SEASONAL VARIATIONS OF PHYSICO-CHEMICAL CHARACTERISTICS OF GROUND WATER SAMPLES OF GADCHANDUR AREA IN CHANDRAPUR DISTRICT, MAHARASHTRA, INDIA

Pidurkar RS[1]*, Lanjewar MR[2] and Lanjewar RB[3]
[1]Sardar Patel Mahavidyalaya, Chandrapur, India
[2]Department of Chemistry, R.T.M. Nagpur University, Nagpur, India
[3]Department of Chemistry, Dharampeth M.P.Deo Memorial Science College, Nagpur, India
*Corresponding author email : pidurkar.raju@gmail.com

ABSTRACT

Quality of water is an important criterion for evaluating the suitability of water for drinking and irrigation. The effect of seasonal changes on the physico-chemical characteristics of water resources quality in fifteen selected sites in and around Gadchandur in Chandrapur district has been investigated for a period of summer, monsoon and winter season during 2016 - 2017 with an objective to assess the water quality status in the study area and its potability. The water quality parameters considered in the present study were temperature, pH, total dissolved solids, alkalinity, total hardness, chloride, dissolved oxygen, turbidity, fluoride, Fe, nitrate, sulphate. The analysis of parameters using standard methods and their comparison with standard values suggested that most of the parameters are within the permissible limit.

KEYWORDS : Ground water, physico-chemical parameters, TDS, DO, APHA

INTRODUCTION

Rapid industrialization and urbanization is leading to deterioration of environmental conditions on global scale[1]. In recent years, environmental pollution has become a critical problem which affect on atmospheric properties, human health, soil, water, vegetation, animal and the whole ecosystem[1-4]. Due to intense industrial activities and dense settlement in urban and industrial areas, the environmental pollution becoming growing hazards to human health[5-8]. Water plays an important role in human life and its elemental composition is important to life processes as it provides all the essential nutrients to living organism**.** Due to tremendous increase in pollution, technological advancement and industrial growth, the lack of safe drinking water emerge as major problem for significant proportion of global population.

Water is a prime natural resource and a basic human need. Therefore, monitoring the quality of water is one of the essential issues of drinking water management[9]. The present work is carried out in vicinity of Gadchandur area in Chandrapur district in order to study the ground water quality. Gadchandur is situated on Eastern side of Maharashtra state and shares the state border of Andhra Pradesh, lies between degree of 19043'N 79010'E, the adjoining districts are Garhchiroli on eastern side, on Southern side Adilabad district of Andhra Pradesh, on western side Yavatmal District. The Gadchandur area falls under the Penganga basin and Wardha river basin.

MATERIALS AND METHODS

Study area : The Physico-chemical parameters of ground water of 15 stations in Gadchandur area were studied. The water samples were collected from bore wells located in this area. Ultratech, Ambuja and Manikgarh cement factories are located near the study area. The samples were collected in clean polythene bottles without air bubbles, the bottles were rinsed using double distilled water before sampling and tightly sealed after collection and labeled. Analysis of pH, Total dissolved solids,

fluoride, iron, nitrate, sulphate, dissolved oxygen, alkalinity, chlorides, total hardness and turbidity was carried out in laboratory using standard methods[10-12] and data is reported in Table No. 1 of summer, Table no. 2 of rainy and Table no. 3 of winter seasons.

RESULTS AND DISCUSSION

The samples collected from Gadchandur area were analyzed. The analysis of water samples includes determination of physico-chemical parameters which were analysed in summer, rainy and winter season have been shown in Table 1, Table 2 and Table 3 respectively. The analyzed data were compared with standard values recommended by WHO[13].

Temperature : Temperature is one of the most important ecological and physical factors which have profound influence on the abiotic and biotic components of the environment. Temperature helps in controlling the solubility of gases. From the above values, it is found that the values of temperature in summer season are higher than the values in winter season. Due to intense solar radiations in summer, temperature of water increases in summer as compared to winter season.

pH:- pH is a measure of the hydrogen ion concentration in water and indicates whether the water is acidic or alkaline. The measurement of alkalinity and acidity of pH is required to determine the corrosiveness of the water. The water samples of above study area indicates slightly acidic or alkaline nature of water. The observed pH values were found within permissible limits prescribed by WHO and ISI[14].

Total dissolved solids:- Solid is a term which is applied to all matter except the water contained in the liquid material under test and defined as matter that remains as a residue upon evapouration and drying in oven at a definite temperature. Total solid is the residue that includes both dissolved and suspended solids. A total solid includes total suspended solids i.e. the portion of total solid retained by a filter and total dissolved solids is the portion that passes through a filter. Total dissolved solid is a soluble mixture of sulphates, phosphates, chlorides, nitrates, carbonates, bicarbonates of different elements like Ca, Mg, Na, K etc.

Water samples of above study area showed high TDS values which may be due to ground water pollution when waste water from residential and hospitals are discharged into pits and ponds[15-16].

Turbidity:- Turbidity in water is caused by suspended and colloidal matter such as clay silt finely divided organic and inorganic matter and plankton and other microscopic organisms. Turbidity is an expression of optical property that causes light to be scattered and absorbed rather than transmitted with no change in direction or flux level through the sample. It is observed that turbidity is high in rainy season for most of the samples while in summer and winter seasons, samples have moderate or low values of turbidity.

Alkalinity:- Alkalinity of water is a measure of its capacity to neutralize acids. Natural alkalinity to water sources is imparted mainly by salts of weak acids such as bicarbonates, carbonates, borates, silicates, phosphates and the salts of humic and fulvic acids. Few industrial effluents such as calcium hydroxide from cement factory, sodium hydroxide from soap manufacturing, textile dyeing, rubber reclaiming and tanneries
also contribute to the water alkalinity. In rainy season, alkalinity is within the BIS standard for all samples while the values are beyond the BIS limits for most of the samples in summer and winter seasons.

Chlorides:- Chloride a major anion in potable and industrial water has no adverse effect on health, but imparts bad taste to drinking water. The chloride concentration serves as an indicator of pollution by sewage. People accustomed to higher chloride in water are subjected to laxative effects[17]. A high concentration of chlorides affects growth of vegetation and imparts an increase in corrosiveness of metals.For all samples in all seasons, chloride values are wit hin the BIS standards.

Fluorides:- The major natural source of fluoride is amphiboles, apatite, fluorite and mica. Its concentration in natural waters generally should not exceed 10 mg/l. The factors responsible for ground water contamination with fluoride are geological factors such as weathering of minerals, rock dissolution and decomposition containing fluoride over a long period of time resulting in the leaching it into ground water.In rainy season, fluoride concentration is within BIS limits for maximum samples while the values

are higher for all samples in summer and winter seasons.

Iron:- The concentration of iron in drinking water is 0.3mg/L as per BIS. Maximum permissible limit is 1mg/L. The ideal daily intake of iron for typical diets has been estimated to be in the range 15 to 22mg. It is an essential element in human nutrition. However, in large quantity it results in a condition known as haemochromatosis. The values of iron of all samples are within BIS limits in all seasons i.e. summer, rainy and winter.

Total Hardness:- Water source in its natural form itself might contain a variable quantity of inorganic salts dissolved in it for example Ca^{2+}, Mg^{2+}, Cl^{-}, SO_4^{2-}, CO_3^{2-} and HCO_3^{-}. Hardness of water may be temporary or permanent. Hardness is expressed in terms of equivalent quantity of $CaCO_3$. Water quality association has provided a general scale of hardness demarcating the limits for soft and hard waters. Hardness although has no health effects; it can make water unsuitable for domestic and industrial use.For most of the samples, the values of total hardness are beyond the BIS standards in all seasons.

Nitrates:- Nitrate is most highly oxidized form of nitrogen compounds commonly present in natural waters. Significant sources of nitrate are chemical fertilizers, decayed vegetables animal matter, domestic effluents, sewage sludge disposal to land, industrial discharge, leachates from refuse dumps and atmospheric washout. Depending on the situation, these sources can contaminate streams, rivers, lakes and ground water.For most of the samples, the values of nitrates are within the BIS standards in all seasons.

Sulphates:- Sulphate ions usually occur in natural water. Many sulphate compounds are readily soluble in water. Most of them original from the oxidation of sulphite ores, the solution of gypsum and anhydrite, the presence of shales, particularly those rich in organic compounds and the existence of industrial waste. Atmospheric SO_2 formed by the combustion of fossil fuels and emitted by the metallurgical roasting processes may also contribute to the sulphate compounds of the water. The values of sulphates of all samples are within the BIS standards in all seasons.

Dissolved oxygen:- Dissolved oxygen is important parameter in water quality assessment and biological processes prevailing in the water. The DO values indicate the degree of pollution in the water bo dies. The values of dissolved oxygen of all samples are within the BIS standards in all seasons

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Table 1. Analysis of ground water samples in summer season (May 2016)

Sr. No.	Site Code	Temp. (^oC)	pH	TDS (ppm)	Turbidity (NTU)	Alkalinity (ppm)	Cl^- (ppm)	F^- (ppm)	Fe (ppm)	Total Hardness (ppm)	NO_3^- (ppm)	SO_4^{2-} (ppm)	Dissolved oxygen (ppm)
1	W1	31.5	7.25	472	0.40	392	26	2.25	0.033	376	0.35	55	3.6
2	W2	29.4	7.62	607	0.46	308	32	0.00	0.019	568	0.69	110	4.0
3	W3	30.5	7.65	528	0.76	332	36	2.20	0.025	348	0.08	20	3.6
4	W4	29.8	7.43	342	0.50	312	28	2.0	0.082	204	0.03	15	4.2
5	W5	30.6	7.10	692	14.58	288	110	2.20	0.117	484	0.832	115	3.4
6	W6	29.3	7.37	403	0.99	240	46	2.34	0.034	264	0.832	30	4.4

7	W7	29.8	7.48	808	0.28	288	108	2.25	0.063	600	0.677	70	3.6
8	W8	29.5	7.40	753	0.40	352	120	2.02	0.117	528	0.956	60	4.6
9	W9	29.2	7.60	575	0.03	320	44	2.29	0.127	300	0.939	50	4.8
10	W10	30.6	7.70	674	0.12	370	38	2.68	0.074	380	0.739	45	4.4
11	W11	30.3	7.35	905	1.12	180	98	2.38	0.042	328	0.801	120	4.2
12	W12	29.7	7.33	573	0.68	300	52	2.19	0.082	476	0.70	315	3.6
13	W13	29.2	7.71	610	0.83	336	88	2.12	0.122	248	0.10	65	4.6
14	W14	30.3	7.29	648	1.30	260	92	2.17	0.095	348	0.11	85	4.2
15	W15	30.5	7.49	467	0.36	180	100	2.27	0.034	392	0.58	48	4.0
BIS/WHO		----	6.5 – 8.5	500	1 – 5	200	250	0.5 – 1.5	0.300	300	45	200	4 – 6

Table. 2. Analysis of ground water samples in rainy season (August 2016)

Sr. No.	**Site Code**	**Temp. (^oC)**	**pH**	**TDS (ppm)**	**Turbidity (NTU)**	**Alkalinity (ppm)**	**Cl^- (ppm)**	**F^- (ppm)**	**Fe (ppm)**	**Total Hardness (ppm)**	**NO_3^- (ppm)**	**SO_4^{2-} (ppm)**	**Dissolved oxygen (ppm)**
1	W1	29.5	7.10	530	1.65	157	55.98	1.195	0.221	290	150.2	60	4.0
2	W2	28.8	7.28	505	0.54	143	37.99	3.442	0.078	562	12.88	140	4.2
3	W3	30.1	7.34	382	1.79	146	43.99	0.532	0.265	298	16.70	30	3.8
4	W4	29.2	7.20	331	2.72	115	21.99	0.437	0.240	240	3.98	20	4.0
5	W5	29.2	7.12	730	20.5	149	115.96	0.620	0.999	322	7.29	135	3.8
6	W6	28.9	7.24	418	0.78	118	23.99	1.714	0.073	288	12.65	35	4.0
7	W7	29.3	7.19	974	0.35	150	197.94	0.739	0.043	732	153.39	65	3.8
8	W8	29.3	7.25	776	1.16	144	115.96	0.939	0.162	490	153.41	70	4.4
9	W9	28.9	7.44	565	0.36	189	53.98	1.715	0.038	334	15.67	60	4.6

10	W10	30.1	7.35	658	4.36	227	47.99	1.572	0.285	406	17.27	40	4.2
11	W11	29.7	7.17	581	0.69	131	45.99	1.157	0.107	294	9.78	130	4.4
12	W12	29.1	6.98	1110	5.96	119	199.94	0.658	0.457	490	153.31	380	3.8
13	W13	28.6	7.30	541	1.35	144	39.99	2.154	0.137	368	20.32	50	4.4
14	W14	29.3	7.19	573	2.13	148	55.98	0.263	0.231	222	9.06	70	4.0
15	W15	29.5	7.50	525	4.69	153	47.99	1.375	0.171	144	5.64	50	4.2
BIS/WHO		----	6.5 – 8.5	500	1 – 5	200	250	0.5 – 1.5	0.300	300	45	200	4 – 6

Table. 3. Analysis of ground water samples in Winter season (November 2016)

Sr. No.	**Site Code**	**Temp. (^oC)**	**pH**	**TDS (ppm)**	**Turbidity (NTU)**	**Alkalinity (ppm)**	**Cl^- (ppm)**	**F^- (ppm)**	**Fe (ppm)**	**Total Hardness (ppm)**	**NO_3^- (ppm)**	**SO_4^{2-} (ppm)**	**Dissolved oxygen (ppm)**
1	W1	28.1	7.20	495	0.60	272	36	2.15	0.013	410	12.20	44	4.4
2	W2	26.0	7.42	674	0.56	210	48	0.94	0.009	544	11.15	75	4.6
3	W3	27.1	6.92	342	1.20	230	46	1.20	0.020	314	9.65	95	4.0
4	W4	26.6	6.83	305	2.50	212	26	2.15	0.090	226	10.30	35	4.2
5	W5	27.2	6.56	690	13.65	145	105	1.60	0.705	390	9.80	150	4.2
6	W6	26.0	7.00	410	0.89	140	67	1.34	0.025	244	11.30	55	4.0
7	W7	26.6	7.15	825	0.18	230	217	1.85	0.090	560	12.70	58	4.4
8	W8	26.7	7.10	676	0.60	315	190	1.75	0.127	480	13.35	68	4.6
9	W9	26.0	7.25	525	0.15	275	63	2.10	0.107	290	7.15	72	3.8
10	W10	27.2	7.20	585	0.05	257	58	2.25	0.050	410	8.85	38	3.4
11	W11	27.0	7.10	715	1.27	149	118	1.26	0.010	340	14.12	142	4.2
12	W12	26.3	6.95	995	4.70	217	175	1.87	0.090	514	11.15	327	4.0

13	W13	26.0	7.31	580	0.60	252	108	2.10	0.112	288	9.30	76	3.8
14	W14	26.9	7.00	540	1.10	238	119	1.80	0.020	384	7.16	66	4.6
15	W15	27.1	7.19	570	0.76	226	120	2.20	0.205	414	14.30	49	4.2
BIS/WHO		----	6.5 – 8.5	500	1 – 5	200	250	0.5 – 1.5	0.300	300	45	200	4 – 6

CONCLUSION

The results revealed that majority of the sampling stations had permissible range of values of physico-chemical parameters while some of them are highly polluted in summer, winter and rainy seasons. The parameters in most of the water samples are in normal range in all seasons and indicated better quality of water. It is advisable that people from this area can use bore well water for domestic purpose in all seasons except few.

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