**Baking with impingement heating**

**Identification**

**Key words**  
impingement, baking, heating, air jet, bread, pizza, cake, cookie, oven

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**Completed by**  
SP

**How does it work?**

**Primary objective**  
Reduction of baking time and energy consumption

**Working principle**  
Baking involves simultaneous heat and mass transport. Heat is transported from the surface into the product and moisture is transported internally towards the product surface and evaporates.

Impingement is a rapid convective heat transfer method. Hot air jets of high velocity are directed towards the product, orthogonally or with an inclination. Different nozzles can be used for adjustment of air jet direction and velocity. The jet disrupts the stagnant boundary gas layer between the product surface and the bulk flow. High air velocity results in a thinner boundary layer and a higher degree of turbulence inside the boundary layer, which improves the heat transfer as well as the removal of moisture from the surface. The heat is further distributed inside the product by conduction and convection (3,4).

The rapid heat transfer achieved with impingement heating gives a faster colour and crust development, as compared to conventional baking, and the baking time can be reduced by as much as 50%. Also, a lower oven temperature can be used. Colour is developed faster in an impingement oven than in a conventional oven because of the more rapid surface temperature increase. The water loss rate is about the same as for conventional baking, but shorter baking times provides for reduced moisture loss. High moisture retention gives softer crumb and increased shelf life (1,3,4,7).

To achieve even lower energy consumption levels, impingement can be combined with energy efficient baking methods such as infrared or microwave heating.

**Images**

**Additional effects**  
Impingement heating offers space savings, since the ovens are smaller than conventional ovens.

**Important process parameters**  
Baking time, oven temperature, impingement air temperature and velocities, impingement nozzle geometry, nozzle-to-product distance, jet orientation.

**Important product parameters**  
Product structure and geometry, product composition, moisture content.

**What can it be used for?**

**Products**  
Bread, pizza, cakes, cookies and other baked products.

**Operations**  
Baking

**Solutions for shortcomings**  
Conventional baking is a time and energy consuming process. Impingement heating can speed up the process and is more energy efficient.
What can it NOT be used for?

**Products**
Products that require long baking times to allow for desired chemical and physical conversion to take place, for example flavour and texture components, may be difficult to adapt to fast impingement methods.
Products that are sensitive for the distortion from the air jet.

**Operations**
Impingement can be used in all baking operations.

**Other limitations**
In impingement heating the crust cannot reach a higher temperature than the air temperature, as is possible with other baking techniques (3).

**Risks or hazards**
Observe normal safety regulations when working with hot ovens.

Implementation

**Maturity**
Impingement ovens are available at the market. The first impingement oven was patented in 1975. Impingement ovens are common for pizza making.

**Modularity/Implementation**
Impingement ovens can be inserted in an existing production line. Impingement nozzles can be added as a complement in for example IR and microwave ovens.

**Consumer aspects**
Impingement heating is a form of conventional convective heating, which has been used for long time and is well accepted.

**Legal aspects**
Please check local legislation.

**Environmental aspects**
Impingement baking uses less energy than conventional baking.

Facilities that might be interesting for you

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Further Information

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<td>Buhler Aeroglide</td>
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