Analysis of Physical and Combustion Characteristics of Briquetting Mechanisms

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Abstract— A briquette is a compressed block of coal dust or other combustible biomass material such as charcoal, sawdust, wood chips, peat, or paper used for fuel and kindling to start a fire. The present study deals with determination of physical and combustion characteristics like length, diameter, mass, density, compressive strength, shearing strength, moisture contents, total ash contents, fixed carbon, volatile matter, gross calorific value of Sawdust briquette. Briquette quality is evaluated mainly by briquette density. Briquette density is very important beginning the viewpoint of manipulation, burning speed, briquette durability, etc. During our studies, theoretical analyses of parameters which have an impact on briquette quality are conducted. The compression test and shear test were conducted using manual compression machine.

Key words: Briquetting mechanisms, charcoal, wood chips

I. INTRODUCTION

The importance of energy for a nation's development cannot be overemphasizing. This energy is the corner stone of economic and social development. Globally, 140 billion metric tons of biomass is generated every year from cultivation. This volume of biomass can be convert to an enormous amount of energy and raw materials equivalent to approximately 50 billion tons of smear with oil. Agricultural biomass waste, if converted to energy can substantially displace fossil fuels, reduced emission of greenhouse gases and provide renewable energy to some 1.6 billion public in developing countries, which can be lack access to electricity. As commonly practiced, direct combustion of agricultural residue results in air pollution, thereby an important health risk to both human and ecology.

II. LITERATURE SURVEY

Francesco Romagnoli, Anna Beloborodko [1] Biomass residues from industrial processes are not frequently used within the perspective of energy production for different reasons. Some of these weaknesses could represent an opportunity for the usage of biomass residues for briquettes production, in order to provide a higher energy value per unit of mass and to overpass the drawbacks connected to transportation, handling, treatment, and storage. The results of the combustion tests prove that several types of herbaceous biomass can stabilize and prolong the combustion process by reducing combustion intensity. This can result in a much longer and safer combustion process with a lower emission of CO.

Daham Shyamalee, A.D.U.S. Amarasinghe, N.S. Senanayaka[2] saw dust is an abundantly available solid waste in Sri Lanka. Large heaps of saw dust are common sight around the saw mills while some are appearing at the environmentally sensible areas such as river basins, estuaries and woodlands. The annual production of saw dust in the country is about 112,000MT which can be used to produce the energy products. Manual densification of saw dust DBBF is possible with the piston press technology. However, binding agents should be added externally to get the proper binding. Calorific value of briquettes obtained with 30% paper binder is 18.14 MJ/kg and with 30% wheat flour binder it is 20.04MJ/kg.

Agidi Gbabo, Samuel Alake2, Andrew Ndudi Efomah [3] A briquetting machine to utilize sugarcane bagasse as raw material was designed, fabricated and tested. It was developed in order to convert excess sugarcane bagasse produced by both cottage and industrial sugar factories into briquette for both domestic and industrial use as source of heat energy. The equipment was able to effectively convert sugarcane bagasse, sawdust and rice husk into briquettes of varying qualities. Other agricultural wastes such as groundnut husk, corn cobs etc can be used. The highest binder concentration ratios, 35% and 45% produced the best briquettes

Briquettes	Compressive strength (KN/m2)			
	15% binder concentration	25% binder concentration	35% binder concentration	45% binder concentration
Sugarcane bagasse	0.17	0.18	0.35	0.40
Rice husk	0.10	0.15	0.25	0.28
Sawdust	0.35	0.40	0.50	0.60

Bemgba Bevan Nyakuma, Anwar Johari [4] This study was aimed at investigating the calorific fuel properties of Empty Fruit Bunches (EFB) fibre and briquette. Thermal analysis was carried out in the temperature range 30 °C to 500 °C at 10 °C/min heating rate to determine the calorific requirement, Q and specific heat capacity, Cp ,b of the EFB fuels. Calorific requirement is the total amount of heat required to raise the temperature of the feedstock to the pyrolysis peak temperature and complete the reaction. The results showed that physical and chemical properties such particle size, moisture content and binder significantly influence the heating rate and the heating profile of EFB and the briquette.

Lucie Jezerska, Ondrej Zajonc [5] To verify the effect of added starch on flow ability and pelletization of spruce sawdust, were prepared mixtures with addition of 0, 5, 10, 15 and 20 % (w/w) starch. The measured basic mechanical-physical properties of the individual mixtures have shown that starch improves flow ability of the mixture (growing value of the ffc parameter), reduces impact of friction forces on the contact stainless material (reduced wall

friction), thus reducing energy demands of the process as regards flow of the mixture through the hopper of a pellet press. It has been detected that behaviour of mixtures with various representations of starch can be predicted by their basic characteristics and simulation of the flow.

Leandro Rocha Lemos [6] It is important to understand the reduction disintegration mechanism in ferriferous burden that is used in blast furnaces. The behavior of this burden in the granular zone of this metallurgical reactor is important for smooth operation. The objective of this work was to prepare cold self-reducing briquettes using blast furnace dust and sludge and binders and compare the reduction disintegration index (RDI) of these agglomerates with conventional ferriferous burdens such as pellets, sinter and iron ore. The mechanical strength of the briquettes is related to the effectiveness of the contact between the particles and binders, fracture toughness of the phases present and homogeneous distribution of the binder in the mixture.

S. Purwono*, B. Murachman, J. Wintoko [7] Waste from stems can be utilized as alternative energy source by turning into a charcoal briquette. The nicotine content in the tobacco stem can be removed by several extraction processes using many types of solvent such as n-hexane, ethanol, kerosene and steam. The goal of this research was to develop charcoal briquette from waste of tobacco stem. The variables studied were type of solvent for extraction; temperature, time and pressure of pyrolysis, and pressure of briquetting. The results of this investigation that the powder waste from tobacco stems can be used as a raw material for making charcoal briquette. The calorific values of the briquette and gas emissions from their burning depend strongly on the pyrolysis process.

Edgars Repsa, Eriks Kronbergs, Mareks Smits. [8] For design of energy efficient compacting mechanisms it is necessary to understand biomass densification behavior. Experimental investigation of common reeds (Phragmites australis) particles compacting in closed die had been realized by laboratory hydraulic press equipment. During compacting the maximum pressure was 212 MPa. Force – displacement characteristics of compacting are nonlinear curves with two quasilinear parts. For continuous briquetting designed the rhomboid mechanism can be used also for all mentioned size particle compacting, because the necessary maximal force has been obtained at the end of the piston displacement.

T.U.Onuegbu, I.M.Ogbu, C. Ejikeme [9] In an effort to provide an affordable firewood alternative to the rural households in Nigeria, a study was carried out to compare some properties of bio briquettes (elephant grass and spear grass) and bio coal briquettes prepared at moderate pressure, 5MPa and ambient temperature with wood samples. It was found that elephant grass and spear grass have calorific values of 15.98MJ/kg and 16.13MJ/kg, densities of 0.319g/cm3 and 0.367g/cm3, durability ratings of 92.42% and 90.54% and moisture contents of 8.00% and 7.9% respectively. The results of the study show that elephant grass and spear grass cleared during farmland preparation or construction work can be economically processed into a good fuel briquette for domestic cooking.

Edgars Repsa, Eriks Kronbergs, Andris Kronbergs [10] The main task of this investigation is evaluation of patented (LV 14604 B) biomass briquetting mechanism. Theoretical relationship between necessary drive force and resistance force during pressing in die is determine. Briquettes from grinded common reed or common reed – peat mixture were produced with designed experimental briquetting press. Results of theoretical and experimental investigation show that the designed pressing mechanism can be recommended for mobile biomass briquette design. Results of theoretical and experimental investigation show that the designed pressing mechanism can be recommended for mobile biomass briquette design.

Marek Wrobel, Jaroslaw Fraczek, Slawomir Francik [11] Energy plant species are plants characterized by high annual growth, opposition to disease and pests, small habitat requirements and alteration to the Polish climatic condition. A new species, characterize by high values of pro energetic attributes is cup plant Silphium perfoliatum L. The aim of the examine is to determine the influence of the material fragmentation degree on the selected quality parameters of briquette from cup plant biomass. Briquetting be conducted at the pressure of agglomeration: 27 MPa, 37 MPa, 47 MPa. The research material be cup plant shoots pre-chipped to the theoretical length L = 10 mm and then milled into a hammer mill using a sieve with the diameter of holes: Ã¸10 mm (S10) and Ã¸6 mm (S6). The obtained briquette quality was assessed according to the guidelines include. Accordance with these requirements determined the specific density of the briquette. Further the stability of the obtained briquettes according to was determined.

J. O. Chaney, M. J. Clifford And R. Wilson [12] Densifying waste crop residues into biomass briquettes can provide an alternative household solid fuel, particularly in rural areas. They can be manufactured industrially and on a small rural scale using a simple hand-press, making them also very feasible for poorer communities. As well as the material property, all these factors have been shown to have a significant effect on biomass burn rates. For a particular wood stove and cooking situation it is useful to be able to optimize the steady-state burn rate and minimize the emissions, improving efficiency and sinking exposure to smoke for those in the household. This study has shown the burn rate of biomass briquettes is steady and controllable. Particularly it has been found that the A/V ratio of the briquette, its density and the boundary conditions are all significant in determining the burn rate. An empirical expression for the burn rate of a biomass briquette of slab shaped geometry burning in free air is given.

Arinola B. Ajayi, Justina I. Osumune [13] In this paper, the sawdust briquette apparatus is designed. Sawmill dissipate is a big problem especially in urban cities in Nigeria. These wastes are blistered openly which is causing environmental toxic waste. The wastes can beconverted to wealth thereby providing jobs for many unemployed citizens. The principles of apparatus design were employed to design the essential parts such as hopper, belts, housing barrel, and shaft. The apparatus has a production capacity of 95 kg/hr. The briquette machine has been designed. This apparatus has the capacity to produce 95kg of briquette in one hour. It can be easily fabricate with materials sourced locally. This project will provide job occasion to the unemployed graduates, and small-scale industries can be empowered by the government by making briquette from sawmill wastes.

Bichitra Bikash1, Rajib Bhowmik2, Madhurjya Saikia3, [14] this study aim at solving energy crisis in rural area via fuel briquettes from locally available biomasses by a well proven technique called wet briquetting. This procedure has different operational stages of briquette production. The challenges face during each operational stage of briquette production is discussed and solutions of the respective problems are tried to be found as well in order to best the method. An economic analysis of this method is also done to show profitability margin. Wet briquetting depends on the decomposition of biomass materials such as various crop residues. From the above studies we come to opinion that decomposition of finely chopped biomass at anaerobic condition is earlier. Moreover, by keeping biomass materials in heap condition at sun will enhance decomposition.

N. Abilash, M. Sivapragash [15] Biomass material such as rice straw, banana leaves and teak leaves (Tectona grandis) are densified by means of wet briquetting process at lower pressures of 200-1000 kPa using a piston press. Shear force, durability, impact resistance and calorific values were determined. Optimum densities for each type of briquette for good quality and their corresponding die pressure were determined. Shear strength and durability increase with the applied die pressure while impact resistance is not influenced by increasing die pressure. From the experimental results, we can say that rising die pressure and keeping dwell time at optimum value of 40 seconds [5], the quality of briquette has increased. Shear strength and durability enhance with applied die pressure while impact resistance is constant for briquettes of all types at all applied die pressure. It is above 600 kPa for rice straw, 500kPa for banana leaf and 700 kPa for teak leave yields durable briquettes. Therefore corresponding density of rice straw, banana leaf and teak leaves are 207.48 kg/m3, 179.69 kg/m3 and 227.53 kg/m3 correspondingly.

Sujata Tayde and D.M. Mahalle [16] the present study are undertaken to the test the briquettes. For this study availability of the biomass in Akola area and select the best suitable biomass for briquette making are studied for groundnut residue, sawdust, soybean residue, sole and mass mixing ratio, respectively. Briquettes made from screw press and piston press is tested for their physical and thermal properties in laboratory. The best suitable material for briquette making with the saw dust and wood species. Material including groundnut husk, sawdust and soybean straw were collected from University, in Akola and their physical and chemical properties are determined. The physical and chemical properties of Ground nut husk, sawdust, soybean residue were determined using standard test procedure.

Agata RADVANSKA [17] the bulk of the energy is still produced by burning fossil fuels as coal, petroleum products and natural gas. Supplies of these fuels are exhaustible and burning them pollutes the atmosphere. The paper deals with the experiments of compacting wood briquettes made of sawdust in the laboratory conditions. For the process of briquetting as well as for the heating properties are the shape of the final product is very important. Experiments of sawdust briquetting shaped according to demonstrated the applicability of this technique. Since the input data for cylindrical briquettes production are not accessible, it is not possible to compare relevantly these types of briquettes.

Akintunde, M. A. and Seriki, M. E.[18] The enormous problem constituting by waste paper. How to dispose this waste is becoming worrisome and it's generated every day. Since both paper and sawdust are wood products, as sawdust is used for briquettes, paper also can be used. This is one of the ways of reducing the nuisance constitute by these wastes. Mixing waste paper with sawdust briquettes could lead to better briquette performance and cost-effectiveness making this fuel more attractive to both producers and consumers. It was discovered that the grain size of the sawdust have little or no effect on the calorific values of the briquette. It only has effect on the ash content, and this is obviously due to the increase in surface area. As the grain size reduces there is a slight increase in the percentage ash content.

Olawole Abiola Kuti [19] in this paper, composite sawdust briquette fuel were produced and utilized in order to simulate cooking. Within a time frame, a known amount of water was boiled to simulate cooking by burning composite sawdust briquettes in a biomass stove. Renewable energy sources are been sought for domestic cooking in developing countries due to the fact that their non-renewable counterpart such as kerosene, LPG, etc. In this concert of composite sawdust briquette fuel in a biomass stove under simulated conditions was carried using the water boiling test. The power output decreases from the intermediate phase through the low power phase inspite of the variation in the composition of the fuel.

Patrick E.Imoisili, Kingsley O. Ukoba [20] in this study, production and characterization of hybrid biomass briquettes using two major agricultural wastes to be carried out. Briquettes were produced from sawdust of the specie Albiziazygia and sorghum dust using starch as binder. Five different composition of sawdust/sorghum dust hybrid briquette were produced, moisture content, compressive test, ash content, calorific test and burning efficiency tests are carried to determine the physical and mechanical properties of the hybrid briquette. This study has shown that the production of sawdust/sorghum dust hybrid briquette from biomass is possible. The experimental tests performed have also revealed that sawdust and sorghum dust, usually generated in large uncontrolled quantities, can be converted into good quality, highly storable and durable high-grade solid fuel briquettes, which will be suitable for both domestic and industrial energy production for energy generation.

III. CONCLUSION

The literature survey has been carried out considering this paper proposes physical and combustion characteristics of sawdust briquettes are manufactured using piston press technology. Using compression testing machine the compression test and shear test carried out, the deformations of particular load were determined. The density, compressive strength and shear strength of briquettes were determined using formulas and then calorific value, proximate analysis also to be determined.

REFERENCES

[1] Aivars Žandeckis*a, Francesco Romagnolia, Anna Beloborodko(2014), "Briquettes from Mixtures of

Herbaceous Biomass and Wood: Biofuel Investigation and Combustion Tests" Institute of Energy Systems and Environment, Riga Technical University.

[2] Daham Shyamalee 1, A.D.U.S. Amarasinghe 1, N.S. Senanayaka 2 (2015), " Evaluation of different binding materials in forming biomass briquettes with saw dust" International Journal of Scientific and Research Publications

[3] Agidi Gbabo1, Samuel Alake2, Andrew Ndudi Efomah3 (2015), "Development And Testing Of A Disc Actuated Briquette Production Machine From Sugarcane Bagasse And Other Agricultural Wastes" International Journal of Emerging

[4] Bemgba Bevan Nyakuma, Anwar Johari (2013), "Comparative analysis of the calorific fuel properties of Empty Fruit Bunch Fiber and Briquette", Institute of Hydrogen Economy, Faculty of Chemical Engineering, Universiti Teknologi

[5] Lucie Jezerskaa*, Ondrej Zajonca, Jiri Rozbroja (2014), "Research on Effect of Spruce Sawdust with Added Starch on Flowability and Pelletization of the Material" aVSB- Technical University of Ostrava

[6] Leandro Rocha Lemosa, Saulo Henrique Freitas Seabra da Rochab (2015), "Reduction disintegration mechanism of cold briquettes from blast furnace dust and sludge " Journal Of Materials And Research Technology

[7] S. Purwono*, B. Murachman, J. Wintoko, B.A. Simanjuntak (2011), " The Effect of Solvent for Extraction for Removing Nicotine on the Development of Charcoal Briquette from Waste of Tobacco Stem" Journal of Sustainable Energy & Environment .

[8] Edgars Repsa, Eriks Kronbergs, Mareks Smits (2011), " Briquetting Mechanism Analysis For Solid Biofuel Production", Engineering For Rural Development.

[9] T.U. Onuegbu, I.M. Ogbu, And C. Ejikeme (2010), "Comparative Analyses Of Densities And Calorific Values Of Wood And Briquettes Samples Prepared At Moderate Pressure And Ambient Temperature", International Journal Of Plant, Animal And Environmental Sciences

[10] Edgars Repsa, Eriks Kronbergs, Andris Kronbergs (2013), "Evaluation of biomass briquetting mechanism", Latvia University of Agriculture, Faculty of Engineering, Institute of Mechanics,

[11] Marek Wrobel, Jaroslaw Fraczek, Slawomir Francik (2013), "Influence Of Degree Of Fragmentation on Chosen Quality Parameters of Briquette Made From Biomass of Cup Plant Silphium Perfoliatum"

[12] J. O. Chaney, M. J. Clifford And R. Wilson (2009), "An Experimental Study Of The Combustion Characteristics of Low-Density Biomass Briquettes" Faculty of Engineering, University Of Nottingham, University Park.

[13] Arinola B. Ajayi, Justina I. Osumune (2013), "Design Of Sawdust Briquette Machine" Innovative Systems Design and Engineering .

[14] Bichitra Bikash1, Rajib Bhowmik2, Madhurjya Saikia3 (2013)," Challenges of Wet Briquetting from Locally Available Biomass" International Journal of Modern Engineering Research.

[15] Madhurjya Saikia1, Deben Baruah2,(2013)" Analysis of Physical Properties of Biomass Briquettes Prepared by Wet Briquetting Method" International Journal of Engineering Research and Development .

[16] Sujata Tayde, Jyoti Pohare And D.M. Mahalle,(2010)" Physical And Thermal Properties Of Briquettes by Piston Press and Screw Press", International Journal of Agricultural Engineering.

[17] Agata Radvanska,(2013) " Hydrostatic Pressure In The Process Of Wood Briquettes Compacting", Technical University of Košice, Faculty of Manufacturing Technologies In Prešov, Prešov, Slovakia.

[18] Akintunde, M. A. And Seriki, M. E.,(2013) "Effect Of Paper Paste On The Calorific Value Of Sawdust Briquette", International Journal of Advancements in Research & Technology,

[19] Olawole Abiola Kuti, (2009)" Performance of Composite Sawdust Briquette Fuel in a Biomass Stove under Simulated Condition", Department of Mechanical Engineering, University of Hiroshima.

[20] Patrick E.Imoisili1* Kingsley O. Ukoba1, E. Ekweh2, M. C. Ibegbulam3, (2012) "Production and Characterization of 3 Hybrid Briquette from Biomass", Mechanical Engineering Department, Federal University Of Technology, Minna, Nigeria.

