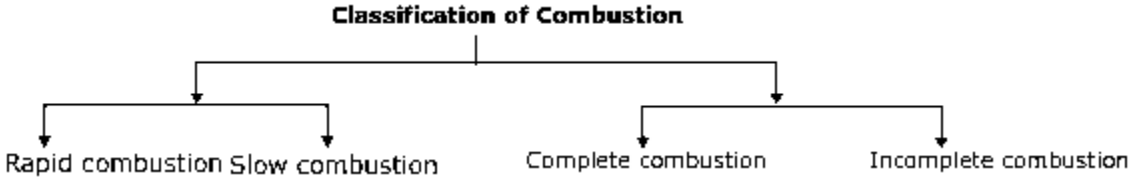
Combustion and Flame

COMBUSTION

❖ Introduction

Combustion is simply burning of a substance. It is an exothermic process, i. e., heat is produced on combustion. During combustion, carbon present in the fuel combines with oxygen and forms carbon dioxide while hydrogen forms water vapour. Therefore, the main products of combustion are CO2 and water vapour. Now the combustion may be defined as the burning of a substance in oxygen or air to produce heat and light. The process in which a substance combines chemically with oxygen or any other supporter of combustion, with simultaneous evolution of heat and light is called combustion.

(I) Classification of Combustion



II. Rapid Combustion (or Burning):

The process in which a substance combines chemically with oxygen at a temperature above its ignition temperature with the evolution of large amounts of heat and light in a short time is called rapid combustion, or burning. Burning of hydrocarbon fuels e.g., LPG, kerosene, petrol etc., is rapid combustion.

Combustion (or burning) of some common substances are described below:

(i) **Combustion of carbon:** Carbon (or charcoal) burns in air or oxygen to give CO2 producing heat and light.

$$\underset{(or\ charcoal)}{carbon} + \underset{(from\ air)}{Oxygen} \rightarrow carbon\ dioxide + Heat + Light$$

(ii) **Combustion of hydrocarbons:** Hydrocarbons burn to produce carbon dioxide (CO_2), water (H_2O) and heat and light.

For example, burning of methane or natural gas is described by the equation.

$$Metane + \underset{(from\ air)}{Oxygen} \xrightarrow{combustion} carbon\ dioxide + Water + Heat + Light$$

Burning of LPG (which contains mainly butane) produces carbon dioxide, water, heat and light.

(iii) **Combustion of magnesium:** Magnesium burns in air (or oxygen) to give magnesium oxide (MgO) producing heat and light.

$$\boldsymbol{Magnesium} + \underset{(\boldsymbol{from\ air})}{\boldsymbol{Oxygen}} \xrightarrow{Combustion} Magnesium\ oxide + Heat + Light$$

III. Slow Combustion

A combustion reaction in which no light is produced and temperature of the substance remains almost unchanged is called slow or spontaneous combustion. Thus, a substance undergoes slow combustion without catching fire. Some example of slow or spontaneous combustion are:

(i) Digestion of food (or respiration)

(ii) Oxidation of yellow phosphorus at room temperature

IV. Complete Combustion

The combustion in which the substance gets completely burnt to form the highest oxide of the substance is called complete combustion. Combustion in the presence of excess (or sufficient) oxygen or air is complete combustion.

For example, burning of carbon-to-carbon dioxide (CO_2) is complete combustion.

$$\begin{array}{ccc} C & + & O_2 \\ Carbon & + & \underset{(from\ air)}{Oxygen} \end{array} \xrightarrow[Complete\ combustion]{} CO_2\ (Carbon\ dioxide)$$

V. Incomplete Combustion

The combustion reaction that takes place in the presence of insufficient quantity of oxygen (or air) is called incomplete combustion. For example, when carbon is burnt in insufficient (limited)

quantity of air, carbon monoxide is formed.

$$2C + O_2 \xrightarrow{\text{in complete combustion}} 2CO$$

Carbon + Oxygen → Carbon monoxide

(Limited amount)

❖ Combustible & Non-Combustible Substances

The substances which burn readily are called combustible substances. For example, Petrol, LPG (cooking gas), Wax, Kerosene, Paper, Cloth, Wood, Coal etc., are combustible substances. The substances which do not burn are called non-combustible substances. For example, Water, glass, sand etc., are non-combustible substances.