

Chemical Analyses for Water Pollutants: An Overview

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ABSTRACT

Water pollution occurs when harmful substances often chemicals or microorganisms contaminate a stream, river, lake, ocean, aquifer, or other body. The paper focuses on major causes of water pollution include industrial waste discharge, agricultural runoff containing pesticides and fertilizers, untreated sewage, oil spills, and the dumping of plastic and other non-biodegradable waste.

The paper enhances the main causes of water pollution include bacteria, viruses, parasites, chemicals, plastics, waste, and pesticides. Water pollution is a result of human activities that make water unsafe for human use and disrupt aquatic ecosystems.

Keywords: Water, pollution, chemicals, pollutants, sources, industrial, discharge, sewage and organic

INTRODUCTION

Water pollution leads to the destruction of aquatic ecosystems, kills marine life, contaminates drinking water, and spreads waterborne diseases. The main causes of water pollution include bacteria, viruses, parasites, chemicals, plastics, waste, and pesticides. Water pollution is caused when water bodies such as rivers, lakes, oceans, groundwater and aquifers get contaminated with industrial and agricultural effluents.

Chemical pollutants in water can be carcinogenic. Villages in Punjab near industrial belts have seen increased cases of cancer. Water pollution is one of the most serious environmental issues. Water pollution in India is mainly caused by domestic sewage, industrial discharge, agricultural runoff, and solid and toxic waste.

Water is essential for life. Without water there would be no life. We usually take water as granted for its purity, but we must ensure the quality of water. Pollution of water originates from human activities. Through different paths, pollution reaches surface or ground water. "Water pollution results when contaminants mix with these water bodies. Contaminants can come from one of four main sources.

These are sewage discharges, industrial activities, agricultural activities, and urban runoff including storm water" (Eckenfelder Jr WW 2000) Easily identified source or place of pollution is called as point source. e.g. municipal and industrial discharge pipes where pollutant enter the water-source. "In India, water pollution comes from a variety of point and non-point sources, affecting all bodies of water, including surface and groundwater.

The main causes of pollution at industrial discharges, inadequate waste management and agricultural runoff" (RiteWater 2024). Non points source pollution are those where source of pollution cannot be easily identified e-g.. Agricultural runoff (from farm, animal and crop-landaj, acid rain, storm-water drainage (from streets, parking lots and law etc. the major water pollutants and their sources:

(ii) Major water Pollutant

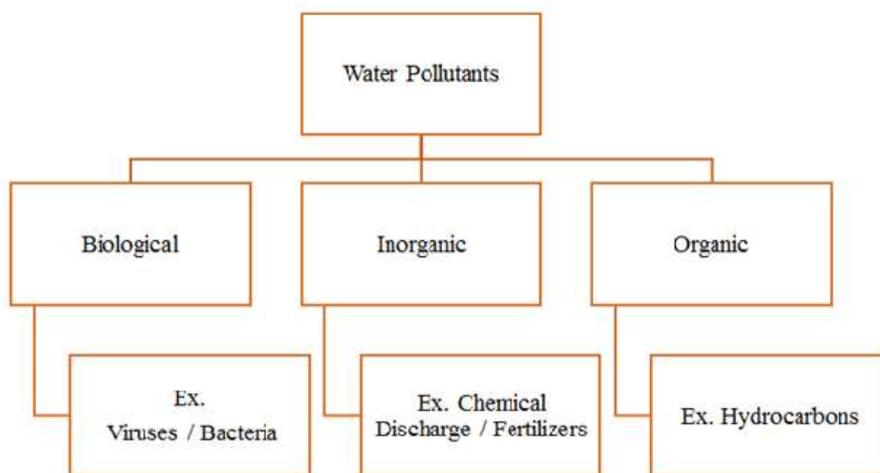
	Pollutant	Source
1	Micro-organisms	Domestic sewage:
1	Organic wastes	Domestic sewage, animal excreta and waste, decaying animals and plants, discharge from food processing factories
3	Plant nutrients	Chemical fertilizers
4	Toxic heavy metals	Industries and chemical factories
5	Sediments	Erosion of soil by agriculture and strip mining
6	Pesticides	Chemicals used for killing insects, fungi and weeds
7	Radioactive substances	Mining of uranium containing minerals
8	Heat	Water used for cooling in industries

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. “Pathogens like Hepatovirus A (HAV may be present in treated wastewater outflows and receiving water bodies but is largely removed during further treatment of drinking water” (Takuissu GR, Kenmoe S 2023) Human excreta contain bacteria such as Escherichia coli and Streptococcus faecalis which cause gastrointestinal diseases.

II) Organic Wastes: The other major pollutant is organic matter such as leaves, grass, trash etc. They pollute water as phytoplankton growth within water is also a consequence of runoff. Excessive cause of water pollution. These wastes are biodegradable. “Petroleum hydrocarbons, including fuels (gasoline, diesel fuel, jet fuels, and fuel oil) and lubricants (motor oil), and fuel combustion byproducts, from oil spills or storm water runoff” (Burton Jr GA, 2001)

The large population of bacteria decomposes organic matter present in water. They consume oxygen dissolved in water. The amount of oxygen that water can hold in the solution is limited. In cold water, dissolved oxygen (DO) can reach a concentration up to 10 ppm (parts per million), whereas oxygen in air is about 200,000 ppm. That is why even a moderate amount of organic matter when decomposes in water can deplete the water of its dissolved oxygen. The concentration of dissolved Oxygen in water is very important aquatic life. If the concentration of dissolved and oxygen of water is below 6 ppm, the growth of ash gets inhibited. Oxygen reaches water either through atmosphere or from the process of photosynthesis carried out by many However, during night; photosynthesis stops aquatic green plants during day light. in reduction of dissolved oxygen. But the plants continue to respire; resulting dissolved oxygen is also used by microorganisms to oxidize 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, in 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. Clean water would have BOD value of less than 5 ppm whereas highly polluted water could have a BOD value of 17 ppm or more.

(iii) Chemical Pollutants: As we know that 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 salts from many different sources including raw salt used to melt snow and ice in the colder climates (sodium and calcium chloride) are water soluble chemical pollutants

The organic chemicals are another group of substances that are found in polluted water. 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. Nowadays most of the detergents available are biodegradable. However, their use can create other problems. "Human-induced salinization is termed as secondary salinization, with the use of de-icing road salts as the most common form of runoff." (Evans DM, 2018)

The bacteria responsible for degrading biodegradable detergent feed on it and grow rapidly. While growing, they may use up all the oxygen dissolved in water. The lack of oxygen kills all other forms of aquatic life such as fish and plants. 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 obnoxious 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 result subsequent loss of biodiversity, is known as Eutrophication

International Standards for Drinking Water:

"As a result, there has been a quick expansion of industry, but regulations have not kept pace with this expansion, leading to issues of water contamination. In India, there is a significant amount of industrial wastewater that is dispersed into rivers and water bodies, leading to increased processes of eutrophication and altering ecosystem services" (Singh, Rupanjali, 2024)

The International Standards for drinking water are given below and they must be followed

Fluoride: For drinking purposes, waters 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 or 1 mg dm³.

The F. Ions make the enamel on teeth much harder by converting hydroxyapatite, [3(Ca, (PO), Ca(OH), the enamel on the surface of the teeth, into much harder fluorapatite, [3(Ca, (PO), CaF) 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).

CONCLUSION

When pollutants are discharged from a specific location such as a drain pipe carrying industrial effluents discharged directly into water body it represents point source pollution. The paper covers organic, inorganic, biological, radiological, heat, which degrades the quality of water so that it becomes unfit for use. Water Pollution occurs due to contamination of water by humans. The causes of water pollution include dumping of commercial and local waste in water bodies. The rapid pace of urbanization, industrialization, and agricultural intensification has led to severe water pollution.

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