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PHYSICAL CHEMICAL CHARACTERIZATION OF WATER AND THEIR EFFECT ON ENVIRONMENT

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Abstract

The purity of water that comes from nature can never be guaranteed. Precipitation is the primary means through which the majority of the world's water supplies are replenished. The water picks up a broad range of dissolved or suspended contaminants as it travels over (in the case of runoff) and through the ground (in the case of infiltration) during precipitation, which drastically reduces the water's utility. Because of its distinctive physical, chemical, and biological qualities, water is an indispensable component of all living things, including plants and animals. These qualities also have a direct impact on the kinds of aquatic biota that can be found and where they are distributed. The properties of the water are taken into consideration while formulating all of the regulations and guidelines that govern the discharge of wastes into the body of water. In addition to this, the formulation of policy measures and the enhancement of water quality are both revolving around these qualities.

Keywords: *Physical ,chemical, water, environment*

Introduction

Water is absolutely necessary for living things. It is necessary for the existence of the biosphere that covers the surface of the world, and without it, it could never be made to function. The ability of water to transition between its solid (snow, hail, sleet, and ice), liquid (rain, water droplets), and gaseous (water vapors) phases within the restricted air temperature and pressure

ranges found at the Earth's surface makes it unique among chemical components. This need can only be met by water. The dynamics of the atmosphere's moisture content are controlled by water in its gaseous state. A water vapor molecule in the atmosphere only briefly exists in a gaseous state before returning to its liquid state.on average before it will either condense into liquid droplets or freeze into ice crystals, which will then create clouds or fog. In a similar fashion, clouds and fog have a short lifespan and typically lose a significant portion of their moisture through evaporation or precipitation within a few hours of their development. This precipitation is the primary source of water for the vast majority of the world's freshwater ecosystems. As a result, the hydrological cycle, which is comprised of the continual exchange of moisture between the ground and the atmosphere (Fig. 1), is in constant motion.

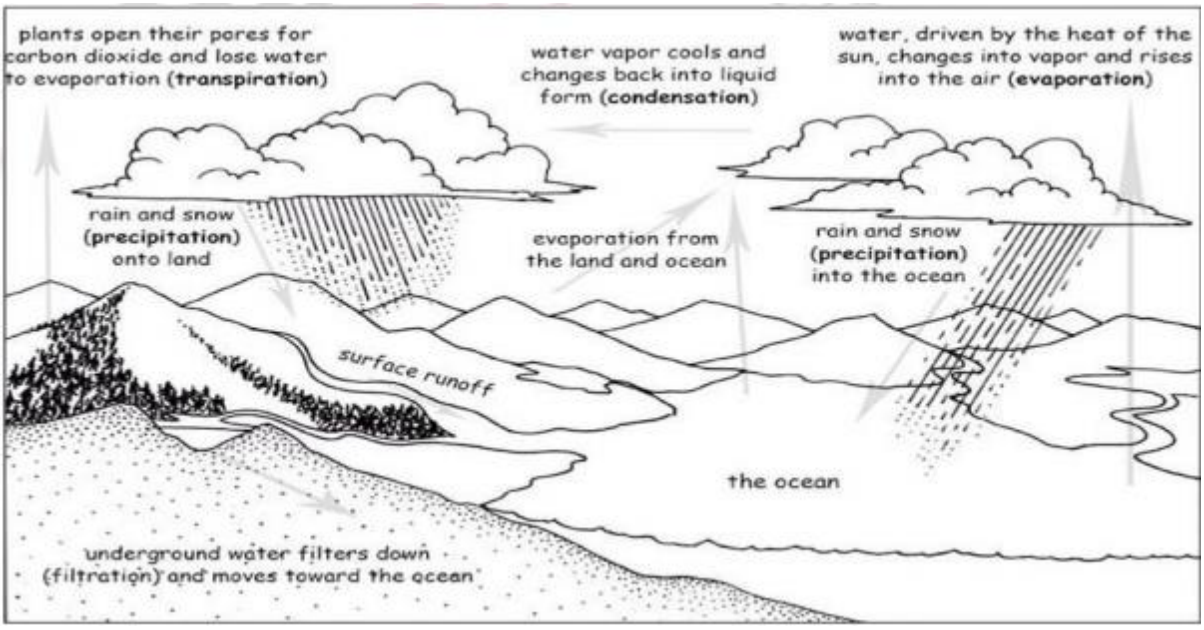

Fig 1: The Hydrological Cycle

Evaporation, precipitation, and runoff are the three primary mechanisms responsible for the circulation of replenishable fresh water. The hydrologic cycle determines how and where this water may be used. The forecasting of this distribution is made much more difficult by the conditions of the climate and the climatic changes that have occurred. However, because to changes in climate, which people are responsible for the great majority of, the ratio of salty to fresh water is always fluctuating. This is a problem. The ratio of fresh water to salt water is

always shifting, despite the fact that the overall volume of fresh water and salt water on Earth has remained relatively stable throughout the course of billions of years. Rainfall patterns and climate are both influenced by the hydrological cycle because of its role in the redistribution of water and the maintenance of stable temperatures. The cycle is extremely important in the process of establishing a comfortable atmosphere and maintaining its consistency. Due to the high concentration of salt in ocean water, it cannot be used for any purpose, including eating by humans. On the other hand, it covers more than 70 percent of the surface of the Earth. Only 3% of the remaining water is fresh water, which is defined as water that is acceptable for human consumption. There are several possible sources, including rivers, lakes, streams, reservoirs, and groundwater. The remaining three percent is frozen solid in glaciers and the ice caps of the poles. Every living thing need consistent access to a source of clean water in order to maintain their health and continue to exist. This is of the utmost significance. This inextricable connection sheds attention on the vital need of upholding high standards for the quality of water all across the world. The features of water quality that are seen in aquatic environments are the result of the intricate interactions between the water's physical, chemical, and biological components. The geological ages of rivers, lakes, and estuaries, as well as other bodies of water, are in a constant state of flux, as are the geochemical properties of these habitats. This classification includes water bodies such as rivers, lakes, and estuaries among its members. The pollution that is caused by human activities upsets the delicate equilibrium of the aquatic system, which is reflected in the death of fish as well as a terrible odor and taste in the water. The physicochemical qualities of the water have a direct impact on the many kinds of aquatic biota that live in a body of water as well as the places in which such aquatic biota may be found.

Properties of water

“The structure of a water molecule, which is denoted by the chemical formula H2O, is comprised of one oxygen and two hydrogen atoms. The oxygen atom in each water molecule is responsible for attracting more electrons than are absolutely required for stability. Because the oxygen end "acts" negatively and the hydrogen end "acts" positively, a single polar covalent

bond is formed between the hydrogen and oxygen atoms in Figure 2a. On the other hand, water does not have any net electrical charge because the electrons and protons that make up its atoms cancel each other out".

The fundamental structure of a water molecule is well understood, and its dimensions are as follows:

Length of the O-H bond, in picometers: 95,7 The H-O-H angle is equal to 104.5 degrees. Energy of the oxygen-hydrogen bond is 450 kilojoules per mole. Moment of dipole = 1.83 debyes.

Because of the attractions that exist between polar molecules, water possesses a wide array of peculiar characteristics. A hydrogen bond is formed when the areas of one molecule that are slightly negatively charged are attracted to the sections of neighboring molecules that are slightly positively charged. Each molecule of water has the potential to create hydrogen bonds with up to four of its surrounding molecules (Fig. 2b). "The dipole moment, the dielectric constant, the heat capacity, and the ability of water to both donate and take protons are considered to be its most important features. This endows water with the capabilities of forming hydrogen bonds with itself, forming hydrogen bonds with both proton donors and proton acceptors, dissociating, coordinating with ions and other dipoles, as well as storing and transmitting heat energy".

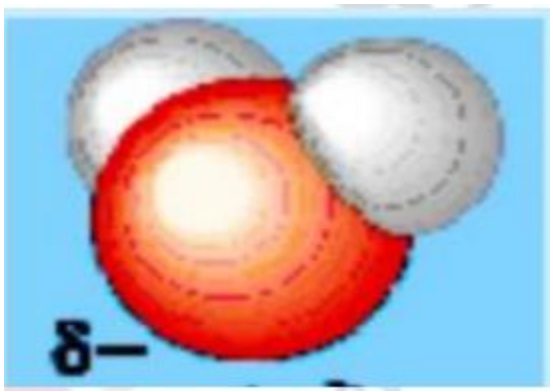

Fig 2a A single water molecule

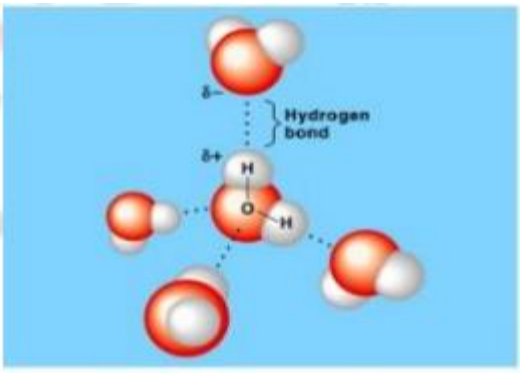

Fig 3. The formation of hydrogen bonds within water molecules.

Water Quality

It is very necessary for all living things to have access to freshwater that is free of contaminants, safe to drink, and in adequate supply if ecosystems, societies, and economies are to function normally. The physical, chemical, and biological aspects of water that are most important in determining whether or not it is suitable for human consumption or for supporting life are referred to together as "water quality." The minimum acceptable quality of water shifts depending on what it will be used for. Water's properties may be broken down into three distinct groups according to its overarching qualities:

1. Temperature, color, odor, turbidity, and solids content are all part of the physical characteristics.
2. Chemical Properties, including pH, conductivity, salinity, hardness, BOD, and
3. “Biological Characteristics, which include counts of individual organisms as well as groupings of organisms”.

Physical Characteristics of Water

The senses of touch, sight, smell, and taste are all responsible for determining the water's physical characteristics. These characteristics include the water's temperature, color, flavor, and odor. If you touch the water, you may be able to detect its temperature, color, floating debris, turbidity, and suspended particles. If you sniff the water, you may be able to tell its flavor and odor.

The term "temperature" refers to the average kinetic energy of water molecules. Temperature is measured in degrees Celsius. On a linear or logarithmic scale, temperature can be expressed in either Celsius or Fahrenheit, depending on the scale. The temperature of the water is an essential component to consider when evaluating its overall quality. It is the factor that decides whether or not a certain body of water is conducive to the development of a broad diversity of aquatic species. Temperatures throughout the year range from 10 to 21 degrees Celsius, with an annual average of 16 degrees. This variance is quite region-specific, as may be shown here. The quantity of dissolved oxygen in water is one of the chemical indicators of the quality of the water, and temperature is one of the factors that influences these indicators. When compared to cold water, the oxygen solubility of warm water is “significantly lower. Temperature is another factor that may affect aquatic life. Species like trout and salmon require lower temperatures in order to live and reproduce successfully, whereas species like bass and sunfish thrive best in higher water temps. There is a strong correlation between the average temperature of the air each day and the average temperature of the water found in lakes, rivers, and seas. It modifies the amount of dissolved oxygen that is available in the water, the rate at which algae and other aquatic plants produce oxygen through photosynthesis, the metabolic rates of creatures, the susceptibility of organisms to toxic wastes, parasites, and diseases, as well as the reproductive, migratory, and hibernatory patterns of aquatic species. If you are worried about the way the water looks, the color of the water should be your first consideration. Even if the water is completely safe for ingestion, the appearance of colored water may create the false impression that it is not intended for human consumption. The color of the water can be used to infer the presence of organic substances, such as algae or humic chemicals, in the environment. In recent years, the use of color has increased in frequency as a quantitative evaluation method for determining whether or not water contains potentially harmful or lethal chemical compounds. Due to the fact that the overwhelming majority of customers and clients prefer colorless water, color is a highly crucial factor in the water sector. The use of color determination allows for an accurate estimation of the costs associated with the discoloration of water. Utilizing coagulation, settling, and filtering are three methods that may be utilized to lighten or

completely eliminate coloring from water. The olfactory and gustatory sensation are as follows: The utilization of the human senses of taste and smell is the method that is used to evaluate water quality. The flavor of caffeine is responsible for the bitter aftertaste, the taste of hydrochloric acid is responsible for the sour aftertaste, sodium chloride is responsible for the salty flavor, and sucrose is responsible for the sweet aftertaste. The sour and salty sensations are produced by very straightforward chemical compounds. Sweet and bitter tastes, on the other hand, are produced by more complicated chemical compounds. An unpleasant odor may be produced as a result of the chemical treatment of wastewater as well as the gas generated by the breakdown of organic substances. Utilizing specialized instruments such as the Portable H2S meter, which is designed for determining the amount of hydrogen sulfide present, it is possible to determine the potency of an odor. Some of the compounds that are mentioned below are among those that can be discovered in Table 1".

Table 1: Odor producing compounds.

Compound	Chemical Formula	Odor Quality
Amines	CH3NH2, (CH3) 3H	Fishy
Ammonia	NH3	Ammoniacal
Diamines	NH2(CH2)4NH2, (CH2)5NH2H25	Rotten eggs
Mercaptans (E. g, methy1 and ethy1)	CH3SH, CH3(CH2) SH	Decayed cabbage
Organic sulfides		Rotten cabbage
Skatole		Fecal matter

Turbidity: The amount of light that may pass through water is measured by the turbidity of the water, which is made up of particles that are suspended and those that are colloidal. It is essential for both the health of the body and the appearance of the person. Human activity, decomposing plant matter, algae blooms, suspended sediments, and plant nutrients are all

factors that can change the transparency of natural bodies of water. The total suspended solids (TSS) concentration may be quickly and cheaply estimated using the turbidity reading. It has very little meaning outside of waterways that are quite clear, but it is helpful in identifying the quality of drinking water throughout the treatment process.

The phrase "total dissolved solids" (TDS) is a word that is used in the scientific community to refer to the sum of all of the solids that are dissolved in water. This includes both the inorganic salts and the trace quantities of organic molecules. “Cations include calcium, magnesium, sodium, and potassium; anions include carbonate, hydrogen carbonate, chloride, sulfate, and nitrate; cations include calcium, magnesium, sodium, and potassium; anions often occur in the most concentrated forms”. Nitrate has also been discovered on rare occasions. This is the total solids content of the water after the water has been evaporated, and after the residue has been dried to a constant weight at temperatures ranging from 103°C to 105°C. There are three unique sorts of solids, each of which may be classified according to whether they settle, remain suspended, or are filtered away. Certain components, such as silt and other heavy organic particles, have the ability to sink to the bottom of a body of water when subjected to the force of gravity. Particle size and the proportion of suspended solids that are retained on typical glass-fiber filters are two characteristics that are used to discriminate between particles that can be filtered and other types of solids in suspension. The importance of solids that are buoyant in water can be attributed to a variety of different factors. In the event that the solids turn out to be algal blooms, the presence of these blooms would cause eutrophication in the body of water in which they ended up. They will obstruct the sunlight that makes its way to the surface of the water, which will make it difficult for aquatic flora to survive. They have the potential to build up on the bottoms of rivers and lakes, leading to unpleasant conditions and maybe indicating that there are problems with the discharge of sewage effluent in the surrounding area.

Chemical Characteristics of Water:

The capacity of chemical constituents to create severe health effects over prolonged exposure time is the primary factor that gives rise to the concerns regarding human health that are linked

with chemical constituents of drinking water. There are very few chemical components in water that might cause health issues even after a single encounter. This is because water is extremely diluted. As a consequence of the presence of chemicals in drinking water, there is a significant risk of a variety of severe adverse health effects occurring. The following is a discussion of the water's primary chemical characteristics:

pH: "The pH of the water is a measurement that indicates how acidic or basic (alkaline) it is. It is expressed as the inverse of the logarithm of the concentration of hydrogen ions. The pH scale is logarithmic and spans from 0 (extremely acidic) to 14 (very alkaline), with 0 being the most acidic and 14 being the most alkaline. When going from one whole number to the next (for example, going from one to two), the concentration of hydrogen ions drops by a factor of 10, and the water becomes less acidic. The natural pH of freshwater may range anywhere from 4.5 for acidic, peaty highland waters to over 10.0 for waters with significant photosynthetic activity from algae". This wide range is due to the fact that natural pH is determined by a variety of factors. Nevertheless, the range of 6.5 to 8.0 is the one that is most usually seen. It is generally agreed that a pH ranging from 5.0 to 9.0 is suitable for fisheries, however a value between 6.5 and 8.5 is optimal. Damage to the gills, exoskeleton, and fins can occur when the pH level is too high or too low (between 2 and 13), respectively. Alterations in pH have the potential to transform the quantities of other compounds in water into a form that is more hazardous to human health. The toxicity of ammonia, the effectiveness of chlorine as a disinfectant, and the metals' solubility may all be affected by variations in pH value.

Turbidity of Water: The quantity of suspended matter is represented as milligrams per liter (mg/l) or parts per million (ppm) when measuring turbidity using optical observations as the method of measurement. Turbidity is expressed as "parts per million" (ppm), which is a unit of measurement. When talking about water, the units of parts per million and milligrams per liter are nearly identical with one another. The volume of fuller's earth that can be replaced by

dissolving one milligram of finely split silica in one liter of distilled water is comparable to one metric liter.

Turbidity Meters: Utilizing a turbidity rod makes it possible to obtain field turbidity measurements in a timely manner that is also accurate. It is a rod made of aluminum that has markings on it that enable it to produce readings for turbidity in milligrams per milliliter (mg/l) of silica units. With the help of a piece of machinery known as a turbidity meter, it is possible to receive an accurate reading of the turbidity while working in the laboratory. The amount of disturbance that a certain sample of water generates to the passage of light is what a turbidity meter measures when it analyzes the water's clarity. Jackson, holding a light to his head Turbidimeter: Therefore, waters that have a lower level of turbidity will have a higher water column, and the opposite will be true. When light is allowed to move through water for a longer period of time, the clarity of the water improves. This particular variety of turbidimeter is unable to measure turbidites with a JTU value of less than 25. This instrument is not capable of determining the turbidity of sources of treated water; instead, a Baylis turbidity meter or a contemporary nephelometer would be more suitable. The usage of this instrument is restricted to just with forms of renewable energy. Using Baylis Turbidimeters In one glass tube is a sample of water whose turbidity will be measured, and in the other glass tube is a solution of reference water whose turbidity has already been measured. The turbidity of the sample water will be compared to that of the reference water. When observed from above, the electric bulb seems to be lit, and a bluish glow may be seen emanating from both of the tubes at the same time. The modern nephelometer has the capability of detecting turbidity levels that are lower than one unit. A unit for measuring turbidity that is used in nephelometry and is abbreviated as NTU. "FTU" is an abbreviation that stands for "Formacin Turbidity Units." The ratio turbidimeter indicates that the water in the river has reached its highest possible level of turbidity.

Conclusion

The purity of water that comes from nature can never be guaranteed. Precipitation is the primary means through which the majority of the world's water supplies are replenished. The water picks up a broad range of dissolved or suspended contaminants as it travels over (in the case of runoff) and through the ground (in the case of infiltration) during precipitation, which drastically reduces the water's utility. Because of its distinctive physical, chemical, and biological qualities, water is an indispensable component of all living things, including plants and animals. These qualities also have a direct impact on the kinds of aquatic biota that can be found and where they are distributed. The properties of the water are taken into consideration while formulating all of the regulations and guidelines that govern the discharge of wastes into the body of water. In addition to this, the formulation of policy measures and the enhancement of water quality are both revolving around these qualities.

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