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The Ground Water Quality Status of Waste Disposal Site in the Eastern Part of Kolkata - A Case Study

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ABSTRACT

Untreated disposal of wastes, both solid and liquid created by various human activities, causes contamination of ground water through the processes of leaching, and percolation through soil. The leachate containing soluble nitrogen, phosphorus and sulfur compounds including toxic metals, originated from the untreated waste percolates through the soil and loads the ground water with these compounds. Such loading may make the ground water unsuitable for drinking purpose. The problem is supposed to be more acute in areas like Dhapa and Bantala situated at the eastern part of the city of Kolkata. This area is not only the main disposal ground of the Kolkata Municipal solid waste but also criss-crossed with untreated city sewage carrying channels and fisheries, fed with this sewage. A detail study of 16 parameters regarding quality of 23 water samples (from 8 villages) drawn from tube wells around the Dhapa waste dumping ground, 12 water samples of tube wells (6 from 3 villages and 6 from nearby 6 bheries) from areas around fisheries of Bantala and 5 water samples of tubewells from normal field of different parts of KMC area have been assessed. The assessment results have been compared with the values obtained from tube wells of normal field of KMC area and for the same parameters (available) of standard drinking water. The findings have been presented in tabular form showing the departure of the quality of water samples from those of the standard drinking water in a qualitative way.

INTRODUCTION

Hazardous waste management is perhaps the most challenging environmental problem of our times. Many of the activities of modern society overload the soil -water-plant system with nitrogen, phosphorous sulfur and others, resulting in the contamination of the ground-water resources. Pollutants emanating from various sources percolate down in dissolved state through soil profile to the ground water system. Nitrogen, Phosphorus and Sulfur compounds are most wide spread contaminants of ground water. They are highly soluble and very mobile. Although they are plant nutrients its higher level of concentration in ground water being utilized for drinking purposes is a potential threat to human health. Decomposition of organic matter (from various types of wastes) in soils, leaching of soluble chemical fertilizers (using in agricultural activities), human and animal excreta, untreated effluents of industries and sewage disposal are potential sources of contamination in ground water. Leaching of these contaminants from multiple sources are more concerned in Dhapa / Bantala area where shallow ground water is the only source of potable water.

To appraise the status of ground water quality, the present investigation were conducted under two different waste (liquid / solid) disposal practices in the area. The quality of water is assessed on comparing with different standards as stipulated for drinking water.

MATERIALS AND METHODS

To understand the nature and degree of contamination of ground water quality, the present investigation was carried out in two different types of waste disposal sites. Bantala and Dhapa areas were separately selected for sampling due to their distinct land use pattern. One of these areas is Bantala area where the raw sewage water is distributed in this entire area to feed a large number of Bheries and the other region is the Dhapa area where the municipal solid waste is fed to the top soil, used as organic manure to produce vegetables. In Bantala areas six tube wells were selected from three villages. The status of these tube wells was mixed in types such as Private and Government. Other six tube wells were selected from those nearest to six bheries. Most of these tube wells were private. In Dhapa areas, twenty-three tube wells were selected from eight villages. All of these tube wells were established by the Government. The additional five tube wells from different parts of KMC area were selected to compare the ground water quality status with those of waste disposal areas. All the physico-chemical parameters depicted in the table 1 were analysed in accordance with the Standard Methods (1).

Table 1. Physico-chemical analysis of water samples collected from selected tubewells of Eastern part of Kolkata and Kolkata Municipal Corporation (KMC) area.

Place	Depth (in ft.)	Temp. (^0C)	pH	Conductivity (μS/cm)	Alkalinity ($mg.l^{-1}$)	Hardness ($mg.l^{-1}$)	NO_3-N ($mg.l^{-1}$)	NO_2-N ($mg.l^{-1}$)	NH_4-N ($mg.l^{-1}$)
Bantala	100 – 250 n = 9	27 ± 0.52	7.20 ± 0.12	2602 ± 836	68 ± 28.87	578 ± 202	1.44 ± 2.23	1.20 ± 1.64	8.39 ± 8.92
	>300 – 500 n = 3	27 ± 0.05	7.07 ± 0.09	1788 ± 89	44 ± 2.83	620 ± 47	0.21 ± 0.23	0.18 ± 0.23	0.81 ± 0.13
Dhapa	>300 – 400 n = 23	27 ± 0.94	7.42 ± 0.20	1972 ± 97	17 ± 1.62	694 ± 39	0.11± 0.16	0.18 ± 0.24	1.31 ± 0.44
Kolkata	>300 – 400 n = 5	27 ± 0.19	7.17 ± 0.08	2005 ± 254	20 ± 2.19	577 ± 46	0.14 ± 0.10	0.01 ± 0.007	0.12 ± 0.02
Standard value		—	6.50 – 8.50	—	200	300	45	—	—

Place	Depth (in ft.)	Total – N ($mg.l^{-1}$)	SO_4^{2-} ($mg.l^{-1}$)	PO_4^{3-} ($mg.l^{-1}$)	Total – P ($mg.l^{-1}$)	Cl^- ($mg.l^{-1}$)	F^- ($mg.l^{-1}$)	As (total) ($mg.l^{-1}$)	FE^{3+} ($mg.l^{-1}$)
Bantala	100 – 250 n = 9	47 ± 56	29.37 ± 35.48	0.61 ± 0.98	20.69 ± 22.23	541± 329	0.73 ± 0.56	< 0.01	0.99 ± 0.64
	>300 – 500 n = 3	4.00 ± 1.62	12.26 ± 1.31	0.02 ± 0.004	4.33 ± 0.31	527 ± 55	0.44 ± 0.00	< 0.01	0.26 ± 0.06
Dhapa	>300 – 400 n = 23	4.41 ± 1.71	11.03 ± 4.53	0.01 ± 0.01	5.43 ± 2.07	536 ± 75	0.21± 0.09	< 0.01	0.74 ± 0.87
Kolkata	>300 – 400 n = 5	2.30 ± 1.05	21.73 ± 3.16	0.03 ± 0.02	2.75 ± 1.41	552 ± 62	0.34 ± 0.16	< 0.01	0.33 ± 0.08
Standard value		—	200	—	—	250	1.00	0.05	0.30

n = number of tube wells under investigation

RESULTS AND DISCUSSION

All ground water samples exhibited normal pH ranges and significantly lower values of alkalinity than hardness implying presence of non-carbonate hardness. Higher level of chloride content in all samples well supported the above fact. Among the parameters, chloride and hardness content were about two times higher than the permissible value (Table 1) of drinking water (2). Conductivity values also signified considerably higher values of dissolved solids in water and the value may exceed the standard value of 500 ppm. Thus the quality of water in these areas does not conform to the drinking water standard (2) and can cause the problems associated with constipation, gastrointestinal disturbances and indigestion (3) after consumption of water from all these areas. Similar observation of water quality at Bantala areas also recorded earlier (4). The water quality of the aquifer in the depth 300-500 ft in both Bantala and Dhapa areas were almost similar, irrespective of different land use pattern on the top soil but differ slightly with higher values of TN, TP, NH_4-N and NO_2-N to the water quality of KMC area, whereas in Bantala area, the aquifer at depth of 100-250 ft., higher values of alkalinity, sulfate and different forms of nitrogen and phosphorus were encountered. This could be linked with anthropogenic use of such product resulting in contamination of ground water through percolation. As this area is sewage affected and sewage contain high amount of cations, anions and organic matter (5), decomposition of organic matter from various types of wastes in soils, leaching of soluble chemical fertilizer in agriculture activity, human and animal excreta and untreated effluents could be the possible sources of contamination in ground water in the shallow aquifer in Bantala area. Besides fluoride content in water also crossed the limit of standard in some of the tube wells as depicted in high standard deviation values during the investigation.

CONCLUSION

From the above investigation this can be concluded that the total dissolved solids, hardness and chloride in all the samples are significantly higher than the stipulated standard values. Moreover samples from shallow aquifer have the possibilities of ground water contamination in Bantala area whereas the quality of samples from deep aquifer has negligible contamination in Dhapa and Bantala areas compared to KMC area.

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