



19CH101 – ENGINEERING CHEMISTRY FOR CIRCUIT BRANCHES

Unit-4

FUELS AND COMBUSTION

FUELS

Fuel is a combustible substance, containing carbon as a main constituent, which on proper burning gives large amount of heat, which can be used economically for domestic and industrial purpose.

Example : Wood, charcoal, coal, kerosene, petrol, diesel, producer gas, oil gas etc.

TYPES

Fuels are classified into

- (i) Primary or Natural fuels - These are found in nature.
- (ii) Secondary or Artificial fuels - These are derived from primary fuels.

COAL

Coal is an important primary solid fuel that has been formed as a result of alteration of Vegetable matter under some favourable conditions.

The process of conversion of lignite to anthracite is called coalification (or) metamorphism of coal.

CLASSIFICATION OF COAL

a) Peat

1. Peat is the first stage in the formation of coal.
2. Its calorific value is about 4000-5400 k cal/kg.
3. It is an uneconomical fuel due to its high proportion of (80 -90%) moisture and lower calorific value.
4. It is a brown fibrous mass.

b) Lignite

1. Lignite is an intermediate stage in the process of coal formation.
2. Its calorific value is about 6500-7100 k cal/kg
3. Due to the presence of high volatile content, it burns with low smoky flame.

c) Bituminous coal

Bituminous coal is further sub-classified on the basis of its carbon content into three types as: i) Sub-bituminous coal, ii) Bituminous coal and iii) semi-bituminous coal.

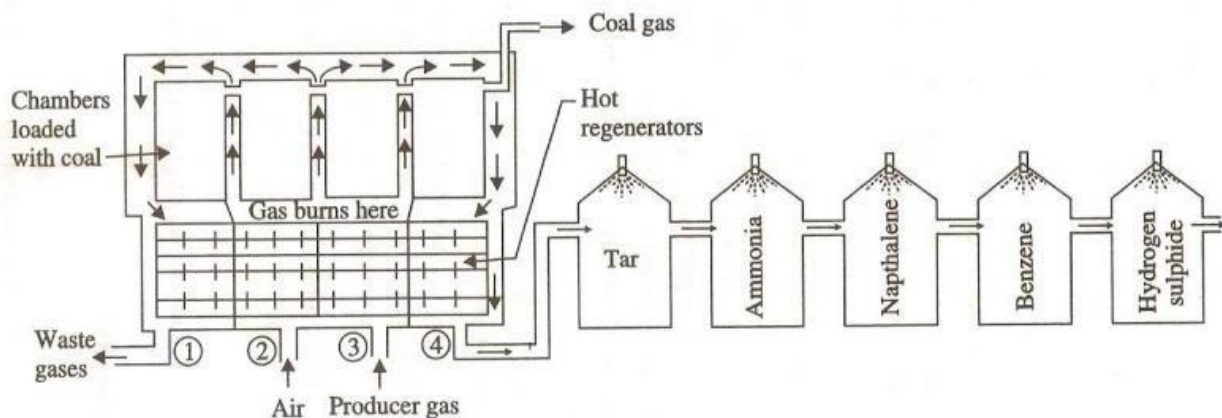
d) Anthracite

1. Anthracite is the superior grade of coal.
2. Its volatile, moisture and ash contents are very less.
3. Its calorific value is about 8650 k cal/kg



MANUFACTURING OF METTULURGICAL COKE BY OTTO-HUFFMANN METHOD

In order to increase the thermal efficiency of the carbonization process and recover the valuable by products (like coal gas, ammonia, benzene, etc.) Otto Hoffman developed modern by-product coke oven. The oven consists of a number of silica chambers. Each chamber is about 10 - 12 m long, 3 - 4 m height and 0.4 - 0.45 m wide. Each chamber is provided with a charging hole at the top, it is also provided with a gas off take valve and iron door at each end for discharging coke.



Coal is introduced in to the silica chamber and the chambers are closed. The chambers are heated upto 1200°C by burning pre heated air and the producer gas mixture in the interspaces between the chambers.

The air and gas are preheated by sending them through 2nd and 3rd hot regenerators. Hot flue gases produced during carbonization are allowed to pass through 1st and 4th regenerators are heated by hot flue gases, the 2nd and 3rd regenerators are used for heating the incoming air and gas mixture.

For economical heating, the direction of inlet and flue gases are changed frequently. The above system of recycling the flue gases to produce heat energy is known as the regenerative system of heat economy. When the process is complete, the coke is removed and quenched with water.

Time taken for complete carbonisation is about 12 - 20 hours. The yield of coke is about 70 %.

The valuable by products like coal gas, tar, ammonia, H_2S and benzene, etc are removed from the flue gas.



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Recovery of by products

i) Tar

The coke oven gas is first passed through a tower in which liquor ammonia is sprayed. Tar and dust get collected in a tank below, which is heated by a steam coil to recover back the ammonia sprayed.

ii) Ammonia

The gas is then passed through the other tower where water is sprayed. Ammonia gets converted to NH_4OH .

iii) Benzene and other aromatic compounds

The gas is then passed through the next tower in which creosote oil is sprayed. Benzene and other aromatic compounds are dissolved in the oil are recovered.

iv) Hydrogen sulphide

The gas then enters into a purifying chamber packed with Fe_2O_3 , which removes any sulphur compound present in coal gas.

Advantages of Otto Hoffman's process

- o High thermal efficiency and carbonization time is less.
- o Valuable by products (like coal gas, ammonia, benzene, etc. are recovered as by products.
- o Heating done externally by Producer gas.