Heat Treatment and Its Effect on Mechanical Properties

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Abstract – Biomass resources are potentially the world's largest and most sustainable energy sources for power generation in the 21st century. The current availability of biomass in India is estimated at about 500 million metric tonnes per year. Studies sponsored by the Ministry has estimated surplus biomass availability at about 120 – 150 million metric tonnes per annum covering agricultural and forestry residues corresponding to a potential of about 17,000 MW. This apart, about 5000 MW additional power could be generated through bagasse based cogeneration in the country's 550 Sugar mills, if these sugar mills were to adopt technically and economically optimal levels of cogeneration for extracting power from the bagasse produced by them.

Keywords: Non-Woody, Coal, Biomass, Briquettes, Power

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INTRODUCTION

The various agricultural crop residues resulting after harvest, organic fraction of municipal solid wastes, manure from confined livestock and poultry operations constitute non-woody biomass. Non-woody biomass is characterized by lower bulk density, higher void age, higher ash content, higher moisture content and lower calorific value. Because of the various associated drawbacks, their costs are lesser and sometimes even negative.

The major physical data necessary for predicting the thermal response of biomass materials under pyrolysis, gasification and combustion reactions are shape, size, void age, thermal conductivity, heat capacity, diffusion coefficient and densities viz. bulk density, apparent particle density and true density. The values of these properties are different for different biomass especially in the case of loose biomass.

As biomass is a natural material, many highly efficient biochemical processes have developed in nature to break down the molecules of which biomass is composed and many of these biochemical conversion processes can be harnessed. Biochemical conversion makes use of the enzymes of bacteria and other micro-organisms to break down biomass. In most cases micro-organisms are used to perform the conversion process: anaerobic digestion, fermentation and composting.

The combustion technology is similar to coal-based thermal power production technology, in which the biomass is burnt in the boiler and produce steam, which is used to drive a turbine to produce electricity. The extend of biomass-based combustion systems is low with only about 466MW installed until 2007. The typical size of these plants is ten times smaller (from 1 to100 MW) than coal-fired plants because of the limited accessibility of local feedstock and the high transportation cost. A few large-scale such thermal or CHP plants are in operation. The small size roughly doubles the investment cost per kW and results in lower electrical effectiveness compared to coal plants. Plant efficiency is around 30% depending on plant size. This technology is used to dispose of large amounts of residues and wastes (e.g. bagasse). Using high-quality wood chips in modern combined heat and power (CHP) plants with highest steam temperature of 540°C, electrical efficiency can reach 33%-34% (LHV) and up to 40% if operated in electricity-only mode.

Fossil energy consumed for bio-energy production using agriculture and forestry products can be as low as 2%-5% of the final energy produced. Based on life-cycle assessment, net carbon emissions per unit of electricity are below 10% of the emissions from fossil fuel-based electricity. When using MSW, corrosion problems limit the steam temperature and decrease electrical efficiency to around 25%. New CHP plant designs using MSW are expected to reach 25%-30% electrical efficiency and above 85%-90% overall efficiency in CHP mode if good similar is achieved between heat generation and demand. Electricity generation from MSW offers a net emission saving between 725 and 1520 kg CO_2/t MSW.

The prime movers are diesel motors associated with alternators, where diesel fuel saving up to 80.00% are conceivable. Small scale gasifiers with the capacity to fulfill the rural power requirements (20–500 kW) and leave a enormous for feeding the national network are among the biomass power options. As of 2017, approximately 4760 Mw is the total installed potential of biomass gasifier systems. Likewise, around 30 biomass power ventures amassing to around 350 MW are under different phases of implementation. Around 70 Co-generation activities are under usage with surplus limit collecting to 800 MW. States which have taken authority position in usage of bagasse cogeneration activities are Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Uttar Pradesh. The main States for biomass control tasks are Andhra Pradesh, Chattisgarh, Maharashtra, Madhya Pradesh, Gujarat and Tamil Nadu.

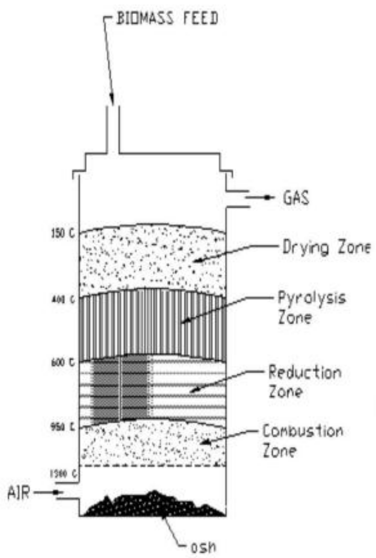

Figure1.1: Updraft-Gasifier

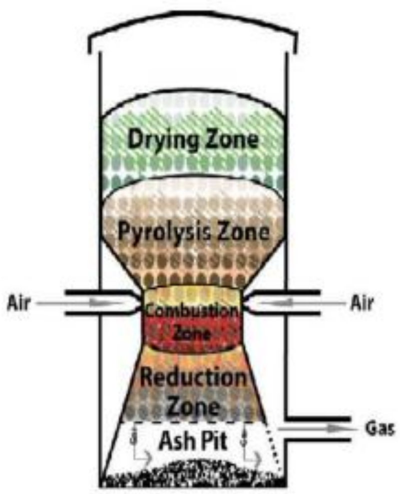

Figure1.2: Downdraft-Gasifier

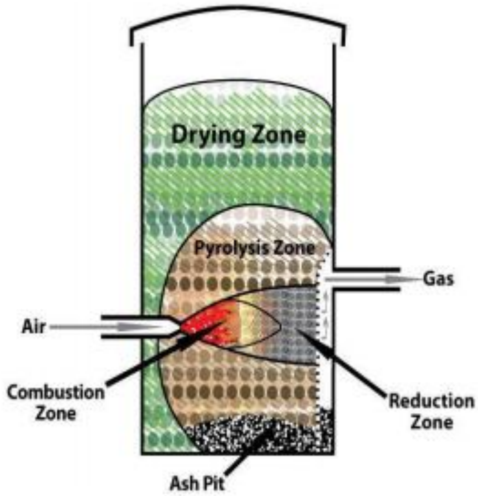

Figure1.3: Crossdraft-Gasifier

HEAT TREATMENT AND ITS EFFECT ON MECHANICAL PROPERTIES

One of the advantages of co-firing is that an existing plant can be used to burn a new fuel, which may be cheaper or more environmentally friendly. For example, biomass is sometimes co-fired in existing coal plants instead of new biomass plants. Co-firing can also be used to improve the combustion of fuels with low energy content. For example, landfill gas contains a large amount of carbon dioxide, which is non-combustible. If the landfill gas is burned without removing the carbon dioxide, the equipment may not perform properly or emissions of pollutants may increase. Co-firing it with natural gas increases the heat content of the fuel and improves combustion and equipment performance. As long as the electricity or heat produced with the biomass and landfill gas was otherwise going to be produced with non-renewable fuels, the benefits are essentially equivalent whether they are co-fired or combusted alone. Also, co-firing can be used to lower the emission of some pollutants.

Biomass resources include woody, non- woody and animal manure, residues from food and paper industries, agricultural residues, wood wastes from industry and forestry, municipal wastes, sewage sludge, sugar crops (sugar cane, beet, sorghum), dedicated energy crops such as short-rotation (3-15 years) coppice (willow, eucalyptus, poplar), grasses (Miscanthus), oil crops (soy, sunflower, oilseed rape, jatropha, palm oil) and starch crops (corn, wheat). Residues and organic wastes have been the key biomass sources so far, but energy crops are achievement importance and market share. With re-planting, biomass combustion is a carbon-neutral process as the CO2 emitted has until that time been absorbed by the plants from the atmosphere. Residues, wastes, bagasse are primarily used for heat & power generation. Starch sugar, and oil crops are primarily used for fuel production. Cheap, high-quality biomass (e.g., wood waste) for power production may become limited as it is also used for heat production and in the paper industry and pulp industry. New resources based on energy crops have larger potential but are more costly.

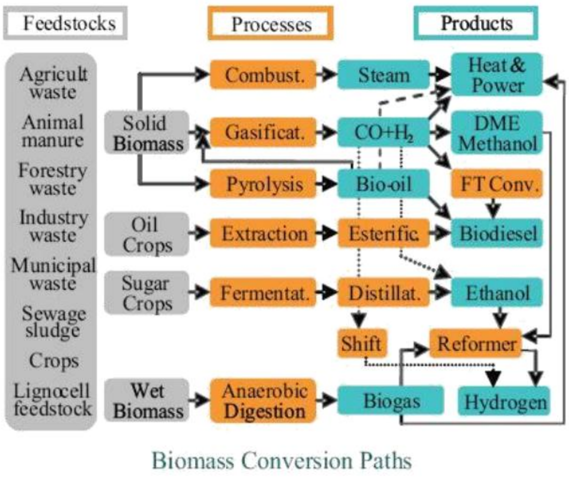

Figure1.4: Feedstock & Processes

In India, there are over 11 million small-scale registered industrial units that provide employment to more than 27 million people. They contribute to 40% of the country's industrial production and 34% of exports. A major number of these units require large quantities of electrical energy. The high cost of supply, which is mostly unpredictable and unreliable on account of scheduled / unscheduled power cuts, drives industries to invest in imprisoned power generation. As fossil fuels are limited and polluting, such order provides an attractive platform to renewable for providing different energy solutions to particularly small and medium enterprises, industrial and commercial establishments.

Under a broad rural development policy, the increase in crop diversity agricultural productivity, crop diversity and the generation of rural income and employment have been given high priority in many developing countries. Promoting and improving rural industries, naturally, is an important strategy for attaining such policy objectives. The majority of small industries are in peri-urban and rural areas. For fuel, majority still uses wood and agricultural residues. The traditional processes in small-scale industries are often traditional and operate under highly competitive conditions. They must compete with both similar scale producers as well as larger scale producers using more modern and technically advanced production facilities. They are relatively isolated from the source of skills, know-how and technology that would allow improvements in their operations, energy, etc. In addition, the very nature and location of the small industries often reinforce their isolation from formal sources of financial, technical and other assistance. Yet, small industries have been recognized to have important role in the growth and stability of national, rural economies and the survival of subsistent economies. The sector provides income and/or local employment to many people. It has also been found that biomass energy typically generates 10 times more employment than oil and coal.

DISCUSSION

Gasification-based small modular biomass systems are emerging as a promising technology to supply electricity and heat to rural areas, businesses and the billions of people who live without power worldwide. Biomass Program support through subcontracted efforts with private sector companies over the past several years, has advanced several versions of the technology to the point where they are now approaching commercialization. By adopting a standardized modular design, these 5 kW-to-5 MW systems are expected to lend themselves to high volume manufacturing techniques to bring them on a competitive level with large standalone plants. Using locally available biomass fuels such as wood, crop waste, animal manures and landfill gas, small modular systems can be brought to the source of the fuel rather than incurring transportation costs to bring biomass fuels to a large centrally located plant. Small modular biomass systems also fulfil the great market potential for distributed, on-site, electric power and heat generation throughout the world. Small modular biomass systems typically convert a solid biomass fuel into a gaseous fuel through a process called gasification. The resulting gas, comprised primarily of carbon monoxide and hydrogen, is then cleaned before use in gas turbine or internal combustion engine connected to an electrical generator. Waste heat from the turbine or engine can also be captured and directed to useful applications. Small modular systems lend themselves to such combined heat and power operations much better than large central facilities.

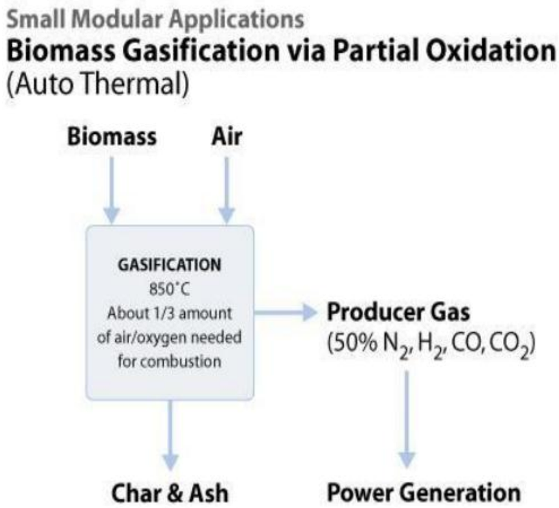

Figure1.5: Small Modern Uses

Small Modular biomass systems offer many benefits to potential customers. They have minimal environmental impact when compared to other existing technologies using coal or biomass as the fuel. On the one hand, economics can be attractive when owners connect the unit to a power grid that will buy unused power.

On the other, small modular systems can electrify isolated areas for which the cost of connection to the grid is prohibitive. Another economic benefit may be realized if the customer has a biomass waste stream that can be converted into a source of energy rather than being an economic burden. The flexibility to use more than one fuel also appeals to many users. Modern microprocessor control has been coupled to gasification technology to result in systems requiring minimal operator attention. And, in off-grid locations small modular biomass systems offer the potential for lights, refrigeration, heat and power to enable small cottage industries to become economically viable.

CONCLUSION

There are various type of renewable energy sources such as solar, wind, hydropower, biomass energy etc. out of these renewable energy sources, biomass is more economically viable for almost all the continents in the world. Biomass is a carbonaceous material and provides both the thermal energy and reduction for oxides, where as other renewable energy sources can meet our thermal need only. Till date, India has been capable to generate only 2000 MW. Air/Atmospheric Pollution is a major challenge faced by the world today and impacts all of us in so many different ways. Importantly, our ability to effectively address air pollution is fundamental to our pursuit of promoting sustained economic growth and sustainable development.

Our approach in dealing with pollution issues is, therefore, built around the high priority accorded by developing countries to economic growth and poverty eradication. Biodiesel, another transportation fuel, can be produced from left-over food products like vegetable oils and animal fats. Biomass fuels provide about 3 percent of the energy used in the United States. People in USA are trying to develop ways to burn more biomass and less fossil fuel. Using biomass for energy can cut back on waste and support agricultural products grown in the United States. Biomass fuels also have a number of environmental benefits.

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