Journal of Mechanical Engineering Research and Developments
ISSN: 1024-1752
CODEN: JERDFO
Vol. 44, No. 11, pp. 108-114
Published Year 2021

Production and Quality Analysis of Coconut Shell Charcoal Briquettes and Durian Shell in Terms of Composition

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ABSTRACT

Making briquettes with agricultural waste raw materials is effective alternative energy for fuel. This study describes the effect of the composition of coconut shell charcoal and durian skin, molasses adhesive and starch on the characteristics of bio briquettes through proximate analysis to obtain the ideal composition. In this study, briquettes were made with a mixture of coconut shell charcoal and durian shell charcoal which were varied (i.e. the ratio of coconut shell charcoal and durian skin charcoal was 65:30, 60:35,55:40,50:45,45:50). Briquettes production is carried out using a furnace at a temperature of 400°C. The resulting charcoal is mixed with different mass ratios and added molasses adhesive. The bio briquettes were analyzed to evaluate the moisture content, ash content, volatile matter, fixed carbon content, burn time, calorific value and morphology. Proximate analysis shows that solid fuel products have almost the same quality as coal, namely the calorific value of 5710.43 cal/g for molasses adhesive. The resulting proximate analysis shows that the resulting bio briquettes have great potential to become a viable fuel source.

KEYWORDS

Quality, Coconut, Briquettes, Durian, composition

INTRODUCTION

In meeting the growing demand for fossil fuels which has decreased, alternative renewable energy sources are needed that can meet the needs of fossil fuel reserves[1]. Several alternative renewable energy sources, abundantly available biomass, can contribute approximately 10% of annual energy needs and reduce waste disposal generated from agriculture[2], [3]. Biomass energy sources are classified as clean energy, the richest carbon stocks [4], environmentally friendly and potentially sustainable [5], [6]. Biomass conversion technology that is generally used is the pyrolysis process, the gasification process[7]. Pyrolysis is a technology that is widely used for the biomass conversion process[8]. This conversion technology can improve the combustion quality of biomass and combustion characteristics[9]. In addition to the choice of technology, the raw materials also affect the mixture of materials and the binder[10]. Utilization of agricultural and plantation waste as raw material for briquettes has been carried out such as bagasse[11], rice husks [12], durian skin[13] and coconut shells.

Durian peel has the potential to be used as a source of alternative energy raw materials, as he has done[10] namely making briquettes from durian skin with starch adhesive, concluded that the briquettes produced already meet the SNI standard (SNI 01-6235-2000) and the addition of adhesive 3 % obtained the best quality briquettes. Besides durian skin, the most widely used biomass as raw material for briquettes is coconut shell. [14] he made briquettes from coconut shells mixed with peanut shells, it was concluded that this briquette is one solution to help overcome the reduced energy supply and has great potential. Another important thing that affects the quality of briquettes is the type of adhesive used. Commonly used adhesives are molasses and starch. This study focuses on the effect of composition between durian shell charcoal and coconut shell charcoal as raw material for briquettes. The purpose of this study was to obtain briquettes according to national standards through proximate analysis by looking at the effect of composition between durian shell charcoal and coconut shell charcoal. Parameters to be analyzed include water content, ash, Volatile Matter content, calorific value, and long burning time. The adhesive used is molasses.

METHODS

Raw materials

The durian skin used in this study was obtained from a shop that sells processed durian and durian fruit. Coconut shells are obtained from coconut shell waste from coconut sellers in traditional markets. While the molasses used is obtained from a sugar industry in Sidoarjo – East Java – Indonesia.

Sample preparation

The moisture content of the sample to be made into charcoal is determined at 10%, both durian shell and coconut shell. The drying method used is oven drying. To speed up the drying process, the durian shell is reduced in size. Figure 1. It is durian shell and coconut shell which are used as raw materials.

Figure 1. Durian Shell

Carbonization Process

The carbonization process is carried out separately between durian shell and coconut shell. Durian is carbonized at a low temperature and the time required is not long, namely 30 minutes at a temperature of 400°C[15]. while for coconut shell, carbonization process is carried out at a temperature of 450°C for 1 hour.

Mixing and Gluing

The durian shell charcoal and coconut shell charcoal resulting from the carbonization process were reduced to 100 mesh in size. The process of mixing coconut shell charcoal and durian skin charcoal based on the mass ratio is 65:30, 60:35,55:40,50:45,45:50. Then proceed with gluing, adding molasses as an adhesive requires initial experiments, so that molasses can unite the two types of charcoal. Molasses was added to this mixture at 5%w.

Characteristics of briquettes

The glued briquettes were dried at a temperature of 100°C for 3 hours [16]. The characteristics of the briquettes were analyzed based on proximate analysis, namely water content[17], ash content[18], volatile matter[19], calorific value[11], and length of combustion time. Proximate analysis was carried out based on American standards, namely the American Society of Testing and Standard Materials (ASTM). The briquette manufacturing process procedure from sample preparation to mixing and glueing is summarized in Figure 2.

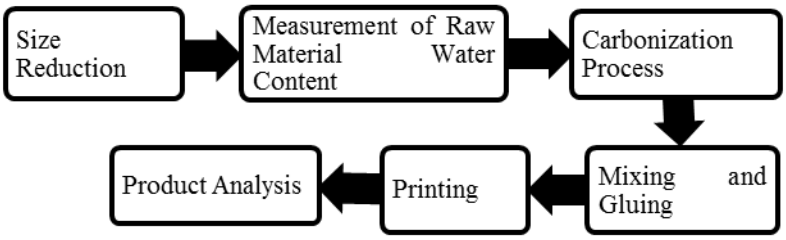

Figure 2. Research Process

RESULTS AND DISCUSSION

Briquettes made from durian skin and coconut shell with molasses adhesive have been successfully created. The product of durian shell charcoal briquettes and coconut shell charcoal briquettes with molasses adhesive is presented in Figure 3. The resulting briquettes have length, diameter, and diameter of 10 cm, 2 cm, and 10 g.

Figure 3. Durian Shell Charcoal Briquettes and Coconut Shell Charcoal

Water content

The water content test was carried out based on ASTM D-3173. The effect of the composition of the mass ratio of durian shell charcoal and coconut shell charcoal is presented in Figure 4. The test results show that the maximum standard of SNI 01-6235-2000 is 8%. The water content obtained ranged from 4.2 to 7.7%. The value of high water content in briquettes can reduce the calorific value[20] and is hygroscopic [21]. Figure 4 shows that the mass ratio affects the water content, and also, the more charcoal content of the durian skin increases the water content of the briquettes.

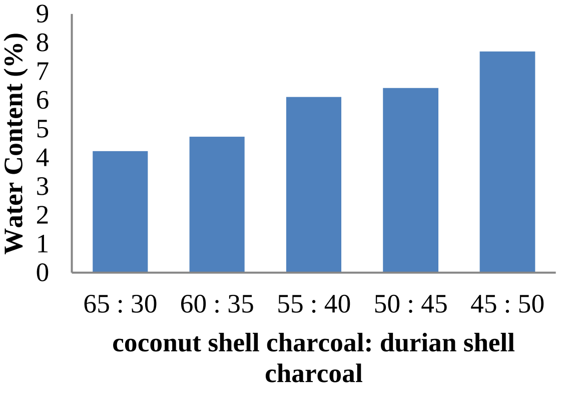

Figure 4. Water Content

Ash content

One of the parameters to show the quality of briquettes other than water content is ash content. This ash is an inorganic mineral that cannot be burned after the combustion process is complete[22]. High ash content indicates that the quality of the briquettes is low[20] and can reduce the calorific value[23]. Figure 5 shows that it is still in the range according to the quality standard of SNI 01-6235-2000 briquettes. According to the test results shown in Figure 5. The ash content has decreased. This is caused by the carbon content in coconut shell charcoal being greater than the carbon content in durian shell charcoal.

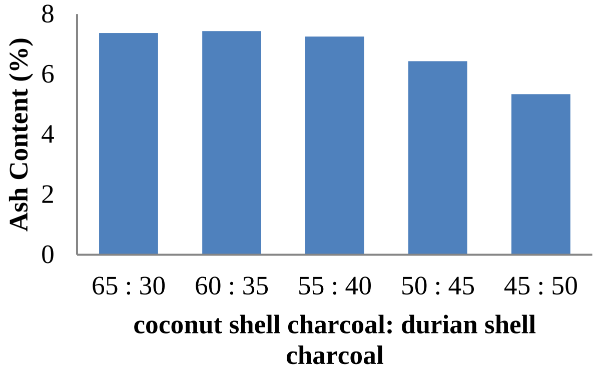

Figure 5. Ash Content

Volatile Matter Content

Based on Figure 6, it can be concluded that the mixture of raw materials significantly affects the level of volatile matter produced, and the volatile matter content in durian shells is more significant than coconut shells. This indicates that highly volatile materials produce volatile matter levels[24], [25]. In addition, what affects the volatile matter content is the particle size[26]. The levels of volatile matter produced still meet SNI 01-6235-2000, which is around 4.04 – 10.83%, with the standard limit being at 15%. The value of high volatile matter content can extensively reduce the char produced after the combustion process[27].

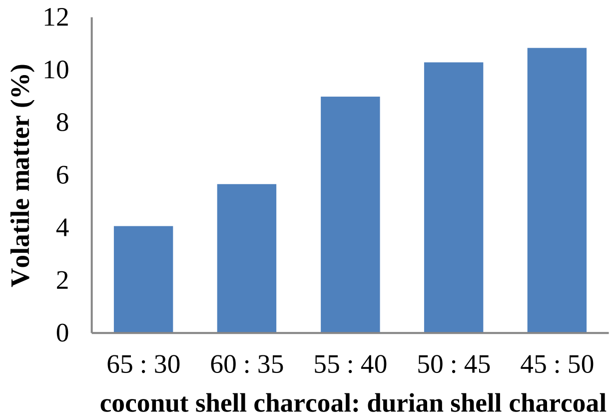

Figure 6. Volatile matter content

Calorific Value

The results obtained in this study indicate that bio-briquettes from durian peel and coconut shell waste can compete profitably with coal as a renewable energy source[28]. The calorific value of the briquettes produced in this research is 4966.68 – 5710.43 cal/g, shown in Figure 7**.** Based on the variation of the mass ratio, the calorific value of the briquettes is in the standard calorific value range of SNI 01-6235-2000. The greater the composition of coconut shell charcoal, the greater the calorific value produced, while the greater the composition of durian shell charcoal, the smaller the calorific value produced. The fixed carbon content influences the calorific value in bio briquettes. A low fixed carbon content will have a low calorific value and conversely a high fixed carbon content will have a high calorific value as well[29].

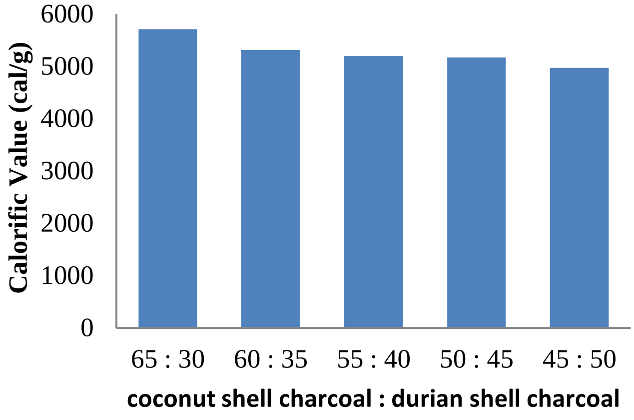

Figure 7. Calorific Value

Burn Time

Burn time is one type of test to determine the performance of the resulting briquettes. Burn time is when it takes for the briquettes to burn until the fire is extinguished[21]. Based on Figure 8, the burn time obtained is 57 – 83 minutes. The length of the burning time on the briquettes affects the calorific value produced. The higher the calorific value created, the longer the burning time required. According to him[30], the higher the ash content of the briquettes, the more complex the burning process due to the low volatile matter content. So it can be concluded that briquettes have a high calorific value, low water content, resulting in a longer burning time[31].

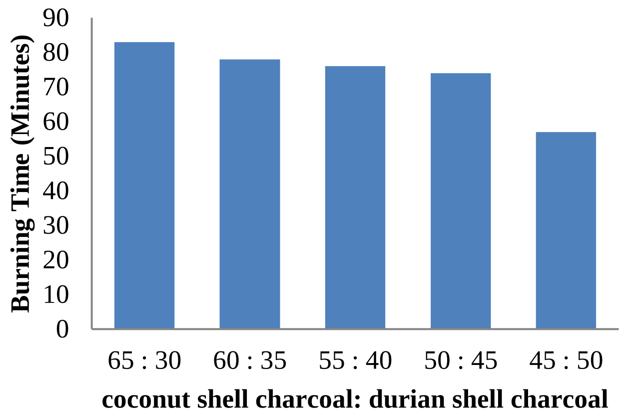

Figure 8. Burning Time

CONCLUSION

Based on the results of this study, it can be concluded that compositional variations affect moisture content, ash content, volatile matter, calorific value and burning time of durian skin and coconut shell bio briquettes. The best composition for making bio briquettes from durian skin and coconut shell is 65: 35 with a heating value of 5710.43 cal/g, 4.2% water content, 7.37% ash content, 4.06% volatile matter content and carbon content. 75.4% meets the standardization of biochar briquettes (SNI 016235-2000). This briquette with durian skin and coconut shell raw materials can recommend as alternative renewable energy to replace coal.

ACKNOWLEDGMENTS

The authors would like to thank the Indonesian Ministry of Research and Higher Education for financial support through the PDUPT (2021) research scheme. Author too recognized the Adhi Tama Institute of Technology Surabaya (ITATS) to provide the necessary laboratory equipment and facilities for this work.

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