

PHYSICO-CHEMICAL CHARACTERISTICS OF GROUNDWATER ANALYSIS IN NAMAKKAL DISTRICT OF TAMILNADU STATE

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ABSTRACT

Groundwater quality studies were carried out in and around Namakkal District, Tamilnadu. The objective of this study is to identify the quality of groundwater especially in the town and rural areas where groundwater is used for domestic and agriculture purposes. Fifteen locations of ground water samples were collected and studied for a month of June-2014 and October-2014. The present investigation is focused on the determination of Physico-Chemical parameters such as temperature, taste, turbidity, electrical conductivity, pH, hardness, total solids, total dissolved solids, total suspended solids, chlorides, sulphate, nitrate, fluorides, dissolved oxygen, sodium, potassium and E.coli. Groundwater suitability for domestic and irrigation purposes was examined by using WHO and BIS standards, which indicate the Groundwater of few areas, were not much suitable for drinking purposes.

Keywords: Well water, Water quality parameters, WHO and BIS, Monitoring, Correlation.

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INTRODUCTION

Groundwater is used for domestic, agriculture and industrial purpose in most parts of the world. Rural population living in India depends on groundwater for domestic and agriculture purpose¹. The major sources of water are rainfall, surface water involving rivers, lakes and ground water involving wells and bore wells. Groundwater is the only alternative option even for the urban centers having well planned, designed and executed water supply systems like Namakkal during the periods of water scarcity due to shortfall of rain or its non-occurrence. Also normally the ground water is the only water sources for the different locations, where the municipal water supply facilities are not available. Now a day, the groundwater potential and its quality level in major cities and urban centers is getting deteriorated due to the population explosion, urbanization, industrialization, failure of monsoon and improper management of rain water. The groundwater quality is normally characterized by different physico-chemical characteristics. These parameters change widely due to the various types of pollution, seasonal fluctuation, groundwater extraction, etc. Hence a continuous monitoring on groundwater becomes mandatory in order to minimize the ground water pollution and have control on the pollution causing agents. Continuous monitoring on ground water may become easier with the development of rapid water quality measurement techniques without making much compromise on the accuracy of measurement. The water samples were collected from the different wells and analyzed. The physico-chemical properties were compared with WHO and BIS standards².

Study area

The areas chosen for the present study are in and around Namakkal District. Namakkal District reveals that the very famous temple of Lord Anjenaya and Narashimar temple, Education city, Poultry and Egg city throughout India, Body builder of transport, tourist place and medical plants in Kollihills. The population of Namakkal District is around fourteen lakhs and area is 3363 Sq.km. The present studies, fifteen locations of samples were collected; three samples from each location and totally forty-five samples were collected.

The list of sample location and its area codes were given below-

Area Code	Area
1	Thusur
2	Puthansanthai
3	Vellalapatty
4	Elayapuram
5	Irulapatty
6	Thillaipuram (Namakkal town)
7	Ealur
8	Vallaiyapatty
9	Pavithiram
10	Thiruchengodu
11	Velagoundampatty
12	Erumapatty
13	Kanthampalayam
14	Rasipuram
15	Paramathi-velur.

The water samples collected from wells which have the depth of 70 to 90 feet. The areas extensively used for drinking, household purposes and agricultural purposes were selected and identified. The groundwater samples from the sampling locations were taken after operating the motor pumps for about 10 to 15 mts. The samples were collected in the pre-cleaned polythene bottles with necessary precautions. All the samples were tested for the environmentally significant parameters.

EXPERIMENTAL

Forty-five water samples were collected from fifteen locations using spot sampling procedure in previously washed and dried polythene bottle from different places^{3,4}. These groundwater samples were studied for a month of June-2014 and October-2014. The temperatures of the samples were noted at their sampling point itself. The samples were put for examination in the laboratory to determine the physical, chemical and biological parameters. These include temperature, taste, turbidity, conductivity, pH, hardness, total solids, total dissolved solids, total suspended solids, chlorides, sulphate, nitrate, fluorides, dissolved oxygen, sodium, potassium and heavy metals. The Standard instruments and methods such as spectrophotometry, flame photometry and volumetry were used for the experiment. Presumptive test using lactose bath was performed for drinking water samples to detect the presence of bacteria. The results were compared with WHO and BIS⁴.

RESULTS AND DISCUSSION

Color, Odor, Taste, Turbidity and Temperature

All the water samples were colorless, clear and odorless, which indicate that there may be the absence of colloidal substances, suspended and decomposed vegetation. Temperature is basically important for the chemical and biological reactions of organisms in water. The temperature of the samples lies between 29 to 31°C (Table-1a).

Table-1a: Physical parameters, in mg/L.

Area Code→ Parameter↓	1	2	3	4	5	6	7	8
Temp., °C	29	28	27	30	31	28	27	28
Colour	cl	cl	cl	cl	cl	cl	cl	cl
Odour	ol	ol	ol	ol	ol	ol	ol	ol
Taste	normal	salty	salty	normal	salty	sour	pleasant	sour
Turbidity	clear	clear	clear	clear	clear	clear	clear	clear

Conductivity	2.9	3.3	4.6	2.6	0.8	1.3	2.4	0.8
Total solids	888	1160	1650	845	268	840	750	380
TDS	850	1100	1600	800	250	810	720	350

cl – colorless; ol – odourless; TDS – Total Dissolved Solids.

Table-1b: Physical parameters, in mg/L.

Area Code→ Parameter↓	9	10	11	12	13	14	15
Temp., °C	29	30	31	30	28	29	30
Colour	cl	cl	cl	cl	cl	cl	cl
Odour	ol	ol	ol	ol	ol	ol	ol
Taste	sour	salty	normal	normal	normal	sour	salty
Turbidity	clear	clear	clear	clear	clear	clear	clear
Conductivity	3.3	3.2	1.9	1.4	1.1	2.6	1.9
Total solids	1077	1143	700	444	480	1140	1120
TDS	1050	1120	680	430	460	1120	1080

cl – colorless; ol – odourless; TDS – Total Dissolved Solids

Conductivity and Total solids

Conductance of water samples were varied from 0.8 to 3.3 mS/cm. But samples from area codes 1,2,9,10,14 and 15 had relatively higher conductivity, which may be due to contamination of conducting material in water samples. According to BIS Standards, the acceptance limit for TDS in ground water is 500 mg/L, which may go up to 1500 mg/L. As per classification of TDS well water of Namakkal area come under moderately hard to harder especially sample code 2,3,9,10,14 and 15 exceeds BIS permissible limit. Total solids include the presence of volatile and non-volatile solids. The presence of excessive solids in water indicates pollution which can lead to a laxative effect. The presence of excessive solids in water may be due to agricultural activities and geological parameters⁵.

Table-2a: Chemical parameters of well water in mg/L

Area Code→ Parameter↓	1	2	3	4	5	6	7	8
pH	6.97	7.23	7.17	7.45	6.93	6.92	7.27	6.78
Total hardness	815	1035	1000	680	365	525	415	420
Total Alkalinity	500	375	475	300	450	350	450	325
Chloride	419	452	622	340	33	140	297	63
Sulphate	180	320	340	170	165	166	170	155
Nitrate	30	60	62	25	30	34	38	40
Sodium	90	190	198	98	36	90	98	98
Potassium	15	84	100	40	42	45	36	40
Iron	0.3	0.5	0.6	0.2	0.1	0.2	0.1	0.2
Chromium	0.04	0.08	0.09	0.03	0.04	0.02	0.02	0.04
Nickel	0.03	0.09	0.08	0.02	0.03	0.03	0.04	0.03
Lead	0.02	0.08	0.09	0.03	0.04	0.03	0.05	0.06
Fluoride	0.8	1.8	2.0	0.8	0.7	0.5	0.9	1.0
Dissolved oxygen	8	6	6	8	7	8	7	8
E.coli (counts/100ml)	2	8	6	2	4	2	4	2

Discussion of Chemical Parameters

The chemical parameters are tabulated in table- 2a and 2b. The collected water samples have pH within the permissible limits ranging from 6.80 to 7.5. Total hardness of collected samples was found to be in the range from 365 to 1125 mg/L. Total hardness values for samples from area codes 2, 3, 9 and 14 are high due to the high content of calcium and magnesium salts. Those samples using frequently for drinking which leads to arise heart diseases and kidney stone formation⁶. The chloride content of water samples

were lies in the range from 63 to 622 mg/L. Samples from area codes 1, 2,3,9,10,14 and 15 have high concentration of chloride content and exceeds the permissible limit proposed by BIS and WHO. High chloride content in water bodies harms metallic pipes and structure as well as agricultural crops⁷. Total alkalinity of water samples were lies in the range from 125 to 550 mg/L. Samples 1, 14 and 15 have high concentration of alkalinity and exceeds the permissible limit proposed by BIS. High alkalinity in water bodies leads to sour taste and salinity.

Table-2b: Chemical and Biological parameters of well water in mg/L

Area Code→ Parameter↓	9	10	11	12	13	14	15
pH	6.72	7.47	7.19	7.41	6.72	6.93	6.8
Total hardness	915	715	575	410	450	1125	825
Total Alkalinity	450	375	125	450	425	550	525
Chloride	533	444	185	119	77	391	382
Sulphate	310	330	140	165	150	250	290
Nitrate	55	60	35	30	30	56	60
Sodium	196	195	94	68	67	180	198
Potassium	90	59	30	25	46	90	85
Iron	0.4	0.5	0.3	0.2	0.3	0.4	0.5
Chromium	0.08	0.09	0.04	0.03	0.02	0.08	0.09
Nickel	0.07	0.08	0.03	0.02	0.03	0.08	0.09
Lead	0.09	0.09	0.04	0.05	0.04	0.09	0.08
Fluoride	1.6	1.8	1.0	0.8	0.9	1.6	1.8
Dissolved oxygen	6	5	8	7	8	6	6
E.coli (counts/100ml)	4	6	2	4	4	6	8

Sulphates of water samples were lies in the range from 140 to 340 mg/L. Samples from area codes 2, 3, 9, 10, 14 and 15 have moderately high values of sulphate and exceeds the permissible limit proposed by BIS and WHO. At concentrations of sulphate around 1000 mg/L, it has laxative effect and causes gastro intestinal irritation⁸. Nitrate of water samples collected lies in the range from 25 to 62 mg/L. Samples from area codes 2,3,9,10,14 and 15 have moderate values of nitrate and exceeds the permissible limit proposed by BIS. High nitrate concentration in water bodies leads to organic pollution causes blue baby syndrome and it can be removed by desalination⁹. Sodium of water samples were lies in the range from 36 to 198 mg/L. Samples from area codes 2, 3, 9, 10, 14 and 15 have moderately high values of sodium and exceeds the permissible limit proposed by WHO.

Potassium of water samples were lies in the range from 15 to 100 mg/L. Samples from area codes 2, 3, 9, 10, 14 and 15 have slightly high values of potassium and exceeds the permissible limit proposed by BIS. High potassium values may cause nervous and digestive disorder¹⁰. Iron, Chromium and Nickel of water samples collected lies in the range from 0.1 to 0.6 mg/L, 0.02 to 0.09 mg/L and 0.02 to 0.08 mg/L and respectively. The most of the samples were almost within limits compared with BIS and WHO standards. But, the presence of high concentration of heavy metals may be causes kidney damage, carcinogenic, bone damage, nervous disorder and Cancer¹¹. Fluoride of water samples collected lies in the range from 0.5 to 1.8 mg/L. Samples from area codes 2, 3, 9, 10, 14 and 15 have slightly high values of fluoride and exceeds the permissible limit proposed by BIS. High fluoride values may be causes fluorosis, which is characterized by mottling of teeth-enamel, nervous and skeletal disorder. Dissolved oxygen of water samples were lies in the range from 5 to 8 mg/L. Samples from area codes 2, 3, 9, 10, 14 and 15 have slight lower values of dissolved oxygen and lower the permissible limit proposed by BIS. This Lower values may be slightly affect the fish life in aquatic system¹².

Table- 3 and the above discussion shows that some of the parameters has the concentration level greater than the permissible limit. The observed coefficient of variation for the parameters shows that the variations in the Chlorides (61.85%), Iron (49.06%), and Chromium (52.83%) and Nickel (56.0%) are of

moderately high range. It shows that the various parameter concentrations were varying in different locations.^{13, 14}

Table-3: Statistical evaluation for different parameters in the well waters of in and around Namakkal District.

S.No.	Parameter	Range	BIS	WHO	Mean	Standard Deviation	Standard Error	Coefficient of Variation %
1	Temperature °C	28-31	28-30	28-30	29	1.31	0.339	4.5
2	Conductivity mS/cm	0.8-3.3	1.4	1.8	2.29	1.12	0.289	49.1
3	Total Solids	268-1160	500	500	859	370.78	95.81	43.16
4	pH	6.8-7.5	6.5-8.5	6.5-9.5	7.06	0.265	0.068	3.75
5	Total hardness	365-1125	500	500	684.67	256.31	66.23	37.44
6	Chlorides	63-622	250	250	299.8	185.43	47.91	61.85
7	Total Alkalinity	125-550	200	250	408	106.3	27.47	26.05
8	Sulphate	140-340	200	200	220.07	76.29	19.71	34.67
9	Nitrate	25-62	45	45	43	13.94	3.60	32.42
10	Sodium	36-198	100	100	106.4	47.50	12.27	44.64
11	Potassium	15-100	10	10	55.1	27.41	7.08	49.75
12	Iron	0.1-0.6	0.3	0.3	0.32	0.157	0.041	49.06
13	Chromium	0.02-0.09	0.05	0.05	0.05	0.028	0.007	52.83
14	Nickel	0.02-0.09	0.01	0.01	0.05	0.028	0.007	56.00
15	Lead	0.02-0.09	0.05	0.05	0.06	0.026	0.007	43.33
16	Fluoride	0.5 - 1.8	1	1-1.5	1.2	0.50	0.13	41.67
17	Dissolved oxygen	5 - 8	8	8	6.93	1.03	0.27	14.91
18	E.coli.counts/ 100ml	2 - 8	10	10	4.27	2.12	0.57	49.65

CONCLUSION

In the current study based on physico-chemical parameters concluded that the Samples from area codes 1, 4, 5, 6, 7, 8, 11, 12 and 13, these water parameters within the limits of BIS and WHO standards. Hence these sample water can be used for drinking, irrigation and fisheries and followed suitability and also sustainable for the human health and the environment. The water samples from area codes 2, 3, 9, 10, 14 and 15 are slightly higher values in physical and chemical parameters which may not be much fit for a long period for drinking, cooking purposes. In general, those water samples may be subjected to adsorption techniques, boiling, cooling, filtration and then used for drinking and cooking purposes. The statistical analysis of the experimentally estimated water quality parameters on water samples yielded the range of the variation, mean, standard deviation and co-efficient of variation. Since the correlation co-efficient gives the interrelationship between the parameters, correlation coefficients were calculated. Results of correlation analysis show that sulphate and fluoride, nitrate and fluoride, conductivity and chloride are having high correlation with most of the other parameters.

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