Nature Environment and Pollution Technology © Technoscience Publications	Vol. 7	No. 2	pp. 299-302	2008

GROUNDWATER QUALITY OF TULSIPUR TOWN AT INDO-NEPAL BORDER

D. K. Mishra and A. K. Srivastava*
*Chemistry Department, M. L. K. College, Balrampur-271 201, U.P., India

ABSTRACT

The paper presents a case study on the influence of environmental parameters on groundwater quality in Tulsipur town. Groundwater samples were taken from hand pumps from three depths, i.e., 10-12 metre, 20-25 metre and 30-35 metre. The study revealed significant changes of water quality during three different depths. A device to remove pathogens has also been suggested.

INTRODUCTION

Tulsipur town is located in the Terai region of Uttar Pradesh and most of the population suffers from waterborne diseases like amoebiasis, worm infection, typhoid, diarrhoea, dysentery and other intestinal infections. A possible cause for this might be polluted groundwater, which may be the outcome of unsystematic and unscientific disposal of effluents from industrial units and civic system. These effluents are disposed off into nearby waterbodies from where they seep underground causing pollution in groundwater.

MATERIALS AND METHODS

To evaluate the extent of groundwater pollution, a number of physico-chemical and biological parameters were determined by standard techniques described by APHA (1992) and Trivedy & Goel (1986), and compared with standard permissible values assigned by various agencies like WHO, ICMR, etc. pH was determined by pH meter at the site immediately after collecting the sample. Total coliform and faecal coliforms were estimated by multiple tube fermentation technique.

A new single parameter called “Water Quality Index” (WQI), which takes into account the effect of all the parameters was also evaluated. WQI, alone, is quite capable of evaluating the suitability of a water sample for a particular use like domestic, industrial or agricultural.

RESULTS AND DISCUSSION

In this study, some important physical, chemical and biological parameters of groundwater along with WQI were evaluated. Samples were taken from hand pumps from three depths, analysed and the results are presented in Table 1.

The results show that total hardness, total alkalinity, sulphate and chloride moderately increase with increase in depth suggesting more dissolution of these as we move to greater depths. Nitrate and fluoride remain more or less the same suggesting that the rocks containing these ions are much less. Water in this region is slightly alkaline as suggested by pH values. All these parameters are well within limits of standards provided by WHO and ICMR. Iron’s behaviour was reverse as its concentration decreased with increase in depth. Further, its concentration was well above the limits provided by WHO and ICMR, making it one of the major pollutants. Total coliforms and faecal coliforms also decreased with increase in depth as expected. These pathogens are maximum in first strata (10-

Table 1: Parameters of groundwaters in Tulsipur.

S. No.	Parameters	Samples from 10-12 metre depth; S-l	Samples from 20-25 metre depth; S-2	Samples from 30-35 metre depth; S-3	WHO Permissible Limit	ICMR Permissible Limit
1	pH	7.7	7.9	8.00	8.2	7.0
2	Turbidity	clear	clear	20 NTU	5 NTU	5 NTU
3	Total Hardness in mg/L	135	162	178	500	300
4	Total Alkalinity in mg/L	265	290	305	1 20	120
5	Sulphate in mg/L	13.5	169	10 5	400	250
6	Chloride in mg/L	135	160	175	600	250
7	Nitrate in mg/L	2.92	2.98	2.98	45	20
8	Fluoride in mg/L	0.45	0.46	0.45	1.5	1.0
9	Iron mg/L	1.8	1.2	1.4	1.0	1.0
10	Total Coliforms (TC)/100mL	95	67	44	0	0
11	Faecal Coliforms (FC)/100mL	10	5	2	0	0

Table 2: q and W values in relation to WHO water quality standards.

		WHO					
		S_1		S_2		S_3	
		q	W	q	W	q	W
1	pH	53.33	0.2181	62.66	0.2181	66.66	0.2181
2	TH	28	0.0037	33	0.0037	36	0.0037
3	TA	225	0.0 1 545	245	0.01545	257	0.01545
4	Sulphate	3.5	0.00463	4.25	0.00463	5	0.00463
5	Chloride	23.33	0.00309	27.5	0.00309	30	0.00309
6	Nitrate	6.48	0.0412	6.62	0.04 1 2	6.62	0.0412
7	Fluoride	30	1.236	30.6	1.236	30	1.236
8	Iron	180	1.854	120	1.854	140	1.854
9	TC	∞	∞	∞	∞	∞	∞
10	FC	∞	∞	∞	∞	∞	∞

TC and FC = They should not be present in potable water Σ_{Wn}=3.37617

12 metre) and lowest in third strata (30-35 metre). Another finding of this work is the turbid nature of groundwater of third strata, which is perhaps due to the structure of earth's crust as this level might be containing some clay like colloidal matter responsible for turbidity.

Water Quality Index (WQI): In order to see the overall impact of three parameters on the quality of groundwater, WQI of the samples at the three depths was calculated. WQI, a single parameter, having contributions from various physical, chemical and biological parameters, was calculated using following formula.

$$WQI = \sum_{i=1}^{n} q_{ni} W_{ni} \Big/ \sum_{i=1}^{n} W_{ni}$$

Where,

q_{ni} = Quality rating of i^{th} parameter

W_{ni} = Unit weight of same parameter defined by the following equation.

Table 3: q and W values in relation to ICMR water quality standards.

		ICMR					
		S_1		S_2		S_3	
		q	W	q	W	q	W
1	pH	0	0.2648	0	0.2648	0	0.2648
2	TH	46.66	0.00618	55	0.00618	60	0.00618
3	TA	225	0.001545	245.8	0.01545	256.6	0.01545
4	Sulphate	5.6	0.007416	6.8	0.007416	8	0.007416
5	Chloride	56	0.007416	66	0.007416	72	0.007416
6	Nitrate	S4.6	0.0927	14.9	0.0927	14.9	0.0927
7	Fluoride	45	1 .854	46	1.854	45	1.854
8	Iron	180	1.854	120	1.854	140	1.854
9	TC	∞	∞	∞	∞	∞	∞
10	FC	∞	∞	∞	∞	∞	∞

Σ_{Wn}= 4.088057

Table 4: WQI values in relation to WHO and ICMR standards.

Sample	WQI as per WHO Standards	WQI as per ICMR Standards
S-l	114.43	102.3
S-2	82.4	75.9
S-3	93.52	84.5

Table 5: WQI values and water quality.

S.N.	WQI	Status	Possible use of water
1.	0-25	Excellent	All purpose like potable, industrial, agricultural
2.	26-50	Good	Domestic and agricultural
3.	51-75	Fair	Agricultural and industrial
4.	76-100	Poor	Agricultural
5.	101-150	Very poor	Not much, possible agriculture
6.	151 and Above	Worst	Can be used only after proper treatment

$W = K/S_{ni}$

Where,

S_{ni} = Standard value of the parameter (maximum permissible limit of the parameter assigned by various health agencies like WHO, ICMR, etc.)

K = Proportionality constant (1.8544 in this case)

q and W values of different samples are presented in Table 2 and Table 3, and calculated values of WQI from these are given in Table 4. From a number of studies, the status of water quality has been correlated with WQI values as given in Table 5.

On comparing Table 2 and Table 3, it was found that quality of groundwater in Tulsipur town is on the borderline of fair to very poor, therefore, it is not fit for human consumption until it is properly treated to remove the pollutants, although it can be used for agricultural and industrial purposes.

REMEDIAL MEASURES TO REMOVE BIOLOGICAL PARAMETERS

It has been tried to remove the biological parameters by a novel method, which was quite satisfactory and simple as described below:

The sample was slowly filtered through a fine bed of freshly precipitated silver chloride in a sintered funnel. The filtered sample was analysed for total coliforms and faecal coliforms, and a significant reduction in population of both the coliforms was observed as shown in Table 6.

Table 6: Reduction in total coliform and faecal coliform.

Sample	% Reduction in total Coliforms	% Reduction in faecal Coliforms
S-l	78	85
S-2	75	84
S-3	75	84

A possible reason for the reduction in biological pathogens is due to antibacterial action of silver cations which are present in very low concentration because AgCl is sparingly soluble in water, thereby releasing very low amounts of silver cations in the filtered sample during filtration process.

The chloride content has been negligibly increased in filtered sample and is well within permissible limits. Silver cations are present in trace amounts. Although this is a very preliminary study which needs further work, nevertheless this could be one of the possible solutions to remove/reduce biological pathogens.

REFERENCES

APHA 1992. Standard Method of Examination of Water and Wastewater. American Public Health Association, Washington DC.

Trivedy, R.K. and Goel, P.K. 1986. Chemical and Biological Methods for Water Pollution Studies. Environmental Publications, Karad, India.