*International Research Journal of Environment Sciences*_____ ISSN 2319–1414
Vol. **4(5),** 57-61, May **(2015)** *Int. Res. J. Environment Sci.*

Assessment of Ground Water Quality and its Impact on Human health At Padghe in Raigad District, Maharashtra, India

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Available online at: www.isca.in, www.isca.me
Received 16th March 2015, revised 27th April 2015, accepted 15th May 2015

Abstract

Water plays a vital role in domestic and industrial usage as water is the main part of an earth. The quality of drinking water is directly proportional to the health of living organism. Assessment of water quality of drinking water supplies has always been paramount in the field of environmental quality management system as per WHO guidelines. Assurance of drinking water safety is a foundation for the prevention and control of water borne diseases to better health of living organism. The suitability of drinking water has many requisite potable conditions. Groundwater quality of Padghe has a special significance and needs greater attention of all concerned since it is the only major source for domestic consumption. In this work we have estimated the ground water quality for drinking purpose at Padghe in raigad district of Maharashtra, India. The various parameters for quality of underground water in Padghe are analyzed and these are compared to established Indian standards. The obtained results indicate that the quality of water slightly deviate from the potable conditions. The analysis showed that water is not well within the parameters of potable use.

Keywords: Water analysis, ground water quality, drinking water, Padghe, Taloja MIDC.

Introduction

In recent years, because of continuous growth in population, rapid industrialization and the accompanying technologies involving waste disposals, the rate of discharge of the pollutants into the environment is far higher than the rates of their purification. The implications of deteriorating quality of the receiving waters are considerable both in the immediate situation and over the longer term. In this context, water quality assessment is critical for pollution control and the protection of surface and ground waters. In India, disposal of untreated domestic sewage from cities, towns and villages is the major source of pollution of surface water bodies leading to the outbreak of water borne diseases. Biodegradable organic matter is the contaminant of concern for Dissolved oxygen concentration which is the principal indicator of pollution of surface water. According to world health organization (WHO) estimates, about 80% of water pollution in developing countries like India is caused by domestic wastes. In India, numbers of studies have been carried out to assess the water quality in terms of various physico-chemical / biological Characteristics and heavy metals of surface and ground water at various places. The growth in numbers lacking access to safe water and sanitation will be driven in large part by the growth rate of the people living in urban areas. The objective of any water quality management is to balance the interests of users with the development of the resource, while at the same time improving and preserving environmental quality[1].

The demand for water has increased over the years and this has led to water scarcity in many parts of the world. The situation is aggravated by the problem of water pollution or contamination. India is leading towards a fresh water crisis mainly due to improper management of water resources and environmental degradation, which has lead to a lack of access of safe water to millions of people. Safe drinking water is essential to human beings and other life forms. Access to potable drinking water has improved over the last decades in almost every part of the world, but approximately one billion people still lack access to safe water and over 2.5 billion lack accesses to adequate sanitation. However some observers have estimated that by 2025 more than half of the world population will be facing water based vulnerability[2].

Ground water is used for domestic and industrial water supply and irrigation all over the world. It is an important source of drinking water but is polluted because of the waste generated in the industrial, agriculture and domestic sectors. Water is essential for any development activity and the availability of good quality of water for domestic and industrial use will help in fast development of the region. In the last few decades, there has been a tremendous increase in the demand for fresh water due to rapid growth of population and the accelerated pace of industrialization. Human health is threatened by most of the agriculture development activities like application of fertilizers and unsanitary conditions. In India several places now suffer from non availability of water for domestic and industrial use due to its over exploitation and improper waste disposal, especially in urban areas[3].

The quality of groundwater is getting severely affected because the widespread pollution of surface water. Besides, discharge of untreated waste water through bores and leachate from unscientific disposal of solid wastes which are likely to be polluting ground water, thereby reducing the quality of fresh water resources. Due to discharge of untreated sewage into the Narmada River, the water quality of Narmada has been severely deterioted and the potable nature of water is being lost. Changes in surface water physico-chemical parameters following the dredging; the water quality is localized and short terms due to that the impact of dredging World population requires cleaner water for better living condition. In this paper, we present the obtained results related to the analysis of quality of underground water for drinking purpose at Padghe in raigad district of Maharashtra, India[4-5].

Material and Methods

Experimental, Study area: Padghe Village is located approximately 0.5 kilometer from Taloja MIDC, raigad district of Maharashtra, India. Raigad district is located at latitude of 18° 39' N, longitude of 75° 52' E. In this village the majority of the people depend on underground water as a source for their day to day life.

Water sampling: The water samples are collected as per the standard methods in the month of November 2014 and again the samples were collected at the same places in the month of February 2015.

The Eight water samples are collected from Bore and wells water. In addition to this, one more water sample is collected where the water purified by locally available water purifier with automatically senses the quality of input water and chooses the optimum purification RO + UV/ UF + UV technology by name Pureit of Aquaguard is also analyzed. The list of sample collection places in Padghe are given in the table-1. These samples are collected in two liter plastic bottles, which are earlier washed and rinsed with triple distilled water before the collection of water samples. Separate and individual samples are collected for the purpose of dissolved oxygen. After sample collection, they are either analyzed immediately for various parameters like TDS, Hardness, Fluoride etc or preserved safely by taking suitable precautions to avoid deterioration or alterations[6-8].

Instruments: The following instruments are used to analyze ground water samples. Atomic Absorption Spectrometer (AAS) (PerkinElmer), Digital pH meter (Orion 3 Star, Thermo Scientific), Nefleometer (Model 132, Systronics), UV-visible spectrophotometer (Model 117, Systronics), Digital Conduct meter (Model 306, Systronics), Micro processor based bunch PH / Ion meter, Cyber scan 2100, Eutech instruments (USA) with fluoride sensitive electrode, Flame photometer (Elico,CL361) along with compressor (Elico, CL 158) and Shimadzu analytical balance (AUX 20, shimadzu Japan) .

Chemicals Required: All Chemicals used are of Analytical Reagent grade (Merck, BDH and Qualigens) and all the solutions are prepared by using triply distilled water and wherever water without carbon dioxide is used when required. Established methods 15 are used to prepare for standardized solutions.

Potassium hydrogen phthalate, Potassium hydrogen phosphate and borax buffer are used for pH meter calibration. Every time the instrument is calibrated, by using known pH buffer solutions and then the pH values of samples are measured. pH maintenance is one of the most important attributes of any aquatic system since all the biochemical activities depend on pH of the surrounding water. High value of pH may results due to waste discharge, microbial decomposition of organic matter in the water body.

After calibration of the conductivity meter, conductivity of the samples is measured. Standard Calcium Carbonate, standard EDTA, Buffer solution (NH_4Cl +NH_4OH), EBT indicator and Muroxide indicator are used for measuring the Total, Calcium and Magnesium hard nesses in the samples. In the estimation of p-alkalinity and m-alkalinity, standard Na2CO3, HCl and indicators of phenolphthalein and methyl orange are used. The standard NaCl, $AgNO_3$ solutions and K2CrO4 indicator are used for analysis of Chloride in the samples. Through gravimetric analysis, the sulphates in the samples are analyzed using the solutions of $BaCl_2$, HCl, $AgNO_3$ – Nitric acid reagent and methyl orange indicator. In the analysis of estimation of nitrites, the chemicals used are of standard nitrite solution, standard sodium oxalate, Potassium permanganate, Ferrous Ammonium sulphate and Sulphanalamide reagent, N-(1-Napthyl) – ethylenediamine dihydrochloride and 1:1 H_2SO_4. For estimation of fluoride in the samples the required solutions are stock fluoride and Total Ionic Strength Adjustment Buffer (TISAB). The standard solutions of $K_2Cr_2O_7$, Hypo, 10% KI and 1% starch indicator are used for estimation of Dissolved oxygen in the samples In the determination of phosphates, standard phosphate solution (Potassium dihydrogen phosphate), vanadate molybdate reagent (a proper mixture of Ammonium molybdate and Ammonium metavanadate) and dilute Hydrochloric acid is used for adjustment of pH. The 0.3% of N-(1-napthyl) - ethylene diamine dihydrochloride solution and 0.5% sulphanilamide reagent is used in the estimation of nitrites in the samples[6-11].

For estimation of metals like Cadmium, Zinc, Iron and Copper in water are extracted by using APDC (Ammonium 1-pyrolidiene dicarbomate), MIBK (Methyl Isobutyl ketone) and Concentrated HNO_3 solution.

Procedure: For estimation of following various components in the water samples are estimated by follow the standard methods[6-11].

Estimation of pH and Electrical conductivity: The pH and

electrical conductivity of all water samples are measured by using digital pH meter and conductivity meter.

Estimation of total dissolved solids: 100 ml of sample water is taken into a clean porcelain dish and heated at 180 ± 20C up to dryness and it is cooled to room temperature and finally placed in desiccators for complete removal of any moisture present in it. After that from the obtained weight, the amounts of total dissolved solids in the samples are determined by using appropriate formula.

Determination of Total hardness, Calcium and Magnesium: The known quantity of water samples are titrated in presence of Ammonia Buffer solution against with 9.3 × 10-3 N concentration of EDTA. The Calcium in the water samples are estimated by using with same EDTA in presence of KOH buffer solution. Finally the Magnesium content in the samples is estimated by using the consumed volumes of EDTA in the estimation of total hardness and Calcium hardness.

Estimation of Chlorides: Known quantity of water samples are titrated in presence of Potassium Chromate indicator against with 1.94 ×10-2 N Silver Nitrate solution.

Determination of Total alkalinity: Using phenolphthalein and methyl orange indicators, the total alkalinity in water samples is estimated with 2.5 × 10-2 M Hydro Chloric acid.

Estimation of Sulphates: Known quantity of water samples are taken and these are adjusted to a pH value of 4.5 to 5.0 by dilute HCl and these samples are heated up to desired conditions, while in hot, 10% $BaCl_2$ solution is added till a white precipitate is obtained and the precipitate is separated by Whatman no. 42 filter paper and is dried and weighed.

Estimation of fluoride: With the help of the standard fluoride solution (from Sodium Fluoride) the ion analyzer instrument is calibrated. Now known quantity of water samples are added with 5 ml of TISAB buffer in a polythene container and then the concentrations of fluoride in the samples are estimated by ion analyzer.

Estimation of Sodium and Potassium: The flame photometer is calibrated separately with 4, 8, 12, 16 and 20 ppm of solutions of KCl and NaCl respectively at each time and immediately directly measured the concentrations of Sodium and Potassium in ppm units.

Determination of Turbidity: The Nefleometer is calibrated with 1, 10, 100, and 500 NTU of Formazin solutions and finally. The turbidity of water samples are directly measured by Nefleometer.

Results and Discussion

Human beings are in the top of food chain and they receive the toxic elements and suffer from various diseases. The environmental impact of physicochemical parameter and heavy metals in aquatic system is immense; hence attempt should be made to assess the load of certain pollutants. Heavy metals are not biodegradable and they tend to accumulate in plants and animals[12]. Hence, it is necessary to determine heavy metals in sediment. On the basis of water and sediment analysis, it was conclude that the water and sediment soil of the study points were affected when the results was compared with IS and WHO. Water and sediment of the study area is not fit for irrigation, bathing and other purpose without proper treatment.

The present study clearly reveals that all the water sources chosen for study are not suitably for the utilization of drinking purposes. From the present study, it is observed that these drinking water sources are poorly managed and show sign of groundwater pollution[13]. As per WHO guidelines, nearly 75-85% of all the diseases in human beings are caused by water? Good quality of water plays essential role in good health of human beings so, after purification treatment only this water can be used for drinking purpose. Drinking water pollution in the studied area should be controlled by the proper environment management plan to maintain proper health conditions of people.

Table-1
Areas of sample collection in Padghe

Sample No.	Sample Location	Source
1	Nisarg C.H.S.	Bore Water-1
2	Nisarg C.H.S.	Bore Water-2
3	Nisarg C.H.S.	Bore Water-3
4	Primary Government School	Bore Water
5	Market Street	Bore Water
6	Krishna Park	Bore Water
7	Panchayati office	Well Water
8	Back Nisarg C.H.S.	Well Water
9*	Nisarg C.H.S. (Thange House)	Pureit Water*

Conclusion

The present study it is very evident that the groundwater source is the only reliable source of drinking water for the residents in the study area. Among the various parameters studies, most of the chemical constituents do not comply with the water quality standards prescribed by BIS. People should be aware about the quality of water they are drinking and this problem will be more aggressive when similar water sources are used for drinking purpose for a longer period (Chronic) because of the possible clinical problems associated with these chemicals in the drinking water. There is an urgent need to create public awareness on the sources, causes and prevention of groundwater pollution and also the consequence of impact of pollution on human health, which would be a key factor for sustainable development of the area.

Table -2
Values of various constituents in the water samples in November 2014

S. No.	pH	EC	TDS	Turb.	HAR Total	HAR Ca	Ca	Mg	Na	K	Fe	Total Alk.	Cl	SO42-	F
S1	7.2	1056	976	0.1	670	313	94	46	119	3.2	0.23	146	185	329	0.9
S2	7.6	1112	3617	1.6	712	426	132	37	138	1.2	0.56	176	312	112	0.3
S3	7.5	956	2463	1.2	816	524	98	58	202	0.9	0.97	123	516	96	0.3
S4	7.3	716	870	0.2	936	672	116	69	156	1.0	0.33	113	226	109	0.1
S5	7.5	872	673	0.1	560	403	88	43	124	2.4	0.43	156	339	156	0.2
S6	7.8	1556	2245	0.2	723	626	113	108	309	4.2	0.03	179	423	133	0.0
S7	8.1	1763	896	0.4	833	724	122	76	87	0.6	0.09	224	76	92	0.0
S8	7.9	1836	3213	0.7	972	388	156	45	413	4.6	0.23	137	139	103	0.2
S9*	6.7	833	426	0.2	443	98	93	53	40.2	8.3	0.02	238	162	221	0.3

**All the values are in mg/L, except pH, Turb and EC. Units of EC are mmhos/cm and units of turb; is NTU

Table -3
Values of various constituents in the water samples in February 2015

S. No.	pH	EC	TDS	Turb.	HAR Total	HAR Ca	Ca	Mg	Na	K	Fe	Total Alk.	Cl	SO42-	F
S1	7.6	1102	813	0.4	663	406	89	59	116	3.9	0.36	152	192	402	0.7
S2	8.6	1132	3235	1.2	705	526	126	39	154	1.5	0.46	192	295	139	0.5
S3	7.2	994	2532	1.0	842	622	102	66	263	0.7	0.85	115	456	102	0.4
S4	7.9	802	872	0.3	958	985	110	72	135	1.4	0.26	124	202	94	0.1
S5	7.7	916	586	0.1	432	601	92	49	132	1.6	0.39	165	321	142	0.1
S6	7.0	1334	1945	0.1	696	587	109	97	322	4.0	0.13	192	399	163	0.0
S7	7.9	1779	845	0.3	840	746	119	87	92	0.9	0.16	205	82	87	0.1
S8	8.1	1812	2987	0.2	956	298	139	52	323	3.5	0.52	76	142	100	0.0
S9*	6.8	802	430	0.2	439	90	95	45	43	7.2	0.01	232	159	227	0.2

**All the values are in mg/L, except pH, Turb and EC. Units of EC are mmhos/cm and units of turb; is NTU

Acknowledgement

I am very grateful to the management of Mumbai Waste Management Ltd. For continuous encouragement and willingly providing necessary facilities for this research work.

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