# PYSICO CHEMICAL AND BIOLOGICAL PARAMETERS OF WATER

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**ABSTRACT**

*Water is the most important natural resources on earth. It is important to all existing organisms, most ecological systems, food production and economic development. Drinking water is water intended for human consumption for drinking and cooking purposes from any source. It includes water supplied by any means for human consumption.The safety of drinking water is affected by various pollutant chemical and microbiological. These contaminants affect the quality of the drinking water. Sometimes poor quality water causes many diseases in the humans so that the quality of the water must be tested for chemical and microbial contaminants. This study explains about various physico, chemical and biological parameters of water.*

**Keywords:** *Drinking Water, Physico-chemical, Standards, Surface water.*

## 1. INTRODUCTION

Water is one of the most important of all natural resources known on earth. It is important to all living organisms, ecological systems, human health, food production and economic development. The safety of drinking water is important for the health [1].Water plays a significant role in maintaining the human welfare. Clean drinking water is now recognized as a fundamental right of human beings. Around 780 million people do not have access to clean and safe water and around 2.5 billion people do not have proper sanitation. As a result, around 6–8 million people die each year due to water related diseases and disasters Therefore, water quality control is a top-priority policy agenda in many parts of the world . In the todays world, the water use in the house supplies is commonly defined as domestic water.This water is processed to be safely consumed as drinking water and other purposes [2].The standards of the concentration of various parameters for water quality were controlled throughout the world by legislation. These parameters will be different to some extent from one country to the other. Most of people over the world using freshwater which forms the main sources for the drinking water and some places using ground water for both drinking and agricultural, industrial, household,recreational and environmental activities [3]. Due to increased human population, industrialization, the use of fertilizers in agriculture and man-made activity, the natural aquatic resources are causing heavy and varied pollution in the aquatic environment leading to water quality and depletion of aquatic biota. It is therefore necessary that the quality of drinking water should be checked at regular time interval because due to use of contaminated drinking water, human population suffers from a variety of water borne diseases . It is difficult to understand the biological phenomena fully because the chemistry of water reveals much about the metabolism[4]. Groundwater is used for domestic, agriculture and industrial purpose in most parts of the world. The a like agriculture and domestic release large number of pollutants into the water bodies. The major sources of water are rainfall, surface water involving rivers, lakes and groundwater involving wells bore wells [6]. Rivers are the most important freshwater source for humans. The social, economic and political developments, in the past, were largely related to the availability and distribution of fresh water contained in river systems. These of main river water include drinking water supply sources, irrigation of agricultural land, industrial and municipal water supply, industrial and municipal waste disposal, navigation, fishery, recreational boating and body recreation [5]. The objective of the study is to know about the water quality parameters and standards. It is helpful for maintaining the water resources in the safe condition.

## 2. PHYSICO- CHEMICAL PARAMETERS

It is very essential and important to test the water before it is used for drinking, domestic, agricultural or industrial purpose. Water must be tested with different physic-chemical parameters. Selection of parameters for testing of water is solely depends upon for what purpose we going to use that water and what extent we need its quality and

purity. Water does content different types of floating, dissolved, suspended and microbiological as well as bacteriological impurities. Some physical test should be performed for testing of its physical appearance, such as temperature, color, odour, pH, turbidity, TDS etc, while chemical tests should be performs for its BOD, COD, dissolved oxygen, alkalinity, hardness and other characters. For obtaining more and more quality and purity water, it should be tested for its trace metal, heavy metal contents and organic pesticide residue. It is obvious that drinking water should pass these entire tests and it should content the 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 the water it needs highly sophisticated analytical instruments and well trained manpower. Following different physic chemical parameters are tested regularly for monitoring quality of water.

**2.1Temperature**

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.

**2.2 pH**

pH is most important in determining the corrosive nature of water[7]. Lower the pH values higher is the corrosive nature of water. pH was positively correlated with electrical conductance and total alkalinity. The reduced rate of photosynthetic activity the assimilation of carbon dioxide and bicarbonates which are ultimately responsible for the 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 was affected more due to change in physico-chemical condition.

**2.3 EC (Electrical Conductivity)**

Conductivity shows significant correlation with ten parameters such as temperature , pH value , alkalinity total hardness , calcium , total solids, total dissolved solids , chemical oxygen demand , chloride and iron concentration of water. The underground drinking water quality of the 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.

**2.4 Carbon Dioxide**

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. Therefore, in aquatic bio geochemical studies, it is desirable to measure parameters that define the carbon dioxide system. $CO_2$ is also the most important green house gas on earth. Its fluxes across the air-water or sediment-water interface is among the most important concerns in global change studies and are often a measure of the net ecosystem production/metabolism of the aquatic system.

**2.5 Alkalinity**

It is composed primarily of carbonate (CO32-) and bicarbonate (HCO3-), alkalinity acts as a stabilizer for pH. Alkalinity, pH and hardness affect the toxicity of many substances in the water. Alkalinity in boiler water essentially results from the presence of hydroxyl and carbonate ions. Hydroxyl alkalinity (causticity ) in the boiler water is necessary to protect the boiler against corrosion. Too high a causticity causes other operating problems, such as foaming.

**2.6 Dissolved Oxygen**

DO is one of the most important parameter. Its correlation with water body gives direct and indirect information, bacterial activity, photosynthesis, availability of nutrients, stratification etc[8]. In the progress of summer, dissolved oxygen decreased due to increase in temperature and also due to increased microbial activity . 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 the summer .

**2.7 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 the equivalent amount of bicarbonates.

**2.8 Bicarbonate**
It 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.

**2.9 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.

**2.10 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 the waste water treatment rarely in general water treatment.

**2.11 Sulphate**
It is measured by nephelometric method in which the concentration of turbidity is measured against the known concentration of synthetically prepared sulphate solution. Barium chloride is used for producing turbidity due to barium sulphate and a mixture of organic substance (Glycerol or Gum acetia) and sodium chloride is used to prevent the settling of turbidity.

**2.12 Ammonia (Nitrogen)**
It is measured spectroscopically at 425 nm radiation by making a colour complex with Nessler's reagent. The conditions of reaction are alkaline and cause severe interference from hardness in water.

**2.13 Calcium**
It is measured by complexometric titration with the 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.

**2.14 Magnesium**
It is also measured by complexometric titration with the 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.

**2.15 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.

**2.16 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.

**2.17 Chloride**
It is measured by the titrating a known volume of sample with standardized silver nitrate solution using potassium chromate solution in water or eosin/fluorescein solution in alcohol as the 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.

**2.18 Silicates & Phosphate**
These are also measured spectroscopically. Yellow colour was developed from the action of phosphates and silicates on molybdate ion under strong acidic conditions. The intensity of colour is directly proportional to the concentration of phosphate and silicates in the sample. Phosphate complexes are reduced by the weak reducing agents such as

ascorbic acid or tartaric acid (potassium antimonyl tartarate) where as silica complexes require strong reducing conditions of hydrazine or bisulphite. The colour of reduced complex is sky blue. Most of the physico- chemical parameters are determined by standard methods prescribed by ASTM (2003) and APHA (1985), Trivedy and Goal (1986), Kodarkar (1992).

## 3. BIOLOGICAL CHARACTERISTICS

**3.1 Microbial Contamination:** Microbial contamination is one of the major concerns of water quality. Many types of microorganisms are naturally present in the water such as

•Protozoans -Amoeba, cryptosporidium, giardia,
Bacteria – Salmonella, typhus, cholera, shigella,
•Viruses –Polio, hepatitis A, meningitis, encephalitis,…
•Helminths –Guinea worm, hookworm, roundworm,…

### 3.2 Feacal Matter

### Total Coliform and Feacal Coliform

Total coliform bacteria, fecal coliform bacteria, and E. coli are all considered indicators of water contaminated with fecal matter. Contaminated water may contain other pathogens (micro-organisms that cause illness) that are more difficult to test for. Therefore these indicator bacteria are useful in giving us a measure of contamination levels.
*E. coli* is a bacterial species found in the fecal matter of warm blooded animals (humans, other mammals, and birds). Total coliform bacteria are an entire group of bacterial species that are generally similar to and include the species *E. coli*. There are certain forms of coliform bacteria that do not live in fecal matter but instead live in soils. Fecal coliform bacteria are coliform bacteria that do live in fecal matter, including, but not limited to, the species *E. coli*. Most of the fecal coliform cells found in fecal matter are *E. coli*. Untreated sewage, poorly maintained septic systems, un-scooped pet waste, and farm animals with access to water bodies can cause high levels of fecal coliform bacteria to appear in and make the water unhealthy[10].

## 4. WATER QUALITY INDEX ( WQI)

WQI is a dimensionless number that combines multiple water-quality factors into a single number by normalizing values to subjective rating curves [9]. Factors to be included in WQI model could vary depending upon the designated water uses and local preferences. Some of these factors include DO, pH, BOD, COD, total coliform bacteria, temperature, and nutrients (nitrogen and phosphorus), etc. These parameters occur in different ranges and expressed in different units. The WQI takes the complex scientific information of these variables and synthesizes into a single number. Calculation of WQI: The Water Quality Index (WQI) was calculated using the Weighted Arithmetic Index method. The quality rating scale for each parameter Qi was calculated by using this expression: Quality rating, $Qi = 100 [(Vn - Vi) / (Vs - Vi)]$
Generally, WQI are discussed for a specific and intended use of water. In this study the WQI for human consumption is considered and permissible WQI for the drinking water is taken as 100. The overall WQI was calculated by using Equation: Water Quality Index $= \Sigma(Qi)Wi / \Sigma Wi$

## 5. CONCLUSION

Water quality is dependent on the type of the pollutant added and the nature of self purification of water. Natural water is never completely pure. Most of the earth's water sources get their water supllies through precipitation. During precipitation water passes over (runoff) and through the ground (infiltration), acquiring a wide variety of dissolved or suspended impurities that intensely alters its usefulness. Water is an essential ingredient of animal and plant life crediting to its unique physical, chemical and biological properties. These characteristics also have a direct influence on the types and distribution of aquatic biota. All the standards for prescribed discharge of wastes into the water body are designed on the basis of water quality characteristics.The effects of water pollution are not only devastating to people, but also to animals, fish, and birds also destroy aquatic life and reduces its reproductive ability. Polluted water is unsuitable for drinking, recreation, agriculture, and industry. It diminishes the aesthetic quality of lakes and rivers. Eventually, it is a hazard to human health. The present paper undertaken to account to bring an acute awareness among the people about the quality of water. The individual and the community can help

minimize water pollution by simple housekeeping and management practices the amount of waste generated can be minimized.

## REFERENCES


[1] Devangee shukla , Kinjal Bhadresha , Dr. N. K. Jain , Dr. H. A. Modi, Physicochemical Analysis of Water from Various Sources and Their Comparative Studies. Journal of Environmental Science, Toxicology And Food Technology. 5 (2013): 89-92.

[2] N. Rahmanian, Siti Hajar Bt Ali, M. Homayoonfard,N. J. Ali, M. Rehan, Y. Sadef, and A. S. Nizami, Analysis of Physiochemical Parameters to Evaluate the Drinking Water Quality in the State of Perak, Malaysia. Journal of Chemistry. http://dx.doi.org/10.1155/2015/716125.

[3] Yousif Algamal, Assessment and statistical study of physico-chemical properties of water quality in some local water treatment plants in Jeddah,Kingdom of Saudi Arabia. Advances in Applied Science Research, 6 (2015) :49-56.

[4] Lakshmi P, Reddy MS, Reddy CP and Rao AN, Studies of Physico-Chemical Parameters to Evaluate Quality of Water at Different Zones of Nalagonda District of Telangana, India. Journal of Earth Science & Climatic Change.7 (2016): 1000347.

[5] Faiza Tawati Yenny Risjani, M. Sasmito Djati, Bagyo Yanuwiadi, Amin Setyo Leksono, The Analysis of the Physical and Chemical Properties of the Water Quality in the Rainy Season in the Sumber Maron River - Kepanjen, Malang – Indonesia. Resources and Environment 8 (2018) : 1-5.

[6] A Ghamdi,A.Y., Mohamed El-Shahate Ismaiel Saraya, A.O. Ghamdi and S.A. Zabin, Study Of Physico-Chemical Properties Of The Surface And Ground Water. American Journal of Environmental Sciences 10 (2014): 219-235.

[7] SS Sagar, RP Chavan, CL Patil, DN Shinde, SS Kekane, Physico-chemical parameters for testing of water-A review. International journal of chemical studies. 3 (2015): 24-28.

[8] Patil. P.N, Sawant. D.V, Deshmukh. R.N, Physico-chemical parameters for testing of water – A review. International Journal Of Environmental Sciences.3(2012): 1194-1207.

[9] S. P. Gorde, M. V. Jadhav, Assessment of Water Quality Parameters: A Review. International Journal of Engineering Research and Applications. 3(2013): 2029-2035.

[10] Pooja Arora, Physical, Chemical and Biological Characteristics of Water (e Content Module). Water Resources and Management. 5(2018): 1-16.