

Combustion and Flame



What is Combustion?

Combustion is a chemical reaction where a substance reacts with oxygen, releasing heat.

Flammable (Combustible) Materials

These substances burn in the presence of oxygen, emitting heat and light. They can be:

- ➔ Solid (e.g., charcoal)
- ➔ Liquid (e.g., petrol)
- ➔ Gas (e.g., methane)

Ignition Temperature

The minimum temperature needed for a substance to catch fire.

Highly Flammable (Inflammable) Substances have low ignition temperatures and ignite quickly (e.g., petrol, LPG).

Fire Control Methods

Fire can be extinguished by:

- ➔ Removing the fuel source
- ➔ Blocking oxygen supply
- ➔ Cooling the fuel below its ignition temperature

Water is effective for wood and fabric fires but unsafe for electrical and oil fires due to conductivity and oil's buoyancy. Instead, carbon dioxide (CO_2) is preferred, as it smothers flames without harming electrical equipment.

Sources of CO_2 for Fire Suppression:

- ➔ **Fire extinguishers** (CO_2 stored under pressure)
- ➔ Chemicals like **sodium or potassium bicarbonate**, which release CO_2 when heated

Types of Combustion

- ➔ **Rapid Combustion** – Quick burning with heat and light (e.g., LPG).
- ➔ **Spontaneous Combustion** – Ignites without an external heat source (e.g., phosphorus, coal mine fires, forest fires).
- ➔ **Explosion** – Sudden combustion with heat, light, sound, and gas release (e.g., fireworks).

Flames

A flame is the luminous gaseous zone of combustion, with three regions:

- ➔ **Outer Blue Zone** – Hottest, complete combustion.
- ➔ **Middle Yellow Zone** – Moderate heat, partial combustion.
- ➔ **Inner Dark Zone** – Least hot, contains unburned vapours.
- ➔ Liquid fuels (e.g., kerosene) produce flames, while solid fuels (e.g., charcoal) do not, as they lack vaporization.
- ➔ Goldsmiths use the outermost flame zone for melting metals.
- ➔ Black residue on cookware indicates unburnt carbon from incomplete combustion.

Fuels & Their Characteristics

A **fuel** is a substance that undergoes combustion to produce energy.

➔ Ideal Fuel Qualities:

- Suitable ignition temperature
- High calorific value (energy output)
- Minimal pollution and residue
- Easy storage, transport, and affordability

Fuel Efficiency

Calorific value (kJ/kg) measures a fuel's energy output.

E.g., Hydrogen - 150000 kJ/kg

Petrol - 45000 kJ/kg

Harmful Effects of Fuel Combustion

- ➔ **Respiratory issues** from ash and suspended particles
- ➔ **Carbon monoxide poisoning** from incomplete combustion
- ➔ **Global warming** due to CO₂ emissions
- ➔ **Acid rain** from sulphur dioxide, damaging ecosystems
- ➔ **Deforestation** from wood burning

Fuel Conservation Tips

- ➔ Gather cooking materials before lighting the stove.
- ➔ Maintain proper vehicle tyre pressure.
- ➔ Walk for short distances.
- ➔ Use public transport when possible.

By adopting these measures, we can reduce fuel consumption and environmental impact.