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ACTIVATED CARBON UTILIZATION FROM CORN COB (*Zea mays*) AS A HEAVY METAL ADSORBENT IN INDUSTRIAL WASTE

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ABSTRACT

Corn is a diet staple for many people in the world. It's found as a side dish, in soup, in casseroles, and more. The use of corn as a food ingredient also increase corn production which is also leaves cobs waste that has not been optimally utilized. Therefore to increase the economic value and utilization of this plant, the corn cobs can be utilized as a bio absorbent through activation process. The purpose of this study was to reduce the concentration of heavy metal using activated carbon from corn cobs and also to determine the effect of the addition of activated carbon in various concentrations to heavy metal content. Determination of heavy metal absorption of Ferrous, Copper and Lead in industrial waste was using Inductively Coupled Plasma (ICP). Result showed that addition of 1 gram corn cob activated carbon decreased level of ferrous, copper and lead as much as 60.20%; 59.24% and 59.67% respectively. The addition of 1.5 gram corn cob activated carbon decreased level of ferrous, copper and lead as much as 80.01%, 79.5% and 79.89 % respectively It could be conculded that activated carbon form corn cobs decreased heavy metal content in industrial waste.

Keywords: Corn Cob, Industrial Waste, Ferrous, Copper, lead, Inductively Coupled Plasma.

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INTRODUCTION

Corn (*Zea mays*) is the second largest agricultural commodity subsequent to rice commodity in Indonesia[1]. North Sumatera province is the largest area which producing corn in indonesia[2]. The corn production in indonesia increace from 12 million tons in 2014 to 17 million tons in 2016[3]. The use of corn as a food ingredient also increase corn production which is also leaves cobs waste that has not been optimally utilized. Therefore to increase the economic value and utilization of this plant, the corn cobs can be utilized as a basic material of activated carbon as bio adsorbent through activation process.

Activated carbon, as known as activated charcoal, is a form of processed carbon to have small and low-volume pores which increase the surface area available for chelating chemical reactions and adsorption[4]. Activated carbon is highly adsorptive medium that has a complex structure composed of atoms carbon[5]. Adsorption occurs in pores slightly larger than the molecules that are being adsorbed, which is why it is very important to match the molecule which trying to adsorb with the pore size of the activated carbon. These molecules will trapped in the structure of carbon internal pore of by Van Der Waals Forces or other bonds of attraction and accumulate into a solid surface[6].

Activated carbon is widely used in treatment of drinking water. Activated carbon can remove a varios compounds, including heavy metals. In waste water treatment, activated carbon plays an important role in treatment processes, where it is used to remove organic and some inorganic substances[7]

Industrial waste is the residual waste generated from the production process in an industry, where serious handling is needed for industrial waste because the bad impact on the envferrousment.Large amounts of metal-contaminated waste water, such as Cu, Fe and Pb are

the most hazardous among the chemical-intensive industries. Because of their high solubility in the aquatic envferrousments, heavy metals can be absorbed by living organisms and it was non biodegredable product[8]. Once heavy metals enter the food chain, large concentrations of heavy metals may accumulate in the human body[9].

The study illustrates that the long-term exposure of the body to ferrous, lead and copper is one of the diseases triggers such as anemia, hypertension, down syndrome, cardiovascular desease, renal function disorder, carcinogenic disorders, encelopathy and peripheral neuropathy [10-13]. Because of that, it is necessary to conduct research on the effect of activated carbon from corn cob (*Zea mays*) as a heavy metal adsorbent in industrial waste.

MATERIAL AND METHODS

Materials

Corn Cob (Zea mays), Hydrogen Peroxide Acid (H_2O_2) in concentration 65%,aqua bidest, aqua demineralisation, Nitric acid 5 N, liquid waste of palm oil, copper standard solution 1000 mcg / ml, ferrous standard solution 1000mcg / ml, lead standard solution

Apparatus

The measurements were performed with a inductively coupled plasma (ICP) spectrometer.

Preparation of corn cob

Corncobs (Zea mays) are separated from the seeds and then sliced into smaller sizes (± 0.5 cm) then dried at 105ºC for 24 hours .

Preparation of activated carbon

25 grams of dried mash corn cobs added with activator H2O23% 5%, 7%, 15% as much as 17.5 ml then dried at 105ºC for 24 hours. Thereafter put it in the furnace, and then heated at a temperature of 450ºC with a increasing temperature of 5ºC/minute. After reaching a temperature of 450ºC, hold for 3 hours. The charcoal that is formed is taken and cooled at room temperature (open air), subsequently washed several times with ion-free water until there is no hydrogen peroxide content in the charcoal[14.]

Preparation of liquid waste solution test

Liquid waste is divided into 4 groups, each group consist of 100 ml liquid waste and 25 grams of activated carbon are added respectively. Then shake with Orbital Shaker for 3 hours, thereafter it is filtered using whatman paper No. 42 and stored in a container.

Destruction procedure

20 ml solution each group was pipetted and put it into erlenmeyer and then added 5 ml HNO_3 65% and left ± 24 hours then heated using a hot plate until the solution turned clear and nitrate vapor depleted at 100ºC,then cooled. The solution is put into a 50ml measuring flask and added aqua demineralisation to the mark line. Filtered with Whatman filter paper No 42.

Determination Fe, Cu and Pb procedure using Inductively Coupled Plasma (ICP)

Determination method of Fe, Cu and Pb level was using method based on the previous study[15]. Inductively Coupled Plasma aparatus showed in figure 1.

Figure 1. Inductively Coupled Plasma aparatus

RESULTS

Determination Calibration curve

Determination calibration curves of Ferrous,Copper and Lead by measuring standard solution at wavelength 248.3, 324.8 and 283.3 nm respectively . It can be seen in the following figure2, figure 3 and figure 4.

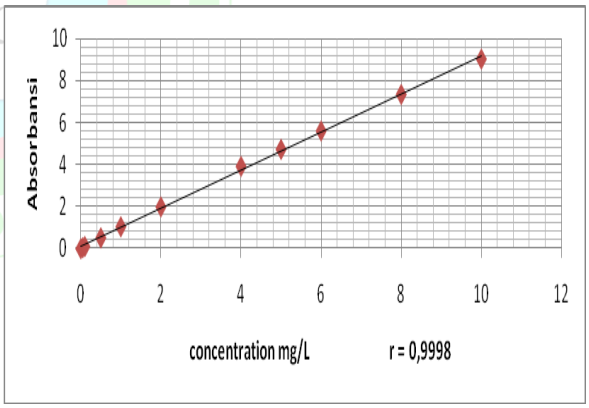

Figure 2. Calibration curves of Fe

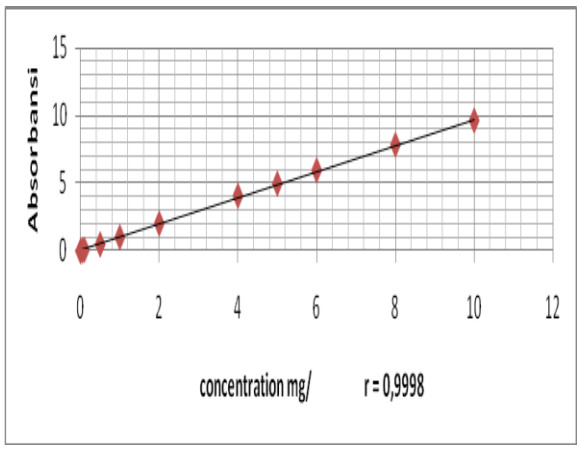

Figure 2. Calibration curves of Cu

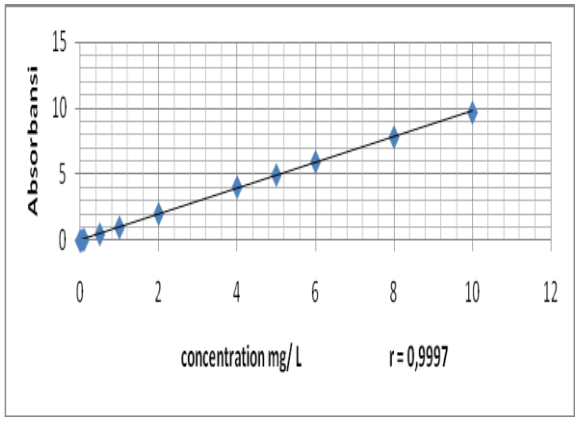

Figure 3. Calibration curves of Pb

Based on the figure 1, 2 and 3, the equation of the regression line for ferrous is Y = 0.830242421X + 0.738392555; copper is Y = 0.969629834X + 0.05109759 and lead is Y = 0.961333272X 0.0975. Based on the figure 1, 2 and 3, there is a linear relationship between concentration and absorbance with a correlation coefficient (r) for ferrous , copper and lead are 0.9999. According to Ermer (2005), the value of r ≥ 0.997 indicates a linear correlation between X (concentration) and Y (absorbance).

Determination of Ferrous, Copper and Lead Levels in the samples

Determination of Fe, Cu and Pb content was determined based on the calibration curve regression equation of each solution.. Results of Fe, Cu and Pb determination levels in industrial liquid waste showed in table 1

. **Table 1.** Determination of Fe, Cu and Pb levels in industrial liquid waste

NO	Sampel	Ferrous level (mg/L)	Copper level (mg/L)	Lead level (mg/L)
1	Without Activated Carbon	4.9358	5.943	5.4955
2	Addition 1 gr Activated Carbon	1.9641	2.422	2.216
3	Addition 1.5 gr Activated Carbon	0,9865	1,2181	1,1051

Table 1 showed the decreased levels of Fe, Cu and Pb after addition 1 gram of activated carbon, it can be calculated that the decreased level percentage of Fe, Cu and Pb was 60.20 %, 59.24% and 59.67% respectively. In addition of 1.5 gram of activated carbon, the decreased level percentage of Fe, Cu and Pb was 80.01%, 79.5% and 79.89 % respectively. Increasing the amount of activated carbon also increases the percentage of heavy metal absorbed. These results indicate that the activated carbon from corn cobs can reduce the heavy metal content of Fe, Cu and Pb which are heavy metals that are widely distributed in industrial waste. The use of activated carbon in the process of industrial waste purification could be a good option because of its effect in reducing heavy metal content.

Activated carbon is treated physically or chemically to generate microfissures that vastly increase its adsorptive surface area. The large surface area (between 500 and 1500 m^2/g) and electrical charge effectively adsorb metal ion. Activated carbon is used primarily to decolorize wine or remove off-odors. Different preparations are available for specific applications[16].

CONCLUSION

Based on the result, it can be concluded that activated carbon from corn cob (*zea mays*) could decreace level of ferrous, copper and lead in industrial waste.

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