RSU JOURNAL OF BIOLOGY

AND

APPLIED SCIENCES

ISSN: 2811 – 1451

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CREATING FUEL BRIQUETTES FROM DISCARDED COCONUT SHELLS AND PEANUT SHELLS AS RENEWABLE ENERGY SOURCES

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ABSTRACT

This study explores the potential of creating fuel briquettes from discarded coconut shells and peanut shells as renewable energy sources. The increasing demand for sustainable and eco-friendly energy sources has led to the exploration of alternative options such as biomass briquettes. Coconut shells and peanut shells are abundant agricultural waste materials that can be utilized for the production of fuel briquettes. The process of creating fuel briquettes involves collecting and drying the discarded coconut shells and peanut shells, crushing them into smaller pieces, and mixing them with a binder such as starch. The mixture is then crushed into briquettes using a briquetting machine, and the heat value, moisture content, ash content, and caloric value are measured to determine the quality of the briquettes. It evaluated the calorific value, burning efficiency, and emissions of the briquettes compared to traditional fuels. Creating fuel briquettes from discarded coconut shells and peanut shells possesses the capacity to provide A long-lasting and renewable energy source with the potential to lessen environmental damage and lessen dependency on fossil fuels. This research contributes to the development of innovative solutions for utilizing agricultural waste materials for energy production, promoting a more sustainable and greener future.

Keywords: coconut shells, peanut shells, briquettes, starch, furnace, water

INTRODUCTION

The search for substitute energy sources, including biomass, has been prompted by the growing need for renewable energy sources. Fuel briquettes and other biofuels can be produced from biomass, which comprises organic resources including wood, animal dung, and agricultural waste. Compressed blocks of biomass called fuel briquettes can be utilized as an environmentally acceptable and sustainable substitute for conventional fossil fuels.

Agricultural wastes such as coconut and peanut shells are frequently thrown away as rubbish. Nevertheless, a process of carbonization and compression may be able to turn these materials into fuel briquettes. Because of their high calorific value and carbon content, coconut shells are a perfect fuel briquette feedstock. Conversely, peanut shells are rich in oil and protein, which can improve the briquettes' ability to bond.

The process of turning peanut and coconut shells into fuel briquettes has been the subject of numerous investigations. For instance, a study by Njenga et al., (2017) examined the manufacture of fuel briquettes from coconut shells and discovered that the briquettes had a low ash level and a high calorific value. A different investigation by Ogunranti et al., (2019) examined the use of peanut shells as a binder in fuel briquettes and discovered that doing so enhanced the briquettes' mechanical qualities.

The finished product of biomass briquettes, has numerous applications in both industry and domestic settings (Oladeji et al., 2015). Charcoal and coal can be replaced by biomass briquettes as a biofuel. In poor nations where finding cooking fuel is difficult, briquettes are extensively used. Typically, industrial boilers are heated using briquettes in order to convert steam into electricity. Heat provided to the boiler is produced using briquettes. Briquettes made of biomass have been in use by humans since before recorded history. Produced from leftover agricultural debris, biomass briquettes are useful for heat factory boilers can act as a substitute for fossil fuels like coal or oil (Sh arma et al., (2015). Thus, the purpose of this work is to analyze biomass briquettes created from leftover coconut and peanut shells, as well as the technological applications and basic ideas of biomass. Along with elements that may affect biomass briquettes, its benefits and drawbacks are also explored. The review research comes to the conclusion that briquettes are a workable method of converting biomass leftovers into renewable energy. Moreover, it mentions that a variety of operational factors, including the kind of biomass feedstock used, affect briquette quality, including temperature, moisture content, addition of substrates and particle size. Regulations that pertain to particular stages of the process (biomass densification) provide the foundation for the production of biofuel briquettes. The rule establishes requirements for the briquette quality indicator level, briquette size and form, pressing method, pressure press, and other technical details of the densification process (Brunerová et al., 2018). It also covers the selection and processing of suitable raw materials. Factors that occur before, during, and after manufacturing are among the many variables that have a significant impact on the ultimate quality of the briquettes (Mitchual et al., 2013; Kaliyan and Morey, 2009). Particle size and moisture content of the raw materials are the primary factors influencing pre-production (Eissa et al., 2013; Saptoadi, 2008). Briquette handling, storage, and transportation conditions are the primary factors influencing post-production (Brozek, 2013; Brunerova et al., 2016).

The purpose of J.T. Oladeji's (2010) research on briquettes made from rice husk residue and maize cob waste is to determine which residue may be used as fuel more effectively and sensibly. The study's findings suggest that the briquettes made from these two leftovers will make excellent biomass fuels. Nonetheless, the results show that compared to rice husk briquettes, maize cob briquettes have more advantageous biomass fuel properties. Its density is higher at 650 kg/m3, its relaxation ratio is lower at 1.70, and its moisture content is 13.47%. The lengthy after-light period (370 seconds) and the sluggish propagation rate (0.12/s) of corncob briquettes on rice husks are further advantages.

Despite the potential of coconut shells and peanut shells as renewable energy sources, there is still a need for further research on the optimization of the production process and the quality of the briquettes. This study aims to investigate the feasibility of creating fuel briquettes from discarded coconut shells and peanut shells as renewable energy sources, with a focus on the carbonization and compression process.

RESEARCH METHODOLOGY

Data collection in this study was carried out in both Farm Power and Processing Laboratories, Department of Agricultural and Environmental Engineering, Niger Delta University Bayelsa State.

Materials and Tools

Utilized in this investigation are:

2.1.1 Coconut shell: The coconut shell is the hard-outer covering of a coconut fruit. It is composed of fibrous material and is typically brown or tan in color.

2.1.2. Peanut shell: Peanut shells are the outer covering or husk of peanuts, which are the edible seeds of the peanut plant. After peanuts are harvested, the shells are typically removed and discarded as waste.

2.1.3. Starch: Starch is a carbohydrate molecule composed of long chains of glucose units. It is frequently present in plants and acts as a type of energy storage. Starch, which can be found in foods like grains, potatoes, and legumes, is a significant source of carbohydrates for humans. During digestion, it is converted into glucose, which the body uses as its main energy source. Starch is also used in various industries, such as food production, paper manufacturing, and textile processing.

2.1.3. Water as a mixture of binding material.

2.2 Experimental Procedure

Raw Coconut and peanut shells see plate 1&2 are burned in the furnace as shown the plate 5 and a tiny shovel is used to put the shells inside the furnace. The instruments used to pound biochar are a mortar and pestle. Basins and buckets are utilized to mix the biochar dough. a measuring cup for calculating the volume of water required to create a starch solution. To ensure that the biochar dough is dispersed properly, a wooden stirrer is employed as a tool. Briquette mold used for printing samples of briquettes. The bomb calibrator is a gadget used to calculate the number of calories in the final briquettes. Treatment samples are identified with name tags in order to observe the impact of the component combination on the quality produced, this research combined two types of briquette producing materials coconut and peanut shells with certain compositions. In accordance with Table 1, the letter C stands for the composition of a coconut shell, and the letter P for that of a peanut shell. It is anticipated that, when utilizing an electronic weighing balance see plate 3 the two briquette material compositions combined will have the same mass of 100 grams per treatment. The study involves many working operations, such as drying raw materials, carbonization, grinding and filtering, adhesive mixing, molding and pressing, drying, and assessing briquette quality by measuring its caloric value moisture content, ash content and heat value.

Plate 1: Coconut shell before carbonization

Plate 2: Peanut shell waste before carbonization

Plate 3. An electronic weighing balance

Plate 4: Sifted to create charcoal powder

Table 1 Treatment of composition between coconut shell and peanut shells.

Treatment	Composition	
T1	C (g)	P (g)
	90	10
T2	80	20
T3	70	30
T4	60	40
T5	50	50
T6	40	60
T7	30	70

RESULT AND DISCUSSION

The study's operational methods involve the following: drying the raw materials; carbonization; grinding and filtering; mixing adhesives; molding and pressing; drying; and assessing the briquettes' heat value, moisture content, and ash content. The image below displays the results

3.1. Drying of Raw Materials

The following contaminants, such as fibers, dirt, and other pollutants connected to the shell, are removed from the coconut shell powder during this procedure. Moreover, the shell is divided into tiny pieces to speed up the composition process. The water content of the coconut and peanut shells decreased by drying them using the oven (Plate 7).

1. Carbonization Process

The following displays images of the instruments used in the study..

Plate 5: The process of carbonization of coconut shell and peanut shell waste

Plate 6: The Briquette Machine: Process of Pressing and Printing

The material is removed from the furnace after it is ignited and turned into charcoal. The substance was made up of dried coconut and peanut shells, which were progressively and individually added to the furnace. The material was processed into charcoal flour, which in accordance with SNI 01-6235-2000, was sifted to create charcoal powder see plate 4, manufactured from peanut and coconut shells that each had a size of 60 mesh.

Starch that has been dissolved in water at a ratio of 1: 2.5 needs to be boiled at 70ºC in order to form a gel. The gel-shaped starch adhesive is then uniformly mixed with up to 20% of the mass combination between the mixtures of T and S to create a mixture. Peanut shell charcoal flour (P) and coconut shell charcoal flour (C) are among the constituents. Two distinct forms of briquette-making material which are coconut and peanut shells are combined with certain compositions to observe how the combination of materials influences the quality of the finished product. It is anticipated that for each treatment, the two briquette components will weigh 100 grams apiece. Table 2 displays how the material's mixing procedure was handled.

Table 2 Treatment of composition between coconut shells and peanut shells.

Treatment	Composition		
	T (g)	S (g)	Adhesive (g)
T1	90	10	40
T2	80	20	40
T3	70	30	40
T4	60	40	40
T5	50	50	40
T6	40	60	40
T7	30	70	40

As the mixtures were added, the mold plates had to be put into the briquetting molds of the hydraulic press briquette molder see plate 6. The mixture was briquetted by closing the mold lid and using the hydraulic jack to exert pressure on it. The mixture inside the mold is compressed as a result of this movement, which also raises the moveable portion of the mold up to the immovable part and causes it to bunch in the briquette plate 8.

Plate 7: During drying process of the briquette

Plate 8: After drying the briquettes

The resultant charcoal briquettes are further dried for thirty minutes at a temperature of 1200C. Ash content, moisture content, and heating value are used to test the quality of the produced briquettes.

According to Dyah M et al. (2019), briquette agglomeration technique that modifies briquette composition namely, adding biomass to reduce bottom ash produced during briquette burning and ensure full burning—is one way to increase the added value of briquettes. Rejected coal was discovered to still have a high calorific value of 5,929 cal/gr based on the analysis' findings. Along with meeting the physical standards, briquettes also meet the requirements for fractional index value of less than 0.5% and density of greater than or equal to 1 gr/cm3.

According to the test results, natural gas emissions were undetectable for NOx, 0-3.6 ppm H2S, and 0-30 ppm CO. After assessment, the findings demonstrated that the ignition time could be lowered and the amount of bottom ash or unburned briquettes could be decreased by 68.68% with the addition of 30% of the biomass.

After that, briquettes were used to boil water for the test. Approximately seven to fourteen briquettes can fit inside the burner. By burning a briquette with a candle, the stove is lit. It takes between five to ten minutes for coals to start to burn. Furthermore, once the burning briquettes are placed inside the stove, more briquettes were added, and they are all fanned until they burn completely. Subsequently, the water-filled pot is set on the stove and allowed to boil for an additional half hour. Based on the duration required for coals to form, this outcome is still less efficient when used in comparison to alternative fuels like LPG gas or kerosene stoves, which ignite fires more quickly. But briquette stoves are comparable to LPG gas stoves in that the latter do not release many exhaust emissions, which keeps cooking utensils (pans) clean. On the other hand, it is observed that using more briquettes will optimize the amount of time needed to bring the water to a boil.

Kindriari. et al. (2012) have also investigated the carbonization of peanut shell charcoal briquettes, it is possible to turn peanut shells into charcoal by carbonizing them, then shape the charcoal into briquettes by combining it with tapioca starch glue. This is a viable alternative fuel that can be used in place of fuel. This research aims to develop a method for producing briquettes out of leftover peanut shells using tapioca starch glue. Following a 90-minute carbonization procedure at 200, 225, 250, 275, and 300 degrees Celsius, peanut shells are divided into two halves then exposed to the sun to dry. The resulting charcoal is ground into small pieces and sieved through a 40-mesh screen to achieve a consistent size. It is then weighed into five different amounts: 25, 50, 75, 100, and 125 grams. Finally, it is combined with adhesive and print. The created briquettes were left to air dry for a whole day, then they were dried at 100 degrees Celsius for an hour. The calorific value, moisture content, ash content, and flame color were all measured. At a temperature of 250 0C for carbonization, 75 grams of charcoal weight provided the maximum calorific value, which was 6536.98 kcal/kg, from the peanut shell charcoal briquettes.

When 125 grams of charcoal weight were carbonized at a temperature of 300 0C, the lowest water content was created, while when 75 grams of charcoal weight were carbonized at a temperature of 200 0C, the lowest ash content was formed.

4. CONCLUSION

Creating fuel briquettes from discarded coconut shells and peanut shells is a sustainable and environmentally friendly way to utilize agricultural waste as a renewable energy source. These briquettes can serve as a substitute for conventional fossil fuels that lower greenhouse gas emissions and advance the development of cleaner energy. Additionally, this process can help reduce waste and provide economic opportunities for communities that rely on agriculture. Utilizing coconut and peanut shells for fuel briquettes has the potential to contribute to a more sustainable energy system and address both environmental and social challenges. Based on the briquettes' calorific value, moisture content, ash content, and levels of the compounds they created, more research with different concentrations and additional ingredients are anticipated to yield the highest briquette quality. It is anticipated that the highest caliber briquettes will be manufactured in large quantities and distributed to the general public and many industries, including the food, bakeries, industrial and home sectors.

5. ACKNOWLEDGEMENT

The authors express gratitude to Faculty Engineering, Department of Agricultural and Environmental Engineering, Niger University Delta, Wilberforce Island, Amassoma, Bayelsa State for the access to the Processing and Farm Power Laboratory

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