IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

ASSESSMENT OF WATER QUALITY PARAMETERS

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Abstract: The water is a primary natural resource for people for different consumptions such as drinking, irrigation, hydro-electricity, fish fostering and recreation; therefore, it requires at least an acceptable level of water quality. The quality of water usually described according to its physical, chemical and biological characteristics. Due to use of contaminated water, human population suffers from water borne diseases. It is therefore necessary to check the water quality at regular interval of time. Parameters that may be tested include pH, conductivity, turbidity, hardness, dissolved oxgyen, alkalinity, total dissolved solids, iron, sulphates and chlorides. Five different samples at five different locations are taken for sampling, Industrial area (Steel Plant), Seashore area (Bheemili), Agricultural area (Anandapuram), Slum area (Allipuram), Hilly area (Kommadi) are selected and the water quality parameters are studied and compared with the Standard water quality parameters.

IndexTerms **- Alkalinity, Conductivity, Dissolved Oxgyen, Hardness, Total Dissolved Solids, Turbidity**

I. INTRODUCTION

Introduction

Water quality refers to the chemical, physical, biological, and radiological characteristics of water. It is a measure of the condition of water relative to the requirements of one or more biotic species, or to any human need or purpose. Human activities that involve urbanization, agricultural development, over use of fertilizers, inadequate management of land use and sewage disposal have directly or indirectly affected the quality of water and making it unfit for different purpose. Therefore now a day's fresh water has become a scare commodity due to over exploitation and pollution. Water quality is largely determined by both natural processes including the lithology of the basin, atmospheric inputs and climatic conditions, and by anthropogenic inputs. In this paper, some parameters assessing the quality of water has been presented with past work carried out by scientist and academicians related with quality of water.

According to WHO estimate about 80% of water pollution in India is due to domestic waste. The improper management of water systems may cause serious problems in availability of drinking water. Water resource is most often polluted by industrial effluents. When waste from different industry are discharged without proper treatment in to the water. The physical, chemical and biological characteristics of water are altered in such a way that they are not useful for the purpose for which they are intended.

Need of the Study

The need of study of surface water quality is one of the major issues today due to increasing the load of pollution from industrial, commercial and residential with its effects on human health and aquatic ecosystems.

II. WATER QUALITY PARAMETERS AND ITS SIGNIFICANCE

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 physio-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 pH, turbidity, conductivity, TDS etc, while chemical tests should be perform for its dissolved oxygen, alkalinity, hardness, chlorides, iron, sulphate and fluorides.

pH- pH is an indicator of the existence of biological life as most of them thrive in a quite narrow and critical pH range. A lower value of pH below 4 produces sour taste and higher value above 8.5 an alkaline taste. Extreme pH can result in rapid disturbance to both aquatic life, flora and fauna.

Turbidity -Turbidity may be due to organic and/or inorganic constituents. Organic particulates may harbour microorganisms. Thus, turbid conditions may increase the possibility for waterborne disease. The turbidity of drinking water should not be more than 5 NTU, and should be ideally below 1 NTU. Low Turbidity value indicates high water clarity, high value indicates low water clarity.

Conductivity- Conductivity indicates the presence of ions within the water, usually due to in majority, saline water and in part, leaching. It can also indicate industrial discharges. . It is an important parameter for determining suitability of water and waste water for irrigation.

TDS- The total dissolved solids (TDS) in water consist of inorganic salts and dissolved materials. In natural waters, salts are chemical compounds comprised of anions such as carbonates, chlorides, sulphates, and nitrates (primarily in ground water), and cations such as potassium (K), magnesium (Mg), calcium (Ca), and sodium (Na). In ambient conditions, these compounds are present in proportions that create a balanced solution. Dissolved solids in higher concentration reduce its palatability.

DO- DO is essential for aquatic life. A low DO (less than 2mg/l) would indicate poor water quality and thus would have difficulty in sustaining many sensitive aquatic life.

Alkalinity- Alkalinity is the sum total of components in the water that tend to elevate the pH to the alkaline side of neutrality. It is measured by titration with standardized acid to a pH value of 4.5 and is expressed commonly as milligrams per liter as calcium carbonate (mg/L as CaCO3).

Alkalinity is a measure of the buffering capacity (ability to resist changes in pH) of the water, and since pH has a direct effect on organisms as well as an indirect effect on the toxicity of certain other pollutants in the water, the buffering capacity is important to water quality. It is caused due to carbonates and bicarbonates. In polluted waters, silicates, phosphates, borates, hamates also contribute to Alkalinity of water. Alkalinity value is important for calculating alum dosage.

Total Hardness-The hardness of water is not pollution parameter but indicates low salinity due to the presence of calcium and magnesium ions expressed as $CaCo_3$ (temporary hardness), largely combined with bicarbonate and carbonate and with sulfates, chlorides, and other anions of mineral acids (permanent hardness).

The water containing excess hardness is not desirable for potable water as it forms scales on water heater and utensils when used for cooking and consume more soap during washing of clothes. The determination of hardness is carried out by titrating water sample with sodium salt of Ethylene Diamine Tetra Acetic Acid (EDTA) using Eriochrome Black -T as an indicator and keeping the P^H of the water at 10.0.

Chlorides- High chloride content in water sample may be due to the pollution from rich effluent of sewage and municipal waste however chloride in excess imparts salty taste to water and people who are not accustomed to high chloride are subjected to laxative effect. They occur naturally in waters. Discharge of sewage contributes to chloride. Therefore chlorides serve as an indicator pollution by sewage.

Iron- Iron may be present in two forms, namely the reduced form (ferrous, Fe^{2}+) and the fully Oxidized form (ferric, Fe^{3}+). Ferric iron is seldom found in true solution in natural waters, unless they are highly acidic, because of the formation of insoluble ferric hydroxides. Since some iron may exist as iron hydroxide precipitates, therefore it is necessary to bring precipitated form(s) of iron back in 'to solution before oxidizing total iron content in water.

Sulphate- Sulphate are found in appreciable quantity in all natural waters, particularly high in arid and semi arid regions where natural waters in general have high salt content. Sulphate salts are mostly soluble in water and impart hardness. Water with high concentrations has a bitter test. Discharge of domestic and industrial waste increases its concentration. It also occurs naturally in water. Rainwater has high concentration of Sulphate in areas of high air pollution. Sulphate produces objectionable taste above 300 mg/l.

Fluoride- All water contains some fluoride. Usually, the fluoride level in water is not enough to prevent tooth decay; however, some groundwater and natural springs can have naturally high levels of fluoride. Fluoride has been proven to protect teeth from decay. Bacteria in the mouth produce acid when a person eats sugary foods.

Optimum contents of fluoride (0.5mg/l-WHO value) however are essential for the growth of bones and formation of dental enamel, while higher levels (>1.5 mg/L-WHO guideline value) in drinking water may pose a threat to human health such as dental fluorosis (even at 1mg/l), skeletal fluorosis, crippling skeletal fluorosis, renal diseases etc. Further, even at lower concentrations of fluoride, exposure over a long period of time can cause for kidney failures.

For this purpose the main Indian agencies are like Indian Council of Medical Research (ICMR), Bureau of Indian Standards (BIS), and Ministry of Works and Housing (MWH) whereas international agency is named as World Health Organization (WHO). Some important drinking water standards are as follows:

Table 1: Water Quality Parameters

Sr. No.	Parameters	ID	Units	BIS (10500-2012)		WHO (2004)
				Acceptable Limits	Permissible Limits	
1	Temperature	Temp.	^{o}C	--	--	15-35
2	Potential of Hydrogen	pH	--	6.5-8.5	No relaxation	6.5-8.5
3	Electrical Conductivity	EC	mic.mho/ cm	----	---	300
4	Total Dissolved Solids	TDS	mg/l	500	2000	1000
5	Alkalinity	Alk.	mg/l	200	600	---
6	Total Hardness	TH	mg/l	200	600	---
7	Calcium	Ca	mg/l	75	200	---
8	Magnesium	Mg	mg/l	30	100	---
9	Chloride	Cl	mg/l	250	1000	250
10	Sulphate	SO_4	mg/l	200	400	400
11	Dissolved Oxygen	DO	mg/l	4	6	
12	Biochemical Oxygen Demand	BOD	mg/l	---	---	5
13	Chemical Oxygen Demand	COD	mg/l	---	---	10
14	Nitrogen	NO_3	mg/l	45	---	---
15	Nitrogen as Ammonia	NH_3– N	mg/l	0.5	No relaxation	1.5
16	Nitrogen as Nitrite	NO_2-N	mg/l	---	---	---
17	Nitrogen as Nitrate	NO_3-N	mg/l	45	No relaxation	10

III TESTS CONDUCTED

[1] Determination of pH

pH of water is a measure of amount of hydrogen ions that is present in the water. It determines if the water is alkaline or acidic in nature. There are two methods involved in the determination of pH value of water.
They are: 1. Colorimetric Method 2. Electrometric Method

[2] Determination of Turbidity

Turbidity of water can be measured by using turbidimeters, the turbidity test is the extent to which light scattered or absorbed by suspended materials in water. The most commonly used method for the measurement of turbidity by nephelometer method.

[3] Determination of Conductivity

Conductivity is an expression of the ability of a water sample to carry an electric current. This can be measured by measuring the electrical resistance of the sample by using Digital Conductivity Meter. Conductivity is the reciprocal of the electrical resistance of a solution.

[4] Determination of Total Dissolved Solids

In a laboratory setting, the total dissolved solids is determined by filtering a measured volume of sample through a standard glass fiber filter. The filtrate (i.e., filtered liquid) is then added to a pre weighed ceramic dish that is placed in a drying oven at a temperature of $103^{0}C$.

[5] Determination of Dissolved Oxygen

Dissolved oxygen is used as an indicator of the health of a water body, where higher dissolved oxygen concentrations are correlated with high productivity and little pollution. The Winkler Method is a technique used to measure dissolved oxygen in freshwater systems.

[6] Determination of Alkalinity

Alkalinity is determined by titrating a water sample with a strong acid (such as chlorine and sulfuric acid) and expressed by the calcium carbonate content (mg/L) corresponding to the amount of acid consumed until the pH value reaches the prescribed value.

[7] Determination of Total Hardness

The estimation of hardness is based on complexometric titration. Hardness of water is determined by titrating with a standard solution of ethylene diamine tetra acetic acid (EDTA) which is a complexing agent. Since EDTA is insoluble in water, the disodium salt of EDTA is taken.

[8] Determination of Chlorides

Chloride ions are present in water in the form of compounds like NaCl, $CaCl_2$, $MgCl_2$ etc These chlorides are estimated by titrating with standard silver nitrate solution using potassium chromate indicator in the P^H range of 7 to 8.

[9] Determination of Iron

The phenanthroline method is the preferred standard procedure for the measurement of iron in water. Spectrophotometric methods is used to determine the concentration of iron in a water sample.

[10] Determination of Sulphate

Sulfate are found in appreciable quantity in all natural waters, particularly high in arid and semi arid regions where natural waters in general have high salt content. Water with high concentrations has a bitter test. Sulphate content in water is determined by Turbidimetric Method.

[11] Determination of Fluoride

To perform the test, the user must mix a 4 ml water sample and 1 ml zirconium xylenol orange reagent. The color changes from pink to yellow depends on the fluoride concentration in the sample. By comparing the color produced with the color chart, the fluoride content in the water can be quantified.

IV RESULTS AND DISCUSSIONS

All the samples are tested as per IS 10500:2012 Drinking-Water Specifications

Table 1: pH Values for different water samples of different field areas

Parameter	Sample Field Area	Obtained values	Permissible values	Method Used
pH	Industrial area (Steel Plant, Gajuwaka)	7.21	6.5 – 8.5	pH meter
	Seashore area (Bheemili)	7.11		
	Agricultural area (Anandapuram)	7.32		
	Slum area (Allipuram)	7.17		
	Hilly area (Kommadi)	7.23		

Table 2: Conductivity Values for different water samples of different field areas

Parameter	Sample Field Area	Obtained values	Permissible values	Method Used
Conductivity (µs/cm)	Industrial area (Steel Plant, Gajuwaka)	10960	------	APHA
	Seashore area (Bheemili)	1389		
	Agricultural area (Anandapuram)	1384		
	Slum area (Allipuram)	836		
	Hilly area (Kommadi)	1104		

Table 3: TDS Values for different water samples of different field areas

Parameter	Sample Field Area	Obtained values	Permissible values	Method Used
TDS (mg/l)	Industrial area (Steel Plant, Gajuwaka)	5548	<500	IS 3025- P 16
	Seashore area (Bheemili)	698		
	Agricultural area (Anandapuram)	692		
	Slum area (Allipuram)	418		
	Hilly area (Kommadi)	552		

Table 4: DO Values for different water samples of different field areas

Parameter	Sample Field Area	Obtained values	Permissible values	Method Used
DO (mg/l)	Industrial area (Steel Plant, Gajuwaka)	3.02	4-6	ASTM D888
	Seashore area (Bheemili)	5.57		
	Agricultural area (Anandapuram)	6.52		
	Slum area (Allipuram)	4.89		
	Hilly area (Kommadi)	6.79		

Table 5: Alkalinity Values for different water samples of different field areas

Parameter	Sample Field Area	Obtained values	Permissible values	Method Used
Alkalinity as $CaCO_3$ (mg/l)	Industrial area (Steel Plant, Gajuwaka)	341.0	< 200	IS 3025- P 23
	Seashore area (Bheemili)	311.0		
	Agricultural area (Anandapuram)	262.0		
	Slum area (Allipuram)	232.0		
	Hilly area (Kommadi)	252.0		

Table 6: Total Hardness Values for different water samples of different field areas

Parameter	Sample Field Area	Obtained values	Permissible values	Method Used
Total Hardness as $CaCO_3$ (mg/l)	Industrial area (Steel Plant, Gajuwaka)	834.7	< 200	IS 3025- P 21
	Seashore area (Bheemili)	199.2		
	Agricultural area (Anandapuram)	194.0		
	Slum area (Allipuram)	113.4		
	Hilly area (Kommadi)	177.6		

Table 7: Chloride Content Values for different water samples of different field areas

Parameter	Sample Field Area	Obtained values	Permissible values	Method Used
Chlorides	Industrial area (Steel Plant, Gajuwaka)	4913.1	<250	IS 3025- P 32
	Seashore area (Bheemili)	49.6		
	Agricultural area (Anandapuram)	39.89		
	Slum area (Allipuram)	39.84		
	Hilly area (Kommadi)	59.3		

Table 8: Iron Content Values for different water samples of different field areas

Parameter	Sample Field Area	Obtained values	Permissible values	Method Used
Iron as Fe (mg/l)	Industrial area (Steel Plant, Gajuwaka)	1.38	< 0.3	IS 3025- P 53
	Seashore area (Bheemili)	0.07		
	Agricultural area (Anandapuram)	0.08		
	Slum area (Allipuram)	0.17		
	Hilly area (Kommadi)	0.04		

Table 9: Sulphate Content Values for different water samples of different field areas

Parameter	Sample Field Area	Obtained values	Permissible values	Method Used
Sulphate as SO_4 (mg/l)	Industrial area (Steel Plant, Gajuwaka)	2463.7	< 250	IS 3025- P 24
	Seashore area (Bheemili)	23.8		
	Agricultural area (Anandapuram)	28.7		
	Slum area (Allipuram)	28.11		
	Hilly area (Kommadi)	27.9		

Table 10: Fluoride Content Values for different water samples of different field areas

Parameter	Sample Field Area	Obtained values	Permissible values	Method Used
Fluoride as F (mg/l)	Industrial area (Steel Plant, Gajuwaka)	0.63	<1	APHA
	Seashore area (Bheemili)	0.00		
	Agricultural area (Anandapuram)	0.00		
	Slum area (Allipuram)	0.00		
	Hilly area (Kommadi)	0.00		

V CONCLUSIONS

The physical and chemical factors are investigated in this study to assess the water quality and it is clear that all parameters are equally important and broad range of parameters is to be studied with more details for water quality modeling. Also, those parameters were selected due to their simple, fast and continuous measurement at water quality monitoring stations. So it can be conclude that Temperature, pH, TDS, EC, DO etc are the broad range of water quality parameters for drinking, irrigation, aquatic life for surface water.

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