The effectiveness of tabingga briquettes and corncob briquettes as biocoal

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Abstract. Energy needs and consumption are increasing in line with the increasing human population and increasing community economy. The energy needs and consumption are focused on the use of fuel oil. To minimize the worst possibility of the impact of the use of fossil fuels, one of them is through the development of renewable energy sources. Alternative energy can be generated from appropriate technology by utilizing biomass waste such as tabingga and corncobs which are by products and discharges that have not been much studied for their benefits. The purpose of this study was to determine the effectiveness of tabingga briquettes and corncob briquettes as alternative fuels. This research is an experimental research. The research was carried out from May to August 2019. The objects in this study were the biocoal tabingga and the corncobs biocoal with adhesive variations of 10 grams, 20 grams and 30 grams. The briquette is then printed with a diameter of 5 cm and a height of 7 cm. The results of this study indicate that tabingga briquettes can produce heat temperatures until 89 °C. While corncob briquettes can produce heat temperature until 83 °C.

1. Introduction

Energy is one of the problems of the world [1, 2]. The increase in the number of human population is followed by an increase in energy needs, but causes the energy reserves of petroleum, coal, and gas to run out faster. One way to minimize the use of earth energy sources is by finding materials that can be used as alternative energy sources [3-5]. Alternative energy can be generated from appropriate technology by utilizing biomass waste originating from agricultural and forestry products, the quantity of which is abundant, but has not been optimized for use such as coconut shells, rice husks, corncobs, sawdust, etc [2, 3, 6]. The heating values of some types of fuel are shown in the following table 1 [7].

| No. | Fuel       | Heating Value (kal/g) |
|-----|------------|-----------------------|
| 1   | Wood       | 4491,2                |
| 2   | Young Coal | 1887,3                |
| 3   | Coal       | 6999,5                |
| 4   | Crude Oil  | 10081,2               |
| 5   | Fuel Oil   | 10224,6               |
| 6   | Natural Gas| 9722,9                |
Central Sulawesi Province is one of the copra-producing regions on the island of Sulawesi. Tabingga is a by-product and waste from copra waste. Tabingga is usually used by people in Central Sulawesi as fuel in the process of making bricks / red stones. The production of tabingga is high, however, it has not yet studied its added value. Likewise the case with corn cobs which are usually only used as animal feed. Based on this, the researchers are interested in knowing which briquettes are more effective between the two ingredients.

2. Material and methods
The composition used in this study was tabingga and corn cobs. First, tabingga and corn cobs are dried in the sun for 7 days. After that, doing authoring process. The charcoal is then ground into charcoal flour. The charcoal flour is then sieved to make fine granules. Take 200 grams of charcoal flour are then mixed with the starch adhesive mixture with a variation of 5%, 10% and 15%, diluted with 300 ml of water. After that batter is then printed with a length of 7 cm and a diameter of 5 cm. and then briquettes are then dried for 7 days. Finally, briquettes are tested to determine water content, ash content, volatile matter levels, carbon content, also to determine the temperature that can be produced by the briquettes.

2.1 Moisture Content Testing
Calculation of the percentage of water content (moisture content) contained in the briquettes using ASTM D7582-12 standard with the following equation:

\[ MC = \frac{W - B}{W} \times 100\% \]

where:
W = the mass of the specimen analyzed (g)
B = the mass of the specimen after drying in moisture testing (g)

2.2 Ash Content Testing
Calculation of the percentage of the ash content of briquettes using ASTM D7582-12 with the following equation:

\[ Ash = \frac{F - G}{W} \times 100\% \]

where:
F = mass of crucible and ash residue (g)
G = mass of the empty crucible (g)
W = the mass of the specimen analyzed (g)

2.3 Volatile Matter Content Testing
Calculation of the percentage of volatile matter content of briquettes using ASTM D7582-12 with the following equation:

\[ VM = \frac{B - C}{W} \times 100\% \]

where:
B = the mass of the specimen after drying in moisture testing (g)
C = the mass of the specimen after heating in the volatile matter (g)
W = the mass of the specimen analyzed (g)

2.4 Fixed Carbon Content Testing
Calculation of the percentage of fixed carbon content of briquettes using ASTM D7582-12 with the following equation:

\[ FC = 100 - (MC + Ash + VM) \]

2.5 Testing the Temperature Produced by the Briquettes
Briquettes are tested to heat some water. Then recorded temperature produced during the heating process. It aims to find out which competition can heat water better and produce higher temperatures.

3. Result and Discussion
The finished biocoal briquettes are then tested in a laboratory.

3.1 Moisture content
The water content in fuels is called water content. The water content in fuel must be transported, and stored together with fuel. The moisture content will reduce the heat content per kg of fuel [8]. From table 2 shows that, briquettes which have a more adhesive concentration, cause the composition of the briquette to be denser and absorb more water. And if the two briquettes are compared, then the tabethane briquette is more water absorbing compared to the corncob briquettes. This is due to the constituent materials of tabingga briquettes which are composed of coconut coir fibers which are easier to store water, so in this type of briquettes it is easy to lose heat, due to evaporation and overheating of vapors, helps bind particles and helps heat transfer radiation [8].

| No. | Adhesive concentration | BT (%) | TJ (%) |
|-----|------------------------|--------|--------|
| 1   | 5%                     | 10,018 | 6,857  |
| 2   | 10%                    | 11,096 | 8,046  |
| 3   | 15%                    | 12,136 | 8,329  |

3.2 Ash content
Ash or called mineral substances contained in solid fuels are materials that cannot be burned in the combustion process radiation [8]. From table 3 shows that, briquettes that have a more adhesive concentration, causing ash levels in briquettes decreases. And if the two briquettes are compared, then corn cob briquettes have a higher ash content than tabingga briquettes. This is caused by the constituent ingredients of the briquettes themselves, where corn cobs produce more ash than tabingga. With more ash content, it will affect handling and combustion capacity, increase handling costs, affect combustion efficiency and cause clotting and blockage [8].

| No. | Adhesive concentration | BT (%) | TJ (%) |
|-----|------------------------|--------|--------|
| 1   | 5%                     | 6,028  | 7,241  |
| 2   | 10%                    | 5,346  | 6,740  |
| 3   | 15%                    | 4,684  | 6,001  |

3.3 Volatile Matter content
From table 4 shows that, briquettes which have a more adhesive concentration, cause the levels of substances that evaporate decreases. And if the two briquettes are compared, then corncob briquettes have higher levels of evaporating substances than turbofan briquettes. This is evidenced by the amount of smoke produced during the combustion process using corn cob briquettes. The more platinum levels of substances that evaporate in the briquette, the easier it is to burn and burn, so the burning rate is faster [8].
Table 4. Percentage of Volatile Matter content Tabingga Briquettes (BT) and Corn cob Briquettes (TJ)

| No. | Adhesive concentration | BT (%) | TJ (%) |
|-----|------------------------|--------|--------|
| 1   | 5%                     | 5.173  | 7.311  |
| 2   | 10%                    | 4.264  | 6.388  |
| 3   | 15%                    | 3.655  | 5.870  |

3.4 Carbon content
The carbon content is a component that when burned does not form gas [8]. From table 5 shows that, briquettes which have a more adhesive concentration, cause carbon levels to increase. And if the two briquettes are compared, then corn cob briquettes produce higher carbon content than tabingga briquettes. Carbon content gives a rough idea of the heat value of solid fuels [8].

Table 5. Percentage of Carbon content Tabingga Briquettes (BT) and Corn cob Briquettes (TJ)

| No. | Adhesive concentration | BT (%) | TJ (%) |
|-----|------------------------|--------|--------|
| 1   | 5%                     | 78,780 | 78,592 |
| 2   | 10%                    | 79,294 | 78,826 |
| 3   | 15%                    | 79,525 | 79,799 |

3.5 The temperature produce by briquettes
Briquettes with a mass of 131 were tested to boil as much as 500 ml of water. The result obtained are:

![Graph showing the relationship between heating time and temperature produce by tabingga briquettes](image)

**Figure 1.** Relationship between heating time and temperature produce by tabingga briquettes

Based on the figure 1, it can be seen that the higher concentration of the adhesive constituent tabingga briquettes results in people getting faster and faster in heating water. The maximum temperature that can be achieved is 89 °C. and its nature is more stable compared to other adhesive concentrations.
Based on Figure 2, it appears that the briquette with a 5% adhesive concentration is capable of heating water to a temperature of 83 °C. But it takes longer than other concentrated briquettes. In addition, briquettes with concentrations of 5% and 10% produce odor. Briquettes with a concentration of 5% produce a sharper odor than briquettes with an adhesive concentration of 10%. While briquettes with a concentration of 15% do not cause odor.

4. Conclusion
Tabingga briquettes produce greater water content and carbon content than corncob briquettes. But at a 15% adhesive concentration, the carbon content of corncob briquettes is greater than tabingga briquettes. Tabingga briquettes produce less ash content and less volatile substances than corn cobs briquettes. And tabingga briquettes can heat water faster to 89°C in 20 seconds, compared to corn cobs briquettes which can heat up to 83°C in 32 seconds.

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