

QUALITY ASSESSMENT OF GROUND WATER IN PALLAVAPURAM MUNICIPAL SOLID WASTE DUMPSITE AREA NEARER TO PALLAVARAM IN CHENNAI, TAMILNADU

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ABSTRACT

Ground water samples in and around from the dumpsite located in Pallavaram were studied to assess the impact of Municipal solid waste on ground water resources in the particular area. Ground water samples were collected from the 5 different bore-wells in and around the dumpsites. The water samples in all 5 locations have mild to high iron concentrations and mild to high acidity. The high acidity in some of the water samples is related to products of anaerobic decomposition of waste while the high iron concentration noticed in most samples which are higher than Indian Standards limit of 1.0 mg L^{-1} can be attributed to the location of such bore-wells close to such source as dumpsites. The presence of such dumpsites therefore is a potential source of pollution to the ground water.

Keywords: Ground water quality, Water pollution, Landfills

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INTRODUCTION

Water is one of the most important compounds to the ecosystem. Better quality of water is described by its physical, chemical and biological characteristics. Due to the increased human population, industrialization, use of fertilizers in agriculture and man-made activity the water gets polluted. The natural aquatic resources are causing heavy and varied pollution in aquatic environment leading to water quality and depletion of aquatic biota. It is therefore necessary that the quality of drinking water should be checked at regular time interval because due to use of contaminated drinking water, human population suffers from a variety of water borne diseases. It is difficult to understand. The biological phenomenon is fully because the chemistry of water reveals much about the metabolism of the ecosystem and explains the general hydro biological relationship. The physico-chemical parameters of water and the dependence of all life process of these factors make it desirable to take as an environmentally viable or not. The leachate produced by waste disposal sites contains a large amount of contaminants which are likely to pollute ground water¹. In present study involves the analysis of water quality in terms of physico-chemical parameters of ground water in Pallavapuram municipal solid waste dumpsite area nearer to Pallavaram in Chennai, Tamilnadu.

The study on physicochemical and biological characteristic of standing and running water resources²⁻⁴ reveals the pollution. The presence of bore well at the landfill sites to draw ground water threatens to contaminate the ground water⁵. This study involves the water quality analysis in the Pallavaram solid waste dumpsite nearer area. Contamination of groundwater can take place from either a wider source like percolation from landfills on account of application of solid and liquid wastes from a point source like waste disposal sites⁶. The aim of the study is to understand how the water gets polluted due to the dumping of solid waste in and around.

Study area

Pallavaram is located at $12.98^\circ \text{ N } 80.18^\circ \text{ E}$. It has an average elevation of 16 meters (52 feet). The Pallavaram land filling dumpsite (Periayeri) shown in Figure 1 is in the beginning of Grand South Trunk road connecting Old Mahabalipuram road by 200 feet road. Pallavaram Land filling dumpsite is

surrounded by residential areas in which they are heavily affected by water pollution through the leach out of hazards from the solid waste.

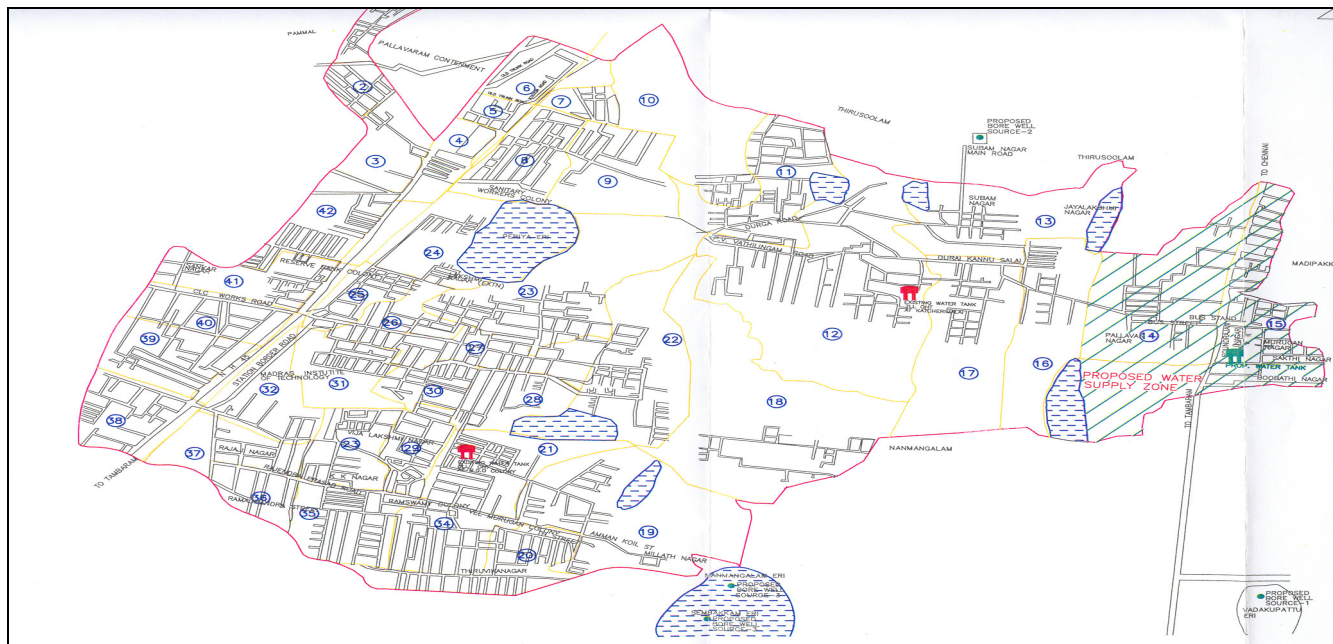


Fig.-1: Pallavapuram Municipality Ward Map



Fig.-2: Pallavaram Landfills site (Periyaeri) area and Joy Nagar in Pallavaram Municipality

Figure 2 shows the study area. The water samples collected from the Joy Nagar which is nearer to the solid waste dumpsite.

Water Sampling

The survey on the quality of ground water samples was conducted in the month of March 2011. Sample Collection, preservation and analysis were done as per the standard methods⁷. Water samples were taken at each station. Five water samples were collected at different locations at Joy Nagar. The polyethylene sample containers cleaned by 1 mol/L of nitric acid and left it for 2 days followed by thorough rinsing of distilled water. Two liters of samples collected for the analysis. The pH, electrical conductivity, total alkalinity, hardness and chloride tests were done at the site. Total suspended solids, nitrate, phosphate and sulphate were analysed as soon as possible. The samples for trace metal analysis were acidified with concentration HNO₃ to bring pH < 2.

EXPERIMENTAL

Instrumentation

GBC Avanta PM for Metal Analysis.

Instrument operating conditions are shown in Table 1

Sample Preparation and Analysis

1 litre of sample was taken and acidified with 1 mL of conc. HNO₃ and boiled it to reduce to 100 mL. The same was carrying out for blank also. Table 2 reveals the standard methods used for the sample preparation and analysis for the analysis of water for the specific tests performed.

Schimadzu UV 1601 PC for Colorimetric Analysis

Shimadzu UV-1601 UV-VIS spectrometer is used for transmission spectroscopy in the range from 190 nm to 1100 nm. There are two lamps used: a tungsten lamp that covers the region from 350 nm to 1100 nm, and a deuterium lamp that covers the region from 190 nm to 350 nm. The instrument can be used in a scanning spectrum mode, a kinetics mode, and a quantitative analysis mode. The instrument operating conditions are shown in Table 3

Sample Preparation and Analysis

Sample preparation techniques vary from parameter to parameter. The same was carrying out for blank also. Table 4 reveals the standard methods used for the sample preparation and analysis for the analysis of water for the specific tests performed.

RESULTS AND DISCUSSION

The results in Table 5 can be compared with the following Table 6 (Indian Standard – Drinking Water – Specification IS 10500 – 1991 (Reaffirmed 2009)). The water samples in all 5 locations have mild to high iron concentrations and mild to high acidity. The high acidity in some of the water samples is related to products of anaerobic decomposition of waste while the high iron concentration noticed in most samples. The sample collected very nearer to the dumpsite having very high conductivity, due to leaching of solid wastes. The W1, W2 and W3 samples show very high TDS as compared to Drinking Water specification. In case of W3, all the parameter values were very high which reveal that they are not suitable for portability. The fluoride and boron values are well within the limits. In W3, cadmium is just above the drinking water limit. Lead content in all the sites above the drinking water specification mentioned. Rest of the metals is well below the limits only.

CONCLUSION

The GBC Avanta PM and Schimadzu UV1601 have been successfully used for the determination of physico-chemical characteristics of water. On the basis of the above discussion, it may be concluded that the underground drinking water at almost all the collected sites at Pallavapuram landfills dumpsite area was highly polluted in comparison with the Drinking Water Standards⁸. In few sites, it was moderately polluted in the catchments study area. The drinking water is polluted with reference to almost all the water quality physicochemical parameters studied. Therefore, the use of such bore well water should be discouraged. People dependent on this water are often prone to health hazards due to polluted drinking water. Therefore, some effective measures are urgently required to enhance the drinking water quality.

Table-1: Instrument Operating conditions of GBC Avanta PM

S.No.	Parameter	Setting
1	Burner type	Air-Acetylene
2	Acetylene gas flow	2 L/min
3	Air flow	10 L/min
4	Uptake delay	3 seconds
5	Stabilization delay	3 seconds
6	Rinse time	3 seconds
7	Integration time	3 seconds
8	Replicates	3
9	Measurement mode	Concentration

Table-2: Standard methods used for the sample preparation and analysis for the analysis of water.

S.No	Specific tests performed	Standard method used	Wavelength used
1	Lead as Pb	IS 3025 Part 47 : 1994 (Reaff.2009)	217.0
2	Cadmium as Cd	IS 3025 Part 41 : 1992 (Reaff.2009)	228.8
3	Chromium as Cr	IS 3025 Part 52 : 2003 (Reaff.2009)	357.9
4	Zinc as Zn	IS 3025 Part 49 : 1994 (Reaff.2009)	213.9
5	Manganese as Mn	IS 3025 Part 59 : 2006 (Reaff.2009)	279.5
6	Nickel as Ni	IS 3025 Part 54 : 2003 (Reaff.2009)	232.0
7	Copper as Cu	IS 3025 Part 42 : 1992 (Reaff.2009)	324.7
8	Iron as Fe	IS 3025 Part 53 : 2003 (Reaff.2009)	248.3

Table-3: Instrument Operating conditions of Shimadzu UV-VIS 1601

S.No	Parameter	Setting
1	Wavelength range	190.0 to 1100.0nm
2	Spectral bandwidth	2nm
3	Photometric system	Double-beam optics
4	Light source	50W halogen lamp (2,000 hrs life) and deuterium lamp
5	Monochromator	Aberration corrected concave blazed holographic grating
6	Detector	Silicon photodiode
7	Method	Multipoint working curve
8	Number of cell	2
9	Recording range	0.0000 to 1.0000
10	Concentration	Unit & Range
11	Acquire mode	Quantitative

Table-4: Standard methods used for the sample preparation and analysis for the analysis of water.

S.No	Specific tests performed	Standard method used	Wavelength used (nm)
1	Fluoride as F	IS 3025 Part 60 : 2008	570
2	Boron as B	APHA 21 st Edition 4500 B/B	540
3	Sulphate as SO ₄	IS 3025 Part 24 - 1986 (Reaff. 2009)	420
4	Phosphate as PO ₄	IS 3025 Part 31 - 1988 (Reaff :2009)	690
5	Nitrate as NO ₃	IS 3025 Part 34 - 1988 (Reaff :2009)	220

Table-5: Results of Water from W1 to W5

Parameters	Ground Water				
	W1	W2	W3	W4	W5
Colour, Hazen units, Max	50 (True Colour)	100	150	< 5	< 5
Odour	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
Taste	Disagreeable	Disagreeable	Disagreeable	Agreeable	Agreeable
Turbidity, NTU, max	25.4	7.0	6.5	0.6	0.5
pH@ 25°C	5.48	7.35	4.18	7.12	8.60
Electrical Conductivity @ 25°C , μmhos/cm	3606	2958	16490	810	1084
Total alkalinity as CaCO ₃ ,mg/L	480	550	604	122	118
Total Hardness (as CaCO ₃) mg/L, max	2150	1350	2560	544	720
Calcium mg/L , max	341	261	461	112	96
Magnesium , mg/L, max	316	170	343	64	117
Chloride , mg/L, max	655	500	4474	136	160
Nitrate , mg/L, max	15.9	33.9	35.5	17.7	7.69
Sulphate , mg/L, max	204	128	611	66	25
Total Dissolved solids, mg/L	2724	2426	11050	588	760
Total Suspended solids, mg/L	16	8	6	< 1	< 1
Fluoride , mg/L	0.06	0.36	0.55	0.27	0.20
Boron, mg/L	0.13	0.28	1.28	0.026	0.026
Copper , mg/L	0.023	0.047	0.04	0.023	0.015
Manganese , mg/L	0.199	1.302	0.257	0.053	0.031
Lead , mg/L	0.361	0.318	0.296	0.253	0.239
Cadmium , mg/L	0.002	0.006	0.017	0.002	0.002
Chromium, mg/l	0.004	0.062	0.103	0.026	0.012
Nickel , mg/L	0.08	0.085	0.111	0.066	0.041

Phosphate , mg/L	5.74	1.81	12.2	0.75	0.98
Iron, mg/L	2.54	1.82	2.69	0.243	0.325
Zinc, mg/L	0.023	0.047	0.04	0.023	0.015

Table-6: (Indian Standard – Drinking Water – Specification IS 10500 – 1991 (Reaffirmed 2009).

Parameters	Requirement (Desirable Limit)	Permissible limit in the absence of alternative source	Undesirable effect outside the Desirable Limit
Colour, Hazen units, Max	5	25	Above 5, consumer acceptance decreases
Turbidity, NTU	5	10	Above 5, consumer acceptance decreases
pH value	6.5 to 8.5	No relaxation	--
Total alkalinity as CaCO ₃ ,mg/L	200	600	Beyond this limit taste becomes unpleasant
Total Hardness (as CaCO ₃) mg/L	300	600	Encrustation in water supply structure and adverse effects on domestic use
Calcium, mg/L	75	200	Encrustation in water supply structure and adverse effects on domestic use
Magnesium, mg/L	30	100	Encrustation in water supply structure and adverse effects on domestic use
Chloride , mg/L	250	1000	Beyond this Limit, test, corrosion and palatability are affected
Nitrate , mg/L	45	No relaxation	Beyond this methaemoglobinemia takes
Sulphate , mg/L	200	400	Beyond this causes gastro intestinal irritation when magnesium or sodium present
Total Dissolved solids, mg/L	500	2000	Beyond this palatability decreases and may cause gastro intestinal irritation
Copper , mg/L	0.05	1.5	Astringent taste, discoloration and corrosion of pipes, fitting and utensils will be caused beyond this
Manganese , mg/L	0.1	0.3	Beyond this limit taste/appearance are affected, has adverse effect on domestic uses and water supply
Lead , mg/L	0.05	No relaxation	Beyond this limit the water becomes toxic
Cadmium , mg/L	0.01	No relaxation	Beyond this limit the water becomes toxic
Chromium , mg/l	0.05	No relaxation	May be carcinogenic above this limit
Fluoride, mg/l	1.0	1.5	Fluorosis
Iron, mg/L	0.3	1.0	Taste and appearance are affected. It
Boron , mg/L	1	5	--
Zinc, mg/L	5	15	Beyond this limit it can cause astringent taste and opalescence in water.

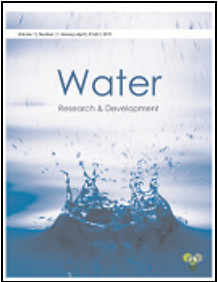
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