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Physico-Chemical Characteristics of Well Water in and Around Villages of Kolathur Block, Salem District, Tamil Nadu, India

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Abstract: ***The present study deals with the physico-chemical characteristics of well water in and around villages of Kolathur block, Salem District, Tamil Nadu India. For the present study water samples from the well were collected at ten places in Kolathur Block, Salem District, Tamil Nadu, India. Physico-chemical characteristics such as colour, temperature, odour, pH, electrical conductivity, total solids, total dissolved solids, total suspended solids, total hardness, calcium, magnesium, chloride, dissolved oxygen and dissolved carbon-di-oxide were analysed as per APHA, 1990. All the parameters were within the permissible limit at Site I. At Site II content of calcium were above the standard prescribed permissible limits of BIS. At Site III content of chloride were above the standard prescribed permissible limits of BIS. Site I water was ideal and suitable for irrigation purposes.***

Keywords: Physico-chemical Characteristics, APHA, BIS

1. Introduction

Water is one of the most important natural resources and plays an important role for existence of mankind. Water is a useful resource for domestic, industrial and agricultural purposes and its importance to man cannot be overemphasized due to its essentially in body metabolism and proper functioning of cells. Though, water is abundant in nature occupying 71% of the earth surface only 1% is accessible for human consumption. Clean drinking water is essential for the survival. Access to adequate supply of safe drinking water for all is one of the primary goals of the World Health Organization About 95% rural population living in India depends on ground water for domestic use (Moharir *et al.*, 2002). The World Health Organization reports approximately 36% of urban 65% of rural India is were without access to safe drinking water. Owing to rapid urbanization, growing population and speedy industrialization have lead to the pressure on demand for safe drinking water. According to World Health Organization, about 80% of all diseases in human beings are caused by contaminated water. Well water is an invaluable commodity available in very limited quantity to man and other living beings. It is estimated that approximately one third of world's population use well water for drinking. Well water is used for domestic, industrial and irrigational purposes all over the world. Well water pollution unlike others is very critical, as once an aquifer becomes polluted, it is very difficult, expensive and time consuming affair to clean it up and may remain unusable for decades. Drinking water contamination with different chemicals and heavy metals released from different anthropogenic source has become a global concern (Rapant and Krcmova, 2007).The well water is very important drinking water source in and around villages of Kolathur, Salem district, Tamilnadu, India. Therefore, it has become necessary to monitor the water quality to observe the demand and pollution level of well water. The present study is an attempt to examine the physico-chemical characteristics of well water various villages in and villages of around Kolathur, Salem district, Tamilnadu, India. It is in this context that the present study has been undertaken with the following objectivies:

- To evaluate the physico-chemical characteristics of well water of vilages in and around villages of Kolathur, Salem District, Tamil Nadu, India.
- To calculate Water Quality Index and Evaluation.

2. Materials and Methods

The details of collection of well water samples and analytical techniques followed for the well water samples during the course of this investigation are explained in this chapter.

i) collection of water samples

For the present study well water samples were collected from ten villages in and around Kolathur, Salem District, Tamil Nadu, India, in plastic containers. After collection, the water samples were immediately transported to the laboratory for analysis. The sites are indicated in table.1

Table 1: Water sampling stations in the study area:

S.No	Site	Name of the village	Source
1	S1	Moolakadai	Well Water
2	S2	Chettiyur	Well Water
3	S3	Kolathur	Well Water
4	S4	Cithirappatti pudhur	Well Water
5	S5	Karakkalam	Well Water
6	S6	Karunkaradu	Well Water
7	S7	Thattankadu	Well Water
8	S8	Boomanur	Well Water
9	S9	Boraimedu	Well Water
10	S10	Kannamoochi	Well Water

Preservation of water samples:
Polythene bottles for sample preservation were thoroughly cleaned by rinsing with 8M, HNO_3 followed by reported washing with distilled water. The bottles were rinsed thrice with well water samples before the preservation. During the period of analysis the water samples were preserved as for the preservation techniques of APHA, 1990, (table 2).

Table 2: Water preservation techniques:

S.No	Parameters	Recommended sample volume(ml)	Type of container	Preservation	Allowable holding time
1	pH	100	P,G	Determine on site	-
2	Specific conductance	100	P,G	Refrigerate-4^{0}C	24hr
3	Solids (total dissolved)	100	P,G	Refrigerate-4^{0}C	7 days
4	Dissolved oxygen	100	P,G	Fix on site	6 hr
5	Hardness	100	P,G	Refrigerate-4^{0}C	7 days
6	Chloride	100	P,G	Not required	7days

P-Plastics, G-Borosilicate Glass

iii) Characterization of the the well water samples:
The physico-chemical characteristics of water samples such as colour, temperature, odour, pH, electrical conductivity, total solids, total dissolved solids, total suspended solids, total hardness, calcium, magnesium, chloride, dissolved oxygen and dissolved carbon-di-oxide were determined using standard methods (APHA,1990). The methods are indicated in table 3.

Table 3: Methods used to measure physico-chemical characteristics of water samples;

S.No	Parameters	Analytical method	Reference
1	pH	pH meter	APHA, 1990
2	Electrical Conductivity	Conductivity bridge	APHA, 1990
3	Total Solids	Gravimetric	APHA, 1990
4	Total Dissolved Solids	Gravimetric	APHA, 1990
5	Total Suspended Solids	Gravimetric	APHA, 1990
6	Total Hardness	Titrimetric	APHA, 1990
7	Calcium	Flame Photometer	APHA, 1990
8	Magnesium	Flame Photometer	APHA, 1990
9	Chloride	Titrimetric	APHA, 1990
10	Dissolved Oxygen	Titrimetric	APHA,1990
11	Dissolved carbon-di-oxide	Titrimetric	APHA, 1990

iv) Water Quality Index:
The Water Quality Index of the collected water samples was calculated to arrive at the level of population. However, the Water Quality Index (WQI) is bound to depend on the intended use of the water. The standards for surface irrigation of the effluent recommended (Goel and Sharma, 1996) by Bureau of Indian Standards for the 10 parameters chosen for the analysis along with the assigned weights (Punmia, 1977) are shown in Table 4.

Table 4: Standards for surface irrigation of the effluent recommended by Bureau of Indian Standards (BIS)

S.No	Parameters*	Standard (si)	Weight (wi)	Unit weight (wi)
1	pH	6 - 9.0	1	0.04
2	Electrical Conductivity	400	2	0.09
3	Total Harness	250	1	0.04
4	Total Dissolved Solids	2100	2	0.09
5	Calcium	75	3	0.13
6	Magnesium	50	1	0.04
7	Chloride	600	4	0.18

All the values are expressed in mg l^{-1} except pH and electrical conductivity. Water Quality Intex calculation was carried out as per Harton (1965), as modified by Tiwari and Mishra (1985). Weights (wi)wre assigned to various water parameters as indicated in the above table, which ranged from 1 to 4. According to the role of various parameters on the overall quality of water, the rating scales fixed. The parameters were assigned according to their importance and incidence in surface irrigation. The weight (wi) for the i^{th} parameter (i= 1,2…..10 in our case) was calculated from the following relation:

$$wi = \frac{W}{10} \quad \ldots\ldots\ldots\ldots (1)$$

$$\sum wi = 1$$

Which ensures that $\sum_{i=1}^{10} wi = 1$ ……(2)

The unit weight calculated from the relation shown are indicated in the Table. The rating scales for the 10- water quality parameters considered here are given in Table 5. Each parameter has been divided into 5 intervals according to the ranges. The quality index (qi) was corresponding to each range (varying from 0-100) and the extent of pollution corresponding to various value ranges, in descriptive terms, are given in the table.

qi-100- Ideal limit (BIS)
0-Severe value (BIS)

Other ratings, namely qi-25,50 and 75 are intermediate scales between ideal and severe values of BIS for irrigation water.

Of The Water Quality index (WQI) is the aggregate of the multiplication of qi and wi of the parameters.

i.e. $WQI = \sum_{i=1}^{10} pi\ wi$

Based on WQI value the quality status is assigned, i.e. if WQI is 75-100 the parameters are in "ideal" limit as shown in Table 5.

Table 5: Extent of Pollution:

S.No	Parameters	Ideal	Slight	Moderate	Extreme	Severe
1	pH	6.0-7.5	7.6-8.0	8.1-8.5	8.6-9.0	>9.0
2	Electrical Conductivity	0-100	101-200	201-300	301-400	>400
3	Total Harness	50-100	101-150	151-200	201-250	>250
4	Total Dissolved Solids	0-500	501-1000	1001-1500	1501-2100	>2100
5	Calcium	0-20	21-40	41-60	61-75	>75
6	Magnesium	5-15	15-25	26-35	36-50	>50
7	Chloride	50-150	151-250	251-400	401-600	>600
	Rating (qi)	100	75	50	25	0

All the values are expressed in mg l^{-1} except pH and electrical conductivity.

3. Results

The physico-chemical characteristics of water samples at site I is presented in Table 6. The pH of the water samples at site I was 7.47. The total solids, total dissolved solids and total suspended solids of the water sample at Site I 623.3, 386.66 and 236.66 mgl^{-1} respectively. The content of calcium, magnesium, total hardness and chloride content were low compare than Site II. Dissolved oxygen content of the water sample was 7.63mgl^{-1}.

The physico-chemical characteristics of water samples at site II is presented in Table 7. The pH of the water sample at site II was 8.84. The electrical conductivity of the water sample was 4.36 mS/cm. The total solids, total dissolved solids and total suspended solids of the water sample at site I were 3000, 1966.66 and 1033.33 mgl^{-1} respectively. The content of calcium, magnesium, total hardness and chloride content were high compare that site I and III. Dissolved oxygen and dissolved carbon-di-oxide content of the water sample were 0.33 and 35.66mgl^{-1} respectively.

Table 6: Physico-chemical characteristics of Site I.

S.No	Parameters	Value
1	Colour	Colourless
2	Temperature	29^0C
3	Odour	Odourless
4	pH	7.47
5	Electrical Conductivity(mS/cm)	2.3
6	Total Solids	623.33
7	Total Dissolved Solids	386.66
8	Total Suspended Solids	236.66
9	Total Hardness	86.30
10	Chloride	44.88
11	Dissolved Oxygen	7.63
12	Dissolved carbon-di-oxide	-
13	Calcium	54.50
14	Magnesium	26.31c

All the values are average of three individual observations.

Table 7: Physico-chemical characteristics of site II.

S.No	Parameters	Value
1	Colour	Colourless
2	Temperature	30^0C
3	Odour	Unpleasant
4	pH	8.84
5	Electrical Conductivity(mS/cm)	4.36
6	Total Solids	3000
7	Total Dissolved Solids	1966.66
8	Total Suspended Solids	1033.66
9	Total Hardness	129.40
10	Chloride	345.06
11	Dissolved Oxygen	0.03
12	Dissolved carbon-di-oxide	35.66
13	Calcium	60.90
14	Magnesium	37.52

All the values are average of three individual observation.

The physico-chemical characteristics of water sample at site III is presented in Table 8. The pH of the water sample at site III was 8.22. The electrical conductivity of the water sample was 2.33mS/cm. The total solids, total dissolved solids, and total suspended solids of the water sample at site I 1516.66, 996.33 and 523.33 mgl^{-1} respectively. The content of calcium, magnesium, total hardness and chloride content were low compare that site II and high compare than site I. Dissolved oxygen and dissolved carbon-di-oxide content of the water sample were 3.18 and 6.82mgl^{-1} respectively.

The Water Quality Index (WQI) of the water samples at site I,II and III were calculated as a measure of water quality and it is shown in Table 8,9,and 10. The water quality index of the water samples at Site I, II and III is presented in Figure 9. The Water Quality Index of Site I, II and III were 94.50, 38.25 and 74.75 respectiviely.

Table 8: Water Quality Index of the site I

S. No	Parameters	Value (BIS)	Rating (pi)	Unit weight (wi)	Product (piwi)
1	pH	6.0-9.0	100	0.04	4
2	Electrical Conductivity (mS/cm)	400	100	0.09	9
3	Total Hardness	250	100	0.09	4
4	Total Dissolved Solids	2100	100	0.04	9
5	Calcium	75	75	0.13	9.75
6	Magnesium	50	100	0.04	4
7	chloride	600	100	0.18	18
Total Water Quality Index					94.50

All the values expressed in mgl^{-1} except pH and EC.

Table 9: Water Quality Index of the site II

S. No	Parameters	Value (BIS)	Rating (pi)	Unit weight (wi)	Product (piwi)
1	pH	6.0-9.0	100	0.04	1
2	Electrical Conductivity (mS/cm)	400	100	0.09	9
3	Total Hardness	250	25	0.09	1
4	Total Dissolved Solids	2100	25	0.04	2.25
5	Calcium	75	0	0.13	0
6	Magnesium	50	75	0.04	3
7	chloride	600	50	0.18	9
Total Water Quality Index					38.25

All the values expressed in mgl^{-1} except pH and EC.

Table 10: Water Quality Index of the site III

S. No	Parameters	Value (BIS)	Rating (pi)	Unit weight (wi)	Product (piwi)
1	Ph	6.0-9.0	50	0.04	2
2	Electrical Conductivity (mS/cm)	400	100	0.09	9
3	Total Hardness	250	75	0.09	3
4	Total Dissolved Solids	2100	75	0.04	6.75
5	Calcium	75	50	0.13	6.50
6	Magnesium	50	75	0.04	3
7	Chloride	600	50	0.18	9
Total Water Quality Index					74.75

All the values expressed in mgl^{-1} except pH and EC.

4. Summary

For the present study water samples from the well water was collected at ten places in Kolathur area, Salem District, Tamil Nadu, India. Physico-chemical characteristics such as colour, temperature, odour, pH, electrical conductivity, total solids, total dissolved solids, total suspended solids, total hardness, calcium, magnesium, chloride, dissolved oxygen and dissolved carbon-di-oxide were analysed as per APHA, 1990.All the parameters were within the permissible limit at Site I. At Site II content of calcium were above the standard prescribed permissible limits of BIS. At Site III content of chloride were above the standard prescribed permissible limits of BIS.Water Quality Index of Site I was 94.50 as per rating scale mentioned in materials and methods. Site I water was ideal and suitable for irrigation purposes.Water Quality Index of Site II was 38.25 as per rating scale mentioned in materials and methods. Site II water was moderately polluted and suitable for irrigation purposes after proper treatment methods.7P[Water Quality Index of Site III was 74.45 as per mentioned in materials and methods. Site II water was slightly polluted and suitable for irriation purposes after proper treatment methods.

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