International Journal of Chemistry and Applications.
ISSN 0974-3111 Volume 3, Number 3 (2011), pp. 245-254

http://www.irphouse.com

Chemometric Analysis of Groundwater of Few Villages of Narwana Block in Jind District, Haryana, India

[1]Sultan Singh, [2]Rajesh Kumar and [3*]Sunita Saharan

[1]Haryana Space Application Centre, CCS Haryana Agriculture University, Hisar, Haryana, India
[3]Dept. of Chemistry, Singhania University, Rajasthan, India
[3]Deptt. of Environmental Science, Haryana College of Technology & Mgt., Kaithal, Haryana, India
**Corresponding Author E-mail: polymer_hctm@rediffmail.com*

Abstract

The analysis of physiochemical parameters of groundwater from twenty villages of Narwana block in Jind District, Haryana was carried out. Each parameter was compared with the standard desirable limits prescribed by World Health Organization (WHO), Bureau of Indian Standard (BIS) and Indian Council of Medical Research (ICMR) to assess the quality of ground water. The physiochemical parameters namely pH, electrical conductivity, Total Dissolved Solids, Total Alkalinity, Total Hardness, Chloride, Calcium, Magnesium and fluoride were determined. Systematic calculation was made to determine the correlation coefficient 'r' amongst the parameters. Significant value of the observed correlation coefficients between the parameters was also carried out. The results showed significant variations in water quality parameters in the study areas.

Keywords: Narwana block, ground water, water quality, physiochemical parameter, pH, water pollution.

Introduction

Groundwater is used for drinking and irrigation in Haryana. In the last few decades, there has been a tremendous increase in the demand for fresh water due to rapid growth of population and the accelerated pace of industrialization. Human health is threatened by most of the agricultural development activities particularly in relation to

excessive application of fertilizers and unsanitary conditions. Water quality is an index of health and well being of a society. Industrialization, urbanization and modern agriculture practices have direct impact on the water resources. These factors influence the water resources quantitatively and qualitatively. According to World Health Organization, about 80% of all the diseases in human beings are caused by water. Once the groundwater is contaminated, its quality cannot be restored by stopping the pollutants from the source. It therefore becomes imperative to regularly monitor the quality of groundwater and to device ways and means to protect it. Water quality index is one of the most effective tools to communicate information on the quality of water to the concerned citizens and policy makers. It, thus, becomes an important parameter for the assessment and management of groundwater. Thus, there is a need to look for some useful indicators, both chemical and physical, which can be used to monitor both drinking water operation and performance. Careless deposit of animal waste close to the hand pumps, tube wells, wells and ponds cause pollution of water through leaching. The pathogenic organisms of these wastes transmit to the water and pose serious problems. In villages of District Jind, the hand pump and tube well water is used for drinking and domestic purposes. The objective of this study is to present the quality of the drinking water supply sources in some of the villages of Narwana Block in District Jind, Haryana, India.

Sampling and Physio-Chemical Method of Analysis

Ground water samples collected from twenty villages of Narwana block in district Jind were analyzed for their physio-chemical parameters. The different sampling locations are given in Table 1. Samples were collected in good quality polythene bottles. The bottles were well rinsed before sampling and tightly sealed after collection and labeled in the field. Sampling was carried out without adding any preservative. The physio-chemical analysis of water samples was carried out for various quality parameters such as pH, electrical conductivity (EC), Total dissolved solids (TDS), Total alkalinity (TA), Total Hardness (TH), Chloride (Cl^-), Calcium (Ca^{2+}), Magnesium (Mg^{2+}) and Fluoride (F^-) as per standard procedure described "Standard methods for the examination of water and waste water American public Health Association (APHA)" [4]. The pH of all the water samples was determined by using a pH meter (eutech cybernetics Model pH Scan Meter). Electrical conductivity was measured using a conductivity meter. The chloride, total hardness and total alkalinity were estimated by the standard methods of water analysis.

Table 1: Sampling Locations of Narwana.

Sr. No.	Sampling Locations	Code	Sources
1.	Narwana	N1	Tube well
2.	Danoda Kalan	N2	Hand pump
3.	Danoda Khurd	N3	Tube well
4.	Dhanauri	N4	Hand pump

5.	Naraingarh	N5	Tube well
6.	Dhamtan Sahib	N6	Tube well
7.	Ujhana	N7	Hand pump
8.	Lawan	N8	Tube well
9.	Belarkha	N9	Hand pump
10.	Hatho	N10	Tube well
11.	Dhakal	N11	Hand pump
12.	Dablain	N12	Tube well
13.	Ismailpur	N13	Hand pump
14.	Bhikhewala	N14	Tube well
15.	Dharaudi	N15	Hand pump
16.	Pharain Khurd	N16	Tube well
17.	Pharain Kalan	N17	Hand pump
18.	Dharamgarh	N18	Tube well
19.	Saccha Khera	N19	Hand pump
20.	Sainthly	N20	Tube well

Results and Discussions

Characterization of the physiochemical parameters of groundwater from twenty different locations in Narwana block of Jind district, Haryana (India) are reported in Table 2. The experimental results are compared with the standard limits [4, 14] recommended by the World Health Organization (WHO), Indian Council of Medical Research (ICMR) and Bureau of Indian Standards (BIS). Considerable deviations are observed in the water quality parameters from the standard limits. The desirable limit of pH value for drinking water is specified as 6.5 to 8.5. Measured pH value of the water samples ranges from 6.8 to 7.8. pH values show a slightly alkaline trend. The electrical conductivity of the samples ranges from 0.62 mS to 2.34 mS. BIS prescribed that the desirable limit of TDS is 500 ppm and the maximum permissible level is 2000 ppm. The TDS value ranges from 400 to 900 ppm. The standard desirable limit of alkalinity in portable water is 200 ppm and the maximum permissible level is 600 ppm. The values of alkalinity in the water samples of villages of District Jind are in between 241 ppm to 395 ppm. The value of alkalinity of water provides an idea of natural salts present in water. Main cause of alkalinity is the mineral, which dissolves in water from the soil. Water hardness is a measure of capacity of water to react with soap. Hardness is very important property of ground water from utility point of view for different purposes. Standard permissible limit for total hardness specified by ICMR and BIS is 300 ppm of $CaCO_3$. A fluctuating trend i.e., from 150 ppm to 380 ppm is observed in the measured total hardness values in all the twenty villages of Narwana block of District Jind. The permissible limit of chloride in drinking water is 250 ppm. The chloride concentration in water samples from all the locations ranged from 50 ppm-350 ppm. The concentration of chloride in all the samples is not within the maximum permissible limit. For domestic use, the maximum desirable limit for calcium is 75 ppm whereas in case of non availability of

water calcium up to 200 ppm could be accepted. Calcium concentration in water samples from all the locations was found to vary from 25 ppm to 95 ppm. The highest permissible limit of magnesium concentration is 150 ppm. Magnesium concentration in all the samples is below the highest permissible limit. Magnesium concentration in water samples from all the locations ranged from 13 ppm to 55 ppm. The standard permissible limit of fluoride is 1.5 ppm. Fluoride concentration in all the samples ranged from 0.4 ppm to 3.98 ppm. High level of fluoride content in some of the villages of block Narwana is a matter of concern. The comparative values of pH, electrical conductivity, total dissolved solids, total alkalinity, total hardness, chloride, calcium, magnesium, fluoride and dissolved oxygen are depicted in Figs. 1(a-j), respectively.

Table 2: Physiochemical parameters of groundwater from twenty villages Narwana block of District Jind, Haryana (India).

Parameters → Sample Site ↓	Area Code	Source	Colour	pH	EC (µs/cm)	TDS (ppm)	Total Alkalinity (Ppm)	Total Hardness (ppm)	Chloride (ppm)	Calcium (ppm)	Magnesium (ppm)	Fluoride (ppm)
WHO Standards				7-0 - 8.5	-	500 - 1,500	-	100 - 500	200 - 600	75 - 200	30 -150	1-0
ICMR Standards			25 Hazen	6.5 - 9.2	-	500 - 3000	-	300 - 600	200 - 1000	75 - 200	30 -150	-
BIS (IS 10500-91)			5 Hazen	6.5 - 8.5	500	500 - 2000	200 - 600	300 - 600	250 - 1000	75 - 200	30 -150	-
Narwana	N1	T	Colourless	7.8	1.25	800	335	200	350	80	36	0.4
Danoda Kalan	N2	H	Colourless	7.7	1.56	750	390	320	224	75	32	1.52
Danoda Khurd	N3	T	Colourless	7.5	0.62	400	245	250	75	60	27	1.15
Dhanauri	N4	H	Pale yellow	7.8	0.93	600	340	150	85	39	13	2.55
Naraingarh	N5	T	Colourless	7.5	1.25	800	343	260	142	50	30	1.4
Dhamtan Sahib	N6	T	Colourless	7.3	1.4	900	295	310	171	90	21	1.35
Ujhana	N7	H	Pale yellow	7.3	2.18	820	351	310	250	85	24	1.5
Lawan	N8	T	Colourless	6.8	2.18	900	243	240	126	60	40	1.4
Belarkha	N9	H	Colourless	7.5	1.09	700	350	330	167	55	47	1.85
Hatho	N10	T	Colourless	7.5	1.09	700	340	280	85	90	16	1.6
Dhakal	N11	H	Pale yellow	7.3	1.56	690	395	300	225	25	31	3.98
Dablain	N12	T	Pale yellow	7.4	1.4	900	241	260	188	50	55	1.53
Ismailpur	N13	H	Colourless	7.8	1.25	800	305	380	325	70	50	1.35
Bhikhewala	N14	T	Colourless	7.3	1.25	800	294	210	252	75	54	1.32
Dharaudi	N15	H	Pale yellow	7.5	0.93	600	343	220	128	48	24	1.33
Pharain Khurd	N16	T	Colourless	7.5	1.4	900	245	250	50	60	27	1.6
Pharain Kalan	N17	H	Colourless	7.4	1.4	900	395	360	225	65	48	0.9
Dharamgarh	N18	T	Colourless	7.3	2.18	685	339	355	265	46	18	2.25
Saccha Khera	N19	H	Colourless	7.7	1.56	800	349	270	171	60	26	1.5
Sainthly	N20	T	Colourless	7.5	2.34	770	325	315	265	95	19	1.52

H □ Hand pump, T □ Tube well

Correlation Studies

The study of correlation reduces the range of uncertainty associated with decision making. The correlation coefficient 'r' was calculated using the relation. Let X and Y be any two variables (i.e. physico-chemical parameters) and (Xi, Yi) be n pairs of the observed values of these variables (i= 1, 2,…..n). Then the correlation coefficient between these variables X and Y is given (Trivedy and Goel, 1984) by the well known relation:

$$r = \frac{N\Sigma XY - \Sigma X \times \Sigma Y}{\sqrt{[\{N\Sigma X^2 - (\Sigma X)^2\} \times \{N\Sigma Y^2 - (\Sigma Y)^2\}]}}$$

The correlation matrix for the water quality parameters are given in Table 3.

Table 3: Correlation matrix for the water quality parameters of Narwana block.

	EC	TDS	TA	TH	Ca^{2+}	Mg^{2+}	Cl^-	F^-
EC	1.00							
TDS	0.519	1.00						
TA	-0.320	-0.256	1.00					
TH	0.079	-0.023	0.314	1.00				
Ca^{2+}	0.121	0.266	-0.027	0.419	1.00			
Mg^{2+}	-0.178	-0.020	-0.250	0.007	0.058	1.00		
Cl^-	0.277	0.249	-0.013	0.537	0.331	0.168	1.00	
F^-	0.043	-0.190	-0.073	-0.148	-0.525	-0.040	-0.243	1.00

Test of significance of the observed correlation coefficients

Significance of the observed correlation coefficient has been tested by using 't' test. A total of 28 correlations were found between the two parameters. Negative correlations were found in 14 cases between electrical conductivity and total alkalinity, between electrical conductivity and magnesium ions, between total dissolved solids and fluoride, between total dissolved solids and total alkalinity, between total dissolved solids and total hardness, between total dissolved solids and magnesium, between total alkalinity and Calcium, between total alkalinity and Magnesium, between total alkalinity and Fluoride, between total alkalinity and Chloride, between Fluoride and Chloride, between Fluoride and Calcium and between Fluoride and magnesium. Some of the highly significant correlations were discernible between the electrical conductivity and total dissolved solids, between total dissolved solids and calcium, between total dissolved solids and chloride, between total hardness and total alkalinity and between Calcium and Chloride.

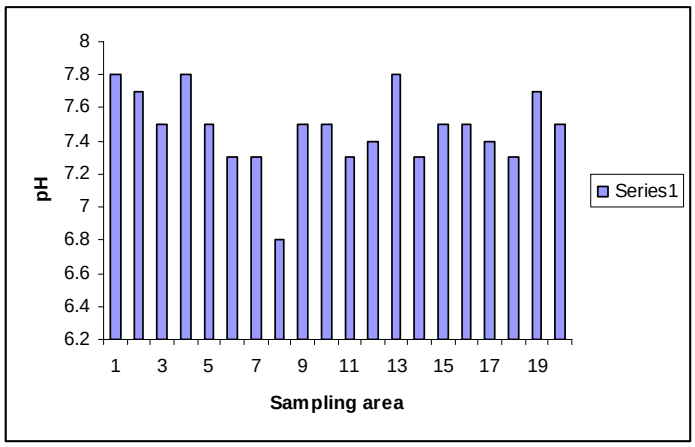

Figure 1a: The pH values of different sampling locations.

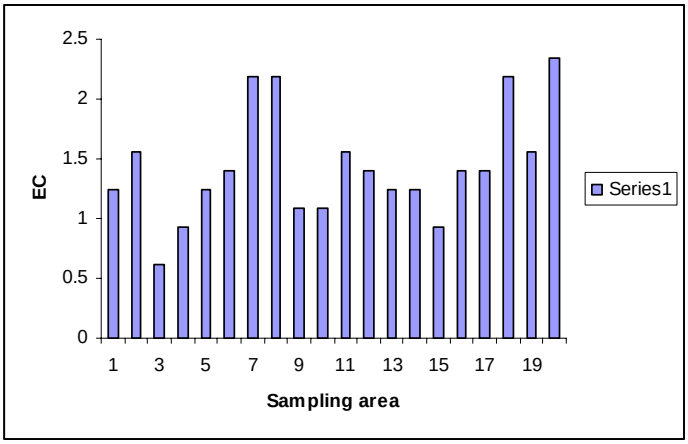

Figure 1b: The electrical conductivity values of different sampling locations .

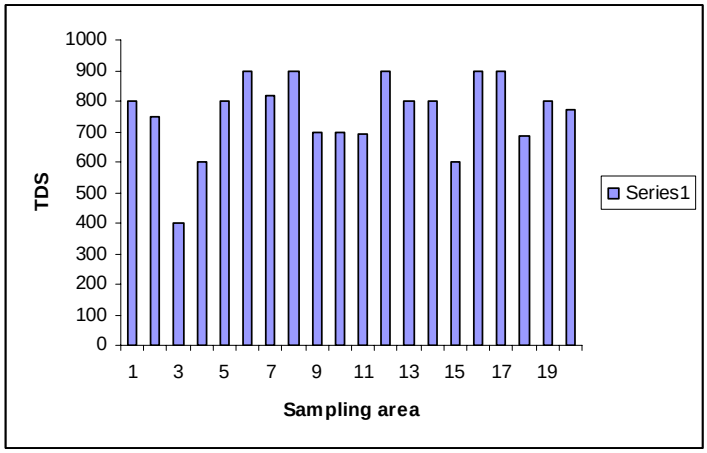

Figure 1c: The total dissolved solids values of different sampling locations.

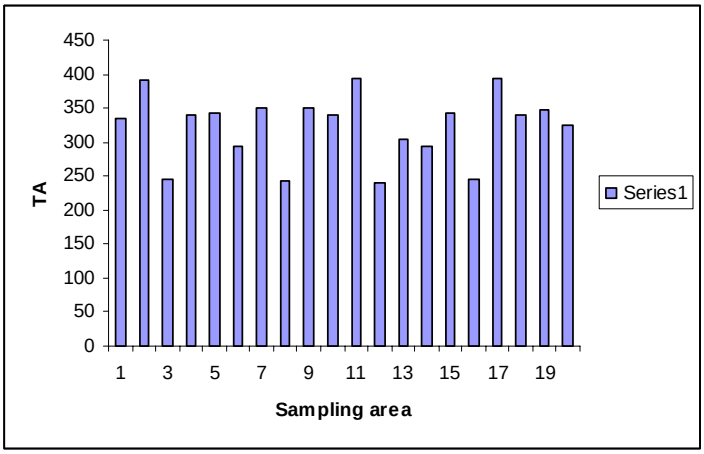

Figure 1d: The total alkalinity values of different sampling locations.

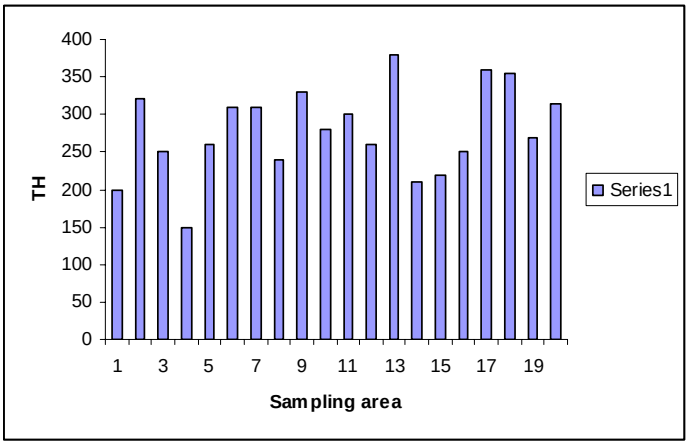

Figure 1e: The total hardness values of different sampling locations.

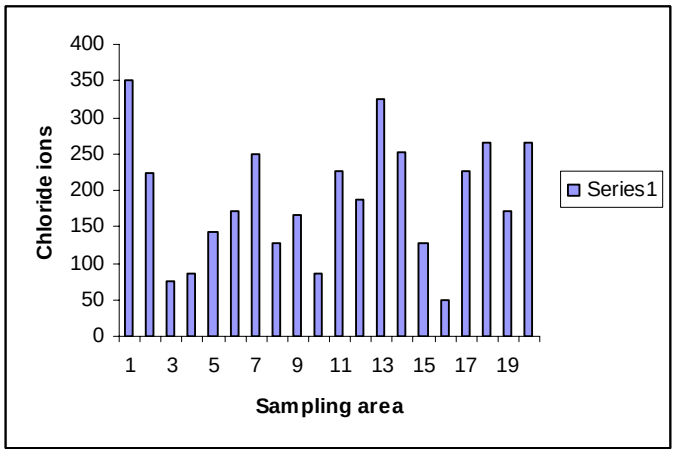

Figure 1f: The chloride values of different sampling locations.

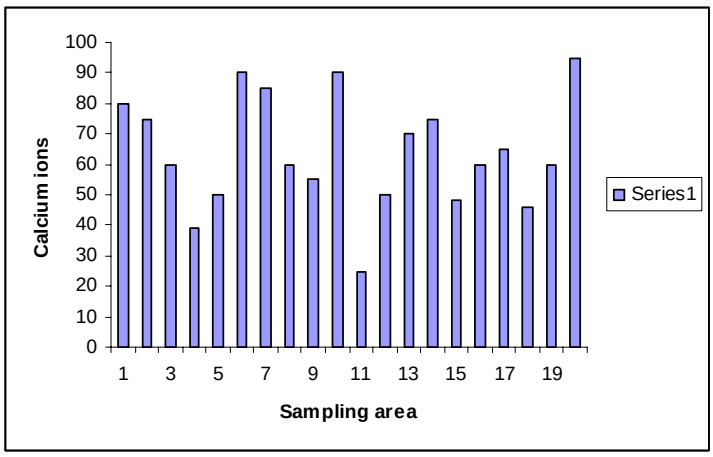

Figure 1g: The calcium values of different sampling locations.

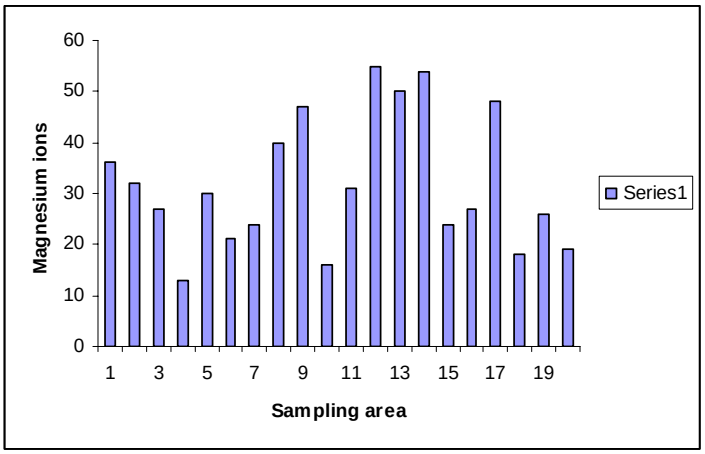

Figure 1h: The magnesium values of different sampling locations.

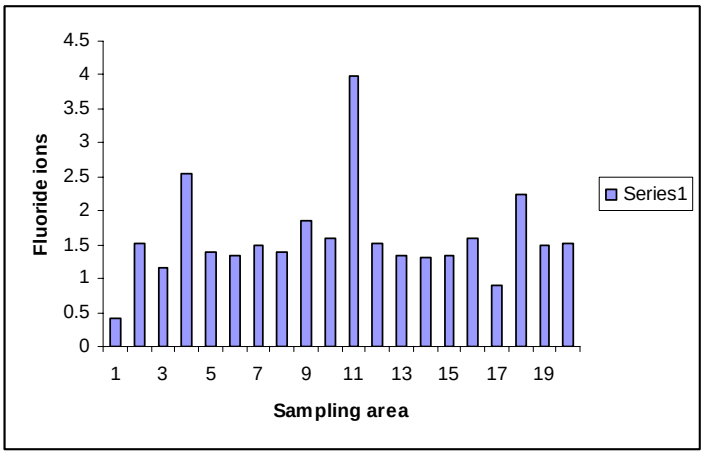

Figure 1i: The fluoride values of different sampling locations.

Conclusions

Groundwater samples from the twenty villages of Narwana block of District Jind, Haryana, India were analyzed for the physio-chemical parameters. The quality of drinking water depends on the harmful elements present in it. The pH of water samples ranges in the entire area shows slightly alkaline trend. The values of alkalinity and total dissolved solids at some locations have been found within the desirable limits. The extent of fluoride in some of the groundwater samples was found high with respect to the WHO standard. Groundwater of the villages of Narwana block of District Jind is suitable for drinking and domestic purposes but in some areas there is the need of treatment to minimize the contamination especially hardness, chloride and fluoride. It is hard to imagine that one person can make a difference in protecting and conserving water supplies but each individual can really help the environment. However, the hazardous effects of fertilizers, pesticides, animal wastes and sediments have not been detected in the ground water samples. It is advised that the animal waste and domestic waste should not be deposited near the water sources. The use of fertilizers and pesticides in the agriculture should be limited and proper and only the standard quality pesticides should be used.

References

[1] V.K. Garg, S. Dahiya, A. Chaudhary and D. Shikha, Fluoride distribution in ground waters of Jind district, Haryana, India. *Ecol. Environ. And Cons.* 1998a.,4(1-2): 19-23.

[2] V.K Garg,., I.S Sharma,. and M.S Bishnoi,., Fluoride in underground waters of Uklana town, district Hisar, Haryana. *Poll. Res.,* 1998b., 17(2): 149-152.

[3] VK Garg, A. Chaudhary, Deepshikha, S. Dahiya, An appraisal of groundwater quality in some village of district Jind. *Indian J Environ Prot,* 19(4) (1999), 267-272

[4] APHA, Standard methods for analysis of water and wastewater.18th Ed. *American Public Health Association, Inc*., Washington D C. 1992.

[5] ASTM (American Society for Testing and Materials), Annual Book of ASTM Standards, ASTM, Philadelphia, USA., 1972.

[6] BIS (Bureau of Indian Standards), Indian Standard Specification for Drinking Water. 15-10500., 1983.

[7] S. Kumar, Correlation among water quality parameter for groundwater in Barmer district. *Indian J. Environ. Protec.,* 1993., 13(7): 487-489.

[8] WHO (World Health Organization), Guidelines for drinking water quality, 3rd ed. Geneva, Switzerland: WHO., 2004.

[9] A.K Yadav, Characteristics of under ground quality block Hansi in Hisar district. M.Sc. Thesis CCSHAU, Hisar.,(2000).

[10] J.P. Yadav and S. Lata, Pollution of fluoride in ground water in Bahadurgarh Block of District Jhajjar, Haryana. *Indian J. Environ. Prot.,* 2003., 23(6): 680-686

[11] S. Sharma, Asian J. Chem. 16 (2004) 309.

[12] S.K. Sharma, V. Singh and C.P.S. Chandel, Environ. And Eco. 22 (2) (2004) 319.
[13] S.K. Sharma, V. Singh and C.P.S. Chandel, Environ. And Eco. 22 (2) (2004) 319.
[14] BIS, Specification for Drinking water ISI: 10500.1991.