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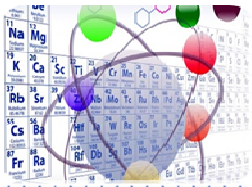

Effect of Contact Time and Stirring Speed on Biosorption of Lead (II) Using Sugarcane Bagasse

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ABSTRACT

Lead is a hazardous and toxic metal if it reaches human organs in sufficient doses or if it is present in water. Pb^{2+} can build up in the brain, causing cancer, disorders of nerve cells, kidneys and mental health as well as problems with male reproduction and resulting in bone irregularities in children. As a result, it is vital to regulate the presence of this metal in water. Biosorption is a heavy metal removal technique that use biomass as an adsorbent. The biosorption method was conducted in this study employing sugarcane bagasse as an adsorbent and batch contacting. Variations in contact duration and stirring speed were tested in this study to determine the influence of contact time and stirring speed on the biosorption process. The study's findings revealed that a contact duration of 60 minutes and a stirring speed of 100 rpm were the best conditions in this research.

Keywords: Biosorption, lead, contact time, stirring speed, bagasse.

1. INTRODUCTION

Metals are pollutants found in waste water from a variety of businesses. Heavy metal ions can be harmful to the environment because they accumulate, are poisonous, and are not biodegradable. Heavy metals are hazardous to human health at certain concentrations and can harm the digestive system, kidneys, and peripheral and central nerves. Heavy metals found in high concentrations in industrial waste can cause physical, chemical, and biological changes in water bodies, such as turbidity, increased oxygen consumption, pH shifts, and so on, resulting in increased levels of organism death.[1]

One of the dangerous heavy metals is lead. Lead is a heavy trace metal because it has a specific gravity more than five times the specific gravity of water. Lead is a chemical element found in rocks, soil, plants and animals. Apart from that, lead can be found in the air as particles because lead does not evaporate.[2] So new methods or materials are needed for metal removal that are simple, cheap and more efficient, where the biosorption method can be used as metal removal.[3] Biosorption is an adsorption

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technique that use biomass as an adsorbent. They are called biosorbents because they do not leave a solid deposit and do not emit hazardous compounds throughout the process.[4]

Many biomasses are reported to be promising for metal biosorption, such as microorganisms, which can collect metal ions due to the diversity of functional groups in their cell walls, such as carboxylate, hydroxyl, amine, phosphate groups.[5] Sugarcane bagasse is one of the agricultural wastes that can be used to absorb metals from aqueous solutions, where bagasse is easily available and abundant. Sugarcane bagasse has groups for functional like as hydroxyl, carboxyl, cellulose, hemicellulose, lignin and pentosan which can help adsorb heavy metals onto its surface.[6]

2. EXPERIMENTAL

2.1. Chemicals, Equipment and Instrumentation

The materials utilized in this research were bagasse, lead (II) nitrate (Pb $(NO_3)_2$), nitric acid (HNO_3), sodium hydroxide (NaOH), distilled water, filter paper. The tools used in this research are analytical balance, Erlenmeyer, pipette, beaker, funnel, magnetic stirrer, sharer, micro sieve, dropper pipette and the instrument used is an atomic absorption spectrophotometer.

2.2. Research Procedure

2.2.1. Making sugarcane bagasse biosorbent

Sugarcane bagasse waste is taken from the sugarcane drink seller, then washed clean and cut into pieces approximately 2 cm in size. then air dried. Once dry, the bagasse is crushed.

2.2.2 Determination of the optimum contact time for Pb (II) ion biosorption

A total of 0.2 g of sugarcane bagasse biosorbent each was put into 5 100 mL Erlenmeyer flasks, then into all flask was added 25 mL of 200 ppm Pb (II) solution whose pH had been adjusted to pH 5. Then shaken with time. which varies, namely for 30, 60, 90, 120 and 150 minutes with a speed of 150 rpm each. Following that, the way is filtered, and the resulting filtrate is collected. A spectrophotometer measuring atomic absorption was employed determine the filtrate concentration and the optimal contact time for absorption of Pb (II) metal ions was obtained.

2.2.3 Determination of the optimum stirring speed for biosorption of Pb (II) ions

A total of 0.2 g of sugarcane bagasse biosorbent each was put into 5 100 mL Erlenmeyer flasks, then into all flask was added 25 mL of 200 ppm Pb (II) solution whose pH had been adjusted to pH 5. Then shaker with variations, the stirring speed is 50, 100, 150, 200 and 250 with a time of 60 minutes. Following that, the way is filtered, and the resulting filtrate is collected. A spectrophotometer measuring atomic absorption was employed reveal the filtrate concentration and the optimal contact time for absorption of Pb (II) metal ions was obtained.

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3. RESULTS AND DISCUSSION

3.1. Effect of Contact Time

Contact time is a crucial consideration influences biosorption, where contact time is the length of time required for mixing sugarcane bagasse as an adsorbent and lead solution as an adsorbate. The stronger the adsorption power, the longer the contact, however, contact that is too long can result in a decrease in the absorption of metal ions.

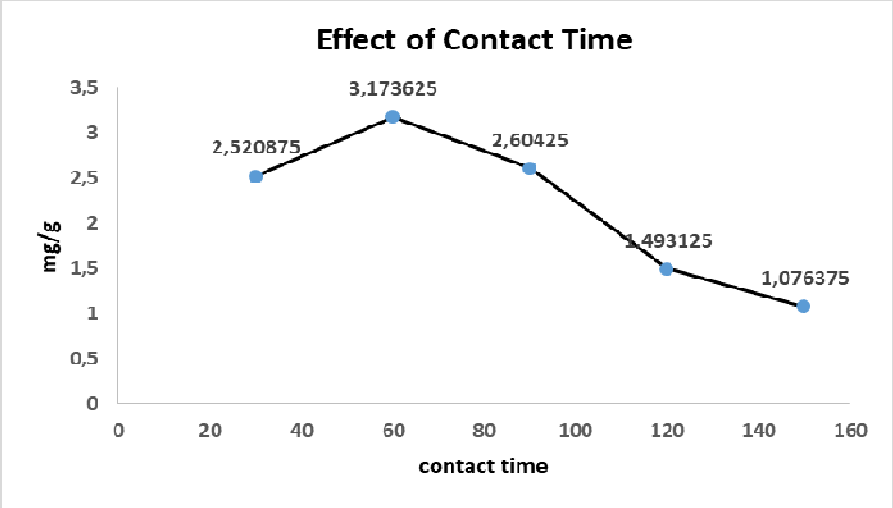

Figure 1. Effect of contact time on the absorption of Pb metal

Based on the graph above, as a time of contact of 30 minutes to 60 minutes there is an increase in absorption to optimal. Optimal absorption occurred within 60 minutes, as indicated by the absorbed Pb metal ion concentration of 3.173625 mg/g. As a time of contact of 90 minutes, the biosorbent's absorption of the solution decreases, this is the process of desorption (releasing) the Pb(II) metal ions that have been absorbed.[7] The greater the concentration, the longer the contact duration of Pb metal ions that are adsorbed because there are more opportunities for the particles to sugarcane bagasse to come into contact with Pb metal ions

3.2 Effect of stirring speed

The stirring speed is one of the parameters that needs to be carried out in the biosorption process, because if the stirring is too fast it is likely to damage the structure of the biosorbent and if the stirring process If the reaction rate is too slow, the adsorption process will be too.[8]

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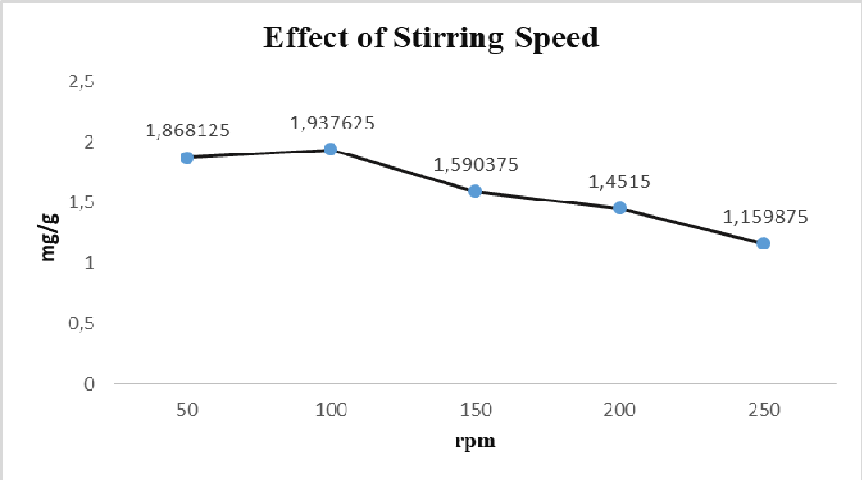

Figure 2. Effect of stirring speed on the absorption of Pb metal

Based on the graph above, it shown that the Pb metal ions absorption increases until it reaches the optimum stirring speed, namely at a speed of 100 rpm with a total absorption of 1.937625 mg/g. After reaching the optimum speed the absorption decreases at a rate of 150 rpm to a rate of 250 rpm. This decrease in absorption capacity is caused by the stirring rate being too fast, which damages the structure of the adsorbent and will result in the adsorbate being released from the adsorbent so that it cannot bind lead metal ions effectively, which causes the adsorption process to be less than optimal.[9]

4. CONCLUSION

The maximum time of contact for absorbing Pb (II) metal ions using sugar cane bagasse is 60 minutes and the optimum stirring speed is 100 rpm.

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