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Continuous and uncontinuous gasification systems of rice husk using variation modification of burner

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Abstract. The aim of the research is to know differences between continuous and uncontinuous system of gasification of rice husk with attach the modification of burner. The differences can be measured upon time flame effectiveness and average temperatures that are produced by two systems. Methodology of this research is started by applied all of burners variation such as burner without cap and with cap, burner without reflector and with reflector, after that comparison all variations to continuous and uncontinuous systems. The result of this research shows that continuous gasification system with variation of burner reach better average temperature compare than uncontinuous system. On the other hand, time flame effectiveness tends to the same.

1. Introduction

Recently, World Bank releases their investigated that the world currently generates around 4 billion tons of all types of waste every year. Furthermore, the world's cities can generate approximately 1.5 billion tons of solid waste per year. This volume is showed that occur enhancement of waste about 2.4 billion tons by 2025. In developing countries and lower income countries, waste generation will be increase over the next 25 years [1]. In addition, waste of biomass such as rice husk, in development countries some time being a problem, but that is can be used as source of energy.

Susilo [2] in his research stated that there is a high number of consumption of crude oil Indonesia meanwhile Indonesia's fuel reserves are less than 0.4% of world's fuel reserves. Crude oil is not renewable energy, so this condition is forcing to government and researchers to explore another energy resources which is easy to find and apply in Indonesia.

Biomass, such as rice husk, corn cob, sawdust is available abundantly in Indonesia and having big potential to become source of renewable energies. This is could be the most reasonable solution for our energy crisis. Furthermore, biomass has another benefit to obtain the heat as source of energy that can be used for to cooking, and other activities which using flame as source of energy.

Almost all agricultural country such as Indonesia, Thailand, India, Philippines and more than 75 countries in the world produced rice husk as waste. Nordin *et al.* [3] identifies that around the world, annual rice husk output is around 80 million tons. That is potential to produce energy of 1.2×10 GJ or can be converted to become a heating value of 15 MJ/kg. Another research which done by [4] shows

that every year there is 13 million tons of husk is not used in Indonesia. He claims the potential of rice husk in Indonesia can be used as diesel power plant (PLTD), it could be equal to 2.1 million kiloliter or 3.5 thousand billion rupiahs per year. PLTD 100 kilowatt operated with diesel oil, it would need 0.3 litter of diesel oil per kilowatt hour (kWh). If PLTD operated husk, it's only need 0.06 litter of diesel oil per kWh. Nevertheless, diesel oil is needed but it can be more effective till 80 percent.

Gasification is defined as conversion process of solid fuel become gas fuel with high temperature. Gasification process produces environmentally friendly gas such as hydrogen and carbon monoxide. furthermore, gasification process is easier to control than another biomass direct combustion because it is gasiform. Nevertheless, Indonesia only has a few researchers that research of gasification of biomass or utilizing of gasification to become source of energy. Gasification product is usable for cooking, rotate turbine, power up internal combustion engine, and so on. with this fact, gasification technology is suitable to be developed in Indonesia and can produced with mass production.

Another research is done by [5]. They investigate energy supply and the potential of meeting the annual energy requirement with rice husk. The potential of rice husk is widely examined under different utilization scenarios using energy replacement value. Their research is built upon a heating value, greenhouse gas (GHG) reduction potential and annual energy expenditure. Result of their research showed that rice husk could efficiently and effectively to replace wood which achieving up to 67% wood savings, 62.94% GHG emission reduction and an annual parboiling energy expenditure reduction of 73%.

Rice Husk Gasification Furnace with updraft system has investigate by [6]. He designed the simple process gasification by linking up the reactor, burner, ash chamber, and blower into one body. Pathak *et al.* [7] already done another gasification type that is downdraft gasification. From their research, it can be concluded that performance and the relation between air flow velocity from blower and temperature that are produced. When the air flow is faster, temperature will be higher as well.

2. Research methodology

This section explains the research methodology. This research utilizes modification of burner that can be seen in figure 1, figure 2 and figure 3.

2.1. Material

Rice husk is used as main material with a water content of +10%. Rice husk is destroyed by a grinding machine, and then be sifted by size of mesh 10. Then 1.5 kg of the shifted rice husk was put into the gasifier tube. Continuous system done by add rice husk a little bit through the hole on the funnel on the burner modification (figure 3).

2.2. Equipment

The main equipment use type gasifier updraft (TLUD) with an outer diameter of 200 mm and an inner diameter of 160 mm. Refractory clay gasifier is used as an insulator, and placed between an inner and an outer diameter of the gasifier tube. Height of the reactor tube is 600 mm. In the burner attached the reflector and cap on top of burner modification (figure 3).

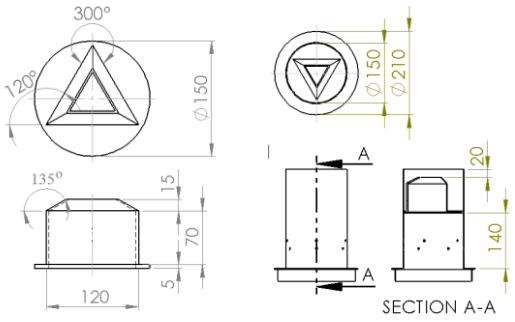


Figure 1. Burner with reflector.

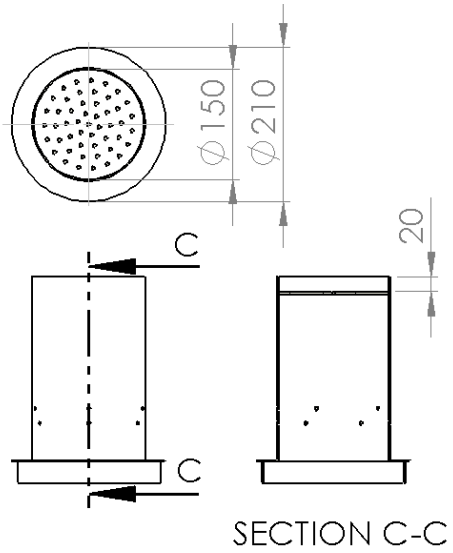


Figure 2. Burner with cap.

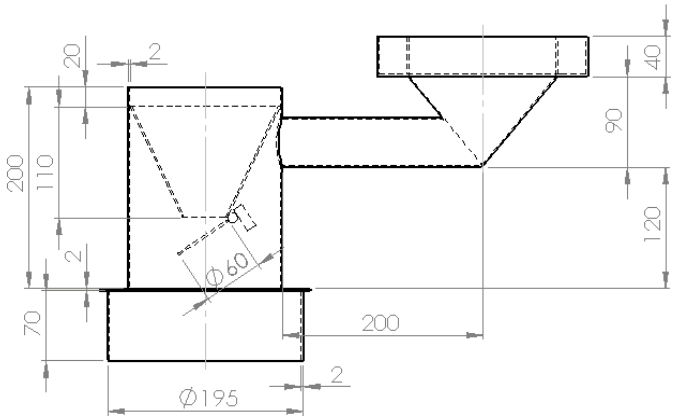
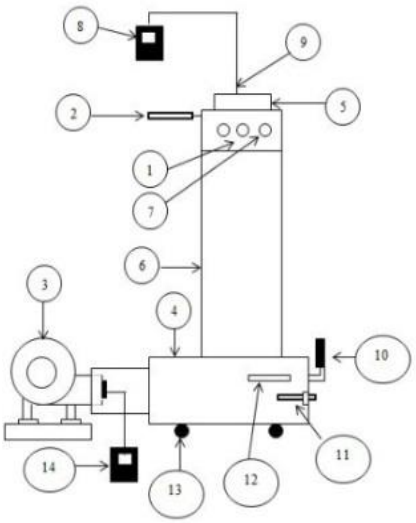


Figure 3. Modification of burner with additional funnel.



1. Burner
2. Handle of Burner
3. Blower
4. Ash Chamber
5. Reflector
6. Gasifier tube
7. Secondary air flow burner
8. Thermocouple reader
9. Thermocouple
10. Ash discharge lever
11. key
12. handle of door lever
13. wheels

Figure 4. Research installation.

Figure 4 shows the installation of the research. Initially, the gasifier tube (6) was filled with 1.5 kg rice husk. Secondly, the process of gasification was started with burning the surface of rice husk on the gasifier using the lighter. Following this process, the blower (3) was turned on at a speed of 10 m/s. After gasification process began, the temperature at the burner was measured using thermocouple (9) while the time process was noted using a stopwatch. The steps were done repeatedly with time span of 30 seconds until the fire off. Additional rice husk to continuous process system passing to the hole on the funnel a little by little with mass around 250 grams as long as two times.

3. Results and discussion

Figure 5 represents result of gasification process without reflector and without cap, burner with reflector only and burner with cap only at uncontinuous gasification type. Obviously burner with reflector having the highest temperature is around 700ºC with average temperature approximately 655ºC, and decline gradually. On the other hand, burners with reflector on uncontinuous gasification type having length of flame as long as 34 minutes. Comparing with gasification using burner without reflector and without cap time flame effective almost the same, that is approximately 34 minutes as well. Moreover, burner with reflector having the best of average temperature compare with burner without reflector and burner with cap only.

Figure 6 shows results of the research using continuous gasification type. It was apparent that the continuous gasification type which was reflector on the burner reaches length of flame as long as 45 minutes, burner without reflector and without cap reaches time flame around 39 minutes and burner with cap only reaches 41 minutes to flame. As can be seen on figure 6, burner with reflector gain the average temperature more stable which is around 600ºC.

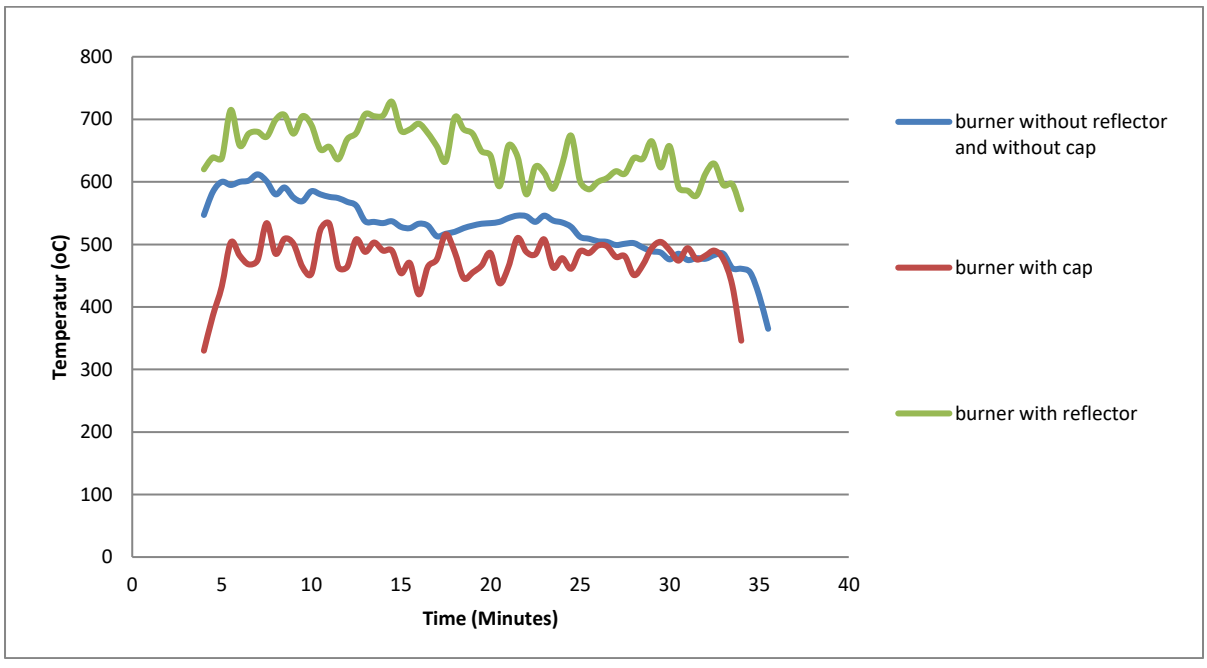


Figure 5. Comparison result between gasification without reflector and without cap and with reflector and with cap at uncontinuous gasification type.

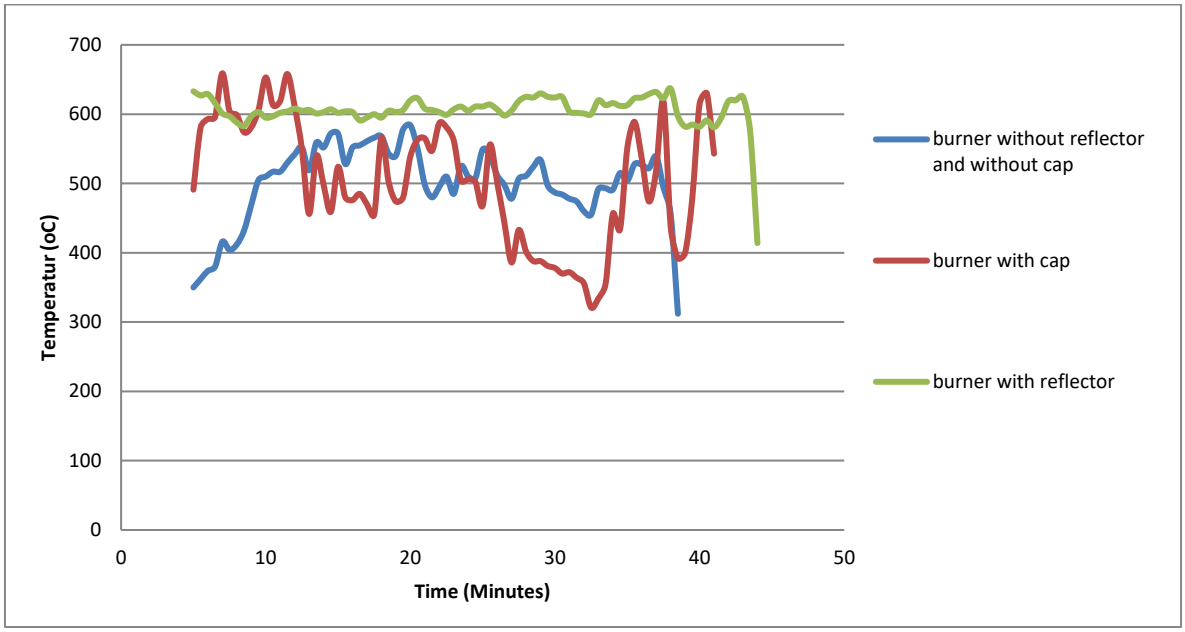


Figure 6. Comparison result between gasification without reflector and cap and with reflector and cap at continuous gasification type.

4. Conclusions

According on analysis of data result, there are some particulars about correlation between variation of burner and modification that burner with combustion temperature and effective time flame on rice husk gasification, such as the average highest temperature is gained on burner with reflector. Burner with reflector both continues and uncontinuous type are the best modification and the longest gasification process without modification burner recorded reach around 34 minutes and the longest gasification process in continue system with reflector on the burner obtain the effective time flame until 44 minutes and the average temperature is around 600oC. It means that continuous system gasification with reflector can be used to prefer in develop model and manufacturing of gasification stove.

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