

DENITRIFICATION TECHNOLOGY FOR MARINE AQUACULTURE USING BIODEGRADABLE BIOPOLYMER

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Commercial-scale marine aquaculture has the potential to close the gap between an increasing demand for high quality seafood products and marine fisheries near maximum sustainable yields. High nitrate levels are toxic to many marine species in intensive recirculating aquaculture, zoo and aquarium systems. In flow through aquaculture systems, the release of nitrate to nearby streams and lakes can be detrimental to the ecology of the receiving water body. The development of a low tech, cost effective denitrification technology is mandatory as commercial producers push the limits of production in recirculating aquaculture systems. With the increasing use of recirculating aquaculture systems and especially in marine systems, there will be an increasing demand for highly effective denitrification units in the aquaculture, commercial aquariums and zoo industries.

Denitrification has been traditionally achieved in the wastewater treatment industry by adding methanol or a similar chemical to act as the necessary carbon source. The major drawback of these systems is that they require sophisticated computer monitoring and control systems, since many of the carbon sources can be toxic. This project investigated the potential for using Polyhydroxyalkanoates (PHAs), a biodegradable biopolymer, produced from sugar fermentation, as an alternative carbon source for denitrification in recirculating aquaculture systems. The denitrification capability of PHA was quantified during Phase I of the project for relatively high concentrations of nitrate (75 mg/L). During follow-up studies, their denitrification potential at low nitrate concentrations (10 mg/L) was studied in both fresh and saltwater conditions.



Three experimental denitrification bioreactors with floating PHA pellets were constructed and installed on a freshwater recirculating aquaculture system containing tilapia during Phase I. The experimental denitrification units were operated under three different flow regimes and three different backwash frequencies. Nitrate-rich water from the RAS was pumped through the experimental units and daily influent and effluent samples taken. These samples were analyzed for dissolved oxygen, alkalinity, ORP, pH, temperature, ammonia-nitrogen, nitrite-nitrogen and nitrate-nitrogen. During the follow-up studies, a reservoir was used containing either freshwater or saltwater at lower nitrate concentrations. The same experimental protocols were followed as described above and denitrification removal rates at low nitrate concentrations were determined.