International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-8 Issue-3, September 2019

Briquetting of Biomass for Low Cost Fuel using Farm Waste, Cow Dung and Cotton Industrial Waste

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Abstract*: The ultimate source of energy for crucial activities like cooking, heating and parboiling process is burning wood and other agricultural products. Due to growing populations utilizing resource of combustible biomass materials will finally result in insufficiency of those materials until certain measures are taken to secure them. It mainly focuses on the minimization of pollution especially land, water and air and to avoid the deforestation mainly for many fuels for burning. The product taken is the by-product, which is obtained from the residue left after letting the cotton industrial waste for reuse. The raw materials used are cassava waste, coconut shell, groundnut shell, cotton waste and cow dung with thirty different mix ratios. The briquettes were made without using any binder. Using hydraulic pressure with UTM given to produce the briquettes are 5.0 kN/cm^2, 5.6 kN/cm^2 and 6.0 kN/cm^2. Good energy content has been obtained when the pressure for producing briquettes at 5.6 kN/cm^2.These briquettes are mainly used for industrial boiler running and cooking purpose.

***Keywords*: Biomass, Briquetting Technology, Proximate analysis, Ultimate analysis..**

I. INTRODUCTION

A survey was conducted by International Energy Agency (IEA) shows the fuel consumption in India hike's 10% within a year (September 2016 – September 2017). IEA says that India will be the fastest growing consumer. India imports 81% of fuel from other countries to fulfill the demand. The price of the fuel also hiking day to day [1]. Industries in India are using non-renewable fossil fuels for boiling and heating. Using non-renewable fuels leads to loss of energy resource. The demand for ecofriendly fuels was increasing to control the pollution. The requirement of alternate fuel increases due to the minimum availability of fossil fuels and also due to their increasing cost [2]. The fuel should be ecofriendly, renewable source and should have high efficiency than other fuels[3]. Renewables were the second most essential energy source and one third was forestry in the territory, biomass was one of the major prospective energy resources [4]. Biomass can be produced using agricultural waste [5]. Briquettes produced were good alternative to fuel wood for out-door and in-door cooking and for mitigation of deforestation, desertification and environmental pollution and degradation [6] [7]. It was also used to convert the wastes to a valuable material. Biomass Briquettes are the prime source of energy, renewable & biodegradable in properties. Bio-Briquettes contribute towards the greener environment. Briquettes will be ecofriendly which do not produce pollution [8]. Calorific value, cooking efficiency, fuel efficiency rate and boiling time would serve as a determinant for evaluating the performance of briquette [22]. During strident activation conditions like steam flows, higher temperatures and time higher specific areas were obtained, but mechanical resistance were slightly reduced [23].Each briquette made of bio-waste material need optimum condition for industrial use. The handling characteristics in terms of lack of deterioration and storage of briquettes were found to be the best [24].The size of the particle has enormous effects on the energy consumption and quality of the briquette. Simplex- centroid design was an appropriate way to examine the effects of particle size on the biomass briquetting process [25]. Various biomass materials need pretreatment to enhance its characteristics and to make them appropriate alternatives in future [26].Some ash forming elements of biomass might cause various environmental problems and technological during biomass processing [27]. Carbon footprint briquettes were intended for the sustainable development by reducing the emission of greenhouse gas [28]. In 2023, 1.7% of electricity demand would be supplied using biomass [29]. Some of the excess materials available at the agricultural lands are cassava stem, ground- nut shell, coconut shell and cow dung. From cotton industries, we can take cotton waste to mix with other materials to produce briquettes.

Manuscript published on 30 September 2019
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This study mainly focuses on the minimization of pollution especially land, water and air and to avoid the deforestation mainly for many fuels for burning. Apart from this, the project will be successfully carried out to the enhancement of rainfall in our country directly and indirectly facilitates the whole country and global people in terms of development all through various disciplines and also infrastructural development where nature meets.

Government has taken wide initiative for renewable energy technologies [30].

II. MATERIALS AND METHODS

A. Materials

The materials and methods included in manufacturing of briquettes include: Cotton waste, Coconut shell, Groundnut shell, Cassava waste and Cow dung.

B. Production Method

Drying

The first and foremost step in this project is to dry the waste which are collected. Because dried wastes are only used to make briquettes. The dried wastes only catch fire easily. If wet wastes had been used then it will definitely affect the calorific value of the briquette. The dried wastes can only be shredded. This step can be done by using the sun light. We allowed 1week for sundry the wastes collected.

Grinding

Shredder is the machine which is used to grind the collected dried wastes. These machines are used to grind the coconut pith. But this machine only helps to convert wastes into chips not as a powder. These machines are available at two different types they are fixed and mobile shredders. Fixed shredders are used to grind the materials continuously with the help of electricity. But the mobile shredder is used to small amount of materials available at the site itself. We hired a mobile shredder machine to grind our wastes. But that machine, converts the wastes into chips not as a powder. In flouring machine, the grinding of solid matters occurs under exposure of mechanical forces that trench the structure by overcoming of the interior bonding forces. After the grinding the state of the solid is changed: the particle size, the particle size disposition and the particle shape. There are many types of grinding machines are available to grind the different materials, they are ball mill, rod mill, auto genous mill, SAG mill, pebble mill, high pressure grinding rolls, burrstone mill, vertical shaft impactor mill and tower mill. We used plate type grinding mills to grind the cassava waste and groundnut shell. And we used ground nut shell high pressure grinding rolls.

III. PREPARATION OF BRIQUETTE

A. Mould for briquette

We made a briquetting mould by using 7.5cm inner dia. steel pipe to give a standard size to briquette. Then a shaft is made up of pipe's inner dia. with weight of 10kg. The height of the shaft is 17.5cm. The shaft is made up of steel to withstand the load. The shaft is used to transfer the load from UTM to briquette materials. The height of the mould is 15cm. A steel plate is temporarily fixed to the bottom of the mould. That plate can be removed after the compression had given. The briquette can be removed through bottom of the mould where the plate is removed.

B. Universal Testing Machine (UTM)

UTM is used to test the compression and tensile strength of the materials. We used this machine to compress the materials to produce briquette. The load given through the UTM is denoted in the unit of kN. We gave 250kN to compress the materials. It consists of many parts such as Load frame, Load cell, Cross head, output device and Extensometers. The specimen is placed between two grips. When the machine starts it gradually applies load to the specimen. Stop the machine when required pressure attains and remove the specimen.

C. Prepared Biomass Briquettes

Fig.1: Biomass Briquettes

D. Testing of briquettes

The prepared briquettes were tested in a knitting industry (SHAKTHI Knitting Private Limited) at SIPCOT. They use these fuels to produce steam by boiling the water using the 1000 liters capacity boiler.

Fig.2: Testing of Briquette in Sipcot Industry

IV. MIX RATIO

TABLE 1 Mix ratio (1 to 10)

Samples	1 2	3	4	5	6	7	8	9	10
Raw Materials	(gram)								
Cotton waste	20 25	25	25	25	40	40	40	40	40
Ground nut shell	20 30	30	30	30	20	15	20	15	20
Coconut shell	20 15	20	25	15	20	20	20	20	20
Cassava waste	20 10	20	10	15	10	15	10	10	10
Cow dung	20 20	5	10	15	10	10	10	15	10
Total	100 100	100	100	100	100	100	100	100	100

TABLE 2 Mix ratio (11 to 20)

Samples	11 12	13	14	15	16	17	18	19	20
Raw Materials	(grams)								
Cotton waste	25 30	20	35	25	20	30	25	20	25
Ground nut shell	20 10	20	10	15	20	15	15	30	25
Coconut shell	25 25	25	25	25	20	15	20	15	10
Cassava waste	20 20	20	20	20	25	25	25	25	25
Cow dung	10 15	15	10	15	15	15	15	15	15
Total	100 100	100	100	100	100	100	100	100	100

TABLE 3Mix ratio (21 to 30)

Samples	21 22	23	24	25	26	27	28	29	30
Raw Materials	(grams)								
Cotton waste	25 25	25	25	25	20	25	40	35	40
Ground nut shell	35 30	25	20	20	10	15	20	25	30
Coconut shell	15 20	30	30	25	25	25	15	10	5
Cassava waste	15 15	10	15	20	30	25	20	20	10
Cow dung	10 10	10	10	10	15	10	5	10	15
Total	100 100	100	100	100	100	100	100	100	100

V. RESULTS

TABLE 4 Characteristic of biomass briquettes

Test	Samples Result				
	Cotton	Groundnut Shell	Coconut Shell	Cassava Waste	Cow dung
Calorific value (Kcal/kg)	4201	4528	3724	2890	7248
Ash content (%)	3.1	7.55	19.8	7.95	1.55
Fixed carbon (%)	3.81	23.25	20.24	17.28	6.9
Volatile matter (%)	1.59	0.72	0.67	0.20	6.12

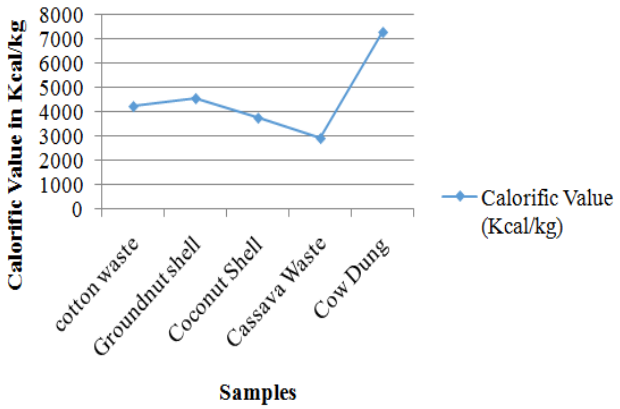


Fig.3: Calorific value of sample

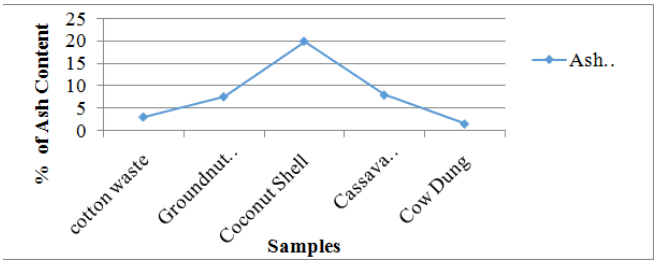
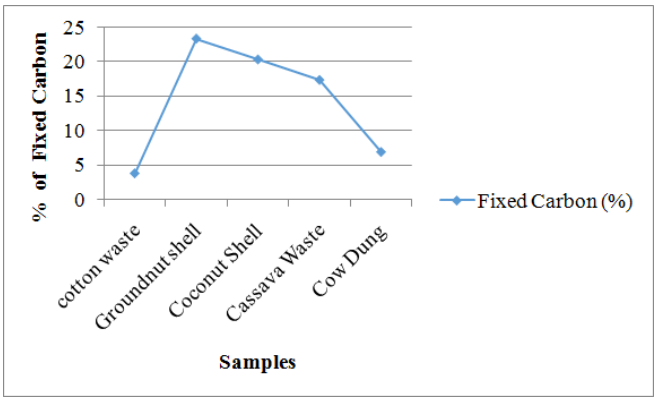


Fig.4: Ash content of samples



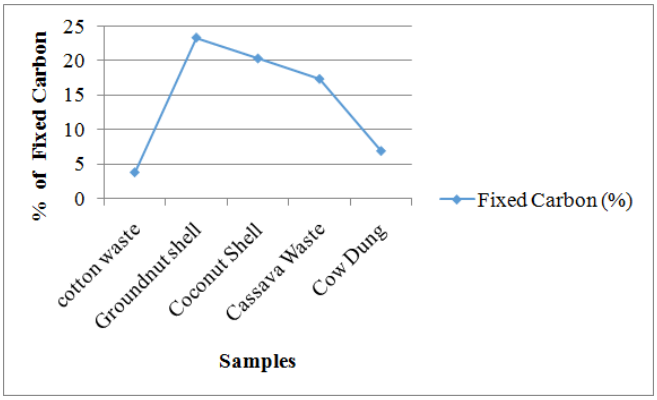


Fig.5: Fixed Carbon of samples

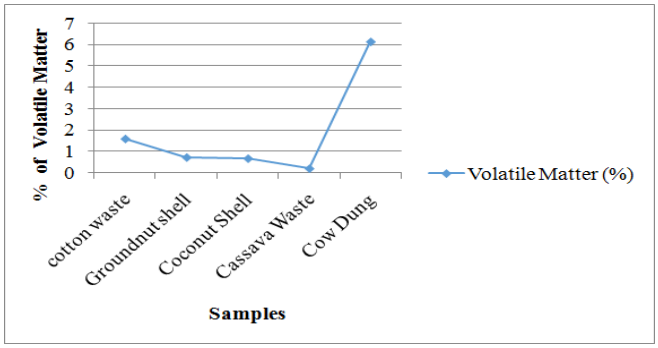


Fig.6: Volatile matter of samples

TABLE 5 Sieve analysis

Sieve size	Groundnut Shell	Coconut Shell	Cassava Waste	Cow Dung
	(g)	(g)	(g)	(g)
4.75 mm	20	20	20	20
2.36 mm	19.875	19.991	4.3	19.564

1.18 mm	8.475	17.51	2.501	7.31
600 micron	7.013	10.16	1.864	5.63
300 micron	1.479	2.17	0.822	1.582
150 micron	0.381	1.035	0.404	0.347
Pan	0	0	0	0

Fig.7: Sieve analysis Graph

VI. DISCUSSION

The calorific value of the samples has been tested in ALPHA laboratory, Coimbatore. The results obtained from the laboratory shows that the calorific value of the briquette is higher than that of other fossil fuels. It proves that the briquettes were best alternate to be used as a fuel. And it produces zero hazardous to the environment. By using these briquettes we can reduce the residues left after burning. It also helps to reduce the consumption of forest trees and also it prevents the resource. The briquettes are cheaper and economic.

VII. CONCLUSION

The briquette made up of ratio 2.5:3:1.5:1:2 gives high calorific value because this briquette consists of more amount of cow dung which has highest calorific value. The ash produced during the combustion of the briquette of ratio 2.5:3.5:1.5:1.5:1 is very minimum. Then the ratio of briquette which has least calorific value is 2:2:2:3:1 because it consists of more amount of cassava waste which has low calorific value. The usage of briquettes will prevent the emission of CO_2, during the combustion of fuels. Since we used wastes from agriculture fields, the emission of harmful gases are retarded. It has good efficiency in burning. It reduces the expenses of fuels. It is used reduce the consumption non-renewable resources. It does not produce any residue after burning. The size of the briquettes can be maintained. It does not affect the boilers. It is eco-friendly. It will be a renewable resource which is easily available. It reduces the solid wastes dumped into the land. It converts waste to valuable material

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