VOL. 9, NO. 9, SEPTEMBER 2014 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences


www.arpnjournals.com

EXPERIMENTAL STUDY OF BIOMASS STOVE PORTABLE WITH AND WITHOUT FIN WHICH BRIQUETTES FUEL FROM CORNCOB

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ABSTRACT

The increase in energy demand caused by population growth and resource depletion of oil reserves as well as the problems of emissions from fossil fuels put pressure on every country, especially Indonesia. Briquettes of corncob were one of the alternatives. In addition replaced the firewood, they also did not potentially damage the ecology of the forest and could replace fossil fuel reserves that were running low. Water boiling test was used to determine the performance of a portable stove with and without fin. Inside the stove there were 3 pots: pot 1 contained egg, pot 2 contained of rice, and pot 3 was vegetables. This study was obtained for the power of furnace for different diameter of briquette 3/4 ", 1" and 1.5" without fins was equal to 0.87 kW, 1.12 kW and 1.57 kW, respectively. Efficiency 17.58%, 19.7%, and 23.15%. While the furnace with diameter briquette 3/4 ", 1" and 1.5" using fins obtained the power 0.98 kW, 1.32 kW and 1.96 KW. Efficiency 14.84%, 20.91% and 25.27%. The fastest cooking time was gained for the finned pan with diameter of briquettes 1.5" over 20 minutes.

Keywords: briquettes, corncob, portable furnaces fins and without fins.

INTRODUCTION

Background

Some of last year's energy is a crucial issue in the world. The increase in energy demand caused by growth population and the depletion of world oil reserves and also the problem of emissions from fossil fuel makes a pressure to each country to produce and use renewable-energy [1]. In addition to that, the increase in world oil prices that so high make a very serious reason that has befallen to many countries in the world, especially Indonesia.

Various solutions have been offered by scientists in the world to overcome the dependence on non-renewable resources of energy (fuel) including, among others: the technology of bio-gas, bio-diesel, bio-ethanol, bio-briquettes. Bio-briquette products derived from a corncob has the prospect of a reliable due to the utilization of corncob waste into briquettes very profitable for farmers and consumers, especially those who consume lots of corn.

The process of making briquettes from the waste corncobs with tapioca starch adhesives through the carbonization process is useful as an alternative-fuel [2]. In addition, it has pored that corncob good for burning. Furnace used for burning fuel briquettes and produce thermal energy. The heat energy is used to heat objects or substances needed.

In other countries such as India, sugarcane leaf formed into charcoal briquettes. If the briquettes heated it will produce a clean flame and no smoke. Appropriate Rural Technology Institute (ARTI) developed a portable device for making charcoal from dried sugarcane leaves. ARTI also developed a furnace and cooking equipment called Sarai [3].

The research about the design and performance of biomass stove portable using briquette's fuel from sugarcane leaves and coconut shell briquette has already been done by [4]. Sarai's furnace developed by ARTI has straight walls with no fins on the nest. However, for this type of cooking use finned on the nest still has not been developed. Research about fuel briquette has been done by [4], [5], [6] and [7]. However, the research about the fuel briquettes with corncob waste has never been done. Through this, research is expected to understand the performance of the stove cookware, heat output and the results of subsequent studies compared with other studies using the configuration, geometry, and the same conditions.

The aim of the research

The purpose of this study is as follows:

a. To determine the effect of fins and without fin's performance biomass stove portable using fuel briquettes from a corncob.
b. To know how the effect of variations in the diameter of the fuel to the performance biomass stove portable for fuel briquettes from a corncob.

THEORY

Power stove

To determine the amount of power of the stove / furnace used the following equation [8]:

$$P = \frac{m_f . E}{\Delta t} \quad (1)$$

where: P is the stove power (kW), m_f is the fuel consumption during time t (kg), E is the Low Heating Value (LHV) fuel, kJ / kg. fuel and t is testing time (s).

Efficiency

Efficiency is the percentage of useful heat compared to heat given by the fuel during the test, the equation used is as follows [8]:

$$\eta_{overall} \frac{[(M]_w.C_p + M_{pa}.C_{pa})(T_2 - T_1) + M_s.H_{fg}}{M_f.E} x \quad 100\% \quad (2)$$

where: η is the overall efficiency of the stove, Mw is the mass of heated water, kg, Mpa is used pan mass, kg, Cp is the specific heat of water, kJ / kg, Cpa is the specific heat of pan, kJ / kg, T_2 is the temperature of boiling water, ^oC, T_1 is the initial temperature of the water, ^oC, Ms is the mass of evaporated water, kg, Mf is the mass of material used, kg, Hfg is the latent heat of vaporization water, and E is LHV.

RESEARCH METHODOLOGY

Pan without a fins

This pan without a fin is made in order to get the temperature distribution at the time. Pan without a fin is used to distribute heat without any obstacles, so that certain efficiency obtained.

Figure-1. Pan without a fin.

Operating conditions

Initial weight of briquettes was 150 g. Water is added 650 g. The briquettes are burned until the material to be cooked all and after that weigh briquettes. Weights of briquettes are the same for all diameters. Material of the pot is made of stainless steel because this material is a good conductor in addition to that the corrosion resistance.

Pan with a fins

While the pan with a fin is made to conduct the heat from the bottom of the pan up to the top. This fin are used for transferring heat much longer by following the curvature of the shape of flippers [9]. It finned surface area is 0,099 m2, while the area without fins is 0.088 m2. Design of the fin using a spiral shape with a gap between the fin is 1 cm.

Figure-2. Pan with a fins.

Mechanical testing and data acquisition (Boiling Water Test)

In this test, the steps are: weighing the briquettes, briquette ignition using the paper that to be fired, enter the briquettes that are already burned into the furnace, weighed and afterwards put the water into a pan, measure the temperature (T0) in each hamper, testing was conducted in the interval 5 minutes and then the hamper removed and measured the temperature of each hamper, once the food is ready, a basket lifted and removed from the pan, weigh fuel after combustion, weigh the remaining water in a saucepan.

RESULTS AND DISCUSSIONS

The effect of variation in the briquettes diameter without fins to the power

The effect of variation in the briquette's diameter for the pan without fins to power can be seen in the following Figure:

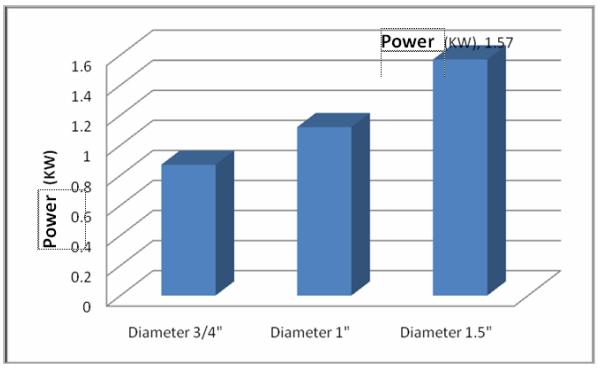

Figure-3. The effect of variation of the briquettes diameter to power for the pan without fins.

From Figure-3 shows that the addition of briquette diameter will increase the power. This is due to with the largest diameter. The mass of fuel during the testing is also considerable so that the stove power becomes great. This research corresponds with the research conducted by [10].

The effect of variation of the briquettes diameter using fins to the power

The effect of variation of the briquette's diameter to the power for a pan with fins can be seen in the following image below:

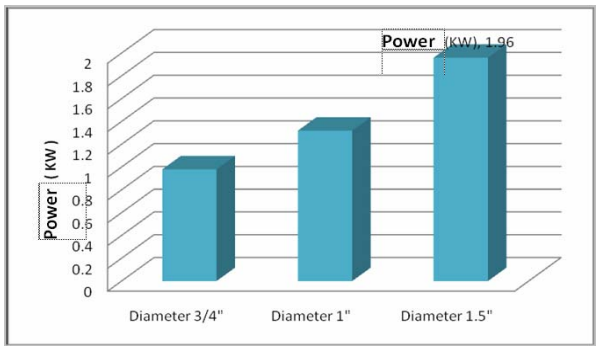

Figure-4. The effect of variation of the briquettes diameter to the power for a pan with fin.

From Figure-4 appears that the addition of a briquette diameter causes the power becomes great with using a finned pan. This is due to with the largest diameter; the mass of fuel when it is test is great so that the results of testing stoves are also with a great power. In addition to that the presence of a fin as well affects the power generated.

The effect of variation of the briquettes diameter to the power using a pan with and without fins

Here is the effect of variations in the briquette's diameter to the power using a pan with and without fins can be seen as follows:

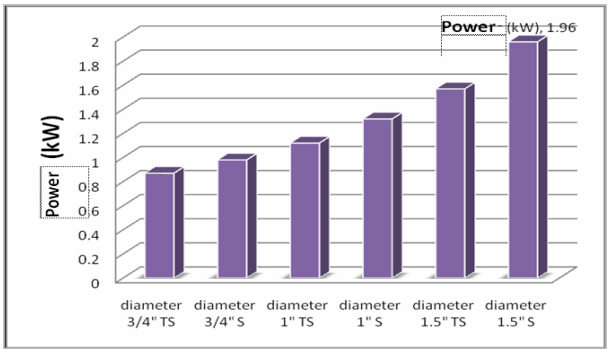

Figure-5. The effect of variation of the briquettes diameter to the power using a pan with and without fins.

From the graph, it can be concluded that the finned pot affects the value of the power. It is proved with the value of the power using finned to pan especially for a diameter of 1.5 " using fins generate power of 1.96 kW.

The effect of variation of the briquettes diameter to the efficiency using a pan without fin

Below is the effect of variation in the briquette's diameter to the efficiency using a pan without fins, can be seen in the image below:

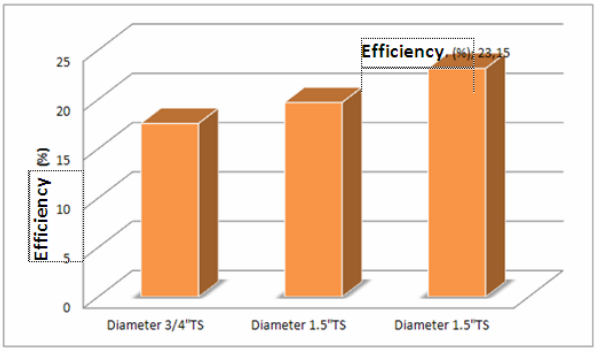

Figure-6. The effect of variation of the briquettes diameter to the efficiency using a pan without fins.

In Figure-6 shows that the addition of briquette diameter the efficiency that produced also increased. This is because with the largest diameter, the heat production when it is test is as well considerable so that the efficiencies of stoves are also great.

The effect of variation of the briquettes diameter to the efficiency using a finned pan

Here is the effect of the variation of the briquette's diameter to the efficiency using a pan fins can be seen in the following Figure:

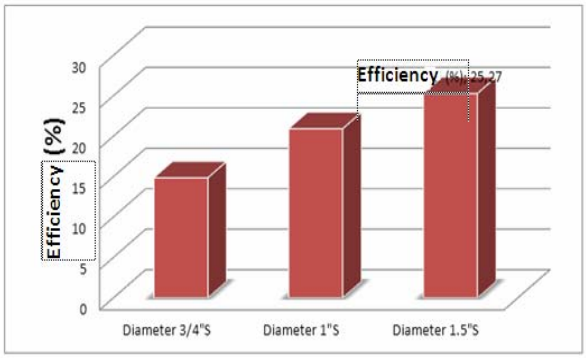

Figure-7. The effect of variation of the briquettes diameter to the efficiency using a pan fins.

In contrast to the picture 7 shows that the addition of briquette diameter the efficiency that is produced also increased. This is because with the largest diameter, the heat production by the fuel when it is test as well considerable so that the efficiency of a stove is finally great.

The effect of variation of the briquettes diameter to the efficiency using a pan with and without fins

Here is the effect of variation of the briquette's diameter to the efficiency using a pan with and without fins can be seen in the following Figure:

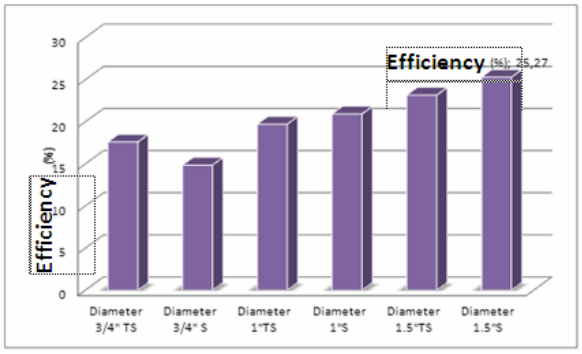

Figure-8. The effect of variation of the briquettes diameter to the efficiency using a pan with and without fins.

From the graph above it can be concluded that the finned pan influence the efficiency. This is the evidenced that with the greatest efficiency of fuel diameter that is 1.5" will get the efficiency of 25.15%.

CONCLUSIONS

From the results of experiments and calculations, it can be concluded:

a) The power generated by a briquette stove is quite high, especially when added to the pan wall, a fin and the modification briquette diameter. The greatest power is obtained at finned pan for the briquette's diameter of 1.5."
b) Efficiency is almost equal to the power. The highest efficiency is attained at a pan with fins to the briquette's diameter of 1.5"
c) The fastest cooking time is obtained for the finned pan with the diameter of briquette's 1.5" over 20 minutes.

ACKNOWLEDGEMENTS

Thanks to Adhi Tama Institute of Technology Surabaya that has been funded the research activity.

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