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Removal of Lead (II) Metal by Immobilized of Langsat Shell with Sodium Silicate Using Batch Method

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Abstract:

Heavy metals are found in industrial waste waters whose presence is harmful to the environment even in low concentrations. Lead is an example of a heavy metal that is dangerous and needs to be addressed. Biosorption is one method that can be used to absorb heavy metals. Langsat shell as a biosorbent was immobilized with sodium silicate. Langsat shell that has been immobilized can improve the performance of the adsorbent in the adsorption process. This study using the batch method with variations in particle size, contact time and stirring speed. The optimum conditions obtained in each variation were particle size 150 μm, contact time 60 minutes and stirring speed 200 rpm.

Keywords **—Biosorption, lead (II), langsat shell, immobilization, batch method.**

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I. INTRODUCTION

Heavy metals are found in industrial wastewater and can harm the environment. High and low concentrations of heavy metals are found in industrial waste waters such as metal plating, battery manufacturing, mining, agriculture (pesticides and fertilizers), textiles, pharmaceuticals, etc [1]. Lead is one of the most toxic heavy metals and must be removed before being discharged into the environment [2].

Several techniques that have been used to absorb heavy metals from water pollution are ion exchange, precipitation, coagulation, membrane separation, and adsorption [3]. However, this method has disadvantages such as being relatively expensive, produces toxic waste, and is not always effective for metals with low concentrations[2]. Biosorption is a method that can be used to remove heavy metals using biomass[4]. In this study, the biomass used was langsat shell.

Langsat shell contains terpenoid compounds in the form of lansic acid and lansiolic acid, and langsat shell also contains flavonoids and saponins[5]. Some of the functional groups present in these components are O-H, N-H, C=O, C-H and C-O[6]. The langsat shell was immobilized using sodium silicate. The purpose of this immobilization is to produce better absorption.

This immobilization study using sodium silicate has been carried out by Marfania (2019)using longan shell biosorbent to absorb Cd (II) metal. The optimum conditions obtained were a concentration of 250 mg/L, a contact time of 30 minutes and a stirring speed of 250 rpm with a maximum absorption capacity of 26.73 mg/g. The same research was also carried out by Kharisma Putra (2019)by absorbing Pb (II) metal and Khairunnisa (2019)absorbing Cu (II) metal. The optimum conditions obtained for the absorption of Pb (II) metal were pH 6 and a concentration of 550 mg/L with a maximum absorption capacity of 29.67 mg/g. Research conducted by Khairunnisa (2019)to adsorb Cu (II) metal obtained optimum conditions at pH 4 and a concentration of 550 mg/L with 19.607 mg/g.

II. MATERIALS AND METHODS

A. Tools and Materials

In this study the tools used were mortar and pestle, pH meter, sieve, filter paper, electric oven, analytical balance (ABS 220-4), spray bottle, shaker, magnetic stirrer, glassware and Atomic Absorption Spectrophotometer (Perkim Elmer AA-10). The materials used are Pb(NO3)2, langsat shell, sodium silicate, NaOH 0.01 M, 0.1 M, HNO3 0.01 M, 0.1 M, 0.5 M, H2SO4 5% BaCl2 0.2 M, and aquades

B. Procedur

1) Sample Preparation

The shell of the langsat is separated from the flesh and then cleaned of dirt and cut into small pieces, and dried at room temperature. The dried shell was mashed with a lumping pestle or blender and sieved through 106, 150, 250, 425 μm sieves.

2) Immobilization of Langsat Shell Using Sodium Silicate

75 mL of 5% sulfuric acid solution was mixed with 20 mL of sodium silicate solution until pH 2. was added to the mixture as much as 5 g of langsat peel and stirred for 15 minutes. Then it was added with sodium silicate little by little until pH 7. The polymer formed was rinsed with distilled water, until it did not form a white precipitate when 2 drops of BaClsolution were added2. Then the immobilized langsat shell was dried overnight at a temperature of 60, then crushed to obtain one particle size[10].

3) Research Treatment with Batch Method

A solution of Pb (II) 300 mg/L as much as 25 mL was contacted with 0.2 grams of immobilized langsat shell. Experiments were carried out by varying the particle size (104, 150, 250 and 425 m), contact time (30, 60, 90 and 120 minutes) and stirring speed (50, 100, 150, 200, 250 rpm).

III. RESULT AND DISCUSSION

A. Effect of Particle Size

In biosorption, the adsorption capacity value is strongly influenced by particle size. If a particle size gets smaller, the value of the absorption capacity will be even greater, this is because the surface area is getting bigger[11].

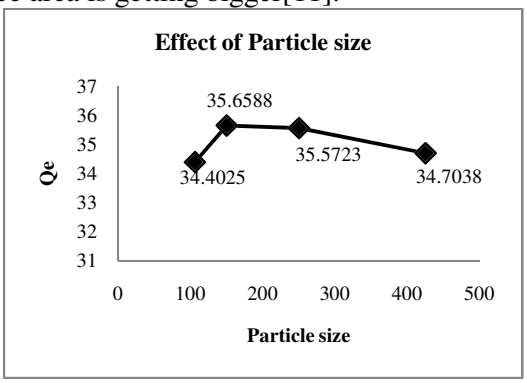

Fig. 1Effect of particle size on metal absorption of Pb(II)

Optimum absorption conditions for Pb (II) metal occurred at a particle size of 150 m with an adsorption capacity value of 35.6588 mg/g which can be seen in Figure 1. At a size of 106 μm there was a decrease in the absorption capacity value because at that size there were still sizes smaller than 106 m which caused The smaller size is not stirred and there is no contact with the Pb (II) metal solution because it is on the surface of the solution[12].

B. Effect of Contact Time

Contact time can affect the value of absorption capacity in the biosorption process.

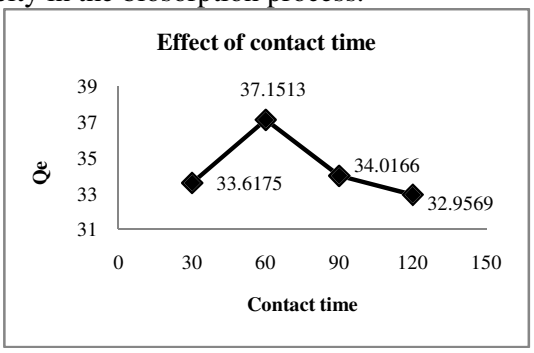

Fig. 2Effect of contact time on metal absorption of Pb (II)

At a contact time of 60 minutes with an absorption capacity of 31.1513 mg/g is the optimum condition for the absorption of Pb (II) metal which can be seen in Figure 2. The decrease in absorption capacity occurs at a contact time of 90

and 120 minutes due to desorption, namely the release of metal ion Pb(II) which has bonded with immobilized shell of langsat because it has been in contact for too long [13].

C. Effect of Stirring Speed

Stirring speed was carried out to determine the optimum speed of immobilized langsat shell to bind Pb^{2+}. In the biosorption process, the stirring speed can affect the value of the adsorption capacity. The faster the stirring, the greater the value of the absorption capacity [13]. The variation of stirring speed is 50, 100, 150, 200, 250 rpm. The effect can be seen in the figure 3.

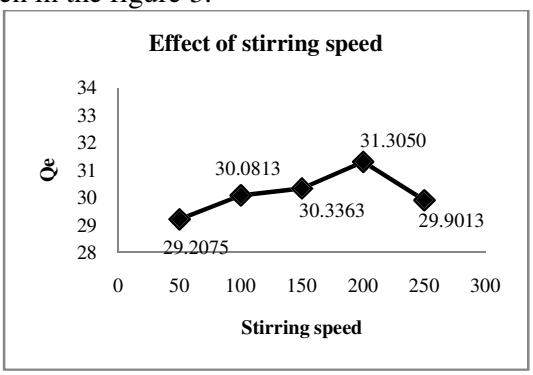

Fig. 3Effect of stirring speed on metal absorption of Pb (II)

It can be seen in Figure 3 that the optimum absorption conditions for Pb (II) occurred at a speed of 200 rpm with an absorption capacity value of 31.305 mg/g. The decrease in absorption capacity occurred at a speed of 250 rpm due to stirring too fast which disrupted the bond between the active sites. on biosorbents with metal ions Pb (II) [13].

IV. CONCLUSIONS

In this study, it was concluded that the optimum conditions occurred at a size of 150 m, a contact time of 60 minutes and a stirring speed of 200 rpm

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