A Review on Renewable Biofuel Production from Biomass

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Abstract- **Awareness of climate change and the likelihood that we will run out of fossil fuels is encouraging the development and use of renewable energy. The need for energy sources with low greenhouse gas emissions and sustainable production encourages the search for alternative biomass sources. However, the use of biomass fuels faces the problem of storage, transport and lower energy densities. Low-density values can negatively affect energy density, leading to an increase in transportation and storage costs. Use of pellets as alternative biomass source is a way to reduce the volume of biomass by densification, which improves their energy quality.**

Renewable energy currently accounts for only 8% of total global energy consumption, but estimated that it will reach 30% by 2050 if renewable energy is continuously researched and developed. European countries, the US and Canada lead wood pellet production, accounting for over 90% of the global volume. Asia and South America have enormous potential to contribute to global production and consumption of wood pellets, yet they have produce very small quantities and lack coherent strategies and policies to increase capacity. Experts encouraged the use of wood pellets, because they are easy to handle and use and are generally very safe, cost efficient and environmentally friendly. However, by 2011, only 22 million tonnes of pellets were used for fuel (0.38 EJ), about 1% of the global biomass consumption (55EJ) (WBA, 2014). Therefore, to increase their use and to become a significant global energy source, more study is needed, including how to address environmental and health concerns culminating in global policies, standards and strategies.

They are produced by diverse biomass resources and mainly from wood materials. In all cases, it is important to evaluate the fuel characteristics, to determine their suitability on the heating system and handling properties

Index terms- Biomass, Pelletization, Bio Fuel, Pellets, Renewable

1. INTRODUCTION

In January 2014, the European Union presented some climate and energy targets to achieve in 2030, which imply more contribution of renewable energies to the energy mix, although with a postponement of the achievement for these goals. The preceding scenario, the well-known 20-20-20 target, was signed in 2008 and implied, compared to 1990, 20% reduction in CO2 emissions by 2020, consuming 20% less energy (with efficient and saving measures) and generating 20% primary energy with renewable sources. This target has been replaced by a new scenario that proposes 27% for renewable contribution to the European energy mix, along with 40% greenhouse gases reduction by 2030.

Among the renewable energies that are available for the achievement of these targets, biomass stands out. It is defined as the biodegradable fraction of the products and wastes of biological origin that come from agricultural activity, forestry and related industries.

Due to the extended use of fossil fuels, biomass was a secondary energy source for decades, with a minimal contribution to the production of primary energy. Currently, and due to several factors, such as the increase of oil prices, the growth in agricultural production and the subsequent need of searching for alternative uses of the generated wastes, biomass has reappeared as an energy source.

The use of biomass as an energy source provides substantial socio-economic and environmental benefits, compensating its localized nature for its high availability. However, bio-fuels have low bulk densities which limit their use to areas around their origin; plus, their heterogeneity is considerable when it comes to moisture and granulomere, among others.

These drawbacks are restrictive factors for their energy use.

Biomass is a type of sun vitality that is put away in structure synthetic bonds between hydrogen, oxygen and carbon particles. These substances discharge the put away vitality when the obligations of these atoms are broken by disintegration or ignition. Biomass alludes to those plants and plants based materials are not utilized for feed and nourishment, it is a quick sustainable type of vitality and accessible free as misuse of tree and harvests disposed of items.

Classification of Biomass

- Forestry biomass
- Agricultural biomass
- Energy crops
- Municipal waste

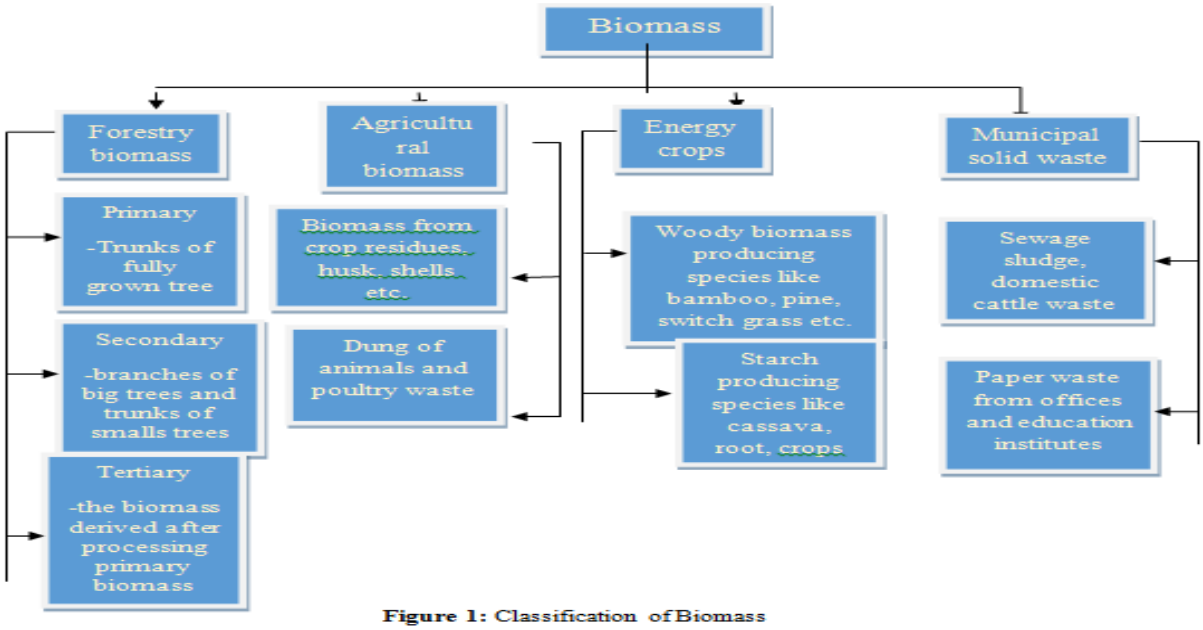

Figure 1: Classification of Biomass

Conversion of Biomass to Bio-Fuels

- Slow pyrolysis (carbonization)
- Fast pyrolysis
- Torrefaction

Thermal Conversion: These are those processes in which heat is dominant factor to convert on form of biomass to another chemical form these processes are:

- Gasification
- pelletization
- Combustion
- Hydrothermal conversion

Gasification

Gasification is a procedure of fractional oxidation of biomass where a carbon source, for example, petroleum gas, coal or biomass are broken into hydrogen (H2) carbon monoxide (CO), carbon dioxide (CO2) and hydrocarbon particles, for example, methane (CH4). These blend gas is known as maker gas and the normal for the gas is relies upon the oxidizer utilized and the gasification temperature, oxidizer for the most part utilized is air. In the event that gasification happens at low temperature, for example, 700 to1000 oC is low temperature gasification and creates elevated level of hydrocarbons and if the gasification temperature of range 1200 to 1600 oC it is high temperature gasification and gives high piece of CO and H2 and couple of hydrocarbons. The gasification advances additionally utilized in dates when hot gases from coke and coal heaters were utilized in lighting and evaporator applications.

Gasification Reactors Categories:

- Fluid bed gasifiers
- Entrained stream gasifiers
- Moving bed gasifiers

Torrefrection

Torrefaction is thermal process of converting raw biomass into a solid material like coal, has better fuel characteristics than the original raw biomass. Torrefied biomass is more brittle, and makings

grinding easy. Torrefaction involves heating of biomass to a temperature of ranging 200 to 400°C in the absence of oxygen.

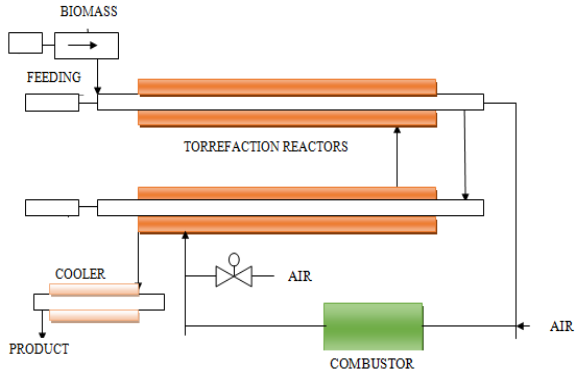

Figure 2: Torre faction Setup

Torrefaction Process:

- Biomass feeding section
- Reactor section
- Cooling section

Combustor section

Biomass Pyrolysis Process

It is the substance response for the most part done before both the gasification and ignition forms. The biomass pyrolysis results in bio-oil, strong roast and gases the extent of each relying on the parameter of the procedure. Pyrolysis basically gives biochar at when the warming rate is delayed at low temperatures, under 460 0C, and produces gases at higher temperatures, more than 750 0C, with fast warming rates. Pyrolysis procedures are delegated moderate pyrolysis and quick pyrolysis. Quick pyrolysis is a most broadly utilized pyrolysis process. Slow pyrolysis setting aside more effort to finish and results in biochar as a primary item.

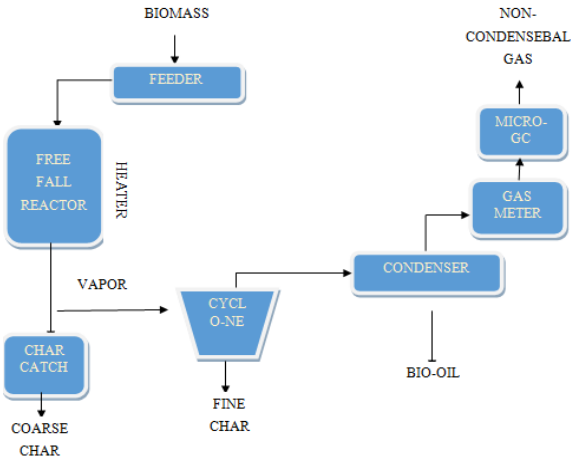

Figure 3: Pyrolysis Setup

Biomass Pelletization

Pellet fills (or pellets) are the kinds of fuel that are made by packing natural issue or biomass. Any kind of biomass, for example, horticultural deposits, mechanical waste and coproducts, virgin wood, nourishment waste and vitality yields can be utilized for making pellets. The biomass into pencil estimated pellets that is uniform fit as a fiddle, size, thickness, dampness and vitality content as it has lower dampness which means it has higher BTU esteem likewise the thickness of pellet fuel is significantly higher than the crude biomass more fuel can be moved a given truck. Wood pellets are is most regular pellet and are produced using sawdust and related squanders. Other modern waste, for example, palm bit shells void natural product packs, coconut shells, and tree tops and branches. Pellets are ordered by their warming worth, fiery debris content, dampness substance and measurements of the pellets. Pellets fuel can be utilized for private and business warming, control age, and cooking.

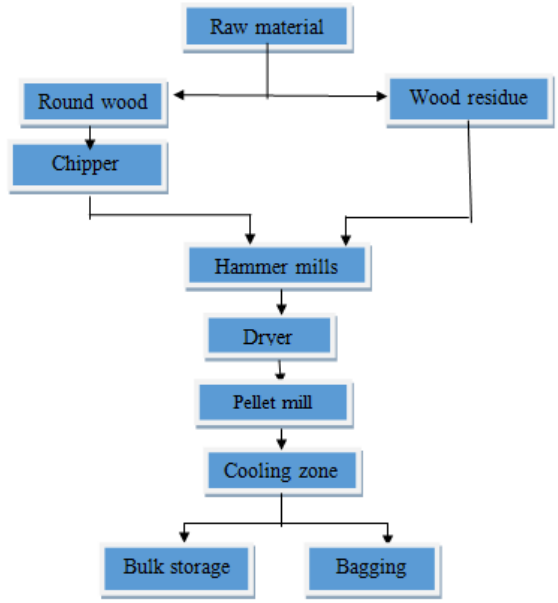

Figure 4: Pelletization Process

Classification of Wood Pellets According to the amount of the Ash produced.

1. Premium (ash content of pellets less than one percent)
2. Standard (ash content between one and two percent)
3. Industrial (ash content three percent or more)

- Premium and standard may be sold for commercial, industrial or residential use.

- Industrial for industrial use only

Advantages of Pellets over Unmodified Wood Waste:

- higher energy efficiency
- high calorific value - 16 MJ/kg
- Low ash content (up to 2 %)
- Low water content (10 % - 12 %)
- reduction the volume of the biomass so low demand for storage space (660 kg/m3)
- production of a low emission combustion
- a full-featured substitute for other types of fuel
- acceptable price per unit of heat produced
- a renewable source of energy for heating

II. LITERATURE REVIEW

Magnus Rudolfsson et al. Torrefaction is the procedure wherein the biomass is exposed to a warm treatment process at a temperature of 200–350 oC in an inactive gas or diminished oxygen air for some fitted timespan and improve the gross calorific estimation of the biomass. With low Torrefaction the power required for pelletization abatement and furthermore diminishes the power for making biomass control which additionally diminishes with decline in dampness content. This part is an investigation of consolidated Torrefaction and pelletization performed pertinent to modern settings. Initially the Scots pine wood chips were torrefied at high temperature 291–315 oC and brief time 6–12 min. At that point utilizing diverse dampness content 10 to 14% and strainer size of 4 to 6 mm. these pellets framed utilizing toerrified materials brings about higher mass thickness 558–725 kg m3 and toughness 46.3–86.5%. Torrefaction temperature has the best impact pursued by torrefaction time and dampness content.

Marius Wohler et al. This paper study the measure of emanation by the burning of the wood pellets in a regularly utilized home machine, for example, bio Chula and pellets stove is principally relies upon the ignition trademark and the properties of the pellets. This paper gives the impact of pellets of various length on the exhibition of the stove in the genuine activity. For this three wood test distinctive long are tried on two unique kinds of pellets stove under examination and non-study condition. The outcomes demonstrates an impressive impacts of pellets length on the exhibition of the two kinds of stoves and result in reduction in the of long pellets contrasted with shorter pellets likewise the utilization of the long pellets increment essentially particulate and vaporous discharge which lessening the warmth yield proportion.

Shalini Graham et al. This paper study and analyse the mechanical debasement of the steam detonated wood pellets and white pellets because of long haul outside capacity and inside capacity. The multi month activity is performed of capacity of the pellets in the indoor and open air condition and the lessening in the sturdiness of the equivalent is contemplated.

III. PELLETIZATION PROCESS

3.1 Pre-Pelletization

Torre group or Pre Pelletization: Torrefaction which otherwise called mellow carbonization in this procedures the biomass is exposed to a warm pre-treatment process which results in up degree of biomass into an excellent vitality and carbon bearers, as of coal. In this procedure the biomass is exposed to a temperature extending from 200 to 300 degree Celsius without oxygen for up to 30 min and moderate warming procedure prepare biomass bringing about discharging of unstable compound. Torrefaction has been anticipated as a husky system that diminishes the no uniformity among contrasting kinds of feed stocks, and assembling uniform quality vitality materials with improve vitality substance. Anyway the mass thickness of the torrefing material is for the most part lower when contrasted with the crude biomass, making ease in vehicles and capacity.

Table 1: Comparison of torrefied pellets with other fuels

	Wood	Wood pellets	Torrefie pellets	Charc oal	Coal
Moistures content (wt %)	30-45	7-10	1-5	1-5	10-15
Calorific value (Gj/t)	9-12	16-20	20-24	26-32	17-28
Volatile (%db)	70-75	70-75	55-65	10-12	15-30
Bulk density (t/m^3)	200-250	550-750	700-850	180-240	800-850
Fixe carbon (%db)	20-25	20-25	28-35	85-87	50-55
Energy densitty (Gj/m^3)	2-3	7-11	15-19	5-7	18-24

Table 2: Physical properties comparision

Types of pellets	Diameter(mm)	MC(%)	Particle Density (g/cm^3)	Bulk density (kg/m^3)	High heat Value(MJ/kg)	Durability (%)
untreated wood chip pellets	6.44	6.7	1.14	673	18.80	80.5
Terrified woodchips pellets mixed with 8% wheat flour binder, at 255ºC	6.48	8.6	1.22	_	_	86
White regular pellets terrified at 255ºC	6.29	1.9	1.16	615	21.07	63.8
White regular pellets terrified at 275ºC	6.13	1.7	1.06	589	21.96	63
White regular pellets terrified at 290ºC	6.14	1.5	0.95	515	24	60.8

3.2 Pelletization Process:

The biomass used for pelletization is initially passed through the hammer mill to get decrease size and uniform quality of biomass powder. This biomass powder is squeezed through small opening of die having hole of diameter of 6 to 8 mm at very high pressure. This high pressure result in a very high increase in the temperature of the biomass which causes an increase in the lignin present in biomass forms a natural binder for the powder for pelletization.

Figure 5: Diagram of fuel pellet manufactures

3.3 Mechanism of Pelletization

Pelletization system includes a few procedures, for example, combination, nucleation, scraped spot move, size decrease and layering which prompts pellets development. In nucleation there is an arrangement of three stage strong cores because of compaction of the biomass at high weight. The impact of these little cores and arrangement of some enormous cores is blend and development of different materials layers on these materials is the layering. Transferring of material from 1 molecule to other in any side is the scraped spot move.

IV.CONCLUSIONS

Biomass residues – wood and agricultural waste, have high potential to contribute to the energy needs of developing countries, but factors such as low density and high moisture content are some drawbacks, making them technically unsuitable for direct use. Densification technologies provide practical options for overcoming some of the inherent drawbacks of biomass (moisture content and low energy density being the most important). Pelletizing can be regarded as one of the well-established densification procedure, gaining increasing popularity and acceptance in recent years in the developed countries. Which are mainly due to pellets dimensions (appropriate for automatic feeding and for application in small domestic appliances). In this paper, the characteristics of pellets, biomass raw materials for pelletizing, biomass pelletizing process and description of a typical biomass pelletizing operation were described.

Massive production of fuel pellets from wood and agricultural waste, for application as domestic fuel could give a positive development to developing countries, where there are a lot of these resources and yet lack a sustainable source of biomass fuel supply.

Therefore, more research on different alternatives - combination of raw materials for the production of pellet from wood and agricultural waste, on analysis of their characteristics and their behaviour on combustion, and on the appropriate appliance for their application, should be performed, to encourage the use of pellet as domestic fuel in developing countries.

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