Chapter 16

Environmental Issues

Introduction: Pollution & Pollutants

POLLUTION

"Any undesirable change in physical, chemical or biological characteristic of air, water and land which is harmful to the man directly or indirectly through the animals, plants industrial unit or raw materials is called pollution."

Pollutants

"Any material or product of man or nature which leads to pollution is called pollutants."

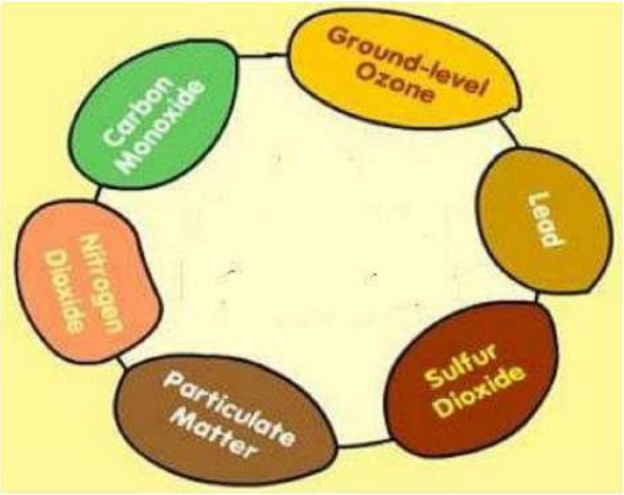


Fig: Some common types of pollutants

Types of Pollutants:

usually Pollutants are Divided into Following Categories:

1. Non degradable pollutants: Many of such pollutants are usually not degraded or degraded partially in environment. Such as **aluminium pecks, Mercury compounds of phenols, Glass, D.D.T., Benzene, BHC pesticides, etc.**

They are collected in the environment and cause pollution. These pollutants are harmful even in low concentration and harm increases with their increasing concentration. No treatment is found in the nature for their recycling. There are only two methods by which we can stop the pollution caused by pollutant.
(i) Such type of substance should be banned by law.
(ii) Use their alternative substance.

Fig: Non-degradable waste

2. Biodegradable pollutants: The **domestic sewage papers, woods, garbage, live stock wastes, etc. are easily degraded completely by micro-organisms**, it becomes useful. But if these materials enter the environment in such large quantities, that they cannot be degraded completely then addition of these materials cause pollution in environment.

a. Primary pollutants- These persist in the form in which they are added to the environment. Eg., DDT, CO etc.

b. Secondary pollutants- These are formed by chemical reaction among primary pollutants. eg., **Photochemical smog, London smog, PAN, O_3.**

Fig: London smog

Synergism- Formation of secondary pollutants is known as synergism. Secondary pollutants are more toxic than primary pollutants.

1. Quantitative pollutants- These are the substances which occur in nature but become pollutant when their concentration reaches beyond a threshold value in the environment.
eg., CO_2, Nitrogen oxide.

2. Qualitative pollutants- These are the substance which do not occur in the environment but are passed in through human activity. eg., Fungicides, Herbicides, DDT etc.

Other types of pollution:

1. Natural pollution- Caused by natural sources like, **CH_4 from paddy fields and cattle, marsh, forest fire.**

Fig: Forest fires

2. Anthropogenic pollution- Caused by human activities.

Main sources of pollution:

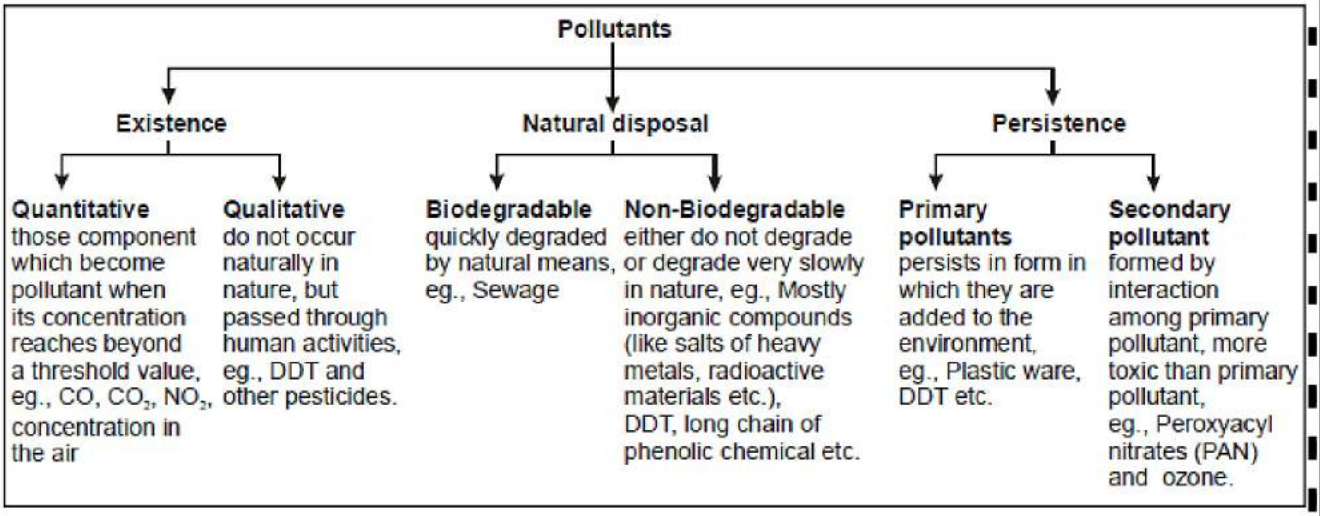
(i) Point source pollution- Where the effluent discharge occurs at a specific site. eg., factory outlet and Municipal sewage.

(ii) Line source pollution- It is passed along a narrow belt, Roads, eg., Rods, Railway tracks.

(iii) Diffuse source pollution- It is over a large area.

eg., sprayed fertilizer or pesticides through run off.

(iv) Area source pollution- Industrial estate and mining area.



Noise Pollution

SOUND POLLUTION / NOISE POLLUTION

Increase in the noise in the atmosphere is called noise pollution or sound pollution. Noise is a loud and unwanted or unpleasant sound. The common things which are responsible for noise pollution are - industries and mills, means of transportation, television, stereo, loud speakers and jet plane etc.
Intensity: The intensity of sound is measured in **bel or decibel** [1 bel = 10 decibel]. A man can hear at **0-decibel.** Normally at 25 decibel, the atmosphere may be peaceful. **Above 80 decibel intensity** of sound is called **noise pollution.**

Effect: It causes drowsiness, irritation, weakness and 130-140 decibel causes heart pain. Noise pollution reduces the capacity of hearing and results in headache. Sudden excitation in skin, constriction of gastric muscles starts above the 90 decibel. It also produces excitation in habit of man and anger. Noise pollution causes ulcers, heart disease, high blood pressure, higher secretion of adrenal hormones etc. Excluding these, high intensity of sound can also break down the walls of the houses and burning of rubber.

Control:

Noise pollution can be controlled by the use of such type of apparatus which can decrease the intensity of sound at place of origin. Sound absorber must be used to minimise the sound. Excluding this growing of more plants can also minimise the noise pollution.
Green muflur scheme. Tree such as neem and ashoka absorb sound to a great extent, along road side.

	Day Time	Night Time
Industrial	75 dB	70 dB
Commercial	65 dB	55 dB
Residential	55 dB	45 dB
Silence zone	50 dB	40 dB
Very Quiet	20 – 30 dB	Sound quiet place is – 20 dB, Motion Picture studio, Broadcasting studio
Silence/Quiet	30/35 – 50 dB	Hospitals (30 – 35), Schools (45 – 50), Libraries (45 – 50), Offices (40 – 50)
Normal voice	55 dB	
Conversational speech	60 dB	
Moderately Loud	70 dB - 90 dB	Factories (60 – 65 dB) Average traffic – 70 dB Heavy city traffic – 90 dB
Uncomfortable	above 100 dB	Air craft (120 dB)
Painful	above 130 dB	Rocket (180 dB) Jet plane (150 dB)

Air Pollution: Causes & Effects

AIR POLLUTION:

The air pollution is caused due to addition of unwanted substances or gases. The atmospheric pollution is mainly caused by the activities of man and concentrated to the inhabited and the industrial complexes in cities.
There are two main categories of air pollutants:
(i) Gases
(ii) Particulates
(i) Gases
The gaseous materials include various gases and vapours of volatile substances or the compound with a boiling point below 200ºC.

Particulate matter:

Particulate matter consist of solid particles or liquid droplets (aerosols) small enough to remain suspended in air. eg., soot, smoke, dust, asbestos, fibres, pesticides, some metals (including Hg, Pb, Cu and Fe) and also biological agent like tiny dust mites and flower pollen.
Atmospheric particles having diameter > 10 μm, generally settle down in less than a day, whereas particles with diameters 1 μm or less can remain suspended in air for weeks.
Suspended particulate matter in the lower atmosphere (troposphere) causes and aggravates human respiratory illness, like asthama, chronic bronchitis etc.
According to **Central Pollution Control Board (CPCB), particulate size of 2.5 micrometers** or less (diameter) (PM 2.5) are responsible for causing harm to human health as inhaled deep into lungs can cause breathing and respiratory symptoms, irritation, inflammations, damage to lungs & premature death.

MAJOR AIR POLLUTANTS AND THEIR EFFECTS:

1. Carbon monoxide (CO) -

Source - It is the main air pollutant released from smoke of automobiles.
Effect - Carbon monoxide is a highly toxic gas, it **combines with haemoglobin** of the blood and blocks the **transportation of oxygen.** Thus, it **impairs respiration** and it causes **death due to asphyxia** when inhaled in large amount.

2. Unburn Hydrocarbons - (3,4 Benzopyrine, CH4, Benzene)
Source - These are mainly released from **automobiles** and **burning of fossil fuel (coal, petrol, diesel). Methane** (CH_4) is the most abundant hydrocarbon in atmosphere and its main source is marshy area and paddy fields.
Effect - Hydrocarbons cause **lungs cancer.**
Polynuclear hydrocarbon is major hydrocarbon pollutant which causes cancer.'

3. Ethylene -
Source - Its main sources are **automobiles, chimneys.**
Effect - Falling of leaves without particular reason, **falling of flowering bud** before time.

4. Nitrogen oxide (NO, NO_2) -
Source - Burning (combustion) of fossil fuel in automobiles.
Effect-These nitrogen oxide form **photochemical smog** in atmosphere and release ozone.
Nitrogen oxide is also responsible for **acid rain**. Entry of nitrogen oxide causes

respiratory trouble such as **emphysema, bronchitis, swelling of lungs and lungs cancer** etc.

5. Sulphur oxide (SO_2, SO_3)
Source - These are most harmful gaseous pollutants. Main source of sulphur oxides are **coal burning, smelters, oil refineries.**
Effect - Lichen and mosses do not grow in SO_2 polluted areas, Lichen and mosses are indicator of **SO_2** pollution. Oxides of sulphur produce acid rain and smog in atmosphere.

6. Smoke - (SO_2, SO_3, NO_2, NO, CO, CO_2)

SECONDARY POLLUTANTS:

A. Smog (Smoke + Fog) -
This word was given by **Desvoeux.** Smog/Smoke is measured by **Ringlmann method.**
(a) Los Angles Smog or Photochemical smog -
It was first observed in Los Angeles. In this process **smoke, fog, nitrogen oxide, hydrocarbons, oxygen, UV light and high temperature are essential**. These components react with each other and form reddish brown smog (PAN + O_3 + Nitrogen oxides) or brown haze/brown air.
Los Angeles smog is **light induced smog.**
Effect -
Due to smog, elastic substances (rubber/tyres) are also affected. Smog causes damage in rubbers.
During smog, peroxyacetyl nitrate (PAN) is formed. PAN stops or **inhibits the photolysis of water** in hill reaction of photosynthesis and inhibit the photosystem-II. PAN also **inhibits the chlorophyll formation in plants.**
In animals, PAN causes **irritation in eyes** and **harms the lungs.**
Ozone causes harm to mucous membrane.
(b) London smog or sulphur smog -
It was first observed in London. In this process **coal, smoke, fog, sulphur oxide and low temperature** are involved. These components react with each other and form vapor (Fog) of H_2SO_4 which is known as London smog.
Effect -
Due to inhalation of H_2SO_4 vapour with fog, **4000 people died in London in 1952.**
B. Acid rain-
This word was given by **Robert August.** NO_2 and SO_2 are released from different sources in form of smoke and dissolved in atmospheric water vapour to form sulphuric acid and nitric acid (H_2SO_4 + HNO_3).
These acids come down on earth with rain water, this is called acid rain.
Wet deposition:- If acid comes down on earth with **rain, fog and smog**, it is known as

wet deposition.
Dry deposition :- If acid settles on earth surface through **solid dust particles** with **nitrate** or **sulphate**, this is called dry deposition.

Note:

The pH of acid rain is 3.5-4 while for normal rain is 5.6.
In acid rain, the ratio of H_2SO_4 and HNO_3 is **7 : 3** (70% H_2SO_4 + 30% HNO_3)
Effect -
Due to acid rain, acidity of soil and water increases.
Acid rain also cause **damage historical monuments. eg., Taj Mahal, Red fort.**

GREEN HOUSE EFFECT:

Without green house effect the average (mean) temperature of earth surface were – 18º C rather than present 15 ºC.
Usually carbon dioxide is not considered as pollutant, but its higher concentration forms a thick layer above the earth's surface, checks the radiation of the heat from the earth surface. Because of this, temperature of the earth's surface increases, this is called "**Greeen House Effect" or Global warming.**

The relative contribution of various Green House Gases to total Global Warming.
Main green house gases are **CO_2, CH_4, CFC, N_2O.** These are **radiation active gases**, Because they absorb long wave infrared radiations. SO_2, NO_2, O_3 do **not** contribute in green house effect. Water vapours are also released from industries and agriculture which are responsible to increase the green house effect.

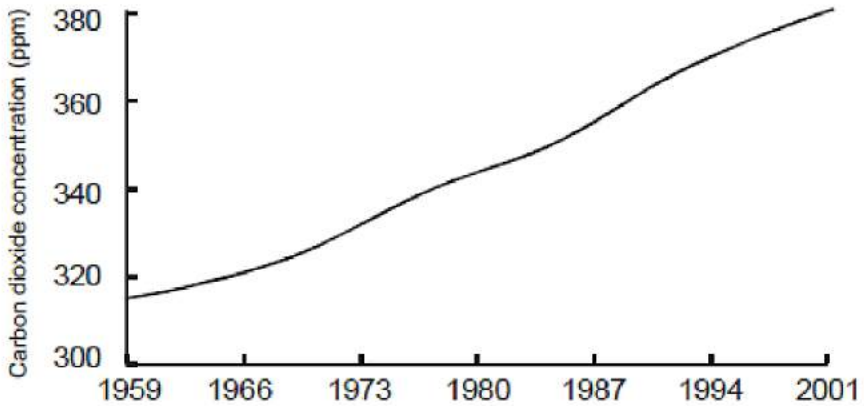


Diagram IV : Showing the increase in mean carbon dioxide concentration in the atmosphere from 1959 to 2001 based on a data from Maunaloa observatory, USA

In this phenomenon, cover of CO_2 layer around the earth, allow the short wavelength (U.V. rays) incoming solar radiation to come in but does not allow the long wavelength (IR) of out going heat radiation from warm surface of earth to keep earth warm. The **consequent increase in the global mean temperature is referred to as global warming.**

Effects of Green House Gases:

1. It has been observed that in the recent past, the level of CO_2 in the atmosphere has increased from **280 ppm to 368 ppm in 1956 to 2002.** If present growth rate is continued then the amount of CO_2 will be doubled upto 2020. Even 2-3ºC rise in temperature will lead to **melting of glaciers and ice caps of polar region** and consequently the **floods in rivers, rise in sea level** and **changes in cycle of rain**. Islands may be submerged in sea water. **CO_2 conc. in 2009-2010 is 385 ppm.**

2. Carbon dioxide fertilisation effect - Due to increased CO_2 concentration the rate of photosynthesis will increase (up to a few year). The response of the plants to the elevated concentration of CO_2 is known as the CO_2 fertilization effect, if would be **shown by C_3 plant**, if rest of environment factors are optimum. The **stomatal conductance decrease (due to partial closure of stomata).**Thus **transpiration may be reduced** and **water use efficiency will increase**. It allows many species to grow successfully in regions of water scarcity.
* Under high CO_2 conc. **higher rate of photosynthesis** provide high amount of food to roots. This **greater root production** enhance mycorrhizal development and **N_2 fixation in root nodules** and enables the plant to grow in nutrient poor soil.
* But all these effects are possible only when the rest of environmental factors are optimum.

3. The **global mean temperature** has increased by **0.6ºC in 20th century.** Depletion of ozone layer in stratosphere.

4. Sea level has been raised by 1 to 2 mm per year during 20th century.

Control of Global Warming:

UNCED (United Nations Conference on Enivronment and Development) **Earth Summit held at Rio-de- Janerio (Brazil) in 1992 for reducing green house gases and biodiversity conservation and make Agenda-21.**
Kyoto protocol conference held in **Kyoto (Japan)** for climate change (1997). This protocol requires countries to take appropriate measures to reduce their overall **green house gas emission** to a level at 5 percent below the 1990 level by the commitment period **2008-2012.**

Earth Summit or world summit on sustainable development (2002) was held in Johanncsburg (SAfrica).

1. Reducing the green house gases emission by limiting uses of fossil fuels and developing alternative renewable sources of energy (wind and solar energy).
2. Increasing the vegetative cover mainly forests for photosynthetic utilization of CO_2.
3. Minimizing the use of Nitrogen fertilizers in agriculture for reducing N_2O emission.
4. Developing substitute for CFC's.

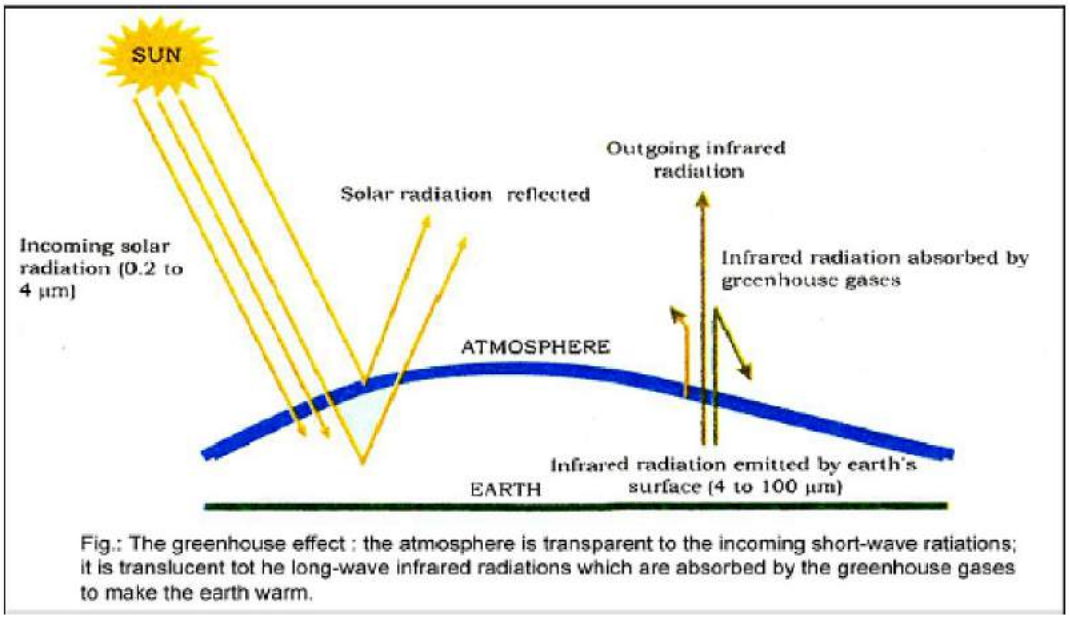


Fig.: The greenhouse effect : the atmosphere is transparent to the incoming short-wave ratiations; it is translucent tot he long-wave infrared radiations which are absorbed by the greenhouse gases to make the earth warm.

CONTROL OF AIR POLLUTION:

1. Control of particulate matter - Two devices are used to remove particulate air pollutants.

(a) Arresters
(b) Scrubbers

(a) ARRESTERS:

These are used to separate particulate matters from contaminated air.

Arresters are of different types:

(i) Cyclonic separators and Trajectory separators: These are commonly used to separate out particulate matters from **industrial emissions with minimum moisture**

content. These separators work on the principle of dust separation by centrifugal force.

(ii) Electrostatic Precipitator: It is the **most efficient device** to remove fine particulate pollutants. Electrostatic precipitation device work on the principle of **electrical charging of the dust particles** and collecting it on a differently charged platform.

* It can remove 99% of particulate matter present in exhaust form a **Thermal Power Plant.** It has **electrode wire (act as anode)** which maintained at several thousand volts, which **produce corona** and release **electrons.**

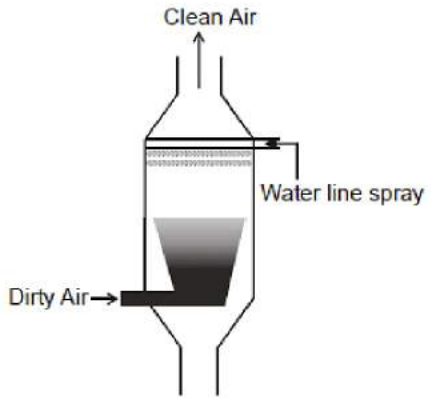
These electrons attached to dust particles provide them negative charge. The base have **collecting plate (acts as cathode)** and attracts the charged dust particles.

The low velocity air is provided between the plates which allow the dust to fall.

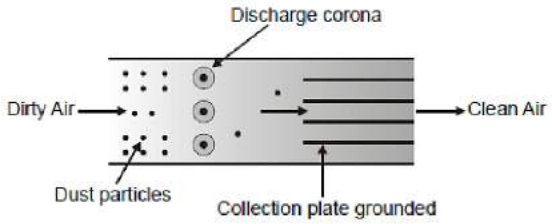
(b) SCRUBBERS:

These are used to clean air for both dust and gases. Wet and dry two types of scrubbers are used for dust separation.

They can **remove gases like sulphur**. In scrubber the exhaust is passed through a spray of water or lime.



Scrubber



Electrostatic precipitator

2. Control of gaseous pollutants: Combustion, absorption and adsorption technique are used to control gaseous pollutants.
(a) Combustion - In combustion process, **oxidisable gaseous pollutants are completely burnt** at a high temperature. Petrochemical, fertilizer, paints and varnish industries used combustion control of gaseous pollutants.
(b) Absorption - In this technique, gaseous pollutants are absorbed in suitable **absorbent materials.**
(c) Adsorption - This technique is applied to control toxic gases, vapours and inflammable compounds that could not be efficiently removed or transferred by a fore said technique. Such air pollutants are adsorbed on large solid surface.
(d) Catalytic converters: Automobiles are a major cause for atmospheric pollution in the metro cities. Proper maintenance of automobiles along with use of lead free petrol or diesel can reduce the pollutants they emit. Catalytic converters having expensive metals **platinum, palladium** and rhodium as the catalysts, are fitted into automobiles for **reducing emission of poisonous gases.**
As the exhaust passes the catalytic converter, **unburnt hydrocarbons are converted into CO_2** and **water, CO and nitric oxide are changed into CO_2 and nitrogen gas respectively.** Motor vehicles equipped with catalytic converter should **use unleaded petrol because lead in the petrol inactivates the catalyst.**
Some other Method -
1. Engines should not be kept started when vehicle is in rest condition.
2. Barium compound mixed with petrol reduce the smoke.
3. It is also very essential to check the quality of gases released from the factories.
4. Industries should not be established at one place.
5. The smoke should be released into the atmosphere after filtration and purification (by cyclone collector or electrostatic precipitators).
6. To separate particles larger than 50 μm, gravity settling tanks or porous filters are being used.

Controlling Vechicular Air Pollution: (A case study of Delhi)

1. With its very large population of vehicular traffic, Delhi leads the country in its level of air-pollution. It has more cars than the state of Gujarat and West Bengal put together.
2. In the 1990s, Delhi ranked fourth among the 41 most polluted cities of the world. Air pollution problems in Delhi becomes so serious that a Public Interest Litigation (PIL) was filed in the Supreme Court of India. After being censured very strongly by the Supereme Court, under its directives, the government was asked to take, within a specified time period, appropriate measures, including switching over the entire fleet of public transport, i.e., buses, from diesel to **compressed natural gas (CNG).** All the buses of Delhi were converted to run on CNG by the end of 2002.
3. Why CNG is better than diesel. The answer is that **CNG burns most efficiently**,

unlike petrol and diesel, in the automobiles and very little of it is left unburnt. Moreover **CNG is cheaper than petrol or diesel, cannot be siphoned off by thieves and adulterated like petrol or diesel.**

4. The main problem with switching over to CNG is the difficulty of laying down pipelines to deliver CNG through distribution point / pumps and ensuring uninterrupted supply.

5. Simultaneously parallel steps taken in Delhi for reducing vehicular pollution include **phasing out of old vehicles, use of unleaded petrol, use of low-sulphur petrol and diesel, use of catalytic converters in vehicles,** application of stringent pollution-level norms for vehicles, etc.

6. The Government of India through a new auto fuel policy has laid out a road map to cut down vehicular pollution in Indian cities. More stringent norms for fuels means **steadily reducing the sulphur and aromatic content in petrol and diesel fuels. Euro-II norm,** for example stipulate that **sulphur be controlled at 350 parts-per million (ppm)** in diesel and **150 ppm in petrol.**

7. Aromatic hydrocarbon are to be contained at 42% of the concerned fuel. The goal, according to the road map, is to **reduce sulphur to 50 ppm in petrol and diesel** and bring down the level to 35%. Corresponding to the fuel, vehicle engines will also need to be upgraded.

8. The **Bharat Stage-II (equivalent to Euro-II norms),** which currently in place in Delhi, Mumbai, Kolkata, Chennai, Banglore, Hyderaba, Ahmedabad, Pune, Surat, Kanpur and Agra, **will be applicable to all automobiles throughout the country from 1 April 2005.**

9. All automobiles and fuel-petrol and diesel- were to have met the **Euro-III emission specification** in **these 11 cities from 1 April 2005** and have to meet the **Euro-IV norms by 1 April 2010.** The rest of the country will have **Euro-III emission norm compliant automobiles and fuels by 2010.**

OZONE DEPLETION

1. Ozone is present in less quantity in atmosphere. But at height of **16 km to 25** km on earth, concentration **of ozone is maximum in stratosphere.**
2. Naturally there is bad ozone and good ozone. 'Bad' ozone, formed in the lower atmosphere (troposphere) that harms plants and animals. There is 'Good' ozone also; this ozone is found in the upper part of the atmosphere called the **stratosphere,** and it acts as a shield absorbing ultraviolet radiation from the sun.

3. UV rays are highly injurious to living organisms since **DNA and proteins** of living organisms preferentially **absorb UV rays**, and its **high energy, breaks the chemical bonds within these molecules.** The thickness of the ozone in a column of air from the ground to the top of the atmosphere is measured in terms of **Dobson unit (DU).**
4. Ozone gas is continuously formed by the action of UV rays on molecular oxygen in the stratosphere. There should be a balance between production and degradation of ozone in the stratosphere. Of late, the balance has been disrupted due to enhancement of ozone degradation by **chlorofluorocarbons (CFC's), CH_4, N_2O.**
5. CFCs find wide use as refrigerants. CFCs discharged in the lower part of atmosphere move upward and reach stratosphere. In stratosphere, UV rays act on them releasing Cl atoms. Cl degrades ozone releasing molecular oxygen, with these atoms acting merely as catalysts; Cl atoms are not consumed in the reaction.
In this process **one chlorine atom** convert each O_3 molecule into O_2 by photo dissociation.
The life time of **CF_2Cl_2 (CFC-12)** is 139 years while that for **$CFCl_3$ (CFC = 11)** is about **77 years.**

Chemical process of ozone depletion - chain reaction

$$CF_2Cl_2(g) + h\nu \longrightarrow Cl^{\bullet}(g) + {}^{\bullet}CF_2Cl(g)$$

$$Cl(g) + O_3(g) \longrightarrow ClO^{\bullet}(g) + O_2(g)$$

$$ClO^{\bullet}(g) + O(g) \longrightarrow Cl^{\bullet}(g) + O_2(g)$$

↑

Active chlorine

Hence, whatever CFCs are added to the stratosphere, they have permanent and continuing affects on Ozone levels. Although ozone depletion is occuring widely in the stratosphere, the depletion is particularly marked over the **Antarctic region**. This has resulted in formation of a large area of thinned ozone layer, commonly called as the **ozone hole.**
For making these discoveries related to ozone depletion or O3 destruction. **Sherwood Rowland, Mario Molina, Paul Curizen were honoured with Nobel Prize for chemistry in 1995.**
U.V. radiation of wavelengths shorter than UV-B, are almost completely absorbed by Earth's atmosphere, given that the ozone layer is intact. But, **UV-B damages DNA and mutation** may occur. It causes **ageing of skin, damage to skin cells** and **various types of skin cancers (Melanoma). In human eye, cornea absorbs UV-B radiation,** and a high dose of **UV-B causes inflammation of cornea, called snow blindness, cataract,** etc. Such exposure may **permanently damage the cornea.**

Recognising the deleterious affects of ozone depletion, an international treaty, known as the **Montreal Protocol,** was signed at **Montreal (Canada) in 1987 (effective in 1989) to control the emission of ozone depleting substances.**
Subsequently many more efforts have been made and protocols have laid down definite road maps, separately for developed and developing countries, for reducing the emission of CFC's and other ozone depleting chemicals.
At normal temperature and pressure, thickness of ozone layer is **3 mm.** (But at poles thickness of ozone layer is **4 mm).**
Ozone hole was first discovered in 1985 over Antarctica by **Nimbus-7** satellite. It is also confirmed at **Arctic in 1990.**
The aerosols like C.F.C (Chloro flouro carbon) release into the atmosphere from the **refrigerators, air conditioners** and **jet planes** deplete or **reduce the ozone layer.** This is called ozone depletion and these substance are called **O.D.S. (ozone depleting substance).** This thin layer ozone is also known as ozone holes. (The decline in ozone thickness in spring time (Feb-April) is called ozone hole.)

$$O_3 \xrightarrow[C.F.C.]{U.V.} O_2 + O$$

Number of pollutants like **CFCs (14% of total depletion),** Nitrogen oxide [3.5%], CH_4 and halogens (chlorine) cause depletion of ozone layer. **Maximum ODP** (ozone depleting potential) is of **CFCs due to release of chlorine.**

1. Thickness of ozone layer is measured by **Dobson unit** (1 DU = 1ppb)

Year	Thickness of ozone layer
1979	225 DU.
1985	136 DU.
1994	94 DU.

2. Ozone hole occurs mainly during (July - October) and lowest during spring time (Feb. - Apr). Means concentration of O3 is highest in stratosphere in Feb.-April (spring season) and lowest during July-October (Full season).

Water Pollution & Soil Pollution

WATER POLLUTION

The water pollution is caused by the addition of organic and inorganic chemicals as well as the biological materials which change the physical and chemical properties of water. This harmful process is called **water pollution.**
The water pollution is caused by many sources such as **sewage matter, industrial wastage, agriculture wastage, domestic wastage, hot water of thermal plant and nuclear reactors etc.**

- Water having **D.O. (Dissolved Oxygen)** content below **8.0 mgL^{-1}** may be considered as **contaminated** and below **4.0 mgL^{-1} as heavily polluted.**

- D.O. is measured by **oximeter.**

1. Biochemical Oxygen Demand (B.O.D.):

The water pollution by organic wastes is measured in terms of Biochemical oxygen demand. It is the amount of dissolved oxygen **(D.O. = Dissolved Oxygen)** needed by bacteria in decomposing the organic wastes present in water.

B.O.D. increased = water polluted	B.O.D. ∝ input of organic wastes

If **B.O.D. is increased, dissolved oxygen is decreased in water.** Higher amount of organic waste increases the rates of decomposition in water. O2 is rapidly consumed by microbes, thereby causing drop in D.O. content in water.

- **Daphnia** is the indicator of **B.O.D.**
- Biochemical oxygen demand [BOD] is the amount of **oxygen taken up by the micro organisms present in water.** BOD is measured by keeping a sample of water containing known amount of oxygen for **5-days at 20ºC** in the dark. At the end of this period, the oxygen content is again measured. A high BOD indicates intense level of microbial pollution.

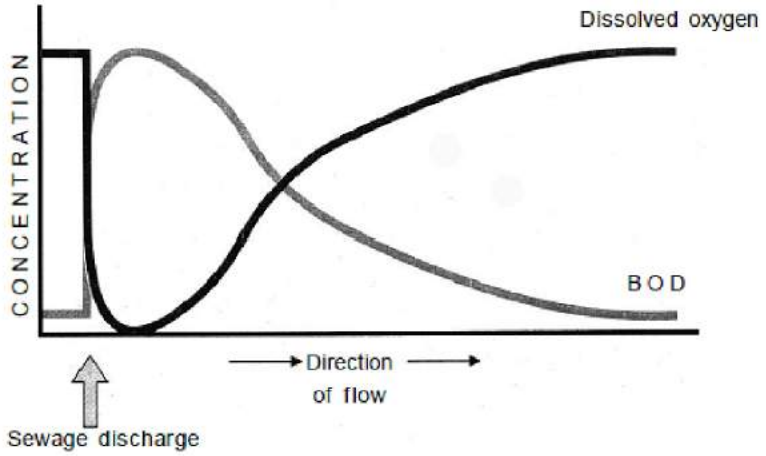


Fig.: Effect of sewage discharge on some important characteristics of a river

2. Chemical Oxygen Demand (C.O.D.):
It is the oxygen requirement by chemicals for oxidation of total organic matter (biodegradable + non biodegradable) in water.

Note: C.O.D. value is always higher than B.O.D. value.

3. Biological magnification

The non-biodegradable pollutant like Al, Hg, Fe, D.D.T., pesticides, phenolic compound ABS (Alkyl benzene sulphonate) are not decomposed by micro-organisms.

They get accumulated in tissue in increasing concentration along the food chain, called biological magnification. The highest concentration occurs in top consumer.

Note: High concentration of DDT disturb calcium metabolism in birds, which causes thinning of egg shell and their premature breaking, eventually causing decline in bird populations.

4. Eutrophication:

The process of nutrient enrichment of water and consequent loss of species diversity (or death of aquatic animals) is referred to as Eutrophication and lake is known as eutrophic lake. In this process, presence of nutrients in lake stimulates growth of algae (algal bloom) increase organic loading and bring about reduction in the oxygen content of water causing death of aquatic animals.

Note:

- Eutrophication is the natural ageing of a lake by biological enrichment of its water. Natural ageing of a lake may span thousands of years and lake finally gets converted into land due to deposition of silt. Pollutants from man's activities like effluents from the industries and homes can radically accelerate the ageing process, this phenomenon is called accelerated eutrophication.
- B.O.D. of Eutrophic lake is very high.

Water Pollution can be caused by the following man made sources:

1. Household Detergents: The house hold detergents include the compounds of **phosphate, nitrate, ammonium** and **alkyl-benzene sulphonate (ABS)** etc. harmful substances which are gathered in water. **Alkyl benzene sulphonate** is non degradable, so its concentration increases which is harmful for aquatic life.

Inorganic phosphorus and Nitrogen: The growth of algae is very fast due to presence of higher concentration of these substances. After the death of algae, their carbonic material decomposes and gets deprived of oxygen, which causes death of aquatic organisms. The presence of large amount of organic material leads to eutrophication because of this, amount of oxygen in water decreases. Some of the algae also secrete toxic materials. The drinking of such polluted (toxic) water causes death of the cattles.

For the control of this pollution, **lime ferric chloride,** etc. are used to precipitate the phosphate.
Zirconium considered best for this purpose.

2. Industrial waste: The wastes of industries are discharged into the running water of rivers and canals. Industrial waste mainly contains inert suspended particles such as dust, coal, toxins like acid, base phenols, cyanides, mercury, zinc etc., inorganic reduced material like-ferrous salts sulphide, oils and other residues of organic material and hot water. The water polluted by mercury, lead etc. Metals when used causes disorganisation of nervous system. It means it produces insanity. The Minamata disease was caused in Japan by eating of polluted fishes from the water polluted by mercury. So, many humans died because of this disease.
For the control of the industrial wastes and toxic components should be purified before draining into rivers, lakes and ponds or sea. So the water pollution by industrial effluents can be controlled by suitably treating the pollutants.

3. Sewage: Sewage contains highest amount of carbonic materials and biological material, as pollutants. These carbonic materials increase the number of decomposers like bacteria and fungus. The rate of reoxygenation is reduced as compared to deoxygenation in water reservoirs. The acceleration of microbial activity increases BOD of water. This indicates the essential amount of oxygen for decomposition in bacteria.
BOD is very less in pure water. The higher BOD is the indication of water pollution and the water of polluted reservoir cannot be utilized and very bad smell spreads around the locality. The infections or infectious diseases also take place.

Method of water purification:

Water (prevention and control of pollution) Act. 1974 passed by Government of India.
The industrial and municipal waste water are treated in "Effluent Treatment Plant" (ETP).
Generally following treatments are given in ETP.

1. Primary treatment: This physical process involves the separation of large debris (particles), followed by sedimentation in tanks.

2. Secondary treatment: This is a biological process and is carried out by microorganisms. In this process, the waste water is pumped in shallow stabilisation or oxidation ponds or activated sludge chamber, where the microbes oxidise its organic matter. The process results in release of CO_2 and this CO_2 is used by algae in photosynthesis. In photosynthesis process algae release O_2.

3. Tertiary treatment:-This physiochemical process removes turbidity in waste water caused by the presence of nutrients (nitrogen, phosphorus etc.), dissolved organic matter, metals or pathogens.
This step involves chemical oxidation of waste water by strong oxidising agents, such as chlorine gas, perchlorate salts, ozone gas and UV radiations.
After tertiary treatment, the waste-water can be discharged into natural water sources or used in irrigation.

Daphnia, trout fishes and larva of stone fly are sensitive to water pollution and show the intensity of water pollution.

Some animals are very specific to their habitat, other have wider choice or tolerance levels. For example, Tubifex (an annelid) and many insect larva such as chironomous larva lives in polluted water. They can survive in water with very low oxygen quantity and high organic content. Certain fishes like trout can live only in fresh water, whereas others like Hilsa can live in both fresh water and saline water.

SOIL POLLUTION

Soil is also polluted through polluted water and air. These pollutants are mixed into the soil through the rain water.
Such as H_2SO_4 acid is formed by mixing of SO_2 with rainy water in the air. The fertilizers, pesticides and weedicides are being sprayed over the crops. All these are mixed with soil to produce harmful effects. The growth of plants is inhibited or reduced due to this type of pollution and sometime their death also takes place. Excluding these, soil pollution is also caused by the disposal of house hold detergents, sewage, flowing oils, radio active substances and hot water etc. The main pollutants of soil are D.D.T. and weedicides [2, 4D (2, 4 dichlorophenoxy acetic acid), 2, 4, 5-T (2, 4, 5, tri chloropheinoxy acetic acid)].

Control: Soil pollution can be controlled through biological degradation of waste materials. The various carbonic materials of agriculture waste, cattle dung etc. can be minimized by the use of bio-gas plants which can produce energy also. Inspite of all the measures, pesticides and weedicides should be used in limited quantity only when it is required.

Plant indicators: "Such type of plants which give additional information about the environment or habitat are called plant indicators". e.g. growing of **Viola plants** indicates the presence of Zinc in soil. **Occimum** shows presence of copper in soil. **Silene** (a plant) indicates presence of cobalt. The presence of **Lichens** shows that atmosphere is free from the pollutants like CO and SO_2.

Solid Wastes

SOLID WASTES

Solid wastes means everything that goes in trash. Municipal solid wastes are wastes from homes, offices, stores, schools, hospitals etc. which are collected and disposed by municipality. It comprises mainly of paper, food waste, plastics, glass, metals, rubbers, leather, textiles etc.
Generally, these wastes are burned. Sanitary landfills are adopted as the substitute for open bring dumps in which wastes are dumped in depression or trench and covered with dirt.
But it also causes harm as it is a cause danger of seepage of chemicals and cause pollution of underground water.
Whole solid waste can be categorised as:
(1) Biodegradable
(2) Recyclable
(3) Non-biodegradable
Plastic is non-biodegradable, so its use should be minimized by minimum use of plastic bag or use of eco-friendly packaging material.
Electronic waste or e-waste are the irreparable computers, mobiles, electronic goods. E-waste are buried in landfills or incinerates.
Over half of e-waste of developed world are exported to developing countries mainly China, India, Pakistan where metals like copper, iron, silicon, nickle and gold are recovered during recycling process.
In these countries the people who participate in recycling of e-waste are exposed to toxic substances present in e-waste.
The eco-friendly recycling is only treatment of e-waste.

Case Study of Remedy for Plastic Waste:

A plastic sack manufacturer in **Bangalore** has managed to find the ideal solution to the ever increasing problem of accumulating plastic waste. **Ahmed Khan,** aged 57 years old, has been producing plastic sacks for 20 years. About 8 years ago, he realised that plastic waste was a real problem. **Polyblend**, a **fine powder of recycled modified plastic**, was developed then by his company.
This mixture is mixed with **bitumen** that is used to lay roads. In collaboration with **R.V. Collage of Engineering** and the **Banglore City Corporation**, Ahmed Khan proved that blends of Polybend and bitumen, when used to lay roads, enhanced the bitumen's water repellant properties, and helped to increase road life by a factor of three.
The raw material for creating Polyblend is any plastic film waste. So, against the price of Rs. 0.40 per kg that rag pickers had been getting for plastic waste, Khan now offers Rs. 6.

Using Khan's technique, by the year 2002, more than 40 kms of road in Bangalore has already been laid. At this rate, Khan will soon be running short of plastic waste in Banglore, to produce Polyblend.
Thanks to innovations like Polyblend, we might still avoid being smothered by plastic waste.

Radioactive Wastes & Environmental Laws

RADIOACTIVE POLLUTION:

The property of **sudden emission of the different particles (charged) and radiation (rays) by the decay of atomic nuclei is called radioactivity** and the **elements** are called as **radioactive elements.** The radioactivity of the atmosphere is increased by Atomic power stations and Atomic tests. Radioactivity contributes to the **pollution of air, water** as well as soil and it proves extremely harmful to the organisms.

The various sources of radioactive materials are as follows:

Natural sources: Cosmic rays, radiation from the earth such as Radium-224, Uranium-235, Uranium-238, Thorium-232, Radon-222, Potassium-40 and Carbon-14.

Man-made Radiation: The radiations are released in the atmosphere during mining and purification of Thorium and Plutonium, and in producing nuclear weapons etc. Nuclear reactor and nuclear fuel causes pollution by radioactive radiation. The nuclear fuel and coolants are the sources of radioactive radiation. Radioactive waste is also the most important radio active pollutants because these wastes are not dumped at particular or right place.

Other sources: Some of the radioactive elements (isotopes) are used in experimental laboratories for scientific researches which causes radio active pollution. X-rays are also proved to have harmful effects. In the month of April 2010, 6 people at Delhi were affected by such radioactive pollution by **cobalt-60.**
Harmful radiation are divided into two categories:

(a) Non-ionizing components: Non ionising components such as UV radiation. UV radiations are harmful for living beings. These radiations cause harm to the DNA, RNA and protein. Higher concentration of U.V. radiation can cause **xeroderma pigmentosum** disease. UV radiations cause destruction of hydrogen bonds in DNA.

(b) Ionising components: X-rays, α-particles, β-particles etc. are ionising components. Ionising radiations are high energy radiations which release electrons from atoms and form a pair of negative and positive ions.
Ionising radiations cause **physical weakness** and **sudden death of living beings.** The effects like hereditary changes, mutations, tumours, cancer and developmental changes are seen due to radiations.
Excluding these, **Iodine-131, Strontium-90** are spreading in the environment through nuclear explosion and their effects remain for long duration. **Iodine-131** reaches in the human body through the food chain and causes harm to the **bone marrow, WBC, Lymph nodes and spleen.**
Similarly, they lead to **skin cancer, sterility and poorer eye sight. Strontium-90** leads to **bone cancer** and **degeneration of tissues.**

Control Measures: The competition of nuclear weapons should be completely banned to prevent radioactive pollution. An atomic bomb was first used in Hiroshima and then in Nagasaki in 1945 during the second world war and due to that genetic disorders are present even today therefore, such type of atomic blast should be avoided. Leakage of nuclear reactions has been totally plugged. Transportation, use and disposal of the radioactive fuels and wastes has to be handled carefully.

SPECIAL POINT:

1. Air pollution: According to central pollution control board (CPCB), particulate size of 2.5 micrometers or less in diameter are responsible for causing the greatest harm to human health. These fine particulates can be inhaled deep into the lungs and can cause breathing and respiratory symptoms, irritation, inflammations and damage due to the lung and premature deaths.

2. Catalytic converters: Automobiles are a major cause for atmospheric pollution in the metro cities. Proper maintenance of automobiles along with use of lead free petrol or diesel can reduce the pollutants they emit.
Catalytic converters, having expensive metals namely platinum – palladium and rhodium as the catalysts, are fitted into automobiles for reducing emission of poisonous gases. As the exhaust passes the catalytic converter, unburnt hydrocarbons are converted into CO_2 and water, and CO and nitric oxide are changed into CO_2 and nitrogen gas respectively.
Motor vehicles equipped with catalytic converter should use unleaded petrol because lead in the petrol inactivates the catalyst.

CNG (compressed natural gas):-

- In the 1990's, Delhi ranked fourth among the 41 most polluted cities of the world.
- All the buses of Delhi were converted to run on CNG by the end of 2002.
- CNG is the better than diesel because CNG burns most efficiently as compared to diesel or petrol in the automobiles and very little of it is left unbrunt. CNG is cheaper than petrol or diesel.

3. MIC [Methyl Isocyanate] was released in Bhopal gas tragedy on 3rd December 1984. which was used in the production of "Savin" insecticide in Union Carbide.
4. Tetraethyl lead and tetramethyl lead are formed by combustion of petroleum. They are known to hamper haemoglobin formation.

- The disease caused by use of lead polluted water is called as plumbism.
- Lead causes nervousness, anaemia in human beings. It also damages kidney.
- Lead concentration in blood is considered alarming if it is 10 mg/ 100 ml.

5. Common dust disease is known as **Pneumoconiosis.**

- Disease due to cotton dust in textile industries is – **Lung fibrosis or Byssinosis.**
- Disease due to coal dust – **Anthracosis.**
- Disease due to asbestos dust – **Asbestosis.**
- In stone grinders disease due to sillica dust – **Sillicosis.**
- In Iron mills, disease due to iron dust – **Siderosis.**
- Cadmium causes anaemia, hypertension, damage to liver and kidneys. In Japan, it causes bone softening or skeleton deformitcis called **Itai-Itai disease or Ouch-Ouch.**

6. **Stone leprosy** is caused due to acid rain because due to acid rain outer surface of metals, marbles, and stone gets destroyed.
7. **Blue Baby disease:-** This disease is caused by the high amount of nitrate in water. It is also known as **methaemoglobinaemia or cyanosis.**
8. Hypertension and Uremia – Caused by Copper
9. Arsenic :- It causes black-foot disease and poisoning in fodder plants which are eaten by live stock and causes their death.
10. Fluorides :- The higher concentration of fluorides causes chlorosis or necrosis in tips and margin of leaf (leaf lamina). The compounds of fluorine reach in the animals through the fodder and causes abnormal calcification of teeth, this is called Fluorosis.

Note: The experts hold that the maximum level of fluoride which the human body can tolerate is 1.5 parts per million [ppm]. When ingested in excess over a long period of time it causes "Fluorosis".

11. ELNino effect - It is the process in which water of Pacific ocean get warm, in this process warm water current flows to Ecuador & Peru in between 5 to 8 year at Christmas time. Effect of ELNino is flood, drought and monsoon damage in India. On the other hand, when cold water comes in effect in pacific ocean it is called **La-Nina** effect.

12. Cesium[Cs] accumulates in muscles and causes muscular pain.

13. Strontium-90 is radioactive element which causes Leukamia and bone cancer.

14. Iodine isotope-131[I^{131}] causes damage to RBC, bone marrow, Lymph nodes and Skin cancer.

15. Tobacco and smoke contain seven poly cyclic hydrocarbon and Radio active Polonium-210 which is carcinogen and causes Lung cancer.

16. Aldehydes produce irritation in the gastrointestinal and respiratory tract.

17. Phenols cause damage to spleen, Kidney, liver and lungs.

18. D.D.T. caused Cerebral haemorrhage and malfunctioning of sexual maturity.

19. Largest source of air pollution (80%) caused by automobiles in the cities i.e., CO(77.2%), Nitrogen oxide(7.7%), Hydro carbons (13.7%), SO_2, NH_3, Aldehyde and Lead [in the form of $Pb(C_2H_5)_4$ and $Pb[(CH_3)_4]$ as anti-knocking agent].Lead is an air pollutant. Automobiles also reduce atmospheric O_2 which is utilised in oxidation.

20. Particulate pollutants [soot] are Carcinogenic [Cancer causing].

21. The particulate matter released to the atmosphere by mechanical operations include a number of trace metals contained in the **fly ash.** Some of harmful trace metals are Antimony, Arsenic, Beryllium, Cadmium, Germanium, Lead, Mercury, Nickel, selenium, Vanadium and yttrium.

22. Studies have shown that tobacco smoke contain at least seven poly-cyclic hydrocarbons and radio active Polonium-210 which are known as carcinogens. An average smoker has the risk of developing and dying from lung cancer **ten times** more than a non-smoker. The risk of lung disease is six times and that of heart disease is twice as compared to a non-smoker.

23. Exposure of plants to high fluoride concentration results in nectosis or chlorosis in leaf tip and leaf margin.

ENVIRONMENT LAW FOR CONTROLLING POLLUTION

1. **The National Environment (Protection) Act (NEPA) 1986 :-** This act clearly brings the protection of water and soil quality, and the control environmental pollutants.

2. **The insecticide Act, 1968:-** This act deals with the regulation of import, manufacture, sale, transport, distribution and use of insecticides with a view of preventing risk to human health and other organisms.
3. **The water (Prevention and control of pollution) Act, 1974 :-** This act deals with the preservation of water quality and the control of water pollution with a concern for the detrimental effects of water pollutants on human health.
4. **The air (Prevention and control of Pollution) Act, 1981 :-** This act deals with the preservation of air quality and the control of air pollution with a concern for the detrimental effects of air pollutants on human health and also on the biological world.
In 1987, important amendments to the air Act 1981 were made and noise was recognized as air pollutants.

Important Information:

1. Conference on human environment in 1972 held at Stockholm.
2. In 1987, 27 industrialized countries signed the Montreal protocol to protect stratospheric ozone. Till date, more than 175 countries have signed the Montreal protocol.
3. UNCED (United Nations Conference on Environment and Development) Earth Summit held at Rio-de-Janerio (Brazil) in 1992 for reducing green house gases & biodiversity conservation and make Agenda-21.
4. Kyoto protocol conference held in Kyoto (Japan) for climate change (1997). This protocol requires countries to take appropriate measures to reduce their overall green house gas emission to a level at 5 percent below the 1990 level by the commitment period 2008-2012.
5. Earth Summit or world summit on sustainable development (2002) was held in Johannesburg (S. Africa).
6. International Biological Programme (IBP) 1967-74.
7. The united Nations, conference on desertification was held in Nairobi (Kenya) in 1977 under the United Nations Environment Programme (UNEP).

Types of Lakes –

(i) Eutrophic lake – They are shallow water lakes which contain high amount of organic materials and nutrients. They have little O_2 because decomposers rapidly use it up. Chironomous larva are commonly present in it. e.g. Dal lake of Kashmir
(ii) Oligotrophic lakes – These are deep lakes which have less amount of organic materials and nutrients.
(iii) Dystrophic lake – Maximum amount of un-decomposed organic matter is present e.g. Marshy lake.

Some Other Information:

1. Third pollution or landscape pollution :- To make Fertile-land barren by dumping wastes e.g., ash, industrial waste.
2. Incineration – Solid wastes burning in presence of oxygen.
3. Pyrolysis – Solid wastes burning (combustion) in the absence of oxygen.
4. Flu gas – Gas which releases from chimneys.
5. Plume – Smoke which release from chimneys.
6. Hydro thermal vents – These are hot water springs in the deep ocean having high concentration of H_2S, ocean water oxidizes H_2S producing energy which is used by bacteria, Filter-Feeders (clams) eat the bacteria so that this food chain is based on chemical energy.
7. Phytotrons - Such a type of house where plants are grown in controlled environment.
8. Hydrocarbon – Are also known as volatile organic carbons (VOC).
9. Snow-blindness – In human eye, cornea absorbs U.V.-B radiation, and a high dose of U.V.-B radiations causes inflammation of cornea, called snow-blindess cataract.
10. Electronic wastes are also called e-wastes.
11. Ganga Action plan for controlling pollution in Ganga (1985) included city : (i) Kolkata (ii) Kanpur.
12. At 50 ppm, CO converts 7.5% of haemoglobin into carboxy haemoglobin within 8 hours.
13. Maximum green house gas is released by USA .
14. Cotton dust is an important pollutant in Ahmedabad.

- CEPHERI: An institution established in India. It majorly works on Environmental issues arising through industries and environmental pollution issues. i.e. "Central Environmental and Public Health Engineering research institute" (CEPHERI).
  This institution submits the measures on the basis of results of detailed survey.
- NEERI: National Environmental Engineering Research Institute - Nagpur. (Environmental planing organisation is related with NEERI)
- IPCC: The " Inter-governmental Panel on Climate Change".
- I. A. P.: Index of atmospheric pollution prepared with the help of lichens.
- I. W. P.: Index of water pollution, prepared by Daphnia, E. coli, Trout.
- M. P. N.: Most probable number of E. coli in water.

The increase in the concentration of greenhouse gases in the atmosphere is affected by human activities.

Greenhouse gases	Pre-Industrial con centration ~ 1750 AD	Concentration in 2000 AD	Increase since ~ 1750 AD	Atmospher ic life-time (years)
Carbon dioxide (CO_2)	280 ppm	368 ppm	31	5-200
Methane (CH_4)	700 ppb	1750 ppb	151	12
Nitrous oxide (N_2O)	270 ppb	316 ppb	17	114
Chlorofluoro carbons (CFC – 11) + Hydrofluroc	0	282 ppt		45-260

Case study - Integrated Waste Water Treatment:

One of the example of waste water treatment including sewage is the town of Arcata (California) in collaboration with Humboldt State University.
This cleaning occurs in two stages -
(1) Conventional sedimentation, filtration and chlorine treatment. But dissolved heavy metals still remain.
(2) Series of six connected marshes over 60 hectares of marshland. Appropriate organisms were seeded into this area, which neutralise, absorb and assimilate the pollutants.
Friends of Arcata Marsh (FOAM) are responsible for upkeep and safe guarding this wonderful project. Ecological sanitation is a sustainable system for handling human excreta, using dry composting toilets. This is a practical, hygienic, efficient and cost effective solution for recycling human excretion. **EcoSan** toilets are common in Kerala & Sri Lanka.

Case study of Remedy for Plastic Waste:

Polyblend: A fine powder of recycled modified plastic, developed by company owned by Ahmed Khan in Bangalore.

This mixture is mixed with Bitumen that is used to lay roads. Blends of polyblend and bitumen, enhanced the bitumen's water repellant properties and increased road life.

Case Study of Organic Farming:

Integrated organic farming is a cycle, zero waste procedure when waste products from one process are cycled as nutrients for other processes. There is maximum utilisation of resources. Ramesh Chandra Dagar is the initiator of this process. He includes

Bee keeping – Dairy management – Water harvesting – Composing – Agriculture

Dagar has created '**Hariyana Kisan Welfare Club**'.

Forest Conservation & Deforestation

FOREST CONSERVATION

It is conducted by two methods

1. Protection or conservation forests: By making national park and Biosphere Reserve.

2. Production or commercial forestry: It is two types

(a) Social forestry: To grow trees and shrubs on unused farmland, road sides, rail sides, community land etc.

(b) Agro Forestry : woody species are grown in combination with herbaceous crops either at the same time or in time sequence.

Taungya system : Growing agricultural crops between rows of planted trees.

Shifting Cultivation or Jhum Cultivation : It is a major cause of deforestation. Many tribal communities practice slab and burn agriculture in tropical and subtropical regions of Asia. Africa and Oceania. This consists cutting down trees and setting them or fire and raising crops on the resulting ash called "Juming" in north eastern India.

WET LANDS

Low lying area's covered with shallow water are called wet land's. The wet lands are transitions, zones between terrestrial and aquatic area's. **6% of the world** land surface is occupied by wet lands.

Marshes: Wetlands where grass - like plants dominate.

Swamps : Wetlands where trees or shrubs dominate.

Riverine forest : Periodically Flooded forest found in lowland along streams.

Mangrove is a salty water swamp.

DEGRADATION BY IMPROPER RESOURCE UTILIZATION AND MAINTENANCE:

The degradation of natural resources can occur, not just by the action of pollutants but also by improper resource utilization practices.

(i) Soil erosion and desertification: The development of the fertile top-soil takes centuries. But, it can be removed very easily due to human activities like over-cultivation, unrestricted grazing, deforestation and poor irrigation practices, resulting in arid patches of land. When large, barren patches extend and meet over time, a desert is created. Internationally, it is particularly due to increased urbanization.

(ii) Water logging and soil salinity : Irrigation without proper drainage of water leads to water logging in the soil. Besides affecting the crops, water logging draws salt to the surface of the soil. The salt then is deposited as a thin crust on the land surface or starts collecting at the roots of the plants. This increased salt content is inimical to the growth of crops and is extremely damaging to agriculture. Water logging and soil salinity are some of the problems that have come in the wake of the Green Revolution. This leads to **'sem'** problem in many canal irrigated areas of India.

Deforestation:

Deforestation is the conversation of forested areas to non-forested ones. According to an estimate, almost 40% forests have been lost in the tropics, compared to only 1% in the temperate region. The present scenario of deforestation is particularly **grim in India.**

At the beginning of the twentieth century, **forests covered about 30% of the land** of India. By the end of the century, it shrunk to 19.4%, whereas the National Forest Policy (1988) of India has recommended **33% forest** cover for the **plains** and **67% for the hills.**

How does deforestation occur? A number of human activities contribute to it. One of the major reasons is the conversion of forest to agricultural land so as to feed the growing human population. Trees are axes of timber, firewood, cattle ranching and for several other purposes.

Slash and burn agriculture, commonly called as Jhum cultivation in the north-eastern state of India, has also contributed to deforestation. In slash and burn agriculture, the farmers cut down the trees of the forest and burn the plant remains. The ash is used as a fertilizer and the land is then used for farming or cattle grazing. After cultivation, the area is left for several years so as to allow its recovery. The farmers then move on to other areas and repeat this process. In earlier days,

when **Jhum cultivation** was in prevalence, enough time-gap was given such that the land recovered from the effect of cultivation. With increasing population, and repeated cultivation, this recovery phase is done away with, resulting in deforestation.
What are the consequences of deforestation? One of the major effects is enhanced carbon dioxide concentration in the atmosphere because trees that could hold a lot of carbon in their biomass are lost with deforestation. Deforestation also causes loss of biodiversity due to habitat destruction, disturbs hydrological cycle, causes soil erosion, and may lead to desertification in extreme cases.

Reforestation is the process of restoring a forest that once existed but was removed at some point of time in the past. Reforestation may occur naturally in a deforested area. However, we can speed it up by planting trees with due consideration to biodiversity that earlier existed in that area.

Case study of People's Participation in Conservation of Forest

People's participation has a long history in India. In **1731,** the **king of Jodhpur in Rajasthan** asked one of his ministers to arrange wood for constructing a new place. The minister and workers went to a forest near a village, Khajadli inhabited by **Bishnois**, to cut down trees.
The Bishnoi community is known for its peasful co-existence with nature. The effort to cut down trees by the kings was thwarted by the Bishnois.
A Bishnoi women **Amrita Devi** showed exemplary courage by hugging a tree and daring king's men to cut her first before cutting the tree. The tree mattered much more to her than her own life.
Sadly, the king's men did not heard to her pleas, and cut down the tree along with **Amrita Devi.**
Her three daughters and hundreds (total 363 peoples of other Bishnois followed her, and thus lost their lives saving trees.
Nowhere in history do we find a commitment of this magnitude when human beings sacrificed their lives for the cause of the environment. The Government of India has recently instituted the **Amrita Devi Bishnoi Wildlife Protection Award** for individuals or communities from rural areas that have shown extraordinary courage and dedication in protecting wildlife.
Government of India instituted **Indra Gandhi Priydarshni; Vraksh Mitra Award** for forest conservation.
You may have heard of the **Chipko Movement** of Garhwal Himalayas. In 1974, local women showed enormous bravery in protecting trees from the axe of contractors by hugging them. People all over the world have acclaimed the **Chipko movement.**
Realising the significance of participation by local communities, the **Government of India** in **1980s** has introduced the concept of **Joint Forest Management (JFM)** so as

to work closely with the **local communities for protecting and managing forests.** In return for their services to the forest, the communities get benefit of various forest products (e.g., fruits, gum, rubber, medicine etc.) and thus the forest can be conserved in a sustainable manner.

SPECIAL POINTS

WILDLIFE ORGANISATIONS

I.U.C.N.	The International Union for Conservation of Nature and Natural Resources. (Switzerland)
W.W.F.	The World Wildlife Fund.
I.B.W.L.	India Board for Wildlife.
B.N.H.S.	The Bombay Natural History Society.
W.P.S.I.	The Wildlife Preservation Society of India.
C.P.C.B	Central Pollution Control Board.
IBP	International Biology Programme.
M.A.B.	Man and Biosphere Programme.
U.N.E.P.	United Nation Environment Programme.
N.M.N.H.	National Museum of Natural History.
UN.D.P	United Nations Development Programme.
B.R.P.	Biosphere Reserve Programme.
Z.S.I.	Zoological Survey of India.
B.S.I.	Botanical Survey of India
C.A.Z.R.I.	Central Arid Zone Research Institute, Jodhpur.
C.I.T.E.S.	Convention and International Trade in Endangered Species of Wild Fauna and Flora. (1976)
F.R.I.	Forest Research Institute, Dehradun.
W.I.I.	Wild Life Institute of India, Dehradun.
U.N.E.S.C.O.	United Nations Educational Scientific and Cultural Organization.
28th February	Science Day
21st March	World Forest Day
22nd April	Earth Day

5th June	World Environment Day
7th July	Van Mahotsav Day
11th July	World Polulation Day
16th September	World Ozone Day
3rd October	World Animal Day
4th October	World Habitat Day
1st Week of October	Wild life week
2nd December	National Pollution prevention day or National environment day
3rd Decern ebr	World Conservation Day
22th May	World Biodiversity Day

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Lead concentration in blood is considered alarming if it is 10 μg/500 ml.

Common dust disease is known as Pneumoconiosis.

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Disease due to coal dust - **Anthracosis.**
Disease due to asbestos dust - **Asbestosis.**
In stone grinders disease due to silica dust - **Sillicosis.**
In iron mill disease due to iron dust - **Siderosis.**
Cadmium causes anaemia, hypertension, damage to liver and kidneys. In Japan it caused bone softening or skeleton deformitcis called **Itai-Itai disease or Ouch-Ouch.**
Stone leprosy is caused due to acid rain because due to acid rain outer surface of metals, marbles and stone gets destroyed.
Blue Baby disease: This disease is caused by the high amount of **nitrate in water.** It is also known as **Methaemoglobinaemia** or **cyanosis.**
Hypertension and **Uremia:** Caused by **Copper.**
Arsenic: It causes **black-foot disease and poisoning in fodder plants** which are eaten by live stock and causes their death.
Fluorides: The higher concentration of fluorides causes **chlorosis or necrosis** in tips and margin of leaf (leaf lamina). The compounds of fluorine reach in the

animals through the fodder and causes abnormal calcification of teeth, this is called **Fluorosis.**

Note: The experts hold that the maximum level of fluoride which the human body can tolerate is **1.5 parts per million (ppm).** When ingested in excess over a long period of time causes "Fluorosis".

EL Nino effect: It is the process in which water of Pacific ocean get warm, in this process warm water current flow to Ecuador & Peru in between 5 to 8 years at christmas time. **Effect of EL Nino is flood,** drought and monsoon damage in India.

Cesium (Cs) accumulates in muscles and causes muscular pain.

Strontium-90 is radioactive element which causes **Leukamia and bone cancer.**

Iodine isotope-131[I^{131}] causes damage of RBC, bone marrow, Lymph nodes and Skin cancer.

Tobacco and smoke contain seven poly cyclic hydrocarbon and Radio active Polonium-210, which is carcinogen and causes Lung cancer.

Aldehydes produce irritation in the gastrointestinal and respiratory tract.

Phenols caused damage to spleen, Kidney, liver and lungs.

D.D.T. caused Cerebral haemorrhage and malfunctioning of sexual maturtity.

Largest source of air pollution **(80%) caused by automobiles** in the cities i.e., **CO(77.2%).Nitrogen oxide (7.7%), Hydrocarbons (13.7%), SO2, NH3, Aldehyde and Lead** [in the form of $Pb(C_2H_5)^4$ and $Pb[(CH_3)_4$ as antiknocking agent]. Lead is an air pollutant. Automobiles also reduce atmosphereic O_2 which is utilised in oxidation.

Particulate pollutants [soot] are Carcinogenic [Cancer causing].

The particulate matter released to the atmosphere by mechanical operations include a number of trace metals contained in the **flyash**. Some of harmful trace metals are Antimony, Arsenic, Beryllium, Cadmium, Germanium, Lead, Mercury, Nickel, Selenium, Vanadium and Yttrium.

	ENVIRONMENT LAW FOR CONTROLLING POLLUTION
1	**The National Environment (Protection) Act (NEPA) 1986** : This act clearly brings the protection of water and soil quality, and the control environmental pollutants.
2	**The insecticide Act, 1968** : This act deals with the regulation of import, manufacture, sale, transport, distribution and use of insecticides with a view of preventing risk to human health and other organisms.
3	**The water (Prevention and control of pollution) Act. 1974** : This act deals with the preservation of water quality and the control of water pollution with a concern for the detrimental effects of water pollutants on human health.

4	**The air (Prevention and Control of Pollution) Act. 1981** : This act deals with the preservation of air quality and the control of air pollution with a concern for the detrimental effects of air pollutants on human health and also on the biological world.
5	**In** 1987, important amendments to the air Act.1981 were made and noise was recognised as an air pollutants.

Conference on human environment in 1972 held at Stockholm.
International Biological Programme (IBP) 1967-74.
The unitedNations, conference on desertification was held in Nairobi (Kenya) in 1977 under the United Nations Environment Programme (UNEP).

Type of Lakes –

(i) Eutrophic lake - They are shallow water lakes which contain **high amount of organic materials** and nutrients. They have little O2 because decomposers rapidly use it up. Chironomous larva are commonly present in it. eg., Dal lake of Kashmir
(ii) Oligotrophic lakes - These are deep lakes which have **less amount of organic materials and nutrient.**
(iii) Dystrophic lake - Maximum amount of **undecomposed organic matter** is present. eg., Marshy lake.
Third pollution or land scape pollution : To make Fertile-land barren by dumping wastes. eg., ash, insustrial waste.
Incineration : Solid wastes burning in presence of oxygen.
Pyrolysis : Solid wastes burning (combution) in the absence of oxygen.
Flu gas : Gas which release of from chimnies.
Plume : Smoke which release from chimnies.

Hydro thermal vents : These are hot water springs in the deep ocean having high concentration of H_2S, ocean water oxidizes H_2S producing energy which is used by bacteria, Filter-Feeders (clams) eat the bacteria so that this food chain based on chemical energy.

Phytotrons: A such type of house where plants are grown in controlled environment.

Hydrocarbon: Are also known as volatile organic carbons (VOC).

Snow blindness: In human eye cornea absorbs U.V.-B radiation, and a high dose of U.V.-B radiations causes inflammation of cornea, called snow-blindness cataract.
Electronic wastes is also called e-wastes.
Ganga Action plan for controlling pollution in ganga (1985) included city :
(i) Kolkata

(ii) Kanpur.
Land of maximum wind mills - Netherland.
Largest wind will complex in India, Lamba (Gujrat)
At 50 ppm, CO converts 7.5% of haemoglobin in to carboxy haemoglobin with in 8 hours.
Maximum grean house gas released by - USA
Cotton dust is an important pollutant in Ahmedabad.

CEPHERI: An institution established in India to check pollution i.e., "Central Environmental and Public Health Engineering Research Institute" (CEPHERI). This institution submits the measures on the basis of results of detailed survey.

NEERI: National Environmental Engineering Research Institute - Nagpur. (Environmental plannig organisation is related with NEERI)

IPCC: The "Intergovermental Panel on Climate Change".
I.A.P.: Index of atmospheric pollution prepared with the help of lichens.
I.W.P.: Index of water pollution, prepared by Daphnia, E.coli, Trout.
M.P.N. : Most probable number of E.coli in water.

The increase in the concentrations of green house gases in the in the atmosphere as affected by human activities

Green house gases	Pre-industrial concentration - 1750 AD	Concentration in 2000 AD	Increase since ~ 1750 AD	Atmospheric life-time (years)
Carbon dioxide ($C0_2$)	280 ppm	368 ppm	31	5 - 200
Methane (CH_4)	700 ppm	1750 ppb	151	12
Nitrous oxide (N_70)	270 ppb	316 ppb	17	114

Chlorofluorocarbons (CFC - 11) + Hydroflurocarbons (HFC - 23)	0	282ppt		45-260