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BIOMASS- As an economic alternative energy option

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Abstract: *Now a day's energy demand increasing day by day because of high rate of population growth. Because of high energy demand resources of fossil fuels depleting very rapidly. Continuous use of fossil fuels adversely affecting on environment which leads to global warming. So there is a need to find out alternative energy option which is free, easily available and environment friendly. The paper defines biomass & its sources, methods of extracting biomass energy, cost associated with biomass, advantages and disadvantages.*

Key Words: **Biomass, biomass sources, Characteristics of biomass, Pyrolysis, fermentation, gasification, direct combustion**

1. INTRODUCTION

Biomass, as a renewable energy source, is plant matter created by the process of photosynthesis. Photosynthesis is naturally occurring process which produced its energy requirement from solar radiation; reaction of this process is as follows:

$$H_2O + CO_2 \xrightarrow{\text{Energy}} CH_2O + O_2$$

In the above process water and carbon dioxide are converted into organic matter. It exists in one form as plants and may be transferred through food chain to animals' bodies and their waste. Biomass includes all plant life- tress, agricultural plant, bush, grass, algae and their residue after processing. The residue includes crop residue like straw, stalk, leaves, roots and agro processing residue like coconut, ground nut shell, bagasse, husk etc. and they obtained from forest, agricultural land, arid land.

1.1 Biomass sources

Biomass energy is derived from five distinct energy sources: garbage, wood, waste, landfill gases, and alcohol fuels. Wood energy is derived by using lignocelluloses biomass as fuel. This is either by using harvested wood directly as a fuel, or collecting from wood waste streams. The largest source of energy from wood is pulping liquor or "black liquor," a waste product from processes of the pulp, paper and paperboard industry .Waste energy is the second-largest source of biomass energy. The main contributors of waste energy are municipal solid waste (MSW), manufacturing waste, and landfill gas. Sugars and oils such as sugarcane and corn, are used to produce bioethanol, an alcohol fuel. Alcohol fuels can be used directly, like other fuels, or as an additive to gasoline. Biomass can be converted to other usable forms of energy like methane gas or transportation fuels like ethanol and biodiesel. Rotting garbage, and agricultural and human waste, all release methane gas—also called "landfill gas" or "biogas." Crops such as corn and sugar cane can be fermented to produce the transportation fuel, ethanol. Biodiesel, another transportation fuel, can be produced from left-over food products like vegetable oils and animal fats.

1.2 Characteristics of biomass

Biomass material properties and characteristics are changed because of nature of plant species, resource material and its content, Technologies for biomass to convert it in useful energy determined by the fuel used, and each of them has specific requirements by considering dry matter content, shape, size, and particle consistency of the raw material. Other than the moisture content and the energy content, properties of biomass fuels are defined by their physical structure, weight, volume, density and ash content.

2. METHODS OF EXTRACTING BIOMASS ENERGY

Biomass can be converted to thermal energy, liquid, solid or gaseous fuels and other chemical products through a variety of conversion processes. All of today's capacity is based on direct-combustion technology. There are different methods to obtained energy from biomass like direct combustion gasification, pyrolysis, anaerobic digestion, and fermentation. Future efficiency improvements will include co-firing of biomass in existing coal-fired boilers and the introduction of high-efficiency gasification, combined-cycle systems, fuel cell system and modular systems.

2.1 Direct combustion

It is the burning of biomass in the presence of oxygen. Furnaces and boilers are used typically to produce steam for use in district heating/cooling systems or to drive turbines to produce electricity. In a furnace, biomass burns in a combustion chamber converting the biomass into heat. The heat is distributed in the form of hot air or water. In a boiler, the heat of combustion is converted into steam. Steam can be used to produce electricity, mechanical energy, or heating and cooling. A boiler's steam contains 60-85% of the energy in biomass fuel.

2.2 Gasification

Gasification is the use of high temperatures and a controlled environment that leads to nearly all of the biomass being converted into gas. This takes place in two stages: partial combustion to form producer gas and charcoal, followed by chemical reduction. These stages are spatially separated in the gasifier, with gasifier design very much dependant on the feedstock characteristics. Gasification requires temperatures of about 800°C.

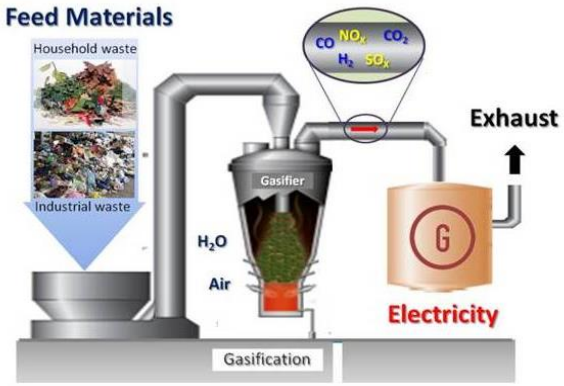

Fig -1: Biomass Gasification Process

2.3 Pyrolysis

Pyrolysis is a process of subjecting a biomass feedstock to high temperatures (greater than 430 °C) under pressurized environments and at low oxygen levels. In this process, biomass undergoes partial combustion. Processes 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 temperatures which are too low to destroy all of the carbon molecules in the biomass so the result is production of tars, oils, methanol, acetone, etc.

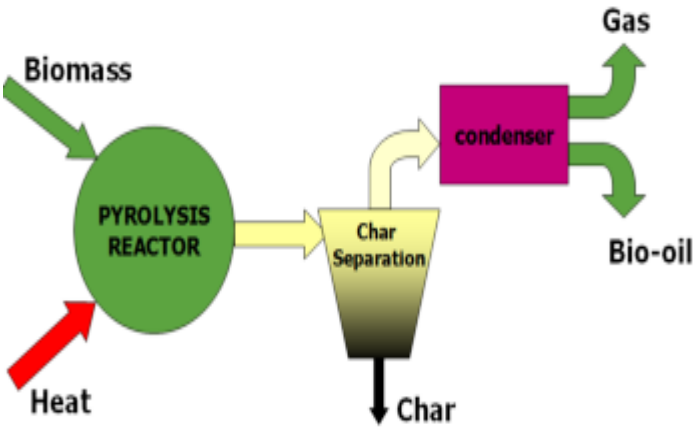

Fig -2: Pyrolysis Process

2.4 Digestion

Biomass digestion works by utilizing anaerobic bacteria. These microorganisms usually live at the bottom of swamps or in other places where there 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 sewage into tanks, called digesters, and adding bacteria, we collect the emitted gas to use as an energy source. This process is a very efficient means of extracting usable energy from such biomass. Usually, up to two thirds of the fuel energy of the animal dung could be recovered. Another related technique is to collect methane gas from landfill sites. A large proportion of household biomass waste, such as kitchen scraps, lawn clipping and pruning, ends up at the local tip. Over a period of several decades, anaerobic bacteria at the bottom of such tips could steadily decompose the organic matter and emit methane. The gas can be extracted and used by capping a landfill site with an impervious layer of clay and then inserting perforated pipes that would collect the gas and bring it to the surface.

2.5 Fermentation

Fermentation is the use of yeasts to convert carbohydrates into alcohol – most notably ethanol, also called bioethanol. The total process involves several stages. In the first stage crop materials are pulverized or ground and combined with water to form slurry. Heat and enzymes are then applied to break down the ground materials into finer slurry. Other enzymes are added to convert starches into glucose sugar. The sugary slurry is then pumped into a fermentation chamber to which yeasts are added. After about 48-50 hours, the fermented liquid is distilled to divide the alcohol from the solid materials left over.

3. DIFFERENT COSTS ASSOCIATED WITH BIOMASS ENERGY

3.1 Investment costs

The investment costs for biomass based energy systems varies, depending mainly on the type of technology used, the size and type of energy produced (heat, electricity, liquid biofuels). However, the general conclusion could be that due to more complex logistics of biomass handling and still not fully developed market for bioenergy systems, their typical investment costs are higher than those for fossil fuels. One of the problems when evaluating the economics of a biomass heating system is the difficulty of comparing biofuels and conventional fuels prices, due to the complicated conversion factors.

3.2 Energy production costs

Energy production cost (cost per kWh of energy produced) is the best criteria for comparing bioenergy with other energy sources. The extremely varied of biomass and the many routes possible for converting the biomass

resource to useful energy make this whole topic a complex subject. However, it should be noted that due to considerable R&D efforts, costs of energy production from biomass are generally decreasing and in many cases today, are comparable with fossil fuels energy. The comparatively large amount of subsidies provided to conventional energy sources is another problem preventing biomass-derived fuels from playing a more substantial role in global energy supply. The bioenergy industry can also take advantage of scale effects as the market grows. This will create markets for specialists -- consultants, fuel dealers and brokers -- who will improve the overall market performance. Larger series of machinery and equipment and larger volumes of biofuels also contribute to reduced production costs. And there will be more incentives for spending on R&D, standardization, and marketing. A growing market will therefore lead to reduced costs at different stages and a positive loop may be created.

3.3 External costs

An external cost, also known as an externality arises when the social or economic activities of one group of persons have an impact on another group and when that impact is not fully accounted, or compensated, by the first group. There are several ways of taking account of the cost to environment and health, i.e. for external costs. One possibility would be via eco-taxes, i.e. by taxing damaging fuels and technologies according to the external costs caused. External costs are usually another strong argument for using more biomass and other renewable in regional, national and global energy supply.

3.4 Hidden costs

Among other barriers to the wider expansion of bioenergy technologies is that the markets do not acknowledge various costs and risks connected with the usage of fossil and nuclear fuels. Oil shipping accidents, such as the Exxon Valdez disaster, cause devastating and long lasting effects on the environment. Nuclear accidents such as Three Mile Island and Chernobyl still leave questions as to the effects on future generations. The costs of maintaining channels to fossil fuel sources through military means should also be taken into consideration when promoting increased use of biomass fuels.

4. BIOMASS ENERGY GENERATION

4.1 Advantages of Biomass Energy:

Some of the advantages of using biomass as a source of energy are as below.

1. By promoting biomass in energy production can reduce pollution emission of CO, NO and protect the environment.
2. Use of lands to plant energy crops can bring incomes and benefits the water retention of soil at the same time.
3. Biomass energy is not associated with environmental impacts such as acid rain, mine spoils, open pits, oil spills, radioactive waste disposal or the damming of rivers.
4. Sufficient biomass resources, affordable price and eco-friendly characteristic make biomass fuel over fossil fuels. And these factors also motivate the development of biomass fuel market.
5. Alcohols and other fuels produced by biomass are efficient, viable, and relatively clean burning.
6. Prompting biomass in energy sector reduces dependency on fossil fuels.
6. Biomass is cheap and readily available source of energy. If the trees are replaced, biomass can be a long-term, sustainable energy source.

4.2 Disadvantages of Biomass Energy Use:

1. Biomass boiler systems are generally larger than gas or oil boilers and require a separate storage area for fuel so therefore a large amount of space is required.
2. The initial cost of a biomass boiler is higher than a regular gas or oil boiler.
3. Burning wood in boiler requires more energy to produce the same heat as fossil fuels so a larger amount of fuel is required.
4. Biomass also makes use of the animal and human wastes; the emission of methane gas is also harmful to environment and even human also. Its large amount in the atmosphere will cause the oxygen to deplete leading to oxygen deficiency that cause nausea, headaches, dizziness, and unconsciousness.
5. The excessive use of plants and trees to create biomass fuel leads to the destruction of the environment. Not only that it destroys the habitat for the plants and animals but it leads to deforestation.

5. CONCLUSION

Future of biomass energy depends on providing reliable energy services at competitive cost. In India, this will happen only if biomass energy services can compete on a fair market. Thus it is seen that the emerging technologies of biomass as a renewable source of energy is highly advantageous to promote a greener planet and also cut down on the need for fossil fuels which not only cause pollution in the atmosphere but also are fast depleting.

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BIOGRAPHIES

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