Importance of Physico-Chemical and Bacteriological Parameters in Reckoning Water Quality: A Review

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Abstract

Since it is impractical to assess water quality simply by its appearance, so various parameters (physical, chemical and bacteriological) has to be considered while evaluating water quality. A selection of parameter for determining water quality is totally based on the purpose of its use and the extent of required water quality and purity.

Levels of chemicals like Calcium ,Magnesium, Chlorides, Dissolved Oxygen (D.O), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) as well as pH, Colour, Temperature, Transparency, Turbidity ,Odour ,microbial pathogens etc. are some of the important parameters in water quality assessment. The present review paper depict about the importance of various parameters in reckoning water quality to check its suitability for drinking purpose, industrial purpose or marine life etc.

Keywords*: Biochemical oxygen demand (BOD), Parameters, Turbidity, microbial pathogens*

1. Introduction

Water is the most important resource present in ecosystem. Life is impossible without water. The quality of water usually defined according to its physical, chemical and biological characteristics .Now a days, water quality is degrading due to human activities and contaminants. As a result of water contamination water quality is degrading. Regular consumption of contaminated water results into serious water borne diseases. About 80% of diseases in human being are caused by water (Neeraj Kalra,2012).Therefore it is mandatory to analyse water quality at regular interval of time .This review article is to assess various parameter of water which   describe water quality.

2. Material and Methods

Contaminants or pollutants affect the water quality in a symbiotic manner and it cannot be detected only with particular physical, chemical or biological parameter .All the parameter that defined water   quality   are   equally   responsible   in characterising water quality and therefore its uses .Following parameters should be   analysed   for water quality assessment :

2.1. pH (Potential of Hydrogen)

pH is the measure of hydrogen ions in the water. According to BIS (Bureau of Indian Standards), pH level of water should have desirable limit 6.5 to 8.5 .Water with lower pH is considered acidic while water with higher pH is alkaline in nature.

2.2. Electrical Conductivity

Conductivity is a measurement of the ability of an aqueous solution to carry an electrical current .It is directly related to concentration of ions in water. According to BIS, desirable limit of conductivity should be 600 µm/cm.

2.3. Alkalinity

It can be defined as tendency of water to neutralise acids .Potable water should have 120mg/L of alkaline ions and the maximum permissible limit is 600mg/L. High alkaline water cause eye irritation in humans and disease like chlorosis in plants (Sisodia & Moundiotiya ,2006). Alkalinity is measured by acid base titration and is expressed in mg/L in term of $CaCO_3$ equivalent.

2.4. Total Dissolved Solids (TDS)

It is a measure of combined content of all organic and inorganic substance contained in water in

ionized/molecular /suspended form .It is calculated by TDS meter and according to BIS, permissible limit of TDS in water should be 500mg/L .

2.5. Temperature

It is the most important factor that affect metabolic rate of living organisms. It is measured by thermometer and should be max 20-25 ^{0}C.

2.6. Hardness

Hardness can be defined as soap precipitating power of water or property of water which prevent leather formation with soap. The limit of total hardness (temporary and permanent) for drinking water is to be within 300mg/L in terms of $CaCO_3$ equivalents .It is done by complexometric titration using standard EDTA and EBT as indicator. High concentration of hardness results in heart disease and kidney stones.

2.7. Chloride

Presence of organic pollution in water results in high concentration of chlorides (Yogendra and Pottaiah, 2008).Acc to BIS, the permissible limit of chlorides in water is 250mg/L .In drinking water ,high chloride content results in laxative effect (Ravi Prakash and Rao 1989) .Chloride can be determined by Argentometric titration using potassium chromate as indicator. The end point is considered when white precipitate of AgCl converts into red precipitate of Ag_2CrO_4.

2.8. Turbidity

Presence of turbid particles defined turbidity of water .It is measured by Nephelometer which measures the intensity of scattered light by turbid particles of water at right angle to the incident beam of light in comparison with the intensity of light passing through the sample.

2.9. Appearance

Potable water should appear clear.

2.10. Sulphate

Sulphate ions usually occur in natural waters .These are measured by the Nephlometric method in which concentration of turbidity is measured against concentration of synthetically prepared sulphate   solution.

2.11. Calcium

A complexometric titration is considered by using standard EDTA solution and EBT as indicator in presence of ammonia buffer for maintaining pH at 10.

2.12. Magnesium

A complexometric titration is considered by using standard EDTA solution and EBT as indicator in presence of ammonia buffer for maintaining pH at 10.

2.13. Iron

Our blood has an important element which is iron. Drinking water must contain a maximum of 0.3 ppm of iron in it (P.Tambkar 2013).

2.14. Sodium and potassium

Flame photometer is used for measuring the concentration of sodium and potassium in water. The instrument used for the elemental determination is standardized with the known concentration of sodium ion (1 to 100 mg/l) and potassium ion (1 to 5 mg/l). Water softened by Zeolite process contains high concentration of sodium while Potassium is a fundamental element in both plant and human nutrition and occurs in groundwater as a result of mineral dissolution (APHA 2005).

2.15. Fluoride

Fluoride is determined by ELICO spectrophotometer. High concentration of fluoride in water leads to dental fluorosis and skeletal fluorosis.

2.16. Microbial Pathogens

It is the method of evaluating number of bacteria present in water which are responsible for its bad taste and odour. Bacteriological analysis can be carried out by Plate count method. This method depends on growing a colony of bacteria on a nutrient medium .The colony gets visible to the naked eye and can be counted easily. For accuracy, the dilution of the original sample must be done in such a manner so that on average between 30 and 300 colonies of the target bacterium is grown on the nutrient medium.

Various parameters with their analytical methods and BIS specifications

S. No.	Parametrs	Equipments/ Methods	Bis Specifications
1.	$_pH$	$_pH$	6.5-8.5
2.	Electrical conductivity	Conductivity meter	600 µm/cm.
3.	Alkalinity	Acid base titration	200 mg/L
4.	TDS	TDS meter	500 mg/L
5.	Temperature	Thermometer	20-25^{0}C
6.	Hardness	Complexometric titration	300mg/L
7.	Chloride	Argentometric titration	250mg/L
8.	Turbidity	Nephlometer	1 NTU
9.	Appearance	Eye	Clear
10.	Sulphate	Nephlometer	200mg/L
11.	Calcium	EDTA Method	75mg/L
12.	Magnesium	EDTA Method	30mg/L
13.	Iron	Redox Titration	0.3mg/L
14.	Sodium & Potassium	Flame photometer	1-100 &1-5 mg/L
15.	Fluoride	ELICO Spectrophotometer	1 mg/L
16.	Microbial pathogens	Plate count method	Very few

3. Literature Review

Several research papers were considered and referred on physico-chemical analysis of water which may be surface water as well as ground water of various cities. These parameters are compared with BIS specification to evaluate the quality of water for its suitability for drinking purpose, irrigation purpose and domestic purpose. The comprehensive literature review was carried out by referring standard journal and reference books.

Vikas Tomar et.al [01] collected water samples from 67 locations during pre and post-monsoon seasons of the year 2011 from Karnal district, Haryana and were analysed for chemical characteristics. It was found the water contains a large concentration of sodium-calcium bicarbonate and magnesium bicarbonate salts during pre and post-monsoon seasons of the year 2011 respectively.

Sarala C.et.al [02] has studied the physico-chemical parameters of the surrounding wells of Jawaharnagar in Andhra Pradesh. The bore wells data was collected from the study area for two seasons i.e., post monsoon in December 2007and pre monsoon in June 2008. The groundwater is acidic in nature and very hard. It was done by using Arc GIS software. The study reveals that the total hardness and fluoride concentrations were high in water samples.

Yadav (2010), Rasayan, did experimental work on physico–chemical properties of ground water taken from four blocks (Suar, Milak, Bilaspur, Shahabad) of Rampur district, Uttar Pradesh, India. Only eight locations show quality of ground water suitable for drinking water.

Shah (2012), report about quality of drinking water samples of kathalal territory, Gujarat .Water samples from twenty different locations bore wells water samples were collected for physico-chemical analysis. Studies shows that most of water samples in that area were suitable for drinking purpose and only simple water treatment methods are enough to make the water potable.

V. Pradhan, M. Mohsin, B. H. Gaikwad [05] has studied water quality of Chilika Lake during the month of January 2012. It was observed that all the parameters were above permissible limit except few samples.

S. Chandra, A. Singh and P. K. Tomar [06] have described, lake water is a source of drinking and domestic use water for rural and urban population of India. Water from Porur lake of Chennai, Hussain Sager lake of Hydrabad and Vihar Lake of Mumbai was analysed. For this, lakes water samples were collected from six different sites and various physico-chemical parameters were analysed .Some heavy metals like Iron, Zinc, Cadmium, Mercury, Nickel and Chromium were analyzed in those samples. Water pollution indicates that these parameters were many times higher than the prescribed limit by the WHO & BIS standard.

 Rajesh Kumar (2011), carried out water analysis of ground water quality in and around shahzad Nagar block of Rampur district, Uttar Pradesh, India. For water analysis, ground water samples from twenty five locations were selected and analysis of water was carried out using standard methods. Physico-chemical parameters were compared with WHO, USPH, European and ICMR Standards shows considerable variation. The statistical analysis

showed that electrical conductivity has positive and significant correlation with TDS, Calcium, sodium, sulphate, magnesium etc.(Makwana, 2012).They carried out work on drinking water collected from fifteen sampling stations of water (bore well, wells and lacks) of Gandhinagar territory area to determine water quality index.Analysis shows that parameters of drinking water shows the variation from prescribed value.

M. Pejaver and M. Gurav [08] have explained, the two lakes namely Kalwa and Jail lake of Thane city were considered to study various physico-chemical parameters for the period of 6 months. The Jail Lake was found to be more polluted than the Kalwa Lake.

S. Hussaina, V. Maneb, et al. [09] have studied various samples from treatment plant of Ahmedpur, Dist Latur .Various physico chemical properties like pH, conductivity, Turbidity, TDS, Dissolved oxygen, fluoride, chloride, Sodium, Sulphate, etc. were analysed and the values were compared for treated and untreated water samples.

Usha (2013) carried out work on urban water bodies in Bilari town of Moradabad (Uttar Pradesh) to determine water quality index and fitness of Ground water samples in three different months January, June and September 2011.Samples were collected from ten different sites. Analysis of ground water samples were carried out for different physico-chemical parameters. Water quality index shows that contamination of water increases day by day. So require treatment for purification before use.

4. Conclusion
Water pollution is not only disastrous to humans but also threatening to animals, birds and marine animals. Due to this, aquatic life is destroying and its reproductive ability is reducing. Such polluted water is inadequate for drinking, agricultural and industrial purpose. The purpose of present review paper is to bring an intense awareness in society about the importance of quality of water, as water quality is dependent on the type of the pollutant added and the nature of self purification of water.

So water pollution can be minimized by simple housekeeping and management practices.

References
[1] VikasTomar, Kamra S.K, Kumar S, Kumar Ajay and Vishal Khajuria, "Hydro-chemical analysis and evaluation of groundwater quality for irrigation in Karnal district ofHaryana state, India", International Journal of Environmental Sciences, Volume 3, No 2, 2012, pp.756-766.

[2] Sarala C, Ravi Babu P, " Assessment of Groundwater Quality Parameters in and around Jawaharnagar, Hyderabad, International Journal of Scientific and Research Publications, Volume 2, Issue 10, 2012, pp.1- 6.

[3] Yadav S.S and Rajesh Kumar, Assesment of physico–chemical properties of ground water taken from four blocks (Suar, Milak, Bilaspur, Shahabad) of Rampur district, Uttar Pradesh, India, Rasayan J.Chem, 3, 2010, 589-596.

[4] Shah D.G and Patel P.S, Water quality of some drinking water samples of Kathalal territory, Gujarat, J.Chem. Pharm. Res, 4 (4), 2012, 2285-2287.

[5] V. Pradhan, M. Mohsin, B. H. Gaikwad - "Assessment of physico chemical parameters of Chilika Lake water", International Journal of Research in Environmental Science and Technology, 2(4): 101-103, 2012.

[6] S. Chandra, A. Singh and P. K. Tomar - "Assessment of Water Quality Values in Porur Lake Chennai, Hussain Sagar Hyderabad and Vihar Lake Mumbai, India", Chem Sci Trans., 1(3), 508-515, 2012.

[7] Rajesh Kumar and Yadav S.S, Correlation analysis of ground water quality in and around shahzad Nagar block of Rampur district, Uttar Pradesh, India, Int. J. Chem. Sci, 9 (1), 2011, 440-447.

[8] M. Pejaver, M. Gurav - "Study of Water Quality of Jail and Kalwa Lake, Thane, Maharashtra", J. Aqua. Biol. Vol. 23(2), 44 -50, 2008

[9] S. Hussaina, V. Maneb, S. Takdea, A. Pathanc, M. Farooquic - " Comparison between Treated and Untreated water so as to study water treatment plant of Ahmadpur Dist. Latur," International Journal of Modern Engineering Research (IJMER) www.ijmer.com, Vol.1, Issue2, pp- 564-569, ISSN: 2249-6645.

[10] Usha, Shamim Ahmad and Pramendra Kumar, Determine water quality index and fitness of urban water bodies in Bilari town of Moradabad (Uttar Pradesh), J. Chem. Pharm. Res, 5 (11), 2013,726-731.