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Decomposition of Food Waste and Material Composition's Effect on Fuel Briquette Properties

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Abstract

This study looked into the possibility of producing non-carbonized fuel briquettes from locally available municipal solid waste (MSW), such as food waste from restaurants, charcoal dust, coconut husk and shell, and sawdust. A minimal expense briquetting machine obtained from Alfaster Businesses in Kenya exhibited the idea. When compared to using regular food waste, briquettes made from decomposed food waste had a higher bulk density (+4%), a higher net calorific value (+18%), and a lower burning rate (-24%).The amounts of ash in the two different kinds of briquettes were not significantly different. The findings also indicate that the quality of briquettes and the temperatures achieved during combustion are enhanced when food waste is decomposed and mixed with tree-based raw materials like sawdust, coconut waste, or charcoal waste. In addition to reducing rural land degradation and deforestation, this recycling solution has the potential to serve multiple benefits in MSW management for sustainable cities.

Keywords: Municipal solid waste • Food waste • kitchen waste • Briquette

Introduction

In sub-Saharan Africa (SSA), the use of wood fuel is rising due to population growth and emerging urbanization trends. The consumption of charcoal has typically increased by 14% for every one percent increase in urbanization. Since unsustainable production and inefficient use of wood fuel frequently result in land degradation, deforestation, and other negative effects on the environment, these trends are cause for concern. Wood and/or charcoal are used by 96% of rural and 67% of urban Ghanaians. The public normal for biomass utilization per capita is 100 kg, i.e., comparable in volume for 2019 to 3 million and 4.2 million metric lots of charcoal and kindling, separately. Charcoal and wood are the primary energy sources for domestic cooking as well as small food and industrial enterprises like fish smoking, local brewing, pottery making, cooking oil extraction, street food, and grills, which contribute to the country's high fuel consumption. Waste-based substitutes in the form of briquettes are frequently investigated worldwide in an effort to reduce demand for wood or charcoal [1].

Discussion

Briquettes are made by compressing waste biomass into a uniform solid unit that can be used in the same way as firewood or charcoal. By meeting the energy and safe environment needs of the urban and industrial sectors, the production of briquettes from biomass could make a significant contribution to the economic development of developing nations. The majority of non-carbonized briquettes are intended to replace wood and are made from dry solid residues. When compared to the carbonized briquettes, they have the advantage of being simple to ignite. Nonetheless, the detriment is that they don't keep going long due to their delicate surface. They also produce more fine particulate matter than carbonized briquettes do, which if used indoors could be harmful to human health. In addition, densification of carbonized (or pyrolyzed) materials or carbonization of densified briquettes is the processes that are used to produce carbonized briquettes, which are also referred to as charcoal briquettes. These processes are used to replace charcoal. There are three different kinds of machines that have been used to make briquettes: a screw press, a piston press, and a hydraulic press. Each one has its own advantages and disadvantages. The materials to be processed, the expected quality, and the customers who will be using the briquettes should all play a role in the equipment selection process. When processing briquettes at a low temperature in briquetting machines with limited pressing ability or when the feedstock contains a lot of carbonized materials that lack plasticity because their lignin content is below 5%, binder ingredients like cassava starch, molasses, red soil, and clay are required. The binding properties of both the waste mix and the binder determine how much binder is needed. Most of the time, it has to be kept to a minimum for financial reasons. In the end, the characteristics of the biomass, such as whether or not it is carbonized, the method of densification, the strength, and the chemical composition, including whether or not binders are added, will all have an impact on how well the briquettes perform [2-5].

It has been reported that biomass briquettes are produced on a pilot, industrial, and research scale. Typically, biomass that is herbaceous and woody, like sawdust, is preferred. Various agro-processing wastes, such as cashew processing waste, which is typically a mixture of shell, press cake, and nut shell, tuber peels, and agrowaste like bamboo, husks, kernel, maize cob, straws and coconut waste, are common emerging feedstock. However, materials like faecal sludge (FS) and municipal solid waste (MSW) are also gaining interest [6].

The overflow of MSW in Ghana addresses a likely chance for fuel briquette creation. The majority of household waste (55–80%), followed by commercial or market areas (10–30%), constitutes the majority of food waste (FW), and biodegradable organics account for 68% of the MSW's mass. In Ghana, the amount of MSW produced, which varies depending on socioeconomic factors, reaches 0.86 kg per person per day in the largest city, Accra, but ranges on average between 0.47 and 0.51 kg per person per day in the smaller urban areas. Although it consumes 50 to 70% of municipal budgets, the labor-intensive and inefficient process of collecting and disposing of MSW in open

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dumps or landfills is inefficient. The negative effects of poor sanitation cost Ghana approximately 1.6% of the country's GDP [7].

In comparison to the use of other materials, the production of briquettes from MSW is not yet widespread. Afsal tried using sawdust and waste from vegetable markets to make briquettes at 25, 50, 75, and 100% waste mass ratios. Bentonite clay was used as the binding material. When compared to briquettes made solely from vegetable market waste, they discovered that the addition of sawdust to the feedstock mixture enhanced the characteristics of briquette combustion by increasing the calorific value by up to 12% and the volatile matter content by up to 16%. Vegetable market waste and sawdust briquettes appeared to be of a quality that was acceptable when compared to firewood, coal, and conventional sawdust briquettes. Moreover, delivered briquettes utilizing a combination of FS and different individual FW portions (e.g., pineapple strips, charcoal fines, and bean husks) at a mass proportion of half FS:50% biomass. Fermented red soil served as the process's binder. Although most MSW briquettes are intended for use in domestic settings, some formulations that incorporate plastics are only intended to replace conventional coal in industrial combustion processes due to the possibility of emitting harmful flue gases. For instance, we tested the briquetting of a MSW mixture made up of 60% paper and non-corrugated cardboard, 10% textile material, and 30% plastic. Their main conclusion was that the resulting briquette product possessed the same physicochemical and physical characteristics as conventional herbaceous and woody biomass [8].

Materials are typically left to dry on farmers' fields or under sheds in order to process agro waste residues, which can have a moisture content of up to 80%. This is the most economical method. Under shed and sun drying are typically used to get the desired moisture content and remove excess water from vegetable urban waste or processed agro waste. This essential drying step could compel the cycle, given the period of time it expects to be finished, and thusly the land impression. On the other hand, utilizing a mechanical drying process, e.g., a press as well as a warmed dryer, is energy and capital-escalated, and just suggested for handling during stormy season, while sun-drying is scarcely conceivable, or as a system to diminish the impression of the evaporating system or to speed the handling rate. Finally, after the briquettes have formed, a further drying step is required for wet briquetting processes [9].

The FW generation changes over the course of a season. Mixtures of raw materials are preferred to minimize the impact on manufactured briquettes' quality and guarantee the production of standardized briquettes throughout the year. This helps reduce the variability of the process's availability and individual feedstock characteristics. The degree of biodegradation of the raw residue, which would affect its physicochemical characteristics, could be linked to another process challenge; however, this parameter has not yet been investigated [10].

Conclusion

The purpose of this study was to investigate the production of briquettes, which can replace charcoal or wood for cooking, from a variety of waste materials that are readily available locally. We investigated the effect of FW on the quality of the briquettes after optimizing the production process, particularly the amount of water required and the concentration of cassava starch added as a binder in a pre-gelatinized form. Briquette use is new and unregulated in Ghana. According to Gebrezgabher and Amewu, potential briquette users identified key qualitative criteria they would consider when choosing a fuel. In addition to the price, these include the fuel's longevity and heating value. As a result, the burning characteristics of the produced briquettes were taken into consideration as one of the quality parameters in our study. These characteristics included the net calorific value, flame temperature, and ash content. We also looked at the amount of ash that was produced and, in some cases, how it was made to figure out if it could be recycled in agriculture to make the treated soils richer in minerals. Given the impact of this parameter on costs associated with transportation and handling, the bulk density of the produced briquettes was evaluated as a final step. A quick feasibility study was used to select four MSW types for our briquette production experiment because of their availability; sawdust, charcoal, coconut fiber, husks, and mixed uncooked FW. The general examinations of the feedstock are introduced. The supplemental file contains the final analyses for sawdust and coconut husk/shell.

Acknowledgement

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Conflict of Interest

None.

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