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BIOMASS: A RECYCLED ENERGY SOURCE

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Abstract:

Biomass utilization for several applications is the need of hour. The concept of reusing and recycling the waste biomass strengthens the goals of waste to energy. The focus of the study is to understand and utilize various processes on biomass including its by-products which convert the raw form into meaningful energy source. The study emphasized to develop biomass availability system to so that it could be adopted as reliable energy resource. The vital goal of social entrepreneurship and sustainable development has been considered during study.

Keywords **—Biomass, Recycling, Bioenergy, Bio residue.**

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I. INTRODUCTION

Biomass has potential of increasing the share of sustainable energy and reducing the carbon emission by suitable technical interventions. Biomass to bioenergy system is a complex technique contains a long pathway from harvesting raw material to fuel production. Recycling of waste is a tool to achieve goal of circular economy. In developed countries the tradition of throw away largely impact in terms of landfill and environmental issues, which includes issues of non-biodegradable materials[1]. A biomass is generated from plants and their extracts it requires preparation and conversion processes to be a bioenergy source as shown in Figure 1.

Figure 1 Conversion Process of Biomass to Bioenergy

The plants make their food by the process of photosynthesis. In this process the plants absorb carbon from carbon dioxide present in atmosphere. Which means that energy is stored in the plants in form of bioenergy.When biomass is burnt it liberate energy in form of heat and stored carbon in plant with y present in atmosphere liberate carbon dioxide in atmosphere. The CO_2 liberated equals to CO_2 absorbed. Waste to energy route of biomass help environment in two ways. Firstly it reduce carbon emission which would be done for producing same of energy and secondly by burning biomass it prevent the methane liberation to environment which will be done of biomass allowed to degrade in open environment

II. GENERATIONS OF BIOMASS

Biomass to biofuel development make use of various technologies rime to time. Therefore the

technologies are characterized in different generations as:

i. **First Generation Biomass:** This type of fuel is derived from the plants produced developed above the surface of the crust. Ethanol can be identified as first generation biomass developed with simple fermentation of sugar extract. Also, the production of biodiesel from the oil seed can be treated as first generation biofuel. In India, Jatropha is seen under biodiesel tracked strategy in wasteland [1].

ii. **Second Generation Biomass:** this generation belongs to non-edible crop residue. E.g. Twigs, bushes, rice husk. Fuel production requires biochemical and thermochemical processes. The biofuel produce from these process known to be Ethanol and butaneol but these are known as Cellulosic ethanol and cellulosic butaneol.

iii. **Third Generation Biomass:** the third generation is similar to second generation but difference is the development of technology which produce fuel and at the same time maintain feedstock. Algae is promising choice to be a fuel and feed stock.

iv. **Fourth Generation Biomass:** in this generation we not need to convert energy to fuel and then fuel to energy. E.g. in previous generation the stored carbon in biological components of the fuel producer is converted into energy but in this generation the sun energy and directly available energies is used as fuel directly. Fourth generation requires specially designed photosynthetic microorganisms which produce photo biological solar fuels [2].

III. Classification of Biomass

On the basis of requirement of processes the biomass is designated into different types as:

i. **Primary Biomass:** The biomass directly derived from the environment around is known as primary biomass e.g wood, bark, wheat straw [3]. The agriculture residue also came under this categories. The application of such biofuel is for steam raising in industry and the places where low to medium temperature range heat is required.

ii. **Secondary Biomass:** The remains of the processing occurred with primary biomass known to be secondary biomass e.g wood came under primary biomass and sawdust produced from this known as secondary biomass. Seed oil has been identified as primary biomass but black liquor after processing is known as secondary biomass. Such biofuels have high efficiency and used generally in high temperature industrial processes.

iii. **Tertiary Biomass:** The byproduct remains after consumption is called as tertiary biomass. Eg. Used vegetable oil.

IV. Processes of Bio Resources

As discussed earlier there are various conversion processes which make biomass to be ready to use as biofuel. These processes are as under:

i. **Combustion:** The process of direct burning of biomass to produce heat in presence of air is called combustion. The process provide desired energy for a specific work done e.g the firewood utilized in stove for cooking and heating water. The process is generally used in small boilers to produce steam in small scale industrial setups.

ii. **Gasification:** the process of converting biomass into fuel with the help of temperature above 700 c without burning it directly in controlled oxygen environment. The hydrogen gas and carbon monoxide gas produced during process.

$$C_6H_{12}O_6 + O_2 + H_2O \rightarrow CO + CO_2 + H_2 + \text{other species}$$

$$CO + H_2O \rightarrow CO_2 + H_2 \text{ (+ small amount of heat)}$$

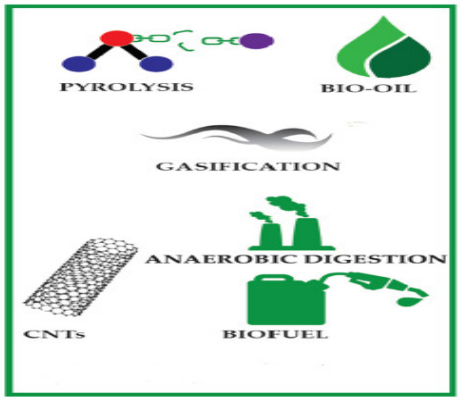

Figure 2 Biomass Processes

iii. **Pyrolysis:** The process of thermal decomposition of biomass into biochar in low oxygen environment is called as pyrolysis. The process can utilize for production of bio oil, biochar and other gases like CO, H_2, CO_2 .Pyrolysis should be done on remote location to reduce transportation cost and easy handling.

iv. **Liquefaction:** this is the process to convert solid biomass in to stable hydrocarbon liquid through thermal decomposition at certain pressure.

v. **Torrefaction:** It is process of progression of biomass to make it suitable for other energy generation processes e.g direct combustion. Generally, it is thermal degradation of organic biomass in an inert or nitrogen atmosphere under temperature range of 200–300°C, for certain time.it reduce moisture, enhance energy density, enhance heating value.

vi. **Steam Explosion:**It is a biomass pre-treatment method utilized to improve the biomass feedstock quality. This process exposes biomass to steam at temperatures between 180–240o C (1.03 – 3.45 MPa) for several minutes, followed by depressurization to ambient condition.

vii. **Hydrothermal Carbonization (HTC):** It is the process of coalification which converts biomass into a coal-like product, known to be hydrochar, having high carbon content with high calorific value. Such type of thermo-chemical conversion, also denoted as wet pyrolysis[5].

viii. **Anaerobic Digestion (AD):** The process is the bacterial breakdown of organic materials in the absence of oxygen produces biogas utilize to cook food and to generate electricity.

V. Recycling Biomass

1. Woody Biomass

Biomass produced from different sources like used furniture, saw industry and other sources called as woody biomass. After 2008 economic crises the use of secondhand used items which use the pathway of recycling and reusing is increased, which help to reduce green house emission in the atmosphere. The recycling of woody biomass requires a small chemical processes. The Different sources with examples are given Table

Table 1. Source of Woody Biomass

WOOD BIOMASS	Wood Extracts From FOREST AND PLANTATION	Forest
		Plantation
		Rotation trees
		Complete tree Extracts
		Whole tree
	Byproduct of WOOD - PRODUCTS	Byproduct of Edgings
		Wood shavings
		Grating dust
		Saw dust
		By-products in Board making Process
		By-products of Plywood
		Cork production by-products
	RECYCLED WOOD	Flattening wood
		Construction extracts wood
		Bulkwood waste
		Paper Extract

2. Herbaceous biomass:

This type of biomass usually contains agricultural extracts such as cones, leaves and stems in which size

reduction is required, so as to increase the bulk density of the biomass [6]. The sources of herbaceous biomass are as shown in Table 2.

TABLE 2. BIOMASS PRODUCED BY HERBACEOUS PLATS

Herbaceous biomass	Energy crops	Grass Extracts
		cereal crops waste
	Agricultural waste	Straw of wheat
	Agro-industrial waste	Bagasse
		By-products Textile industry
	Residue	recycled clothes
		Old insulation material

3. **Biomass from fruits and seeds**: The sources of such biomass are of same as herbaceous biomass but produces biofuel could be in the form of solids and oils. The process of gasification and wet pyrolysis may be employed for production of fuel as in Table 3.

TABLE 3. BIOMASS FROM SEEDS AND FRUITS

fruits and seed Biomas	Fruit crops	Grain
	Agricultural waste	stones
		Coco shells
		Rice husks
	Agro-industrial waste	Oil extracts
		Brewery by-products
		starch by-products
	Residue	vegetable oil Extracts

4. **Miscellaneous Source:**The byproduct of several industrial applications, agricultural byproduct kitchen waste cab be a source of biomass. The processing technique for different source should be applied accordingly. Here ae have various sources which produce biomass as byproduct.

TABLE 4: MISCELLANEOUS SOURCE OF BIOMASS

Miscellaneous /mixtures	Animal Excreta	Cow dung
		Bio Manure
		Poultry waste
	Horticultural Product	Prooning
	Landscape management by-products	Road side green bush
		Protected areas
		management by-products
	Agro-industrial waste products	abattoir by-products
		bio-sludge
	End use material	kitchen waste
		Sewage sludge
		Bone meal

VI. BIOMASS AVAILABILITY MANAGEMENT

Biomass is an important component to achieve waste to energy goals. India is one of the fastest growing economy in the world with world 2nd largest population. The energy demand of the nation increases with its development. India is also a big importer of energy and spent large amount of money on that. Biomass could be source of opportunity to fulfill energy requirement but before that the sector has to supply continuous supply to be a faith full source. The main aim of this study to achieve the vital goal of biomass energy resource utilization and waste management. The study provides the opportunity of entrepreneurship and employability to maintain the supply chain for biofuel industry. The system requires target strategies as the main feeder to the biofuel are not continuous supplying systems, and for being a reliable source the product supply should be uninterested. Accordingly, there should be two supply system, one of them is dedicated energy crop provide raw material for biofuel production. This could be seed crop or bushes which provide woody or herbaceous biomass with minimum grown time and second feeder is recycled system in which recycled biomass from forestry, municipal waste, wood processing industry should be derived. The wetbiomass, organic waste can be use for production of biogas which uplift the rural economy and solve waste disposal problem.

VII. CONCLUSION:

The above discussion has attempted to show that there is immense power in biomass if it could be use properly. Biomass gasification, pyrolysis, torrification are indeed are very encouraging technologies for biofuel production. The generation of power with the help of biomass contributes towards the environment bio reducing carbon emission. The prospects for this technology are very good, but challenges in implementation are also very high.

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