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Efficiency of Sea Pandan Leaves (*Pandanus tectorius*) in the Biosorption of Mercury (Hg) in Coastal Areas

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Abstract. Mercury (Hg) heavy metal pollution is one of the serious problems that can threaten human health and ecosystems. In an effort to reduce mercury contamination, this research uses sea pandanus leaves (*pandanus tectorius*) as a natural biosorbent. The purpose of this study is to determine the contact time and adsorbing concentration capacity of sea pandanus leaves to mercury ions. One of the steps to reduce mercury contamination is by biosorption. The data obtained were analyzed using J.S.A.P software to determine the real difference test on contact time and adsorption concentration. The results of this study indicate that sea pandanus has a mercury adsorption capacity determined by the optimum contact time in the ratio of 1:100, the best optimum contact time is 60 minutes with an adsorption concentration of 100 ppm by achieving an adsorption of 0.372 mg/g using a mesh size of 120, Comparison of 1:75, the best optimum contact time is 30 minutes with an adsorption concentration of 0.907 mg/g using a mesh size of 120. Sea pandan leaves are proven as a potential biosorbent to remove mercury ions with the application of sea pandan leaves with seawater, which is 95% able to absorb heavy metals in polluted seawater.

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1 Introduction

Heavy metals are very dangerous pollutants for environmental systems because they are toxic, cannot be decomposed naturally and tend to accumulate in waters and the bodies of living things [1-6]. The accumulation of heavy metals in the environment can also have a negative impact on the preservation of biodiversity and disrupt the activities of biota in heavy metal polluted environments [2-9]. Among the dangerous and toxic environmental pollutants is Mercury (Hg).

Mercury (Hg) is an example of the most dangerous and most common heavy metal found in the environment [10-15]. These heavy metals in high concentrations are very harmful to the environment which can accumulate in seawater, sediments, and marine biota that live in them. Mercury (Hg) heavy metal pollution can cause symptoms of central nervous system (CNS) disorders that can cause abnormalities, and can damage the kidneys and cause congenital defects [4, 16-22].

Hg heavy metal pollution is strongly bound to organic and non-organic materials, which are very difficult to decompose into non-toxic forms and are not easy to handle, therefore heavy metals must be a concern that needs to be addressed so as not to enter the food chain and undergo biogmagnification in the human body and cause health problems [21-24].

Biosorption is one of the most appropriate methods used in dealing with heavy metal pollution. The biosorption process can efficiently adsorb heavy metals present in highly dilute complex solutions. Biosorption is considered a suitable model for in situ removal of heavy metals [24-28]. Biosorption can be performed using live biomass, dead biomass or constituent components.

In this study using biological materials, namely sea pandan leaves. According to [5, 29], stated that sea pandan leaves are able to absorb heavy metal chromium because sea pandan leaves contain cellulose and liginin.

The purpose of this study was to determine the optimum contact time and concentration of sea pandanus leaf adsorption in heavy metal absorption.

2 Research Method

2.1 Sampling Location

The location of this research was carried out in 2 locations, namely the first location of the seawater sampling location. The second location is the location of taking sea pandanus leaves which are used as adsroben in this study. This research was conducted at the Raja Ali Haji Maritime University science laboratory, Indonesia. The sampling location can be seen from Figure 1.

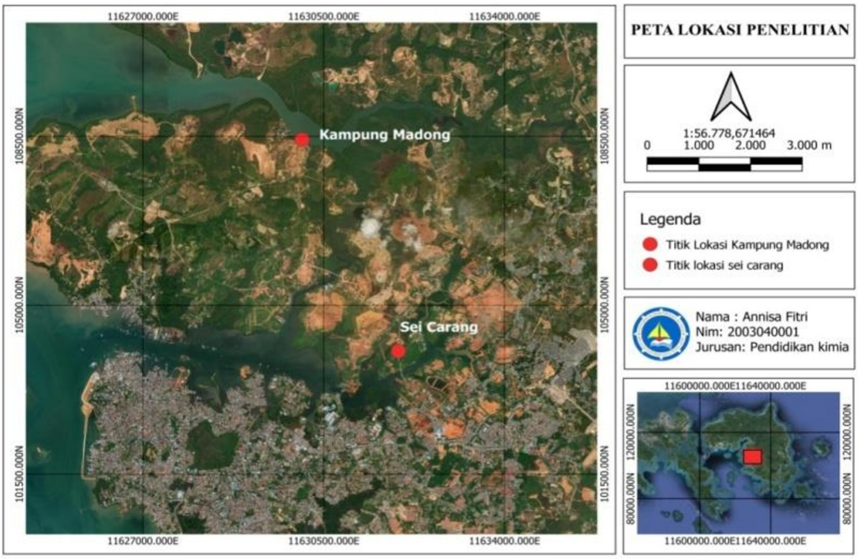

Figure 1. Sampling Research Location

2.2 Data Colletion

This research method is carried out in 2 stages, namely using data collection and data processing methods. The data collection method was obtained from laboratory testing of the optimum contact time and absorption of Hg metal. Testing Hg metal levels using UV-VIS Spectrophotometry and Atomic Absorption Spectrophotometry (AAS).

2.3 Tools and Material

The tools used in this study are: Measuring cup, 10ml measuring flask, measuring pipette, Aluminum Foil, Oven, Hotplate Magnetic Stirrer, Whatman Filter Paper, Analytical Balance, Glass Funnel, UV-VIS, SSA, Graded Sieve Size 60 and 120. The materials used in the study are: Sea Pandan leaves, Aquades, HgCl, Nitric Acid..

2.4 Reseacrh Prosedur

The preparation stage of sea pandan leaves, clean the leaves of sea pandan and then dry the sea pandan under the sun for 2 hours and then in the oven for 4 hours. After the oven process the sea pandanus is pureed using a blender and then on a graded sieve of 60 and 120 mrsh. After the sea pandan preparation procedure, the next step is to determine the optimum contact time and adsorption concentration. Determination of the optimum contact time using a contact time of 15, 30, 45, 60 minutes with a ratio of 1: 100 and 1: 75 in this comparison is 1 gram of pandan leaf extract added to 100ml of distilled water and do the following steps for a ratio of 1: 75. Adsorption concentration is carried out 50, 100, 150, 200 ppm HgCl solution, at this stage the sea pandanus leaf extract is added by ppm solution (HgCl) and then stirred [30-32].

3 Results and Discussion

At this stage, adsorbent testing will be carried out using Hg solution taken from 1000 mg/l mother liquor which will then be diluted according to the concentration of mercury solution needed at each stage of variation. Testing starts from the variation of optimum contact time and concentration of the test solution. Testing the concentration value will be done spectrophotometrically using UV-VIS.
Experiments with variations in contact time and adsorbent concentration have two adsorbent comparisons carried out, namely the ratio (1: 100) with a scheme of 1 gram of sea pandan extract and 100ml of distilled water and a comparison (1: 75) with a test scheme of 1 gram of sea pandan extract and 75ml of distilled water. Using mesh 60 and 120 mesh particle sizes.

3.1 Contact Time and Adsorption Concentration of Sea *Pandanus tectorius* Comparison 1:100 Mesh Size 60 dan 120

In this study, the results of the ratio of 1:100 and 1:75 using mesh sizes 60 and 120 can be seen in Figures 2 and 3 below.

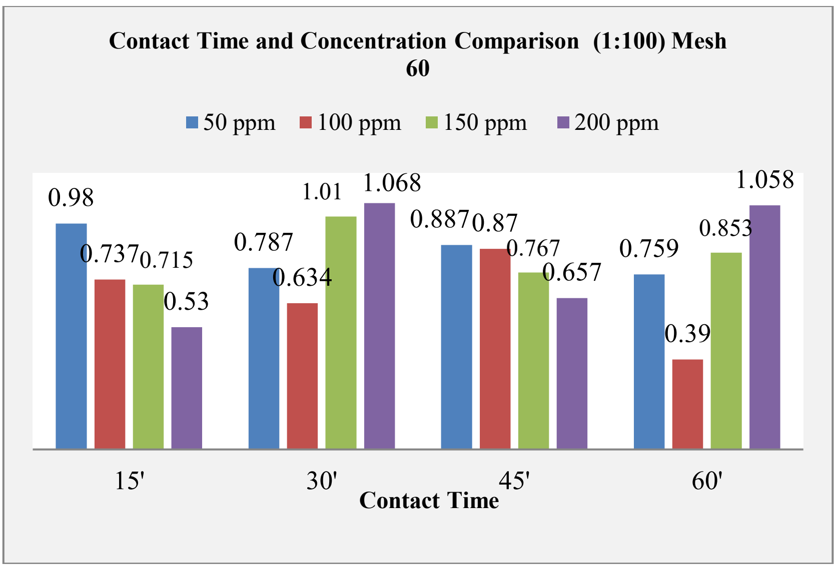

Fig. 2. 1:100 Comparison using 60 mesh particles

The highest adsorbance was achieved at a concentration of 200 ppm with a contact time of 30 minutes, which amounted to 1.058 mg/L. The lowest adsorbance was achieved at a concentration of 100ppm with a contact time of 60 minutes, which amounted to 0.390 mg/L.

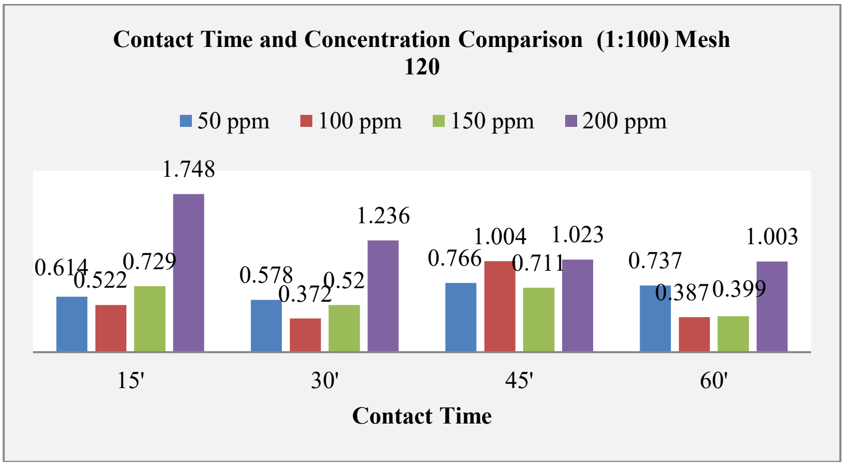

Fig. 3. 1:100 Comparison of Mesh 120 Particle Size

The highest adsorbance was achieved at a concentration of 200 ppm with a contact time of 15 minutes, which amounted to 1.748 mg/L. The lowest adsorbance was achieved at a concentration of 100ppm with a contact time of 60 minutes, which amounted to 0.372 mg/L. It can be seen that the optimum contact time of 60 minutes of sea pandanus leaf adsorbent is considered to reach the optimum contact time because at that time it has the highest absorption ability. And the adsorption concentration of 200 ppm is considered to be the best concentration in heavy metal absorption. It can be seen in the results that a contact time of 60 minutes at a ratio of 1: 100 using mesh 60 and mesh 120 gives the best adsorption results with a yield of 60 mesh 0.390 mg/L and 120 mesh 0.371 mg/L. This shows that too short a contact time may not provide enough time for the adsorption process, while a longer contact time allows more molecules or ions to actively interact on the biosorbent, thus increasing the efficiency of the adsorption process [4].

In the results of the best concentration capacity of sea pandanus leaf adsorption produced at a concentration of 100 ppm particle size 60 mesh 0.390 mg/g and 120 mesh 0.372 mg/L. At this concentration gives the best and efficient results in heavy metal absorption. This is due to several factors, including the maximum adsorption capacity achieved is more absorbent at moderate concentrations, resulting in faster adsorbent saturation and decreased efficiency [17, 22].

3.2 Contact Time And Adsoprtion Concentratin of Sea *Pandanus tectorius* Comparison 1:75 Mesh Size 60 dan 120

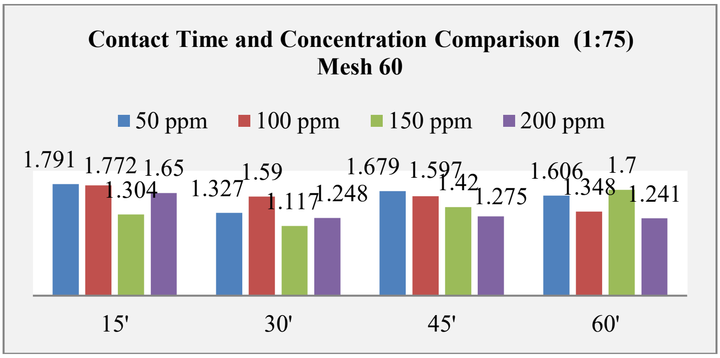

Fig. 4. 1:75 Comparison of Mesh 60 particle Size

The highest adsorbance was achieved at a concentration of 50 ppm with a contact time of 15 minutes, which amounted to 1.791 mg/L. The lowest adsorbance was achieved at a concentration of 150 ppm with a contact time of 30 minutes, which amounted to 1.117 mg/L.

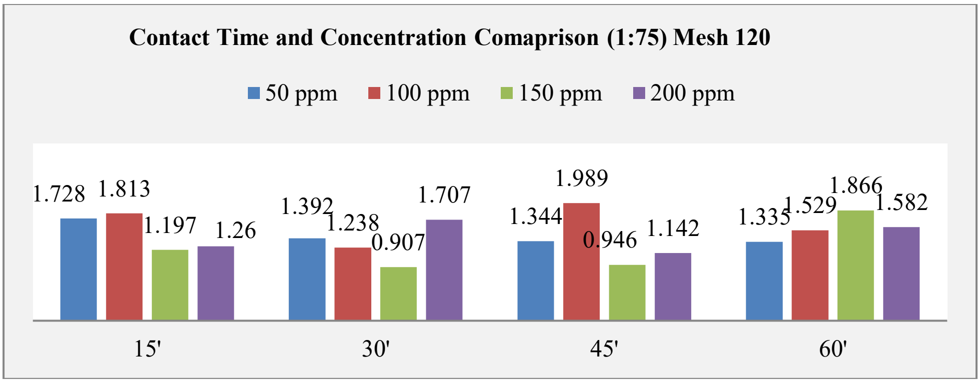

Fig. 5. 1:75 Comparison of Mesh 120 Particle Size

The highest adsorbance was achieved at a concentration of 100 ppm with a contact time of 45 minutes, which amounted to 1.989 mg/L. The lowest adsorbance was achieved at a concentration of 150 ppm with a contact time of 30 minutes, which amounted to 0.907 mg/L. Based on the results of 30 minutes contact time and 150 ppm adsorption concentration, the adsorption capacity of 1.117 mg/g is the result with optimal adsorption ability. At a contact time of 30 minutes at a ratio of 1:75. The result of medium concentration with faster contact time has enough adsorbate molecules that can interact with active sites on the surface of biosrobes. The process can maximize the effective sorption of heavy metals [30]. The results of faster contact time and medium concentration show the best adsorption results in heavy metal absorption, because enough heavy metal molecules can interact with active sites on the adsorbent surface and faster contact time provides enough time for heavy metal molecules to interact with active sites that can maximize heavy metal absorption [27, 31].

4 Conclusion

Based on the results of the research and discussion, several conclusions can be drawn based on the formulation of the research problem as follows: The time variation test resulted in the optimum contact time required for the biosorption process using a 1:75 ratio of 60 and 120 mesh particle sizes having an optimum contact time of 60 minutes, while at a 1:100 ratio of 60 and 120 mesh particles having an optimum contact time of 30 minutes. The concentration variation test was carried out to determine the maximum adsorbent absorption ability, namely at a ratio of 1: 75 getting a concentration of 150 ppm and a ratio of 1: 100 concentrations of 100 ppm.

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