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Raymond Fernandes

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ICSE

Living Science

Chemistry

Class 9

Chapter 8 Atmospheric Pollution

LEARNING OBJECTIVES

Air Pollution

- ❖ Air pollutants

Acid Rain

- ❖ Causes of acid rain
- ❖ Harmful effects of acid rain

Greenhouse Effect

- ❖ Greenhouse gases
- ❖ How can we reduce emission of greenhouse gases?

Global Warming

- ❖ Harmful effects of global warming

Ozone Layer

- ❖ Function of ozone layer
- ❖ Depletion of ozone layer

What is Air Pollution?

Air pollution is contamination of the indoor or outdoor environment by any chemical, physical or biological agent that modifies the natural characteristics of the atmosphere.

What are the Cases of Air Pollution?

1. Use of coal by power plants and industries, and burning of fuels at home for cooking, etc. release substantial amount of carbon dioxide into the atmosphere. Sulphur dioxide levels have also risen in the air due to the burning of fossil fuels.
2. Vehicular traffic releases carbon monoxide, carbon dioxide, nitrogen oxides and hydrocarbons into the atmosphere.

Air pollutants

1. **Carbon dioxide and carbon monoxide:** These gases are emitted from thermal power plants, vehicular traffic and industrial furnaces. If the fossil fuel does not undergo complete combustion, carbon monoxide is released. It is also released on burning of agricultural remains, in volcanic eruptions and from marshes.
2. **Sulphur dioxide:** Oxides of sulphur are released from electric power plants and factories that make use of coals and fossil fuels that contain sulphur. Vehicular traffic also releases sulphur dioxide gas. In nature, volcanic eruptions are a cause of release of sulphur dioxide gas into air.

3. Nitrogen oxides: Nitrogen oxides are released on combustion of fossil fuels by automobiles, industries, power plants and burning of biomass. They are produced due to the use of nitrogen-based fertilisers also. Nitrogen oxides cause smog as well as greenhouse effect.

4. Hydrocarbons: Hydrocarbons are produced by vehicles due to the incomplete combustion of fuel and by decomposition of organic matter. The most prominent hydrocarbon is methane (CH_4). Hydrocarbons cause smog in cities, and decrease visibility.

5. Chlorofluorocarbons: Chlorofluorocarbons (CFCs) are man-made chemicals that are used in factories, aerosols, refrigerators and air conditioning units. They are very light and can rise easily high up in the atmosphere.

6. Suspended particulate matter (SPM): Smelting activities, fly ash plants, fossil fuels, transportation, construction activities and forest fires produce suspended particulate matter. These particles contain harmful substances like asbestos, lead, mercury, dust and soot.

7. Smog: Smog is a smoky mixture of unburnt organic compounds, and is formed due to the incomplete combustion of fossil fuels.

8. Radon: Activities in mining, power plants and construction release the radioactive gas, radon. It is also formed in nature by underground wastes. Radon causes lung cancer and respiratory problems.

Acid Rain

When rainfall contains very high amounts of nitric and sulphuric acids, it is called acid rain. Acid rains are formed when gases like sulphur oxides and nitrogen oxides react with oxygen and water in the atmosphere. Neutral water has pH of 7. If the pH of a substance goes below 7, it gets an acidic nature. Normal rainwater, with small traces of dissolved carbon dioxide, has pH of about 6. Acid rain would have pH values below 6.

Causes of acid rain

Industrialisation and vehicular traffic are the main causes of acid rain, as they release large amounts of sulphur oxides and nitrogen oxides into the atmosphere. Power plants that use coal as fuel release about 70% of the world's sulphur oxide emission.

Vehicular traffic releases 50% of the world's nitrogen oxide emission. Sulphur oxides and nitrogen oxides can travel great distances, and so can affect the environment very far away.

Harmful effects of acid rain

The ecological balance in nature is disturbed by acid rain due to the following reasons:

- 1.** Surface water in lakes and rivers is harmed due to increase in its acidity level. This is harmful for aquatic life also.
- 2.** Water present in watersheds is also affected, as the soil is not able to neutralise the acidic compounds that descend with acid rain.
- 3.** Acid rain releases aluminium from soil, which eventually flows into water bodies, and harms aquatic life. Agricultural soil too has to be treated with limestone to reduce its acidic content.
- 4.** Acid rain causes damage to trees, forests and forest soil. Entire forests have been known to be destroyed due to acid rain. Deforestation is also caused by acid rain.
- 5.** Several species of flora and fauna have been endangered due to ecological impacts of acid rain. Agricultural production has also suffered.
- 6.** Acid rain erodes metals, marble, limestone, monuments and buildings.
- 7.** Acid rain is harmful to human health also, as the NO_2 content causes pollution of the immediate environment.

Greenhouse Effect

Our planet earth is like a greenhouse that is surrounded by the atmosphere. The atmosphere protects life on earth by absorbing harmful ultraviolet (UV) radiations from the sun, warming the earth's surface by heat retention and reducing the temperature difference between day and night.

Air consists mainly of the gases nitrogen, oxygen and argon. The remaining gases, called trace gases, consist of greenhouse gases, that is, carbon dioxide, methane, nitrous oxide, water vapour and ozone. These greenhouse gases in the earth's atmosphere have the property to allow short wave radiations from the sun to easily reach earth's surface. Luckily for us, the short wave UV radiations from the sun are absorbed by the ozone layer in earth's stratosphere and so these harmful radiations do not reach us on earth. But these greenhouse gases do not allow long wave infrared radiations radiating from earth's surface to escape from the earth's atmosphere. This way, these gases in the atmosphere trap the heat radiated from earth. This process is termed as the 'greenhouse effect'.

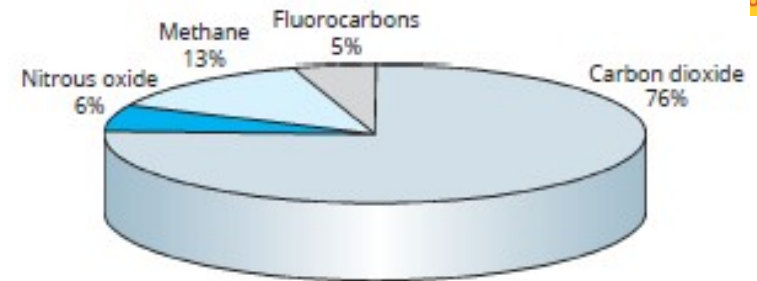
Greenhouse gases

The main greenhouse gases, which lead to greenhouse effect and rise in global temperature, are carbon dioxide, methane, oxides of nitrogen, water vapour and chlorofluorocarbons (CFCs).

How can we reduce emission of greenhouse gases?

It is of utmost importance today to reduce emissions of greenhouse gases into the atmosphere. The steps we can take are as follows:

- Use of fossil fuels to meet our energy demand should be curbed.
- We should develop energy production from renewable sources of energy. This will reduce carbon dioxide emissions into the atmosphere.
- Use of coal with low sulphur content as fuel in thermal power plants should be encouraged, so that sulphur oxide emissions are reduced.
- Automobiles should be fitted with catalytic converters to reduce the harmful emissions.
- The chlorofluorocarbons (CFCs) used in aerosols, refrigerator and air conditioning units should be replaced by hydrofluorocarbons.
- Prevent deforestation. Trees help to lower the carbon dioxide pollution in the atmosphere.
- Chimneys of industrial units should be fitted with scrubbers and electrostatic precipitators to reduce the emissions.



Distribution of greenhouse gases in the earth's atmosphere

Global Warming

The primary cause of global warming is the increase in carbon dioxide level in the atmosphere. The right level of carbon dioxide in the atmosphere is necessary to maintain the global temperature at the required level to maintain life on earth. However, due to human activities, level of carbon dioxide content has increased in the atmosphere. As a result, there has been a rise in global temperature, by 0.4 °C to 0.8 °C per decade. This has led to global warming.

Harmful effects of global warming

- The average temperature of the earth has risen, leading to ecological and climatic changes.
- Global warming is causing melting of polar ice caps. This is leading to a rise in sea level, causing low lying coastal areas to be submerged.
- Global warming will lead to disappearance of various terrestrial and marine flora and fauna.
 - Shortage of water, due to high temperature, is a matter of great concern.
 - All the above impacts of global warming will lead to economic problems.

Ozone Layer

Life is possible on earth only due to the presence of stratospheric ozone layer present in our higher atmosphere, at altitudes between 16 km and 40 km from earth's surface. The ozone layer prevents harmful ultraviolet radiations from the sun from reaching earth's surface, and thus saves damage to the cells of plants and animals on earth.

Function of ozone layer

The stratospheric ozone layer consists of about 90% of the earth's ozone content. The main function of the ozone layer is the absorption of the sun's ultraviolet (UV) radiation. This protects humans, animals and plants from the harmful UV radiations, as the ozone layer absorbs 97–99% of the UV radiation.

Depletion of ozone layer

In recent years, there has been depletion of the protective ozone layer due to the presence of certain chemicals or compounds in the atmosphere.

Chlorofluorocarbons, also known as freons, when released from refrigerators and air conditioners, mix with atmospheric gases and eventually reach the stratosphere. The free chlorine is continuously being formed, and this causes the break down of ozone molecules and thus damaging the ozone layer. Apart from freons, other chlorofluorocarbon compounds, known as halons, are also responsible for destroying the ozone layer.

SUMMARY..

1. The two main sources of air pollution are fuel combustion and transportation.
2. The main air pollutants are sulphur dioxide, oxides of nitrogen, carbon dioxide, suspended particulate matter, chlorofluorocarbons and radon.
3. Sulphur dioxide is mainly produced by burning of fossil fuels in power plants and vehicles, and from industrial activities. Volcanic eruptions also produce sulphur dioxide emissions.
4. Oxides of nitrogen are produced by combustion of fossil fuels by automobile engines, power plants, industrial plants and on burning of biomass.
5. Carbon dioxide is mainly produced by combustion of fossil fuels in vehicles, industrial furnaces and engines. When the fossil fuels undergo incomplete combustion, the poisonous carbon monoxide gas is produced.
6. Hydrocarbons are released mainly due to combustion of fossil fuels in vehicles and industrial plants.
7. Suspended particulate matter is mainly produced during smelting activities, industrial activities, fly ash plants, combustion of fossil fuels, and from construction and transportation.
8. Chlorofluorocarbons are the main cause of depletion of the ozone layer.
9. Radon is a radioactive gas released during mining and construction activities, and from power plants and underground wastes.

10. Gases like sulphur oxides and nitrogen oxides react with water in the atmosphere, and form acids which mix with the rain water to form acid rain.

11. Acid rain harms surface water of lakes and rivers, disturbs the chemical balance of soils, damages trees and plant life, corrodes metals, marble, limestone, monuments and buildings.

12. The ozone layer in the earth's stratosphere is responsible for absorbing the sun's ultraviolet radiation, and so protects the life on earth.

13. Chlorofluorocarbons are the major cause of depletion of the ozone layer.

14. Gases in the atmosphere, which include carbon dioxide, methane, oxides of nitrogen and water vapour, do not allow the long wave infrared radiations radiating from the earth's surface to escape from the atmosphere.

Thus, the heat of the earth is trapped in the atmosphere, causing a rise in the global temperature. This is called greenhouse effect.

15. The heat of the earth remains in the atmosphere, and is causing a rise in earth's temperature. This is called global warming.

16. The harmful effects of global warming are: rise in global temperature, melting of ice caps in polar regions, rise in sea levels, submerging of coastal areas resulting in migration and loss of livelihoods, change in global weather patterns resulting in hurricanes, floods, etc., loss of biodiversity, and emergence of new diseases, etc.

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