PAPER NAME

2. Artikel - The Performance of Clay Furn ace with Variation in the.pdf

AUTHOR

S. Suluh

WORD COUNT

1920 Words

CHARACTER COUNT

9772 Characters

PAGE COUNT

6 Pages

FILE SIZE

1.7MB

SUBMISSION DATE

Apr 25, 2023 8:38 PM GMT+8

REPORT DATE

Apr 25, 2023 8:39 PM GMT+8

15% Overall Similarity

The combined total of all matches, including overlapping sources, for each database.

- 13% Internet database
- 6% Publications database
- Crossref database
- Crossref Posted Content database
- 4% Submitted Works database

Excluded from Similarity Report

- Bibliographic material
- Quoted material
- Cited material
- Small Matches (Less then 12 words)
- Manually excluded sources
- Manually excluded text blocks

IOP Conf. Series: Materials Science and Engineering **875** (2020) 012068 doi:10.1088/1757-899X/875/1/012068

The Performance of Clay Furnace with Variation in the Diameters of the Briquette Burning Chamber

Z Djafar[1]*, N Amaliyah[1], S Suluh[2], M Isra[1] and W H Piarah[1]

[1] Mechanical Engineering Department, Engineering Faculty, Hasanuddin University, Makassar, Indonesia
[2] Mechanical Engineering Department, Universitas Kristen Indonesia Toraja, Indonesia

*Email: zuryatidjafar@unhas.ac.id

Abstract. Biomass fuel is an alternative energy source used in the form of briquettes using clay stoves. Utilization of clay as a briquette stove often results are not satisfactory as is the use of other fuel stoves, this is because the amount of air in the furnace burning chamber has not been determined and focused properly, so the purpose of this study is to determine the thermal efficiency of the furnace at variations in the diameter of the aluminum sleeve in the furnace burning chamber. The method used is to test 5 variations in diameter of the furnace burning chamber (cylinder). The results showed the best thermal efficiency was obtained at 52.87% at 180 mm slab diameter, boiling time at 9 minutes, with a heat loss of only 2.02 kW.

1. Introduction

As population growth is so rapid and followed by the depletion of the amount of fossil fuel energy reserves, it is necessary to broaden the investigation of the use of non-fossil alternative energy sources. One of them is the use of biomass energy. Biomass energy is very interesting to use due to its abundant availability. The biomass used in this research is plantation waste, which is coconut shell waste that is used as fuel in the form of briquettes. Coconut shell waste has become material in several research objects, such as Phonphuak and Thiansem [1] in their research, making the waste as an additive for brick making which aims to increase water absorption before burning. Jamilatun [2] has examined the heat content of coconut shell briquettes and obtained a maximum value of 5779.11 kcal/gram. Budi [3] in the same study noted value of 76.52% coconut shell carbon content, and these results are a reference that coconut shell has the potential to become fuel. Higher heating values were obtained in research conducted by Sallolo and Pineng [4] at a heating value of 5839.33 cal/gram with a thermal efficiency of 64.15%.

The problem that often arises in the utilization of biomass briquettes is not from the type of briquette material but in the furnace burning chamber which is not effective in transferring heat to the cooking device. This is largely influenced by the amount of air in the fuel chamber which is often uneven in the arrangement of the briquettes, so this paper is focused on modifying the burning chamber by adding sleeves so that the heat transfer process can be better, so as to provide a better furnace performance. The use of aluminum sleeve is used because the thermal efficiency is quite good at 70.73% [5] and 54.12% [4]. In this study, the diameter of the sleeve will be varied to get the best diameter in producing the best efficiency.

IOP Conf. Series: Materials Science and Engineering **875** (2020) 012068 doi:10.1088/1757-899X/875/1/012068

Cookstoves made of clay or also called 'brazier' traditionally use firewood as fuel, which naturally has a lot of exhaust emissions. Therefore, the Technology Assessment and Application Board (BPPT) has already socialized the use of low-emissions non-fossil fuels, especially carbon emissions and particulates. Haryanto and Triyono [6] have made experimental comparisons of several types of household stoves such as coal, kerosene, LPG stoves, thick pot furnaces and brick/biomass stoves in terms of CO, NO_2, SO_2 and particulate gas emissions. Kerosene stoves have the highest CO emissions, while thick pot furnaces have the lowest SO_2 emissions. In this study, the Proximation test and the heating value of the briquettes were also carried out.

2. Materials and Methods

In this study, the clay stove (brazier) taken is the result of Takalar Pottery Center handicraft as shown in Figure 1 below. The brazier dimensions; 300 mm high, 220 mm outside diameter, 200 mm inner diameter, 10 mm distance from the base of the stove.

Figure 1. Clay furnace (Brazier)

The research method used is an experimental method by utilizing coconut shell charcoal briquette waste as the fuel of the stove that is tested. The briquette used was in the form of a wasp nest because it has a larger flame surface area [7]. Tests of estimation, heating value, burning process, thermal efficiency and burning efficiency of briquettes were carried out on several variations of the sleeve diameter placed in the furnace burning chamber. Sleeves that made of Aluminum plate material, have air holes with a diameter of 10 mm with a distance of 20 mm between holes along the diameter of the upper cylinder (see Figure 2).

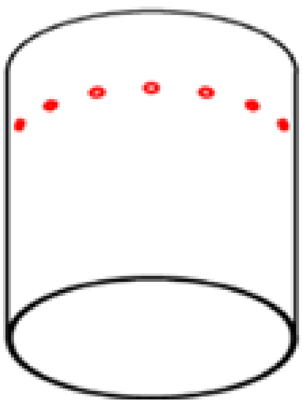

Figure 2. Furnace burning wall cylinders

With the addition of the sleeves, it is expected to improve the burning process in the burning chamber and also reduce heat loss to the radial wall. The diameter of the cylinder varied from 140mm, 150mm, 160mm, 170mm and 180mm.

3. Result and Discussions

This research begins with the manufacture of briquettes, estimation testing, and Calorific Value and then proceed with the Burning Test (performance) with a variation of 5 sleeve diameter sizes. The test parameters are the duration (time) of burning, fire temperature, fuel-burning chamber temperature, boiling time, fuel consumption and efficiency. The fire temperature as a function of burning time can be seen in Figure 3 below.

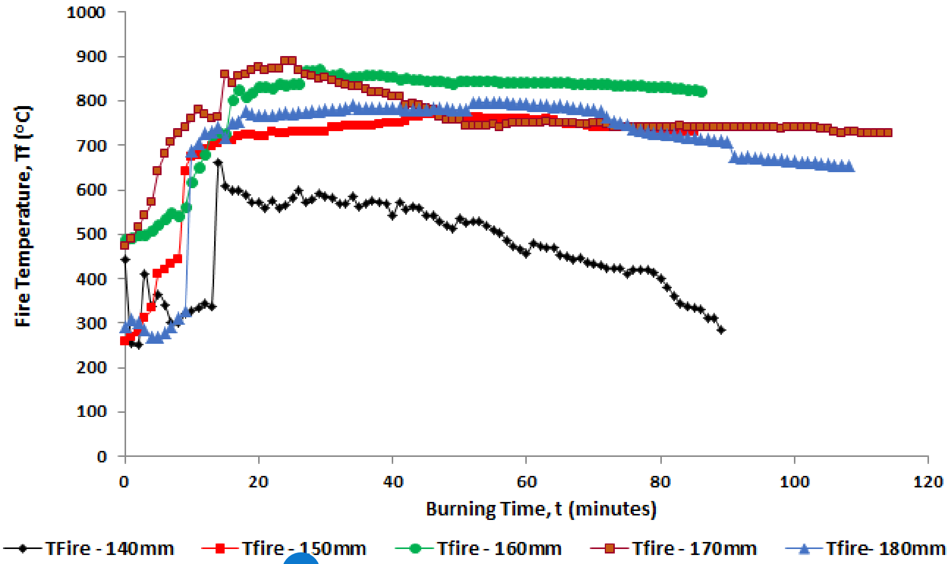

Figure 3. The fire temperature to the burning time

Figure 3 shows that the maximum temperature occurs at 160 mm sleeve diameter of 854°C. Meanwhile, for the diameter of 170 mm sleeves, although it has a relatively lower temperature (790°C), it has a longer burning time (114 minutes) and is able to boil as much as 30 liters of water.

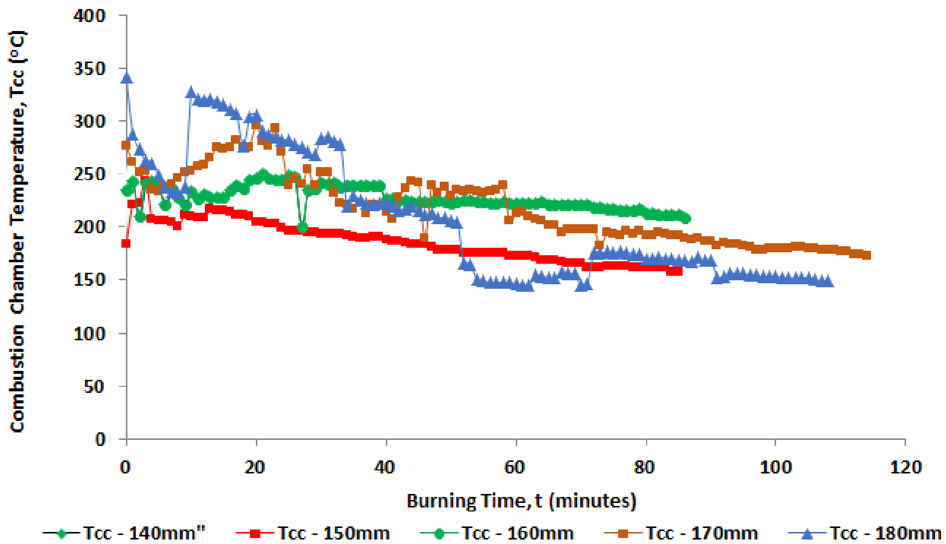

Figure 4. The burning chamber temperature to the burning time

Figure 4 shows the phenomenon of burning chamber temperature which is identical to the temperature in Figure 3. The highest temperature occurs at 160 mm sleeve diameter and the longest combustion at 170 mm diameter. It can be said, the larger the diameter is, the longer the heat in the combustion chamber can be maintained.

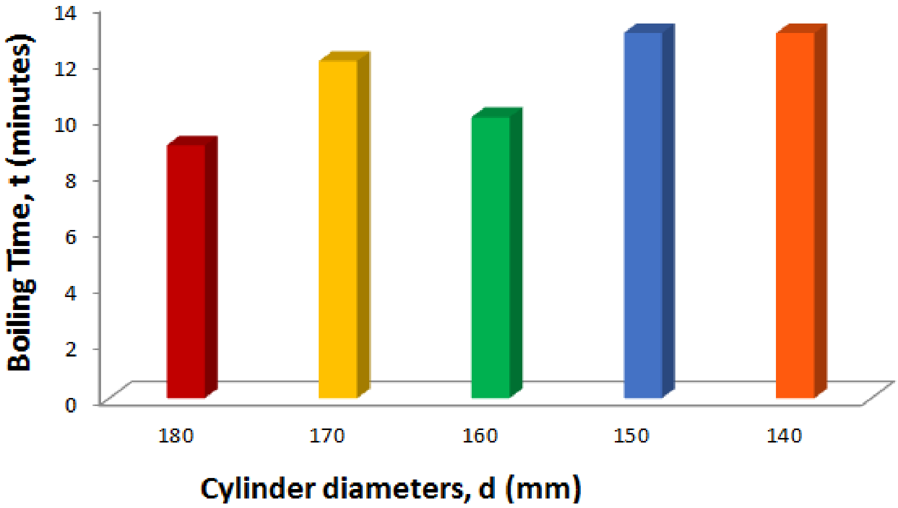

Figure 5. Boiling time to the changes in the diameter of the furnace cylinder

In Figure 5 we can see the relationship between boiling time and sleeve diameter variation. The results show that 180 mm sleeve has the best boiling time. It can be said, the wider the surface area of the sleeve diameter is, the faster the heat transfer process of the briquettes to the cooking utensil. Because the supply of air entering the cylinder burning chamber is more and more, the burning rate is also faster.

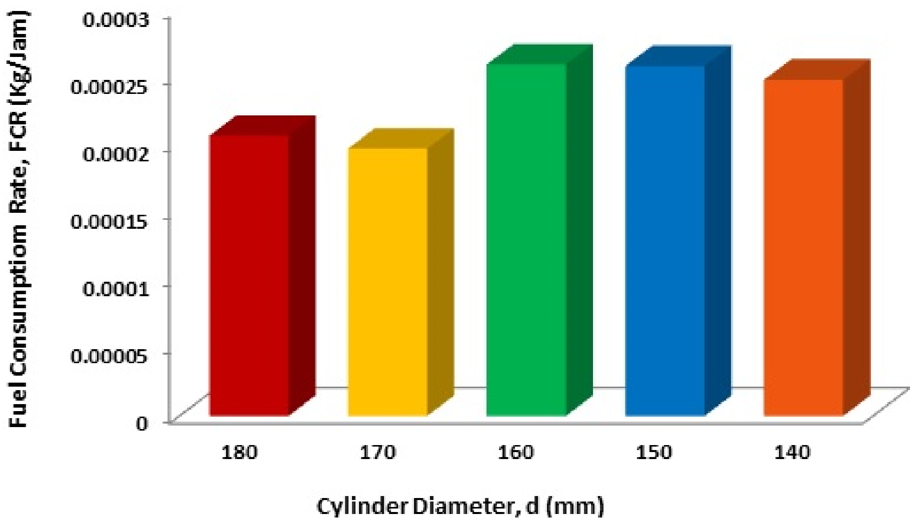

Figure 6. The fuel combustions rate to the cylinder diameter

The best effect of fuel consumption (at least) in Figure 6 is obtained in the 170 mm cylinder of 0.0002 kg/hour and the greatest consumption in the cylinder diameter of 160 mm and 150 mm cylinder of 0.000026 kg/hour. The more surface area of the cylinder diameter, the better fuel consumption. In general, if the rate of air entering the cylinder gets smaller, the fuel burning process will be faster and run out.

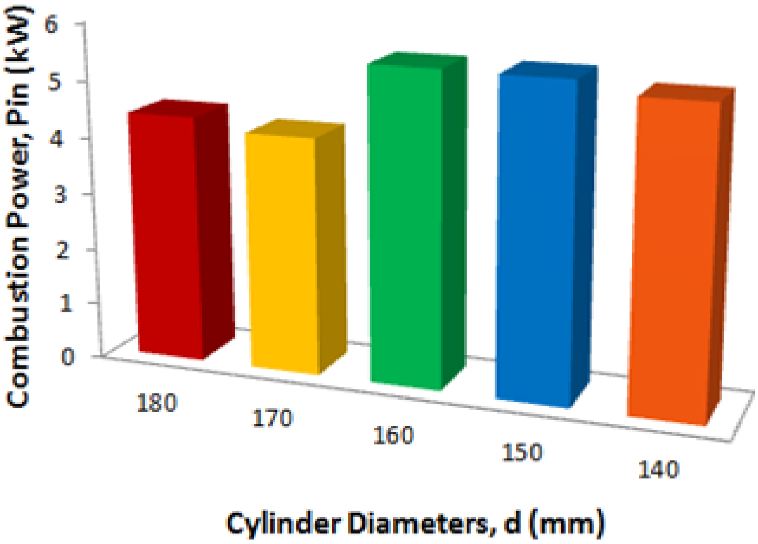

Figure 7. Furnace burning power on 5 various cylinder diameters

Figure 7 shows the effect of burning on variations in cylinder diameter, which shows that the best burning power is obtained in a 160 mm cylinder of 5.50 kW, the lowest in a 170 mm cylinder. The effect of fuel-burning power is not too significant on the area or diameter of the cylinder but depends on the factor of the incoming air supply affecting the burning process.

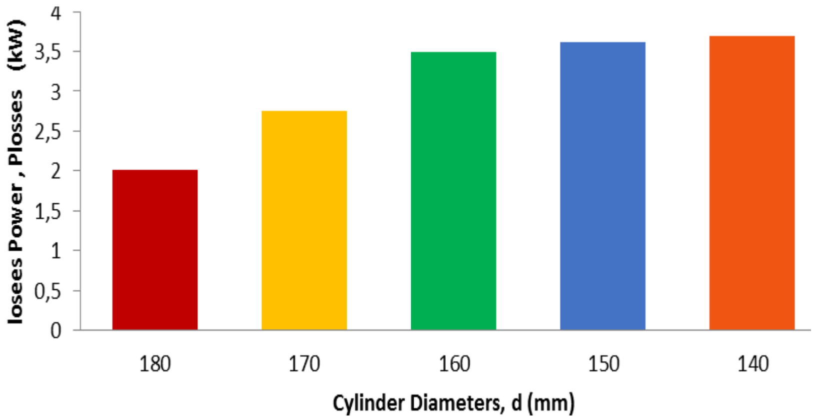

Figure 8. The heat losses to the cylinder diameter

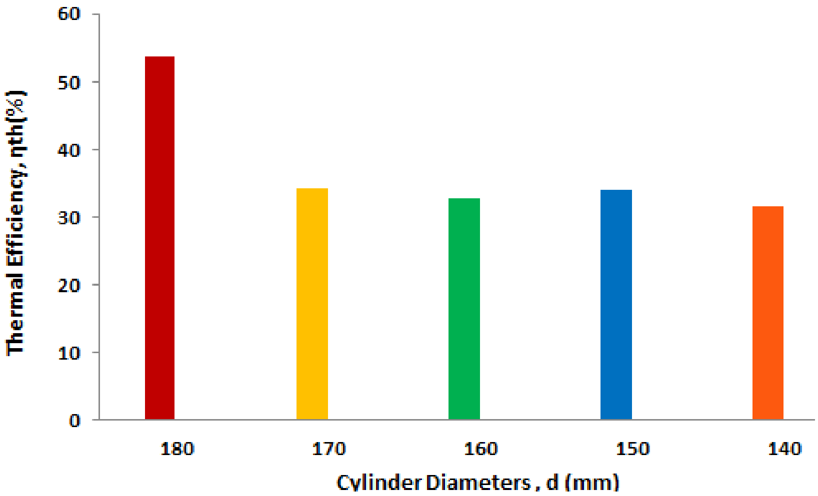

Figure 9. The thermal efficiency to the cylinder diameter

In Figures 8 and 9, we can see the effect of diameter variations on the loss and thermal efficiency. The best thermal efficiency is obtained at a cylinder diameter of 180 mm which is 53.87% with heat losses of only 2.02 kW and the worst thermal efficiency of a cylinder diameter of 140 mm which is 31.7% with heat losses reaching 3.69 kW. The more surface area of the cylinder diameter, the better the thermal efficiency, inversely proportional to the power losses obtained, and vice versa. The larger the diameter of the cylinder, the more supply of air that affects burning and the faster the rate of burning, so that it can reduce the heat loss.

4. Conclusion

From the results of calculations and analysis, it can be concluded that the best burning temperature is at 160 mm sleeve diameter and the best burning time occurs at 170 mm sleeve diameter. Meanwhile, the best thermal efficiency was 53.87% on a 180 mm cylinder diameter with the best heat losses of 2.02 kW and had the fastest boiling time in 9 minutes.

References

[1] N. Phonphuak, S. Thiansem, 2011. *Effects of charcoal on physical and mechanical properties of fired test briquettes*, ScienceAsia, 37, pp 120–124.

[2] S. Jamilatun S, 2011. *Quality properties of burning coconut shell, teak sawdust briquettes, husk briquettes and coal briquettes*. Proceedings of the National Chemical Engineering seminar Universitas Ahmad Dahlan Yogyakarta. [In Bahasa]

[3] B. Esmar, 2011. *Overview of the Process of Forming and Using Coconut Shell Charcoal as Fuel* Journal of Science Research, Vol. 4, No. 3(B). [In Bahasa]

[4] S. Suluh and P. Martina, 2017. *Analysis of Coconut Shell Briquettes as an Alternative Energy Source Reviewed from the Adhesive Material*, Proceedings of the Politeknik Ujung Pandang (Ujung Pandang Polytechnic) Research Seminar, Makassar Sulawesi Selatan. [In Bahasa]

[5] S. Suluh, 2014. *Study of Performance Improvement of Various Stoves with Waste Biomass Briquettes Fuel*, 1th The International Symposium On Smart Material and Mechatronics, Universitas Hasanuddin, pp 39-45, (2014).

[6] A. Haryanto, S. Triyono, 2012. *Household Stove Emissions Study*, *AGRITECH*, Vol. 32, No. 4, NOVEMBER, pp. 425-431. [In Bahasa]

[7] Musabbikhah, H. Saptoadi, Subarmono and M. A. Wibisono, 2015 *Optimization of Biomass Briquette Making Process Using Taguchi Method To Meet the Needs of Alternative Fuels that are Environmentally Friendly*, Journal of Human and Environment, Vol. 22, No. 1, pp. 121-128. [in Bahasa]

15% Overall Similarity

Top sources found in the following databases:

- 13% Internet database
- 6% Publications database
- Crossref database
- Crossref Posted Content database
- 4% Submitted Works database

TOP SOURCES

The sources with the highest number of matches within the submission. Overlapping sources will not be displayed.

1	researchgate.net	Internet	9%
2	pt.scribd.com	Internet	3%
3	Sallolo Suluh, Yafet Bontong, Anastasia Baan, Roni Labiran, Mersilina L...	Crossref	2%
4	arpnjournals.org	Internet	<1%
5	Universitas Khairun on 2023-04-12	Submitted works	<1%