Qualitative Assessment of Groundwater Around the Municipal Solid Waste Landfill Site at Pirana in Ahmedabad City

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Abstract--- The characteristics of leachate and its probable risks on groundwater pollution were investigated following the analysis of some chemical parameters of the leachate generated in the Pirana landfill site, Ahmedabad, India. Three samples of the groundwater were collected from the different locations around the Pirana landfill site. The laboratory test results on groundwater samples show high concentration of TDS (2100 mg/lit), Total hardness (740 mg/lit), Sulphates (470 mg/lit), Calcium (196 mg/litre) and Magnesium (100 mg/lit) and have very high potential for contaminating ground and surface water. The data collected from the Ahmedabad Municipal Corporation also shows high concentrations of TDS (2272 mg/litre), Total Hardness (840 mg/lit), Sulohates (470 mg/lit), Chlorides (818 mg/lit), nitrates (668 mg/lit) and Iron (8.50 mg/lit). The surface water samples around the landfill site appear to be contaminated, most probably, through the overflow of leachate. Groundwater parameters do not satisfy drinking water quality standard so it is harmful if consumpted without proper treatment. Biological treatment through Reverse Osmosis improves the quality of groundwater significantly. The water should be used for drinking and cooking but only after its purification through RO system as it removes almost 95 % of the dissolved solids.

Keywords: Leachate, Groundwater, Pollution, Solid waste, Landfill, Qualitative Assessment.

I. INTRODUCTION

Ahmedabad is the 7th largest Metropolis in India with a population of 55.6 lakh and spread over an area of 466 Sq Km (as per Census 2011). Solid waste production in Ahmedabad city is almost 4000 t/d. [1]. These wastes are dumped in the landfill sites as the cheapest means of solid waste management system. The waste dumped in this process causes various aesthetic and public health problems and also attracts insects, rodents and various disease vectors. The solid waste, in this dumping process, undergoes slow, anaerobic decomposition and generate substantial amount of leachate with decomposition products, heavy metals and a variety of hazardous pollutants which may seep from the landfill site into underground aquifers and thus polluting much needed urban water resources. There are also possibilities of surface runoff and/or overflow of the leachate to the surrounding agricultural lands, ponds, canals and rivers causing surface water quality deterioration [2].

Leachate vaies widely in composition depending on many interacting factors such as the composition and the depth of the waste, availability of moisture and oxygen, landfill design, operation and age. Leachate composition is primarily a function of the age of the landfill and the degree of waste stabilization [3].

Improper solid waste management is a major environmental problem in Ahmedabad City due to the absence of modern engineered landfills, therefore posing serious contamination risk to both groundwater and surface water. Landfills are considered one of the major threats to groundwater. The scale of this threat depends on the concentration and toxicity of contaminants in leachate, type and permeability of geological strata, depth of the water table and the direction of groundwater flow, modern sanitary landfills have also been reported to leak leachate and pollute groundwater. Failures of liners and /or leakage of the collection systems are the primary causes of such leachate seepage and infiltration into groundwater [3].

Groundwater is the major source of potable water supply in the study area and its contamination is a major environmental and health concern. This study was therefore undertaken with the objective of assessing the possible impact of leachate percolation on groundwater quality of an unlined MSW landfill site at Pirana in Ahmedabad city.

II. MATERIALS AND METHODS

A. *Description of the study area*

The study area is located near the highway away from the central part of the city. The industrial and residential areas are also nearby to the landfill site. The Sabarmati River is situated near to the site of around 3 km. The total area of Pirana landfill site is 84 hectares. 65 hectares land has been used up so far for the disposal of waste since 1980. The average depth/height of the waste is 22 meters. As per survey conducted by Abellon Clean Engg. in Feb 2010 at Pirana dump site, food waste constitute around 40% of sample tested. There is no mechanism in Ahmedabad for ensuring Recycling of food waste. It was found that around 70,000 flies can live in 1 cubic foot of garbage [1].

B. *Waste disposal practices*

The landfill started operation in 1980 and on an average about 2500 tons/day of waste is dumped on the site with the waste filling heights varying from 20 to 22 meters. The wastes dumped into this site are largely from domestic and commercial sources. Nearly 61% of the accumulated waste is collected from municipal bins and street sweeping. More than 12500 workers are employed by AMC and they work on all 365 days of a year and twice a day – 6:30 am to 11:30 am and 3:00 pm to 6:00 pm. The site is a non-engineered open pit and the waste brought here by collection trucks from different parts of the city are dumped haphazardly

without segregation. AMC has identified more than 1100 locations as waste collection points. 900 closed body 7 cubic meter metal community storage bins have been provided at these points and AMC ensures that these containers are lifted at least once on a daily basis with the help of Jigar Transport Co. and Om Swachtha Corporation [1].

C. Segregated collection of hotel and kitchen waste

For collection, transportation and disposal of kitchen waste from hotels and restaurants, AMC has contracted with Sahara Public Health Organization and Abhishek Sanitation Sahakari Mandali Ltd. On 'Pollutes Pay Principle'. Waste collected from more than 1100 units under this system is transported to the composting plant everyday [1].

D. Collection of Bio- medical waste

AMC has contracted the daily collection and transportation of bio-medical waste from 4 municipal hospitals, 64 urban health centers to the incineration plant. The contracts have been given to GPCB approved and authorized contractors Semb Ramky Environmental Management Pvt. Ltd. And Pollucare Bio Medical Management Pvt. Ltd [1].

E. Sampling of Leachate

In an effort to study the extent of groundwater contamination, three sampling points were selected around the landfill site from where the solid waste samples were taken. The pure water from RO then passed through these samples. The water obtained after passing through the waste was collected in 500 ml plastic bottles.

F. Physico-chemical analysis of leachate

Sr. No.	Parameters	Sample 1	Sample 2	Sample 3
1	pH	6.8	7.3	7.1
2	TDS	2100	1870	1810
3	Total Hardness	740	700	680
4	Calcium Hardness	490	470	450
5	Magnesium Hardness	250	230	230
6	Sulphates	430	390	470
7	Chlorides	200	290	310
8	Acidity	100	120	100
9	Calcium	196	188	180
10	Magnesium	100	92	92

Table. 1: Characteristics of the landfill leachate

The leachate samples were transported to the laboratory and all the samples were analyzed for relevant physico-chemical parameters according to the accepted procedures and standard methods. The paremeters analyzed in the leachate samples include pH, total dissolved solids (TDS), total hardness (TH), sulphates, chlorides, acidity, magnesium and calcium. All the experiments were performed in the laboratory of environment department of L. D. Engineering College, Ahmedabad. The results of the tests are listed in table 1.

G. Data from AMC

AMC officials had collected the groundwater samples from four sampling points. The samples were taken from the borewells of UPL Plant, Excel Industries, Sayna Chemicals and Ajmeri Farm located near the Pirana landfill site. The collected samples were given to Akshar Consultants for testing against various parameters. The parameters include pH, total dissolved solids (TDS), total hardness (TH), sulphates, chlorides, iron and nitrates. The results of the tests are listed in table 2.

Sr. No.	Parameters	UPL Plant	Excel Industries	Sayna Chemicals	Ajmeri Farm
1	pH	7.37	7.57	7.44	7.19
2	TDS	2138	1210	2046	2272
3	Chlorides	633	438	558	818
4	Sulphates	307	96	470	124
5	Total Hardness	530	250	840	680
6	Iron	7.80	6.00	6.30	8.50
7	Nitrates	575	263	590	668

Table. 2: Characteristics of groundwater samples by AMC officials [1].

Sr. No.	Parameters	Desirable limits as per BIS
1	pH	6.5 to 8.5
2	TDS	500
3	Total Hardness	300
4	Sulphates	150
5	Chlorides	250
6	Calcium	75
7	Magnesium	300
8	Iron	0.3
9	Nitrates	45

Table 3: Desirable limits of different parameters for drinking water as per BIS [4].

III. Results and Discussion

The pollution potential of leachate depends on its composition and it usually contains high concentrations of a wide range of contaminants. Uncontrolled and untreated leachate of a landfill site pollutes the surrounding soil, surface water and groundwater and hence a potential threat to human and environment. The experimental results and the data collected from AMC shows high concentrations of almost all the parameters as compared to the BIS standards for drinking water. The experimental results and the data collected from AMC shows high concentrations of almost all the parameters as compared to the BIS standards for drinking water. The people residing nearby the landfill site uses this polluted groundwater which is very harmful to their health. So the groundwater nearby the pirana landfill site is recommended for drinking and cooking but only after the proper treatment which removes all the contaminants present in the water.

The TDS is a valuable indicator of the total dissolved salt content of water. The very high TDS observed in the groundwater suggest a downward transfer of leachate into groundwater. High concentrations of TDS decrease the palatability of water and may also cause gastrointestinal irritation in humans [3].

The presence of high concentration of Fe in the leachate indicates that Fe scraps are likely dumped in the landfill. Concentration of Fe above the permissible limit in

water results in aesthetic problems relating to taste, odour and colour.

IV. CONCLUSION

The result shows very high amount of almost all parameters and so it is harmful for drinking and cooking. The reverse osmosis (RO) system should be used because it removes all the dissolved solids upto 90% and makes the water safe for drinking.The only li mitation of this system is that the membrane should be replaced during regular time intervals and frequent service should be given to the RO system. It is better to spend some money on this system and it is profitable also because it saves money which would otherwise be wasted for curing of diseases caused due to drinking of contaminated water.

REFERENCES

[1] Corporation, A. M. (2011). Ahmedabad.
[2] Md. Azim*, m. M. (2011). Characteristics of leachate generated at landfill sites and probable risks of surface and groundwater pollution in the surrounding areas : a case study of matuail landfill site, dhaka . Journal of Bangladesh Academy of Sciences, Vol. 35, No. 2, 153-160.
[3] Aderemi Adeolu O, O. A. (2011). Assessment of groundwater contamination by leachate near a muicipal solid waste landfill. African Journal of Environment Science and Technology, Vol. 5(11), pp. 933-940.
[4] Malek, B. R. (2013). Environmental Engineering Ahmedabad: Mahajan Publication.

