

## Composition Variation Effect of Rice Straw and Coconut Shell to Biobriquette Characteristics as Alternative Fuel

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### Abstract

Rice straws are agricultural waste that have not been used by the public or farmers, they are considered as waste that no economic value, whereas rice straws have a big potential when processed into solid fuel, due to the rice straws have high content of volatile matter level so flammable, therefore rice straws used as raw materials in the manufacture of biobriquette. Biobriquette making process done by varying between rice straw and coconut due to coconut shell already has good essential in making biobriquette. Rice straw and coconut shell carbonated and then performed size reduction to 60 mesh size. Raw material analysis was conducted on moisture content, ash content, volatile matter, sulfur content, and calorific value. . The mixing charcoal and coconut rice straw with powder adhesive tapiuoka were doing with the composition of 90:10, 80:20, 70:30, 60:40, 50:50. After the mixing, the products scored. Further that the analysis of products included ultimate analysis, test press, calorific value, ignition test early, the flame time of biobriquettes, and the rate of mass reduction during combustion with the best results were obtained the biobriquette variation in the composition of 50:50 with 4355 cal / gr of calorific value, 69 seconds of beginning old flame and 102 minutes of ash briquette.

**Key words:** rice straw, coconut shell, biobriquettes, carbonization.

### Introduction

The issue of rising oil price (especially kerosene) and LPG alerted us that energy consumption was increasing from year to year and it was not balanced with the availability of the energy sources. Scarcity and rising oil prices will continue to take place because it is non-renewable. This has to be balanced with the provision of energy sources. Renewable alternatives, the raw material is easy to find and cheap so affordable by the community. [3]. Agricultural waste such as rice straw has not been assessed as products that has economic value by farmers, even regarded as wastes that interfere with tillage and planting rice, so they let the straws were taken by someone else or burn it in place. Similarly with coconut shell, farmers only used the most part of coconuts into copra and shell allowed to become solid waste. Therefore wastes originating farms and plantations can be used as a solid fuel.

Solid fuel in the form of biobriquette will be used when the source of raw material has good fuel value [1]. Besides, it also depends on other fuel characteristics such as Inherent Moisture, volatile matter, ash, fixed carbon. [4]. as a source of fuel, rice straw has fuel value of 1525.5 kcal / kg. This value is not included into the range rather than the value of coal, while the coconut shell has a fuel value of 7283.5 kcal / kg [10]. Some researchers have used rice straw and coconut shell into the solid fuel. Subroto [8] utilization of bagasse with rice straw by mixing coal with a ratio of 90%: 10% to biobriquette. These results indicated that flammable substances pollutants will be reduced to 20%. Budiman et al [2] utilizing Jatropha seed meal and husks into fuel biobriquette without carbonization with ratio 70%: 30%, which gave results that biobriquette products were highly flammable and provided a large CO levels.

Subroto [9] made biobriquette of straw and wood charcoal with a ratio of 40%: 60%. Their research suggested that reduced levels of CO and high fuel value of  $5.4 \times 10^{-3}$  kw. Supriyadi et al [11] produced biobriquette by utilizing agricultural waste feedstock mixed with coal 60%: 40%, where the results of their study showed the temperature 300°C with a time of 90 minutes gave the minimum CO levels. Mahendra [5] mixed Straw-coal to get fuel (biobriquette), with variation of raw materials. From the results of research that were 30% coal and 70% straw with a firing rate 3.5 g / min obtained at 890 ppm CO levels. Coconut shell is also a solid waste plantation his most farmers utilized as coconut shell charcoals. Ndraha [7] conducted a study biobriquette manufacture of coconut shell with wood dust. From the research obtained water content 4.74%, ash content of 5.61% and a calorific value of 7192.15 cal / g.

From the description above, the researcher conducted a study to utilize rice straw and coconut shell. In this case it is expected that waste rice straw and coconut shell can be used as biobriquette charcoal mixed with variation of raw material composition of 90% -50% rice straw and 10% -50% coconut shell using tapioca as an adhesive and press constancy 12600 Psi, which can be used as an alternative fuel.

Variables determined the quality biobriquette were volatile matter content, water content, ash and fixed carbon. The fuel value to be derived from the results of this study.

## **Materials and Methods**

### ***Procedure***

Rice straw and coconut shell carbonization process is carried out at 298°C for rice straw within 24 minutes and 485 ° C for coconut shell within 15 minutes. Carbonization results for size 60 meshes sieve. Biobriquettes were produced by comparisons (Rice Straw: Coconut shell) 50%: 50%, 60%: 40%, 70%: 30%, 80%: 20% and 90%: 10% and mixed with 10% starch adhesive. Then they molded by using mold briquette with the cylinder size were 7.9 cm high, 2.54 cm ID, OD 4.5-in. Biobriquette dried in the oven at 110°C for a day and then they were analyzed water content by using the method of ASTM D.3173-03, analysis of ash content by using the method of ASTM D.3174-04, analysis of volatile matter content by using the ISO -562, fixed carbon analysis by using method ASTM D.3172-89, test press, calorific value by using ASTM D.5865-07, the old flame biobriquette to ashes and the rate of mass reduction during combustion.

## **Results and Discussion**

Biobriquette products analysis data shown on table 1 consist of calorific value, press test, ignition test early and flame time. On table 2 consist of mass reduction during combustion. These data resulted from raw material mixed composition with 60 mesh and tapioca as starch adhesive with ratio compositions 90:10, 80:20, 70:30, 60:40, and 50:50 of 15 g.

**Table 1.** Results of biobriquette product analysis

Compositions of rice straw and coconut shell	Particle sizes (mesh)	Proximate analysis				Fixed carbon (FC)	Calorific Value (cal/g)	Press Test (psi)	Ignition Test Early (sec)	Flame Time (Min)
		Water content (IM)	Ash content (AC)	Volatile matter (VM)						
15 g 90:10	60	7.10	28.10	33.44	31.36	4070	12600	52	88	
15 g 80:20	60	6.63	27.09	30.60	3568	4175	12600	61	95	
15 g 70:30	60	6.54	24.54	29.46	39.46	4236	12600	62.29	97	
15 g 60:40	60	6.35	22.13	28.78	42.74	4307	12600	62	97	
15 g 50:50	60	6.30	21.31	28.59	43.81	4355	12600	69	102	

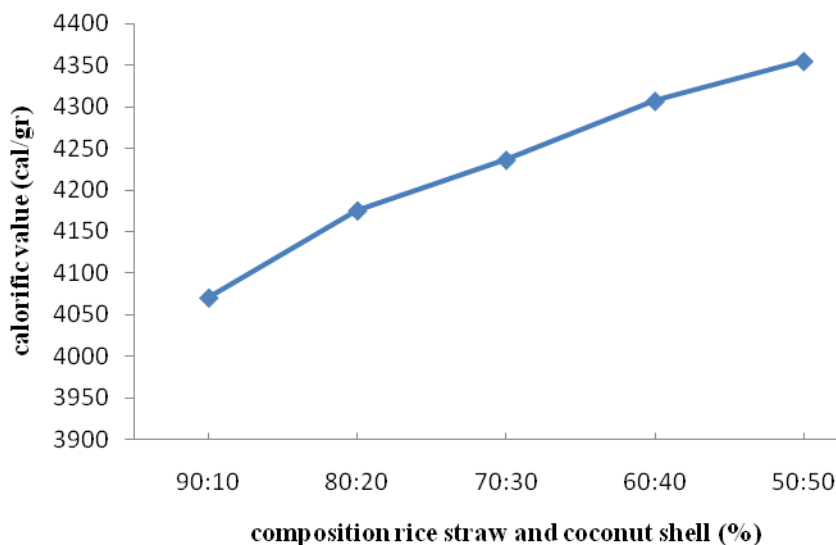
**Table 2.** Comparison mass reduction rate during combustion

Time (Min)	Mass (gr)	Mass (gr)	Mass (gr)	Mass (gr)	Mass (gr)
	90:10	80:20	70:30	60:40	50:50
0	14.03	14.43	14.59	15.58	15.62
5	12.09	13.33	13.1	14.78	15.18
10	11.7	12.56	12.71	13	14.25
15	10.99	11.79	11.4	12.97	13.67
20	10.61	10.86	10.47	11.36	12.36
25	9.89	9.91	10.18	10.71	11.77
30	9.28	9.68	10.77	10.34	10.74
35	8.01	9.38	10.52	10.01	10.3
40	7.74	8.79	9.71	9.86	10.12

Based on table 1 composition 50:50 was the best composition for making biobriquette with the longest ignition early test.

#### ***Effect of Composition Ratio Variations to Calorific Value***

In Figure 1 below is a graph of the effect of the composition ratio of rice straw and coconut shell where the comparison starts from 90:10 (rice straw and coconut shell) until 50:50 to calorific value.

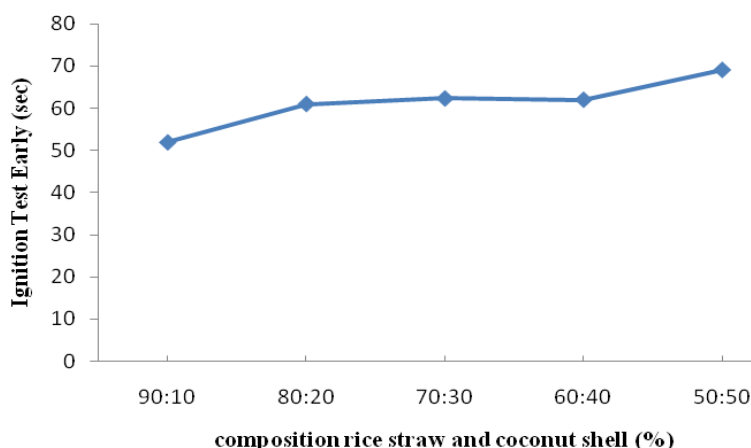


**Figure 1.** Effect of composition ratio variation to calorific value

Figure 1 shows the calorific value graph of each briquettes produced which the variation of composition 50:50 (rice straw: coconut shell) had highest calorific value 4354.5 and the composition of 90:10 (rice straw: coconut shell) had low calorific value of 4070. It happened because the coconut shell had a higher calorific value than rice straw so that the larger the ratio the greater the coconut shell on the calorific value of briquettes produced.

***Effect of Composition Ratio Variations of Rice Straw and Coconut Shell to Ignition Test Early***

In Figure 2 below is effect of the composition ratio graph of rice straw and coconut shell where the comparison starts from 90:10 (rice straw and coconut shell) and until the ratio of 50:50 to ignition test early of briquettes produced.



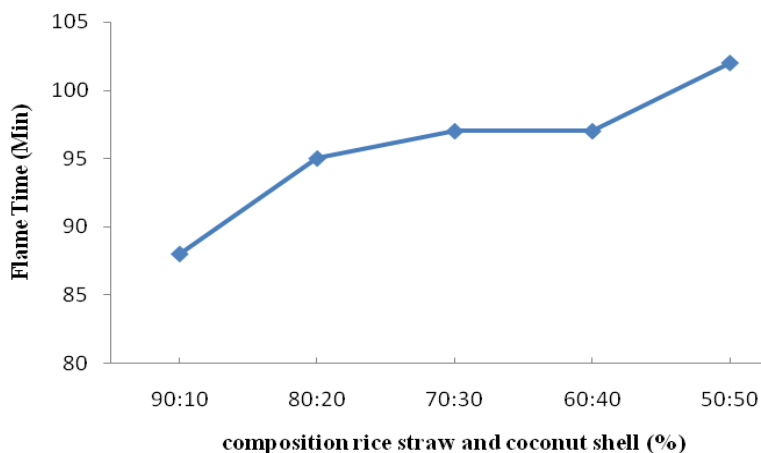
**Figure 2.** Effect of composition ratio variation of rice straw and coconut shell to briquettes ignition test early.

Effect of coconut shell ratio and rice straw ratio to ignition test can be seen in Figure 2, where the composition 90:10 (rice straw: coconut shell) was the fastest flame time while the composition of 50:50 was the longest one, this was due to the physical nature of straw that has

a high content of volatile matter so combustible, combustion process occurred very quickly and relatively short baking time. So more straw rice composition will make ignition test early become faster.

***Effect of The Composition Ratio of Rice Straw and Coconut Shell to Briquette Flame Time***

In Figure 3, below is a composition ratio graph of rice straw and coconut shells which were used starting composition ratio of 90:10 (rice straw and coconut shell) until 50:50 to briquettes produced flame time.

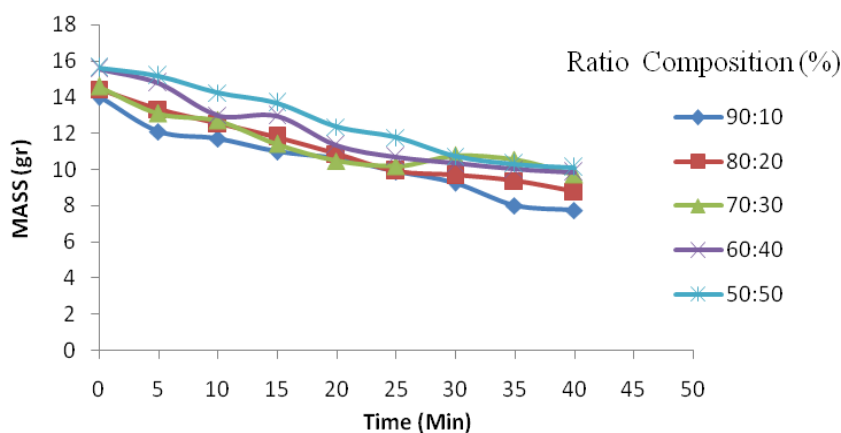


**Figure 3.** Effect of composition ratio of rice straw and coconut shell to briquette flame time

Effect of coconut shell ratio and rice straw ratio to flame time can be seen in Figure 3 where the composition 90:10 (rice straw: coconut shell) was the fastest time while the composition of the longest flame time was 50:50, it was due to the rice straw physical properties with high content of volatile matter so combustible, combustion process occurred very quickly and the burning time was relatively short. So it influenced briquette flame time, more straw rice composition will make short flame time

***Effect of Rice Straw and Coconut Shell Composition Ratio to the Mass Reduction Rate During Combustion***

In Figure 4 below is the effect of the composition ratio graph of rice straw and coconut shell where the comparison starts from 90:10 (rice straw and coconut shell) until 50:50 to the rate of mass reduction during combustion.



**Figure 4.** Graph of mass reduction rate during combustion of biobriquette variety compositions

From Figure 4 can be seen how mass reduction rate of rice straw and coconut shell composition from 90:10, 80:20, 70:30, 60:40, 50:50. The composition of 90:10 (rice straw and coconut shell) has easy to flame and the fastest of flame time. Likewise mass reduction rate seen in the data this composition had fastest mass reduction rate compared with others, otherwise the composition ratio of 50:50 (rice straw and coconut shell) which had slow mass reduction rate. It was because the characteristic of the raw material had a high content of volatile matter so combustible, combustion process occurred very quickly and relatively short burning time. So it influenced briquette flame time, and mass reduction rate.

### Conclusions

Based on the results obtained from this study several conclusions can be drawn as follows:

1. Biobriquette optimum conditions resulting in the composition ratio of 50:50 (rice straw and coconut shell), with a calorific value of 4355 cal / g, total carbon 43.81%, 28.59% volatile matter content, water content 6.30 %, 12600 psi compressive strength, with ignition test early of 69 seconds, and the 102-minute flame time.
2. At 90:10 biobriquette composition (rice straw and coconut shell) had a rapid reduction mass rate compared to the others. It due to high content of volatile matter in the straw so combustible, combustion process occurred very quickly and relatively short burning time. It influenced briquette flame time, and mass reduction rate.

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