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Study On Utilization of Active Natural Zeolite As Ammonia Absorbent In Aquarium As A Medium Fresh Fish Cultivation

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Abstract. A study of the use of natural zeolite active as ammonia absorbent in an aquarium as the cultivation of medium fresh fish has been conducted. The water sample was taken from the surface water of Toba Lake, Pangururan, Samosir Regency. Natural zeolite was refined until measured at 200 mesh and activated by physics. Determination of ammonia was performed using spectrophotometrically with the Nessler method at the maximum wavelength of 410 nm. The result of the analysis of this study obtained that decrease in water pH and ammonia content in the water after feeding the fish was caused by the absorption of active natural zeolite active to the tenth day which concentration of ammonia on the first and tenth day was 1.2723 mg/L and 2.4171 mg/L with the largest absorption percent on the day to ten was 38.04%.

Keywords: Zeolite, Ammonia, Absorbent, Fresh Fish Cultivation,

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1 Introduction

Water is one of the most abundant chemical compounds in nature. However, the availability of water that meets the requirements for human needs is relatively small because it is limited by various factors. Therefore, water resources must be protected so they can still be used properly by humans and other living things. Industrial, domestic and other activities harm water resources, among others, causing a decrease in water quality (Effendi, H. 2003).

Toba Lake is a water ecosystem that has undergone many changes, especially as a result of various human activities. The problems experienced by the Toba Lake ecosystem are mainly the decline in water quality as a result of various wastes discharged into the lake, causing pollution, such as household waste, agricultural waste, waste from aquaculture in cages, and oil waste originating from water transportation activities (Barus et al., 2008).

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Ammonia waste is one of the problems that are often encountered in fish cultivation. Intensively, fish cultivation with increased distribution density and increased use of protein-rich artificial feed causes an increase in toxic nitrogen and phosphate waste. Toxic nitrogen and phosphate waste in aquaculture waters generally come from uneaten feed residue and fish feces. During one period of rearing fish indirectly, the waste remains from feed and fish waste is always obtained. Toxic nitrogen waste in the water is generally in the form of ammonia or nitrate and nitrite. Ammonia levels in water are usually less than 0.1 mg/L (Mc Neely et al., 1979). The level of free un-ionized ammonia (NH_3) in freshwater should not exceed 0.02 mg/L. In contrast, if the free ammonia level is more than 0.2 mg/L, the water is toxic to several types of fish (Sawyer and McCarty, 1978).

Previous research has been conducted to determine the content of ammonia in fish cultivation. Hulu, O (2013) reported that a study on the effect of temperature and pH on the ammonia content in the freshwater fish culture medium where the results obtained showed fish cultivation with industrial feeding caused by the pH of Lake Toba to increase from 6.83 to 7.23. In addition, the increase in water temperature by 2ºC causes the pH of the water to decrease by 0.066 % and the ammonia content to decrease by 0.010 %.

Simanjuntak, P. (2002) reported a study on the determination of the content of ammonia, nitrite, nitrate, alkalinity, temperature, and pH in Nile Tilapia pond water. From this study, it was found that ammonia levels increased from day to day accompanied by an increase in the pH value of the tub water which caused the alkalinity to continue to increase, while the levels of nitrite and nitrate fluctuated.

Based on the description above, the authors are interested in utilizing active natural zeolite as an absorbent of ammonia waste from freshwater fish cultivation as a simulation of the water conditions of Toba Lake.

2 Materials and Methods

2.1 Equipments

In this study, the equipments used were a spectrophotometer, aquarium, pH meter, furnace, aerator, analytical balance, oven, 200 mesh sieve, pestle and mortar, suction rubber, magnetic stirrer, Whatman filter paper no.42, and glassware.

2.2 Materials

The materials used were Sarulla Natural Zeolite, Toba Lake Water, Tilapia, fish feed, $ZnSO_4$, HgI_2, KI, NaOH, and EDTA.

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2.3 Zeolite Preparation

Sarulla natural zeolite was heated in an oven at 100 ± 100ºC for 3 hours, then cooled and crushed. Then sieved through a 200 mesh sieve.

2.4 Zeolite Activation

A total of 100 g of Sarulla natural zeolite has been prepared and then heated to a temperature of 250ºC for 3 hours and then cooled in a desiccator.

2.5 Preparation of Nessler's Reagent

As much as 160 g of NaOH was dissolved with 500 mL of distilled water in 1L of the beaker glass and cooled at room temperature. A total of 100 g of HgI_2 and 70 g of KI were put into a 100 mL of beaker glass containing 50 mL of aquadest, then stirred with a magnetic stirrer until the crystals dissolved. The two solutions were mixed slowly and then put the solution in a 1000 mL of volumetric flask and diluted with distilled water to the marked line. Homogenized.

2.6 Preparation of Ammonia Standard Solution Calibration Curve

A total of 10 mL from each ammonia solution with a concentration of 0.0; 1.0; 2.0; 3.0; 4.0; 5.0 mg/L was taken by pipette and put into 5 50 mL Erlenmeyer and added 0.5 mL of Nessler's reagent then stirred and allowed to stand for 10 minutes. The % transmittance was measured at max = 410 nm with a visible spectrophotometer.

2.7 Aquarium Water Sample Measurement

2.7.1 pH Measurement

A total of 100 mL of aquarium water sample was put into a beaker glass. The pH of the solution was measured using a pH meter.

2.7.2 Removing of Floc on Samples

As much as 10% of $ZnSO_4$ was put into 100 mL of sample and the pH was adjusted to 10 to 11 with the addition of 6N of NaOH and then stirred using a magnetic stirrer. After the floc was formed, it was filtered, and added 1 drop of EDTA to the filtrate.

2.7.3 Determination of Ammonia in Aquarium Water Samples

A total of 100 mL of aquarium water sample was filtered then 10 mL of the filtrate was taken and put into an Erlenmeyer. Then, 0.5 mL of Nessler's reagent was added then stirred, and allowed to stand for 10 minutes. The % transmittance was measured at max = 410 nm with a visible spectrophotometer.

2.7.4 Determination of Absorbed Ammonia by Active Zeolite

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As much as 100 mL of an aquarium water sample sprinkled with active zeolite was taken and then filtered. Next, as much as 10 mL of Nessler'reagent was taken and placed into Erlenmeyer and mixed then left for 10 minutes. The % transmittance was measured at max = 410 nm with a visible spectrophotometer.

3 RESULT AND DISCUSSION

3.1 Ammonia Standard Solution Calibration Curve

The absorbance data obtained for a series of ammonia standard solutions were plotted on the concentration of the standard solutions so a calibration curve was obtained in the form of a linear line as shown in figure 1.

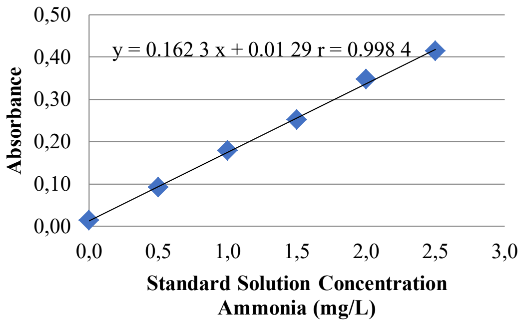

Figure 1. Ammonia Standard Series Solution Calibration Curve

3.2 Calculation of Amount of Absorbed Ammonia

The amount of absorbed ammonia by the zeolite was calculated using equation 1:

$$[\text{Ammonia}]_{\text{absorbed}} = [\text{Ammonia}]_{\text{initial}} - [\text{Ammonia}]_{\text{residual}} \quad (1)$$

3.3 Percentage of Ammonia Content Absorption Using Active Natural Zeolite

The percentage of absorption of ammonia content in water samples previous to and after being absorbed by the active zeolite was determined using equation 2

$$\%\ \text{Absorption} = \frac{\text{Initial concentration} - \text{Final concentration}}{\text{Initial concentration}} \times 100\ \% \quad (2)$$

The addition of active zeolite into the water was known to decrease the pH of the water and can absorb the ammonia from fish feces. The ammonia content in Toba Lake water without fish and feed was 1.2723 mg/L at a pH of 6.85. After feeding the fish, the ammonia content increased to 1.6531 mg/L at a pH of 7.03. A total of 2 g of active zeolite was added to the water and the results showed that the pH of the water decreased to 6.83 and the concentration of ammonia became 1.3632 mg/L. The increasing of ammonia content in water can be controlled by the addition of active zeolite so the fish can survive in high pH conditions.

4 Conclusion

Based on the data obtained in this study, it can be concluded that fish cultivation with artificial feeding causes the pH of Toba Lake water to increase from 6.85 to 7.03. In addition, the ammonia content in the water also increased from 1.2723 mg/L to 1.6531 mg/L. Giving active natural zeolite can reduce the ammonia content up to 38.04% on the 10th day.

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