

Studies on Groundwater Samples Collected from Ranipet Town, Tamilnadu and Incorporation of Natural Polymeric Material

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Abstract: Groundwater quality study was carried out in the Tiruvannamalai Town water samples, Tamilnadu. The objective of this study is to identify the quality of groundwater especially in the town areas where groundwater is used for domestic, agriculture and industrial purposes. Ten locations of ground water samples were collected and studied for a month of January-2024. The present investigation is focused on the determination of Physico-Chemical and Mechanical parameters such as temperature, taste, Electrical conductivity, pH, hardness, total solids, total dissolved solids, total suspended solids, chlorides, sulphate, nitrate, fluorides, Dissolved Oxygen, corrosion resistance, abrasion resistance and strength of materials on water. Then, groundwater suitability was examined by using WHO and BIS standards. Therefore, the some of the water samples are not good agreement within the limits; those waters are treated with natural polymeric material like Ricinus Communis seed shell nano-aggregates, and then used for domestic, agricultural, industrial and machinery purposes

Keywords: Bore well water, Water quality parameters, Ricinus Communis, WHO and BIS standards

I. INTRODUCTION

Water is one of the abundantly available substances in nature. It is an essential constituent of all human beings, animals, vegetable matter and forms about 75% of the matter of earth crust. It is also essential in agriculture, manufacturing, transportation and countless other human activities. Water is required for the satisfactory performance of various life processes as a circulatory fluid as a carrier of nourishing food and for the removal of products of wastes. Water is not only essential for the lives of animals and plants but also occupies a unique position in industries. Probably, it's most important use as an engineering material is in the Steam generation. Water is also used as a coolant in power plants and chemical plants. In addition to it, water is widely used in other fields such as production of steel, rayon, paper, atomic energy, textiles, chemicals, ice, and for-conditioning drinking, bathing, sanitary, washing, fire-fighting etc. Approximately 70% of the freshwater used by humans goes to agriculture. Fishing in salt and fresh water bodies has been, and continues to be, a major source of food for many parts of the world, providing 6.5% of global protein. Much of the long-distance trade of commodities (such as oil, natural gas, and manufactured products) is transported by boats through seas, rivers, lakes, and canals. Large quantities of water, ice, and steam are used for cooling and heating in industry and homes. Water is an excellent solvent for a wide variety of substances, both mineral and organic; as such, it is widely used in industrial processes and in cooking and washing. Water, ice, and snow are also central to many sports and other forms of entertainment, such as swimming, pleasure boating, boat racing, surfing, sport fishing, diving, ice skating, snowboarding, and skiing.



II. EXPERIMENTAL SECTION

S.NO	Sample Code	Name of Sample	Name of place
1	A	R.SWETHA	GANDHINAGAR
2	B	S.TAMILARASU	VENGIKKAL
3	C	S.P.NANDHINI DEVI	KEENATHUR
4	D	A.S.APARNA	NALLAVANPALAYAM
5	E	S.JAYASHREE	THAMARAI NAGAR
6	F	R.RAJALAKSHMI	THENI MALAI
7	G	M.SIVARANJANI	KILCHETTIPATTU KOOT ROAD
8	H	S.THENDRAL	THENMATHUR
9	I	R.ARUNA	KUBERA NAGAR
10	J	S.GAYATHRI	EANDHAL

There are ten ground water samples i.e. bore well waters were collected in polythene bottles from the month of January – 2024, Tiruvannamalai district and the list of place can be given above, There is standard procedure has to be followed and study the physical, chemical and mechanical parameters of bore well water .

III. RESULTS AND DISCUSSION

The results are presented in the following tables and detailed discussion of all the parameters is given below
PHYSICAL PARAMETERS

Table 1. Physical parameters

S.No	SampleCode	Colour	Odour	Temperature	Taste	EC, mS/cm	TS, mg/lt	TDS, mg/lt	TSS, mg/lt
1	A	colourless	odourless	26	normal	1.51	680	678	2
2	B	colourless	odourless	25	salty	1.25	760	751	9
3	C	colourless	odourless	27	normal	0.48	310	304	6
4	D	colourless	odourless	28	normal	1.18	708	701	7
5	E	colourless	odourless	29	salty	1.49	872	864	8
6	F	colourless	odourless	27	normal	0.9	546	543	3
7	G	colourless	odourless	27	normal	0.8	485	482	3
8	H	colourless	odourless	25	normal	0.92	270	268	2
9	I	colourless	odourless	25	normal	1	589	565	24
10	J	colourless	Odourless	26	salty	1.3	752	750	2

*EC = Electrical conductivity; TS = Total Solids; TDS = Total Dissolved Solids;

*TSS = Total Suspended Solids

The results of physical parameters are given in the table1. All the bore well water samples were colourless, clear and odourless indicating the absence of colloidal substances, suspended and decomposed vegetation. The sample code B, E and J samples are salty and remaining are normal taste. Conductance of water samples varied from 0.8 to 1.51 mS/cm. But all the water samples were relatively higher conductivity, which may be due to contamination of conducting materials in water samples. According to BIS Standards, the acceptable limit of TDS in ground water around 500 mg/L. As per classification of TDS bore well water of Tiruvannamalai09 area come under moderately high especially sample code A,



B, D, E and J. Total solids and TDS include volatile and non-volatile solids. The presence of excessive solids in water indicates pollution which can lead to a laxative effect .

CHEMICAL PARAMETERS

Table 2. Chemical Parameters

S.No	Sample Code	pH	TH, mg/lt	TA, mg/lt	Chlorides	Sulphates	Nitrates	Fluorides	DO, mg/lt
1	A	7.10	440	400	181	185	70	0.9	8.5
2	B	7.80	390	425	270	285	65	1.5	6.2
3	C	7.60	180	200	81	201	50	0.8	8.7
4	D	7.90	450	300	207	185	43	0.5	9.0
5	E	7.50	535	325	295	278	70	1.6	6.0
6	F	7.09	405	375	131	160	44	0.4	8.3
7	G	7.48	330	425	104	152	40	0.5	8.4
8	H	7.54	180	200	79	144	38	0.5	6.1
9	I	7.11	330	375	168	168	35	0.6	8.3
10	J	7.50	415	475	291	283	78	1.4	6.4

*TH = Total hardness, TA = Total Alkalinity, DO = Dissolved Oxygen

The chemical parameters of water samples are tabulated in table 2. The collected bore well water samples have pH within the permissible limits ranging from 7.10 to 7.90. Total hardness of sample code E has moderate values which due to the slightly higher concentration of calcium and magnesium salts. Samples A, B, and J have slightly high concentration of alkalinity and exceed the permissible limits proposed by BIS. High alkalinity in water bodies leads to sour taste and salinity. Samples B, E and J have moderately high concentration of chloride content and exceed the permissible limit proposed by BIS. High chloride content in water bodies harms metallic pipes and structure as well as agricultural crops . Samples B, E and J have slightly high concentration of sulphate and exceed the permissible limit proposed by BIS. High sulphate concentration in water bodies leads to gastro-intentional irritation. The excess sulphate causes risk to human beings as algae produces toxins, which damage neurological system . Samples B, E and J have slightly high concentration of fluoride and exceed the permissible limit proposed by BIS. High fluoride concentration values may be causes fluorosis, which is characterized by mottling of teeth- enamel, nervous and skeletal disorder .

MECHANICAL PARAMETERS

The mechanical parameters like corrosion resistance, abrasion resistance and strength of materials on water are studied. The sample code B, E, and J are not much corrosion resistance, abrasion resistance and strength also gradually decreased compared to other samples.



Sl. No.	Parameter	Method	Instruments/Equipment
A. Physico-chemical			
1.	pH	Electrometric	pH Meter
2.	Conductivity	Electrometric	Conductivity Meter
3.	TDS	Electrometric	Conductivity/TDS Meter
4.	Alkalinity	Titration by H ₂ SO ₄	-
5.	Hardness	Titration by EDTA	-
6.	Chloride	Titration by AgNO ₃	-
7.	Sulphate	Turbidimetric	Turbidity Meter
8.	Nitrate	Ultraviolet screening	UV-VIS Spectrophotometer
9.	Phosphate	Molybdophosphoric acid	UV-VIS Spectrophotometer
10.	Fluoride	SPADNS	UV-VIS Spectrophotometer
11.	Sodium	Flame emission	Flame Photometer
12.	Potassium	Flame emission	Flame Photometer
13.	Calcium	Titration by EDTA	-
14.	Magnesium	Titration by EDTA	-
15.	Boron	Carmine	UV-VIS Spectrophotometer
16.	BOD	5 days incubation at 20°C followed by titration	BOD Incubator
17.	COD	Digestion followed by titration	COD Digester
B. Bacteriological			
18.	Total coliform	Multiple tube fermentation technique	Bacteriological Incubator
19.	Faecal coliform		
C. Heavy Metals			
20.	Iron	Digestion followed by Atomic spectrometry	Atomic Absorption Spectrometer
21.	Manganese		
22.	Copper		
23.	Nickel		
24.	Chromium		
25.	Lead		
26.	Cadmium		
27.	Zinc		
D. Pesticides and Polynuclear Aromatic Hydrocarbons			
28.	Aldrin	Gas chromatography	Gas Chromatograph with ECD, NPD and FID
29.	DDT		
30.	DDE		
31.	DDD		
32.	A-BHC		
33.	B-BHC		
34.	γ-BHC		
35.	δ-BHC		
36.	Methoxychlor		
37.	Endosulphan		

Table : 4 INDIAN STANDARDS & WHO GUIDELINES FOR DRINKING WATER

IS 10500: 1991 and WHO Guideline, 1996) in Metropolitan cities and Problem areas

Water is a prime natural resource, a basic human need and precious natural asset. The provision of drinking water that is not only safe is a matter of high priority. The supply of water that is un-satisfactory in this respect will undermine the confidence of consumers leading to complaints and possibility of using water from less safe sources. Looking to the seriousness of groundwater contamination is now a great concern. Therefore, all the groundwater samples collected from



drinking sources have been compared with present Indian standards in this report. The BIS –10500 and WHO Guideline has been presented in the form of Table 5 is given below:

S. No.	Parameter	BIS, Indian Standards (IS 10500:1991)		World Health Organization (WHO Guideline)
		Desirable Limit	Permissible Limit	Maximum allowable concentration
1	Colour	5 Hazen Units	25 Hazen Units	15 True Colour Units
2	Turbidity	5.0 NTU	10 NTU	5.0 NTU
3	PH	6.5-8.5	No relaxation	6.5-8.5
4	Total Hardness (as CaCO ₃)	300 mg/L	600 mg/L	500 mg/L
5	Chlorides (as Cl)	250 mg/L	1000 mg/L	250 mg/L
6	Residual Free Chlorine (when Protection against viral infection is required it should be Min 0.5 mg/L)	0.2 mg/L	-	-
7	Dissolved Solids	500 mg/L	2000 mg/L	1000 mg/L
8	Calcium (as Ca)	75 mg/L	200 mg/L	-
9	Sulphate (as SO ₄ ²⁻)	200 mg/L	400 mg/L	400 mg/L
10	Nitrate (as NO ₃ ⁻)	45 mg/L	100 mg/L	10 mg/L
11	Fluoride (as F ⁻)	1.0 mg/L	1.5 mg/L	1.5 mg/L
12	Phenolic Compounds (as C ₆ H ₅ OH)	0.001mg/L	0.002 mg/L	-
13	Anionic Detergent (as MBAS)	0.2 mg/L	1.0 mg/L	-
14	Mineral Oil	0.01 mg/L	0.03 mg/L	-
15	Alkalinity	200 mg/L	600 mg/L	-
16	Boron	1.0 mg/L	5.0 mg/L	-
Micro Pollutants (Heavy Metals & Pesticides)				
17	Zinc (as Zn)	5.0 mg/L	15 mg/L	5.0 mg/L
18	Iron (as Fe)	0.3 mg/L	1.0 mg/L	0.3 mg/L
19	Manganese (as Mn)	0.1 mg/L	0.3 mg/L	0.1 mg/L
20	Copper (as Cu)	0.05 mg/L	1.5 mg/L	1.0 mg/L

Observations on Groundwater Quality in Tiruvannamalai Town

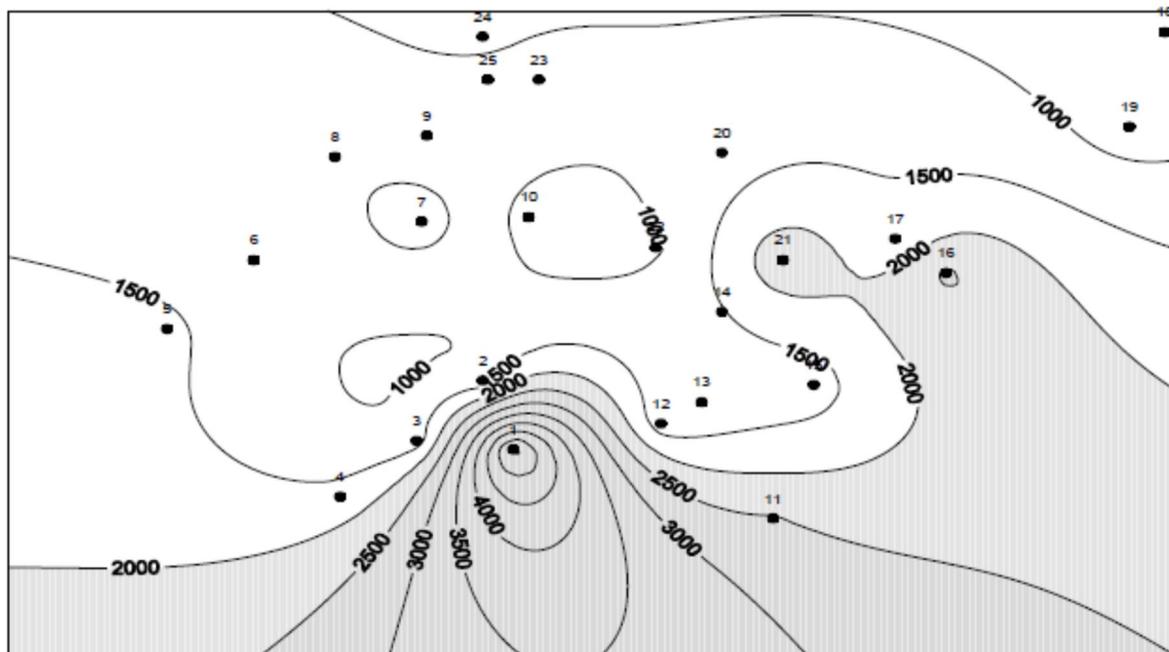
The groundwater quality of the Metropolitan City of Tiruvannamalai has been assessed to see the suitability of groundwater for domestic applications. The samples collected during pre- and post-monsoon seasons were analyzed for various physico-chemical and bacteriological parameters, heavy metals, pesticides and poly-aromatic hydrocarbons. The hydro-chemical and bacteriological data was analyzed with reference to BIS and WHO standards and hydro-chemical facies were determined. The quality of the groundwater varies from place to place with the depth of water table. The groundwater quality has indicated higher concentration of electrical conductivity, total dissolved solids, alkalinity, hardness, calcium, magnesium, chloride, sulphate, fluoride, iron, manganese, nickel, lead and cadmium vis-à-vis drinking water quality standards. Pesticides analysis indicated the presence of Aldrin, α -BHC, β -BHC and γ -BHC in groundwater

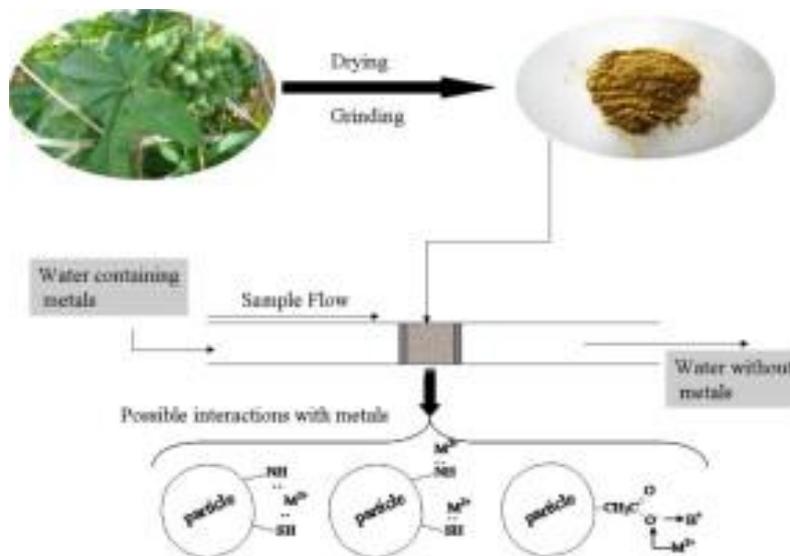


of the metropolitan city. The presence of these pesticides in groundwater may be attributed to their use in agricultural activities and for vector control programmes. No organo-phosphorous pesticides and poly-nuclear aromatic hydrocarbons were detected in any of the groundwater samples of Tiruvannamalai town. The range of each parameter along with observations/comments on groundwater quality is presented in Table 7 of Annexure I. An attempt has also been made to show TDS and Nitrate distribution in Tiruvannamalai during pre and post Monsoon season (Figure 17 & 18).

Incorporation of Natural Polymeric Material into water samples

A green adsorbent was successfully applied to remove toxic metals from aqueous solutions. Dried minced castor leaves were fractionated into 63- μm particles to perform characterization and extraction experiments. Absorption bands in FTIR (Fourier Transform Infrared Spectroscopy) spectra at 1544, 1232 and 1350 cm^{-1} were assigned to nitrogen-containing groups. Elemental analysis showed high nitrogen and sulfur content: 5.76 and 1.93%, respectively. Ricinus Communis seed shell nano-aggregates are investigated those of the samples moderately high values. Then, the results are correlated with WHO and BIS standards. Treated water have the within the limits of WHO and BIS standards. Therefore, those waters are to be used after treatment for drinking and industrial purposes.





IV. CONCLUSION

There are ten water samples are collected in Tiruvannamalai town, Tamilnadu. The various physical, chemical and mechanical parameters were studied. The results shown that, water sample code B, E and J, those sample values are moderately high value compared to the WHO and BIS standards which may not be fit for long period of months for drinking and industrial purposes. But, treated with *Ricinus Communis* seed shell nano-aggregates and then used for drinking and industrial purposes.

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