Indonesian Journal of Chemical Science and Technology (IJCST)

State University of Medan, https://jurnal.unimed.ac.id/2012/index.php/aromatika

IJCST-UNIMED 2023, Vol. 06, No. 1 Page; 23 – 27

Received : Oct 22th, 2022 Accepted : Dec 2nd, 2022 Web Published : Jan 31st, 2023

Adsorption of Lead Ion (II) Using Activated Carbon of Langsat Shell (Lansium domesticum Corr) with Column Method

Muhammad Taufiq*, Desy Kurniawati

Department of Chemistry, Faculty of Mathematics and Natural Sciences, Padang State University, Padang, Indonesia
**mhdtaufiq695@gmail.com*

ABSTRACT

Lead (II) ion is one of the dangerous metal ions produced from various industrial wastes and its existence needs to be addressed. Adsorption using langsat peel activated carbon was proven to be able to absorb lead (II) ions. The stages of absorption are carried out by varying the adsorbent weight (0.2, 0.3, 0.4, and 0.5) g, and flow rate (1,2,3,4) mL/minute by column method then continued with testing using atomic absorption spectrophotometer (AAS). The results showed that the optimum conditions occurred at the weight of the adsorbent is 0.2 g, and the flow rate is 2 mL/min.

Keywords: Adsorption, Lead, Activated Carbon, Column Method

1. INTRODUCTION

Pb2+ ion is one of the most common and most toxic metal ions found in industrial wastewater, this ion is released into the environment especially waters through mining, smelting, galvanizing and industrial metallurgy processes as well as from batteries, paints, ceramics, ammunition, lead pipes, and others.[1] At low concentrations lead can be harmful and cause poisoning to humans and other life forms. Lead can accumulate in bones, kidneys, brain and muscles and increased concentrations of lead can cause many serious disorders such as anemia, kidney disease, liver disease, neurological disorders, damage to the digestive tract and even lead to death.[2]

Considering the danger posed by the presence of Pb^{2+} metal ions, many methods have been developed in order to overcome the presence of heavy metal ions from industrial wastewater, such as precipitation, ion exchange, evaporation, oxidation, and membrane filtration.[3] Although their effectiveness has been proven, the use of some of these methods requires large operational costs. So it takes a processing method that is cheap, safe, and certainly effective.

Adsorption is a process that occurs when a fluid (liquid or gas) combines with a solid and eventually forms a thin layer on the surface of the solid. In adsorption, the concepts of adsorbate and adsorbent are used, where the adsorbate is the substance to be adsorbed or separated from the solvent, and the adsorbent is the

e-ISSN : 2622-4968, p-ISSN : 2622-1349

adsorption medium, such as carbon compounds.[4]

Activated carbon itself is a porous carbon-based solid with a carbon content of 85-95%. Activated carbon has a very high surface area, exceeding 600 m2/g. This very high surface area is influenced by the porous structure, so that activated carbon has characteristics as an adsorbent.[5] Activated carbon is produced from several carbonaceous materials, namely wood, sawdust, seed coats, rice husks, shells, peat, bagasse, coal, lignite, and animal bones.[6]

The skin of Lansium domesticum fruit contains various compounds that can be used as natural insecticides. Some of these compounds are terpenoids, flavonoids, alkaloids, and saponins in the form of lanolin and lanolin.[7] Some of the functional groups found in langsat skin are C-H, C=O, O-H, C-O and N-H. This functional group will be responsible for absorbing heavy metal ions later.[8]

Based on this description, in this study, activated carbon from langsat peel was used as an adsorbent which was activated with hydrochloric acid (HCl) to absorb Pb^{2+} ions using the column method. For this purpose, the optimum conditions for Pb^{2+} ion absorption will be determined on the effect of adsorbent weight and flow rate.

2. EXPERIMENTAL

2.1. Chemicals, Equipment and Instrumentation

The tools used in this study were glass, stirrer, spray bottle, chromatographic column, pH meter (HI2211), analytical balance (ABS 220-4), paper filter (Whatman No. 42), micro filter (BS410), furnace (Brand Hofmann), oven and desiccator. The equipment used for characterization are Fourier Transform Infrared (FTIR) and Atomic Absorption Spectrophotometer (SSA) (Perkin Elmer AA-100).

The materials used in this study were activated carbon from langsat skin, aquades, Pb(NO3)2, HNO3 p.a, and NaOH.

2.2. Research Procedure

The first step, the prepared langsat skin was washed with distilled water and dried at room temperature for 7 (seven) days. Then the langsat skin was cut into small pieces and heated in a furnace at 350°C for 1 hour to obtain carbon. The obtained carbon is then ground into a powder. Finally, it was sieved with a 250 m sieve.

The second step, the langsat skin that has been obtained is then activated with HNO3 activator. A total of 20 grams of carbon was immersed in 80 ml of 5 M HNO3 reagent for 2 (two) hours. Then the soaked carbon is washed and filtered with distilled water until a pH value is obtained that corresponds to the pH (neutral) value of the distilled water. After that, the carbon is dried in an oven at a temperature of 105°C for 3 (three) hours. Finally, put in a desiccator until the activated carbon can be used.

Next, determine the effect of adsorbent weight and flow rate on lead ion adsorption. The first stage is the influence of the weight of the adsorbent by weighing the activated carbon of the langsat peel at variations of 0.2-0.5 grams. Then dissolve the Pb2+ solution in distilled water as much as the number of variations. After that, put the weighed langsat peel activated carbon into 4 columns, then add 15 mL of the prepared Pb2+ solution into 4 columns. Next, let the filtrate flow out of the column and be collected. The filtrate obtained was measured using AAS at every change in the weight of the adsorbent, so that the absorption at the optimum weight of the adsorbent could be determined.

e-ISSN : 2622-4968, p-ISSN : 2622-1349

The second stage is the effect of flow rate on the lead ion adsorption process. Weigh the activated carbon of the langsat peel as much as the optimum weight of the adsorbent. Then enter it into 4 columns. After that, flow the Pb2+ ion solution that has been made according to variations into 4 columns. Variations in flow rates used were 1 mL/ minute, 2 mL/ minute, 3 mL/ minute dan 4 mL/ minute. Next, let the filtrate flow out of the column and be collected. The obtained filtrate was measured using AAS at each flow rate variation, so that absorption at the optimum flow rate could be determined.

3. RESULT AND DISCUSSION

3.1 *Analysis of Characterization Results*

The weight of the adsorbent is one of the important parameters in the adsorption process to evaluate the adsorption capacity of metal ions on the adsorbent. The adsorption of metal ions depends on the type of surface of the adsorbent and on the form of ions found in the metal in aqueous solution, the more adsorbent, the greater the surface area, thus increasing the active site of the adsorbent surface which results in the amount of Pb metal binding to the active site increasing. [9]. The influence of the adsorbent weight varies from 0.2 to 0.5 grams and the effect can be seen in Figure 1.

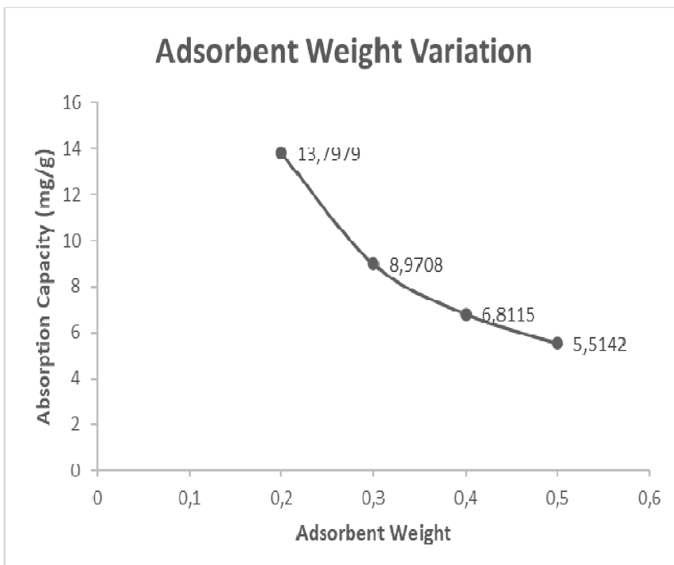

Figure 1. The Curve of the Effect of Adsorbent Weight Variations on Metal Absorption of Pb^{2+}

Figure 1. Shows that the optimum absorption conditions for Pb2+ on langsat peel activated carbon occur at a weight of 0.2 grams. However, at an adsorbent weight of 0.3 grams to 0.5 grams, the adsorption capacity decreased because all Pb^{2+} metal ions had been absorbed which caused the activated carbon of langsat skin to become saturated in binding Pb2+ metal. The increase in the relative weight of the adsorbent no longer affects the absorption of metal ions [10].

e-ISSN : 2622-4968, p-ISSN : 2622-1349

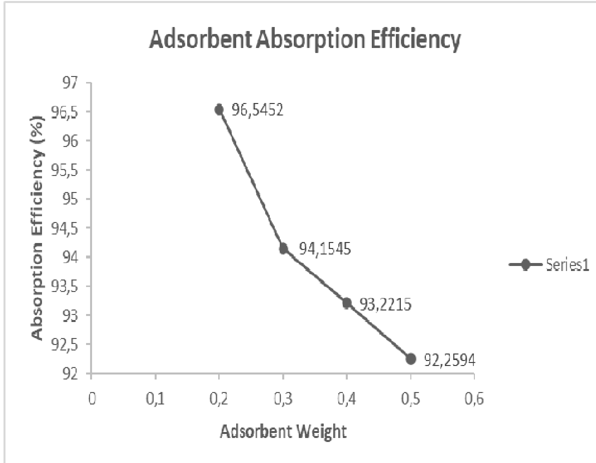

Figure 2. The Curve of the Effect of Adsorbent Weight on the Efficiency of Pb2+ . Metal Adsorption

Figure 2. Shows the absorption efficiency of langsat fruit peel on Pb^{2+} metal ions. Based on the results of the study, the greater the amount of adsorbent, the greater the percentage of adsorbed Pb. At an adsorbent weight of 0.2 g there was an increase in the absorption efficiency. However, the mass of biosorbent 0.3 to 0.5 grams decreased. According to [11] this means that the surface of the adsorbent has been saturated by metal ions where the active center has been saturated with metal ions, the increase in adsorbent weight does not increase the absorption of metal ions by the adsorbent.

3.2. *Flow Rate Effect*

This flow rate is needed to determine how much fluid is used in the adsorption process by using a variety of flow rates starting from 1-4 ml/minute while also knowing the capacity at the optimum absorption.

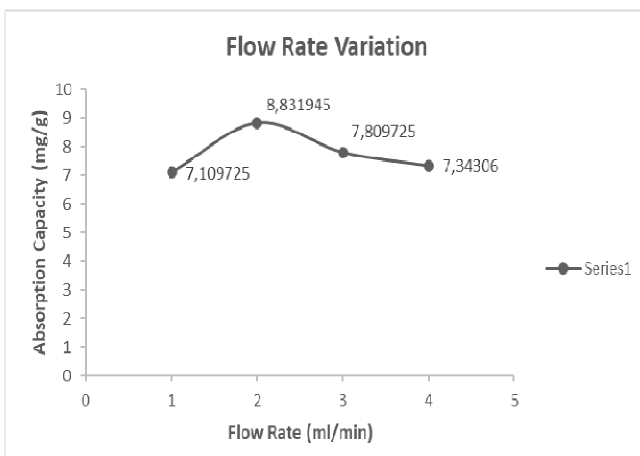

Figure 3. Curve of the Effect of Flow Rate Variations on Metal Absorption of Pb^{2+}

Figure 3. Shows that the absorption of metal Pb^{2+} using activated carbon of langsat skin gives optimum absorption results at a flow rate of 2 ml/min. On the water rate, it means that the lower the flow rate used, the

e-ISSN : 2622-4968, p-ISSN : 2622-1349

higher the ability of langsat peel activated carbon to adsorb Pb^{2+} metal. At flow rates of 3 and 4 mL/min, a decrease in absorption capacity was seen. This is because the pressure at a high flow rate becomes smaller when compared to a lower flow rate so that the amount of Pb^{2+} that can be adsorbed is greater.[12].

4. CONCLUSION

The conclusions obtained in this study are :

1. The effect of adsorbent weight obtained optimum results at the adsorbent weight of 0.2 grams with an adsorption efficiency of 96.54%.
2. The effect of flow rate obtained optimum results at a flow rate of 2 ml/minute.

Referensi

1. Alguacil F. J., Alcaraz L., García-Díaz I., andLópez F. A. (**2018)**. Removal of Pb^{2+} in wastewater via adsorption onto an activated carbon produced from winemaking waste. *Metals (Basel).*, vol. 8, no. 9.
2. El-naggar N. E., Hamouda R. A., Mousa I. E., Abdel-hamid M. S., and Rabei N. H. (**2018**). Biosorption Optimization , Characterization, Immobilization Biomass For Complete Pb2+ Removal From Aqueous Solutions. *Sci. Rep.*, no. September, 2018.
3. Kurniawati D., Bahrizal, Sari T. K., Adella F., and Sy S. (**2021**). Effect of Contact Time Adsorption of Rhodamine B, Methyl Orange and Methylene Blue Colours on Langsat Shell with Batch Methods. *J. Phys. Conf. Ser.*, vol. 1788, no. 1.
4. Syauqiah I., Amalia M., and Kartini H. A. (**2011**). Analysis Of Variation Of Time And Speed Of Shirter On The Adsorption Process Of Heavy Metal Waste With Active Charcoal Isna Syauqiah[1]), Mayang Amalia, Hetty A. Kartini Abstrak- Dalam limbah cuci foto," *Info Tek.*, vol. 12, no. 1, pp. 11–20, 2011.
5. Sharp R. *et al.* (**2016**). Manufacturing And Characterization Of Active Charcoal From Gumitir Plants Waste Stem With Zncl2 Activator. *Carbohydr. Polym.*, vol. 17, no. 1, pp. 1–13.
6. Silaban D.P. (**2018**). Active Carbon From Coconut Shell Charcoal Waste Of Boiler Machinery As A Metal Absorption Material Cd, Cu and Pb. *J. Din. Penelit. Ind.*, vol. 29, no. 2, p. 119.
7. Putranta N. R.*et al.* (**2017**). The Effectiveness of Duku Bark Extract (Lansium domesticum corr) as Larvicide of Aedes aegypti. *Medula*, vol. 7, no. 5, pp. 165–170.
8. Khoiriah, Furqoni F., Zein R., and Munaf E. M. (**2015**). Biosorption of Pb (II) and Zn (II) From Aqueous Solutionusing Langsat (Lansium domesticum Corr) Fruit Peel. *J. Chem. Pharm. Res.*, vol. 7, no. 1, pp. 546–555.
9. Kurniawati D.*et al.* (**2016**). Removal of Cu(II) from aqueous solutions using shell and seed of Kelengkengfruits (Euphoria longan Lour). *Der Pharma Chem.*, vol. 8, no. 14, pp. 149–154.
10. Nuban A. A., Andayani U., Safitri A., Matematika F., and Brawijaya U. (**2021**). Biosorption of Lead (Pb) in Solution Using Immobilized Aspergillus niger. Green Technology for Heavy Metal Removal, pp. 21–27.
11. Alfiany H., Bahri S., and Nurakhirawati. (**2013**). Study on the use of corncob activated charcoal as Pb metal adsorbent with several acid activators. *J. Nat. Sci.*, vol. 2, no. 3, pp. 75–86.
12. Hukama I. H. and Hayati S. Y. (**2019**). Effect Of Flow Rate On Reducing Cr (Vi) Concentration Using Membranes, no. Vi, pp. 0–5.

e-ISSN : 2622-4968, p-ISSN : 2622-1349