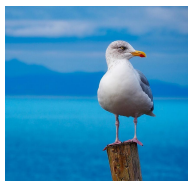




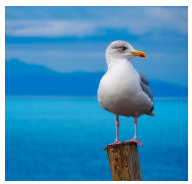
Environment & Ecology

Pollution



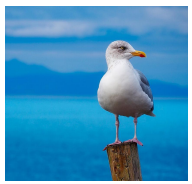
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Topics

- Pollution
- Pollutant
- Sources of Pollution
- Causes of pollution
- Air Pollution
 - Air Pollutants
 - a. Primary Air Pollutant
 - b. Secondary Air Pollutant
 - Air Pollution and Atmospheric Problems



Topics

- Water Pollution
 - Types of Water Pollutants
 - Biological Agents
 - Chemical Agents
 - Physical Agents
- Eutrophication
- Soil Pollution
 - Effects of soil pollution
- Pollution by Radioactivity
 - Types of nuclear radiation
 - Sources
 - Effects

Acid Rain



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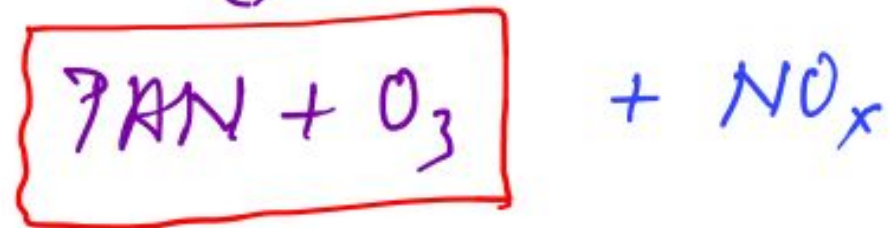
Sulphuric Acid +
Nitric Acid

Smog

Los Angeles Smog (Photochemical Smog)

Smoke + fog + HC + NO_2 + O_2

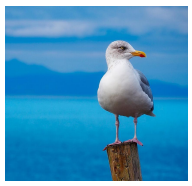
* light induced } UV-light, High temp



Smog

London Smog (Sulphur Smog / Classical)

Coal \rightarrow Smoke + SO₂ + fog
Day Night
low temp
H₂SO₄



Pollution

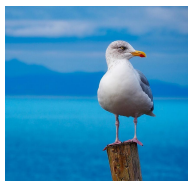
- Pollution is defined as any undesirable change in the physical, chemical or biological characteristics of environmental components i.e. air, water and soil that adversely affects the life forms and life support system of the biosphere directly or indirectly
- The agent that contaminate the environmental component is called **pollutant**.



Pollutant can be grouped in two broad categories:

1. Non biodegradable pollutants

- These remain in an unchanged form in the environment for a very long time such as pesticide, heavy metals, rubber, nuclear waste etc.
- Such substances are not broken down and decomposed by bacteria.
- These pollutants persists for very long time in nature, get accumulated and often biomagnify to a dangerous level when they move in material cycles in the nature and along with the food chain.



2. Biodegradable pollutants

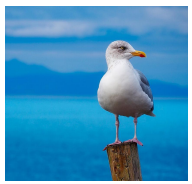
- Pollutants such as paper, garden waste, domestic sewage, agro-based residues and fertilizers etc. breakdown into simple product by bacterial decomposition process.
- The simple products are raw material of nature that are utilised in the ecosystem
Decomposition of these non-persistent pollutants occur naturally as well as through engineered systems such as sewage treatment plant.
- Such man-made systems enhance nature's capacity to decompose.
- These biodegradable pollutants pose a threat when their input in the environment exceed the decomposition capacity.



Sources of Pollution

Pollutants can enter the environment either through point or nonpoint sources.

- Point sources are distinct and confined sources that discharge the pollutants/effluents through a chimney or through its discharge channel such as pipes or tunnels from industries or municipal areas.
- Nonpoint sources or area sources are diffused sources that discharge pollutants over a large area some of the examples are runoff from construction sites and agricultural fields.



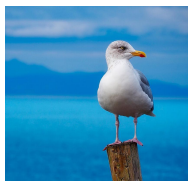
Causes of Pollution

- Uncontrolled growth in human population
- Rapid industrialization
- Urbanization
- Uncontrolled exploitation of nature
- Forest fires, radioactivity, volcanic eruptions, strong winds etc.,



1. Air Pollution

- Air pollution is aggravated because of four developments: increasing traffic, growing cities, rapid economic development, and industrialization.
- The presence in the atmosphere of one or more contaminants in such quality and for such duration as it is injurious, or tends to be injurious, to human health or welfare, animal or plant life.
- It is the contamination of air by the discharge of harmful substances.
- Air pollution can cause health problems, damage the environment, property and climate change.



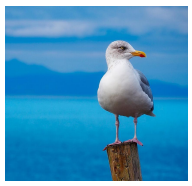
Air Pollutants

- Airborne emissions emitted from various industries are a cause of major concern.
- These emissions are of two forms, viz. solid particles (SPM) and gaseous emissions.
- Thus, Air Pollutants can be solid particles, liquid droplets, or gases.
- They can be natural or manmade.
- The pollutants have been classified into primary and secondary categories.



Air Pollutants

- The **primary pollutants** are “directly” emitted from the processes such as fossil fuel consumption, Volcanic eruption and factories.
- The major primary pollutants are Oxides of Sulphur, Oxides of Nitrogen, Oxides of Carbon, Particulate Matter, Methane, Ammonia, Chlorofluorocarbons, Toxic metals etc.
- The **secondary pollutants** are not emitted directly. The secondary pollutants form when the primary pollutants react with themselves or other components of the atmosphere.
- Most important secondary level Air Pollutants are Ground Level Ozone, Smog and POPs (Persistent Organic Pollutants).



Primary Air Pollutants

- Persist in the form in which they are added to the environment. DDT, CO, SO_x, NO_x, Insecticides

Oxides of Sulphur

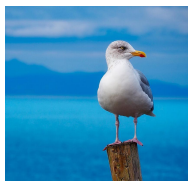
- Sulphur Oxides are generally a product of the Volcanoes, Industrial processes, Coal and petroleum, because most of them have Sulphur as a component.
- The Sulphur Dioxide in presence of a catalyst such as NO₂ causes [Acid Rain](#), because of the formation of Sulphuric Acid.
- The Indian Coal is though low in sulphur content but still coal consumption is a major danger of acid rain because of the coal based power plants.

Acid Rain



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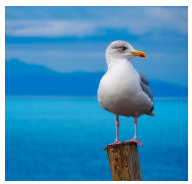
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Primary Air Pollutants

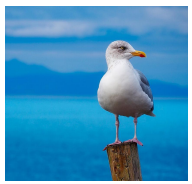
Oxides of Nitrogen

- Most of the Nitrogen Oxides are produced due to high temperature combustion.
- In the cities the brown haze dome above the cities is mostly because of the Nitrogen Oxides.
- The most important toxic gas is Nitrogen dioxide which is brown, with sharp odour.



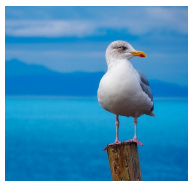
Oxides of Carbon

- Carbon Monoxide, which is colourless, odourless and non irritating but very poisonous gas is the product of incomplete combustion of the natural gas, coal or wood.
- The vehicle exhaust is the major source of CO.
- The Carbon Dioxide is associated with the Ocean Acidification and is emitted from combustion, factories and respiration of living organisms.



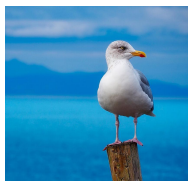
Primary Air Pollutants

- We have primary pollutants such as [Volatile Organic Compounds or VOCs](#) which are methane (CH_4) and non-methane (NMVOCs).
- Methane is a GHG which contributes to Global Warming.
- The NMVOCs include the aromatic compounds such as Benzene, Toluene, Xylene which are proved or suspected carcinogens.
- Another dangerous compound is the 1,3-butadiene, often associated with industrial uses.



Particulate Matter

- The particulate matters are the fine particles which may be either solid or liquid, suspended in a gas.
- They are different from the Aerosols. Aerosols are particle and gas referred together.
- The aerosols which are created by the Human activities are anthropogenic aerosols. They account for around 10% of the total aerosols in the atmosphere.



Primary Air Pollutants

Other Primary Pollutants

- Another category of the primary air pollutants is toxic metals such as Cadmium, Lead and Copper, which are products of the Industrial processes.
- The Chlorofluorocarbons (CFCs) are proved to be harmful to the ozone layer emitted from products currently banned from use.
- In agriculture process, Ammonia is emitted which has characteristic pungent odor. It is a precursor to foodstuffs and fertilizers.
- Ammonia is also a building block for the synthesis of many pharmaceuticals.

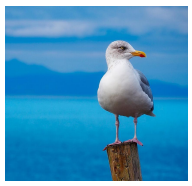


Secondary Air Pollutant

Secondary Air Pollutant : These are formed by the chemical reactions amongst Primary Pollutants.

Ground Level Ozone

- The most important secondary pollutant is the Ground Level Ozone or Tropospheric Ozone.
- Emissions from industrial facilities and electric utilities, motor vehicle exhaust, gasoline vapours, and chemical solvents are some of the major sources of NO_x and VOC.
- Ground Level Ozone forms due to reactions of the NO_x, Carbon Monoxide and VOCs in presence of sunlight.
- in the last 100 years, the emission of Methane (a Volatile Organic Compound) has increased dramatically and it has contributed to the increased concentration of Ground Level Ozone.



Secondary Air Pollutant

Smog

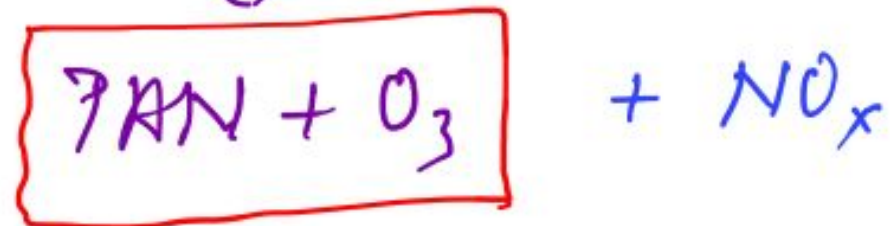
- Another most important secondary pollutant is the Smog, which has made up of Smoke and Fog.
- Traditionally, the smog has resulted from large amounts of coal burning in an area caused by a mixture of smoke and sulphur dioxide.
- Now a days, the Vehicle emissions and Industrial emissions that are acted on in the atmosphere by ultraviolet light from the sun to form secondary pollutants that also combine with the primary emissions to form photochemical smog.

Smog

Los Angeles Smog (Photochemical Smog)

Smoke + fog + HC + NO_2 + O_2

* light induced } UV-light, High temp



Smog

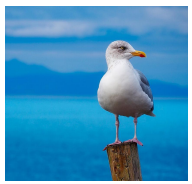
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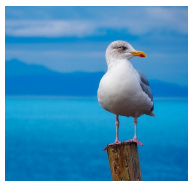
Air Pollution and Atmospheric Problems

- Apart from causing damage to materials, plant and animal communities and health problems in humans, air pollution affects the atmospheric processes.
- Acid rain, smog, global warming, ozone depletion etc. are some of the effects of pollution in our atmosphere.



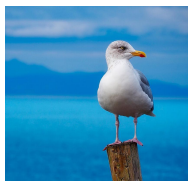
2. Water Pollution

- Addition of certain substances to the water such as organic, inorganic, biological, radiological, heat, which degrades the quality of water so that it becomes **unfit for use**.
- Water pollution is not only confined to surface water, but it has also spread to groundwater, sea and ocean.



Types of Water Pollutants

1. Biological Agents
2. Chemical Agents
3. Physical Agents



Types of Water Pollutants

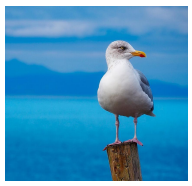
1. Biological Agents :

- Pathogenic organisms like viruses, bacteria and protozoans are serious water pollutants as far as human health is concerned.
- Cholera, bacterial and amoebic dysentery, gastroenteritis, typhoid, polio, viral hepatitis, worm infections, flue etc. are important water borne disease.
- Some insect that have aquatic larvae transmit Malaria, dengue, yellow fever and viruses in our country generally onset of rainy season is accompanied by such epidemics.



Types of Water Pollutants

- Floods, water lodging, pipe bursting, mixing of sewage water with drinking water are some of the common problem we face during rainy season that cause these epidemics.
- Over populated areas, unplanned Industrial and human settlement, lack of proper civic amenities are some of the contributory factors.
- Water gets contaminated due to human wastes, animal wastes, domestic sewage and waste water discharges from tanneries and slaughter houses.



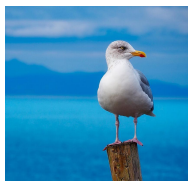
2. Chemical Agents

- Chemical pollutants can be water- soluble, water insoluble or oxygen demanding wastes.
- These can be inorganic in nature like nitrates, phosphates, acids, salts and toxic heavy metals.
- Organic chemical pollutants include oil, gasoline, pesticides, dyes, paints, plastics, cleaning solvents, detergents and organic wastes like domestic sewage, animal waste etc.



Types of Water Pollutants

- Radioactive substances that make the third category of chemical pollutants are released into water bodies as a result of processing of uranium ore, wastes from research laboratories etc.
- Organic wastes and inorganic nutrients like phosphates and nitrates enrich the water bodies that may cause eutrophication.



Types of Water Pollutants

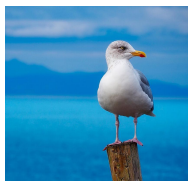
3. Physical Agents

- Suspended solids, sedimentary solids and temperatures are the physical factors that affect the quality of water.
- These water pollutants adversely affect by silting, clogging the waterways, filling the dams and making water muddy.
- Aquatic animal face problem in breathing through gills in such water.
- Suspended organic and minerals solid absorb toxic substance like heavy metals and pass them in food chain.
- Thermal Pollution occurs when heat-laden water enters the water body.



Eutrophication

- Addition of phosphates, nitrates and organic waste from industries like tanneries slaughterhouses, starch factories, paper mills, milk plants, run-offs from agricultural lands over - enrich the water bodies by increasing their nutrient content and so increase their productivity
- The productivity of an ecosystem reflects the rate at which its producer photosynthesises.
- A lake with high productivity is called an eutrophic lake and it has a dense population of producer often visible as green scum on the surface water.



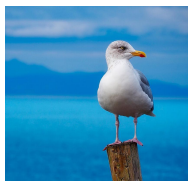
Eutrophication

- The activities of aerobic bacteria, the decomposers, in the presence of oxygen release the nutrients from the organic waste.
- These nutrients act as fertilizers and cause population explosion of water microscopic plants like algae and other like duck beat weed, water hyacinth etc.
- The abundant growth of algae is called **algal bloom**



Eutrophication

- Bacterial activity consumes lot of dissolved oxygen and so do the algae and other green plants for respiration.
- This leads to decrease in the oxygen available to fishes that ultimately cause the death of the fishes.
- Eutrophication occur only in a stagnant water bodies and not in flowing water because flowing water carries away the wastes and the nutrients and disperses it too larger area.
- An oligotrophic lake has low nutrient content low productivity and clearwater that could be drinkable



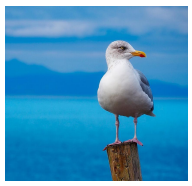
3. Soil Pollution

- Soil pollution is defined as the build-up in soils of persistent toxic compounds, chemicals, salts, radioactive materials, or disease causing agents and other xenobiotic (man-made) chemicals or other alteration in the natural soil environment.
- Pollution in soil is mainly associated with :
 - Indiscriminate use of fertilizers
 - Indiscriminate use of pesticides, insecticides and herbicides
 - Dumping of large quantities of solid waste
 - Deforestation and soil erosion



Soil Pollution

- The most common chemicals involved in soil pollution are petroleum hydrocarbons, solvents, pesticides, lead, and other heavy metals.
- A soil pollutant is any factor which deteriorates the quality, texture and mineral content of the soil or which disturbs the biological balance of the organisms in the soil.
- Pollution in soil has adverse effect on plant growth.



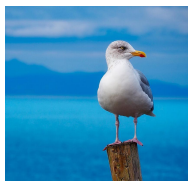
Effects of Soil Pollution

- Pollutants runs off into rivers and kills the fish, plants and other aquatic life
- Crops and fodder grown on polluted soil may pass the pollutants on to the consumers
- Polluted soil may no longer grow crops and fodder
- Soil structure is damaged (clay ionic structure impaired)
- Corrosion of foundations and pipelines
- Impairs soil stability
- May release vapours and hydrocarbon into buildings and cellars
- May create toxic dusts
- May poison children playing in the area



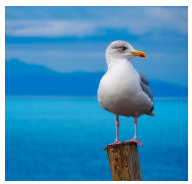
4. Pollution by Radioactivity

- Radioactivity is a phenomenon of spontaneous emission of proton (Alpha-particles), electrons (Beta-particles) and gamma rays (short wave electromagnetic waves) due to disintegration of atomic nuclei of some elements. These cause radioactive pollution.
- All types of the radiations are the form of energy.
- Radiations that have longer wavelength have low frequency, low energy and less penetrating power.
- Radiations with shorter wavelengths have high frequency, high energy and high penetrating power.



Types of Nuclear Radiation

- Alpha particles, can be blocked by a piece of paper and human skin.
- Beta particles can penetrate through skin, while can be blocked by some pieces of glass and metal.
- Gamma rays can penetrate easily to human skin and damage cells on its way through, reaching far, and can only be blocked by a very thick, strong, massive piece of concrete.

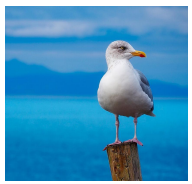


Natural

- They include cosmic rays from space and terrestrial radiations from radio nuclide present in earth's crust such as Radium - 224, Uranium-238, Thorium-232, Potassium-40, Carbon-14, etc.

Man-made

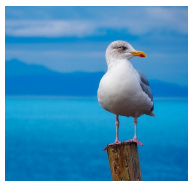
- Nuclear power plants
- Nuclear weapon
- Transportation of nuclear material
- Disposal of nuclear waste
- Uranium mining
- Radiation therapy



Effects

The effects of radioactive pollutants depend upon

- Half-life
- Energy releasing capacity
- Rate of diffusion and rate of deposition of the pollutant
- Various environmental factors such as wind
- Temperature, rainfall also influence their effects



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Spread the word! If you need it, someone else too.