ILL-EFFECTS

Acid rain is harmful for agriculture, trees and plants as it dissolves and washes away nutrients needed for their growth.

It causes respiratory ailments in human beings and animals.

When acid rain falls and flows as ground water to reach rivers, lakes etc. it affects plants and animal life in aquatic ecosystem.

It corrodes water pipes resulting in the leaching of heavy metals such as on lead a d copper into the drinking water.

Acid rain damages buildings and other structures made of st or metal. The Taj Mahal in India has been affected by acid rain

How We Can Help To Reduce The Formation Of A d Rai

- reducing the emission of sulphur di xid and nitrog n dioxide in the atmosphere.
- use less vehicles driven by fossil f els; us less su phur content fossil fuels for power plants and industries.
- use natural gas which is a b tter fuel an coal or use coal with less sulphur content.
- Catalytic converters m be used cars to reduce the effect of exhaust fumes on the atmosphere.
- We can also re uce the acid y of the soil by adding powdered limestone to neutralise the cidity of the soil.

Taj Mahal a d Aci in

- Th air aro d the city of Agra, where the Taj Mahal is located, contains fairly high l vels of Sulphur and nitrogen oxides.
- It is main y due to a large number of industries and power plants around the area
- Use of poo quality of coal, kerosene and firewood as fuel for domestic purposes add up to this problem.
- The resulting acid rain reacts with marble, CaCO3 of Taj Mahal causing damage to this wonderful monument
- As a result, the monument is being slowly disfigured and the marble is getting discoloured and lusterless

- The Government of India announced an action plan in early 1995 to prevent the disfiguring of this historical monument
- Mathura refinery has already taken suitable measures to check the emission of toxic gases.
- This plan aims at clearing the air in the 'Taj Trapezium'– an area that includes the towns of Agra, Firozabad, Mathura and Bharatpur
- Under this plan more than 2000 polluting industries lying inside the trapezium would switch over to the use of natural gas or liquefied petroleum gas instead of coal or oil.
- A new natural gas pipeline would bring more than half a million cu ic m res of natural gas a day to this area.
- People living in the city will also be encouraged to use liquefied p tr eum g s in place of coal, kerosene or firewood.
- Vehicles plying on highways in the vicinity of Taj woul be en uraged to use low sulphur content diesel.

2. Particulate Pollutants

- Particulates pollutants are the minute so d particle or liquid droplets in air.
- These are present in vehicle emissi s, s oke parti les from fires, dust particles and ash from industries. Particul t s in the tmos here may be viable or non-viable.

1. 1.Smoke particulate consist of lid or ixture of solid and liquid particles formed during combus n of organ c matter. Examples are cigarette smoke, smoke from burning of fo sil fuel, garbage and dry leaves, oil smoke etc.
2. 2.Dust is comp sed of fine s lid particles (over 1μm in diameter), produced during crushing, grin ng and at ibution of solid materials. Sand from sand blasting, saw dust from woo works, pu verized coal, cement and fly ash from factories, dust orms et , are so ty ical examples of this type of particulate emission.
3. 3.M sts a e produced by particles of spray liquids and by condensation of va herbic d and cticides that miss their targets and travel through air and form m sts.
4. 4.F mes ar generally obtained by the condensation of vapours during sublim ion, distillation, boiling and several other chemical reactions. Generally, organic s vents, metals and metallic
5. 5.xides form fume particles.

- The effect of particulate pollutants are largely dependent on the particle size. Airborne particles such as dust, fumes, mist etc., are dangerous for human health
- Particulate pollutants bigger than 5 microns are likely to lodge in the nasal passage, whereas particles of about 10 micron enter into lungs easily.

- Lead used to be a major air pollutant emitted by vehicles. Leaded petrol used to be the primary source of air-borne lead emission in Indian cities.
- This problem has now been overcome by using unleaded petrol in most of the cities in India.
- Lead interferes with the development and maturation of red blood cells.

Smog

The word smog is derived from smoke and fog. This is the most common xamp e of air pollution that occurs

in many cities throughout the world

There are two types of smog:

(a) Classical smog occurs in cool humid climate. It is a xture of moke, fog and sulphur dioxide. Chemically it is a reducing mixture and s it is also called as reducing smog.

(b) Photochemical smog occurs in warm, dry nd sunny imate. The main components of the photochemical smog result from th action f sunlight on unsaturated hydrocarbons and nitrogen oxides produ d by automobiles and factories. Photochemical smog has high concentration of oxidising agents and is, therefore, called as oxidising smog.

Formation of photochemical s og

- When fossil fu ls are burnt, a ariety of pollutants are emitted into the earth'spours in ir. Exam es are sulphuric acid mist and troposphere.
- Two of t e pollu nts th are emitted are hydrocarbons (unburnt fuels) and nitric ox de (N).
  When h p llutants build up to sufficiently high levels, a chain reaction occurs om the interaction with sunlight in which NO is converted into nitrogen dioxide (N 2).
- This NO2 in turn absorbs energy from sunlight and breaks up into nitric oxide and free oxyg n atom

(i) Oxygen atoms are very reactive and combine with the O2 in air to produce ozone.

(ii) The ozone formed in the above reaction (ii) reacts rapidly with the NO(g) formed in the reaction to regenerate NO2. NO2 is a brown gas and at sufficiently high levels can contribute to haze.

(iii) Ozone is a toxic gas and both NO2 and O3 are strong oxidising agents and can reactwith the unburnt hydrocarbons in the polluted air to produce chemicals such as formaldehyde, acrolein and peroxyacetyl nitrate (PAN).

Effects of photochemical smog

- The common components of photochemical smog are ozone, nitr ox de, ac lein, formaldehyde and peroxyacetyl nitrate (PAN).
- Photochemical smog causes serious health problems.
- Both ozone and PAN act as powerful eye irritants
- Ozone and nitric oxide irritate the nose and throat nd the high concentration causes headache, chest pain, dryness of the throa ough and difficulty in breathing
- Photochemical smog leads to cracking of ubber nd ex nsive damage to plant life. It also causes corrosion of metals, ones, buil ng materials, rubber and painted surfaces

How can photochemical smog be ontroll d?

- control the primary pr rsors of p otochemical smog, such as NO2 and hydrocarbons, the second ry precursors such as ozone and PAN, the photochemical mog will au matically be reduced.
- Usually cataly c convert rs ar used in the automobiles, which prevent the release of nitrogen oxi e and hyd ocarbons to the atmosphere.
- Certain p ants e.g Pinu Juniparus, Quercus, Pyrus and Vitis can metabolise nit gen xide and therefore, their plantation could help in this matter.

Stratosph ric Pol tion

Formation and Breakdown of Ozone

- The upper stratosphere consists of considerable amount of ozone (O3), which protects us from the harmful ultraviolet (UV) radiations (λ 255 nm) coming from the sun.
- These radiations cause skin cancer (melanoma) in humans. Therefore, it is important to maintain the ozone shield.

- Ozone in the stratosphere is a product of UV radiations acting on dioxygen (O2) molecules.
- The UV radiations split apart molecular oxygen into free oxygen (O) atoms. These oxygen atoms combine with the molecular oxygen to form ozone. O2 (g) O(g) + O(g) O(g) + O2 (g) O3 (g) Ozone is thermodynamically unstable and decomposes to molecular oxygen.
- there have been reports of the depletion of this protective ozone layer because of the presence of certain chemicals in the stratosphere.
- The main reason of ozone layer depletion is believed to be the release of chlorofluorocarbon compounds (CFCs), also known as freons.
- These compounds are nonreactive, non flammable, non toxic org nic m ecules and therefore used in refrigerators, air conditioners in the product n f plast foam and by the electronic industry for
  cleaning computer parts etc.
- Once CFCs are released in the atmosphere, they mix the norm l atmospheric gases and eventually reach the stratosphere.
- In stratosphere, they get broken down by powerfu UV radiat ns, releasing chlorine free radical.
- The chlorine radicals are continuously regenerat d and use the breakdown of ozone.
- Thus, CFCs are transporting agent or c ntinuousl generating chlorine radicals into the stratosphere and damagi g the ozo lay r.

The Ozone Hole

- I 1980s tmosph ic s entists working in Antarctica reported about depletion of ozo e la er commonly known as ozone hole over the South Pole.
- In summ se nitrogen dioxide and methane react with chlorine monoxide) a d chlor e atoms forming chlorine sinks, preventing much ozone depletion, wh eas in inter, special type of clouds
  called polar stratospheric clouds are formed over Antarctica.
- These po r stratospheric clouds provide surface on which chlorine nitrate formed gets hydro sed to form hypochlorous acid .It also reacts with hydrogen chloride to give molecular chlorine
- When sunlight returns to the Antarctica in the spring, the sun's warmth breaks up the clouds and HOCl and Cl2 are photolysed by sunlight,
- The chlorine radicals thus formed, initiate the chain reaction for ozone depletion

Effects of Depletion of the Ozone Layer

- With the depletion of ozone layer, more UV radiation filters into troposphere.
- UV radiations lead to ageing of skin, cataract, sunburn, skin cancer, killing of many phytoplanktons, damage to fish productivity etc
- plant proteins get easily affected by UV radiations which leads to the harmful mutation of cells.
- It also increases evaporation of surface water through the stomata of the leaves and decreases the moisture content of the soil
- Increase in UV radiations damage paints and fibres, causing them to fad faster.

WATER POLLUTION

- Easily identified source or place of pollution is call d as p int source. e.g., municipal and industrial discharge pipes where p utants en r the water-source

Non point sources of pollution

- are those where a s urce f pol tion c not be easily identified, e.g., agricultural run off (from farm, an als and cr p-lands), acid rain, storm-water drainage (from streets, parking lots and wns),

Causes of Water Pol ution

(i) Pathogens:

The os i us water pollutants are the disease causing agents called pathogens.
- Pathoge include bacteria and other organisms that enter water from domestic se ge an animal excreta.

Human excret

- contain ba teria such as Escherichia coli and Streptococcus faecalis which cause gastrointestinal
diseases.

(ii) Organic wastes:

- The other major water pollutant is organic matter such as leaves, grass, trash etc.
- They pollute water as a consequence of run off.
- Excessive phytoplankton growth within water is also a cause of water pollution. These wastes are biodegradable
- The large population of bacteria decomposes organic matter present in water. They consume oxygen dissolved in water. That is why even a moderate amount of organic matter when decomposes in water
  can deplete the water of its dissolved oxygen
- dissolved oxygen in water is very important for aquatic life . If the concentration of dissolved oxygen of water is below 6 ppm, the growth of fish ge s inhi ited.
- The dissolved oxygen is also used by microorganisms to oxidise gani matter.
- If too much of organic matter is added to water, all the available o y n is u d up. This causes oxygen dependent aquatic life to die.
- Thus, anaerobic bacteria (which do not require oxygen) egin to reak down the organic waste and produce chemicals that have a fou ll and ar harmful to human health.
- Aerobic (oxygen requiring) bacteria degrade thes rganic w tes and keep the water depleted in dissolved oxygen.
- Thus, the amount of oxygen required by acteria o bre down the organic matter present in a certain volume of a sample f water, is alled Biochemical Oxygen Demand (BOD)
- The amount of BOD in the wate i a meas of he amount of organic material in the water, in terms of how much oxygen will be required to break it down biologically.

(iii) Chemical Pollutants:

- water is an exc llent solvent, water soluble inorganic chemicals that include heavy metals such as admium, mercury, nickel etc constitute an important class of pollutants
- A l these metals a da gerous to humans because our body cannot excrete them. Ov the me, it crosses the tolerance limit
- These als th can damage kidneys, central nervous system, liver etc.
- A ids (lik sulphuric acid) from mine drainage and raw salt used to melt snow and ice the co der climates (sodium and calcium chloride) are water soluble chemic l pollutants.
- Petroleum products pollute many sources of water e.g., major oil spills in oceans.
- Other orga ic substances with serious impacts are the pesticides that drift down from sprays or runoff from lands.
- Various industrial chemicals like polychlorinated biphenyls, (PCBs) which are used as cleansing solvent, detergents and fertilizers add to the list of water pollutants. PCBs are suspected to be
  carcinogenic.

- Fertilizers contain phosphates as additives.
- The addition of phosphates in water enhances algae growth. Such profuse growth of algae, covers the water surface and reduces the oxygen concentration in water.
- This leads to anaerobic conditions, commonly with accumulation of abnoxious decay and animal death.
- Thus, bloom-infested water inhibits the growth of other living organisms in the water body.
- This process in which nutrient enriched water bodies support a dense plant population, which kills animal life by depriving it of oxygen and results in subsequent loss of biodiversity is known as Eutrophication.

International Standards for Drinking Water

- The International Standards for drinking water are gi below an they must be followed.
- Fluoride: For drinking purposes, water should be sted for fl oride ion concentration.
- Its deficiency in drinking water is harmfu to ma and uses diseases such as tooth decay etc.
- Soluble fluoride is often added to d nki g water to bring its concentration upto 1 ppm .The F– ions make the ename on teet much harder
- However, F– ion concentration ab ve 2 ppm causes brown mottling of teeth.
- At the same time, excess fl ide (ov 10 ppm) causes harmful effect to bones and teeth, as
- reported from some pa of Rajast n.

Lead: Drinking wate gets cont minated with lead when lead pipes are used for transportation of wate The pres ribed upper limit concentration of lead in drinking water i bout 5 ppb. L d ca damage kidney, liver, reproductive system etc.

Sulphate: E e siv hate (>500 ppm) in drinking water causes laxative effect, otherwi at mo rate levels it is harmless.

Nitrate: The aximum limit of nitrate in drinking water is 50 ppm. Excess nitrate in drinking water c n cause disease such as methemoglobinemia (‘blue baby’ syndrome)