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Research Paper

Influence of Temperature and Particle Size on Heating Value of Bio briquette from Rubber Seed

Tiara Armita[1]*, Sri Haryati[1], Risfidian Mohadi[2], Puteri Kusuma Wardhani[3]

[1] *Department of Chemical Engineering, Faculty of Engineering, University of Sriwijaya, Sumatera Selatan, Indonesia*
[2] *Department of Chemistry, Faculty of Mathematics and Natural Sciences, University of Sriwijaya, Sumatera Selatan, Indonesia*
[3] *Department of Civil Engineering, Faculty of Engineering, University of Sriwijaya, Sumatera Selatan, Indonesia*
***Corresponding author**: armitatiara@yahoo.co.id

Abstract
Rubber seed as biomass is potentially used as the source of alternative energy in briquette. The effect of temperature and particle size on the amount of heat of rubber seed bio-briquette from Muarakuang (Batu Raja) was investigated to increase the heating value of briquette. The temperature was varied by 250 °C, 500 °C, and 750 °C, while the particle size varied by 80 mesh, 120 mesh, and 200 mesh. Quality test of fabricated bio-briquette consisted of proximate analysis such as calorific value, inherent moisture, ash ratio, volatile matter ratio, and fixed carbon ratio. The highest of heating value was 6836 cal/g from bio briquette sample were found under particle size of 80 mesh and temperature of 250 °C. The heating value reached minimum on 5371 cal/g which the particle size was 200 mesh and temperature of 750 °C.

Keywords
Rubber seed, Bio briquette, Temperature, Particle size

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1. INTRODUCTION

World energy resources are still dominated by non-renewable energy resources, such as coal, crude oil, and natural gas. These primary energy resources are predicted to be used up in a short time. Renewable and eco-friendly energy resources are needed as an alternative to our fossil energy resources.

One of the promising alternative energy resources is biomass. The rubber plant is one of the abundant biomasses in Indonesia. In 2015, rubber production in Indonesia reached 353.883 tons from the production area of 306.163 Ha. In South Sumatera, the production area of the rubber plant reached 31.122 Ha.

Rubber plant produces latex and rubber seed. In this recent day, Latex from the rubber plant is used, but the rubber seeds are still classified as waste. Rubber seed as biomass is potentially used as the source of alternative energy in briquette form.

One of the processes that can be used to convert rubber seed biomass to briquette is torrefaction process. Torrefaction process is a thermochemistry process for raw material which contains carbon in a temperature range of 200 – 300 °C (Bergman, 2005). There are some advantages of torrefaction process, such as increasing fixed carbon composition, decreasing volatile matter composition, increasing product quality, reducing water composition, and reducing the product ability to absorbs the containing water in the air (Chen and Kuo, 2011).

Some researches about the torrefaction process had been done. This research used durian peel waste and bagasse waste to produces briquette in a temperature range of 200 – 350 °C and torrefaction time of 10 – 30 minutes (Rahmatullah, 2016; Haryati et al., 2018). The produced durian peel waste briquette had the highest amount of heat of 6157 cal/g in torrefaction temperature of 350 oC while the bagasse briquette had the lowest amount of heat of 6076 cal/g in temperature of 200 °C.

Research about the torrefaction process in rubber seed biomass is also done by Pratiwi (2017). In this research, the highest amount of heat of 6287,3 cal/g is reached in temperature of 300 °C and torrefaction time of 60 minutes while the lowest amount of heat of 5349,88 cal/g is reached in temperature of 200 °C and torrefaction time of 15 minutes.

In 2017, Siagian and Christian (2017) also did research about producing durian shell briquette by using torrefaction process by the standard particle size of 10 and 20 mesh and torrefaction temperature of 200 – 350 °C. From this research, the bio briquette with optimum quality is determined from a sample with a particle size of 10 mesh and torrefaction temperature of 200 °C. The amount of heat of the optimum quality bio briquette is 6432 cal/g.

From researches mentioned, we do research about the effect of carbon particle size from the torrefaction process of rubber

Table 1. The ratio of Rubber Seed Biobriquette Quality with the Particle Size of 80 mesh and Temperature of 250 °C – 750 °C and Indonesian Quality Requirement SNI 01-6235-2000

Parameter	Unit	Quality Requirement	Temperature (°C)		
			250	500	750
Calorific Value	cal/gr	Min. 5000	6836	6270	5723
Inherent Moisture	% adb	Maks. 8	3,57	3,08	2,44
Ash Content	% adb	Maks. 8	6,38	7,99	7,72
Volatile Matter	% adb	Maks. 15	6,29	10,69	12,16
Fixed Carbon	%adb	Min. 77	87,79	75,93	64,43

Table 2. Ratio of Rubber Seed Biobriquette Quality with the Particle Size of 120 mesh and Temperature of 250 °C – 750 °C and Indonesian Quality Requirement SNI 01-6235-2000

Parameter	Unit	Quality Requirement	Temperature (°C)		
			250	500	750
Calorific Value	cal/gr	Min. 5000	6737	6252	5477
Inherent Moisture	% adb	Maks. 8	6,25	5,66	3,39
Ash	% adb	Maks. 8	7,27	7,7	7,4
Volatile Matter	% adb	Maks. 15	9,06	11,67	13,09
Fixed Carbon	%adb	Min. 77	79,81	79,04	65,61

seed in increasing bio briquette amount of heat.

2. EXPERIMENTAL SECTION

2.1 Materials

This research was conducted at Coal Laboratory Politeknik Sriwijaya Palembang, started from February - April 2018. The materials used in this research are rubber seed, tapioca powder, and aquades. Equipment used in this research includes: Briquette mold, digital balance, hydraulic press, crusher, Bomb Calorimeter, furnace, oven, grinding mill, and jar.

2.2 Methods

The rubber seeds were separated from its shell, then measured the mass. The rubber seed heated into the furnace under different temperature conditions (250 °C, 500 °C, and 750 °C). The furnaced rubber seed was grinded in grinding mill and filtered into different particle size (80, 120, 200 mesh). The rubber seed was put into the mold and pressed until it formed a briquette, and then dried in sun. Proximate analysis was done including calorific value, inherent moisture, ash ratio, volatile matter ratio, and fixed carbon ratio.

3. RESULTS AND DISCUSSION

Biobriquette in this research is fabricated from rubber seed. The temperature varied to 250 °C, 500 °C, 750 °C. The particle size is also varied to 80, 120, and 200 mesh. Quality test of fabricated bio briquette consisted of proximate analysis such as calorific value, inherent moisture, ash ratio, volatile matter ratio, and fixed carbon ratio.

Based on Table 1, Table 2, Table 3, rubber seed biobriquette amount of heat has met the Indonesian National Standardization (SNI) with minimum amount of heat of 5000 cal/g. The amount of heat of the samples ranges from 5371 cal/g until 6836 cal/g.

Amount of heat is a number that shows amount of calories or heat in fuel in the combustion process and a number that considers the quality of a bio briquette. When the amount of heat is higher, the bio briquette quality is better.

For every sample with 80 mesh, 120 mesh, and 200 mesh particle size, the amount of heat tends to decrease when the temperature increases. It is caused by the increasing of fixed carbon composition during torrefaction process and the decreasing of volatile matter composition in rubber seed (Azhar and Rustamaji, 2009). Amount of heat decreases as the temperature increases for every sample. In a temperature of 750 °C, which is the maximum temperature for the carbonization process, the rubber seed fixed carbon composition becomes ash and gas. The highest amount of heat for rubber seed sample with 80 mesh particle size and 250 °C temperature is 6836 cal/g. The lowest amount of heat of 5371 cal/g is reached for a sample with 200 mesh particle size and 750 °C temperature. Inherent moisture composition is determined by varying temperature from 104 °C to 110 °C in 1 hour. The inherent moisture composition for every sample is made as low as possible. Table 1 shows the lowest inherent moisture composition of 3,57% for 80 mesh particle size in temperature of 250 °C. Highest inherent moisture composition of 7,83% is reached for a sample with 200 mesh particle size and temperature of 250 °C. Highest bio briquette inherent moisture composition is affected by complete raw material drying process and small particle size that allows water enters the sample pores

Table 3. Ratio of Rubber Seed Biobriquette Quality with the Particle Size of 200 mesh and Temperature of 250 °C – 750 °C and Indonesian Quality Requirement SNI 01-6235-2000

Parameter	Unit	Quality Requirement	Temperature (°C) 250	500	750
Calorific Value	cal/gr	Min. 5000	6188	5398	5371
Inherent Moisture	% adb	Maks. 8	7,83	7,61	5,69
Ash	% adb	Maks. 8	7,58	7,04	7,44
Volatile Matter	% adb	Maks. 15	10,21	12,96	14,18
Fixed Carbon	%adb	Min. 77	77,94	78,68	67,89

(Ristianingsih, 2015).

Ash bio briquette composition is important to determine fixed carbon composition which can determine the amount of heat. Ash composition is inversely proportional to the amount of heat and fixed carbon composition. Ash composition in raw material can be found from sand, clay, and other mineral matters. The lowest volatile matter composition of 6,29% is reached for a sample with 80 mesh particle size and temperature of 250 °C while the highest volatile matter composition if 14,18% is reached for a sample with 200 mesh particle size and temperature of 750 °C. Volatile matter composition is affected by a charcoal chemical component such as impurities (Ristianingsih, 2015).

Highest fixed carbon composition of 87,79% was reached for a sample with 80 mesh particle size and temperature of 250 °C while the lowest fixed carbon composition of 64,43% is reached for a sample with 80 mesh particle size and temperature of 750 °C.

4. CONCLUSIONS

Rubber plant produces latex and rubber seeds. Latex from the rubber plant is used, but the rubber seeds are still classified as waste. Rubber seed as biomass is potentially used as the source of alternative energy in briquette form. Previous research had found that rubber seed briquette has the highest amount of heat of 6287,8 cal/g.

In this research, the effect of temperature and particle size on the amount of heat of rubber seed bio briquette from Muarakuang (Batu Raja) was investigated. The temperature was varied of 250 °C, 500 °C, and 750 °C with the particle size varied by 80 mesh, 120 mesh, and 200 mesh. Quality test of fabricated bio briquette consisted of proximate analysis such as calorific value, inherent moisture, ash ratio, volatile matter ratio, and fixed carbon ratio.

The highest amount of heat of 6836 cal/g is reached for the sample with 80 mesh particle size and temperature 250 °C while the lowest amount of heat of 5471 cal/g is reached for the sample with 200 mesh particle size and temperature of 5471 cal/g. Rubber seed bio briquette amount of heat parameter also meets Indonesian National Standardization (SNI) with a minimum amount of heat of 5000 cal/g.

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