Study of Pollutants Present In Ground Water – A Case Study of Patan Block, Durg District, Chhattisgarh, India

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Abstract: The objective of this study was the ground water quality assessment of northern part of Patan Block, Durg District, Chhattisgarh where effluent from steel industry is discharged. Water sample in pre monsoon and post monsoon season were collected and analyzed for trace metals and toxicity in Central Control Board Laboratory, New Delhi. Among various trace metals examined Cd, Cr were found high in concentration. Similarly nitrate, cyanide and phenol are also found high in concentration. This indicates that disposal of hazardous chemicals and industrial wastes causes pollution of ground water as well as subsurface soil layers.

The present study area falls on Survey of India Toposheet No. 64G/8 and 64G/12. Based on the survey results, a network of 23 observation sites were selected for periodic water quality in pre-monsoon and post- monsoon seasons. Water samples were collected and analyzed for various physico-chemical characteristics. Waste effluent from steel industry were also collected and analyzed. The results of the analysis indicate significant variations in the ground water quality with respect to space and time.

From analysis it is found that the trace elements like Cadmium, Chromium, , Lead, Cyanide, Phenol are present in both surface and ground water samples exceeding the limits prescribed by WHO and other agencies.

1. INTRODUCTION

The water which is essential to human life is the fresh water and it is 2.8% of the total water resources on the planet earth. Of this fresh water, 2.2% is surface water and 0.6% is present in the form of ground water. It is estimated that about 0.4%, of total water resources available on planet earth is available for direct utilization by man, animals and plants. As such water is precious to man.

Pollution of air, water and soil is unavoidable with the "growth of industries in developing country like India. Keeping in view, the ill effects of the industrial activities on the sanctity of environment, the water quality evaluation work was selected for the present study. The industry of this region is disposing off its effluents in surrounding areas. One of the watershed which is directly affected by the disposal of liquid waste is Somni Stream Watershed, which is situated in northern part of Patan Block in Durg District. The study aims to assess the degradation of water resources of Somni Stream Water Shed.

The study area is easily approachable by rail route and road both. The National Highway No.6 and Mumbai-Howrah rail route (via Nagpur) runs along, northern perimeter of the basin area. The present Watershed area falls in Survey of India Toposheet No.64 G/8 and G/12. It is bounded by latitudes 21° 5' -2 10 14' 30" N and longitudes 81° 231 30" -810 341 10" E. (Figure 1)

2. MATERIALS AND METHODS :

The study area is underlain by limestones of Chattisgarh Supergroup. Shales occur in small patches in NE and SW portions of the basin. A coarse textured drainage network drains the area. The first order tributaries of Somni Stream originating in the area receives liquid waste discharged by the industry. The physical and chemical quality of Somni stream water is badly affected by factory effluents. No aquatic biospecies are seen flourshing in stream water.

Some important Hydrological and Hydrogeological field investigations which are pre-requisites for understanding ground water pollution problems were carried out in the field. The surface water available annually by precipitation in the watershed area is "estimated to be 20438.38 ha m. The Somni Stream Water Shed is mainly drained by Somni, Pahandor and Amlidih streams. These streams are basically ephemeral, streams. The ground water structures present in the area are dug wells, dug cum bore wells and bore wells. According to the survey report of PHE Dept.1999 there are 274 dug wells and 284 tube wells present in the area. 38 dug wells, distributed over the entire water shed area were selected as observation wells. It is observed that the post monsoon static water level in the watershed area in generally lowered during pre-mansoon by 4-10 meter.

3. SAMPLING OF WATER RESOURCES :

The surface water and ground water samples have been collected from pre-selected sites during pre-monsoon and post monsoon seasons. The sampling site locations are shown in the figure 1. The preservation method recommended by Robert- Kerr Environmental Research Laboratory,

Okhavhama were adopted while sampling of surface and ground waters.

Parameters like Temperature, Conductivity, and Total Dissolved solids were determined in each water sample in the field using portable analysis pit. The remaining parameters were determined using routine analytical techniques at Central Pollution Control Board Laboratory, New Delhi. The chemical analysis of surface and ground water includes three physical parameters viz. Temperature, Colour, Turbidity, twenty two inorganic parameters viz pH, Conductance, TDS, TH, Ca, Mg, Na, K, CO_3, HCO_3, Cl, SO_4, NO_3, NO_2, NH_3, F, CN, Cd, Cr, Fe, Pb, B and two organic parameters viz COD and phenol. These elements were determined by the methods given in the book standard methods for the examination of water and waste water (APHA-AWWA-WPCF, 1985)

4. SUITABILITY OF WATER FOR DRINKING :

The safe drinking water is the first and for most requirement for good public health. To safeguard public health, various agencies such as WHO, IS, ICMR have laid down certain guidelines for safe quality of drinking water. The physical and chemical parameters in the present work are compared with guidelines values of IS : 10500 (1992) Table No.3. It is clear from the table that the surface waters in general show colours, turbidity, iron, phenol, fluoride, cadmium, chromium, cyanide and lead values exceeding the maximum permissible limit of IS drinking water specifications.

(A) Surface Water :

The pre monsoon surface waters are effluent mixed waters. The parameters such as colour, Turbidity and Iron of ground water show high values exceeding the maximum permissible limits and as such are unfit for drinking purpose. About 55% samples exceed maximum permissible limit of colour (25 Hazene unit) while 100% samples cross the max. permissible limit (1 ppm) of iron. 44% shows phenol concentration greater than 0.002 ppm, 55% samples show cyanide above 0.05 ppm and 33% samples indicate lead exceeding 0.05 ppm for drinking water.

The post monsoon surface water samples are partly effluent mixed Somni Stream Waters and partly fresh stream waters of Pahandor, .Amlidih, streams and Morid and Bendri tanks. The maximum permissible limit of parameters like colour is exceeded by 44% samples, turbidity by 66%, fluoride by 33%, Cd and Cr by 33% and CN by 22% water samples.

(B) Ground Water:

The pre monsoon ground water samples collected from adjacent area of Somni Stream Course show concentrations of Cd and Pb, exceeding the maximum permissible limits for drinking. 58% samples show C (Max.concentration 0.05 ppm) and 75% show Pb (more 0.14 ppm) concentrations exceeding the maximum permissible limit .

The post monsoon ground water samples representing entire watershed area are in general, high in concentrations of turbidity, Total Hardness, , Ca, Fe, Phenol, No3, Cd and Cr. About 8% samples show turbidity (max. 12 NTU in PoGW 18), Ca (max 226 ppm in PoGW8) and NO3 (max. 117.30 ppm in PoGW 18) exceeding the permissible limit. About 16% samples show total hardness (max 9.88 ppm in PoGWll), 42% show Cr (Max. 0.08 ppm in PoGW 17) and 50% samples show Cd content in waters (max. 0.03 ppm is PoGW 1, 2, 4, 5, 6, 9, 10) exceeding the permissible limit of drinking water.

It is thus found that only about 8% pre monsoon ground water representing adjoining area of Somni Stream Course and only about 4% of Post monsoon ground water samples representing entire basin area is safe for drinking purpose.

5. DISCUSSION AND CONCLUSION :

The Somni Stream Water Shed water resource quality evaluation results indicate that the surface and ground waters both are unfit for drinking except one borewell water of village Aundhi and one from Aunri village. The main parameters responsible for water contamination are physical parameters like colour and turbidity and dissolved constituents like iron, phenol, fluoride, cadmium, chromium, cyanide and lead.

Amongst ground waters, the concentration of parameters like phenol, cadmium, cyanide and lead have made about 92% of pre monsoon ground waters unfit for drinking. About 95% of post monsoon ground waters are disqualified due to the presence of high turbidity, total hardness, calcium, iron, phenol, nitrates, cadmium and chromium.

The rate of toxicity can be correlated with time. During the study it was observed that some pollutants are found less in concentration in the post monsoon season as compared to pre monsoon season perhaps because of dilution factor. No appreciable change in concentration of conductivity and Cadmium is observed in ground water sampled during pre and post monsoon period. Lead show higher concentration in pre monsoon and Phenol in post monsoon ground water. Cyanide is present in appreciable concentration in pre monsoon while untraceable in post monsoon ground water.

REFERENCES

[1] APHA, AWWA, WPCF (1985), Standard methods for Examination of Water and Waste Water (17th Edition) AmericanPublic health Association, Washington D.C.

[2] Camp, T.R. and Meserve, R.L. (1974), Water and Impurities Hutchison and Ross, Inc., Pennsy Ivania, 384 .

[3] IS10500, (1991) Indian Standard Drinking Water Specification. Bureau of Indian Standards, New Delhi, 5.

TABLE: 3 Drinking Water Classification Criteria and Classification of Water for Drinking Purpose

SR. No.	Parameters	WHO (1971) International Standards		ICMR (1985) Standards		ICMR (1985) Standards		Water showing values exceeding recommended guideline			
		Highest Desirable	Max Permissible	Highest Desirable	Max Permissible	Highest Desirable	Max Permissible	Premonsoon surface water (PRSW1 to 9)	Postmonsoon surface water (PRSW1 to 9)	Premonsoon surface water (PRSW1 to 12)	Postmonsoon surface water (PRSW1 to 12
(A)	Physical Parameters										
1.	Colour (Hazene Units)	05	50	05	25	05	25	1,5,6,7,8, 55.55%	1,5,6,8 44.44%	-	- - -
2.	Turbidity (NTU)	05	25	05	10	05(JJU)	25(JJU)	1,2,3,4,5, 6,7,8,9, 100%	1,2,3,5, 6,8 66.66%		10,18 8.32%
(B)	Chemical Parameters										
1.	pH	7.0-8.5	6.5-9.2	6.5-8.5	6.5-9.2	7.0-8.5	6.5-9.2	- -	- -		- -
2.	TDS (mg/l)	500	1500	500	2000	500	1500				
3.	TH as CaCo3 (mg/l)	100	500	300	600	300	600		-		1,8,16,18 16.64%
4.	Ca (mg/l)	75	200	75	200	75	200		7 - 11.11%		1,8 8.32%
5.	Iron (mg/l)	0.05	1.5	0.3	1.0	0.1	1.0	1,2,3,4,5, 6,7,8,9, 100%	- - –		3,5,9,10,11,12,14,15 16,17,18,19,20,21,24 58.33%
6.	Chloride (mg/l)	200	600	250	1000	200	1000	-	-		-
7.	Phenol (mg/l)	0.001	0.002	0.001	0.002	-	-	1,3,7,8 44.44%	-	12 8.33%	11,14,16,18,21,23,24 33.28%
8.	Flouride (mg/l)	0.6-0.9	0.8-1.78	1.0	1.5	1.0	1.5	1,2 22.22%	1,2,5,6,8 55.55%	-	- -
9.	Nitrates (mg/l)	-	- 45	- 45 -	- 100	20	100	-	-		8,18 8.32%
10.	Cadmium (mg/l)		0.01	0.01	No Relaxation	-	- 0.01	- 1,2,3,4,5 55.55%	2,7,9 33.33%	6,7,8,9,10,11,12 58.31%	1,2,4,5,6,7,9,10,13 18,24– 50.00%
11.	Chromium (mg/l)		-	0.05	No Relaxation		-	-	4,5,9 33.33%	-	6,10,11,13,17,18, 21,22–41.60%
12.	Cyanide (mg/l)		0.05	0.05	No Relaxation		0.05	3,5,6,7,8 55.55%	1,2 22.22%	8 8.33%	-
13.	Lead (mg/l)		0.1	0.05	No Relaxation		0.05	6,8,9 33.33%	-	1,2,3,4,6,8,9, 10,12 75.00%	-