THE PROCESSING OF FIBROUS WASTE MATERIALS (SAW-DUST AND RICE HUSK) TO BE USED AS AN ALTERNATIVE TO FUEL WOOD IN DOMESTIC APPLICATIONS

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ABSTRACT

Fibrous waste materials (saw dust and rice husk) were compressed with suitable adhesives into briquettes in a compressing machine, with the intention of using the briquettes as alternative to firewood in domestic and industrial applications.

Test results obtained after burning the briquettes in open-fire shows that Sample A (composed of 50% saw dust, and 50% rice husk using gum Arabic as adhesive) gave a better combustion behaviour than either sample B (composed of 50% saw dust and 50% rice husk by weight with starch as adhesive) or sample C (50% saw dust and 50% rice husk with bentonite as adhesive).

INTRODUCTION

This country is endowed with wood which is obtained from trees sawn into timber. Popular trees which are used for timber are found in the rain forest of the country. These trees include. Iroko, Mahogany, Obeche, black and white Afara, Obobo and others. Wood all over the world, was the dominant fuel in the 1850's (1). It had lost about 20 percent of the market to coal by the year 1990. It still forms the bulk of energy requirements of the rural populace of the third world countries primarily for domestic heating. Firewood is now being consumed more rapidly that it is grown (2). In many countries, the result is the elimination of trees from around cities.

Some families therefore devote time and labour searching for firewood. In places where the wood is in scare supply, they resort to the use of animal dungs which normally serves as a source of manure. This trend has a great influence on the environment whereby vast areas of the top soil are left exposed to rain and wind erosion causing a serious threat to life. In many parts of Northern Nigeria, using trees for firewood has led to desertification.

The World Bank and other International organisations have proposed several actions in response to the firewood crisis. These include the establishment of plantations accessible to populated centres and mixing of production of agricultural products with the production of wood for fuel (3, 4).

During the processing of timber, and carpentering, saw dust always comes out as a waste product of wood. Also during the milling of rice grain, husk, is produced as a waste product. The ever increasing demand for fuelwood, which in turn causes serious threat to environmental protection, has motivated this work, namely to find ways to utilize the waste product of wood and rice, which otherwise would have been an environmental nuisance, marring the beauty of the landscape.

The aims of this work are to compress these fibrous waste materials into briquettes, use them as an alternative to fuelwood in domestic applications, and also to find out the caloric values of the compressed briquettes.

EXPERIMENTAL METHODS

A fibrous waste compressing machine had been designed and constructed (5). A slight modification was made on the machine, to improve functional effectiveness and as much as possible minimise loss of valuable power. The modification details have been described elsewhere (6). Sawdust and rice husk were obtained from timber sheds and rice mills. Three adhesive materials were used namely, gum arabic, starch and bentonite. They were locally sourced. The samples of the adhesives were prepared separately using water as the solvent. Equal weights of saw dust and rice husk sample were taken for each adhesive. Then a definite quantity of a particular adhesive solution was added to each waste sample. The mixture was thoroughly mixed and then moulded. The compositiions of each sample used in the experiment are shown in Table 1.

A preliminary-test was carried out in order to determine the combustion behaviour and caloric value of the samples. The Bonet Oxgyen Bomb Calorimeter which has been standardised by the American Society for Testing Materials (ASTM) was used. Ethanol was used as the reference sample during the determination of the caloric value.

RESULTS AND DISCUSSION

In the preliminary test, it was observed that sample A burned uniformly and slowly with greater flame build-up than samples B and C, where the flame sizes were less and died out after some times. When a little quantity of kerosene was added to the sample to aid the combustion process, the burning was observed to be uniform in all samples and the quantity of flames was the same. However, the flame of sample A lasted longer than those of the other samples.

Smoke is defined as finely divided carbon which results from the decomposition of carbonaceous materials evolved during the process of combustion. The emission of smoke has been reported to be one of the most serious limitations in flame burning capacity (7).

Observations made on the samples revealed that sample A gave off little quantity of smoke in comparision with samples B and C. This could be attributed to the start life span of the flame in the samples which goes on glowing. The residue after an organic material has been completely burned is referred to as ash. The main components of wood ash has been identified to constitute the following: silica, calcium oxide, magnesium oxide and potassium (7)

The percentage of these constituents by weight depends on the plant species it is derived from, the condition and extent of burning (7)

The results revealed that Sample A had the greatest percentage by weight of ash up to 46.3% while sample B had the least percentage of 43.5% with sample B having 44.2%
However, ash from A appears to be black, shinny and gritty, resembling fused metal. This type of residue has been reported to be deposited on the furnace, boiler wall creating an insulating effect (8).

The determination of caloric value was done using Bonent oxygen bomb calorimeter, which had been standardised by the America Society for Testing Materials (ASTM). The sample, whose energy content is to be determined, was weighed on a scale and placed in the calorimetric bucket into which a thermometer was inserted. An electric current was allowed to flow through the metal wire in contact with the sample. The resulting temperature rise was then recorded within intervals of 90 seconds until a final steady temperature was reached.

During the process of passage of the electric current the water was constantly stirred in the water jacket by an electrically operated stirrer to ensure constancy of speed. The total energy released by the sample was determined by multiplying the temperature rise by the energy equivalent of the caloric value determined from the standard test. The caloric value was calculated by dividing the total energy value by the sample weight.
The results are shown in Table 2

The results show that Sample C had the highest caloric value of 3055 cal/g. in comparison to samples B and A with values of 2837.5 cal/g. and 2946.6 cal/g respectively.

These results were found to be lower than that obtained from the conventional fuel by about 40%. However, these results are promising since the work is still in progress.

CONCLUSION

The results from this paper show that there is the possibility of using briquetted saw-dust and rice-husk as an alternative source of fuel to firewood. More work is needed to improve on the calorific value of the briquettes.

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Table 1 Compositions of Samples

Sample	Adhesive	Composition in % by weight of the fibrous materials	
		Saw-dust	Rise-husk
A	Gum-arabic	50	50
B	Start	50	50
C	Bentonite	50	50

Table 2: The results of the determination of caloric values of the samples

	SAMPLE		
	A	B	C
Mass of Sample (g)	3	3	3
Temperature rice (°C)	34	52	56
Total heat released in (cal)	8839.8	8512.4	9167.2
Caloric value of sample (cal/g)	2946.6	2837.7	3055.7