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Commentary

Brief Note on Recirculating Aquaculture Systems

Rodgers M. Stryjeckin*

Department of Marine Science, University College London, London, UK

DESCRIPTION

Where water exchange is limited and biofiltration is necessary to prevent ammonia toxicity, Recirculating Aquaculture Systems (RAS) are utilized in home aquaria and commercial fish production. To keep clean water and maintain a healthy habitat for fish, additional methods of filtration and environmental control are frequently required. The capacity to decrease the requirement for fresh, clean water while still providing a healthy environment for fish is the main benefit of RAS. Commercial RAS requires high fish stocking ratios to be profitable, and several researchers are now conducting tests to see if RAS is a suitable kind of intensive aquaculture.

RAS water treatment processes

In intensive fish farming operations, water quality is maintained by a number of treatment techniques. These procedures are usually carried out in the following format, but they can also be carried out together. After removing the fish-holding vessel, the water is initially cleaned for pollutants before passing through a biofilter to convert ammonia, followed by degassing and oxygenation, and finally heating/cooling and disinfection. Each of these procedures can be carried out using a number of methods and equipment, but they all must be carried out in order to maintain a healthy climate that supports fish development and health.

Biofiltration

To convert ammonia excreted by the fish into nitrate, all RAS rely on biofiltration. Ammonia is a waste product of fish metabolism that is harmful to most finfish at high doses (>0.02 mg/L). Nitrifying bacteria are chemoautotrophs that convert ammonia to nitrite, which is then converted to nitrate. A biofilter provides a bacterial community with a substrate, results in a thick biofilm forming within the filter. Water is poured through the filter, and the bacteria use ammonia as a source of energy. Nitrate (>100 mg/L) is less harmful than ammonia and can be eliminated with a denitrifying biofilter or by replacing the water. To maintain that the biofilter works well, it must be kept in a stable environment and maintained on a regular basis.

Solids removal

Solid waste should be disposed in addition to the liquid waste generated by fish. This is done by concentrating and cleaning the solids out of the system. The removal of solids minimizes bacterial growth, oxygen demand, and disease spread. The most basic way for removing solids is to create a settling basin in which the relative velocity of the water is low and particles can settle at the bottom of the tank, where they can be flushed out or manually vacuumed out using a syphon. This strategy, however, is not suitable for RAS operations that require a compact footprint. Solids become trapped in a sand or particle filter and can be periodically back flushed out of the filter in typical RAS solids removal.

Another standard method is to utilize a mechanical drum filter, which involves running water through a spinning drum screen that is cleaned periodically by pressurized spray nozzles, and then treating or disposing of the resulting slurry. A protein fractionator, with or without the use of ozone, can be used to extract extremely tiny particles or liquid solids (O3).

Oxygenation

To obtain optimum production densities, it's critical to deoxygenate the system water. Fish, like bacterial culture in the biofilter, require oxygen to consume food and flourish. Aeration and oxygenation are two strategies for increasing dissolved oxygen levels. Aeration involves pumping air through an air stone or other device that generates microscopic bubbles in the water column, resulting in a large surface area where oxygen can dissolve. In general, this method is deemed ineffective due to poor gas dissolving rates and the high air pressure required to form little bubbles, and the water is instead oxygenated by pumping in pure oxygen.

Various approaches are utilized to ensure that all of the oxygen dissolves into the water column during oxygenation. The oxygen demand of a system must be carefully calculated and considered, and that demand must be fulfilled using either oxygenation or aeration equipment.

Correspondence to: Rodgers M. Stryjeckin, Department of Marine Science, University College London, London, UK, E-mail:stryjecki.m@rodgers.uk

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