A Introduction

A fuel is a substance that contains carbon and hydrogen undergoes combustion in presence of oxygen to gives large amount of energy. (Refer to alternative definition)

$$\text{Fuel} + O_2 \longrightarrow CO_2 + H_2O + \text{Energy}$$

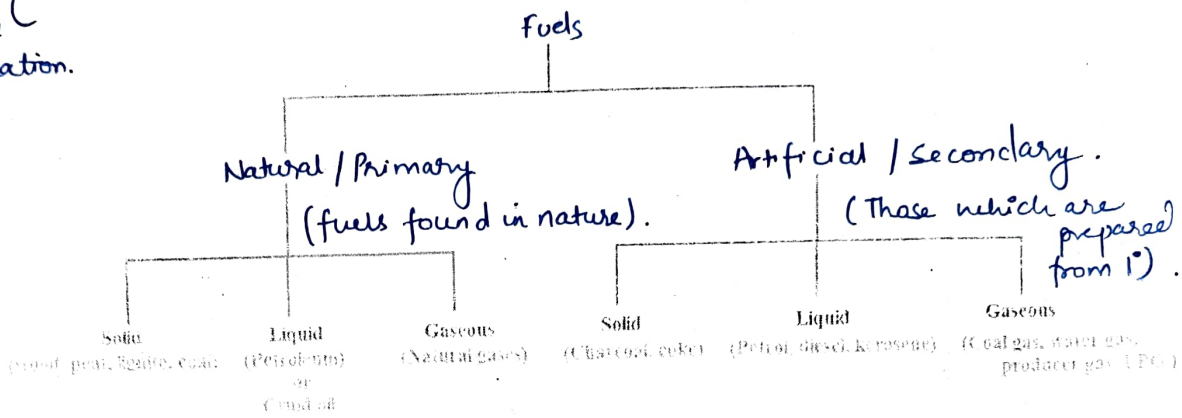
B. Classification of Fuel

On the basis of occurrence fuel is classified into two categories; natural or primary fuels and artificial or secondary fuels.

Classification on the basis of occurrence and preparation.

i) **Natural/primary fuels**: These fuels are naturally present.

ii) **Artificial/ secondary fuels**: They are synthesized by primary fuels.



Characteristics of Good Fuel

i) Fuel should have high calorific value. → Total quantity of heat liberated when unit amount of fuel is burnt completely.

ii) Must have moderate ignition temperature. — lowest temp @ which fuel starts burning smoothly.

iii) Fuel should have low moisture content. → Reduces heating value.

iv) Available in bulk at low cost.

v) Should not burn spontaneously. — spontaneous combustion can cause fire hazard.

vi) Fuel should burn efficiently, without releasing hazardous pollutants.

vii) Handling, storage and transportation should be easy.

viii) Combustion should be easy to start and stop.

C. Unit of heat

i) **Calorie**: it is the amount of heat required to raise the temperature of 1 gram of water through one degree centigrade.

ii) **British Thermal Unit (BTU):** it is the amount of heat required to raise the temperature of 1 pond of water to one degree Fahrenheit.

1 B.T.U. = 252 cal = 0.252 kcal

1 kcal = 3.968 B.T.U.

iii) **Centigrade Heat Unit (CHU):** it is define as the amount of heat required to raise the temperature of 1 pond of water to one degree centigrade.

A.2. fuel: A combustible substance, containing Carbon as main constituent, which on proper burning gives large amount of heat, which can be used economically for domestic and industrial purpose.

A 3. During combustion of a fuel, the atoms of Carbon and hydrogen combine with oxygen with simultaneous liberation of heat at a rapid rate. This energy is liberated due to rearrangement of e^-

A 4. $\text{fuel} + O_2 \longrightarrow CO_2 + H_2O + \text{energy}$.

1 kcal = 3.968 B.T.U. = 2.2 C.H.U.

(D) Calorific value

I. Calorific value of fuel can be define as the amount of heat evolved when one unit mass or volume of the fuel undergoes completely combustion in presence of oxygen.

II. 2. **High or gross calorific value (HCV or GCV)**: it is defined as amount of heat evolve when one unit mass or volume of the fuel is completely burnt and combustible products are cooled to room temperature (25°C or 77°F).

III 2. **Low or net calorific value (LCV or NCV)**: it is defined as amount of heat evolve when one unit mass or volume of the fuel is completely burnt and combustible products are permitted to escape. Therefore net calorific value is lower than gross calorific value.

energy absorbed / released during change in physical state without change in Temp.

LCV = HCV – latent heat of water vapour

LCV = HCV – mass of hydrogen × 9 × latent heat of steam (587 kcal/kg)

One part by mass of hydrogen produced nine parts by mass of water molecule. Therefore,

LCV = HCV – H/100 × 9 × 587 kcal/kg

H = percentage of hydrogen in fuel

Determination of calorific value

i) Bomb calorimeter

Bomb calorimeter is used to determine calorific value of solid and liquid fuels experimentally. A bomb calorimeter contains a cylindrical bomb made by stainless steel. Combustion takes place in this cylinder. The lid contains two stainless steel electrodes. Oxygen is supplied through oxygen valve for combustion. The electrode is attached with a small ring which supports nickel or stainless steel made crucible. The bomb is taken in a copper calorimeter which is surrounded by air and water jacket in order to prevent heat loss by radiation. The copper calorimeter also contains electrically operated stirrer and Beckmann's thermometer (take reading with temperature difference up to 0.01°C.

(D) Calorific Value:

II. HIGH / GROSS CALORIFIC VALUE

1. Usually all fuels contains some H. The calorific value of H containing fuel is ~~burnt spontaneously~~ determined experimentally, the H is converted to steam.
If the product of ~~combu~~ combustion are cooled down - condensation takes place @ RT., The Latent heat of condensation of steam also gets included in the measured heat, which is called higher or gross calorific Value.

III LOWER / NET CALORIFIC VALUE.

1. In actual the water and moisture are not condensed and escapes long way with hot combustion gases. Hence a lesser amount of heat is available. ∴ lower calorific value.

(E). SOLID FUELS : 'COAL' :- → Coal is highly carbonaceous matter that has been formed as a result of alteration of vegetable matter under favourable condition. Chiefly composed of C, H, N, and O, beside non combustible inorganic matter.

CLASSIFICATION OF COAL -

1. I stage of coal formation is PEAT stage - it's a biochemical stage.
   ↳ SPONGY, POROUS. (Micro-Org. attack on plant waste and form peat.)
2. Metamorphism stage. : CHEMICAL STAGE
   Spongy peat → changes to hard brittle coal. (moisture, O_2 content ↓ces) (C ↑ses).
   ~~10^7~~ 10^7 years.

→ Classified on the degree of coalification → for how much time the wood remain in earths crust).

WOOD — (40-50 %)
↓
PEAT (45-60 %.)
↓
BROWN COAL (LIGNITE). (60-75%)
↓
BITUMINOUS COAL (75-90%)
↓
ANTHRACITE (90-95 %)
↓
Major source of Carbon.

Carbon content ↑ses downwards.
(along with Calorific Value)