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Combustion Characteristics of Briquettes Produced from Saw Dust and Kurumthotti Herbal

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Abstract- Briquette density is the primary criterion used to assess briquette quality. From the standpoint of manipulation, burning rate, briquette longevity, etc., briquette density is crucial. The current study examines the physical and combustion properties of Sawdust and Kurumthotti herbal sticks, including their length, diameter, mass, density, moisture content, total ash content, fixed carbon, volatile matter, and gross calorific values. Theoretical assessments of the variables that affect the quality of the briquettes were carried out throughout our investigation. The density and strength characteristics of the produced briquette were ascertained in order to assess its quality.

Keywords- Sawdust and Kurumthotti herbal, Moisture content, volatile matter, fixed carbon, Total Ash content, Gross Calorific Value.

I. INTRODUCTION

It is impossible to overstate how crucial energy is to a country's prosperity. The reason for this is that energy is essential to both social and economic progress. Around the world, agriculture produces 140 billion metric tons of biomass annually. A staggering quantity of energy and raw materials, about equal to 50 billion tons of oil, may be produced from this volume of biomass. Agricultural biomass is waste that, if turned into energy, may replace fossil fuels in a sustainable manner, cut greenhouse gas emissions, and give renewable energy to the 1.6 billion people in developing nations who do not yet have access to electricity [4]. Remaining stalks, roots, leaves, husks, shells, and animal feces are examples of biomass. Waste biomass is a plentiful renewable resource that is almost completely free. The briquetting process, which is defined as the compaction of residues into a product with a greater density than the original material, is one of these promising technologies, despite the fact that there are several conversion pathways by which these leftovers might be transformed into biomass energy [1]. Briquetting is another definition of it as a densification procedure. Briquette use may significantly lower the need for wood, which will lessen the amount of deforestation [3], [5]. Investigating the physical and combustion properties of briquettes made from Sawdust and Kurumthotti herbal using a piston press mechanism is the main goal of this work [2].

II. MATERIAL AND METHODS

Methodology

The research methodology flow chart is shown below, showing how the study was conducted.

Fig 1: Methodology flow chart

2. Selection of Biomass

There are many different kinds of trees and woodlands in the globe. Since we are just talking about woods here, each type of wood has unique qualities. Here, we've chosen the powdered neem tree wood [6]. Due to the high Lignin Property of Neem Wood. The sawdust's ability to bind and burn is enhanced by the lignine property [9]. It is inexpensive and readily accessible on the market. Every Ayurvedic industrial company carries it. One kind of herbal waste is Kurumthotti herbal. This material weighs little and burns easily. Thus, Kurunthotti Materials is our choice [7]. The raw material of saw dust and the Kurunthotti herbal as shown in Fig2.2.

a) Sawdust

b) Kurunthotti herbal

Figure 2: a) and b) Selection of Materials

3. Drying

Pre-treatments could be necessary in order to maximize the product's calorific value and energy content before densification. Chop length/grinding; drying to the necessary moisture content; application of a binding agent are examples of pre-treatments. For each densification operation, a particular cut length and/or grinding are needed to accomplish: Reduced energy consumption during densification, denser goods and a reduction in the final product's breakage. Reduced moisture increases the fuel's durability and density. The ideal moisture content for most biomass densification procedures is between 8% and 20%. A tiny bit of moisture is needed for the majority of compaction procedures in order to "soften" the biomass for compaction. The strength and durability of the densified biomass are reduced above the ideal moisture content.

Addition of a Binding Agent

Typically, sawdust helps the biomass's natural binder, lignin, bind the material together to create densified biomass known as briquettes. The natural binding agents in the material have an impact on the density and durability of densified biomass. The higher the protein and starch concentration, the greater the binding ability. The material may be given binding agents to improve its binding qualities. Binders such as vegetable oil, clay, starch, and cooking oil are frequently utilized [8]. Cassava starch is widely accessible on the market. Its potential to bond is excellent. Here, Cassava starch is utilized as a biomass binder [13], [21]. The Cassava starch binder is shown in Fig 2.3

Fig. 3: Cassava Starch Powder and Cassava Starch binder solution

4. Making of Briquette

The Super-70 briquetting machine is specifically made for industries with medium levels of raw material availability and medium production requirements. This briquetting machine is specifically made using cutting-edge technology, which reduces the need for expensive monitoring

[10]. If the size of the raw materials is less than 12 mm, we can grind them into a Super-70 briquetting machine instead of directly grinding them. The Setup and specification of the Briquetting machine show in Fig.2.4 and Table 2.1. For the purpose of producing consistent briquettes from sawdust and Kurunthotti herbs generated in various mixed proportions, the dwell period of each press was maintained at 60 seconds [16]. The briquette die for biomass production is shown in Fig. 2.5. 200 grams of sawdust and Kurunthotti herbs were weighed, and they were manually and thoroughly combined with the prepared binder solution to create a homogenous moist mass with a consistent size. In a variety of ratios, including 100:0 (S1), 20:80 (S2), 50:50 (S3), 20:80 (S4) and 0:100 (S5) [11], [12], [14], [20]. The Compositions of saw dust and the Kurunthotti herbs as illustrated in the Fig.2.6.

Table 1: Specification of Briquetting machine

S.No	Model	Super 70
1.	R.P.M	240
2.	Power Requirements	49 HP
3.	Production Capacity	750 Kg/hr. [±20% depending on density and quality of raw material]
4.	Finished Product Size	80 mm Diameter
5.	Finished Product Shape	Cylindrical
6.	Finished Product Length	70 mm to 30 mm
7.	Raw Material Form	Up to 4 mm size can be used directly

Fig. 4: Briquette Machine Setup

Fig 5: Dye for Briquette

Fig. 6: Compositions of saw dust and the Kurunthotti herbs

5. Determine the Physical and Combustion Characteristics

Carefully examining every sample revealed the physical characteristics of the biomass briquettes, including Moisture content, Volatile matter, Ash content, Fixed content and Calorific Value [17], [18]. All five briquettes' heat energy values and proximate analyses were looked at by specialist testing services, using an approach compliant with ASTM standard E711-87(2004), [15]. The Proximity testing machine is shown in Fig 2.7. The R.B for briquette samples are shown in Table 2.3.

Fig. 7: Proximity testing machine

Table 2: R.B for Briquette Samples

Parameter	100:0	80:20	50:50	20:80	0:100
Moisture	6.74	2.7	2.8	3.1	3.5
Volatile matter	69.10	81.33	75.77	74.15	68.53
Ash	19	1.6	8.75	9	12.5
Fixed carbon	18.60	14.37	12.68	13.75	15.47
Calorific value	3425	4756	4768	4795	4011

III. RESULT AND DISCUSSION

Below is a discussion of each of the five samples' performance and compaction characteristics depending on the ratio and test conditions.

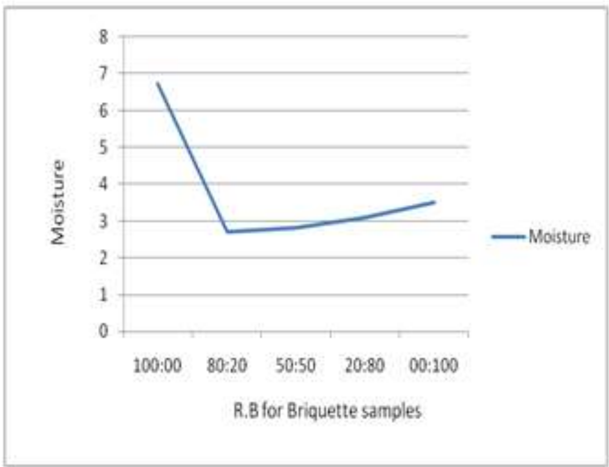

Fig. 8: R.B for Briquette sample Vs Moisture

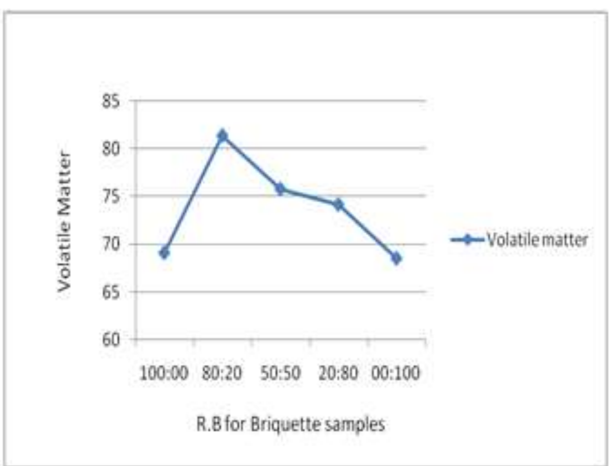

Fig. 9: R.B for Briquette sample Vs Volatile Matter

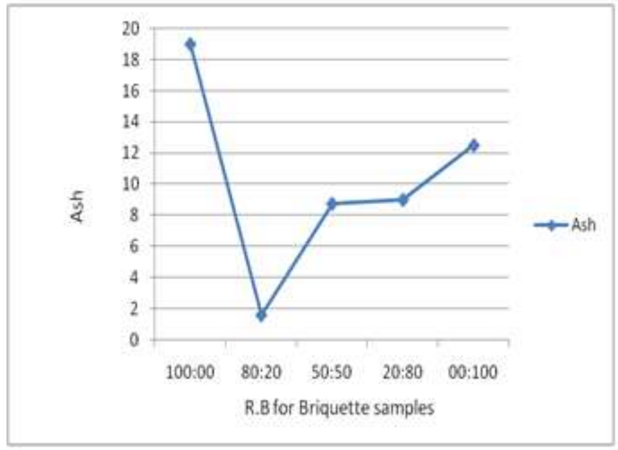

Fig. 10: R.B for Briquette sample Vs Ash

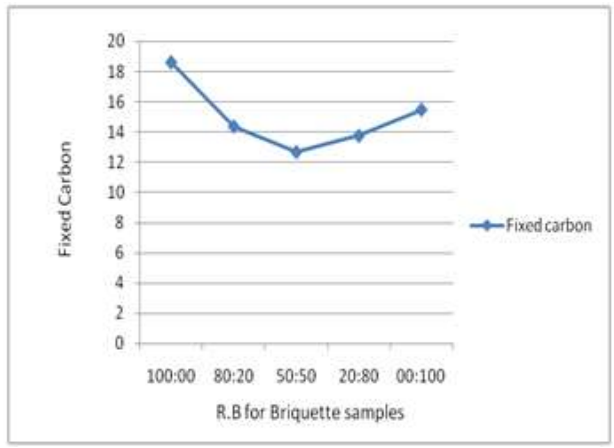

Fig. 11: R.B for Briquette sample Vs Fixed Carbon

The R.B. and the parameters (moisture content, volatile matter, ash content, and fixed carbon) for the briquette sample are displayed in Fig. 3.1, Fig. 3.2, Fig. 3.3, and Fig. 3.4. Of all the samples, S2 (80:20) has the lowest moisture content, whereas S1 (100:00) has the highest moisture content. Even with less moisture, a significant calorific value is possible [19]. When compared to the other samples, the volatile concentration of the S2 (80:20) is greater. Higher heating values are possible if the percentage of volatile materials is more than 70%. The volatile matter content of sawdust and Kurunthotti plants is around 70% [24]. In comparison to all samples, the S2 has the lowest ash content if the ash concentration is less than 18% and has a good heating value [22]. Have an excellent calorific value if the fixed carbon content is less than 20%. Out of all the samples, the S3 had the least amount of fixed carbon [25].

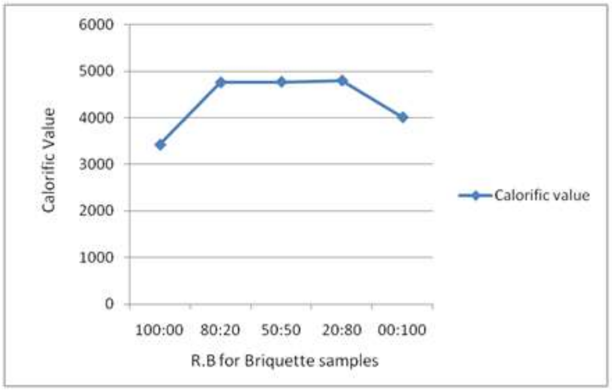

Fig. 12: R.B for Briquette sample Vs Calorific Value

Figure 3.5 shows the R.B. and the Calorific Value for the briquette sample. A high value indicates that the briquette is an excellent biomass. Of all the samples, the S4 has the highest calorific value [23].

IV. CONCLUSION

The investigation's findings have shown that, in addition S4 (20:80). As a result, there is a large burning capacity. S4 briquetted combination (20:80) has the potential to yield biomass fuels of superior grade. Premium briquettes have low total ash content, oil content, carbon content, and high calorific value. S2 has a low calorific value and very low total ash content. After that, S4 has low total ash content and a very high calorific value. The briquettes S1 and S5 have high total ash content and low calorific values. There is a constant carbon content in S4 (20:80). Out of these four different briquettes, we have selected the S5 (50:50) briquetted sample. This is 80% efficient based on the Calorific Value of earlier samples. Future aims for this investigation include thermogravimetric analysis, differential scanning calorimetry (DSC) analysis, ultimate analysis, and an assessment of the strength-to-weight ratio.

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