Novel Mechanical Filter for reducing Ammonia Concentration of Silver Barb culture in a Recirculating Aquaculture System (RAS)

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Abstract

This study aims to reduce the concentration of ammonia in the silver barb culture in recirculation system by adding a mechanical filter. This research was conducted on January to February 2014 at hatchery of Freshwater Aquaculture Production Development Centre (BPPBAT) Singaparna, Tasikmalaya Regency, West Java, Indonesia. The study was designed experimentally with two treatments i.e. treatment without filter and filtering treatment. The experiment was carried out for 24 days and observed every two days. The results showed that the addition of filter can reduce total ammonia up to 92.82%, unionized ammonia up to 89.12% and it is able to increase dissolved oxygen up to 54.23% and silver barb survival rate equal to 99.87%.

Keywords: Ammonia, recirculation, silver barb, mechanical filter.

Introduction

Aquaculture is an economic activity that increases in order to fulfill animal protein requirement. This activity is having a positive impact in the fulfillment of animal protein requirement, making aware on waste generated. Waste generated from aquaculture can cause negative impact on the waters if it is not managed properly. Aquaculture waste entering the aquatic environment composed of organic and inorganic materials including ammonia, phosphorus and dissolved organic carbon[1,2]. Waste generated from the intensive aquaculture can lead to decrease in water quality both in the aquaculture environment and in the surrounding waters, this can have an impact on the decrease in aquaculture productivity due to decreasing fish growth and cause death in severe condition[1,2].

Ammonia is one of the wastes to be noticed. Ammonia in the aquaculture is mainly derived from uneaten feed, fish faces and fish urine. Ammonia concentration will increase as the protein content in the feed increases. Ammonia is a growth inhibiting factor[3]. Furthermore, it is stated that at concentrations of 0.18 mg/ L ammonia can inhibit fish growth. An un-ionized ammoniacal nitrogen (NH_3-N) level of 0.019 mg/L would be considered acceptable for channel catfish production.

However, the un-ionized NH_3-N concentration of 1.2 mg/L recorded at 1600 hr could be lethal to channel catfish within several hours[4]. Even, according to Sawyer et al[5], unionized ammonia concentrations above 0.2 mg/ L can cause death in some species of fish. Therefore, the concentration of ammonia in the water needs to be observed. Treatments that can be done to overcome these problems include by applying aquaculture recirculation system. According to Suantika[6], the aquaculture recirculation system has been used since the 1990s. This system has advantage of repeated water utilization[7].

The use of filters in aquaculture with recirculation system plays an important role to improve water quality in fish ponds. The filter used is a mechanical filter using materials such as zeolites, confirmed by Purtie[8] which states that zeolites and activated charcoal as absorbent in filtration can reduce ammonia concentration of 85.40%. The effectiveness of filtration using a mechanical filter is related to the filter design used, as Collins[9] states that water filters with down-flow and up-flow water flow systems can maximize the filtering process.

The recirculating aquaculture system (RAS) can be defined as an aquaculture system related to treatment and reuse of water with less than 10% daily replacement of water. The treated water is required to accommodate feed inputs of high amounts to support high growth rate and stocking density [10].

Several researches on the RAS have been done to improve the quality of water in the form of physical quality such as temperature[11] and chemicals such as oxygen, ammonia, nitrate, pH, alkalinity[12], water equilibrium model of aquaculture recirculation system[13,14]. Water flow models for mechanical filtration and changes in hydraulic properties[13] and fish growth in the aquaculture recirculation system[12] have been studied.

Nurhasani et al[15] in their study stated that the activated carbon can be used as an absorbent with an adsorption efficiency value up to 88.43% and 41.6% for Al ion and Fe ion respectively and the value of adsorption capacity for each ion is of 1.0262 mg/ g and 0.2473 mg/ g. Sumarlin et al[16] stated that zeolites can absorbs ammonium (NH_4^+) of varying urine concentrations from 5% up to 25%. The smallest ammonium concentration was found in the treatment with a urine concentration of 20% i.e. 51.243 mg/L with an initial concentration of 72.513 mg/L. Meanwhile, Putrie[8] states that the mixture of zeolite and activated charcoal is the most effective absorbent in filtration because it can reduce the concentration of ammonia in the vermicelli liquid waste up to 85.40%. While Irmanto and Suyata[17]