

Vacuum Cooling Rises Through the Ranks

By Tudor Vintiloiu

Vacuum cooling has been around for decades, but it's only today that the technology has reached a level of maturity high enough to gain widespread acceptance especially for bakery applications. Several reasons have prevented this acceptance before.

The first is the fact that - contrary to all other vacuum cooling applications, for bread & bakery, vacuum cooling will directly influence the quality of the product, as the baking process continues in the cooler. One needs to understand the implications, and adapt their process to it, reducing baking times, increasing oven temperature and even sometimes modifying the proofing time and recipe. Failing to consider these modifications will prompt undesirable effects on product quality. Embracing the advantages the technology can bring, however, will result in premium bakery products, with respect to structure, volume, shelf life & optimum crispness. Another reason has been the availability of (affordable) vacuum coolers suited for bakery applications. Vacuum cooling professionals from Weber Cooling, Koenig-Rex and BVT Bakery Services shared their expertise with European Baker &

Biscuit, in order to help us clarify some of the complexities of this technology.

END PRODUCT BENEFITS

Vacuum cooling can be used for almost all bread types. "Some bread types (like gluten free and products with high rye and wheat content or with a high water content) are more difficult to cool, but adapting both the vacuum cooler as well as the baking process, makes it possible to prepare even the most difficult product", explains Hans Juursema, CEO of Weber Cooling. He goes on to detail some of the undeniable benefits of using vacuum cooling:

- A larger volume, as during the cooling process there is a pulling effect on the bread, resulting in a volume increase;
- A more homogenous and tender internal structure, as the gelation process continues under vacuum, giving a finer structure, and even a whiter color;
- A crispier crust which will stay crispy for a

Vacuum Cooling means more than cooling, it is part of the baking process. That's why the baking process time is shortened by this technique.

*Patrick Duss,
Executive Director
Vacuum Cooling at
BVT Bakery Services*



longer time, as the moisture is mostly sucked out (also for cookies: less moisture will lead to a longer crispness!);

- Longer shelf life, as less bacteria will be formed during the minimized cooling time.

Patrick Duss, Executive Director Vacuum Cooling at BVT Bakery Services takes the argument even further by bringing up energy saving and food regulations:

"Roughly speaking we can see advantages in substantial savings of space, time and energy and an impressive improvement of the product quality. The looks, volume, taste and healthiness of the products can substantially be improved due to vacuum cooling. Health authorities demand a serious reduction of sugar in future recipes and a chemical treatment of the bakery products nowadays is unwanted. In this respect vacuum cooling is no less than a game changer. A higher amount of water in the recipe (up to 4-12%) without influence on the amount of evaporation, automatically reduces the percentage of other ingredients and leads to a better volume and taste", he points out.

CHALLENGES AND UNWANTED OUTCOMES

You can get surface cracks and inhomogeneities if vacuum cooling is not applied correctly. If surface cracks appear, most likely a mistake was made in the process parameters. Vacuum cooling can only be successful when reliable technique is supported by knowledge of the process technology. One of the main challenges in this respect is the change of know-how in an industry that has remained fundamentally unchanged for roughly 3000 years. It requires a mind change.

The risk of disappointing results is present mostly when working with compact (non-porous) bakery products which increase in size considerably or form cracks. This can happen in the case of unsuitable products such as baked cheesecake or, conversely, with very un-porous meringues whipped up with air - as air expands greatly in the vacuum, and ruins the product shape.

ENERGY CONSIDERATIONS

From a business perspective, the main advantage this technology brings, is the reduction of process time. For example: a conventional production process of a tin bread takes approximately 4.5 hours from mixing to packaging. By using vacuum cooling, the production time can be reduced to one hour and 45 min.

"The average reduction of the baking process

is 30%. In a new production facility, the physical oven length can be shortened with the same percentage which results in lower investment and energy costs. For existing lines the production capacity on the same equipment can be increased, or energy costs can be decreased. The cooling process is reduced by 80-95%. This has a huge impact on availability of production surface, energy costs and investment costs", Duss explains. Providing high-quality baked goods is one of the main selling points for bakeries to compete against other bakeries or retail stores. Vacuum conditioning is one possibility to increase the freshness, look and quality of the baked goods. Also, energy efficiency is becoming more and more important as it can save energy costs and minimize CO₂ emissions. Therefore, it is of high interest for bakeries to reduce the baking time with vacuum cooling and reducing energy costs by avoiding shock freezers.

"The baking time is reduced by up to 30 percent for par-baked products and, compared to conventional methods, the ovens can already be loaded with other products during this time. Thanks to the shorter prebaking period and the also shortened baking time, the moisture content of the products is comparable with other interrupted baking methods, such as shock freezing and deep-freeze storage. Energy consumption in vacuum conditioning is considerably lower than in other processes, since no shock freezer is required and the products can be stored at ambient temperature or in the cold storage room at +5 °C. By stabilization in the vacuum conditioning, the products have a higher volume and thus, feature a better eye appeal and higher quality", describes Wolfgang Stauffer, CEO of Koenig-Rex.

MAINTENANCE AND FOOD SAFETY

The required maintenance time for a vacuum cooling system is substantially lower because there is no physical contact with the product. "A conventional cooling system needs at least a weekly maintenance - defrosting, cleaning etc. A vacuum cooling system needs 4-8 hours maintenance per year in no more than 1-2 maintenance operations. A vacuum cooling system is a multi-purpose system. It takes no time to changeover a product. To put it simple: it is 'only' air that does the job", says Patrick Duss of BVT Bakery Systems.

Due to rapidly reducing the pressure and temperature, the formation of mold and other bacteria - which mainly occurs in the temperature range of 60 to 30 degrees Celsius - is also greatly reduced.

Hans Juursema of Weber Cooling explains

30%

is the average reduction of the baking process time.

20°C

lower baking temperature is required when using vacuum cooling technology.

80-90%

is the average reduction of the cooling time.

4-8

hours/year is the maintenance requirement of a vacuum cooler.

For gluten-free bakeries the advantages vacuum can bring are just huge. With vacuum you can easily bake even the most difficult gluten free recipe and can produce bread which has a texture & bite comparable to normal bread.

“

Hans Juursema, CEO
of Weber Cooling

further: "The vacuum rooms are constructed of stainless steel, and it is easy to clean the inside of the room. The air in the room will flow in a controlled way, ensuring no contaminated air can return to the room. By adding filtration & clean air solutions, a next level hygiene can be achieved. Oil used in the vacuum pumps is food approved, and no machine contact is made to the floor. All outside casing is stainless steel as well." Another notable health benefit of using this technology is the inherent reduction of acrylamide and other harmful by-products of the baking process. Baking under vacuum allows the decrease of baking temperature without retarding the drying process, because moisture evaporation is accelerated under vacuum. Reducing atmospheric pressure in the oven by half enables the decrease in baking temperature by 20°C with approximately the same drying rate. Since vacuum cooling lowers the thermal input without extending total processing time, the technology limits significantly the formations of acrylamide and HMF (hydroxymethylfurfural) in baked products.

FUTURE DEVELOPMENTS

Patrick Duss envisions a scalable ubiquitous presence of this technology in the future of baking: "Vacuum cooling is very easy to integrate in industry 4.0 configurations. The

key part in this solution is the small surface necessary to install the equipment. The scale is the same if there is a semi-automated production or a manual production. When some 30-40 years ago the first rack ovens popped up on the market, everybody was scared and skeptic. Same thing happened with fully automated proofers, etc. Today those technologies are common technologies and vacuum cooling will be no different. The question is, will the vacuum cooling success also influence the kitchen technology in professional kitchens or household kitchens like for instance the microwave technology did?". Weber Cooling is currently designing its first big scale industrial solutions and expects to deliver their first machines in 2019. "Small steps still can be made in heat recovery from the cooling system, but this can be also offered as of 2019. As of 2020 we will offer full GWP-free refrigerants for all our bakery cooling solutions, adding a complete ecological friendly cooling solution", said Hans Juursema. Considering the fact that each product has its own specific cooling curve, Koenig's experts focus their attention on the future customization of this technology to fit various products: "All manufacturers of vacuum chambers make use of the same physical principle. What matters here, now and in the future, is how the cooling curve is individually adapted to each product", says Klaus Ratz, heating and air conditioning specialist at Koenig. •

Wolfgang Staufer,
CEO of Koenig-Rex

“

There is no limitation to products. With various adjustable cooling curves and storable programs, vacuum conditioning makes it possible to simplify process steps for different kinds of baked goods.

Read more about
this topic on
worldbakers.com

BVT Bakery Services
Vacuum Cooler

