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**Fuels:** It is defined as any naturally occurring or manufactured substance which after burning gives a large amount of energy which can be used for domestic and industrial purposes.

### **Classification:**

On the basis of occurrence:

- i) Natural or Primary fuels:- These are found in nature.  
For Ex - wood, coal, Petroleum & natural gas.
- ii) Artificial or Secondary fuels:- The fuels which are prepared artificially. For Ex - Coke, Petrol, kerosene, diesel.

On the basis of Physical state:

- 1) Solid fuels : → Coal, wood, peat (primary)  
Charcoal, Coke (secondary)
- 2) Liquid fuels :- Crude oil (primary)  
Petrol, Diesel, kerosene (secondary)
- 3) Gaseous fuels :- Natural gas (primary)  
Coal gas, water gas, Bio gas (secondary)

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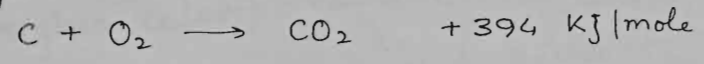
usually occur

### Characteristics of a good fuel :

- 1. It must have high calorific value.
- 2. It must have moderate ignition temperature.
- 3. Its moisture content should be low.
- 4. It should have low ash content.
- 5. It should not pollute the environment.

### Calorific value :

Total amount of heat evolved when unit mass or unit volume of fuel is completely burnt in excess supply of oxygen is known as calorific value of fuel.



- $\Rightarrow$  12 gm - C - produces = 394 KJ of energy
- $\Rightarrow$  1 " " " = 32.83 KJ {Calorific value}

### Units of heat :

(i) Calories : The amount of heat required to raise the temp of 1 kg of water through  $1^\circ C$ . is known as 1 calorie.

1 k Cal = amount of heat required to raise  $1^\circ C$  temp. of 1 kg of water

$$1 \text{ k Cal} = 1000 \text{ Calories} = 4.185 \text{ J}$$

(ii) British Thermal unit (B.Th.U.) :

1(B.Th.U.) = Amount of heat required to raise the temp of 1 lb of water through  $1^\circ F$ .

$$1 \text{ B.T.U.} = 1054.6 \text{ J}$$

grade heat Unit (C.H.U.):

C.H.U. = Amount of heat required to raise the temp. of 1 lb of water through  $1^{\circ}\text{C}$ .

$$1 \text{ Kcal} = 3.968 \text{ B.T.U.} = 2.2 \text{ C.H.U.}$$

$$\left\{ \begin{array}{l} 1 \text{ kg} = 2.2 \text{ lb} \\ 1^{\circ}\text{C} = 1.8^{\circ}\text{F} \end{array} \right.$$

Calorific values of solid and liquid fuels are usually expressed in calories per gram or KCal/kg or B.Th.U./lb.

Calorific values of gases are expressed as K.Cal<sup>s</sup>/m<sup>3</sup> or B.Th.U./ft<sup>3</sup>. There are two types of calorific values of fuels:-

### 1. Gross Calorific value or Higher calorific value (H.C.V.):

It is defined as the amount of heat evolved when unit mass or unit volume of a fuel is burnt completely in excess supply of oxygen and the products of combustion are allowed to cool at room temp.

In this case latent heat of ~~steam~~ steam is also included.

### 2. Net calorific value or Lower calorific value (L.C.V.):

It is defined as the amount of heat evolved when unit mass or unit volume of a fuel is burnt completely in excess supply

oxygen and products of combustion are allowed to escape.

$$\begin{aligned} \text{L.C.V.} &= \text{H.C.V.} - \text{Latent heat of water vapour formed.} \\ &= \text{H.C.V.} - \left\{ \begin{array}{l} \text{Mass of Hydrogen} \\ \text{per unit mass of fuel} \end{array} \right\} \times 9 \times \left\{ \begin{array}{l} \text{Latent} \\ \text{heat of} \\ \text{steam} \end{array} \right\} \end{aligned}$$

if we represent hydrogen as %.

$$\begin{aligned} \Rightarrow \text{L.C.V.} &= \text{H.C.V.} - \frac{H}{100} \times 9 \times 587 \\ &= \text{H.C.V.} - 0.09 \times H \times 587 \text{ Cal/gm} \\ &\quad \text{or KCal/kg.} \end{aligned}$$

Dulong's formula:

If C, H, O & S are % of carbon, hydrogen, oxygen and sulphur in fuel then

$$\begin{aligned} \text{H.C.V.} &= \frac{1}{100} \left[ 8080C + 34500 \left( H - \frac{O}{8} \right) + 2240S \right] \text{ Cal/gm} \\ &\quad \text{or KCal/kg.} \end{aligned}$$