Potential of Biomass For Power Generation In Thermal Power plant

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Abstract- *The exploitation of Fossil Fuels (Coal and natural gases), and depletion of environment due to greenhouse gases has increased the attention of researchers towards the renewable energy sources. Amongst all, Biomass could be the better future for energy dependence. Biomass is the purest fuel consisting of very lesser amount of ash materials. It produces negligible amount of oxides as compared to others. Presently the Co-firing (Coal+ biomass) system has been proved to be more attractive and economical technique for power generation. The proximate analysis of biomass contents and their various methods of utilization technologies emphasize on the maximum output results on biomass. The Co-firing system could be a wise step in meeting energy demands. So the future of power generation depends on wise selection of techniques both economical and environment friendly.*

Keywords- biomass, gasification, electricity, proximate analysis, G.C.V, fermentation, energy.

I. INTRODUCTION

India is a fast developing nation which largely dependent on fossil fuels for energy requirement. Every sectors of Indian Economy derive energy from fossil fuels. This dependence has lowered the progress of nation, so biomass could be a bright opportunity for energy source. It offers cheapest source with environment benefits. Biomass is renewable, widely available, carbon-neutral, with reduction in oxides and potential to provide significant employment in rural areas. Biomass is carbonaceous organic waste mainly consisting of plants and animals waste. Biomass is freely available as waste materials and could be effectively used to generate energy. The effective methods in transforming the energy could [prove to be a boon in this situation.

The conversion of energy from biomass is achieved by various technological steps and hence this could enrich our power sector by generating low cost and eco-friendly electricity. The awareness and steps by government needed to be emphasized for maximum output of energy in every sector.

II. BIOMASS CLASSIFICATION AND PROPERTIES

Researchers classify the various types of biomass in four different ways

- woody plants, derived from forest residues.
- Herbaceous plants/grasses,
- aquatic plants,
- manures.

Within herbaceous plants we have two classifications, high- and low-moisture contents. Aquatic plants and manures have high-moisture materials and, are more suited to 'wet' processing techniques. In High moisture content biomass, biologically reactions such as fermentation is needed, while a 'dry' biomass such as wood chips, is more economically suited to gasification, pyrolysis or combustion process.

BIOMASS PROPERTIES:-

• moisture content,• calorific value, • proportions of fixed carbon and volatiles, • ash/residue content, • alkali metal content,

Moisture content:-The moisture content of biomass is studied depending on their nature and proximate analysis is done below.

Biomass materials	Moisture (%)	VM (%)	FC (%)	Ash (%)	LHV (MJ/Kg)
Wood	21	80	18	2	18.6
Wheat straw	18	60	21	4	16.8
Barley straw	32	45	18	6	16.4
Lignite	34	30	31	6	26.6
Bituminous coal	11	34	45	9	34.6

Table 1: Proximate analysis of some biomass feed stocks (wt%)

Calorific value:-The CV is usually measured in terms of the energy content per unit mass, or volume; in MJ/kg,or MJ/l. The CV of a fuel can be expressed as the gross CV (GCV), or

higher heating value (HHV) and the net CV (NCV), or lower heating value (LHV). The HHV is the total energy released when the fuel is burnt in air, including the latent heat contained in the water vapor. In practical terms, the latent heat cannot be used effectively and therefore, the lower heating value (LHV) is used.

Proportions of fixed carbon and volatile matter:-

The volatile matter (VM) of a solid fuel, is the amount which exhaust as a gas (including moisture) by heating nearly up to (950 C for 7 min). • The fixed carbon content (FC), is the mass remaining after the releases of volatiles matter, excluding the ash and moisture contents. This analysis of biomass fuel is termed as proximate analysis which helps in gasification process of biomass.

Ash/residue content:-The chemical breakdown of biomass leaves sold residue. The solid wastes produced after oxidation in air called as Ash. The percentage of solid residue will be greater than the ash content formed during combustion of the same material. Ash content reduced the efficiency of fuels.

Alkali metal content:-The presence of alkali metal in biomass i.e. Na, K, Mg, P and Ca, plays an important role for thermo-chemical conversion processes. The alkali metal when reacts with silica present in ash produces a sticky, mobile liquid , which lead to blockages of airways in the furnace and boiler plant. Hence their contents need to be reduced before treating biomass.

III. BIOMASS ENERGY CONVERSION TECHNOLOGIES

Technologies play an important role in enhancing the maximum productivity. Among several of them we have key technologies that are available for promoting power generation from biomass in India such as: - gasification, combustion, co-firing and bio-methanation processes.

1. ***Gasification***

Biomass gasifiers are devices that promote thermo-chemical conversion of Biomass into high energy combustible gas to be utilized in gas turbine, through oxidation and reduction process. Gasifiers are broadly classified into updraft, downdraft and cross draft depending on direction of airflow. Different processes in a gasifier are:

- **Drying of fuel: -**The first step is the removal of moisture content frombiomass by evaporation which is in the range of 7-15% using radiation heat at less than 120^{o}C.
- **Pyrolysis:-** It is a process in which biomass loses all its volatile matter in the presence of air and gets converted to char, vapor, methanol at temperature above 200^{o}C.
- **Combustion: -** The combustion of solid fuels into carbon dioxide and water in form of steam**,** releasing heat at 1400^{o}C.
- **Reduction :-** The products of partial combustion now passes through a red-hot charcoal bed where reduction reactions take place, forming carbon monoxides and hydrogen gas with absorbing heat.

2. Combustion:

This technology is similar to coal-based thermal power plant in which the biomass is burnt in boiler to produce steam and drive turbine to generate electricity. The sizes of these plants are typically ten times smaller than coal-fired plants. This technology disposes the large amount of bio wastes(bagasse).

3. Co-Firing:

Coal +Biomass called as Co-Firing system has proved an effective tool in utilization of fuels. They improve the combustion of fuels completely. In thermal plant the complete combustion of fuel never takes place, so the unburnt fuel remains disposed in environment. So, we used Co-firing technology to enhance the production rate. Also they results in less Sulphur emissions. Two distinct techniques:

1. Direct co-firing, biomass fuels are blended with coal and fed into boiler.
2. Indirect co-firing, biomass is prepared separately from coal and then fed into boiler.

4. Bio-Methanation:

The process in which the organic wastes materials like animal and plant wastes are converted into Biogas and manure by the process of anaerobic decomposition in the absence of oxygen. So the biogas can be used as fuel in energy generation as clean source of power. The construction of such plant is modular and requires less area.

IV. ADVANTAGES OF BIOMASS

- Rural electrification can be achieved.
- Overcoming Power deficits in agriculture sector.
- Providing job opportunities in rural areas.

- Clean and efficient energy source.
- Achieving initiatives as “Green Nation”.
- Production of organic fertilizers at low costs.
- Increasing productivity of crops.
- Giving our nation’s economy a powerful boost.

V. FUTURE OF BIOMASS IN INDIA

In India we have large bulk of Biomass fuel produced from the forests and households. The proper utilization of these renewable sources is much concern. The awareness among people for its maximum utilization is most important. India has potential for the consuming non-conventional energy source, and lead to clean and free energy technology. Future of biomass energy depends on providing reliable energy at much affordable cost. Government initiatives and their steps could easily promote our safer energy source. Moreover processing technology could make this our eco-friendly and cheaper source of power generation in future times.The economical utilization of waste materials in every aspects of society could easily promote this renewable source. Potential estimates of animal residues and plant waste could easily generate energy nearly of 10000MW annually, which could easily lower our demands on fossils fuels. The future of energy demands depend on our efficient utilization of available free and clean sources.

VI. CONCLUSION

- Biomass can be used as profitable mean to reduce global warming, by displacing the use of fossil fuels.
- Biomass could be used as a source of rural electrification.
- The efficient management of waste produce in our country could generate clean energy with less carbon footprints.
- Biomass with coal based system in thermal plant could generate lower cost electricity with maximum efficiency.
- Both plant species (Sugarcane Bagasse and Soya Husk) showed almost the similar proximate analysis, having large utilization factor for energy generation.
- CO-Firing system with different content ratios shows various results as follows.
- Mixed ratio of both Biomasses with coal at different ratio showed same proximate analysis, but the ash content being more when 95% coal mixing with 5% biomass and volatile matter is more when 80% coal mixing with 20%biomass.
- Amongst the four different ratios, ratio 80:20 gives the highest energy value compared to 95:05, 90:10, and 85:15 ratios of coal and Biomass in Co-Firing thermal plant.

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