

Treatment of marine hatchery water to eliminate NoroVirus



Parameters

location	Eastern Mediterranean
Fish species	Sea Bass
Water flow	150m ³ /hr
salinity	35ppt
temperature	25 deg c
turbidity	0.1 to 1 ntu

The problem

Marine fish hatcheries are susceptible to the introduction parasites, bacterium and viri and can impact on the profitability and viability of a fish farm installation. The most sensitive stages include egg incubation, first feeding and early rearing, until grow-out stage, however all stages are at risk.

The virulence of Norovirus is but one example of an endemic risk associate with a viral pathogen. Parasites can be removed by good filtration down to 5 microns, bacteria can usually be deactivated by good mechanical filtration followed by UVc irradiation with a dose rate of 60 mj/cm²/sec. However viri are very difficult to remove by standard mechanical filtration and they have a very high resistance to UV. For IPN (infectious pancreatic necrosis) 120mj/cm²/sec is required to denature the RNA and as a safe guard systems rated at 200 mj/cm²/sec are usually installed.

The solution

The first stage is the best possible filtration, membrane filtration down to 0.01microns may be applied, but this would be very expensive and impractical in the vast majority of cases. AFM filtration using grade 1 and grade 0 AFM can provide a lower cost option which is actually more effective than UF.

Stage 1. ZPM

Pump water out of the sea and through a Seawater ZPM, delta P should be approx. 0.2 bar. The ZPM will spin and cavitate the water. The action will cause mechanical coagulation and flocculation reactions. The small particles including viri protein will be flocculated which will allow the AFM to physically remove the organisms.

The injection of a small quantity of ozone between 0.05 and 0.1 mg/l can enhance the mechanical coagulation reactions.

Stage 2. AFM

The water is now filtered by AFM using grade 3 on the base with a layer of grade 2. The bulk of the filter media will be grade 1 with a layer of grade 0. Refer to the AFM instruction manual for more detail.

Filtration performance is a function of water flow velocity. The maximum recommended flow for aquaculture applications is 20 m/hr. If there is a requirement to remove or deactivate viri then a flow velocity of 10m/hr is recommended. The pressure filters should be in compliance to Germ DIN standard with 1200mm of filter bed and a nozzle distribution plate and side window.



Back-wash water flow is dependent on filter bed AFM grade sizes, water temperature and water salinity. Refer to manual for more detailed instructions. As a guide line the back-wash flow must be sufficient to expand the filter bed by 20% for a period of 5 minutes. After back-wash there should be a rinse phase for approximately 10 minutes before going back-online.

Stage 3 Disinfection

The water is now mechanically clean, but there will still be viri and bacteria present in the water. The ZPM and AFM systems will have reduced the concentration by 50% to 90% when grade 0 is used but this is not sufficient to protect the fish.

The water now needs to pass through a second ZPM into which you inject hydrogen peroxide at a rate of 1 to 6ml per 1 m³ of water treated. As an alternative ozone may be applied at a concentration of 0.1 mg/l. The ZPM will either kill the bacteria and viri or render them much more susceptible to oxidation reactions for a short period of time.

Immediately after the ZPM the water enters the UVC chamber and is irradiated to a value of 200mj/cm²/sec. for viri and over 60 mg/cm²/sec for bacteria. Please note that irradiation level will be a function of the UVC transmission through the water. The presence of a small amount of hydrogen peroxide or ozone will be catalysed by the UVC systems to generate up to 7 times the concentration of hydroxyl radicals. The combination is essential to insure adequate treatment of the water.

Solved.

The fish farm in question could not produce juveniles due to infection by Norovirus, after installation of the system, the farm was a success.

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