Original Article

Ground water quality evaluation in Latur city, Maharashtra, India

Kedar N A

Department of Chemistry, Dayanand Science College Latur-413512, Maharashtra, INDIA.
Email: nak12572@gmail.com

Abstract A survey was undertaken to assess the quality of ground water in Latur district of Maharashtra taking both physic-chemical bacteriological parameters into consideration. The present investigation is aimed to calculate Water Quality index (WQI) go ground water and to assess the impact of pollutants due to agriculture and human activates on its quality. The WQI varied form 329.28 (winter) to 141.56 (monsoon) indicating level of nutrient load and pollution in the handpumps and bore wells. The existing results revealed that water from handpumps and borewells are not safe for human use.

Keywords: Ground water, pollution water quality index Seasonal variations.

*Address for Correspondence:
Dr. Kedar N A, Department of Chemistry, Dayanand Science College Latur-413512, Maharashtra, INDIA.
Email: nak12572@gmail.com

Received Date: 14/05/2016 Revised Date: 04/06/2016 Accepted Date: 30/06/2016

Access this article online

Quick Response Code:

Website: www.statperson.com

DOI: 04 July 2016

INTRODUCTION

Water is unarguable the most essential and precious. Life began in water. There are organisms, such as anaerobes witch can survive for any length of time without water. There crucial role of water as the trigger and sustained of civilizations has been witnessed throughout the human history it si common knowledge that our planet is faced with a major problem in the available water resources. This problem has two dimensions. The first is with respect to the quantity of water available. With increasing population, the demand for water both for human consumption and agriculture, has been steadily in increasing. Also, the melting of glaciers, deforestation and general environmental degradation, in particular, of rives, has cut the retentively, flow and availability of water on the planet. Secondly with the quality of water, which has deteriorated over this last 30th Years, so as to render most of its unfit for drinking. How has this happened? Excessive urban migrating has inflated cities beyond manageable limits, to produce such quantities of effluents so as to render both the local groundwater and rivers flowing by cities to be criminally polluted. This has happened mostly due to leaching of contaminants from landfills, indiscriminately disposed anthropogenic toxic waste, unplanned application of agrichemicals and surface run-off from farm lands. At presents, it is estimated that almost half the world's population has no access to good drinking water (Soni *et al*., 2009) But, up till as late as 1960s, the overriding interest in water has been *vis-vis*its quantity. Except in mamfestly undesirable, situations, the available water was automatically demand utilizable water. Only during the last three decades of the twentieth century the concern of water quality has been exceedingly felt so that, by now water quality has acquired as much importance as water quality.

Table 1: Water Quality index (WQI) range

WQI	Status
0-25	Excellent
26-50	Good
51-75	Poor
76-100	Very Poor
100 and above	Unsuitable for drinking

Source Mishra and Patel, 2001

A water quality index is an indicator of the quality of water. It is useful for a variety of purpose, such as :

- Planning tool for managing water resources use,
- Assessing changes in the quality of the water at different times, places and seasons.
- Evaluating the performance of pollution control pro-grammes, and – communicating water quality information to the public and to decision makers.

How to site this article: Kedar N A. Ground water quality evaluation in Latur city, Maharashtra, India. *International Journal of Recent Trends in Science and Technology*. July 2016; 19(3): 373-376. http://www.statperson.com (accessed 06 July 2016).

MATERIALS AND METHODS

The present investigation in aimed to calculate Water Quality index (WQI) in Latur city. For this reason, Eightphysico-chemical parameters such as DO (Dissolved Oxygen), BOD (Biochemical Oxygen Demand), pH, CI (Chlorides) Total Alkalinity, Total were selected and analyzed as per standard procedure of APHA (1998), Trivedy and Goel (1986): Kodarkar *et al* l (1998). Water samples were collected for physcio-chemical analysis from 12 sampling statin of handpumps and borewells, form Novermber, 2014 October, 2015 Water samples were collected in one liter morning hours between 7 – 10. 00 am every time. pH dissolved oxygen were monitored at the sampling spots, while other parameters were analyzed in the laboratory.

Water Quality Index (WQI)

Water Quality index is an important parameter for the assessment and management of ground water. Water Quality index is a single number (like a grade) that expresses the overall water quality at a certain location based on several water quality parameters. The concept of indices to represent by Horon (1965). It is defined as a rating reflecting the composite influence of different of water quality selection of parameters has great importance. Since selection of too many parameters might widen the quality index and importance of various parameters depends on the intended use of water (Table 1.1). Weighted arithmetic index has been used for calculation of WQI, in the following steps:

Calculation of Sub Index or Quality retting(q_n)

Let there be n water quality parameters and quality rating sub-index (q_n) corresponding to n^{th} parameter is number of reflecting the relative value of this parameter in the polluted water with respect to its standard permissible value. The $q_n$is calculated using expression :

q_n= 100[V_n-V_{10})/ (S_n-V_{io})

Where q_n = 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 n^{th} parameter, and V_{io} = ideal Al ideal value s (V_{io}) are taken as zero for the drinking water except for pH = 7.0 and dissolved oxygen = 14.6 mg/L

Calculation of quality rating for pH

FropH, ideal value is 7.0 (for neutral water) and permissible value is 8.5 (for polluted water).

Therefore quality rating for pH is calculated form the following relation:

q_{pH}= 100[V_{pH}-7.0)]/[(8.5-7.0)]

Where V_{pH}= observe value of $_{pH}$

Calculation of quality rating for dissolved oxygen

The ideal value (V_{Do}) For dissolve oxygen in 14.6 mg/L and standard permissible value of drinking water is 5 mg /L. Therefore, quality rating is calculated from following relation.

q_{Do}= 100[V_{Do} -14.6)]/[(5-14.6)]

Where V_{Do} = observe value of dissolved oxygen.

Calculation of unit Wight (W_n)

The unit weights (W_n) for various water quality parameters are inversely proportional to the recommended standards for the corresponding parameters; (W_n) = K / S_n Where (W_n)= unit wight for n^{th} parameter, S_n= standard value for n^{th}parameter, and K = constant for proportionality. WQI is calculated from the following equation:

WQI =$\sum_{n=1}^{n} qn\, wn / \sum_{n=1}^{n} wn$

RESULTS AND DISCUSSION

The physic-chemical and bacterioulogical quality of drinking water totally depends fo the geological condition fo the soil ad ground water pollution of the area. The physic- checical parameters value. The seasonal average value of various physico-chemical parameters, drinking water standards, unit weights (W_i) quality rating (q_i) Subindex value (W_iq_i) and WQI value of handpumps and borwells are calculated during different season are recorded in tables 3 to 5 The pH value of handpumps and borwell water sample was foun on 8.19 (winter) to 8.32 (monsoon). The pH of all wate samples were within the normal range (WHO, 1984). High TSS values in surface water might be due to mixing of sewage and industrial effluents (Chatterjee and Raziuddin, 2002).

Table 2: Seasonal values of some water quality parameters of Handpumps and borewells at twelve sampling stations (S_1- S_{12}) during different seasons (all values are mg/L except PH)

Parameter	Season	S_1	S_2	S_3	S_4	S_5	S_6
Dissolved	Win.	5.4	8.4	6.5	11.2	8.2	4.6
Oxygen	Sum.	3.2	5.3	2.1	5.50	4.3	2
(DO)	Mon.	7.4	6.1	6.3	6.90	6.3	5.5
Biological	Win.	12.6	7.8	13.8	14.40	5.3	8.36
Oxygen	Sum.	3.4	3.9	4.1	4.50	2.2	3.2
Demand (BOD)	Mon.	7.6	6.6	9.7	7.80	6.3	5.3
	Win.	6.5	7.79	8.08	5.84	8.72	6.87
PH	Sum.	7.17	6.7	6.37	6.1	10.02	7.12
	Mon.	7.10	7.5	5.1	5.9	5.92	7.10
Chlorides	Win.	496	422	600.5	630.5	520.5	461.53

(CL)	Sum.	440.3	423	380.4	420	560	906.8
	Mon.	4.64	407	560	512	580	598
	Win.	612	573	340	410	372	650
T. Alk	Sum.	403	482	352	403	398	323
	Mon.	186	354	199	312	290	187
Total	Win.	744.1	483	642	802.2	440	511.4
Harness	Sum.	661	367	400	512	390	507
(TH)	Mon.	753	492	535	700	412	508
Total	Win.	35	63	512	48	58	88
Suspended Solid	Sum.	53	42	40	56	56	58
Dissolved (TSS)	Mon.	66	65	70	85	61	77
(COD)	Win.	43.1	42.4	28.50	43.3	40.2	45.1
	Sum.	26.2	12.6	22.30	28.8	21.8	22.5
	Mon.	5.6	7.8	5.8	7.7	7.8	6.1

Table 3: WQI of Hand pumps and Bore wells during in winter season

Parameter	Unit Weight (W_n)	ICMR (S_n)	Observed values (V_{io})	Quality rating (q_m)	Sub-index value (q_m W_n)
DO	0.2000	5	7.38	78.33	15.67
BOD	0.2000	5	10.38	220.4	44.08
PH	0.0040	7.0-8.5	7.30	12.67	0.05
CI	0.0040	250	521.85	204.72	0.82
T. Alk	0.0083	120	492.83	222.85	1.85
TH	0.0033	300	603.78	211.28	0.69
TSS	0.0020	500	134.00	11.22	0.02
COD	0.2000	5	140.43	777.8	155.56
SUM	**0.6216**	**1185**	**1917.95**	**1739.27**	**218.74**

Water quality index= 330.50

Table 4: WQI of Hand pumps and Bore wells during summer season

Parameter	Unit Weight (W_n)	ICMR (S_n)	Observed values (V_{io})	Quality rating (q_m)	Sub-index value (q_m W_n)
DO	0.2000	5	3.73	110.10	22.02
BOD	0.2000	5	3.55	74.6	14.92
PH	0.0040	7.0-8.5	7.25	18.67	0.07
CI	0.0040	250	521.75	221.52	0.89
T. Alk	0.0083	120	393.50	311.6	2.59
TH	0.0033	300	472.83	160.94	0.53
TSS	0.0020	500	50.83	9.82	0.01
COD	0.2000	5	22.67	458.6	91.72
SUM	**0.622**	**1185**	**1476.11**	**1365.85**	**132.75**

Water quality index= 216.40

Table 5: WQI of Hand pumps and Bore wells during monsoon season

Parameter	Unit Weight (W_n)	ICMR (S_n)	Observed values (V_{io})	Quality ratin (q_m)	Sub-index value (q_m W_n)
DO	0.2000	5	6.42	82.08	16.42
BOD	0.2000	5	7.22	138.00	27.60
PH	0.0040	7.0-8.5	6.44	21.33	0.09
CI	0.0040	250	443.81	210.87	0.84
T. Alk	0.0083	120	254.67	206.18	1.71
TH	0.0033	300	566.67	191.69	0.63
TSS	0.0020	500	70.67	14.95	0.03
COD	0.2000	5	6.80	131.0	26.20
SUM	**0.622**	**1185**	**1362.7**	**996.1**	**73.52**

Water quality index= 151.50

The observed values of total alkalinity were found in the range of 254.67 mg/L (rainy) to 393.50 mg/L (summer). Harish *et al*. (2006) reported total alkalinity the ground water between 62 and 140 mg/L. Harish *et al*. (1991) recorded alkalinity values in the range of 200-610 mg/L in city side from handpump water. The BIS (1998) accepted limit for total alkalinity is 1000 mg/L. observed values are well within the permissible limit. Total Hardness in handpump and bore well water samples were recorded in the rang of 472.83 mg/L (Summer) to 603.78

mg/L (winter) High values of hardness can be attributed low water level and high rate of evaporation. Finding of present study is in harmony with the study of Harish *et al*. (1991) and Garg *et al*. (1990) water with little variation, water with hardness more than 180 mg/L is very hard; in this respect, water of these sources are very hard. Content of chlorides were noted as 521.85 mg/L (winter) to 521.75 mg/L (Summer) in all above sources. Nalina and Puttaiah (2000) observed the maximum and minimum values of chloride in summer, rainy and winter season, respectively, from ground water. The level of DO varied within 3.73 mg/L (Summer) to 7.38 mg/L (winter); BOD ranged from 3.55 mg/L (Summer) to 10.38 mg/L (Winter); COD observed within 6.80 mg/L (monsoon) to 140.43 mg/L (Winter) Pradhan *et al*. (2003) noted BOD as 1.1 mg/L (Summer) 3.55 mg/L (rainy) and 10.38 (Winter) in tube well water at Rimuli, district Keonjar (Orissa) India. The upper limit for BOD in drinking water is 3 mg/L, but when BOD values reach 5 mg/L, the water is doubtful in purity (Hari, 2002) A considerable increase in COD values in some sampling stations near those locality which has poor sanitation and filthy water accumulation. Pathak (1994) reported COD values varied from 4 mg/L (rain) to 46 mg/L (winter) from handpump sample in Rewa region (M.P.), India. Application of WQI is a useful method in assessing the water quality of hand-pump and borewells. The WQI values in all three season are much above 100 indicating unsuitability for drinking purpose (Tables 1, 3, 4 and 5). The WQI values are maximum because for the continuous discharge of municipal sewage and industrial effluents near to the sources of water which may percolate in the ground water. From the present observation, it can be concluded that water quality of hand pumps and bore wells is under stress of severe pollution. The Latur district water is not suitable of drinking, bathing, swimming and pisciculture. In order to save these sources from further deterioration, effective pollution control measures must be taken in to consideration.

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Source of Support: None Declared
Conflict of Interest: None Declared