Analysis of pollutants present in the ground water due to Leachates at Thuraipakkam Dumpyard, Chennai

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Abstract

Water is a gift of nature, but many regions are facing water shortage due to its being polluted by human activities, or increasing demand by industrialization and high population growth. In the present scenario most of the wastes which are discharged into natural water bodies such as lakes and rivers, it also affects the ground water quality. Groundwater is the alternative source of fresh water in areas where surface water is polluted and deficit. However, the ground water that is polluted by various sources e.g. solid waste, Industrial waste etc. The leachate from Municipal Solid Waste (MSW) landfills is a highly concentrated, so it can pollute large amounts of groundwater and hence it becomes unsuitable for domestic purposes. In this study we have analyzed the physical and chemical parameters of ground water samples at Thuraipakkam dumpyard located at Chennai, Tamil Nadu, India and the impacts of leachates on ground water is evaluated. In this report we have summarized the laboratory results of all the samples collected from the study area against the Bureau of Indian Standards (BIS) for drinking water. Spatial maps also created using ArcGIS Software for various parameters. The results of this study demonstrated that, the high concentration of Total Dissolved Solids, Electrical Conductivity, Hardness, Nitrates, Chlorides, Sulphates in ground water near landfill deteriorates the quality of water are compared to the samples away from the dumping yard.

Keywords: ground water quality, leachate, ArcGIS, spatial maps.

1. Introduction

Urbanization and rising incomes are the two most important factors that lead to enormous waste generation. Inappropriate solid waste management causes air, land and water pollution leading not only to environmental degradation but also to a growing list of human health problems (Parameswari & Karunakaran 2010). Ground water is the largest source of fresh water in developing countries and it is also subjected to such danger. During the past 7-8 years (2003-2010) the solid waste has increased from 1000 tons to 3000 tons per day (Saritha Banuraman & Veda Madavan 2011). Landfills have been identified as one of the major threats to ground water resources (Fatta et al.1999). More than 90% of the Municipal Solid Waste (MSW) generated in India is directly dumped on land in an unsatisfactory manner (Chatterjee 2010). The solid waste placed in landfills or open dumps are subjected to either groundwater underflow or infiltration from precipitation or any other possibility of infiltration of water. During rainfall, the dumped solid wastes receivers water and the by-products of its decomposition move into the water through the waste deposition. The liquid containing innumerable organic and inorganic compounds is called 'leachate'. This leachate accumulates at the bottom of the landfill and percolates through the soil and reaches the groundwater (Mor et al. 2006).

Heavy metals in water refers to the heavy, dense, metallic elements that occur in trace levels, but are very toxic and tend to accumulate, hence are commonly referred to as trace metals. The major anthropogenic sources of heavy metals are industrial wastes from mining sites, manufacturing and metal finishing plants, domestic waste water and run off from roads. Many of these trace metals are highly toxic to humans, such as Hg, Pb, Cd, Ni, As, and Sn. Their presence in surface and underground water at above background concentrations is undesirable. Some heavy metals such as Hg, Pb, As, Cd, Fe, Co, Mn, Cr etc., have been identified as deleterious to aquatic ecosystem and human health (Abdul Jammel et al.2012).

In the present study physical and chemical parameters of ground water samples were analyzed at Thuraipakkam and the impacts of leachate on ground water were evaluated. The various physical and chemical parameters are colour, odour, turbidity, Total Dissolved Solids, Electrical Conductivity, pH, Alkalinity, Total Hardness, Calcium, Magnesium, Sodium, Potassium, Iron, Manganese, Free Ammonia, Nitrite, Nitrate, Chloride, Fluoride, Sulphate and Phosphate. The spatial maps have been created for various physical and chemical parameters.

2. Materials and Methods

2.1 Study area details

Thuraipakkam dumpsite is situated at 120 57'22'' North and 800 14' 21'' East and its functioning since 1987. Okkiyam Thoraipakkam also spelt Thuraipakkam, is an area. It is situated on what is called as the IT expressway, on now known as Rajiv Gandhi Salai, the first six lane road in Chennai. Thuraipakkam is on the eastern banks of the marsh land which has been designated as a reserve forest area and is one of the few remaining significant natural ecosystems within Chennai. Thuraipakkam is 3 km in length, starting to its north. Thuraipakkam is highly polluted area because a portion of marsh land has been converted into a dump yard and garbage including plastics and tires are burnt. However, since beginning of 2009, burning has been officially banned and this has led to considerable improvement in the air quality and reduced the levels of pollution in the area. The study area image from google earth is shown in figure 1.

Figure 1 Study Area View from Google Earth

2.2 Sample collection

To know the impact of pollutants on ground water, 18 ground water samples were collected randomly around the Thuraipakkam dumpsite and named as S1 to S18. 12 samples were collected in the west side of the dump yard, and then two samples were collected from other three sides. Sampling locations over the boundary as shown in Figure2.

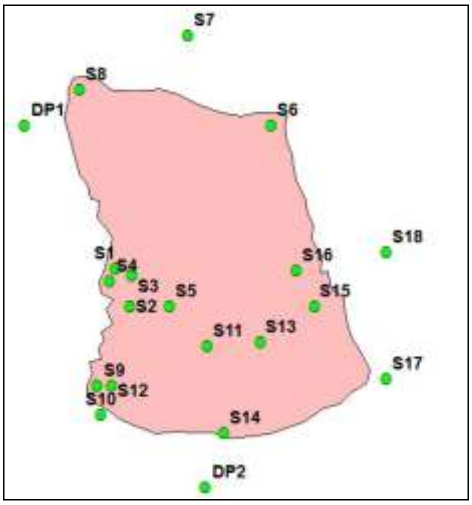

Figure 2 Sampling Locations over boundary

2.3 Laboratory Analysis

The various physical and chemical parameters were analyzed in the laboratory for the collected ground water samples such as colour, odour, turbidity, Total Dissolved Solids, Electrical Conductivity, pH, Alkalinity, Total Hardness, Calcium, Magnesium, Sodium, Potassium, Iron, Manganese, Free Ammonia, Nitrite, Nitrate, Chloride, Fluoride, Sulphate and Phosphate. The chlorides concentration was estimated by using Argentometric method.

3. Results and Discussion

The obtained results in the laboratory were compared with drinking water standards BIS (10200:2012). The interpolation has been done using ArcGIS software over the boundary with the help of obtained results by Krigging method. From the maps, the spatial variation can be obtained for various parameters and it is shown in figure 5. The graph has been plotted for various parameters which are shown in the following figures 3& 4. The obtained results for the collected ground water samples are listed in Table1. From the comparison of results with the standards it was obtained that the samples which are nearer to the dump site are mostly not in the permissible limit. For turbidity, the samples S1, S2, and S3 are not in the permissible limit. The TDS values for samples S5, S7, S17 were not in the considerable limit. Similarly this happened to all the parameters. This is mainly due to continuous dumping of Municipal Solid Waste and leaching action which affects the ground water quality in the study area. From the results it is clear that some of the samples were not suitable for domestic purposes as well as drinking.

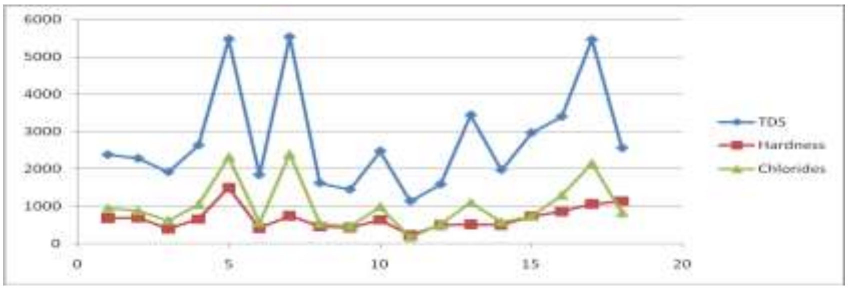

Figure 3 Comparison of TDS, Hardness and Chlorides

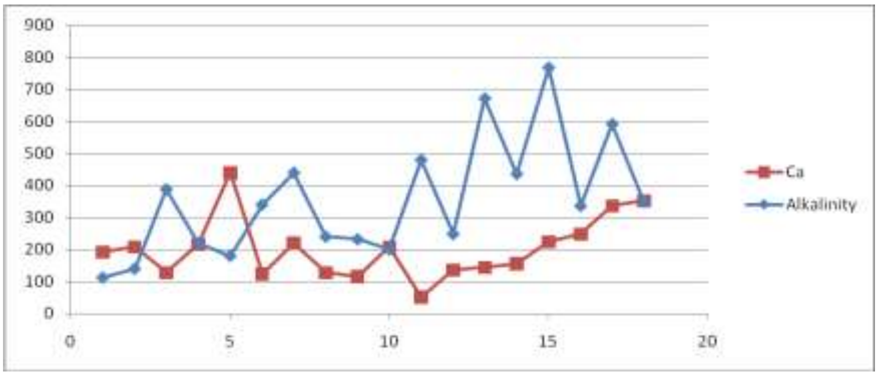

Figure 4 Comparison of Ca and Alkalinity

Table no 1: Sample results

Sample No.	Turbidity NTU	TDS (mg/L)	pH	Alkalinity (mg/L)	Hardness (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Chloride (mg/L)
1	31.5	2380	5.5	112	680	192	48	950
2	34.1	2282	5.62	140	700	208	43	880
3	7.5	1918	6.96	388	400	128	19	620
4	0.4	2639	6.31	220	660	216	29	1050
5	0.3	5475	6.45	180	1500	440	96	2325
6	0.1	1841	7.06	340	420	124	26	560
7	0.4	5537	7.25	440	750	220	48	2400
8	0.1	1624	6.66	240	460	128	34	540
9	0.2	1449	6.63	232	430	116	34	470
10	0.3	2478	6.57	200	640	208	29	990
11	0.4	1138	7.7	480	232	51	25	168
12	1.1	1589	6.58	248	500	136	38	515
13	0.9	3444	7.52	672	520	144	38	1100
14	0.9	1974	7.02	436	500	156	26	580
15	0.1	2968	7.19	768	740	224	43	730
16	0.8	3402	7.08	336	860	248	58	1300
17	0.8	5467	7.16	592	1060	336	53	2150
18	0.2	2562	7.05	348	1140	352	62	830

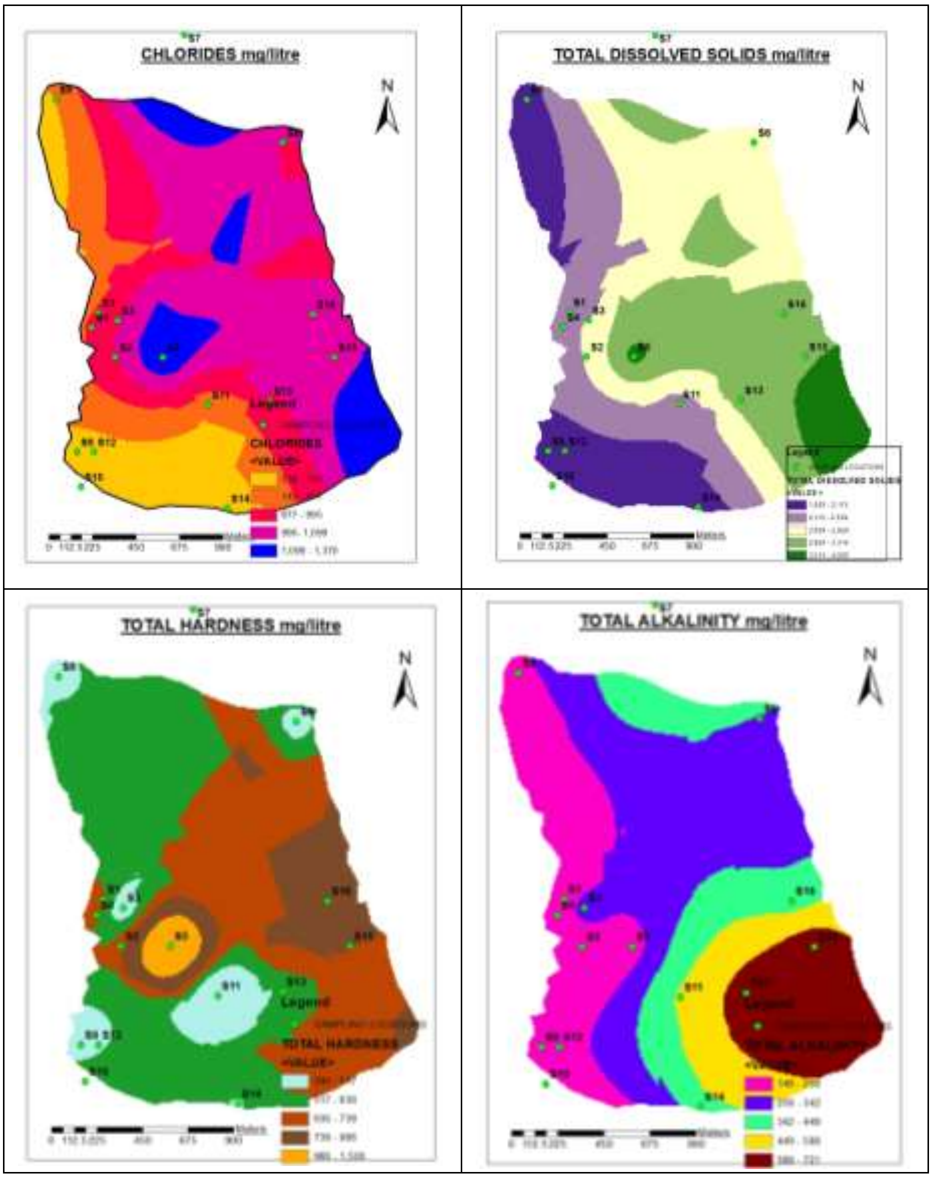

Figure 5 Spatial Mapping of chemical parameters

4. Conclusion

The water quality analysis carried out in the study area proves that quality has been degraded. The concentration of TDS, chloride, sulphate, sodium, magnesium and calcium is high and also it was not in the permissible limit. From the result we can conclude that the status of ground water quality is degrading as years goes on which may lead threats to the living community near the dump site. The quality of ground water is improved as the distance of well is increased from the dump site. The main reason for the degrading water quality is due to continuous dumping of wastes from the local residents. To reduce the contamination of pollutants on ground water, many awareness programmes need to be conducted to the people about the ground water importance, health issues, treatment methods, waste disposal etc.

References

Abdul Jameel, A., Sirajudeen, J and Abdul Vahith, R., (2013) "Studies on heavy metal pollution of ground water sources between Tamil Nadu and Pondicherry, India", *Pelagia Research Library, Advances in Applied Science Research*, 424-429.

Chatterjee, R., (2010) "Municipal solid waste management in Kohima city-India" *Iran Journal of Environmental health science and engineering*, 7(2):173–180.

Fatta, D., Papadopoulos, A., & Loizidou, M., (1999) “A study on the landfill leachate and its impact on the groundwater quality of the greater area” *Environ Geochem Health*, 21(2):175–190

Mor, S., Khaiwal, R., Dahiya, RP., & Chandra, A., (2006) “Leachate characterization and assessment of groundwater pollution near municipal solid waste landfill site” *Environmental Monitoring Assessment*, 118:435–456.

Parameswari, K., and Karunakaran, K., (2010) “Ground water issues and community awareness in Perungudi dumpsite, Chennai, India”, *Journal of environmental research and development,*Vol 5 page no:404 -412.

Saritha Banuraman., and Veda Madavan, (2011) “Study of ground water in Perungudi area of Chennai: correlation with physico-chemical parameters”, *civil and environmental research*, Vol 1 page no: 23 to 31.