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SURVEY ON POWER GENERATION POTENTIAL OF NON-WOODY BIOMASS AND COAL-BIOMASS MIXED BLOCKS

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Abstract: With the development in technology the power consumption is rising gradually. This necessitates that in addition to the obtainable source of power such as coal, water, petroleum etc. other sources of energy should be searched out and new and more efficient ways of producing energy should be devised. Power generation from biomass becomes attractive way for energy generation due to their high energy potential and less pollutants. In this paper we present the study and literature survey on power generation of biomass.
Keywords: Biomass, coal-biomass briquette, proximate analysis, calorific value, energy value.

I. INTRODUCTION

Today fossil fuels such as oil, coal and natural gas represent the prime energy sources in the world (approximately 80% of the total use). However, it is anticipated that these sources of energy will be at a low level within the next 40–50 years[14]. In the renewable energy scenario dominated by solar, wind and micro/mini hydel, biomass is beginning to look promising in the view of new emerging technologies. The renewable energy sources Biomass provides both, thermal energy as well as reduction for oxides. Biomass being a product of natural resources viz. land, water, air and sun's energy, gives much hope as an alternative, reliable and renewable source of energy. Biomass is an organic matter produced by plants, both terrestrial and aquatic and their derivatives [12]. The two different types of non-woody biomass species are taken, one is Cassia Tora (Chakunda) and another is Gulmohar (Krishnachura).These biomass species were cut into small 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 around 20 days. When the moisture contains of these air-dried biomass sample came in balance with that of the air, they were crushed in mortar and pestle into powder of -72 mess size. The sample of Coal for making the blend was collected from coal mines. These materials were than processed for the determination their proximate analysis and Energy values.

II. ENERGY GENERATION FROM BIOMASS

A brief description of the technologies for energy generation from biomass is as follows:

A. Combution

In this process, biomass is directly burned in presence of excess air (oxygen) at high temperatures (about 800°C), liberating heat energy, inert gases, and ash. Combustion results in transfer of 65%–80% of heat content of the organic matter to hot air, steam, and hot water. The steam generated, in turn, can be used in steam turbines to generate power.

B. Transesterification

The traditional method to produce biodiesel from biomass is through a chemical reaction called transesterification. Under this method, oil is extracted from the biomass and it is processed using the transesterification reaction to give biodiesel as the end-product.

C. Alcohlic fermentation

The process of conversion of biomass to bio-fuels involves three basic steps:

- Converting biomass to sugar or other fermentation feedstock
- Fermenting these biomass-derived feedstock using microorganisms for fermentation.
- Processing the fermentation product to produce fuel-grade ethanol and other fuels.

C. Anaerobic Digestion

In the absence of air, organic matter such as animal manures, organic wastes and green energy crops (e.g. grass) can be converted by bacteria-induced fermentation into biogas (a 40%-75% methane-rich gas with CO2 and a small amount of hydrogen sulphide and ammonia). The biogas can be used either for cooking/heating applications, or for generating motive power or electricity through dual-fuel or gas engines, low-pressure gas turbines, or steam turbines.

D. Pyrolysis

Pyrolysis is a process of chemical decomposition of organic matter brought about by heat. In this process, the organic material is heated in absence of air until the molecules thermally break down to become a gas comprising smaller molecules (known collectively as syngas). The two main methods of pyrolysis are "fast" pyrolysis and "slow" pyrolysis. Fast pyrolysis yields 60% bio-oil, 20% bio-char, and 20% syngas, and can be done in seconds. Slow pyrolysis can be optimized to produce substantially more char (~50%) along with organic gases, but takes on the order of hours to complete.

E. Gasification

In this process, biomass reacts with air under extreme temperatures and results in production of producer gas, to produce power (or) react with pure oxygen to produce synthesis gas for fuel production. The combustible gas, known as producer gas, has a calorific value of 4.5 - 5.0 MJ/cubic meter. A wide range of biomass in the form of wood or agro residue can be used for gasification [14].

III. LITERATURE SURVEY

Gulab Chand Sahu et al. [2013] have present environmental problems associated with the use of fossil fuels (coal, petroleum and gas) in power production, deeply attention is being paid world-over by the scientists and technocrats for the utilization of renewable energy sources in power production, metallurgical industries etc. There are different types of renewable energy sources like solar, wind, hydropower, biomass energy etc. In all of renewable energy sources, biomass is more reasonably feasible for almost all the continents in the world. Biomass is provided both the thermal energy and reduces oxides, where as other renewable energy sources can fulfill our thermal need only. It is a carbonaceous material. Biomass is the purest fuel consisting of very lesser amount of ash materials. The power production potential data for renewable energy sources in India clearly indicates that the biomass has potential to generate more than17000 MW of electricity per year in India. In the present work, briquettes were prepared by mixing non-coking coal from Orissa mines and the related biomass species in different ratio (coal: biomass = 95:05, 90:10, 85:15, 80:20). The objectives have been to examine their energy values and power production potential.[17]

T.T. Al-Shemmeri et al. [2015] In this paper, the authors attempt to investigate the performance of a small-scale biomass combustor for heating, and the impact of burning different biomass fuels on useful output energy from the combustor. The test results of moisture content, calorific value and combustion products of various biomass samples were presented. Results from this study are in general agreement with published data as far as the calorific values and moisture contents are concerned. Six commonly available biomass fuels were tested in a small-scale combustion system, and the factors that affect the performance of the system were analysed. In addition, the study has extended to examine the magnitude and proportion of useful heat, dissipated by convection and radiation while burning different biomass fuels in the small-scale combustor. It is concluded that some crucial factors have to be carefully considered before selecting biomass fuels for any particular heating application[6].

Xiang Liu et al. [2015] are present the significant differences between combustion kinetics of bituminous coal and biomass. The blending ratios and the heating rates had certain effect on the mechanisms of switch grass/coal blends at pre-peak. The dominant mechanisms associated with co-combustion kinetics for beetroot/coal at pre-peak and post-peak were described by the Avramierofeev equations. The mechanisms of co-combustion for switch grass/coal samples at pre-peak were described by the Avramierofeev equation, Z–L–T equation or Anti Jander equation; however, at post-peak, their mechanisms were described by the Avramierofeev equation. The general kinetic compensation effect correlations were deduced for all samples within the heating rates of 10–90 C/min [15].

Nathan C. Crawford et al. [2015] Due to its low density and poor flow ability, raw biomass may not be an economically viable feedstock for the production of bio-fuels. However, mechanical densification can be employed to improve its viability. In this study, the flow properties (compressibility, shear, and wall friction) of ―pure feed stocks (corn stover, hybrid poplar, switch grass and Miscanthus), and feedstock blends, were investigated and compared to measured pelleting energy consumption values. As anticipated, the more compressible materials required lower pelletization energies. Conversely, the less flow able feed stocks (i.e., the materials with higher cohesion and yield strength) were less energy intensive to pellet. In addition, the flow ability parameters of the blended materials were predicted by averaging the measured flow parameters of their pure feedstock constituents. Strong correlation was observed between the measured pelleting energy consumption and the predicted pelleting pressure values. This newly developed model allowed for a material's pelleting feasibility [16].

Stanislav V. Vassilev et al. [2015] An extended overview of the advantages and disadvantages of biomass composition and properties for biofuel application was conducted based on reference peer-reviewed data plus own investigations. Initially, some general considerations and comparisons about composition and properties of biomass and coal as the most popular solid fuel were addressed. Then, some of the major advantages related to the composition and properties of biomass and/or biomass ash (BA) were discussed. They include: (1) high values of volatile matter, H, structural organic components, extractives and reactivity of biomass, water-soluble nutrient elements and alkaline-earth elements in biomass and BA, and pH of BA; and (2) low values of C, fixed C, ash, N, S, Si and initial ignition and combustion temperatures of biomass, and low contents of many trace elements including hazardous ones in biomass and BA. Further, some of the major disadvantages connected with the composition and properties of biomass and/or BA are described. It was found that the disadvantages of biomass for biofuel and biochemical applications prevail over the advantages; however, the major environmental, economic and social benefits appear to compensate the technological and other barriers caused by the unfavorable composition and properties of biomass [13].

C. Antwi-Boasiako et al. [2016] Due to survey Agricultural and wood residues are principal energy sources for domestic and industrial activities. However, they are often hardly utilized. Conventional wood material for briquetting optimizes combustion and efficient power production. The relationship between strength properties, resistance to humidity and calorific values of sawdust-briquettes from three tropical hardwoods of different densities Enormous briquette Swelling Values for A. toxicaria (60.04%), Mixed type (66.16%) and C. pentandra (70.88%) indicate they would deteriorate fast and require great care to store, handle and transport. However, the large Shatter Indices for the mixed type (98.8%) and C. pentandra (99.16%) denote their high durability to gravitational deterioration. Briquette technology, a ―waste-to-energy method, contributes to offset bio-residue management problems and reduce toxic emissions from its incomplete carbonization. Thus, comprehensive understanding of wood-residue briquette characteristics was significant for fuel-energy generation [9].

Haiping Yang et al. [2016]. To introduce application status and illustrate the good utilization potential of biomass paralytic poly generation using retort reactors, the properties of major products and the economic viability of commercial factories were investigated. The capacity of one factory was about 3000 t of biomass per year, which was converted into 1000 t of charcoal, 950,000 Nm3 of biogas, 270 t of woody tar, and 950 t of woody vinegar. Charcoal and fuel gas had LHV of 31 MJ/kg and 12 MJ/m3 commercial fuels. The woody tar was rich in phenols, while woody vinegar contained large quantities of water and acetic acid. The economic analysis showed that the factory using this technology could be profitable, and the initial investment could be recouped over the factory lifetime. This technology is promising means of converting abundant agricultural biomass into high-value products, respectively, indicating their potential for use as commercial fuel [10].

IV. RESULT AND DSCUSSION

In 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 present study, the time required to bring their moisture contents 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 humidity 12-25 %). [16]. the studies of the proximate analysis of fuels /energy sources are important because they give an approximate idea about the energy values and extent of pollutants emissions during combustion. The proximate analysis of different components of plant and these biomass species component blocks with coal are presented. The components of these species are very close to each other and hence it is very difficult to draw a concrete conclusion. However, it appears from these biomass species has somewhat higher ash and lower fixed carbon contents than these of biomass species and the ash contents being more and volatile matter is less when 95% coal mixing with 5% biomass and 90% coal mixing with 10% biomass but when 85% coal mixing with 15% biomass and 80% coal mixing with 20% biomass then ash content is being less and volatile [17,19] matter is more due to literature review.

V. CONCLUSION

In this paper we present the review work two non-woody biomass species. 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. Estimation 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 literature survey work: Some species showed almost the similar proximate analysis results for their components, the ash contents being more in their leaves and volatile matter content less in coal. The non-wood biomass species showed highest energy values for their branch. Both biomass species has the highest energy value compared to other. 80:20 [18] of coal and biomass ratio gives the highest energy value compared to other.

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