Bio-Mass as Renewable Power

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***Abstract*- Fossil fuel consumption should be reduced for three main reasons, to save human health, climate change and energy security. Combustion of fossil fuels leads to exhaust of carbon gases and other greenhouse gases which are harm to humans as well as nature. Electricity in modern days have not just become necessary to urban countries but also under developed countries. Now a days power is generated using fossil fuels, such as coal as in thermal power plant. But along with efficient electric generation it also leads to exhaust of harmful and adverse pollutants which causes harm to living beings considering these aspects it has become necessary for major countries to adopt one of the most popular way of power generation, Biomass(Bio-power). This method of generation utilizes varieties of biomass to derive power**

Index terms- Bio power council in India, combined power, case study

I. INTRODUCTION

Present primary energy use in India is dominated by fossil fuels (40%), 59%energy production is done by coal (IEA 2017). The rising energy demand will not only increase the demand for fossil fuel and coal but will also lead to increase in greenhouse emission and gases. While looking at reduce use of fossil fuel, India faces a tough task in meeting energy need. India has its 70% of rural population which uses 40% of electric power

India has largest capability of adopting and to make optimum use of renewable natural resources. India with other countries has given indication for first time to reduce GHE (Greenhouse emissions) , as is evident in Cancun Climate Agreement 2010

The market for renewable system in India is growing exponentially. Of this 90% rural energy need and 40% urban energy is met by bioenergy. Despite this bioenergy is classified into 'non-commercial' energy. While India has progressed well in initiating the use in renewable resource with 2% (1628MW) of power in 2002 increasing to 11% (18,115MW) of power in 2010.

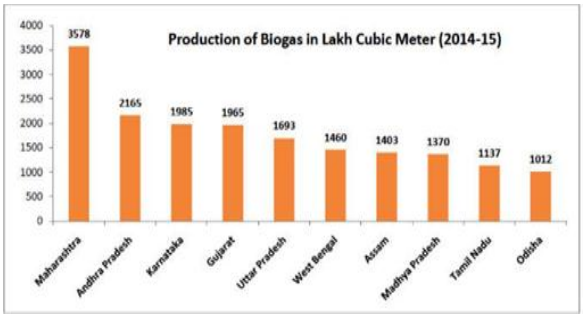
Bio-energy is one of such sustainable power generation resource which is encouraged by maximum population in rural areas of India as it constitutes of major energy source to majority households in India. Bio-energy is generated from biomass. This biomass can be used to generate heat and power which is used in combined power generation plant.

Indian government is promoting the use of bio-energy in rural areas for this these is established BIO-ENERGY COUNCIL (BECI). To promote and co-ordinate promotion of bio-energy industries in India. As 2010 the total power generation using biomass is 2559MW to rise to 20GW in following future

To promote the development and deployment of Bio-Energy in India, Government of India has established Bio-energy council as a clean and sustainable energy resource that addresses countries need for energy along with helping to combat the twin issue of global warming and energy security. On global scale, biomass supplies 1% of electricity demand i.e. 257TWH per year (IAE, 2009).

The main objective of Bio Energy Council (BECI):-

- Bio-Energy friendly policies
- Collaborating with research and other academic institution
- serving as the one point expert source on bio energy for policy makers and financial industries



Dia-1

The graph above shows production and installed capacity of bio energy in India. The government provides one time capital subsidy based on installed capacity of project the entire capital subsidy is then released to lead bank/ leading financial institution for giving loan amount after commission project design. The current availability of biomass is about 500million tones per year which correspond to about potential of18000MW. With addition to this 5000MW of power can be generated in surplus from this biomass. Currently biodiesel is not sold in market on commercial basis but government plan to meet 20% need into bio-diesel In last six decades the use of electrical energy in India has increased to 16 times , installed electric capacity by 84 times in 2008 India was 5th largest in use of energy in world still India suffers from electrical scars city

Table below shows the state-wise potential of biomass power in India. Pujab has the maximum potential of biomass power of about 3172MW followed by Maharastra of about 1887MW

TABLE-1

S. No.	State	Power Potential (MW)
1	Punjab	3172
2	Maharashtra	1887
3	Uttar Pradesh	1617
4	Madhya Pradesh	1364
5	Haryana	1333
6	Gujarat	1221
7	Karnataka	1131
8	Tamil Nadu	1070
9	Kerala	1044
10	Rajasthan	1039
11	Bihar	619
12	Andhra Pradesh	578
13	West Bengal	396
14	Odisha	246
15	Chhattisgarh	236
16	Assam	212
17	Himachal Pradesh	142
18	Jharkhand	90

State Electricity Regulatory Commission has undertaken the preferential tariff and Renewable purchase standard at state level. Various states have undertaken various obligations in range of 08%-13% of total electricity supplied in state

II. BIO-ENERGY MECHANISM

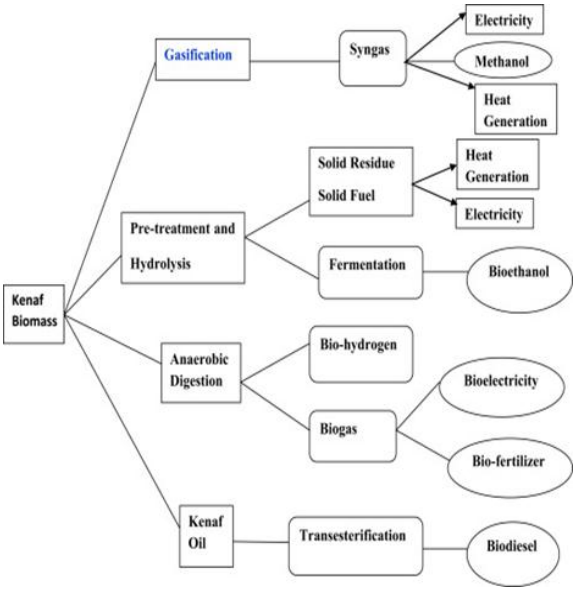
The steps for bio power generation are

- Combution
- Payrolysis
- An-aerobic digestion
- Fermentation
- Trans-electrification

These are the basic steps involved in bio-energy production. Further these gases not only produce electricity and heat but along with that it also produces usefull gases such as methonol, natural-gas which is further treated in making LPG

An-aerobic digestation further creats bio-dieselk and used in bio-fertilizers. Now a days bio-energy plants are connected in combination with refinaries. These refineries are in constant need for heat which is used for refining of oila and crude, therefore the heat generated is sent to these refinires for crude refining.

TABLE-2



The first and fore-most step for bio-energy generation is to collect feed-stock matter (woody biomass house-hold waste residue &waste) which is composted in digester the following process is processed further:

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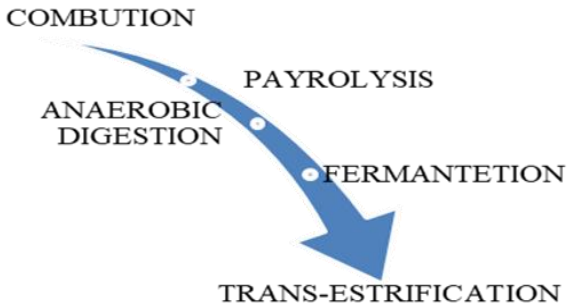

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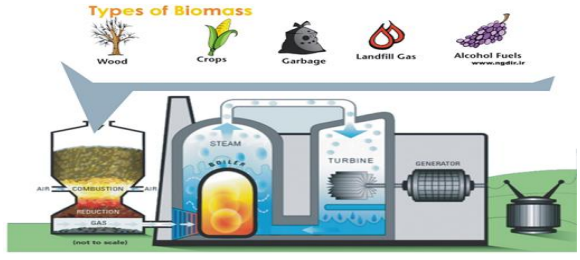
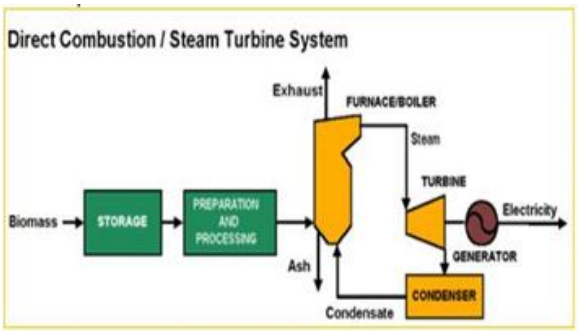


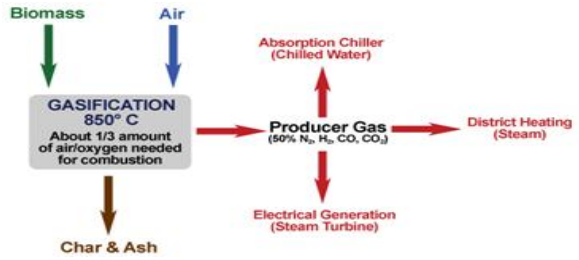
A. COMBUTION

This is perhaps the simplest method of extracting energy from biomass. Industrial biomass combustion facilities can burn many types of biomass fuel. Biomass fuel include wood, agriculture residues, wood pulping liquid, municipal solid waste and refuse derived fuel. Biomass is burned to produce steam, the steam turns a turbine and the turbine drives a generator producing electricity.



GASIFICATION

It is process that exposes a solid fuel to a high temperature and limited oxygen, to produce a gaseous fuel. The gas produced by this process is mix with the gases such as carbon monoxide, carbon dioxide, nitrogen-hydrogen, and methane. The gas is then used to drive a high-efficiency, combined power gas turbine.

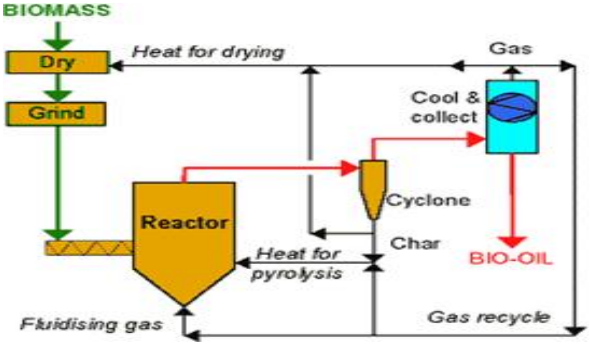


B. PAYROLYSIS

It is the simplest form in which pyrolysis represent heating the biomass to drive off the volatile matter and leaving behind the charcoal. This process has doubled the energy density of the original material because charcoal. Which is half the weight of the original biomass. Contain the same amount making the fuel more transportable The charcoal also burnt at a much higher temperature than the original biomass, making it more useful for manufacturing process.

Pyrolysis is the process of subjecting a biomass feedstock to high temperature (greater than 430 C) under pressurised environments and low oxygen levels. In the process of pyrolysis result in liquid fuels and a solid residue called char, or biochar. Biochar is like charcoal and rich in carbon

Liquid phase products result from temperature which is too low to destroy all the carbon molecules in the biomass so the result is production of tars, oils, methanol, acetone etc.



DIGESTATION

Biomass digestion works by utilizing anaerobic bacteria. The microorganism usually lives at the bottom of swamps or in other places where is no air, consuming dead organic matter to produce methane and hydrogen. We put these bacteria to work for us. By feeding organic matter such as animal dung or human's sewage into tanks, called digesters, and adding bacteria, we collect the emitted gas to use as a energy source. The process is very efficient means of extracting usable energy from such biomass.

FERMENTATION

Fermentation is the use of yeasts to convert carbohydrates into alcohol – most notably ethanol, also called bioethanol. Producing the fuel from biomass by this process is just extension of this process, although a wider fiber can be used. For instance, the waste from wheat mill in new south wales is used to produce ethanol through fermentation.

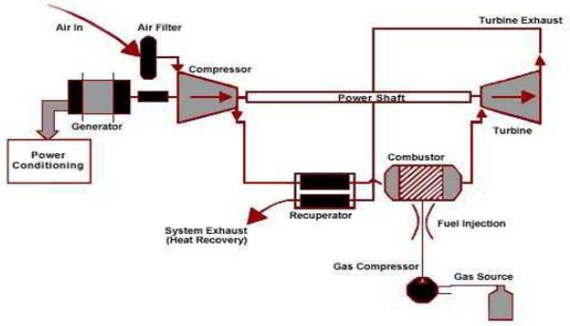
TRANS-ESTRIFICATION

It is a chemical reaction used for the conversion of vegetable oil to biodiesel. In this process vegetable oil is chemically reacted with an alcohol like methanol or ethanol in presence of a catalyst like lye. After chemical reaction various component of vegetable oil break down to form new compounds.

COMBINED POWER

Combined power or cogeneration is refereed to the process wherein we obtain both heat and electricity from same fuel and at same time. The process is also refereed to CHP (Combined Heat and Power). Biomass-fueled CHP (combined heat and power) is one of the cost effective method of energy recovery. Because the byproduct i.e. the heat generated id not wasted but is utilized as thermal energy total efficiency is reached to 60-80%.

Co firing of biomass with coal and other fossil fuel can provide short term low risk, low cost option of producing renewable energy while simultaneously reducing the use of fossil fuels. Biomass can typically provide between 3 to 15% of input energy into power plant



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A. STEAM TURBINE

Steam turbines work on the principle of the Rankine cycle, which consists of a heat source (boiler) that converts water into high-pressure steam. A multistage turbine allows the high pressure steam to expand, which lowers its pressure. The steam is then transported to a condenser, which is like a vacuum chamber and thus has negative pressure and converts, or condenses, the steam into water. Alternatively, the steam may be transported to a distribution system that delivers steam at intermediate temperatures for different applications. The condensate from the condenser or from the steam utilization system returns to the feed water pump, and the cycle continues. These systems are suitable for capacities of 500 kW to 100 MW or even higher

B. GAS TURBINE

Gas turbine cogeneration systems work on the principle of the Brayton cycle, in which atmospheric air is compressed, heated, and then expanded, producing more power than what is consumed by the compressor in compressing and heating the air. The capacity of gas turbines varies from a fraction of a megawatt to about 100 MW. A variety of fuels can be used: natural gas, light petroleum distillates such as gas oil and diesel oil, products of coal gasification, etc. Gas turbine cogeneration systems are often more useful than steam turbines because gas turbine systems are more flexible; they can operate at widely varying ratios of electrical output to thermal output as required by the intended use.

C. RECIPROCAITNG ENGINE

A reciprocating engine, such as a diesel engine, can be combined with a heat-recovery boiler that supplies heat to the steam turbine to generate both electricity and heat. Heat from reciprocating engines can be recovered from four potential sources: exhaust gases, water from the engine jacket used for cooling, lube oil used for cooling, and the turbocharger used for cooling.. Of the total heat lost from an engine (depending on its operating efficiency), roughly half is in the form of exhaust gases (400–500 °C), which can be utilized for producing steam or for drying bricks, ceramics, animal feed, etc. The waste heat in the form of the water used for cooling the engine (20%–30%) can be utilized for pre-heating water or generating hot air.

III. CASE STUDY ON C.H.P

The countries like U.K and Europe are developing and are using C.H.P as their combined power if same implemented in India can make a grate sustainable and economical development.

The power plant input fuels are wood and 77MW of power can be generated by this fuel, peat can be used as fuel in power plant too. Fluidized bed boiler can be used as boiler method for boiling method foe bio-mass. The power of electricity production is 23MW and heat power is 45MW. The total efficiency is

88.3%. the steam temperature of power plant is 520oC at 115 bar pressure.

The main part of CHP power plant are

- Boiler
- Turbine
- Direct heating network
- Liquid coolers

The case study is related to a small district named kasai located in Madhya Pradesh. Kasai is a small village in Bitul district of Madhya Pradesh. This village is electrified using electric bio gas gasifiers. Under Non-Conventional Energy source (NCES) this is a department under Biogas Council of India.

Village committee

- In all there were 11 members
- A village energy fund was contributed from all
- A sum of in all 120/- was collected from all families for expenditure of system works.
- A village Energy committee was et up by Gram Pnchayat. This committee was responsible for maintenance of system.

The project was executed in year 2005 and was 100% bio-mass based. It and was later on commissioned by forest department. This bio gas gasifire was able to supply 20KWe of electric power to grid. The table below shows the basic set up of pant initially

Table-4

Size of village	35
Population	392
Installed capacity	20.0
Installed end use capacity	
• Lights	4.0
• Drinking water	2.6
• Flour mill	5.6
• Irrigation pump	18.5
Total capacity	30.7

Table-5

SR NO	Description	Cost in Rs.
1	Cost of bio-mass	0.5/kg
2	Contribution per family to bio-gas system	120
3	Cost of labor (1000x3)	3000
4	Cost of diesel and oil	500
5	Total operating cost per month	4550
6	Unit power generation cost	3.79

Table-6

Item	Value Unit/year	Electrical output	Heat evolved
Wood	$2.69.10^{15}$	$1.62.10^{5}$	$4.44.10^{20}$
Water	$4.12.10^{10}$	$6.65.10^{5}$	$2.74.10^{16}$
Air	$1.22.10^{12}$	$5.16.10^{7}$	$6.3.10^{19}$
Natural gas	$1.63.10^{12}$	$4.10.10^{4}$	$6.52.10^{12}$
Sand	$3.10.10^{9}$	$1.31.10^{9}$	$3.93.10^{18}$
SERVICES			
Electricity	$7.92.10^{13}$	$2.9.10^{5}$	$2.3.10^{19}$
Heat	$6.29.10^{13}$	$3.46.10^{5}$	$2.18.10^{19}$
Chemical	$4.64.10^{6}$	$9.9.10^{7}$	$4.59.10^{14}$
Transport	$1.47.10^{11}$	$2.6.10^{9}$	$3.82.10^{20}$
OUTPUT			
Electricity	$8.05.10^{14}$	$5.59.10^{5}$	$4.5.10^{20}$
Heat	$1.57.10^{15}$	$3.46.10^{5}$	$5.44.10^{20}$
Ash	$1.29.10^{9}$	$1.93.10^{9}$	$2.49.10^{18}$

The table above shows the basic calculation of energy generated using biomass. The same is implemented in India can be useful and economically protective.

Power generation table of Biomass CHP and Coal CHP is shown below

	Electrical transformation	Heat transformation
Biomass C.H.P 77MW	$5.59.10^{5}$	$3.46.10^{5}$
Biomass CHP 71,1MW	$8.17.10^{4}$	$3.03.10^{4}$
Coal CHP 71,1MW	$2.72.10^{5}$	$9.49.10^{4}$
Coal CHP 150MW	$2.68.10^{5}$	$9.34.10^{4}$

Above result shows is the biomass CHP gives give better transformation results than other conventional fuels. Transformation of wood is the most important transformation in bio-power energy.

IV. FUTURE ASPECTS

Many influential organizations foresee bio mass in playing a key role in a future, more sustainable, global energy supply matrix. Both developed or underdeveloped countries are actively encouraging the use of bio mass

- There is a growing consensus that renewable energy must progressively displace the use of fossil fuels, with fear of global climatic change adding urgency to this need.
- The potential resource of bio energy is large, especially in areas where the forest land is richer, where surplus of agriculture land and in many lalatitude countries where biomass can be yield.

- The country like India where there is abundant of agriculture land with large scale forest area, the future of bio-energy shows an excellent shine
- Therefore we expect biomass to be an important and social benefit

V. CONCLUSION

Biomass is one of the most abundant natural and renewable resources for power generation, as well as being versatile and having a relatively high calorific value. Biomass industry is renewable and harmless to living thing. A biomass industry has a capacity to produce a lot of energy with a small amount of biomass material. More and more bio-waste can produce through different sources such as (biodegradable garden, and park waste, food and kitchen waste from house-hold, restaurants, caterers and retail premises and comparable waste from processing plants). As the research say that building industries with the biomass concept, it will overcome the challenges of the depletion in energy resources in India. The issues of depleting fossil fuel will surely can control and electricity problems can be resolved in India. However, these new technology need to environment –friendly, health-compatible, and should result in small investment and management costs.

Biomass-based power systems are among non-hydro renewable power resources because of their wide ranges of applicability to a diverse set of needs. Biomass based systems are the only non-hydro renewable sources of electricity that can be used for base-load electricity generation. Biomass energy has a potential to supply a significant portion of India energy needs. Farmers would gain a valuable new outlet for their products. Rural communities could become entirely self-sufficient when it comes to energy, using locally grown crops and the residues to a fuel cars and tractors and to heat and power homes and building.

REFRENCES

[1] Darshini Ravindranath and Shrinivas Shroff, BIOENERGY IN INDIA
[2] www.bioenergyindia.org
[3] Ministry of new and renewable energy, government of India issue7 march 2011
[4] bioenergy India 2010