

## Chapter- 6 Combustion and Flame

Combustion

Flame

Fuel

## Combustion

A chemical process in which a substance reacts with oxygen to give heat is called **combustion**. The substance that undergoes combustion is said to be **combustible**. It is also called **fuel** e.g. petrol, kerosene. The fuel may be solid, liquid or gas. Air is necessary for combustion to occur.

The lowest temperature at which a substance catches fire is called **ignition temperature**. A combustible substance cannot catch fire or burn as long as its temperature is lower than its ignition temperature.

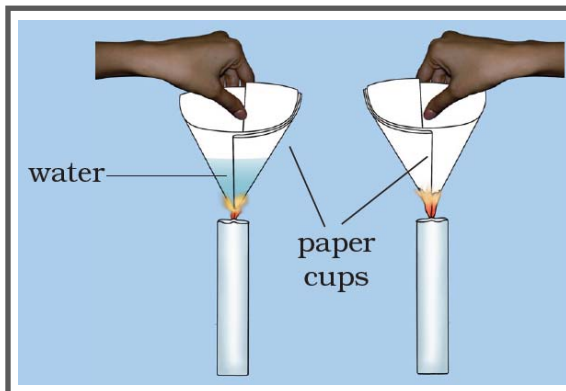


Wood is a combustible substance

The substances which have very low ignition temperature and can easily catch fire with a flame are **inflammable substances** e.g. petrol, alcohol, LPG (Liquified petroleum gas) etc.

### Activity

Make two paper cups by folding a sheet of paper. Pour about 50 mL of water in one of the cups. Heat both the cups separately with a candle. What do you observe? If we continue heating the cup, we can even boil water in the paper cup. The heat supplied to the paper cup is transferred to water by conduction. So, in the presence of water, the ignition temperature of paper is not reached. Hence, it does not burn.



### Methods to control fire

When there is a fire, break out, the fire brigade pours water on the fire. Water cools the combustion material so that its temperature is brought below its ignition temperature thus, preventing the fire from spreading.

The job of the fire extinguisher is to cut off the supply of the air, or to bring down the temperature of the fuel or both. The most common fire extinguisher is water but

it is not suitable for fire involving oil and petrol. For fires involving electrical equipment and inflammable materials, carbon dioxide ( $\text{CO}_2$ ) is the best extinguisher, which is stored at the high pressure as a liquid in cylinders. Also, near the fire  $\text{CO}_2$  can be given off by using chemical like sodium bicarbonate, potassium bicarbonate etc.

The head of the safety match is made from antimony trisulphide and potassium chlorate. The rubbing surface has powdered glass and a little red phosphorous. When the matches is struck against the rubbing surface, some red phosphorous get converted into white phosphorous which reacts with the potassium chlorate in the match ignite antimony trisulphide and start the combustion.

### Types of Combustion

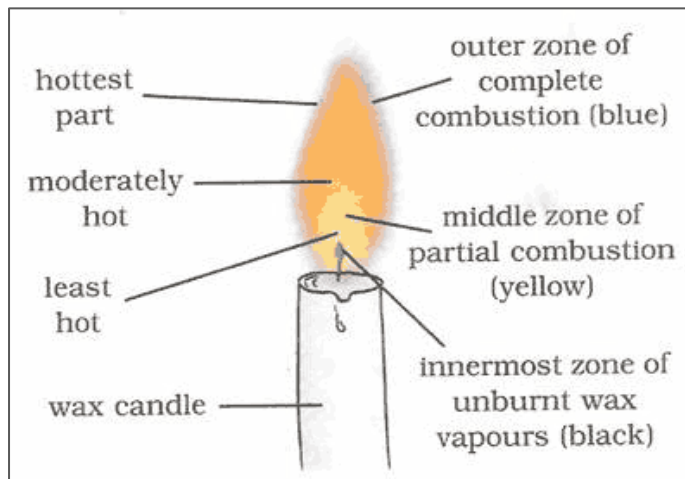
- Combustion in which gas burns rapidly and produces light and heat is known as **rapid combustion** e.g. burning of gas stove in kitchen.
- The type of combustion in which a material suddenly bursts in flames without application of any apparent is called **spontaneous combustion** e.g. spontaneous combustion of coal dust.
- Combustion in which a sudden reaction takes place with the evolution of heat, light and sound is known as **explosion**. For e.g. ignition of fire crackers



Burning of crackers

## Flame

Flame is the hot, glowing mixture of burning gases and tiny particles that arises from combustion. Flames get their light either from the fluorescence of molecules or ions that have become excited, or from the incandescence of solid particles involved in the combustion process, such as the carbon particles from a candle. The different zones of the candle flame are outer zone, middle zone and innermost zone.



Zones of Flame

## Structure of a Flame

The substances which vapourise during burning, give flames. For example, kerosene oil and molten wax rise through the wick and are vapourised during burning and form flames.

Charcoal, on the other hand, does not vapourise and so does not produce a flame.

## Fuel

The substance that undergoes combustion is said to be combustible. It is also called a fuel. The fuel may be solid, liquid or gas.

Characteristics of an ideal fuel

- Cheap
- Readily available
- Burns easily in air at a moderate rate
- It produces a large amount of heat
- It does not leave behind any undesirable substances.

### Fuel Efficiency

The amount of the heat produced on complete combustion of 1 kg of the fuel is called its **calorific value**. It is expressed in **kilo joule per kg**. A good fuel has a high calorific value. The calorific value of a fuel is expressed in a unit called **kilojoule per kg** (kJ/kg).

### Burning of Fuels Leads to Harmful Products

- Carbon fuels like wood, coal, petroleum release unburnt carbon particles that cause respiratory diseases like asthma.
- Combustion of most fuels releases carbon dioxide in the environment leading to global warming.
- Burning of coal and diesel releases sulphur dioxide. Moreover, petrol engines give oxides of nitrogen. Oxides of nitrogen and sulphur dissolve in water of rain to form acids. Such rain is called **acid rain** which is very harmful for crops, building and soil.



Burning of fuels