Department of biology

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((Environmental Pollution))

Stage (3)

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Types of water pollutants

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Types of water pollutants

1. Organic pollutants

Organic pollutants can be further divided in to following categories:

a) Oxygen Demanding wastes:

The wastewaters such as, domestic and municipal sewage, wastewater from food processing industries, canning industries, paper and pulp mills, tanneries, breweries, distilleries, etc. have considerable concentration of biodegradable organic compounds either in suspended, colloidal or dissolved form.

These wastes undergo degradation and decomposition by bacterial activity. The dissolved oxygen available in the water body will be consumed for aerobic oxidation of organic matter present in the wastewater. Hence, depletion of the DO will be a serious problem adversely affecting aquatic life, if the DO falls below 4.0 mg/L. This decrease of DO is an index of pollution.

Biochemical oxygen demand (BOD) is a measure of demand for oxygen utilized by micro-organism, during oxidation of organic matter. It is defined as the amount of oxygen in milligram per liter or in ppm used by micro-organisms to degrade the organic matter. A high BOD value indicates more polluted water.

Chemical Oxygen Demand or COD is a measurement of the oxygen required to oxidize soluble and particulate organic matter in water. The method involves using a strong oxidizing chemical, potassium dichromate Cr2O72-, to oxidize the organic matter in solution to carbon dioxide and water under acidic conditions. COD

is normally higher than BOD **because more organic compounds can be chemically oxidised than biologically oxidised.**

b) Synthetic Organic Compounds

Synthetic organic compounds are also likely to enter the ecosystem through various manmade activities such as production of these compounds, spillage during transportation, and their uses in different applications. These include synthetic pesticides, synthetic detergents, food additives, insecticides, paints, synthetic fibers, plastics, solvents and volatile organic compounds (VOCs).

Most of these compounds are toxic and they are resistant to microbial degradation. Even concentration of some of these in traces may make water unfit for different uses. The detergents can form foams and volatile substances. Polychlorinated biphenyls (PCBs) are used in the industries since 1930s which are complex mixtures of chlorobiphenyls. Being a fat soluble they move readily through the environment and within the tissues or cells.

2. Inorganic Pollutants

Apart from the organic matter discharged in the water body through sewage and industrial wastes, high concentration of heavy metals and other inorganic pollutants contaminate the water. These compounds are non-biodegradable and persist in the environment. These pollutants include mineral acids, inorganic salts, trace elements, metals, complexes of metals with organic compounds, cyanides, sulphates, etc.

The accumulation of heavy metals may have adverse effect on aquatic flora and fauna and may constitute a public health problem

where contaminated organisms are used for food. Metals in high concentration can be toxic to biota e.g. Hg, Cu, Cd, Pb, As, and Se.

3.Disease causing agents

Pathogens are another type of pollutants that prove very harmful. They can cause many illnesses that range from typhoid and dysentery to minor respiratory and skin diseases.

Pathogens include such organisms as bacteria, viruses, and protozoan. These pollutants enter waterways through untreated sewage, storm drains, septic tanks, runoff from farms, and particularly boats that dump sewage. One of the biggest threats for the developing countries is the disease caused by polluted water such as cholera. Regular intake of polluted water may cause sclerosis, skin legions, and problems in blood circulation, mineral deposits in bones, certain cancers and disease of the nervous system. Diseases caused by water pollution are the major cause of human death across the world.

✓ Bacterial indictors of water pollution:

Bacteria are naturally present in water. However, fecal coliform bacteria in the water may indicate human or animal wastes because these bacteria inhabit the intestines of humans and other vertebrates.

Coliform do not necessarily cause disease themselves. Rather they are an indicator of fecal material, which may contain pathogens. Coliform are used as an indicator because simple

inexpensive methods are available to detect them. If coliform are found in the water, then it is tested further for the presence of organisms definitely known to be pathogens. Enteric viruses are pathogens which can cause gastrointestinal distress. *Legionella* bacteria are responsible for the respiratory disease, Legionnaire's disease. *Giardia lamblia*, a protozoan, causes intestinal illness. Any of these diseases can be serious or, sometimes, deadly.

4.Thermal pollutants

Considerable thermal pollution results due to discharge of hot water from thermal power plants, nuclear power plants, and industries where water is used as coolant. As a result of hot water discharge, the temperature of water body increases, which reduces the DO content of the water adversely, affecting the aquatic life. This alters the spectrum of organisms, which can adopt to live at that temperature and DO level. When organic matter is also present, the bacterial action increases due to rise in temperature; hence, resulting in rapid decrease of DO. The discharge of hot water leads to the thermal stratification in the water body, where hot water will remain on the top.

5. Plant nutrients

The agriculture run-off, wastewater from fertilizer industry and sewage contains substantial concentration of nutrients like nitrogen and phosphorous. These waters supply nutrients to the plants and may stimulate the growth of algae and other aquatic weeds in receiving waters. However, these nutrients are responsible for what is known as the phenomenon Eutrophication.

In freshwater environments (e.g. lakes), **phosphorus** is usually the nutrient in the lowest concentration and therefore generally limits the growth of phytoplankton. In coastal environments (estuaries), nitrogen usually limits the growth of phytoplankton because it is generally the nutrient in the lowest concentration.

Nitrogen is commonly found in aquatic environments as nitrate (NO3-), nitrite (NO2-), or ammonia (NH4+ or NH3). Human factors affecting the concentration of nitrogen in aquatic environments are wastewater and septic system effluent, fertilizer runoff, animal waste, fossil fuel, and industrial discharge.

Phosphorus is commonly found in aquatic environments as phosphate (PO4 -3). The sources of phosphorus in aquatic environments are wastewater and septic system effluent, detergents, fertilizer runoff, animal waste, development/paved surfaces, industrial discharge, phosphate mining, drinking water treatment, forest fires, and synthetic material.

Based on the amount of phytoplankton growth and the concentration of nutrients, the degree of eutrophication in aquatic environments can be classified: as **Oligotrophic, Mesotrophic, Eutrophic**, or **hypereutrophic.**

Oligotrophic : environments are characterized by clear waters, little suspended organic matter, and low primary production (phytoplankton growth).

Mesotrophic: environments have higher nutrient inputs and rates of primary production.

Eutrophic: environments have extremely high nutrient concentrations and biological productivity.

Hypereutrophic: environments are characterized by murky, highly productive waters in which many clear water species cannot survive.

The algal blooms(eutrophication) lead to

1- Produce extremely dangerous toxins that can sicken or kill people and animals.
2- Create dead zones in the water due to the depletion of oxygen and reduce the amount of light available to organisms and plants beneath the surface layer
3- Species diversity decreases and the dominant biota changes
4- Turbidity increases
5- Rate of sedimentation increases, shortening the lifespan of the lake
6- Raise treatment costs for drinking water

Also, Nitrate levels above 10 mg/L (10 ppm) in water can cause **blue baby syndrome** (**methemoglobinemia**), leading to **hypoxia** (which can lead to coma and death if not treated). It is widely believed to be caused by nitrate contamination in water resulting in decreased oxygen carrying capacity of haemoglobin in babies leading to death. The drinking water can be contaminated by leaching of nitrate generated from fertilizer and chemicals used in agricultural lands. Cases of blue baby syndrome have for example been reported in villages in Romania and Bulgaria where the groundwater has been polluted with nitrate leaching from pit latrines. However, the linkages between nitrates in drinking water and blue baby syndrome have been disputed in large number of studies.

6. Suspended solids and sediments

These comprise of silt, sand and minerals eroded from land. These appear in the water through the surface runoff during rainy season and through municipal sewers. This can lead to the siltation, reduces storage capacities of reservoirs. Presence of suspended solids can block the sunlight penetration in the water, which is required for the photosynthesis by bottom vegetation. Deposition of the solids in the quiescent stretches of the stream or ocean bottom can impair the normal aquatic life and affect the diversity of the aquatic ecosystem.

If the deposited solids are organic in nature, they will undergo decomposition leading to development of anaerobic conditions. Finer suspended solids such as silt and coal dust may injure the gills of fishes and cause asphyxiation.

7. Radioactive Substances

Contamination of radioactive substances such as wastes of uranium and thorium can be carried into water from nuclear power plants, during their mining and refining processes. Scientific and medical institutions, which utilize radioactive materials can also contaminate water bodies. These substances may cause radioactivity in living organisms and produce harmful effects.

Testing of Nuclear capability for war or peaceful purposes in oceans damages marine eco systems. The use of oceans for nuclear testing has damaged much of marine life in these water zones and nuclear explosions in oceans are now banned under an international treaty.

8. Oil

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Oil is a natural product which results from the plant remains fossilized over millions of years. It is a complex mixture of hydrocarbons and degradable under bacterial action, the biodegradation rate is different for different oils, tars being one of the slowest. Oil enters in to water through oil spills, leak from oil pipes, and wastewater from production and refineries. Every year, between 1 and 10 billion tons of oil are spilt in to different ecosystems. Cleanup efforts have been weak, as only about 10% of the oil is removed by the most successful efforts. Oil pollution is a growing problem, particularly devastating to coastal wildlife. An oil spill from a **tanker** is a severe problem because there is such a huge quantity of oil being spilt into one place. Oil cannot dissolve in water and forms a thick sludge in the water. This suffocates fish because the oil layer on the surface of water reduce the DO level in water as oxygen transfer from atmosphere is prevented , also gets caught in the feathers of marine birds stopping them from flying and blocks light from photosynthetic aquatic plants. Also ,they are toxic to most living organisms , carcinogenic to other and have the ability to transport through the food chain.