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PRODUCTION OF WOOD ENERGY (STICK) FROM THE ORGANIC NOT RECOVERED MATERIAL: THE CASE OF NEEM LEAVES, RICE BRAN AND SAWDUST

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ABSTRACT

This study focuses on energy recovery from biomass plants which are generally considerated as waste. Specially, it is the production of a form of cooking energy source from the leaves of neem, rice bran and sawdust. These plant materials were mixed in three different proportions of clay and kneaded by hand to make rods. It appears from the combustion test that only rod made from approximately 25% clay has burnt. From 1kg of these kinds of fuels, it was possible to boil 5 liters of water. Rods obtained from neem leaves were more energy efficient despite the smoke they produce. It therefore appears that 1kg of rod equals to 0.7 kg of fire wood and supplied at least 770 kcal. An amount of 2.2 kg of this type of fuel is enough to cook three times a day meal to a person. Therefore, the technology of rod production can contribute significantly to provide a cooking source of energy to people where there is abundant biomass not valued as the leaves of neem, rice bran, and sawdust.

INTRODUCTION

Access to a source of energy for cooking is increasing in Cameroon. The main resource used is firewood. The population which consumes the solid biomass for this purpose is estimated around 90%. According to the Institute Of Science In Society (ISIS, 2006), the use of firewood was one of the main causes of deforestation in Africa. This institute has estimated a loss of about 64 million hectares of forest between 1990 and 2005 caused mainly by collection of the firewood in Africa. The situation is more critical in the Sahel region particularly in the Far North region of Cameroon with a weak ecology (Madi *et al*., 2002). The Vegetation is poor with trees, but trees are the only source of the firewood. Unfortunately, there is strong pressure from urban and rural populations on some existing shrubs in search of wood. Nature is no longer able to support this demand. This creates the price inflation of wood in urban areas. The poorer classes do not have financial means, women and children wandering in nature to collect twigs usually found in the town of Maroua, bark, dried dung and other plant debris for their source of cooking energy (Merle and Gautier, 2003) predicted this shortage. In order to limit the disastrous consequences of the collection of firewood on the environment, policies to prevent the cutting need to be established without an alternative source is proposed appear inappropriate. Furthermore, we are witnessing the formation of a large mass of plant debris that is not valued. Examples are the leaves of the trees in the city of Maroua, constitute the bulk of household waste collected by the Health and Safety Service. We also note the non-recovery of sawdust, bran and rice stem etc. Is it not possible to undertake energy recovery of these types of biomass to provide another source of household fuel for cooking? It is in this context that this study was focused on the production of sticks from the leaves of trees, rice bran and sawdust can be used as fuel.

The main objective of this study is to enhance the leaves of neem, rice bran and sawdust for the production of sticks used as a source of energy for cooking.

Specifically, we will focus on:
- Making sticks from leaves of neem leaves of rice bran and sawdust;
- Test the energy potential of these sticks.

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MATERIALS AND METHODS

Manufacture sticks

The process begins with the collection of various types of biomass such as the leaves of neem, rice bran and sawdust. The leaves have particularly undergone a mechanical pretreatment which was to grind them into fine particles. These plant materials are in the more or less powder. They were mixed with clay in three proportions (Dubois and Temmerman, 2004). The mixture was realized by hand with the addition of a little quantity of water to have a enough strong dough. The molding was done manually by forming tubes. Table 1 summarizes the composition of three types of produced rod.

Table 1: The proportion of biomass and clay used in the manufacture of various sticks

Biomass (%)	Clay (%)
25	75
50	50
75	25

Sticks products following the compositions shown in Table 1 were spread in the sun for drying. The Drying was performed in a week due to multiple problems caused by precipitation. The sticks were considered dry when they can be ground in to the powder state.

Test of the potential energy of the rods

Combustion Test sticks

The samples obtained after sun drying for a week was submitted to a burn test. For this purpose 1kg of each type of rod was collected to load an improved stove. Combustion is initiated by pouring oil on the rods before ignition. After a quarter of an hour, the burning sticks were inspected by hand checking to verify if they are burning. Whenever the product sample heat and burns, it is noted positive and otherwise noted negative.

Determination of the energy potential of the rods

At the end of the first test, different sticks that burn were selected to test their calorific value. The objective of this test is to determine the amount of water that a given mass of fuel can boil. The time to reach this boiling state is measured. For this purpose 1kg of each type of fuel was collected. This amount of fuel has been used for a boiling test on 1 L, 2 L, 3 L, 4L and 5 L with three repetitions. The main approach is to add a quantity of water in the aluminum kettle whenever its content was boiling. With a thermometer, the determination of the initial temperature of the water before heating was made. This temperature was 32 °C.

RESULTS AND DISCUSSION

2-1 Production of sticks

Different sticks made from neem leaves, sawdust, wood and rice bran are shown in Figure 1 below.

a ***b*** ***c***

Figure 1: Different sticks products. a) sticks from sawdust. b) sticks from rice bran. c) sticks from leaves of neem.

It appears from the manufacturing process of stick that, it was easier to shape the samples when there is a high proportion of clay. This could be explained by the fact that, the adhesive properties of the clay which therefore provides greater cohesion between the particles of mixture plant material. The sawdust is more appropriate to give well-elongated shape to the stick. In contrary, from rice bran and neem leaves, more or less round shape was obtained.

Test of the potential energy of the rods

Combustion Test

The test results of different stick combustion types are summarized in the table 2.

Table 2: Results of tests of combustion different sticks

Types of rod	**25% of biomass**	**50% of biomass**	**75% of biomass**
Neem leaves	negative	negative	positive
Sawdust	negative	negative	positive
Rice bran	negative	negative	positive

The result of the test of combustion in table 2 showed that only sticks containing 75% of plant material consumed with great satisfaction. Indeed, burning of the 50% of biomass was not entirely negative. It was observed that a continuous release of a small amount of heat remained for more than 30 minutes. Unfortunately, this did not allow heat to boil water. In other way, with 25% of biomass, fuel could not burn. It therefore appears that the concentration of clay to produce a good stick should be around 25%. From the samples that had positive test sticks containing rice bran produced a better result. They burn with the production of very little smoke. The figure 2 shows the burning state of sticks from rice bran.

a ***b***

Figure 2: Combustion sticks rice bran. b) Ash produced after combustion.

Determination of the energy potential of the rods

The test for the determination of the calorific power of sticks had revealed that in general It was possible to boil 5 liters of water from 1kg of each type of stick. The difference observed between these fuels was the combustion time as shown in figure3.

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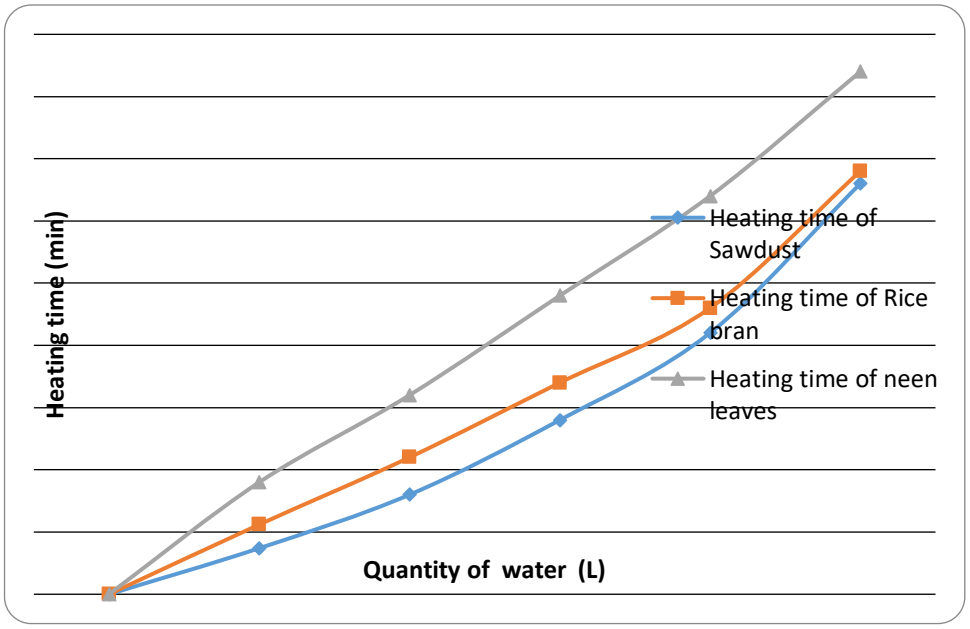

Figure 3: Time to boil water from 1kg of rod

It is clear from this table that sticks produced from neem leaves have a higher calorific value. It is noted that this type of fuel used to boil a quantity of water in a relatively shorter time. For example, using sticks of 1kg neem leaves, 1 liter of water boils after 4mn30s then it takes about 10 minutes using the sawdust. This could be due to the species of the tree that provided the sawdust. Indeed, certain tree species are generally referred to produce good fuel, good and bad firewood. This would suggest that another source of sawdust probably would produce a different result. However, dead sticks of neem leaves produce more smoke than others. That could induce a faster adoption of sticks made from rice bran which have the very near potential with those wich produces less smoke.

According to the work of Nembrini and Kimaro, (2006), 1 kg of these sticks boiling 5 liters of water equivalent to 140 liters of biogas. For Igou, (2002) this amount of biogas is corresponding to 0.7 kg of firewood and 770 Kcal. According to 75% of the biomass used in the sticks, so there is 0.7 kg of wood energy provided. This is equivalent to 0.75 kg of leaves, sawdust or rice bran. This difference could be minimized further if the amount of heat that continues to identify the sticks after boiling 5 liters of water was quantified. From these equivalences coupled associated to the work Madi et *al*., (2002), 2.2 kg of sticks were enough to cook a meal for one person three times per day. It takes an average of 1.6 kg of biomass to produce this quantity of sticks. A neem tree according to Tizé, (2012) may provide during this period of defoliation this mass of leaves. Thus, there could not only offer a significant new source of energy for cooking, but especially to a better management of waste neem leaves as seen today by the population (Table 3).

Table 3: Different states of neen leaves collection by HYSACAM

	1	2	3
A			
B			

The summary table (3) above shows that in a certain period of the year in the city of Maroua, raking leaves of neem is the essential work of the HYSACAM service. This shows that neem trees drop in all the length of days a large mass of leaves. These sheets constitute a biomass available for energy recovery through the production and use of sticks

CONCLUSION

At the end of this study, it shows a way to recover energy neem leaves, rice bran and sawdust through the production of sticks. The most suitable composition comprises mixing biomass to about 25% clay. From 1kg rod, it was possible to heat 5 L of water in 30 minutes. In addition, 2.2 kg rod can provide the energy needs for cooking of one person per day Therefore production technologyof sticks appears as an alternative energy supply for cooking. Unlike renewable energy technologies (biogas, solar) that are costly, it does not involve any financial outlay. It is more traditional and available to anyone, even the poorest populations.

Production rod thus appears as a new field of study to explore. To this end, it would be desirable to initiate new studies incorporating other types of biomass. In addition, studies on further energy and economic evaluation would be interesting.

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