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A Preliminary Study on Use of Candlenut Shell as a Renewable Source of Energy, Min Indonesia

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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 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 89,155 tons/year will produce 207,958 tons shell/year. Candlenut shells are made into briquette with particle size < 1 mm, and then burnt in combustion test instrument with variations raw material composition of biomass and biomass charcoal. Mass reduction of each variable is measured using digital scale include RS232 that is connected to computer, burning gas temperature by using thermocouple. In terms of burning rate, generated energy and gas temperature the best raw material composition is 75% of biomass raw material and 25% of biomass charcoal.

KEY WORDS: *Candlenut Shell; Renewable Energy Resource.*

1.0 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 (Armstrong, 2006).

Candlenut is 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 as shown in Table 1. The candlenuts have two layers of the skin and rind shells, each kilogram of seed will produce 30% hazelnut core and 70% shell.

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

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

2.0 REVIEW OF LITERATURE

Some previous researchers concluded that some parameters have an influence on the rate of combustion of biomass and coal briquettes. (Syamsiro at al, 2011) Utilization of Cocoa Pod Husk (CPH) as a renewable source of energy has been experimentally investigated. The result shows that CPH has higher heating value of 17MJ/kg and relatively high ash content as compared with bagasse and EFB. The air flow rate and fuel composition significantly affect the burning time and CO emission factor. The shortest burning time occurs at an air flow rate of 0.2 m/s. The increase of carbonized CPH portion in the fuel increases the burning time of the pellet as carbonized CPH has higher fixed carbon content. Increase of air flow rate and carbonized CPH portion also increases the emission factor of CO due to higher fixed carbon content requiring more oxygen for completing the combustion process. A lower level of oxygen causes CO formation since the fixed carbon cannot completely react to form $CO2$.

Dujambi (1999) have examined the influence of coal particle size, air preheat temperature, the furnace wall temperature, and air flow rate. The results showed that the firing rate will decrease with the increase in particle size, otherwise the firing rate will increase along with the increase of air flow rate, air preheat temperature, and the temperature of the furnace wall.

(Saptoadi,2006) which examines the influence of the size of the constituent particles of the sawdust briquette burning rate shows that the smaller the particle size will decrease the rate of combustion, this was due to the higher density of the briquettes become so lower porosity and diffusion becomes obstructed. (Lu et al,2006) investigated the influence of particle shape on the wood of the mass loss rate which indicates that the particle has a sphere near the cylinder mass loss rate is slower than the long, thin cylinder cylinders as shown in Figure 2. This is due to the surface area and volume ratio of smaller particles, because the reaction rate will be strongly influenced by the particle surface area.

3.0 MATERIAL AND METHOD

After 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 75% and 25% 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. Proximate analyzer and bomb calorimeter were used to determine the composition and calorific value of CNS. Combustion tests were carried out in order to investigate the fuel composition on the fuel combustion characteristics.

Figure 2: CNS pellets using starch as a binder.

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 of0.3 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 Figure.3.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 mass and CO emissions was stopped, if the mass of pellet displayed a constant value indicating that the combustion was completed.

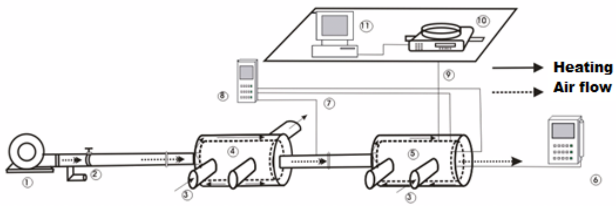

Figure 3: A schematic diagram of combustion test : 1. air fan; 2. control valve; 3. LPG heater; 4. combustion chamber; 5. gas analyzer; 6. thermocouple wire; 7. digital thermocouple reader; 8. wire hanger; 9. digital balance; 10. computer.

3.0 RESULTS AND DISCUSSIONS

Proximate Analysis conducted twice Calorific Value While testing performed three times then take the average value. Test results can be seen in Table 2.

Table 2: Results of Proximate Analysis and Calorific Value Test Properties of Non carbonization carbonization

Propertis	Non karbonisasi	karbonisasi
Moisture (%)	9,54	5,35
Volatile (%)	48,75	8,73
Ash (%)	6,99	9,56
Fix Carbone(%)	34,92	76,31
Caloric Value (kal/gr)	5.245	7.810

To determine the effect of the addition of biomass briquettes Charcoal briquettes in print with a mixture of biomass with biomass raw materials are already in carbonization (charcoal). Selected five composition of 100%: 0%, 75%: 25%, 50%: 50%, 25%: 75% and 0%: 100%, respectively briquettes burned at Tw = 400 ° C, air velocity 0.3 m / s with no preheat.

The survey results revealed that the most rapid combustion occurs when the briquettes with a composition of 75%: 25% ie 35 minutes as shown in Figure 4.

The energy generated is also visible on the optimal mix of 75%: 25%, ie 46.98 Watt as shown in Figure 5.a. The addition will certainly add charcoal briquettes calorific value, but the addition of above 25% will increase the time so that combustion energy generated in units of Watts (Joules / sec) will also be small.

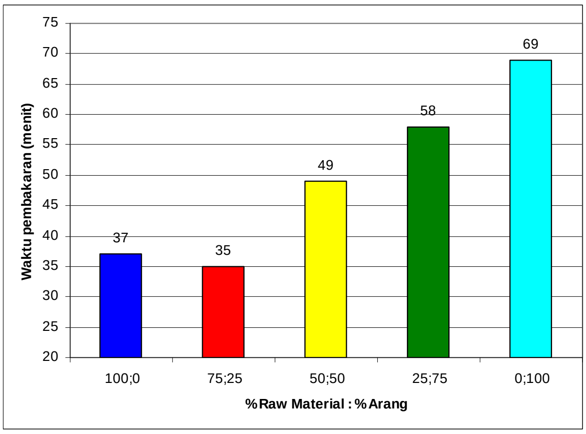

Figure 4: Burning Time.

The highest temperature of the combustion gases also occurs in burning briquettes with a composition of 75%: 25% as shown in Figure. 5.b, This shows that the optimal addition of charcoal is 25%, as can be seen from the graph above that the addition of 25% charcoal burning time just added and decrease the rate of generation of energy and lowering the temperature of the combustion gases.

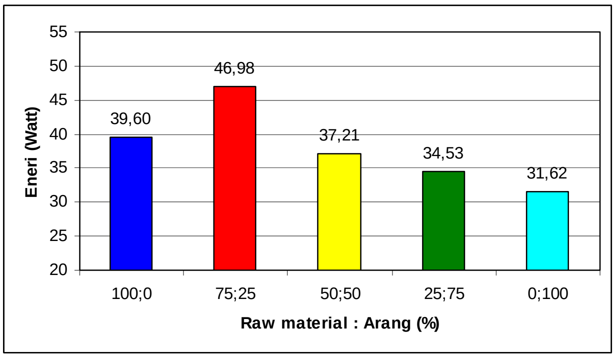

Figure 5.a: Energy Produced.

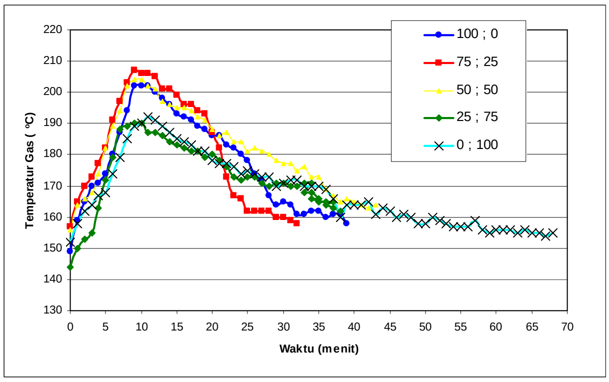

Figure 5.b: Gas Temperature

5.0 CONCLUSION

The optimal value of the mixture is 75% raw material with 25% charcoal, because at this burn rate percentage, energy generation and flue gas temperature indicates the optimal value, if the percentage of charcoal plus hold time will prolong the combustion, lowers the rate of energy generation and lowering the temperature of the combustion gases.

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