

ENVIRONMENTAL CHEMISTRY –I ATMOSPHERE

Atmosphere: The envelope of gases and water vapors surrounding the planet earth is called atmosphere.

Layers of atmosphere: There are four major layers of atmosphere.

- i) The Troposphere
- ii) The Stratosphere
- iii) The Mesosphere
- iv) The Thermosphere

The Troposphere:-

It is the first layer around the surface of earth. It extends to about 12 kilometer above the surface of earth. It is the layer which is closest to the surface of earth. It is the layer in which we live nearly all the dust particles and vapours are present in this layer. Most of the clouds are formed in this layer. Air craft fly in this layer. Tropo-means turning or changing. Therefore the condition in this layer changes regularly. As the attitude increase in this layer then the temperature decreases from 17° to -55° C. for every 1km increase in attitude the temperature of air gets 6.5° cooler.

The Stratosphere:-

It is the second layer around the surface of earth. This layer extends from top of the troposphere to about 50km above the surface of earth.

Stratosphere is further divided into two parts.

- i) Lower stratosphere.
- ii) Upper Stratosphere.

The lower stratosphere is cold about -55° C but the upper stratosphere is warmer than the lower stratosphere. Ozone is present in upper stratosphere and this ozone is responsible for the rise in temperature. Ozone saves us from harmful effects of ultraviolet radiation coming from the sun. When ozone absorbs energy from the sun then this energy is converted into heat. Due to this heat the temperature in stratosphere increases. The temperature in the stratosphere varies -55° to -5° C.

The Mesosphere:-

It is the third layer around the surface of earth. It extends from top of stratosphere to about 80km from the surface of earth. Meso-means middle so, mesosphere is the middle layer of the atmosphere. In outer part of mesosphere the temperature decreases up to -93° C. this layer protect the surface of earth from being hit by meteoroids.

The Thermosphere:-

It is the outer most layer of the atmosphere. It extends from 80km above the surface of earth and goes into space. Thermo- means heat. Temperature in this layer is very high and it reaches up to 1800° C. The oxygen and nitrogen molecules convert the solar energy into heat. As a result, the temperature increases up to 800° C. Thermosphere is further divided into two layers.

- i) Ionosphere
- ii) Exosphere

i) Ionosphere:

The lower part of the thermosphere is called ionosphere. It extends from 80km to four hundred kilometer/ 400km above the surface of earth.

ii) Exosphere:-

The outer part of thermosphere is called exosphere. It extends from 80km to thousands of kilometers from the surface of earth.

Air pollutants:-

Anything that is in the air, water or soil which has harmful effect on some part of the environment is called pollutant.

Important Air Pollutants:-

There are seven/7 major air pollutants

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|---|-------------------------------|------------------------------|
| i) Sulphure oxides (SO _x) | ii) Carbon monoxide (CO) | |
| iii) Nitrogen oxides (NO _x) | iv) Methane(CH ₄) | |
| v) Chlorofluoro carbons (CFCS) | vi) Lead compounds | vii) Ozone (O ₃) |

i) Sulphuric Oxide:-

Sulphur oxides are one of the major air pollutants. In the air, sulphurdioxide. Is converted into sulphurtrioxide. This sulphurtrioxide is responsible for the acid rain. Its chemical reaction is



Sulphur dioxide is very easily absorbed in the respiratory system. It is very powerful irritant therefore it affects the people who suffer from asthma, bronchitis, emphysema and other lung diseases.

ii. Carbon monoxide (CO):-

When any organic material such as wood burns then two gases, carbon monoxide and carbon dioxide are produced. Carbon monoxide is a poisonous gas. It causes headache and dizziness. If it is inhaled for a long time then it can cause death. Carbon dioxide is not an air pollutant. It is also non-poisonous but it causes global warming.

When carbon reacts with limited supply of oxygen then carbon monoxide is formed.

When carbon reacts with excess amount of oxygen then carbon dioxide is formed.



iii) Nitrogen oxide:- (NO_x)

Nitrogen oxides are major sources of air pollution. Two important oxides of nitrogen that causes air pollution are nitric oxide (NO) and nitrogen dioxide (NO₂). They are represented as NO_x. Nitric oxide (NO) is colourless and odourless gas. It is heavier than air and it is soluble in water. Nitrogen dioxide (NO₂) is reddish brown gas with pungent odour. It dissolves readily in water. Both these oxides are highly toxic gases. They damage lungs, they also cause headache and cough.

iv) Methane:- (CH₄)

Methane is major source of air pollution. It is produced when dead plant material. Decays in the absence of air. It is released in the air from marshes, swamp and rice paddy field. Methane produces a very special photo chemical reaction in the air. As a result very irritating and toxic compounds are formed. Methane is an excellent heat absorber and it also causes global warming.

v) Chlorofluorocarbons: (CFCS)

CFCS are a group of chemically un reactive compounds which are used as solvents. CFCS trap heat in the atmosphere and cause global warming. CFCS are affecting ozone layer very badly. They can cause skin allergy, they can damage liver and nervous system.

vi) Lead Compounds:

Lead particles are also one of the major causes of air pollution. Lead particles in the air come from combustion of leaded petrol or from lead based paints. Lead and its compounds in the affect the human brain especially among children.

vii) Ozone:- (O_3)

Ozone is a light blue gas and it unpleasant odour. In the troposphere, ozone cause breathing difficulties, asthma and eye irritation.

Sources of air pollution:-

There are two main sources of air pollution.

- i) Natural sources.
- ii) Human activities.

i) Natural sources:-

Many natural processes such as forest fires and dust storms release smoke and dust particles into the air. These smoke and dust particles cause air pollution. Volcanoes emit clouds of dust and poisonous a long with ash. All these factors cause air pollution. There are large numbers of electrical discharges produce nitrogen oxide which are major causes of air pollution.

ii) Human activities:-

Most of the air pollution is the result burning fossil fuels such as coal, petroleum and natural gas. Nearly half of the air pollution comes from cars and other motor vehicles. Many factories and power plants that burn coal and oil produce carbon monoxide (CO) and nitrogen oxides. These oxides are major cause of air pollution.

Global warming:-

The warming of the atmosphere due to our influence on the green house effect is known as global warming. Global warming is due to disturbance in the natural balance of the concentration of green house gases in the atmosphere. If global warming continuous then following changes can occur.

- i) Temperature of the earth will gradually increase.
- ii) The earth climate may change which effect the rainfall cycle. As a result there is a great change of flooding in some regions and drought in other regions.
- iii) Polar ice may melt and cause increase in sea levels.
- iv) Atmosphere becomes hotter.

Question: what are advantages of green house?

Ans:- Green house are constructed from glass or transparent polymer films. Some light can pass through these materials and it is used by plants for photosynthesis. The plants radiate some energy in the form of infrared radiations these infrared radiations cannot pass through the green house and they are reflected back. As a result the atmosphere inside the green house becomes not enough to promote the plant growth.

Acid Rain:

The rain which has PH value less than '5.6' is called 'Acid Rain'. Normal rain water has PH value '5.6' but in some area due to presence of sulphur oxides and nitrogen oxides in the air, sulphuric Acid (H_2SO_4) and nitric acid (HNO_3) are formed when rain water passes through the air containing these two acids. Then its PH value becomes less than '5.6'. This PH value of rain water can decrease up to '2.1'. This PH value is less than PH of Vinegar and Lemon.

Effect of Acid Rain:

- 1) Acid rain corrodes the metal surfaces, stone buildings and statues.
- 2) Acid rain can destroy different plants.
- 3) Due to acid rain the water of lakes and rivers become too acidic for living things to survive.
- 4) Acid rain can also kill fish.

OZONE DEPLETION AND ITS EFFECTS:

Ozone is an allotropic form of oxygen and it consists of three oxygen atoms. Ozone is an important gas which is present in stratosphere. Ozone protect the surface of earth from most of the ultraviolet radiations coming from the sun. These rays are filtered by the ozone before come on the surface of earth.

Ozone Hole:

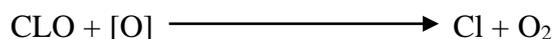
The region in which amount of ozone has been reduced is called 'ozone hole'. Ozone hole was first observed in October 1980 over Antarctica.

REASON OF DEPLETION OF OZONE:

Chlorofluorocarbons coming from air conditioners refrigerators and aerosol sprays escape into the air. These CFC's are gases or low boiling liquids. They are so inert, that they do not react with any other chemical in the atmosphere. Therefore they directly goes in the upper atmosphere and diffuse into the ozone layer. Ultraviolet radiations (UV) coming from the sun react with these CFC's as a result chlorine free radicals are formed.



These (Cl) free radical react with ozone and as a result chlorine monoxide (ClO) and molecular oxygen (O_2) are formed chlorine monoxide reacts with atomic oxygen and again chlorine free radical is produced. This Cl free radical can destroyed thousands of ozone molecules.



Aurora Borealis:

Aurora Borealis are the light displays that occurs in the northern hemisphere.

Aurora are caused by particles coming from the sun and enters the ionosphere near the poles when these particles strikes. The atoms in the ionosphere then these atoms of ionosphere glow and produced light.