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Study of the physio-chemical parameters for testing water: A review

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Abstract

Due to undesired changes in the physical, chemical and biological characteristics of air, water and soil people on global scale are under threat. Due to increased human population, industrialization, use of fertilizers and man-made activity water become highly polluted. Hence the quality of drinking water should be checked at regular time of interval, because due to use of contaminated water, human population suffers from various water brone diseases, like cholera, hepatitis, dysentery, typhoid etc. The good quality of water prevents many diseases and saves the life of human beings. Hence it is necessary to know about different physic-chemical properties such as colour, temp, acidity, hardness, PH, DO, BOD, alkalinity, sulphate, chloride used for testing the water quality. 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.

Keywords: Water; Physico-Chemical parameters; Hardness; BOD

1. Introduction

Water is one of the most important and essential compounds of the ecosystem. All living organisms on the earth need water for their survival and growth. As earth covers 70% of water, hence it is some time well known as water planet. But due to increased human population, industrialization, use of fertilizers and man-made activities, it gets highly polluted. Therefore it is necessary that the quality of drinking water should be checked at regular time interval, because such polluted water is unfit for human population, as a result human suffers from different water borne diseases such as typhoid, cholera, dysentery, hepatitis etc. It is difficult to understand the biological phenomenon fully because the chemistry of water reveals 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 into aquatic system by different ways such as weathering of rocks and leaching of soils, dissolution of aerosol particles and from several human activities. People on global scale are under tremendous threat due to undesired changes in the physical, chemical and biological characteristics of air, water and soil. These are related to fauna and flora and finally affecting on it (Misra and Dinesh 1991). Many industrial development results in the generation of industrial effluents, and it results in water pollution as well as soil pollution. High levels of pollutants mainly organic matter in water bodies create and increase in biological oxygen demand (Kulkarni, 1997) chemical oxygen demand, total dissolved solids, total suspended solids etc. They make water unfit for drinking, irrigation or any other purpose (Hari, 1994). In many parts of the country available water is rendered non potable because of the presence of heavy metals in excess. This situation gets worsened during the summer season due to water scarcity and rain water discharge. Contamination of water resources available for

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household and drinking purposes with heavy elements, metal ions and harmful micro-organisms is one of the serious major health problems.

Most of the rivers in the urban areas of the developing countries are the ends of effluents discharged from the industries. Developed countries experiencing rapid industrial growth and this is making environmental conservation a difficult task (Agarwal Animesh, 2011).

2. Physico-chemical Parameters

These parameters are very essential and important to test water before used for various purposes. Selection of parameters for testing is depends upon for what purpose water using and what extent we need of water quality and purity. Water contains many contents that include floating, dissolved, suspended, microbiological and bacteriological impurities. Some physical parameters are tested for physical appearance of water such as temp, color, odour, PH turbidity, TDS etc. while chemical parameters are tested for its chemical appearance like BOD, dissolved oxygen, alkalinity, hardness and other characteristics for obtaining more and more quality and purity, water should be tested for its trace metal, heavy metal content and organic residues. It is obvious that drinking water should pass these all tests and it should contain required amount of mineral level. Following some physic-chemical parameters are tested regularly for monitoring water quality.

2.1. Temperature

The water temperature controls the rate of all chemical reactions and also affects fish growth, reproduction and immunity of fishes.

2.2. PH

PH is the most important physical characteristics of water. PH is positively correlated with electrical conductance and total alkalinity (Gupta 2009). The reduced rate of photosynthesis, assimilation of carbon dioxide and carbonates are responsible for increase in PH of water. Many factors brings about changes in PH of water, it may be high or low. The higher PH value suggests that Co_2, carbonate, bicarbonate equilibrium is affected more due to change in physic chemical characteristics (Karanth 1987).

2.3. Carbon Dioxide

O_2 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). Co_2 is also the most important greenhouse gas on Earth.

There are various measurable parameters of aquatic Co_2 system such as PH (PCo_2), total dissolved inorganic carbon (DIC) and total alkalinity (TA). Surface water (PCo_2) can be measured by photometric method (Wangz 2002) and DIC Co_2 is measured by coulometer (Dickson 1994) TA Co_2 is measured by HCl titration of the water sample to the Co_2 equivalence point (Gran 1952).

2.4. Dissolved Oxygen

DO is also one of the most important parameter. Its correlation with water body gives direct and indirect information of bacterial activity, photosynthesis, availability of nutrients, stratification etc. (Premalata Vikal 2009). In summer DO decreased due to increase in temperature and microbial activity (Moss 1972, Kataria 1996). During summer the long days and intense sunlight seems to accelerate photosynthesis by phytoplankton, utilizing Co_2 and giving off O_2. This accounts for the greater qualities of O_2 recorded during summer (Krishnamurthy R. 1990).

DO is measured titrimetrically by Winkler's method after five days incubation at 293 k. The difference in initial and final DO gives the amount of O_2 consumed by the bacteria during this period.

2.5. Alkalinity

It is composed of carbonate (Co_3) and bicarbonate (HCO_3). Alkalinity acts as a stabilizer for PH. Alkalinity, PH and hardners affect the toxicity of many substances in the water. It is determined by dilute HCL titration in the presence of phenolphthalein and methyl organe indicators.

2.6. Carbonate and Bicarbonate

When the PH of water becomes 8.3, this indicates the presence of carbonates. It is measured by titration method with standard HCl using phenol as indicator. Below the PH of water than 8.3, the carbonates are converted into bicarbonates.

Bicarbonate also measured by titration with standard HCl using methyl organe as indicator. Methyl organe turns yellow below PH 4.0 at this PH, the carbonic and decomposes to give Co_2 and H_2O

2.7. Biological Oxygen Demand (BOD)

BOD is a measure of organic material contamination in water, specified in mg/l. BOD is the amount of dissolved O_2 required for the biochemical decomposition of organic compounds and the oxidation of certain inorganic material. The test for BOD is conducted over a five day period (Milacron Marketing Co.)

2.8. Chemical Oxygen Demand (COD)

COD is also a measure of organic material contamination in water in mg/l. It is the amount of dissolved O_2 required to cause chemical oxidation of the organic material in water. Both BOD and COD are key indicators of the environmental health of water. These are commonly used in waste water treatment but rarely in general H_2O treatment. (Milacron Marketing Co.)

2.9. Sulphate

It is measured by nephelometric method in which the concentration of turbidity is measured against the known conc. of sulphate solution. Barium chloride is used for producing turbidity due to barium sulphate and a mixture of organic substance and sodium chloride is used to prevent the setting of turbidity.

2.10. Calcium

It is measured by complex metric titration with standard solution of EDTA 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 tire (EDTA soln.) against the known volume of sample gives the concentration of calcium in the sample.

2.11. 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.

2.12. 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.

2.13. Potassium

It is also measured with the help of flame photometer the instrument is standarilized with known concentration of potassium sol^n, 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.

2.14. Chloride

It is measured by titrating a known volume of sample with standard silver nitrate sol^n. using potassium chromate sol^n. in water as an indicator. Eosin or fluorescein sol^n. in alcohol also used as another indicator. The eosin indicator is an adsorption indicator while the potassium chromate makes a red coloured compound with silver as soon as the chlorides are precipitated from sol^n.

Table 1 Different 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
1	Color	Visual color kit	-	5 Hazen unit	-
2	Odour	Physiological sense	Acceptable	Acceptable	-
3	Temp.	Thermometer	-	-	-
4	PH	PH meter	65.-9.5	65.-9.5	65.-9.5
5	Dissolved O_2	Redox titration	-	-	-
6	Alkalinity	Acid-base titration	-	200 ppm	-
7	Carbonate & Bicarbonate	Titration	-	-	-
8	BOD	Incubation followed by titration	6	30	5
9	COD	COD giester	10	-	40
10	Chloride	Argentometric titration	250 ppm	250 ppm	250
11	Magnecium	Complexo metric titration	150 ppm	30 ppm	-
12	Potassium	Flame photometer	-	-	-
13	Sodium	Flame photometer	200 ppm	180 ppm	200
14	Sulphate	Nephelometer Turbidimeter	250 ppm	200 ppm	250
15	Calcium	Complexometri c titration	-	-	-

Ref: WHO, USEPA, Indian Standard, National Primary Drinking Water Regulations, Drinking Water Contaminants USEPA)

Table 2 Different water quality parameters used for testing of quality of water and their source of an occurrence and potential health effects with USEPA guidelines

Sr.No.	Parameters	Source of occurrence	Potential health effect
1	Turbidity	Soil runoff	Higher level of turbidity are associated with disease causing bacteria
2	Color	Due to present of dissolved salts	-
3	Odor	Due to biological degradation	Bad odor unpleasant
4	PH	PH is changed due to different dissolved gases and solids	Affects mucous membrane, bitter taste
5	Dissolved Oxygen (DO)	Presence due to dissolved oxygen	DO corrode waterlines, boilers and heat exchangers at low level marine animals ant surive
6	Total Alkalinity	Due to dissolved gases (Co_2)	Embrittlement of boiler steel, boiled rice turns yellowish
7	TDS	Presence all dissolved salts	Undesirable taste, gastro-intestinal irrigation, corrosion
8	BOD	Contamination due to organic matter	High BOD decreases level of dissolved O_2
9	Calcium	Precipitate soaps, anionic	Interference in dyeing textile
10	Magnesium	Surfactants, anionic, emulsifiers	Paper industry
11	Carbonate	Due to dissolution of Co_2	Product imbalance, unsatisfactory production short product life

12	Chloride	Water additive used to control microbes, disinfect	Eye/nose irritation, stomach discomfort
13	Sodium	Natural component of water	-
14	Sulphate	Due to dissolved ca/mg/Fe sulphates	Taste affected, gastro-intestinal irrigation

3. Conclusion

A study of physico-chemical parameters for testing water showed that, these parameters are essential for to test water whether water is clear or away from pollution. On these parameters one can come to conclusion, that water is potable for domestic uses as well as for crop field. Hence the study has taken in to consideration.

Compliance with ethical standards

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