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Physico-Chemical Analysis of Ground Water of Different Tehsils of Osmanabad District

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Abstract: ***The groundwater is determined of five tehsil of Osmanabad district of Maharashtra, where samples are under studied for Physico-chemical status of groundwater. In Physico-chemical analysis, the water quality parameters are measured like pH, temperature (T) turbidity (TUB), electrical conductivity (EC), total dissolved solids (TDS), total hardness (TH), content of calcium (Ca^{+2}), magnesium (Mg^{+2}), sodium (Na^{+}), potassium (K^{+}), chloride (Cl^{-}), sulphate (SO_4^{-2}), total alkalinity (TA), dissolve oxygen (DO). Physico-chemical studies of twenty groundwater samples from different tehsils of Osmanabad district was carried out during the month of May 2011 and outcome of the results were discussed.***

Key Words: Physico-chemical analysis; ground water; Osmanabad district; TDS; TH.

I. INTRODUCTION

Water plays an important role in living life on earth. Recent years increase in urbanization, industrialization, uses of pesticides in agriculture and human activity has increase the pollution of water. Recently, the WHO reports that 65% of rural and 36% of urban Indians was without access to pure drinking water [1]. Osmanabad is considered to be oldest and religious district of Maharashtra state. A famous temple of goddess Tuljabhavani is situated in Tuljapur taluka and historical Naldurg fort is situated near Naldurg town. The peoples of Osmanabad district usually use water from dug well and bore well for drinking and domestic purposes. There is a huge variation in the concentration of different species due to factors like depth, different land, underground water conditions, rain conditions, and industrialization etc. The present work attempts to evaluate the ground water quality in Osmanabad district.

II. MATERIAL AND METHODS

In present work study twenty ground water samples from four tehsils of Osmanabad district were collected during morning hour. The water samples were collected in the glass bottles with necessary precautions and preserved as per the recommended procedures [2-11].

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All the chemicals used were of AR grade and double distilled water was used throughout the work to prepare standard solutions [12]. The water temperature, pH, DO, EC and TDS were analyzed immediately on the spot after collection, whereas the analyses of remaining parameters were done in the laboratory. The study was carried for a period of 1 year (June 2010 to May 2011). Monthly data was collected, but results were represented in three seasons. Four month make one season like first March to June summer season, July to October monsoon season, and November to February winter season. Power of hydrogen (pH) was determined electrometrically using digital pH meter, electrical conductivity was measured by digital conductivity meter, dissolved oxygen is measured by Winkler's method, total dissolve solid was measured by using TDS meter and similarly turbidity is measured by evaporation method. Total Alkalinity is measured standard procedure [13], chloride by argentometry, calcium, magnesium, total hardness by complexometric titration method, nitrate and phosphate were determined by method suggested [14-16]. Estimation of sodium was done by Flame Photometric method.

III. RESULTS AND DISCUSSION

Twenty ground water samples were selected from the study area. The results of fifteen physicochemical parameters of ground water are presented. The data presented in table 1, 2 and 3 season wise respectively. Some of the interesting observation of ground waters is summarized below.

A. Temperature (T):

The heat released by decomposition of organic matter and respiration may significantly raise the temperature in polluted water. The change in atmospheric temperature with change in season brought corresponding change in the water temperature. In the present investigation maximum value of water temperature were recorded in summer season corresponding with the atmospheric temperature [17-19]. During summer water temperature was higher because of low water level, clear atmosphere and greater solar radiation and lower water temperature in the rainy and winter season can be explained on the basis of frequent clouds, high percentage of humidity and high water level [20]. The other reasons may be due to the fact that the particles floating in water absorbs heat more rapidly than the water itself. These particles in term radiate their heat to the surrounding water thereby increasing the temperature of water [21].

Seasonal variation showed that the temperature value is maximum during summer and minimum during winter which can be observed.

B. pH:

pH value of water depends upon number of factors like biological activities, nature of waste discharge. Unni et. al. [22] observed high pH values in winter and low during rainy season. Our results are in agreement with this observation. Seasonal fluctuations in pH values were also reported by Sireenivasan et. al. [23], Vyas and Kumar [24] while Sumatra et. al. [25] could not notice seasonal fluctuation in pH. However maximum pH is observed during winter is in agreement with Goels et. al. [26]. The reason for higher value of pH in winter may be due to the growth of microscopic as well as filament algae which utilize carbon from carbonates, sulphur from sulphate, and nitrogen from nitrates and phosphorus from phosphate converting them into hydroxyl ion which are responsible for increase in pH reference. The lower pH during rainy season and winter and higher values in summer season may be due to increase in the temperature which enhances the microbial activity causing excessive production of CO2 [27]. In the present work pH value varies in between 6.32 to 8.33 throughout the year for all sampling stations which are within the permissible limits according to water quality standards [28-29].

C. Electrical conductivity (EC):

The conductivity is an important parameter for providing an indication of ion concentration in the water. It has been observed from tables that the conductivity values vary significantly with season in all the study sites, however these values are high and water samples are unsuitable for drinking purposes when compared with drinking water specification [28-29]. In the present investigation maximum conductivity values were observed in the water samples near canals carrying industrial effluents, bore-well samples from industrial areas. Usually high conductivity values are observed in summer as compared to rainy and winter seasons, which is in agreement with the observation made by Rao et. al. [30], Bansan et. al. [31].

D. Total Dissolved Solid (TDS):

TDS values in present work are higher than the permissible limit in most of the cases which is clear indicating that the ground water in some of the locations is very hard [28] and unsuitable for drinking purposes. In the present work maximum concentration was recorded during summer which decreases in rainy season obviously due to the dilution of ground water in this season. Concentration of dissolved solid showed wide range of fluctuations from station to station in different months, Joshi et. al [32] observed that in summer, most of vegetation start decaying, so a rise in the amount of dissolved solid was natural, as the production of decaying matter were returned to the water. The highest value of TDS in summer may be due to evaporation of ground water and river water. High TDS is also attributed to the disposal of raw effluent which eventually reaches into the ground water table.

Total alkalinity (TA):

The total alkalinity values for all the sample sites are presented in tables. The TA values are above permissible limit, 200 ppm, in all the cases indicating presence of bicarbonate, carbonate and hydroxide salts. It also indicates that most of the water samples in study area are hard. TA is found to be maximum in summer and minimum in rainy season. Higher values of TA in summer may be due to dissolution of carbon dioxide present in soil which forms carbonic acid, leaching of rocks and weathered products. Ruttner et. al. [33] has also recorded the similar results. Decrease in alkalinities was observed in rainy season during the present investigation which may be due to dilution effects. Similar trend was also observed in the earlier findings [34].

E. Total hardness (TH):

Hardness values are higher in most of the cases as per WHO [29]. The hardness values are high in almost all the sample studied in summer which may be due to decrease in water table. The values are low in winter and rainy which is mainly due to dilution.

F. Chloride (Cl^-):

It has been observed from tables that the concentration of chloride ion is found to be lower in the baseline stations but is suddenly found to be increased at the stations situated in the vicinity of industrial areas. The abnormally high values of chloride concentrations in above cases indicate high degree of pollution may be due to discharge of either domestic or industrial waste i.e. high degree of pollution. The maximum value of chloride content in summer whereas in rainy season it is low. Higher value of chloride may be due to domestic sewage, bathing and pollutants from industries.

G. Sulphate (SO_4^{-2}):

Sulphate concentration is high in case of samples close to industrial areas and near municipal and industrial wastes leading to enhancement of sulphate concentration in ground water. Higher values of sulphate in summer may be due to reduction of water level and constant industrial waste pollution.

H. Calcium (Ca^{2+}) and Magnesium (Mg^{2+}):

In the present investigation the high value of calcium and magnesium are observed in summer and low values in rainy and winter season. This may be due to dilution of calcium in rainy season. It has been found that the disposal of sewage and industrial wastes are important sources contributing to calcium and magnesium content of water. In the present investigation the higher value of calcium and magnesium are observed in samples from the sites situated along the canals [17] in industrial areas which are due to high pollution of water. The rise in calcium content during autumn and summer months could be attributed to its great solubility at lower temperature while during summer months due to rapid oxidation of organic matter in the substrate.

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The decline in the value of calcium during the month of monsoon might be on account of its dilution in rain water and its utilization by the phytoplankton as the higher concentration of calcium water samples in summer season in the present investigation may be due to pouring of runoff of waters containing industrial effluents of high neighboring industries into the canals and finally the percolation in the ground water table.

I. Sodium (Na^+) and Potassium (K^+):

The lowest values of sodium and potassium were obtained in summer and highest concentration in winter. The observed higher values of concentration of sodium and potassium in winter season may be due to weathering and leaching of sodium silicate minerals releasing sodium ions into the water. It has been observed that some ground water samples show very high concentration of sodium and potassium which probably arise due to the contamination of ground water from domestic sources and industrial waste. As compare to sodium, occurrence of potassium is less because it gets incorporated into clay than in water.

J. Dissolved oxygen (DO):

K. The lower values of DO during summer may be due to loss of oxygen to the atmosphere at high temperature and its utilization in fast decomposition of organic matter [35]. The maximum amount of DO was observed in monsoon due to aeration of water on account of rapid flow. Abnormally low concentration of DO was recorded in some of the samples; this might be due to overloading concentration of organic and industrial wastes in these months. In winter, solubility of DO increases with decrease of water temperature. Our

L. results are well in agreement with Jain, Sharma and Thakur [36].

Table I: Variation of ground water quality parameter in month of September 2010

S.N.	T	pH	EC	TDS	TA	TH	Cl^-	SO_4^{-2}	CA^{2+}	Mg^{2+}	Na^+	K^+	DO	TUB
1	25.9	6.7	8.9	371.6	224	680	167.9	25.0	182.7	36.2	62	7.1	7.1	4.00
2	26.5	5.5	8.6	465.5	224	510	83.8	6.0	52.9	29.8	68	11.6	8.3	4.30
3	26.4	5.9	1.0	538.2	228	592	115.9	16.0	38.4	23.3	60	3.9	8.0	4.10
4	26.3	7.0	1.2	590.0	276	400	95.9	21.0	83.7	27.2	67	7.1	0.0	2.10
5	26.1	6.8	1.6	688.8	244	504	227.9	20.0	129.8	62.2	69	5.9	7.2	3.10
6	26.8	6.7	1.2	591.4	344	440	207.9	36.0	150.7	77.2	65	6.21	6.9	2.10
7	27.1	6.7	1.3	601.4	336	430	95.9	30.0	32.1	15.1	78	4.2	7.1	3.60
8	26.8	6.7	1.2	592.6	372	336	83.8	29.0	73.7	42.7	70	4.1	7.2	4.10
9	26.4	6.6	1.3	632.1	312	488	291.9	38.0	144.3	93.2	61	8.29	7.1	1.50
10	26.3	5.7	1.3	658.6	252	504	260.9	5.0	115.4	2.9	69	4.21	6.6	1.50
11	26.3	6.6	1.7	802.7	184	390	83.9	7.0	160.6	84.7	69	11.6	6.6	1.60
12	27.0	6.7	1.6	666.4	416	448	271.9	50.0	160.3	96.2	60	3.91	4.4	3.50
13	26.2	6.7	2.2	520	340	368	119.9	47.0	161.9	48.6	65	11.1	7.2	1.30
14	26.4	6.2	1.6	891.6	244	392	123.9	11.0	105.8	40.4	69	4	6.1	4.10
15	26.5	6.9	1.7	911.1	184	456	383.8	42.0	160.0	72	70	14.1	6.2	1.30
16	26.5	6.7	1.3	605.6	252	264	87.9	45.0	89.8	44.2	81	14.2	8.0	2.10
17	26.9	6.5	2.0	878.4	356	752	292.9	38.0	166.7	77.2	75	10	1.1	2.60
18	26.4	6.7	1.3	507.6	320	282	119.9	36.0	59.3	30.2	62	11	6.0	3.10
19	27.1	6.6	1.7	790.0	260	624	275.9	9.0	144.3	72.7	58	3.2	6.5	2.70
20	27.2	4.1	1.5	732.9	252	456	215.9	41.0	112.2	58.5	60	9.9	6.4	2.10

All parameters are given in ppm, excluding E.C. Mhos/cm, Temperature ^{0}C and pH

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Table II: Variation of ground water quality parameter in month of January 2011

S.N.	T	pH	EC	TDS	TA	TH	Cl^-	SO_4^{-2}	CA^{2+}	Mg^{2+}	Na^+	K^+	DO	TUB
S1	24.5	6.7	1.0	505.8	224	640	151.95	13.0	161.9	18	60	6.1	6.88	2.60
S2	24.8	6.7	4.1	191.8	232	342	63.98	70.0	51.3	28.6	80	7.1	7.21	2.30
S3	25.3	6.7	7.2	340.4	228	525	131.95	30.0	49.3	23.1	61	6	7.20	2.40
S4	25.1	7.8	6.0	486	288	336	59.98	23.0	89.7	36.8	81	7.21	7.21	2.60
S5	24.1	4.3	1.1	530.5	296	568	212.93	66.0	144.2	77.2	95	1.19	5.90	3.30
S6	26.0	6.7	9.7	469.4	301	504	119.96	20.0	141.1	84.17	90	8.69	6.01	1.5
S7	24.0	6.7	4.7	497.2	300	380	47.98	16.0	25.0	16	45	7.11	6.08	3.00
S8	24.3	6.8	2.0	969.9	460	650	419.86	56.0	232.4	231.6	34	6.19	6.48	4.30
S9	25.3	5.9	2.1	1034	504	960	331.89	14.0	168.3	94.3	48	6.92	6.84	4.50
S10	23.4	6.6	1.1	501.5	372	410	127.96	56.0	59.3	1.62	56	6.9	6.32	2.30
S11	23.8	7.2	1.7	890	412	767	353.9	0.3	76.4	36.25	56	5.9	6.12	2.70
S12	24.2	6.7	1.7	890.3	444	552	307.9	30.0	173.1	104.6	78	8.11	6.52	3.30
S13	25.7	6.4	8.9	412.9	396	392	99.96	30.1	102.6	61.2	67.2	7.11	6.87	3.70
S14	26.7	6.1	7.9	875	300	448	107.96	0.1	112.2	48.19	68	5.7	6.08	3.90
S15	25.0	7.0	2.2	1434	172	512	444.84	0.2	192.3	91.12	70.4	4.94	5.72	3.70
S16	26.3	6.8	5.4	812	304	510	51.98	56.0	148.0	512.5	91	9	8.10	3.80
S17	26.3	6.5	1.6	558.5	376	880	272.91	28.0	176.3	98.19	61	7.9	6.08	4.36
S18	25.0	6.5	7.2	512.16	460	272	55.98	29.0	59.3	20.1	52	6.9	5.61	4.31
S19	24.8	4.5	1.5	760.9	316	584	278.91	27.0	147.4	73.16	62	5.6	6.12	4.12
S20	6.1	6.8	1.2	740.8	308	416	219.93	4.0	181.6	83.9	60	4.99	6.38	3.00

All parameters are given in ppm, excluding E.C. Mhos/cm, Temperature ^{0}C and pH

Table 3: Variation of ground water quality parameter in month of May 2011

S.N.	T	pH	EC	TDS	TA	TH	Cl^-	SO_4^{-2}	Ca^{2+}	Mg^{2+}	Na^+	K^+	DO	TUB
S1	29.9	6.688	8.186	430.1	116	456	215.93	41.0	131.460	26.48	49	7.15	5.96	4.00
S2	29.9	5.700	1.099	580.7	252	632	275.9	92.0	142.680	98	70	5.6	2.26	2.60
S3	29.2	6.750	1.053	554.9	196	760	251.92	80.0	56.110	23.21	56	6.6	6.40	1.90
S4	28.2	6.781	1.01	810	224	568	207.93	61.0	101.840	90	62	8.21	6.68	4.50
S5	30.4	5.160	1.294	916	276	520	295.9	89.0	191.360	111.2	78	7.1	5.53	1.67
S6	31.2	6.210	1.025	576	244	488	183.94	52.0	126.650	95.24	71	5.19	5.52	4.70
S7	30.6	6.420	9.44	720	308	568	231.92	38.0	121.850	83.16	69	8.38	5.47	1.10
S8	30.5	6.688	1.211	640.7	240	544	279.93	55.0	247.490	108.08	69	6.54	5.21	3.00
S9	30.4	6.510	1.35	960.5	188	496	207.93	38.0	102.600	88.16	70	6.14	5.02	1.50
S10	30.2	5.480	1.261	890.1	300	528	187.94	36.0	117.030	2.97	60	4.38	3.84	2.00

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S11	30.5	6.320	1.737	1260	436	616	219.93	36.0	123.440	98.2	57	5.31	5.44	2.70
S12	30.6	6.640	1.336	950.4	556	584	275.91	56.0	334.660	97.12	62	5.45	5.11	2.90
S13	31.2	5.200	2.453	1028	284	560	143.95	52.0	96.190	40.4	39	8.78	6.5	2.70
S14	30.5	5.600	2.124	1117	360	600	291.9	21.0	153.900	72.16	6.9	4.31	5.52	2.00
S15	29.9	5.680	1778	1350	316	912	395.87	59.0	329.000	116	71	11.1	5.50	3.00
S16	31.0	6.727	1.363	1030	408	896	303.9	60.0	153.900	89.7	70	16.1	7.40	2.60
S17	30.6	5.460	2.209	1390	444	968	335.89	58.0	123.440	92.15	65	10	5.72	4.90
S18	30.5	5.870	1.280	1012	320	536	323.89	55.0	129.850	82.12	62	12	5.11	2.00
S19	30.7	5.960	1.309	1090	348	768	291.9	19.0	218.630	112.6	58	3.91	5.24	3.10
S20	31.2	6.260	1.215	1114	304	920	351	48.0	277.950	166.3	38	7.71	5.92	1.10

All parameters are given in ppm, excluding E.C. Mhos/cm, Temperature ^{0}C and pH

V. CONCLUSION

The result obtained during study was compared with standards [37-38] and it was found that maximum number of parameters in ground water of Osmanabad were above desirable limit in all the three season. This study shows that ground water is the only source for people in the study area, and the results of the chemical analyses of ground water indicate considerable variation. The water quality in the investigated area is found to be suitable for drinking only in few locations, while as out prior treatments. It must be noted that a regular chemical analysis must be done to insure that the quality of water in this area is not contaminated, in addition to research for new walls in the area in order to get additional water for the resident people.

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