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Characterization of Rice Husks Active Carbon Using Catalyst and Ultrasonic

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Abstract

We has conducted a study of activated carbon impregnation rice husks through the stages of formation of carbon rice husks, rice husk activated carbon formation and establishment of rice husk activated carbon impregnation. Rice husk carbon formation is done by heating at a temperature of 110ºC to remove the water content further carbonized at a temperature of 400ºC in furnice. The formation process of rice husk activated carbon made H_3PO_4 activation by 7% at a ratio of 1:10 (w / w). Activated carbon impregnation process rice hulls do calcining the activated carbon at a temperature of 400º C. Calcined activated carbon made by impregnating the activated carbon catalyst Fe (NO3) 3.9H2O and sonification. The results obtained were characterized by using DCS.

Keywords: Impregnation, Rice husks, Activated carbon, Catalyst

INTRODUCTION

Rice husk is one kind of paddy waste that could be used to fertilize the soil, loosen the soil, optimizing and maximizing plant growth, able to bind metal, containing silica as the main material of cement mix, and reducing waste.

Unique chemical properties of rice husks which contained silica-cellulose in rice husks that is very different from other plant wastes. The high contain of silica won't be torn apart even through perfect combustion. The main components of rice husks are cellulose, hemicellulose and lignin. The chemical composition of rice husks consists of some important chemicals such as carbon 1.33%, hydrogen 1.54%, oxygen 33.64%, silica 16.98%, lignin 25%, cellulose 20%, and other organic components such as oil and protein 3.51%. Neutral acidity and alkali is in the degree of 6.5 pH until 7. Charcoal and rice husks doesn't contain salts that ruin plant.

From those compositions and also the high percentage of husks produced by each year of course it doesn't cause environmental trouble if it doesn't used properly. Inside the soil, charcoal from rice husks works by changing the physical, chemical, and biology of soil. The rice husks charcoal could increase the soil porosity so that the soil is looser and also able increase the soil ability to absorb water.

Impregnation process using Fe (iron) as the catalyst of active carbon done through some stages started from catalyst dissolution using acetone to dissolve salt and minerals and then mixed with some active carbon which size depends on the catalyst that want to be used. The catalyst mixed with active carbon homogenized through sonification process, dried at temperature above 100° so that the solvent could be exhausted. The next step is to create active core inside the active carbon through the process of calcination and reduction (Najma, 2012).

Active carbon that impregnated to catalyst will help to keep the size of Fe nanoparticle as the active core. Calcination is the heating process to omit impurity so that it could form Fe_2O_3 which after that reduced by hydrogen gas to omit the oxide in the catalyst so that there will only the final active core of catalyst that remained and to strengthen the structure of gravity (Snoeck, 1997).

Therefore, lately there has been a development of rice husks usage as active charcoal and used as support media or buffer with active carbon rice husks and $Fe(NO_3)_3.9H_2O$ catalyst that could produce rice husks active carbon impregnation.

It is important to know that mercury is very toxic to human body and could kill the person. Unfortunately, after the mercury is in human body, it couldn't be released. The contamination could happen through the process of swallowing or skin absorption.

It is important to know that mercury could bring these epidemic symptoms:

- Brain malfunction (Nerve disorder such as paresthesia, ataxia, dysarthria)
- Cancer
- Digestion system damage.
- Cardiovascular disorder.
- Psychological Disorder such as anxiety, and sudden aggression.
- Acute kidney failure
- Liver damage at birth, and
- Death.

The problem is how rice husks active carbon ability and rice husks impregnation active carbon in absorbing mercury level.

The purpose of this research is to know the effectiveness level of rice husks active carbon absorption and rice husks impregnation active carbon usage in reducing the level of mercury. The research results could be used as reference as the best kind of adsorbent that obtained by the process of fluid waste mercury absorption.

RESEARCH METHOD

Tools and Materials

As for the tools that will be used in this research are sieves, furnace, chromatography columns, analytics scale, oven, pH meter, stirring test-jar, a set of laboratory apparatus, some analytic tools and characterization which is DSC. As for the materials that necessary in this research are acetone, ethanol, CH_3COOH, $Fe(NO_3)_3.9H_2O$, HCl, HCOOH, H_3PO_4, NaOH. While the samples are solid waste of rice husks.

Creating Rice Husks Carbon Active

300g of rice husks is cleaned and put into a container and put into an oven for 2 hours in the temperature of 110 °C to omit the water contain. After that it's carbonized in 400 °C for 2.5 hours in the furnace. Charcoal is activated with H_3PO_4 7% with ratio of 1:10 (b/b), stirred for 30 minutes, soaked for 24 hours, filtered and dried in an oven with temperatures of 120-150 for 24 hours. The charcoal ad then heated in 600 °C for 2.5 hours in a furnace ad washed with 5N HCL to omit the chloride element, washed with hot aquadest so that it could have neutral pH, washed with cold aquadest to omit the phosphor, dried in 120-150 °C oven, crushed and blended, and then filtered using 400 mesh filter, and we obtain rice husks active charcoal or active carbon. (Zurairah M, 2015).

Rice Husks Impregnation Active Carbon Formation

50g rice husks active carbon is calcinated for 4 hours at the temperature of 400°C. $Fe(NO_3)_3.9H_2O$ catalyst dissolved with 0.09 M acetone. Catalyst Fe and active carbon that has been calcinated by combining 500 mL Fe solution into 50g actvive carbon is impregnated with each other. The combination then sonified for 1 hour by heating in 60-70°C until all of the solution vaporized. After that the combination is dried in temperature of 60-70°C in an oven for 12 hours. The result is characterized using DSC (Zurairah. M, 2015 Najma, 2012 Sivakumar, 2011).

Reduction of Mercury Contain Process. The Determination of Adsorbent Optimum Weight

100 mL of standard solution of Hg^{2+} 5 mg/L set on pH 8 (optimum pH) with the addition of NaOH .2 M, put in a plastic bottle and added with .25gr rice husks active carbon. After that 10mL is pipetted and put into 100mL Erlenmeyer flask. After that its added with aquadest until the borderline while set on pH $\leq$ 2 and homogenized. Then the mercury ion is determined using ICP –OES at $\lambda_{spesifik}$ 253,652 nm. The same treatment is repeated with variations of egg shells powder of .5, .75, 1.0 and 1.25 grams.

RESULT AND DISCUSSION

DSC Carbon Characterization Result of Rice Husks Active Carbon.

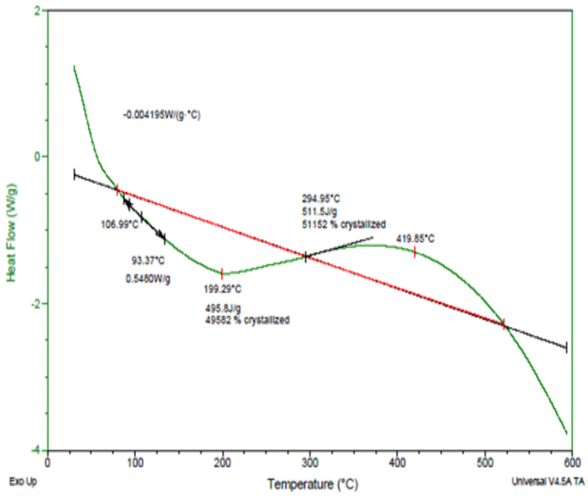

Figure 1: Rice Husks Active Carbon

DSC Carbon Characterization Result of Impregnated Rice Husks Active Carbon.

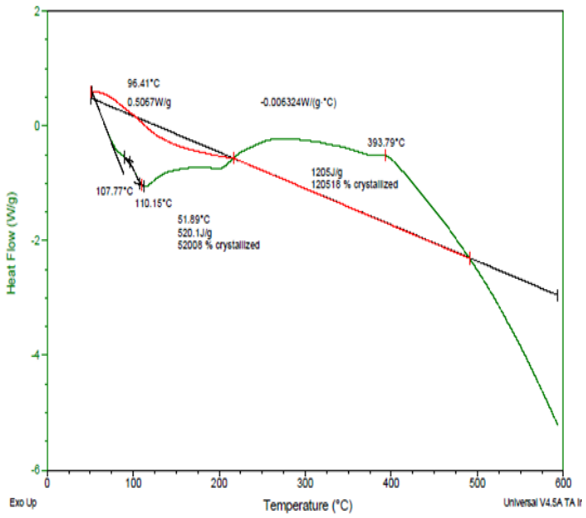

Figure 2: Impregnated Rice Husks Active Carbon

Decrease of Regression Line Formula Using Least Square Method

The measurement of Mercury Ion (Hg^{2+}) Standard Series Solution Light Intensity in table 3.1 plotted against the concentration so that a calibration curve in the form of linear line is obtained. Regression line formula for this calibration is derived with least square method.

Mercury (Hg^{2+}) based on the measurement of Mercury Ion (Hg^{2+}) Standard Series Solution Light Intensity.

Light Intensity

Table 1: Mercury Ion (Hg^{2+}) Standard Series Solution Light Intensity Data

Concentration (mg/L)	Light Intensity (c/s)
0,0000	0,0000
0,0050	4,0116
0,0100	7,6816
0,0500	41,6538
0,1000	74,9313

Correlation Coefficient Determination

Correlation Coefficient could be determined by using these formulas:

$$r = \frac{\sum(X-\bar{X})(Y-\bar{Y})}{\sqrt{(\sum(X-\bar{X})^2)(\sum(Y-\bar{Y})^2)}}$$

$$r = \frac{5,4395}{\sqrt{(0,008183)(4153,7197)}}$$

$$r = \frac{5,4395}{5,4465} = 0,9987$$

The value of correlation coefficient that obtained is (r) = 0,9987

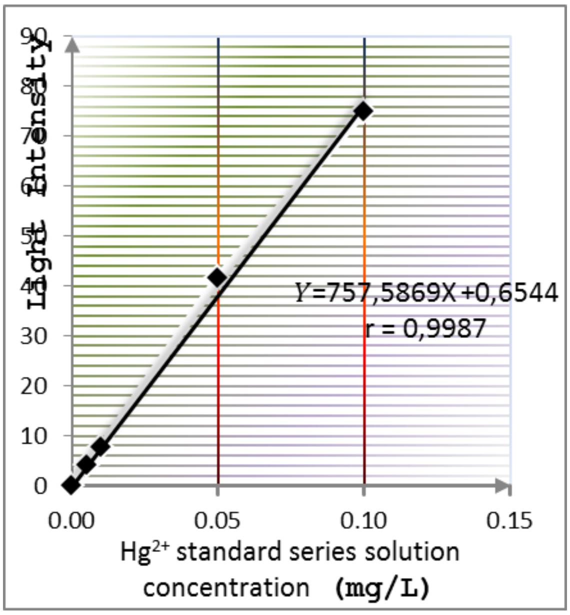

Figure 3: Hg^{2+} standard series solution calibration curve

Rice Husks Active Carbon Adsorbent Optimum Weight Determination Data

The determination of adsorbent optimum weight in this research is done starting from the weight of rice husks active carbon 0.25g until 1.25g, with Stirring time of 120 minutes (optimum stirring time). Optimum weight of adsorbent determination could be seen from table 3.2..

Table 2: Adsorbent Optimum Weight Determination Data

No	Adsorbent Weight (gram)	Hg^{2+} Solution Final Concentration (mg/L)
1	0,25	0,8118
2	0,50	0,1305
3	0,75	0,0976
4	1,00	0,0908
5	1,25	0,0872

Adsorbent Optimum Weight Determination

The adsorbent optimum weight in this research is done by using .25-1.25g of adsorbent. The purpose of this optimum weight determination is to figure out the minimum adsorbent amount that required for the absorption process so that the amount of adsorbent is more efficient and more cost-efficient. This research use 100mL 5 mg/L of Hg^{2+} ion concentration and contact time of 120 minutes.

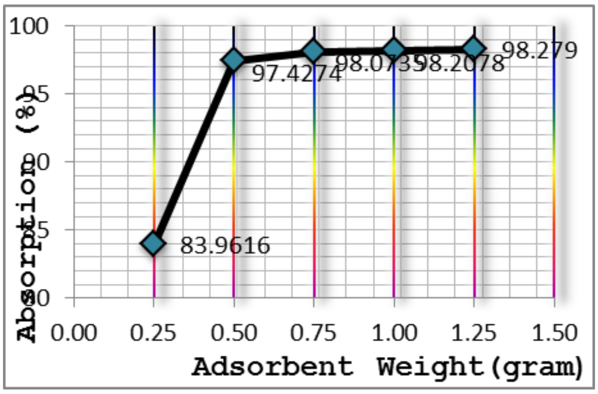

Figure 4: Percentage (%) rice husks active carbon absorption

Rice Husks Active Carbon Impregnation Adsorbent Optimum Weight Determination Data

The determination of adsorbent optimum weight in this research is done starting from the weight of rice husks impregnation active carbon 0.25g until 1.25g, with Stirring time of 120 minutes (optimum stirring time).

CONCLUSION

From the obtained data it could be concluded that absorption of rice husks active carbon with weight of .25g produce 83.96% of adsorbent strength and increased significantly at the weight of .5g adsorbent with 97.43% of adsorbent strength. With adsorbent weight of .75 and 1.25g there is no significant increase of absorption strength percentage. This occurred because with the weight of .5g adsorbent, the availability of adsorbent's active surface is proportional with the amount of adsorbate that will be absorbed to the solution adsorbent.

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