Yeast	1.25	1.25
Improver	0.75	0.75
BTR Solution		0.006
Baking Time	13 min	10 min
Gas Consumption	0.86 m ³	0.70 m³
Gas Consumption Difference		-19%
Bake Time Difference		-23%

The results demonstrated a significant trend in energy savings when utilizing the Lallemand BTR solution. On average, the **trials revealed a 19% reduction in energy consumption** compared to conventional baking processes. This energy saving resulted from a 23% decrease in



bake time. The process and formulation changes did not affect the quality parameters of the baked products, such as crust color and final humidity.

It is essential to acknowledge that the energy-saving impact of the BTR solution may vary depending on the specific circumstances of individual bakeries. Factors such as equipment configuration, production volume, and product specifications can influence the extent of energy savings achieved. Therefore, to accurately assess the potential benefits for your bakery, we recommend conducting trials tailored to your needs. We are dedicated to supporting your plant trials to ensure that you accurately evaluate the impact of the BTR solution for your bakery.

Lallemand Baking, Innovation by Application

Capitalizing on more than 100 years of baking experience, from our core fermentation-based technologies and scientific knowledge, we manufacture ingredients and continuously improve and expand our portfolio to deliver baking solutions in record time to ensure your commercial success. Engaging in dialogues with you, we focus our expertise and resources on developing the most promising clean label solution to match your needs. Our solutions are your innovation.

Lallemand Baking Update is produced by Lallemand Inc. to provide bakers with a source of practical technology for solving problems. You can find the latest issues online at www.lallemandbaking.com. If you have questions or comments, please contact us at: baking@lallemand.com