WATER POLLUTION

Water pollution can be defined as the contamination of water bodies. Water pollution is caused when water bodies such as rivers, lakes, oceans, groundwater and aquifers get contaminated with industrial and agricultural effluents.

When water gets polluted, it adversely affects all life forms that directly or indirectly depend on this source.

Sources of Water Pollution

i. **Point Sources:** When the cause and place of pollution is easily identifiable, it is known as a point source of water pollution. *Examples:* Municipal and industrial discharge pipes.

ii. **Nonpoint Sources:** When the cause and place of pollution cannot be readily identified, it is known as a nonpoint source of water pollution. *Examples:* Mining runoff and acid rain.

The most significant sources of water pollution are:

- **Sewage (Waste Water):** The sewage water carries pathogens, a typical water pollutant, other harmful bacterias, and chemicals that can cause serious health problems and thereby diseases.
- **Agricultural Pollution:** Chemical fertilizers and pesticides are used by farmers to protect crops from insects and bacterias. However, when these chemicals are mixed up with water, they produce harmful pollutants for plants and animals.
- **Oil Pollution:** Oil spill poses a huge threat to marine life when a large amount of oil spills into the sea and does not dissolve in water. It causes problems for local marine wildlife, including fish, birds, and sea otters.
- **Industrial Waste:** Industries produce a tremendous amount of waste, which contains toxic chemicals and pollutants, causing water pollution and damage to our environment.
- **River and Marine Dumping:** The garbage produced by households in the form of paper, plastic, food, aluminium, rubber, and glass, is collected and dumped into the rivers and seas. They not only cause water pollution but also harm aquatic animals.

Water Pollutants

(i) Organic Pollutants : They include oil, synthetic organic compounds, sewage and agricultural run-off, disease-causing wastes and oxygen-demanding wastes.

(ii) Inorganic Pollutants : They include metals, metal compounds, organometallic compounds, mineral acids, inorganic salts, etc.

(iii) Suspended Solids and Sediments: They comprise of sand, silt and minerals eroded from the land.

(iv) Radioactive Materials: They include radioactive isotopes from nuclear reactors, nuclear power plants, research, industrial applications, agriculture and therapeutic as well as diagnostic medical applications.

(v) Thermal Pollution: They include discharge of waste heat to water bodies by thermal and nuclear power plants.

Types of Water Pollution

Surface water pollution

The water on the surface of the planet is made up of seas, oceans, lakes, rivers and other waterways. These bodies of water can become contaminated from point sources (such as industrial effluents and improper wastewater management systems) or non-point sources (such as agricultural run-off, precipitation and seepage). This can contaminate the surface water and make it unsafe for humans, animals and plants alike.

Groundwater pollution

When contaminants (such as fertilizers, pesticides, heavy metals and wastewater) are allowed to pollute the soil, they can penetrate far deeper and render groundwater supplies unpotable and unusable.

Chemical pollution

Chemicals are used in a wide variety of anthropogenic activities, from protecting agricultural crops from pests and disease to manufacturing consumer goods to transporting and consuming energy sources such as oil and petrol. Automatically some of these chemicals find their way into the natural environment, either through agricultural run-off after heavy rainfall, accidental spillage or improper disposal of waste products. This can have a dramatic impact on water sanitation.

Microbiological pollution

Microbiological pollution refers to that which is caused by microorganisms within the water. This type of contamination largely occurs naturally and, on many occasions, the bacteria, protozoa and viruses are harmless or even beneficial to the ecosystems they inhabit. However, this is not always the case and some microorganism kill off plant & animal life and causing disease among humans which consume or use this water.

Nutrient pollution

Fertilizers, pesticides and other products used during agricultural processes often contain significant amounts of nutrients, such as phosphorous and ammonia. These are specifically used to protect crops from pests or disease, or increase their growth and maximize yields. When run-off sends these chemicals into water sources, they can cause an imbalance of nutrients, promoting the growth of some organisms (such as algae) to the detriment of others.

Suspended matter pollution

Although water is often dubbed the universal solvent, some particles of pollution are simply too large to mix with water molecules. This means that they either form a layer of floating silt atop the water's surface, or else sink to its floor in the form of a thick mud. Either way, they can inhibit the growth of marine life beneath the waves and compromise the quality of the water in their vicinity, posing a risk to humans as well as animals.

Effects of Water pollution

1. Diseases: In humans, drinking or consuming polluted water in any way has many disastrous effects on our health. It causes typhoid, cholera, hepatitis and various other diseases.

2. Destruction of Ecosystems: Ecosystems are extremely dynamic and respond to even small changes in the environment. Water pollution can cause an entire ecosystem to collapse if left unchecked.

3. Eutrophication: Chemicals in a water body encourage the growth of algae. These algae form a layer on top of the pond or lake. Bacteria feed on this algae and this decreases the amount of oxygen in the water body, severely affecting the aquatic life there.

4. Affects the food chain: Disruption in food chains happens when toxins and pollutants in the water are consumed by aquatic animals (fish, shellfish etc) which are then consumed by humans.

Eutrophication

Eutrophication is the process in which a water body becomes overly enriched with nutrients, leading to excessive growth (or bloom) of algae and plankton in a water body Eutrophication is considered to be a serious environmental concern since it often results in the deterioration of water quality and the depletion of dissolved oxygen in water bodies.

Marine pollution

When the salt content of a water body is equal to or more than 35 parts per thousand (ppt), then it is known as a *marine water body*.

Examples of Marine Water Bodies: Seas, oceans, brackish water, salt marshes, etc.

Marine Pollution refers to trash and pollutants that come from land sources to end up in the ocean. This pollution causes widespread damage to ocean life as well as to economic structures that rely on marine infrastructure.

Thus, marine pollution is harmful and is caused by human activities. Damages or disturbances caused by earthquakes, volcanic eruptions, tsunamis, etc., are not considered marine pollution.

Steps to control marine pollution

- Almost 80% marine pollution caused due to waste from lands. We can reduce this.
- Plastic bags, bottles etc. have become one of the big reasons for marine pollution. We need to stop using plastic made material to save marine life and our environment.
- We all need to put efforts to clean the sea beaches. If beaches will be cleaned, marine pollution can be reduced to some extent.
- The farmers should use organic farming techniques instead of using chemical pesticides and fertilizers. When these fertilizers and pesticides entered into ocean water causes various health issues to the plants & animals of the sea.
- We all need to make sure that only rainwater goes into the drainage because most of the drain water goes into oceans. If we allow sewage and waste material to get into the drainage, it will eventually affect the marine life.

- Most of the rivers flow into the oceans and also the wastes get entered in the sea water. Hence we also need to take care of the cleanliness of the rivers so that it cannot contaminate the marine life.
- We should stop using single-use plastic to protect the marine ecosystem.
- Say “NO” to disposables such as straws, tumblers, plastic carry bags, etc. These items only increase the amount of waste that ultimately goes into oceans.
- Recycling helps a lot to protect ocean ecology.
- We should try to minimize energy use to reduce the oceanic temperature.
- Give preference to buy Eco-friendly products and materials.

Point Sources	**Non-point Sources**
Pollutants are discharged directly into water bodies.	Pollutants are discharged away from water bodies and at various places.
Easy to treat the pollutants in the water treatment plant before they enter the water bodies	Difficult to treat the pollutants before they enter water bodies.
More harmful	Less harmful in comparison to point source water pollution.
For Example- Sewage outlets in the municipal area, power plants, oil wells, and underground coal mines close to water bodies.	For Example- Garden, roads, construction sites, runoff water from the field, etc.

BOD and COD: Biochemical oxygen demand (BOD) is the amount of oxygen required by the microorganisms to break down organic materials. In contrast, chemical oxygen demand (COD) is the amount of oxygen required to break down the organic material via oxidation.

Biological Oxygen Demand	**Chemical Oxygen Demand**
It is the amount of oxygen the microbes require to decompose the organic matter under aerobic conditions.	It is the total amount of oxygen required to break down the organic matter by chemical oxidation.
Test: It can be determined by putting a sealed water sample under specific temperature conditions for five days.	Test: It can be determined by placing a water sample with a strong oxidizing agent under specific temperature conditions for a short period.
Value: Lower than COD	**Value:** Higher than BOD
It is used to waste loadings in treatment plants. Evaluation of BOD removal efficiency of the waste plants.	To quantify the amount of oxidisable pollutants found in water bodies. It provides a measurement on how an effluent will affect the water body.

SOIL/LAND POLLUTION

Soil pollution is defined as the presence of toxic chemicals (pollutants or contaminants) in soil, in high enough concentrations to pose a risk to human health and the ecosystem or in simple words Alteration in the natural soil due to human activities is termed Soil Pollution. For example, exposure to soil containing high concentrations of benzene increases the risk of contracting leukaemia.

Types of Soil Pollutants

- Agriculture soil pollution is caused due to the excessive use of pesticides and insecticides.
- Soil Pollution by industrial discharges of chemicals from mining and manufacturing of goods.
- Solid waste / poor management or inefficient disposal of waste.
- Soil Pollution due to urban activities.

Effects of Soil Pollution

The harmful effects of soil pollution are briefly described below:

(i) Fluorosis occurs as a result of consumption of fluoride containing maize and jawar *crops*. The fluoride is absorbed by the crops from the fluoride-contaminated soil.
(ii) Emission of toxic gases (from dumped solid wastes on land) is detrimental to health. The unpleasant smell and spread of insects cause inconvenience to people.
(iii) Poisoning of the ecosystem takes place by soil pollution.
(iv) *Contamination* of underground and surface drinking *water* takes place by soil pollution.
(v) Reduction in the fertility of *soil* takes place by soil pollution.

Control of Soil Pollution

The soil pollution can be controlled by the following methods:

(i) Polluted soil can be *treated* by *bioremediation*. It uses microorganisms (yeast, fungi or bacteria) to break down, or degrade, hazardous substances into less toxic or nontoxic substances (such as CO_2 and H_2O). Proper treatment of liquid wastes from industries and mines must be done.
(ii) The principles of three Rs, namely, *Recycle*, *Reuse* and *Reduce*, help in minimizing the generation of solid waste. For example, use of bio fertilizers and natural pesticides help in minimizing usage of chemical fertilizers and pesticides.
(iii) Proper disposal methods must be employed. For example, composting of biodegradable solids and incineration of non-biodegradable solids should be done.
(iv) Planned *afforestation* helps in preventing soil erosion.
(v) Formulation and effective implementation of stringent pollution-control *legislation* also helps in controlling soil pollution.
(vi) Faulty *sanitation practices* must be improved.

NOISE POLLUTION

Noise pollution is defined as environmental noise or an unwanted sound that is annoying, distracting, or physically harmful. Harms include hearing loss, stress, sleeplessness etc. Noise pollution is also known as sound pollution.

Sources of Noise

Source is the equipment or process directly responsible for sound generation.

The major sources of noise are summarized below:

(i) **Transportation Sources** Railways, road traffic and air traffic.

(ii) **Industrial Sources** Noise is generated in mostly all industrial activities such as power generation, processing, product fabrication and product assembly.

(iii) **Public Address System Sources** Use of loudspeaker at any occasion like marriages, functions, festivals, etc.

(iv) **Agricultural Machine Sources** Use of tractors, tubewells, farm machines for agriculture.

(v) **Defence Equipment Sources** Shooting practices, wars, bomb explosion, etc.

(vi) **Household Sources** Mixer-grinder, lawn mowers, food blenders, vacuum cleaners, etc.

(vii) **Other Sources** Rock concerts, barking dogs, construction equipments, etc.

Effects of Noise Pollution

Noise affects human health in the following ways:

(i) **Physical Effects:** Damage to ear drum, temporary impairment of hearing, permanent deafness.

(ii) **Physiological Effects**: Muscular strain, headache, eye strain, decreased color perception, nervous breakdown, pain in heart, etc.

(iii) **Psychological Effects**: Emotional disturbance, depression, fatigue, frustation, irritation, reduced efficiency, etc.

Prevention of Noise Pollution

Some noise pollution preventive measures are provided in the points below.

- Honking in public places like teaching institutes, hospitals, etc. should be banned.
- In commercial, hospital, and industrial buildings, adequate soundproof systems should be installed.
- Musical instruments' sound should be controlled to desirable limits.
- Dense tree cover is useful in noise pollution prevention.
- Explosives should not be used in forest, mountainous and mining areas.
- Turn off Appliances at Home and offices
- Shut the Door when using noisy Machines

- Use Earplugs
- Lower the volume
- Stay away from Noisy area
- Follow the Limits of Noise level
- Control Noise level near sensitive areas

THERMAL POLLUTION

Thermal pollution may be defined as the degradation of water quality by any process that changes ambient water temperature.

Thermal pollution is best known as sudden increases or decreases in the temperature of water bodies like oceans, seas, rivers, lakes, streams, etc. Usually, the industries use water for cooling purposes for machinery or other production processes.

Causes of Thermal Pollution

Causes (or sources) of thermal pollution are briefly described below:

(i) **Coal-fired Power Plants**: River water is used for cooling the condenser rods of coal-fired thermal power plants. When water used as a coolant is returned to the river, its temperature is high which lowers down the dissolved oxygen of water and affects ecosystem composition.

(ii) **Nuclear Power Plants:** Large amount of heat along with toxic radionuclides are discharged into nearby water streams by nuclear power plants. Radiation leakages are also responsible for increasing the temperature of water bodies. Nuclear experiments and nuclear explosions are also responsible for thermal pollution.

(iii) **Domestic Sewage:** Normally, the municipal water sewage has a higher temperature than normal water. When domestic sewage is discharged into lakes, rivers, etc., it causes thermal pollution.

(iv) **Industrial Effluents:** Textile, sugar, paper, pulp and various other industrial effluents when discharged into lakes, rivers, etc., cause thermal pollution.

(v) Deforestation: When shade-providing trees are cut down, water temperature rises.

Effects of Thermal Pollution

The harmful effects of thermal pollution are described below:

(i) **Reduction in DO**: Elevated temperature typically decreases the level of dissolved oxygen in water. This can harm aquatic animals.

(ii) **Change in Quality**: With rise in temperature, the density, viscosity and solubility of gases in water decreases.

(iii) **Damage to Biological Activity**: Above 37°C, biological activity of enzymes of aquatic flora and fauna gets severely damaged.

(iv) **Interference with Reproduction Capability** Temperatures higher than 9 to 10°C interferes with reproduction capabilities of certain fishes.

(v) **Increase in Metabolic Activity**: At increased temperatures, metabolic activities such as oxygen uptake, food intake and mobility of fishes are increased.

(vi) **Increased Mortality Rate:** At higher temperatures, the mortality rate of fish and all

other aquatic organisms increases.

(vii) **Malnutrition**: High temperatures can lead to the denaturing of life-supporting enzymes. It means, within the quaternary structure of the enzymes, hydrogen bonds and disulphide bonds break down.

(viii) **Ecological Effects of Cold Water** Elimination of native fish species and drastic alteration of macro invertebrate fauna has been observed by releases of unnaturally cold water from reservoirs like dams.

Control Measures of Thermal Pollution

Heated water from power plants, petroleum refineries, pulp and paper mills, steel mills and chemical plants can be cooled down for controlling thermal pollution by using cooling ponds, cooling towers, etc.

(i) ***Cooling ponds*** are man-made bodies of water which help in reducing the temperature of water by evaporation, convection and radiation.

(ii) ***Cooling towers*** transfer waste heat to the atmosphere through evaporation and/or heat transfer.

(iii) ***Cogeneration*** is a process for recycling waste heat for domestic and/or industrial heating purposes.

(iv) ***Storm water management facilities*** absorb urban run-off or direct it into groundwater, such as bioretention systems. Otherwise, urban run-off can have significant thermal impact during summers on small streams, as storm water passes over hot parking lots, roads and sidewalks.

(v) ***Afforestation*** By planting trees along streams and shorelines, thermal pollution can be controlled. If these trees and tall plants are not there for providing shade, the water warms by as much as 10°C. Even removal of vegetation far away from a lake can speed up the erosion of soil into water, making it muddy. Muddy water absorbs more energy from the sun than clear water does, resulting in further heating, Afforestation controls erosion, keeps water clearer and thus, cooler.