ExtendaPak™ Modified Atmosphere Packaging for Seafood

Precise Packaging Atmospheres with Linde

Preserving and extending the shelf life of fresh fish and seafood is particularly challenging due to its very perishable nature. This is affected by several factors including high water content and neutral pH. Both of these conditions are ideal for the rapid formation and development of bacteria and enzymatic activity that cause unfavorable odor and taste.

Linde's *ExtendaPak* line of gas mixtures are available to help you select the right atmosphere for your specific product. The three main gases used in Modified Atmosphere Packaging (MAP) of seafood are carbon dioxide, nitrogen and oxygen.

- Carbon dioxide is a gas with antibacterial properties that inhibits the growth of common microorganisms such as *Pseudomonas*, *Aeromonas*, *Bacillus*, and *E. coli* by lowering the surface pH of the fish tissue. Optimal carbon dioxide levels are in the 20-30% range, but this can change depending on the product.
- Nitrogen is an inert gas used to displace reactive gases such as oxygen and thus prevents oxidation and rancidity of the product. It is also used to balance the pressure inside the package and prevent its collapse.
- Oxygen is used to prevent discoloration of certain type of seafood products and also as a preventive measure to guard against the growth of anaerobic microorganisms.

Important Considerations

One of the concerns about fresh seafood is the potential for the formation of the *Clostridium botulinum* toxin in oxygen deprived or anaerobic environments as a result of time and/or temperature abuse during processing, storage and distribution. The *C. botulinum* toxin is responsible for botulism which can cause consumer illness and even death. The primary preventive measure against the growth of and toxin production of non-proteolytic strains of *C. botulinum* is temperature control below 38°F from the time of packaging through consumption.

Packaging considerations

Gases and the proper combination of those gases are only part of the modified atmosphere packaging process. Packaging methods, materials and packaging films all play an important role in achieving the desired shelf life extension. There is packaging material specifically designed for the seafood industry and the FDA recommends packaging material with a permeability of less than 10,000 cc/m2/24 hour at 75°F.

Major Food Products					ExtendaPak#	Extended Shelf Life	Storage Temperature
Raw White Fish					45	8 - 12 Days	32° – 36°F
Catfish	Flounder	Hake	Pike	Skate	$N_2 – O_2 – CO_2$		
Cod	Grouper	Halibut	Red Snapper				
Dover	Haddock	Monfish	Shark				
Raw, High Fat & Oily Fish*					16	8 - 12 Days	32° – 36°F
Carp	Herring	Salmon	Swordfish	Tuna	$N_2 – CO_2$		
Eel	Mackerel	Sardines	Trout				
Crutaceans and Mollusks*					45	Up to 10 Days	32° – 36°F
Abalone	Conch	Mussels	Prawns	Squid	$N_2 – O_2 – CO_2$		
Clams	Crayfish	Octopus	Scallops				
Crab	Lobster	Oysters	Shrimp				
Dried Fish					14, 15	Months	32° – 40°F
					$N_2 – CO_2$		

*Retail Pack

A Preparation, Handling and Storage Specifications

The National Advisory Committee on Microbiological Criteria for Foods published several recommendations regarding MAP for seafood such as:

- → Temperature control at all times at or below 38ºF
- → Product packaged under HACCP plan
- → High quality raw fish used Product adequately labeled for storage, temperature, shelf life, and cooking requirements

For additional information please review FDA's "Fish and Fishery Products Hazards and Controls Guidance". https://www.fda.gov/food/seafood-guidance-documents-regulatory-information/fish-and-fishery-products-hazards-and-controls

Food Processing Expertise

Extended shelf life, fresh flavor, correct aroma and expected texture. That's what you can expect when working with Linde. We provide gases in a variety of cylinders, bulk delivery and on-site production options to meet your needs. In combination with our delivery systems, our specialty gases, liquid or gaseous nitrogen and carbon dioxide, and oxygen are used in the seafood industry for:

- → Cryogenic freezing and chilling operations
- → Dry ice and direct snowing applications
- → Modified atmosphere packaging
- → Water treatment
- → Aquaculture

MAP Applications and Product Safety Information

MAP represents only one aspect of what a food processor can practice to ensure that a high quality food product reaches the marketplace to meet consumer expectations. Most importantly, MAP does not eliminate or reduce the processor's responsibility for good manufacturing practices. In fact, the opposite is true. MAP is only appropriate for products in well-maintained and clean operations. No gas combination in the package will ever reverse a food's poor microbial condition. MAP is best suited to simply extend the shelf life of high quality foods. All statements, information, suggestions and recommendations are based on information we believe to be realizable, but the accuracy or completeness of the information is not guaranteed and no warranty of any kind is made with respect to the information provided. Quality control verification and monitoring in conjunction with any and all claims relating to atmosphere packaging is essential and is the responsibility of the Linde *Extendapak*™ gases purchaser and/or user.

Contact Linde Today

For more information about applications developed with atmosphere, cryogenic and process gases, call Linde at **1-844-44LINDE**, or visit our website at **www.lindefood.com**.

Linde
10 Riverview Drive
Danbury, CT 06810
Phone 1.844.44LINDE (1.844.445.4633), Fax 1.800.772.9985; 716.879.2040
www.linde.com