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RESEARCH ARTICLE OPEN ACCESS

Adsorption of Lead (II) from Aqueous Solution Using Column Method by Lengkeng (*Euphoria longan Lour*) Shell Activated Carbon

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Abstaract:
The lead (II) is one of the hazardous metal ions produced from various industrial wastes and its existence needs to be addressed. Adsorption using activated carbon from lengkeng shell is proven to be able to absorb lead (II). The absorption stage was carried out by varying the pH (2, 3, 4, 5, and 6) and the concentration (50. 100, 150, 200, 250) mg /L by the column method. The results showed that the optimum conditions occurred at pH 5 and a concentration of 150 mg /L with an absorption capacity of 3.7058 mg/g.

Keywords—Adsorption, Lengkeng Shell Activated Carbon, Lead (II), Column Method

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I. INTRODUCTION

Lead (II) is one of the dangerous metal ions produced from various industrial wastes,such as mining, smelting, galvanization, and industrial metallurgy[2]. Its accumulation in the human body can lead to chronic poisoning. As for the effects on health, such as seizures, brain damage, and death. According to the World Health Organization, the maximum level of lead (II) ions in the recommended waters is below 0.01 mg / L [6]. Given the dangers posed by the presence of these metal ions, many methods have been developed to overcome the presence of heavy metal ions from industrial waste, such as precipitation, ion exchange, evaporation, oxidation, and membrane filtration [8]. Although effective, the use of some of these methods requires large operational costs. Adsorption using activated carbon is a processing method that has been developed. Apart from being cheap, the adsorbents used are also easy to obtain and proven to be effective in absorbing metal ions. Activated carbon is a solid that has pores and consists of carbon with a percentage of85% - 95% so it is very good to be used as an adsorbent [8]. Some adsorbents that have been used as activated carbon in research related to metal ion absorption, such as activated carbon Typha orientalis leaves [4], olive stones [3], saffron leaves [5], and acai seed [12]. In this study, activated carbon from lengkeng shell was used to absorb lead (II) using the column method which was expected to provide better absorption.

II. EXPERIMENTAL SECTION

A. Tools and Materials

The tools used in this study consisted of glassware, spray bottles, columns, pH meter(HI2211), analytical balance (ABS 220-4), filter paper (Whatman no 42), micro sieve (BS410),Heat Treatment Furnace (Merk Hofmann), oven and desiccator. Characterization was carriedout using Atomic Absorption Spectrophotometer (AAS) (Perkin Elmer AA-100). While thematerials used consist of activated carbon from lengkeng shell, distilled water, $Pb(NO_3)_2$, HNO_3p.a, NaOH, and HCl p.a.

B. Activated Carbon Preparation

The lengkeng shell that have been prepared are washed and dried at room temperature until constant weight is obtained. Then, the lengkeng shell is cut into small pieces and heated in a furnace at a temperature of 400 ℃ for one hour [13]. After that, crushed and sieved with a 250 µm sieve. Furthermore, as much as 20 grams of carbon were activatedwith the activator reagent 80 mL 4 M HCl for two hours [11]. Finally, it is washed and filtered using distilled water until the pH is

neutral and then dried at 105°Cfor 4 hours in an oven and cooled [4].

C. Reagent Preparation

Prepare 1000 mg/L lead (II) standart solution. Then, dilution was carried out with different concentrations (50-250) mg/L.

D. Research Treatment with Column System

The adsorption study using columns was carried out by inserting 15 mL of lead (II) solution into a column containing 0.2 grams of activated carbon from lengkeng shell. The experiments were carried out by varying the pH (2-6) and the solution concentration (50-250) mg/L. The filtrate was then tested using an Atomic Absorption Spectrophotometer (AAS).

III. Result and Discussion

A. Effect of pH Solution

The pH of the solution is an important parameter that affects the value of the absorptioncapacity between the adsorbent and the metal ions present in the solution. Absorption occurswhen the active site contained in the adsorbent binds metal ions by involving the replacementof protons so that the pH value must be appropriate so that the adsorption process can takeplace optimally [10].The effect of pH variations can be seen in Figure 1.

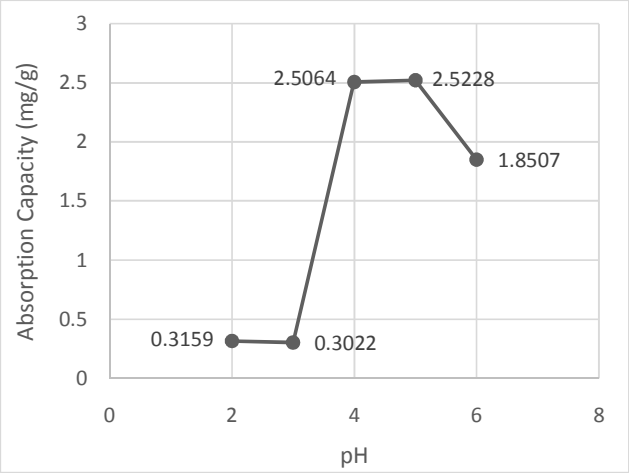

Figure 1. Effect of pH variations on absorption capacity

The curve above shows that at pH 2-3 the absorption tends to be smaller. This is due tothe influence of H^+ from HNO_3 which is used when setting the pH, where the effect causescompetition between H^+ and Pb^{2+} to bind the active site contained in the activated carbon oflengkeng shell. The H^+ in acidic pH tends to cause more protonation at the active site to becomepositively charged so that the absorption of Pb^{2+} is smaller, due to the repulsive force betweenthe active site and the positively charged metal ion. Furthermore, as the pH increases from 3-5, the absorption increases. This occurs due to two things, firstly the addition of HNO_3 tends to be less so that the effect on the formation of a positive charge on the active site is also less [7], secondly the occurrence of deprotonation which causes the active site to be negatively charged, this occurs due to the release of protons of the functional group resulting in an attractive force with Pb^{2+} so that absorption tends to increase. Then, at pH 5-6 there is a decrease in absorption, this occurs because OH^- in NaOH which isused to adjust the pH causes Pb^{2+} hydrolyze to $Pb(OH)_2$ so that the formation of deposits which results in decreased absorption [14].

B. Effect of Concentration Solution

The concentration variation was used to determine the relationship between the adsorption power of Pb^{2+} by using various concentrations as well as to determine the optimum absorption capacity. The effect of concentration variations can be seen in Figure 2.

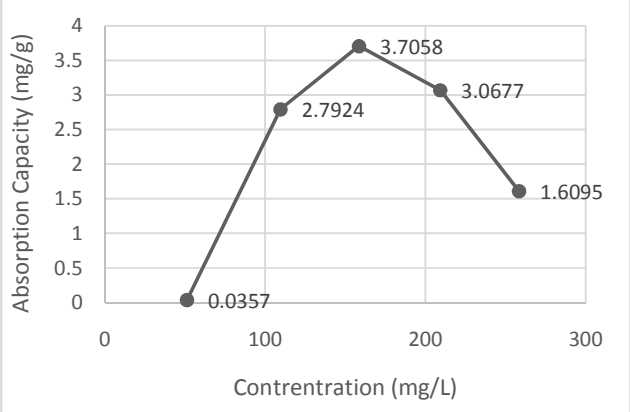

Figure 2. Effect of concentration variations on absorption capacity

The curve above shows an increase in absorption with increasing concentrations seen at 50-150 mg/L. Absorption occurs because the bonds on the active site on the surface of the activated carbon will bind Pb^{2+} chemically [14]. The increase in absorption is because the active site on activated carbon is not saturated so that it can still absorb Pb^{2+}.Conversely, when the active site is saturated, a decrease in absorption capacity is seen at a concentration of 150-250 mg/L [3].

III. Conclusion

Based on the results of the research that has been done, it can be concluded that the optimum conditions occur at a pH of 5 and a concentration of 150 mg/L with an absorption capacity

of 3.7058 mg/g so that the activated carbon of lengkeng shell is proven to be able to absorb lead (II).

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