Pollution Management of Water and Wastewater in Aquaculture Farms Using Constructed Wetlands

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Abstract

This study integrated constructed wetlands (CWs) into a recirculating aquaculture system, in which CWs were used as a facility for aquaculture water treatment so as to regulate the water quality in fishponds and reduce pollutant level of the fishpond effluent. Performance of the constructed wetland in removing the major pollutants from the recirculating aquaculture water was investigated, and the effect of wetland treatment on water quality of the fishpond in the recirculating aquaculture system was examined. Results of water quality monitoring for influent and effluent showed that constructed wetlands effectively reduced TSS (54~78%), turbidity (52~65%), chlorophyll a (54~68%), and BOD_5 (27~46 %). The treatment wetland regulated water quality sufficiently in the recirculating fishpond, which was significantly better than that in a control fishpond without connection of CW. Furthermore, the wetland treated effluent always satisfied a national discharge standard for aquaculture farms (i.e. TSS < 30 mg/L, BOD_5 < 30 mg/L, COD < 100 mg/L).

Keywords: constructed wetlands; recirculating aquaculture; shrimp; fishpond

1. Introduction

Aquaculture with earthen ponds has been conventionally and widely used in Taiwan. However, fishponds normally produce polluted effluent when harvesting and water exchange in response to deterioration of water quality of ponds. Although the levels of effluent pollutants are relatively dilute, the volumes are very large when being discharged. Thus, it can still degrade the water quality in receiving waters. Application of conventional wastewater treatment technology to manage quality of fishpond effluent is often expensive, difficult and of limited success, because of very different nature of aquaculture and domestic wastewater [1].

Constructed wetland (CW) technology is a natural treatment system for wastewater engineering and is characterized by the advantages of moderate capital costs and very low energy consumption and maintenance requirements [2]. The Center of Ecological Engineering and Technology (CEET) of Chia-Nan University of Pharmacy and Science has conducted a series of pilot-scale studies on the performance of CWs for treating aquaculture wastewater and water from recirculating aquaculture systems since 1998. The results demonstrate that the CWs efficiently and consistently reduced the major pollutants, such as suspended solids, turbidity, chlorophyll a, organic oxygen demand, ammonium, nitrite, and nitrate from both the water and wastewater from aquaculture production under a wide range of hydraulic loading rates (0.018-2.82 m/day) [3-7].

Based on the pilot-scale results in the previous studies, this study built a practical-scale CW that was integrated with an earthen fishpond for shrimp production. The objectives of the study were to confirm the performance of CW in treating aquaculture pond water, and evaluate the practical approach to manage the quality of water and wastewater of aquaculture farms using CWs.