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Study of The Utilization of Pineapple Leaves (*Ananas cosmosus*) as Adsorbent for Lowering Copper Ion Content (Cu^{2+}), Iron (Fe^{3+}), and Zinc (Zn^{2+}) in the Water.

Megawati Simanjuntak[1], Jamahir Gultom[2*], and Chairuddin[3*]

[1,2,3]Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Sumatera Utara, Jalan Bioteknologi No.1 Kampus USU Medan 20155, Indonesia

Abstract. It has been conducted the use of pineapple leaf (*Pineapple cosmosus*) as an adsorbent to reduce ion copper (Cu^{2+}), iron (Fe^{3+}), and zinc (Zn^{2+}) contents in water. First pineapple leaf powder is cut to pieces, dried, finely ground, and activated with 10% HCl by soaking for 24 hours. Two grams of pineapple leaf powder, which was previously activated by 10% HCl added into each 100 mL ions of copper (Cu^{2+}), iron (Fe^{3+}), and zinc (Zn^{2+}) standard solution 20 mg/L, stirred homogeneously, and left for 24 hours, then filtered. The concentration ions of copper (Cu^{2+}), iron (Fe^{3+}), and zinc (Zn^{2+}) infiltrate were determined by using Atomic Absorption Spectrophotometer (AAS). The result of this research showed that pineapple leaf powder-activated 10% HCl can absorb 95.98% of copper (Cu^{2+}), 79.16% of iron (Fe^{3+}), and 88.71% of zinc (Zn^{2+}).

Keywords: Activation, Adsorbent, Standard Solution

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1 Introduction

Water is an important substance in the life of living things in this world, from the lowest to the highest animal species, as well as humans and plants. If the water is contaminated with harmful metals, it will cause bad things for life. Various cases of heavy metal pollution have been reported in both developed and developing countries. Likewise, the bad effects on the people who live around it (Darmono, 1995).

In Indonesia, heavy metal pollution tends to increase in line with the increasing industrialization process. Heavy metal pollution in the environment can pose a hazard to health, both for humans, animals, plants, and the environment (Widowati, 2008). Very dangerous toxins generally come

*Corresponding author at: Department of Chemistry, Faculty of Mathematics and Natural Sciences Universitas Sumatera Utara, Medan, Indonesia.

E-mail address: chairuddin2@usu.ac.id

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from industrial waste, especially chemicals (products from the pesticide industry) and industries that involve heavy metals (eg Cu, Fe, and Zn) in the production process (Palar, 2008).

In general, Cu is obtained from mining. Cu or copper enters into an environmental setting as a result of human activities that can pollute water sources around the environment. For example, industrial waste that uses Cu in its production process and household waste (Palar, 2008). Oxidized iron in water is brownish in color and insoluble, causing limited water use. In industrial waste, iron comes from the corrosion of water pipes. So that water cannot be used for the needs of living things (Prime. G, 1992). While zinc (Zn) is found in metal mining, some forms of zinc compounds are often used in coating metals such as steel. Also used as a dye for paints, lamps, and pesticides. This Zn metal can cause poisoning, and the occurrence of metal poisoning is most often caused by the influence of environmental pollution by heavy metals such as Zn in its use as pest control (pesticide), fertilization, and because the disposal of factory waste using Zn metal (Darmono, 1995).

Indonesia is rich in biological natural resources including natural fiber and one of the natural fibers that still has the potential to be developed is pineapple leaf fiber. Pineapple (Ananas cosmosus) is a plant that has a high fiber content (Onggo, 2005). Hidayat (2008), stated that pineapple leaf fiber contains 69.5-71.5% cellulose. The high fiber content in pineapple leaves is expected to be used as a source of cellulose as a new alternative for heavy metal adsorbents.

Research on the utilization of pineapple leaf fiber is still active in its utilization as an alternative textile raw material and the results obtained that pineapple leaf fiber is very possible to be spun into yarn. In this study, pineapple leaf fiber was tried to be used as an adsorbent or metal adsorbent in water. This adsorbent from pineapple leaf fiber has advantages, namely its abundant presence as waste from pineapple production, easy preparation process, and relatively low cost. This research was conducted by adsorption of metals using pineapple leaf fiber after activation with 10% HCl. Pineapple leaf fiber which has been activated with 10% HCl is expected to absorb metal.

2 Materials and Methods

2.1 Equipments

In this study, a Shimadzu Atomic Absorption Spectrophotometry (AAS) device type AA-7000F was used, measuring cup, beaker glass, volume pipette, measuring flask, watch glass, funnel, Cimarec hot plate, magnetic stirrer, Whatman No. filter paper. 42, Philips blender, Fischer scientific oven, desiccator, analytical balance.

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2.2 Materials

The materials used include pineapple leaf powder, HCl (pa E. Merck), $CuSO_4.5H_2O$ crystals (pa E. Merck), $FeCl_3.6H_2O$ crystals (pa E. Merck), $ZnSO_4.7H_2O$ crystals (pa E. Merck), HNO_3 (pa E. Merck), distilled water and acetylene fuel.

2.3 The preparation of Pineapple Leaf Powder

Pineapple leaves were taken randomly from the Pancur Batu area and then washed with water until clean and then removed from the pineapple leaf thorns. Cut into small pieces and dried in the sun for 14 days and then mashed with a blender.

2.4 Pineapple Leaf Powder Activation With HCl 10%

A total of 140 g of pineapple leaf powder was put into a 1000 mL glass beaker. 1000 mL of 10% HCl was added. Stirred for 3 hours then covered with aluminum foil and soaked for 24 hours. Washed with distilled water to pH 7. Dry in the oven at 1100 C for 5 hours. Cool in a desiccator and then weigh the results.

2.5 The preparation of Cu^{2+}, Fe^{3+}, and Zn^{2+} for calibration curves

The absorbance of the blank solution was measured using Atomic Absorption Spectrophotometer at a specific 324.8 nm for Cu^{2+}, 248.3 nm for Fe^{3+}, and 213.9 for Zn^{2+}. The treatment was carried out 3 times. The same procedure is done for the standard series solutions of Cu^{2+} and Fe^{3+} of 0.5; 1.0; 2.0; 3.0; 4.0 mg/L. And the same procedure is done for the standard series solution Zn^{2+} of 0.2; 0.4; 0.6; 0.8; 1.0 mg/L

2.6 Absorption of Cu^{2+}, Fe^{3+}, and Zn^{2+} after addition of activated pineapple leaf powder using 10% HCl and determination of Cu^{2+}, Fe^{3+}, and Zn^{2+} using Atomic Absorption Spectrophotometer (AAS)

A total of 2 g of pineapple leaf powder activated by 10% HCl was put into 100 mL of standard Cu^{2+} 20 mg/L solution. Covered with aluminum foil. Stirred using a magnetic stirrer for 24 hours. Filtered with Whatman No. filter paper. 42. The resulting filtrate was adjusted to pH up to 3.50 and its absorbance was measured using an Atomic Absorption Spectrophotometer at a specific 324.8 nm. The same treatment was repeated for standard solutions of Fe^{3+} with a specific of 248.3 nm, and standard solutions of Zn^{2+} with a specific of 213.9 nm.

3 RESULT AND DISCUSSION

The results of the measurement of absorbance of standard series solutions of Copper (Cu^{2+}), Iron (Fe^{3+}), and Zinc (Zn^{2+}) were plotted against the concentration of standard series solutions to obtain a linear calibration curve. The regression line equation for this calibration curve can be derived using the least square method.

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The calculation of the percentage (%) decrease in the concentration of a metal ion in a standard solution of 20 mg/L after being adsorbed with pineapple leaf powder which has been activated with 10% HCl is carried out using the formula below

$$\%\ Reduction = \frac{[metal\ ion]initial - [metal\ ion]final}{[metal\ ion]initial}\ x\ 100\%$$

Below are data and calibration curves of Copper (Cu^{2+}), Iron (Fe^{3+}), and Zinc (Zn^{2+})

Table 1. The absorbance of Cu^{2+} standard solution

Concentration (mg/L)	Absorbance
0.0000	0.0000
0.5000	0.0901
1.0000	0.1787
2.0000	0.3458
3.0000	0.5019
4.0000	0.6500

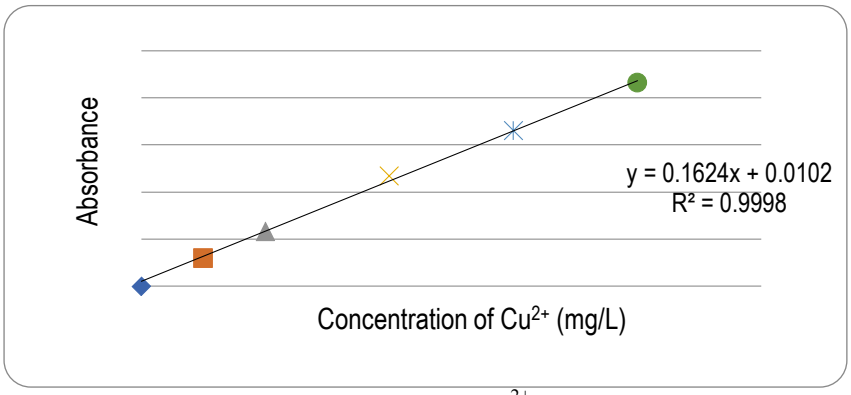

Figure 1. Calibration Curve of Cu^{2+} standard solution

Table 2. The absorbance of Fe^{3+} standard solution

Concentration (mg/L)	Absorbance
0.0000	0.0000
0.5000	0.0602
1.0000	0.1166
2.0000	0.2335
3.0000	0.3302
4.0000	0.4320

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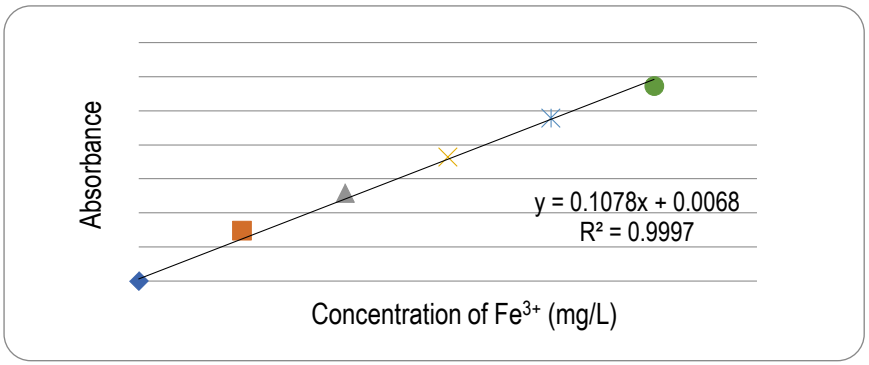

Figure 2. Calibration curve of fe^{3+} standard solution

Table 3. The absorbance of Zn^{2+} standard solution

Concentration (mg/L)	Absorbance
0.0000	0.0000
0.2000	0.1478
0.4000	0.2585
0.6000	0.3639
0.8000	0.4782
1.0000	0.5732

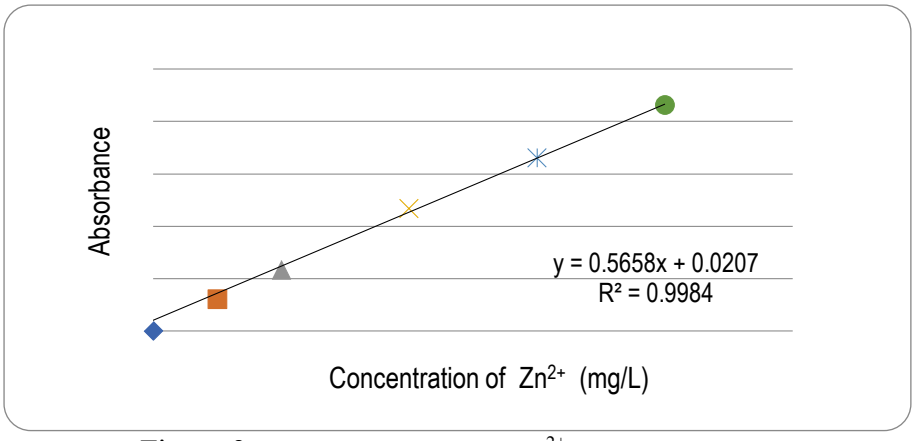

Figure 3. Calibration Curve of Zn^{2+} standard solution

Table 4. The results of decreased content of copper (Cu^{2+}), iron (Fe^{3+}), and zinc (Zn^{2+}) in a standard solution of 20 mg/L before and after being adsorbed with 10% HCl by using activated pineapple leaf powder

Element	Initial Concentration (mg/L)	Final Concentration (mg/L)
Copper	19.9000	0.7995
Iron	19.7243	4.1106
Zinc	19.7800	2.2329

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Table 5. The percentage (%) of decrease in content of copper (Cu^{2+}), iron (Fe^{3+}), and zinc (Zn^{2+}) in Standard Solution 20 mg/L

Element	Decreasing of Concentration (%)
Copper	95.98%
Iron	79.16%
Zinc	88.71%

From the results of the study, the determination of the standard solution of 20 mg/L was not correct after measurements were made on the Atomic Absorption Spectrophotometer. This is because the preparation is done by humans, and there are some mistakes in the process. In theory, the standard solution used is 20 mg/L, but in practice, it is different but close.

From the research results, it is also known that pineapple leaf powder which has been activated with 10% HCl has the potential to be used as an adsorbent in reducing metal content in water. This can be seen from the results of the decrease in the concentration of each standard solution after adsorption with 10% HCl-activated pineapple leaf powder.

4 Conclusion

Based on the results of the research, it can be concluded as follows:

The content of copper (Cu^{2+}), iron (Fe^{3+}), and zinc (Zn^{2+}) in a standard solution of 20 mg/L after being adsorbed with 10% HCl activated pineapple leaf powder decreased, namely for Copper (Cu^{2+}) it was 95.98% with a concentration of 19, 9000 mg/L to 0.7995 mg/L; for Iron (Fe^{3+}) is 79.16% with a concentration of 19.7243 mg/L to 4.1106 mg/L; and Zinc (Zn^{2+}) was 88.71% with a concentration of 19.7800 mg/L to 2.2329 mg/L.

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