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Potential of a Selected Biomass as Fuel Briqutte

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Abstract: In this work, waste agricultural biomass (sugarcane bagasse) was carbonized. Twelve different briquette samples were produced at varying pressures using locally sourced Locust Beans (*Parkiabiglobosa*) flour as binder at pressures of 40KN and 50KN, respectively. Test was carried out for the charcoal briquettes. The fixed carbon content of the briquette grades is 16.15% and 17.03% respectively. Similarly, the ash content for the briquette grades is 3.00% and 3.05% respectively. The bulk density is 1.90g/cm^{3}and 2.00g/cm^3 respectively and the moisture content is 11.50% and 10.80% respectively. The comparison of the briquette of sugarcane bagasse was done with the local firewood. It was found that firewood boiled water at 25 min and the briquettes boiled water at 18minutes and 19minutes respectively.The briquettes can compete with other biomass particularly firewood. The results also showed that the heating values ware 32624.80Kcal/g and 32464.0 Kcal/g at 40KN and 50KN respectively. The differences in the heat evolved by the fuels could be attributed to the differences in the pressures and hence densities applied during production. The fuels proved to be at par with firewood and can reduce deforestation while keeping the environment clean.

Keywords: *Biomass, Briquettes, pressure, binders.*

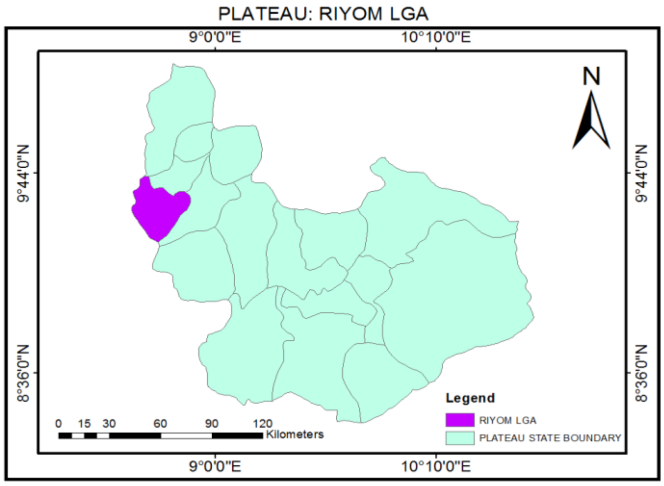
I. INTRODUCTION

For most developing countries, it appears that biomass, particularly agricultural wastes, has become one of their most promising energy sources. The idea of utilizing the residues from agricultural sectors as primary or secondary energy sources is somewhat attractive since they are available as free, indigenous and environmentally friendly ones. Furthermore, the decreasing availability of firewood has necessitated that efforts be made towards efficient utilization of agricultural wastes. The majority of them, however, are not appropriate to be used as fuel without a suitable process since they have low density, high moisture content and low energy density (Williapon, 2009).To eliminate this problem, the densification (briquetting) of this biomass must be done (Che, 2003). These processes involve two techniques: Screw-press, piston press technology and low pressure briquetting technology (Shreya et al, 2015, Mohammad, 2005 and Mangena and Cann, 2007).The major agro-based residues come from rice husk ,coffee husk, maize stalk husk and cob, sugar cane baggages, jute sticks ,silk cotton pods, groundnut shells(Sotannde et al., 2010).The conversion of biomass into value-added products such as bio char and biofuel has attracted tremendous research interest. This can be attributed to the rising energy demands and concerns over greenhouse gas emissions, as well as worldwide soil degradation (Laird et al., 2009; Lehmann, 2007). The production of briquettes enhances the potential of biomass to be used as fuel (Chesta, 2011).

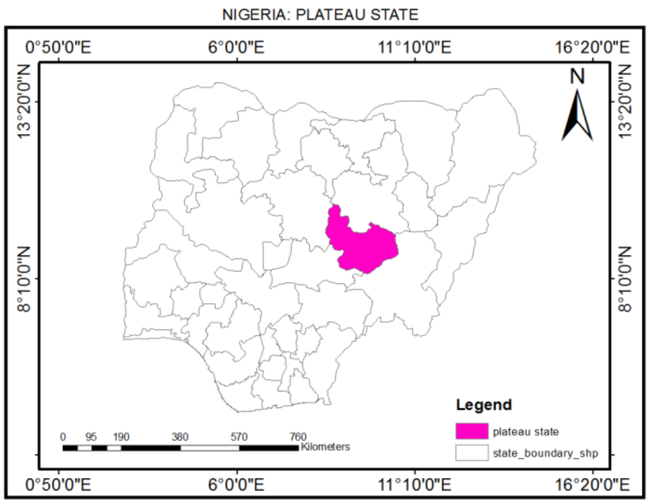
II. MATERIALS AND METHODS

A. Study Area

This study was carried out in Goll-Hoss in Riyom local government area of plateau state, Nigeri.Riyom is a Local Government Area in Plateau State, Nigeria. Its headquarters are in the town of Riyom to the north of the area as it has an area of 807 Km^2 and a population of 131,557 at the 2006 census, which is predominantly Berom. The L.G.A has boundaries with Kaduna and Nasarawa state. (NIPOST, 2009).



SOURCE: PLASU GIS LAB (2018)



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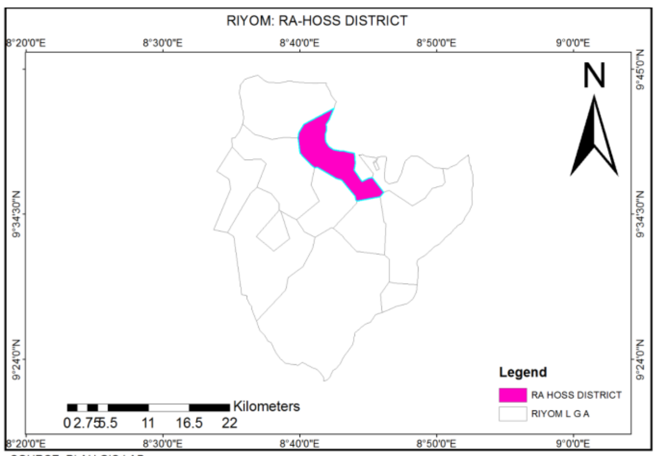

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The biomass used was the pressed sugarcane (Saccharum officinarum). These were obtained from various sugarcane selling spots at Goll-Hoss in RiyomLocal Governmentarea of Plateau State, Nigeria. The binder used is the locally sourced African locust beans (*Parkiabiglobosa*) flour.

B. Briquettes production and analysis

The briquettes were produced by drying, carbonizing, grinding and compacting the pressed sugarcane (Onuegba, 2010). Various analysis were conducted on the compacted briquettes, which includes; the moisture content, ash content, volatile matter, fixed carbon, and the heating value. Water boiling test was also conducted on the compacted briquettes at various pressures(Chaney, 2010).

III. RESULTS AND DISCUSSION

The summaries of the results obtained for the analysis are presented in tables 1 and 4 below.

Table 1: Proximate analysis of briquettes

S/No	Parameters	Sample A	Sample B
1	Moisture content (%)	11.50 ± 0.10	10.8 ± 0.06
2	Volatile matter (%)	80.85 ± 0.05	79.47 ± 0.14
3	Ash content (%)	3.00 ± 0.12	3.50 ± 0.10
4	Fixed carbon (%)	16.15 ± 0.08	17.03 ± 0.09
5	Heating value (Kcal/g)	32624.80 ± 0.08	32464 ± 0.13

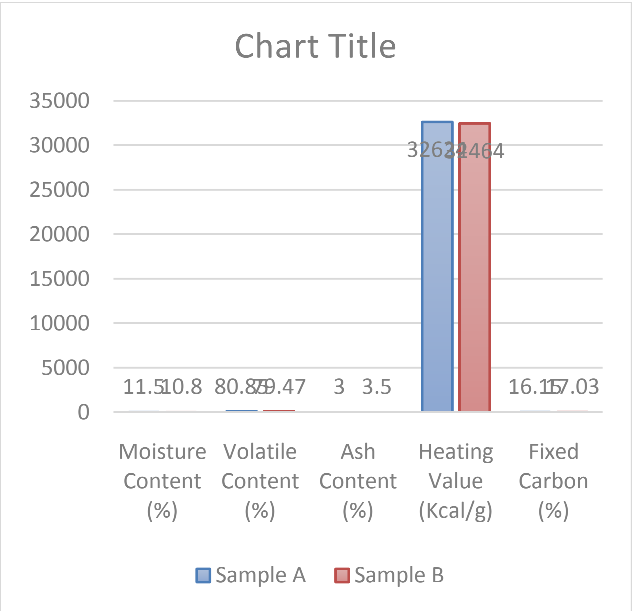

Figure 1: Analysis of briquette samples

Moisture content

In accordance with the test from table 1, it was found that the percentagemoisture content of the fuel briquettes sample were 11.50±0.10 and 10.8 ± 0.06 for samples A and Brespectively.

For better combustion of fuel briquettes, the moisture content should be as low as possible. The above result is not uncommon as it falls within a limit of 15% recommendation by Grover and Mishra (1996), for briquettes of agro-residues.

Volatile matter

Values of 80.85 ± 0.05 and 79.47 ± 0.14for samples A and B fuel briquettes were recorded. These values are below the limits of 86% given by Akowuah et al., (2013). The ease to ignite, much faster homogenous combustion is an indication of the values obtained above.

Ash

Ash is the non-combustible component of a biomass, and the higher the fuel's ash content, the lower its calorific value. It is formed from both the mineral matter bound in the carbon structure of the biomass during its combustion (the inbuilt ash) and is present in the form of particles from dirt and clay introduced during processing (the entrained ash) (Tamilvanan,2013).A value of 3.0 ± 0.12 and 17.03± 0.10 was obtained in this work.

Heating Value

The heating values shows slight variation in this property when the two fuel briquetteare compared. This could be attributed to their differences in density. Briquettesthat are produced at lower pressure have lower density and the ones produced at higher pressure have higher density.A typical biomass must have fewer ashes, low moisture content and higher volatile matter, this is due to the chemical composition of the biomass (Macrejewska et al., 2006).

Fixed Carbon

The fixed carbon of a fuel which is the percentage of carbon valuable for combustion was found to be 16.15+0.08% and 11.68 ± 0.09 %

Table 2: Water boiling test

S/No	Parameters	Time (min)
1	Sample A	18 ± 0.10
2	Sample B	19 ± 0.11
3	Firewood	25 ± 0.05

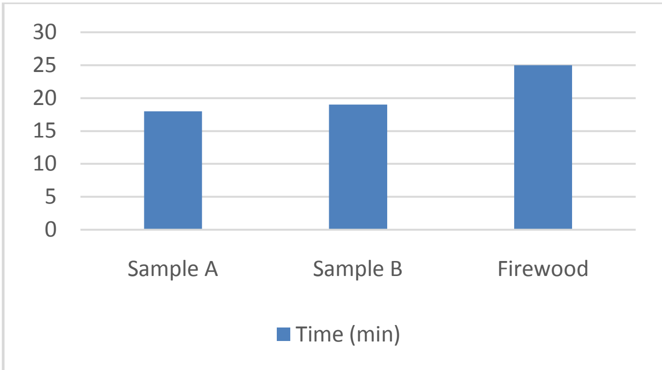

Figure 2: Water boiling test of briquettes

It was observed during the analysis that all briquettes on ignition produced strong bright yellow fames with little smoke emitted without added effort to keep it on. Although the briquettes burned more slowly, the maintained their shape as they burnt with intense flame. Fire wood burned with intense but scattered weak flame and with higher smoke compare to briquettes

The briquettes boil 5 ml of water at 18 minutes and 19 minutes respectively while firewood boils water at 25 minutes.

D. Results for Bulk and Relaxed Density of the Briquettes

Table 3: Results for bulk and relaxed density of the briquettes

S/No	Samples	Bulk Density (g/cm^3)	Relaxed Density (g/cm^3)
1	Sample A	1.90.0 ± 0.06	1.10 ± 0.13
2	Sample B	2.00 ± 0.08	1.20 ± 0.12

From the table above it can be seen that the bulk and relaxed density of the fuel briqttes do not vary much after drying.This will help in easy transportation and handling of the briquettes.Bhattacharya et al, (2013) obtaining densities of 0.52g/cm^3 and 0.48g/cm^3 for rice husk briquettes and sawdust briquettes.

E. Results for the Compressive Strength of the Briquettes

Table 4: Results for the compressive strength of the briquettes

S/No	Samples	Compressive Strength (N/mm^2)
1	Sample A	1.05 ± 0.08
2	Sample B	1.03 ± 0.14

The compressive strength results are shown in Table 4.Compressive strength of briquettes is important from the point of view of briquettes transportation, handling for firing and storage.

CONCLUSION

Due to their uneven nature, biomass waste materials from sugarcane bagasse possess inherent low bulk densities and thus are difficult to efficiently handle, store and transport large quantities as fuel stock for energy purposes. However this waste can be compacted into fuel briquettes to enhance energy output on the whole. Low pressure compaction was employed in briquette production. The briquettes were well formed and burnt smoothly. The physical and chemical test showed that can be at par particularly with firewood, which helps to fulfill the energy demand gap. This is environmentally friendly as it reduces deforestation and keeps the environment clean.

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