Absorption of Copper Metal Ions Using the Immobilized Langsat (*Lansium domesticum*)

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Abstract. High community activity can cause water pollution by heavy metals that are very dangerous for living things. Copper (Cu) is one of the heavy metals that has a very detrimental effect on biotic components, copper is toxic to all plants at a solution concentration above 0.1 ppm. Biosorption is the absorption process for the removal of contamination by heavy metals in solution using biological materials. Langsat shell as bio sorbent has been proven to bind to heavy metal ions in the presence of useful groups that can form complexes with heavy metal ions. Bio sorbent, which are mobilized using silica, can provide increased functionality of the function group and bond resistance. The study used batch methods with variations in contact time treatment and stirring speed. The study used batch methods with variations in contact time treatment and stirring speed. The results of each variation obtained the optimum state of absorption of Cu (II) metal ions, namely at a contact time of 60 min and a stirring speed of 250 rpm with an absorption capacity of 26,675 mg/g.

Keywords: Cu · Immobilization · Langsat shell · Biosorption

1 Introduction

Along with technological advances, developments in the industrial field have also increased. Initially, development in the field of the industry aims to provide convenience for humans through its products. The increase in industrial fields was also accompanied by an increase in the use of heavy metals. Heavy metals are widely used in industry because they have properties such as electricity and heat and can form alloys with other metals. Some heavy metals (essential metals serve to aid the physiological processes of living things [4]. In fact, heavy metals not only provide benefits but also have caused a lot of pollution with very worrying risks to living things. Waste from heavy metals is particularly dangerous to living things because it damages aquatic habitats and ecosystems and is a toxic and carcinogenic substance [5]. One of the most dangerous heavy metals is copper (Cu). The presence of Cu (II) heavy metals in the water that exceeds the limit can cause health problems for humans who consume them, although Cu (II) is a metal needed by the body copper (Cu) but Cu has a very detrimental effect on biotic components, cu is toxic to all plants at solution concentrations above 0.1 ppm [6].

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Biosorption is the latest waste treatment technology that can set aside / eliminate heavy metals that are toxic, therefore biosorption can be considered an environmentally friendly alternative technology to treat industrial liquid waste that is economically feasible to use [7]. The biosorption process can occur due to the presence of biological material called bio sorbents and the presence of solutions containing heavy metals with a high affinity so that they are easily bonded to bio sorbents [8]. Another thing that makes biosorption an attractive option is the availability of various bio sorbents, [9] there is another alternative to be used as an adsorbent, namely langsat shell [1]. The Langsat shell contains terpenoid compounds in the form of lansic acid and lansiolic acid, the langsat shell also contains flavonoids and saponins [1]. Some of the functional groups present in these components are O-H, N-H, C = O, C-H, and C-O [2]. The advantages of using the biosorption process are relatively cheap fees, area friendly, can be applied to low waste concentrations, and the ease of the regeneration process [3].

Based on [18] research on the Reduction of lead (II) from aqueous solution by bio sorbent derivated from lengkeng (euphoria logan lour) shell with the batch method, the results of The optimum concentration was 400 mg / L with the adsorption capacity was 30,543 mg /g, and the optimum contact time was 75 min with adsorption capacity was 34,740 mg/g. Similar research was also conducted by [12], Effect of Contact Time Adsorption of Rhodamine B, Methyl Orange, and Methylene Blue Colours on Langsat Shell with Batch Methods, the results showed that langsat shell can bind to Rhodamine B, Methyl Orange, and Methylene Blue Colours in aqueous solutions, The results reveal that the biomass adsorption on rhodamine B, methyl orange, and methylene blue dyes was 11,578 mg/g, 3.8425 mg/g, 36,735 mg/g respectively and with an optimum contact time of 60, 90 and 150 min, respectively, of [19] on Influence of operating conditions on the removal of Cu, Zn, Cd, and Pb ions from wastewater by adsorption, the result of which can be the equilibrium time was attained within 60 to 90 minand the maximum removal percentage was achieved at an adsorbent loading weight of 1.5 g / 50 mL mixed ions solution. In this study, modifications were made using a langsat shell bio sorbent that does not move with sodium silica to absorb cu metal ions in solution with the batch method in hopes of producing better absorption. The parameters tested were variations in contact time and variations in stirring speed.

2 Experimental

2.1 Chemicals and Apparatus

The materials used were langsat shell, distilled water, Cu solution 1000 mg/L, sodium silicate, 2 M HNO3, 5% H2SO4, and 0.2 M BaCl2. The tools used are glassware, shaker, pH meter, analytical balance, filter paper, magnetic stirrer, sieve, lumping and pestle, electric oven, and spray bottle. The tool used for characterization is the Atomic Absorption Spectrophotometer (AAS).

2.2 Preparation of Bio Sorbent

The langsat shell is separated from the flesh and then cleaned of dirt and cut into small pieces, and dried at room temperature. The dried langsat shell was mashed with a blender and sieved with a 250 μm sieve [10].

2.3 Immobilization Treatment of Langsat Shell with Sodium Silicate

75 mL of H2SO4 5% solution was mixed with 20 mL of sodium silicate solution to obtain a pH of 2. Then 5 gr of langsat shell was added to the mixture and stirred for 15 min. Added sodium silicate again until obtained pH 7. The mixture formed rinsed with aquades until no white precipitate was formed when 2 drops of 0.2 M BaCl2 were added. The immobilized langsat shell was dried in an oven at 60 °C overnight. Then the results obtained were ground to obtain one particle size [11].

3 Research Studies with Batch Method

3.1 Effect of Contact Time

As much as 0.2 g of demobilized langsat shell are contacted with a Cu (II) solution of 25 mL with pH, concentration, and optimum using system batch, then shaker at a speed of 150 rpm with variations in contact time; 30, 60, 90, 120, 150 min. Then the solution is filtered and accommodated filtrate and measured with atomic absorption spectrophotometer (SSA) [12].

3.2 Effect of Stirring Speed

A total of 0.2 g of demobilized langsat shell is contacted with a solution of Cu (II) as much as 25 mL with pH, optimum concentration using a batch system, then shaker with speed; 100, 150, 200, 250 rpm during optimum contact time. Then the solution is filtered and accommodated filtrate then measured with Atomic Absorption Spectrophotometer (SSA) [12].

4 Result and Discussion

4.1 Effect of Contact Time

Contact time greatly affects the adsorption process, the longer the conditioning, the better the adsorption power [13]. However, prolonged conditioning can result in a decrease in metal absorption because the active site that binds metal ions has been saturated so that it can no longer bind [14]. Variations in contact time were carried out at 30, 60, 90, and 120 min. The effect of variations in contact time on the adsorption of Cu (II) metal ions can be seen in Fig. 1.

In Fig. 1 can be seen the optimum contact time occurred at 60 min with an absorption capacity of 21.08125 mg/g. The optimum time is the equilibrium time between the adsorption and desorption rates [15]. Furthermore, after more than 60 min of absorption will tend to be constant this is because the active site that binds to metal ions is saturated so that it cannot bind anymore [14]. This is in accordance with the theory that the longer the time used the more solutes are absorbed. However, the amount of solute in adsorption will reach the maximum limit because the bio sorbent surface has been covered by a layer of adsorption Cu (II) ions [16]. This result is the same as the [12] study on the Effect of Contact Time Adsorption of Rhodamine B, Methyl Orange, and Methylene Blue Colours on Langsat Shell with the results of the optimum contact time occurring at 60 min.

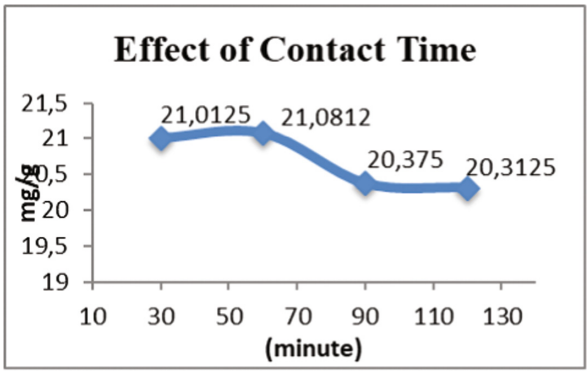

Fig. 1. Effect of variation in contact time on the adsorption of Cu (II) metal ions

4.2 Effect of Stirring Speed

The speed of stirring greatly affects biosorption results against Cu (II) heavy metal ions. The faster the speed of stirring will result in greater absorption. This is because, with the faster stirring, the contact that occurs between the active site on the surface of the bio sorbent and metal ions will be faster and better so as to produce a large absorption capacity. The effect of variations in stirring speed on the absorption of Cu (II) metal ions can be seen in Fig. 2.

In Fig. 2 can be seen with the increasing speed of stirring can increase the absorption capacity. Optimum stirring speed occurs at a speed of 250 rpm with an absorption capacity of 26.675 mg/g. Furthermore, there is a decrease in absorption capacity to a speed of 350 rpm. This happens because the bio sorbent is saturated and cannot absorb Cu (II) metal ions anymore. When the stirring speed is lower than 250 rpm, the binding efficiency of Cu (II) metal ions decreases, this is because the contact between the liquid phase (metal solution) and the solid phase (bio sorbent) is not enough to get optimal

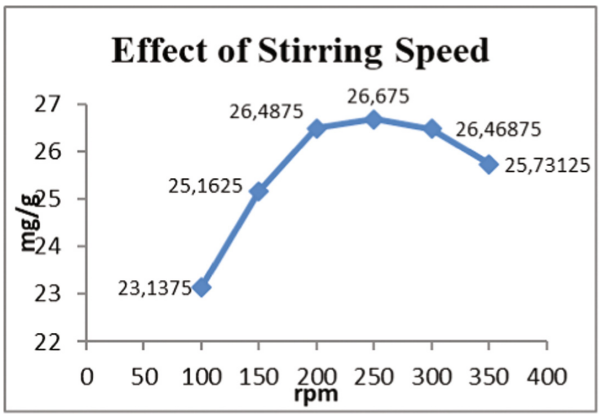

Fig. 2. Effect of variations in stirring speed on the absorption of Cu (II) metal ions

adsorption [17]. The results obtained are the same as those produced [20] using a longan skin that is mobilized as a bio sorbent in binding metal Cd ions at a stirring speed of 250 rpm.

5 Conclusion

Based on the above results, it can be concluded that the optimal contact time occurs at 60 min with an absorption capacity value of 21.08125 mg/g while the optimal stirring speed at a speed of 250 rpm with an absorption capacity of 26.675 mg/g.

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