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ANALYSIS OF ORTHOPHOSPHATE PHYTOREMEDIATION FROM HOTEL DETERGENT WASTE AND ITS EFFECT ON INCREASING BIOMASS IN WATER HYACINTH PLANTS *(Eichhornia Crassipes)*

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Abstract: This research is motivated by the high levels of phosphate, which can be in the form of orthophosphate in the waters where most of it comes from hotel waste that contains detergents which are one of the factors of water pollution. The research aims to strive for an environmental mitigation engineering system to reduce or even eliminate pollution using a plant-based waste treatment technique known as phytoremediation. Phytoremediation uses water hyacinth, which utilizes water hyacinth plants as an adsorbent of waste containing phosphate in a medium. The phosphate levels in hotel detergent waste will be reduced before the waste is released into the waters of Lake Toba. The results of this study are that the pH and temperature are still following the parameters of the predetermined threshold; namely, the pH is around 6-9, and the temperature does not change. The average TSS test results decreased from the first, fourth, and seventh days to around 21. The average BOD test results did not meet the wastewater quality standard of more than 50 mg/liter. The average Orthophosphate test results increased so that the effect of water goiter to reduce pollution is not such a big impact, and the effect of the mass of water hyacinth before and after being put into the detergent waste decreased by an average of 3.75 grams.

Keywords: *Orthophosphate, Phytoremediation, Hotel Detergent Waste, Biomass*

INTRODUCTION

The need for water is indispensable for human activities is increasing due to population growth and increased agricultural, industrial, mining, and other activities. Meanwhile, production processes and human activities that use more and more artificial chemicals cause more dirt and waste to be washed into rivers, lakes, and seas so that the water is increasingly polluted. One of the pollution factors in the current waters is the high levels of phosphate, which can be in the form of orthophosphate in the waters, where most of it comes from hotel waste that contains detergents. Detergent is a soap compound that is formed through a chemical process. The main components of detergent are Sodium Dodecyl Benzene Sulfonate (NaDBS) and Sodium Tripolyphosphate (STPP), which are very difficult to degrade naturally [1].

Related research on Orthophosphate Phytoremediation generally leads to overcoming water pollution. Detergents can increase phosphate levels because phosphate ions are one of the constituents of detergents [2]. In phytoremediation, plants utilize chemicals in waste as nutrients to meet their nutrient needs [3]. The plant used as a phytoremediator is water hyacinth (Eichhornia Crassipes). The selection of water hyacinth plants is based on the high hyperaccumulator nature, the ability to grow in waters with low nutrient levels, and very fast growth rates [4]. Lotus Plants at a wet plant weight of 198 g and a hydrolysis loading rate of 210 l/ml [5]. This plant reduced the levels of heavy metals in the form of TSS, nickel, and total chromium by 75%, 55.47%, and 61.13%, respectively. Kiambang plants, which have anatomical structural characteristics similar to Lotus plants, were able to reduce nitrogen levels by 60.2% and phosphate levels by 52.38% [6].

Water quality status is the level of water quality conditions that indicate polluted or good conditions in a water source within a particular time by comparing the established water quality standards. One of the ingredients of water pollution is detergent. The quality standard for liquid waste in the form of detergent is set at 2 ppm [7]. Detergent wastewater is a pollutant because it contains a substance called ABS. The type of detergent that is widely used in households as an ingredient for washing clothes is anti-stain detergent. The first generation of detergents appeared using surface activating chemicals (surfactants), Alkyl Benzene Sulfonate (ABS), which were able to produce foam.

However, due to the nature of ABS, which is difficult to decompose by microorganisms on the soil surface, it is finally replaced with Linear Alkyl Sulfonate (LAS) compounds which are believed to be relatively more familiar with the environment. Although more environmentally friendly, detergents are not friendly to organisms in the water. If the detergent dissolved in water is significant enough, it can kill the fish in it. Fish take in oxygen dissolved in water through their noses. In the presence of a water-soluble detergent, these substances will enter the fish's body directly into the circulation system. The presence of this substance interferes with fish metabolism. If it exceeds the threshold, the fish will die [8].

Orthophosphate is a polyatomic ion or radical consisting of one phosphorus atom and four oxygens. Phosphate comes from Sodium tripolyphosphate, one

of the ingredients with large levels in detergents. The reaction is as follows:
From this reaction, the polyphosphate compound undergoes hydrolysis to form orthophosphate before it can be used as a source of phosphorus by plants. After entering the plant, inorganic phosphate will change into organophosphate [9].

Phytoremediation is an effort to use plants and their parts to decontaminate waste and environmental pollution problems, either ex-situ or using artificial ponds [10]. Water temperature affects the growth and development of fish. African catfish can live in water temperatures ranging from 20-300 C [11]. The appropriate water temperature will increase the activity of eating fish, thus making African catfish grow fast [12]. Aquatic organisms can live in waters that have a neutral pH value with a tolerance range between weak acids and weak bases [13]. If the pH value of the water is not in that range for a long time, the reproduction and growth of fish will decrease [14]. Chronic decrease in oxygen solubility can cause stress in fish, thereby increasing the chance of infection in fish [15]. Oxygen in water is a limiting factor for the presence or absence of life in it [16].

The problem in this study is water pollution caused by excessive nutrients, especially phosphates contained in detergents, which tend to cause eutrophication. Eutrophication is an environmental problem caused by phosphate waste, especially in freshwater ecosystems, which causes excess nutrients needed by plants in the waters to increase the primary productivity of the waters. The urgency of this research is very important to strive for an environmental mitigation engineering system to reduce or even eliminate the pollutant if possible.

Waste treatment techniques using plants are known as phytoremediation. Phytoremediation using plants does not require high costs and aesthetically supports environmental reforestation efforts. The solution that can be applied through this research is to utilize the water hyacinth plant as an adsorbent for waste containing phosphate. The phosphate level in hotel detergent waste will be reduced through a phytoremediation process before the waste is released into the waters of Lake Toba.

The specific purpose of this study was to determine the percentage of effective absorption from various concentrations. The most effective absorption rate with the efficient detention time phytoremediation in absorbing detergent orthophosphate content using water hyacinth plants (Eichhornia crassipes).

The feasibility study of this research based on the application of technology has been carried out commercially in several countries such as America and Europe, while in Indonesia, this technology is still relatively new. The reason for choosing the water hyacinth plant agent for waste treatment is not only because of its high growth rate (abundant in the waters of Lake Toba) and ability to absorb nutrients directly from the water column.

RESEARCH METHODS

In this study, each treatment was repeated three times using a completely randomized design (CRD). The control variables in this study consisted of (1) bottles of mineral water without treatment, (2) bottles of mineral water with 50 grams of water hyacinth, (3) bottles of mineral water with 100 grams of water hyacinth, (4) bottles of mineral water with water hyacinth 150 gram and (5) Bottle of mineral water with water hyacinth 200 grams. Bound Variable: Hotel detergent waste. Free Variable: Mineral Water Bottle.

A. Plant Acclimatization

Plant acclimatization was carried out by adapting the plant to a plastic tub/basin for almost 1 week before being transferred to the actual test tank. Water hyacinth plants acclimatized are weighed with various plant weights, namely, 50 g, 100 g, 150 g, and 200g. They are selected with the criteria of plants having fresh green leaves, height and root length of each water hyacinth plant being relatively the same. Plants that have been acclimatized were transferred to a test container containing a hotel detergent waste solution with a division of water hyacinth plant weight of 50 g, 100 g, 150 g, 200 g, and without water hyacinth. Observation and measurement of temperature, pH, turbidity, and BOD for 7 days.

B. Determination of Orthophosphate Levels

Before treating various water hyacinths, the hotel detergent waste was first measured for orthophosphate levels by UV-Vis spectroscopy. After adding various weights of water hyacinth, the orthophosphate levels were measured every day until the 7th day.

C. Determination of Biomass in Water Hyacinth Plants

The various weights of water hyacinth were put into the hotel detergent waste solution for 7 days, then measured with a scale to compare the weight before and after adding hotel detergent waste.

The additive linear model for a two-factor factorial design with its environmental design in the form of RAL is:

$$Yijk = + 1 + j + (\alpha\beta)ij + \varepsilon ijk$$

The effect of concentration and detention time on differences in the absorption of orthophosphate concentrations of hotel detergent waste using water hyacinth was analyzed using the SPSS program. If the results of the analysis of variance obtained an F-count > Ftable 0.5, a further test was carried out using the Tukey further test (significantly honest difference).

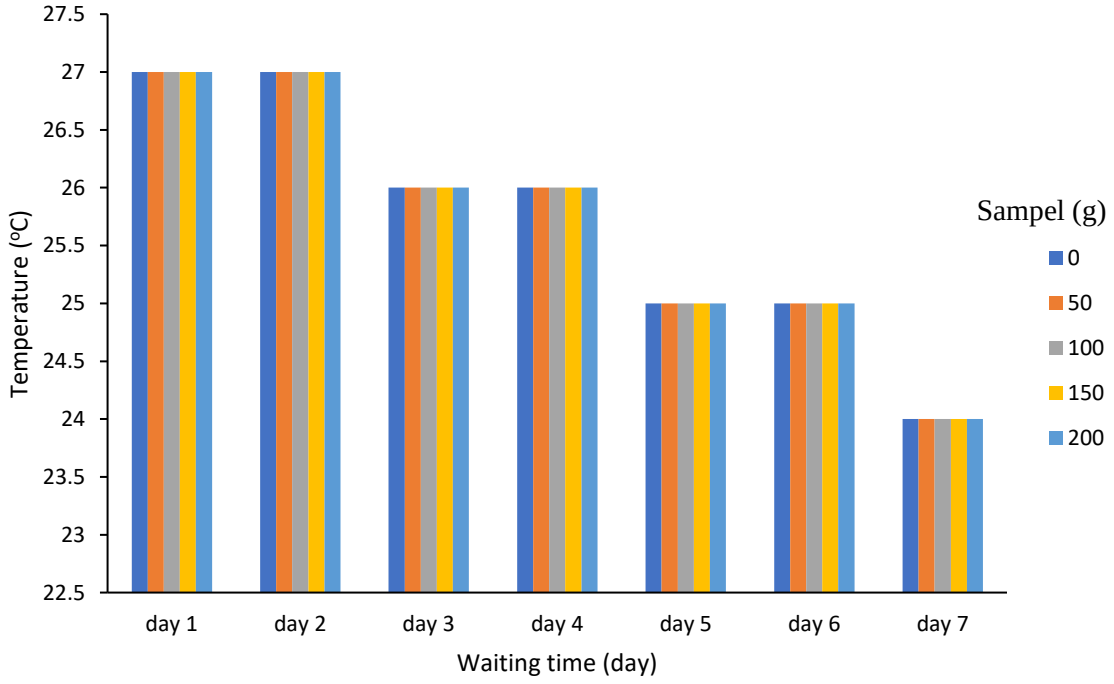
RESULTS AND DISCUSSIONS

Detergent samples taken at one of the hotels in Parapat were treated by dividing them into five containers. Each container contains 3.5 liters of detergent waste. Each container containing detergent waste is added without water hyacinth (0 g), 50 g, 100 g, 150 g, and 200 g of water hyacinth: water hyacinth that has been put into the container first, the plants acclimatized for a week.

Figure 1. Water hyacinth Plants distribution

Measurement of Temperature and pH

Temperature and pH observations were carried out for 7 days. On the first day of each treatment, it obtained the same temperature and pH, around 27 ^{0}C and pH 6. On the first day, 1 liter of samples was also taken in each container to be tested for BOD, TSS (turbidity), and Phosphate at the Baristand Medan laboratory. On the second day of each treatment, the same temperature and pH were obtained, around 27 ^{0}C and pH 6. There is no difference between the second day with the first day. Each treatment obtained the same temperature and pH on the third day, around 26 ^{0}C and pH 6. On the third day, the temperature dropped only 1^{0}C from the first and second days. The temperature did not change on the third day. On the fourth day of each treatment, the same temperature and pH were obtained, namely 26 ^{0}C and pH 6. The fourth day did not have a difference from the third day. On the fourth day, 1 liter of samples will be taken for BOD, TSS, and Phosphate testing. On the fifth day of each treatment, the same temperature and pH were obtained, namely 25 ^{0}C and pH 6. The fifth day differed from the fourth day, namely a decrease of 1 ^{0}C. On the sixth day of each treatment, the same temperature and pH were obtained, namely 25 ^{0}C and pH 6. The sixth and fifth days also did not differ in temperature and pH. On the seventh day of each treatment, the same temperature and pH were obtained, namely 24 ^{0}C and pH 6. The seventh day had a decrease of 1^{0}C compared to the sixth day. On the seventh day, 1 liter of samples will be taken for BOD, TSS, and Phosphate testing. On the first, fourth, and seventh days, samples that have taken as much as 1 liter each are sent to the Baristand Medan laboratory for testing. The test results will come in a certificate within 30 days from the sample received (figure 2).



Fugure 2. Measurement of Temperature and pH

Measurement of BOD, TSS, and Orthophosphate.

To find out the results of the BOD, TSS, and Orthophosphate tests on the first, the fourth, and the seventh day, measurements were made with the following results.

Table 1. TSS, BOD, and Orthophosphate Test Results First Day

	Result		
Weight	TSS	BOD	Orthophosphate
0	4	27.2	1.09
50	11	73.3	1.00
100	23	58.0	1.09
150	32	330	1.09
200	34	148	1.02

Table 2. TSS, BOD, and Orthophosphate Test Results Fourth Day

Weight	Result		
	TSS	BOD	
0	9	6.79	1.01
50	22	13	1.06
100	32	127	1.13
150	11	63.3	1.12
200	26	162	1.18

Table 3. TSS, BOD, and Orthophosphate Test Result Seventh Day

Weight	Result		
	TSS	BOD	Orthophosphate
0	5	16	1.15
50	18	201	1.26
100	10	102	1.18
150	24	201	1.15
200	21	46.9	1.19

Weight Water Hyacinth Plants

Weight water hyacinth plants before and after in Detergent Waste.

Table 4. Weight hyacinth plants before and after

Before Weight	After Weight
0 gram	0 gram
50 gram	47 gram
100 gram	97 gram
150 gram	143 gram
200 gram	188 gram
Average	3.75 gram

The weight of the water hyacinth has a reduction from the previous mass, having an average of 3.75 grams. Orthophosphate is a form of phosphorus that can used directly by plants aquatic, while polyphosphate must undergo hydrolysis form orthophosphate first, before use as a source of phosphorus [17-20]. After entering into plants, for example phytoplankton, phosphate inorganic changes to organophosphate.

CONCLUSION

The conclusion of this research is the pH and temperature are still following the parameters set; the pH is around 6-9, and the temperature does not change. The average TSS test results decreased from the first, fourth, and seventh days to around 21. The average BOD test results do not meet the liquid waste quality standard of more than 50 mg/liter. The average results of the orthophosphate test have increased so that the effect of water hyacinth to reduce pollution is manageable. The mass effect of water hyacinth before and after being put into the detergent waste decreased by 3.75 g.

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