Analysis of Durian Peel and Teak Wood Sawdust Combination Briquettes as an Alternative Fuels

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Abstract: Agricultural and wood waste are potential energy sources for industrial and domestic activities. Nevertheless, they are hardly utilized. Briquette offers not only accessible different forms alternatives and sustainable energy source, but also can reduce waste. This study is aimed to analyse the effect of durian peel and teak wood sawdust combination briquettes, compressive strength on calorific value. Durian peels and teak wood sawdust were dried in the sun for 3 days until 15% moisture content, charcoal burning, milling, and pressing. The briquettes calorific value tests were conducted using a bomb calorimeter with compressive strength variation. The results show that the increasing the durian peel content in briquettes enhances the caloric value. In case of compressive strength, with increase in pressure influencing calorific value. These mixed briquettes calorific value is qualify based on quality of standards in Indonesia. Thus, it's strongly recommended for contributes to offset bio-residue management problems.

1 INTRODUCTION

The role of energy in sustainable development process is gaining more attention and concern over the last few decades than ever. The increasing prices and environmental impacts makes the biofuel production slightly increased. Moreover, the alternative cheaper and accessible form of energy is developed. These include the improvement biomass and wood waste which are prospect an important emergency backup fuel. Biomass is considered a global renewable energy resource and a way out of human dependence on non-renewable materials.

Indonesia known as an agrarian country which is also rich in forest product that are potential used as renewable energy source. Durian peel waste has not been used properly because of its character which is difficult to be composed and its potential impact to environmental pollution. This also occurs in sawmill waste which is 10% in the form of sawdust. Furthermore, that's have a negative impact on the environment if it left unchecked, stacked, and burned.

Briquetting is one method used convert loose biomass by optimizing fuel efficiency, reduce unused product, and could be among the most right solution (Purohit et al. 2006., Cosgrove-Davies, 1985).

Several studies on various briquetting parameters have been done. These included determination of physical properties (moisture content, ash content, density, particle size, humidity), mechanical properties (compressive strength), and calorific value (Boasiako and Acheampong, 2016; Friedl et al. 2005). The calorific value of any fuel is its essential property, as it is a measure of the amount of energy that the resource is capable of producing. Meanwhile, Eastop and McConkey (1993) stated calorific value as the number of heat unit that is obtained by the complete combustion the fuel unit mass.

Other experiments have been conducted over the years to relate the calorific values of different wood fuels and biomass. In the case of biomass, higher lignin and extractive content positively correlate to calorific value (Demirbas, 2001; White, 1987). Ben-Dzam and Hagan (1986) noted that a good or an effective briquette has a higher calorific value (CV) than solid wood since a considerable part of the moisture and volatiles are removed during the briquetting process.

Hence, the objective of the present study was to analyse the effects of durian peel and teak wood sawdust combination through calorific value. Thus, this work sought to determines the relationship between compressive strength and calorific value.

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This is helps in selecting compressive strength needed to prepare briquettes with the highest calorific value. A laboratory experiment was performed to investigate the calorific value of each and mixed briquettes. Also, the properties evaluated to study the effects of compressive strength and particle size on calorific value. Additionally, a simple recommendation is developed to help the consumers in deciding the best option of available mixed briquettes for heating purpose.

2 MATERIAL AND METHOD

2.1 Materials

Materials used in this study are the durian peel waste and teak wood sawdust. Fresh durian peel and teak wood sawdust obtained from durian sellers centres and furniture store in Bandar Lampung. Durian peel has been chopped/sliced and dried in the sun for 3 days until 15% of moisture content, subsequently air dried durian peel was carbonized in charcoal to get a carbon and it sieved with 50 mesh sized sifter. Sawdust from teak wood screened for splinters and metals, then air-dried to 15% moisture content and sieved through 50 mesh sized sifter for briquette. Starch and water cooked as glue in the amount of 5% of the total weight of briquette. Collected samples were then placed on plastic containers for further analysis. The equipment used was a mortar, knife, pestle, basin scales, sieving, bomb calorimeter, winnowing, furnace, printing press equipment briquettes, and universal compressive testing machine.

2.2 Method

2.2.1 Sample Preparation

The dry durian peel and teak sawdust air-dried and grounded using a mortar and pestle. The sample powder of durian peel, teak wood sawdust, and mixed of durian peel and teak wood sawdust were pressed by using universal compressive testing machine. Printing was using a square shape mould from the box plate with a pressure gauge. The sample mixed with starch as a binder for the briquettes and then compressed with 600 PSI (Per Square Inch), 800 PSI, and 1000 PSI. The briquette produced when sawdust mixed with starch. The sample was placed in between plates of the machine. The briquettes were produced at combination using durian peel and teak wood sawdust as follows 100%, 75%: 25%, 50% : 50%, and 25%: 75%.

2.2.2 Calorific Value/Heating Value of Briquettes

Calorific value (CV) is amount of energy (kg) emitted during combustion (Kollman and Cote, 1968) and it's an important parameter of fuel. Calorific value of raw teak wood sawdust and durian peel made at various 600 PSI, 800 PSI, and 1000 PSI were determined according to ASTM Standard D 5865 by using bomb calorimeter.

During sample combustion, the temperature was rising due to the heat release. The amount of heat released by the sample determined by multiplying the measured the number of rising temperature with the energy equivalent of the calorimeter. Furthermore, calorific value on a unit weight basis, the release heat divided by the weight of the sample.

$$Q\ (kJ/kg) = [W\ x\ (T1 - T2)]/X$$

Q is heating value, W is the energy equivalent of calorimeter that was found at 10027.42 kJ/C by using standard benzoic acid, T1-T2 is the temperature rise in a calorimeter, and X is the sample mass.

3 RESULT AND DISCUSSION

3.1 Preliminary Calorific Value Testing

An important characteristic of any biomass fuel lies on its heating value. In this study, the researcher used the mixed durian peel and teak wood sawdust briquettes with compressive strength 800 PSI (Pounds per Square Inch) in 1 gram of each powder. The result of the experimental test of the calorific value can be seen in Figure 1.

The obtained result values expressed as the durian peel had a higher caloric value than teak wood sawdust with 51,7%. This is because of combined effect of higher content or lignin carbon of the individual biomass materials (Emerhi, 2011, Syahri et al., 2015). Furthermore, durian peel briquette density is smaller than briquette from hardwood (Tumurulu et al, 2010, Yudanto and Kusumaningrum, 2011). That's also consistent with Nuriana *et al*., 2014 finding that stated calorific value of durian peel briquette is greater than teak wood sawdust, palm

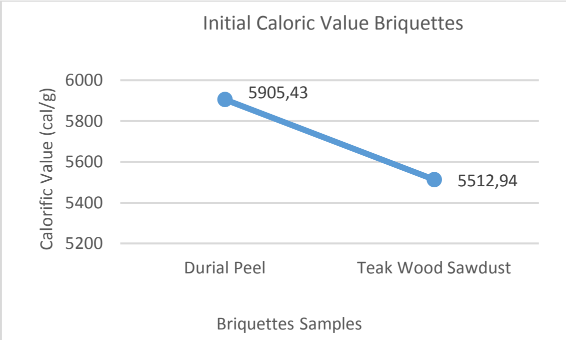

Figure 1: Initial calorific value in durian peel and teak wood sawdust Briquettes.

shell, coal briquettes mix (type of lignite), coconut fibre, rice husk.

3.2 Durian Peel and Teak Wood Sawdust Testing

This study continues the effort of author to understand the calorific value of mixed durian peel and teak wood sawdust briquettes. Figure 2 presents the comparison of 100% teak wood sawdust, durian peel 25% and teak wood sawdust 75%, durian peel 50% and teak wood sawdust 50%, durian peel 75% and teak wood sawdust 25%. All the combination tested with compression strength of 800 PSI.

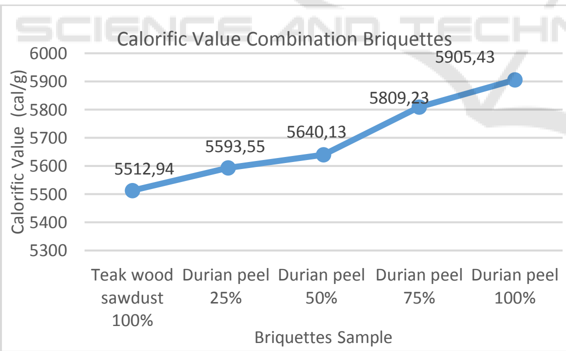

Figure 2: Calorific value durian peel and teak wood sawdust combination briquettes.

From Figure 2, it is apparent that the highest calorific value in briquettes shown by the mixed of durian peel 75% and teak wood sawdust 25% (5809.23 cal/g), then followed by durian peel 50% and teak wood sawdust 50% (5640.13 cal/g), durian peel 25% g and teak wood sawdust 75% (5593.55 cal/g). This finding also support the preliminary calorific value test that with the greater combination of durian peel than teak wood sawdust, it's definitely increase briquettes calorific value.

3.3 Calorific Value Test

Figure 3 illustrates the effect of compressive strength on briquettes density, that shows gradual increase in density for mixed (50:50) briquette with increasing compressive strength of 600 PSI, 800 PSI, and 1000 PSI. The calorific value shows the high result on 1000 PSI. Interestingly, the caloric value was increasing gradually from 600 PSI to 1000 PSI. The higher compressive strength indicated more water content comes out which correlates well with the caloric value of mixed briquette (Nuriana et al, 2014., Poddar et al, 2014). The higher moisture content is responsible for the low mass and height of their briquettes. This effect of lower moisture and water content occurred along with increasing of compressive strength. Thus, compressive strength is prominent in the context changes the higher calorific value.

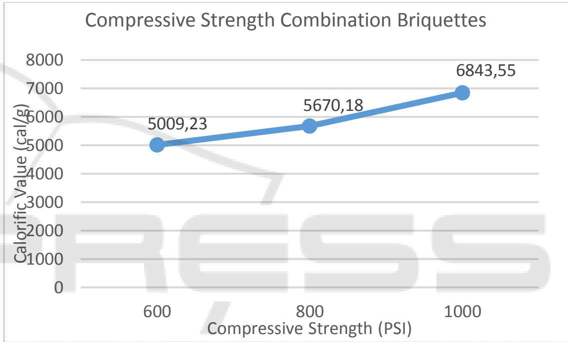

Figure 3: Compressive strength durian peel and teak wood sawdust combination briquettes.

4 CONCLUSIONS

The current work evaluated the durian peel briquette, teak wood sawdust, and its blends. The result illustrates that the durian peel has higher caloric value than the teak wood sawdust briquettes. The test with various blend ratio powder shows that the increasing content of the durian peel briquette enhances the calorific value of the briquettes. The compressive strength test result shows that the increase in compressive strength will also increase the caloric value briquettes. Therefore, it can be concluded that mixed durian peel and teak sawdust can be used as good quality of biomass briquettes which fit with the standards in Indonesia quality (BSN, 2000). Further investigation on mixed durian peel and teak wood sawdust briquettes is suitable for the source of alternative energy in all communities.

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