

Balok Anti-Asap (*Balas*) With Biochar as an Air Purifier to Reduce Air Pollutant from the Home Industries of Brem in Kaliabu Village, Madiun Regency

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ABSTRACT

Home industries of brem in Kaliabu Village, Madiun Regency is still carried out traditionally by burning wood, and it's resulting particulate matter, CO gas, NO₂, SO₂ and O₃. The air quality index in Madiun Regency is 16.1 g/m². Exposure to air pollution can reduce visibility and lead to health problems, especially problems on respiratory tract. The Kaliabu Final Disposal Site accommodates about 27 thousand m³ with the amount of plastic waste as much as 20 quintals per day. The abundance of waste can be used as an air purifier material called balok anti-asap (BalAS). The research method used is the experimental method. BalAS is made by a box with an area of 1.0034 m² coated with biochar. Biochar is made by a fusion of plastic waste and rice husks. The interior of the BalAS has a fan, and 3 natural filters. BalAS is activated by electricity. BalAS works by flowing electricity to drive the fan, so that polluted air enters the tool through the front open. The polluted air will pass through the first filter which made by coconut fiber as a particulate matter filter, the second filter comes from *Musa acuminata* × *balbisiana* peels as a filter for harmful gases, and the third filter made by betel leaf, turmeric, and ginger soaking cloth as a filter for bacteria, viruses, allergens, and mushrooms. The filtered air exits through the rear slit. The top of the beam can be opened, which is used as a way of maintaining the components that make up the BalAS. The difference in air pressure in the chamber is also applied in the manufacture of BalAS, so that air can flow from high pressure to low pressure. The analyzed data is obtained from the BreezoMeter application which is placed in front and behind the BalAS. Based on the results of this study, the average value of air quality before entering BalAS is 40.25 and after going through BalAS of 55.75 BalAS can improved air quality to 15.5, so it is expected to increase healthy air for people who are exposed to polluted air in Kaliabu Village, Madiun Regency.

Keywords: *biochar, pollutant, plastic.*

1. INTRODUCTION

Air pollution occurs due to activities that produce by-products in the form of smoke. Smoke contains harmful gases whose presence in the air in the long term can cause global warming. Smoke that pollutes the air and is inhaled by living things continuously can cause health problems, especially in the respiratory tract. Air polluted

by smoke can also affect the level of intelligence and mental health. Microparticles that are inhaled will be carried in the blood vessels and cause dilation of the veins in the brain so that it affects the mental state of living beings.

Home industry is one of the activities that contribute pollutants to the air. Home industries of brem is one of the largest cottage industries in Madiun Regency. Brem

is one of the biotechnology products that utilizes sticky rice as a raw material. Kaliabu Village is one of the villages where the majority of the people have a home industry of brem. Home industries of brem have been running for a long time and are still done traditionally using firewood. The wood burning process produces by-products in the form of exhaust gases containing particulate matter, CO, NO₂, SO₂ and O₃ gases (Rohmahwati, et al., 2018). Air conditions are getting worse due to post-harvest burning of agricultural waste which results in reduced visibility. The air quality index obtained through IQAir AirVisual Pro in Madiun Regency as of September 16, 2019 was 16.1 g/m². Exposure to polluted air can reduce visibility due to smog and health problems due to reduced oxygen availability.

Kaliabu Village also has a final disposal site which accommodates more than 2,700 m³ of waste. Organic waste is used as organic fertilizer (compost). Waste treatment is carried out when the reservoir is full. Inorganic waste such as plastic which is difficult to decompose and its presence in large quantities has not been utilized properly. Plastic waste is allowed to accumulate, even plastic waste is also found in dry wells around the final disposal site. The existence of plastic waste causes Kaliabu Village to become a flood-prone area. The availability of unused materials in the surrounding environment can be used to make an air purifier.

Biochar is a carbon-rich architecture made from scrap and waste processed by pyrolysis or heating without oxygen. The principle of using biochar is to take carbon in the air to be reused, one of which is to reduce air pollution. The solid product called biochar is 35% with reduced size and dry texture resulting from slow pyrolysis. Garbage contains more carbon than wood. Biochar made from plastic waste is pyrolyzed at a temperature >400°C for 4 hours (Laird, et. al., 2009). The use of low temperatures during pyrolysis can provide carbon-rich properties for biochar materials.

Agricultural waste husks that are biodegradable can be processed through a pyrolysis process for 2 hours (Widiastuti, et al., 2017) and mixed with plastic pyrolysis results. Rice husk is produced as much as 20-30% during the milling process. Rice husk has not been utilized optimally because of its abrasive nature, low nutritional value, high ash content, and low bulk density of around 96-160 kg/m³. Bulk density can be increased from 196 to 384 kg/m³ through the milling process (Asmawati, 2017). Pyrolysis of rice husks produces biochar containing carbon and silica whose composition is influenced by pyrolysis conditions (Danarto, et. al., 2010).

The process of making biochar requires the addition of cellulose as an adhesive. Cellulose can be obtained from leopard water which is known to contain carbohydrates, protein gluten, vitamins, cellulose,

hemicellulose and sugars, as well as vitamin B₁, nitrogen, phosphorus, and other nutrients that are commonly found in the pericarp and aleurone which are also eroded. Cellulose that is involved in the process of making biochar forms a porous layer as an absorber of harmful gases, so that biochar has the potential to absorb air pollution around it.

2. METHOD

This research is a descriptive qualitative research. Data is collected through prototype trials and number of changes in air quality seen from BreezoMeter application. The application is placed near the front slit as a detector of pollutant levels before entering the appliance, while one application is placed near the rear slit to determine the decrease in pollutant levels after the air passes through the appliance. The trial of the instrument was carried out with 16 repetitions and 2 treatments with a research time of 30 minutes each. Air quality data obtained based on data analysis of the BreezoMeter application, then analyzed descriptively based on the numbers and color index in the BreezoMeter application.

3. RESULT

Based on the results of research conducted with 16 repetitions and 2 treatments with a research time of 30 minutes each, the data obtained are as shown in Table 1.

Table 1. Result Data

r	t		r	t	
	Q _{before}	Q _{after}		Q _{before}	Q _{after}
1	36	64	9	40	59
2	36	64	10	42	45
3	37	65	11	44	46
4	38	65	12	44	47
5	40	66	13	44	47
6	36	65	14	44	45
7	38	63	15	44	45
8	36	59	16	45	47
Mean	37.13	63.88	Mean	43.38	47.63

The data shows that the air quality before passing through the balok anti-asap (BalAS) is 40.25, while the average air quality after passing through the balok anti-asap (BalAS) is 55.75. The use of balok anti-asap (BalAS) can improved air quality by 15.5 which is analyzed based on the difference between the average air quality data before entering the balok anti-asap (BalAS) and after passing through the balok anti-asap (BalAS). Air quality value data obtained using the BreezoMeter application as shown in Figure 1.



Figure 1. One of the results of the study

4. DISCUSSION

Balok anti-asap (BALAS) consists of components in the form of a box, biochar, fan, coconut fiber filter, banana peel filter, and betel leaf soaking filter, turmeric, and ginger. The box used is 0.05 m wide with the front and back given a gap measuring 30×4 cm as a way for air in and out, the top part can be opened as a way for component maintenance. Biochar which functions as a pollutant absorber around the device is installed on the side of the box. The fan blades with a diameter of 30 cm function to draw dirty air into the tool and push clean air out. The particulate matter filter is made from coconut fiber by utilizing the hydrophobic cellulose fiber content, insoluble in acids and bases. Banana peel filter is used as a filter for harmful gases such as CO, NO₂, SO₂ and O₃ result from the wood burning process because they contain cellulose which forms a porous layer and the number of pores is increased through the activation process. Microbial filter is made from cloth and soaked in betel leaf, turmeric, and ginger which has anti-bacterial, viral, allergen, and fungal properties.

The balok anti-asap components (BalAS) are arranged with different distances, namely the distance between the microbial filter and the fan blade is 10 cm, the distance between the blades and the coconut fiber filter is 15 cm, and the distance between the fiber filter and the banana peel filter is 10 cm. The difference in distance applied in the installation of components in the box aims to reduce air pressure in each bulkhead so that air can flow from a room with high air pressure to low. Factors that affect performance degradation include the density of the coconut fiber filter, the ability of the *Musa acuminata* × *balbisiana* peel, and the microbial filter. Coconut fiber filters are known to absorb large amounts of particulate matter if they have a large density, while coconut fiber filters in balok anti- asap (BalAS) are only about 3 cm.

The ability of *Musa acuminata* × *balbisiana* peels is related to the number of pores formed during the activation process, the more pores formed, the greater the ability to absorb harmful gases. The microbial filter requires updating of betel leaf, turmeric, and ginger once a day. Balok anti-asap (BALAS) are estimated to last up

to 1 - 2 months, which is known through the air quality match before and after passing through the appliance. The quality of the air that has passed through the tool does not change from the quality before entering the tool, it can be said that the performance of the tool is starting to decline.



Figure 2. Prototype of BalAS

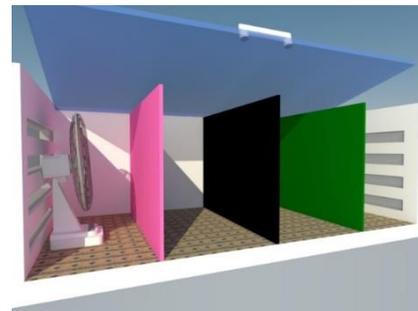


Figure 3. Design sketch of BalAS

5. CONCLUSION AND SUGGESTION

The use of balok anti-asap (BalAS) can improve air quality by 15.5. The decrease in the performance of the balok anti-asap (BalAS) is influenced by the density of the coconut fiber filter, the ability of the *Musa acuminata* × *balbisiana* peel, and the microbial filter. Balok anti-asap (BalAS) is estimated to last up to 1- 2 months, which is known through the match of the air quality index before and after passing balok anti-asap (BalAS) using the BreezoMeter application. Balok anti- asap (BalAS) are one of the latest innovations by applying materials that have been previously researched so that they become more useful. Balok anti-asap (BalAS) is still a prototype so it requires greater workmanship and supporting equipment to increase the durability of components before being implemented in the community.

AUTHORS' CONTRIBUTION

Nia Eka Mayasari, Ardiana Ayu Anjarwati, Dyanita Tyananda, and Cicilia Novi Primiani.

ACKNOWLEDGMENTS

We are grateful to the Biology Education Study Program, Faculty of Teacher Training and Education, PGRI Madiun University for funding this research. We also thank Khoirul Huda for granting permission to conduct research at the home industries of brem in Kaliabu village.

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