Experimental Evaluation of a Floating Bead Bioclarifier and Fluidized Sand Filter for a Small-Scale Recirculating Aquaculture Production System

Timothy J. Pfeiffer[1] and **Kenneth Riley**[2]

[1]USDA Agricultural Research Service, Sustainable Marine Aquaculture Systems, 5600 U.S. Highway 1 North, Fort Pierce, FL 34946
tim.pfeiffer@ars.usda.gov

[2]Harbor Branch Oceanographic Institution, Aquaculture Division, 5600 U.S. Highway 1 North Fort Pierce, FL 34946
kriley@hboi.edu

A major target of a recirculating aquaculture production system is maximum fish production without the use of large amounts of resources (land, energy, water) at a competitive cost. The objective of the study is to maximize the production a basic RAS unit without the use of supplemental oxygenation. The culture units are two 3.65 meter (12 ft) diameter panel fiberglass circular tanks with sloping bottoms. Culture volume for each tank at 1.0 m depth is approximately 10,500 L (2775 gal). Tilapia are produced through a two-phase system with 3500 25-g fish stocked into the first culture unit and 400 350-g fish stocked into the second culture unit.

Solids removal is accomplished in part by using a 0.61 m diameter (265 L) swirl separator to capture the low-volume, high solids effluent from the center bottom drain of each tank. Flow from the swirl separator joins the high volume flow from the elevated sidewall drain of each tank into a wastewater sump of approximately 1000 L. Flow from the sump is pumped (1.5 hp) through a 0.28 m^3 (10 ft3) prop-washed floating bead bioclarifier (PWBF) for additional solids removal. Backwashing of the bioclarifier is an automated process. Biological filtration is provided by a fluidized bed biological filter, FBB (1.5 m diameter) which uses a silica sand media for the nitrification process. At this point the water is returned to the culture tanks by gravity flow.

To determine limitations of this basic setup, the solids removal performance of the swirl separators and bioclarifier as well as the nitrification performance and oxygen demands of the bioclarifier and biofilter were monitored with increasing feed loading rates. The solids removal, nitrification, and oxygen demands of this system were measured at six feed rates ranging from 0.9 to 68 kg feed per day. Means of extending the system limits included replacement of air stones with diffuser tubing, and purging the bioclarifier of solids more than once a day. Additional parameters measured to evaluate system performance include makeup water volume, energy utilization, and water quality variables including alkalinity and CO_2.