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2018 5th International Conference on Advanced Engineering and Technology (5th ICAET)

To cite this article: 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **507** 011001

IOP Conf. Series: Materials Science and Engineering **507** (2019) 011001 doi:10.1088/1757-899X/507/1/011001

Preface

The 5th ICAET 2018 is the 2018 5th International Conference on Advanced Engineering and Technology (5th ICAET) took place in Incheon, South Korea, on December 14-16, 2018.

The conference program covered invited, oral, and poster presentations from scientists working in similar areas to establish platforms for collaborative research projects in this field. This conference will bring together leaders from industry and academia to exchange and share their experiences, present research results, explore collaborations and to spark new ideas, with the aim of developing new projects and exploiting new technology in this field.

The committee of ICAET expresses their sincere thanks to all authors for their high-quality research papers and careful presentations. All reviewers are also thanked for their careful comments and advices. Thanks are finally given to IOP Publication as well for producing this volume.

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Harbin Engineering University

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Conference Photograph

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IOP Conf. Series: Materials Science and Engineering **507** (2019) 011001 doi:10.1088/1757-899X/507/1/011001

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The 5th Engineering Science & Technology International Conference 5-6 August 2020, Padang, West Sumatera, Indonesia

Accepted papers received: 10 November 2020

Published online: 01 December 2020

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To cite this article: E Sari *et al* 2020 *IOP Conf. Ser.: Mater. Sci. Eng.* **990** 012013

IOP Conf. Series: Materials Science and Engineering **990** (2020) 012013 doi:10.1088/1757-899X/990/1/012013

Design of Biomass Briquette Stoves: Performance Based on Mixed of Durian Bark, Coconut Shell and Palm Shells as Materials of Bio Briquette

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Abstract. Biomass is a renewable energy source derived from plants and is known as green energy. Biomass is a term used for various types of organic matter in solid form that can be used as fuel. Bio Briquette is a solid fuel made from a mixture of biomass. This fuel is an alternative material that was developed in a bulk with relatively short time and is relatively cheaper. The use of briquettes that must be included with the use of a stove or stove which type and size must be adjusted to the needs. To increase the heat efficiency of the existing briquette stoves, this research was carried out using two different types of stove walls, namely cement-filled stoves and glass wool-filled walls. The performance of the stove can be seen from the combustion of biomass briquette fuel against the briquette shape was molded. From the tests that have been carried out, the efficiency of stoves with cement walls is 29.86%, while for stoves with glass wool walls is 40%. Of the three forms of bio briquette (ellipsoidal, cylinder, perforated cylinder) the use of cylindrical bio briquettes is better because the flame on the briquette is longer when compared to other forms.

1. Introduction

Briquettes are a renewable alternative energy that has great potential in Indonesia. Consider an agricultural country where there are many raw materials for briquettes in large quantities.When compared to oil raw materials which are now classified as rare and non-renewable, briquettes have their own advantages. Meanwhile, bio briquette is a source of biomass energy that is environmentally friendly and also biodegradable.One of these is biobriquettes from biomass.Biomass is composed of cellulose, hemicellulose and lignin that is commonly found in plant parts [7]. Biomass is a source of energy for the future that will never run out, even the number will always increase, so it is very suitable as a source of fuel for households [1]. The biomass that used in this research is durian peel with mixed biomass coconut and palm shells. The addition of coconut shell and palm shell biomass improve the quality of briquettes durian peel [8]. The making of biobriquettes is carried out by the carbonization process, which is the process of making charcoal. The optimum temperature and time in the carbonization process for making biobriquettes are 400℃and 2 hours [9].In the biobriquettes manufacture, carbonization is a very important process because it is the main process in the biobriquettes manufacture whichcan affect the biobriquettes quality [7].The forms of biomass briquettes used are ellipsoidal, perforated cylinders and cylinders [10]. From the three forms of biobriquette (ellipsoidal, cylinder, perforated cylinder) which has the best compressive strength, density and ignition rate is the cylinder shape.The used of briquettes must be accompanied by the use of a stove or stove with the type and size of the furnace that must be adjusted to the needs. It is just that briquette stoves that have been sold in the market have not attracted the public's interest due to their complicated use and also the flue gas produced from the briquette burning process can harm

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health and besides that it also damages kitchen utensils because it leaves black spots on cooking utensils. In previous research, the stove produced still had shortcomings.

One example is the research on the design of the bio briquettestove Sudip which has disadvantages such as baked ceramic stoves and burnt stoves easily cracked, and all that becomes a problem is the ash remover place that is not available so that it does not last long and cannot continue burning[5]. For the design of this briquette stove, it aims to get a high calorific value with maximum efficiency. Maximum in terms of minimum heat loss value, minimum exhaust gas loss, minimizing heat loss due to material.

2. Methods

The methodology used in this study is an experimental method, testing each variation of the amount of charcoal, ignition time, and cooking time. The resulting of bio briquette stoves are cement walls and *glasswool*. For *glasswool* stove specification details are ; the stove equipped with jack with overall height is 70 cm, wall stove height is 40 cm , diameter is 26 cm. The process of measuring data is carried out by determining the initial volume of water and the initial temperature of the water. Determining the amount of bio briquette with various shapes of cylinders, perforated cylinder, ellipsoidal and mixtures.

The tests carried out were the performance of the bio briquette stove, the efficiency of the stove, and the effect of the shape of the bio briquette on temperature and cooking time. Flowchart of the testing phase can be seen in Figure 1.

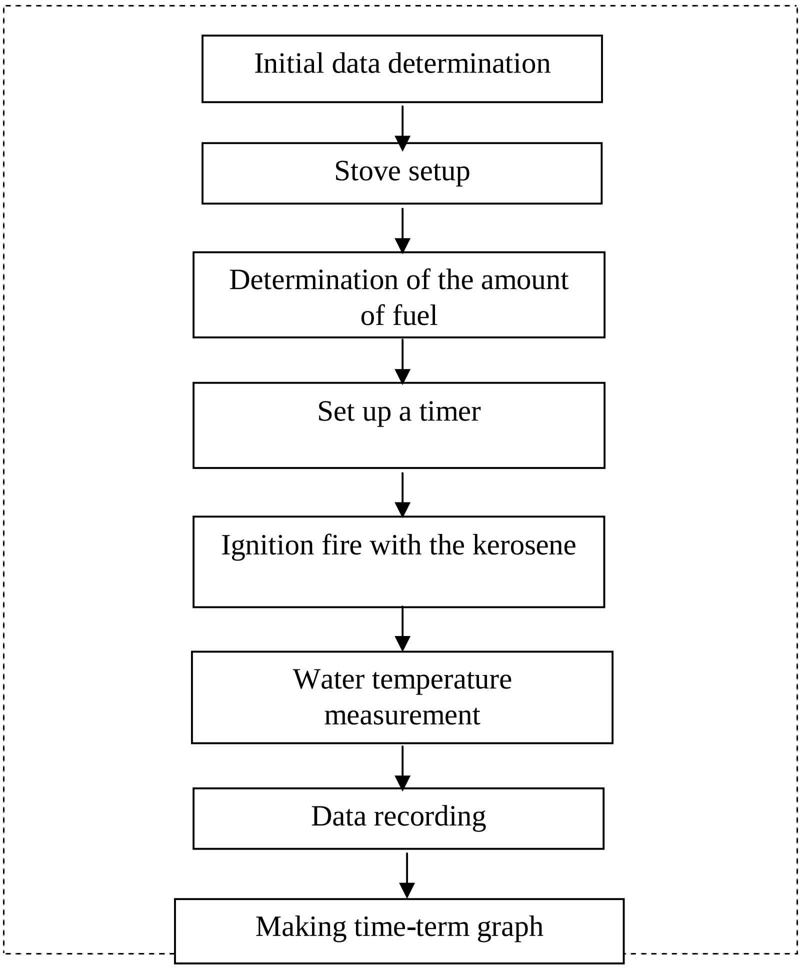

Figure 1. Flowchart of the testing phase.

3. Results and Discussion

The results of the biomass briquette stove design can be seen in Figure 2.

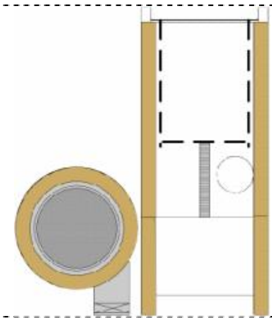

Figure 2. Bio Briquette stove design

The design results of the biomass briquette stove can be seen in Figure 3.

(a) (b)

Figure 3. Design of biomass briquette stove results ; (a) Stove top view, (b) Stove side view

From the results of the design that has been done, there are two variations of the stove wall, namely glass wool and cement, by varying the stove wall in order to see the inhibitor of heat loss from biomass briquettes so that the heat generated can be completely absorbed by water.

This biomass stove has a fan that is located on the side of the stove which is used to blow air from the bottom up so that the resulting fire does not smoke. Then on the stove there is a jack which functions to facilitate the rise and fall of the fire used. Furthermore, on the stove, there is a hollow biomass container or place where the ash after burning will fall and not accumulate in the container. And beside the stove wall there is an ash holder that can be opened so that it can be easier to clean. The performance of the bio briquette stove can be seen in Figure 4.

Figure 4. Bio Briquette stove performance

Figure 4. is the result of turning on the bio briquette stove. The resulting fire does not produce smoke when there is an air supply from the fan so that the combustion of bio briquettes is more complete than the absence of air supply.

According to another researcher,the combustion process that occurs often results in incomplete combustion so that the combustion that occurs produces carbon monoxide, so to obtain complete combustion, sufficient oxygen must be met [3]. The oxygen used can be pure oxygen or oxygen from the air.

The calculation data for the efficiency of the biomass briquette stove can be seen in Table 1

Table 1. Calculation data of the Efficiency of the Biomass Briquette Stove

Spesification	Data 1		Data 2		Data 2	
	Cement Wall Stove	Glass Wool Wall Stove	Cement Wall Stove	Glass Wool Wall Stove	Cement Wall Stove	Glass Wool Wall Stove
Initial briquette weight (g)	316	319	350	350	350	350
Weight of briquettes after burning (g)	209	188	210	209	206	209
Initial volume of water (ml)	500	500	500	500	500	500
Final volume of water (80℃)(ml)	445	466	461	455	477	464
Weight of remaining charcoal (g)	141	137	142	157	136	157.1
Weight of used charcoal (g)	68	51	68	52	70	51 , 9

From the experiments and calculations that have been carried out, the efficiency value of each bio briquette stove is obtained, namely, for the bio briquette stove with a variety of stove walls using for cement valued at 29.86%, while for bio briquette stoves with a variation of the stove walls, glass wool was valued at 40%. Compared to the variation of cement stove walls, the efficiency of glass wool stove wall variations is much higher. The thermal conductivity value of cement and glass wool has respective values of 1.73 and 0.038 W / m^{o}C which means that the ability to conduct heat for cement is greater than that of glass wool, so that glass wool is more can reduce the heat loss [2].

In testing the ignition of the bio briquette stove using variations in the form of ellipsoidal bio briquettes, cylinders and perforated cylinders which can be seen in Figure 5.


(a)

(b)

(c)

Figure 5. The shapes of bio briquettes ; (a) Ellipsoidal shape, (b) Perforated Cylinder shape,(c) Cylinder shape

This testing is carried out from boiling water until the briquettes run out, the results can be obtained. seen in Figure 6.

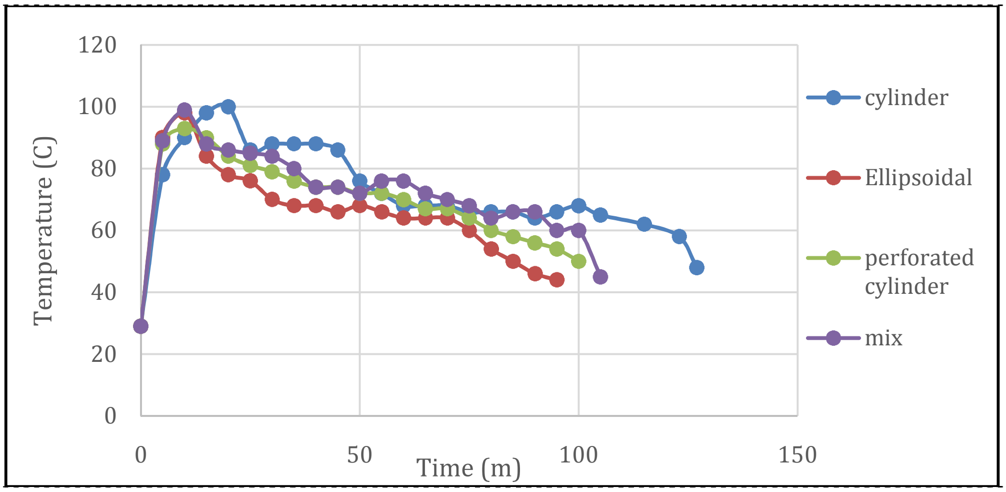

Figure 6. The effect of briquetes shape on cooking time

In Figure 6, it is the result of the trial results of the long ignition of the bio briquette stove using variations in the form of briquettes weighing 200 grams to boil 300 ml of water. From this experiment, the highest temperature ellipsoidal briquette in water was obtained at 98 °C, with 10 minutes cooking times. The length of time to turn on the stove in the ellipsoidal form until the charcoal runs out is 95 minutes with the result that the final volume of water is 79 ml, the final temperature is 44 °C.

For variations in the shape of cylindrical briquettes, the highest temperature that can be achieved is 100 °C at 20 minutes of turning on the stove. The charcoal runs out for 127.19 minutes with a final volume of water 69 ml and a final temperature 48 °C of water. For variations in the shape of the perforated cylinder briquettes, the results obtained are the highest temperature of 93 °C in the 10 minute of stove ignition. The ignition time for this hollow cylinder shape is 109.41 minutes. The final water temperature was 50 °C with a final volume of 49 ml. For the last trial, it was carried out with a mixture of the three variations of briquette shapes, namely ellipsoidal, cylinder and perforated cylinder. The ignition of this mixed variation briquette, the stove ignition time reached 124.12 minutes, the final temperature obtained was 45 °C with the final volume of water as much as 35 ml.

Compared to the results of the four experiments above, the shape of this cylindrical briquette takes longest to ignite. This is because perforated briquettes have a wider oxygen flow space, therefore combustion occurs more easily. The flow of oxygen in the hollow briquette occurs on the outside and inside of the briquette so that the briquette burns out faster. Whereas in cylinder briquettes, oxygen flow only occurs on the outer contents of the briquettes. Another study explaine the reduced air cavity in briquettes with a higher density will slow down the rate of combustion [4]. During the cooking process, a distance from the fire to the boiling pot must be kept. To maintain this distance, this is done by raising the shell where the briquettes are ignited by using a jack.

4. Conclusion

The results of the research that have been carried out provide the following conclusions:
- The resulting bio briquette stove design is a stove with glass wool-coated walls.
- In the stove, it is added with holes in the shell to remove ashes so that it does not accumulate, as well as an air supply from the fan.
- The bio briquette stove that has better efficiency between cement wall variations and glass wool coated walls is a stove with glass wool coated walls, which is 40%.
- Of the three forms of bio briquette (ellipsoidal, cylinder, perforated cylinder) the use of cylindrical bio briquette is better because the flame on the briquette is longer when compared to others.

Acknowledgments
We would like to thank:
- Directorate of Research and Community Service, Directorate General of Research and Development, Ministry of Research, Technology and Higher Education,
- Chancellor and Chair of LPPM Bung Hatta University for the opportunities and facilities provided by
- All parties involved in this research, lecturers, students and workshops from Bandung who helped carry out this research.

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