INTERNATIONAL JOURNAL OF ENVIRONMENTAL SCIENCES Volume 3, No 3, 2012

© Copyright by the authors - Licensee IPA- Under Creative Commons license 3.0

Review article ISSN 0976 – 4402

Physico-chemical parameters for testing of water – A review

Patil. P.N, Sawant. D.V, Deshmukh. R.N
Department of Engineering Chemistry, Bharati Vidyapeeth's College of Engineering, Near Chitranagari, Kolhapur, Maharashtra, 416013 (INDIA)
pnpatil_chem@rediffmail.com

ABSTRACT

People on globe are under tremendous threat due to undesired changes in the physical, chemical and biological characteristics of air, water and soil. Due to increased human population, industrialization, use of fertilizers and man-made activity water is highly polluted with different harmful contaminants. Natural water contaminates due to weathering of rocks and leaching of soils, mining processing etc. It is 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 varied of water borne diseases. The availability of good quality water is an indispensable feature for preventing diseases and improving quality of life. It is necessary to know details about different physico-chemical parameters such as color, temperature, acidity, hardness, pH, sulphate, chloride, DO, BOD, COD, alkalinity used for testing of water quality. Heavy metals such as Pb, Cr, Fe, Hg etc. are of special concern because they produce water or chronic poisoning in aquatic animals. Some water analysis reports with physic-chemical parameters have been given for the exploring parameter study. Guidelines of different physic-chemical parameters also have been given for comparing the value of real water sample.

Keyword: Water, Physico - chemical, Parameters, Hardness, BOD, Heavy metals.

www.IndianJournals.com
Members Copy, Not for Commercial Sale
Downloaded From IP - 18.97.14.83 on dated 19-Feb-2025

1. Introduction

Water is one of the most important and abundant compounds of the ecosystem. All living organisms on the earth need water for their survival and growth. As of now only earth is the planet having about 70 % of water. But due to increased human population, industrialization, use of fertilizers in the agriculture and man-made activity it is highly polluted with different harmful contaminants. Therefore it is 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 varied of water borne 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 (Basavaraja Simpi et al. 2011).

The availability of good quality water is an indispensable feature for preventing diseases and improving quality of life. 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 (Ipinmoroti and Oshodi 1993, Adeyeye 1994, Asaolu 1997). The increased use of metal-based fertilizer in agricultural revolution of the government could result in continued rise in concentration of metal pollutions in fresh water reservoir due to the water run-off. Also faucal pollution of drinking

Received on October 2012 Published on November 2012

water causes water born disease which has led to the death of millions of people. (Adefemi and Awokunmi, 2010).

People on globe are under tremendous threat due to undesired changes in the physical, chemical and biological characteristics of air, water and soil. These are related to animal and plants and finally affecting on it (Misra and Dinesh 1991). Industrial development (Either new or existing industry expansion) results in the generation of industrial effluents, and if untreated results in water, sediment and soil pollution (Fakayode and Onianwa 2002, Fakayode 2005).

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 (Ellis 1989). High levels of pollutants mainly organic matter in river water cause an increase in biological oxygen demand (Kulkarni 1997), chemical oxygen demand, total dissolved solids, total suspended solids and fecal coli form. They make water unsuitable for drinking, irrigation or any other use (Hari 1994).

www.IndianJournals.com
Members Copy, Not for Commercial Sale
Downloaded From IP - 18.97.14.83 on dated 19-Feb-2025

There are trends in developing countries to use sewage effluent as fertilizer has gained much importance as it is considered a source of organic matter and plant nutrients and serves as good fertilizer (Riordan 1983). Farmers are mainly interested in general benefits, like increased agriculture production, low cost water source, effective way of effluent disposal, source of nutrients, organic matter etc, but are not well aware of its harmful effects like heavy metal contamination of soils, crops and quality problems related to health. Research has proven that long term use of this sewage effluent for irrigation contaminates soil and crops to such an extent that it becomes toxic to plants and causes deterioration of soil (Quinn 1978, Hemkes1980). This contains considerable amount of potentially harmful substances including soluble salts and heavy metals like Fe^{2+}, Cu^{2+}, Zn^{2+}, Mn^{2+}, Ni^{2+}, Pb^{2+}. Additions of these heavy metals are undesirable. Plants can accumulate heavy metals in their tissues in concentrations above the permitted levels which is considered to represent a threat to the life of humans, and animals feeding on these crops and may lead to contamination of food chain, as observed that soil and plants contained many toxic metals, that received irrigation water mixed with industrial effluent (Adnan Amin 2010).

The quality of ground water depends on various chemical constituents and their concentration, which are mostly derived from the geological data of the particular region. Industrial waste and the municipal solid waste have emerged as one of the leading cause of pollution of surface and ground water. In many parts of the country available water is rendered non-potable because of the presence of heavy metal in excess. The situation gets worsened during the summer season due to water scarcity and rain water discharge. Contamination of water resources available for household and drinking purposes with heavy elements, metal ions and harmful microorganisms is one of the serious major health problems. The recent research in Haryana (India) concluded that it is the high rate of exploration then its recharging, inappropriate dumping of solid and liquid wastes, lack of strict enforcement of law and loose governance are the cause of deterioration of ground water quality (Guptaa 2009).

Most of the rivers in the urban areas of the developing countries are the ends of effluents discharged from the industries. African countries and Asian countries experiencing rapid industrial growth and this is making environmental conservation a difficult task (Agarwal Animesh 2011). Sea water contains large number of trace metals in very small concentration. This is a challenging matrix for the analytical chemist due to the very low concentrations of many important trace metals (Robertson 1968, Riley).

www.IndianJournals.com
Members Copy, Not for Commercial Sale
Downloaded From IP - 18.97.14.83 on dated 19-Feb-2025

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 perform 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 i.e. pesticide residue. 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.

2.1 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.

2.2 pH

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(Guptaa 2009). 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 (Karanth 1987).

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. Navneet Kumar et al (2010) suggested that the underground 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.

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(Smith 1997, 1993, Hopkinson 1985). Therefore, in aquatic biogeochemical 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 are among the most important concerns in global change studies and are often a measure of the net ecosystem production/metabolism of the aquatic system.

There are various readily measurable parameters of aquatic carbon dioxide system: such as pH (pCO_2), total dissolved inorganic carbon (DIC) and total alkalinity (TA). Surface water pCO2 can be measured by photometric method (DeGrandpre 1993, Wang, Z 2002) and DIC CO_2 is measured by coulometer or by an infrared CO_2 analyzer (Dickson 1994). Total Alkalinity CO_2 is determined by HCl titration of the water sample to the CO_2 equivalence point.(Gran 1952).

2.5 Alkalinity

It is Composed primarily of carbonate (CO_3^{2-}) and bicarbonate (HCO^{3-}), alkalinity acts as a stabilizer for pH. Alkalinity, pH and hardness affect the toxicity of many substances in the water. It is determined by simple dil HCl titration in presence of phenolphthalein and methyl orange indicators. Alkalinity in boiler water essentially results from the presence of hydroxyl and carbonate ions. Hydroxyl alkalinity (causticity) 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".

www.IndianJournals.com
Members Copy, Not for Commercial Sale
Downloaded From IP - 18.97.14.83 on dated 19-Feb-2025

2.6 Dissolved Oxygen

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. (Premlata Vikal, 2009). In the progress of summer, dissolved oxygen decreased due to increase in temperature and also due to increased microbial activity (Moss 1972, Morrissette 1978, Sangu 1987, 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 CO_2 and giving off oxygen. This possibly accounts for the greater qualities of O_2 recorded during summer (Krishnamurthy R, 1990). DO in sample is measured titrimetrically by Winkler's method after 5 days incubation at 293 K. The difference in initial and final DO gives the amount of oxygen consumed by the bacteria during this period. This procedure needs special BOD bottles which seal the inside environment from atmospheric oxygen.

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 equivalent amount of bicarbonates. The titration can also be done pH metrically or potentiometrically.

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.

www.IndianJournals.com
Members Copy, Not for Commercial Sale
Downloaded From IP - 18.97.14.83 on dated 19-Feb-2025

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 (e.g., iron, sulfites). Typically the test for BOD is conducted over a five-day period (Milacron Marketing Co.).

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 waste water treatment but rarely in general water treatment. (Milacron Marketing Co.).

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 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 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 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.

2.18 Silicates & Phosphate

These are also measured spectroscopically. Yellow colour is 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 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).

www.IndianJournals.com
Members Copy, Not for Commercial Sale
Downloaded From IP - 18.97.14.83 on dated 19-Feb-2025

3. Some physico chemical analysis study of polluted water sample in India

Physico chemical parameter study is very important to get exact idea about the quality of water and we can compare results of different physico chemical parameter values with standard values. Aftab Begum et al.(2005) studied various physico-chemical parameters and analysis of untreated fertilizer effluent. His result revealed that the parameters like EC, TDS, TSS, BOD, COD and ammonia are high compared to permissible limits of CPCB (1995), and fungal analysis showed the presence of 15 species isolated on Malt Extract Agar (MEA) medium thereby indicating the pollutional load of the effluent. Dey Kallol et al.(2005) studied various physio-chemical parameters on the samples drawn from the river Koel, Shankha and Brahmani. It was observed that dilution during rainy season decreases the metal concentration level to a considerable extent. However the enrichment of these metals by bio-magnification and bioaccumulation in edible components produced in water is accepted to produce a remarkable effect on the water of the river Brahamani which is of deep public concern.

Pawar Anusha et al.(2006) has studied the bore well and dug well water samples from a highly polluted industrial area – Nacharam. Sample were collected and analysed for physico-chemical parameters by adopting the standard methods for examination for water and waste water. The analyzed samples obtained a high values, compared with drinking water standards. Poonkothai and Parvatham (2005) had been studied physico-chemical and microbiological studies of automobile wastewater in Nammakkal, Tamil Nadu, India indicated that the values for physico-chemical parameters were on the higher side of permissible limits of BIS. Microbiological studies revealed the presence of bacteria at high concentration and these organisms serves as indicators for pollutants. Rokade and Ganeshwade (2005) showed high fluctuations in the physico-chemical parameters indicating the intensity of pollution. The pH ranged from minimum of 6.6 to maximum of 8.4, chlorides from 132.5 to 820.4mg/l, hardness ranged from 74 to 281 mg/l, CO_2 from 2.1 to 5.09, BOD from 4.437 to 112.432 mg/l, sulphates 0.192 to 5.12 mg/l, nitrates 0.5 to 1.012. The minimum pH value of 6.3 mg/l was found during winter season and maximum of 8.93 mg/l in summer. The pH shows general decline from upstream to downstream. CO2 was found to maximum in summer reaching up to 55.44 mg/l and reduced to a minimum of 2.28 mg/l during rainy season. From the data collected it can be concluded that the inverse relationship, which is known to exist between pH and CO2 , is not existing in the present investigation(Sawane 2006).

Sharma Madhavi et al. (2005) studied ground water quality of industrial area of Kishangarh for various physicochemical parameters seasonally without and after addition of marble slurry in different proportions. From the study it is clear that these parameters increase with the addition of marble slurry leading to deterioration of the overall quality of the groundwater. Singhal et al.(2005) study reports on the treatment of pulp and paper mill effluent by *Phanerochaete chrysosporium* and the same has been compared at two different pH 5.5 and 8.5. At both the pH, colour, COD, lignin content and total phenols of the effluent significantly declined after bioremediation. However, greater decolourisation and reduction in COD, lignin content and total phenols were observed at pH 5.5. Chavan et al. (2005) was carried out investigation to study the different organic pollutants present in the Thane creek water. The creek water shows high values of BOD and COD along with 15 phenolic compounds, detergents, alcohols, ether and acetone, which are harmful to aquatic life. The origin of this pollutants is mainly from the entry of effluents from surrounding industries.

www.IndianJournals.com
Members Copy, Not for Commercial Sale
Downloaded From IP - 18.97.14.83 on dated 19-Feb-2025

Two major cement industries of the Ariyalur and Reddipalayam were selected and the waste water discharged from these units were collected and subjected to analysis. The values of different parameters were compared with the standard values given by Tamil Nadu Pollution Control Board. The reasons for variations are analysed and remedial measures suggested (Gnana 2005). In mineral based industry among various environmental issues the water pollution has posed most disastrous effect and complex challenges for undertaking necessary remedial measures. The sources of water pollution in different mineral based industries including mining, mineral processing, integrated iron and steel plant and nonferrous metal industries are described. Various liquid effluent treatments techniques both physiochemical and biological have been described and discussed. The process in each case being used commercially, have been outlined.(Jena and Mohanty 2005).

Premlata Vikal (2009) has been work out the physico-chemical characteristics of the Pichhola lake water. He studied various parameters like air and water temperature, pH, free CO_2, dissolved oxygen, biochemical oxygen demand, chemical oxygen demand, conductivity, total dissolved solids, hardness, total alkalinity, chloride, nitrate, phosphate and sulphate. The results revealed that the values of conductivity, COD, and sulphate were found to cross the standard limits in water samples. The coefficient of correlation (r) among various physico-chemical parameters was also made.

Gupta et al (2009) were analyzed water samples from 20 sampling points of Kaithal for their physicochemical characteristics. Analysis of samples for pH, Colour, Odour, Hardness, Chloride, Alkalinity, TDS etc. On comparing the results against drinking water quality standards laid by Indian Council of Medical Research (ICMR) and World Health Organization (WHO), it is found that some of the water samples are non-potable for human being due to high concentration of one or the other parameter. Thus an attempt has been made to find the quality of ground water in and around Kaithal City town, suitable for drinking purposes or not. Basawaraj simpi et al.(2011) studied monthly changes in various physic chemical parameters of Hosahalli water tank in shimoga district Karnataka. Study shows that all parameters are within the limit and tank water non polluted and it can be used for domestic, irrigation and fishery purpose.

Saravanakumar and Ranjith Kumar (2011) presents paper studies about groundwater quality of Ambattur industrial area in Chennai City. They studied parameters such as pH, total alkalinity, total hardness, turbidity, chloride, sulphate, fluoride, total dissolved solids and conductivity. It was observed that there was a slight fluctuation in the physico-chemical parameters among the water samples studied. Comparison of the physico-chemical parameters of the water sample with WHO and ICMR limits showed that the groundwater is highly contaminated and account for health hazards for human use. Manjare et al. (2010) were studies the Physico-chemical Parameters of Tamadalge Water Tank in Kolhapur District, Maharashtra. Monthly Changes In Physical and Chemical Parameters Such as Water Temperature, Transparency, Turbidity, Total Dissolved Solids, pH, Dissolved Oxygen, Free Carbon dioxide, and Total Hardness, Chlorides, Alkalinity, Phosphate and Nitrates. Were analyzed for a periods of one year. All Parameters were within the Permissible limits. The results indicate that the tank is Non-polluted and can be used for Domestic and Irrigation.

Highly impure water has various effects on human being, domestic purpose as well as industrial use. Such as human beings get affected/ infected due to presence of different bacteria and heavy metals present in water. It may affect the different body organ and physiological disorder. Hard water is not suitable for domestic use such as washing, bathing, cooking as well as other purpose. Hard water is also not suitable for industrial and agricultural use. It damages the delicate machineries and affects the quality, stability and glossiness of the final product.

www.IndianJournals.com
Members Copy, Not for Commercial Sale
Downloaded From IP - 18.97.14.83 on dated 19-Feb-2025

Central water commission is maintaining a three tier Laboratory system for analysis of the parameters. The Level-I Laboratories are located at 258 field water quality monitoring stations on various rivers of India where physical parameters such as temperature, colour, odour, specific conductivity, total dissolved solids, pH and Dissolved Oxygen of river water are observed . There are 24 Level-II Laboratories located at selected Division Offices to analyse 25 different physico- chemical characteristics and bacteriological parameters of river water.

Table 1: Different analytical water quality parameters with their analytical technique and guideline values as per who and Indian standard

Sr. No.	**Parameter**	**Technique used**	**WHO standard**	**Indian Standard**	**EPA guidelines**
01	Temperature	Thermometer	-	-	-
02	Color	Visual / color kit	-	5 Hazen units	-
03	Odour	Physiological sense	Acceptable	Acceptable	-
04	Electrical conductivity	Conductivity meter / Water analysis kit	-	-	2500 us/cm
05	pH	pH meter	6.5 – 9.5	6.5 – 9.5	6.5 – 9.5
06	Dissolved oxygen	Redox titration	-	-	-
07	Total Hardness	Complexometric titration	200 ppm	300 ppm	< 200 ppm
08	Alkalinity	Acid – Base titration	-	200 ppm	-
09	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 (B.O.D.)	Incubation followed by titration	6	30	5
13	Carbonate	Titration	-	-	-
14	Chemical Oxygen Demand (C.O.D.)	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 / Turbidimeter	250 ppm	200 ppm	250 ppm

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

www.IndianJournals.com
Members Copy, Not for Commercial Sale
Downloaded From IP - 18.97.14.83 on dated 19-Feb-2025

Table 2: Different analytical water quality parameters used for testing of quality of water and their sourse of occurance and potential health effects with USEPA guidelines.

Sr. No.	Parameter	Source of occurrence	Potential health effect
01	Turbidity	Soil runoff	Higher level of turbidity are associated with disease causing bacteria's.
02	Color	Due to presence of dissolved salts	-
03	Odor	Due to biological degradation.	Bad odor unpleasant
04	Electrical conductivity	Due to different dissolved solids.	Conductivity due to ionizable ions. High conductivity increases corrosive nature of water.
05	pH	pH is changed due to different dissolved gases and solids.	Affects mucous membrane; bitter taste; corrosion
06	Dissolved oxygen	Presence due to dissolved oxygen.	D. O. corrode water lines, boilers and heat exchangers, at low level marine animals cannot survive.
07	Total Hardness	Presence of calcium (Ca2+) and magnesium (Mg2+) ions in a water supply. It is expressed. Hardness minerals exist to some degree in every water supply.	Poor lathering with soap; deterioration of the quality of clothes; scale forming
08	Total Alkalinity	Due to dissolved gases (CO_2)	Embrittlement of boiler steel. Boiled rice turns yellowish
09	TDS	Presence all dissolved salts	Undesirable taste; gastro-intestinal irritation; corrosion or incrustation
10	Calcium	Precipitate soaps, anionic	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 of CO2	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 sulphates	Taste affected; gastro-intestinal irritation. Calcium sulphate scale.

www.IndianJournals.com
Members Copy, Not for Commercial Sale
Downloaded From IP - 18.97.14.83 on dated 19-Feb-2025

4. References

1. Adefemi S. O. and E. E. Awokunmi, (2010), Determination of physico-chemical parameters and heavy metals in water samples from Itaogbolu area of Ondo-State, Nigeria, African Journal of Environmental Science and Technology, 4(3), pp 145-148.

2. Adeyeye EI, (1994), Determination of heavy metals in *Illisha Africana*, associated Water, Soil Sediments from some fish ponds, International Journal of Environmental Study, 45, pp 231-240.

3. Adnan, Amin, Taufeeq, Ahmad, Malik, Ehsanullah, Irfanullah, Muhammad, Masror, Khatak and Muhammad, Ayaz, Khan, (2010), Evaluation of industrial and city effluent quality using physicochemical and biological parameters, Electronic Journal of Environmental, Agricultural and Food Chemistry, 9(5), pp 931-939.

4. Aftab, Begum, S. Y, Noorjahan, C. M., Dawood, Sharif, S, (2005), Physico-chemical and fungal analysis of a fertilizer factory effluent, Nature Environment & Pollution Technology, 4(4), 529-531.

5. Agarwal, Animesh and Manish, Saxena, (2011), Assessment of pollution by Physicochemical Water Parameters Using Regression Analysis: A Case Study of Gagan River at Moradabad- India, Advances in Applied Science Research, 2(2), pp 185 -189.

6. APHA, (1985), Standard Methods For Examination of Water and Wastewater, 20th Edition, American Public Health Association, Washington D. C.

7. ASTM International, (2003), Annual Book of ASTM Standards, Water and Environmental Technology v. 11.01, West Conshohocken, Pennsylvania,pp 6-7.

8. Basavaraja, Simpi, S. M., Hiremath, K. N. S. Murthy, K. N. Chandrashekarappa, Anil N. Patel, E.T.Puttiah, (2011), Analysis of Water Quality Using Physico-Chemical Parameters Hosahalli Tank in Shimoga District, Karnataka, India, Global Journal of Science Frontier, Research, 1(3), pp 31-34.

9. Chavan, R. P., Lokhande, R. S., Rajput, S. I., (2005), Monitoring of organic pollutants in Thane creek water, Nature Environment and Pollution Technology, 4(4), pp 633-636.

10. DeGrandpre, M. D, 1993. Measurement of seawater *p*CO2 using a renewable-reagent fiber optic sensor with colorimetric detection, Analytical Chemistry, 65, pp 331-337.

11. Dey, Kallol, Mohapatra, S. C., Misra, Bidyabati, (2005), Assessment of water quality parameters of the river Brahmani at Rourkela, Journal of Industrial Pollution Control, 21(2), 265-270.

12. Dickson, A. and Goyet, C, (1994), DOE Handbook of Methods for the Analysis of the Various Parameters of the Carbon Dioxide System in Sea Water, Version 2.

13. Drinking Water Inspectorate, available at http//www.dwi.gov.uk, accessed during September 2012.

14. Ellis, K.V., (1989), Surface water pollution and its control" Macmillan press Ltd, Hound mill, Basingstoke, Hampshire RG 21 2xs and London, 3-18, pp 97,100,101 and 208.

15. Gnana Rani, D. F., Arunkumar, K., Sivakumar, S. R., (2005), Physio-chemical analysis of waste water from cement units, Journal of Industrial Pollution Control, 21(2), 337-340.

16. Gran, G., (1952), Determination of the equivalence point in potentiometric titrations. Part II. Analyst, 77,pp 661-671.

17. Gupta, D. P., Sunita and J. P. Saharan, (2009), Physiochemical Analysis of Ground Water of Selected Area of Kaithal City (Haryana) India, Researcher, 1(2), pp 1-5.

18. Hari, O. S., Nepal, M. S. Aryo, and N. Singh. (1994), Combined effect of waste of distillery and sugar mill on seed germination, seeding growth and biomass of okra. Journal of Environmental Biology, 3(15), pp 171-175.

19. Hemkes, O. J, Kemp, A, Van, B. L.W., (1980), Accumulation of heavy metals in the soil due to annual dressings of sewage sludge, New Zealand Journal of Agricultural Sciences. 28, 228-238.

20. Hopkinson, C.S, (1985), Shallow-water and pelagic metabolism: Evidence of heterotrophy in the near-shore Georgia Bight, Marine Biology, 87, pp 19.

21. Indian Standard Specification for Drinking Water; IS: 10500: 1992. (Reaffirmed 1993)

www.IndianJournals.com
Members Copy, Not for Commercial Sale
Downloaded From IP - 18.97.14.83 on dated 19-Feb-2025

22. Jena, P. K., Mohanty, M, (2005), Processing of liquid effluents of mineral processing industries, Intl Symposium Environ Manag Mining Metallurgical Industries, 11-14 , Bhubaneshwar, pp 193- 212.

23. Karanth, K. R, (1987), Groundwater Assessment Development and Management Tata McGraw Hill publishing company Ltd., New Delhi, pp 725-726..

24. Kataria, H. C., Quershi, H. A., Iqbal, S. A. and Shandilya, A. K, (1996),Assessment of water quality of Kolar reservoir in Bhopal (M.P.). Pollution Research. 15(2)**,** pp 191-193.

25. Kodarkar, M. S., (1992), Methodology for water analysis, physico-chemical, Biological and Microbiological Indian Association of Aquatic Biologists Hyderabad, Pub. 2 : pp. 50.

26. Krishnamurthy, R., (1990), Hydro-biological studies of Wohar reservoir Aurangabad (Maharashtra State) India, Journal of Environmental Biology, 11(3), 335-343.

27. Kulkarni, G. J., (1997), Water supply and sanitary engineering. 10^{th} Ed. Farooq Kitabs Ghar. Karachi, 497.

28. Manjare, S. A., S. A. Vhanalakar and D. V. Muley, (2010), Analysis of water Quality using Physico-Chemical parameters Tamdalge Tank in Kolhapur District, Maharashtra, International Journal of Advanced Biotechnology and Research, 1(2), pp 115-119.

29. Milacron Marketing Co., The Effects of water Impurities on Water-Based Metal working fluids, Technical Report No. J/N 96/47.

30. Misra, S. G., Dinesh, D., (1991), Soil Pollution, Ashing Publishing House, New Delhi, India

31. Morrissette, D. G., and Mavinic, D. S., 1978. BOD Test Variables. Journal of Environment: Engg. Division, EP, 6, 1213-1222.

32. Moss, B., (1972), Studies on Gull Lake, Michigan II. Eutrophication evidence and prognosis, Fresh Water Biology, 2**,** pp 309-320.

33. National Primary Drinking water regulations, Drinking water contaminants US EPA.

34. Navneet, Kumar, D. K. Sinha, (2010), Drinking water quality management through correlation studies among various physicochemical parameters: A case study, International Journal of Environmental Sciences, 1(2), pp 253-259.

35. Pawar, Anusha, C., Nair, Jithender, Kumar, Jadhav, Naresh, Vasundhara, Devi, V., Pawar, Smita, C., (2006), Physico-chemical study of ground work samples from Nacharam Industrial area, Hyderabad, Andhra Pradesh, Journal of Aquatic Biology, 21(1), pp 118-120.

36. Poonkothai, M., Parvatham, R., 2005. Bio-physico and chemical assessment of automobile wastewater, Journal of Industrial Pollution Control, 21 (2), pp 377-380.

www.IndianJournals.com
Members Copy, Not for Commercial Sale
Downloaded From IP - 18.97.14.83 on dated 19-Feb-2025

37. Premlata, Vikal, (2009), Multivariant analysis of drinking water quality parameters of lake Pichhola in Udaipur, India. Biological Forum, Biological Forum- An International Journal, 1(2), pp 97-102.

38. Quinn, B. F., Syers, J. K., (1978), Surface irrigation of pasture with treated sewage effluent, heavy metal content of sewage effluent, sludge, soil and pasture, New Zealand Journal of Agricultural Research. 21, pp 435-442.

39. Riley, J. P. and G. Skirrow, Eds., Chemical Oceanography, Academic Press, London and New York.

40. Riordan, O', E. G., Dodd, V. A., Tunney, H., Fleming, G. A, (1983), The chemical composition of sewage sludges, Ireland Journal of Agriculture Research, 25, 239-49.

41. Robertson, D. E, 1968. Role of contamination in trace element analysis of sea water. Analytical Chemistry, 40(7), pp 1067-1068.

42. Rokade, P. B., Ganeshwade, R. M., (2005), Impact of pollution on water quality of Salim Ali Lake at Aurangabad, Uttar Pradesh, Journal of Zoology, 25(2), pp 219-220.

43. Saravanakumar, K. and R. Ranjith, Kumar, (2011), Analysis of water quality parameters of groundwater near Ambattur industrial area, Tamil Nadu, India, Indian Journal of Science and Technology, 4(5), pp 1732-1736.

44. Sawane, A. P., Puranik, P. G., Bhate, A. M., (2006), Impact of industrial pollution on river Irai, district Chandrapur, with reference to fluctuation in CO2 and pH, Journal of Aquatic Biology, 21(1), pp 105-110.

45. Sharma, Madhvi, Ranga, M. M., Goswami, N. K., (2005), Study of groundwater quality of the marble industrial area of Kishangarh (Ajmer), Rajshthan, Nature Environmental and Pollution Technology, 4(3), pp 419-420.

46. Singhal, V., Kumar, A., Rai, J. P. N., (2005), Bioremediation of pulp and paper mill effluent with *Phanerochaete chrysosporium*, Journal of Environmental Research, 26(3), pp 525-529.

47. Smith, S.V. and Hollibaugh, J. T, (1993), Coastal metabolism and the oceanic organic carbon balance, Reviews of Geophysics, 31, pp 75-76.

48. Smith, S.V. and Hollibaugh, J. T, (1997), Annual cycle and interannual variability of ecosystem metabolism in a temperate climate embayment, Ecology/Ecological Monographs, 67, 509.

49. Trivedy, R. K., and Goel P. K., (1986), Chemical and biological methods for water pollution studies, Environmental Publication, Karad, Maharashtra.

50. United States Environmental Protection Agency, (2009), 816-F-09-004.

51. Wang, Z., Wang, Y. and Cai, W.-J. and Liu, S. Y, (2002), A long lathlength spectrophotometric *p*CO2 sensor using a gas-permeable liquid-core waveguide, Talanta, 57, pp 69-80.

www.IndianJournals.com
Members Copy, Not for Commercial Sale
Downloaded From IP - 18.97.14.83 on dated 19-Feb-2025

52. WHO Geneva, (2008), Guidelines for drinking-water quality (electronic resource), 3rd edition incorporating 1st and 2nd addenda, Volume 1, Recommendations.

53. WHO guidelines for drinking water quality. 2nd edition. Recommendation. World Health organization Geneva, 1, pp 30-113.

www.IndianJournals.com
Members Copy, Not for Commercial Sale
Downloaded From IP - 18.97.14.83 on dated 19-Feb-2025