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INFLUENCE OF SOLID WASTE DUMPING ON THE GROUND WATER QUALITY CHARACTERISTICS IN MAYILADUTHURAI, TAMILNADU

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Abstract

Excessive population growth in developing countries nurture threat of environmental pollution in the human world and is still growing fast due to improper management. Indecorous solid waste management worsens public health and greatly impacts the quality of life of citizens. Absurdly managed dumping yards are prone to groundwater pollution because of leachate production. Influence of solid-waste disposal in groundwater pollution of Mayiladuthurai municipal administration was analysed. Average per-capita waste generation of the study area was estimated as 385gms/capita/day.Parameters like Total Dissolved Solids, Turbidity, Total Hardness, Calcium, Magnesium, Total Alkalinity, Chlorides, Sodium and Iron are deviating from the standards prescribed by CPCB in the study area during the study period.

Introduction

Per capita waste generation fueled by changing lifestyles ranges between 200 - 870 grams/day. India with a population of 1.21 billion (**1)**, accounting 18% of world's population is confronted with two conflicting scenarios with possibilities of advances in science and technology and a increasing population starved of resources and choked by pollution **(2)**.Proper municipal solid waste (MSW) disposal systems to discourse the escalating amount of wastes are inattentive in India. Improper solid waste management deteriorates public health, pollutes the environment, quickens natural resources degradation, causes climate change and significantly impacts the quality of life of citizens **(3).** Various management practices such as landfill, recycling, aerobic composting and vermin- composting are in practice, however open dumping is quite common in developing countries due to low budget for waste disposal, which in turn poses serious threat to groundwater **(4)**.Irrationally managed dumping yards are prone to groundwater pollution because of leachate production. The volume of leachate depends mainly on the area of the landfill, climatological and hydro-geological factors **(5)**. The volume of leachate produced is expected to be very high in tropical regions with high rainfall, or high run off and shallow water table. They in turn alter the soil properties and greatly modify the behaviour of soil and has a significant effect on the chemical properties as well as the geotechnical properties of the soil. The influence of leachate on groundwater and its physio-chemical parameter can be monitored

only if a thorough study of the area influenced by the leachate is carried out **(6).** The present study focuses in assessing the influence of solid-waste disposal in groundwater pollution of a municipal administration.

Study area

Mayiladuthurai situated at 11^0N latitude and 79^0 65' E Longitude is located in new Mayiladuthurai district. Governed under the municipal administration and is rated as grade I municipality from the year 1969 covering an extent of 11.27 km^2.Healthy climate prevails throughout the year and the annual mean maximum and mean minimum temperature are 39.4.C and 33.8.C respectively. Rich mineral deposits for commercial exploitation, high fertility alluvial soils are predominant along the river Cauvery and its distributary for wet crop cultivation.Based on the previous census, the city registered a growth rate of 9.40% against the urban population of Tanjore district. Figure 1 shows the location of Mayiladuthurai town.

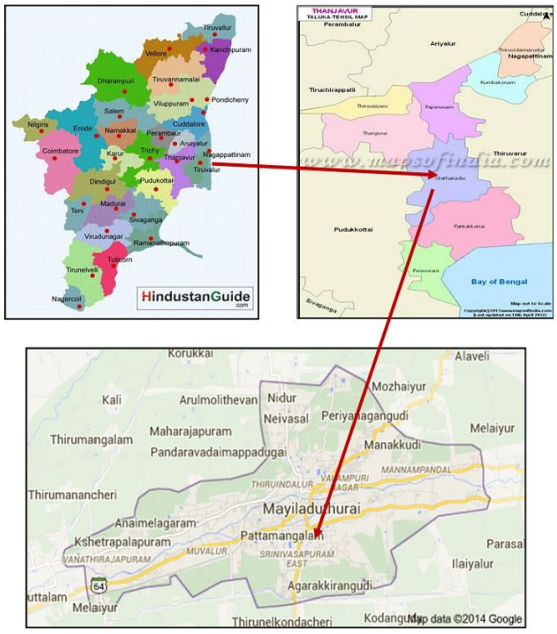

Figure 1 Location map of Mayiladuthurai town

Materials and methods

Quantification and characterization of solid waste

Waste from the community, commercial establishments and public places where been collected, sector wise and weighed for fifteen days and the average per-capita waste generation of the study area was estimated. Based on the type of activity from which it was produced such as households, shops and restaurants the composition of municipal solid waste such as physical characteristics and chemical characteristics were monitored.

Borewells Monitoring

To ascertain the ground water contamination due to leaching of wastes into the ground, open wells and underground borewells located in and around the solid-waste dumping yard, such as East Mathura street, North ATP road, South-Yadava street, West-Ambedkar-nagar and inside dumping yard were selected and monitored. All the open wells and the underground borewells situated in this area were considered for investigation and the average of the data has been presented.

Physio-Chemical Analysis of Groundwater

Water samples were collected from the borewells after pumping for 15 minutes. The water samples in all the borewells in the study area specified, were collected and tested for its physio-chemical parameters viz. EC, pH, TDS, Alkalinity, Bicarbonate, Total Hardness, Calcium, Magnesium, Iron, Chloride **(8)** etc in the Environmental Engineering laboratory, Department of Civil Engineering, Annamalai University.

Results and Discussion

Sector wise waste from the community had been collected for fifteen days and weighed, the average per-capita waste generation of the study area was estimated as 385gms/capita/day. To ascertain the characteristics of the solid waste, waste sample from different sectors of the study area were collected and analyzed. Based on the quality of lifestyle of the citizens in the study area, the properties of the solid waste generated would vary and in turn will impact the characteristics of the leachate formed in the dumping yard and finally the groundwater. Table 1 shows the composition of waste in the study area with highest proportion of biodegradables followed by plastic, silt, paper, clothes, rubber, metals and glass.

Table: - 1: Composition of waste collected from the study area

Biodegradables	Paper	Rubber	Plastic	Glass	Silt	Metals	Cloth
60%	5%	1%	15%	1%	13%	1%	4%

Based on the composition of waste generated and the lifestyle of the people in the study area, the physical and chemical composition of the solid waste generated, diverge and influence the characteristics of the leachate. The physical properties like bulk density, moisture content etc. and the chemical composition like carbon, nitrogen, sulphur etc. was estimated. Table 2 presents the characteristics of the waste in the study area observed at three different time during the study period.

Table: - 2: Properties of solid waste observed at study area

Parameter	Sample I	Sample II	Sample III
Bulk density (BD)	186	198	232
Moisture in %	27.57 %	27.88 %	28.63 %
pH	7.90	8.00	8.22
Loss of Ignition	16.59 %	19.85 %	9.85 %
Ash Content	8.99 %	8.56 %	6.54 %
Total Organic Carbon	15.49 %	13.54 %	12.87 %
Calcium (Ca)	1.26 %	1.52 %	0.65 %
Sodium (Na)	0.94 %	0.88 %	1.56 %
Potassium (K)	0.67 %	0.63 %	0.97 %
Sulphate (So_4)	1.22 %	1.26 %	1.26 %
Phosphate (Po_4)	0.25 %	0.38 %	0.38 %
Total Nitrogen (TN)	0.31 %	0.49 %	0.51 %

In order to know the effect of solid waste on ground water and soil strata due to leaching of organic and inorganic chemicals, the water samples in and around the dumping yard were drawn fortnightly for a period of three months to study the physio-chemical characteristics of the water in and around the compost yard/dumping yard at Anavathandapuram of Mayiladuthurai Municipality and the mean of the results were tabulated. Table 3 presents the physio -chemical characteristics of the groundwater observed in the study area.

Table 3 Physio -chemical characteristics of the groundwater observed in the study area.

S.No	Characteristics	Standard	East-Mathura Street	Inside Dump Yard (Bore well)	North-ATP Road	South-Yadav Street	West-Ambedkar Nagar
	Description of Sample		Slightly Yellowish, turbid liquid free from sediments	Yellowish, turbid liquid free from sediments	Yellowish, turbid liquid free from sediments	Colourless, Clear liquid free from sediments	Slightly Yellowish, turbid liquid free from sediments
1.	pH	6.50 to 8.50	7.07	7.02	7.26	7.16	7.12
2.	E C	-	1160 µs/cm	1490 µs/cm	5100 µs/cm	680 µs/cm	5800µs/cm
3.	T D S	500	**660 mg/l**	**850 mg/l**	**2900 mg/l**	**390 mg/l**	**3300 mg/l**
4.	Turbidity	5.0	**21 NTU**	**6 NTU**	**17 NTU**	0.8 NTU	4 NTU
5.	Total Hardness (as $CaCO_3$)	300	**1190 mg/l**	**1210 mg/l**	**1200 mg/l**	240 mg/l	**1240 mg/l**
6.	Calcium (as Ca)	75	**190 mg/l**	**220 mg/l**	**200 mg/l**	**110mg/l**	**220 mg/l**
7.	Magnesium (as Mg)	30	**240mg/l**	**237 mg/l**	**240 mg/l**	**31 mg/l**	**245 mg/l**
8.	Total Alkalinity (as HCO_3)	200	**562mg/l**	**730 mg/l**	**650 mg/l**	**310 mg/l**	**730 mg/l**
9.	Bicarbonate (HCO_3)	-	502mg/l	730 mg/l	650 mg/l	310 mg/l	730 mg/l
10.	Nitrate (as NO_3)	45	-	-	0.23 mg/l	-	-
12.	Nitrite (as NO_2)	-	0.6 mg/l	0.08 mg/l	2.13 mg/l	0.13 mg/l	0.5 mg/l
13.	Chlorides (as Cl)	250	119 mg/l	129 mg/l	**1300 mg/l**	79 mg/l	**1508 mg/l**
14.	Sulphate (as SO_4)	200	11 mg/l	10.6 mg/l	65 mg/l	11.4 mg/l	59 mg/l
15.	Sodium (as Na)	150	**576 mg/l**	**192 mg/l**	**488 mg/l**	60 mg/l	**556 mg/l**
16.	Potassium (as K)	-	1.2 mg/l	3.9 mg/l	5.7 mg/l	3.1 mg/l	1.7 mg/l
17.	Iron (as Fe)	0.30	**0.72 mg/l**	**1.8 mg/l**	**2.3 mg/l**	**0.31 mg/l**	**1.2 mg/l**
18.	Copper (as Cu)	0.05	<0.0015*	<0.0015*	<0.0015*	<0.0015*	0.8 mg/l
19.	Zinc (as Zn)	5.0	1.2 mg/l	1.5 mg/l	0.18 mg/l	1.21 mg/l	0.15 mg/l
20.	Lead (as Pb)	0.05	<0.003*	0.003mg/l	0.002 mg/l	<0.015*	0.032 mg/l
21.	Nickel (as Ni)	0.02	<0.006*	<0.006*	<0.006*	<0.006*	<0.006*
22.	Cadmium (Cd)	0.10	<0.0008*	<0.0008*	<0.0008*	<0.0008*	<0.0008*
23.	Chromium (Cr)	0.05	<0.01*	<0.01*	<0.01*	<0.01*	<0.01*
24.	Silicates (as SiO_2)	0.4 to 25	BDL	BDL	BDL	BDL	BDL
25.	COD	-	115 mg/l	192 mg/l	153 mg/l	76.8 mg/l	168 mg/l

The results of the analysis ascertain that the concentration of certain parameters are found to be well within the standards and certain other parameter excess over the limit prescribed. Particularly parameters like Total Dissolved Solids, Turbidity, Total Hardness, Calcium, Magnesium, Total Alkalinity, Chlorides, Sodium and Iron are deviating from the standards prescribed by CPCB in the study area.

Total Dissolved Solids is the measure which associates with the concentration of dissolved minerals and depend on the nature and number of ions. Higher the value of TDS would have high influence on the quality of ground water.

Bicarbonates, Carbonates, Sulphates and Chlorides of Calcium and Magnesium present in ground water would contribute significantly to Total Hardness. Total Hardness is a measure of the occurrence and abundance of divalent cations that is Ca2+ and Mg 2+. High hardness indicate the non potability of groundwater.

Total alkalinity in terms HCO3 in water is mainly associated with Ca and Mg.

Chloride present naturally in groundwater or may originate from diverse sources such as weathering, leaching of sedimentary rocks, sea water intrusion etc., Excessive amount of Chloride will impart salinity to groundwater.

Calcium dissolve readily from carbonate rocks and lime stones or may be through leaching of soils from industrial and municipal discharges. Calcium is of nutritional value to the human beings and it helps in maintaining the structure of plant cells and soils. Excessive calcium is directly related to hardness.

Sodium compounds are soluble in water and remain in aqueous solution. Higher concentration of sodium may cause heart problem. Higher concentration of sodium ion when used for irrigation purposes may cause salinity problems. Excessive amount of sodium ion in groundwater affects the palatability in general.

Magnesium is another mineral which is directly responsible to hardness also found abundant in groundwater. It’s deficiency may lead to protein malnutrition.

Transition metals like Iron are essential but harmful at high concentrations.

Conclusions

The dumping yard at Anavathandapuram of Mayiladuthurai Municipality was found prone to the ground water contamination through leaching action. The concentration of various physio-chemical parameters such as Total Dissolved Solids, Turbidity, Total Hardness, Calcium, Magnesium, Total Alkalinity, Chlorides, Sodium and Iron were recorded higher at the study area. Despite the fact that the concentration of several other parameters in ground water is within permissible limits yet it is important and is thought provoking as the ground water should have been free from any kind of contamination. Even though most of the Physio-chemical parameters were within the permissible limits, some of them are above the maximum allowable limits of WHO guidelines. Hence, there is a need of integrated municipal solid waste management to prevent groundwater contamination by regular monitoring of the ground water in and adjoining areas of landfill dumping site is required. The study discloses that the quality of ground water in the neighbourhood of the yard at Anavathandapuram of Mayiladuthurai municipality is deterioting due to dumping of the solid waste.

References

1. Municipal Solid Waste (Management and Handling) Rules,(2000), MNES, Govt of India, New Delhi.
2. Kaparaju P, et.al (2007), 'Effect of mixing on methane production during Thermophilic anaerobic digestion of manure: Lab-scale and pilot-scale studies', Bioresource Technology 99 (2008) pp 4919-4928.
3. Dhussa A. K and Tiwari R.C (2000), Article on Waste-to-energy in India.http://www.undp.org.in/programme/GEF/march00/page 12-14.
4. Kashyap. D.R, Dadhich. K. S, Sharma. S. K (2003), 'Biomethanation under psychrophilic conditions', Bioresource Technology 87 (2003) pp 147 - 153.
5. Bhattacharyya J.K., Kumar S., Devotta S., (2008), 'Studies on acidification in two-phase biomethanation process of municipal solid waste', Waste Management 28 (1), 164-169. Bioresource Technology 77 (2000) pp 612-623.
6. Kumar D., Khare M., AlappatB.J.(2001), 'Leachate generation from municipal landfills in New Delhi, India'.27th WEDC Conference on People and Systems for Water, Sanitation and Health, Lusaka, Zambia.
7. NEERI Report (2005), 'Assessment of Status of Municipal Solid Waste Management in Metro Cities, State Capitals, Class I Cities and Class II Towns'.
8. APHA–AWWA., 2005. Standard methods for water and wastewater. 20th ed. American Public Health Assoc/American Water Works Assoc. Washington DC, USA.