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Development of Biomass Briquetting Technology for Northern Regions of Karnataka Using Tamarind Seed Powder as Binder

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Abstract – It is generally acknowledged that burning fossil fuels and deforestation are major contributors to anthropogenic climate change. Biomass from plants can serve as an alternative renewable and carbon-neutral raw material for the production of energy. Low densities of 80–150 kg/m3 for herbaceous and 150–200 kg/m3 for woody biomass limit their application in energy production. Prior to cost-effective use in energy applications, these materials need to be densified to increase their bulk densities to help reduce technical limitations associated with storage, loading, and transportation. Pelleting, briquetting, or extrusion processing are methods commonly used to achieve densification. The aim of the present report is to apprise the possibility of subjecting agro-residues to briquetting technology for the region of study i.e. Northern Regions of Karnataka by making different combinations of biomass (easily available in abundant quantity at cheaper rate that has relatively higher calorific value - coconut shells, groundnut shells and saw dust) in definite proportions and proposing the best combination after calculating CV, % of ash content and also calculating the density of all the combinations.

Keywords—Northern Region, Briquetting, Biomass, Binder, Calorific Value, Peterson's Press, Ash content.

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I. INTRODUCTION

Biomass Briquettes are the compressed blocks of Agro & Forestry residues. The wastes may include rice husk, soya husk coffee husk, Coir Pitch, Jute Sticks, Sugarcane Bagasse, Groundnut Shell, Mustard Stalks, Cotton Stalks, Saw Dust, Castor seed Shells/Stalk, Wood Chips, Bamboo Dust, Tobacco Waste, Tea Waste, Paddy Straw, Wheat Straw, Sunflower Stalk, Palm Husk, Veneer Residues, Barks and Straw, Forestry Waste, seeds Cases, etc.

According to T V Ramachandra et.al [1] there is huge availability of energy in biomass in Northern regions of Karnataka i.e., about 10,595,592.78 Mkcal. Although there are many techniques are available in conversion of biomass into useful energy, biomass briquetting is growing in a faster rate due to its feasibility and flexibility towards production [2]. Biomass briquettes can be produced using the automated briquetting machine which includes screw press technology and Piston press technology and the other type is manual type of press [3]. In all of the manual press technologies developed Peterson's press has got a significant usage all over the globe due to its simplicity [4]. Studies so far undertaken revealed that, only the biomass briquettes are studied using some of the parameters which include Moisture content, effect of density, grain size, effect of binder, combustion test etc., this warrants the investigation of biomass briquettes using the different combinations of biomass by mass from the available agro residues in the Northern regions of Karnataka.

II. METHODOLOGY AND RESULTS

A. Selection of the biomass

The biomass in the proposed region is collected on the basis of the Calorific value (CV) and the availability. This included Coconut Shell, Groundnut Shell and Saw dust. The CV of various biomass collected are given below in Table 1.

Table 1. Calorific Value of individual biomass collected

S.I. No.	Biomass	Calorific value Kcal/kg
1	Groundnut shell	4571.42

2	Coconut shell	4878.57
3	Saw dust	4754.76

B. Selection of Binder

In Northern Dry Regions of Karnataka it is observed that the growth of tamarind trees is frequent and after the extraction of tamarind for usage the seeds were left unused which contains the protein content. So the tamarind seeds were collected and crushed to make the power of it. The powder was mixed with water and checked for the stickiness. The stickiness was found to be proper as per the requirement of the briquetting of biomass.

C. Drying and Making pellets of biomass

The collected biomass is dried under sun for 15 days and they were crushed for the grain size of -6 mm using a crusher. The crushed biomasses were then weighed and mixed in different proportions by percentage and made as pellets of weight of 0.5 grams using tamarind seed powder as binder. The proportions of various biomass mixed are given in Table 2.

Table 2. Combinations of biomass mixed in proportions in percentage basis

Biomass Combination	Coconut shell in percent(%)	Saw dust in percent(%)	Groundnut shell in percent(%)
A	33.3	33.3	33.3
B	40	20	40
C	20	40	40
D	20	30	50
E	50	30	20
F	10	30	60
G	40	40	20
H	60	20	20
I	10	60	30
J	30	20	50

D. Testing of biomass combinations for CV and ash content

The pellets of biomass samples are then taken and tested for calorific value using an oxygen bomb calorimeter. Finally the percentage of ash is calculated by the formula, % of ash = ×100 Where, y= weight of ash and x= initial weight of fuel. The calculated CV and ash content are given in the Table 3.

Table 3. CV and Ash contents of various combinations

Biomass Combination	% Ash content	Calorific Value in Kcal/kg
A	8.3	4396.22
B	4.167	4528.12
C	6	4726.87
D	1.96	5047.99
E	1.96	5254.89
F	2.273	5323.48
G	4.167	5759.19
H	6.12	5770.86
I	6	6161.95
J	3.92	6622.45

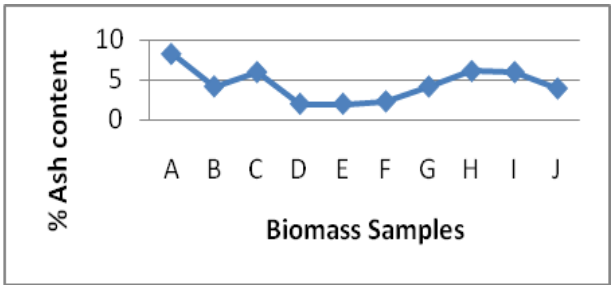

Figure 1 Variation of Ash content with various combinations of biomass.

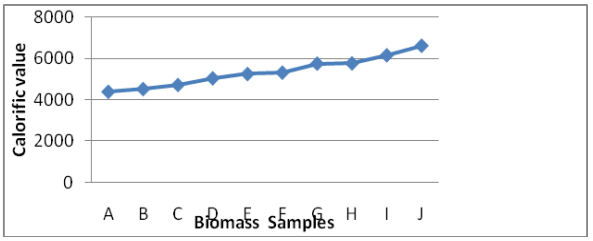

Figure 2 Variation of Calorific value with various combinations of biomass.

E. Manufacturing of Biomass Briquettes

Biomass Briquettes were made from the fabricated unit as shown in the figure 3, which is a type of

Peterson's press. The diameter and length of the briquettes produced were 30 mm in diameter and 75 mm in length. The briquettes were then tested for the density. The densities of each biomass briquette produced as shown in table 4.

Table 4. Densities of various biomass samples produced

Sample	Weight(Kg)	Density (Kg/m3)
A	0.06225	579.069
B	0.05839	543.066
C	0.05864	531.156
D	0.06862	674.148
E	0.05532	543.484
F	0.05438	579.713
G	0.05064	497.151
H	0.05655	587.768
I	0.05940	617.391
J	0.05298	550.727

Figure 3 Fabricated Briquetting unit

Figure 4 Briquettes produced

CONCLUSION

The results obtained from the study show that the combinations of various biomasses is strongly influencing the Calorific value and also the produced ash content. It is always suggested that the biomass briquette should have higher energy content and lower ash content. Based on the results it can be concluded that the sample J (Coconut shell 30%, saw dust 20%, groundnut shell 50%) has higher energy content of 6622.45 Kcal/kg and lower ash content of 3.92% with the density of 531.156 Kg/m3. So the combination J can be used for the preparation of the briquettes with Tamarind seed powder as binder.

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