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Research Article

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Biosorption metal ion of Pb (II) and Cd (II) using kepok banana weevil powder (*Musa balbiana colla*)

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ABSTRACT

Research on metal ion biosorption of Pb (II) and Cd (II) using banana stems kepok powder (Musa Paradisiaca) in aqueous solution have been conducted. Functional group owned by the banana stems kepok powder determined by FTIR, the sides have active among others is amine (3300 – 3500 cm^{-1}), carboxylic acid (2500 – 3000 cm^{-1}), and aromatic (1650 – 1450 cm^{-1}) as the absorbent metal ions in solution. The rendency of the metal ions Pb (II) and Cd (II) is absorbed by the powder banana stems kepok is determined by Atomic Absorption Spektrophotometri (AAS). The initial concentration of metal ions is used by 50 mg/L Pb (II) and Cd (II) metal ions as many as 15 mg/L, which is to obtain maximum absorption capacity (Qm) both heavy metals. The maximum absorption results obtained for the absorption of the metal ions Pb (II) is 8.18 mg/g and 2.08 mg/g for metal ion Cd (II) with conditions pH 4, biomass 0.1 g, contact time of 30 minutes and the particel size 180 µm. Based on the data gernerated can be used as biosorbent for the aqueous solution metal ions.

Keywords: Biosorption, Metal ion Pb (II) and Cd (II), AAS, Banana stems kepok (*Musa Paradisiaca*)

INTRODUCTION

Indonesia is the third country, which is still in the developing stage. The industrial sector is experiencing rapid growth, thus causing the tendency of the use of chemicals in large quantities, which undergo a process, then becomes waste that can pollute the environment. Today's environmental pollution has become a problem that often interfere with human life. Pollution of the environment based on the location of the pollution is water pollution, air pollution and soil contamination. Water pollution is often caused by inorganic components, including various hazardous heavy metals are often used in a variety of industrial purposes.

Metallic lead (Pb) and cadmium (Cd) fall into the category of toxic heavy metals with a specific gravity of 5.0 g/cm [1]. Lead can be detected practically on all inanimate objects in the environment and the entire biological systems. Lead showed toxic to the nervous system, hemetology, hemetotoxic and affects the kidneys. The concentration of metallic lead is safe for human drinking water is not more than 1 ppm. In this study, metallic lead (Pb) and cadmium (Cd) was chosen because of its toxicity and its use in a wide variety of applications including mining, metal electroplating, anthropogenic, and other industries. Some industries such as coloring, paper, oil, copper plating industry to release a number of unexpected [2].

Some methods such as chemical precipitation, filtration, ion exchange, membrane technology, and so forth have been made to absorb heavy metals. However, this process is less effective especially for heavy metals at levels of 1 to 100 ppm [3]. One alternative to overcome this heavy metal contamination used biosorption of heavy metals using agricultural waste. Besides, because of its low cost, the use of agricultural waste as biosorbent also aims to reduce organic waste. Biosorbent derived from agricultural waste has been reported to be effective to remove heavy metal contamination. Mangosteen rind, sawdust, bark bark, olive leaf, shell almonds and walnuts, as well as other agricultural wastes have been used as biosorbent. Indonesia produces large amounts of agricultural waste each year. Most of the waste is left to rot by itself, causing aesthetic problems, both in the water, on land and in the air. Banana weevil in fact contain high nutrient with a complete composition. Banana weevil contains carbohydrates (66%), protein, water and essential minerals [4]. According Sukasa*et al.* (1996), banana weevil have a starch content of 45.4% and 4.35% protein content. Until now there is no literature that states the use of banana stem weevil as an absorbent material metal ions in wastewater. So in this research studied the ability of banana stem weevil as an absorbent material metal ions Pb (II) and Cd (II)

EXPERIMENTAL SECTION

Instruments

The tools used this study were analytical (kern and Sohn Tubigen), pH meter (metrohm), atomic absorption meter, FTIR (Unicon Mattson Mod 7000 FTIR Spectrophotometer) and other laboratory glasswares.

Material

Material used in this study were kepok banana weevil powder, distilled water, NaOH pa (Merck), 65 % HNO_3 (Merck), Pb $(NO_3)_2$ and Cd $(NO_3)_2$, CH_3COOH pa (Merck), CH_3CONa pa (Merck).

Procedure

The kepok banana weevil was dried the crushed using a cruiser and then, it was activated by 0.01 M HNO_3 solution.

Optimum condition of absorbtion Pb(II) and Cd(II) by kepok banana weevil powder

0.1 g of banana weevil powder was put in to 5 pieces of Erlenmeyer 50 mL. 25 ml solution of 15 mg/L Pb $(NO_3)_2$ was added respectively. PH was set each 3, 4, 5, 6 and 7 with the addition of HNO_3 or 0.1 M NaOH (0.1 M and 1 M). Then it was stirred at 100 rpm for 1.5 hours at room temperature. After it is filtered with filter paper and the filtrate was analyzed by AAS. The same treatment was done for Cd(II) metal ion, to see the influence of particle size (150, 180, 212µm), weight of biosorbent (0.1; 0.15; 0.2; 0.25; 0.3 g), and the contact time (15, 30, 60, 90 minutes) on the absorption of Pb(II) and Cd(II) was taken from the maximum value of each variable trearment. Then do the same thing as the treatment effect and then analyzed by AAS.

FTIR Analysis

The sample before and after treatment were analyzed by using FTIR.

RESULTS AND DISCUSSION

Optimal condition of absorbtion Pb(II) and Cd(II) by kepok banana weevil powder

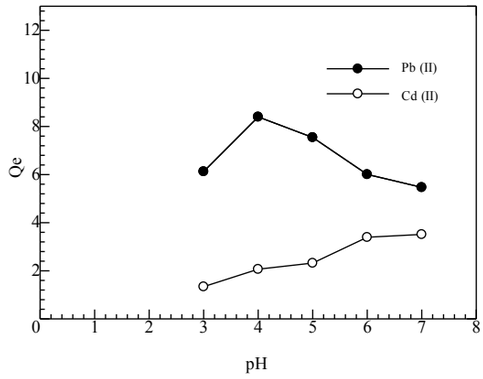

Figure 1. Effect of pH on Ion Absorption Pb(II) and Cd(II)on the banana stem weevil kepok powder, 25 ml of solution of metal ions; concentration of 15 mg / L : mass of 0.1 g biomass ; contact time of 90 minutes the stirring speed of 100 ppm, biomass size 180 µm

The maximum absorption capacity of Pb(II) at 8.3987 mg/g occurred at pH 4. The absorption capacity of Cd(II) on the banana weevil powder kepok 2.32125 mg/g occurred at pH. If the pH is increased from 4 to 7 for Pb(II) and Cd (II), the absorption capacity decreased. This is caused by divalent cations which may react with OH^- ions produces a precipitation and reduced free metal ions available in solution. Heavy metal cations are usually less absorbed at low pH (pH = 1-2). If the pH is low, then the metal ions will compete with H^+ ions to obtain the active side.

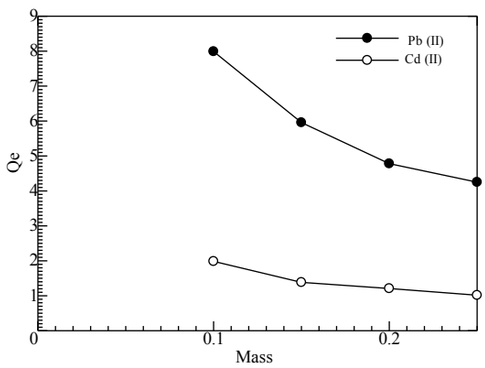

Figure 2. Mass Effect on Ion Absorption Pb(II) and Cd(II) on the banana stem weevil kepok powder, 25 ml of solution of metal ions ; concentration of 15 mg / L : pH 4 ; stirring speed of 100 ppm, biomass size 180 µm

When the initial concentration constant and mass increases, the absorption capacity will be reduced. Kaya et al. (2009) who studied *Abies nordmanniana* (Stev) also get biosorption capacity of Pb (II) and Zn (II) decreases with increasing mass. Jonglertjunya (2008) studied the moldy maize cobs also get biosorption capacity of Pb (II) and Cu (II) decreases with increasing mass. In the chart above that obtained the optimum mass of metal absorption of Pb(II) and Cd (II) is the same, namely 0.1 g.

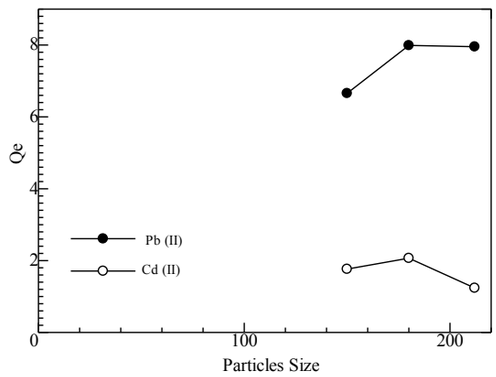

Figure 4. Effect of particle size on Ion Absorption Pb(II) and Cd(II) on the banana stem weevil kepok powder, 25 ml of solution of metal ions ; concentration of 15 mg / L : pH 4 ; biomass mass of 0.1 g ; stirring speed of 100 ppm

The graph above shows the adsorbent powder kepok banana weevil with a size of 180 µm has the ability to adsorb ions Pb(II) and Cd (II). The percentage of metal ions adsorbed inversely related to the large size of the adsorbent. The smaller the diameter of the adsorbent, the percentage decreased and levels of metal ions increases. This is because the smaller the diameter of the adsorbent means the surface area of contact between the adsorbent powder banana weevil kepok with metal ions increases. In addition, the surface area is also directly proportional to lots of pores possessed per unit adsorbent particles .

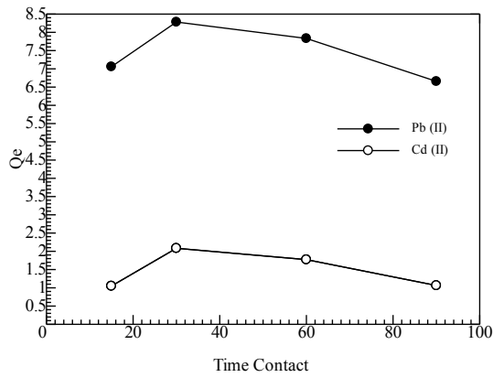

Figure 5. Effect of contact time on ion absorption Pb(II) and Cd(II) on the banana stem weevil kepok powder, 25 ml of solution of metal ions ; concentration of 15 mg / L : pH 4 ; biomass mass of 0.1 g ; stirring speed of 100 ppm biomass size of 180 µm

The efficiency of metal ions biosorption was evaluated as a function of contact time. Biosorption process of second metal ion initially takes place quickly and decreases after achieving the optimum time of 30 minutes for Pb(II) and Cd(II) on the banana weevil kepok. The absorption capacity obtained optimum Pb(II) and Cd(II) on the banana weevil kepok is 8.1825 mg/g and 2.08375 mg/g.

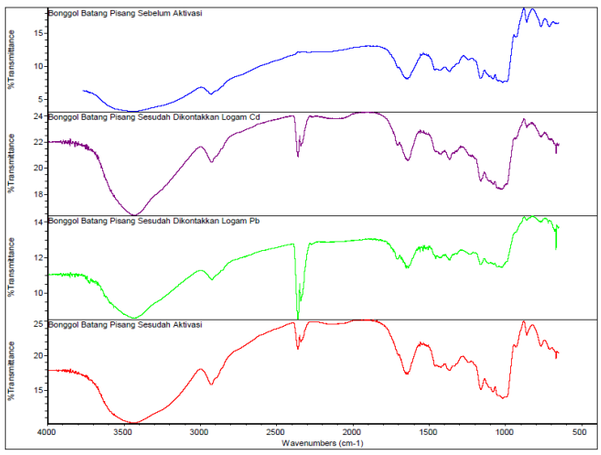

Figure 5. Results of the determination of functional groups kepok powder banana weevil

Figure 5 The result of the determination of the functional group which are: amines (3300-3500 cm - 1), acidic carboxyl (2500-3000 cm - 1) and aromatic (1650-1450 cm - 1) which acts as an absorber of metal ions in solution.

CONCLUSION

Kepok banana stem powder can be used as biosorbent of Pb(II) and Cd(II). The optimal condition of Pb(II) and Cd(II) metal ion were pH 4,0.1 g biomass, 30 minutes of contact time and a particle size at180 µm. The maximum adsoption capasity of Pb(II) and Cd(II) metal ions were 8.18 mg/g and 2.08 mg/g.

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