



BMS INSTITUTE OF TECHNOLOGY AND MANAGEMENT

VI SEMESTER

Renewable Energy Resources(18EE653)

“BIOMASS ENERGY”

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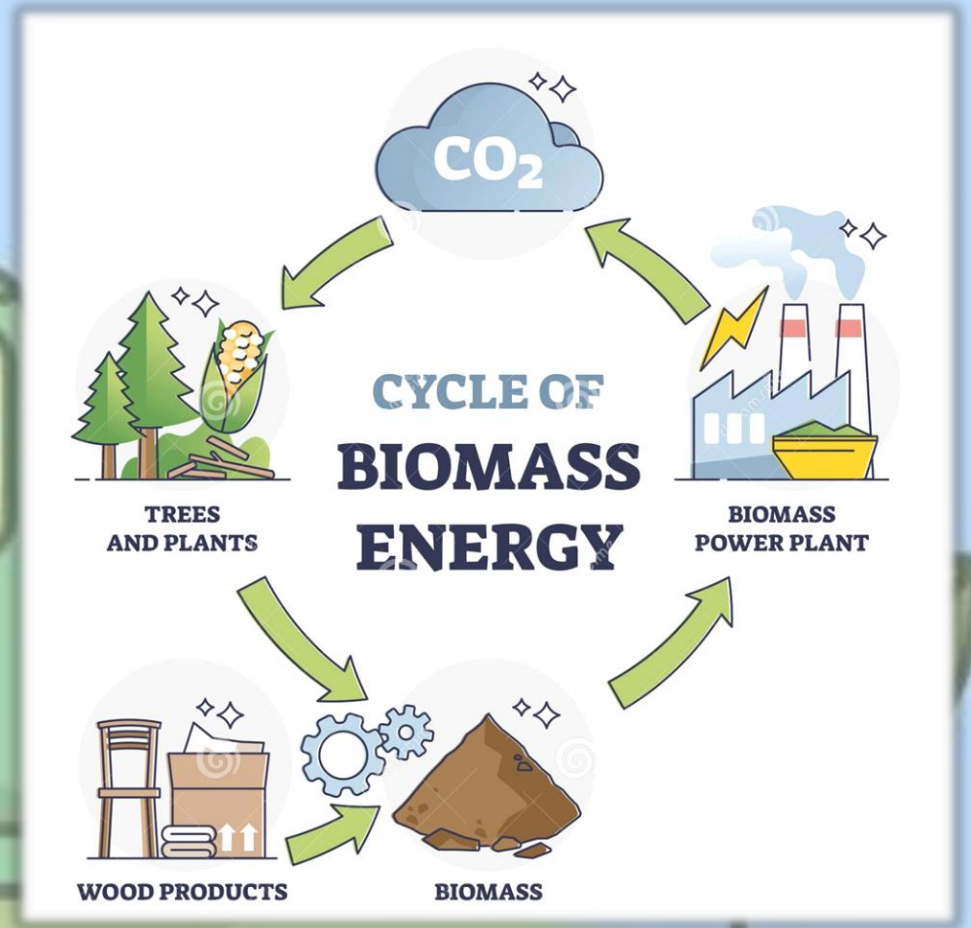
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BIOMASS PRODUCTION

➤ The term biomass refers to those organic matters that are stored in plant and trees in the form of carbohydrate (sugar). It is then transferred through food chains in humans, animals, and other living creatures and their wastes.

➤ The term biomass includes all plant life: trees, agricultural plants, bush, grass and algae, and their residues after processing.



BIOMASS PRODUCTION

- Biomass may be obtained from forest woods, agricultural lands, arid lands, and even waste lands.
- It may be obtained in a planned or unplanned manner.
- The term is also generally understood to include animal and human waste.
- Biomass has the advantage of controllability and availability when compared to many other renewable energy options.
- Wood and wood residues is the largest biomass energy source today. Wood can be used as a fuel directly or processed into pellet fuel or other forms of fuels.



Pellet fuels are a type of solid fuel made from compressed organic material. Wood pellets are generally made from compacted sawdust.

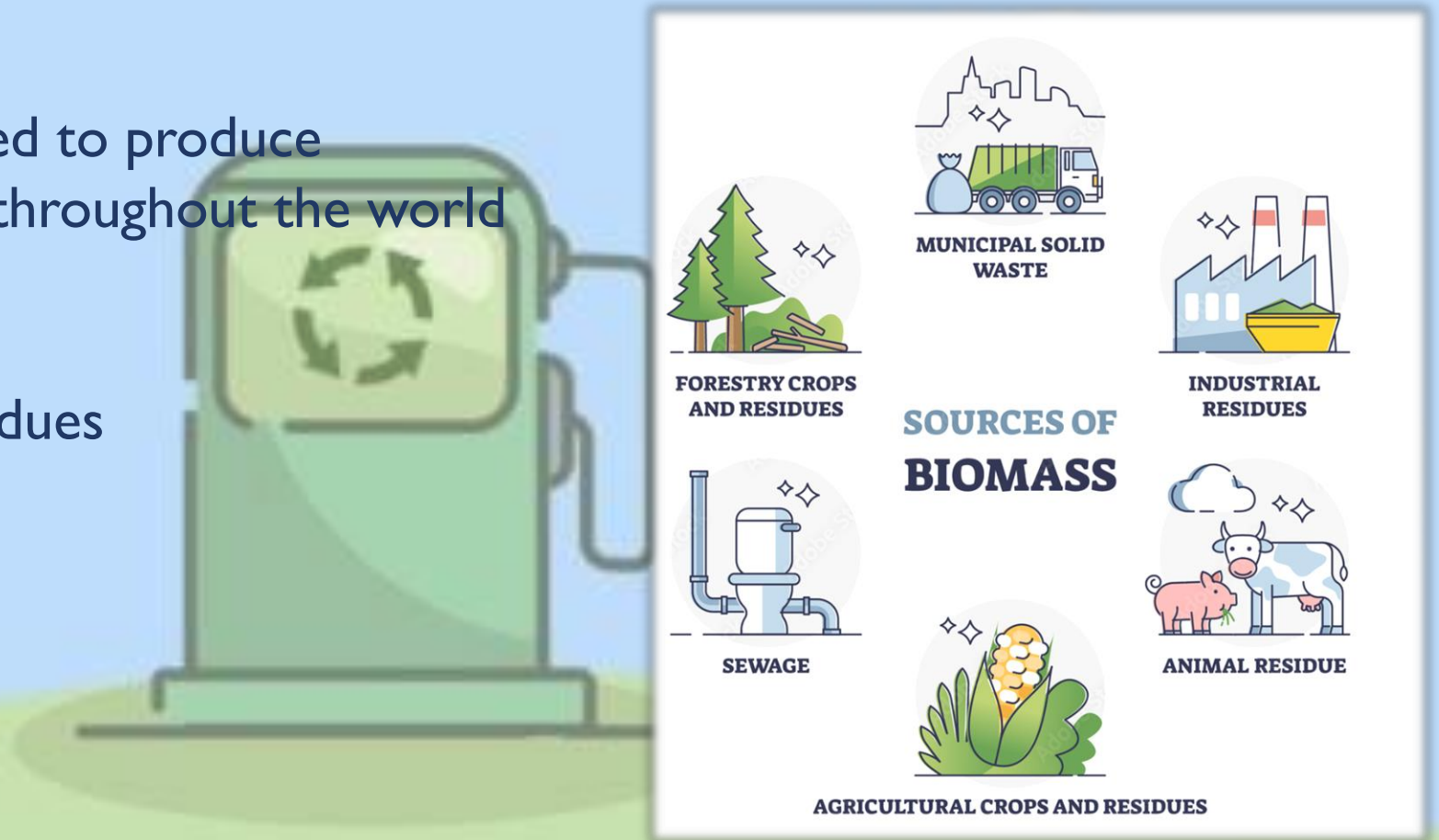
BIOMASS PRODUCTION

These may be broadly classified as direct methods and indirect methods.

Direct Methods:

Raw materials that can be used to produce biomass energy are available throughout the world in the following forms:

1. Forest wood and wastes
2. Agricultural crops and residues
3. Residential food wastes
4. Industrial wastes
5. Human and animal wastes
6. Energy crops



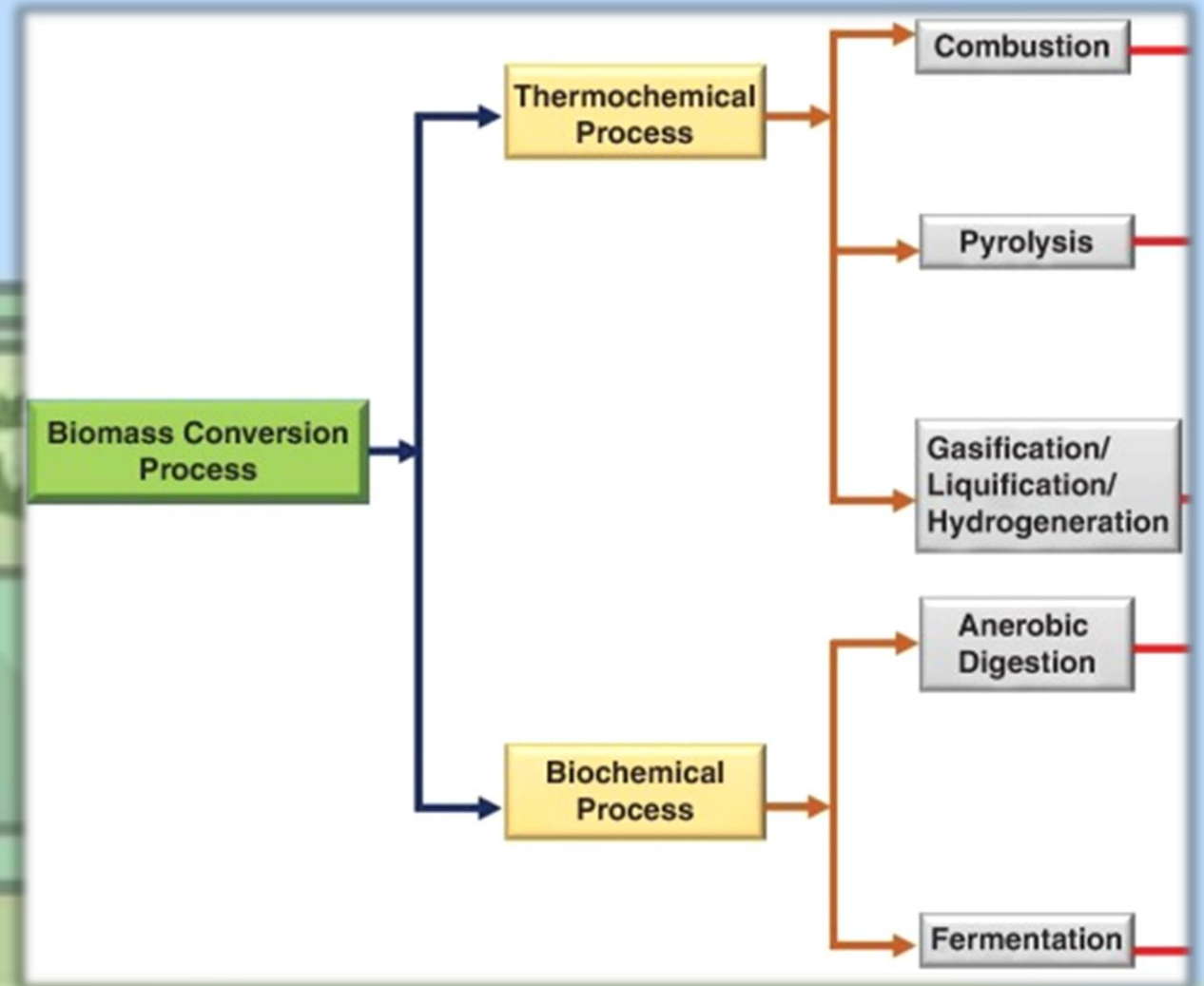
BIOMASS PRODUCTION

Indirect Methods:

Biomass can also be used indirectly by converting it either into electricity and heat or into a convenient usable fuel in solid, liquid, or gaseous form.

The efficient conversion processes are

1. Thermo-electrical conversion
2. Biomass conversion to fuel



ENERGY PLANTATION

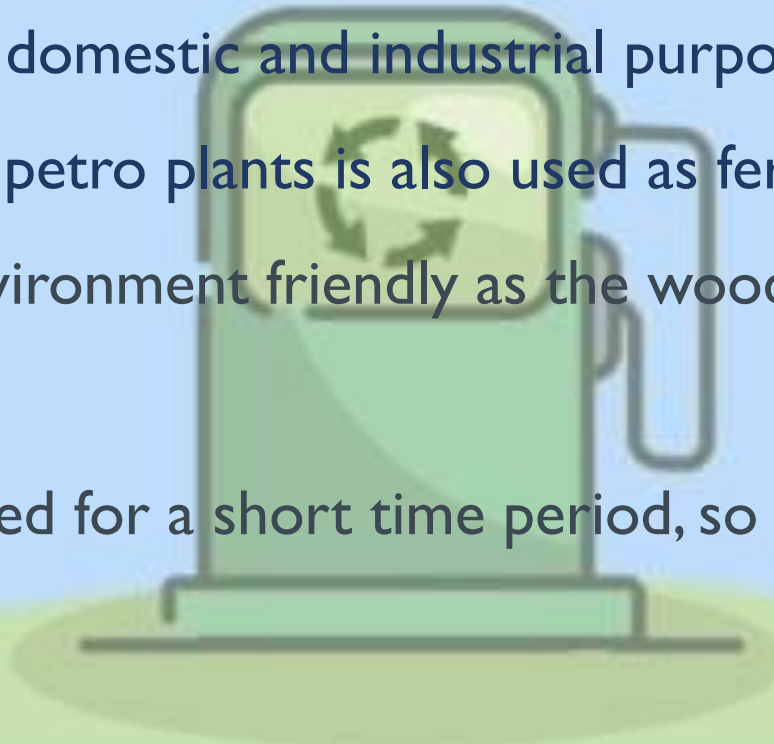
- In this , selected species of trees are planted and harvested over regular intervals of time in a phased manner so that wood is continuously available for cooking or allied purposes.
- Energy plantations include, amongst others, pine, cottonwood, hybrid poplar, sweetgum, and eucalyptus. The wood grown in this manner can be used as a fuel for the boilers of a conventional power plant.



ENERGY PLANTATION

Advantages of energy plantation:

- Energy plants are mainly harvested for fuel, so they produce a good amount of heat that can be used for domestic and industrial purposes.
- The ash produced by the petro plants is also used as fertiliser.
- The energy plants are environment friendly as the wood is low in sulphur, and they are non-pollutants.
- Energy plants are harvested for a short time period, so they are renewable sources of energy.



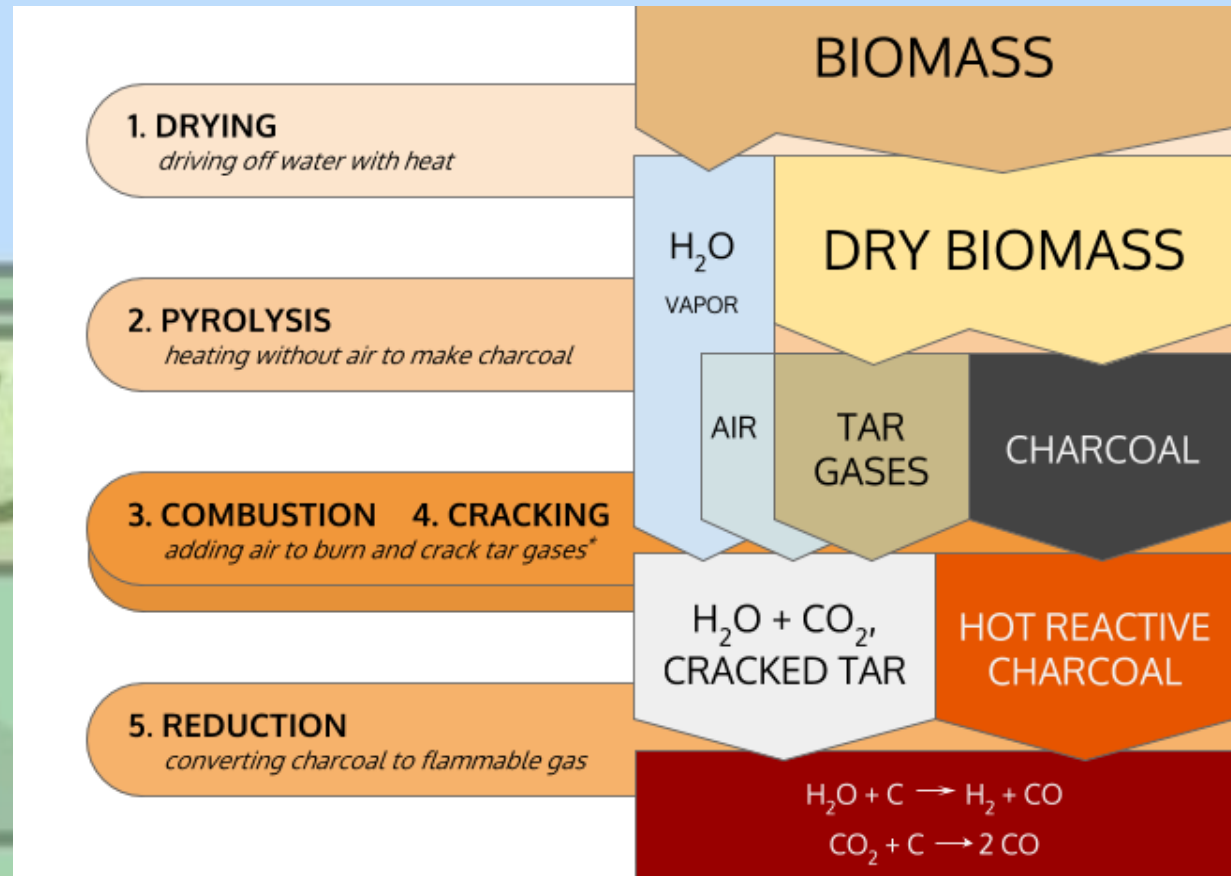
BIOMASS GASIFICATION

➤ Biomass gasification is a process of partial combustion in which solid biomass usually in the form of pieces of wood or agricultural residue is converted into a combustible gas mixture.

➤ Gasification processes are as follows:

1. Drying of fuels: It is the process of drying biomass before it is fed into gasifier.

2. Pyrolysis: It is a process of breaking down biomass into charcoal by applying heat to biomass in the absence of oxygen.

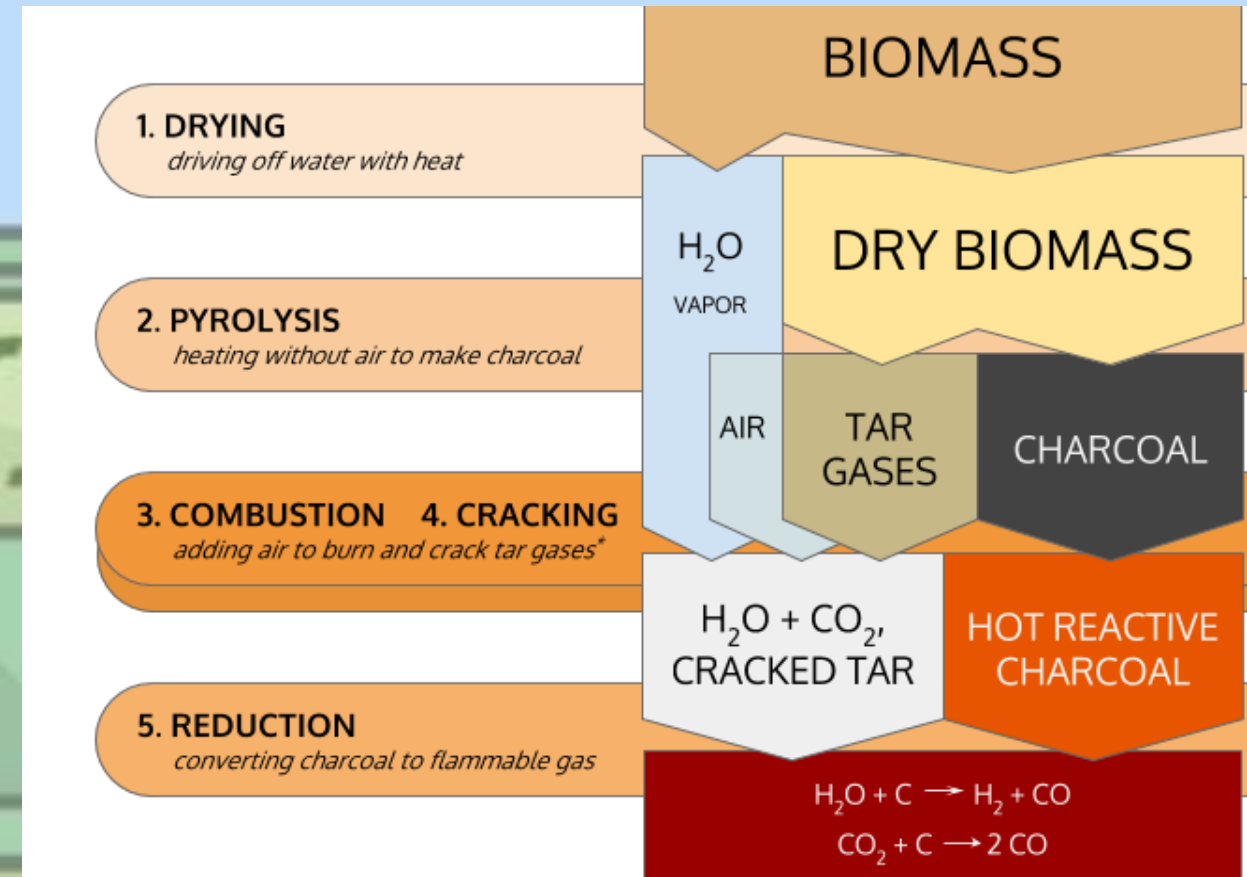


BIOMASS GASIFICATION

3. Combustion: All the heat required for different processes of gasification are made available from combustions.

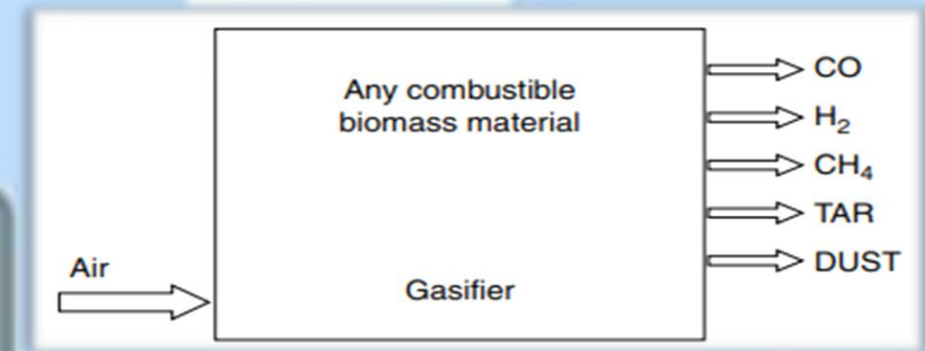
4. Cracking: In this process, breaking down of large complex molecules (such as tar) takes place when heated into lighter gases.

5. Reduction: Oxygen atoms are removed in this process from the combustion products (hydrocarbon) molecules and returning them to combustible form again.



THEORY OF GASIFICATION

- Gasification may be considered as a special case of pyrolysis where destructive decomposition of biomass (wood wastes) by heat is converted into charcoal, oils, tars, and combustible gas.
- It is referred to as the partial combustion of solid fuel (biomass) and takes place at temperatures of about $1,000^{\circ}\text{C}$.
- The reactor used for gasification is called a gasifier. The key to gasifier design is to create conditions such that
 1. Biomass is reduced to charcoal.
 2. Charcoal is converted at suitable temperature to produce CO and H₂.



Products of gasifiers

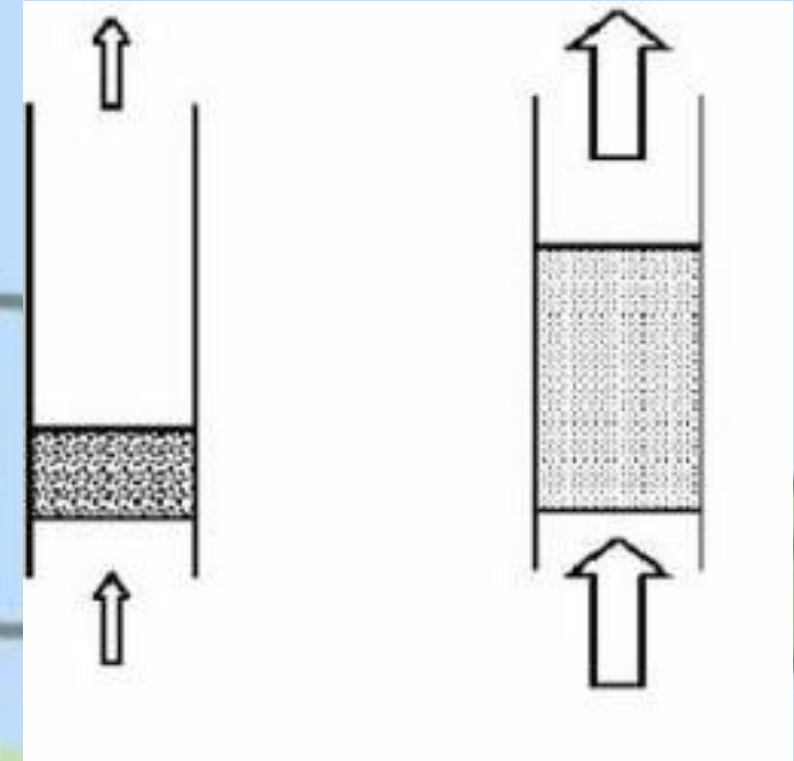
GASIFIER AND ITS CLASSIFICATION

➤ Fixed bed gasifier:

In this gasifier, biomass fuels move either countercurrent or concurrent to the flow of gasification medium (steam, air, or oxygen) as the fuel is converted to fuel gas.

➤ Fluidized bed gasifier:

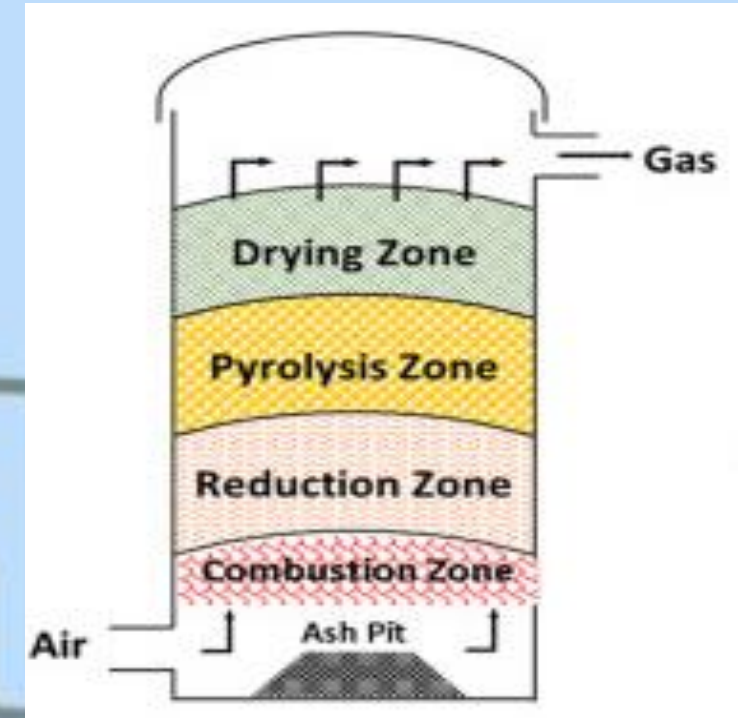
In fluidized bed gasifier, an inert material (such as sand, ash, or char) is utilized to make bed and that acts as a heat transfer medium.



GASIFIER AND ITS CLASSIFICATION

UPDRAFT GASIFIERS:

Updraft gasifier has air passing through the biomass from bottom and the combustible gases come out from the top of the gasifier.

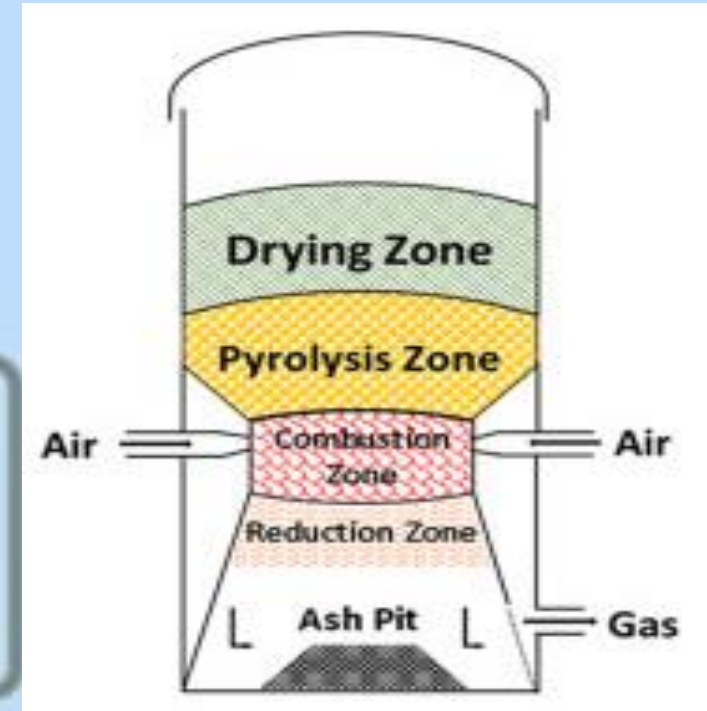


UPDRAFT GASIFIER

GASIFIER AND ITS CLASSIFICATION

DOWNDRAFT GASIFIERS:

In the downdraft gasifier, the air is passed from the layers in the downdraft direction. Single throat gasifiers are mainly used for stationary applications, whereas double throat gasifier is used for varying loads as well as automotive purposes.

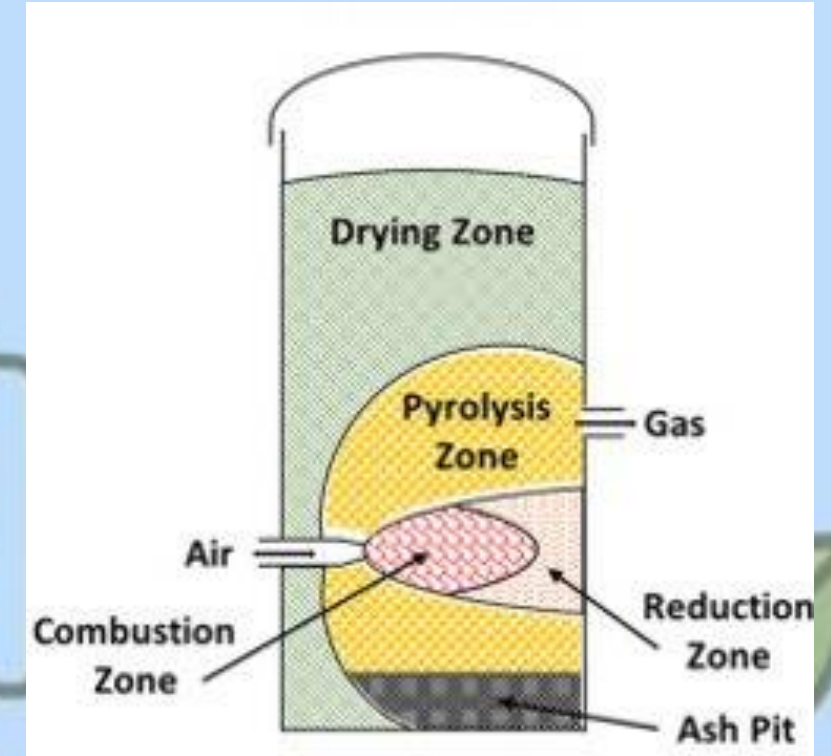


DOWNDRAFT GASIFIER

GASIFIER AND ITS CLASSIFICATION

CROSSDRAFT GASIFIERS:

It is a very simple gasifier and is highly suitable for small outputs. In this, air enters from one side and fuel is released from the opposite side.



CROSSDRAFT GASIFIER

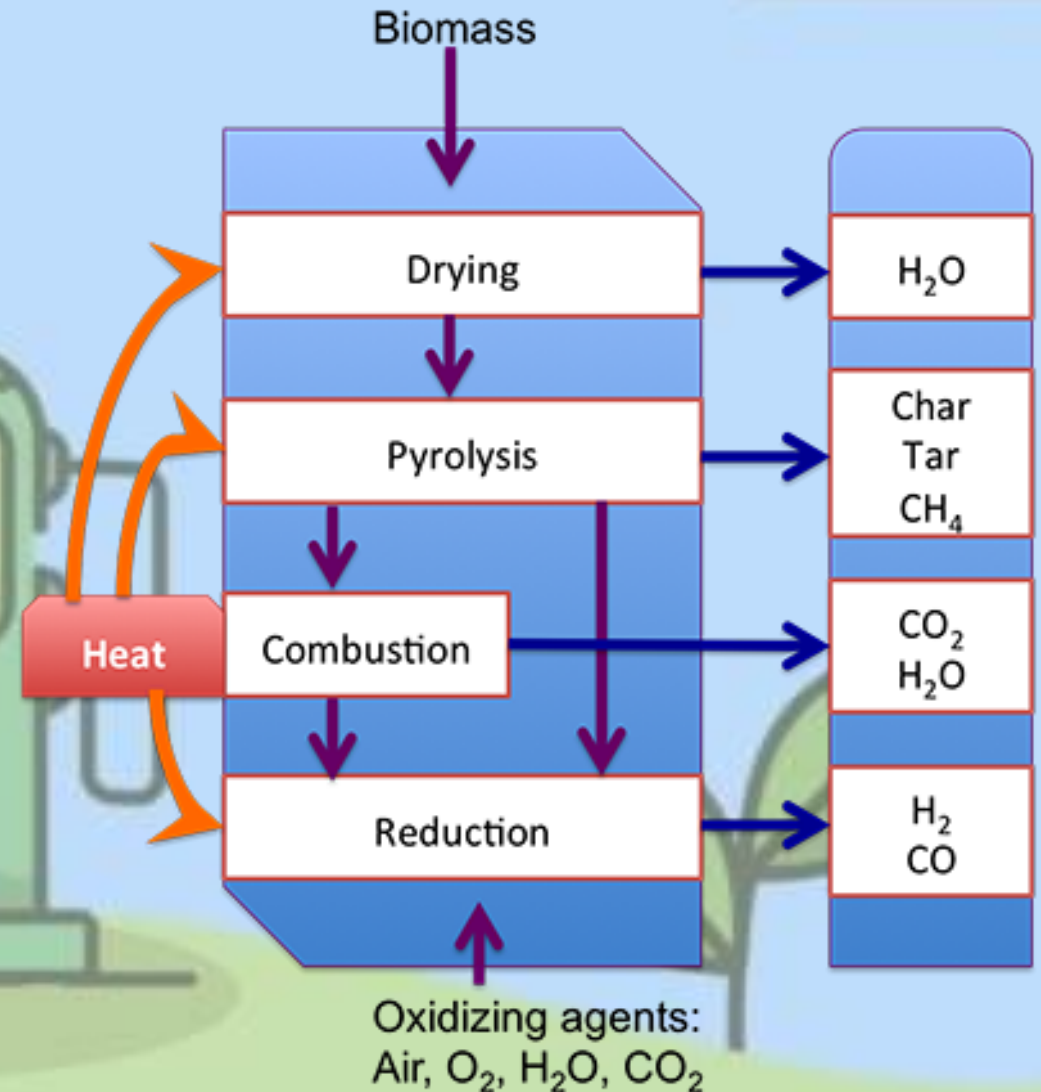
CHEMISTRY OF REACTION PROCESS IN GASIFICATION

1. Drying zone of fuel:

In this zone, the moisture content of biomass is removed to obtain the dry biomass. Some organic acids also come out during the drying process. These acids give rise to corrosion of gasifiers.

2. Pyrolysis zone:

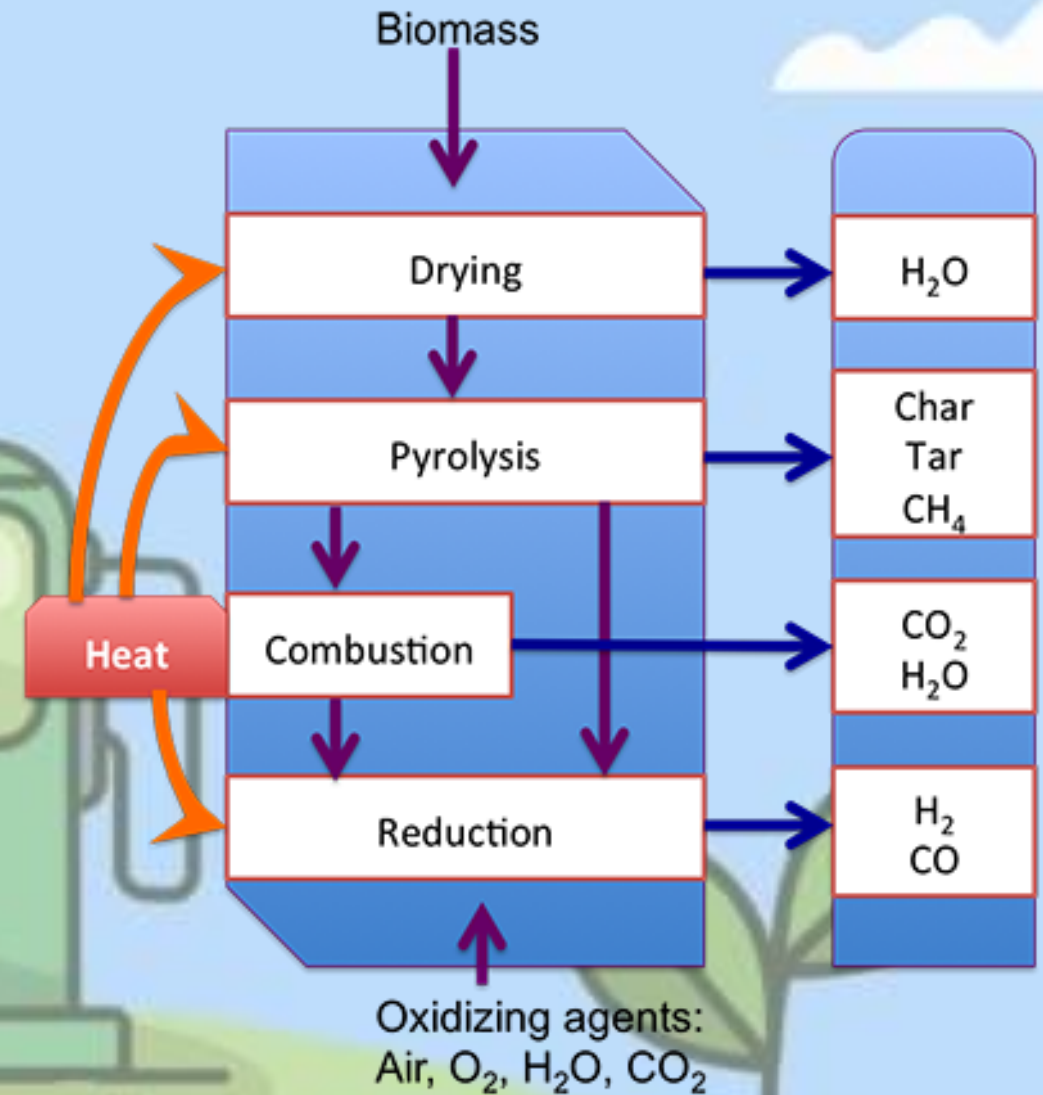
In this zone, the tar and other volatiles are driven off. The products depend upon temperature, pressure, residence time, and heat losses.



3. Combustion(oxidation) zone: In this zone, carbon from the fuel combusts and forms carbon dioxide with the oxygen in the air by the reaction:



4.Reduction zone: The hot gas passes through the reduction zone after the combustion zone. As there is no free oxygen in this zone that causes inflammable carbon dioxide gas to react with the carbon in the fuel and forms flammable carbon monoxide gas. This reaction is endothermic and occurs at temperature exceeding about 1,000°C.



THANK YOU....!

