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POTENTIAL OF POWER GENERATION OF CASSIA-TORA AND GULMOHAR BIO-MASS AND MIXING OF COAL AND BIO-MASS

Hardeep Kaur, Mohnish Gaur

ABSTRACT

Today as we all know that co-firing is becoming an effective technology of power generation and it becomes economically viable. In the present work the mixture is prepared with the help of coal which is not used for cooking purpose and non woody biomass. The coal is taken from Orissa local mine that is lingaraj mine. The mixture is prepared in the ratio of (coal: biomass = 94:06, 90:10, 84:16, 79:21). Our main objective is to examine the energy values of the mixture that will help to determine the generation of power potential. The result obtained from analysis of two non-woody biomass is compared with each other. On the basis of this work we can find out how much power can be generated with the particular area of land.

KEYWORDS: *Calorific value, proximate analysis, Bio-mass, Renewable Energy.*

1. INTRODUCTION

In India consumption of fossil fuels are continuously increasing and on the other hand depletion of some matters that are known reserves increasing so it is a matter of serious concern. So here we can say that India is becoming highly dependent on fossil fuels which are coal, oil and gas. Prices of the fossil fuels (gas, oil) are rising and also a problem of potential shortage in future it leads to concern about kind of problem that is security of energy supplied and it is needed to sustain our economic growth. It is also known to us as the consumption of fossil fuel increase it will cause some environmental problems that may be globally and locally. Now we talk about biomass it is always an important energy source for any country as per we concern about benefits it offers. Using of biomass gives thermal energy and sometimes it reduces the oxides.

2. MATHEMATICAL CALCULATIONS

2. 1 Calorific value and proximate analysis of different components of coal and non-woody bio-mass species

We have represented all the data that is related to our project work is summarized in the tables this data is obtained from the calorific value of non-woody biomass species, ash fusion temperature of selected biomass species, coal biomass mixed briquettes and proximate analysis.

Table 1: Gulmohar plant Proximate Analysis (Local name: Krishnachura)

Component	Proximate Analysis				G.C.V(gross calorific value) Kcal/kg Dried basis
	Moisture	(Wt. %, Air Dried Basis)	Volatile matter	Fixed carbon	
Wood	10.00	4.00	73.68	16.00	4550
Leaf	9.90	8.20	71.11	16.00	3948
N.branch	10.80	5.20	71.05	15.00	4062

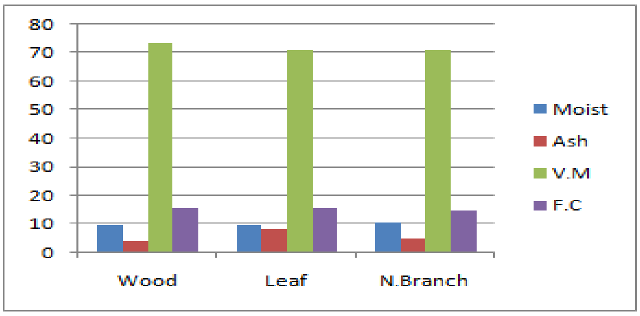

Table 2: Proximate Analysis of Cassia Tora (local name: Chakunda)

Component	Proximate Analysis				Calorific value Kcal/kg Dried basis
	Moisture	Ash	Volatile matter	Fixed carbon	
Wood	12.00	8.80	69.50	13.00	4345
Leaf	12.50	8.40	70.00	16.00	4114
N.branch	11.00	6.20	71.00	15.00	3698

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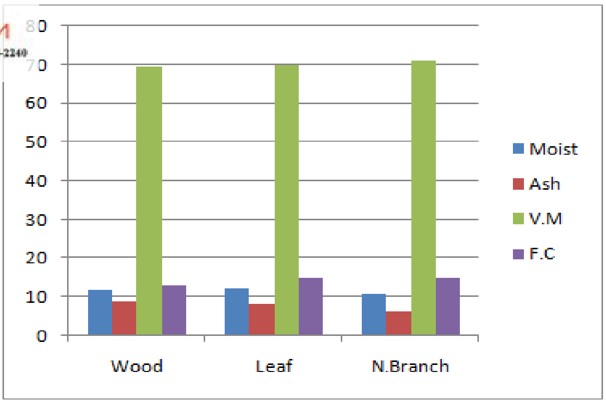

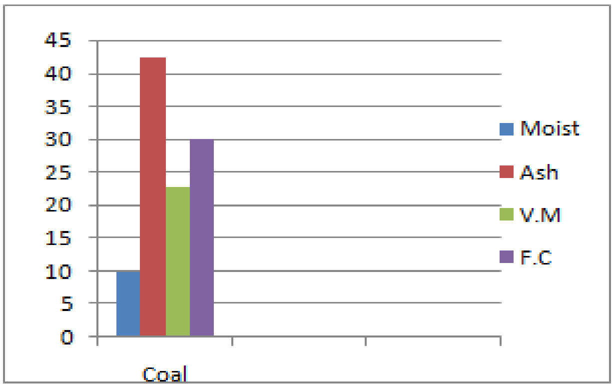

Table 3: Non-coking coal Proximate Analysis

Component	Proximate Analysis				Calorific value Kcal/kg Dried basis
	Moisture	Ash	Volatile matter	Fixed carbon	
Lingaraj mines	9.90	42.20	22.70	30	4238

Table 4: Coal: Gulmohar Biomass Different Component

(Coal Ratio Biomass)	Proximate Analysis (Wt. %, Air Dried Basis)				Calorific value (Kcal/ kg, Dried Basis)
	Moisture	Ash	V.M.	Fixed Carbon	
Wood					
94:06	8	37	26	33	3215
90:10	6	35	32	31	3498
84:16	5	37	34	28	3749
79:21	5	35	35	30	4088
Leaf					
94:06	5	36	30	33	3423
90:10	5	37	32	30	3484
84:16	6	30	36	32	3078
79:21	7	33	35	32	3831
Nascent Branch					
94:06	5	38	33	28	3585
90:10	44	34	36	30	3552
84:16	7	30	40	27	3558
79:21	8	31	43	22	3802

Table 5: Variation of mixture of coal and gulmohar Biomass (wood)

	Moist	Ash	V.M	F.C
94:06:00	8	37	26	33
90:10:00	6	35	32	31
84:16:00	5	37	34	28
79:21:00	5	35	34	30

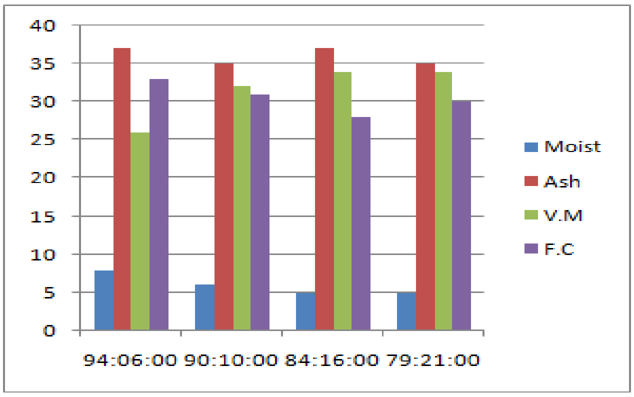

Table 6: Variation of mixture of coal and gulmohar Biomass (leaf)

	Moist	Ash	V.M	F.C
94:06:00	5	36	30	33
90:10:00	5	37	32	30
84:16:00	6	30	36	32
79:21:00	7	32	34	31

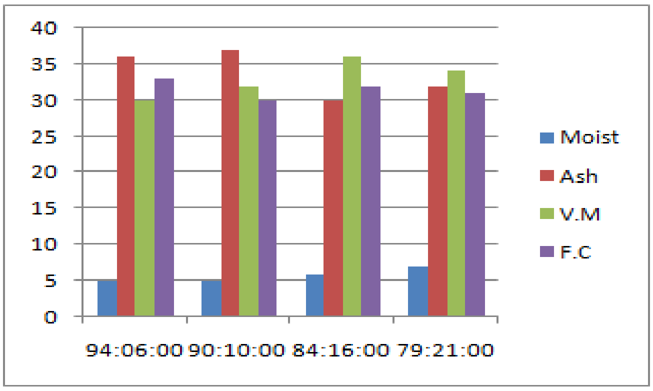

Table 7: Variation of mixture of coal and gulmohar Biomass (N. Branch)

	Moist	Ash	V.M	F.C
94:06:00	5	38	33	28
90:10:00	4	34	36	30
84:16:00	7	30	40	27
79:21:00	8	31	43	22

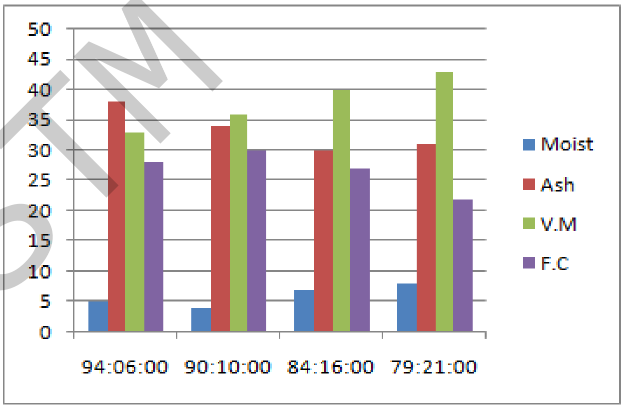

Table 8: Coal: Cassia Tora Biomass Different Component

(Coal Ratio Biomass)	Proximate Analysis (Wt. %, Air Dried Basis)				Calorific value (Kcal/ kg. Dried Basis)
	Moisture	Ash	V.M	Fixed Carbon	
Wood					
94:06	44	37	37	26	3147
90:10	5	37	34	28	2981
84:16	5	38	40	21	3483
79:21	7	36	42	19	3455
Leaf					
94:06	4	40	30	30	3276
90:10	5	40	30	29	3669
84:16	5	32	40	27	3052
79:21	5	34	35	30	4144
Nascent Branch					
94:06	5	40	33	26	3472
90:10	8	38	30	28	3212
84:16	4	32	40	28	3676
79:21	4	37	40	23	3673

	Moist	Ash	V.M	F.C
94:06:00	4	37	37	26
90:10:00	5	37	34	28
84:16:00	5	38	40	21
79:21:00	7	36	42	18

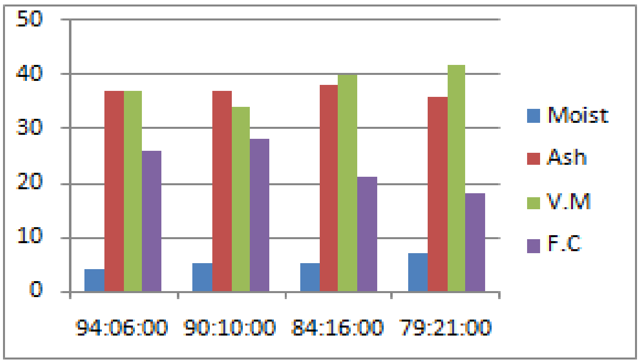

Table 9: Variation of mixture of coal and cassia-tora Biomass (Leaf)

	Moist	Ash	V.M	F.C
94:06:00	4	40	30	30
90:10:00	4	40	30	29
84:16:00	5	32	40	27
79:21:00	5	34	35	30

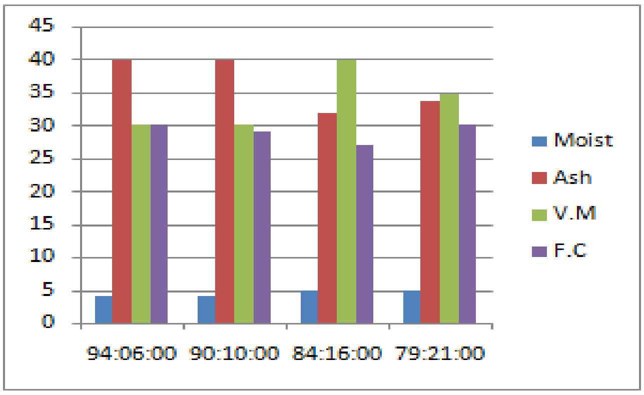

Table 10: Variation of mixture of coal and cassia-tora Biomass (Branch)

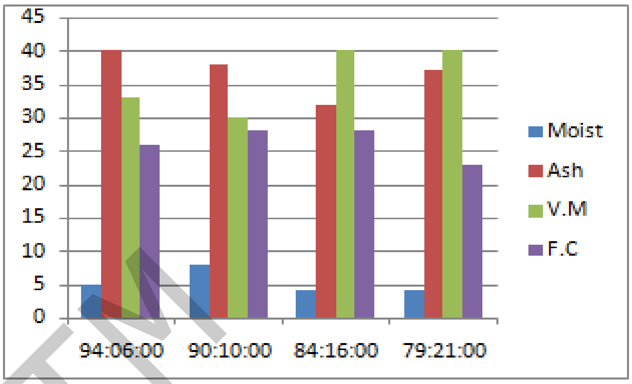

Table 11: Variation of mixture of coal and cassia-tora Biomass (N.Branch)

Table 12: Temperatures of Ash Fusion of Selected Coal- Biomass and Biomass Species Mixed sample

Temperatures of ash fusion(°C)				
Biomass Species/ Coal-Biomass Mixed Ratio	Initial Deformation temperature	Softening Temperature	Hemispherical temp	Flow temperature
Gulmohar	1059	1250	>1400	>1400
Cassia Tora	894	1246	>1400	>1400
Coal : Biomass (90:10)	1161	1298	>1400	>1400
Coal : Biomass (79:21)	1189	1299	>1400	>1400

IDT: Initial Deformation Temperature

ST: Softening Temperature

HT: Hemispherical Temperature

FT: Flow Temperature

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2.2 Calculations

Table 13: Power Generation and total generation Structure from 4 Months old

(approx.), Gulmohar Plants

Component Main wood	Calorific Value (kcal/t, dry basis) 4532 × 103	Production of Biomass (t/ha, dry basis) 21.00	Value of Energy (kcal/ha) 95180 × 103
Leaf	3907 × 10³	7.00	27355× 10³
Nascent branch	3997 × 10³	9.50	37978.5 × 10³

* Field studies data (biomass production)

Energy Calculation:

Total energy from one hectare of land on even dried basis

$(95180+27355+37978.5) \times 10^3$

= 160513.5×10^3 kcal

It is assumed that wood fuelled thermal generators efficiency is = 26 % and power plant mechanical efficiency = 85 %.

Value of energy of the total functional biomass that is obtained from one hectare of land at 26% efficiency of conversion of thermal power plant = $160513.5 \times 10^3 \times 0.26$

= 41733.51×10^3

= $41733.51 \times 10^3 \times 4.186 \div 3600$

= 48526.79 kWh

Generation of power at mechanical efficiency of 85 %

= 48526.79×0.85

= 41247.77 kWh/ha

To supply electricity for entire year land required

$=73 \times 10^5 / 41247.77 = 176.97$hec

Table 14: Power Generation and total generation Structure from 4 Months old

(approx.), Cassia Tora Plants

Component	Calorific Value (kcal/t, dry basis)	Production of biomass (t/ha, dry basis)	Value of Energy (kcal/ha)
Main wood	4344 × 10³	4.00	17384 × 10³
Leaf	4013 × 10³	1.50	6025.5× 10³
Nascent branch	3672 × 10³	2.50	9187 × 10³

* Field studies data (production of biomass)

Calculation of Energy:

Total energy from one hectare of land on even dried basis

= $(17384+6025.5+9187) \times 10^3$

= 32597×10^3 kcal

It is assumed that wood fuelled thermal generators efficiency is = 26 % and power plant mechanical efficiency = 85 %.

Value of energy of the total functional biomass that is obtained from one hectare of land at 26% efficiency of conversion of thermal power plant = $32597 \times 10^3 \times 0.26$

= 8475.22×10^3 kcal

= $8475.22 \times 10^3 \times 4.186 \div 3600$

= 9854.79 kWh

Generation of power at mechanical efficiency of 85 %

= 9854.79×0.85

= 8376.57 kWh/ha

To supply electricity for entire year land required

= $73 \times 10^5 / 8376.57 = 71.47$ hectares

3. CONCLUSION AND DISSCUSSION

In this project work we have taken two biomass species that was cassia tora and gulmohar. With the help of experiment we have determine ash fusion temperature, calorific value and proximate analysis on component of selected biomass species which include leaf, wood and nascent branch. The main purpose of estimation is to find out the potential of power from one hectare of land from each of the species that is available. Some of conclusion are pointed below that we draw from our project work:

1. Less Volatile matter in cassia tora wood and leaf, proximate analysis showed for two biomass species is almost similar for the biomass species components, leaves having more ash contents.

2. When the biomass is mixed with the coal that is in different ratio (in four different ratio) the result of proximate analysis is nearly same, the ash contents are little more when 6% biomass with 94% coal mixing and volatile matter is somehow higher when 20% biomass with 80% coal mixing.

3. Branch is having highest energy values after that wood and after wood leaf and at last nascent branch it is showed by two non woody species of biomass.

4. Gulmohar plant is having the highest energy value as compared to Cassia tora among the two biomass species.

5. In all among the four different ratios, 79:21 ratios gives the highest energy value as compared to 94:06,

90:10, and 84:16.

6. Values of energy of coal mixed Cassia tora biomass component are found to be little bit lower than coal mixed Gulmohar biomass component.

7. Calculation results shows that nearly 176.97 and 871.47 hectares land will require generating continuous power of 41247.77 kWh per hectares from Gulmohar and 8376.57 kWh / hectares from biomass species of Cassia tora.

8. Here it can be concluded that the temperature of ash fusion obtaining from all the species are obtaining above the boiler operation range, this would effectively avoid clinker formation in the boiler.

9. This work will give a effective impact to the power developers in the exploitation of non-woody biomass species to generate power.

valuable time and thought in giving necessary guidance. His rich and varied experience as an academician immensely helped me in understanding this topic clearly.

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