



International Journal of ChemTech Research CODEN (USA): IJCRGG ISSN: 0974-4290 Vol.7, No.4, pp 1795-1800. 2014-2015

Physico Chemical analysis of ground water samples of Rasipuram Taluk, Namakkal District Tamilnadu india.

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Abstract: Ground water samples of open wells, bore wells and hand pumps collected from 10 different locations in Rasipuram Taluk in Namakkal district during the pre –monsoon period (June 2013) and post monsoon period (Dec 2013-Jan 2014) were analyzed for their physic-chemical parameters such as pH , Electrical conductivity (EC), Total dissolved solids (TDS), Total Hardness (TH), Total Alkality (TA), Calcium $(Ca)^{2+}$, Magnesium $(Mg)^{2+}$, Manganese $(Mn)^{2+}$, Iron $(Fe)^{2+}$, Sodium (Na)⁺, Potassium (K)⁺Ammonium (NH₃)³⁺, Nitrate (No₃)⁻, Nitrite (No₂)⁻Flourine (F)⁻, Chlorine (Cl)⁻, sulfate (So₄)⁻, Phosphate (Po₄)⁻, were analyzed to known the present status of the ground water quality. The results were compared with standards approved by ISI 10500-91. The statically tool as correlation co efficient analysis were also used for the interpretation of water quality data and its spatial variations.

Keywords: Physico-Chemical parameters: water quality, Rasipuram Taluk, Correlation coefficient Analysis.

Introduction

Ground water is the major source of water for drinking, agricultural, and industrial desires. The availability of water determines the location and activities of humans in an area and our growing population is placing great demands upon natural fresh water resources.⁽¹⁻²⁾

Ground water is an important resource and is the elixir of life. But peoples are not aware of disease caused due to water contamination. Drinking water with good quality is very important to improve the life of people and prevent disease.⁽³⁾

The physico –chemical contaminants that diversely affected the quality of ground water is likely to arise from a variety of sources including land application of agricultural chemicals and organic waste in filtration of irrigation water, septic tank and infiltration of effluents from sewage treatment plants, pit lagoons and ponds used for storage.⁽⁴⁻⁵⁾

In this study physic-chemical assessment of ground water samples is determine by using standard analytical methods, the objective of the study is to analyze the 17 parameters of water along 10 locations for 2 sessions' pre monsoon and post monsoon (during 2012-2014). The aim of this study was determine the physic-chemical analysis of ground water sources of Rasipuram village area and to compare with levels obtained with the ISI and WHO drinking water directive .The correlation coefficient is a helpful tool for the promotion of research in water pollution problems. No attempt has yet been made to predict the ground water quality of the study area with precision using the correlation coefficient analyzing the ground water of Rasipuram area of Namakkal district.



Fig-1.Sampling locations and map of study area.

Materials and methods

Study Area

Rasipuram is a municipal corporation in Namakkal district in the Indian state of Tamil Nadu. Rasipuram is located at 11.47to North and 78.17in East (Fig-1). It has an average elevation of 246 meters (807 feet). A lot of medicinal plants and varieties of fruits are available. Bore well water is generally using for drinking and irrigation purposes in this district. The ground water samples were collected from bore wells and municipal supply water of ten villages of Rasipuram taluk of Namakkal district during December 2013-February 2014.

Collection Water Samples.

Samples were collected from ten locations of drinking water in plastic containers previously washed with nitric acid and rinsed with sampled water several times. The samples container were tightly sealed and labeled in the field. The temperatures of the samples were measured in the field itself at the time of sample collection. The sample locations are given Table-1.

Villages of various region of Namakkal district												
Samula la satiana	Source											
Sample locations	Bore well	Municipal supplying water										
Rasipuram	BW_1	MW_1										
Kurukka puram	BW_2	MW_2										
Palayam	BW ₃	MW ₃										
Ellayapalayam	BW ₄	MW_4										
Parakkalpudur	BW ₅	MW ₅										
Vandi pettai	BW_6	MW_6										
Malayampatty	BW ₇	MW_7										
Pudur malayam patty	BW ₈	MW_8										
Muniyappanpalayam	BW ₉	MW ₉										
Kamaraja nagar	BW ₁₀	MW_{10}										

Table-1 Name of villages of Namakkal district used for water sampling

Analysis of water samples.

Analysis was carried out for various water quality parameters such as pH , Electrical conductivity (EC), Total dissolved solids (TDS), Total Hardness (TH), Total Alkality (TA), Calcium $(Ca)^{2+}$, Magnesium $(Mg)^{2+}$, Manganese $(Mn)^{2+}$, Iron $(Fe)^{2+}$, Sodium $(Na)^+$, Potassium $(K)^+$, Ammonium $(NH_3)^+$, Nitrate $(No_3)^-$ Nitrite $(No_2)^-$, Flourine $(F)^-$, Chlorine $(Cl)^-$, sulfate $(So_4)^-$, Phosphate $(Po_4)^-$, as per standard procedure recommend by APHA 1995 method. The water quality parameters values are in mg/L expect PH and EC. The quality of ground water has been assessed by comparing each parameter with the standard desirable limit of the parameters in drinking water as prescribed by ISI 10500-91.

Result and Discussion

The result of the physical chemical parameters for water samples are presented in table -2

Parameters	Water samples																				
	BW_1	MW ₁	BW ₂	MW ₂	BW3	MW ₃	BW_4	MW_4	BW ₅	MW ₅	BW_6	MW ₆	BW ₇	MW ₇	BW_8	MW ₈	BW_9	MW9	BW10	MW10	ISI-10500-
																					91/WHO
PH	6	7.3	6.7	7.1	7.5	6.6	7.7	7.5	7.3	7.3	7.3	8	7.6	7.8	8.2	8.3	7.3	8.3	7.3	7.5	6.5-8.5
EC	2790	2630	2270	1841	2030	1519	2090	1861	2150	1447	2080	1859	2160	2040	1462	2330	2820	1752	2150	1447	1400
TDS	1953	1841	1589	1285	1421	1063	1463	1303	1505	1013	1456	1301	1512	1428	1023	1631	1974	1208	1505	1013	500
Turbidity	1.4	0.8	1.2	2.9	1.3	0.9	1.1	0.9	0.7	0.8	1.3	1.5	0.9	1.2	1.5	0.8	1.6	1.1	0.7	0.6	10
DO	4.8	4.2	5	5.2	5.1	4.2	5.2	4.9	5	5.7	5.2	4.3	4	5.6	5	5.1	5	5.3	4.8	4.5	5
TA	412	300	352	232	300	400	212	316	380	260	320	280	352	380	202	452	384	312	382	260	200
TH	520	540	412	416	400	412	380	344	412	280	400	332	420	412	272	150	536	360	412	230	300
Temp	26.4	30.2	26.5	31	31.5	30.1	31	29.2	28.4	26.8	31	29.2	26.8	26.2	30	28.4	26.9	30.4	31	31.5	-
Ca ²⁺	122	90	122	99	102	101	94	86	110	72	102	90	101	104	72	101	115	82	110	72	75
Mg ²⁺	57	52	39	57	35	38	35	31	33	24	35	26	40	36	22	54	115	82	33	24	30
Na ⁺	360	320	300	320	230	140	260	285	235	181	280	270	290	230	210	330	60	37	235	184	200
Fe ²⁺	0.1	0	0	0	0.3	0	0.5	0.1	0.1	0.3	0.5	0.3	0.5	0.2	0.4	0.2	0.8	0.8	0.1	0.3	0.3
K ⁺	30	10	45	28	25	16	30	12	50	20	28	24	20	20	10	16	20	18	23	15	30
C1-	392	452	380	392	328	212	344	300	348	200	336	320	348	272	252	308	484	204	348	200	250
F	0	0	1	0	1	0	0	1	0	0	1	0.8	0	0.4	1	0	1	1	0 2	0.8	1
NO ₃	27	20	24	19	21	31	22	21	23	15	22	35	23	17	18	23	15	22	23	15	45
PO4 2-	0.06	0.02	0.04	0.02	0.08	0.2	0.5	0.08	0.02	0.8	0.09	0.02	0.1	0.05	0.4	0.09	0.02	0.04	0.02	0.8	0.1
SO4 2-	352	330	312	83	239	91	260	244	258	206	248	229	260	287	183	334	335	260	258	206	200

Table-2 Water quality Parameters of sample

All parameters are in mg / L expected PH, EC in micromho/cm, Turbidity in NTU (nephelometric turbidy unit)

PH

PH is a term used universally to express the intensity of the acid and alkaline condition of a solution. The PH value of water samples varied between 6.0 to 8.3.It is observed that almost all the water samples have PH value within the permissible limit prescribed by ISI.

Electrical Conductivity (EC)

Electrical conductivity is a measure of water capacity to convey electric current .It signifies the amount of total dissolved salt. EC values were in the range of 1447 to 2820 micromhos/cm. High EC values were observed for 2 samples (bore well samples) indicating the presence of high amount of dissolved inorganic substance in ionized form. The electrical conductivity also influences by ionic mobility, inch valance and temperature. The present study all area also exceed the permissible limit. ⁽⁶⁾

Total Dissolved Solids (TDS)

The total dissolved solids of the variation dissolved solids of TDS was maximum is 1794 mg/lit and the minimum 1013 mg/lit. In water total dissolved solids are composed mainly of carbonates , bicarbonate , chloride, phosphate, nitrate, calcium, magnesium, sodium, potassium and manganese , organic matter , salt and other particles. $^{(7)}$

Dissolved Oxygen (DO)

Dissolved oxygen is important parameters in water quality .The DO values indicate the degree of pollution in water bodies. The Dissolved oxygen value of all the samples varies in the range of 4 to 5.6 mg/lit. The permissible limit of the Dissolved oxygen value of the ground water is 5.0 mg/lit as per ISI 10500-91 standards. The samples showed slightly low DO indicating the contamination by organic matter.

Total Alkalinity (TA)

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. The Alkalinity value of all the samples varies in the range of 202 to 452 mg/lit.

The permissible limit of the Alkalinity value in the ground water is 200 mg/lit as per ISI 10500-91 standards. The present study all area also exceed the permissible limit.

Total Hardness (TH)

Hardness is the land of water which prevents the lather formation with soap and increases the boiling points of water. Hardness of water mainly depends upon the amount of calcium and magnesium. The Hardness value of all the samples varies in the range of 150 to 540 mg/lit. The permissible limit of the Hardness value in the ground water is 300mg/lit as per ISI 10500-91 standards. The area MW5, BW8, MW10 other than this exceeds the permissible limit.⁽⁸⁾

Calcium (Ca²⁺)

The study of calcium exposed a range of between 75 mg/lit ISI /WHO stranded of drinking water indicates that the taste threshold for the calcium ions in the range of 72 to 122 mg/lit depending on the related anion the cations are the major role of hardness in water.

Magnesium (Mg²⁺)

The study of Magnesium exposed a range of between 75 mg/lit ISI /WHO stranded of drinking water. Magnesium concentrations in samples were in the range of 22 to 57 mg/lit, the cations are the major role of hardness in water.

Sodium (Na⁺)

Sodium concentration were found in between 37 to 360 mg/lit. The permissible limit of the Sodium value in the ground water is 0.3/200 mg/lit as per WHO/ISI 10500-91 standards. The area MW5, BW9, MW9 other than this exceeds the permissible limit.

Iron (Fe²⁺)

The iron value of all the samples varies in the range of 0 to 0.8 mg/lit. The maximum value of iron is abstained at the area; the minimum value of iron is abstained at the area. The permissible limit of the iron value in the ground water is 0.3 mg/lit as per WHO standards. This area exceeds the (BW4, BW6, BW7, BW9, MW9) permissible limit.

Potassium (K⁺)

The naturally occurring minerals in the ground water are potassium. The potassium values of all the samples various in the range of 10 to50 mg/lit. The maximum value of potassium is abstained at the area; the minimum value potassium is abstained at the area.

Chloride (Cl⁻)

The chloride concentration serves as an indicator of pollution by sewage. People adapted higher chloride in water are subjected to laxative effects ⁽⁹⁾ in the present analysis chloride concentration was found in the range of 200 to 452 mg/lit. The area MW5, MW9, MW10 other than this exceeds the permissible limit.

Fluoride (F⁻)

The Fluoride value of all the samples varies in the range of 0.02 to 1.0 mg/lit. The permissible limit of the Fluoride value in the ground water is 1.0 mg/lit as per WHO standards. The present study all area also within the permissible limit.

Nitrate (NO₃⁻)

Ground water contains nitrate due to leaching of nitrate with the percolating water. Nitrate can reach both surface and ground water as consequences of agricultural activity .but ground water may also have nitrate contamination as a consequence of leaching from natural vegetation. The Nitrate value of all the samples varies in the range of 15 to 35 mg/lit was observed which below the WHO /ISI of drinking water permissible limit. ⁽¹⁰⁾The permissible limit of the Nitrate value in the ground water is 45 mg/lit as per ISI 10500-91 standards.

Phosphate (PO₄)

The Phosphate value of all the samples varies in the range of 0.002 to 0.8 mg/lit. The maximum value of Phosphate is abstained at the area, The minimum value of Phosphate is abstained at the area. The permissible limit of the Phosphate value in the ground water is 0.1 mg/lit as per WHO standards. This area MW3, BW4, MW5, BW8, MW10 exceeds the permissible limit. Normal water contains only a maximum phosphorus level because of low solubility of native phosphate minerals and the ability of soil to retain phosphate ⁽¹¹⁻¹²⁾

Sulphate (SO4)²⁻

The sulphate concentration of all the samples varies in the range of 83 to 352 mg/lit. The maximum value of sulphate is abstained at the area; the minimum value of sulphate is abstained at the area. The permissible limit of the sulphate value in the ground water is 200 mg/lit as per ISI 10500 -91 standards. The area MW2, MW3, BW8 other than this exceeds the permissible limit. High concentration of sulphate may cause gastro –intestinal irritation particularly when magnesium and sodium ions are also present in drinking water resources. ⁽¹³⁾3.17. Stastiscal analysis

Correlation coefficient

The mathematical models used to determine the water quality parameters. Correlation coefficient measures the closeness relationship between chosen independent and dependent variables. In the study, the relationship of physic chemical analysis on each other in the data of water analyses was determine by calculating correlation co efficient R, by using the formula as given

$$R = \frac{N\Sigma(XiYi) - \Sigma(Xi) \cdot \Sigma(Yi)}{\sqrt{[N\Sigma(Xi)2 - \Sigma(Xi)2][N\Sigma(Yi)2 - \Sigma(Yi)2]}}$$

Where Xi and Yi represents two different parameters. N is number of total observations. The numerical values of correlation coefficient R for 17 parameters are tabulated in Table -3.

Conclusion

Twenty ground water samples are collected for physic chemical analysis of water samples in Namakkal District, Rasipuram Taluk Physico chemical parameters are out of the highest desirable limit or maximum permissible limit set by ISI 10500-91. The result of present study it may be said that to determine whether the ground water is suitable for drinking purpose or not. It is found that 50% is suitable for drinking purpose. The remaining area has contaminated water greater than the permissible limit. It is recommended that water analysis should be carried out from time to time monitor the rate and kind of contamination. It is need of human to expand awareness among the people to maintain the cleanness of water at their highest quality and purity levels to achieve a healthy life.

Parameters	pН	EC	TDS	Turbidity	DO	TA	TH	Ca2+	Mg2+	Na+	Fe2+	K+	Cl-	F-	NO3-	PO4(2-)	SO4(2-)
pН	1																
EC	-0.3255	1															
TDS	-0.3294	0.9998	1														
Turbidity	-0.1085	0.0569	0.0547	1													
DO	0.1844	-0.114	-0.1169	0.2177	1												
TA	-0.291	0.5357	0.5357	-0.325	-0.1323	1											
TH	-0.5916	0.6368	0.6355	0.243	-0.2106	0.2039	1										
Ca2+	-0.5637	0.7441	0.7453	0.1582	-0.0462	0.6856	0.5935	1									
Mg2+	-0.0513	0.575	0.5671	0.311	0.0848	0.3345	0.4506	0.3578	1								
Na+	-0.258	0.3179	0.3244	0.1259	-0.176	0.0531	0.0191	0.2803	-0.4092	1							
Fe2+	0.4923	0.0058	-0.0006	0.0252	0.2007	-0.1813	-0.0474	-0.2234	0.4682	-0.6228	1						
K+	-0.3952	0.2636	0.2642	0.1239	0.2151	0.1658	0.2526	0.6127	-0.0558	0.2239	-0.1889	1					
Cl-	-0.3362	0.8649	0.8668	0.3462	-0.1836	0.2054	0.6924	0.6543	0.4765	0.3839	-0.0824	0.3088	1				
F-	0.2788	-0.1577	-0.1605	0.1321	0.1511	-0.2339	-0.1118	-0.171	0.1115	-0.3654	0.4362	-0.1035	-0.1086	1			
NO3-	-0.1898	0.0646	0.0644	-0.016	-0.5028	0.2871	0.0887	0.3141	-0.175	0.2608	-0.27	0.2317	0.0207	-0.1384	1		
PO4(2-)	0.0948	-0.5926	-0.5886	-0.29	0.1627	-0.5234	-0.5249	-0.6694	-0.4149	-0.2131	0.1367	-0.2396	-0.5812	-0.0569	-0.4206	1	
SO4(2-)	0.0133	0.7848	0.7837	-0.35	0.0572	0.4717	0.2482	0.4223	0.3574	0.1845	0.1906	0.136	0.4797	0.0688	-0.0726	-0.2978	1

Table-3 correlation matrix for different water quality parameters

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