International Journal of Current Engineering and Technology
E-ISSN 2277 – 4106, P-ISSN 2347 – 5161

Available at http://inpressco.com/category/ijcet

Research Article

Evaluation of suitability of ground water for drinking purpose in Bhubaneswar city, Odisha

G.Sunpriya Achary[1*] and Abdulla Sarief[2]

[1]Department of Chemistry, KIST, Bhubaneswar, India
[2]Department of Chemical and Process Engineering Technology, Jubail Industrial College, Jubail, Saudi Arabia

Received 02 June 2019, Accepted 03 Aug 2019, Available online 05 Aug 2019, **Vol.9, No.4 (July/Aug 2019)**

Abstract

An attempt is made in the present study to assess the ground water quality of Bhubaneswar city for drinking purpose. For that nine different sampling points were chosen for water sampling in three different seasons (winter, summer, rainy) of the year 2018. The results obtained had been compared with the standards. It was found that the ground water is slightly acidic in nature. Most of the parameters except iron found below permissible limit. Overall ground water is safe for drinking purpose.

Keywords: *Ground water quality of Bhubaneswar city etc.*

Introduction

Water is an essential commodity for survival. The present urban water problem is not only regarding quality of water but also its quantity. Depending upon the class of city the per capital consumption vary between 150 to 250 lbd and in small towns it may be 100 lbd. It is estimated that 25% of urban population are deprived of safe water and 50% are suffering from waterborne diseases. Due to serious water shortage in many urban areas people are exploiting more ground water. So the level of groundwater is decreasing rapidly.

Due to the lack of sufficient surface water invariably the people are thriving upon ground water sources to meet their water requirements. Hence if ground water are to be suggested for various uses, its quality should be assessed.

Bhubaneswar the capital of Odisha state is one of the fastest developing cities of India is no exception with respect to the increased usage of groundwater. Hence an attempt is made in the present work to assess the groundwater quality, keeping in view of the increased usage of ground water in the recent time. A systematic study on the groundwater quality was carried out over a period of one year from January 2018 to December 2018, which include various Physico-Chemical and microbial parameters.

*Corresponding author **Sunpriya Achary** is working as Associate Professor **and Abdulla Sarief** as Lecturer DOI: https://doi.org/10.14741/ijcet/v.9.4.8

Description of study area

The Bhubaneswar city lies in Khurda District of Odisha. It is situated between latitudes of 20°12′N to 20°25′N and longitudes of 85°44′E to 85°55′E. The city master plan area covers 233 sq.km. The city is divided into 30 wards(converted from its original 28 villages). Location map of Bhubaneswar city is given in figure-01.

The city lies on the western side of the Mahanadi delta on the bank of river Kuakhai (a distributory of Mahanadi). Bhubaneswar is situated on the western fringe of the mid-coastal plain of Odisha with an average elevation of 45m above the main sea level. It lies on the low lateritic plateau and the erosion has made its topography a valley and ridge one.

Geologically the Bhubaneswar region belongs to the Gondwana landmass, one of the oldest and most stable landmasses in the world. So the rocks range from the Archaean to the recent period. But the major part of the area is covered with the quaternary alluvium and lateritic soil. Upper Gondwana rocks are grouped as the semi consolidated formations. The older and the younger alluviums which occur to the east of the city are the unconsolidated formations. The depth of the water table ranges from 5-12 meters in the lateritic and the weathered sandstones to 40-150 meters in the fractured and friable sandstones forming the deeper aquifers that are under semi- confined to confined conditions. The rock types in and around the western parts of the city store water recharged by rainfall. The depth is maximum up to 6m bgl in December that falls to 8m bgl in May.

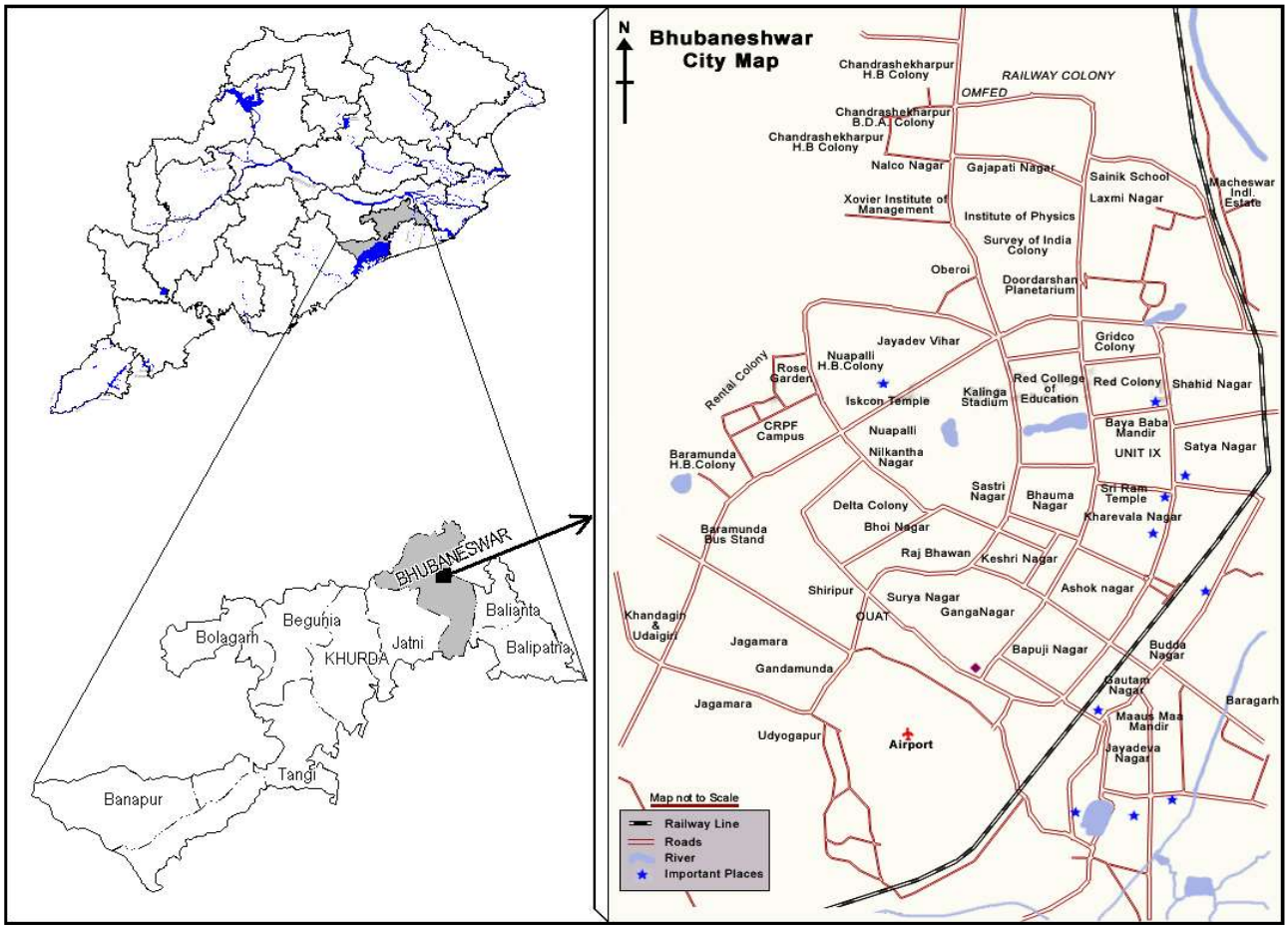

Fig-01

Table-01 Physico-Chemical and microbiological Characteristics of ground water for the year 2018

Locations		pH	Turb	Cond	TH	Cl-	TDS	Fe	F-	TC	FC
L-01	Winter	6.6	6	119	34	22	85	0.35	0.17	>2	>2
	Summer	6.3	6	124	39	24	96	0.39	0.18	>2	>2
	rainy	6.0	8	118	31	21	89	0.34	0.16	>2	>2
L-02	Winter	6.1	7	181	34	27	120	1.3	0.41	>2	>2
	Summer	5.7	9	195	40	32	126	1.5	0.45	>2	>2
	rainy	5.9	11	179	28	29	119	1.2	0.40	>2	>2
L-03	Winter	6.8	6	498	108	75	420	3.7	0.09	>2	>2
	Summer	6.0	6	501	114	88	438	4.2	0.12	>2	>2
	rainy	6.3	8	464	101	79	442	3.9	0.08	>2	>2
L-04	Winter	6.2	39	179	54	29	112	6.5	0.09	>2	>2
	Summer	6.0	36	188	62	38	124	6.9	0.09	>2	>2
	rainy	6.4	42	169	49	32	108	6.4	0.08	>2	>2
L-05	Winter	7.0	36	301	79	34	178	5.4	0.24	>2	>2
	Summer	6.5	32	320	84	39	195	5.5	0.25	>2	>2
	rainy	7.1	38	298	69	36	168	5.3	0.23	>2	>2
L-06	Winter	6.0	31	1332	161	318	801	2.4	0.24	>2	>2
	Summer	5.8	29	1412	165	349	824	2.7	0.25	>2	>2
	rainy	6.1	35	1326	159	322	812	2.3	0.21	>2	>2
L-07	Winter	5.7	40	172	55	36	105	5.0	0.15	>2	>2
	Summer	5.6	37	183	68	42	128	5.2	0.16	>2	>2
	rainy	5.8	45	169	49	32	112	4.9	0.12	>2	>2
L-08	Winter	6.0	64	489	88	112	328	6.3	0.11	>2	>2
	Summer	5.7	60	495	95	120	356	6.5	0.12	>2	>2
	rainy	5.9	64	471	82	108	346	6.1	0.1	>2	>2
L-09	Winter	6.2	24	211	44	46	112	7.5	0.06	>2	>2
	Summer	5.9	21	232	53	49	128	7.6	0.08	>2	>2
	rainy	6.1	25	200	34	42	118	7.4	0.07	>2	>2

L-01 = Khandagiri area L-02 = Unit-IX area L-03 = Capital Hospita area L-04 = Chandrasekharpur area L-05 = Unit-I area L-06 =Samantarapur area L-07 =Rasulgarh area L-08 =Laxmisagar area L-09 =Unit-III area

Material and methods

To have a through idea regarding ground water quality of Bhubaneswar, nine different locations were chosen. The locations were chosen keeping in mind that all the areas of Bhubaneswar can be covered properly. The detailed locations of sampling points are described below table-01. From each location a particular tube well was chosen and grab sampling was done quarterly from that particular tube well.The samples were collected in plastic and glass bottles as per requirement. Using these samples different physical, chemical and microbiological parameters such as **pH, turbidity, conductivity, total hardness, chloride, total dissolved solids, iron, fluoride, TC, FC** were studied. All chemicals/reagents used were of analytical reagent grade. After sample collection and under preservation, the samples are analyzed in laboratory following water and waste water analysis by **APHA 2000(20th Edition)**

Result and discussion

pH

All chemical and biological reactions are directly dependent upon pH of the system. pH affects the degree of dissociation of weak acid and base and also the toxicity and persistence of numerous compounds and activities of micro-organisms.

During the study period a little variation of pH was noticed(5.6 – 7.1). The ground water of study area was found to be slightly acidic. At location-07 the water was found more acidic compared to other locations and it may be due to sampling sources close to sewage channel having higher pH.

It was also noticed that in most of the areas the acidic character slightly increases in summer season compared to rainy and winter seasons. It may be due to decreased of water level.

Turbidity

No such seasonal variation observed in samples except at few stations. The turbidity of ground water was found between 6 – 64 NTU. The samples found to have high turbidity (the turbidity of ground water should be less than 5 NTU). High turbidity of ground water of Bhubaneswar city may be due to impact of underground soil and rocks. Contaminated ground water systems however can have considerably high turbidity (Well and others,1989,Gschwend and others,1990,Puls andPowell,1992, Backhus and others,1993).

Conductivity

Conductivity is an index of the degree to which water is mineralized. Conductivity of water depends upon the ions concentration and ionic mobility of the mineral contents in water. Conductivity of samples ranged from 118-1412 μmho/cm. it was found that location-06 had relatively higher conductivity compared to other locations and this may be due to sewage contamination. No such seasonal variation was observed in samples but a marked spatial variation was found.

In Bhubaneswar the sewage contamination may be the reason for higher conductivity. The other sources like sea water intrusion and industrial waste discharge are ruled out.

Total hardness

Calcium and Magnesium ions as their bicarbonates, sulphates and chloride render the hard both temporarily and permanently.

Total hardness represented by $CaCO_3$ in water samples found between 28-165 mg/l.

Location-06 had relatively higher values compared to other locations. Higher values of hardness observed in some locations may be due to their proximity to the sewage drains as higher hardness was observed in samples which are located close to it.

Chloride

Except location-06 none of the samples exceeds permissible limit i.c 250 mg/l. The chloride content of water samples varies from 21 to 349 mg/l during study period.

At location-06 higher chloride is may be due to contamination from waste water. Sources of chloride in ground water is domestic sewage (Trivedy and Goel, 1984, Karanth,1987 and Narayana 109 and Suresh,1989).

Total Dissolved Solids

Total Dissolved Solid values indicate the total amount of ions present in different forms. Higher values of TDS associated with higher residues are normally less potable and may induce an unfavorable physiological reaction in the transit consumer. The total dissolved solid of samples varies from 85 to 824 mg/l. Samples drawn from location-06 record higher values of TDS and these samples may be influenced by some pollution sources.

A well marked temporal variation was observed in the samples. The samples of summer season exhibit higher concentration of TDS compared to other seasons. Drying up of the clay material above the water table during summer period might have led to oxidation which increase the stability of minerals by the infiltrating water during the recharge period.

Iron

The analysis of ground water in the study area showed Iron concentration ranging from 0.34 to 7.6 mg/l during the study period. Except L-01, all the stations of Bhubaneswar recorded much higher values than the prescribed limit by WHO i.e 0.3 mg/L. The iron occurs naturally in the aquifers but levels in ground water can be increased by dissolution of ferrous borehole and hand pumps components. Iron dissolved in ground water is in the reduced iron(ii) form. This form is soluble and normally does not cause any problem by itself. Iron(ii) is oxidized to iron(iii) on contact with oxygen in the air or by the action of iron related bacteria. Iron(iii) forms insoluble hydroxides in water. Iron is generally present in organic waste and as plant debris in soil. Activities in the biosphere may have strong influence on the occurrence of the element in ground water. Higher iron concentration in the ground water could result from interaction between oxidized iron minerals and organic matter or dissolution of $FeCO_3$. This type of water is clear when drawn but soon becomes turbidy and then brown by precipitation of $Fe(OH)_3$ (Hem,1991) which is a common problem in some parts of the study area. The other reasons of higher concentration of the element may be removal of dissolved oxygen by organic matter within the sediments leading to reduced conditions. Under this condition the solubility of iron bearing minerals (Siderite /marcacite) increases leading to enrichment of the dissolved iron in the ground water (White,et.al,1991, Applin and Zhao,1989).

Floride

The fluoride concentration of samples varied from 0.06 to 0.45 mg/l during study period. A little variation was observed among the samples. All the samples are found below permissible limit set by WHO and other regulating organizations. A little increase in the concentration was observed at few locations in all seasons which may be attributed to the geological deposition and geochemistry of the location (Lakshamana *et al*,1986). As the sewage water contain negligible amount of Flouride, there was no chance of contamination of the ion with the nearest ground water source.

TC &FC

None of the samples found above WHO limit for TC & FC. So the ground water of the study area is safe for drinking purpose.

Conclusion and suggestions

From the results obtained and subsequent discussion it was found that the ground water is slightly acidic in nature. The samples in general contain a little higher concentration of iron than that of permissible limit.

The concentration of different parameters and pH varies in pre and post monsoon period.

The physico – chemical and microbial parameters show that ground water is safe for drinking purpose being with in safe limit of prescribed by WHO.

The high amount of iron contents found in water samples may be due to the soil which is lateritic in nature or may be due to the age old hand pumps contain iron pipe which require immediate replacement.

The river water is not attaining the quality of drinking. So ultimately ground water is the main source of water for drinking. As a result there is depletion of groundwater table and also the groundwater is getting contaminated due to unplanned way of discharge of solid waste and domestic waste. we should make a rule in each household and all institutions and offices to make water harvesting in their own building in order to increase the ground water table. Also the Government should take cess for using groundwater and permission should be taken before digging the tube wells. By this way the extravagant use of ground water can be restricted.

References

APHA 2000.standard methods for estimation of water and waste water (20th edn). *American public Health Association, Washington D.C.*

Mohanty S K.2001. Strategy to control environmental pollution in Koraput area. PhD thesis . *Utkal University, Bhubaneswar*

WHO Guidelines for drinking water quality. *World Health Organisation, Geneva.*