Making our world more productive

MAPAX® – Best for bakery products

Linde's MAPAX® portfolio meets today's food preservation challenges with bespoke gases and mixtures, application expertise and complementary installation, test and safety services.

Carbon dioxide slows mould growth on bread

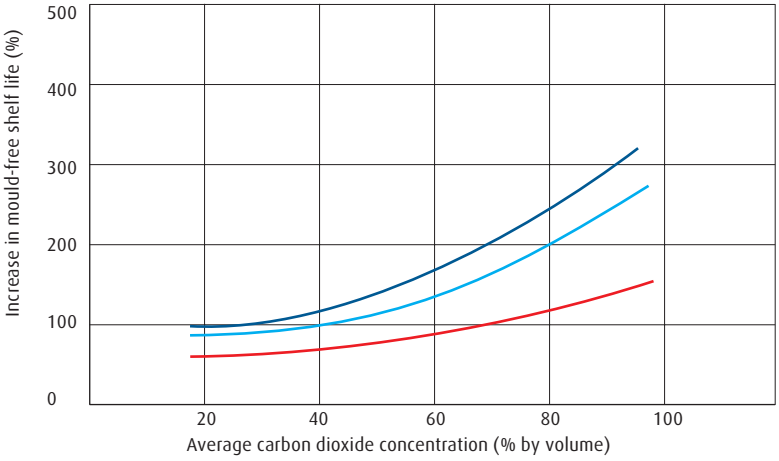
The main spoilage factors for bakery products are mould growth and chemical breakdown. Fermentation may cause problems in filled bakery products. Since the water activity of bakery products is low, the growth of microorganisms other than mould is seldom a problem. To reduce the risk of mould and spore contamination, very good hygienic conditions are required, e.g. a clean room. Mould is an aerobic microorganism, so it can be effectively controlled by carbon dioxide and low oxygen content, which subsequently extends shelf-life by many valuable days.

Modified atmosphere packaging (MAP) is especially suitable for rye bread, sweet bakery products and certain pies. For Danish pastries and other iced bakery products, excessive levels of carbon dioxide can worsen the appearance of the icing by dissolving into the fat content and causing it to "melt away". If the carbon dioxide concentration is balanced by nitrogen, the product's appearance remains unchanged. The loss or adsorption of moisture in bakery products is prevented by a barrier material.

Recommended gas mixtures for bakery products

Product	Gas mixture	Gas volume / Product volume	Typical shelf-life Air	Typical shelf-life MAP	Storage temp.
Pre-baked bread	100% CO_2	50–100 ml / 100 g prod.	5 days	20 days	20–25°C
Cakes	50% CO_2 + 50% N_2	50–100 ml / 100 g prod.	15 days	60 days	20–25°C
Fresh dough	50% CO_2 + 50% N_2	50–100 ml / 100 g prod.	3–7 days	18–31 days	5°C
Pastries/ doughnuts	30% CO_2 + 70% N_2	50–100 ml / 100 g prod.	7 days	21 days	20°C
Sliced bread	50% CO_2 + 50% N_2	50–100 ml / 100 g prod.	2 weeks	2 months	20°C
Sandwiches	30% CO_2 + 70% N_2	50–100 ml / 100 g prod.	3–7 days	10–28 days	0–4°C
Cream cakes	30% CO_2 + 70% N_2	50–100 ml / 100 g prod.	3–4 days	21 days	0–4°C

Increase in shelf-life for different bakery products at various levels of CO_2 concentration



Product	ERH %	Storage temp.
Part-baked bread	91	21°C
Fruit pies	95	27°C
Part-baked rolls	88	21°C

*ERH: Equilibrium Relative Humidity

The importance of managing O_2 levels

Bread is a very porous product with a lot of air bubbles inside it. Once it has been packed, the air inside the bread and the modified atmosphere will balance each other out and the low O_2 content within the package will rise naturally by a few percentage points. The choice of machine has an impact on the O_2 level in the packaging and thus on the shelf-life. Horizontal flow-packers and thermoforming machines are typically used to pack bread in a modified atmosphere.

Horizontal flow-packers

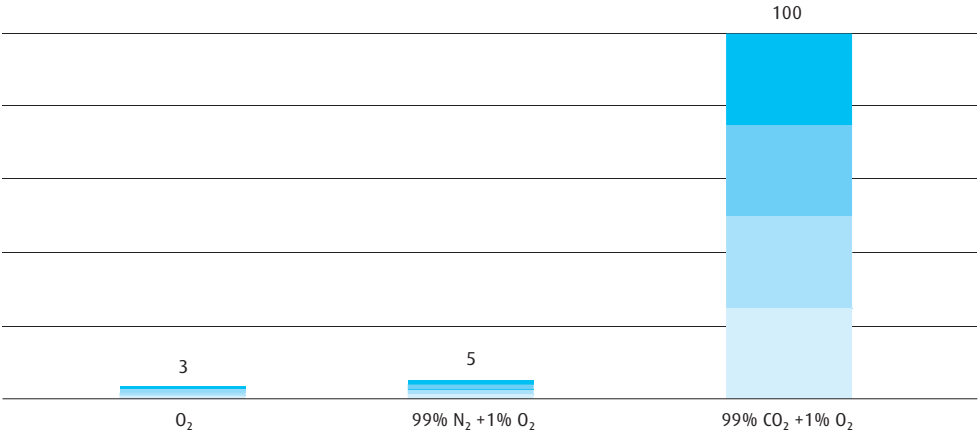
This packaging technology flushes gas into the packages to replace the air. This usually results in higher final oxygen levels because the flush effect mixes the modified atmosphere gas with the air around the product. In the case of flow-packers, oxygen levels are around 2–5%. Any concentration above that would have a detrimental effect on the shelf-life.

Thermoformers

Thermoformers can combine vacuum packing with MAP. This flexibility enables further reductions in the oxygen level. With many – but not all – breads, this enables manufacturers to extract as much oxygen from the packaging as possible. With both packaging technologies (flow-pack & thermoforming), the modified atmosphere must be combined with the right packaging material to optimise shelf-life overall.

A note on the staling process

The use of MAP has little or no effect on the rate at which bakery products go stale. Staling is caused by starch retrogradation. Staling rates increase at chilled temperatures and therefore most bakery products eaten cold are normally stored at ambient temperature. For bakery products eaten hot, such as pizza bases, the staling process is reversed during the reheating cycle.



Time (days) to reach mould development on toast in various atmospheres and at 20 °C.
The toast was initially infected with mould.

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