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Design And Fabrication of Honeycomb Biomass Briquettes Making Machine

Mr. R.K. Bhoyar[1] , Swapnil Meshram[2]., Vedant Chore[3] , Yogesh Kukade[4] , Ankit Pantawane[5], Vrushabh Mohurle[6]

Project Guide[1], Department of Mechanical Engineering, Priyadarshini College of Engineering , Nagpur.

Students[2345], Department of Mechanical Engineering, Priyadarshini College of Engineering , Nagpur.

Abstract -

Coal in the form of briquettes provides more energy, produces less ash, is easier to handle, and has less environmental impact through greenhouse gas emissions. The briquette machine was designed and developed with all these aspects in mind. The existing machines have been successfully tested and are considered groundbreaking due to their innovative approach to energy solutions and their absolute diligence. This article is about the development and manufacture of biomass briquette machine suitable for India. This could replace manual briquetting in terms of product quality, reduce labor costs and increase production speed. The machine has been successfully tested and is considered a breakthrough product due to its innovative approach to energy solutions and relentless efforts to reduce production costs per briquette. When there is an abundance of agricultural residue, effective use of it can contribute to energy conservation and increase the income of farmers. Effective utilization of agricultural and industrial biomass residues in the form of briquettes. We will discuss the different types of raw materials used and the techniques used in the briquette process. Describe the process parameters and raw material variables that affect briquette forming. Combustion research with briquettes is extensive.

Keywords— Briquettes, Bio-mass, Agricultural Residues , Honeycomb etc.

1. Introduction

Biomass, especially agricultural residues, appears to be one of the most promising energy sources for developing countries (Patomsok, 2008). Rural households and a few urban dwellers have relied solely on firewood (charcoal, firewood, sawdust) as their main source of energy for decades (Onuegbu, 2010). Among all available energy resources in Nigeria, coal and coal derivatives such as smokeless briquettes, biochar briquettes and biomass briquettes are suitable substitutes for coal/firewood in industrial boilers and brick kilns for thermal power generation. It has been proven to be most likely to be used as Intended use and home use.

Global warming has become an international issue. Global warming is caused by greenhouse gases, and carbon dioxide is one of the main culprits. It was shown that the country's deforestation rate is higher than its reforestation activity, thus significantly reducing the increase in CO2 emissions. In addition to environmental factors, the use of firewood for cooking has health implications, especially for women and children who are over-exposed to smoke. Rural women, who often carry small children on their backs or are at their side, spend one to six hours a day cooking with firewood. In some areas, exposures are even higher, especially when cooking in poorly ventilated areas or using firewood to heat a room.

2. Identification Of Problems

- Poor indoor and outdoor air quality is also a result of the burning of biomass briquettes.
- Because these fuels are organic, combustion of them may release hundreds to thousands of different chemicals as organic aerosol.
- Many organic gases are released by the unburned biomass briquettes as well, and these gases might interact to create ground-level ozone.
- It has been determined that burning biomass briquettes, such as dry cow dung cakes, is probably a factor in poor air quality. Emissions from these burning materials are 120 times more reactive with the hydroxyl radical than emissions from liquefied petroleum gas.
- The calorific value of cylinder briquettes ranges from 14.9 to 15.5 MJ/kg.

3. Objective

The briquettes should be primarily bound together by a binder, and the manufacture should be done in locally made motorised presses.

1. Briquette production offers an alternative to burning wood for cooking and heating, saving forests and preventing issues like soil erosion and desertification.
2. Recycling agricultural waste, such as honey comb, into briquettes.
3. Making the presses using locally accessible materials, supplying materials, supplying materials and creating the briquettes, selling and distributing the briquettes are just a few of the microbusiness options briquettes create.

4. The availability of briquette as a substitute for firewood can also improve the living conditions of rural women and children, who spend the majority of their time gathering firewood rather than engaging in other income-generating activities or attending to their children's educational needs.

- It might increase burning efficiency.
- By improving briquette combustion, it reduces emissions.
- It can have a higher caloric value.

4. Literature survey

The world economy is dominated by technologies that rely on fossil fuels (oil, coal, natural gas) to produce fuels, electricity, chemicals and materials. The use of conventional energy such as oil, coal and electricity in the ASEAN economy has increased significantly over the last 25 years. India still imports more than 111.92 million tonnes of crude oil and petroleum annually. This heavy dependence on imported oil creates economic and social instability.

There is currently a strong global interest in developing technologies that enable the use of renewable energy sources, for both environmental (pollutant release and fossil reserves depletion) and economic reasons. . As a domestic energy source, biomass is abundant in nature and offers promising renewable energy opportunities that can potentially replace the use of fossil resources. Biomass is he third largest primary energy source in the world after coal and oil (Bapat, 1997) and still provides much of the energy needed in rural areas of most developing countries. Biomass in all its forms currently provides about 1.25 billion tons of oil equivalent (MTOE) of primary energy, equivalent to about 14% of the world's annual energy consumption (Hall, 1991; Werther, 2000).

Using biomass feedstock as an alternative to fossil fuels is even more important with respect to climate change, as biomass can be CO2 neutral. Another problem associated with biomass is that it is expensive to transport and transported in large quantities, leading to its uneconomical use at locations other than its source (such as rice mills). In response to these concerns, new methods of storing, handling and transporting rice husks have been developed. One of these is in the form of briquettes (Singh & Kasyhap 1985). Briquetting converts granular or powdery substances into larger, more practical sizes. As described by Maglaya & Biona (2013), briquetting improves the homogeneity of the mixture, allowing for more uniform and controlled combustion performance. In addition, transporting and storing the fuel is greatly facilitated. In this process, a high force is applied to a mass of particulate matter within a limited volume in order to increase its density.

5. Project Details

To determine the necessary compression ratio (compression pressure) and the kind of mould to be utilised, preliminary experiments were conducted. To shape the briquette, a plastic bottle with a diameter of around 50–60mm was purchased. A piston made of a tin that fits inside the bottle is also utilised, along with a plastic bag, knife, samples of the grasses, and bits of wire for size reduction.

The preliminary test yielded the following design specifications: mixture ratio, mould design, compression ratio, and compression force. Design criteria were established that served as a guide in developing conceptual designs that satisfied the functional requirements. These criteria include the materials utilised, the machine's size, the environment in which it will be used, maintenance requirements, safety standards, and ease of use.

Description of the Machine

The mechanical (hydraulic or piston) compression principle is the foundation for the design of the briquette machine. A reciprocating ram compresses the biomass as it is punched into a die to create briquettes. A hydraulic system is used to manually operate the machine and produce the pressure needed for compression. The hydraulic pump's lever handle pumps hydraulic fluid into the master cylinder to produce a pressure differential. This moves the piston that forces the loaded biomass into the mould for compression. Figure 1 depicts a biomass briquetting machine, and Figure 4 depicts an isometric representation of the same machine.

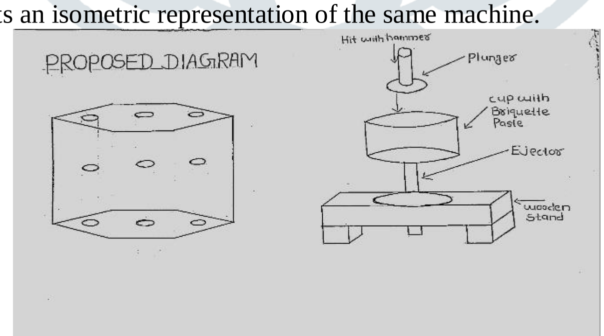

Fig.1. System diagram of machine

Process

- Gathering raw materials from the environment.
- Prior to carbonization, the raw material might need to be dried. Shells, for example, must dry in the sun before being processed.
- Use a crusher to smash the raw material once it has dried.
- Before putting it on the press, the cylinder must first be filled with the prepared mixture.
- Constantly compressing the cylinder's material content with modest, repeated pressure.
- The press's handle only needs to be raised and lowered to form the briquette.

Briquetting process

Fig.2. Flow chart for briquette process

6. **Advantages**

- Once used, oil, coal, or lignite cannot be replenished.
- Because briquettes don't contain sulphur, they don't contaminate the environment.
- The thermal value of biomass briquettes is higher in practise.
- The ash level of briquettes is substantially lower than that of coal (2-10% as opposed to 20-40%).
- In comparison to coal, combustion is more consistent.
- Briquette production typically takes place close to consumption hubs, so supplies are not dependent on unreliable long-distance transit.
- Due to their higher density and low moisture content, briquettes significantly increase boiler efficiency.

It may effectively transform waste agricultural residue, low-rank coal, and coal fines into a useful product with economic value. It has a much lower moisture content than other fuels.

7. **Results And Discussion**

Bulky materials can be mechanically compacted to increase their density through the process of briquetting. The method is employed to mould tiny particles into the desired shape. When agricultural waste is used to make briquettes (Honeycomb), it might be seen as a waste control measure. An enhanced low-cost biomass briquetting machine was successfully built and made for use locally in India as part of this research project. To determine the necessary compression ratio (compression pressure) and the kind of mould to be utilised, preliminary experiments were conducted. The establishment of conceptual designs that meet the functional criteria was aided by design considerations. The mechanical (hydraulic or piston) compression principle is the foundation for the design of the briquette machine. The machine's actuator mechanism is used to manually provide the pressure needed for compression. The following factors—functionality, cost, and maintenance—were taken into consideration during the detail design and manufacture.

The results obtained from the design calculations show that the piston weight (F3) is 24.53 N, the force on the piston (F1) is 490.5 N, and the stress calculation for the tensile spring constant (k) is 0.0654 N/. increase. mm is the extension force (T) by the spring of 327 N, the total compression force (FT) of 355.03 N, the maximum base plate thickness (tb) of 1.67 mm, the total compression pressure (PC) of 2 MPa, the maximum bending stress recorded is At 456 MPa, the projected area was determined to be 0.015 m2 with a total upward force of 654 N from the springs and a pressure of 4.34 MPa on the compression piston. We built the designed machine and evaluated the performance of the final product.

The calorific value of biomass (honeycomb) before briquetting was 14011.2 KJ/kg. After briquetting, the calorific value increased by 15013.9 KJ/kg. This increase is partly due to the moisture content of the honeycombs. Positive results have been achieved with lower fixed carbon, ash and sulfur levels compared to currently used forest and coal firewood. Table 4 shows the material cost for manufacturing the biomass briquettes. At the time of this research, the Naira to Dollar exchange rate is 363 Naira to the dollar ($1=₦363). In other words, about $188 (US$108) was spent on building the biomass briquettes. Therefore, the biomass briquettes produced are inexpensive. Machine throughput is given by equation (2).

$$MTC = \frac{M}{T_{(s)}} \qquad (2)$$

Where,

MTC = Machine through put capacity

M = Mass of Honeycomb Briquette

T(s) = Time required to produce Honeycomb Briquette

Equation (3) was used to determine the average mass of Honeycomb briquette produced and the amount of time needed to make biomass briquette from Honeycomb. The results for the moisture content of honeycomb and twelve (12) samples of biomass briquette made from honeycomb are displayed in Tables 2 and 3.

Table 2: Result of Proximate Analysis of Honeycomb

Moisture Content (%)	Calorific Value (KJ/Kg)	
20.00	Before	After
	14011.2	15013.9

Table 3: Result obtained with Briquette Machine

Samples	M (kg)	$T_{(s)}$	MTC (kg/s)
1	2.04	64.00	0.0319
2	1.87	59.25	0.0316
3	2.05	65.12	0.0315
4	2.10	66.01	0.0318
5	1.99	60.35	0.0330
6	1.94	60.05	0.0323
7	1.78	52.45	0.0339
8	2.01	61.95	0.0324
9	2.02	63.45	0.0318
10	2.12	68.34	0.0310
11	2.25	70.01	0.0321
12	1.05	45.25	0.0232
∑	23.22	736.23	0.0315
Average	1.935	61.35	0.0315

A biomass briquette with an average mass of 1.935 kg was formed from the honeycomb and took 61.35 seconds to produce. The average throughput of the machine was 0.0315 kg/sec. Decision.

Recent estimates put the total amount of agricultural residues available in India at over 500 million tonnes per year. About 20-25% of this is used for energy production (Murali et al, 2015). Fossil fuel-based technologies are a major source of supply in India and can meet energy needs in both small-scale and large-scale industrial applications. Briquette is a technique of compacting agricultural residues and wastes to increase bulk density, reduce moisture and produce briquettes of uniform size and shape that are easy to handle, transport and store. Briquettes can be defined as products resulting from the physical-mechanical deformation of discrete fine-grained materials of various shapes and sizes, with or without binders.

In this study, suitable low-density, low-cost briquettes are obtained from various biomass, such as rice straw and sawdust, based on various studies conducted in this research paper.

1. A comparison of different biomass ratios in briquette production was carried out. B3 – ratio of sawdust, rice straw and cow dung (20:
05:40) Other he produced heavier briquettes compared to the two ratios. The diameter of the briquettes is always the same. However, very little length was observed. The longest briquette (6.19 cm) is made with B3 briquette, followed by the first and second material ratio.

2. Physical properties and detailed analysis of the manufactured briquettes were conducted. A maximum compaction density of 0.91 g/cm3 was achieved for B3 briquettes. The highest moisture content (63.11%) was found in B2 – rice husks, rice straw, cow dung (10:05:40), briquettes and minimum moisture content (53.64%) B3 briquettes.

3. Maximum ash (16.23%) and minimum ash (9.56%) of rice straw and cow dung in B1 were measured (10:
40), briquettes or B3 briquettes. The optimum volatiles content was found to be 66.09% for B1 briquettes and a minimum of 63.2% for B3 briquettes. The maximum percentage (18.97%) and minimum (10.03%) of fixed carbon were determined for B3 and B1 briquettes, respectively. B3 briquettes have a higher calorific value of 4086 kcal/kg and release more energy than other biomass.

Four. In the final analysis, various chemical element components such as carbon, hydrogen, oxygen, and sulfur in B1 briquettes were 43.26 µrbon, 5.2% hydrogen, 32.72% oxygen, 2.16% nitrogen, 0.43% sulfur, and 46.46 µrbon, 5.6% in B2 briquettes. . Hydrogen, 30.3% oxygen, 2.27% nitrogen and 0.56% sulfur, and B3 briquettes are 49.86% carbon, 5.72% hydrogen, 33.16% oxygen, 1.31% nitrogen and 0.56% sulfur. 39% sulfur.

5. Comparison of combustion behavior between manufactured briquettes and commercial briquettes. B3 briquettes have the highest calorific value of 4086 kcal/kg among B1 and B2, but it is lower than coal (4726 kcal/kg) and the ratio of evaporated water to spent coal is also high. A value of 0.61 ml/g than the other three.

8. Conclusion

The successful development of new honeycomb briquette technology for raw material biomass at room temperature has greatly reduced the required space, energy consumption and operating costs of honeycomb briquettes. With optimized system operation, small volumes and low energy costs, this technology enables practical mobile biomass collection and processing units.

The study found that sawdust, which is generated in large quantities and is usually burned to pollute the environment, can be converted into high-quality, durable solid-fuel briquettes suitable for domestic and industrial heat-producing power generation. I was. Although no cost analysis was performed in this study, the user perception survey indicated a future market potential for honeycomb briquettes in the surveyed housing and hospitality sector (hotels, food stalls, restaurants, etc.) sector in terms of acceptance. It was shown that there is area. This is evident from his 93% of respondents who said they would be happy to use briquettes if the price was competitive enough. The average savings in power consumption from preheating was 23.5% for the heater and 10.8% for the engine. The average total energy savings was about 10.2%. The lowest electrical energy consumption for rice husks without and with preheating was 0.172 and 0.150 kWh per kg of briquettes produced, respectively. Honeycomb furnaces designed for mold heating have been found to work well and require regular fuel loading and ash removal. The furnace can continuously heat the molds to the temperature range of 300-320 °C required for briquetting. The average power energy saved by replacing electric heaters for mold heating with biomass furnaces is estimated to be around 35% of the total power consumption.

9. Future Scope

The use of honeycomb briquettes for industrial and domestic purposes will enable the diversification of Nigeria's already strained fossil fuel economy, increase the economic value of biomass waste and mitigate greenhouse gas emissions. , is an important alternative fuel to be further developed. Performance analysis of the designed and manufactured honeycomb briquettes showed lower fixed carbon content, similar calorific value (15013.9 KJ/kg), ash and sulfur content compared to currently used forest and coal firewood Good results were obtained because of the low It creates a healthier environment for consumers and is an excellent fuel alternative. From the cost analysis, it is clear that biomass briquettes are cost-effective and affordable.

1. Produced in large quantities as a by-product of crop production, honeycombs can be converted into high-volume, long-lasting soil fuel briquettes suitable for both domestic and industrial power generation. 2. Power driven machinery can be used to produce low density briquettes, which can be used in local kilns as domestic and industrial fuels.
3. The calorific value calculated using the optimal biomass to binder ratio was sufficient to generate the heat required for home cooking in rural areas and small industrial applications such as stoves and boilers.

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