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A Study on water and Physico Chemical Properties

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Abstract - Water's special properties make it essential to human existence in a broad variety of environments. Water is unlike any other material due to its exceptional anamolus properties. Water's polar properties make it a suitable solvent for almost any substance. Water is a vital natural resource for humans, plants, and animals living on the water world.

Keywords - Water, Physical properties, Chemical properties

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INTRODUCTION

A Look at the Consequences of Not Having Access to Clean Water Pollution might be caused by many different types of human activity, such as farming or the incorrect disposal of municipal waste water. Wastewater treatment plants and factories are examples of point sources since they produce waste only at certain locations. Point sources of pollution are simple to identify, meaning that they may be monitored and regulated, and in some cases even treated at the source. Agricultural practises are a major contributor to nonpoint source pollution, often known as long-distance pollution. Agricultural activities and weather extremes are two examples of transient drivers of nonpoint source pollution. Nonpoint sources contribute significantly to water pollution, and their contamination may start from large land regions and travel via the air, the ground, and the water to reach the ocean. Because of this, keeping tabs on and controlling emissions from diffuse and mobile sources is no easy task.

Various toxic substances, including human waste, suspended particles, rubbish, and chemicals from households, businesses, and industries, may be found in municipal wastewater. A major contributor to polluted water supplies in Canada. The cellular and organ levels, the organismal and community levels, and even the trophic level may all be affected by urban sewage. Nutrients like as nitrogen and phosphate, viruses such as Cryptosporidium, and endocrine disrupting compounds such as medicines and hormones from birth control pills are just some of the many contaminants that may be found in municipal waste water effluents.

PROPERTIES OF WATER

Physical properties of Water:

Water's unique physical properties set it apart from all other substances. It exists in solid, liquid, and gaseous forms at standard temperature and pressure. Water has a high heat of vaporisation and specific heat capacity. The strong hydrogen bonds between water molecules are responsible for these properties. Water's large specific heat capacity makes it a useful medium for distributing the sun's warmth around the globe. Both the temperature and the concentration of the dissolved substances in water affect its density. Water is unique among the elements because its density is less in its solid (ice) form than in its liquid condition. The density of liquid water is greatest at 4 degrees Celsius. In comparison to other liquids, water has a high surface tension due to the strong cohesion between its molecules. Surface tension is responsible for capillary action, which transports water from the soil to the plant's roots (3). One can float a solid piece of water on a pool of liquid water, but this is impossible with any other substance. Intermolecular hydrogen bonding between water molecules is responsible for a variety of the substance's distinctive features, including its melting point, boiling temperature, viscosity, and latent heat and cold capacity. Water has a high dielectric constant (4). It takes a lot of heat to evaporate water, which is another reason why water is so unique. Water can dissolve the vast majority of gases. This includes oxygen, carbon dioxide, nitrogen, hydrogen, sulphur monoxide, and ammonia.

Chemical properties of Water:

Water's myriad particular properties make it a great medium for all kinds of life. Water's molecular formula is H2O, and it takes the form of a spherical sphere. Hydrogen bonds make water a liquid even when the temperature is quite low. Polarity in water is caused by the positive and negative charges produced by the oxygen and hydrogen atoms, respectively (5). As its temperature increases, water dissociates into the gases hydrogen and oxygen.

Biological properties of Water:

To put it simply, water is the universal solvent since it can dissolve anything. Water is essential for the transport of biotic molecules, biominerals, hormones, and vitamins throughout the bodies of animals and plants. Water is an essential component because it is present in the cytoplasm of living cells, a liquid environment in which all metabolic processes required for life occur in solution. Water's polar nature makes its molecules attractive to and prone to adhering to other polar substances (7). This allows plants to carry water up their xylem against the force of gravity. For aquatic organisms, oxygen must be dissolved from the air.

MAJOR WATER COMPARTMENTS

Spaces designed specifically to store large quantities of water are termed "water chambers." Water is stored in a wide variety of subsurface and surface reservoirs across the globe. See below for a breakdown of the many types of water on Earth and where you may find them:

Oceans and seas:

The Ocean is the largest body of water on Earth, and the vast majority of it is salt water. The oceans cover 70% of Earth's surface and contain potentially 97% of the planet's total liquid water. The world's seas and oceans have a major role in determining the weather. By absorbing part of the sun's heat, the seas help to keep Earth at a more manageable temperature. It's possible that the oceans contain more than 4 billion tonnes of biomass (8).

Glaciers, Ice and Snow:

Glaciers seem like frozen rivers, but they flow a lot slower. When starting from a glacier, one must be patient. Very dense glacier ice takes on a bluish tint (9).

The ocean level, the weather, and the overall climate are all affected by the melting of glaciers. Glacial glacier contains the world's largest freshwater reservoir. Glaciers store over 75% of the world's freshwater. The amount of water that is frozen in glaciers and ice caps is negligible.

Groundwater:

Ground waters are underground aquifers that are connected to the surface water system. Hydrologic percolation is the process by which water moves downhill from a surface body into a deeper aquifer. Groundwater is the water found deep down that permeates all the spaces in the earth. Aquifers are underground water supplies made up of a layer of saturated, permeable rock or soil. Groundwater seepage naturally restocks aquifers, which may then be tapped by drilling wells (10). Aquifers have been used for thousands of years to provide drinking water for humans and livestock as well as for agricultural and industrial uses. Subsurface, in the zone of saturation, all of an aquifer's crevices and fissures are completely filled with water. A cone of depression is a valley in the water table (11). A larger area may be contaminated if contaminated water were to travel and spread inside the aquifer. Due to contamination of surface water in recharge zones and seepage of pollutants through wells, a number of aquifers have been polluted to the point that they are no longer useful.

Rivers and streams:

There isn't a single species on Earth that doesn't rely on rivers in some way. Streams and rivers are crucial in shaping the planet's topography. They help to absorb rainwater and provide shelter for a diverse range of plant and animal species. Rivers comprise around 0.2% of the world's total fresh water supply. Rivers and streams transport water, life, and essential gases over huge areas (12). Flowing rivers are harnessed to power hydroelectric facilities. At some point, the water reaches the ocean through rivers and streams.

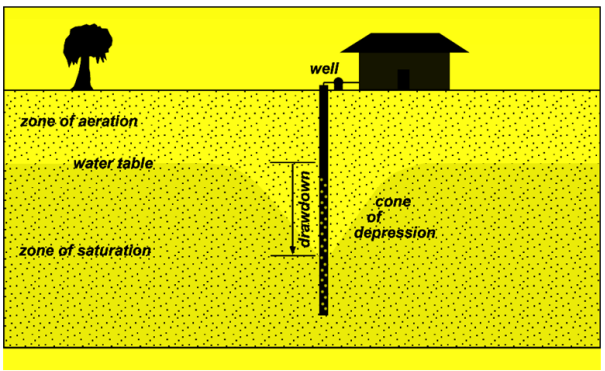

Figure 1: Source of Groundwater: The area in an aquifer, below the water table is zone of saturation

Springs:

Water seeps up from the earth in a predictable, quantifiable fashion every spring. For all their subtlety, springs are the groundwater phenomenon that stands out most to the casual observer. Springs are sometimes the sole place from which

rivers, streams, and even the ocean may get their fresh groundwater supply. The temperature of spring water is determined in part by the amount and rate of groundwater flow.

Ponds and Lakes:

Slang for a small body of fresh water; sometimes called a pond. The lack of a steady stream of water distinguishes it from a river or stream. Most ponds have a muddy bottom and support only limited plant life. Ponds may be either naturally occurring or manmade bodies of water (13). Water from the rain is collected in the pond. Although ponds are often shallower than lakes, the latter are typically considerably deeper.

Lakes are inland bodies of water that are either completely still or have a very sluggish current. In terms of location, frequency of formation, size, depth, and other characteristics, lakes may vary greatly. Most of the world's lakes were formed by glaciers. The water level in lakes may fluctuate dramatically. There are three primary sources of water for lakes: precipitation, river and stream flow, and underground aquifers (14).

Wetlands:

When water, either salty or fresh, covers the ground, we call it a wetland. These ecosystems are some of the most productive in the whole world. Water covers the ground in wetlands, which are dynamic, ever-changing bodies of water. Lakes may be natural or manmade, and they can be any of a variety of different types of water, including fresh, salt, brackish, saline, inland, coastal, transient, or permanent. Wetland ecosystems are among the most important ones for human survival and development. The planet's surrounding wetlands are crucial to its ecosystem's overall health. They protect our coastlines from flooding, improve water quality, and decrease pollution. Several different kinds of wetlands go by names like "swamp," "marsh," and "bog" (15). Many different kinds of animals depend critically on wetlands. The provision of an abundant food supply is the fundamental contribution of wetlands to society and the economy. Man-made wetland types include fish ponds, farm ponds, agricultural land, reservoirs, and canals.

Atmosphere:

A planet's atmosphere is the layer of gases that surrounds it. The amount of water stored in the Earth's atmosphere is negligible compared to the total amount of water on the globe. There is some water vapour in the atmosphere, and it is found in the troposphere (16). The amount of water contained in the atmosphere is quite little compared to the total amount of water on Earth.

SIGNIFICANCE OF WATER

A healthy environment relies on water since it is essential to life. To them, all of Earth's chemicals are only a click away. Every living creature is affected in some manner. Ample water sources are required for human habitation and commercial activities. Water is essential for the survival of all known forms of life on Earth. Water transports nutrients, oxygen, and waste products to and from every single one of your cells. The amount of water in the body has a role in regulating its temperature. Water also helps in the prevention of disease. Access to clean, uncontaminated water is essential to good health. Water availability is dependent on its quality. Water is essential for life, hygiene, the economy, the environment, recreation, and entertainment. Water is essential in the production of nuclear energy, chemicals, ice, paper, and steel. Water is essential for a wide variety of body functions, including breathing, sweating, growing, digesting, eliminating waste, reproducing, and many more. Water is crucial to the proper functioning of society and the economy. It's crucial to differentiate between consumptive and non-consumptive uses of water while having a conversation about it. Allotting water for consumption uses depletes the source at the moment of appropriation, making that water unavailable for subsequent applications; allocating water for non-consumptive uses does not have this impact and leaves the source intact for future reuse (17-20).

HYDROLOGICAL CYCLE

The hydrological cycle comprises the atmosphere, biosphere, lithosphere, and hydrosphere in its storage and transport of water. Water may be found in a wide variety of storage systems, including oceans, lakes, ponds, wetlands, soils, rivers, water vapour in the atmosphere, glaciers, and groundwater. The hydrological cycle includes the processes of evaporation, condensation, precipitation, deposit, runoff, infiltration, sublimation, transpiration, melting, and groundwater movement. Some of the water from the oceans evaporated and returned to the sea as rain or snow, while the remainder was transported by the wind to areas over land masses where precipitation also occurs as a result of weather patterns (21). The hydrosphere receives storm water via surface runoff and groundwater circulation. To facilitate the transfer of heat between the atmosphere and the surface of the planet, hydrology relies on the water cycle. All of the water storage facilities are constantly recycling their water (Fig 2).

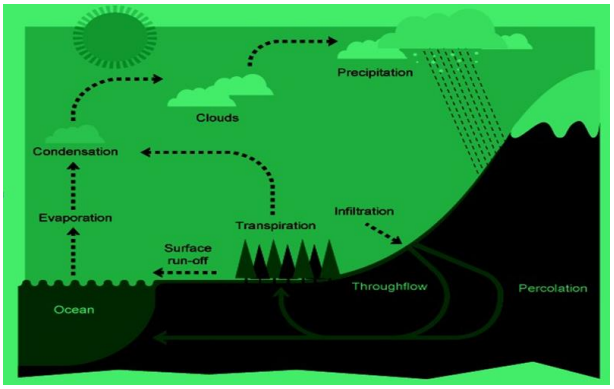

Figure 2: The hydrological water cycle

GROUNDWATER QUALITY

Protecting our ability to get drinkable water from the earth is essential. The chemical and biological composition of ground water is still appropriate for most uses despite being altered by human activity. Groundwater takes acquire local features as it flows from its original source, such as a river or spring, to its final destination. Sodium, potassium, magnesium, calcium, bicarbonate, chloride, and sulphate are some of the most often found dissolved minerals in groundwater. Ground water's adaptability to different purposes depends on a number of factors, such as the kinds and quantities of dissolved minerals and organic compounds it contains. There might be somewhat safe components, some potentially harmful ones, and a few very toxic ones. More people living in cities means more people tossing their rubbish. Groundwater quality is significantly affected by intensive farming operations. Urbanization and industrialisation have a major effect on groundwater quality. In many parts of the world, the weather has a significant impact on the quality of the underground water. There is a risk of illness from drinking groundwater if there is an excessive amount of dissolved minerals in the water. When groundwater contains dissolved minerals, it takes on a salty flavour. It's possible that organisms can't handle a lot of dissolved minerals. Hard water is groundwater that has high quantities of calcium and magnesium due to its natural occurrence. There is a direct correlation between water hardness and the presence of calcium carbonate. Because of a rise in population, an increase in industrial production, and an increase in technological advancements, the quality of the world's freshwater resources has been deteriorating in recent years.

GROUNDWATER CONTAMINATION

Some human-made wastes may pollute groundwater, rendering it unsafe for human use. Drinking contaminated groundwater might pose serious health risks. Pollutants, both airborne and buried, have long been assumed to exist. Pollutants are distributed over a wider area because of groundwater movement and aquifer dispersion. Surface water that percolates into the ground picks up minerals, salts, and organic compounds along the way. Subsequently, dissolved solids become increasingly concentrated in the water as it sinks. However, in certain areas the mineral content of the groundwater is so high that it must be filtered before it can be used for human consumption or in irrigation systems. Polluted water from the surface of the Earth may contaminate underground water supplies if enough of it penetrates into the earth and reaches an aquifer. There are both point and nonpoint sources contributing to groundwater contamination. Point sources include agriculture (pesticides and fertilisers) and urban waste (septic systems and landfills), whereas non-point sources include water and air.

SOURCES OF WATER POLLUTION

There is probably a lot of water hiding in the soil and rock deep below the surface. Ground water pollution may be caused by both natural and human-caused causes. The quality of groundwater is deteriorating for a variety of reasons.

Industrial Effluents:

The chemical, metal, steel, and textile industries each release their own distinct effluents. Inorganic chemicals are also present in industrial effluent with organic substances. Organic industrial effluents come from many different industries, including the pharmaceutical, organic dye, cosmetics, glue, soaps, synthetic detergents, herbicide, pesticide, textile, paper, oil, metal, and fermentation ones. Primarily, inorganic industrial effluents come from iron mine, electroplating plants, coal, and steel manufacture. Untreated industrial effluents are mostly to blame for the serious pollution problem harming ground water sources, human life, and the Environment.

Agriculture Discharges:

This is because agricultural discharge is a kind of non-point source pollution that affects a wide area, making it more difficult to manage and clean up. Agricultural runoff has a negative impact on both groundwater and surface water quality. Fertilizers, herbicides, insecticides, agricultural waste, plant and animal debris, inorganic material, and manure slurry have all been blamed for contributing to high levels of chemical pollution in both surface and groundwater. Contamination of fertilisers is difficult to restrict and manage. Nitrogen and phosphorus are found in high amounts, whereas potassium is found in lesser concentrations.

Nitrates in nitrogen fertilisers are a major source of groundwater contamination since they are soluble in water. Nutrient-rich rainwater eventually ends up in bodies of water including rivers, streams, lakes, and oceans.

Sewage and Domestic wastes:

Human waste disposal also has a significant role in the pollution of water sources. Wastewater from cities, towns, and businesses is commonly referred to as "sewage" since it contains trash. Sewage is often comprised of used water from homes and businesses. Human waste, soap, detergent, glass, metal, yard trash, and sewage sludge are all components of sewage. Domestic sewage refers to wastewater collected from houses, whereas industrial sewage refers to wastewater collected from businesses. In addition to nitrates, phosphates, bacteria, viruses, protozoa, oils, greases, mercury, cadmium, lead, chromium, copper, and other metals, untreated sewage may also include a broad range of other potentially dangerous compounds. Human health is at risk when raw sewage is released into bodies of water including lakes, rivers, and oceans.

Fertilizers:

If fertiliser is applied correctly, there shouldn't be any problems, but if too much is washed off at once, it might pollute storm drains and then lakes and streams. To put it simply, fertilisers are anything that gives plants more of the nutrients they need to grow and flourish. Fertilizers, whether they are manufactured from synthetic chemicals or from natural materials, pose a threat. Fertilizers with a lot of nitrogen and phosphorus are bad for the environment. In high enough amounts, the nitrogen fertilisers that have leached into the groundwater may be harmful to human health. Fertilizer pollution is blamed for the most drastic change in algal populations (Algal blooms). Excessive amounts of fertiliser runoff into waterways lead to algae blooms.

Runoff from Urban Areas:

Runoff from impermeable surfaces is a major contributor to water pollution in urban areas. In urban environments, water is lost to storm drains because impermeable barriers are not used. Pollutants such as dead plants, fertilisers, pesticides, and unused cleaning products all contribute to urban runoff. As it flows through a city, urban runoff gathers up contaminants that lower water quality. There is a significant issue with nonpoint-source pollution, which includes urban runoff.

Organic Chemicals:

Many different types of chemical companies depend on organic chemicals. Many contaminants in drinking water offer serious health risks even at low concentrations.

Multiple synthetic organic compounds are released into the environment as a result of human activity. Harmful organic chemicals in water may come from a variety of sources, some of which you may be familiar with, such as synthetic pesticides, food additives, synthetic detergents, pharmaceuticals, insecticides, synthetic fibres, plastics, solvents, and volatile organic compounds.

Inorganic Pollutants:

Many different types of inorganic pollutants, such as mineral acids, trace elements, inorganic salts, metals, metal complexes, cyanides, and sulphates, have been found in groundwater aquifers as a result of human activities. To put it simply, inorganic contaminants don't biodegrade and hence persist for lengthy periods of time. Toxic inorganic materials pose a serious threat to aquatic ecosystems and the life forms that inhabit them. Generally speaking, inorganic compounds present in nature are the main culprits in contaminating groundwater.

Thermal Pollutants:

Thermal pollution occurs when human activity causes fast temperature changes in water bodies including lakes, rivers, and oceans. Factories and other industrial facilities are the primary contributors of thermal pollution. Hot water released from institutions like nuclear power plants, thermal power plants, and factories all contribute to thermal pollution. Changing oxygen levels due to heat pollution might have disastrous effects on local species and humans.

Dissolved oxygen levels in water decrease with increasing temperature, Oxygen is not preserved as well in warm water as it is in cold water. Because temperature change affects metabolic rate and other biological processes, it has a bigger effect on aquatic creatures. Another way of putting it is that thermal pollution disrupts and alters the delicate species balance in food webs because of the increase in metabolic rates and enzyme activity in animals exposed to high temperatures.

Radioactive Pollutants:

Radioactive waste has been produced by humans in a wide variety of contexts, including the mining and processing of radioactive materials, the development and use of nuclear weapons, the running of nuclear power plants, the handling of nuclear fuel, and the purification of radioactive isotopes. Anything contaminated by radioactive nuclides is considered "radioactive rubbish" by us. An unstable isotope of an element, or radionuclide, is one that, when decayed, emits radiation.

Human activity is the primary cause of radioactive material pollution. Radioactive materials enter the food chain and are consumed by humans and other animals. Radiation that has found its way into the water supply is taken up by aquatic creatures. The human body absorbs these radioactive substances through food chains

tainted with sewage. Everyone and everything is affected by radiation contamination.

Toxic Metals:

Toxic metals include, but are not limited to: aluminium, arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. Heart disease, birth defects, neurological and behavioural issues, diabetes, hearing loss, hematologic and immune system diseases, and cancer are only some of the illnesses that have been related to these metals. Human activities are the primary cause of toxic metals entering water systems. Human health-threatening metals may be found in all three major food groups: air, water, and food. Toxic metals in water sources may be introduced either naturally or artificially (20). Water naturally dissolves metals when it comes into contact with rock or soil. Metal contamination is also caused through landfill leaks and pipe corrosion (20).

CONCLUSION

Water plays a fundamental and important role in the normal functioning of every cell and organ system in the human body, human beings cannot live much longer if not for it. The human body is governed by water, which is responsible for all of its functions. Safe and adequate drinking water supply is a critical problem in developing nations, both in rural and urban regions. Groundwater is a dependable and limited source of water in rural regions. Surface water and groundwater are the most prevalent sources of water for agriculture and other uses. They are interwoven, groundwater and surface water. Surface water is found on the earth's surface in the form of oceans, rivers, lakes, ponds, and streams, whereas groundwater is found under the earth's surface in permeable soils and rocks.

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