

Module - III (RBS)

Bio Mass Energy

Biomass is a general term for living material - plants, animals, fungi - bacteria. taken together, It has been estimated that just one eighth of the total biomass produced annually would provide all of human's current demand for energy. and since biomass can be re-grown it is a potentially renewable resource.

→ Energy obtain from biomass is known as biomass energy. Animal feed on plant and plant grow through photosynthesis process using solar energy. thus the photosynthesis process is primarily responsible for generation of biomass energy.

→ A small portion of the solar radiation is captured and stored in plant during the photosynthesis process. therefore it is an indirect form of solar energy.

Biomass resources for energy production encompasses a wide variety of material ranging from silviculture forest, agriculture and industrial and social activities that produce organic waste residue when plants are cultivated especially for the purpose of energy. It is known as energy farming.

Forest - Forest natural as well as cultivated, serve as a source of fuel wood, charcoal and produce gas. Forest waste and residue from forest-processing industries can be utilized at the mill itself.

Grain - Such as maize, barley, rice and wheat provide starch which can be converted to ethanol.

oil producing plants

diesel engine test over 40 different plant-derived oil have been evaluated including sunflower.

aquatic plants

some water plant grow faster than land-based plant and provide raw material for producing biogas or ethanol.

urban waste

urban waste is of two types

① municipal solid waste

② Energy from MSW can be obtained from direct combustion or as a landfill gas

Biomass Conversion Technology

There are many different way of extracting energy from biomass.

These energy-conversion technologies maybe grouped into four basic types

- ① Physical method
- ② Incineration
- ③ Thermochemical
- ④ Biochemical

(a) Physical Method

The simplest form of physical conversion of biomass is through compression of combustible material, its density is increased by reducing the volume by compression through the process called pelletization.

(b) Pelletization

Pelletization is a process in which waste wood is pulverized, dried and forced under pressure through an extrusion device. The extruded mass is in the form of pellets, facilitating its use in steam power plant and gasification system.

Pelletization reduces the moisture to about 7 to 10 percent and increases the heat value of biomass.

(c) Briquetting

Biomass briquettes are made from woody material and are replacement for fossil fuel such as oil or coal and can be used to heat boiler in manufacturing plants. Burning a wood briquette is far more efficient than burning firewood.

The moisture content of briquette can be as low as 4% whereas for green firewood it may be as high as 65%.

(d) Fuel Extraction

occasionally milky latex is obtained from freshly cut plants. The material is called ~~exudates~~ and is obtained by

cutting the stem or trunk of living plants. Some plants are not amenable to tapping and in such cases the whole plant is crushed to obtain the product.

For example - plant is crushed to extract hydrocarbons of less molecular weight than rubber which may be used as a petroleum substitute.

(e) Incineration

Incineration means direct combustion of biomass for immediate useful heat.

The heat and steam produced are either used to generate electricity or provide the heat for industrial process, space heating, cooking or district heating.

(f) Thermochemical

The basic thermochemical process to convert biomass into a more valuable and / convenient product is known as pyrolysis. Biomass is heated either in absence of oxygen or by partial combustion of some of the biomass in restricted air or oxygen supply.

→ Pyrolysis can process all forms of organic material including rubber and plastic which cannot be handled by other method. The product are three types of fuel - usually a gas mixture (H_2 , CO_2 , CH_4 , and H_2) an oil like liquid water - soluble phase including oil and tar and a nearly pure carbon char.

→ The distribution of these products depends upon the type of feedstock, the temperature

and pressure during the process and its duration and the heating rate.

→ High temperature pyrolysis (upto 1000°C) maximizes the gaseous product, the process is known as gaseous product gasification.

→ Low temperature pyrolysis (upto 600°C) maximizes the char output. the process is known as (250-450°C), high pressure (270 atm) thermochemical conversion of wet biomass.

(6) Biochemical

The process makes use of metabolic action of microbial organisms on biomass to produce liquid and gaseous fuel.

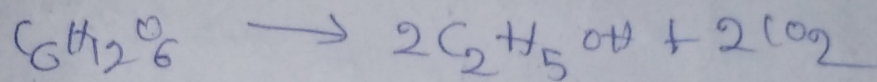
two major biochemical processes are explained below:

✓ (a) Ethanol fermentation

Alcoholic alcoholic fermentation is the decomposition in the absence of air, of simple hexose sugar. Sugar containing six

carbon atom per molecule. i.e. $(C_6H_{12}O_6)$

→ In aqueous solution by the action of enzyme (a natural catalyst) present in yeast, in acidic conditions thus



The products are ethanol and carbon dioxide

✓ (b) Anaerobic fermentation

This process convert decaying and biomass and animal wastes into biogas. through the decomposition process by the action of anaerobic bacteria (bacteria that live grow in absence of oxygen). Carbon present in

carbon present in biomass may be ultimately divided between fully oxidized CO_2 and fully reduced CH_4 thus

decaying ~~wet~~ biomass $\rightarrow$ biogas
 CH_4 and CO_2

$\rightarrow$ The biomass material in the form of water slurry is digested by the bacteria anaerobically for several days in an air tight container. The reaction are slightly exothermic and a small amount of heat per kg dry digestible is also generated that helps in maintaining a favourable temperature.

Prepared by
Madhumini Mahapatra