

Biosorption of Plumbum Ions by Immobilized Lengkung(*Euphorialogan lour*) Shell

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Abstract:

The plumbum ions biosorption was batch method by silica immobilized lengkung shell has been conducted. The biosorbents obtained were characterized using FTIR. The spectrum shows the bonding of immobilized lengkung shell, seen in wave number 3355.52 cm^{-1} is OH group, wave number 1637.09 cm^{-1} is group C=O and wave number 1063.91 cm^{-1} which is the Si-O-Si group. The uptake capacity of plumbum ions have been examined for influence of pH and concentration solutions. The proceedswas foundat pH 6, and concentration solutions 550 mg/L are the optimum adsorption of plumbum ionswith maximum uptake capacity was 29.67 mg/g.

Keywords —Biosorption, plumbum, immobilization, lengkung shell, batch method

I. INTRODUCTION

The environmental matter almost all of the world and one of a serious are heavy metal industrial contaminat of aquatic. The heavy metals are unravelableonenviromentaland it can be accumulatedin organisms and affect human life [1][2].

Plumbum is among the much poisonous and dangerous in the environmental even at low concentration [3].Plumbumcontaminat wasproducebyglass industries, ceramic, textile deing, battery manufacturing.WHO has been established lead guideline values on drinking-water 0.01 mg/L [4].

A lot ofmethod are now being useful to lowed concentration heavy metal from aquaticenviromental, one of which is biosorption.Biosorption is the process of absorptionheavy metal ions that occur on the biosorbent surface. This process occurs through chemical and physical mechanisms, such as: ion exchange, complex formation, and adsorption.In the biosorption mechanism there are ionic interactions, polar interactions, combined interactions and mineralization between metals and biopolymers (macromolecules). Macromolecules are sources of various functional groups, such as: carboxyl, amine, hydroxyl, thiolate, phosphodiester, carbonyl, imidazole, and phosphate in biosorbents have

high affinity to form metal complexes. Functional groups can be interact with metal center atoms through free electron pairs[5].

Lengkeng (*Euphoria loganlour*) shell have variety functional groups N-H, O-H, C=O, and COOH [6]. Kurniawati (2015), have done research about lengkeng shell without immobilization in the adsorption of plumbum ions using column methods. The results obtained adsorption capacity 5.533 mg/g for lengkeng shell.

Immobilization is a modified method of biomaterials can be bound to membranes or particles in cells while maintaining its catalytic activity to adsorb metals ion in continuous and can be regenerated [7]. Biomaterial have deficiency such as low density, instability and different particle size can be minimized by immobilized the biomaterial [8]. Immobilization of biomaterials using silica show enhanced metal binding capabilities and chemical resistivity[9].

In this study, immobilized lengkeng shell was conducted to determine the ability for the removal plumbum ions. The purpose would investigate influence of pH and concentration solution in the biosorption of plumbum ions by silica immobilized lengkeng shell with batch method.

II. METHODS

In present works all analytical grade chemical reagents including $Pb(NO_3)_2$, HNO_3 , $NaOH$, Na_2SiO_3 technical, H_2SO_4 , $BaCl_2$.

A. Preparation of Biosorbent

Lengkeng were obtained from the market in Padang city. Lengkeng were cleaned and dried with the sun for 7 days and crushed with particle size to 150 μm [3].

B. Immobilization of Lengkeng Shell

A mixed 75 ml of 5% H_2SO_4 with Na_2SiO_3 solution just enough to up pH 2. Next, the biomass as much 5 g added to the silica solution and stir to 15 minutes. Na_2SiO_3 was added to reach pH 7. The polymer gel was cleaned with water and when added $BaCl_2$ as much two drops there wasn't white precipitate. Barium chloride was used to indicate whether the sulfates has been removed. The polymer gel was dried overnight at 60 °C and crushed with particle size 150 μm [10].

C. Metal Biosorption Experiments

The biosorption of plumbum ions on silica immobilized lengkeng shell was applied in flask containing 25 ml of plumbum solution and biosorbent were stirred at 150 rpm, periods at 60 min, dosage 0,2 g and particle size 150 μm . We were studied effects of pH (2-7) and initial metal ion concentration (150-650 mg/L). The filtrate were measured by Atomic Absorption Spectroscopy.

The adsorption capacity of heavy metal ions was calculated a following equations:

$$Q = \frac{(C_0 - C_f) \times V}{M}$$

Where,

Q = the uptake capacity (mg/g)

C_0 = the initial metal concentrations (mg/L)

C_f = the final concentrations of metal ions (mg/L)

M = the adsorbent mass (g)

V = volume of solution (L) [3].

III. RESULTS AND DISCUSSION

A. FTIR Analysis

The functional group in the biomass was characterized by FTIR. Fig. 1 shows the broad and intense peak with ranging from 3600 to 3200 cm^{-1} such as at 3330,36 cm^{-1} , 3355,52 cm^{-1} , and 3350,83 cm^{-1} , was O-H stretching. At 1637,09 cm^{-1} peak was carboxyl stretch in ester. At 2924,92 cm^{-1} was the stretching of C-H group. At 1063.91 cm^{-1} which is the Si-O-Si group.

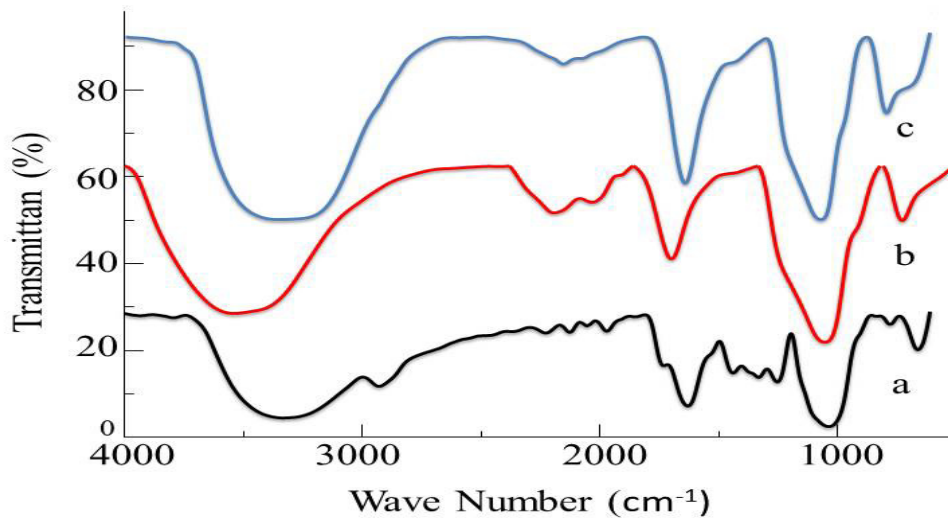


Fig. 1 FTIR spectrum of lengkeng shell, (a) before immobilized, (b) immobilized, (c) after contact plumbum solution.

B. Influence of pH

Generally, the pH of solution will be influence adsorption ability of sorbents on metal ions in aqueous. The influence pH by plumbum ions adsorption is show in Fig.2.

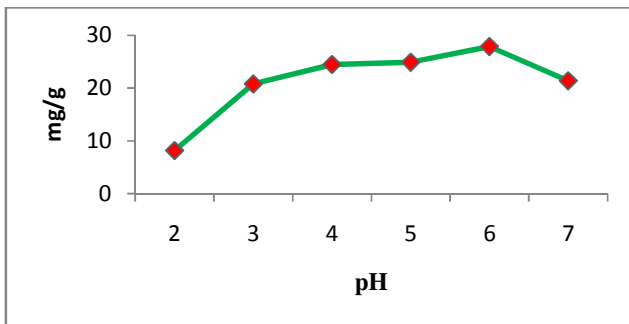


Fig. 2 Influence of pH solution on adsorption of plumbum ions by immobilized lengkeng shells

Fig.2 shows that the uptake capacity of plumbum ions increases from pH 2 up to at pH 6, and then decreased at pH 7. The uptake capacity of pH 6 at 27.861 mg/g. The sorbent surface at lower pH experience protonation with ions positive bound the active sites available. Furthermore, increases of pH the sorbent surface will be open and then

positive metal ions in solution will be attracted electrostatic [11]. The optimum adsorption obtained at pH 6 with uptake capacity 27.861 mg/g for the immobilization and activated biomass with HNO₃ at pH 3 with uptake capacity 0.299 mg/g [3].

C. Influence of Solution Concentration

The adsorption increases with the increase of metal ion concentration in solution until metal diffused to biomass surface and affects lower the adsorption of heavy metal ions. The influence of plumbum ion concentration to adsorption is show in Fig.3.

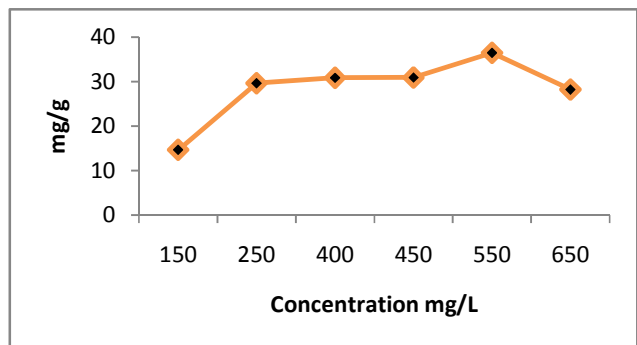


Fig. 3 Influence of solution concentration on adsorption of plumbum ions by immobilized lengkeng shells

Fig.3 shows the uptake capacity of plumbum ions increased up to a maximum adsorption at 550 mg/L with the uptake capacity 36.45 mg/g. The adsorption at the lower concentration will be more quickly with all metal ions in solution would interact with the binding sites. However, at the higher concentration ions metal diffused to biomass surface so the adsorption will decrease. Optimal concentration adsorption obtained at 550 mg/L with uptake capacity 36.45 mg/g for the immobilization and activated biomass with HNO₃ at 400 mg/L with uptake capacity 5.6 mg/g metal solution [3].

D. Adsorption Isotherm Study

An adsorption isotherm describes the relationship between the amount of sorbate concentration in solution taken by the sorbent [12]. In this study, Freundlich and Langmuir isotherm models will be evaluated for biosorption process of plumbum ions on immobilized lengkung shell. Table 1 shows the comparison between the Langmuir and Freundlich regression coefficients. The Langmuir isotherm was the model best was closer to unity.

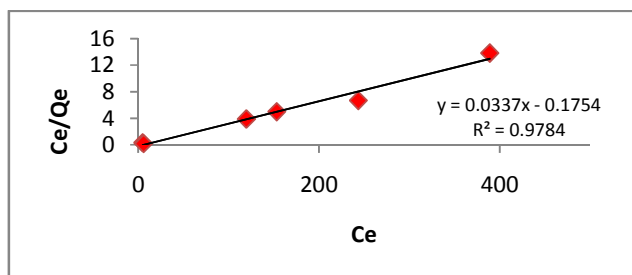


Fig. 4 Langmuir Isotherm

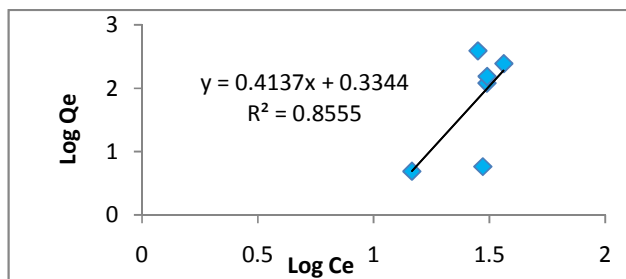


Fig. 5 Freundlich Isotherm
TABLE I

COMPARISON BETWEEN THE LANGMUIR AND FREUNDLICH ISOTHERM

Isoterm Langmuir			Isoterm Freundlich		
qm	KI	R ²	n	Kf	R ²
29,67	0,19	0,9784	2,417	2,159	0,8555

IV. CONCLUSION

Silica immobilized lengkung shell can be increases the uptake capacity. Biosorption process was effective at pH 6 with uptake capacity 27.861 mg/g and solution concentration 550 mg/L with uptake capacity 36.45 mg/g. The maximum uptake capacity of plumbum ions by silica immobilized lengkung shell at 29.67 mg/g. The adsorption isotherm Langmuir was better with regression coefficient was closer to unity. It is suggesting that plumbum ion adsorption on immobilized lengkung shell is monolayer chemical sorption process.

ACKNOWLEDGMENT

The author are grateful to Dr. Desy Kurniawati S.Pd, M.S.i as my guide for guidance, advice, and encouragement throughout my study. The author also express the deepest gratitude to PNBP 2019 Number: SP-DIPA 042.01.2.400929/2019 for research funding and chemical laboratory, Chemistry department, Faculty of Mathematic and Natural Science, Padang State University for providing support to this research.

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