CO Emissions From Burning Briquettes Of Candlenuts Shell Mixed With Charcoal

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Abstract. The decreased world fossil energy reserve, in general, and specifically in Indonesia requires us to find alternative energy resources. Biomass was the primary source of energy for millons people in the wold, but when coal, oil and gas widely available, it use was declined. How ever in recent years interest in biomass utilization increase because of energy crisis and enviorment problem. Utiluzation of biomass for substituting fossil fuel and reduce global CO emission problem. The objective of this research is to reduce CO emiss ion from biomass burning. Biomass is one of alternative energies with great potential in Indonesia. One of it is candlenuts shell (CNS) as the waste of candlenuts fruit, with the production of 89,155 tons/year will produce 207,958 tons shell/year. Candlenuts shell are made into pellets with particle size < 1 mm, and then burnt in combustin test instrument with variations of wall tempetature, air velocity, air temperature, raw material composition of biomass and biomass, briquettes dimension and charcoal's composition. CO emission is measured using Flue Gas Analyzer in clude RS232 that is connected to computer. The increase of air temperature and wall temperature can reduce CO emission because that can help copleting the combustion. In terms of charcoal composition, minimum CO on 25% of biomass charcoal.

Keywords: Biomass, candlenuts shell, Pellet, Combustion, CO emission

1. Introduction

Indonesian fossil energy potential has been greatly depleted, for example, the type of oil reserves and 9.1 billion barrels of production of 387 million barrels / year, will last only 23 years old, 185.8 TSCF gas reserves and production of 2.95 TSCF, will only survive 62 years and coal 146 years (Priyanto, 2007). While some types of waste biomass has considerable potential as waste bagasse, palm shell, municipal waste and also cundlenuts shell (Aleurites Molucca).

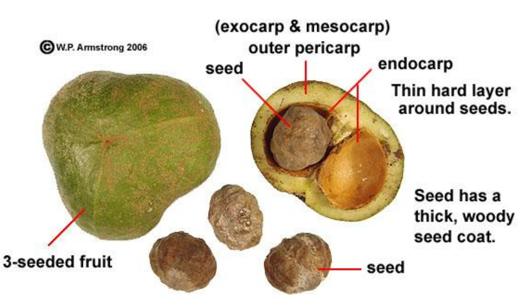

Figure 1. Sections Candlenut

Candlenut widely grown in the area NTT, Sulawesi and Sumatra. Based on data from the Department of Agriculture National hazelnut production increased from 74 317 tonnes in 2000 to 89 155 tonnes in

2003 (Table 1). The candlenuts has two layers of the skin and rind shells, each kilogram of seed will produce 30% hazelnut core and 70% shell.

Table 1. Area and Smallholder Production in Indonesia (Ministry of Agriculture, 2003).

Types of Plants	Prodution (tones)			
	2000	2001	2002	2003
Kakao	363628	476924	511379	512251
Areca nut	1680	2196	2730	2372
Candle Nut	74317	77373	88481	89155

2. Review of Literature

Emissions resulting from the burning of biomass is CO2, CO, NOx, SOx, and particulates. Several researchers have done studies of emissions from biomass either as a single ingredient or mixed with coal (Himawanto and Setiabudi, 2006; Kwong et al, 2005; Jamradloedluk et al, 2004; Hurt and Lang, 2001; Houck, 1998; Moerman and Prasad, 1995).

Kwong et al (2004) examined the powder mixture of coal and rice husk for various compositions and more air (excess water). The results showed that a decline in CO emissions of more than 40% to 50% mixture of rice husk. This means that rice husk can enhance the combustion process. CO concentration was also decreased with the addition of excess water. Optimal results occurred in 30% of excess water and 10-20% mixture of rice husks.

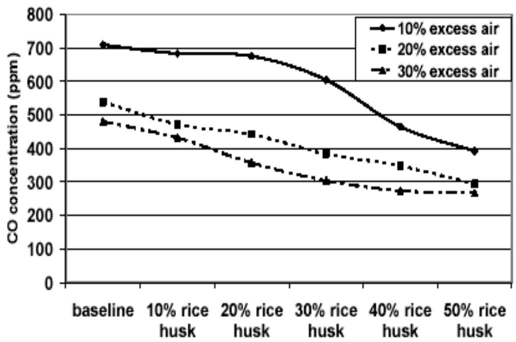

Figure 2. CO Emissions from coal-burning mixture of rice husks(Kwong, 2004).

Similar results were obtained Himawanto and Setiabudi (2006) for burning briquettes mix 60% of municipal solid waste is organic and 40% wood charcoal. The addition of air flow will accelerate the process of burning and reducing the levels of CO that happen because it will meet the needs of oxygen resulting in complete combustion.

Emissions of CO mixture bagasse biomass-rice husk has been investigated Jamradloedluk et al (2004) with CO emissions result the lowest average for a 40:60 ratio that is equal to 3.3 ppm and the highest for the 20:80 ratio of 14.4 ppm. Moerman and Prasad (1995) examined the ratio of CO / CO2 from the burning of wood in the stove type downdraft. The ratio of CO / CO2 for clean combustion range (clean combustion) can be predicted by simulation with an error of 10% compared with experimental data. In combustion with low excess air factor gained a high ratio. The increase factor of excess water will lower the ratio, but the rise to above 2 would increase the return ratio CO / CO2.

Surjosatyo and Ani (2003) examined the emissions from various types of biomass gasification burner on palm shells. In general, an increase equivalent ratio (equivalence ratio) which means a decrease of excess water to give effect to an increase in CO emissions in all types of burners.

3. Material and method

Fig. 3. Raw material of CNS

The material used in this work was CNS. Research was carried out by drying CNS under sunlight for 3 days. CNS then was crushed and screened to obtain a particle size of less than 1 mm. Five grams mixture of CNS and binder in the proportion of 70% and 30% by weight respectively was pelletized by using a 16 mm diameter-mold pelletizing machine and then dried in an oven at 50 °C for 5 hours. Carbonization of CNS was performed at 400 °C for 2 hours using an electrically heated reactor.
To determine the effect of mixing raw material biomass and charcoal briquettes, selected five compositions (raw material : charcoal) 100 % : 0 % , 75%, 25 % , 50 % : 50 % , 25 % : 75 % and 0 % : 100 %.

Fig.4. CNS Pellets

The first experiment was conducted at constant wall temperature of 350 °C and air velocity ranging between 0.1 and 0.4 m/s, while the second experiment was performed at constant wall temperature of 400 °C and air flow rate of 0.3 m/s. LPG was used as a heating source for supplying heat to the reactor. A schematic diagram of the arrangement to undertake this work is shown in Fig. 5. After the desired wall temperature was reached, the pellet was inserted into the reactor and placed on the cup which was hung by a wire connected to a digital balance. Measurement of CO emissions was stopped, if the mass of pellet displayed a constant value indicating that the combustion was completed.

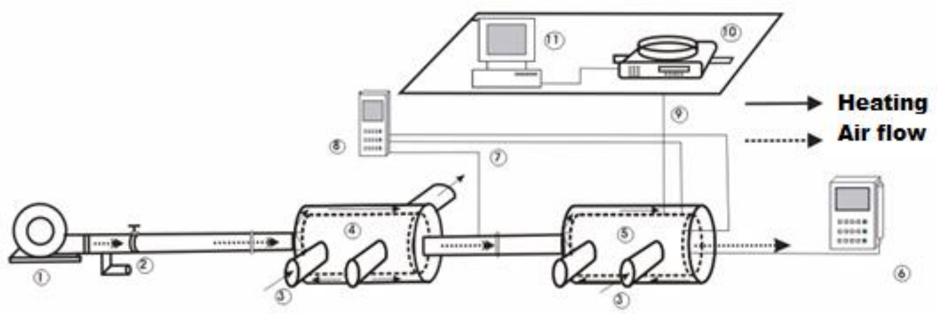

Fig. 5. A schematic diagram of combustion test : 1. air fan; 2. control valve; 3. LPG heater; 4. combustion chamber; 5. gas analyzer; 6. thermocouple wire; 7. digital thermocouple reader; 8. wire hanger; 9. digital balance; 10. Computer

4. Results and discuss

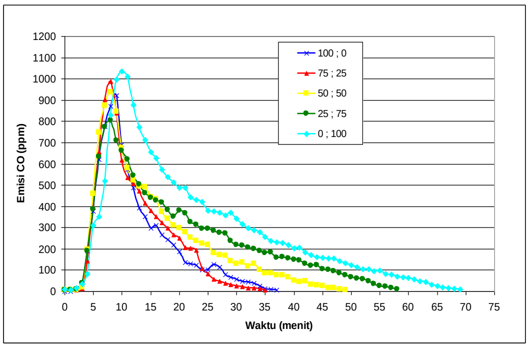

Fig. 6. Total CO vs burning Time

Total CO per energy generated (gram / Watt) is shown in fig. 6 , the minimum on burning briquettes with a composition of 75 % : 25 % . From these parameters it can be seen that the optimum mix between the raw materials with biomass charcoal , both in terms of burning time , energy generated , the combustion gas temperature and CO emissions are 75 % : 25 % Because the mixture of 75 % : 25 % , burning time the fastest , most high- temperature combustion gas , the energy generated total CO biggest and smallest per unit of energy .

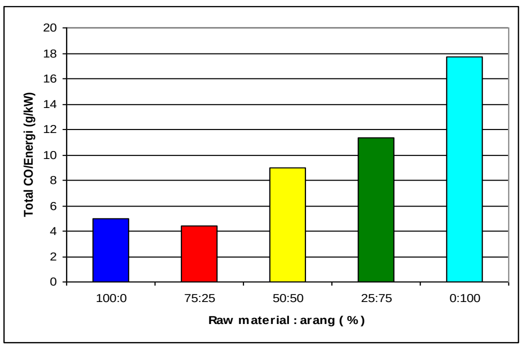

Fig. 6. Total CO vs Pellets composition

5. Conclusion

The minimum total CO per energy generated (gram / Watt) on burning briquettes with a composition 75 % the raw material of CNS : 25 % charcoal of CNS .

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