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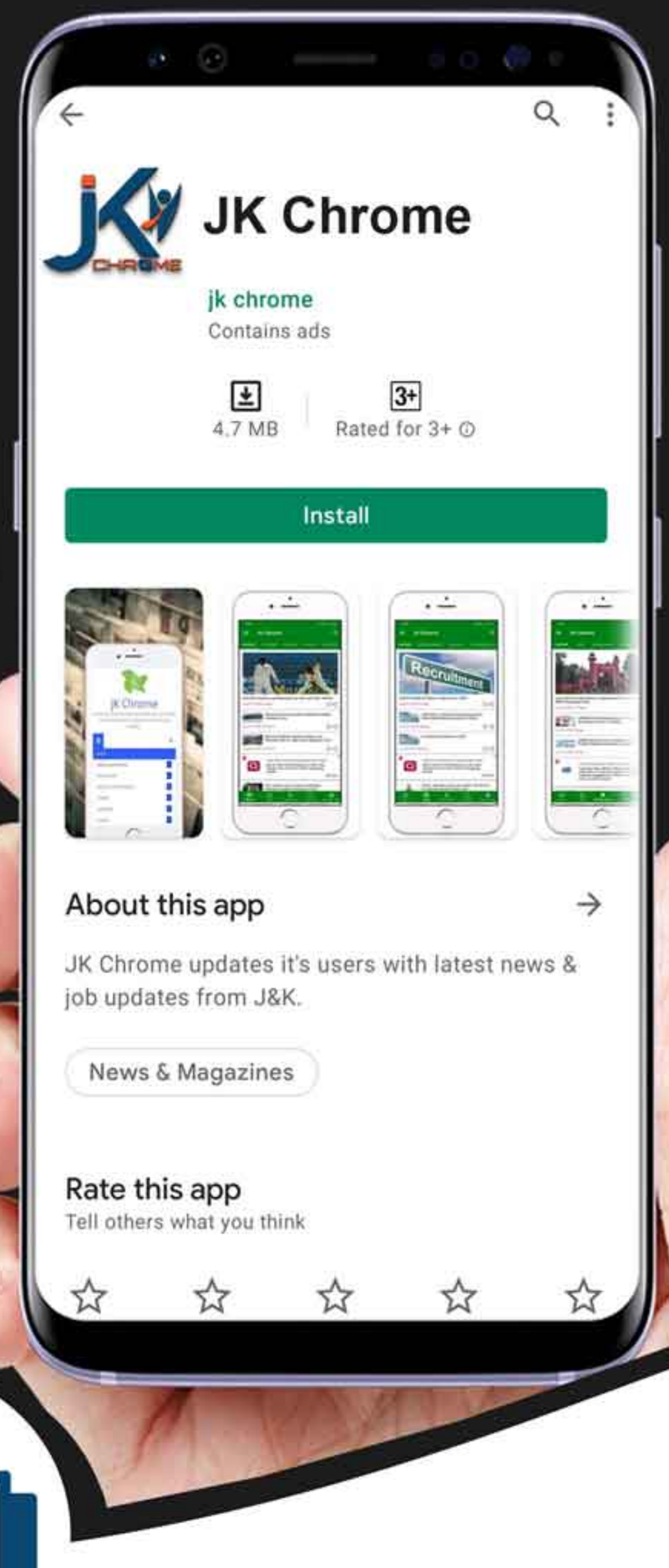


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# ILL-EFFECTS

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 iron, lead and copper into the drinking water.

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

**How We Can Help To Reduce The Formation Of Acid Rain.**

- reducing the emission of sulphur dioxide and nitrogen dioxide in the atmosphere.
- use less vehicles driven by fossil fuels; use less sulphur content fossil fuels for power plants and industries.
- use natural gas which is a better fuel than coal or use coal with less sulphur content.
- Catalytic converters must be used in cars to reduce the effect of exhaust fumes on the atmosphere.
- We can also reduce the acidity of the soil by adding powdered limestone to neutralise the acidity of the
  soil.

**Taj Mahal and Acid Rain**

- The air around the city of Agra, where the Taj Mahal is located, contains fairly high levels of Sulphur and nitrogen oxides.
- It is mainly due to a large number of industries and power plants around the area
- Use of poor quality of coal, kerosene and firewood as fuel for domestic purposes add up to this problem.
- The resulting acid rain reacts with marble, $CaCO_3$ of Taj Mahal 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 cubic metres of natural gas a day to this area.
- People living in the city will also be encouraged to use liquefied petroleum gas in place of coal, kerosene or firewood.
- Vehicles plying on highways in the vicinity of Taj would be encouraged to use low sulphur content diesel.

**2. Particulate Pollutants**

- Particulates pollutants are the minute solid particles or liquid droplets in air.
- These are present in vehicle emissions, smoke particles from fires, dust particles and ash from industries. Particulates in the atmosphere may be viable or non-viable.

1. 1.Smoke particulates consist of solid or mixture of solid and liquid particles formed during combustion of organic matter. Examples are cigarette smoke, smoke from burning of fossil fuel, garbage and dry leaves, oil smoke etc.
2. 2.Dust is composed of fine solid particles (over 1μm in diameter), produced during crushing, grinding and attribution of solid materials. Sand from sand blasting, saw dust from wood works, pulverized coal, cement and fly ash from factories, dust storms etc., are some typical examples of this type of particulate emission.
3. 3.Mists are produced by particles of spray liquids and by condensation of va herbicides and insecticides that miss their targets and travel through air and form mists.
4. 4.Fumes are generally obtained by the condensation of vapours during sublimation, distillation, boiling and several other chemical reactions. Generally, organic solvents, 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 example 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 mixture of smoke, fog and sulphur dioxide. Chemically it is a reducing mixture and so it is also called as reducing smog.

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

**Formation of photochemical smog**

- When fossil fuels are burnt, a variety of pollutants are emitted into the earth'spours in air. Examples are sulphuric acid mist and troposphere.
- Two of the pollutants that are emitted are hydrocarbons (unburnt fuels) and nitric oxide (NO).
- When these pollutants build up to sufficiently high levels, a chain reaction occurs from their interaction with sunlight in which NO is converted into nitrogen dioxide (NO2).
- This NO2 in turn absorbs energy from sunlight and breaks up into nitric oxide and free oxygen 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, nitric oxide, acrolein, 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 and their high concentration causes headache, chest pain, dryness of the throat, cough and difficulty in breathing
- Photochemical smog leads to cracking of rubber and extensive damage to plant life. It also causes corrosion of metals, stones, building materials, rubber and painted surfaces

**How can photochemical smog be controlled?**

- control the primary precursors of photochemical smog, such as NO2 and hydrocarbons, the secondary precursors such as ozone and PAN, the photochemical smog will automatically be reduced.
- Usually catalytic converters are used in the automobiles, which prevent the release of nitrogen oxide and hydrocarbons to the atmosphere.
- Certain plants e.g., Pinus, Juniparus, Quercus, Pyrus and Vitis can metabolise nitrogen oxide and therefore, their plantation could help in this matter.

**Stratospheric Pollution**

**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 organic molecules and therefore used in refrigerators, air conditioners in the production of plastic foam and by the electronic industry for
  cleaning computer parts etc.
- Once CFCs are released in the atmosphere, they mix with the normal atmospheric gases and eventually reach the stratosphere.
- In stratosphere, they get broken down by powerful UV radiations, releasing chlorine free radical.
- The chlorine radicals are continuously regenerated and cause the breakdown of ozone.
- Thus, CFCs are transporting agents for continuously generating chlorine radicals into the stratosphere and damaging the ozone layer.

**The Ozone Hole**

- In 1980s atmospheric scientists working in Antarctica reported about depletion of ozone layer commonly known as ozone hole over the South Pole.
- In summer season, nitrogen dioxide and methane react with chlorine monoxide) and chlorine atoms forming chlorine sinks, preventing much ozone depletion, whereas in winter, special type of clouds
  called polar stratospheric clouds are formed over Antarctica.
- These polar stratospheric clouds provide surface on which chlorine nitrate formed gets hydrolysed 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 fade faster.

## WATER POLLUTION

- Easily identified source or place of pollution is called as point source. e.g., municipal and industrial discharge pipes where pollutants enter the water-source

### Non point sources of pollution

- are those where a source of pollution cannot be easily identified, e.g., agricultural run off (from farm, animals and crop-lands), acid rain, storm-water drainage (from streets, parking lots and lawns),

### Causes of Water Pollution

### (i) Pathogens:

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

### Human excreta

- contain bacteria 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 gets inhibited.
- The dissolved oxygen is also used by microorganisms to oxidise organic matter.
- If too much of organic matter is added to water, all the available oxygen is used up. This causes oxygen dependent aquatic life to die.
- Thus, anaerobic bacteria (which do not require oxygen) begin to break down the organic waste and produce chemicals that have a foul smell and are harmful to human health.
- Aerobic (oxygen requiring) bacteria degrade these organic wastes and keep the water depleted in dissolved oxygen.
- Thus, the amount of oxygen required by bacteria to break down the organic matter present in a certain volume of a sample of water, is called Biochemical Oxygen Demand (BOD)
- The amount of BOD in the water is a measure of the amount of organic material in the water, in terms of how much oxygen will be required to break it down biologically.

**(iii) Chemical Pollutants:**

- water is an excellent solvent, water soluble inorganic chemicals that include heavy metals such as cadmium, mercury, nickel etc constitute an important class of pollutants.
- All these metals are dangerous to humans because our body cannot excrete them. Over the time, it crosses the tolerance limit
- These metals then can damage kidneys, central nervous system, liver etc.
- Acids (like sulphuric acid) from mine drainage and raw salt used to melt snow and ice in the colder climates (sodium and calcium chloride) are water soluble chemical pollutants.
- Petroleum products pollute many sources of water e.g., major oil spills in oceans.
- Other organic 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 given below and they must be followed.
- Fluoride: For drinking purposes, water should be tested for fluoride ion concentration.
- Its deficiency in drinking water is harmful to man and causes diseases such as tooth decay etc.
- Soluble fluoride is often added to drinking water to bring its concentration upto 1 ppm .The F– ions make the enamel on teeth much harder
- However, F– ion concentration above 2 ppm causes brown mottling of teeth.
- At the same time, excess fluoride (over 10 ppm) causes harmful effect to bones and teeth, as
- reported from some parts of Rajasthan.

**Lead:** Drinking water gets contaminated with lead when lead pipes are used for transportation of water. The prescribed upper limit concentration of lead in drinking water is about 50 ppb. Lead can damage kidney, liver, reproductive system etc.

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

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