

Making our world more productive



MAPAX[®] – Best for fish and seafood





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

Fresh fish deteriorates very quickly

Fresh fish rapidly loses its original quality due to microbial growth and enzymatic processes. The sensitivity of fish and seafood is caused by its high water activity, neutral pH value (at which microorganisms thrive best) and the presence of enzymes which rapidly undermine both taste and smell. The breakdown of proteins by microorganisms gives rise to unpleasant odours. The oxidation of unsaturated fats in high-fat fish such as tuna, herring and mackerel also results in an unappetising taste and smell. Fish such as herring and trout can turn rancid even before microbial deterioration is detectable.

In order to maintain the high quality of fresh fish products, it is absolutely necessary to keep the temperature as close to 0°C as possible. In combination with the right gas mixture, shelf-life can be extended by a few important extra days. Provided, of course, there has been a continuous cold chain. Cod, flounder, plaice, haddock and whiting are examples of fish that can be stored at 0°C twice as long in a modified atmosphere as in air.

Carbon dioxide: a prerequisite for maintaining quality

The presence of carbon dioxide is necessary to inhibit the growth of common aerobic bacteria such as *Pseudomonas*, *Acinetobacter* and *Moraxella*. This is primarily because CO_2 reduces the pH value of the product surface. The CO_2 concentration should always be above 20% and can be as high as 50% to achieve the maximum shelf-life extension.

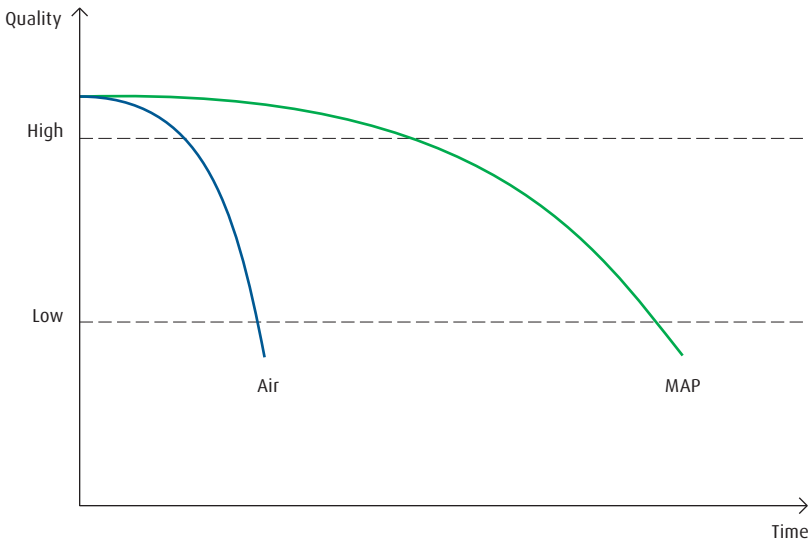
Depending on the storage temperature (0–2°C), modified atmosphere packaging (MAP) prolongs shelf-life by 3 to 5 days compared with the shelf-life of raw fish in a tray with film over-wrap. Excessively high concentrations can produce undesirable after-effects in the form of lost tissue liquid or, in the case of crabs, an acidic or sour taste.



Recommended gas mixtures for fish and seafood

Product	Gas mixture	Gas volume Product volume	Typical shelf-life		Storage temp.
			Air	MAP	
Raw fish	40-90% CO ₂ + 10% O ₂ + 0-50% N ₂	200-300 ml 100 g fish	3-5 days	5-14 days	0-2°C
Smoked fish	40-60% CO ₂ + 40-60% N ₂	50-100 ml 100 g fish	15 days	30 days	0-3°C
Cooked fish	30% CO ₂ + 70% N ₂	50-100 ml 100 g fish	7 days	30 days	0-3°C
Prawns (peeled, cooked)	4% CO ₂ + 60% N ₂	50-100 ml 100 g prod.	7 days	21 days	4-6°C

Quality loss in fish preserved in air and MAP



Fish such as cod and plaice kept at 0°C can maintain their high quality for twice as long in the correct modified atmosphere.

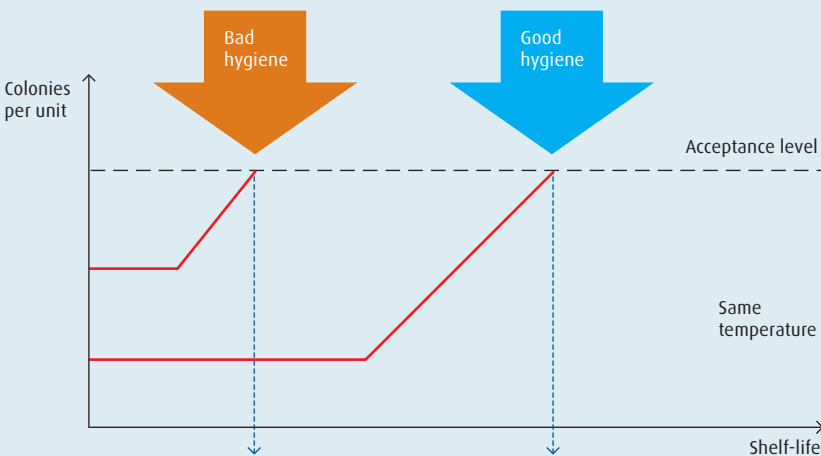
Oxygen keeps colour

Oxygen can be used as a component of a modified atmosphere to avoid colour changes and pigment fading in fish and seafood. The gas is also used to prevent the growth of anaerobic microorganisms such as *Clostridium*, which can produce toxins. However, the risk of *Clostridium* growth in fish with a short shelf-life packaged in the correct modified atmosphere is negligible. If the temperature is kept below 2°C, there can be no growth.

To combat rancidity, oxygen should not be used in packages of high-fat fish. Nitrogen is more suitable in such cases.



Importance of hygiene for a long shelf-life



Linde Aktiengesellschaft

Gases Division, Carl-von-Linde-Strasse 25, 85716 Unterschleissheim, Germany

Phone +49 89 31001-0, www.linde-gas.com/mapax

Linde is a company name used by Linde plc and its affiliates. The Linde logo, the Linde word and MAPAX are trademarks or registered trademarks of Linde plc or its affiliates. Copyright © 2019. Linde plc.