Use of Ozone in the Fish Industry

Technical Information Sheet No: 1997/07/FT

Since the 1920's scientists have tried to harness the powerful disinfection properties of ozone to slow the spoilage and improve the safety of fishery products. Recent advances in electronics and ozone technology have led to the development of a new generation of compact ozone generators. This data sheet aims to provide a basic introduction to ozone. It describes some of the potential applications which have been investigated to date and the health and safety risks that can be involved.

What is Ozone?

Ozone (O_3) is a gas generated from oxygen (O_2) by either ultraviolet (UV) radiation or a high voltage electrical discharge. Ozone is highly toxic, invisible and heavier than air. At low concentrations it has a distinctive pungent odour but at higher concentrations you cannot smell it. It is also highly corrosive and will quickly destroy most plastics and natural rubber.

Ozone kills microorganisms by oxidizing and destroying their cell wall. It has the advantage of being able to kill resistant microorganisms such as bacterial spores, cysts and viruses at relatively low concentrations, without requiring a long time to work. However, a much higher dose of ozone is required to kill microorganisms when they are surrounded by other organic matter. The organic material acts like a shield, neutralising the ozone and protecting the bacteria.

Ozone is mainly used for potable water and sewage disinfection. In France, ozone is also used in mollusc purification systems.

Safety First!

Ozone is highly toxic even at low concentrations. Symptoms of exposure to low concentrations include irritation of the upper airways (coughing and tightness of the chest). Permanent damage to the lining of the lung occurs at higher concentrations. Exposure to ozone gas at workplaces ashore is strictly controlled by the COSHH Regulations.

The occupational exposure standard (OES) for ozone in air is currently set at 0.2 ppm (parts per million) averaged over a 15 minute reference period. To comply with COSHH Regulations exposure must not exceed this level. It is prudent to reduce exposure to well below this level to allow for fluctuations and as a matter of good practice, all employers are encouraged to reduce exposure to well below the OES.

Dangers from exposure to ozone gas may arise from the following sources:

I. Working in an ozonated area where the background level of ozone is too high.

ii. Leakage of ozone as a result of poorly designed/installed equipment (particularly the use of non-ozone resistant material).

iii. Gassing off from ozonated water.

To protect workers from ozone, an effective and reliable ozone monitoring and alarm system must be used. To gain quick access into an ozonated area, powerful extraction/ozone destruction equipment is required to remove the ozone. It can take many hours for ozone to disappear naturally in a closed chill store.

Little is known about the long term health effects of ozonated water in contact with the skin.

Can Ozone Gas Flushing extend the Storage Life of Fish in a Hold or Chill Store?

It has been claimed that pumping ozone gas into a hold or chill store can extend the storage life of boxed and iced fish.

Seafish trials have shown that keeping boxed and iced fish in a high concentration of ozone (2 ppm) had no effect on the microbiological or sensory quality of the fish over an extended storage period. It is likely that the majority of ozone is prevented from reaching the fish by the ice. If ozone does manage to reach the fish, it is probably neutralised by slime, scales and skin before it had chance to reach the spoilage bacteria which penetrate the flesh of the fish. Ozone is however very effective at neutralising odours. Ozonated fish rooms and chill stores smell much sweeter than their unozonated counterparts.

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Can Ozonated Ice Slow the Spoilage of Fish?

It has been claimed that boxing fish in ice produced from freshly ozonated water can slow the rate of spoilage of the fish.

Seafish trials have shown that boxing fish in ice produced from ozonated water had no effect on the microbiological or sensory quality when compared with ordinary ice. Other scientific studies have found similar results. This is not surprising as any residual ozone in the ice is likely to decay naturally within a few hours of production and consequently have little effect on the fish.

However, it is well known that fish stored in bacterially contaminated ice spoil faster than fish stored in clean ice. Ice should always be made from potable water or clean seawater and be kept clean. Ozone is a proven water disinfectant and can be used to ensure that the water for ice production is clean. However, the ozonation of seawater can produce harmful chemical residuals which may be transferred to the product.

Other Potential Uses of Ozone

Fish Washing

Several scientific studies have investigated the use of ozonated water for dipping and washing fish. Most results showed that ozonated water had no significant effect on the product.

Work Surface Disinfection

It has been claimed that ozone gassing can be used as a powerful surface disinfectant. Seafish trials have shown that ozone can reduce surface bacterial contamination but that washing with traditional disinfectants such as sodium hypochlorite (bleach) is more effective. It is possible that ozonated water would be more effective than ozone gas for this application.

RSW Fish Storage

Seafish trials have indicated that there may be some storage life extension for mackerel held in ozone treated seawater. However, the US Food and Drug Administration (FDA) has some concern over the safety of chemical by products formed when ozone reacts with fish and seawater. Further investigation is necessary.

In Conclusion

Ozone is an effective water disinfectant, but ozone gas presents considerable health and safety risks and its use has little effect on fish quality. There is no substitute for the basic principles of handling fish carefully, chilling it to ice temperature and marketing it quickly.

Further Information

Those using ozone are advised to obtain HSE Guidance Note EH38 (Revised) Ozone: Health Hazards and Precautionary Measures.

HSE Mail Order Publications:
HSE Books
P O Box 1999
Sudbury
Suffolk
CO10 6FS
Tel No: 01787 881165

HSE Enquiries:
HSE Information Centre
Broad Lane
Sheffield
S3 7HQ
HSE Information Line - Tel No: 0541 545500

For further technical guidance on the use of ozone within the fish industry can be obtained from Seafish Fish Technology Department.

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