PRODUCTION AND CHARACTERIZATION OF BIOMASS BRIQUETTES

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Abstract - *This study states the potential threat posed by climatic change due to high emission of greenhouse gases (CO2 being important one) has become a major stimulus for renewable energy sources in general. The production of briquettes from groundnut shell, rice husk and sawdust bonded with starch as a binding agent. Proximity analysis is done to find out the percentage of volatile matter, ash content, fixed carbon and calorific value. All processing variables assessed are not significantly different from coal except for fixed carbon at five percent level of probability. The result showed that briquettes produced from this sample have the Calorific Value approximately equal to coal. The aim of briquetting is to produce briquettes that will serve as the alternative fuel for coal. This bio matter which contains the energy of sunlight which can be easily extracted can be used as alternate combustion fuel.*

Key Words: Stimulus, Briquettes, Proximity Analysis, Volatile Matter, Calorific Value,

1. INTRODUCTION

1.1 Introduction to biomass briquettes

Biomass briquettes are economical fuel substitute for coal, lignite and firewood. There are used to cook food in village areas and to heat boilers for producing steam in most of the villages. Peoples spent their 30% of the money for purchasing fuel for their cooking purpose. In general people use coal or wood as a fuel in this area which increases deforestation and decreases reserves of fossil fuels. Currently, there is tremendous increase in using biomass materials in the INDIA for producing liquid transportation fuels, combined heat and power, chemicals and bio-products.

In addition to numerous advantages, use of biomass materials in place of fossil fuels would result in low emission of greenhouse and acid gases. The original size and shape of briquettes is difficult to handle, transportation and store. One solution to this problem is densification of biomass materials into pellets, briquettes or cakes.

Densification increases the bulk density of biomass from an initial bulk density (include baled density) 40-200 kg/m^3 to a final bulk density of 600-800 kg/m^3. Thus densification of biomass materials could reduce the cost of transportation, handling and storage. Because of uniform shape and sizes, densified products can be easily handle and store. Saw dust was utilized as the biomass while paper, topsoil soil and earth soil were utilized as the covers. The saw dust briquettes were created from homogeneous sawdust of Eucalyptus tree species fortified with various folios (paper, mud soil and topsoil soil).

The briquettes were sun dried for a limit of about fourteen days from there on were exposed to different tests to survey their dampness content, thickness, mechanical sturdiness and compressive quality. Compressive strength was also found primarily dependent on binder and machine type with paper briquettes having the highest compressive strength followed by clay and loam respectively. The hand dual press machine was found to produce briquettes with high compressive strength, this is because the compression took place in stages hence there was adequate time for agglomeration of the materials. The briquettes produced by multiple pedals were observed to have the lowest compressive strength. Mechanical properties were found to depend on press machine, type and quantity of binder.

Densification procedure can deliver briquettes with uniform shape and sizes that can be all the more effectively took care of utilizing existing taking care of and capacity hardware and in this manner decrease cost related with transportation, dealing with, and capacity.

For successful densification is required that the briquettes presents moisture content between 5 and 10% and particle size can be varied from 1 to 10 mm. Briquettes have a higher thickness and vitality content and less dampness contrasted with its crude materials.

As indicated by the thickness and solidness (mechanical quality) of briquettes are conversely relative to the molecule size since littler particles have more noteworthy surface region during densification. According to, briquettes manufactured at lower pressures (30-60 MPa) fall to pieces easily. According to while investigating the thermal energy potential of coffee husks, banana peelings, wood shavings, charcoal dust. Goat droppings, cow dung and saw dust with cassava glue as a binder found that the compressive strength and density of the briquettes ranged from 0.3 to 1.12 kg/cm^2 and 0.785 to 1.509 g/cm^3 respectively.

Material and procedure factors that could furthermore impact the physical and mechanical qualities of briquettes are compacting pressure, dampness content, molecule size circulation of biomass crude material and temperature. The thickness and sturdiness (mechanical quality) of briquettes are conversely corresponding to the molecule size since littler particles have more prominent surface territory during densification. Mechanical durability of a briquette is a function of compressed density and variation in binder level. Increment in compacted thickness and folio level upgrades strength while dampness content lessens it.

According to spear grass briquette has compressive strength of 2.00N/mm^2 and durability rating of 90.54% while that of elephant grass briquettes are 3.50N/mm^2 and 92.42% respectively. It was found that elephant grass and spear grass have calorific values of 15.98MJ/kg and 16.13MJ/kg, densities of 0.319g/cm^3 and 0.367g/cm^3, durability ratings of 92.42% and 90.54% and moisture contents of 8.00% and 7.9% respectively. The overall objective of this study was to optimize the utilization of saw dust as a fuel in tea industry by determining the mechanical properties of briquettes produced with different binders and press machines.

Many of the developing countries produce huge quantities of agro residues but they are used inefficiently causing extensive pollution to the environment. The major residues are rice husk, coffee husk, coir pith, jute sticks, bagasse, groundnut shells, mustard stalks and cotton stalks. Sawdust, a milling residue is also available in huge quantity. Apart from the problems of transportation, storage, and handling, the direct burning of loose biomass in conventional grates is associated with very low thermal efficiency and pollution.

Figure 1: Saw dust briquettes

Sawdust: Sawdust or wood dust is a side-effect or waste result of carpentry activities for sawing, milling, planning, routing, drilling and sanding. It is made out of fine particles of wood. These activities can be performed by carpentry hardware, versatile force devices or by utilization of hand instruments. Wood dust is also the byproduct of certain animals, birds and insects which Ogatan Japanese charcoal briquettes made from sawdust live in wood, such as the woodpecker and carpenter ant. In some manufacturing industries it tends to be a significant fire danger and wellspring of word related residue presentation.

Figure 2 Groundnut shell briquettes

Groundnut shell: Ground nutshell waste based powdered enacted carbon. Groundnut creation produces enormous measure of procedure buildups, for example, groundnut shell. These groundnut deposits which are as of now of low utility incentive in Nigeria are possibly practical alternatives for vitality creations. Notwithstanding, these buildups after reap and preparing must be assembled, handled and densified so as to encourage.

Figure 3: Rice husk Briquettes

Rice husk: Rice husk is inexhaustible agribusiness waste and significant source formless silica. Rice husk is a natural waste and is delivered in huge amounts. It is a significant result of the rice processing and agro-based biomass industry. Rice husk is a cellulose-based fiber. It is light weight, with high explicit territory. Rice husk is a natural waste and is created in huge amounts.This is because of its exceptionally permeable structure and its great protecting property. The properties of rice husk debris silica change as per the terminating temperature and time. The debris of rice husk contains around 90% silica, which is a profoundly permeable structure and is lightweight, with high explicit surface.

1.2 MUFFLE FURNACE

Figure 4: Muffle furnace

A muffle furnace is a furnace with a remotely warmed chamber, the dividers of which brilliantly heat the substance of the chamber, so the material being warmed has no contact with the fire.

Structure: This muffle furnace material is made of standard quality materials which make it durable, reliable in perfect for long time use. The external case or cabinet of this muffle furnace is made of thick PCRC sheet. The case is painted with stove empower that keeps the unit rust free.

The entryway accompanies solid cover which can be utilized to open and close the unit at any temperature. The temperature control unit contains controller control before the unit with pilot lights.

2. LITERATURE SURVEY

The purpose of this literature review is to provide background information and to emphasize the relevance of the present study. This treatise embraces some related aspects of biomass material.

2.1 Preparation of Biomass Briquettes using various agro-residues and waste papers by Tamilvanan .A

Development of a substitute fuel for conventional fuels, such as wood, coal, charcoal and Liquefied Petroleum Gas (LPG), is important. Briquette production technology, a kind of unpolluted coal technology, will facilitate to prevent global warming and serve to conserve forest resources. The main ingredients of Biomass Briquettes are agricultural wastes such as straw, sugarcane bagasse, maize stalk, coconut husks and leaves, groundnut shells, rice husk, sawdust and the waste papers from the municipal waste, which mainly acts as a binding agent. Briquettes are very cheap as they are manufactured from waste. They are additionally used as a substitute fuel for cooking purposes and several other heating processes. The experimental work focuses on developing a method to manufacture Briquettes of consistent quality at low pressures by employing a wet technique. The impact of process variables like shape, density, moisture content and calorific value on Briquettes with different combinations were studied. The usage of briquettes instead of firewood results in preventing deforestation and reducing greenhouse effect. In this situation, briquettes could potentially offer a means of waste management while providing a new fuel business opportunity for the local economy.

2.2 Producing Fuel Briquettes from sugarcane waste, National research an education conference by C. Tiwari

The sugarcane plant is an exemplar of how nature can provide us with renewable resources to sustain ourselves without dependency upon unsustainable and damaging fossil fuels. Across the world research is being done to see how this humble plant can be used to provide alternatives to anything from petrol to plastics. More interest is being generated in the alternative uses of such plants and agro more evident. Deforestation is harmful both on a global scale, with diminished overall potential for CO and on a local scale, with increased risk of soil erosion which can lead to desertification and subsequent malnutrition or even famine.

The geographical location of Pondicherry in relation to the Western Ghats mountain range means it has a natural aridity, which, combined with often heavily-irrigated agriculture and the monsoon climate mean soil erosion and subsequent desertification are more likely. Project Green Hands tsunami, set itself the goal of increasing green Green Hands, 2010) India is not well known for deforestation rate, but cover then India's native forests have actually declined at an alarming pace, from 0.8% to 3.5% per year," during 2000-2005 India suffered from a higher rate of forest loss than the Brazil and Malaysia. Briquetted agricultural waste (agro to wood and can therefore reduce the deforestation rate.

The usage of agro-waste products, such as S.C.W, also avoids the cost and environmental impact of otherwise dealing with them. In some regions, S.C.W is burnt in emissions.

3. PROBLEM STATEMENT

The potential threat posed by climate change, due to high emission levels of greenhouse gases (CO_2 being important one), has become a major stimulus for renewable energy sources in general. When produced by sustainable means, biomass emits roughly the same amount of carbon during conversion as it is taken up during plant growth. The use of biomass therefore does not contribute to a buildup of CO_2 in the atmosphere. Hence there is the need of an appropriate briquetting to make biomass a significant impact as fuel.

With the rapid development of global economy, the energy consumption is also constantly growing, as the important resources of human survival and development, the non-renewable resources such as coal, natural gas and oil will be eventually exhausted, at the same time in the extensive use of these nonrenewable energies will lead to a series of serious environmental pollution problems.

So drastically improve existing the actual utilization of energy and low pollution and developing a kind of low polluted and renewable resource through the high and new science and technology to gradually replace the high pollution and non-renewable fossil energy, is the main way to solve the human energy and the environment pollution crises problems.

At present, among many renewable energy sources, biomass energy has the most potential for development, because it has the characteristics of large resource reserves.

4. METHODOLOGY

Raw Materials used: The raw material used in the production process is sawdust, rice husk, groundnut shell, and better efficiency. The binding materials used for the briquetting purpose are waste rice.

Figure 5: Sawdust

Figure 6: Groundnut shell powder

Figure 7: Rice husk powder

Briquette Formation: Heating rice waste in a cooker by adding the ratio of water to rice waste. Stir it for 7 minutes after 7 minutes it will become paste like material which acts as a binding agent.Mix the rice paste and bio waste mixture in the ratio of 1: 3.

After mixing pour desired amount of mixture into the Mould and ram it to avoid blow holes and irregularities which increases its strength and durability.

Immediately reverse the mould and give a gentle hit on it. Wet briquette will be formed.

Depending upon the thickness of the briquette will take 2-5 days to dry after that we can use it as a fuel.

Figure 8: Briquette preparation

5. CHARACTERIZATION AND RESULTS

5.1 Characterization of the briquette samples:-

a) Ignition time: It is the time taken for a flame to raise the briquette to its ignition point. The sample was adjusted and ignited at the base to give a steady light as described earlier.

b) Water boiling test: These tests were conducted under similar conditions using the sample of 100 g each. To start the ignition, some wood chips and kerosene were used to burn the briquettes and the remaining un burnt material (wood chips) was carefully removed.

c) Burning rate (R): This indicates the mass of fuel burnt per minute during the boiling phase. The formula which is used to calculate the burning rate:

Burning rate (R) = Mass of fuel consumed/Total time taken (min)

d) Specific fuel consumption (SFC): It indicates the mass of fuel required to produce one liter of boiling water. It is calculated by using the formula:

SFC = Mass of fuel consumed (kg)/Total volume of boiling water (L)

5.2 Combustion Properties Determination

The combustion properties include percentage of volatile matter, fixed carbon, ash content and heating value and these tests were conducted on four samples based on ASTM Standard E711-87 (2004). For percentage of volatile matter, 1g of the briquette was placed in a crucible of known weight and oven dried to constant weight after which it was heated in the furnace at temperature of 900oC for 10 minutes. The percentage of volatile matter was then expressed as the percentage of loss in weight to the oven dried weight of the original sample.

Proximate Analysis: A proximate analysis, as defined by American Society for Testing Materials, is the determination by prescribed methods of Moisture, volatile matter, fixed carbon (by difference) and ash.

a) Moisture content procedure: In proximate analysis the moisture is determined by heating the sample until a consistent mass is obtained. This treatment will also drive off any volatile substances present, the mass of such compounds is generally insignificant, and is included in the moisture content.

Calculations

% moisture = [sample weight (g)-dry weight (g)] x 100 Sample weight (g)

b). Volatile matter: The Volatile Matter refers to the components of the sample, except for moisture, which are liberated at high temperature in the absence of air. This is normally a blend of short and long chain hydrocarbons, aromatic hydrocarbons and some sulphur.

Apparatus: Muffle furnace.

Procedure: The analysis of VM of municipal solid waste was done in muffle furnace. Silica VM crucibles were used for the analysis. 1 g sample of each component was taken in VM crucibles and were kept in muffle furnace for 7 minutes at 900C ± 5 C. Volatile matter (in percent) was calculated by using the following formula

Volatile matter (in percent) = [(W2-W3)/(W2-W1)]x100

Where, W2 = weight of VM crucible + I g of sample.

W3 = final weight,

W1 = weight of VM crucible.

c). Fixed carbon: The fixed carbon content is the carbon found in the material which is left after unpredictable materials are driven off. This differs from the ultimate carbon content because some carbon is lost in hydrocarbons with the volatiles.

Apparatus: Muffle furnace.

Procedure: Fixed carbon is determined by removing the mass of volatiles determined by the volatility test, above, from the original mass of the sample. Calculation was done by using the following formula.

Fixed carbon (in percent) = [(W3-W1)/(W2-W1)]x100

Where, W3=final weight

W1=weight of VM crucible

W2=weight of VM crucible+1g of sample.

d). Ash content: Ash content is the non-combustible residue left after the sample is burnt. It speaks to the mass mineral issue after carbon, oxygen, sulfur and water (counting from muds) has been driven off during ignition. Analysis is fairly straightforward, with the MSW thoroughly burnt and the ash material expressed as a percentage of the original weight.

Apparatus: Muffle Furnace.

Procedure: The ash content was determined by placing 1 g of sample in open silica crucibles in muffle furnace for 1 hour and was burnt to 800 ± 5 °C. Calculation was done by using the following formula,

Ash content (in percent) = [(W3-W1)/(W2-W1)]x 100

Where, W3 = final weight,

W1 = weight of VM crucible,

W2 = weight of VM crucible + 1 g of sample,

e). Heating value (Hv): This was calculated using the formula:

Hv =2.326 (147.6c +144v)

Where c is the percentage fixed carbon and v is the percentage volatile matter (Bailey et al. 1982)

COMBUSTION PROPERTIES OF BIOMASS BRIQUETTES:

PVM	PAC	PFC	HV
15.4	11.1	73.5	30.3

Table 1: Combustion properties of biomass briquettes

6. CONCLUSION

The results from this study have shown that satisfactory briquettes can be produced from Bio waste. Heating value of the sawdust briquette is almost comparable to the coal. So, it can be used instead of coal, lignite, hardwood for various domestic and industrial purposes. Biomass is available very easily and it is very economic. It reduces the GHGs & acid gas emission and prevents deforestation. It is very easy to prepare these briquettes at home as lot of skill is not required and it will bring good revenue.

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