Comparative Fuel Characterisation of Briquettes produced from Two Species of Corncob

Oladeji, J. T.

Mechanical Engineering Department, Ladoke Akintola University of Technology,

P.M.B. 4000, Ogbomoso, Nigeria

oladeji2004@yahoo.com

Abstract: Corncobs residue are usually dumped and flared on the farms, where they constitute health risk to both human and ecology. Densification of corncobs would improve their bulk handling, transportation and storage properties. This work investigated densification characteristics of corncobs using an experimental briquetting machine. Corncobs from white and yellow maize were milled into particles by a hammer mill. The blends of ground corncob and cassava starch gel were compacted in a briquetting machine with a dwell time of 120 seconds. The ASAE standard methods were used to determine the moisture contents (dry basis) and densities of the milled residues and briquettes, while ASTM standard methods were used to determine the proximate and ultimate analyses of the residues. The compaction, density and relaxation ratios of the briquettes were also determined. The mechanical properties were determined using universal testing machine, while the heating value was determined with the aid of Ballistic Bomb calorimeter. The mean moisture contents of the corncob from white and yellow maize were 9.64 % and 9.98 % respectively, while those of relaxed briquettes were 7.46 % and 8.18 % respectively. The corresponding values of bulk densities of the residue materials were 95.33 and 98.00 kg/m^3. The initial, maximum and relaxed densities ranged from 151-235 kg/m^3; 533-981 kg/m^3 and 307-417 kg/m^3 respectively for briquettes produced from corncob from white maize, while the corresponding values for briquettes produced from corncob from yellow maize were 145-225 kg/m^3; 502-871 kg/m^3 and 314-464 kg/m^3 respectively. The compaction ratio ranged from 2.27 to 6.50 giving an average value of 3.39 and 2.23 to 6.01giving an average value of 3.76 for briquettes produced from corncobs from white and yellow maize respectively. The compressive strength of briquette produced from corncob from white maize was 2.30kN/m^2, while that of yellow maize was 2.34kN/m^2. The lower and higher heating values of briquettes from corncob from white maize were found to be 16,945 J/kg and 19,356 kJ/kg respectively, while the corresponding values for yellow maize were 17,438 kJ/kg and 20,890 kJ/kg respectively.

[Oladeji, J. T. Comparative Fuel Characterisation of Briquettes produced from Two Species of Corncob. Researcher. 2011;3(4):1-4]. (ISSN: 1553-9865). http://www.sciencepub.net.

Key words: **-** Corncob, briquette, agricultural wastes, processing parameters, briquetting machine

1. Introduction

The importance of energy for a nation's development cannot be over-emphasized. This is because energy is the cornerstone of economic and social development (El-Saeidy, 2004). At present, there is a problem of energy shortage world-wide, Nigeria inclusive. There are two principal reasons for this. Firstly, there is a huge increase in population and secondly, there is a rapid advancement of technological development.

One of the principal sources of energy is fossil fuels and according to Wilaipon (2007) and Kaliyan and Morey (2009), 86 % of energy being consumed all over the world come from fossil fuels. Although, the use of fossil fuels is very convenient, many problems associated with their application. They are non-renewable and there is a problem with their supply. This is because; there is an uneasy calm in most of the areas, where these fuels are being produced. Typical examples are the Niger-Delta Area of Nigeria and the Middle- East region. Another reason is that a large amount of pollutant is deposited as they are used causing health risk to both human and ecology. The seriousness of global warming was underscored by the United Nation sponsored conference on climate change held at Copenhagen in Sweden in early December, 2009, where notable world leaders rubbed minds on how best to reduce global warming. Therefore, there is the need to shift attention from fossil fuels which are non-renewable to renewable form of energy. In this regard, agricultural residues and wastes can play a significant role in renewable energy generation. It is however very unfortunate that most of these wastes are left to rot away or they are subjected to open field burning leading to environmental pollution (Oladeji et al., 2009). However, various scientific studies had revealed that most of these residues contain enormous energy which is renewable from time to time (Wilaipon, 2008; Oladeji and Olafimihan, 2008). However, using these residues in their present form will not bring a desired result. This is because; most of these residues are loose low density materials (Enweremadu, et al., 2004). Apart from that, their combustion cannot be effectively controlled (Wilaipon, 2007).

There are many conversion routes through which these residues can be converted into biomass energy. However, one of the promising technologies by which they could be converted to renewable energy is briquetting process, which has been investigated by several researchers (Wilaipon, 2008); Olorunnisola, 2007); Musa, 2007; Oladeji, et al., 2009; Kaliyan and Morey, 2009) and so on. Olorunnisola 2007 and Wilaipon 2008 described briquetting as a process of compaction of residues into a product of higher density than the original material, while Kaliyan and Morey (2009) and Gilbert et al. (2009) defined briquetting as a densification process. The use of briquettes can reduce drastically the demand for wood and therefore decrease deforestation. Besides, briquettes have advantages over fuel wood in terms of greater heat intensity, cleaningness, convenience in use and relatively smaller space requirement for storage (Yaman et al., 2000; Olorunnisola, 2004). Among the agro and forestry residues that can be subjected to process of briquetting are residues from maize, wood, guinea corn, beans, groundnut, rice, cotton and sugar cane. A lot of residues had been subjected to process of briquetting. Such residues are woods, (Granada et al., 2002), cotton (Singh, 2004), olive refuse (Yaman et al., 2000), and banana-peel (Wilaipon, 2008). Others are waste paper + admixture of coconut husks (Olorunnisola, 2007), rattan furniture waste (Olorunnisola, 2004) and maize cob (Wilaipon, 2007; Oladeji, 2010)**.** In this work, two species of corncob which are residues generated from cultivation of maize were subjected to process of briquetting for biomass energy production, which is renewable and environmentally friendly. The densification properties of the briquettes produced from the two species were further characterized to determine which of the two would exhibit more positive attributes of biomass energy.

2. Materials and Methods

The agro-residue selected for briquetting was corncob from maize (***Zea mays***). This is because; in Nigeria, maize is annually cultivated in about 5.33 million hectares of land yielding about 7.5 million tonnes of maize (FOS, 2006). Most often, the residues from maize are dumped or flared resulting in wide spread fire hazards and environmental pollution, which means corncobs will always be available for briquette production. The initial moisture content and bulk density of raw and treated corncob from the two species were determined. Particle sizes were determined using the procedure highlighted in ASAE 424.1(2003). The particle size 2.40 mm which represented medium series was chosen.

For the experimental aspect of the work, a briquetting machine was designed and fabricated (Figure 1). Material used for the construction of the briquetting machine was mild steel. Mild steel was preferred because, it is widely available, strong, cheap and easy to fabricate. The machine consists of four lower rectangular moulds (where biomass feedstock was placed), which were welded together. These moulds were placed upon a base plate, which moves up and down in vertical guide. This plate is also capable of horizontal movement by sliding on a pair of rails made from angle bars. The vertical motion of the plate along with the moulds is made possible through a manually operated jack, while their horizontal motion is achieved by manual pulling or pushing. The design of the machine was based practically on hydraulic principle, although the loading of the biomass feedstock was purely a manual process.

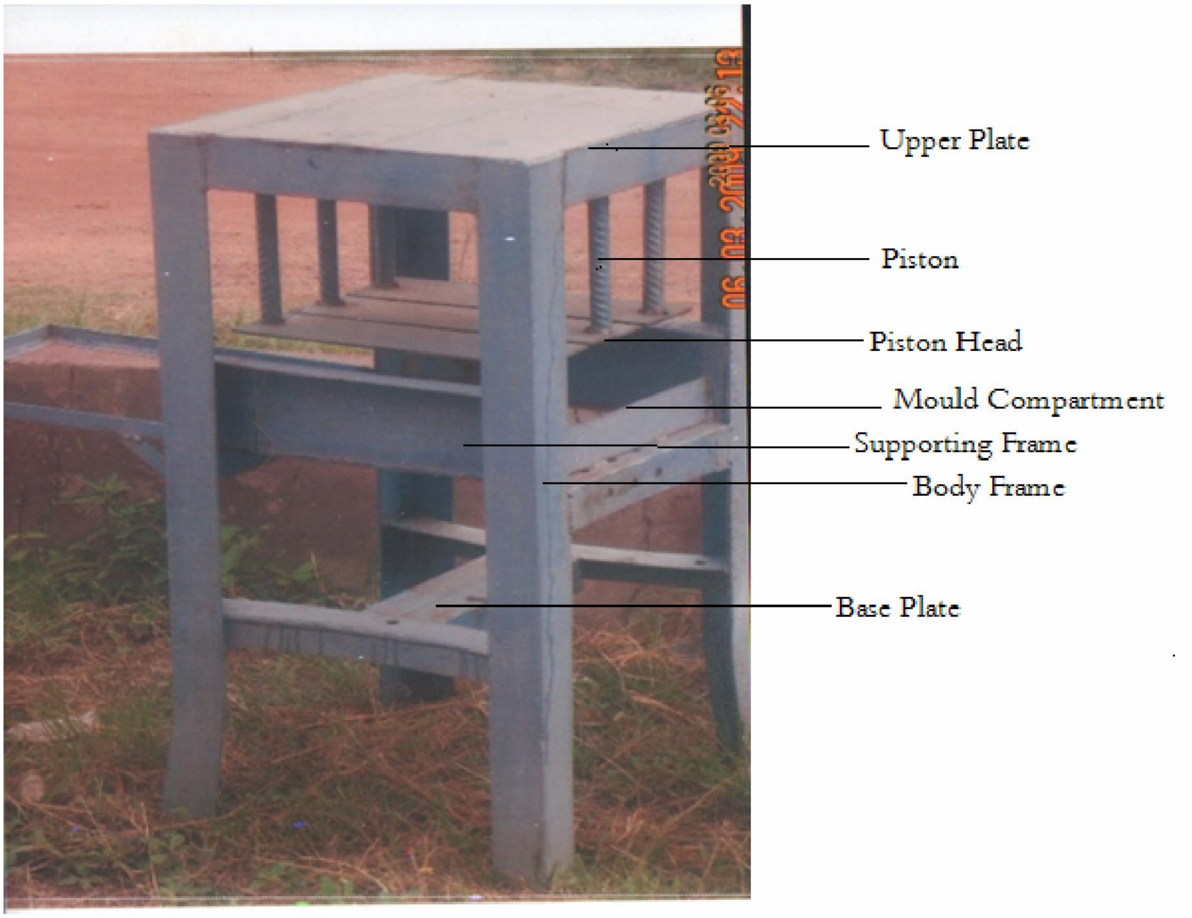

Figure 1 briquetting Machine

Briquette Production

For the production of briquettes, the biomass feedstock was mixed with cassava starch gel which acted as a binding agent. The mixture was stirred vigorously to ensure a proper mix. The resulting mix was fed into the moulds of the briquetting machine and compressed. The briquettes (Figures 2 and 3) were late ejected after the dwell [holding] time of 120 seconds was observed. This was followed by immediate measurement of briquette dimensions and densities. The ejected briquettes were later sun-dried.

2/17/2011

Figure 2 briquettes produced from white corncob

Figure 3 briquettes produced from yellow corncob