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The Effect of Briquette Pressure on the Mechanical Characteristics of Peanut Shell Briquettes

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Abstract. This study aims to determine the mechanical characteristics of briquettes, namely density, modulus of elasticity, and ultimate strength made from peanut shell waste with variations in briquetting pressure. The manufacturing process uses a briquette press with pressure variations of 30 N/m^2, 40 N/m^2, 50 N/m^2, 60 N/m^2, and 70 N/m^2, the materials used are peanut shells, water, and tapioca flour. The results of this study showed that the highest density was obtained from briquettes made from a compressive strength of 60 N/m^2, which was 950.424 kg/m^3, while the lowest density was produced from briquettes made from a compressive strength of 50 N/m^2, which was 678.742 kg/m^3. The highest elastic modulus value is owned by briquettes made from a compressive strength of 50 N/m^2, which is 20,000 MPa, while the lowest modulus of elasticity is produced from briquettes made from a compressive strength of 30 N/m^2, which is 10 MPa. The highest ultimate strength value is owned by briquettes made from a compressive strength of 70 N/m^2 which is equal to 4.208 MPa while the lowest ultimate strength is produced from briquettes made from a compressive strength of 30 N/m^2 which is equal to 3.019 MPa. Based on the three mechanical test measurements, can conclude that the best briquettes during transportation are briquettes with the highest ultimate strength value, namely at a pressure of 70 N/m2, which means that the briquettes are the least easily broken among all briquettes.

INTRODUCTION

Today, the level of energy use, especially fuel oil, is increasing along with the increase in human population and the increase in the rate of industry in various countries in the world. The increasing use of fuel oil in Indonesia is not matched by adequate oil production. This raises concerns about a fuel oil crisis. To overcome these concerns, it is necessary to renew the main energy sources [1].

In essence, energy is needed in every human life and is a fundamental factor in addressing the world's main problems today, not only in Indonesia. In other words, as time goes by the level of energy demand increases every year based on human activities in managing these fuel sources. Biomass is one of the new and renewable energy sources whose potential is very abundant in Indonesia, but its use is not yet optimal, while the provision of biomass energy in the constellation of national development is very important even though its contribution to total national energy consumption is very small. The potential of biomass resources in Indonesia is estimated at 49,810 MW, which comes from plantation product waste such as oil palm, coconut, and sugarcane, as well as forest product waste, such as sawn waste and wood production waste, and food crop (agriculture) waste which has been mostly used by society for various interests (agriculture, energy, industry) [2].

The use of biomass as an alternative renewable energy source has become a global concern today because it is environmentally friendly and inexpensive. Some of the advantages of using biomass energy include; This energy source can be utilized sustainably because it is a renewable resource, this energy source relatively does not contain

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sulfur so it does not cause air pollution as is common in fossil fuels, and the use of biomass energy can also increase the efficiency of forest resource utilization. In several developing countries energy from biomass is the main source of energy, although most are still in the traditional form [3]. Biomass contributes 13% of the world's energy supply and is the main source of energy for living things [4].

Much research has been done on briquettes based on variations in briquette pressure originating from the biomass itself, including research on the effect of variations in the composition of the basic ingredients and variations in briquette pressure on the calorific value and temperature of briquettes mixed with rice husk and coconut shell in 2018 [5]. Furthermore, research on the effect of pressure on density, moisture content and combustion rate of bio briquettes from sengon wood waste in 2018 [6], research on testing the burning rate and calorific value of rice husk wafer briquettes with various pressures in 2020 [7], research on the effect of pressure variations on density, moisture content and combustion rate of mahogany wood waste biobriquettes in 2021 [8], study the effect of shape change, particle size and pressure on burning characteristics of Alaban coal - rice husk waste bran coal in 2022 [9], studying the effect of pressure difference on the quality of cow dung charcoal in 2020 [10], studying the effect of shape change (rectangle and hexagon), grain size and pressure on burning characteristics of briquettes from alaban wood and rice husk in 2021 [11], research on the effect of applying pressure and heating on the density of fuel (bio-coke) based on corncob biomass [12], studying the effect of pressure change on the properties of oil palm shell bio briquettes using bio briquette casting machine [13], research on the effect of compaction on the characteristics of cocoa pod and cashew nut shell briquettes in 2020 [14], study on the effect of compressive force on the properties of cocoa shell bio briquettes in 2017 [15], research on reducing the value of water content and burning rate in biobriquettes from sengon wood waste with variations in pressure in 2018 [16], and finally research on analysis the effect of variations in pressure and dimensions of rice husk briquettes on temperature and flame duration in 2021 [17].

So this study discussed the effect of briquetting pressure originating from peanut shell waste to see its effect on the mechanical characteristics of the briquettes, namely the value of density, modulus of elasticity, and ultimate strength.

METHODE

This research was conducted at the Biophysics Laboratory, Bandung Institute of Technology. The tools used are a Universal Testing Machine, analytical balance, stopwatch, mortar/mortar, 40 mesh passing sieve, hydraulic press, cylindrical briquette mold, crucible/porcelain cup, measuring cup, stirrer, digital camera, calculator and tools write. The materials used are peanut shell powder, tapioca flour, and water.

Working procedures and observations: making charcoal powder from peanut shell powder, namely peanut shells being cleaned of dirt, then dried in the sun until dry. Weigh the dried peanut shells, then put them in a crucible and bake them in an electric oven at 400^0C for 20 minutes until coagulation occurs [18]. Next, the charcoal powder is kneaded and filtered until it passes a 40-mesh sieve.

Making the adhesive: The adhesive is made from a mixture of 2 grams of tapioca and 15 ml of water which is heated until it forms glue and then removed.

Preparation of the briquette sample: Weigh 18 grams of peanut shell charcoal powder that passes a 40 mesh sieve, then mix it with an adhesive until evenly distributed. Put the mixture into a cylindrical briquette printer equipped with a press with variations in printing pressure. Pressing was carried out hydraulically with pressures of 30 N/m^2, 40 N/m^2, 50 N/m^2, 60 N/m^2, 70 N/m^2 for 25 minutes. Charcoal briquettes were removed from the mold and heated in an oven with a heating temperature of 55^0C for 9 hours.

Testing: The mechanical quality of charcoal briquettes can be determined by testing the density, elastic modulus, and ultimate strength with the Universal Testing Machine.

RESULT AND DISCUSSION

Density

Density has an important role in determining the quality of briquettes, a high-density value indicates the level of robustness and cohesiveness of the constituent particles in the briquettes. Density is the ratio between the mass of the briquette and the volume of the briquette, the greater the density value in a briquette, the smaller the space or volume required with the same mass [19].

Density is the amount of mass in each volume unit size that is owned by a briquette, based on the density results in peanut shell briquettes with variations in briquetting pressure can be seen in figure 1.

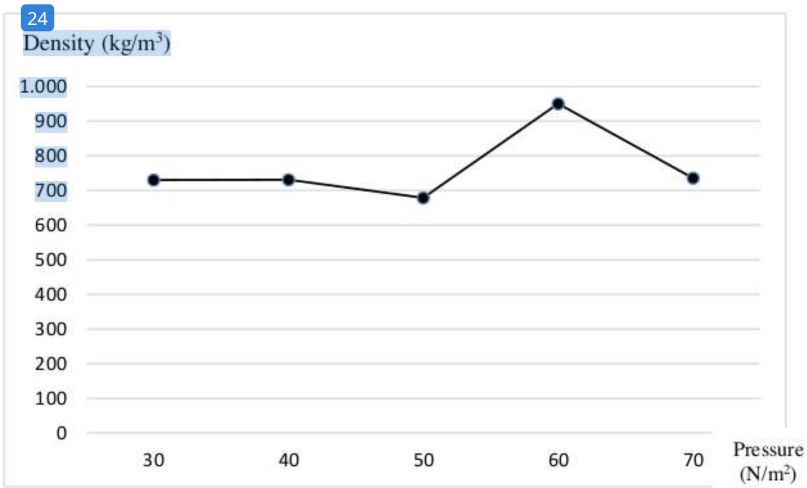

FIGURE 1. Effect of compressive strength on density

The density value produced by peanut shell briquettes with variations in the strength of the briquette pressure is at a pressure of 30 N/m^2 which is 730.352 kg/m^3, at a pressure of 40 N/m^3 which is 730.595 kg/m^3, at a pressure of 50 N/m^3 which is 678.742 kg $/m^3$, at a pressure of 60 N/m^2 that is equal to 950.424 kg/m^3 and at a pressure of 70 N/m^2 that is equal to 735.352 kg/m^3. The highest density value was produced by briquettes with a compressive strength of 60 N/m^2 which was 950.424 kg/m^3 and the lowest density value was produced by briquettes with a compressive strength of 50 N/m^2 which was 678.742 kg/m^3. From the graph, it can be seen that the density value of peanut shell briquettes fluctuates based on the amount of pressure applied. [20] said that high pressing pressure would also result in a high density of charcoal briquettes, but this was not the case in this study, this could be due to the uneven distribution of the charcoal powder particles, as well as during carbonization, the coagulation process was incomplete. or less evenly carbonized material. There is an increase in density due to increased pressure which results in a more compact arrangement of the charcoal particles. This causes the possibility of smaller gaps (pores) both in terms of size and number so that the density increases. In addition to pressure variations also stated that the higher the fineness of the charcoal powder used, the higher the density of the resulting charcoal briquettes.

Modulus of elasticity

Elastic property is the ability of an object to return to its original shape as soon as the external force exerted by the object is removed. Elasticity is the property of an object that deforms temporarily, without permanent changes, namely the property of resisting the deformation that occurs. An object is said to be perfectly elastic if after the force causing the deformation is removed the object returns to its original shape. Even though there are no perfectly elastic objects, there are many objects that are almost perfectly elastic, that is, up to a limited deformation called the elastic limit. If an object is deformed above its elastic limit, and when the forces are removed, the object will no longer return to its original shape.

The value of the elastic modulus of peanut shell briquettes can be seen in Figure 2 with variations in pressing pressure on the briquettes.

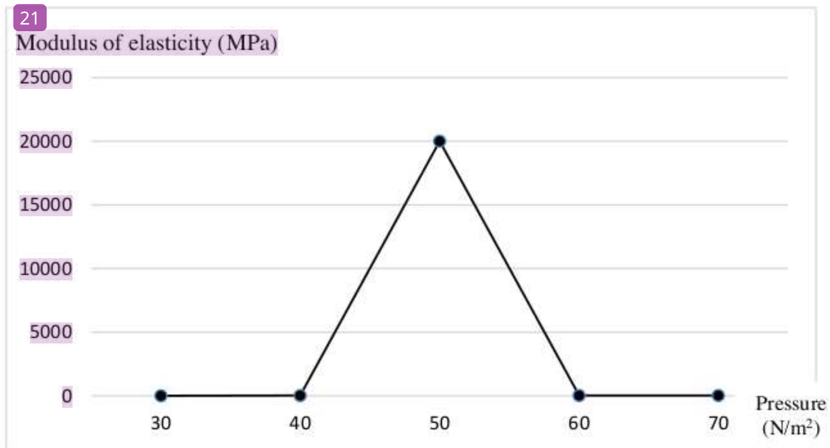

FIGURE 2. Effect of compressive strength on the modulus of elasticity

The value of the elastic modulus produced by peanut shell briquettes with variations in the strength of the briquette pressure was at a pressure of 30 N/m^2 which was 10 MPa, at a pressure of 40 N/m^2 which was 30 MPa, at a pressure of 50 N/m2 which was 20,000 MPa, at a pressure 60 N/m^2 which is equal to 20 MPa and at a pressure of 70 N/m^2 which is equal to 20 MPa. The highest elastic modulus value was produced by briquettes with a compressive strength of 50 N/m^2, which was 20,000 MPa, and the lowest density value was produced by briquettes with a compressive strength of 30 N/m^2, which was 10 MPa. From the graph, it can be seen that the value of the modulus of elasticity at a pressure of 50 N/m^2 is very significantly different from other pressures. This can be related to the density value in the previous measurement, namely in the previous measurement the lowest density value was at a pressure of 50 N/m^2.

Ultimate Strength

Ultimate tensile strength (UTS) is the maximum stress a material can withstand while being stretched or pulled before breaking. Tensile strength is not the same as compressive strength and its values can be very different. Some materials will fracture, without plastic deformation, which is called brittle failure. The ultimate strength value of peanut shell briquettes can be seen in Figure 3 with variations in pressing pressure on the briquettes.

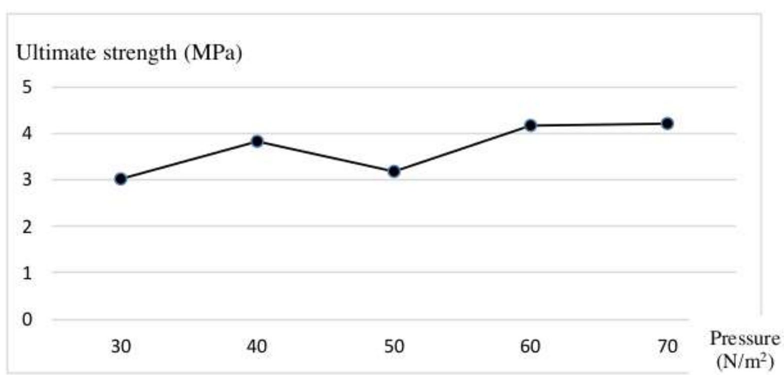

FIGURE 3. Effect of compressive strength on ultimate strength

The ultimate strength value produced by peanut shell briquettes with variations in strength of briquette pressure is at a pressure of 30 N/m^2 which is 3.019 MPa, at a pressure of 40 N/m^2 which is 3.824 MPa, at a pressure of 50 N/m^2 which is 3.181 MPa, at a pressure 60 N/m^2 which is equal to 4.169 MPa and at a pressure of 70 N/m^2 which is equal to 4.208 MPa. The highest ultimate strength value was produced by briquettes with a compressive strength of 70 N/m^2 which was 4.208 MPa and the lowest ultimate strength value was produced by briquettes with a compressive strength of 30 N/m^2 which was 3.019 MPa. From the graph, it can be seen that the ultimate strength value of peanut shell briquettes fluctuates based on the amount of pressure applied. The occurrence of these fluctuations could also be caused by the uneven distribution of the charcoal powder particles, as well as during carbonization, the writing process occurs incompletely or the material is carbonized unevenly. There is an increase in density due to increased pressure which results in a more compact arrangement of the charcoal particles. This causes the possibility of smaller gaps (pores) both in terms of size and number so that the ultimate strength value increases.

Based on the three mechanical test measurements, the best briquettes during transportation are briquettes with the highest ultimate strength value, namely at a pressure of 70 N/m^2, which means that the briquettes are the most unbreakable among all briquettes.

CONCLUSION

So based on the results of the study it can be concluded that:

1. The highest density value is owned by briquettes made from a compressive strength of 60 N/m^2 which is 950.424 kg/m^3 while the lowest density is produced from briquettes made from a compressive strength of 50 N/m^2 which is 678.742 kg/m^3.
2. The highest modulus of elasticity is owned by briquettes made from a compressive strength of 50 N/m^2, which is 20,000 MPa, while the lowest modulus of elasticity is produced by briquettes made from a compressive strength of 30 N/m^2, which is 10 MPa..
3. The highest ultimate strength value is owned by briquettes made from a compressive strength of 70 N/m^2 which is equal to 4.208 MPa while the lowest ultimate strength is produced from briquettes made from a compressive strength of 30 N/m^2 which is equal to 3.019 MPa.
4. Based on the three mechanical test measurements, the best briquettes during transportation are briquettes with the highest ultimate strength value, namely at a pressure of 70 N/m^2, which means that the briquettes are the least easily broken among all briquettes.

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