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## Chapter – 4<sup>th</sup>

# COMBUSTION

# AND

# FLAME

## **WHAT IS COMBUSTION?**

**A chemical process in which a substance reacts with oxygen to give off heat is called combustion. The substance that undergoes combustion is said to be combustible. It is also called a fuel. The fuel may be solid, liquid or gas. Sometimes, light is also given off during combustion, either as a flame or as a glow.**

**Eg magnesium burns to form magnesium oxide and produces heat and light. Magnesium and charcoal are combustible substances.**

## **COMBUSTIBLE AND NON-COMBUSTIBLE SUBSTANCES**

**Depending on whether substances burn in the presence of oxygen or not, they are classified into two types- Combustible and Non-combustible substances.**

**Non-combustible substances: Substances which do not burn or catch fire easily in the presence of air are called non-combustible substances. For example, sand, water and glass.**

**Combustible substances: Substances that catch fire easily in the presence of oxygen from air are called combustible substances. Combustible substances are mostly made of hydrocarbons that is, made up of hydrogen and carbon. Thus, when these substances are burnt, carbon dioxide and water are formed as products, and heat and light are released as by-products. For example, wood, paper, coal, coke, hydrogen, liquefied petroleum gas, natural gas, petrol, kerosene, diesel and alcohol catch fire easily, and hence are combustible substances.**

## **Ignition Temperature**

**The lowest temperature at which a substance catches fire is called its ignition temperature.**

## **Inflammable Substance**

**The substances which have very low ignition temperature and can easily catch fire with a flame are called inflammable substances. Examples of inflammable substances are petrol, alcohol, Liquified Petroleum Gas (LPG) etc.**

## **CONDITIONS NECESSARY FOR COMBUSTION**

**Oxygen present in the air is needed for burning. When the supply of air is cut off, the substance stops burning. Any substance or medium which supports combustion is called a supporter of combustion.**

**On the other hand, there are substances which do not allow substances to burn. For example, hydrogen, nitrogen and carbon dioxide do not allow substances to burn. These are called non-supporters of combustion.**

**All combustible substances do not catch fire and burn in the same manner.**

**Combustion takes place only under the three conditions.**

- 1. The substance must be combustible.**
- 2. The medium surrounding the substance should support combustion, like, presence of oxygen.**

**3. The substance should be heated to its ignition temperature.**

### **STRUCTURE OF A FLAME:**

**A flame has three zones,**

**The outermost thin, transparent, blue and non-luminous region. This is due to complete combustion. This is the hottest zone.**

**The middle bright, moderately hot and yellow luminous zone. This is due to partial combustion,**

**The innermost is the coldest and dark zone, which is due to unburned hot vapours.**

### **TYPES OF COMBUSTION**

**Rapid combustion:** It occurs when a substance burns rapidly and releases large amounts of heat and light energy which often results in a fire. For example, burning of match stick and LPG are rapid combustions.

**Spontaneous Combustion:** There are substances like phosphorus which burn in air at room temperature. The type of combustion in which a material suddenly bursts into flames, without the application of any apparent cause is called spontaneous combustion.

**Explosion:** When a cracker is ignited, a sudden reaction takes place with the evolution of heat, light and sound. A large amount of gas formed in the reaction is liberated. Such a reaction is called explosion. Explosion can also take place if pressure is applied on the cracker.

## **WHAT IS A FUEL?**

The sources of heat energy for domestic and industrial purposes are mainly wood, charcoal, petrol, kerosene etc. These substances are called fuels. A good fuel is one which is readily available. It is cheap. It burns easily in air at a moderate rate. It produces a large amount of heat. It does not leave behind any undesirable substances.

### **Ideal Fuel**

There is probably no fuel that could be considered as an ideal fuel. We should look for a fuel which fulfils most of the requirements for a particular use.

### **Calorific Value**

The amount of heat energy produced on complete combustion of 1 kg of a fuel is called its 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**

The increasing fuel consumption has harmful effects on the environment.

- 1. Carbon fuels like wood, coal, petroleum release unburnt carbon particles. These fine particles are dangerous pollutants causing respiratory diseases, such as asthma.**
- 2. Incomplete combustion of these fuels gives carbon monoxide gas. It is a very poisonous gas. It is dangerous to burn coal in a closed room. The carbon monoxide gas produced can kill persons sleeping in that room.**
- 3. Combustion of most fuels releases carbon dioxide in the environment. Increased concentration of carbon dioxide in the air is believed to cause global warming.**

**4. Burning of coal and diesel releases sulphur dioxide gas. It is an extremely suffocating and corrosive gas. Moreover, petrol engines give off gaseous oxides of nitrogen. Oxides of sulphur and nitrogen dissolve in rain water and form acids. Such rain is called acid rain. It is very harmful for crops, buildings and soil.**

**The use of diesel and petrol as fuels in automobiles is being replaced by CNG (Compressed Natural Gas), because CNG produces the harmful products in very small amounts. CNG is a cleaner fuel.**

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