Adsorption Analysis of Active Carbon From Rice Husk And Kepok Banana Peel To The Ogan River Water

ANALISIS ADSORBANSI KARBON AKTIF DARI SEKAM PADI DAN KULIT PISANG KEPOK TERHADAP AIR SUNGAI OGAN

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ABSTRACT

This study aims to obtain the best composition and adsorber raw material between rice husks and kepok banana peels in the processing of river water in the ogan river. So that water is obtained in accordance with quality standards that are safe for use by the surrounding community. Adsorber, which uses rice husks and Kepok banana peels as raw materials, is carbonized first, then further activated with 0.1N H_3PO_4 solution with a v / m ratio and contacted to the ogan river water sample. Based on the test results of the quality of the river water quality ogan after contacting with activated carbon with parameters TSS, Fe, and pH. With activated carbon made from Kepok banana peel in river water treatment, it was able to reduce TSS levels from 79.3 to 48.2 mg / L, Fe from 0.63 to 0.05 mg / L while the pH value from 5.94 to 7 , 89. For activated charcoal based on kepok banana peel, which is carbonized at a temperature of 450^oC, and a concentration of 15 grams of activator H_3PO_4 0.1N 20%, it has the characteristics of active caron, namely 8% moisture content and 3.26% ash content. Meanwhile, activated carbon made from rice husk as raw material in river water treatment was able to reduce TSS levels from 79.3 to 36.1 mg / L, Fe from 0.63 to 0.00 mg / L while the pH value increased from 5.94 to 7,16. For activated charcoal made from rice husks which is carbonized at a temperature of 450^oC, and a concentration of 15 grams of activator H_3PO_4 0.1N 20% has the characteristics of activated carbon, namely water content of 7.45%, ash content of 2.94%. Based on the data, it is known that activated carbon made from rice husks is better than activated carbon from kepok banana peels.

1. Introduction

The Ogan River is one of the rivers located in South Sumatra, Indonesia and is a tributary of the Musi River. For now, the Ogan River is one of the three longest rivers in South Sumatra. The current water condition of the Ogan River is brown. For river water, the people around the Ogan River currently use it as a water source for their daily lives [1]. With household activities, it is very likely that the Ogan River will be polluted, which can affect public health. [2]

Based on the decision of the Governor of South Sumatra Number 16 of 2012 concerning river water quality standards, with temperature parameters of ± 3^0C, the maximum amount of suspended solids (TSS) is 50Mg / L, pH 6-8, and maximum iron is 0.3Mg / L.[3]

The use of an adsorber is one of the efforts to treat polluted river water, so that it can meet the water quality standard requirements that can be used by the community. In this study, an adsorber was used

from raw materials of rice husks and kapok banana peels. With variations in composition and contact time between river water and adsorber.[4]

Activated carbon is used as an adsorber because activated carbon is amorphous which is obtained from the carbonization process and also activation using acids. Activated carbon will have large volumes and pores, so that it is able to adsorb Fe metal and suspended solids in the water to be processed. [5]

The rice husks used as raw material for activated carbon are the outer shells of the rice grains. Rice husks are produced as much as 22% of each rice mill [6]. Rice husks are usually used in the process of purifying water by filtration, coagulation and adsorption methods.

Apart from rice husks, this study also uses Kepok banana peels as raw material for making activated carbon. Kepok banana peels contain cellulose, hemicellulose, chlorophyll pigments, and galacturonic acid which can bind tightly to metal ions. In addition, the cellulose contained in Kepok banana peels can be a heavy metal extractor. [7]

In this research, the method used is adsorption. Adsorption is an event of absorption of a substance on the surface of a solid. The adsorption process occurs due to an unbalanced attractive force between atoms or molecules against a solid surface, therefore a higher concentration of substances will move to a substance with a lower concentration.

Adsorbent is a substance that is able to bind and retain the liquid or gas contained in the adsorbent. Adsorbent has characteristics that become a requirement, among others, a large contact surface area so that its absorption capacity is also large, active with the elements to be absorbed, has the ability to retain the elements present in the adsorbent, the volume of media whose elements are still absorbed There are several conditions that affect the adsorption of the adsorbent, namely the solubility of the adsorption, the purity of the adsorbent, the speed of stirring, the temperature, the amount of adsorbent, and the area of contact of the adsorbent [8].

To determine the quality of river water, there are several parameters that become quality standards so that it can be concluded that the water is safe and can be used by the community. The parameters of the quality standard include pH, which is the level of acidity or base of a liquid. For the water used, the pH should be between 6-8. If it is outside this range of quality standards, water will irritate the skin or damage household appliances and clothing as well [9]. Total Suspended Solid (TSS) or suspended solids or particles, namely the whole solid substance contained in water. These solids can be in the form of soil, mud, and clay. And for particles in the form of bacteria, fungi, and inorganic particles. The maximum amount of suspended solids (TSS) is 50Mg / L. [10]

Iron metal elements, in river water, iron metal is generally the result of pollution caused by industries around the river. For this metal element itself has a maximum quality standard of 0.3 Mg / L.[11]

Based on previous research, the activator used for activated carbon is H_3PO_4 which is better known as phosphoric acid or orthofhosphoric phosphoric (V) acid, which is an acidic inorganic mineral with the chemical formula H_3PO_4[12]. Pure anhydrite phosphoric acid in the form of a white solid which has a melting point of 42.35 ^{0}C, has no color, with a viscosity of 2.4-9.4cP so that the texture is slightly thick, the acidity level is 2.148, the water solubility is 548gr / 100mL, with a point boiling 158^{o}C, the density is 1.8885gr / mL for liquid, and 2.030gr / mL for solids. [13]

For the activation process, there are several factors that influence, including the immersion time of carbon in the activator. Basically, the optimal time of immersion depends on the type of activator used, but if we want a large pore volume so that the area of contact formed will be larger, it will take longer at the time of carbon activation. The second factor that can influence the activation process is the concentration of the activator used. When the activator concentration used is higher, the binding power of the compound that comes out of the carbon pores is increasingly porous so that the absorption of activated carbon will be even greater. And the third factor is the size of the material, the smaller the size and diameter of the activated carbon, the larger the contact area and the higher the absorption.

2. Research Methodology

2.1. Materials

The materials used in this study were rice husks from Talang root village, Pali district, Kepok banana peels from Prabumulih City, Ogan River water from Tanjung Raja village, and phosphoric acid solution (H_3PO_4).

2.2. Procedures

The process of making activated carbon consists of three stages, namely the process of preparation, carbonization and activation. The preparation process is carried out in the process of making activated carbon, namely 1500 grams of rice husk and 1500 grams of kepok banana peels then heated under the sun until dry. Then the process of reducing the size of the banana peels raw material aims to produce pores on the banana skin of the kepok.

The next step is carbonization, where as much as 1500 grams of rice husks and 1500 grams of kapok banana peel are put into aluminum foil and then put into the furnace to be carbonized. The carbonization process takes place at 450ºC for ± 50 minutes, then cool it to room temperature. Then it was grinded and sieved at ± 35 mesh.

After that, entering the activation stage, the rice husk charcoal and kepok banana peels are activated using H_3PO_4 with a concentration of 0.1 N in 20% as much as 10, 15, 20, 25, and 30 grams then stirred for 10 minutes and let stand for 24 hours .

And at the neutralization stage, the mixture is filtered and the cake is washed with aquadest. The cake is washed to a pH that is close to neutral then dried in an oven at about 117^0C and cooled to room temperature.

Analysis of the characteristics of activated carbon The first analysis stage is to determine the moisture content of activated carbon, as much as 10 grams of activated carbon are placed in a porcelain plate with known dry weight. The plate containing the sample was dried in an oven at a temperature of 104°C-110°C for ± 1 hour until the weight was constant and cooled in a desiccator for about 20 minutes and then weighed. Calculation of water content using the equation:

$$\text{Moisture content (\%)} = \frac{(a-b)}{a} \text{ x } 100\% \quad \text{.....(1)}$$

The second stage of analysis is determining the ash content of activated carbon, weighing 10 grams of activated carbon into a known weight plate and closing it quickly. Placing the cup containing the activated carbon into the cold muffle furnace then heating the furnace temperature to 450ºC - 500ºC for 1 hour. Heat activated carbon until the final furnace temperature reaches 700ºC - 750ºC ± 1 hour. Continue heating at temperature for 2 hours or until the activated carbon has completely turned ash. Removing the cup from the furnace, close the cup and press down on the metal plate. Cool for ± 10 minutes then put into a desiccator. After cool, weigh the cup filled with ashes. Calculating the ash content.

Calculation:

$$\text{\% ash content} = \frac{(m3-m1)}{(m2-m1)} \text{ x } 100\ \% \quad \text{.....(2)}$$

Iron analysis to determine the iron content of river water after treatment with activated carbon, iron analysis was carried out using an atomic absorption sprekrometer.

3. Results and Discussion

Analysis of water content and ash content of activated charcoal from rice husks and banana peels, water content of activated carbon after adsorption were analyzed to determine its hygroscopic properties. By increasing the surface area of activated carbon will improve hygroscopic properties. Water from the air is absorbed by activated carbon so that it increases, because the water content in activated carbon also increases. Prior to the analysis, the initial plate was weighed to dry the sample.

The water content in activated carbon has a quality standard based on the SNI maximum of 15%. Based on the research that has been done, it is known that the activated carbon from banana peels tend to be less than the water content of activated carbon from rice husks. The difference in water content in activated carbon can be seen in Fig. 1.

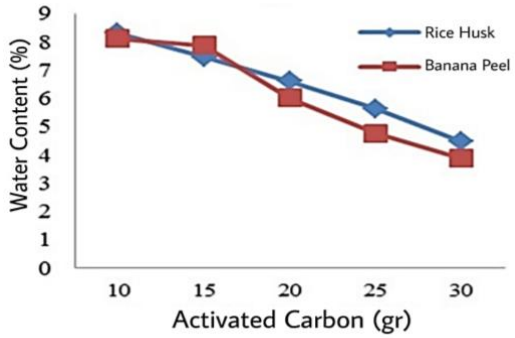

Fig 1. Graph of the relationship between the amount of water content of activated carbon

Based on Figure 1, it is known that the water content has decreased with the increase in the number of adsorbents. Rice husks have a higher water content than banana peels. There weere ten samples of activated carbon from banana peels and five samples of activated carbon from rice husks. In a 5 gram sample of activated carbon, the moisture content of rice husks and banana peels was at 8%. A large enough ratio of water content is in activated carbon 25 grams, while for activated carbon with a mass of 30 grams, the moisture content ranges from 4-5%. This difference is due to the water content bound to banana peels that has evaporated from the rice husks. Based on SNI 06 - 3730 - 1995 the standard requirements for the quality standard of activated carbon are a maximum of 15%. Of the ten activated carbons above are under the quality requirements of activated carbon. The low water content indicates that the free and bound water content in the material has evaporated during the carbonization process.

Determination of Ash Content

Activated carbon produced then tested the ash content. Ash content testing was carried out to determine the quality of activated carbon as an adsorbent. If viewed from the SNI standard, for the ash content of activated carbon to be used as adsorbent has a maximum ash content of 10%. The ash content in the average sample is under the quality standard limit. For the ash content in each sample can be seen in Fig. 2.

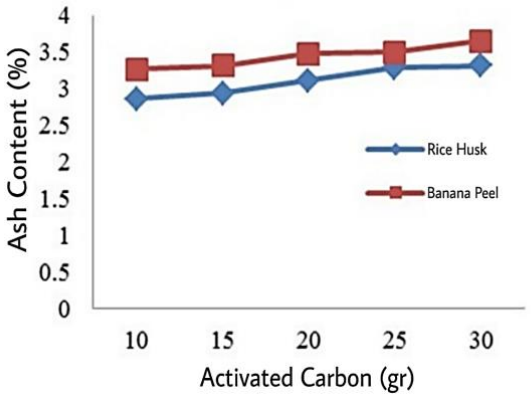

Fig 2. The relationship between the number of adsorber to the ash content of activated carbon

Based on Figure 2, the ash content in rice husks is 10-30 grams, reaching 2.86 - 3.31%, while the ash content in banana peels reaches 3.26-3.65%. Based on SNI 06 - 3730 - 1995 the standard requirements for a maximum quality standard of activated carbon are 10%. Judging from the two activated carbons above, it is below the established standards. The ash content is desired to be as low as possible so that the adsorption of ordinary liquids takes place properly. This is because the mineral

content in the ash such as calcium, potassium, magnesium and sodium can spread out in the activated charcoal lattice and cover the active center and reduce the ability of activated carbon to absorb gas or solution.

Sample characteristics

Before the river water was brought into contact with activated carbon, several characteristic tests of ogan river water samples were carried out. The characteristics of ogan river water before adsorption include a pH of 5.94, a TSS of 79.3 mg / L, and a Fe of 0.63 mg / L. Based on the results of the analysis, it is known that the Ogan river water samples need further treatment so that the TSS and Fe values can meet the water quality standard requirements, so that they can be used by the community. Therefore, this river water is continued to be treated and brought into contact with activated carbon. Analysis of river water after carbon adsorption ogan river water pH analysis after adsorption.

pH analysis

Based on the research that has been done, it is known that the difference in pH in river water from adsorption using either activated rice husk charcoal or banana peel activated charcoal to does not show a significant change in pH on adsorption using activated rice husk charcoal 7,16. And on the adsorption of kapok banana peel, the pH changes from 5.94 - 7.89. This is because the composition of activated carbon in rice husks and kapok banana peels has been able to neutralize river water. From the test results, it can be seen that the activated carbon from the two materials can increase the pH to meet the quality standards for the regulation of the governor of South Sumatra No. 16 of 2012, which is 6-8 results of pH analysis of river water in ogan.[14]

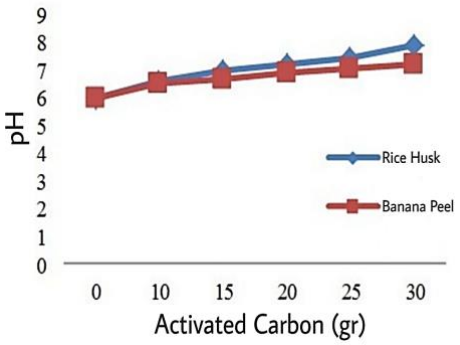

Fig 3. pH after adsorption

Based on Figure 3, it is known that the river water that has been treated with activated carbon from rice husks and banana peels produces a pH that is close to neutral. pH affects the ability of the active side of the mass and affects the metal ion adsorption mechanism. The dependence of metal ion adsorption on pH is closely related to the functional groups present on the surface of the mass and metal ions in the solution.[15]

Total Suspended Solid (TSS) Analysis

The TSS analysis aims to reduce the solids present in the ogan river water. TSS at the dry weight of the particles trapped by the filter, usually with a certain pore size. TSS content has a close relationship with water transparency. The presence of these solids usually hinders the penetration of light that enters the waters so that the relationship with TSS and brightness is biased inversely. Results of TSS analysis in river water ogan. Based on the research that has been done, it is known that the decrease in TSS in the river water of the ogan river adsorption results using either activated rice husk charcoal or activated coconut shell charcoal. With activated rice husk charcoal, TSS decreased from 79.3 - 36.1. And on the kepok banana peels adsorption decreased TSS from 79.3-48.2. This is because the composition of activated carbon in rice husks and kepok banana peels has been able to reduce the TSS of river water.[16]

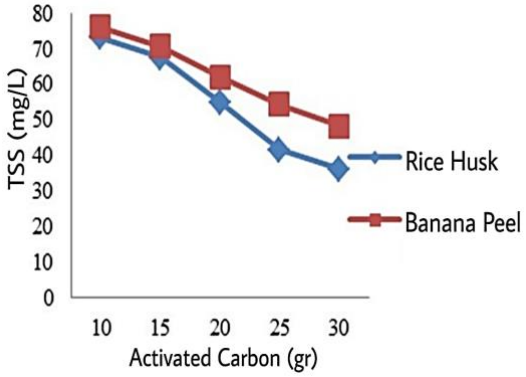

Fig 4. TSS after adsorption

Based on Figure 4, it is known that the TSS value on the surface of the water has decreased after treatment with activated carbon has met the standard quality standards for river water. The decreasing TSS value makes the water clearer because the suspended solids are closely related to the turbidity level of the water so that activated carbon is more effectively used in reducing TSS values.

Iron (Fe) Analysis

The results of iron analysis from river water ogan. Based on the research that has been done, it is known that there is a decrease in the Iron value of river water in ogan. adsorption results either by using activated rice husk charcoal or activated charcoal from kapok banana peels. Activated rice husk charcoal decreased iron from 0.63 - 0.00. And the adsorption of kepok banana peel decreased iron from 0.63 - 0.05. This is because the composition of activated carbon in rice husks and kepok banana peels has been able to reduce iron in the river ogan.[17]

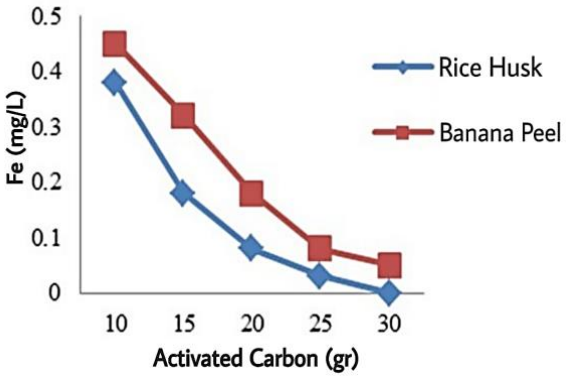

Fig 5. Fe after adsorption

Based on Figure 5, it is known that the water of the Ogan river has decreased in the value of iron after being treated with activated carbon, because activated rice husk charcoal contains main components such as cellulose which has the adsorption ability to increase surface molecules so that carbon changes its physical and chemical properties which can activate metal ions. which is high enough so that it can reduce iron levels. In the adsorption capacity that occurs, it can be seen that the adsorption capacity can increase because the more activated carbon is used, it will increase the absorption of the content in the water. The decrease in the amount of adsorbate is due to the decreasing in the total surface area and a diffusional increase which causes a decrease in the amount of adsorbate.[18]

4. Conclusion

Based on the research and analysis results from the discussion that has been obtained, the following conclusions can be drawn: For activated charcoal made from banana peels carbonized at a temperature of 450^{o}C, and the concentration of activator H_3PO_4 0.1N 20% as much as 15 grams has

the characteristics of active carbon, namely water content 8%, 3.26% ash content. Meanwhile, activated carbon made from rice husks in river water treatment was able to reduce TSS levels from 79.3 to 36.1 mg / L, Fe from 0.63 to 0.00 mg / L while the pH value increased from 5.94 to 7,16. For activated charcoal made from rice husks which is carbonized at a temperature of 450^{o}C, and a concentration of 15 grams of activator H_3PO_4 0.1N 20% has the characteristics of activated carbon, namely water content of 7.45%, ash content of 2.94%. Based on the data, it is known that activated carbon made from rice husks is better than activated carbon from kepok banana peels.

Notation

a : the weight of the sample before heating (g)
b : the weight of the sample after heating (g)
m_1 : the weight of the empty plate
m_2 : the weight of the plate + sample
m_3 : the weight of the plate + ash

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