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Analysis of Calorific Value of *Tibarau* Cane Briquette

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Abstract. The development of product diversification through tibarau cane briquettes as an effort in obtaining alternative fuels. Tibarau cane is one of the potential materials of renewable energy sources that can be processed into briquette. So as to reduce dependence on energy fuel oil, which for the middle to lower class is the main requirement. Efforts and innovations tibarau cane briquettes in producing fuel that has quality and performance can be measured with calorific value. Prior to development of this potential required the existence of test and evaluation stages according to the order of the flow of new material product development. Through process technology of briquette product making with compaction and optimization of composition content on tapioca adhesive and mesh particles suitable to get optimum calorific value. The results obtained in this research are the development of tibarau cane briquette model which is recommended as replacement fuel. Where the calorific value of tibarau cane briquette is 11.221,72 kJ / kg at composition percentage 80: 20 and its density is 0,565 gr/cm^3. The comparison of mass tibarau with tapioca, particle size, pressure force (compaction), can affect the calorific value and density of tibarau cane briquette.

1. Introduction

World energy needs continue to increase, especially in Indonesia as one of the producers of petroleum. According to reports of various print and electronic media has reached about 211 trillion in 2012 in which world energy demand will reach twice that of current needs, especially petroleum. It is estimated that the domestic oil reserves, which are the main source of Indonesia's energy, will be exhausted by 2025. By 2015, domestic fuel consumption is already above 1.5 million barrels per day, while production is below 800,000 barrels per day. This condition indicates an energy and / or energy emergency crisis. So it must import 700,000 barrels per day. The Center for Energy Studies of Asia Pacific (APERC) estimates that fuel energy needs will jump from 1,087 million tons of oil equivalent in 2002 to 1,991 million tons of oil equivalent by 2030. If there is no remarkable effort to reduce oil-based energy consumption or encourage energy use renewable, APERC estimates that Indonesia will rely on imports to meet domestic energy needs by 2030 (http://edukasi.kompas.com/). The delay in anticipation in developing alternative energy and energy sources, according to experts will cause Indonesia to experience serious energy problems entering the year 2020.

This increase in energy demand has an impact amongst the community and burdens the government with fuel subsidies that affect the joints of people's lives. With the increasing demand and fuel prices unpredictable in the last decade has encouraged the development of bioenergy and the use of renewable energy as an alternative energy source. The Government has issued Presidential Regulation RI No. 5 - 2006 on the national energy policy which contains the provision that a certain alternative energy source is a certain energy source substitute for fuel. This is an

opportunity for all components of the nation to actively participate in developing energy resources, including the potential of biomass energy from industrial waste and agricultural products, such as the utilization of bagasse, durian skin, coconut shell charcoal, and so on. In the Presidential Regulation RI No. 79 - 2014 on National Energy Policy, it is formulated that it is necessary to increase the utilization of new energy sources in the form of solid and renewable energy sources of biomass and waste types. Presidential Regulation No. 41 - 2016 on the Procedures for the Determination and Crisis of Energy and / or Emergency of Energy implemented by the National Energy Council (NEC) in order to ensure national energy security. The acceleration of provision in various options and the adoption of alternative energy is one of the steps that must be taken in the future. Among these things can be achieved through the production of solid fuel types, such as tibarau cane-made briquettes. According to Grover and Mishra [1], fuel briquette technology can be done with three methods.

The development of bioenergy as an alternative energy source, outside the fossil energy source is increasingly scarce. One of the renewable energy that has great potential in Indonesia is biomass. As in the policy of renewable energy development and energy conversion of the Department of Energy and Mineral Resources (2016) [2] mentioned that the potential of biomass energy in Indonesia is quite large reaches 49.8 GWe. This biomass energy includes, wood fuel, agricultural & plantation / forest waste, organic material components from industrial and household waste. Some alternative energy that can be developed as a substitution of petroleum is geothermal, coal, and biomass (waste). For geothermal and coal is still a fossil energy although not yet optimal use and processing. In this regard, it is necessary to optimize the development of materials and potential biomass energy sources into a form of innovative fuel products that can meet the demands of energy needs and make it as a trading commodity.

Tibarau cane plant is an alternative source of potential energy because tibarau cane produces biomass of bagasse (bagasse). Biomass can be burned in the form of powder, briquette, or bar. Briquettes are an effective method for converting solid raw materials into a compact form that is easier to use.

The utilization of tibarau cane that has not been touched so far can be used as solid fuel (briquettes) processed with a combination of potential materials of other biomass energy sources. This is one form of solid fuel product innovation so it becomes the embryo of alternative energy. By diversifying sources of potential energy derived from biomass can improve the investment climate and national capabilities in implementing government programs.

The research that has been done on tibarau cane plant that get the result of low heat bio-ethanol power and also has the value of heat energy / calor to the juice by fermentation process after distillation [3]. As a naturally occurring fibrous plant containing lignocellulose, tibarau sugarcane also contains sugar with brix content of origin (niranya) ranging from 3% - 6% and slightly lower than sugarcane cultivation containing 8% - 12% brix [4]. Lalit K Singh, et al [5] from Pelgia Research Library-Indian Institute of Technology reported that tibarau cane plant has chemical content. The potential of this tibarau cane plant can be recommended for raw materials for the development of biofuels.

Before tibarau cane briquette product developed as alternative fuel, it is necessary to evaluate the quality and performance of calorific value analysis so that this innovation model can be applied as a contribution to achieve national energy security.

2. Research Methods

In this research, an experimental study on the characteristics of tibarau cane briquette test sample. The implementation orientation is focused on the manufacture and development of briquette fuel products made from raw tibarau cane (Figure 1, and 2). Sugarcane was previously chopped and made into granular particles (mesh) as a requirement.

Figure 1. Tibarau Cane Plantation

Figure 2. Tibarau Cane Bagasse

The adhesive material used in the manufacture of this briquette is tapioca (Figure 3). The method of making this briquette with optimal percentage of mix as variance, modification of addition of raw material having potency as main mixture. Percentage of main raw material mixture to adhesive is 90%: 10%, 80%: 20%, 70%: 30%, 60%: 40%, 50%: 50%. Prepared mixed variance is followed by made on compaction is 100 kgf/cm^2. The madeed briquette model is then dried in a few days heat radiation of the sun.

Figure 3. Tapioca

The next perform testing in the laboratory for each test sample produced. The objective of this research is by applying appropriate methods to inventory, measure, test or analyze the parameters and research variables that are established or arise due to treatment and conditional.

In the laboratory experiment, a device called "Bomb Calorimeter" (Figure 4) was tested with stable room temperature conditions. The test obtained is related to heat energy of combustion or calorific value.

Figure 4. Bomb Calorimeter

In the analysis of each type and composition of the percentage of mixed materials and treatment parameters will be recorded and tabulated in the table data collection is designed as needed. Data analysis and calculation using the existing raw formula and computed aided processing. The highest heating value (N_{bb}) can be calculated by the equation:

$$N_{bb} = \frac{(t_2 - t_1)\, c_v}{m_{bb}} \qquad (kJ/kg) \tag{1}$$

3. Results and Discussion

In this study prepared as much raw materials as possible for the manufacture and printing of tibarau cane briquettes. The need of research materials in the form of bagasse tibarau by predicting the number of variations of the mixture between bagasse with tibarau adhesive. This is done based on the line of thought according to technical briquette making then obtained some prototype of the physical result of development (Figure 5).

Figure 5. Tibarau Cane Briquette.

Table 1. Physical Characteristic of Tibarau Cane Briquette

Composition Percentage Raw Materials and Adhesives		Briquette Mass dry	Density (ρ)	Calorific Value N_{bb}
Tibarau Cane (%)	Tapioca (%)	(gr)	(gr/cm^3)	(kJ/kg)
90	10	45,4	0,482	9479,82
80	20	53,2	0,565	11221,72
70	30	52,6	0,558	8195,95
60	40	53,2	0,565	7127,22
50	50	52,8	0,561	5059,14

Based on the order of procedure of using the Bomb Calorimeter tool, the values of combustion for tibarau cane briquettes are generated as in Table 1. The values obtained by the quantities of physics in Table 1 are derived based on the standard formula by inputting the data from the measurement results on the test equipment Bomb Calorimeter.

From the testing result of tibarau cane briquette calorific value to all variations, then from the analysis data can be stated that the composition that has the greatest value is recommended for the production more as the next test sample. Tibarau cane briquettes that have an optimum value of 80 : 20 composition variance, where calorific value is 11.221,72 kJ/kg and density 0,565 gr/cm^3.

4. Conclusion

From this research can be concluded as follows:

a. Successfully utilize tibarau cane as a candidate of raw material Briquette in the development of renewable energy to achieve national energy security.
b. The resulting tibarau cane briquettes have physical characteristics of optimum calorific value of 11221,72 kJ/kg at 80: 20 composition variance with density 0,565 gr/cm^3
c. The composition of the mixture between the raw material and the adhesive, the grain size, the pressure force (compaction) greatly affects the mass of the briquette value of the resulting calorific value.

5. References

[1]. Grover,P.D & Mishra,S.K (1996), Biomass Briquetting: Technology and Practices, Field Document No 46, FAO - Regional Wood Energy Development Program in Asia, Bangkok
[2]. Departemen Energi dan Sumberdaya Mineral (2016); Statistik Energi Indonesia
[3]. Hasanuddin & Hendri Nurdin (2016); Pengembangan Bahan Bakar *Bioethanol* Dari Tumbuhan Tebu *Tibarau* Dengan Penambahan Zat Kapur Kulit Kerang Untuk Peningkatan Energi Panas, Laporan Penelitian Desentralisasi
[4]. Hasanuddin & Hendri Nurdin (2015); Design and Contructions of Simple Distilations Unit With Reflux Column Model For Cane Tibarau (*Saccarum Spontaneous Linn*) Bioethnol Productions, Proceeding International Conference ICOMSET, pp. 441 - 447, Oktober 2015
[5]. Lalit K Singh, et al (2011), Utilization of hemicellulosic fraction of lignocellulosic biomaterial for bioethanol production, Journal Pelagia Research Library Adv. Appl. Sci. Res., 2011, 2 (5):508-521