



OZONE KEY TO GAME-CHANGING SOLUTION TO PURGE OFF-FLAVOUR

Ozone has been used to purify water since the early 1900s, initially to treat municipal wastewater. Eventually, it was introduced as a water treatment system used in aquariums, swimming pools, drinking water, industrial process water and fish farms producing fish for human consumption.

Ozone is a powerful oxidizing agent that effectively targets organic matter, viruses, bacteria and parasites. It also targets off-flavour compounds, such as geosmin, and may introduce a new way to avoid the expensive and time-consuming purging of fish grown in recirculating aquaculture systems (RAS). Ozone rapidly decomposes and turns to pure oxygen, giving rise to additional benefits in both the water environment and biofilter.

Research evidence has shown ozone provides promising advantages for water treatment in RAS facilities.

PURGING THE COSTLY PURGE

Geosmin, also referred to as off-flavour in fish, poses one of the biggest challenges for land-based fish farming. Solving this challenge would be a game-changer for RAS.

One effective way of eliminating the off-flavours is to treat the water with ozone.

However, ozonated water in large-scale RAS and flow-through fish farms comes with different challenges. If ozone is transported for long distances, it may be fully decomposed before even reaching the treatment site.

Historically, ozone generators have been big and complicated, necessitating the need for them to be placed far from the treatment site and led to the fish tanks through long pipes. This results in ozone degradation before reaching its target, rendering the treatment ineffective and expensive in RAS.

An optimal solution is the ozone generator, Gaia, developed by Water ApS. Gaia makes it possible to do the cleansing right by the fish tank. One big advantage of this system is that it works with the OxyGuard equipment, including the Pacific, a measuring, monitoring and control system, and the Ozone Sensor, which detects even the smallest amount of left-over ozone. Farm operators can even manage the system online with the digital farm management tool Cobália. Gaia is one of the most powerful and high-producing generators on the market. It is a modular ozone generator separated into smaller units working individually. The modular feature of the generator makes it possible to place the ozone generator directly at the treatment site and treat the water without loss of ozone. This makes the ozonation process more efficient and cost-effective.

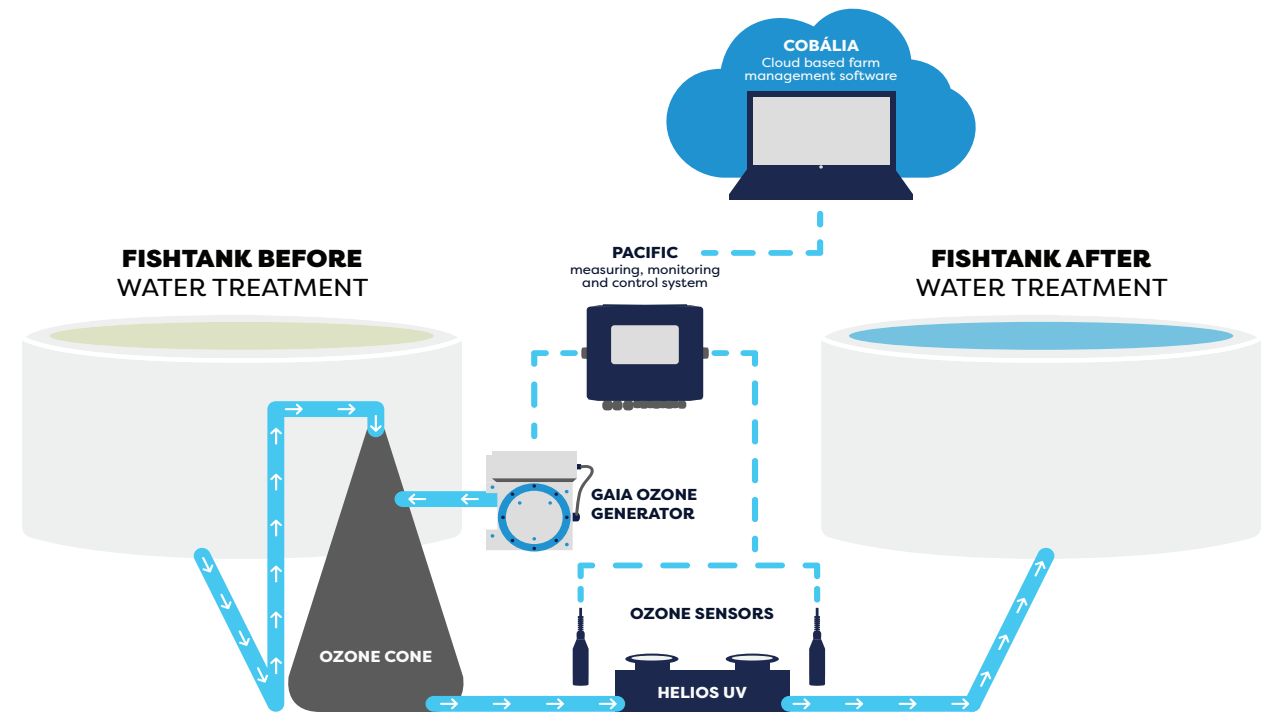


Figure 1: An example of how it is possible to set up the system. The figure shows how the Helios UV Technology, produced by Water ApS, will degrade any remaining ozone.

THE SALTWATER CHALLENGE

Ozone chemistry in saltwater is more complex compared to that in freshwater, due to the higher concentrations of dissolved ions. Seawater naturally contains bromide ions, which are highly reactive to ozone. When ozonating seawater, bromide ion is oxidized to hypobromite, bromite and, eventually, bromate, which are of crucial importance since they have a long lifetime allowing several side reactions to occur. Hypobromite also reacts with ammonia and proteins to form bromamines. Both bromamines and hypobromous acid are toxic to fish, bivalves and crustaceans. To ozonate safely in salt water, it is important to ensure the presence of organic matter. As long as there is organic matter in the water, ozone will react with it first as it is much easier to degrade than anything else.

OxyGuard solved this challenge with the fast-reacting ozone sensor that can measure ozone directly in the water in real-time. By adding the ozone sensor to the system, it is possible to ozonate safely based on feedback from the sensor.

On top of this solution, OxyGuard developed a control feature for ozonation in the Pacific Control System, enabling automated control of the ozonation based on data from the sensor.

The system has been tested through different developmental projects such as RASALT, where OxyGuard, in collaboration with the Technical University of Denmark (DTU), worked with data from the ozone sensor and the ozone generator to prevent brominated by-product for-

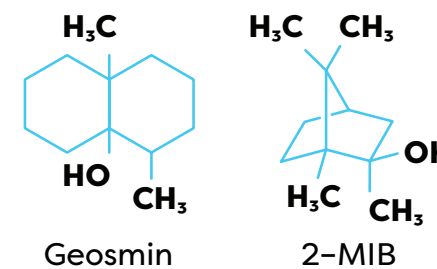


Figure 2. Bacteria develop flavoured substances such as geosmin, methyl-isoborneol (MIB), and other compounds. Even extremely small amounts of these off-flavours lead to a muddy taste in the fish, making it unmarketable for human consumption. Today most of the fish from recirculating aquaculture is purged in clean water to flush out off-flavour. This is very costly, costing up to five per cent of the revenue.

mation. This data was achieved by connecting the sensor and the generator to the digital farm software, Cobália. Cobália is now developing a module specifically for safe and efficient ozonation control. The aim is to enable a capability to automatically turn the ozonation on and off based on feedback from the water matrix. This add-on will increase security and efficiency, making it easy and inexpensive to use.

OPTIMIZING FISH HEALTH

In ProBiOzon, another collaborative project between OxyGuard, DTU Aqua and primary producers, the effect of ozonation was tested on fish health and mortality in freshwater RAS. The results showed a general, overall improvement in fish health and resulted in lower mortality. It improves water quality by removing

organic matter and helps the biofilter function through the supply of pure oxygen for ozone degradation.

In a new project, Bizon, led by OxyGuard, the entire system will be tested at full scale to see if ozonation could either completely or partially remove the need for purging. The Bizon project is expected to be concluded in 2026.

GAME-CHANGING SOLUTION

OxyGuard International and Water ApS have already implemented the system on several larger RAS. It is installed as a part of the entire water cleaning setup on the farms, targeting a sub-stream of the recirculation water.

If the entire setup is effective enough to completely remove geosmin from the water, it will change the way we produce fish in RAS and the feasibility of RAS in general.

THE SOLUTION
An integrated, innovative system for the efficient use of ozone treatment to remove off-flavours in RAS

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