

EFFECT OF CONTACT TIME ON BIOSORPTION OF LEAD (II) METAL IONS USING SIJONTIAK FRUIT RIND (BACCAUREA POLYNEURA)

Nailatul Fadhilah¹, Desy Kurniawati²

^{1,2} Department of Chemistry, Universitas Negeri Padang, Indonesia

Email: desy.chem@gmail.com, nailatulfadhilaah@gmail.com

Abstract

Article Info

Received: 25/04/2023

Revised: 03/05/2023

Accepted: 13/05/2023

Lead is the fifth most dangerous heavy metal contained in industrial wastewater and its presence need to be handled properly. Biosorption is one method that can be used to reduce heavy metal levels ions contained in the wastewater. Sijontiak peel is used as a biosorbent to absorb water lead metal because it has the potential as a biosorbent and its use is still minimal in society. Sijontiak skin uses NaOH activator as an absorber for Pb²⁺ metal ions batch method. In this study, we determine the effect of contact time on metals lead absorption. The results showed that the optimum adsorption time for Pb²⁺ metal ions was at a contact time of 90 minutes with an absorption capacity of 17.5375 mg/g..

Keywords: Biosorption, lead, sijontiak shell, batch method.

1. INTRODUCTION

Industrial growth in Indonesia is very drastic in the era of globalization has many impacts on life. However, the increase and growth of industry also has a negative impact, including industrial waste.

Nowadays humans are used to using metal for activities of daily life. This has an impact on increasing the amount of waste in the form of metals that are not easily decomposed in the environment, such as lead metal (Pb), arsenic (As), mercury (Hg), nickel (Ni), cadmium (Cd), and chrome (Cr). This metal's existence comes from several natural processes, such as geochemistry and chemical weathering. Rapidly growing industrial activity has also led to other sources of heavy metals with unavoidable harmful effects on life (Zaini & Sami, 2016).

The Pb²⁺ ion is a harmful heavy metal ion that is carcinogenic. This toxic metal can cause damage to the nervous system, affect the work of the kidneys, and cause the growth of cancer cells. Pb²⁺ metal ions can enter the environment through air, water, soil, plants, animals, and even humans. Pb²⁺ metal ions enter the environment from waste, such as mining, battery, oil, coal, foundry, purification, and other waste (Sudarmadji et al., 2006). This makes the waters an alternative place for industrial waste disposal (Ir. Lestina Siagian, 2012). Waste will undergo deposition and these heavy metal ions can pollute the environment which they unknowingly can damage humans themselves through the food chain (Prasetyo, 1992).

In 2021, data from the Central Statistics Agency stated that 46 percent of rivers in Indonesia were severely contaminated, 32 percent moderately heavily contaminated, 14 percent moderately contaminated and 8 percent lightly contaminated (Central Statistics Agency, 2021). The maximum level of Pb²⁺ metal ions according to the WHO (World Health Organization) is below 0.01 ppm in waters (Ensafi and Shiraz, 2008).

Biosorption is a method of absorbing heavy metal ions that uses natural biomass, such as bagasse, longan peel, banana leaves, durian peel, salak peel, langsung skin and other skin (Lestari, et al., 2015). Adsorption of this metal can occur when there are complex bonds that generally occur in solid parts and contain functional groups, such as -OH, -NH, -SH, and -COOH. In biosorption, there are several commonly used heavy metal adsorption methods, such as the column method and the *batch* method. This research was carried out by *batch* method, where this method uses a stirring system whose biomass will be tested for absorption of Pb²⁺ metal (Suciandica et al., 2019).

One type of rare plant that is underutilized and can be used as raw material for biosorbents is the skin of the sijontiak fruit (*B. polyneura*). This fruit is spread in Malaysia, Thailand, Sumatra. In Malaysia, this fruit is known as the larvae because when the skin is opened, the fruit is flicked or pressed with fingers (Khadijah et al., 2018). In West Sumatra, especially in Fifty Cities (*Baccaurea polyneura*) it is called by the name of sijontiak. Sijontiak (*Baccaurea polyneura*) is a plant that can be cultivated to increase people's income because the fruit has a sweet-sour taste when consumed (Khadijah et al., 2020). Based on FTIR tests that have been carried out, sijontak skin has the potential to be used as a heavy metal adsorbent because it contains -OH, -CH, -C=C, -CN, -C=O, -C-O groups.

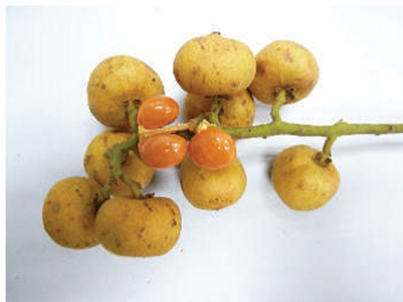


Figure 1. Sijontiak Fruit Skin (*Baccaurea polyneura*)

2. METHODS

A. Reagents and chemicals

Beaker, measuring cup, stirring rod, measuring flask, measuring pipette, funnel, mortar and pestle, spray bottle, pH meter (Hanna Instruments HI 2211/ORP Meter), analytical balance, filter paper, microsieve, shaker, oven used is FTIR (Fourier Transform Infra Red) perkin elmer universal type ATL Sampling Accessor 735 B and Spectronic Genesys 20 Spotted. The materials used in this study were sijontiak fruit peel powder, distilled water, $\text{Pb}(\text{NO}_3)_2$, and Solution, 0.1 M NaOH, HNO_3 0.1 M HNO_3 3, 1 M HNO_3 5 M.

B. Sample preparation

The skin of sijontiak (*B. polyneura*) is cleaned by cutting into small pieces, washed with aquades or fresh water, dried with sunlight then in the oven at a temperature of 105°C and cooled with a desiccator to a constant weight. The skin is smoothed with a mortar and pestle and then sifted using a $180\ \mu\text{m}$ sieve.

C. Activation of Sijontiak Shell Biosorbent

A total of 10 grams of sijontiak skin was activated with NaOH 0.1 M. For 2 hours, then washed with aquades until neutral, then dried and in an oven temperature of 105°C .

D. Metal Biosorption Experiments

Metal biosorption was carried out as much as 25 mL of Pb^{2+} solution contacted with 0.2 grams of sijontiak fruit peel powder with pH 5, concentration of 300 ppm and particle size of $180\ \mu\text{m}$. The solution is shaken at 200 rpm for 30, 60, 90, 120 and 150 minutes, then the solution is filtered, the filtrate is collected and the absorbed Pb^{2+} concentration is measured using an atomic absorption spectrophotometer to obtain the optimum contact time. To determine the biosorption potential of lead metal, it can be addressed from the following equation

$$Q = \frac{(C_0 - C_1)v}{m}$$

Information:



Q = Absorption Capacity (mg/g)
C₀ = Initial Concentration (mg/L)
C₁ = Final Concentration (mg/L)
m = Adsorbent Mass (g)
v = Volume of Solution (L)

After the absorption capacity is known, we see the percentage of absorption produced by the biosorbent used from the parameters we use. The ingestion percentage can be determined using the following formula:

$$\% \text{ Penyerapan} = \frac{(C_0 - C_1)}{C_0} \times 100\%$$

Information:

C₀ = Initial Concentration (mg/L)
C₁ = Final Concentration (mg/L)

3. RESULT AND DISCUSSION

Effect of contact time on absorption lead(II) metal using sijontiak shell

Contact time is one of the important factors in the process of adsorption. Contact time is used to determine how long the optimum time used in the maximum adsorption process is to absorb Pb⁺² metal ions using sijontiac (*B. polyneura*) shells (Artika et al., 2019). Contact time is also related to adsorption efficiency and adsorption reaction speed (Arifiyana & Devianti, 2020). The variation of contact time used in this study was 30, 60, 90, 120, and 150 minutes. The variation in contact time can be seen in figure 2

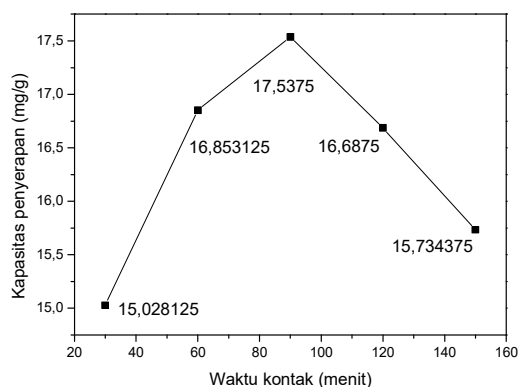


Figure 2. Effect of contact time on lead metal ion absorption using sijontiac skin

Figure 2 shows that the absorption capacity of Pb⁺² metal ions using sijontiac shells (*B. polyneura*) increases with the increase in contact time from adsorption. This increase occurs at a contact time of 30 to 90 minutes. Basically, this is because the longer the contact time, the more metal is adsorbed. From the picture it can be seen that the optimum contact time occurs at a contact time of 90 minutes. This is because the longer the contact time, the more adsorbent particles come into contact with the metal, so that there is an attractive force that causes the absorbent capacity of Pb⁺² metal to increase (Lestari et al., 2020). At contact times ranging from 90 to 150 minutes there is a decrease in absorption capacity because the adsorbent surface is covered by the adsorbate absorbed and the adsorbent has reached the saturation point, which causes the adsorbent to not be able to absorb heavy metals Pb⁺² properly. (Adriansyah et al., 2018).

This decrease in absorption capacity is also caused by the length of the contracting time, causing a strong bond that causes the adsorbent to come back to release (Hasmalina Nasution, 2016). According to chamber research (2017) obtained the optimum contact time at 120 minutes in adsorption of Pb^{+2} solution using cabbage leaf powder.

4. CONCLUSION

The skin of the sijontiak (*Baccaurea polyneura*). Agricultural waste can be used as an adsorbent for lead metal. The adsorption capacity reaches 17.5375 mg/g at. Contact time variation. The absorption efficiency in contact time variation reaches 48.4963%

ACKNOWLEDGMENT

The author would like to thank Dr. Desy Kurniawati, S.Pd, M.Si and Okta Suryani, S.Pd., M.Sc., Ph.D as my guides for direction, guidance, advice, and enthusiasm throughout my studies. The author also expressed his deepest gratitude for the funding of research and laboratory chemistry, Department of Chemistry, Faculty of Mathematics and Natural Sciences, Padang State University.

REFERENCES

- [1] Zaini, H., & Sami, M. 2016. Kinetika Adsorpsi Pb (II) dalam Air Limbah Laboratorium Kimia Menggunakan Sistem Kolom dengan Bioadsorben Kulit Kacang Tanah. November 2016, 1–9.
- [2] Sudarmaji., Mukono, H.J dan Corie, I.P. 2006. Teknologi Logam Berat B3 dan Dampaknya Terhadap Kesehatan. Jurnal
- [3] Ir. Lestina Siagian, M. s. (2012). Pengaruh Pencemaran Logam Berat Pb Terhadap Biota Laut dan Konsumennya di Kelurahan Bagan Deli Belawan. Laporan Akhir Penelitian Program Studi Teknik Elektro Fakultas Teknik Universitas HKBP Nommensen, 1–91
- [4] Prasetyo, I. 1992. Removal of Toxic Metals from Aqueous Solutions by Biosorption.R.
- [5] Badan Pusat Statistik. 2021. Statistik Lingkungan Hidup Indonesia (SLHI) 2021. Badan Pusat Statistik/BPS–Statistics Indonesia, 1–43M.
- [6] Ensafi, A.A and Shiraz, A.Z. 2008. On-line Separation and Preconcentration of Lead (II) by Solid Phase Extraction using Activated Carbon Loaded with Xylanol Orange and Its Determination by Flame Atomic Absorption Spectrofotometry. *J.Hazard Mater*, 150 : 554–559.
- [7] “Lestari, I., Mahraja, M., Farid, F., Gusti, D. R., & Permana, E. (2020). Penyerapan Ion Pb(Ii) Menggunakan Adsorben Dari Limbah Padat Lumpur Aktif Pengolahan Air Minum. *Chemistry Progress*, 13(2). <https://doi.org/10.35799/Cp.13.2.2020.31391>
- [8] Suciandica, M., Dewata, I., Bahrizal, & Kurniawati, D. (2019). Penyerapan Ion Logam Zn (II) dengan Biji Buah Lengkeng (*Euphoria Longan Lour*) sebagai Biosorben. *Journal of RESIDU*, Volume 3, Issue 13, Januari 2019, 3(13), 100–108..
- [9] Khadijah, A., Mohd Khairulazhar, M., Mohd Nor, A., Razali, A.R., Rusli, A., Mohd Khairuddin, O. and Siti Sofiah, M. 2016. Potential elite accessions of *Baccaurea polyneura* Hook. f. (jentik-jentik). MARDI Science and Technology Exhibition, MAEPS, Serdang and Siti Sofiah, M. 2018. Diversity, distribution and conservation of *Baccaurea* species.
- [10] J. Padhye, V. Firoiu, and D. Towsley, “A stochastic model of TCP Reno congestion avoidance and control,” Univ. of Massachusetts, Amherst, MA, CMPSCI Tech. Rep. 99-02, 1999.
- [11] *Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specification*, IEEE Std. 802.11, 1997.