

ENVIRONMENTAL CHEMISTRY

✚ **Chemistry** deals with the study of the origin, transport, reactions, effects, fates of chemical species in the environment.

COMPONENTS OF ENVIRONMENT

✚ Environment has two components

(i) **Physical or abiotic (non-living) components** and

(ii) **Living or biotic components:** Abiotic components of environment are air, water, soil, energy radiation, etc. Biotic components of environment are microbes (such as bacteria, algae and fungi), plants, animals, etc.

✚ Environment is the sum total of living and non living components surrounding an organism.

✚ Environment consists of four segments such as (i) Biosphere (ii) Atmosphere (iii) Hydrosphere, and (iv) Lithosphere

✚ The part of earth on which organisms can survive and reproduce is called **biosphere**.

✚ **Atmosphere** is a thin layer of air (mixture of gases) around the earth which is a great source to all living organisms.

✚ **Hydrosphere** is the part of earth on which all types of water resources exists, viz., oceans, seas, rivers, lakes, glaciers, ice caps, ground water, etc.

✚ **Lithosphere** is the part of the earth where all types of minerals, metals, organic matters, rocks, soils, etc. exists.

Global Environmental Damages

✚ Global climate change, the depletion of the ozone layer, desertification, deforestation, the loss of the planet's

biological diversity and the transboundary movements of hazardous wastes and chemicals are all environmental problems that touch every nation and adversely affect the lives and health of their populations.

POLLUTION

✚ **Environmental pollution** is the effect of undesirable changes in our surroundings that have harmful effects on plants, animals and human beings.

POLLUTANTS

✚ **Pollutants** can be:

(i) **Gaseous air pollutants** (e.g., SO₂, NO₂, CO₂, H₂S, O₃ hydrocarbons etc. and

(ii) **Particular pollutants** (e.g., dust, mist, fumes, smoke, smog etc.)

✚ **Gaseous air pollutants:** SO₂ can cause acute irritation to the membranes of the eyes resulting in tears and redness. It is also responsible for acid rain. NO₂ is extremely toxic to living tissues, textiles and in the production of photochemical smog.

✚ **Particulate pollutants :** They are of two types

(i) **Visible particulate or viable particulates:** There are the minute living organisms that are disposed in atmosphere. **Ex.** Bacteria, fungi, moulds etc.

(ii) **Non-viable particulates:** These are formed either by the breakdown of larger materials or by the condensation of minute particles and droplets. **For Ex.** mists, smoke, fumes and dust.

SOURCES OF POLLUTANTS

- ✚ **Mobile sources** – such as cars, buses, planes, trucks, and trains.
- ✚ **Stationary sources** – such as power plants, oil refineries, industrial facilities, and factories.
- ✚ **Area sources** – such as agricultural areas, cities, and wood burning fireplaces.
- ✚ **Natural sources** – such as wind-blown dust, wildfires, and volcanoes.

AIR POLLUTION

- ✚ Air pollution is a mixture of solid particles and gases in the air. Car emissions, chemicals from factories, dust, and pollen and mold spores may be suspended as particles. Ozone, a gas, is a major part of air pollution in cities. When ozone forms air pollution, it's also called smog. Some air pollutants are poisonous.

Table 32.3: Common air pollutants, their sources and contribution of Natural and Anthropogenic pollution

| Air Pollutants | Some Sources | Emission (% of total) | |
|---------------------------------------|---|-----------------------|---------------|
| | | Natural | Anthropogenic |
| Sulphur oxide (SO ₂) | Fossil fuel burning, industry biomass burning, volcanoes, oceans. | 50 | 50 |
| Carbon monoxide (CO) | Incomplete combustion, methane oxidation, transportation, biomass burning, plant metabolism. | 91 | 9 |
| Nitrogen oxide (NO _x) | Fossil fuel burning, lightning, biomass burning, soil microbes. | 40 | 60 |
| Hydrocarbons (HC) | Fossil fuels, industrial processes, evaporation of organic solvents, agricultural burning, plant isoprenes and other biogenics. | 84 | 16 |
| Suspended Particulate Materials (SPM) | Biomass burning, dust, sea salt, biogenic aerosols, gas to particle conversion. | 89 | 11 |

TEMPERATURE INVERSION AND PHOTOCHEMICAL SMOG

- ✚ Pollutants like sulphur dioxide which is released while burning sulphur containing fuels (fossil fuels) and particulate matter like soot present in stagnant air masses, get modified in sunlight and form a sheet called

photochemical smog.

- ✚ **Smog** is a combination of fog, smoke and fumes released by mills and factories, homes and automobiles.
- ✚ Exposure to smog causes respiratory problems, bronchitis, sore throat, cold, headache and irritation to eyes (red shot eyes). Smog also damages crops and reduces crop yield.

EFFECTS OF EXCESSIVE ATMOSPHERIC POLLUTANTS ON NATURE (OUTDOOR POLLUTION)

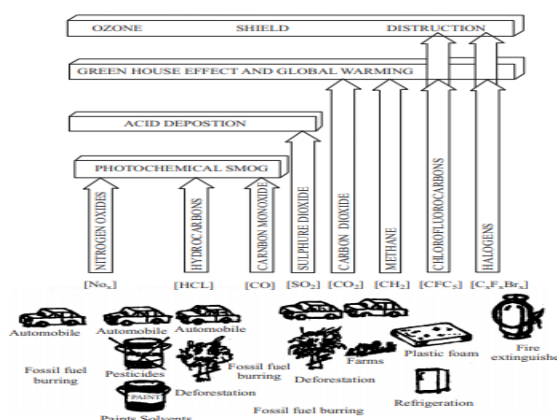


Fig. 32.3: Four Major Effects of Atmospheric Pollutants

ACID RAIN

- ✚ When the pH of the rain water drops below 5.6, it is called acid rain. It damages monuments and structures made of firm marble, corrode articles made from metals, destroy plants and trees and it is also harmful to the aquatic life in lakes and rivers.

GREEN HOUSE EFFECT AND GLOBAL WARMING

- ✚ **Global warming** is defined as the increase in the average global temperature of the atmosphere near earth's surface.

- ✚ **Green House Effect** is the phenomenon of warming of earth by absorption and re-emission of solar radiations.
- ✚ **Green house gases** are CO_2 , CH_4 , O_3 water vapours, chlorofluoro carbons etc.

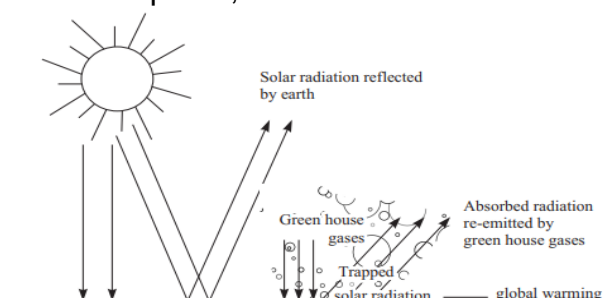


Fig. 32.6: Green House Effect

- ✚ **Electromeric effect:** The complete transfer of the shared pair of π electrons of a multiple bond to one of the atoms in the presence of the attacking reagent is called electromeric effect.

DEPLETION OF OZONE LAYER

- ✚ **Ozone hole** is formed over South Pole due to depletion of ozone layer. CFCs and NO are responsible for ozone layer depletion.
- ✚ **Effects of depletion of ozone layer:** With the depletion of ozone layer, more UV radiation AE lters into troposphere. UV radiations lead to ageing of skin, cataract, sunburn, skin cancer, killing of many phytoplanktons, damage to fish productivity etc.

CONTROL OF AIR POLLUTION

- ✚ Reduce the number of trips you take in your car.
- ✚ Reduce or eliminate fireplace and wood stove use.
- ✚ Avoid burning leaves, trash, and other materials.
- ✚ Avoid using gas-powered lawn and garden equipment.

WATER POLLUTANTS

- ✚ Sewage Pollutants (Domestic and

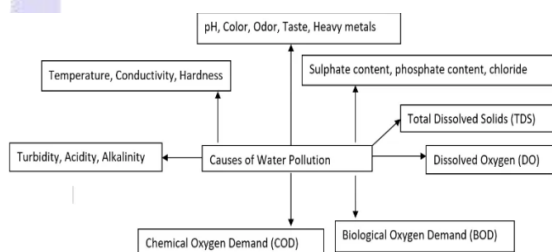
Municipal Waste)

- ✚ Industrial Pollutants
- ✚ Agricultural Pollutants
- ✚ Radioactive and Thermal Pollutants

WATER POLLUTION – PARAMETERS



WATER POLLUTION – SOURCES



WATER POLLUTION AND SOME BIOLOGICAL EFFECTS

Eutrophication

- ✚ **Eutrophication** of a water body results due to the release of large amount of nutrients by the action of aerobic bacteria on organic wastes entering a water body naturally or by human activity.

Biological Oxygen Demand (BOD)

- ✚ The quantity of oxygen used up by microorganisms at 27°C and in darkness during 3 days in breaking down organic

wastes in a water body is called its biological oxygen demand (BOD).

Biomagnification

- Biomagnification is the accumulation of a chemical by an organism from water and food exposure that results in a concentration that is greater than would have resulted from water exposure only and thus greater than expected from equilibrium.

WATER POLLUTION – SOME CONTROL MEASURES

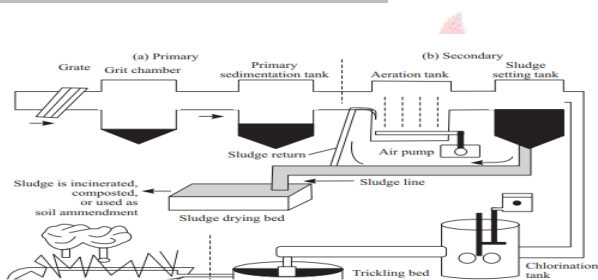
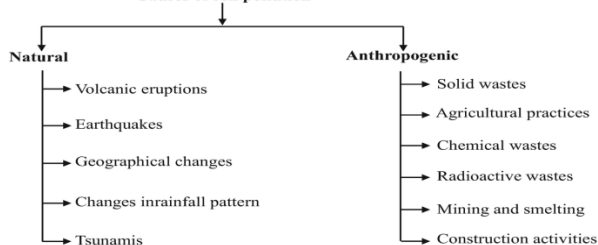


Fig. 32.8: Treatment process of sewage

SOIL POLLUTION

- Soil pollution** is defined as the presence of toxic chemicals (pollutants or contaminants) in soil, in high enough concentrations to pose a risk to human health and/or the ecosystem.

Causes of soil pollution

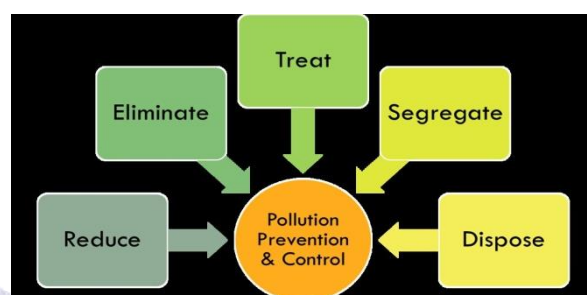


GREEN CHEMISTRY AS AN ALTERNATIVE TOOL FOR REDUCING POLLUTION

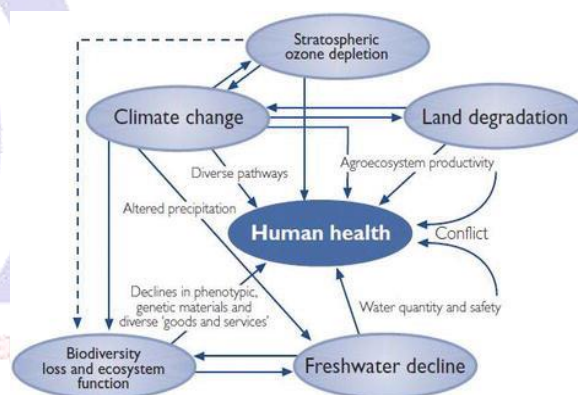
- Green Chemistry** is a way of thinking and is about utilizing the existing knowledge and principles of chemistry and other science to reduce the adverse impact on environment.

- Green Chemistry in Day to Day life : Dry cleaning of clothes by using liquefied CO_2 along with detergent instead of tetrachloroethene, Bleaching of paper and clothes by using H_2O_2 a better bleaching agent as compared to Cl_2 .

STRATEGIES TO CONTROL ENVIRONMENTAL POLLUTIONS



Effects of depletion of ozone layer:



Test Yourself

Question: Which gases are responsible for greenhouse effect? List some of them.

Answer: CO_2 is mainly responsible for greenhouse effect. Other greenhouse gases are methane, nitrous oxide, water vapours, CFCs and Ozone.

Check Yourself

1. The agricultural field that produces maximum methane gas into atmosphere is
(A) Wheat field (B) Paddy field
(C) Cotton field (D) Groundnut field
2. Fluorosis, the bone disease, is caused by the presence of
(A) Pesticides in water
(B) Fluorides in water
(C) Carbon monoxide in air
(D) Sulphur dioxide in air.
3. The most harmful air pollutant produced by automobiles is
(A) HNO_3 (B) NO
(C) SO_2 (D) CO .
4. Photochemical smog is related to pollution if
(A) Air (B) Water
(C) Soil (D) None of these
5. Which of the following acts as a sink for CO ?
(A) Plants
(B) Haemoglobin
(C) Microorganisms present in the soil
(D) Oceans

Stretch Yourself

1. Carbon monoxide gas is more dangerous than carbon dioxide gas. Why?
2. Statues and monuments in India are affected by acid rain. How?
3. What is smog? How is classical smog different from photochemical smog?
4. What are the harmful effects of photochemical smog and how can they be controlled?
5. What are the major causes of water pollution? Explain.



Answers

Check Yourself

Answer: 1(B); 2(C); 3(D); 4(C); 5(C)

Stretch Yourself

1. Carbon monoxide combines with haemoglobin to form a very stable compound known as carboxyhaemoglobin when its concentration in blood reaches 3-4%, the oxygen carrying capacity of the blood is greatly reduced. This results into headache, nervousness and sometimes death of the person. On the other hand CO_2 does not combine with haemoglobin and hence is less harmful than CO.
2. CO_2 is mainly responsible for greenhouse effect. Other greenhouse gases are methane, nitrous oxide, water vapours, CFCs and Ozone.
3. The word smog is a combination of smoke and fog. It is a type of air pollution that occurs in many cities throughout the world. Classical smog occurs in cool humid climate. It is also called as reducing smog. Whereas photochemical smog occurs in warm and dry sunny climate. It has high concentration of oxidising agents and therefore, it is also called as oxidising smog.
4. Do it by yourself.
5. Do it by yourself.