The Effect Of Adhesive Variations (Starch, Liquid Smoke, and Used Oil), And The Form Of Rice Husk Briquette (Cylinder and Block) On The Performance Of The Gasification TLUD Method

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Abstract. This research aimed to determine the effect of the adhesive types on rice husk briquettes in the TLUD gasification process. The types of adhesive used are starch, tar, and used oil. Rice husk briquettes have varied in two forms, namely cylindrical and block shapes. Each variation has a diameter of 1 inch and a side of 1 inch as well. Rice husk in uniform meshing with 20 mesh size. The Gasification process uses rice husk briquette as fuel. The next step is to insert 3 kg of briquettes into the gasification cylinder. Then ignited to start the gasification process. The type of gasification furnace used is the TLUD type. That is an updraft type gasification with initial ignition on the upper surface of the briquette fuel. Data collection was carried out to determine how much the sufficient flame temperature was and how long the gasification process's adequate flame time took place and determine the briquettes' quality by testing the water boiling test. These test results show that rice husk briquettes with used oil adhesive variations are better than other adhesive variations, reach an average temperature of 755°C, and boil 2 liters of water in 6 minutes.

1. Introduction

Energy is an important thing and cannot be separated from human life. Currently, agricultural waste sources are one of the most readily available and easily available sources of fuel. One of the farming wastes is waste from rice husks. With this abundance of material, it can be used to make biomass briquettes. This material can be used as an alternative energy source through the gasification process using the TLUD method by knowing the composition and chemical content in rice husk briquettes [1].

Gasification is a thermochemical process technology that converts solid biomass into combustible gas. TLUD (Top Lit Up Draft) is a gasification method, where the gasification method starts from the top of the gasification cylinder, which is on the fuel surface [2, 3]. The gasification process using the TLUD method can produce fewer emissions so that it is more environmentally friendly. In the gasification period using the TLUD method on gasification cookstoves with various designs [4]. This is done to get the best performance of the gasification cook stove [5].
Biomass is one of the most important renewable energy sources soon [6]. Biomass is the third leading source of energy after coal and oil [7]. Biomass can be transformed into other energy sources. Like thermal, electric, or biogas; in centralized or decentralized small-scale utilities [8]. Due to its extensive spread. Availability, renewable and nutritional capacity concerning global warming. The ability of biomass to help meet global energy demand has been widely recognized. The reduction of imported forms of energy and the conservation of a limited supply of fossil fuels rely on all other indigenous energy sources [9]. Each biomass has carbon, hydrogen, and oxygen significance amount. They are described as the ultimate analytics. The composition of 13 biomass was reported by Raveendran et al. [10] Fabrication of biomass briquette is already simulated from the municipal waste steam (Romalosa and Kraft) [11]. Garrido et al. investigated briquettes from sawdust, date palm trunk, and other plastic wastes [12]. Sawdust briquette with all binders’ variations has a heating value exceeding 4000 Cal/gr, meaning that these briquettes now also reach this same briquette production requirement [13]. In respective of the composite sawdust briquettes’ percentage composition, the Percentage Heat Utilized (PHU) was found to increase [14].

Biomass gasification is aimed toward direct liquefaction, coal combustion, and biochemical conversion [15]. Drying, pyrolysis, gasification, and oxidation are the four major gasifier zones depending on gasifier and feedstock [16]. Different temperatures and reactions occurred in different zones. Each zone relies on feedstock, gasifier, temperature, particle size, moisture content, and chemical composition [17]. The other research regarding briquette quality, shown that variations in bio-residue mixing ratios had significant effects on all properties studied. The increase in carbon particles has contributed to a rise in the fixed carbon content and the briquettes’ heating value [18]. Study about binder of briquette; Zhang [19] said that the binding mechanisms, a binder containing sodium hydroxide, were quite different from that made with lime.

2. Research Methodology

This investigation’s first stage is designing and manufacturing a briquette molding machine Fig. 1 [13]. The tool operates by hydraulic power. This briquette molding method consists of O1 in and one high die and briquette-sized punches. The sawdust is crushed and then filtered into 20 mesh. They mix the sawdust and binder (50:50) contents of the briquette. An adhesive variation involves starch, tar, and oil. After being a dough, the briquette is molded at 30 kg / cm². One molding process will create twenty-five briquettes. Drying is done until the briquettes contain less than 20% water contain Fig. 2.
3. Result and Discussion
Data is recorded after the gasification process occurs, signed by flame to reach temperature 100°C using a thermocouple reader. Sufficient temperature and time flame effectiveness noted on interval 30 seconds.

Figure 4 shows that the lowest initial flame temperature is in the briquettes with starch adhesive, 95°C. The initial flame temperature for liquid smoke briquettes and oil is 270°C and 550°C, for the highest flame temperature occurred in briquettes with oil adhesive, which was 892°C. Meanwhile, the most increased weather for briquettes with starch adhesive was 725°C, while the briquettes with liquid smoke adhesive were 754.5°C in sequence. The adequate ignition time of briquettes from various starch adhesives, liquid smoke, and oil were 83 minutes, 75.5 minutes, and 71 minutes, respectively. The overall average temperature from the highest to the lowest, respectively, is 742.274°C for oil adhesive, 568.529°C for liquid smoke adhesive, and 511.259°C for starch adhesive.
Figure 4: The graph comparison between sufficient temperature and time flame useful on cylinder rice husk briquette with some variation of binder

Figure 5: The graph comparison between sufficient temperature and time flame useful on block rice husk briquette with some variation of binder

Figure 5 shows that the lowest initial flame temperature is found in briquettes with starch adhesive, 116.5°C. In contrast, the initial flame temperature for briquettes with liquid smoke adhesive is 364°C and 570°C for briquettes with oil adhesive. The highest flame temperature is found in the oil adhesive, which is 902°C. While the most elevated weather in briquettes with starch adhesive and liquid smoke, respectively, was 722.5°C and 755°C. The real sufficient flame in this gasification process is 80 minutes for briquettes with starch adhesive, 69 minutes for briquettes with liquid smoke adhesive, and 65 minutes for briquettes oil adhesive. Meanwhile, the overall average temperature from highest to lowest is 755.05°C for oil adhesive, 633.118°C for liquid smoke adhesive, and 526.556°C for starch adhesive.

One method to determine the quality of briquette is by calorie values. Another way is by using a water boiling test. As shown in Figure 6, this test is carried out by heating 2 liters of water in a gasification furnace. The temperature was recorded until it reached the boiling point
of water, namely 100°C at 1 atm pressure. In Figure 6 (a), where briquettes are cylindrical, briquettes with used oil adhesive can boil water in 6.5 minutes, while briquettes with liquid smoke adhesive 18.5 minutes then briquettes with starch adhesive at 20 minutes. Briquettes in the form of blocks with used oil adhesive can boil water in the 11th minute, followed by briquettes with liquid smoke adhesive on the 21st minute and briquettes with starch adhesive at 26.5 minutes that look in Figure 6 (b).

4. Conclusion
Based on the analysis of the research results, it can be concluded that the average temperature flame is highest in the block briquettes with used oil as adhesive, equal to 755.05°C. On the other hand, cylindrical briquettes with used oil as a binder reach an average temperature of around 742.274°C. The quality of briquettes by water boiling test, the fastest boiling time, cylindrical briquettes with variations of used oil adhesive took 6 minutes. The quickest water boiling time is in briquettes with used oil adhesive variations for the block form, which takes 11 minutes.

Acknowledgments
Appreciation and thank you have given to the Directorate General of Research, Technology, and Higher Education, Ministry of Research and Technology (BRIN) of the Republic of Indonesia. Financial of this research according to Contract Number 186/SP2H/DRPM/2020; 006/LL6/PG/SP2H/PL.1/2020; 133.2/A.3-III-LPPM/2020 Project at the Fiscal year 2020.

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