Isomerism

The addition of any undesirable material to air, water and soil by a natural source (or due to human activity) which affects the quality of environment is called as environmental pollution.

The undesirable material which added to the environmentl is called as pollutant.

Causes of pollution

(i) Fast population growth.

(ii) Rapid urbanisation.

(iii) Excessive industrialisation

(iv) Use of pesticides in agriculture.

MIND MAP

Environmental Chemistry

Biodegradable pollutants

The materials (such as cow dung) which are easily decomposed by the micro-organisms.

Thus are not harmful, but in excess in environment, they do not undergo complete degradation and thus become pollutant.

Non biodegradable pollutants

The material (such as Hg, Al, DDT) which do not undergo degradation (or degrade very slowly) but their presence even in very small amount in the environment is very harmful.

Types of pollution

(I) Depending on the part of the environment polluted.

(i) Air pollution

(ii) Water pollution

(iii) Soil pollution (or land pollution)

Atmosphere

Region	Altitude from earth's surface	Temp. range	Species present or gases present
Troposphere	0 – 11 km	Decrease from 15 to – 56°C	N_2, O_2, CO_2, H_2O vapour
Stratosphere or coroyones sphere	11 – 50 km	Increase from – 56°C to – 2°C	N_2, O_2, O_3, 0 – atom

MIND MAP

Environmental Chemistry

Region	Altitude from earth's surface	Temp. range	Species present or gases present
Meosphere	50 – 85 km Ionosphere	Decrease from – 2°C to – 92°C	N_2, O_2, NO^+, O_2^+
Thermosphere	85 – 500 km Ionosphere	Increase from – 92°C to – 1200°C	O_2^+, O^+, NO^+, e^-

Air pollution

It is defined as the undesirable materials in the atmosphere either due to natural phenomena (or due to human activity on the earth)

Gaseous air pollutants

(a) Oxides of Sulphur

(b) Oxides of Nitrogen

(c) Hydrocarbons

Harmful effect of CO

The CO is poisonous because it combine with haemoglobin of R.B.C. about 300 times easily than O2, to form carboxy haemoglobin.

$$Hb + CO \rightleftharpoons HbCO \text{ (Carboxyhaemoglobin)}$$

$$Hb + O_2 \rightleftharpoons HbO_2 \text{ (oxyhaemoglobin)}$$

In blood, when the concentration of carboxyhaemoglobin reaches about 3-4 per cent, the oxygen carrying capacity of blood is greatly reduced.

This oxygen deficiency, results into headache, weak eyesight, nervousness and cardiovascular disorder.

This the reason people are advised not to smoke.

Global Warming and Greenhouse Effect

About 75 % of the solar energy reaching the earth is absorbed by the earth's surface, which increases its temperature.

The rest of the heat radiates back to the atmosphere.

Some of the heat is trapped by gases such as Carbon dioxide, Methane, Ozone,

Chlorofluorocarbon compounds (CFCs) and water vapour in the atmosphere.

Thus, they add to the heating of the atmosphere.

This causes Global warming.

Acid Rain

We are aware that normally rain water has a pH of 5.6 due to the presence of H+ ions formed by the reaction of rain water with carbon dioxide present in the atmosphere.

$$H_2O(\ell) + CO_2(g) \rightleftharpoons H_2CO_3(aq)$$

$$H_2CO_3(aq) \rightleftharpoons H^+(aq) + HCO_3^-(aq)$$

When the pH of the rain water drops below 5.6, it is called Acid rain.

Taj Mahal and Acid Rain

The air around the city of Agra, where the Taj Mahal is located, contains fairly high levels of sulphur and nitrogen oxides.

It is mainly due to a large number of industries and power plants around the area.

Use of poor quality of coal, kerosene and firewood as fuel for domestic purposes add up to this problem.

The resulting acid rain reacts with marble, $CaCO_3$ of Taj Mahal

$$CaCO_3 + H_2SO_4 \longrightarrow CaSO_4 + H_2O + CO_2$$

There are four types of non-viable particulates in the atmosphere

(i) Mists (ii) Smoke (iii) Fumes (iv) Dust

(a) Mists are produced by particles of spray liquids and the condensation of vapours in air.

Examples are portions of herbicides and insecticides that miss their targets and travel through the air to form mists.

MIND MAP

Environmental Chemistry

(b) Smoke denotes very small soot particles produced by burning and combustion of organic matter.

Oil smoke, tobacco smoke and Carbon smoke are typical examples of this type of particulate emission.

(c) Fumes are condense vapours of metals, these are the well-known particulates of this type.

Examples of this category also include metallurgical fumes and alkali fumes.

(d) Dust consists of the particles produced during crushing, grinding and attribution of solid materials.

Non-viable dust particulates in the atmosphere consist of ground limestone, sand tailings from floatation, pulverised coal, cement, fly ash and silica dust.

This type of disease is well known in industrial settings and is termed as 'Pneumoconiosis'.

Smog

Smog which describe the "smoke-fog" like condition, are the best-known examples of air pollution that occurs in many cities throughout the word.

There are two types of smogs

(i) Classical smogs which occur in cool humid climate and are the result of buildup of Sulphur Oxides and particulate matter from fuel combustion

(ii) Photochemical smogs which occur in warm, dry and sunny climate and result from the action of sunlight on the Nitrogen Oxides and Hydrocarbons produced by automobiles and factories.

Formation of Photochemical Smog

The chemistry of formation of photochemical smog centres around Nitric Oxide (NO).

MIND MAP

Environmental Chemistry

$$NO_2(g) \xrightarrow{h\upsilon} NO(g) + O(g)$$

Oxygen atoms are very reactive and can combine with O_2 to form Ozone;

$$O(g) + O_2(g) \longrightarrow O_3(g)$$

The O_3 formed in the above reaction reacts rapidly with the NO(g) formed in reaction to regenerate NO_2.

$$NO(g) + O_3(g) \longrightarrow NO_2(g) + O_2(g)$$

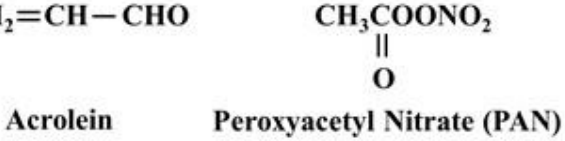
Both NO and O_3 are strong oxidising agents and can react with the unburnt Hydrocarbons in the polluted air to produce chemicals,

Such as formaldehyde, Acrolein and Peroxyacetyl Nitrate (PAN) that cause the eyes to water and burn and are harmful to the respiratory system.

The brownish haze of photochemical smog is largely attributed to the brown colour or NO_2.

$$3CH_4 + 2O_3 \longrightarrow \underset{\text{Formaldehyde}}{3CH_2=O} + 3H_2O$$

Acrolein and Peroxyacetyl Nitrate (PAN) are particularly noxious.



Effect of Photochemical Smog

The three main components of photochemical smog are Nitrogen Oxides, Ozone and organic derivatives (such as Acrolein, formaldehyde, PAN etc.)

Control of Photochemical Smog

Efforts have been made to suppress or control formation of photochemical smog.

Formation of Ozone layer

In the stratosphere (11-50 km), the O2 is partially converted into O_3.

Now at an altitude of 25-30 km, we have a layer in which the conc. of O_3 is 10 ppm.

It is called as O_3 layer and occurs in 2 steps.

In Step (I) $O_2 \xrightarrow{h\upsilon} O^{\bullet} + O^{\bullet}$

In Step (II) $O_2 + O^{\bullet} \xrightarrow{h\upsilon} O_3$

The heat is also given out from this reaction which warm up stratosphere. For this reason stratosphere is a zone of increasing temp.

$$O_3 \xrightarrow{h\nu} O_2 + O^{\bullet} + xk\ cal.$$

In this way the O_3 cycle is completed in this region.

Depletion of Ozone layer

Due to human activity 2 compounds NO and CFC are responsible for depletion of O_3 layer.

The Ozone hole

In 1980s atmospheric scientists working in Antarctica reported about depletion of Ozone layer commonly known as Ozone hole over the South Pole.

Water Pollution

Major water pollutants

Pollutant	Source
Micro - organisms	Domestic sewage
Organic wastes	Domestic sewage, animal excreta and waste, decaying animals and plants, discharge from food processing factories.
Plant nutrients	Chemcial fertilizers
Toxic heavy metals	Industries and chemical factories

MIND MAP

Environmental Chemistry

Major water pollutants

Pollutant	Source
Sediments	Erosion of soil by agriculture and strip mining
Pesticides	Chemicals used for killing insects, fungi and weeds
Radioactive substances	Mining of uranium containing minerals
Heat	Water Used for cooling in industries

Causes of Water Pollution

(i) Pathogens (ii) Organic wastes

(iii) Chemical pollutants

Pathogens

The most serious water pollutants are the disease causing agents called pathogens. Pathogens include bacteria and other organisms that enter water from domestic sewage and animal excreta.

Thus, the amount of Oxygen required by bacteria to break down the organic matter present in a certain volume of a sample of water, is called Biochemical Oxygen Demand (BOD).

The amount of BOD in the water is a measure of the amount of organic material in the water, in terms of how much oxygen will be required to break it down biologically.

Clean water would have BOD value of less than 5 ppm whereas highly polluted water could have a BOD value of 17 ppm or more.

Chemical Pollutants

As we know that water is an excellent solvent, water soluble inorganic chemicals that include heavy metals such as Cadmium, Mercury, Nickel etc. constitute an important class of pollutants.c

International Standards for Drinking Water

Soluble fluoride is often added to drinking water to bring its concentration upto 1 ppm or 1 mg dm^{-3}.

Lead

Drinking water gets contaminated with lead when lead pipes are used for transportation of water.

The prescribed upper limit concentration of lead in drinking water is about 50 ppb. Lead can damage kidney, liver, reproductive system etc.

Sulphate

Excessive Sulphate (>500 ppm) in drinking water causes laxative effect, otherwise at moderate levels it is harmless.

Nitrate

The maximum limit of Nitrate in drinking water is 50 ppm. Excess Nitrate in drinking water can cause disease such as methemoglobinemia ('blue baby' syndrome).

Other Metals

The maximum concentration of some common metals recommended in drinking water are given in Table.

MIND MAP

Environmental Chemistry

Metal	Max. concentration (ppm or mg dm^{-3})
Zn	5
Fe	0.2
Mn	0.05
Cu	3
Cd	0.005
Al	0.2

Soil Pollution

India being an agriculture based economy gives high priority to agriculture, fisheries and livestock development.

Pesticides

Prior to World War II, many naturally occurring chemicals such as nicotine (by planting tobacco plants in the crop field), were used as pest controlling substance for major crops in agricultural practices.

During World War II, DDT was found to be of great use in the control of malaria and other insect-borne diseases.

Industrial Waste

Industrial solid wastes are also sorted out as biodegradable and non-degradable wastes. Biodegradable wastes are generated by cotton mills, food processing units, paper mills, and textile factories.

Non-biodegradable wastes are generated by thermal power plants which produce fly ash; integrated Iron and steel plants which produce blast furnace slag and steel melting slag.

MIND MAP

Environmental Chemistry

Strategies to control Environmental Pollution

Waste Management

Solid waste is not the only waste, which you see in your household garbage box.

Besides household discards, there are medical, agricultural, industrial and mining wastes.

You must be aware of the 'Swachh Bharat Abhiyan' or 'Clean India Mission' launched by the Government of India.

Collection and Disposal

Domestic wastes are collected in small bins, which are then transferred to community bins by private or municipal workers. From these community bins, these are collected and carried to the disposable site.

Non-biodegradable materials such as plastic, glass, metal scraps etc. are sent for recycling.

Biodegradable wastes are deposited in land fills and are converted into compost.

Green Chemistry

Green chemistry is a production process that would bring about minimum pollution or deterioration to the environment.

Green Chemistry In Day to Day Life

(i) Dry Cleaning of Clothes

(ii) Bleaching of Paper

(iii) Synthesis of Chemicals

(iv) Green Solution to Clean Turbid Water

Dry Cleaning of Clothes

These days Hydrogen peroxide (H_2O_2) is used for the purpose of bleaching clothes in the process of laundary, which gives better results and makes use of lesser amount of water.

Bleaching of Paper

Chlorine gas was used earlier for bleaching paper.

These days, Hydrogen peroxide (H_2O_2) with suitable catalyst, which promotes the bleaching action of Hydrogen peroxide, is used.

Synthesis of Chemicals

Ethanal (CH_3CHO) is now commercially prepared by one step oxidation of Ethene in the presence of ionic catalyst in aqueous medium with a yield of 90%.