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Ground Water Quality Assessment Nearer to the Dye user Industry

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ABSTRACT

The water quality index (WQI) was calculated for the assessment of ground water quality near to the dye user industry. For the calculation of WQI physicochemical characteristics of groundwater nearby dyeing- printing, pulp-paper and tanning industrial areas were studied. Various physicochemical parameters such as pH, total dissolved solids, total hardness, total alkalinity, calcium, magnesium, chloride and dissolved oxygen etc have been calculated in all the samples. In some of the parameters the concentration observed were found to be above the permissible limits of World Health Organization (WHO), Bureau of Indian standard (BIS) and Indian Council of Medical Research (ICMR). Drinking water was found to be severely contaminated at all the sites of study. Estimated higher values of different parameters verify the results of contamination on the basis of calculated values of water quality indices.

Key words: Water quality Index, Dyeing-printing, paper-pulp, Tanneries, Physicochemical parameters.

INTRODUCTION

Industrialization is the index of modernization which leads to alteration in the physical, chemical and biological properties of environment. The history of human civilization reveals that water source and civilization runs parallel. The era of unlimited fresh water supply is coming to end due to pollution of water sources owing to the increasing discharge of large volume of waste water and toxic nature of wastes [1]. Much of the health in developing countries is largely due to lack of the safe drinking water. According to WHO, about 600 million cases of diarrhea and 46, 00,000 childhood deaths are reported per year because of contaminated water and lack of sanitation [2]. Although India has substantial freshwater resources there is an acute shortage of safe drinking water of acceptable quality [3]. Most of the Indian rivers and freshwater streams are seriously polluted by textile dyeing and printing industry effluents, which includes wastes like metals, detergents, acids, alkalis, sulfates chlorides, nitrates, dissolved and suspended solids, organic and microbial impurities [4].

Out of the total quantity of water present on the earth about 97 % of the earth water resources are locked up in the oceans and sea, which is too saline to drink and for the direct use for agriculture and industrial purpose and about 24% is trapped in giant glaciers and polar ice. Thus not even 1% quantity of water is available for drinking, agriculture, domestic and industrial consumption [5]. Hence it is necessary to obtain accurate and timely information to observe water quality of any water resources on the basis of these observations it is easy to formulate sound public polices and implemented water quality improvement programmed. Water quality index (WQI) is one of the most effective expressions which reflect a composite influence of contributing factors on the quality of water for any water system.

Therefore, present work deals with WQI of drinking water used in dye user industrial area. To study the effect of dye user industry on ground water, three industrial areas have been selected.

The sampling area were selected are GIDC Surat (Gujrat), Nepa paper mill Nepanagar (MP) and Tannery industrial area, Kanpur (UP) where Textile which dyeing-printing, pulp and paper, ad tanneries are located, respectively.

These are the main dye user industries. The sampling sites were at the vicinity of about 50 to 100 feet from effluent drainage. The work was therefore planned to investigate and assess the existing quality of the ground water regarding its suitability for drinking and purpose is also to find out whether the groundwater is affected by industrial effluent in the region.

MATERIALS AND METHODS

Drinking water samples were collected from different sites of GIDS Surat (S-1,S-2), Nepa Paper Mill, Nepanagar (S-3, S-4) and Tannery industries, Kanpur (S-5 to S-7) during the year 2007. The water samples were collected in polythene bottles. They were analyzed for physicochemical parameters like pH electrical conductivity (EC), total dissolved solids (TDS), total alkalinity (TA), total hardness (TH), calcium (Ca), magnesium (Mg) and chlorides as per standard procedures[6,7]. All chemicals used were of AR grade and double distilled water was used for preparation of reagents. The standards for drinking water recommended by WHO are given Table 1.

Table 1: Water Quality parameters used in the study

Sr. No.	Parameters	Unit	WHO Standards	Weight Wt.	Unit weight Wi
1	P^H	-	7-8.5	4	0.182
2	EC	µmhos/cm	-	-	-
3	TDS	mg/L	500-1500	4	0.182
4	TH	mg/L	100-1500	2	0.091
5	Total Alkaliniry	mg/L	<120	3	0.136
6	Calcium	mg/L	75-200	2	0.091
7	Magnesium	mg/L	30-150	2	0.091
8	Chloride	mg/L	200-600	2	0.091

RESULTS AND DISCUSSION

The average values of the physico-chemical data and assigned WQI values are recorded in Table-2.

Table 2 : Physico-Chemical Characteristics of ground water samples

Sr. No.	Parameters	Units	Ground water Samples						
			S.1	S.2	S.3	S.4	S.5	S.6	S.7
1	P^H	-	7.84	7.34	7.87	7.92	8.13	8.41	8.18
2	EC	µmhos/cm	2634	2432	1391	1703	1463	2060	2509
3	TDS	mg/L	840	1320	410	320	290	1430	1430
4	TH	mg/L	248	1140	210	230	240	160	800
5	Total Alkaliniry	mg/L	183	300	110	170	200	110	280
6	Calcium	mg/L	36.1	32.1	68.9	72.8	48.1	40.6	113.8
7	Magnesium	mg/L	7.3	10.2	29.0	32	41.1	14.6	104.0
8	Chloride	mg/L	710	681.6	56.8	240	235.7	261.3	633.3
9	**WQI**	-	**58.24**	**45.5**	**77.78**	**67.34**	**67.30**	**68.7**	**36.4**

WQI calculation

To determine suitability of the water for drinking purpose, and indexing system is use. It is called water quality index (WQI), for calculating WQI the methods followed by [8,9,10] has been employed. In this method quality rating scale has been assigned to the parameters, which is also weighted to the parameters, which is also weighted according to its relative importance in the overall water quality. The maximum weight of 4 has been assigned to the parameters like pH and TDS to their major importance in water quality assessment other parameters like calcium and magnesium assigned the minimum weight of 1 as they play fewer role in the water quality assessment [11, 12].

The unit weight of each parameter is calculated by the formula

$$W_i = \frac{(W_t)_i}{\sum (W_t)_i} \text{ as } \quad \sum W_i = 1$$

The quality rating scale (q_i) for eight physico-chemical parameters is given in Table 3, the values of the parameters have been divided into four stages viz., permissible, slight, moderate and severe for which quality rating (q_i) rages from 0 to 100.

Table 3: Quality rating Scale for water quality parameters (q_i)

Sr. No.	**Parameters**	**Degree of Pollution Rating (q_i)**			
		Permissible 100	**Slight 80**	**Moderate 50**	**Severe 0**
1	P^H	7-8.5	8.6-8.8	8.9-9.2	>9.2
2	EC	-	-	-	-
3	TDS	500	500-1000	1000-1500	>1500
4	TH	100	100-300	300-500	>500
5	Total Alkaliniry	50	50-85	85-120	>120
6	Calcium	75	75-137	137-200	>200
7	Magnesium	30	30-90	90-150	>150
8	Chloride	200	200-400	400-600	>600

For calculating WQI the Sub index (SI) is first found out for each parameter which is $(SI)_i = q_i W_i$ and thus the formula Which is,

$$WQI = \frac{\sum (SI)_i}{\sum W_i}$$

Therefore $WQI = \sum q_i W_i$ as $\sum W_i = 1$

As an example, the WQI for S-3 has been calculated from the above formula (Table 4)

Table 4 : Sample calculation of water quality index (S-3)

Sr. No.	Parameters	Values of Water sample	Quality rating (q_i)	Unit weight (W_i)	Sub-Index ($W_i q_i$)
1	P^H	7.87	100	0.182	18.2
2	TDS	410	100	0.182	18.2
3	TH	210	80	0.091	7.28
4	Total Alkaliniry	110	50	0.136	6.8
5	Calcium	68.93	100	0.091	9.1
6	Magnesium	29	100	0.091	9.1
7	Chloride	56.80	100	0.091	9.1
	WQI				**77.78**

The results of physico-chemical analysis of ground water samples are given in Table 2. The observed pH values ranging from 7.34 to 8.41 showed that water samples are slightly alkaline. These values are within highest desirable limit prescribed by WHO. Beyond pH 8.5 the water is bitter in test. Total alkalinity of the water samples ranged from 110 to 580 mg/l. Alkalinity in itself is not harmful to human beings, still the water samples with less than 400 mg/L are desirable for domestic use, and less than 120 mg/L are suitable for drinking as desired by WHO.

The electrical conductance ranging from 1391 to 2634 µmhos/cm. there is not prescribed standards suggested by WHO. The total dissolved solid values varied between 310 to 1430 mg/l. These values are within the maximum limits 1500 mg/l of WHO. The calcium and magnesium varied from 32.1 to 113.82 mg/l and 7.3 to 104.02 mg/l respectively. The values of calcium and magnesium are between permissible limits as prescribed by WHO. It is clear from the Table-2 that none of the station showed as WQI of 100 throughout the study period. Therefore drinking water of all seven sites is not fit for direct human consumption. Highest values of WQI 77.78 is observed for S-3 it is sample from Nepanagar paper mill, Nepanagar(M.P.)

Lowest value of WQI 36.4 is observed for S-7 a sample from Tannery industrial area Kanpur and WQI 45.5 for sample S-2 from dyeing printing area Surat which are due to salty soil and S-2 location is near to the sea. Seawater intrusion is the main reason for that.

CONCLUSION

On the basis of above discussion, it may be concluded that the underground drinking water at all the sites of study area is severely contaminated except site S-3. From WQI results it is clear that sample site no S-3 from Nepanagar paper mill is only suitable for drinking water while sample from S-1,S-2 and S-7 are very poor in WQI rating and unfit for drinking as its WQI is 58.24, 45.5 and 36.4 respectively. While sample S.4,S.5, S.6 are also affected by pollution and are suitable for drinking only after purification. Estimated higher values of different parameters and calculated values of WQI suggest similar results. Assessment of water quality on the basis of WQI values is once again proved to be an effective tool.

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