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Characterization of Pakistani Coal and Biomass Blends

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Abstract

Coal is Blackish color sedimentary rock which occurred in layer forms. There are certain ranks of Coal which can be found in different areas of World. It can extract from different mining techniques. The analysis of coal and Biomass blends. By using this technology the low grade coal converts into a valuable material which is used as fuel for domestic, commercial and industrial purpose. Biomass Blends are made of Pakistani coal with different Biomass, bagasse, coconut shell, Coconut waste and saw dust i.e. High Gross calorific value coal is used to blend with biomass of high calorific value and low ash content. Purpose of low ash content is not to effect the environment. The technique was to determine whether which type either Biomass and coal blend to be used for the burning and to give an idea for their use in generating steam for energy production. Which can be used in different types of Gasifier, boilers i.e circulating fluidized bed. Gross calorific value was determined on the basis of heat basis blends and weight basis blends with net calorific value determined in same heat basis blends. Net calorific value was determined using Dulong formula.

composite is body centered cubic.

***Keywords**: Coal; Saw Dust; Coconut Shell; Proximate Analysis, Blending*

1. Introduction:

Coal is Blackish or Brownish black sedimentary rock occurring in layers called coal beds. It is composed primarily of carbon along with variable quantities of other elements, chiefly hydrogen, sulfur, oxygen, and nitrogen [1].

Coal is the largest source of energy for the generation of electricity worldwide. Coal fired electric power generation emits around two thousand pounds of carbon dioxide for every mega watt hour generate, which is almost double the approximately one thousand and one hundred pounds of carbon dioxide released by a natural gasifired electric plant per mega watt hour generated [2][3]. Coal is extracted from the ground by coal mining, either underground by shaft mining, or at ground level by open pit mining extraction. In Pakistan coal quality varies and have different coal types which can be found in different mountain ranges and other ranges. Sindh being the largest coal deposit of the country having resources upto 185 billion tons approximately.[6][7][8]. There are coal reserves other than Pakistan, United States having largest coal deposit (reserve) with approximately twenty three percent of world coal with more anthracite and bituminous reserves than bituminous and lignite. Russia coming at the second with coal reserves of fifteen percent reserve of the total world reserves. [5].

Biomass is an industry term for getting energy by burning wood, and other organic matter. Burning biomass releases carbon emissions, but has been classed as a renewable energy source in the EU and UN legal frame works, because plant stocks can be

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replaced with new growth [10].

It has become popular among coal power stations, which switch from coal to biomass in order to convert to renewable energy generation without wasting existing generating plant and infrastructure. Biomass most often refers to plants or plant based materials that are not used for food or feed, and are specifically called lignocellulo-sic biomass. [11]

2. Experimentation:

The experimentation was carried out using Pakistani coal from different areas and biomass.

Initially analysis of different coals was done separately with some biomass as well, under these value some of the coals selected on the basis of their result and on the other side with blend them with biomass.

1. Sample preparation
2. Proximate Analysis
3. Gross Calorific Value
4. Net Calorific Value

Lump or rock solid coal was crushed and fined, later it was taken after the mesh size of 60. Similarly for the biomass the raw material was crushed and fined.

When the Powdered/Fine form is ready then experimental analysis was done. Analysis performed on given coals and biomass samples and their blends using ASTM standards. Following were determined.

1. Total Moisture Analysis D-3173 [12]
2. Volatile Matter Determination D-3175 [13]
3. Ash Determination D-3174 [14]
4. Fixed carbon Determination D-3172 [15]
5. Gross Calorific Value [16]
6. Net Calorific Value [17]

3. Results and Discussion:

Blending was done on heat basis, the results obtained from analysis which was done. The coal was selected based on its high Calorific value such as gross and net. Further the coal was having least ash content. Whereas biomass for blending was selected based on the High calorific values with little variation in Ash content. Following table show the blending analysis result.

To that volatile matter value in Coal and saw dust blends gradually increases, when moves from high coal percentage towards low coal percentage with low biomass to high biomass. Total moisture remains almost the same in all. Whereas the ash content shows variation in the values.

Similarly in coal and coconut shell volatile matter gradually increase with decrease in fixed carbon value as moving towards high biomass percentage. Total moisture value fluctuate as well as ash content value.

The Gross calorific value were also obtained with Net calorific value. A comparison is setup between both blends.

Table 1: Analysis of coal and saw dust Blend

	Blending Ratios	Total Moisture	Ash	Volatile Matter	Fixed Carbon
Coal+ Saw Dust	**90%+10%**	4.4%	13%	30.6 %	51.94%
	80%-20%	4.4%	10%	43.55%	42.05%
	70%+30%	4%	5%	53%	38%
	60%-40%	5.5%	7%	56.5 %	31%
	50%-50%	7%	4%	59%	30%
	40%-60%	5.8%	5%	63%	26.2%
	30%-70%	6%	3%	69%	22%
	20%-80%	6.32%	3%	74%	16.68%
	10%-90%	5.8 %	2%	82 %	10.2 %

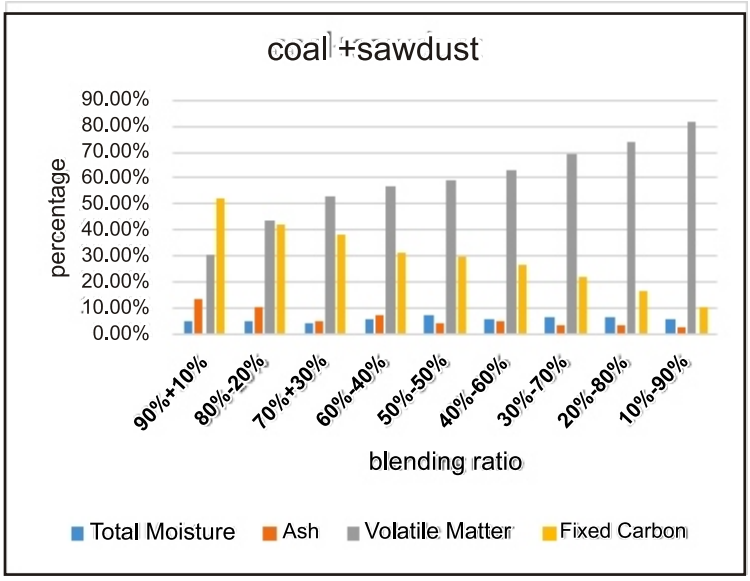

Figure 1: Comparison of Coal and sawdust blends on different blending ratios

Table 2: Analysis of coal and coconut Blend

	Blending Ratios	Total Moisture	Ash	Volatile Matter	Fixed Carbon
Coal+ Coconut Shell	90%+10%	4.42%	10.6%	35.6%	49.38 %
	80%-20%	4.5%	9.2%	44%	42.3%
	70%+30%	5%	7%	49%	39%
	60%-40%	4.25%	7%	52%	36.75%
	50%-50%	4%	8%	56%	32%
	40%-60%	4.6%	8%	58%	29.4%
	30%-70%	5%	7%	61%	27%
	20%-80%	5.2%	8.3 %	66%	20.5%
	10%-90%	4.8%	8%	70%	17.2 %

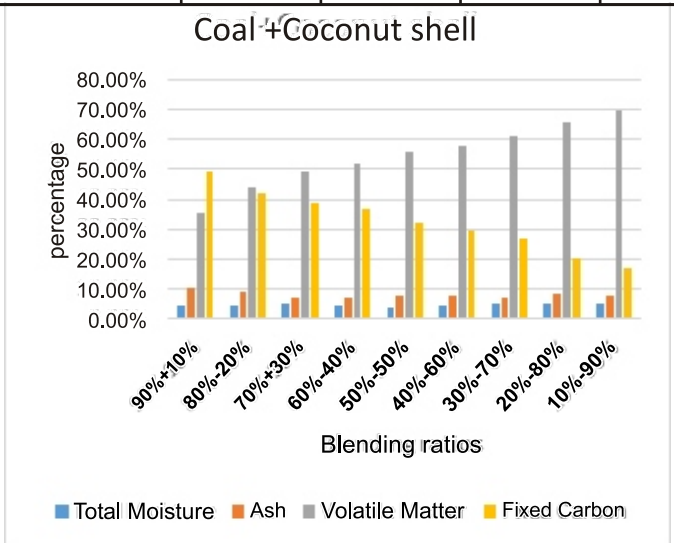

Figure 2: Comparison of Coal and coconut shell blends on different blending ratios

Table 3: GCV of Coal-Saw dust and coal-coconut shell blends

	Blending Ratios	Total Moisture	Coal-Coconut shell
GCV in kJ/kg	90%-10%	31813.12	31461.28
	80%-20%	29335.68	28742.88
	70%-30%	27216.23	26456.88
	60%-40%	25382.39	24507.71
	50%-50%	23780.09	22826.04
	40%-60%	22368.06	21360.34
	30%-70%	21114.33	20071.51
	20%-80%	19993.68	18929.36
	10%-90%	18985.99	17910.2

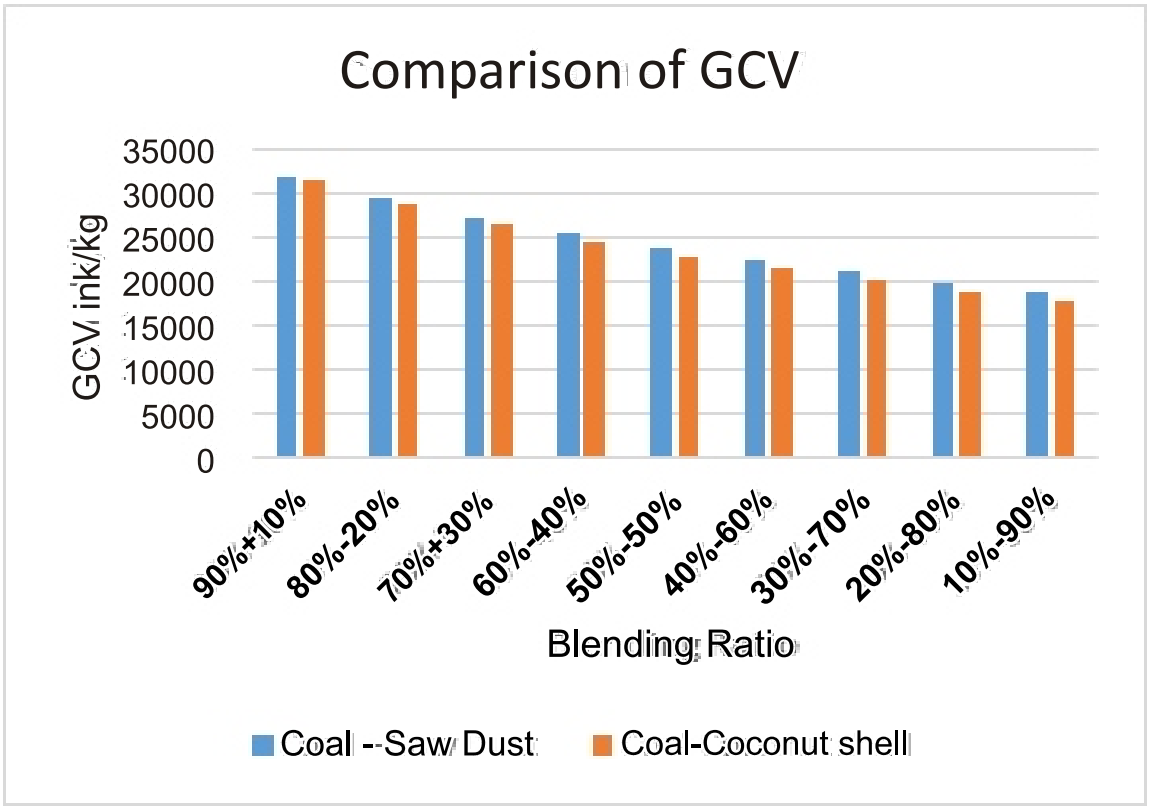

Figure 3: Comparison of GCV of Coal-Saw dust and coal-coconut shell blends on different blending ratios

Table 4: NCV of Coal-Saw dust and coal-coconut shell blends

	Blending Ratios	Total Moisture	Coal-Coconut shell
NCV in kJ/kg	90%-10%	30538.43	30186.6
	80%-20%	28061	27468.19
	70%-30%	25897.59	25138.24
	60%-40%	24063.76	23189.07
	50%-50%	22461.45	21507.41
	40%-60%	21049.43	20041.7
	30%-70%	19795.69	18752.87
	20%-80%	18675.04	17610.72
	10%-90%	17667.35	16591.56

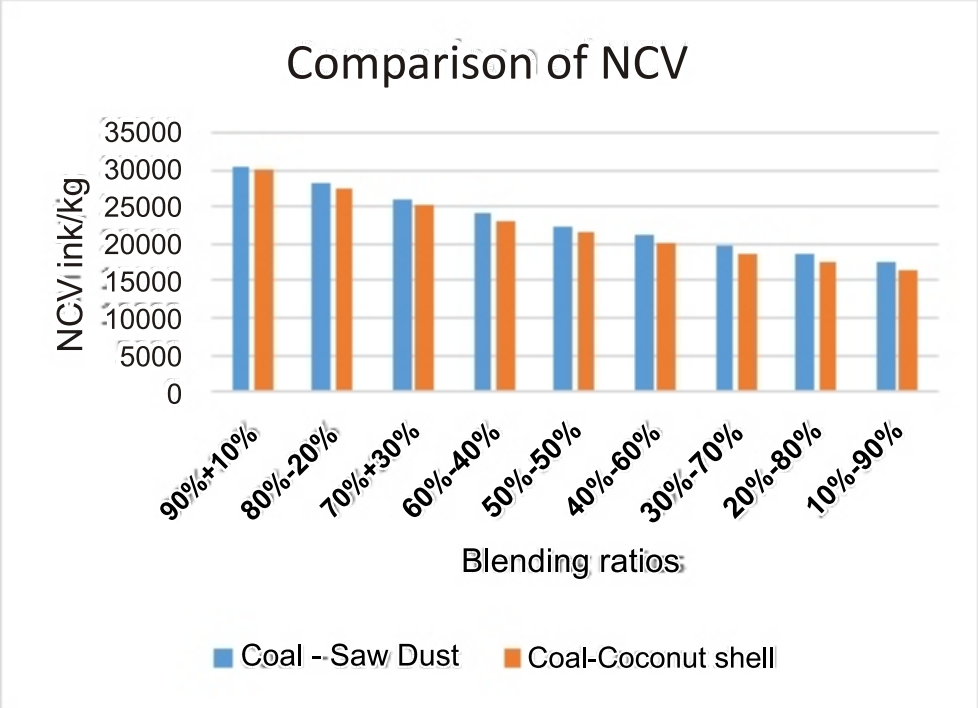

Figure 4: Comparison of NCV of Coal-Saw dust and coal-coconut shell blends on different blending ratios

4. Conclusions:

The selection of coal was done so that we could obtained less ash content and high calorific values. On thinking if values were lower, then the steam could not produce due to less calorific value as it will not reach the required temperature for turning of turbine. Less ash content will be valuable for environment as it can produce less SOx which is harmful for environment. The total moisture, after analysis of both Coal-Saw dust and Coal-coconut shell approximately equal. The Ash content were high in coconut shell and thus in blending remains a bit high as to the saw-dust which gradually decreases. VM of both Saw-dust-coal and coal-coconut shell decreases gradually but coal-sawdust remains high. The Gross calorific value in case of both coal-sawdust and coal-coconut shell gradually decrease. Similarly the net calorific value also decreases. The net calorific value turns out to be almost 93% to 96 % of gross calorific value as we move from biomass towards high percentage of coal value in case of coal-sawdust blends. In case of coal-coconut shell value NCV value comes out to be starting from 92.5% to 96% of that to GCV as we move from high biomass to high coal percentage.

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