Biosorption of Cd (II) ion from aqueous solution using immobilized *Lengkeng* (*euphoria longan lour*) shell

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Abstract. In this paper, lengkeng shell was immobilization with sodium silica yo remove Cd (II) ion from aqueous soutline by biosorption was investigativ in a batch system immobilization of lengkeng shell can improve the ability of biosorbent in the process of absorption. The influence of solution pH and particle size. Were evaluated the result showed that the absorbent was good for the removal of Cd (II) ion with biosorption capacity of 22.587 mg/g at pH 5 and 250 µm particle size. Immobilization lengkeng shell showed the highles potential for the removal of toxic metal aqueous solution.

1. Introduction
There is still a lot of pollution from metal waste. Disposal of this metal causes the accumulation of metal ions to increase in the environment, which can pollute the environment and damage the health system [1]. Heavy metal is toxic but found as industrial waste is cadmium metal. Cadmium metal waste is metal waste originating from various activities such as metal mining, oil paint, battery coating, pesticides and other industrial activities. Cadmium is a metal that is toxic. Therefore, a method is needed to separate the metal ions from the waste.

One way to separate metal from its waste is using longan shell as a metal biosorbent. The use of longan shell as biomass has been carried out by (Kurniawati et al., 2015) and (Kurniawati et al., 2016) which is the absorption capacity of Cu in the seeds and shell respectively 3,734 and 7,513 mg / g[2] and in successive Pb metals on the seeds and shell of the longan is 3.32 and 4.1 mg / g. the use of biomass has advantages such as having functional groups that can play a role in binding heavy metals, are easy to use and are more environmentally friendly[3]. But longan shell biomass has limitations in several ways, such as: absorption is still small and easily damaged by other microorganisms. To overcome this problem, various efforts were made, including the method of immobilization using sodium silica.

2. Materials and Methods

2.1 Materials
The Materials needed is erlemeyer, spray bottle, pestle mortar, sieve (BS410), analytic balance (ABS 220-4), pH meter (HI2211), magnetic stirrer (MR Hei Standard), shaker (model: VRN-480), equipment used for characterization are SSA and FTIR. The material used is 5% H₂SO₄, Sodium Silicate, 0.1 M NaOH, 0.1 M HNO₃, standard solution of Cd and BaCl₂ ions

[1] [2] [3]
2.2 Sample Preparation and Manufacture of Longan Shell Biomass
Longan shell is crushed by using a grinding machine and mashed with mortar, then sifted to a certain size.

2.3 Immobilization of longan shell on sodium silicate
75 ml of 5% sulfuric acid added Sodium Silicate solution until pH 2.0 is obtained. Then add 5 g of longan shell into the mixture and stir for 15 minutes. Then sodium silicate solution is added gradually so that the pH of the solution becomes 7.0. The polymer formed is washed with water until 2 drops of BaCl₂ solution is added and does not form a white precipitate. The gel polymer that has been immobilized with longan shell is dried at 600°C, then crushed is obtained by one particle size.

2.4 Effect of Ph
0.2 g of immobilized longan shell contacted 25 mL of Cadmium (II) 250 ppm solution accompanied by stirring for 60 minutes at a speed of 150 rpm at pH 2, 3, 4, 5 and 6. Then the solution was filtered and the absorbance of the filtrate was measured by Absorption Spectrophotometer Atom.

2.5 Effect of particle size
0.2 grams of longan shell immobilized by sodium silica added to a cadmium (II) solution of 250 ppm, then stirred with a speed of 150 rpm for 60 minutes, the filtrate obtained was tested on Atomic Absorption Spectrophotometer.

3. Results and Discussion

3.1 Effect of pH
The biosorption of cadmium metal ion was carried out by contacting 0.2 grams of non-immobilized and immobilized biomass shell with sodium silica, with 25 ml of cadmium metal ion solution with a concentration of 250 ppm. The contact time used is 60 minutes with pH variations. Then phytrate will be tested by Atomic Absorption Spectrophotometer. Readable results on the instrument are the levels of metal ions that are not adsorbed by longan shell biomass either immobilized in sodium silica or non-immobilized longan shell. The results of adsorption of cadmium metal ions with pH variations are shown in the diagram below.

![Diagram of the effect of pH on absorption of cadmium metal ions by immobilized and non-immobilized longan shell biomass.](image)

**Figure 1.** Diagram of the effect of pH on absorption of cadmium metal ions by immobilized and non-immobilized longan shell biomass.
Biosorption on longan immobilized shell biomass with sodium silica has optimum absorption at pH 5 with absorption capacity of 13.7 mg / g, while in non-immobilized longan biomass optimum absorption is at pH 3 and absorption capacity is 3,932 mg / g. Longan shell immobilization of sodium silica has a higher absorption than non-immobilized longan shell, this is caused by a synergy between longan shell and sodium silica which has an active site on the surface namely silanol (Si-OH) and siloxane group (Si-O-Si). The longan immobilized sodium silica has better particle strength and chemical stability and is resistant to decomposition of other microorganisms.

3.2 Effect of particle size
Particle size can affect the biosorption process, particle sizes vary from 150, 180, 250 and 350 µm. The adsorption results of cadmium metal ions with particle size variations can be showed in Figure 2.

From the diagram it can be explain that the particle size has a different effect on absorption carried out by non-immobilized longan shell with longan shell immobilized by sodium silica. In non-immobilized longan shell optimum absorption occurs at the smallest particle size of 150 µm, this can be explained that the smaller the particle size, the wider the surface of the adsorbent will be, so the absorption will be even greater and more adsorbed metals will also occur. Whereas in the longan shell immobilization of optimum absorption of sodium silica did not occur at the smallest size but at a particle size of 250 µm. The nature of sodium silica adsorption is determined by orientation from the ends of the combined hydroxy groups [4]. The ability to adsorbe sodium silica is not proportional to the amount of silanol and siloxane present on the surface, but depends on the distribution of -OH group on the broad union of adsorbents.

3.3 XRF characterization
Quantitative analysis (XRF) is an analytical technique used to analyze the main constituents of biosorbert. Characterization using XRF was carried out on longan shell biomass immobilization of sodium silica. The results of the XRF test can be showed in the following table:
Table 1. XRF data of the shell is long before immobilization, after immobilization and after absorption.

| Element | Geology | Oxides |
|---------|---------|--------|
|         | Compound | Conc | Unit | Compound | Conc | Unit | Compound | Conc | Unit |
| Before Immobilization | | | | | | | | | |
| Mg | 4.44 | % | MgO | 6.092 | % | MgO | 6.087 | % |
| Si | 1.114 | % | SiO₂ | 1.906 | % | SiO₂ | 1.904 | % |
| P | 3.442 | % | P₂O₅ | 6.176 | % | P₂O₅ | 6.17 | % |
| S | 8.434 | % | SO₃ | 15.958 | % | SO₃ | 15.94 | % |
| Ca | 59.694 | % | CaO | 51.644 | % | CaO | 0.053 | % |
| After Immobilization | | | | | | | | | |
| Mg | 0.694 | % | MgO | 0.814 | % | MgO | 0.814 | % |
| Al | 0.899 | % | Al₂O₃ | 1.093 | % | Al₂O₃ | 1.093 | % |
| Si | 93.269 | % | SiO₂ | 95.221 | % | SiO₂ | 95.185 | % |
| P | 1.924 | % | P₂O₅ | 1.492 | % | P₂O₅ | 1.491 | % |
| Ca | 2.453 | % | CaO | 1.112 | % | CaO | 1.111 | % |
| After Biosorption | | | | | | | | | |
| Mg | 0.07 | % | MgO | 0.066 | % | MgO | 0.065 | % |
| Si | 72.664 | % | SiO₂ | 86.537 | % | SiO₂ | 85.514 | % |
| P | 1.468 | % | P₂O₅ | 1.536 | % | P₂O₅ | 1.512 | % |
| Ca | 3.392 | % | CaO | 1.855 | % | CaO | 1.82 | % |
| Cd | 18.976 | % | Cd | 8.12 | % | Cd | 9.117 | % |

From the table it can be showed on the longan shell before immobilization and then immobilization does not contain metal cadmium, and after the biosorption process there is cadmium metal of 18.976%. This cadmium element is in the CdO oxide arrangement. In addition, the change in the significant changes was not Si on longan shell before 1.114% to 93.269% on longan shell after immobilization.

4. Conclusion
Immobilization method has been able to increase the durability and absorption capacity of longan shell biosorbent. The optimum absorption conditions on longan shell non immobilization occur at pH 3 and size 150 μm with absorption capacity of 3.93 mg / g and 4.31 mg / g, whereas in optimum longan shell immobilization conditions occur at pH 5 and 250 μm particle size with absorption capacity of 13.70 mg/g and 22.58 mg/g.

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