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Physicochemical Analysis of Groundwater Quality of Tosham Town

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Abstract: *A systematic study has been carried out to assess the groundwater quality of Tosham town of Bhiwani district of Haryana state, India. 400 groundwater samples from ten selected stations were collected in the different seasons and assessed for 11 physicochemical parameters i.e. pH, electrical conductivity, total alkalinity, total hardness, total dissolved solids, calcium, magnesium, fluoride, chloride, nitrate and sulphate respectively. The analytical data of various physicochemical parameters of some groundwater samples of the study areas indicates that parameters such as pH, total alkalinity, total hardness, total dissolved solids, calcium, magnesium, fluoride, chloride, nitrate and sulphate are found to be in excess than the desirable limits recommended by ICMR. The groundwater quality parameters values indicates that groundwater samples of some sampling stations are quite unfit for drinking purpose because of high value of total hardness, total dissolved solids, calcium, magnesium, fluoride and chloride so that suitable suggestions were made to improve the groundwater quality.*

Keywords: Physicochemical parameters, groundwater quality

I. INTRODUCTION

The study area Tosham is located at 28° 88' NL 75° 92' EL in Bhiwani district of Haryana state, India. It is located about 25 km from Bhiwani. Water is the most precious gift of the nature to mankind. All life and peripheral activities are ceased without water. The quality of water is a function of physical, chemical and biological parameters and could be change since it depends on a particular intended use and it is influenced by natural and anthropogenic effect including local climate, geology and irrigation practices. Water is the elixir for life. It is essential for all living organisms from microorganisms to the simplest plants and most complex living system known as human body. Water is vital to our body system. The quality of water is of vital concern for mankind because it sustain life. The major source of contamination of groundwater is the industrial waste, hospital waste, domestic waste and ash pond etc. The quality of underground water can be measured in terms of the physical and chemical parameters. The different physicochemical parameters are pH, electrical conductivity, total alkalinity, total hardness, total dissolved solids, chloride ions, magnesium ions, calcium ions etc. In order to ensure the exact quality of water for this purpose, it is extremely important to monitor underground water with all aspects with consideration 3/4th of the earth surface is covered by water. Earth surface water is present in two different kinds of water bodies i.e. Salt water bodies and Fresh water bodies. Fresh water is defined as water that contains less than 0.5 ppt. of dissolved salts. Quality of water can be defined in terms of the physical and chemical parameters. Water quality parameters include chemical, physical and biological properties. It can be tested or monitored based on the desired water quality parameters of concern. Parameters that are frequently sampled or monitored for water quality include temperature, dissolved oxygen, pH, electrical conductivity total hardness, total alkalinity, total dissolved solids etc. The addition of various kinds of pollutants and nutrients through the agency sewage, industrial effluents, agricultural runoff etc. into water bodies bring about a series of changes in the physicochemical characteristics of water which have been the subject of several investigations. Now a days, pollution of fresh water resources has become a global problem. The pollution enhances bad taste, colour, odour, turbidity and causes hardness and frothing of water. It also increases the corrosive action of water towards different metals and alloys. The different physicochemical parameters must have optimum range because

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in India, most of the population is dependent on groundwater as the only source of drinking water supply, domestic use and agricultural purposes etc. The groundwater is the major source of drinking water in both urban and rural areas. The groundwater is believed to be comparatively much clean and free from pollution than surface water. The rain water when reaches to ground, gets percolated in soil and becomes underground water, Generally, underground water is clear and colourless, but when water seeps down the ground, it dissolved inorganic salts. Usually the groundwater contains the least quantity of the dissolved organic matter. It is required to develop low cost technique to decontaminate groundwater for safe drinking water supplies to the peoples.

II. MATERIAL AND METHOD

Area of study : Tosham town is selected as the study area of present investigation. It is a census town in Bhiwani district of Haryana state, India. It is located 25 km from district headquarter, Bhiwani.

Groundwater samples : 400 groundwater samples from ten selected stations of Tosham town were collected in the different seasons. The samples were collected from handpumps, borewells and tubewells in new HDPE bottles pre-washed with dilute HCl and rinsed four to five times with the groundwater before filling it to capacity and then labelled accordingly. All the samples were immediately transported to the laboratory for analysis.

Table-1: Ten selected stations of Tosham town from where groundwater samples were collected

Sample No.	Collected sample address
S1	Near Kanha Farms, Hansi Road Tosham
S2	Near Petrol Pump, Hansi Road Tosham
S3	Near SDM Office, Tosham
S4	Near Herbal Park, Bhiwani Road Tosham
S5	Near Telephone Exchange, Siwani Road Tosham
S6	Near Petrol Pump, Hisar Road Tosham
S7	Near Govt. ITI, Tosham
S8	Near PWD Rest House, Tosham
S9	Near Bus Stand, Tosham
S10	Near Panchayat Bhawan, Tosham

Table-2: Standard values and unit employed in physicochemical parameters examinations of groundwater samples

Sr. No.	Parameters of Groundwater Samples	Methods Used	Standard Values as recommended by ICMR		Unit
			Desirable Concentration	Maximum Permissible Concentration	
1.	pH	pH metric method	7.0 – 8.5	6.5-9.2	----
2.	Electrical Conductivity	Conductometric method	----	----	µmhos/cm
3.	Total Alkalinity (as $CaCO_3$)	Titrimetric method	200	600	mg/l
4.	Total Hardness (as $CaCO_3$)	Titrimetric method	200	600	mg/l
5.	Total Dissolved Solids	Conductometric method	500	1500	mg/l
6.	Calcium ions	EDTA Complexometric method	75	200	mg/l
7.	Magnesium ions	EDTA Complexometric method	30	100	mg/l
8.	Fluoride ions	Ion Selective Electrode method	1.0	1.5	mg/l

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9.	Chloride ions	Argentometric method	200	1000	mg/l
10.	Nitrate ions	Colorimetric method	20	50	mg/l
11.	Sulphate ions	Turbidity method	200	400	mg/l

Table-3: Physicochemical analysis of groundwater samples of Tosham town

Sample No.	pH	EC (µmhos/cm)	TA (mg/l) (as $CaCO_3$)	TH (mg/l) (as $CaCO_3$)	TDS (mg/l)	Ca^{2+} (mg/l)	Mg^{2+} (mg/l)	F^- (mg/l)	Cl^- (mg/l)	NO_3^- (mg/l)	SO_4^{2-} (mg/l)
S1	8.1	854	365	125	503	94	31	1.5	230	23	58
S2	7.8	656	389	127	654	78	16	1.3	280	12	65
S3	7.9	729	402	153	452	81	27	0.9	317	42	55
S4	8.0	451	390	143	572	60	35	1.1	235	47	85
S5	7.6	981	325	140	1011	99	19	1.3	323	38	70
S6	8.2	997	407	135	476	71	75	1.8	259	29	65
S7	8.3	848	430	107	568	54	31	1.7	298	18	48
S8	7.8	552	413	112	880	112	62	0.8	219	45	78
S9	8.0	765	350	129	1025	87	45	1.4	304	27	56
S10	7.9	1053	428	108	887	76	69	0.6	225	32	82

III. RESULTS AND DISCUSSION

400 groundwater samples from ten selected stations of Tosham town were collected and analysed for the following 11 physicochemical parameters such as pH, EC, TA, TH, TDS, Ca^{2+}, Mg^{2+}, F^-, Cl^-, NO_3^- and SO_4^{2-}. The parameters analysed in this assessment includes:

1. pH: In the present investigation, the groundwater samples have pH values between 7.6 and 8.3 . The desirable limits for pH is 7.0 to 8.5 recommended by ICMR. 73 groundwater samples have higher values of pH than desirable limits. In many different kinds of geochemical equilibrium or solubility calculations, the pH of water is a crucial indicator of its quality.

2. Electrical conductivity: In the present study, the EC values in all the groundwater samples varies from 451 to 1053 µmhos/cm. There is no desirable limits for EC recommended by ICMR.

3. Total alkalinity: In the present study, the TA values in all the groundwater samples varies from 325 to 430 mg/l. The desirable limits for TA is 200 - 600 mg/l recommended by ICMR. 42 groundwater samples have higher values of TA than desirable limits. In groundwater, most of the alkalinity is caused due to carbonates and bicarbonates.

4. Total hardness: TH of water is due to the presence of alkaline earths inclusive of calcium and magnesium. It is a crucial factor for determining whether water is suitable for drinking, household uses and a variety of industrial applications. TH values in all of the groundwater samples in the current investigation ranges from 107 to 153 mg/l. The ICMR recommends a desirable limits of 200 - 600 mg/l for TH. 67 groundwater samples have higher values of TH than desirable limits.

5. Total dissolved solids: TDS is an important parameter for drinking water and water to be used for other purposes. TDS values in all of the ground samples in the current investigation ranges from 452 to 1025 mg/l. The desirable limits for TDS is 500 - 1500 mg/l recommended by ICMR. Beyond the prescribed limit, it imparts a peculiar taste to water. 29 groundwater samples have higher values of TDS than desirable limits.

6. Calcium: In the present study, the Ca^{2+} values in all of the groundwater samples ranges from 54 to 112 mg/l. The desirable limits for Ca^{2+} is 75 to 200 mg/l recommended by ICMR. 23 groundwater samples have higher values of Ca^{2+} than desirable limits.

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7. Magnesium: In the present study, the Mg^{2+} values in all of the groundwater samples ranges from 16 to 75 mg/l. The desirable limits for Mg^{2+} is 30 to 100 mg/l recommended by ICMR. 28 groundwater samples have higher values of Mg^{2+} than desirable limits.

8. Fluoride: F^- in human nutrition is important for the normal development of bones. In the present study, the F^- values in all of the groundwater samples ranges from 0.6 to 1.8 mg/l. The desirable limits for F^- is 1.0 to 1.5 mg/l recommended by ICMR. 16 groundwater samples have higher values of F^- than desirable limits. Due to higher concentration of F^- in groundwater may develop molting of teeth, skeletal fluorosis, deformation in knee joints etc.

9. Chloride: In the present study, Cl^- values in all of the groundwater samples ranges from 219 to 323 mg/l. The desirable limits for Cl^- is 200 to 1000 mg/l recommended by ICMR. 12 groundwater samples have higher values of Cl^- than desirable limits.

10. Nitrate: In the current study, NO_3^- values in all of the groundwater samples ranges from 12 to 47 mg/l. The desirable limits for NO_3^- is 20 to 50 mg/l recommended by ICMR. 21 groundwater samples have higher values of NO_3^- than desirable limits.

11. Sulphate: SO_4^{2-} ions is one of the major anions occurring in natural water. In the present study, the SO_4^{2-} values in all of the groundwater samples ranges from 48 to 85 mg/l. The desirable limits for SO_4^{2-} is 200 to 400 mg/l recommended by ICMR. 28 groundwater samples have higher values of SO_4^{2-} than desirable limits. Higher value of sulphate may cause intestinal disorder.

IV. CONCLUSION

A physicochemical investigation was conducted to evaluate the quality of groundwater in Tosham town, located in the Bhiwani district of Haryana state, India. The analytical data of various physicochemical parameters of groundwater samples from the study areas indicates that the levels of pH, total alkalinity, total hardness, total dissolved solids, calcium, magnesium, fluoride, chloride, nitrate, and sulphate exceed the recommended limits set by ICMR. The groundwater quality parameters indicate that the groundwater samples from some sampling stations are unsuitable for drinking due to high levels of total hardness, total dissolved solids, calcium, magnesium, fluoride, and chloride. Consequently, appropriate recommendations were provided to enhance the quality of the groundwater.

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