International Journal of Mechanical and Industrial Technology ISSN 2348-7593 (Online)
Vol. 2, Issue 1, pp: (150-154), Month: April 2014 - September 2014, Available at: www.researchpublish.com

DENSIFICATION CHARACTERISTICS OF GROUNDNUT SHELL

AJOBO J.A

Department of Mechanical Engineering, Osun State College of Technology, Esa-Oke, Osun state, Nigeria

Abstract*: Nigeria is a major producer of groundnut in the world with an average annual production of about one million tons. Groundnut production generates large amount of process residues such as groundnut shell. These groundnut residues which are currently of low utility value in Nigeria are potentially viable options for energy productions. However, these residues after harvest and processing must be gathered, processed and densified in order to facilitate efficient handling, transportation and usage. The experimental procedure involved in the development of a bottle jack press which has the capacity of producing three briquettes pieces per hour. Groundnut shell were pressed hydraulically in a compression compartment (360 x 105 x 155 cm^3) compaction pressures of 1.5, 3.6 and 4.5N/m^2, with binder ratio level of 15, 20 and 25% and particle size of 0.4, 1.8 and 2.7mm. Briquettes were produced from using residue particles mixed with cassava starch binder and moisture contents of experimental substrates were determined using ASAE standard. The ultimate and proximate analyses of the produced briquettes were carried out using ASTM standard method. Experiments were carried out to determine density, durability, indices, compressive strengths and heating value of briquettes produced. The produced briquettes rare densities between 356.3 and 632Kg/m3 The optimum moisture content, compressive strengths, compaction ratio, relaxation ratio and heating value for groundnut shell briquettes are 11.25%, 1.59KN/m^2, 16.33J/kg, 4.3 and 1.45 respectively. The briquette properties are quite good with resistance to mechanical disintegration high value of relaxed density and low value of relaxation ratio obtained for the briquette imply their potentials as energy materials. ASL content = 1.3, Moisture Content = 12.0, Calorific value Kcal/kg = 4200

***Keywords:* Briquettes, Groundnut residues, compaction, ASAE, ASTM**

I. INTRODUCTION

Crop production generates considerable amount of residues that can be used as energy source. This could be distinguished into the field residues and process residues. Field residues are residues that are generated during crop processing e.g milling. Crop residues are used as energy sources as fodder, raw manufacturing materials and in some cases, they are just burnt as wastes. It includes various plant parts such as stems, branches, leaves, chaffs, pits which depends on crop and harvest method. These can be categorized into four major categories:

Woody crop residues e.g coconut shells

Cereal residues e.g rice, wheat straw, and maize stalk.

Green crop residues e.g groundnut plants and soya beans

Crop processing residues e.g baggase and rice husks

These residues constitute a major part of the total annual production of biomass residues and are important potential sources of energy, both your domestic as well as industrial purposes (Clancy, 1995; Jekayinfa and Scholz 2007)

Densification is a method of pre-treating loose, bulky biomass materials and bringing them into a form suitable for use in available combustion equipment. The bulking characteristics of materials for your transport, storage are also improved (Hulscher et al; 1992).

The demand for fuel is expected to have risen to about 213.4 x 10^3 metric tons, while the supplies would have decreased to about 28.4 x 10^3 metric tons by the year 2030. (Adegbulugbe, 1994)

Wood in the form of fuel wood, twigs and charcoal has been a major source of renewable energy in Nigeria, accounting for about 51% of the total annual energy consumption. The other sources of energy include natural gas (5.2%), hydro-electricity (3.1%) and petroleum products (41.3%). (Akinbami,2001).

In Nigeria, large quantities of agricultural and forestry residues produced annually are vastly under-utilized. The common practice is to burn these residues or leave them to decompose. (Olorunsola,1998; Jekayinfa and Omisakin,1995).

The economic downturn coupled with the moribund state of many wood based industries makes this practically impossible in developing countries. For example, out of many wood based industries in Nigeria, Saw mill industry appears to be most active, while others are either moribund or are operating far below capacity (Arufor, 2000).

Briquetting is the process of using mechanical pressure to reduce the volume of Biomass material thereby converting Biomass residues into more acceptable fuels by improving the physical properties of the biomass in terms of higher density, better handling and combustion characteristics than the loose materials. It provides a decent convenient and efficient way of using agricultural wastes (Faborode,1998) and thus improves the economies of material handling, transportation and storage thereby enhancing more versatile application (Olaoye,2001). Residues vary in their physical and chemical properties which require different densification processes parameter influencing the briquettes quality which are moisture content, particle size and morphology (shape).

II. MATERIAL AND METHODS

The experimental methodology consisted of two distinct segments. Firstly, feed stocks were procured, the second segment involved preparing (particle size reduction; moisture conditioning e.t.c) feed stocks for subsequent compression and relaxation studies.

Factors influencing the selection of raw materials are;

1. Moisture Content
2. Ash content.
3. Fixed Carbon Content
4. Particle size.

Materials used.

The following materials were used:

1. Groundnut shell
2. Cassava starch.
3. Water.

The basic equipment used;

1. Pressure gauge
2. Hydraulic Jack
3. Stop watch
4. Sieve Analysis screens
5. Cuboids of different volume
6. Fabricated bottle Jack Briquette machines.

METHOD

This was carried out in a briquette machine (using bottle jack with guage) assembly. It has a slider arm with dimension (410 x 330 x 25), angle bar (75 x 75 x 3658), rod of diameter (25 x 25 x 300), ram plate (360 x 100 x 4), frame (430 x 460 x 1000) and compression compartment (360 x 105 x 115) all in mm.

The shell material was treated with binders (starch) for proper compression. The materials must be in pasty form before pouring into the mould, preferably the materials remained in the moulding box for about ten minutes before the compression in order for them to stick together. The bottle jack was attached with pressure gauge, used to read the amount of pressure used for each material. The mould was put in place and the materials in the moulding box were pressed at once, which allowed the materials to compress to a shape. The outer plate is spring loaded in other to have quick returns of the spring after compression. The briquettes were removed from the moulding boxes and allowed to dry in the sun for two days. After this, the briquette was weighed for marketability.

Fig 2.1 the experimental material (Raw Groundnut Shell)

Fig 2.2 Briquette produced Groundnut Shell with Binder (After Compression)

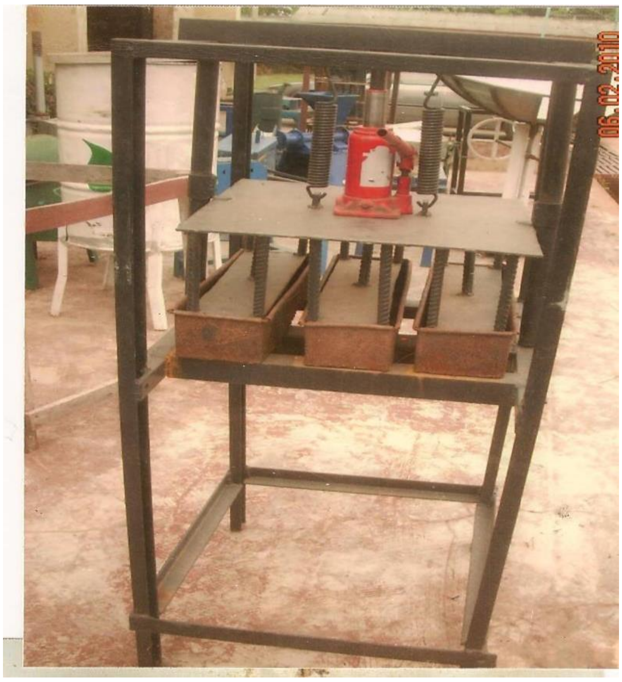

Fig 3.3 Picture of the Bottle Jack briquette Machine

III. RESULTS

The table below shows the ash content of different constituent of biomass which indicate that groundnut shell normally have much lower ash content when compared with the ash content of other types of biomass, this is an indication of sagging behavior.

Table 1: Ash content of different types

Constituent	%percentage of groundnut shell
Corn curb	1.2
Sawdust (mixed)	1.2
Soya beans stalk	1.5
Coconut shell	4.5
Cotton shell	4.6
Groundnut shell	1.3
Beans straw	10.2
Rice husk	15.5

The lower the ash content, the lower the sagging behavior. The stable briquettes have low bulk densities.

IV. MOISTURE CONTENTS

The moisture contents level of groundnut residue from the shell are represented in the actual mean moisture content of the residue from the shell which was 9.34% which falls within the ideal operating region of moisture content of 10-15% for making briquette. See table 2

Table2: Percentage moisture content of groundnut shell residue on Oven dried

No. Of Experimental Replicate	Weight of Residue Before Oven Drying	Weight of Residue After Oven Drying	Actual % Of Moisture Content	Calculated % of Moisture Content
1	28.09	25.49	9.50	9.25
2	27.99	25.47	9.22	9.00
3	28.56	25.87	9.30	9.41
		Mean Moisture Content	**9.34**	**9.22**

V. DISCUSSION

Moisture contents above 10% might lead to excess steam production which can lead to explosion as a result of dissociation. Moisture contents below 10% results in denser, more stable and more durable briquette which are safe for briquette production.

The briquette produced is clean, not smoky like wood (it has greater heat intensity) and relatively small space for storage, it is low cost, durable, easy to store, stable and free of cracks. It improves fuel situation in rural areas.

VI. CONCLUSIONS

It is therefore concluded that groundnut residue provide a great potential as a briquette for energy purpose are locally available. The machine produced 3 briquettes at a time. The briquettes produced will not disintegrate with time or crumble while on transformation. The briquette is strong.

REFRENCES

[1] Adekoya, L.O (1989) 'Investigations of Briquetting Sawdust'. The Nigerian Engineer. Vol.24, No3, ppl-10.

[2] Akpabio, L.O, Garba A, and Klalu, A,(1995). 'The production of solid Fuel briquettes from sugar-cane waste' proc. On chemistry and Biotechnology for National development, Sheda Science and technology centre Abuja, Nigeria, August 17-18,pp175-178.

[3] Enweremadu, C.C, Ojediran J.O, Ogunwa,A and Adedayo M(2004a) 'Determination of the energy potentials of orange pomace' science focus vol 8pp 1-5

[4] Enweremadu, C.C, Ojediran J.O, Oladeji J.T and Afolabi L.O(2004b) 'Evaluation of Energy potentials in Husks from Soy-bean and cowpea' Science focus vol8pp 18-23.

[5] FOS, (2006). Federal Office of Statistics, Agricultural survey, 2003/04, Federal Ministry of Agriculture (June, 2006).

[6] Granada, E, Gonzale, M. L, Miguez, J.L and Moran, J. (2002) 'Fuel lignocellulosic briquettes, die design and product study'. Renewable energy 27;561-573.

[7] .Inegbenebor A.O, (2002) 'development of Briquetting machine 'NJISS Vol. III, Manuscript EE 05 003: 10.

[8] Jekayinfa S.O and Omisakin O.O, (2005) 'The energy potentials of some agricultural wastes' as local fuel materials in Nigeria'. Agricultural engineering international the CIGR E-Journal of scientific research and development vol. III manuscript EE05 003: 10

[9] Khurni R.S and Gupta J.K(2006) a Textbook of Machine Design. Eurasia publishing house (PVT) ltd Ram Nagar. New Delhi.

[10] Mc Kendry P (2002) 'Energy production from biomass (part1): Overview of biomass Bio resource technology, 83,pp 37-46'.

[11] Musa N.A (2007) 'comparative fuel characterization of rice husk and groundnut shell Briquettes' NJRED, Vol 6no 2 pp 23-26.

[12] Oladeji, J.T, Enweremadu, C.C and Olafimihan, E.O (2009) 'conversion of Agricultural wastes into biomass briquettes' IJAAAR 5 (2): 116-123.

[13] Olorunisola, A.O 1998. The performance of sawdust br4riquettes combusted in a conventional local stove. Nigerian Journa of Forestry Research 44: 241-265

[14] Olorunisola, A.O.1999. The Efficiency of two Nigerian cooking stores in handing corncob briquettes Nigerian Journal of Renewable Energy 7(1&2) 31-34.