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Physico-Chemical Parameter: An Indicator of Water Pollution

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Abstract

Fresh water is very important for human life. Water play a crucial role in human being, agricultural, fisheries, domestic and industries. Due to incresed human activity, industrial activities and use of fertilizers, the fresh water is convert to pollutent water. This is the most serious problum in present condition. The inspection of the fresh water status is important to preservation and ideal the natural eco-system. It is important that the quality of fresh must be determined at consitent time intervel, as due to utilize of pollutent drinking water, human life suffering from varied of pollutent water desease.

The availability of good fresh water is an necessary feature for preventing diseases and better quality of human life. It is mandatory to detailed study about different physico-chemical parameters like temperature, pH, electrical conductivity, alkalinity, DO, BOD, carbonate, bicarbonate, COD, sulfate, nitrogen, calcium, magnesium, sodium, potassium, chloride, TDS, turbidity, transparency, total hardness, fluoride used for chacking of water quality. The achieve parameter results are equate with standerd parameters of fresh water given by WHO, INDIAN STANDERD DRINKING WATER SPECIFICATION IS:10500-2012. The study of physico- chemical parameters of fresh water sample suggested that the estimation of drinking water quality. as well as water quality treatment practices the water resources.

Keywords: Physico-chemical parameters, Water quality, Pollutent water, Fresh water, Indian standerd drinking water

Introduction

Pollution is the introduction of Hazardous Substance into the Natural World. These Hazardous Substances are called Pollutants. The word pollution comes from the latin word “Polluere” that means contamination. This term given by Layman. The pollution is something that contaminates the environment. The presence of harmful Substance / Hazardous Substance in the environment (Air,Water,Land) that can have an adverse effect on living organism and Environment is convert in pollutent Environment.

Pollution is also consequential after effect of activities which upsets the biodiversity of the Ecosystem.

Water pollution - Water is basic essential component of living organism. All living organism on this planet need water for their survival and development. Our planet is known as the “Blue Planet” because 71% of the surface is covered with water but due to increased population density, rapid urbanization, rapid industrialization, modern civilization, use of fertilizers in the agriculture and human activities it is high level polluted with different hazardous substance. The planet has fulfill of water but only 0.3% to 0.5% water is useful for human being.

India is struggling a dangerous problem of natural resource scarcity, especially that of water in aspect of population growth and successful development. Mostly all fresh water sources all over the world are becomes polluted, thus reduced the potability of water. The best sources of fresh water are from lakes and rivers.

Basavaraja Simpi et al.(2011) studies that and explain it is necessary that the quality of drinking water, human population suffering from pollutant water diseases. It is difficult to understand the biological phenomenon fully because the chemistry of water revels much about the metabolism of the ecosystem and explain the general hydro-biological relationship.

Adeyeye et al. (1994) explained that the availability of superior quality water is necessary feature for preventing diseases and improving of life quality. Natural water contains different types of impurities are introduced in to aquatic system by different ways such as weathering of rocks and leaching of soils, dissolution of aerosol particles from the atmosphere and from several human activities, including mining, processing and the use of metal based materials.

Adefemi et al. (2010) suggested that the increased use of metal based fertilizer in agricultural revolution of the government could result in continued rise in concentration of metallic pollutions in fresh water sources due to the water run-off. Also faucal pollution of drinking water causes water born disease which has led to the death of millions of peoples.

Misra et al. (1991) studied that Peoples on planet are under dangerous threat due to undesired changes in the physical, chemical and biological characteristics of air, water and soil. These are related to animals and plants and finally effect on it.

Ellis (1989) reported that having mainly excessive amounts of heavy metals such as Pb, Cr and Fe, as well as heavy metals from industrial processes are of special concern because they produce water or chronic poisoning in aquatic animals. Kulkarni (1997)

studied and suggested that the high levels pollutants mainly organic matter in river water cause an increase in biological oxygen demand. Hari (1994) suggested that the chemical oxygen demand, total dissolved solids, total suspended solids and fecal coli from. They make water unsuitable for drinking, irrigation or any other use.

S. Sarda et al. (2015) suggested that the use of fertilizers and pesticides added to the damage done to the soil that eventually disrupted the natural water ecosystem. These ecological changes will, directly and indirectly, affect the population health. Water quality determination nowadays is very important in maintaining the function of the natural ecosystem and the quality of water needed for drinking, industrial and irrigation purposes. Q. U. Maurya et al. (2015) studied on lake water and suggested that Temperature, Turbidity, pH, dissolve oxygen and the total amount of solids suspended in water are some important factors that give a big impact on living organisms development in water bodies.

R. Nayar (2020) suggested these parameters can be affected by human activities such as agriculture, deforestation and use for cooling. The release of high domestic or industrial waste into organic matter into the water results in a significant decline in oxygen concentration and an increase in ammonia and nitrogen concentration, downstream of the effluent input.

Physico-Chemical Parameters

Many research work done on water quality judgment for different water sources around the world that have been publicized at the research level is assess in this study. Some physical, chemical and biological parameters related to the quality water determination are complicated. Physico-Chemical parameters is very necessary and principal to test the water before it is used for domestic, agricultural, drinking and industrial purpose. Water need to be tested with many different physico-chemical parameters.

The selection of Physico-Chemical Parameters for water testing totally depends on for what motive we going to use that water and what scope we required its purity and quality. Water does contentment different type of floating, dissolved oxygen, suspended and micro-biological as well as bacteriological contamination. Some test should be execute testing of its physical aspect such as color, temperature, smell, turbidity, pH, TDS etc. while chemical test need to perform for its BOD, COD, DO, hardness, alkalinity etc. For getting more quality and purity in water, it need to be tested for its trace metal, heavy metals and organic test.

It is obvious that drinking water should pass these entire tests and it should content required amount of mineral level. Only in the developed countries all these criteria's are strictly monitored. Due to very low concentration of heavy metal and organic pesticide impurities present in water it need highly sophisticated analytical instruments and well trained manpower. Following different physic-chemical parameters are tested regularly for monitoring quality of water.

Types of water quality parameters

Table 1: Physico-Chemical Parameter of water quality.

Physical parameter	Chemical parameter	Biological parameters
Temperature	pH	Algae
Colour	Alkalinity	Bacteria
Taste and odor	Chloride	Protozoa
Solids	Chlorine residual	viruses
Turbidity	Acidity	
Electrical conductivity	Nitrogen	
	Fluoride	
	Sulfate	
	Copper and zinc	
	Dissolved oxygen (DO)	
	Biochemical Oxygen Demand (BOD)	
	Chemical Oxygen Demand (COD)	
	Toxic inorganic substances	
	Toxic organic substances	
	Radioactive substances	
	Iron and manganese	

Temperature

In an established system the water temperature controls the rate of all chemical reactions, and affects fish growth, reproduction and immunity. Drastic temperature changes can be fatal to fish. Panday et al (2006) reported that temperature was basically important for its effects on the chemistry and biological activities of organisms in water. Temperature was known to influence in the determination of other factors like pH, conductivity, dissolved gases and various forms of alkalinity. Some of the factors that affect Palar river water temperature are heat exchange on the earth surface under controlled radiation in and out, ground water movement and chemical and thermonuclear processes occurring in aquifers.

pH

Gupta et al. (2009) suggested that the pH is most important in determining the corrosive nature of water. Lower the pH value higher is the corrosive nature of water. pH was positively correlated with electrical conductance and total alkalinity. Karanth et al. (1987) studies the reduced rate of photosynthetic activity the assimilation of carbon dioxide and bicarbonates which are ultimately responsible for increase in pH, the low oxygen values coincided with high temperature during the summer month. Various factors bring about changes the pH of water. The higher pH values observed suggests that carbon dioxide, carbonate-bicarbonate equilibrium is affected more due

to change in physico-chemical condition. Palanichamy et al. (2000) suggested that pH is the measure of the intensity of acidity or alkalinity and measures the concentration of hydrogen ions. The pH of the water samples varied from 5.40- 6.00 at different times, as indicated by the in situ readings. The result reveals that the pH value was not within the desirable limit of BIS and WHO standards. Sulochana et al. (2005) studied that the river water cannot be used for drinking purpose. River waters with a pH of 5.5 and below are particularly at risk.

Electrical conductivity (EC)

Conductivity is a numerical expression of an aqueous solution's capacity to carry an electric current. This ability depends on the presence of ions, their total concentration, mobility, valence and relative concentrations, and on the temperature of the liquid. Solutions of most inorganic acids, bases, and salts are relatively good conductors. In contrast, the conductivity of distilled water is less than 1 µmhos/cm. Because conductivity is the inverse of resistance, the unit of conductance is the mho (ohm spelled backwards), or in low-conductivity natural waters, the micro mho.

Conductivity shows significant correlation with ten parameters such as temperature, pH value, alkalinity, total hardness, calcium, total solids, total dissolved solids, Chemical oxygen demand, and Chloride and iron concentration of water. Navneet k. et al. (2010) reported that the under-ground drinking water quality of study area can be checked effectively by controlling conductivity of water and this may also be applied to water quality management of other study areas. It is measured with the help of EC meter which measures the resistance offered by the water between two platinized electrodes. The instrument is standardized with known values of conductance observed with standard KCl solution.

Dhambare et al. (2002) suggested that the Conductivity is the measure of capacity of a substance or solution to conduct electric current. Conductivity is reciprocal of the resistance. In this study, electrical conductivity values ranged from 11.90-13.15 µmhos/cm at different times, as indicated by the in situ readings. EC values indicate the presence of more salts in river water. Rashid et al. (1982) reported that the EC values are a good measure of the relative difference in water quality between different aquifers.

Carbon dioxide

Smith et al. (1997), Hopkinson et al. (1985) reported that the Carbon dioxide is the end product of organic carbon degradation in almost all aquatic environments and its variation is often a measure of net ecosystem metabolism.

Total Alkalinity

It is composed primarily of carbonate and bicarbonate. Alkalinity, pH and hardness affect the toxicity of many substances in the drinking water. It is determined by simply dil HCl titration in presence of phenolphthalein and methyl orange indicators. Alkalinity in hot water essentially results from the presence of hydroxyl and carbonate ions. Hydroxyl alkalinity in boiler water is necessary to protect the boiler against corrosion. Too high a causticity causes other operating problems, such as foaming. Excessively high causticity levels can result in a type of caustic attack of the boiler called "embrittlement". Uduma AU (2014) studied and suggested that the alkalinity recorded during monsoon season was 220 mg/L due to high nutrients in water.

Dissolved Oxygen (DO)

Premlata et al. (2009) work on lake water and suggested that the DO is one of the most important parameter. Its correlation with water body gives direct and indirect information e.g. bacterial activity, photosynthesis, availability of nutrients, stratification etc. In the progress of summer, dissolved oxygen decreased due to increase in temperature and also due to increased microbial activity (Moss 1972, Morrissette 1978, Kataria 1996). The high DO in summer is due to increase in temperature and duration of bright sunlight has influence on the % of soluble gases (O^2 & CO^2). During summer the long days and intense sunlight seem to accelerate photosynthesis by phytoplankton, utilizing CO2 and giving off oxygen. This possibly accounts for the greater qualities of O2 recorded during summer (Krishnamurthy 1990). Yadav p et al. (2013) worked on fresh water pond and DO amount recorded during monsoon season was 5.86 mg/L due to the turbulence of water facilitating the diffusion of atmospheric oxygen and the increased solubility of oxygen at lower temperature.

Carbonate

Whenever the pH touches 8.3, the presence of carbonates is indicated. It is measured by titration with standardized hydrochloric acid using phenolphthalein as indicator. Below pH 8.3, the carbonates are converted into equivalent amount of bicarbonates. The titration can also be done pH metrically or potentiometrically.

Bicarbonate

Bicarbonate is also measured by titration with standardized hydrochloric acid using methyl orange as indicator. Methyl orange turns yellow below pH 4.0. At this pH, the carbonic acid decomposes to give carbon dioxide and water.

Biochemical Oxygen Demand (BOD)

BOD is a measure of organic material contamination in water, specified in mg/L. BOD is the amount of dissolved oxygen required for the biochemical decomposition of organic compounds and the oxidation of certain inorganic materials (e.g., iron, sulfites). Typically the test for BOD is conducted over a five-day period (Milacron Marketing Co.). Verma et al. (2010) suggested that the demand of oxygen in the water was recorded during monsoon season was 3.20 mg/L due to the possible addition of high amount of waste along with rain water from the surrounding and addition of organic waste in Taal lake by certain human activities which also be responsible for the increase in BOD.

Devaraju et al. (2005) reported during the study period in Maddur Lake, BOD is within the permissible range.

Chemical Oxygen Demand (COD)

COD is another measure of organic material contamination in water specified in mg/L. COD is the amount of dissolved oxygen required to cause chemical oxidation of the organic material in water. Both BOD and COD are key indicators of the environmental health of a surface water supply. They are commonly used in waste water treatment but rarely in general water treatment (Milacron Marketing Co.).

Sulfate

It is measured by nephelometric method in which the concentration of turbidity is measured against the known concentration of synthetically prepared sulfate solution. Barium chloride is used for producing turbidity due to barium sulfate and a mixture of organic substance (Glycerol or Gum acetia) and sodium chloride is used to prevent the settling of turbidity. As per IS; 10500-2012 Desirable limit for Sulphate is 200 and 400 mg/l in permissible limit.

Ammonia (Nitrogen)

It is measured spectroscopically at 425 nm radiation by making a color complex with Nessler's reagent. The conditions of reaction are alkaline and cause severe interference from hardness in water. Total Nitrogen exhibited higher value in monsoon season and very low in summer season the surface run of agricultural wastes fertilizers domestic wastes, house hold sewage and surface run off can also increases the concentration of total nitrogen and carbon in the study area. The TOC observed in high monsoonal season, phosphate value might be due to the regeneration and release of total phosphorus from bottom mud into the water column by turbulence and mixing (APHA, 1995).

Calcium

It is measured by complexometric titration with standard solution of ETDA using Patton's and Reeder's indicator under the pH conditions of more than 12.0. These conditions are achieved by adding a fixed volume of 4N Sodium Hydroxide. The volume of titre (EDTA solution) against the known volume of sample gives the concentration of calcium in the sample. Moss B (1973) reported the amount of calcium in water was recorded during monsoon season due to calcium absorbed by the large number of organisms for shell construction, bone building and plant precipitation of lime.

Magnesium

It is also measured by complexometric titration with standard solution of EDTA using Eriochrome black T as indicator under the buffer conditions of pH 10.0. The buffer solution is made from Ammonium Chloride and Ammonium Hydroxide. The solution resists the pH variations during titration.

Sodium

It is measured with the help of flame photometer. The instrument is standardized with the known concentration of sodium ion (1 to 100 mg/ litre). The samples having higher concentration are suitably diluted with distilled water and the dilution factor is applied to the observed values.

Potassium

It is also measured with the help of flame photometer. The instrument is standardized with known concentration of potassium solution, in the range of 1 mg to 5 mg/litre. The sample having higher concentration is suitably diluted with distilled water and the dilution factor is applied to the observed values.

Chloride

It is measured by titrating a known volume of sample with standardized silver nitrate solution using potassium chromate solution in water or eosin/fluorescein solution in alcohol as indicator. The latter indicator is an adsorption indicator while the former makes a red colored compound with silver as soon as the chlorides are precipitated from solution. Solanki HA (2012) reported the chloride amount in monsoon was 102 mg/L due to frequent run-off loaded with contaminated water from the surrounding slum area and evaporation of water.

Total Dissolve Solid

R islam et al. (2017) suggested the TDS usually correlates and affect pH reading. The presence of dissolved solids in the water will affect the taste of the water. M. S. Islam (2019) studied The TDS cannot have a significant deviation of its levels from standard value in water Not only it is not acceptable to Consumers because of taste but also due to other effects. This condition may states that a possible bacterial contamination in lower a TDS waters and it is also very harmful to human health [42]. Pawar et al. (2005) reported that the TDS during monsoon season was 1226 mg/L due to the addition of organic matter and solid waste into the Surella Taal lake.

Turbidity

B. Kitchener (2017) suggested that the Turbidity is the cloudiness of the effects caused by various individual particles. These particles are generally invisible to the naked eye, just like what happens to smoke in the air. Turbidity results in a decrease in the intensity of light that passes through cloudiness or turbidity water due to light, absorption, and reflection of light. Technically, turbidity can be defined as a disorder or fluid disturbance caused by suspended solids that are usually not visible to the naked eye. T Leziart et al. (2019) studied that the Turbidity can affect the growth rate of algae and other micro-aquatic plants in the water. Increased turbidity can lead to a decrease in aquatic plant growth due to a decrease in the amount of light for plants to perform photosynthesis. Turbidity is also able to increase the water temperature because the particles in the water to the surface absorb more heat. These factors lead to the reduction of dissolved oxygen. A. Soros et al (2019) reported the Turbidity measurement is an important test when trying to determine water quality. In drinking water, the

higher the turbidity level, then it is easier for a person to get water-related illnesses.

Sacchi Disk Transparency

Secchi disk transparency refers to the depth to which the white and black Secchi disk can be seen in the lake water. Water clarity, as determined by a Secchi disk is affected by two primary factors: algae and suspended particulate matter. Particulates (soil or dead leaves) may be introduced into the water by either runoff or sediments already on the bottom of the lake. Erosion from construction sites, agricultural lands, and riverbanks all lead to increased sediment runoff. Bottom sediments may be resuspended by bottom-feeding fish such as carp, or by motorboats or strong winds in shallow lakes. Khan et al. (1994) reported the higher transparence occurred in lake water, during winter and summer due to absence of rain, runoff and flood water as well as gradual settling of suspended particles.

Total Hardness

As per WHO Standard Desirable limit and Permissible limit for hardness is lies between 200mg/l respectively. The effect of hardness is Scale in utensils and hot water system in boilers etc. soap scum's Sources are Dissolved calcium and magnesium from soil and aquifer minerals containing limestone or dolomite. The Treatment of hard Water is Softener Ion Exchanger and Reverse Osmosis process. Thakor FJ et al. (2011) reported that the amount of total hardness in the Suraila Taal lake water was recorded during monsoon was 346 mg/L due to presence of high content of calcium and magnesium in addition to sulphate and nitrate in the sewage waste added during monsoon.

Fluoride

Fluoride occurs as fluorspar (fluorite), rock phosphate, phosphorite crystals, triphite etc., in nature. These factors which control the concentration of fluoride in the water area and the presence of accessory minerals in the rock minerals assemblage through which the ground water is circulating. Fluoride is most important in human body for the normal development of skeletons, As per BIS Standard Desirable limit for fluoride is 1 mg/l in Permissible limit. Saxena et al. (2013) studied the higher concentration of fluoride in drinking water may develop molting of teeth, skeleton fluorosis, deformation in knee joints etc.

Table 2: Different analytical water quality parameter with their analytical technique and guideline values as per who and Indian standard.

Sr. No.	parameter	Technique used	WHO Standard	Indian Standard	USEPA Standard
1	Temperature	Thermometer	-	-	-
2	Color	Visual / color kit	-	5 Hazen units	-
3	Odour	Physiological sense	Acceptable	acceptable	-
4	Electrical Conductivity	Conductivity meter / water analysis kit	-	-	2500 us/cm
5	pH	pH meter	6.5-9.5	6.5-9.5	
6	Dissolved Oxygen	Redox titration	-	-	-
7	Total Hardness	Complexometric titration	200ppm	300ppm	<200ppm
8	Alkalinity	Acid-Base titration	-	200 ppm	-
9	Acidity	Acid-Base titration	-	-	-
10	Ammonia	UV Visible Spectrophotometer	0.3 ppm	0.5 ppm	0.5 ppm
11	Bi carbonate	Titration	-	-	-
12	Biochemical Oxygen Demand (BOD)	Incubation followed by titration	6	30	5
13	Carbonate	Titration	-	-	-
14	Chemical Oxygen Demand (COD)	C.O.D. digester	10	-	40
15	Chloride	Argentometric titration	250 ppm	250 ppm	250 ppm
16	Magnesium	Complexometric titration	150 ppm	30 ppm	-
17	Nitrate	UV Visible Spectrophotometer	45 ppm	45 ppm	50 mg/l
18	Nitrite	UV Visible Spectrophotometer	3 ppm	45 ppm	0.5 mg/l
19	Potassium	Flame Photometer	-	-	-
20	Sodium	Flame Photometer	200 ppm	180 ppm	200 ppm
21	Sulphate	Nephelometer	250 ppm	200 ppm	250 ppm

		Turbidimeter			

Ref.:- [WHO, USEPA, Indian standard, National Primary Drinking Water Regulations, Drinking Water Contaminants]

Table 3: different analytical water quality parameter used for testing of quality of water and their source of occurance and potential health effects with USEPA guidelines.

Sr. No.	parameter	Source of occurrence	Potential health effect
1	Turbidity	Soil runoff	Higher level of turbidity is associated with disease causing bacteria's.
2	Color	Due to presence of dissolved salts	-
3	Odor	Due to biological degradation	Bad odour unpleasant
4	Electrical conductivity	Due to different dissolved solids	Conductivity due to ionizable ions. High conductivity increases corrosive nature of water.
5	pH	pH is changed due to different dissolved gases and solids.	Affects mucous membrane; bitter taste; corrosion
6	Dissolved oxygen	Presence due to dissolved oxygen	D.O. corrode water lines, boiler and heat exchangers, at low level marine animals cannot survive.
7	Total hardness	Presence of calcium and magnesium ions in a water supply. It is expressed. Hardness minerals exist to same degree in every water supply.	Poor lathering with soap; deterioration of the quality of clothes; scale forming.
8	Total alkalinity	Due to dissolved gases	Embrittlement of boiler steel. Boiled rice turns yellowish
9	TDS	Presence all dissolved salts	Undesirable taste; gastro-intestinal irritation; corrosion or incrustation
10	Calcium	precipitate	Interference in dyeing, textile.
11	Magnesium	Surfactants, anionic emulsifiers	Paper industry etc.
12	Ammonia	Due to dissolved gases and degradation of organics	Corrosion of Cu and Zn alloys by formation of complex ions.
13	Barium	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits	Increase in blood pressure
14	Biochemical Oxygen Demand (B.O.D.)	Organic material contamination in water	High BOD decreases level of dissolved oxygen.
15	Carbonate	Due to dissolution	Product imbalance Unsatisfactory production short product life
16	Chloride	Water additive used to control microbes, disinfect	Eye/nose irritation; stomach discomfort. Increase corrosive character of water.
17	Nitrate	Runoff from fertilizer use; leaking from septic tanks, sewage; erosion of natural deposits	Effect on infants below the age of six months symptoms include shortness of breath and blue-baby syndrome.
18	Phosphate	-	Stimulate microbial growth, Rancidity mold growth
19	Sodium	Natural component of water	
20	Sulphate	Due to dissolved ca/mg/fe sulphate	Taste affected; gastro-intestinal irritation. Calcium Sulphate scale.

Conclusion

Fresh water physico-chemical parameter observation is very essential for determining the present states of hydrologic conditions for water pollution, consistent physico-chemical parameter of water monitoring will help in long term provision, which will be helpful to protect human health and protect fresh water.

Fresh water quality is dependent on physico-chemical parameter. Monitoring water quality of lake water is done by collecting regularly water samples and inspection of physico-chemical parameters of lake water at different location of lake.

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