Research Paper

Determination of Water Quality Index in Residential Area of Ferozabad Village, Gulbarga Taluk & District, Karnataka, India

Engineering

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ABSTRACT *Physico - Chemical analysis of well and bore well water samples was carried out from ten sampling sites of ferozabad village, Gulbarga taluk & district, Karnataka, India in Residential area for the month of April 2013. The analysis of different parameters namely - pH, Dissolved oxygen (mg/lit), Electrical Conductivity (millimols), Total Alkalinity (mg/lit), Total hardness (mg/lit), Total suspended Solids, Calcium (mg/lit), Magnesium (mg/lit), Chlorides (mg/lit), Nitrates (mg/lit), Sulphates (mg/lit), and Biological oxygen demand (mg/lit) were carried out as per standard methods. The present study aimed to calculate water quality index (WQI) in order to assess the suitability of water for drinking purposes. The results obtained on WQI from different sampling stations were found to be varied from 44.85 to 66.13. Poor water quality of water were observed in S2, S3, S5, S9 and S10 Sampling Stations.*

Introduction

Water is essential for the survival of any form of life. The three percent of global fresh water is large enough to meet the requirements of man for million of years etc., Studies on water quality parameters of bore waters of Reddigudum Mandal Krishnan (Rambabu, Krishnan, & Rambabu, et. al., 1995). Water pollution is a phenomenon that is characterized by the deterioration of its quality as a result of various human activities. In India only 12% of people get good drinking water (Kudesia, et. al., 1980). Inadequate management of water resources as directly or indirectly resulted in the degradation of hydrological environment (Karanth et. al., 1989). Therefore, a continuous periodical monitoring of water quality is necessary so that appropriate steps may be taken for water resource management practices. The status of water quality at Bondamunda of Rourkela industrial complex-Part (Naik, S. and Purohit, et al., 1998 & 1996). The present investigations were carried out to calculate the Water Quality Index (WQI) in order to assess the suitability of water collected from different areas in Ferozabad village, Gulbarga taluk & district, Karnataka, India.

Study area

The present study deals with the assessment of the quality of water quality index in residential area of Ferozabad village, Gulbarga taluk & district, Karnataka, India. Gulburga taluka and district is situated between the latitude 17°06′North and longitude 76°50′ East. The study was carried out at the 10 sampling locations of Residential areas of Ferozabad village, Gulbarga taluk & district, Karnataka, India.

1. Materials and methods

Water samples collected from ten sampling stations selected for the analysis were given bellow: S1 - Dargah (Bore Well), S_2 – Ferozabad (Open Well), S_3 – Nadhisinnur (Open Well), S_4 – Somnathhalli (Bore Well), S_5 – Naduvinahalli (Bore well), S_6 – Balwaad (Bore Well), S_7 – Bahat saradgi (Bore well), S_8 – Tonsanhalli (Bore well), S_9 – Kirni (Bore well) and S_{10} - Jevargi Halla (Bore well) Samples for analysis were collected in sterilized bottles using the standard procedure for grab (or) catch samples in accordance with standard methods of APHA (1995). The analysis of various Physico – Chemical parameters namely PH, Temperature, Total hardness, Alkalinity, Calcium hardness, Magnesium hardness, Chloride, Sulphate, Nitrate, DO, BOD, COD, TDS etc., were carried out – as per the methods described in APHA (2005). All the chemicals and reagents used were of analytical grade. D.D water was used for the preparation of solutions. The suitability of WQI values for human consumption according to are rated as follows Mishra, & Patel et. al., 2001). 0-25- Excellent; 26-50- Good; 51-75- Bad; 76-100- Very Bad; 100 & above - Unfit.

The study was carried out at the 10 locations of the sampling stations selected for the analysis of ground waters are ferozabad village in Residential area for the month of April 2013.

S1 – Dargah (Bore Well)

S2 –Ferozabad (Open Well)

S3 – Nadhisinnur (Open Well)

S4 – Somnathhalli (Bore Well)

S5 – Naduvinahalli (Bore well)

S6 – Balwaad (Bore Well)

S7 – Bahat saradgi (Bore well)

S8 –Tonsanhalli (Bore well)

S9 – Kirni (Bore well)

S10 – Jevargi Halla (Bore well)

Bore water samples were collected in the all sampling stations. In this study, for the calculation of water quality index, thirteen important parameters were chosen. The WQI has been calculated by using the standards of drinking water quality recommended by the World Health Organisation (WHO), Indian council of Medical Research (ICMR) and Bureau of Indian Standards (BIS) has been used for the calculation of WQI of the water body.

Further, quality rating or sub index (***qn***) was calculated using the following expression.

qn = 100 $(V_n – V_{io}) / (S_n – V_{io})$

(Let there be ***n*** water quality parameters and quality rating or sub index *(qn)* corresponding to n^{th} parameter is a number reflecting the relative value of this parameter in the polluted water with respect to its standard permissible value).

qn=Quality rating for the ***n^{th}*** Water quality parameter.

V_n=Estimated value of the ***n^{th}*** parameter at a given sampling station.

S_n =Standard permissible value of the ***n^{th}*** parameter.

V_{io} = Ideal value of nth parameter in pure water, *(i.e., 0 for all other parameters except the parameter pH and Dissolved oxygen (7.0 and 14.6 mg/L respectively)*

Unit weight was calculated by a value inversely proportional to the recommended standard value **Sn** of the corresponding parameter.

$W_n = K / S_n$

W_n = Unit weight for the **n^{th}** parameters.

S_n = Standard value for **n^{th}** parameters.

K= Constant for proportionality.

The overall Water Quality Index calculated by aggregating the quality rating with the unit weight linearly. The calculation of WQI was made using weighed Arithmetic index method in the following steps: (Brown, Cleiland, Deinjger and Connor et. al., 1972).

$$WQI = \sum qn\,Wn / \sum wn$$

Table 1. Status and Index level (WQI) of water quality (Chatterji, and Raziuddin et. al., 2002 and 1992)

Water quality status	Water Quality Index Level
Excellent water quality	0 – 25
Good water quality	26 – 50
Poor water quality	51 – 75
Very Poor water quality	76 – 100
Unsuitable for drinking	>100

Table – 2. Physico- chemical parameters and water Quality Index status Report of water bodies in Ferozabad Village, Gulbarga Taluk & District, Karnataka, India
(All values except pH and Electrical Conductivity are in mg/L).

S. no.	Parameter	Recommended	Units	Standard values (Sn)	Unit Weight (Wn)	Observed Value (S1)	Observed Value (S2)	Observed Value (S3)	Observed Value (S4)	Observed Value (S5)	Observed Value (S6)	Observed Value (S7)	Observed Value (S8)	Observed Value (S9)	Observed Value (S10)
1	pH	ICMR / BIS	-	6.5-8.5	0.219	7.3	7.61	7.92	6.71	7.36	7.99	6.98	6.82	7.2	7.67
2	Dissolved oxygen	ICMR	mg/lit	5	0.3723	3.9	4	3	3	4	3.5	3.6	3	3.1	2.9
3	Electrical Conductivity	ICMR / BIS	milli-mols	300	0.371	177	400	388	302	266	376	332	200	287	222
4	Total Dissolved Solids	ICMR / BIS	mg/lit	500	0.0037	1960	864	600	248	2119	380	2265	255	389	890
5	Total Alkalinity	ICMR / BIS	mg/lit	120	0.0155	266	322	100	121	186	100	103	142	174	149
6	Total hardness	WHO	mg/lit	300	0.0062	232	240	300	120	345	196	360	285	160	245
7	Total suspended Solids	ICMR / BIS	mg/lit	500	0.0037	566	276	335	409	387	377	310	310	265	187
8	Calcium	ICMR / BIS	mg/lit	75	0.025	200	160	180	77	266	100	212	190	90	109
9	Magnesium	ICMR	mg/lit	30	0.061	32	80	120	43	79	96	148	90	70	136
10	Chlorides	ICMR / BIS	mg/lit	250	0.0074	211	100.1	55	49	225	77	229	44	44	233
11	Nitrates	ICMR / BIS	mg/lit	45	0.0412	41	9	22	16	70	15	49	18	22	7
12	Sulphates	ICMR	mg/lit	150	0.0123	144	45	39	20	99	19	77	27	27	189
13	Biological oxygen demand	ICMR	mg/lit	5	0.3723	3.1	2	2.2	2.1	3	3.3	2.2	2.5	2.8	3.1
14	WQI	--	--	--	--	46.01	61.15	66.13	45.27	61.6	44.85	45.77	48.22	52.31	58.23
15	Water quality status	--	--	--	--	Good	Poor	Poor	Good	Poor	Good	Good	Good	Poor	Poor

Discussions:

The results of Physico-chemical parameters of bore water at various points are given in Table 2.

The pH of the bore well waters in all the stations are acceptable and varies from 6.82-7.99. Though, pH has no direct effect on human health, all biochemical reactions are sensitive to the variation of pH. The permissible limits of pH value for drinking water ICMR (1975) is specified as 6.5-8.5. If

pH is less, algae die, fish cannot reproduce and it cause acidity, corrosion, irritation of mucous membranes, tuberculosis and other health problems in humans.

Electrical conductivity is very important parameter for determining the water quality for drinking arid agricultural purpose. The value in the study area is from 177-400 millimhos. The ideal value of electrical conductivity is <2.4 millimhos.

The total dissolved solids (TDS) in the study area varied from 265-2265 mg/L. The high value of TDS (above 500mg/L) recorded at S1, S2, S3, S5, S6, S7, S8, S9 and S10 may be due to their proximity to the industrial area and seacoast. If TDS is more, water cannot be used for drinking as well as construction purposes. TDS affects palatability of food cooked and also causes gastro intestinal irritation.

Total alkalinity of all the sampling stations is high and varied from 100-322 mg/L. The large amount of alkalinity imparts a bitter taste to water.

Total hardness of water is characterized by contents of calcium and magnesium salts. The total hardness in the study area varied from 120-360 mg/L. The exceed values were observed in S1 and S5 sampling points.

The total magnesium in the study area varied from 32-148 mg/L. The magnesium content is higher than the calcium in the samples indicates the occurrence of magnesium salts is all samples.

Dissolved oxygen (DO), and biochemical oxygen demand (BOD) are very important pollution parameters. The values of DO, and BOD in the study area are 2.9-4mg/L, and 2-3.1 mg/L respectively. Hence the water treatment is required before it is sent into the public distribution system.

The sulphate ion concentration in the entire study area varied from 20 -189 mg/L. High concentration of sulphates at S1 and S10.

The chlorides are also corrosive and impart permanent hardness to water. The chlorides impart a salty taste and sometimes high concentration causes laxative effect in human beings. The chloride content in the study area ranged from 44– 233 (S8, S9 – S10) mg/L. Chloride content observed within the standard value in all samples except S1, S5, and S7.

The nitrate is used to assess the self purification properties of water bodies and nutrient balance in surface waters and soil and the state of determination of organic matter present in waste waters. The nitrate ion concentration is very important in public water supplies, because it causes methemoglobinemia in children. The nitrate concentration in the study area varied between 7 to 49 (S10 & S7) mg/L.

Fig.1: S_1 to S_{10} Sampling station values showing.
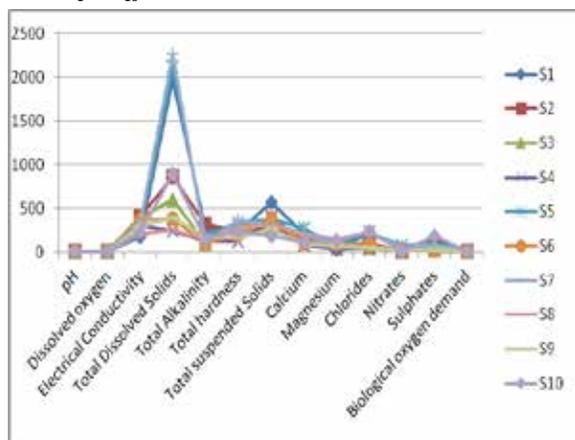
Conclusion:
The Water Quality Index (WQI) of waters in industrial areas of Kakinada is given in Table 4 to 13. The report prepared by WHO the importance of safe water supply and sanitation in the control of waterborne diseases. The value of WQI in water sampling areas was reported to be less than 100 indicating that the water is suitable for human use for all sampling locations.

Fig. 2: S_1 to S_{10} Water Quality Index Rating showing.
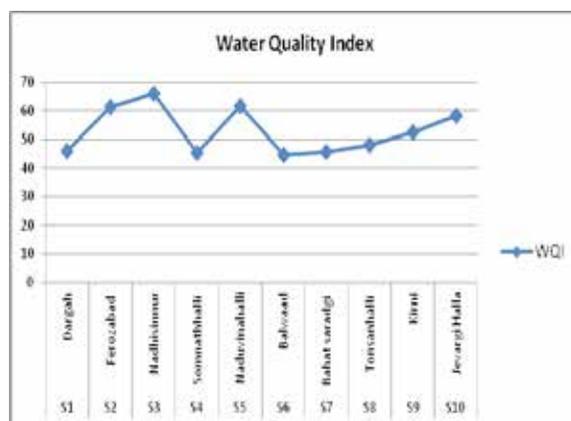
WQI indicates the quality of water in terms of index number which represents overall quality of water for any intended use. It is defined as a rating reflecting the composite influence of different water quality parameters were taken into consideration for the calculation of water Quality index (WQI) .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. In formulation of water quality index the relative importance of various parameters depends on intended use of water. Mostly it is done from the point of view of its suitability for human consumption.

Some of the samples have total dissolved solids, hardness and calcium values exceeding the permissible limits as prescribed by Indian standards. However the WQI values in the present investigation were reported to be less than 67 (66.13 (S3) – 44.85 (S6)) for different samples indicating that the water is safe for human consumption.

However in the present study, it is observed that the Good water quality of water were observed in S1, S4, S6, S7, and S8 sampling stations. Poor water quality of water were observed in S2, S3, S5, S9 and S10 Sampling stations due to industrial activities and domestic sewage.

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