UNIT-4

Energy sources

fuels: A fuel is a combustible substance, containing carbon as the main constituent, which on burning gives large amount of heat. During the process of combustion of a fuel, the atom of carbon, hydrogen etc combine with Oxygen with simultaneous liberation of heat.

$$C + O_2 \longrightarrow CO_2 + 94 \text{ kcal}$$

$$2H_2 + O_2 \longrightarrow 2H_2O + 68.5 \text{ kcal}$$

The main source of fuel is coal and crude petroleum oil. These are stored fuels available in earth's crust and are generally called fossile fuels, because they were formed from fossilised remains of plants and animals.

Characteristics of a good fuel

* It should be cheap and readily available
* It should not undergo spontaneous combustion.
* It should have higher calorific value.

→ It should have moderate ignition temperature

→ The combustion should be easily controllable.

→ It should have low moisture content.

→ The products of combustion should not be harmful

→ It should have low non-combustible matter or ash content.

→ It should be safe and economical for storage and transport.

classification of fuels

fuels can be classified into two types on the basis of a) their occurrence.

b) physical state of aggregation.

on the basis of occurrences, the fuels are further divided into two types.

1) Natural fuels (or) primary fuels

fuels which are found in nature are called as natural fuels eg: wood, coal, peat petroleum and natural gas.

2) Artificial fuels (or) Secondary fuels

fuels which are prepared artificially from primary fuels are called artificially (or) secondary fuels. Eg: Kerosene, petrol, coalgas, coke etc.

On the basis of physical state of aggregation The fuels are divided into 3 types.

1) solid fuels 2) Liquid fuels 3) Gaseous fuels.

Solid fuels. The fuels are present in solid state is called solid fuels.

Eg: Natural :- wood, peat, lignite, dung, coal.

Artificial :- Charcoal, coke etc.

Liquid fuels : The fuels are present in liquid state is called liquid fuels.

Eg: Natural : crude oil

Artificial :- petrol, diesel, kerosene etc.

Gaseous fuels :- The fuels are present in gaseous state is called gaseous fuels.

Eg: Natural : Natural gas

Artificial: coal gas, oil gas, biogas, water gas.

Solid fuels The main Solid fuels are wood, peat, lignite coal and charcoal.

Coal: Coal is a fossile fuel which occurs in layers in the earth's crust. It is formed by the partial decay of plant materials accumulated millions of years of ago and further altered by action of heat and pressure The process of wood into coal can be represented as

wood → peat → Lignite → Bituminous coal → Anthracite

1) peat :- peat is brown fibrous Jelly like mass.

2) Lignite :- These are soft, brown coloured, lowest rank coals.

3) Bituminous :- These are pitch black to dark grey coal

4) Anthracite :- It is a class of highest rank coal.

fuel	percentage of carbon	Calorific value k/cal/kg	Applications
wood	50	4000 – 4500	Domestic fuel
peat	57	4125 – 5400	Used if deficiency of high rank coal is prevailing
Lignite	67	6500 – 7100	For steam generation in thermal power plants
Bituminous	83	8000 – 8500	In making coal gas and metallurgical coke
Anthracite	93	8650 – 8700	In households and for steamraising

Analysis of Coal Two types of analysis.

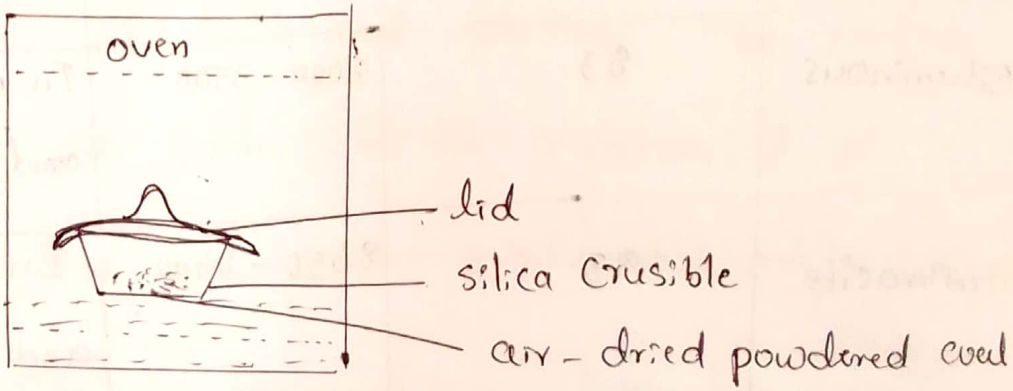
proximate and ultimate

1) proximate analysis It involves the determination of percentage of i) moisture content ii) volatile matter iii) Ash content iv) fixed carbon.

i) Moisture content: About 1 gm of powdered air-dried coal sample is taken in a

crusible and is heated at 100 - 105°C in an electric hot air oven for 1 hour. The loss in weight of the sample is found out and the percentage of moisture is calculated as

$$\text{percentage of moisture in coal} = \frac{\text{loss in weight of coal}}{\text{weight of air-dried coal}} \times 100$$



2) Volatile matter: After the analysis of moisture content the crusible with residual coal sample is covered with alid and is heated at 950 ± 20°C for 7 minutes in muffle furnace. The loss in weight of the sample is found out and the percentage of volatile matter is calculated as

$$\text{percentage of volatile matter in coal} = \frac{\text{loss in wt of coal}}{\text{wt of air-dried coal}} \times 100$$

3) Ash content After the analysis of volatile matter the crusible with residual coal sample is heated without lid at 700 ± 50°c for ½ an hour in a muffle furnace. The loss in weight of the sample is found out and the percentage of ash content is calculated as.

$$\text{percentage of ash content in coal} = \frac{\text{wt of ash formed}}{\text{wt of air-dried coal}} \times 100$$

4) Fixed carbon It is determined by substracting the sum of moisture, volatile and ash content. from 100

percentage of fixed carbon in coal = 100 − % of (moisture, volatile + Ash content).

Significance (or) Importance of proximate analysis

i) Moisture content:- High percentage of moisture is undesirable because it reduces the calorific value of coal.

ii) Volatile matter: High percentage of volatile matter is undesirable because high volatile matter burns

with long flame with high smoke and reduces the calorific value.

iii) Ash content:- High percentage of ash content is undesirable because it causes hindrance to heat flow as well as produces clinkers with blocks the air supply through fuel and reduces the calorific value of fuel.

iv) fixed carbon: High percentage of fixed carbon is desirable because higher the percentage of fixed carbon in a coal, greater is the calorific value.

Ultimate analysis of coal.