The Utilization of Rice Husk Waste and Banana Peels as Adsorbents to Reduce Iron Metal Content and TSS in Lais River Water in Palembang

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Abstract: The water of the Lais River is clearly brown, in addition to the water transportation dock, there is an industrial area along the Lais River. Some of the people who live along the Lais River still use the Lais River water for their daily needs such as bathing and washing. The Lais River is a flow from OKU Regency (Ogan Komering Ulu), Muara Enim Regency, then the Musi River and ends at the Lais River, Kalidoni District, Palembang City. The Lais River is 50 kilometers long and 100 meters wide. The Lais River is a tributary of the Musi River in the West Ilir section. This study aims to determine the comparison of the effectiveness of activated carbon from rice husks and banana peels as adsorbents on the quality of the Lais River water in Palembang City. The Lais River is a tributary of the Musi River which is 50 kilometers long. This study was conducted using activated carbon from rice husks and activated carbon from banana peels which were activated using CH_3COOH with a concentration of 1 N 20% and then adsorbed on the Lais River water. the results of the study showed that activated carbon from rice husks and activated carbon from banana peels were able to reduce TSS levels from 571 mg/L to 27 mg/L, Fe (iron) levels from 0.8 mg/L to 0.0 mg/L. The conclusion is that activated carbon from banana peels is more effective than activated carbon from rice husks in reducing river water pollution levels. In this study, the analysis of Fe (iron) content was carried out using the Atomic Absorption Spectroscopy (AAS) method. While to determine TSS levels using gravimetric analysis.

Keywords: Activated Carbon, Rice Husk, Kepok Banana Peel, Lais River.

1. INTRODUCTION

All human activities in the agricultural, industrial, mining and livestock sectors as well as domestic produce waste which nature is no longer able to absorb, thus polluting groundwater, air, rivers and lakes. This has had a greater impact on environmental degradation. According to [1], the decline in water quality results in a decrease in the carrying capacity, capacity, utility, usability and productivity of water resources which will reduce the wealth of natural resources, so that they are managed so that they are available in safe, quality and quantity (Bahagia et al., 2020)

Rivers have many roles to support human activities. River water resources can be used as a source of water to meet daily human needs such as for bathing, washing, and even as drinking water. Rivers can also be used as power plants, as tourist attractions, and transportation. Along with the rate of development and population growth, rivers have changed function to become places for the accumulation of waste disposal from all human activities, especially in urban areas. This causes pollutants to enter the river flow before finally being discharged into the sea or lake, and at a certain point when the river's capacity to accommodate the pollution load has reached its limit, what will happen is river pollution which will cause various new problems (Poniman et al., 2021)

Adsorption is a simple waste processing process and can use unused natural adsorbents (Widayatno et al., 2017). Activated carbon is carbon that is activated to open pores so that it functions as an adsorbent. The activators used are usually CO2 gas, water vapor or chemicals (Polii, 2017). Carbon activation by heating functions to expand the surface, remove volatile dirt, tar and hydrocarbon impurities. (Nurhayati et al., 2020)

The condition of the Lais River Water in Palembang City has a pH level of 7.62 while Fe is 0.782 ppm and TSS is 571 ppm.These data show that the water parameters for use in everyday life are not efficient considering that many residents in Palembang City still use river water for everyday life such as bathing and washing.

Banana peel is the skin of the banana fruit. As one of the most popular fruits in the world with consumption reaching 145 million tons per year, bananas produce a large amount of waste. Banana peels are used as feed for cattle, goats, pigs, poultry, rabbits, and fish, and can be used as raw materials for making activated carbon because they contain quite high lignocellulose. (Fatimura et al., 2020)

Rice husk is waste from burning rice husk which produces pollutants that can pollute the environment so it needs to be utilized to increase its economic value and reduce its negative impact on the environment, one of which is to be used as a basic material for making activated carbon which is used as an adsorbent to clarify and reduce metal levels in polluted water. (Ilmiah et al., 2021)

The purpose of this study was to determine the quality of activated carbon from rice husk and banana peel with different weight variations in degrading the iron metal content (Fe), and TSS in Lais river water.

The results of research conducted by (Roni, et al., 2021) prove that rice husk and banana peel waste can be an alternative material for making adsorbents to reduce iron metal content and TSS in river water. Experimental data from adsorption results using adsorbents from banana peels showed more optimal results than adsorbents made from rice husks. In the adsorbent from kepok banana peel, the optimum operating conditions to reduce the concentration of TSS and iron in river water occurred at an adsorbent dose of 50 grams where the initial TSS value of 168.2 could decrease to 0.60 mg/L, while the iron (Fe) value decreased by 100%. In addition, the adsorption process causes an increase in the pH value. Testing the ash content and water content of the adsorbent after the adsorption process also showed that the adsorbent produced had met SNI standards. (Roni et al., 2021)

Research conducted by (Muhrinsyah, et al., 2020), the optimum results were obtained at a composition of 40gr Carbon with a concentration of 60% NaCl in 500 ml. With the results of the analysis of water content of 10.7%, ash content of 9.55%, volatile matter content of 13.8%, iodine absorption capacity of 1516.45 mg/gr and pure activated carbon content of 76.65%, activated carbon from banana peel waste has met the requirements of activated carbon standards according to SNI 06 — 3730 — 1995. (Fatimura et al., 2020)

Research conducted by (Nugroho, et al., 2017), Contact time affects the decrease in Pb heavy metal levels. The longer the contact time, the higher the decrease in heavy metal levels. Contact time of 35 minutes, 75 minutes, and 115 minutes using 10% HCl activator type resulted in a decrease to reduce the content of Pb heavy metal waste by 74.37%, 91.07%, 91.36%. Contact time of 35 minutes, 75 minutes, and 115 minutes using 10% ZnCl2 activator type resulted in a decrease to reduce the content of Pb heavy metal waste by 82.76%, 92.51%, 92.47%. (Nugroho et al., 2017

Research conducted by (Adeko, et al., 2020) The reduction in Fe levels using variations in the thickness of the combination of rice husk waste and kapok skin waste of 20 cm was 1.77167 mg/l (63.32%). The reduction in Fe levels using variations in the thickness of the combination of rice husk waste and kapok skin waste of 30 cm was 0.58333 mg/l (87.92%). The reduction in Fe levels using variations in the thickness of the combination of rice husk waste and kapok skin waste of 50 cm was 0.44650 mg/l (90.75%). (Adeko & Mualim, 2020)

Research conducted by (Juniar, et al., 2019). The best quality activated carbon comes from rice husks and banana peels activated with 15% H3PO4 as much as 200 grams at a carbonization temperature of 300o C can function as an adsorbent in the treatment of Enim river water. The best concentration of activated carbon as an adsorbent in the treatment of Enim river water at a concentration of 300oC with 15% H3PO4 activator has activated carbon characteristics, namely a water content of 7.67%, ash content of 2.88% and Iodine absorption capacity of 409.56% mg/g. (Juniar & Sari, 2019)

2. RESEARCH METHOD

2.1. Research Tools and Materials

The tools used in this study, namely furnace, grinder, sieving, pH meter, spatula, analytical balance, rubber ball, filter paper, aluminum foil, desiccator, burette, oven, magnetic stirrer, thermometer, Erlen Meyer, beaker glass. The materials used in this study, namely: Rice husks taken from Sungai Buaya Village, Ogan Ilir Regency. Kepok banana peels were taken from Palembang City. Acetic acid solution (CH3COOH). Lais river water was taken from Palembang City.

2.2. Research Methods

2.2.1. Analyzing samples

Checking the initial data of the Lais river water analysis. The initial analysis of Lais river water has been analyzed at the Sriwijaya State Polytechnic Laboratory, Palembang, the results can be seen in table 1 below.

Sample name	Test parameters	Analysis results (mg/L)
Sungai Lais Water	pH	7,62
	TSS	571
	Fe	0,782

2.2.2. Activated Carbon Manufacturing Process

The activated carbon manufacturing process consists of three stages, namely the preparation process, carbonization and activation. Preparation Process: 1500 gr of rice husk or 1500 gr of banana peel is then heated in the oven until dry. Then the process of reducing the size of the banana peel raw material aims to produce pores in the banana peel. Carbonization Process: 1500 gr of rice husk or 1500 banana peels are put into aluminum foil and then put into a furnace for carbonization. The carbonization process takes place at a temperature of 450^{o} for ± 50 minutes, then cooled at room temperature. Furthermore, it is ground and sieved at ± 100 mesh.

Activation Process: Rice husk charcoal and banana peel are activated using CH3COOH with a concentration of 20% then stirred for 10 minutes and left for 24 hours. Neutralization Process: Then the mixture is filtered and the results are washed with distilled water. The results are washed until the pH is close to neutral, then dried in an oven at a temperature of around 117^{0}C and cooled to room temperature.

2.2.3. Adsorption Process

Prepare 10 samples of Lais river water with a volume of 100 ml each. Add the adsorbent mass of rice husk activated carbon and kepok banana peel activated carbon to each of the 5 water samples with weight variations of 0, 30, 35, 40, 45, 50 gr. Stir at a speed of 200 rpm for 60 minutes. Then the sample is separated from the activated carbon by filtering using filter paper. The filtered water samples are then analyzed to determine the iron (Fe) and TSS content.

2.2.4. Analysis of activated carbon characteristics

Analyzing the water content of activated carbon: A total of 25 grams of activated carbon is placed in a porcelain cup with a known dry weight. The cup containing the sample is dried in an oven at a temperature of 104°C - 110°C for ± 1 hour until the weight is constant and cooled at room temperature for 20 minutes and then weighed. The percentage of water content is the weight of the sample before heating minus the weight of the sample after heating divided by the weight of the sample before heating multiplied by one hundred percent.

Analyzing Ash Content: Weigh 25 grams of activated carbon sample into a cup with a known weight and close it quickly. Place the cup containing the activated carbon sample (open the lid) in the furnace then heat the furnace temperature to 450^{o}C - 500^{o}C for 1 hour. Heat the activated carbon sample until the final furnace temperature reaches 700^{o}C - 750^{o}C ± 1 hour. Continue heating at a temperature for 2 hours or until the activated charcoal sample is completely ash. Lift the cup from the furnace, cover the cup and press on the metal plate. Cool for ± 10 minutes then put it in a desiccator. After cooling, weigh the cup containing the ash. The percentage of ash content can be calculated, namely the weight of the cup plus ash minus the weight of the empty cup divided by the weight of the cup plus sample minus the weight of the empty cup multiplied by one hundred percent.

3. RESULTS AND DISCUSSION

3.1. Results of analysis of water content and ash content of activated carbon

Table 2. Results of Analysis of Water Content and Ash Co

Types of activated charcoal	Amount of activated charcoal (gr)	Water content %	Ash content %
Rice husk	30 35 40 45 50	3,28 3,32 3,37 3,43 3,48	0,48 0,54 0,59 0,70 0,81
Banana skin kepok	30 35 40 45 50	3,23 3,35 3,38 3,42 3,45	0,45 0,56 0,61 0,79 0,85

Based on the research results, it was found that the heavier the mass of the adsorbent, the lower the water content because the adsorbent absorbs water in the sample. The water content value after adsorption on rice husk activated carbon with an amount of 30-50 grams reached 3.48-3.28% and banana peel with an amount of 30-50 grams reached 3.45 -3.23%. The ash content in rice husk with an amount of 30-50 grams reached 0.81 - 0.48% While the ash content in banana peel reached 0.85 - 0.45% the increase in ash content can occur due to the formation of mineral salts during the carbonization process, if continued, fine particles of the mineral salts will be formed. This is due to the presence of mineral content in the initial material for making adsorbents. Activated carbon meets SNI. Based on SNI 06-3730 - 1995 the standard requirements for activated carbon quality are a maximum of 10%.

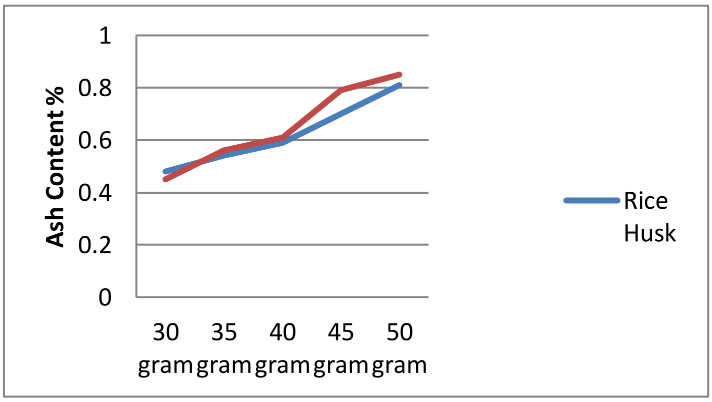

Figure 1. Graph of the relationship between the amount of activated carbon and water content

The water content decreases with increasing adsorbent amounts. Rice husks have a higher water content than banana peels. This difference is caused by the water content bound to banana peels having evaporated more than rice husks, due to the binding of water molecules in the adsorbent. The increase in surface area increases the adsorption capacity of the adsorbent, thus improving the quality of the adsorbent. The high water content in banana peels is not only caused by the increase in the hygroscopic properties of activated carbon to water vapor, but also by the binding of water molecules by the structure on the surface of the activated carbon. Thus, the surface area of activated carbon increases, which also increases the adsorption capacity of activated carbon. This shows that the quality of activated carbon is getting better.

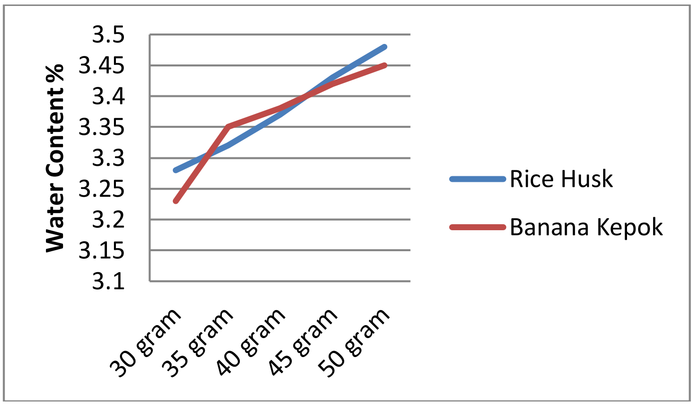

Figure 2. Graph of the relationship between the amount of activated carbon and the ash content

The ash content in rice husks of 30 - 50 grams reaches 0.48-0.81% While the ash content in banana peels reaches 0.45-0.85% Based on SNI 06-3730 - 1995, the standard requirements for the quality of activated carbon are a maximum of 10%. Thus, this study has succeeded in producing adsorbents that have ash content in adsorbents that meet SNI standards. The increase in ash content can occur due to the formation of mineral salts during the carbonization process, if continued, fine particles of the mineral salts will be formed. This is due to the presence of mineral content in the initial material for making adsorbents.

3.2. Results of analysis of Lais river water after adsorption of activated carbon of rice husk and banana peel kepok

3.2.1. Results of analysis of Total Suspended Solid (TSS)

Analysis of suspended solids or Total Suspended Solids (TSS) aims to reduce the solids in the Lais river water.
TSS is based on the dry weight of particles captured by the filter, usually with a certain pore size. TSS content is closely related to water clarity. The presence of these solids usually blocks the penetration of light into the water so that the relationship with brightness is usually inversely proportional. From the results of the analysis after absorption using activated carbon from rice husks and banana peels, TSS can be reduced so that it meets the Quality Standards of the South Sumatra Governor Regulation No. 16 of 2005. The results of the TSS analysis in Lais river water in this study can be seen in Figure 4 below.

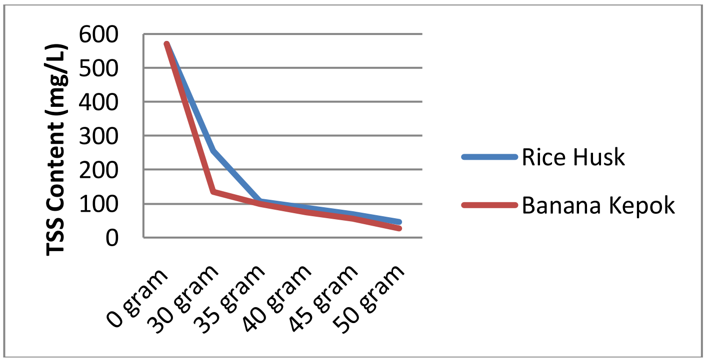

Figure 4. TSS Analysis Graph of Lais River Water

Figure 4 shows the results of absorption using activated carbon from rice husks and activated carbon from banana peels, there was a decrease in TSS. Absorption using activated carbon from rice husks decreased TSS from 571 to

46 mg/L. Meanwhile, absorption using activated carbon from banana peels decreased TSS from 571 to 27 mg/L. This is because the composition of activated carbon in rice husks and banana peels can reduce the TSS of Lais water, it can also be seen in the picture that activated carbon from banana peels and rice husks can reduce the TSS in river water, which is applied using activated carbon. The decrease in TSS value makes the water clearer by suspended solids, this is closely related to the level of water turbidity so that activated carbon is more effective in reducing TSS values. The mass of activated carbon also affects the adsorption process in reducing TSS levels in the Lais River, it can be seen from the picture above, the greater the mass of activated carbon, the lower the TSS levels.

3.2.2. Results of Iron (Fe) Analysis

From the results of the analysis of iron (Fe) levels after absorption using activated carbon from rice husks and banana peels, it can reduce iron (Fe) levels so that it meets the Quality Standards of the South Sumatra Governor Regulation No. 16 of 2005. The results of the analysis of iron levels in the Ogan Kertapati river water can be seen in Figure 5 below.

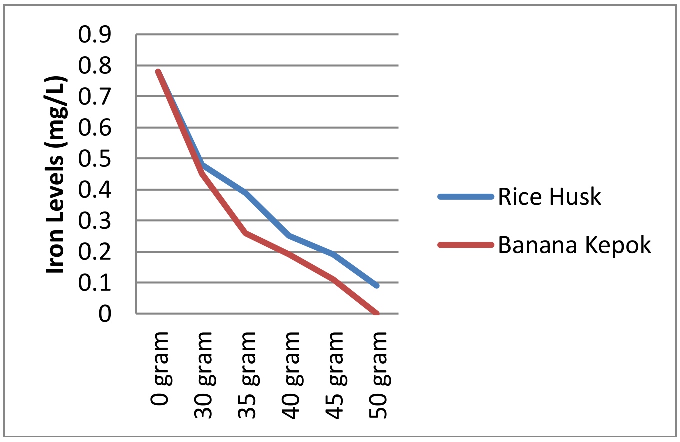

Figure 5. Graph of analysis of iron content in Lais River water

In Figure 5, the results of absorption using activated carbon from rice husks and activated carbon from banana peels showed a decrease in iron (Fe) levels. The results of absorption by activated carbon from rice husks showed a decrease in iron levels from 0.78 to 0.09 mg/L. Meanwhile, the absorption of activated carbon from banana peels showed a decrease in iron levels from 0.78 to 0.00 mg/L. This is because the composition of activated carbon in rice husks and banana peels has been able to reduce iron (Fe) levels in the Lais River water. From the picture above, it can be seen that the Lais river water experienced a decrease in iron content after being treated with activated carbon, because activated carbon from rice husks contains main components such as 58.852% cellulose, 18.03% hemicellulose, 0.6-1% ash and 20.9% lignin which have the ability to adsorb to increase surface molecules so that carbon experiences changes in physical and chemical properties that are able to activate metal ions which are quite high so that they can reduce iron levels, in reducing iron (Fe) levels in adsorption using activated carbon from rice husks and banana peels, it can be seen that the more mass of activated carbon, the more iron (Fe) is bound to the carbon.

4. CONCLUSION

This study has been able to make activated carbon from rice husk waste and banana peels. Testing of water content and ash content also shows that the activated carbon produced has met SNI standards. Activated carbon from rice husk waste and banana peels can reduce the content of iron (Fe) and TSS in river water. Data from the research results that absorption using banana peel activated carbon shows more optimal results compared to activated carbon made from rice husks. In activated carbon from banana peels, the optimum operating conditions for reducing the concentration of TSS and iron in river water occur at an adsorbent dose of 50 grams where the initial TSS value of 571 can decrease to 27 mg/L, while the iron content (Fe) can decrease by 100%.

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