Coal gasification

Coal gasification technology is the conversion of a carbonaceous material (ex. coal) by reaction with oxygen and steam to produce synthesis gas (syngas), syngas is a mixture consisting primarily of carbon monoxide (CO), hydrogen (H_2), and other gaseous compounds.

Gasification occurs in a gasifier, generally a high temperature/pressure vessel where oxygen (or air) and steam are directly contacted with the coal or other feed material causing a series of chemical reactions to occur that convert the feed to syngas and ash/slag.

The gasification efficiency of these processes are very high and they are suitable for a wide range of feed material. **The gases produced by the gasifier are mainly used as a fuel and for ammonia making in fertilizers plants.**

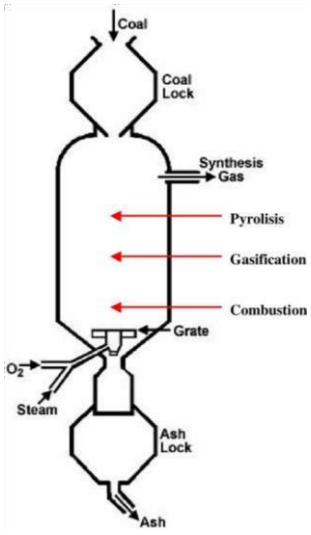

Fig.1 : Coal gasifier

Coal liquefaction

Coal liquefaction is a process where coal is converted into liquid fuels, mainly to provide substitutes for petroleum products, which may be either used directly as fuel or converted into chemicals or other liquid fuels.

Coal liquefaction processes were first developed in the early 20th century. The crude petroleum rich countries may not need this process for fulfilling their requirement of liquid fuel but the countries which are lacking of crude but have a good reserve of solid fuel like coal, a large scale applications of coal liquefaction process is entertained.

There are several processes used to accomplish this task, the two most common being the "direct route" and the "indirect route"

In the direct route, coal is pulverized and reacted with a catalyst, then hydrogen is added under high pressures and temperatures in the presence of a solvent to produce a raw liquid fuel. This raw fuel requires refining in order to yield acceptable transportation fuels.

The indirect route is composed of 2 steps: First, coal is gasified with steam and oxygen to produce a synthesis gas (syngas), which is then cleaned to rid of dust, tar, and acid gases. The second step reacts the synthesis gas with a catalyst in the Fischer-Tropsch process, which converts the syngas into a range of hydrocarbon fuels such as gasoline, diesel and methanol.

Wood

Wood is a domestic fuel used in tropical countries where forests are abundant and other fuels are not easily & cheaply available.

- Main combustible components of wood are: cellulose & lignin, which are compounds of carbon (50%), hydrogen (6%) and oxygen (44%).

- The major non-inflammable component of wood is water which is present up to 25-50% in freshly cut wood. Normally, it is used after air-drying to 10-15% water.

- The ash content of wood is very low (< 1%) but because of its very high oxygen content (up to 45%), its calorific value is very low (4000-5000 kcal/kg).

dried hardwood(Proximate Analysis):

Cellulose= 50%		Lignin	= 30%
Resin + wax= 2%		Moisture	= 15%
Ash= 0.5%		Water solubles	= 2.5%
Calorific value=	4500 Kcal/kg	Density	= 650 kg/m^3.

Ultimate analysis of typical air dried wood:

Carbon = 50%, Hydrogen = 6%,Oxygen=44%.

Burning characteristics of wood:

- It can be ignited easily.
- Smaller pieces of wood burn more readily compared to large pieces.
- It burns with a long non-smoky flame when burned in excess air.

Uses of wood:

It is used:

1. As domestic fuel on large scale in India and for furniture making.
2. To produce wood charcoal by its carbonisation or destructive distillation.
3. To produce producer gas by its gasification.

Charcoal

Charcoal is an impure form of carbon that is obtained by partial burning of carbonaceous materials (wood) at 600°C in the presence of limited oxygen to remove all water and volatile constituents. Charcoal is a manufactured product created from wood. Used as **a fuel, a carbon source, for purification and filtration purposes, etc.**

Characteristics of products of low temperature carbonisation of wood are:

- Charcoal yield is high (35%)
- Ash content of charcoal is low (< 2.5%)
- Volatile matter in charcoal is high (upto 15%), hence it can be easily ignited and burns at low rates.
- Heating value of charcoal is high (7500 kcal/kg)
- Charcoal produced has high vapor adsorption capacity.