The Performance of Biofilters in a Close-Recirculating System for Fish Culture

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Introduction

In aquaculture, the source and quality of water is of utmost importance. In urban areas, one solution to lack of rearing space is growing fish in a recirculating system. For recycle system, in which reused water must be of an adequate quality to maintain the culture organisms in a healthy and fast growing condition, it is especially important to remove waste products quickly and efficiently. Various studies have been conducted into the effects of tank hydrodynamics on suspended particle movement, self cleaning and efficient use of available water (Watten and Beck,1987; Westers,1991; Cripps and Poxton,1992; Yoo et al.,1995), and periodic cleaning (Stabell, 1992). This information, combined with knowledge of the water quality requirements of various fish species (Alabaster And Lloyd,1980; Wickins, 1981; Poxton and Allouse,1982), has led to the development of tank culture designs.

Filtration, removes both particulate and dissolved materials from the water, including unwanted nutrients, debris, pollutants, etc. Biological filters are often considered to be the heart of a recirculating system, since toxic materials such as ammonia must be removed by microorganisms. Biological treatment units employed today are mainly submerged upflow and downflow filters and/or trickling filters with well-structured substrates as support materials for bacterial growth. In view of the above, recycling technology with sand and trickling filters would be the prior emphasis to culture environment for aquaculture. In the aquaculture system, it is important to draw out the overall system design and specify the various system components and associated improvements to maintain high density culture and suitable water quality.

Materials and Methods

The study was conducted at KUSTEM, K.Tereangganu. The recirculating system is comprised of 9 (8 ton) rearing tanks; collector cum sedimentation tanks; secondary sedimentation units; downflow sand filter; trickling filter; denitrification filter; oxygenation unit and reservoir tank.

Water samples were collected and analysed/measured on a daily basis from influent and effluent of each unit to assess the performance such as removal rate of total ammonia nitrogen (TAN), total dissolved solids (TDS) and total suspended solids (TSS). Instruments such as DR/4000 UV-VIS Spectrophotometer (TAN reading), Conductivity meter (WTW, LF 330 for TDS) were used, and TSS measured by standard laboratory procedure using GF/C 47 mm diam. Filter paper.

The system was acclimatized by placing fish (50 indiv/m3) in each tank with TAN concentration at 1.04 mg/l. They were reared for 8 weeks to promote growth of nitrifying bacteria. The desired density of fish for experiment was introduced when TAN concentration was reduced to 0.08 mg/l.

Two freshwater species, Oreochromis niloticus and Tor tambroides were chosen for study. They were stocked at 3 different stocking densities (200 to 250 individuals per cubic meter). Fishes were fed 3 times a day with Cargill tilapia grower pellet until satiation After a rearing period of 78 days their growth performance in terms of specific growth rate ,SGR, feed conversion ratio, FCR, and protein efficiency ratio, PER, were assessed.

Results and Discussion

Performance of Down Flow Sand Filter and Trickling Filter – The efficiency removal of TAN, TDS and TSS by down flow sand filter were 23%, 5% and 53% respectively. The removal of TAN, TDS and TSS from the flow through system contributes to the efficiency of the whole rearing system. The sand filter also removes some bacteria from the water medium. The trickling filter was however, more efficient in removing Total Ammonia Nitrogen TAN, with the removal efficiency of 60.6%.

Growth performance of Fish – The results are shown in tables 1 & 2.

As expected, highest fish growth was achieved at treatment 1, i.e. stocking density 200fish/m3. SGR was 2.92% per day, FCR was 0.66 and PER 4.78. Survival rate was 85%.

Conclusions

Results of study indicates that endangered species like Tor tambroides and commercial species such as Oreochromis niloticus can be cultured in closed recirculatory system at high densities. However a modification of the system is required to increase the performance. This need further studies.

Benefits from the study
Can be commercialized for fish production

Patent(s), if applicable
To be patented after second study

Stage of Commercialization, if applicable
A few entrepreneurs expressed interest

Project Publications in Refereed Journals:
1. Sent for publication in Aquaculture journal

Project Publications in Conference Proceedings
1. Assaduzzaman, M, Ambak,M.A. and Jusoh,A (2003)The role of Sand Filter and Trickling Filter in a close-cycle Aquacultural system to improve culture environment for Intensive culture. In Proceedings of KUSTEM'S second annual seminar on Sustainability Science and Management 2003, pp381-393

Graduate Research

Name of Graduate	Research Topic	Field of Expertise	Degree Awarded	Graduation Year
Md Assaduzzaman	Recirculating system	Aquaculture	PhD (on going)	
Abol Hasanat	Trickling Filter Performance	Aquaculture Engineering	M Sc (on going)	

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