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Determination of Utility Factor Genesis through Different Biomasses Product

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Abstract:
In view of energy and environmental problems associated with the use of fossil fuels (coal, petroleum and gas) in power generation, an increasing attention is being paid world- over by the scientists and technocrats for the utilization of renewable energy sources in power generation, metallurgical industries etc. There are various type of renewable energy sources such as solar, wind, hydropower, biomass energy etc. out of these renewable energy sources, biomass is more economically viable for almost all the continents in the world. Biomass is a carbonaceous material and provides both the thermal energy and reduction for oxides, where as other renewable energy sources can meet our thermal need only. Amongst all the solid fuel like coal etc. biomass is the purest fuel consisting of very lesser amount of ash materials. The power generation potential data for renewable energy sources in India clearly indicates that the biomass has potential to generate more than 17000 MW of electricity per year in India. However, the country is locking in exploitation of biomass in power generation. Till date, India has been capable to generate only 2000 MW (approx.) of electricity per year in spite of declaration of several incentives by the govt. of India. Hence, there is an argent need to increase the utilization of biomass in power generation.

I. INTRODUCTION

India being a developing nation, sustainable development is more important. Energy is a basic requirement for economic development. Every sector of Indian economy – agriculture, industry, transport, commercial and domestic – needs inputs of energy. Energy is an important factor for any developing country. Ever increasing consumption of fossil fuels and rapid depletion of known reserves are matters of serious concern in the country. This growing consumption of energy has also resulted in the country becoming increasingly dependent on fossil fuels such as coal and oil and gas. Rising prices of oil and gas and potential shortages in future lead to concerns about the security of energy supply needed to sustain our economic growth. Increased use of fossil fuels also causes environmental problems both locally and globally. Biomass has always been an important energy source for the country considering the benefits it offers. Biomass provides both, thermal energy as well as reduction for oxides. It is renewable, widely available, carbon-neutral and has the potential to provide significant employment in the rural areas. Biomass is also capable of providing firm energy. About 32% of the total primary energy use in the country is still derived from biomass.

1.1-Different Renewable Energy Sources

Renewable energy sources are continuously replenished by natural processes. For example, solar energy, wind energy, bio-energy –bio fuels, hydropower etc., are some of the examples of renewable energy sources. In view of energy and environmental problems associated with the use of fossil fuels in power generation, scientist and technocrats, world over, are in search of the suitable substitute of fossil fuels for power generation.. The various forms of renewable energy sources having a potential to be utilized in power generation are as follows:

1. Wind Energy
2. Solar Energy
3. Hydropower
4. Geothermal Energy
5. Nuclear Energy
6. Biomass and Bio-energy

1.2- Power Generation Potential From Biomass And Bagasse Based Cogeneration.

Biomass resources are potentially the world's largest and most sustainable energy sources for power generation in the 21st entury (*Hall & Rao, 1999*). The current availability of biomass in India is estimated at about 500 million metric tones per year. Studies ponsored by the Ministry has estimated surplus biomass availability at about 120 – 150 million metric tonnes per annum covering agricultural and forestry residues corresponding to a potential of about 17,000 MW. This apart, about 5000 MW additional power could be generated through bagasse based cogeneration in the country's 550 Sugar mills, if these sugar mills were to adopt technically and economically optimal levels of cogeneration for extracting power from the biogas produced by them (Ministry of New and Renewable Energy). The details of the estimated renewable energy potential and cumulative power generation in the country have been outlined in Table1.1 (*MNRE, 2011*), indicating that the available biomass has a potential to generate around 17,000 MW of electricity.

1.3- Biomass: Classification And Properties.

The overall biomass resources can be broadly categorized into two parts based on its availability in the natural form.

1-Woody biomass -
Woody biomass is characterized by high bulk density, less void age, low ash content, low moisture content, high calorific value. Because of the multitude of advantages of woody biomass its cost is higher, but supply is limited. Woody biomass is a

preferred fuel in any biomass-to energy conversion device; however its usage is disturbed by its availability and cost.

2 - Non- Woody biomass -

The various agricultural crop residues resulting after harvest, organic fraction of municipal solid wastes, manure from confined livestock and poultry operations constitute non-woody biomass. Non- woody biomass is characterized by lower bulk density, higher void age, higher ash content, higher moisture content and lower calorific value. Because of the various associated drawbacks, their costs are lesser and sometimes even negative.

Biomass properties:-

An understanding of the structure and properties of biomass materials is necessary in order to evaluate their utility as chemical feed stocks. Chemical analysis, heats of combustion and formation, physical structure, heat capacities and transport properties of biomass feed stocks and chars are more relevant in the gasification of any biomass.

1. Bulk chemical analysis-

In evaluating gasification feed stocks, it is generally useful to have proximate and ultimate analyses, heats of combustion and sometimes ash analyses. These provide information on volatility of the feedstock, elemental composition and heat content. The elemental analysis is particularly important in evaluating the feedstock in terms of potential pollution. The low energy density of biomass makes them less preferred by the people when compared to fossil fuels like gas, oil and coal.

2. Physical properties-

The major physical data necessary for predicting the thermal response of biomass materials under pyrolysis, gasification and combustion reactions are shape, size, void age, thermal conductivity, heat capacity, diffusion coefficient and densities viz. bulk density, apparent particle density and true density. The values of these properties are different for different biomass especially in the case of loose biomass.

3. Biochemical analysis-

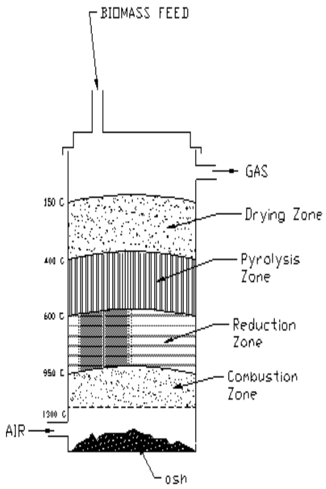
As biomass is a natural material, many highly efficient biochemical processes have developed in nature to break down the molecules of which biomass is composed and many of these biochemical conversion processes can be harnessed. Biochemical conversion makes use of the enzymes of bacteria and other micro-organisms to break down biomass. In most cases micro-organisms are used to perform the conversion process: anaerobic digestion, fermentation and composting.

1.4- Bio-Energy Technologies For Decentralised Power Generation-

The advances in bio-energy technologies (BETs) over the last few decades have enabled a significant increase in the utilization of biomass for power generation. Key technologies available for promoting power generation from biomass in India are gasification, combustion, co-firing and bio- meth nation.

Gasification:

Biomass gasifiers are devices promoting thermo- chemical conversion of biomass into high energy combustible gas for burning in gas turbine (BIG / GT). Biomass, particularly woody biomass, can be converted to high-energy combustible gas for use in internal combustion engines for mechanical or electrical applications. Biomass gasifiers are devices performing thermo-chemical conversion of biomass through the process of oxidation and reduction under sub-stoichiometric conditions. Gasifiers are broadly classified into updraft, downdraft and cross draft (shown in Figs. 1.1 - 1.3) types depending on the direction of airflow. Gasifier systems with various capacities in the range of 1 kg/h to about 500 kg/h are presently in use. These systems are used to meet both power generation using reciprocating engines or for direct usage in heat application. The prime movers are diesel engines connected to alternators, where diesel savings up to 80% are possible.



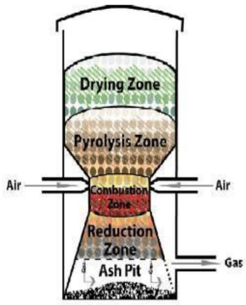


Figure.1. Updraft Figure.2. Downdraft

Gasifier Gasifier

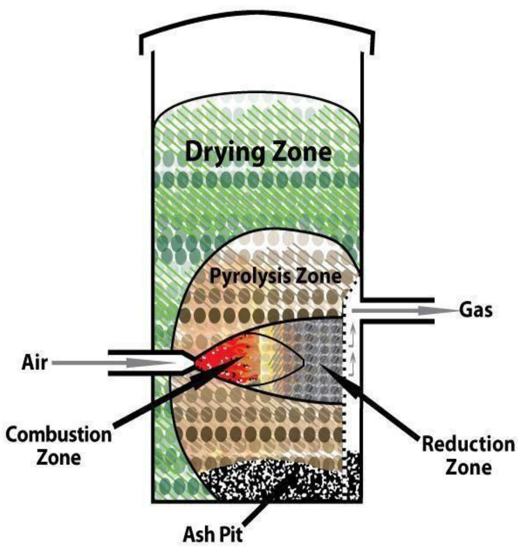


Figure.3. Crossdraft Gasifier

Drying of fuel:

The first stage of gasification is drying. Usually air- dried biomass contains moisture in the range of 7-15 %. The moisture content of biomass in the upper most layers is removed by evaporation using the radiation heat from oxidation zone. The temperature in this zone remains less than 120 °C.

Pyrolysis:

The process by which biomass loses all its volatiles in the presence of air and gets converted to char is called pyrolysis. At temperature above 200°C, biomass starts losing its volatiles. Liberation of volatiles continues as the biomass travels almost until it reaches the oxidation zone. Once the temperature of the biomass reaches 400°C,a self-sustained exothermic reaction takes place in which the natural structure of the wood breaks down. The products of pyrolysis process are char, water vapour, Methanol, Acetic acid and considerable quantity of heavy hydrocarbon tars.

Combustion:

The combustible substance of a solid fuel is usually composed of elements carbon, hydrogen and oxygen. In complete combustion carbon dioxide is obtained from carbon in fuel and water is obtained from the hydrogen, usually as steam. The combustion reaction is exothermic and yields a theoretical oxidation temperature of 1400 °C. The main reactions, therefore, are:

$C + O_2 = CO_2$ (+393 MJ/kg mole) (1) $2H_2 + O_2 = 2H_2O$ (-242 MJ/kg mole) (2)

Reduction:

The products of partial combustion (water, carbon dioxide and un-combusted partially cracked pyrolysis products) now pass through a red-hot charcoal bed where the following reduction reactions take place:

$C + CO_2 = 2CO$(- 164.9 MJ/kg mole)(3) $C + H_2O = CO + H_2$ H2 (- 122.6 MJ/kg mole) (4) $CO + H_2O = CO + H_2$ (+ 42 MJ/kg mole) (5) $CO_2 + H_2 = CO + H_2O$(+ 75 MJ/kg mole (6) $CO_2 + H_2 = CO + H_2O$(- 42.3 MJ/kg mole) (7)

Reactions (3) and (4) are main reduction reactions and being endothermic have the capability of reducing gas temperature. Consequently the temperatures in the reduction zone are normally 800-10000C. Lower the reduction zone temperature (~ 700-8000C), lower is the calorific value of gas.

Combustion: Steam Turbine System:

The combustion technology is similar to coal-based thermal power production technology, in which the biomass is burnt in the boiler and produce steam, which is used to drive a turbine to produce electricity. The extend of biomass-based combustion systems is low with only about 466MW installed until 2007. The typical size of these plants is ten times smaller (from 1 to100 MW) than coal-fired plants because of the limited accessibility of local feedstock and the high transportation cost. A few large-scale such thermal or CHP plants are in operation. The small size roughly doubles the investment cost per kW and results in lower electrical effectiveness compared to coal plants. Plant efficiency is around 30% depending on plant size. This technology is used to dispose of large amounts of residues and wastes (e.g. bagasse). Using high-quality wood chips in modern combined heat and power (CHP) plants with highest steam temperature of 540°C, electrical efficiency can reach 33%-34% (LHV) and up to 40% if operated in electricity-only mode. Fossil energy consumed for bio-energy production using agriculture and forestry products can be as low as 2%-5% of the final energy produced. Based on life-cycle assessment, net carbon emissions per unit of electricity are below 10% of the emissions from fossil fuel-based electricity. When using MSW, corrosion problems limit the steam temperature and decrease electrical efficiency to around 25%. New CHP plant designs using MSW are expected to reach 25%-30% electrical efficiency and above 85%-90% overall efficiency in CHP mode if good similar is achieved between heat generation and demand. Electricity generation from MSW offers a net emission saving between 725 and 1520 kg CO2/t MSW. reduction is even higher for CHP.

Co-Firing:

Biomass conversion into biogas can be either from fast thermo-chemical processes (e.g., pyrolysis1) which can produce biogas and other fuels, with only 2%-4% of ash, or from slow anaerobic fermentation - which converts only a fraction (50%-60%) of feedstock but produces soil conditioners as a by-product. The biogas can be used in combustion engines (10 kW to 10 MW) with efficiency of some 30%-35%; in gas turbines at higher efficiencies or in highly-efficient combined cycles. Biomass integrated gasification gas turbines (BIG/GT) are not yet in commercial use, but their economics is expected to improve. The first integrated gasification combined cycle (IGCC) running on 100% biomass (straw) has been successfully operated in Sweden. IGCC plants are already economically competitive in CHP mode using black-liquor from the pulp and paper industry as a feedstock. Other developments have brought Stirling engines and organic Rankine cycles (ORC) closer to the market whereas integrated gasification fuel cell plants (IGFC) still need significantly more R&D.

Two distinct techniques are available to co-fire bio- fuels in utility boilers:

1. direct co-firing, biomass fuels are blended with coal in coal yard and the blend is sent to the firing system Fig.1.4 and
2. Indirect co-firing, the biomass is prepared separately from the coal and injected into the boiler without impacting the coal delivery process Fig. 1.5. The first approach, in general, is used with less than 5 wt. % co-firing.

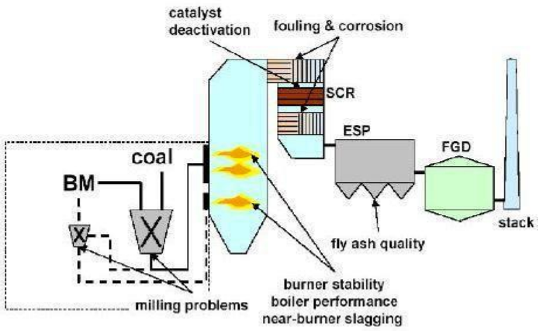


Figure.4. Direct Co-firing system

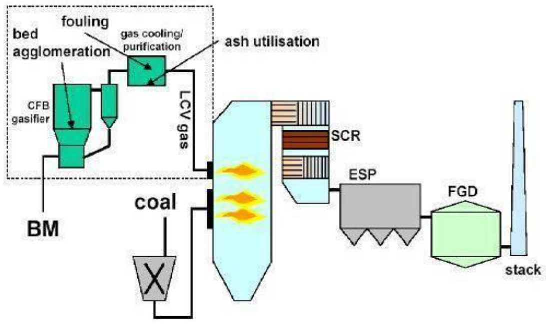


Figure.5. Indirect Co-firing system

Bio-methanation:

It is the technology of biogas (a mixture of 60% methane and 40% carbon dioxide gas) production through anaerobic fermentation of cellulosic materials, such as animal dung, plant and vegetable wastes, etc. (*Ravindranathand Balachandra, 2009*) and combustion of this gas for electricity generation. The anaerobic digestion of waste has the disadvantages of large installation cost, longer reaction time, high amount of water requirement and large area for installing the plant. Except for a few demonstration projects, hardly any potential has been exploited till now in India.

1.5- Feedstock & Process:

Biomass resources include woody, non- woody and animal manure, residues from food and paper industries, agricultural residues, wood wastes from industry and forestry, municipal wastes, sewage sludge, sugar crops (sugar cane, beet, sorghum), dedicated energy crops such as short-rotation (3-15 years) coppice (willow, eucalyptus, poplar), grasses (Miscanthus), oil crops (soy, sunflower, oilseed rape, jatropha, palm oil) and starch crops (corn, wheat). Residues and organic wastes have been the key biomass sources so far, but energy crops are achievement importance and market share. With re- planting, biomass combustion is a carbon-neutral process as the CO2 emitted has until that time been absorbed by the plants from the atmosphere. Residues, wastes, bagasse are primarily used for heat & power generation. Starch sugar, and oil crops are primarily used for fuel production. Cheap, high-quality biomass (e.g., wood waste) for power production may become limited as it is also used for heat production and in the paper industry and pulp industry. New resources based on energy crops have larger potential but are more costly. Fig.1.6 shows that different feedstock and different types of process for heat and power generation from biomass.

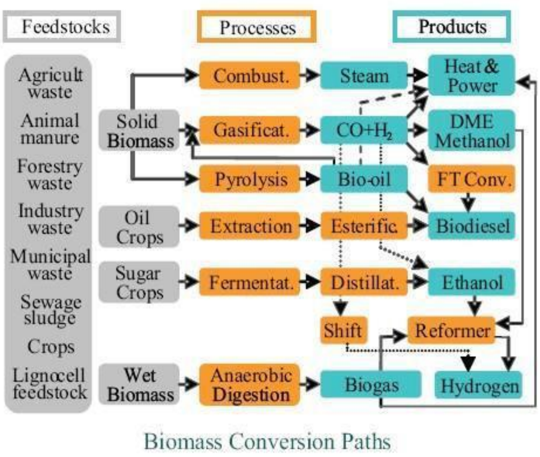


Figure.6. Feedstock & Processes

1.6- Biomass - A source of power generation in small scale industries

In India, there are over 11 million small-scale registered industrial units that provide employment to more than 27 million people (Kumar & Patel, 2008). They contribute to 40% of the country's industrial production and 34% of exports. A major number of these units require large quantities of electrical energy. The high cost of supply, which is mostly unpredictable and unreliable on account of scheduled / unscheduled power cuts, drives industries to invest in imprisoned power generation. As fossil fuels are limited and polluting, such order provides an attractive platform to renewable for providing different energy solutions to particularly small and medium enterprises, industrial and commercial establishments. Biomass energy systems can be deployed to meet power requirement in industries. Such electricity generation will help industries in becoming independent and relieve pressure on fossil fuels.

1.7Biomass environmental and climate change Benefits

Over the past few years, people throughout the world have become very much aware of the terms 'global warming' and 'greenhouse gases'. This has to do with what is going into the atmosphere and how it affects our way of life. When fossil fuels are burned they send carbon dioxide (CO2), sulphur oxides (SOx), NOx emissions and ash production into the atmosphere. It is believed that these emissions stay there for tens of thousands of years and are creating a barrier, which separates the earth from the sun. Reducing this threat to the atmosphere is one of the Environmental Benefits of Biomass. Environmentally, biomass has some advantages over fossil fuels such as coal and petroleum. Biomass contains little sulphur and nitrogen, so it does not produce the pollutants that cause acid rain. Growing plants for use as biomass fuels may also help keep global warming in check. That's because plants remove carbon dioxide--one of the greenhouse gases-from the atmosphere when they grow. The combustion (direct or indirect) of biomass as a fuel also returns CO2 to the atmosphere. However this carbon is part of the current carbon cycle: it was absorbed during the growth of the plant over the previous few months or years and, provided the land continues to support growing plant material, a sustainable balance is maintained between carbon emitted and absorbed. Biomass is practically free from sulphur, nitrogen and heavy metals (Hg, etc.) and has much lower ash content (1-3 wt. %) than coal (Kumar and Gupta, 1993). Hence, unlike fossil fuels, biomass use in electricity generation is not likely to pollute the atmosphere with SOx, NOx, SPM, etc.

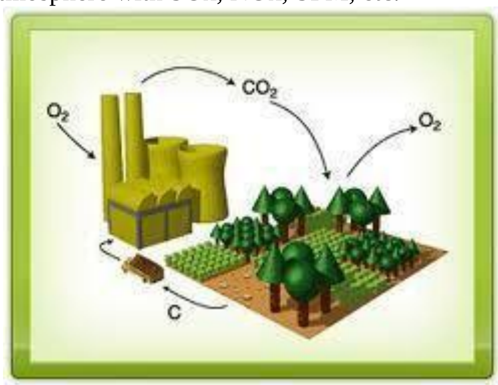


Figure.8. Carbon Cycle Diagram

1.8- Advantages of decentralised biomass power Generation systems

Electricity for lighting and development of small- scale industries, thus making the villagers / small industries self-dependent.

1. Growth of biomass occurs through photosynthesis reaction. Here, the biomass absorbs Carbon dioxide from the atmosphere and gives out oxygen. Thus the sustainable generation and use of biomass in power plants will definitely help in reducing carbon dioxide concentration in the atmosphere and thus the greenhouse effect.
2. In comparison to coal, the ash content in biomass is very less (2-6% approx. as against 20-50% in coal). Thus, the use of biomass in power generation will lead to substantial decrease in the amount of suspended particulate matters in the atmosphere.

4, Energy content in biomass is more than those of E and F grade coals (mostly exploited coals in Indian power plants). Reactivity of biomass towards oxygen and carbon dioxide is much higher than that of coal. This permits the operation of boiler at lower temperatures resulting in greater saving of energy.

5. Power generation on decentralized basis will reduce the transmission losses.
6. Feasibility of installation of biomass gasifiers in any location or village.
7. Easy availability of technology and backup systems.
8. Support for the domestic and industrial waste management projects.

1.9- Aims and objectives of the present project Work

Following are the aims and objectives of the present investigation:

1. Selection of non-woody biomass species and estimation of their yield by field trial.
2. Determination of proximate analysis (% moisture, % volatile matter, % ash and % fixed carbon contents) of their different components, such as wood, leaf and nascent branch.
3. Mixed these biomass components separately with coal sample in different-different ratio.
4. Characterization of these biomass components for their energy values (calorific values).
5. Characterization of coal mixed biomass components for their energy values (calorific values).
6. Determination of ash fusion temperatures (IDT, ST, HT and FT) of ashes obtained from these biomass species and coal-biomass mixed sample.

II. LITERATURE REVIEW

India's energy challenges are multi–pronged (*Ravindranath et al, 2009*). They are manifested through growing demand for modern energy carriers, a fossil fuel dominated energy system facing a severe resource crunch, the need for creating access to

3.2- Proximate analysis

Proximate Analysis volatile matter, consist of moisture, ash and fixed carbon contents determination were carried out on samples ground to - 70 mess size by standard method. The details of these analysis are asfollows; quality energy for the large section of deprived1- 1- Determination of Moisture population, local and global pollution regimes, vulnerable energy security, and the need for sustaining economic development. Renewable energy is considered as one of the most promising alternatives. Recognizing this potential, India has been implementing one of the largest renewable energy programmes in the world. In all of the renewable energy technologies, bioenergy has a large diverse portfolio including efficient biomass stoves, biogas, biomass combustion and gasification and process heat and liquid fuels. India has also formulated and implemented a number of innovative policies and programmes to promote bioenergy technologies. After all, according to some preliminary studies, the success rate is marginal compared to the potential available. This limited success is a clear indicator of the need for a serious reassessment of the bioenergy programme. Further, a realization of the need for adopting a sustainable energy path to address the above challenges will be the guiding force in this reassessment. In this paper an attempt is made to consider the potential of bio energy to meet the rural energy needs: (1) biomass combustion and gasification for electricity; (2) bio methanation for cooking energy (gas) and electricity; and (3) efficient wood-burning devices for cooking.

III. EXPERIMENTAL WORK

3.1- Selection of material

In this project work, two distinct types of non-woody biomass species Gulmohar (Local name: Krishnachura) and Cassia Tora (Local Name: Chakunda) where procured from the local area. These biomass species were cut into different pieces and there different component like leaf, nascent branch and main branch were separation from each other. These biomass materials were air-dried in cross ventilator room for approx 25 days.

Figure.10. Sample of biomass component, component Power and coal power

2- Determination of Ash Content

3- Determination of Volatile Matter 4- Determination of Fixed Carbon

3.3- Calorific value determination

The calorific values of these species (-72 mesh size) were measured by using an Oxygen bomb calorimeter (BIS, 1970, shown in Fig.3.3); 1 gm. of briquetted sample was taken in a nicron crucible. A 15 cm long cotton thread was placed over the sample in the crucible to facilitate in the ignition. Both the electrodes of the calorimeter were connected by a nicrom fuse wire. Oxygen gas was filled in the bomb at a pressure of around 25 to 30 atm. The water (2 lit.) taken in the bucket was continually starred to homogeneous the temperature. The sample was ignited by switching on the current through the fussed wire and the rise in temperature of water was automatically recorded. The following formula was used to determine the energy value of thesample. Gross calorific value (GCV) = {(2500 × ΔT) / (Initial wt. of simple) ─ (heat released by cotton thread + Heat released by fused wire)}

Figure.11. Briquetted Sample

Figure. 12. Oxygen Bomb Calorimeter (BIS,1970)

3.4- Ash fusion temperature determination

Ash fusion Temperature (Flow temperature, Hemispherical temperature and Softening Temperature) of all the ash samples, obtained from the presently selected non-woody biomass species and coal-biomass (in ratio) mixed sample were determined by using Leitz Heating Microscope (LEICA shown in Fig.3.4) in Material Science Centre of the Institute. The appearance of ash samples at IDT, ST, HT and FT are shown in Fig. 3.5

Figure.13. Leitz Heating Microscope

IV. RESULTS AND DISCUSSION

4.1- Proximate analysis of presently selected non- woody biomass plant components and coal biomass mixed briquettes

Freshly chopped non-woody biomass components have a large amount of free moisture, which must be removed to decrease the transportation cost and increase the calorific value. In the plant species selected for the study, the time required to bring their moisture content into equilibrium with that of atmosphere was found to be in the range of 15 to 20 days during the summer season (temperature: 35-45°C and moisture: 6-14%), Because are giving an approximate idea about the energy values and extent of pollutants emissions during combustion, the studies of the proximate analysis of fuel /energy sources are important. The proximate analysis of different components of Gulmohar and Cassia Tora plant and these biomass species component briquettes with coal are presented in Tables 4.1. Proximate analysis's data of the components of these species are very close to each other. However, it appears from these tables that Cassia Tora biomass species has somewhat higher ash and lower fixed carbon contents than these of Gulmohar biomass species and the ash contents being more and volatile matter is less when 90% coal mixing with 4% biomass and 85% coal mixing with 8% biomass but when 80% coal mixing with 10% biomass and 80% coal mixing with 20% biomass then ash content is being less and volatile matter is more.

4.2- Calorific values of presently selected non- woody biomass plant components

The calorific values(CV) of the fuels or energy source are important ideals for judging its quality to be used in electricity generation in power plants. It provides an idea about the energy value of the fuel and the amount of electricity generation. Calorific value of coal mixed Gulmohar biomass (different component in different ratio) were found to be higher than that of coal mixed cassia tora biomass (different component in different ratio).Amongst the four different ratios, ratio 80:20 gives the highest energy value in all mixed component and 85:15 also gives higher energy value except leaf component of both biomass in respect to other two ratios (95:05 and 90:10).

4.3- Ash fusion temperature of presently studied non-woody biomass plant components and species

Ash fusion temperature of solid fuel is an important parameter affecting the operating temperature of boilers. It also experimentally finds out the ash fusion temperatures to confirm its safe operation in the boiler. Clinker creation in the boiler usually occurs due to low ash fusion temperature and this hampers the operation of the boiler. Hence the study of the ash fusion temperature of solid fuel is essential before its operation in the boiler. The four specialty of ash fusion temperatures were analyzed as: (1) initial deformation temperature (IDT) – first sign of change in shape; (2) softening temperature (ST) – rounding of the corners of the cube and shrinkage; (3) hemispherical temperature (HT) – deformation of cube to a hemispherical shape; and (4) fluid temperature (FT) – flow of the fused mass in a nearly flat layer. The shapes of the initially taken cubic ash samples at IDT, ST, HT and FT are shown in Fig. 3.3. Identical shapes at these temperatures were obtained for all the studied non-woody biomass species like Gulmohar, cassia tora and coal mixed these biomass. Data for the ash fusion temperatures (IDT, ST, HT and FT)

4.4- Electricity generation system

The biomass based electricity generation method is outlined in Figure 1.6 freshly cut wood holds a large amount of moisture, which must be removed to decrease the transportation cost and to increase the energy density (i.e. calorific value). The carbonization of biomass yields charcoal as main product and generates a large amount (approximately 60- 70 % of the weight of biomass) of volatile matter (pyrolytic gas). For the biomass energy system to be competitive and to increase energy conversion efficiency, technologies available for promoting power generation from biomass are gasification, combustion, co-combustion and bio-methanation. The pyrolytic gas should also be combusted to generate electricity. The ash obtained would be transported back to the plantation centre and used as a fertilizer, or it could be utilized as building material.

4.5- Proximate analysis and calorific value of different components of non-woody biomass species and coal

The results obtained from proximate analysis and calorific value of non-woody biomass species, coal, coal-biomass mixed briquettes and Ash fusion temperatures of selected biomass species and coal- biomass mixed (in ratio) during the course of this project work have been summarized in presented graphically in Figs. 4.1-4.2.

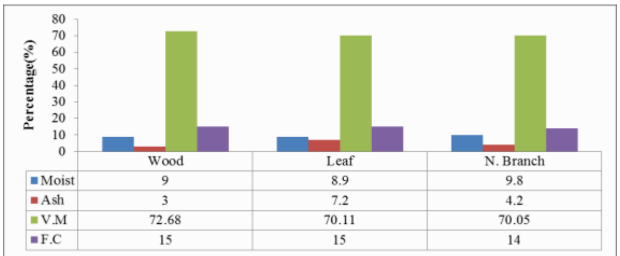


Fig. 4.1: Variation of Proximate Analysis of Gulmohar Biomass

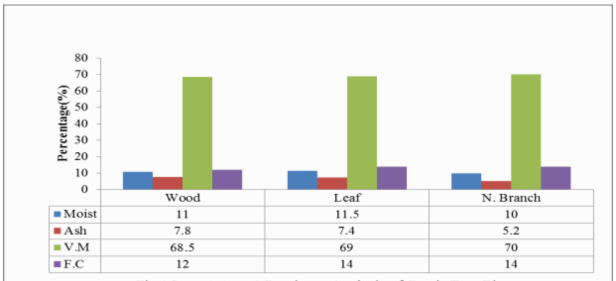


Fig.4.2: Variation of Proximate Analysis of Cassia Tora Biomass

4.6- Calculations

Table.1. Total Energy Consists and Power Generation Structure from 8 Months old (approx.), Gulmohar Plants

Component	Calorific Value (kcal/t, dry basis)	Biomass Production (t/ha, dry basis)	Energy Value (kcal/ha)
Main wood	4532 × 103	21.00	95172 × 103
Leaf	3907 × 103	7.00	27349× 103
Nascent branch	3997 × 103	9.50	37971.5 × 103

Energy Calculation:

On even dried basis, total energy from a hectare of land = (95172×27249×37971.5) ×10^3
= 160492.5×10^3 kcal

It is assumed that conversion efficiency of wood fuelled thermal generators = 26%
Mechanical efficiency of the power plant = 86%

Energy value of the total functional biomass obtained from one hectare of land at 27%conversion efficiency of thermal power plant
= 160491.5 ×10
= 41728.05× 10^3

Land required to supply electricity for entire year
$= 73\times10^5 / 41242.38$
= 177 hectares

V. CONCLUSIONS

In the present work two non-woody biomass species Cassia Tora were selected and Gulmohar. Experiments to determine the proximate analysis, calorific values and ash fusion temperature was done on each of the components of the selected species such as main wood; leaf and nascent branch were performed. Calculation was done to analyse how much power can be generated in one hectare of land from each of these species. The following are the different conclusions drawn from the present work:

(1)- Both plant species (Cassia tora and Gulmohar) showed almost the similar proximate analysis results for their components.

(2)-The non-wood biomass species showed highest energy values for their branch, followed by wood, leaf and nascent branch.

(3)-In the both biomass species Gulmohar has the highest energy value compared to Cassia tora.

(4)-Amongst the four different ratio, ratio 80:20 gives the highest energy value compared to 95:05, 90:10, 85:15.

(5)-Energy values of coal mixed Gulmohar biomass component were found to be little bit higher than as compare to coal mixed Cassia Tora biomass component.

(6)-Calculation results have established that nearly 177 and 872 hectares of land would be required for continuous generation of 41242.38 kWh per hectares from Gulmohar and 8371.05 kWh per hectares from Cassia tora biomass species.

(7)-The ash fusion temperature of all the species are coming beyond the range of boiler operation, this would avoid clinker formation in the boiler.

(8).This study could be positive in the exploitation of non-woody biomass species for power generation.

5.1- Scope for future work

The present study was concentrated on two non- woody biomass species such as Cassia Tora and Gulmohar. The under mentioned works are suggested to be carried out.

1. Similar type of study need to be extended for another non-woody biomass species available in the local area.
$= 160491.5 \times 10$
$= 41728.05\times 10^3$
$\times$ 0.25 with sewage wastes, cow dunk etc.

2.Pilot plant study on laboratory scale may be carried
$= 41728.05\times10^3 \times4.186\div 3600$
= 48520.45 kWh
Power generation at 85 % mechanical efficiency
$= 48520.45 \times0.85$
= 41242.38 kWh/ha
out to generate electricity from biomass species.

3. In these powdered samples of biomass species may be mixed with cow dunk and the electricity generated potential of the resultant mixed briquettes may be studied

4. New techniques of electricity generation from biomass species may be developed

VI. REFERENCES

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