

**CHAPTER  
12****ENVIRONMENTAL CHEMISTRY**pakcity.org**ENVIRONMENTAL CHEMISTRY:**

**“It deals with the study of chemical processes happening in Earth’s environment and their direct or indirect impact on organisms that live on Earth.”**

**POLLUTION:**

The presence of undesirable substances in the environment that harm the natural balance of eco systems is known as environmental pollution.

**PARTS OF ENVIRONMENT:**

Earth’s atmosphere consists of four interconnected parts that work together to sustain life.

- 1. Lithosphere:** It comprises Earth crust and soil covering with rocks.
- 2. Hydrosphere:** It comprises all surface and underground water.
- 3. Biosphere:** It includes the entire living being on the Earth.
- 4. Atmosphere:** It is extended to 500 KM above Earth’s surface and consists of gases.

**LAYERS OF ATMOSPHERE:**

- 1. Troposphere:** It’s the lowest layer of atmosphere extending from Earth’s surface to an altitude of 11 km.
- 2. Stratosphere:** It starts from the top of troposphere and extending up to 50 km above the Earth’s surface.
- 3. Mesosphere:** It lies above stratosphere stretching from 50 km to 85 km above the Earth’s surface.
- 4. Thermosphere:** It is the uppermost layer of the Earth’s atmosphere extending from 85 km to 500 km.

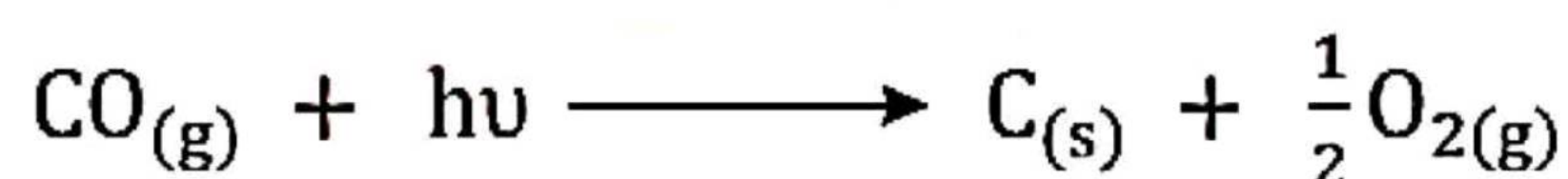
**AIR POLLUTANTS:**

Carbon Oxides ( $\text{CO}_x$ ), Nitrogen oxides ( $\text{NO}_x$ ), Sulphur oxides ( $\text{SO}_x$ ), volatile organic compounds (VOCs) and Ozone ( $\text{O}_3$ ) are air pollutants.



### 1. CO<sub>x</sub>

The oxides of carbon in troposphere are carbon monoxide (CO) and carbon dioxide (CO<sub>2</sub>). CO is a very toxic gas. It is released by the partial combustion of fuel in automobile or forest fire. CO in troposphere is broken down by UV rays into free carbon particles which are responsible for the smog formation.



CO<sub>2</sub> is added to atmosphere due to the combustion of fossil fuels such as coal, petroleum etc. It's also released during the respiration of animals. The increased level of carbon dioxide in atmosphere causes suffocation and respiratory disease.

### 2. NO<sub>x</sub>

There are two main oxides of nitrogen which causes air pollution. These are nitric oxide (NO) and nitrogen dioxide (NO<sub>2</sub>). The high concentration of NO and NO<sub>2</sub> gases in air is harmful because they form acid rain.

### 3. SO<sub>x</sub>

There are two oxides of sulfur found in the air named as SO<sub>2</sub> and SO<sub>3</sub>. They are produced by volcanic eruption. The presence of these gases in atmosphere causes cardiac and respiratory disease and also affects crops production.

### 4. Volatile Organic Compounds (VOCs)

All those solvents which evaporate into atmosphere and contribute the atmospheric pollution are known as volatile organic compound. They are responsible for ozone depletion. Examples of VOCs include formaldehyde, benzene, toluene etc.

### 5. Ozone (O<sub>3</sub>)

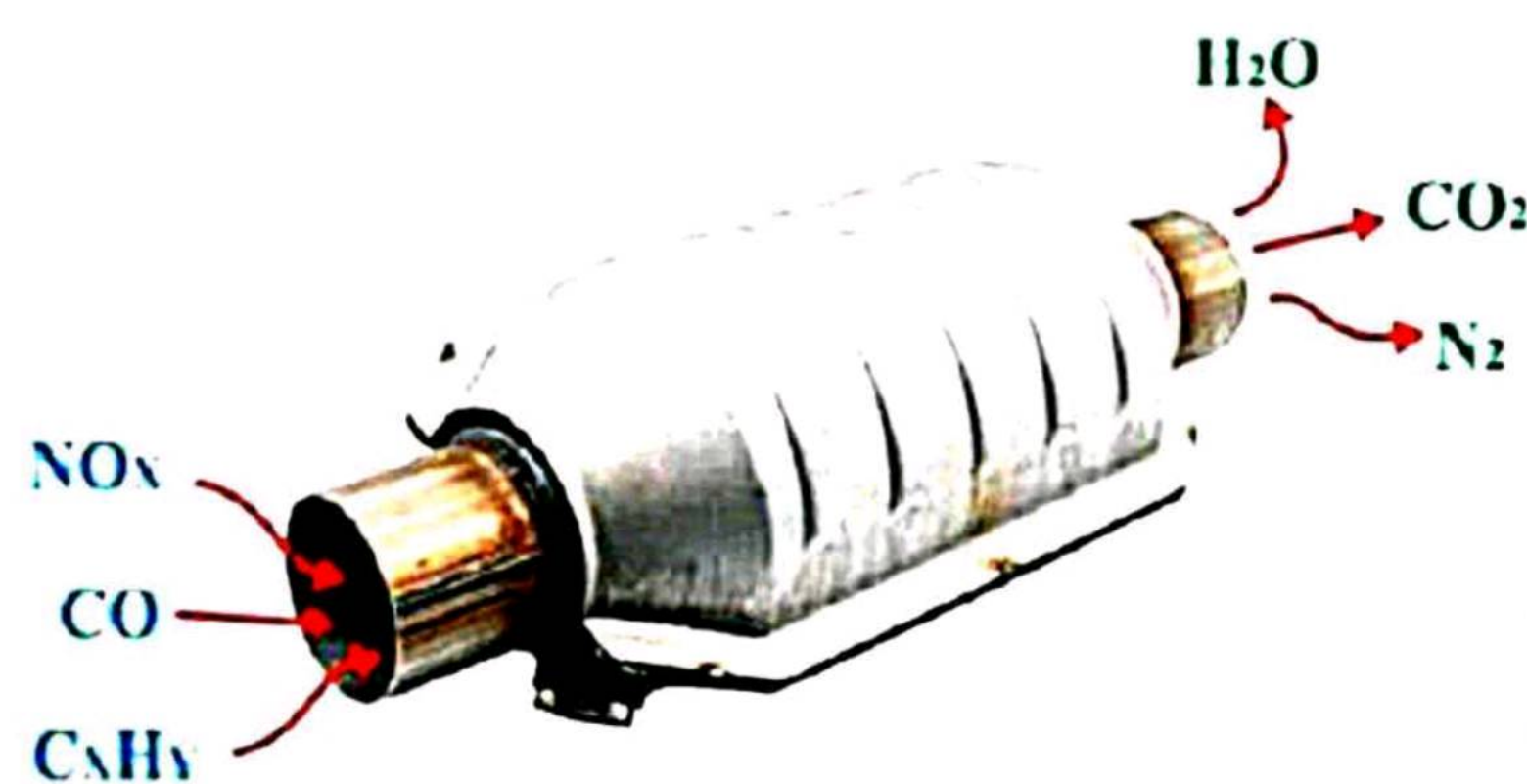
Ozone is an allotropic form of oxygen. It's present in a very low concentration in troposphere. Its side effects include respiratory issues, cardiac issues and irrigation of plants and crops.

### CATALYTIC CONVERTER:

The burning of gasoline in a car engine results in the formation of air pollutants. To solve this issue, modern car engines are equipped with catalytic converters. The purpose of catalytic converter is to transform the harmful chemicals produced during internal combustion engine



into less harmful or non-harmful substances such as  $\text{CO}_2$ ,  $\text{N}_2$ ,  $\text{O}_2$  and  $\text{H}_2\text{O}$ . Catalytic converter contains a mixture of Pt and Pd which serves as catalyst.



**Q. Can a vehicle run without catalytic converter?**

Ans. Yes, a vehicle can run without catalytic converter but it will produce air pollution.

**Q. How does catalytic converter contribute to reducing air pollution?**

Ans. Catalytic converter converts harmful air pollutants into harmless substances.

### INDUSTRIAL SMOG:



Smog is a type of air pollution. This term is a combination of smoke and fog. Smog is a mixture of  $\text{SO}_2$ , aerosols and volatile organic compounds ejected through the chimney of industries. It forms a brown-yellow layer usually in the industrial areas. Smog has many harmful side effects on human health, plant growth and overall, a major contributor of environmental pollution.

### GLOBAL WARMING / GREEN HOUSE EFFECT:

The temperature of our Earth is regulated by certain gases present in the atmosphere such as  $\text{CH}_4$ ,  $\text{CO}_2$ ,  $\text{N}_2\text{O}$  and  $\text{H}_2\text{O}$  known as green house gases. The change in concentration of these gases can lead to alternation in the Earth's climate.

Global warming refers to the gradual rise in Earth's average surface temperature. The average temperature of earth is approximately  $15^\circ\text{C}$  but due to long term climate change resulting from global warming is causing shifts in average temperature.

To prevent global warming, we need to reduce green house gas emissions.

### ACID RAIN:

The term acid rain was first introduced by an English chemist Robert Angus in 1872. Acid rain refers to rainfall that has acidic components such as nitric acid, sulfuric acid and carbonic acid.

The pH of normal rainfall generally ranges between 6 to 6.5 but the pH of acid rain is below 5.

Pollutants like oxides of carbon, nitrogen and sulfur are present in the atmosphere. These oxides may undergo chemical reaction with atmospheric water to produce sulfuric acid, nitric



acid and carbonic acid. These acidic components mixed with rainwater and fall to the earth as acid rain.

Acid rain has several adverse effects on the environment and human life. For example:

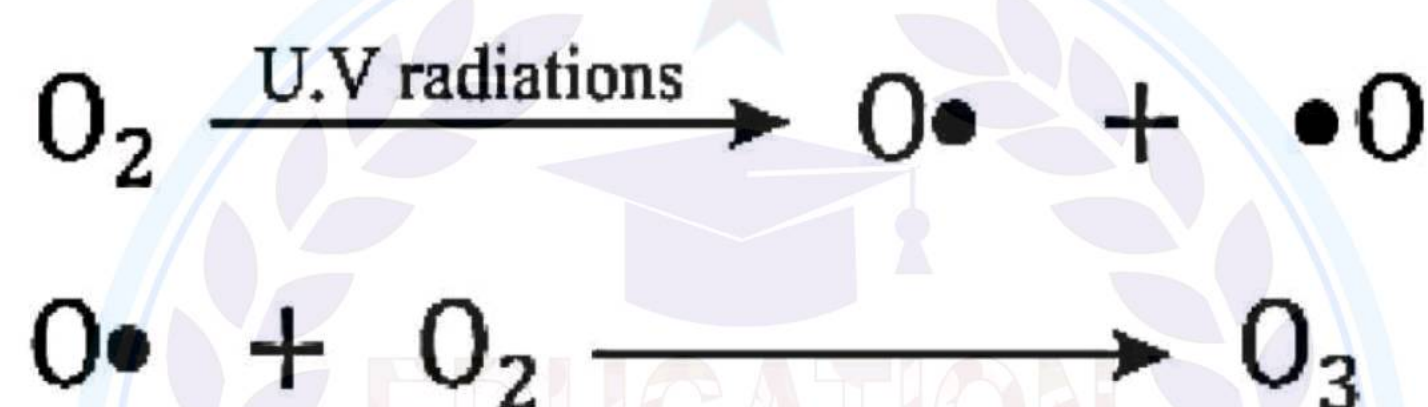
1. Acid rain increases the acidity of rivers, which affect negatively on aquatic animal and plants causing a disturbance of eco system.
2. Acid rain reduces soil fertility due to lowering in soil pH from their normal range and ultimately affects on crops production.
3. Acid rain causes corrosion of building, bridges and other concrete and metal things.
4. Acid rain makes underground water toxic and undrinkable.



### **OZONE FORMATION & OZONE DEPLETION**

Ozone layer is present in stratosphere. This layer plays a vital role in blocking and absorbing maximum portion of Sun's harmful radiations. The life on Earth would not be possible without the protection of this layer.

Ozone is produced in stratosphere due to photochemical reaction of sun rays and oxygen gas. UV radiations of sunlight breaks  $O_2$  into free radicals. The oxygen free radicals are then combined with another oxygen molecule to produce ozone.



Human activities can contribute to the depletion of ozone layer through the emission of certain chemicals known as Ozone Depletion Substances (ODS). The most considerable human activity that have been responsible for ozone depletion is the release of gases from cooling devices such as refrigerator and air conditioners.

Chlorofluoro Carbons (CFCs) is a highly stable gas used as coolant in refrigeration and also a repellent in aerosol spray. When CFC reaches into stratosphere region, it breaks down into free chlorine and fluorine atoms which then react with ozone in UV light and decompose it into oxygen.

The best alternative is Hydro Fluro Carbons (HFCs) which do not have chlorine and do not contribute to ozone depletion.



## WATER POLLUTION

Any undesirable change in the quality of water which affects the life adversely is called water pollution.

## WASTE WATER ANALYSIS

Sample of waste water are collected from many different areas and they are analyzed by a series of tests.

- 1. Physical Test:** This includes estimation of odor, color and taste.
- 2. Chemical test:** This involves the checking of pH and presence of toxic chemical.
- 3. Microbiological test:** This test involves checking for the presence of pathogens.
- 4. Organic test:** This test is performed to check the presence of pesticides and volatile organic solvents such as petrol, benzene, toluene etc.

