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International Journal of Chemical Studies

Determination of Water Quality index near Vamsadhara River, Srikakulam Dt., A. P.

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This present study comprises the determination of water physico – Chemical analysis of surface water samples from six sampling stations in the vicinity of Vamsadhara river, Srikakulam Dt. during the pre and post monsoon seasons in the year 2013. The analysis consists of parameters such as pH, total dissolved solids, total hardness, fluoride, nitrate, sulphate, BOD, COD, iron and manganese content in those selected areas. Based on The results obtained WQI values are calculated (< 50 ie., 40.53 - 46.49) and were found within the prescribed limits for domestic purposes.

Keyword: water quality index (WQI) - Srikakulam Dt. - Vamsadhara River.

1. Introduction

Groundwater is the important source of water supply throughout the world. Its purity has made it a well-known source of potable water. Survival of mankind as well as the social and economic development of the nation [1] is dependent on this natural resource. Increasing urbanization and industrialization resulted in pollution of these water resources. Pollutants are being added to the groundwater system through human and natural processes [2]. Indiscriminate discharge of waste water into natural water resources to such an extent, the water would become unfit for further use. These will change the physico-chemical properties of water such as hardness, conductivity, pH value, turbidity, total dissolved solids (TDS) and dissolved oxygen (DO) there by affecting the aquatic flora and fauna. In view of this, it is proposed to carry out a systematic study on the water samples collected from six stations [namely S$_1$-Srimukhalingam, S$_2$ Savalapuram, S$_3$-Nagirikattakam, S$_4$-Achutapuram, S$_5$-Purushottapuram and S$_6$-Madapam] in the proximity of Vamsadhara river, Srikakulam Dt. AP.

2. Materials and methods

Water samples were collected in clean and sterilised polythene bottles (2 or 5 liters capacity). Bottles were cleaned with hydrochloric acid then washed with tap water and then rinsed with distilled water twice and again rinsed with the water sample to be collected and field up one-liter bottles with the water sample [3]. All the reagents used are analytical grade.DD water was used throughout the study. The procedures adopted for the estimation of various physical and chemical parameters as described in the standard methods [4].

For the estimation of dissolved oxygen, BOD bottles have been used as recommended and the dissolved oxygen was fixed at the site of collection. All the chemicals, reagents used in this work were of analytical grade E. Merck, India.

3. Results and Discussion

The physico – chemical parameters of the water samples are presented in Tables – 1 & 2.

Table 1: Physico – Chemical parameters of water samples collected in pre monsoon period

Parameter	S_1	S_2	S_3	S_4	S_5	S_6
pH	7.39	7.85	7.64	7.38	7.49	7.51
EC	1.6	1.4	1.8	0.8	1.2	1.4
TDS	429.6	395.1	501.4	462.0	395.8	403.7
Hardness	158.4	182.2	194.4	174.8	135.9	186.5
Chloride	57.9	60.5	92.8	91.5	85.3	72.2
DO	4.8	4.6	5.2	4.5	4.0	5.0
BOD	1.0	0.9	1.2	0.9	0.9	1.1
Sulphate	88.9	91.5	75.8	79.2	92.2	86.6
Alkalinity	118.5	110.3	99.8	86.7	91.0	107.2
Nitrate	0.78	1.05	1.08	0.92	0.97	0.95
Cr	0.015	0.018	0.032	0.014	ND	0.026
Fe	0.0022	ND	ND	ND	0.0069	0.0013
Mn	0.014	0.011	ND	ND	0.018	ND

All the parameters expressed in mg/lit. except pH and EC (mmhos)
* All the values are the average of 3 determinations. ; ND- Not detectable

I. **pH:** The pH value of natural water changes due to the biological activity and industrial contamination. Higher pH includes the formation of tri halo methanes which are toxic [5]. The pH values of the present investigation were within the WHO guide lines (7.0 – 8.5) [6].

II. **Electrical conductivity:** It is a measure of current carrying capacity. Thus, as concentration of dissolved salts increases conductivity also increases. Many dissolved substances may produce aesthetically displeasing colour, taste and odour. The values obtained are in the range 0.8 to 1.9 mmhos.

III. **Total Dissolve Solids:** The TDS values for ground water range from 19 to 1280 mg/lt as per standards. TDS values were varied within 395.1 to 512.8 mg/lt. So in this respect the water under study is suitable for drinking purposes.

IV. **Dissolved Oxygen (DO):** Dissolved oxygen (DO) is one of the important pollution parameters, which measures the extent of organic as well as biological pollution load to a water body. The DO content of water is an index of its sanitary condition 9. The recommended DO limit for all the domestic purposes is 4-6 ppm. Oxygen can be rapidly removed from the waters by discharge of oxygen demanding wastes. The DO values obtained in the present study are within the standards.

The BOD and COD parameters pointing out the measure of oxidative decomposable organic components in water, are another two parameters stating the level of pollution like DO. BOD values obtained in the present study are within permissible levels.

V. **Alkalinity:** Alkalinity is a total measure of substance in water that has "acid-neutralizing" capacity. The main sources of natural alkalinity are rocks which contain carbonate, bicarbonate and hydroxide compounds; silicates and phosphates may also contribute to alkalinity. Alkalinity value with less than 100 mg/lt is desirable for domestic use. However, in large quantities imparts bitter taste to water. In the present investigation the total alkalinity of the water samples is found in the Range 86.2 to 122.8 mg/lt.

VI. **Hardness:** Hardness is a measure of the ability of water to cause precipitation of insoluble calcium and magnesium salts of higher fatty acids from soap solutions. The principal hardness causing cations are calcium and magnesium with anions bicarbonate, carbonate, chloride and sulphates. The hardness values of the present study were found to range between 135.9 and 217.2 mg/lit.

VII. **Chloride:** Chloride imparts salty taste to water, depending on the presence of cation constituents. It occurs in all types of natural waters. The high concentration of chloride is considered to be an indication of pollution due to high organic waste of animal origin[7]. Chloride values obtained in the study are found in the range between 57.9-105.8 mg/lt.

VIII. **Sulphate:** Sulphate ion does not affect the taste of water, if present in low concentrations. The sulphate ion concentration in the present investigation varied from 82.0-118.2 mg/lt.

IX. **Nitrate:** Nitrate is the most important nutrients in an ecosystem. Generally water bodies polluted by organic matter exhibit higher values of nitrate. In the present study water samples from the stations (S_1 to S_8) showed low concentrations of nitrate (0.78 to 130.5 mg/lt) well below permissible levels as per the standards.

X. **Heavy metals**
The presence of heavy metals in organisms can cause many diseases even if present in very low concentration [8, 9]. Heavy metals not only cause phyto-toxicity but also enter into the food chain resulting in toxicity in animals and may be carcinogenic to human beings. Metals like Cd, Pb, Hg, as and Cr are not detected in most of the study area. In some study areas Fe, Mn and Cr are present

in very low concentration. These heavy metals are within the permissible limits.

XI. **Water Quality Index (WQI):** Overall the quality of water for a given specific purpose is indicated in terms of index number, called WQI. It is defined as a rating reflecting the composite influence of different water quality parameters which were taken into consideration for the calculation of Water Quality Index (WQI). The indices are among the most effective ways to communicate the information on water quality trends to the general public or to the policy makers and in water quality management. Mostly it is done from the point of view of its suitability for human consumption.
The calculation of WQI was made using weighed Arithmetic Index Method[10] in the following steps:
Let there be water quality rating (q_n) corresponding to n^{th} parameter is a number reflecting relative value of this parameter in the polluted water with respect to its standard permissible value.

XII. q_n values are given by the relationship: $q_n = 100 (v_n - v_i) / (v_s - v_i)$
Where v_n = Standard value, v_s = Observed value and v_i = Ideal value
In most cases $v_i = 0$, except in certain parameters like pH, Dissolved Oxygen etc.
Calculation of Quality Rating for pH and DO ($v_i \neq 0$)
For pH $q_{pH} = 100 (v_{pH} - 7.0) / (8.5 - 1.0)$ & For DO $q_{DO} = 100 (v_{DO} - 14.6) / (15.0 - 14.6)$

XIII. **Calculation of Unit Weight:** The Unit Weight (W_n) to various water quality parameters is inversely proportional to the recommended standards for the corresponding parameters.
$W_n = K / S_n$ Where W_n = Unit weight for nth parameter, K = proportionality constant S_n = Standard permissible value for nth parameter.

XIV. The Unit Weight (Wn) values in the present study are taken from [11] and WQI is calculated by the following expression:

$$\text{i. } WQI = \sum_{n-1}^{n} Qn \times Wn \; / \; \sum_{n-1}^{n} Wn$$

WQI values obtained were compared [12] (standard values) for rating the water and its quality.

The values of WQI were calculated for the post monsoon period only as they were reported on the higher side (as evidenced from Table-2) Hence, in the present investigation the WQI values obtained is less than 50 (40.5296 - 46.4933) as given in Table - 3.

Table 2: Physico – Chemical parameters of water samples collected on post monsoon period

Parameter	S₁	S₂	S₃	S₄	S₅	S₆
pH	7.68	8.06	7.92	7.88	7.49	8.15
EC	1.9	1.7	0.9	1.8	1.4	1.6
TDS	489.2	405.4	512.8	472.6	485.3	409.2
Hardness	217.2	199.8	204.2	188.2	178.5	192.5
Chloride	88.9	80.6	105.8	101.5	97.2	81.5
DO	4.9	5.3	5.0	5.2	4.9	5.0
BOD	1.0	0.9	1.1	0.9	0.8	0.9
Sulphate	118.2	105.6	95.2	82.0	97.8	92.2
Alkalinity see	122.8	130.5	112.3	108.5	99.0	118.2
Nitrate	0.92	1.13	1.02	1.19	0.99	1.07
Cr	0.017	0.030	0.038	0.020	0.004	0.032
Fe	0.0028	ND	0.002	0.005	0.009	0.004
Mn	0.018	0.016	ND	ND	0.008	0.06

All the parameters expressed in mg/lit. except pH and EC (mmhos)
* All the values are the average of 3 determinations. ; ND- Not detectable

Table 3: Water Quality Index of samples near Vamsadhara river (Srikakulam District)

Parameter	ICMR Stand.	Unit Wt. (Wn)	S1	S2	S3	S4	S5	S6
pH	7.74	0.07164	7.1085	7.4602	7.3306	7.2935	6.9326	7.5434
T.D.S	500	0.00100	0.0978	0.08108	0.10256	0.09452	0.09706	0.8184
T.H.	200	0.00167	0.1814	0.1668	0.1706	0.157147	0.1490	0.1607
D.O.	5	0.10030	9.8294	10.6318	10.03	10.4312	9.8294	10.03
B.O.D.	5	0.10030	2.006	1.8054	202066	1.8054	1.6048	0.652
Chloride	250	0.00200	0.07112	0.06448	0.8464	0.812	0.7776	0.4107
Total Alkalinity	120	0.00417	0.4267	0.4535	0.3902	0.3770	0.3440	0.02642
Nitrate	45	0.01111	0.02271	0.0279	0.02518	0.02938	0.02444	0.004
Iron	0.3	1.6666	1.5549	--	1.1107	2.7766	4.9979	2.2213
Wn	--	--						
Qn	--	--	20.752	20.69116	22.2128	23.776	24.7568	23.6723
WQI	--	--	42.2963	40.5296	43.5103	46.5736	46.4933	46.3691

4. Conclusion

On the basis of the result obtained the WQI values are less than 50. It can be concluded that the water is safe and hence suitable for human consumption.

5. Acknowledgements

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