Assessment of Physico-Chemical Status of Ground Water Samples in Akot city

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Abstract

The physico-chemical status of water samples from ten major part of locality in Akot city was assess. The sampling points were selected on the basis of their importance. The physicochemical parameter like, temperature, pH, electrical conductivity (EC), total dissolved solids (TDS), turbidity, dissolved oxygen (DO), total alkalinity (TA), total hardness (TH), calcium (Ca^{++}) magnesium (Mg^{++}), sodium (Na^+), potassium (K^+), chloride (Cl^-), fluoride (F^-), nitrate (NO^-_3) sulphate (SO^{2-}_4) and phosphate (PO^{3-}_4) of Open Well and Bore well was determined. The results were compared with standards prescribed by WHO (1973) and ISI (10500-91). It was found that the ground water was contaminated at few sampling sites namely Shri Shivaji College, Mahalaxmi Nagar While the sampling sites Keshvaoraj vetal, shaukatali chok and Ramtek pura showed physicochemical parameters within the water quality standards and the quality of water is good and it is fit for drinking purpose.

Keywords: Groundwater, physicochemical parameter, open well and borewell, Akot city.

Introduction

Natural resources are the important wealth of our country, water is one of them. Water is a wander of the nature. *" No life without water ''* is a common saying depending upon the fact that water is the one of the naturally occurring essential requirement of all life supporting activities[1] Since it is a dynamic system, containing living as well as nonliving, organic , inorganic ,soluble as well as insoluble substances. So its quality is likely to change day by day and from source to source. Any change in the natural quality may disturb the equilibrium system and would become unfit for designated uses. The availability of water through surface and groundwater resources has become critical day to day. Only 1% part is available on land for drinking, agriculture, domestic power generation, industrial consummation, transportation and waste disposal.[2,3,4]

In India, most of the population is dependent on groundwater as the only source of drinking water supply. The groundwater is believed to be comparatively much clean and free from pollution than surface water. But prolonged discharge of industrial effluents, domestic sewage and solid waste dump causes the groundwater to become polluted and created health problems[5]. The rapid growth of urban areas has further affected groundwater quality due to overexploitation of resources and improper waste disposal practices. Hence, there is always a need for and concern over the protection and management of groundwater quality.[6] Heavy metals are priority toxic pollutants that severely limit the beneficial use of water for domestic and industrial application[7]. The lakes have complex and fragile ecosystem, as they do not have self cleaning ability and therefore readily accumulate pollutants[8]. The physicochemical parameters and trace metal contents of water samples from Delhi were assessed[9].

The most of water bodies in India needs to be treated before using it in domestic applications by various means. Ground water contains high amount of various ions, salts etc. so if we were using such type of water as potable water then it leads to various water-borne diseases[10]. The consequence of

urbanization and industrialization eads to spoil the water. For agricultural purposes ground water is explored in rural areas especially in those areas where other sources of water like dam and river or the canal is not available. During last decade, this is observed that the ground water get polluted drastically because of increased human activities[11-13].

Hence it is very essential to maintain the quality of ground water for human consumption, for the aquatic life and for other subsequent uses. Considering the above aspects of groundwater contamination, the present study was undertaken to investigate the impact of the groundwater quality of some open wells and bore well water samples in Akot city of Akola district in Vidarbha region. Thus, in this research work an attempt has been made to assess the physical and chemical parameters of groundwater like, Temperature (T), pH, electrical conductivity (EC), total dissolved solids (TDS), turbidity, dissolved oxygen (DO), total alkalinity (TA), total hardness (TH), calcium (Ca^{++}) magnesium (Mg^{++}), sodium (Na^+), potassium (K^+), chloride (Cl^-), fluoride (F^-), nitrate (NO^-_3) sulphate (SO^-_4) and phosphate (PO^{3-}_4) of Open Well and Bore well was determined. The analyzed data were compared with standard values recommended by WHO[14]

Material and Methods

Akot city (Distract Akola) which is situated in the heart of the nation in Maharashtra (Vidarbha region) has become an important city because of the natural resources available around it. There are various existing industries and industrial estates. These industries use huge quantity of water for processing and release most of the water in the form of wastewater. The wastewater being generated is discharged into the nearby water resources. Similarly the geochemical and morphological structural changes due to weathering may also leach out some chemicals/minerals from the geostrata into surface and groundwater and may change the original characteristics of water which could be rather harmful to human health after consumption.

The people are using open well water, tube well water as well as municipal water for their daily need. The literature survey reveals that no water quality management studies are made in this region so far. Hence the present study was planned and undertaken. Shri Shivaji College (open well), Mahalaxmi Nagar (bore well), Swarswti Nagar (bore well), Sambhaji Nagar (open well and borewell), Somwar Wesh (bore well), Keshvaoraj Vetal (open well), Shaukatali Chok (bore well), and Ramtek Pura (open well and bore well), site selected were from different localities in Akot city for samples collection.

Preparation of Water Samples: The sample were collected from all the stations at 11.00 am to 12.00 noon in both the seasons for physico-chemical examinations, different methods of collection and handling were adopted based the standard procedures[15]. The samples were collected in plastic canes of five liters capacity without any air bubbles. The instruments were used of accuracy. The temperatures of the samples were measured in the field itself at the time of sample collection. The samples were kept in refrigerator maintained at 4°C. Water samples from ten sampling sites were collected during a post monsoon period of five months *(November-2009 to March -2010)*. The sampling locations in Akot city for assessment of physico-chemical parameter status of ground water are given in Table- 1.

Physico-Chemical Analysis: Analysis was carried out for various water quality parameters such as Temperature, pH, electrical conductivity (EC), total dissolved solids (TDS), turbidity, dissolved oxygen (DO), total alkalinity (TA), total hardness (TH), calcium (Ca^{++}) magnesium (Mg^{++}), sodium (Na^+), potassium (K^+), chloride (Cl^-), fluoride(F^-) nitrate (NO^-_3), sulphate (SO^-_4) and phosphate (PO^{3-}_4) using standard method[16-18]. All The reagents used for the analysis were AR grade and double distilled water was used for preparation of solutions.

Results and Discussion

The physico-chemical parameters of the above mention sites in Akot city can be calculated and it is describe as bellow.

Temperature (T) in ^{0}C: Temperature is an important biologically significant factor, which plays an important role in the metabolic activities of the organism. The temperature was ranging from 23.0°C to 27.00°C during the study period. Lowest water temperature was observed in the Ramtek Pura was 23.0 °C. A study increase in water temperature in the course of Shivaji College was noticed ie 27.0 °C. An increase in temperature was observed from Somwar Wesh (24.0 °C) to Mahalaxmi Nagar (26.0 °C). This might be due to presence of the effluents. Our property of water is that with change in temperature, its density varies and it becomes less with warming up and more with cooling.

pH: pH is a term used universally to express the intensity of the acid or alkaline condition of a solution. Most of the water samples are slightly alkaline due to presence of carbonates and bicarbonates. The pH values of water samples varied between 8.0 to 7.1 and were found within the limit prescribed by WHO. The higher range of pH indicates higher productivity of water.[19]

Electrical Conductivity (EC) in Micro-ohm/cm: Electrical conductivity (EC) is a measure of water capacity to convey electric current. It signifies the amount of total dissolved salts[20]. EC values were in the range of 1563 micro-ohms/cm to 390 micro-ohms/cm. High EC values were observed for five sampling points namely S_1, S_2, S_3, S_4, and S_5 indicating the presence of high amount of dissolved inorganic substances in ionized form.

Total Dissolved Solids (TDS) in mg/l: Total dissolved solids indicate the salinity behavior of groundwater. Water containing more than 500 mg/L of TDS is not considered desirable for drinking water supplies, but in unavoidable cases 1500 mg/L is also allowed[21]. TDS values varied from 108 mg/L to 1650 mg/L. The sampling points S_1, S_2 and S_3 showed higher TDS values than the prescribed limit given by ISI.

Turbidity in NTU: In most waters, turbidity is due to colloidal and extremely fine dispersions. The turbidity values varied between 0.00 to 0.2 NTU and found within the limits prescribed by ISI (10500-91).

Dissolved Oxygen (DO) in mg/l: Dissolved oxygen is important parameter in water quality assessment and reflects the physical and biological processes prevailing in the water. The DO values indicate the degree of pollution in water bodies. DO values varied from 7.4 to 2.9. The sampling points S_6 and S_7 showed high DO values.

Total Alkalinity (TA) in mg/l: Alkalinity of water is its capacity to neutralize a strong acid and it is normally due to the presence of bicarbonate, carbonate and hydroxide compound of calcium, sodium and potassium. Total alkalinity values for all the investigated samples were found to be greater in samples S_1, S_2, S_3 and S_4 than the value prescribed by WHO.

Total Hardness (TH) in mg/l: Hardness is the property of water which prevents the lather formation with soap and increases the boiling points of water[22] Hardness of water mainly depends upon the amount of calcium or magnesium salts or both. The hardness values shown range from 784 mg/L to 312 mg/L. The values for sample from point S_2 and S_3 were higher than the prescribed limit.

Calcium (Ca^{2+}) in mg/l: Calcium are directly related to hardness. Calcium concentration ranged between 80.00 mg/L to 34.00 mg/L and found below permissible limit of ISI, except samples from sampling point S_1, S_2 and S_3.

Magnesium (Mg^{2+}) in mg/l: Magnesium are directly related to hardness. Magnesium content in the investigated water samples was ranging from 147.00 mg/L to 37.1 mg/L which were found within WHO limit.

Sodium (Na^+) in mg/l: Sodium concentrations were found in between 375.00 mg/L to 199.00 mg/L. Sampling sites S_9, S_{10} showed lower sodium

concentration than the prescribed limit by WHO and ISI.

Potassium (K $^+$) in mg/l: The major source of potassium in natural fresh water is weathering of rocks but the quantities increase in the polluted water due to disposal of waste water[22]. Potassium content in the water samples varied from 0.3 mg/L to 0.8 mg/L. It is found that the contents of potassium in site S_1 is higher ie 0.80 mg/l, whereas for sites S_4 to S_{10} is zero.

Chloride (Cl $^-$) in mg/l: The chloride concentration serves as an indicator of pollution by sewage. People accustomed to higher chloride in water are subjected to laxative effects[20]. In the present analysis, chloride concentration was found in the range of 257.00 mg/L to 38.2 mg/L. The values are within the limit except water sample collected from sites S2 and S3. Higher chloride concentration in samples from sites S_1 may be due to big discharge of sewage near the sampling sites.

Fluoride (F $^-$) in mg/l: Probable source of high fluoride in Indian waters seems to be that during weathering and circulation of water in rocks and soils, fluorine is leached out and dissolved in ground water. Excess intake of fluoride through drinking water causes fluorosis on human being. In the present analysis, fluoride concentration was found in all samples sites in Akot city. It is found zero for all sites ie from S_1 to S_{10}

Nitrate (NO$_3$$^-$) in mg/l: Groundwater contains nitrate due to leaching of nitrate with the percolating water. Groundwater can also be contaminated by sewage and other wastes rich in nitrates. The nitrate content in the study area varied in the range 1.28 mg/L to 0.12 mg/L and found within the prescribed limit.

Sulphate (SO$_4$$^{2-}$) in mg/l: Sulphate occurs naturally in water as a result of leaching from gypsum and other common minerals[18]. Discharge of industrial wastes and domestic sewage tends to increase its concentration. The sulphate concentration varied between 80.9 mg/L and 19.1 mg/L. and found within the prescribed limit.

Phosphate (PO$_4$$^{3-}$) in mg/l: Phosphate may occur in groundwater as a result of domestic sewage, detergents, and agricultural effluents with fertilizers. The phosphate content in the study area was found in S_1 site only it is 0.1 mg/L. All the data can be summarized in *Table-2*. And graphical representation of Average values of the physicochemical parameters of different sites in Akot city as shown in *fig-1(a-l)*.

Conclusion

Deviations were observed by some groundwater samples in Akot city . The water samples from sites S_1 and S_2 showed poor water quality as compared to other water samples, probably due to River close to site S_1 The water samples from sites S_1 and S_2 are polluted and unfit for drinking purpose. The sampling point S_1 showed high TDS, total alkalinity and sodium content indicating the need of some treatment for minimization of the parameters. The sampling sites S_9 and S_{10} (In Ramtek pura for both open well and bore well) showed physicochemical parameters within the water quality standards and the quality of water is good and it is fit for drinking purpose. The parameters namely F$^-$ and PO$_4$$^{3-}$ is found as zero for all sites.

Acknowledgements

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Table -1: Sampling locations in Akot city

S. No.	Sample locations	source	Sample number
1	Shri Shivaji College	open well	S_1
2	Mahalaxmi Nagar	bore well	S_2
3	Swarswti Nagar	bore well	S_3
4	Sambhaji Nagar	open well	S_4
5	Sambhaji Nagar	bore well	S_5
6	Somwar Wesh	bore well	S_6
7	Keshvaoraj Vetal	open well	S_7
8	Shaukatali Chok	bore well	S_8
9	Ramtek Pura	open well	S_9
10	Ramtek Pura	bore well	S_{10}

Table -2: Average results of the physicochemical parameters of different sites in Akot city

| S.No.	Parameter	WHO	ISI	Sampling points in Akot City									
				S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}
1	Temperature	--	--	27	26	26	26	25	24	24.0	23.3	23.1	23.0
2	pH	7-8.5	6.5-8.5	8.0	8.0	7.9	7.8	7.8	7.5	7.5	7.4	7.2	7.1
3	EC	1400	--	1500	1563	1477	1476	1476	1250	1249	780	390	390
4	TDS	1000	500	1650	1482	520	456	456	439	411	287	110	108
5	Turbidity	5.0	10	0.2	0.2	0.2	0.2	0.2	0.15	0.15	0.12	0.00	0.00
6	DO	--	5.0	5.1	5.1	5.0	5.0	5.0	7.4	7.3	3.4	2.9	2.9
7	TA	120	200	187	178	176	121	121	120	120	119	116	116
8	TH	500	300	513	784	389	336	336	334	334	331	312	312
9	Ca^{2+}	100	75	80	77	85	72	72	34	92	76	74	74
10	Mg^{2+}	150	30	147	147	143	139	139	137	132	53.7	37.1	37.1
11	Na^+	200	200	255	234	375	214	214	210	207	204	199	199
12	K^+	--	--	0.80	0.57	0.3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	Cl^-	250	250	257	211	186	123	123	78.2	71.6	48.7	38.2	38.2
14	F^-	1.5	--	00	00	00	00	00	00	00	00	00	00
15	NO_3^-	5	45	1.28	0.79	0.46	0.24	0.24	0.20	0.19	0.12	0.12	0.12
16	SO_4^{2-}	250	200	22.3	22.1	80.9	62.3	62.3	56.8	55.7	47.4	19.1	19.1
17	PO_4^{3-}	--	--	0.1	00	00	00	00	00	00	00	00	00

Fig.-1 (a-l) : Graphical representation of Average values of the physicochemical parameters of different sites in Akot city
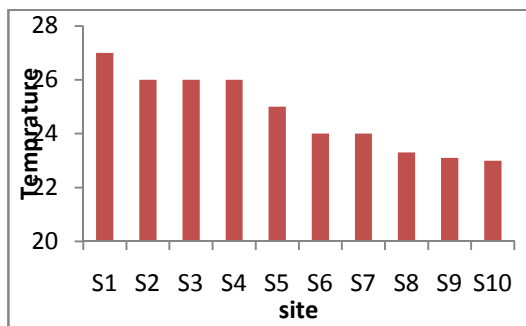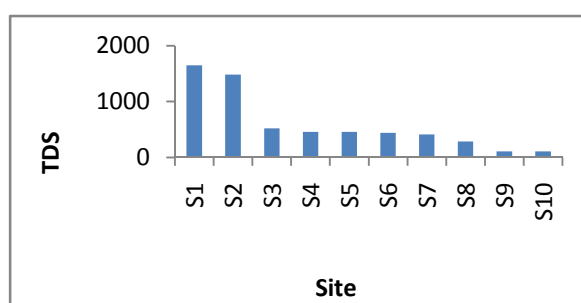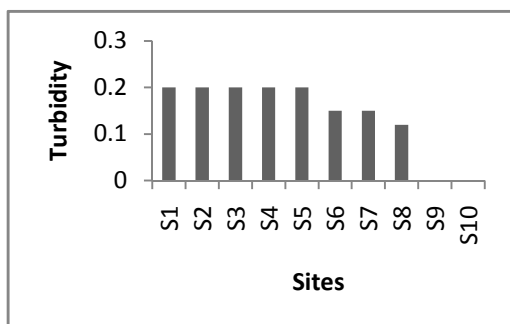

a] **Graphical representation of Temp.**
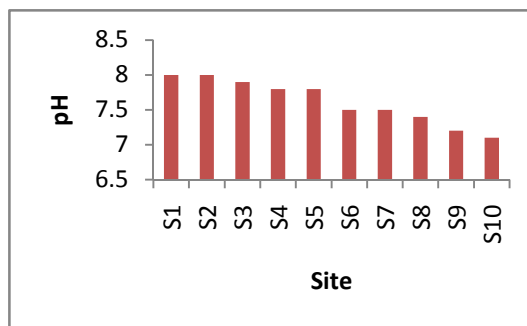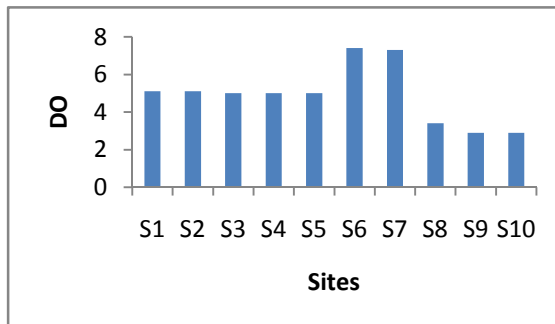
b] **Graphical representation pH**
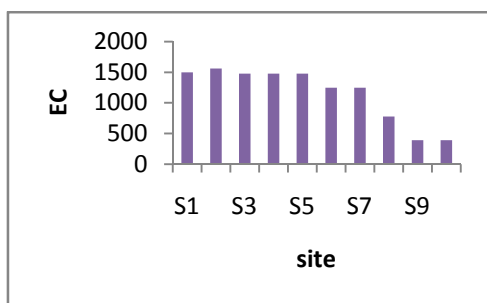
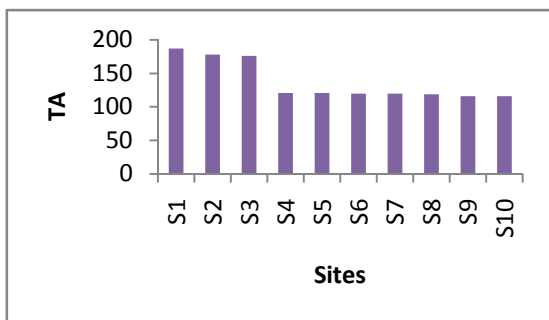c] **Graphical representation EC**

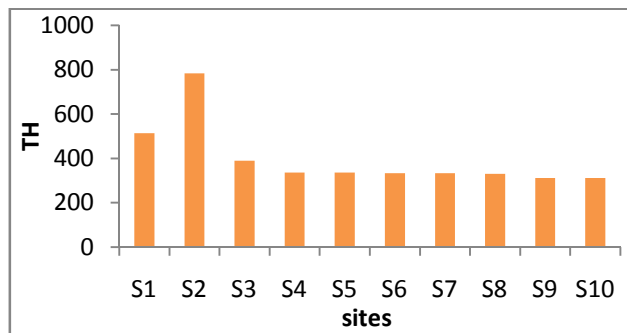d] **Graphical representation TDS**
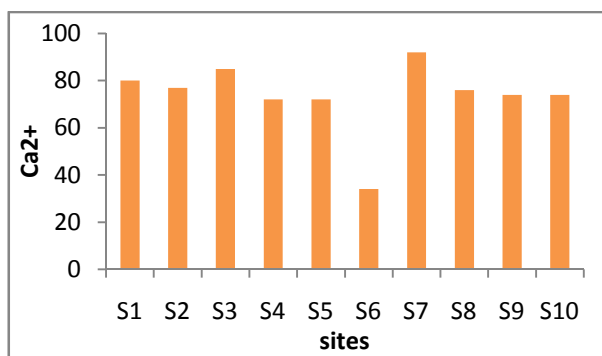
e] **Graphical representation Turbidity**

f] **Graphical representation DO**

g] Graphical representation TA

h] Graphical representation TH

i] Graphical representation of Ca^{2+}
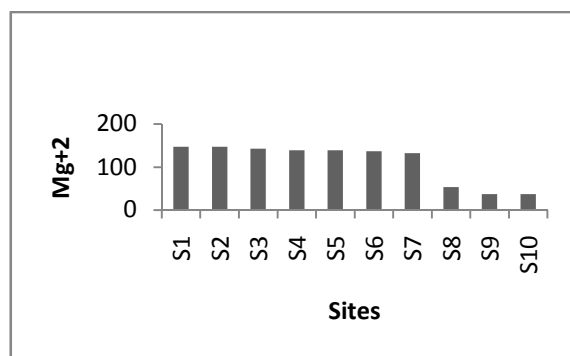
j] Graphical representation Mg^{2+}
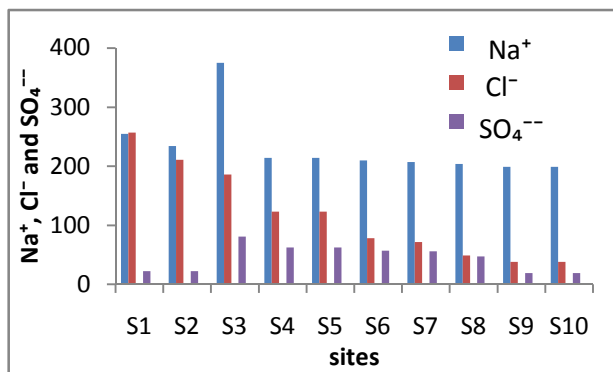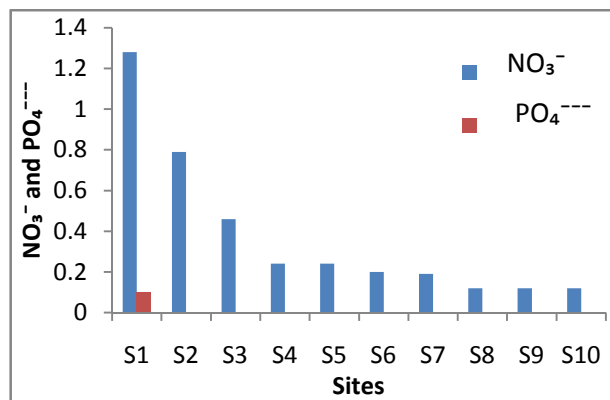
k] Graphical representation of Na$^+$,Cl$^-$ l] Graphical representation of NO$_3^-$ & PO$_4^{3-}$ and SO$_4^{2-}$