

AIR POLLUTION

(I) **Air Pollution -Definition:** It is defined as the excessive concentration of foreign material in the atmosphere which affects the health of individuals and also causes damage to the property. Air pollution is the air taken many forms. They can be gases, solid particles or liquid droplets.

Sources of Air Pollution:

- Industries, mobiles and thermal power plants are the major sources of air pollutants from human activities.
- Forest fires, dust storms, volcanic eruptions and even growing crops (like growing paddy) are the rational source of air pollutants.
- Air gets polluted largely due to the smoke produced by automobiles, power plants and kitchens.
- Also due to the large scale burning of fossil fuels, such as coal, diesel, petrol, kerosene and so on.
- The burning of fossil fuels produces CO_2 , CO , SO_2 , oxides of nitrogen, hydrocarbons, particulate matter and metallic traces.
- Thermal power plants and coal based. The main pollutants are fly ash, soot and SO_2 .
- The major pollutants form the textile industry are cotton dust, nitrogen oxides, chlorine, naphthalene vapours, smoke and SO_2 .
- Fertilizer plants produce oxides of sulphur, oxides of nitrogen and hydrocarbons to the atmosphere.
- Chemical plants and pesticide plants prepare caustic soda and produce Cl_2 gas.
- Automobiles contribute 60% of the air pollution by releasing compounds like carbonmonoxide, oxides of nitrogen and hydro carbons.
- Decomposition of organic waste and municipal garbage provide foul smelling gases which pollute the air.

Types of Air pollutants: There are 2 types

- 1) **1⁰ pollutants:** are directly emitted from the sources into the atmosphere.
Ex: a) *Inorganic gases such as SO_2 , NO_2 , H_2S , CO , NH_3 , CO_2 , HF .*
b) *Particulate matter like ash, smoke, dust, mist, fumes, fog, spray etc.*
c) *Aromatic hydrocarbons.*
d) *Radio active compounds.*

2) **2⁰ pollutants:** are those which are derived from the primary pollutants due to chemical / photochemical reactions in the atmosphere. **Ex: Ozone, PAN, formaldehyde, photochemical smoke.**

INSTRUMENTAL TECHNIQUES TO MONITOR AIR POLLUTION : There are mainly 3 methods -----

1. Analytical Techniques

2. Optical methods

3. Nuclear methods

1. Electro Analytical Techniques:

- These techniques are based on intention of electrical energy with matter.
- Various electro analytical techniques such as **pH meter ,potentiometry used to monitor environmental pollution.**
- Electrostatic devices are used for air pollution in which the dust is a gas removed by electrostatic attraction.
- Potential of air electrode deeping into a solution of an electrolyte depends on the activity of ions by potentiometer can be used to monitor water pollution.
- Volumetric methods such as anodic strapping **volumetry is used to monitor pressure of heavy metal ions such as Pb^{+2} & Zn^{+2}**

2. Optical methods:

- These methods are based on **interaction of electromagnetic radiations** with matter.
- **Spectroscopic methods** are most commonly used in environmental monitoring.
- Various organic and inorganic pollutants can form coloured complex with suitable reagents.
- Such species can be detected and estimated **using spectrophotometer.**
- **For ex:** Cr(VI) is toxic material which is present in tannery effluents, can be estimated using **diphenyl carbozide reagent.**
- Atomic absorption spectroscopy is widely used for estimation of metal items.

3. Nuclear Methods:

- **Scintillation counter, G.M counter** is used to measure radio active materials present in the environment.
- The radioactive materials are very harmful to the workers who are directly in contact with nuclear radiation should monitor their exposure to radiation.

(2) **ACID RAIN :**

Air contains acid gases such as **sulphur dioxide (SO_2) and nitrogen dioxide (NO_2) pollutants.** In the air, these oxides oxidized to corresponding acids, in presence of moisture. These acids (**H_2SO_4 and HNO_3**) come to the earth along with rain water. The rain water containing acids in it is called "acid rain".



AREAS OF ACID RAIN :

1. In density populated cities, internal combustion engines of automobiles emit pollutants such as CO, CO₂, hydrocarbons in air.

2. Industrial areas, various industries emit pollutants like **CO, CO₂, SO₂, SO₃, NO, NO₂ in the atmosphere air.** These pollutants are absorbed by moisture, present in air, resulting in the formation of various acids. As a result, more acid rains occur in densely populated areas and industrial areas.

HARMFUL AFFECTS OF ACID RAIN :

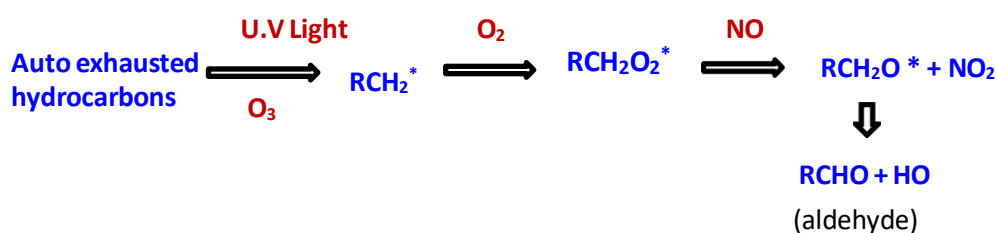
1. Acid rain has adverse effect on the vegetation. It results in suppression of growth, bleached spots on leaves, leaf drop and reduction in yield.
2. Acid rain increases the acidity of water bodies like rivers, lakes, etc., and harms the aquatic life. Some types of fish die if acidity of the water exceeds a limit.
3. Acid rain causes irritation to eyes and mucous membrane.
4. It accelerates the rate of corrosion (rusting) of metals such as iron. (It is due to the fact that the process of corrosion is catalyzed by acids (H^+ ions))
5. Acid rain damages historical monuments like Taj mahal and marble statues. The acid present in the rain water reacts with marble and corrodes it.



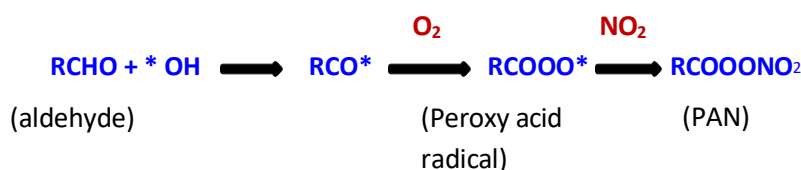
6. Acid rain causes damage to rocks etc., thereby increasing rate of weathering of rocks.
7. Due to acid rain, dissolved salts in the soil such as $CaCO_3$ and metals like aluminium, pass into ponds, lakes, rivers, etc. Where they cause toxic effects to aquatic life.
8. Corrosive damage to oil based paints, automobile coatings, steel and zinc.

(3) _PHOTO CHEMICAL SMOG :

- a) "The fog which causes extreme inflammation in the eyes and lungs and also extremely harmful to plants and rubber is called photochemical smog"
- b) Smog was first identified in 1994 in the cities of Los Angeles and Denver in the USA.
- c) **SMOG = smoke + fog.**
- d) It appears as a brown fog during the morning and afternoon, especially in densely populated, warm cities. Cities that experience this smoke on a daily basis include Los Angeles, Sydney, Mexico city, Beijing and many more.
- e) **Formation:** Nitric oxide (NO) and nitrogen dioxide (NO_2) are emitted from the combustion of fossil fuels, along with being naturally emitted from things such as volcanoes and forest fires.
- f) Photochemical smog is most common in the summer. When exposed to ultraviolet radiation, NO_2 goes through a complex series of reactions with hydrocarbons to produce the components of photochemical smog. A mixture of ozone, nitric acid, aldehydes, peroxyacyl nitrates (PANs) and other secondary pollutants.
- g) The compound NO_2 , ozone and PANs are called photochemical oxidants. Its effects include reduced visibility and respiratory ailments. Ground level ozone is also produced which has various effects on the human body.
- h) Visibility and respiratory diseases due to this smog. Pulmonary edema, heart disease, inflammation of the mucous membranes can occur.
- i) Decreases the rate of photosynthesis in trees. Metals, marble and structures, rubbers, paintings, etc. are all destroyed.

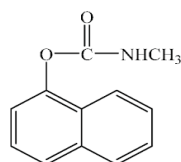


Pan formation :



(4) — BHOPAL GAS DISASTER :

- This is the biggest industrial accident in the world history.
- The tragedy took place on the morning of **December 3, 1984**, at the union carbide plant in Bhopal, Madhya Pradesh (India).
- Approximately forty tons of toxic gas (**methyl-iso-cyanate, MIC**) was accidentally released from the union carbide plant in this accident.
- Going into the description, the **union carbide plant carbaryl (or) selvin** is a liquid MIC liquid that is stored in the refrigerator without moisture. But due to the infiltration of water into it, the MIC spreads into the gall due to the thermal action. This resulted in burns, coughs, and vomiting as a result of the pepper spray in the eyes, **causing many deaths** and leaving many homeless. Also many animals were killed.
- People there have been calling MIC killer gas ever since. Its chemical formula is expressed as **CH₃-N=C=O** ; **cabaryl (or) selvin**



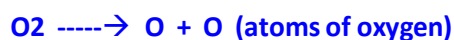
(5) FORMATION & DEPLETION OF OZONE LAYER :

OZONE LAYER- DEFINITION :

The ozone layer is a region in the earth's stratosphere and contains high concentrations of ozone and protects the earth from the harmful ultra violet radiations of the sun.

FORMATION :

Step – 1: Presence of sunlight oxygen molecule dissociates into oxygen radicals.



Step-2 : oxygen radicals combines with oxygen to form ozone.



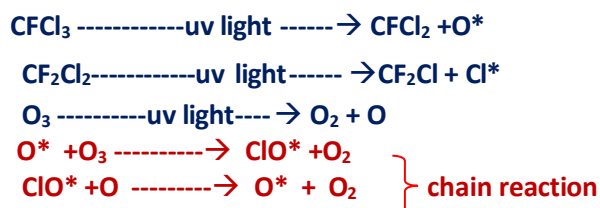
OZONE LAYER DEPLETION :

- Ozone layer depletion is a decrease in the **ozone layer in the stratosphere** called ozone layer depletion.
- The main reasons for this depletion are caused by the depletion of ozone molecules by the reaction of the chlorine and bromine atoms in the stratosphere with ozone.
- One chlorine radical destroys about 100,000 molecules of ozone. It will be destroyed faster than it was created.

MAIN CAUSES OF OZONE LAYER DEPLETION :

- Chlorofluoro carbons (CFCs)** : CFCs play a major role in ozone depletion .They are released into the atmosphere by soaps,solvents, aerosols,refrigerators,air conditioners etc.,

Chlorofluoro carbons are broken down by ultraviolet radiation in the stratosphere to form chlorine radicals . These radicals react with ozone to convert oxygen, reducing ozone concentration is leading to depletion.



MECHANISM : conversion of ozone to oxygen ---

2. Nitrogen oxides: The nitrogeneous compounds such as $\text{NO}_2, \text{NO}, \text{N}_2\text{O}$ are highly responsible for the depletion of the ozone layer. These oxides are generally released from fossil fuels. These are convert 7% of ozone into oxygen.



Conversion of ozone into oxygen:

CONSEQUENCES OF OZONE DEPLETION :

- Depletion of ozone layer causes UV waves to hit the earth directly , leading to skin cancer and leprosy.
- UV light rays cause cataracts (eye problems)
- Inflammation , swelling of skin may occur.
- Global warming increases, polar ice caps are prone to floods and disaster, Island areas sink in seas.
- UV light leads formation of chemical smog which leads to many health problems.
- It affects the rate of photosynthesis in plants.
- Biodiversity problems.

PROTECTION :

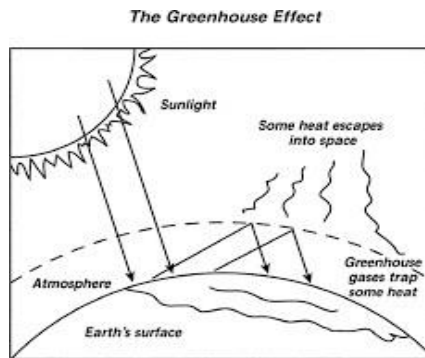
- Use of CFCs should be minimized.
- Reduce the percentage of emission of $(\text{NO})_x$.
- Reduce the use of supersonic aircrafts.

(6) GREENHOUSE EFFECT :

DEFINITION: "Heat from the sun warms Earth's surface but most of it is radiated and sent back into space. Water vapour and CO_2 in the troposphere trap some of this heat, preventing it from escaping thus keep the Earth warm. This trapping of heat is called the greenhouse effect".

MAIN SOURCES FOR GREENHOUSE GASES:

S.NO.	GREEN HOUSE GASES	SOURCES
1.	Carbon dioxide (CO_2)	Burning of fossil fuels, Deforestation
2.	Nitrogen oxides $(\text{NO})_x$	Fertilizers, Automobile exhausts
3.	Chlorofluoro carbons (CFCs)	Refrigerators, air conditioners, foam shaving cream, spray cans.
4.	Methane (CH_4)	Decomposition of organic substances.



CONSEQUENCE OF GREENHOUSE EFFECT:

- **Global warming** : This is due to the gradual increase in the average temp. the Earth's atmosphere results, the icebergs, polar ice caps melt and sea levels rise leads to island areas are in sinks and effected by floods.
- **Harricans and tornadoes** occur frequently.
- **Rapid evaporation of water as a major impact on agriculture and warming held** due to climate also effects on lives on earth.
- Affects the **global economy**.

PREVENTION :

- The use of solar, wind and hydropower instead of fossil fan reduce the greenhouse effect to some extent.
- Afforestation is good practice reduce global warming.

(7) GLOBALWARMING :

- ❖ Global Warming is defined as **the increase of the average temperature on Earth**. Global warming is **a phenomenon where the earth's average temperature rises due to increased amounts of greenhouse gases**. Greenhouse gases such as carbon dioxide, methane and ozone trap the incoming radiation from the sun.
- ❖ As the **Earth is getting hotter, disasters like hurricanes, droughts and floods are getting more frequent**.
- ❖ Global warming has presented another issue called **climate change**.
- ❖ Climate change refers to changes in weather patterns and growing seasons around the world.
- ❖ It also refers to sea level rise caused by the **expansion of warmer seas and melting ice sheets and glaciers**.
- ❖ Global warming causes climate change, which poses a serious threat to life on Earth in the forms of widespread flooding and extreme weather.

PREVENTION :

- ❖ **Control the release of greenhouse gases into atmosphere.**
- ❖ **Control deforestation .**

