

Preparation of Briquettes Using Biomass Combinations and Estimation of Its Calorific Value

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Abstract: *An experimental research design was adopted to conduct the present investigation. For the present study six biomass materials namely Charcoal Dust, Saw dust Rice Husk, Dry Leaves, Wood Chips, Groundnut Shells and two binders namely Cow dung and Starch were identified. The commercially available briquetting machine of 5 horsepower motor was selected for making the briquettes. Subjective evaluation of physical properties of briquette i.e. texture, cohesiveness, moisture, shape, evenness of surface and appearance of surface was conducted by a panel of 6 judges comprising of staff and PhD graduate students of College of Home Science. The data obtained from the experimental tests was compiled, tabulated and statistically analyzed by mean and standard deviation. The data obtained from subjective evaluation was consolidated by averages, standard deviation. The calorific value of all prepared briquettes was measured by using bomb calorimeter. The results indicate that briquettes made from charcoal dust and other biomass materials with starch combinations were found to be best in physical characteristics with highest scores whereas briquettes made from charcoal dust other biomass materials with cow dung combinations were found to be highest in calorific value. The results show that when cow dung is used as binder with charcoal dust and other biomass materials, it was giving higher calorific value. The use of starch as binder with charcoal dust and other biomass materials was making briquettes smooth in texture, compact, dry, uniform, even without cracks and shiny.*

Keywords: Biomass, Briquettes, Calorific Value, Energy, Environment

1. Introduction

A rising standard for the world's growing population means increasing world energy consumption. Present energy use is largely dependent on fossil fuels, which make future sustainable development very difficult. There are drastic changes in the composition and behavior of our atmosphere due to rapid release of polluting combustion products from fossil fuels. Biomass is an important source of energy. Its utilization contributes to the decrease of the emissions of CO₂ in the atmosphere and disposal of the municipal solid wastes. Until the mid-19th century, biomass dominated the global energy consumption. With rapid increase in fossil fuel use, share of biomass in total energy has declined steadily over a century. Yet, biomass still contributes 14% of the world energy and 38% energy in developing countries (Woods and Hall, 1994). Worldwide, energy stored in the form of biomass through photosynthesis is nearly 10 times the world's annual energy use (Hall and Overend, 1987 and Brandt, 1990). Biomass is the most convenient form of renewable resources. India is potentially rich in the biomass resources. It is estimated that the quantity of biomass produced in the form of agricultural residues alone is about 320 million tones. The utilization of these huge resources depends on the development of economically viable technology for converting them into more conveniently useful fuel briquettes.

The research work was undertaken to develop different combinations of briquettes with different biomass combinations i.e. Charcoal Dust, Saw dust, Rice Husk, Dry Leaves, Wood Chips, Groundnut Shells and two binders namely Cow dung and Starch. The calorific value of prepared briquettes was then estimated.

2. The present study was under taken with the following objectives:

1. To test the viability of making fuel briquettes with selected biomass materials and binder combinations.
2. To estimate the calorific value of the biomass briquettes prepared.

3. Methodology

In the preliminary stage six biomass materials charcoal dust, saw dust, rice husk, dry leaves, wood chips, groundnut shells and three binders namely cow dung, starch and clay were finalized for making briquettes in different ratio. The biomass materials and binders with feasible ratios were selected finally for the purpose of the research. Clay was not used as binder because of its non combustive nature and also it gives too much waste after combustion. Jacob K et al. (2000) stated that if organic waste is mixed with too much clay, the briquettes will not easily ignite or burn uniformly.

4. The whole study was conducted in two phases:

Phase I: Preparation of briquettes

Phase II: Estimation of calorific value of biomass briquettes

4.1 Phase I: Preparation of briquettes

This was the first phase of study in which briquettes were prepared. In the first step several combinations were tried out in different ratios and total fifteen final combinations were selected on the basis of feasibility of making briquettes. For preparing the briquettes, the fine particles of

biomass materials and binders were crushed and mixed together. After proper mixing the mixture was loaded in to briquetting machine having 5 hp motor power. In the last step of preparation of briquettes drying of prepared briquettes was done for three to four days to remove moisture content.

4.2 Phase II: Calorific value of biomass briquettes:

In this phase the calorific value of the briquettes was measured by using bomb calorimeter. The following formula was used to measure the calorific value:

$$\text{Higher calorific value of fuel (L)} = \frac{[(W + w)(t_2 - t_1)] - E_1}{X} \text{ cal g}^{-1} \text{ (or kcal kg}^{-1}\text{)}$$

- X = mass of fuel placed in the crucible, g
- W = mass of water placed in the calorimeter, g
- w = water equivalent of the bomb, stirrer, thermometer, g
- t₁ = initial temperature of water in calorimeter, °C
- t₂ = final temperature of water in calorimeter, °C
- L = Higher calorific value of the fuel, cal/g
- E₁ = Correction for heat of combustion of firing wire and cotton thread, calories (Reference: Rathore *et al.* 2007)

5. Results and Discussion

5.1 Preparation of briquettes

In the first phase total fifteen types of briquettes with different ration and biomasses were prepared. All the prepared combinations were grouped in three groups on the basis of raw materials used. These groups were presented in table given below:

Table 1: Groups of briquettes

Group 1	Group 2	Group 3
Saw dust + (rice husk/dry leaves/ wood chips / groundnut shells) + cow dung (binder)	Charcoal dust + (rice husk/dry leaves/ wood chips / groundnut shells) + cow dung (binder)	Charcoal dust + (rice husk/dry leaves/ wood chips / groundnut shells) + starch (binder)

5.2 Group 1: Information, dimensions and calorific value of briquettes:

Table 2: Information, dimensions and calorific value of briquettes

Combinations	Symbolic name	Raw material and binder ratio	Size (cm ²)	Weight (gm)	Calorific value (kcal/kg)
Saw dust +Rice husk + Dry leaves + Cow dung	B1	10:0.5:0.5:3	80	250	2993.89
Saw dust +Rice husk + Cow dung	B2	10:1:3	77	225	3244.20
Saw dust + Cow dung	B3	10:3	70	210	3346.42
Saw dust + Wood chips + Cow dung	B4	10:1:3	88	200	3486.03
Saw dust + Groundnut shells + Cow dung	B5	10:1:3	70	225	3655.90

The table indicates that all the briquettes with saw dust and other biomass combination using cow dung as binder. The above table shows that dimensions of all briquettes were more or less same. Size ranges from 70-90cm² and weight ranges from 200-250 gm. The height and diameter of all the briquettes were observed in the range of 7-8 cm and 10-11cm respectively.

The results indicate that the calorific value of the saw dust briquette by using cow dung as binder was 3346.42 kcal/kg. It is observed that the calorific value of the briquettes made from saw dust and biomass combinations with cow dung as binder were varying between 2993.89- 3655.9 kcal/kg.

5.3 Group 2: Information, dimensions and calorific value of briquettes:

Table 3 indicates that all the briquettes with charcoal dust and other biomass combination with cow dung as binder.

Table 3: Information, dimensions and calorific value of briquettes

Combinations	Symbolic name	Size (dia*h) (cm ²)	Weight (Gm)	Raw material and binder ratio	Calorific value
Charcoal dust + Dry leaves + Cow dung	B6	70	220	10:1:3	3468.6
Charcoal dust + Rice husk + Cow dung	B7	80	250	10:1:3	3622.8
Charcoal dust + Groundnut shells + Cow dung	B8	80	225	10:1:3	3644.2
Charcoal dust + Cow dung	B9	70	250	10:3	3744.3
Charcoal dust + Wood chips + Cow dung	B10	80	200	10:1:3	3793.3

The above table shows that the dimensions of all briquettes were more or less same. Size ranges from 70-80cm² and weight ranges from 200-250 gm. The diameter and height of the all briquettes were also more or less same i.e. 10 cm and 7-8 cm respectively.

The results indicate that the calorific value of the charcoal dust briquette by using cow dung as binder was 3744.3 kcal/kg. It is observed that the calorific value of the briquettes made from charcoal dust and biomass combinations with cow dung as binder were varying between 3468.6 - 3744.3 kcal/kg.

Group 3: Information, dimensions and calorific value of briquettes

Table 4: Information, dimensions and calorific value of briquettes

Combinations	Symbolic name	Size (dia*h) (cm ²)	Weight (Gm)	Raw material and binder ratio	Calorific value (kcal/kg)
Charcoal dust + Dry leaves + Starch+ Water	B11	90	250	10:1:0.33:2.5	3310.40

Charcoal dust + Rice husk + Starch + Water	B12	90	250	10:1:0.33:2.5	3440.66
Charcoal dust + Groundnut shells + Starch + Water	B13	80	275	10:1:0.33:2.5	3506.10
Charcoal dust + Starch + Water	B14	90	550	10: 0.33: 2.5	3528.20
Charcoal dust + Wood chips + Starch + Water	B15	80	270	10:1:0.33:2.5	3744.40

Table 4 indicates that all the briquettes with charcoal dust and other biomass combination with cow dung as binder. Table illustrated that dimensions of all briquettes were more or less same. Size ranges from 80-90cm² and weight ranges from 250-275 gm except B14 which was found to be the heaviest i.e. 550gm.

The results indicate that the calorific value of the charcoal dust briquette by using Starch as binder was 3528.2 kcal/kg. It is observed that the calorific value of the briquettes made from charcoal dust and biomass combinations with Starch as binder were varying between 3310.4 - 3744.4 kcal/kg.

6. Conclusions

Total fifteen varieties of briquettes were prepared with different biomass materials. All fifteen varieties were divided into three groups. The dimensions of all fifteen briquettes were measured and the size was found to be 70-90 cm². The size of group 1 was ranging from 70-90cm², group 2 was 70-80 cm² and group 3 was 80-90 cm². The weight of all the briquettes of each group was ranging from 200gm-300 gm except B14, which was having 550gm. The calorific value was observed the highest for B5, B10 and B15 i.e. 3655.90 kcal/kg, 3793.30 kcal/kg and 3744.40 kcal/kg respectively.

Reference

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