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Investigation for Emission and Thermal Analyses Loose Biomass Making Briquettes

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Abstract: **-- The project is to develop the loose biomass waste to briquettes primarily to explore value of application avenues. The loose biomass waste composites to briquettes are developed in India on the basis of two strategy of preventing depletion of agricultural and forest wastages. Disposal of biomass wastes, produced in different agro-industrial activities, is normally an environmental problem. A key for such condition is the utilization of these residues for the production of energetic solid bio-fuel by increasing their proximate and ultimate properties of biomass. In this loose biomass raw material is Marigold(gillyflower), rose flower, lemon peels, orange peels, gigantean leaves, thorny leaves to briquettes based composites material with the addition of Synthetic adhesives binder have been developed substitutes for coal charcoal of briquettes & high density and comparison of wood. In this project the biomass wastages were fabricated by combining materials of moulding box in copped from hand lay method. A synthetic adhesive (INDOCOL-DLD) was used as the matrix material. The mechanical and thermal properties of these samples were investigated according to IS and ASTM standards. From the result it was observed that the comparison of biomass briquettes and wood with high calorific value and density and also very less carbon and sulphur emission. The biomass briquettes are equal amount of density and durability has been observed. Briquettes have much lower ash content.**

Keywords: **--- Characteristics, Bio-wastes, Ultimate analysis, proximate analysis, Briquettes**

I. INTRODUCTION

The biomass resources of can be identified as wood, forage, grasses, shrubs, animal waste, waste arising from agricultural, municipal, as well as industrial activities, etc. The biomass wastes to briquettes recycled are many of the developing countries produce huge quantities of agro residues but they are used inefficiently causing extensive pollution to the environment. The major residues are wood chips, coffee husk, wood chips, coir pith, rice husk, bagasse, groundnut shells; mustard stalks cotton stalks, flowers and fruits. Agro residues are milling residue is also available in huge quantity and forest residues is available in high quantity. The direct burning of loose biomass in conventional grates is associated with very low thermal efficiency and widespread air pollution. The conversion efficiencies are as low as 40% with particulate emissions in the flue gases in excess of 3000 mg/Nm³ In addition, a large percentage of unburnt carbonaceous ash has to be disposed of. In this raw material is more than 40% of the feed burnt to compare the wood. Briquetting of the loose biomass could mitigate these pollution problems while at the same time making use of this important industrial/domestic energy resource.

Briquetting of biomass process simply means compressing the material to increase its density and to enhance its handling characteristics. Compressing of biomass employing lignin plasticization mechanism has been widely used in many countries. This requires elevated temperature of about 160°C to 280°C and pressure between 4 Mpa -60Mpa. Alternatively, biomass briquette can be prepared at ambient temperature and moderate pressure by compressing the biomass using binder. In some methods, the biomass is first carbonized before briquetting. Common binders used for this process are starch (from various starchy roots and cereals), molasses, clay and even tree gum, etc This paper presents the work on the comparative analyses of some properties of bio fuel samples with different briquette samples prepared at moderate pressure and ambient temperature. India has started to replace charcoal with biomass briquettes in regards to boiler fuel, especially in the southern parts of the country because the biomass briquettes can created domestically, depending on the availability of land. Lehar Fuel Tech Pvt. Ltd is approved by Indian renewable energy development agency (IREDA), is one of the largest briquetting machine manufactures in India. As a result of a few successes and IREDA's promotional efforts, a number of entrepreneurs are confidently investing in biomass briquetting.

II. MATERIALS AND METHODS

A. Matrix Material

Synthetic adhesives (INDOCOL-DLD) is a good Thermo setting polymer that cures (polymerizes& cross

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links) when mixed with water. A synthetic adhesive with a density of 1.1-2.0g/cm3 was used in this research. The matrix material was prepared without mixture and use.

B. Marigold (Gilly flowers)

Marigold flower is a natural flower (scientific name is Gilly flower) of family yields a used in making temples and houses after wastages. Many temples have been devoted to use of other natural flowers in Composite in recent past and gillyflower is a potential candidate for the development of new composites because of their high strength and modulus properties. The flower particles also have decomposition material interest in the flower nursery owing to its hard-wearing quality, good acoustic resistance, moth-proof, not toxic, resistant to microbial and fungi degradation, and easily combustible.

C. Rose flower

Rose flower is a crop of global importance. It is widely grown in the tropics and subtropics, being important to both smallholder and large commercial producers. It is classified as both a grain legume, and, because of its high face oil content, an temples.

D. Lemon peel

This study evaluated the proximate Composition and Photochemical present in the fruit wastes (flavedo, albedo and seeds). The peels obtained from citrus fruits constitute between 50 and 65% of the total weight of the fruits. When not processed further, this by-product becomes a very worrisome waste capable of causing serious environmental pollution.

E. Orange peel

Orange juice is one of the most widely-consumed beverages today. A high percentage of orange production (70%) is used to manufacture derivative products and approximately 50– 60% of the processed fruit is transformed into citrus peel waste (peel, seeds and membrane residues).

F. Gigantean leaves

Calotropis belong to Asclepidaceae Family. It is also known as Akada, Aak, Mandar, Aakh etc. It is estimated that only one percent of 2,65,000 flowering plants on earth have been studied exhaustively for their chemical composition and potential against important medicinal value (Cox et al, 1994).

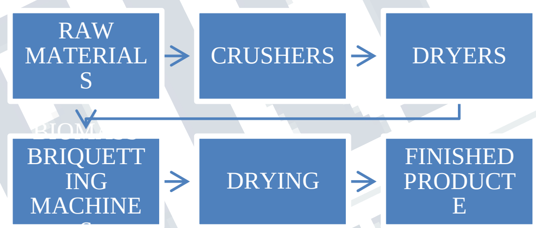
G. Thorny leaves

Thorny leaves are forest and agricultural wastages. It is a renewable resource of energy in environment. These are extracted by process as decortications. These are highly wastages road side and forest residues.

H. Thorny wood material

Thorny wood are forest and agricultural wastages. It is a renewable resource of energy in environment. These are extracted by process as decortications. These are highly wastages road side and forest residues and agro residues.

III. PRODUCTION PROCESS



IV. PREPARATION OF BRIQUETES

The hand moulding box is used for making the sample as per ASTM standards with required dimensions (10*5*5). Then the mould box is prepared with a mould releasing agent for the easy removal of the sample. After that the biomass waste powder and synthetic adhesives is mixed with the ratio of 15:1 respectively. The amount of mixed material pouring into the rectangular mould with high density to three minutes. After leave material carefully into the mould box. The hand layup technique is used to impregnate the composite structure. In this bio briquettes are leave after take three to five days dryer in sun set. These are taking and easily burn with addition of just spray kerosene or bio fuels etc. The test specimens of required size were cut out from the composite manufactured after curing. The three identical test specimens were prepared for each test and subjected to each test.

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SL. No	Raw material	Length(cm)	Width (cm)	Breadth (cm)
1	Gilly flower(Marigold)	10	5	5
2	Rose flower	10	5	5
3	Lemon peels	10	5	5
4	Orange peels	10	5	5
5	Gigantean leaves	10	5	5
6	Thorny leaves	10	5	5
7	Mixed material	10	5	5
8	Thorny wood chips	10	5	5

Table.1

V. PROXIMATE AND ULTIMATE ANALYSIS OF BRIQUETTES

A. Effect of gross calorific value (cal/gram)

The gross calorific value of the samples of biomass materials was determined in accordance with using an adiabatic bomb calorimeter. About 175 g of each sample was burnt in the bomb calorimeter until complete combustion was obtained. The difference between the maximum and minimum temperatures obtained was used to compute the gross calorific values.

B. Effect of ash content (%)

The inorganic component can be expressed as (20-40%) equal to moisture content on a wet, dry and ash free basis. It is the complete combustion of the biomass. PAC of the biomass materials was determined in accordance with heating approximately 160g of oven-dried mass of each biomass material with particle size of 100mm,in an electric furnace at a temperature of 600˚C for four hours. Thereafter, it was cooled in desiccators and weighted to represent the ash content of the sample.

C. Effect of moisture content (%):

The moisture content of biomass is the quantity of water in the material, expressed as a percentage of the material's weight. If the moisture content is determined on a 'wet' basis, the water's weight is expressed as a percentage of the sum of the weight of the water, ash, and dry-and-ash-free matter. Similarly, when calculating the moisture content on a 'dry' basis (however contradictory that may seem), the water's weight is expressed as a percentage of the weight of the ash and dry-and-ash-free matter.

Proximate Analyses of Briquettes

Name of the briquettes	Gross calorific value (CAL/ GMS)	Ash content %	Moisture content %
Gilly flower (Marigold)	4116.0	7.12	4.9
Rose flower	3980.0	7.08	4.3
Lemon peels	4012.0	7.10	4.72
Orange peels	4218.0	10.28	5.36
Gigantean leaves	4136.0	8.32	5.12
Thorny leaves	4079.0	7.36	4.82
Mixed material	4011.0	7.18	4.09

Table: 2

Ultimate analysis of briquettes

Ultimate analysis or the determinations of their % composition were carried out using standards methods. Thus IS: 14988 (P2) methods was used for the determination of percentage composition of C, H, N, O, S content of individual composite agricultural waste briquettes was compared to thorny fire wood was determined by differences as follows below Table.3.

The out of seven biomass briquettes Gilly flower bio fuel briquette and Lemon peels bio fuel Briquettes have high calorific values; compared to traditional fuel (wood) this calorific value is high. Comparison of biomass briquettes with traditional fuel (wood) biomass briquettes have higher calorific value (up to 4200 cal/g) and lower ash content as well as very low moisture content After that, typically 30 to 40 % is oxygen. The high volatile content of biomass means it can lose over 90% of its mass in the develotisation stage of combustion, compared with coals which lose between 5 and 65% of their mass by this process.

Name of the samples	C%	H%	O%	N%	S%
Gilly flower (Marigold)	46.31	5.3	50.16	0.56	0.03
Rose flower	44.27	5.1	49.7	0.48	0.022
Lemon peels	45.21	5.29	50.8	0.51	0.021
Orange peels	52.36	6.31	54.18	0.72	0.046
Gigantean leaves	48.16	5.26	51.71	0.61	0.032
Thorny leaves	42.13	5.22	52.11	0.58	0.034
Mixed material	51.32	5.26	52.02	0.55	0.029

Table: 3

VI. MECHANICAL AND THERMAL ANALYSIS OF BRIQUETTES

Mechanical Analysis of Briquettes

For the density, three briquettes from each batch were randomly picked. Their respective heights and diameters at two different points using digital calipers. From the data obtained, the density after drying (relaxed density) was computed as the ratio of the measured mass to the calculated volume. Equally the density of the wood samples was determined using the same method.

The durability of the briquettes was determined in accordance with the charted index method. Each briquette samples was allowed to fall from a length of 10:5cm metal base for three types of biomass briquettes.

Name of the samples	Compression strength (Mpa)	Density (gram/cm3)	Durability (%)
Marigold)	5.1	0.319	96.22
Rose flower	4.6	0.267	92.42
Lemon peel	4.9	0.352	95.16
Orange peel	4.92	0.393	94.91
Gigantean leaves	4.7	0.286	94.61
Thorny leaves	4.76	0.314	93.76
Mixed material all	4.83	0.291	94.97
Thorny wood chips	5.4	0.659	96.91

Table: 4

Thermal Analysis of Briquettes

Name of the samples	Temperatures, T (0C)	Specific heat, C (j/g C)	Thermal conductivity, K(w/m c)
Marigold	30.52	49.35	0.1772
Rose flower	31.66	55.34	0.1465
Lemon peel	33.12	42.47	0.1290
Orange peel	30.88	36.52	0.1717
Gigantean leaves	32.23	26.09	0.1046
Thorny leaves	31.32	22.65	0.1096
Mixed materials	30.33	45.65	0.1464
Thorny fire wood	35.16	37.20	0.1718

Table: 5

The Thermal conductivity is the physical property of the material denoting the ease with a particular substance can accomplish the transmission of thermal energy by molecular motion. Thermal conductivity of biomass briquettes is found to depend on the chemical composition of the substance, of which it is composed. These are determined

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the value is thermal conductivity of metal bar. The water temperature is maximum in briquettes at 35°C and the room temperature is 18°C, after find and calculate the thermal conductivity values also constant specific heat values (4200 j/kg k) its more possible to thorny fire wood (3720 j/kg k) etc. The apparatus consists of a self-clamping specimen stack assembly with electrically heated source, calorimeter base, and Dewar vessel enclosure to ensure negligible loss of heat and a constant head cooling water supply tank. A multipoint thermocouple switch is mounted on the steel cabinet base and two mercury and glass thermometers are provided for water inlet and outlet temperature readings. Four NiCr/NiAl thermocouples are fitted and connections are provided for a suitable potentiometer instrument to give accurate temperature readings. The specimen is lapped on a comparison material in the Dewar vessel and the thermocouples are inserted in the holes to read temperatures.

VII. RESULTS AND DISCUSSION

However, each Biowastes material briquette requires different optimum conditions and sub- sequent work should concentrate on optimizing the fabrication processes for their industrial use. Recorded data can be aimed to project images of briquette production and consumption in organized systems and macro scale for the study area. Recycling biomass can be significantly alternative fuels. The thermal conductivity of the specimens decreases with increasing sample briquettes additive ratio.

The regression analysis gives a linear formula for the thermal conductivity, l ¼(briquettes ratio) which indicates strong but not linear relation with the values of 0.05 of significance level. The variation of the thermal conductivity also shows that the 12.5% of additive by weight improves the thermal conductivity approximately 30% compared to the specimen without the Marigold additive. This result is explained by examination of eqn. which shows that for similar gas flows and briquette dimensions, the rate of cooling for different materials is determined by the heat content, **Cp**. It can be seen the heat content for lead is the lowest of all metals tested.The density of marigold briquette was 0.319g/cm3 and that lemon peel briquette was 0.352g/cm3.

CONCLUSION

The biomass bulk containing large moisture gets wasted while converting into heat by combustion. The Bio fuel briquettes are an energy source with higher calorific value and can be utilized along with modern technologies efficiently. Comparison of biomass briquettes with traditional fuel (wood) biomass briquettes have higher calorific value (up to 4200 cal/g) and lower ash content as well as very low moisture content . The composition of sulphur its very less in bio fuel briquettes so it does not harms the environment. Due to the low ash content in bio fuel briquettes the emissions is also very less compared to thorny fire wood. Out of seven biomass briquettes Gilly flower bio fuel briquette and Orange peels bio fuel briquettes have high calorific values. Compared to traditional fuel (wood) this calorific value is high.

The composition of density and compression strength in bio fuel briquettes so it does not harms the environment. Due to the low ash content in bio fuel briquettes the emissions is also very less compared to thorny fire wood (with 20-30%) and good thermal efficiency. For burning of biomass bio fuel need starting kerosene, or easy burn fuel. So adding or mixing of low boiling organic fuels may be burn easily.

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