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Assessment of the Power Potential of Agricultural Biomass- A Review

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Abstract

In the current scenario researchers and analysts are looking for a new source of energy which is easily available and having a great potential to fulfil the requirement of power or electricity.In most of the rural areas there is a lack of energy supply or say that there is no source of electricity to fulfil their needs and help them to develop and enhanced their amenities. In present scenario biomass is the largest source of energy in world and first in India. Due to depletion of conventional sources at high rate, the non conventional sources like biomass energy is used. Biomass energy has several advantages over conventional sources of energy. Many authors studied about the biomass energy and their use in power generation. The objective of this paper is to review some of the literatures survey related to biomass potential to identify the possibilities of finding the source of energy to fulfill their needs .

Keywords: Biomass, Conventional energy source, Non conventional energy source, power generation

Introduction

Fossil fuel reserves are very limited in nature and these reserves are expected to last up to 100 years more. Thermal power plants produce a large amount of pollutants, such as carbon dioxide, sulphur oxides, fly ash, etc which are hazardous for human survival on the earth planet. Hence, scientists and technocrat's world-wide are in search of alternative sources of energy whose exploitation is not harmful for the human beings. There are many alternative sources of energy including Biomass.

Due to fast depletion of fossil fuel resources for power generation and growing concern over the environmental degradation caused by conventional power plants, power generation from biomass is becoming attractive throughout the world. Sustainable production and utilization of biomass in power generation can solve the vital issues of atmospheric pollution, energy crisis, wasteland development, rural employment generation and power transmission losses. Thus, the development of biomass-based power generation system is thought to be favorable for majority of the developing nations including India. Besides electricity supply to the national power grids, biomass offers giant opportunities for decentralized power generation in rural areas at or near the points of use and thus can make villagers/ small industries self dependent in respect of their power requirements.

To exploit biomass species in electricity generation, characterization of their various properties like energy values, chemical compositions, reactivities towards oxygen, bulk densities, etc. is essential. The present project work deals with the studies on energy value of different components of agricultural biomasses and their impacts on power generation.

Biomass Potential in Power Generation

Biomass resources are undoubtedly the world's largest and most sustainable energy sources for power generation in the 21st century.[1] Table 1 indicates that the annual sustainable world-wide biomass energy potential; is about 104 EJ/a.[2] The share of non-woody biomass is about 60%. Large potentials of non-woody biomass are available in Latin America, Africa and Asia.[3]

Table 1: Biomass energy potentials and current use in different regions (Parikka, 2003)

Region	Biomass energy potentional (EJ/a)		Use (%)
	Woody	Non-Woody	
North America	12.8	7.1	16
Latin America	5.9	15.6	12

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Asia	7.7	13.7	108
Africa	5.4	16	39
Europe	4	4.9	22
Formar USSR	5.4	4.6	5
Middle East	0.4	0.3	7
World	41.6	62.2	38
Non woody biomass= energy cropes + strows+ others [EJ= 10^{18} J]			

In Table 2, the estimated power generation potentials of renewable energy sources in India have been outlined that the power generation capacity of biomass is considerably greater in the world including India.[4]

Table 2*: *Electricity generation potentials of renewable energy sources in India (Renewable energy statistics, 2005)

Source	**Estimated potential (MW)**	**Cumulative Installed capacity (MW)**
Wind energy	45000	4434
Biomass energy	16000	376
Bagasse	3500	491
Small hydro (up to 25 MW)	15000	1748
Waste-to-energy	2700	45.76
Solar photovoltaic	20 MW/Km^2	2.8

The U.S. based economy uses biomass-based materials as a source of energy in many ways. Wood and agricultural residues are burned as a fuel for cogeneration of steam and electricity in the industrial sector. Biomass is used for power generation in the electricity sector and for space heating in residential and commercial buildings. Biomass can be converted to a liquid form for use as a transportation fuel, and research is being conducted on the production of fuels and chemicals from biomass. Biomass materials can also be used directly in the manufacture of a variety of products. In the electricity sector, biomass is used for power generation. The Energy Information Administration (EIA), in its projects reveals that biomass will generate 15.3 billion kilowatt hours of electricity, or 0.3 percent of the projected 5,476 billion kilowatt hours of total generation, in 2020.

Literature reviews

V. Alderucci et al (1993) have developed a methodology Based on an analogous biomass energy evaluation of the Hawaiian Islands for assessing the biomass resource potential of Sicily was described The methodology features describes the land availability and land suitability criteria for evaluating biomass productivity potential, biomass energy plantation species and site selection, and plantation management strategy. A technical and economic comparison of two biomass-conversion technologies for generating electric power, non-catalytic biomass gasification coupled with a combined-cycle gas turbine and catalytic biomass gasification coupled with a molten-carbonate fuel cell, was presented. Analytical results shows that of Sicily's 236 × 10^6 GJ total annual energy requirement, approximately 50% or 120 × 10^6 GJ could be supplied with biomass resources, including all of the 13 300 × 10^6 kWh of electricity through an installed capacity of 2000 MW of electricity. By switching to indigenous, renewable biomass energy resources to enhance energy security, the 'greening' of Sicily's electrical-power production system can be implemented at a cost of approximately 3400 million ECU in capital costs and 990 million ECU in total annual expenses.[5]

Lynn Wright (2006) have made an assessment on development of bio energy with a focus on energy crop based projects worldwide**.**In this study it was found that the Bio energy consumption is greatest in countries with heavy subsidies or tax incentives, such as China, Brazil, and Sweden. Conversion of forest residues and agricultural residues to charcoal, district heat and home heating are the most common forms of bioenergy. Biomass electric generation feed stocks are predominantly forest residues (including black liquor), bagasse, and other agricultural residues. Bio fuel feedstock's include sugar from sugarcane (in Brazil), starch from maize grain (in the US), and oil seeds (soy or rapeseed) for biodiesel (in the US, EU, and Brazil). Of the six large land areas of the world reviewed (China, EU, US, Brazil, Canada, Australia), total biomass energy consumptions amounts to 17.1 EJ. Short-rotation woody crops (SRWC) established in Brazil, New Zealand, and Australia over the past 25 years equal about 50,000 km^2. SRWC plantings in China may be in the range of 70,000–100,000 km^2.[6]

Jane Hughes Turnbull (1993) have the considered the performance and characteristics of various power plant (46 Nos) located in central and western California. These power plants generating electric power from steam turbine by using heat energy from wood wastes and agricultural residues. The aim of the research was to made an assessment of power plants having capacity of 750 MW, Which was run by using biomass as a fuel and providing power to PG and E grid .the power plant used heat energy to run steam turbine from biomass such as

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saw dust or pulp process wastes, hog fuel in forest thinning, clean land filled wood, vineyard wastes and other agricultural residues. These plants consumes more than 7 million bone dry tons(BDT) of fuel each year in which about 1 BDT is used to generate 1MW with an overall efficiency of 20%.[7]

Saroj Kumar Patel et al (2010) have made an proximate analysis on different components of maize crop residue to evaluate its calorific value .In this analysis the power generating capacity of plants run on biomass fuel energy corresponding to the space requirement was calculated. It was found that an approximate 1100 hectares of land area are required to generate 20 MW hour per day of electricity .In this research the results available from the comparison in between coal sample (6 Types) and maize residues being used in thermal power plants reveals the maize waste can be used to generate considerable amount of power output with negligible emission of suspended particulate matters. It was also found from experimental results that ash produce from the combustion of maize waste can be safely used up to a temperature of 800℃. without any clinker formation in boiler.[8]

N.H Ravindranath et al (2005) have discussed the potential of energy from crop residues ,animal manure,MSW,industrial waste water and biomass fuels that can be conserved for other applications through efficiency improvement. The total potential energy from these resources was estimated to be approximately equivalent to 5.14 EJ, which amounts to a little more than a one-third of the total fossil fuel in india.The energy potential in 2010, was estimated to about 8.26 EJ.[3]

Experimental work

Proximate Analysis

Analysis for moisture, volatile matter, ash and fixed carbon contents were carried out on samples size by standard method. The details of these tests are as follows.[9]

(1) Moisture Determination

One gram of air dried powdered of sample size was taken in a borosil glass crucible and kept in the air oven maintained at the temperature 130˚C.The sample was soaked at this temperature for one hour and then taken out from the furnace and cooled in a dessicator. Weight loss was recorded using an electronic balance. The percentage loss in weight gave the percentage moisture content in the sample.

(2) Volatile Matter Determination

One gram of air dried powdered sample of sample size was taken in a volatile matter crucible (made of silica) and kept in the furnace maintained at the required temperature of 855˚C.The sample was soaked at this temperature for ten minutes and then crucible was taken out from the furnace and cooled in air. Weight loss in the sample was recorded by using an electronic balance. The percentage loss in weight – moisture present in the sample gives the volatile matter content in the sample.

(3) Ash Content Determination

One gram of air dried powdered sample of sample size was taken in a shallow silica disc and kept in the furnace maintained at the temperature of 715-760˚C.The sample was kept in the furnace till complete burning. Weight of ash formed was noted down and the percentage ash content in the sample was determined.

(4) Fixed Carbon Determination

The fixed carbon content in the sample was determined by using the following formula: Fixed Carbon Content (Wt. %) =100-Wt %(Moisture + Volatile matter + Ash)

Ash Fusion Temperature Determination

The ash fusion Temperature, softening Temperature, Hemispherical temperature and Flow temperature of all the ash samples will be obtained from the selected biomass species were determined by using Leitz Heating Microscope (LEICA).

Calorific Value Determination

The calorific values of the biomass samples were measured in a Bomb calorimeter apparatus . In this test an over dried sample briquette of weight 1gm (approx.) was taken in a bomb and oxygen gas was filled into this bomb at a pressure of 25-30 atm. The sample was then fixed inside the bomb and rise in temperature of water was noted with the help of Beckman Thermometer. The calorific value was calculated by using the following formula:

Gross Calorific value = (W.E X Δ T) / Wo – (fuse wire + thread connections)

Where,

W.E = water equivalent of the apparatus

ΔT = Maximum rise in temperature in ˚C.

Wo = Initial weight of briquette sample

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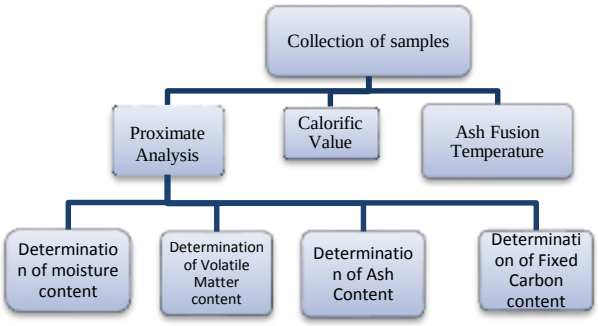
Proposed work plan



Conclusion

From the literature survey it was found that a lot of research has been carried out to find out the new source of energy for power generation with have a great power potential and easy availability. The aim of study is to find out the new renewable source of energy with high power potential to satisfy the upcoming energy requirement due to increase of population and industrial development and also lack of energy availability in rural areas.Biomass is the first energy source in india which currently provides nearly one-third of the energy needs in india, the largest portion of the energy is used in cooking and water- heating due to depletion of conventional energy resources biomass energy source is found the best option to use and fulfilling the energy needs .

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