

BIOMASS: A RENEWABLE SOURCE OF ENERGY

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Abstract

Energy apart from being perceived as the ability to do work is also an integral component of any socio-economic development for raising the standard of living as well as improving the quality of life of the people in general. Many nations seems to depend on only one source (oil) for providing this energy with its attendant crisis. In view of this, the paper, therefore brought to the fore another possible source of energy production called biomass. It begins by examining the meaning of biomass as a source of energy and then highlights the available technologies involved in the conversion of biomass into energy. The paper therefore recommends that many oil production countries including Nigeria should develop a board energy policy, involving many sources such as biomass which is another veritable source.

Energy is an integral component of any socio-economic development for raising the standard of living as well as improving the quality of life of the people in general (Khoshoo, 1988.) It is on record that the cost of generating energy from coal, oil and gas is astronomically high which most often leads to its scarcity.

Eldon and Bradley (2006) defined biomass as all land and water-based vegetation as well as Organic wastes. Eldra, Linda and Diana (2002) perceived it as the quantitative estimate of the total mass or amount of living material in a particular ecosystem which fulfills almost of all human kind energy needs prior to industrial revolution. Dubey (2006) added that 91 percent of total U.S energy consumption is biomass in the form of wood. Though, since industrial revolution, the majority of the developed world's energy requirement have been met by the combustion of fossil fuels such as coal, oil and natural gas, biomass still remain the predominant form of energy used by people in less developing countries, accounting for 14% of the world energy use (Eldon and Bradley, 2006). Dubey (2006) opined that biomass is produced by green plant that converts sunlight into plant materials through photosynthesis.

In recent years, various technologies have been/are being developed to utilize biomass to generate different forms of energy so that people's energy requirement can be met and environment can be protected from the possible hazards that may occur (Dubey, 2006).

Therefore since biomass can provide or serves an alternative source of energy, concerted and combined efforts should be geared towards this direction. It is the recognition of this fact that prompted this study.

Multidisciplinary Journal of Empirical Research Volume 10 No. 1 April, 2012

Composition of Biomass

Plant cell wall is constituted by mainly cellulose, hemi-cellulose, lignin, water, soluble sugars, amino acids and aliphatic acids, ether, alcohol- soluble constituents and proteins (Dubey, 2006). These components build up plant biomass. Proportions of these constituents vary in different groups of plant and even in the same group. If the concentration of sugar is high, the biomass will be sugary e.g. sugar cane, and sugar beet (Jahn, 1982). Similarly high amount of starch present in biomass yields the starchy biomass e.g. potato and tapioca (Mc Inerney and Bryant, 1981).

Terrestrial Biomass

Eldon and Bradley (2006) defined terrestrial biomass as all land based vegetation and organic wastes. It is also simply referred to as the cell mass produced by a population of living organisms found on land.

Terrestrial biomass has been used to fulfill the need of food, feed, vegetables, fibre, furniture and cooking purpose as well (Jahn, 1982). Traditionally, the need of fire/fuel was fulfilled by trees, remains of agricultural crops and fossil (coal and petroleum) (Dubey, 2006).

During the course of time, there was total dependence on conventional energy source of fossil fuels and electricity. But gradually increasing worldwide human population and diminishing stock fossil fuels have led to the need to seek out alternative sources of energy.

Swaminathan (1980) has emphasized for “photosynthetic model of development”. This model is applicable for India and other developing countries. However, the extent and nature of this model may vary with energy demand of that country.

Waste as Renewable Source of Energy

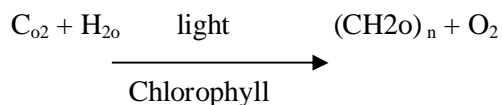
Waste is the spoilage, loss or destruction of either matter or energy, loss or destruction of either matter or energy, which is unusable to man. Gradually increasing civilization through industrialization and Urbanization has lead to increase in generation of waste into environment from various sources. Wastes generation is, therefore, a necessary outcome of consumption, and also because of insufficient process, general ignorance, wasteful habits and social attitudes (Dubley, 2006).

Clegg (1982) classified waste into energy waste and material waste. The main sources of energy in the developed and developing countries is petroleum oil, followed by coal. He further stressed that about 50 percent oil is imported each year. Coalmines are concentrated only in few regions. Coal is used to generate electricity, steam engine and fire. Most potential energy of coal is wasted during electric generations in thermal power plants. Clegg (1982) also maintained that on chemical nature, material wastes are various type: (i) Inorganic waste (those generated by metallurgical and chemical industries, coal mines). (ii) Organic wastes (agricultural products, dairy and milk products, sewage and forestry,) and (iii) missed waste (those discharged from industries dealing with textiles, dyes, cake and gas plastic, wool and leather).

Biomass: A Renewable Source of Energy

Biomass as a Source of Energy

Biomass has been perceived as any accumulation of organic materials produced by living things through the process of photosynthesis (Clegg, 1982). The peculiar features of plants are that they possess various photosynthesis pigments in thylakoids present in cell either in free state or in chloroplast. During photosynthesis in plants cells, in the presence of chlorophyll, carbon (iv) oxide is converted into complex carbohydrates with the release of oxygen. The reaction is shown below:



Dubey (2006) maintained that during photosynthesis solar energy is trapped into light harvesting molecules in the chloroplast by reduction of carbon (iv) Oxide into carbohydrates, fats and protein. Khoshoo (1988) added that biomass is all forms of matters derived from biological activities and present on the surface of soil or at different depth of vast body of water, lakes rivers, sea and oceans and opined that they includes wood, crops, herbaceous plants, fresh water and marine plants, animal waste as well as residue form agricultural and forest products. Table 1 below shows the different types of biomass from various source culled from Dubey (2006).

Table 1: Biomass as Source of Energy.

| Source of Biomass | Forms of Biomass | Conversion Process | Forms of Energy |
|---------------------------------|------------------|--------------------|-------------------|
| A. Plantations | | | |
| (Energy Plantations) | Fuel wood | Destruction | Charcoal |
| Agriculture | Carbohydrate | Fermentation | Ethanol |
| Aquatic biomass | Aquaculture | Fermentation | Methanol |
| B. Residues/Wastes/Weeds | | | |
| Waste | waste | Pyrolysis | Fuel oil |
| Forestry waste | Waste | Combustion | Fire/fuel |
| - | - | Gasification | Gas |
| C. Agricultural Waste | | | |
| Waste | Waste | Fermentation | Methane |
| Weeds and aquatic biomass | - | Fermentation | Methane |
| Cattle | Dung | Combustion | Fire/fuel |
| | | Fermentation | Methane (Bio gas) |

Source: Dubey (2006)

Biomass Conversion Technology

There exist several technologies capable of converting biomass into energy. Anaerobic digestion, palletizing, direct combustion and cogeneration, phrolysis, gasification and ethanol

production are the technologies as opined by Eldon and Bradley (2006) employed in the conversion of biomass into energy. These various technologies are hereby examined below:

Anaerobic Digestion

Anaerobic digestion is the decomposition of wet and green biomass through bacterial action in the absence of oxygen to produce a mixed gas output of methane and carbon dioxide known as biogas. The anaerobic digestion of municipal solid wastes buried in landfill sites produces a gas known as landfill gas. This process occurs naturally as the bacterial decomposition of the organic matters continues over time. The methane gas produced in land fill sites eventually escapes into the atmosphere. However, the landfill gas can be extracted by inserting perforated inserting perforated pipes into the landfill. In this way, the gas will travel through the pipes under natural pressure to be used as an “ENERGY” source, rather than simply escaping into the atmosphere to contribute to greenhouse gas emission.

Pelletising

Pelletising involves the compaction of biomass at high temperature and very high pressure. The biomass particles are compressed in a die to produce briquettes or pellets. These products have significantly smaller volumes than the original biomass and thus, have a higher volumetric energy density, making them more compact source of energy. They are also easier to transport and store than natural biomass. The pellets can be used directly on a large scale as direct combustion feed or on a small scale in domestic stove or wood heaters.

Direct Combustion and Cogeneration

This is also known as the Non-biological process or thermal-chemical process (Dubey, 2006). It is the main process adopted for utilizing biomass energy. The energy produced can be used to provide heat or steam for cooking, space heating and industrial process, or for electricity generation. Large biomass power generations systems can have comparable efficiencies to fossil fuel systems, but this comes at a higher case due to the design of the burners to handle the higher moisture content of biomass. However by using the biomass in a combined heat - and electricity-production system (or Cognations System), the economic are significantly improved.

Pyrolysis

Pyrolyses is the basic thermochemical process of converting solid biomass to a more useful liquid fuel. Biomass is heated in the absence, of oxygen or partially combusted in a limited oxygen supply to produce a hydrocarbon — rich gas mixture, an oil — like liquid, and a carbon-rich solid residue. Traditionally, in developing countries, the solid residue produced is charcoal, which has a higher energy density than the original fuel. The traditional charcoal kilns are simply mounds of wood covered with earth or pits in the ground. However, the process of carbonization is very slow and inefficient in the kilns, and more sophisticated kilns are replacing the traditional ones. The pyrolytic residue or “bio-oil” produced can be easily transported and refined in a series of products. The process is similar to refining crude oil

Gasification

This is a form of pyrolysis, carried out with more air and at high temperature, to optimize the gas production. The resulting gas, known as producer gas, is a mixture of carbon monoxide, hydrogen and methane, together with carbon dioxide and nitrogen.

The gas is more versatile than the original solid biomass, and it can be used as a source of heat or used in internal combination engines or gas turbing to produce electricity. During the Second World War, countries such as Australia and Germany even used it to power vehicles.

Ethanol Production

Ethanol can be produced from certain biomass materials that contain sugars, starch or cellulose. The best known feedstock for ethanol production is sugar cane, but other materials including wheat, corn, other cereals and sugar beets can be used.

Starch-based biomass is usually cheaper than sugar based Materials but requires additional processing. Similarly, a cellulose material, such as wood and straw are readily available but requires expensive preparation. Ethanol is produced by a process known as fermentation. Typically, sugar is extracted from the biomass crop by crushing and mixing with water and yeast and then keeping the mixture warm in large tanks called ferments. The yeast breaks down the sugar and converts it to ethanol.

A distillation process is required to remove the water and others impurities from the dilute alcohol products. Brazil has a successful industrial scale ethanol project, which produces ethanol from sugarcane for blending with gasoline. In the United State, corn is used for ethanol production and then blended with gasoline to produce “gasohol”.

Conclusion and Recommendation

At this juncture, it is pertinent to say that energy play a significant role in the dawn of human civilization. To a very large extent, many nations including Nigeria still rely heavily only on one source of energy If called fossil fuel energy. To be succinct, over dependence on only one form of energy spells doom for any nation. This paper, therefore has been able to lucidly bring to he fore other possible sources of energy, (biomass) which if well explored and exploited by many countries including Nigeria, serve as succour in the event of oil crisis.

To this end, it is recommended that all oil producing countries should as a matter of urgency imbibe a broad energy policy, involving other sources such as biomass so as to be able to eschew any crisis that may result from dependence on only one source of energy (fossil fuel).

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