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Landfill Impact on Ground Water

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Abstract: Hyderabad is a major Indian city with a population of more than six million and the extent of solid waste generated from the city is estimated to be 2000 to 2500 tonnes per day. The solid wastes generated in Hyderabad metropolitan areas are majorly disposed off as landfill in low-lying areas. There has been a serious concern about the contamination of ground water when the wastes are, thus, disposed. For the present study two landfill sites – Autonagar and Golkonda—were selected. The impact of municipal solid waste disposal on groundwater characteristics was investigated by obtaining groundwater samples from both sites. The groundwater samples at both the landfill sites were polluted and are unfit for human consumption and domestic use but could be used for irrigation purpose. Overall analyses indicate increasing risk for sustainability of groundwater resources.

Key words: Domestic solid waste, landfill, leachate, groundwater pollution.

Introduction

The problem of municipal waste management, principally is a result of unplanned development, rural-urban migration and natural increase within the city. Yet this remarkable growth rate has not been matched by improvement in the quality of the urban environment. Instead, the demographic expansion and increased industrial and commercial activities have caused an astronomical increase in the volume and diversity of solid wastes generated in Hyderabad (Aluko, 2001).

Hyderabad is a major Indian city with a population of more than six million and the extent of solid waste generated from the city is estimated to be 2000 to 2500 tonnes per day. The solid waste generated in and around Hyderabad city municipal corporation area is transferred to the dumping sites which are mostly low lying areas where slums are in inhabitation which adversely affects the surroundings, more particularly groundwater contamination. Leachates have been implicated worldwide in environmental pollution, developmental anomalies, birth defects, surface and groundwater pollution (Muyeed, 2007).

Solid waste management has been a very serious problem in urban centres. Wastes taken to a dumpsite for disposal yield leachates which cause serious problems through contaminating the land and water resources nearby. Leachates from municipal and many industrial landfills contain a wide variety of chemical contaminants that can impair the use of ground water for domestic water supply. This may be hazardous to the ecosystem and public health since metals are cumulative toxicants that pose danger to organisms near the top of the food chain. It could also lead to bioaccumulation and bioconcentration of these metals in the food chain. Developing countries like India have not been able to address these problems due to high cost involved (CWPR, 2003).

The main objective of the preset study is to evaluate the impact of domestic solid waste disposal in Hyderabad Municipal Corporation area by landfills, which is polluting the ground water. Collecting and analyzing the groundwater samples from various distances of the landfills have evaluated the contamination level of ground water.

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Material and Method

Disposal of municipal solid wastes by landfill is the most widely practiced method in several Indian cities including Hyderabad. For the present study two landfill sites were selected. The details of the landfill sites are given in Table 1.

Table 1: Details of municipal solid waste landfill sites

Location of landfill sites	*Area (ha)*	*Landfill age (years)*	*Amount of garbage received/day*
Autonagar (AN)	20	15 yrs	800 (MT/day)
Golkonda (G)	10	20 yrs	340 (MT/day)

Collection of Water Samples

Groundwater samples were collected from different distances from the fringe of landfill sites for this study. Sampling bottles were cleaned with 10% nitric acid followed by distilled water to avoid any accidental contamination. Samples were collected in 1.5 litre pet bottles from selected sampling sites and were sealed tightly and labelled properly. The groundwater samples were collected according to standard methods and analysed for physical and chemical parameters (APHA, 1998).

Results and Discussion

The present study indicated the quality of ground water due to disposal of municipal solid waste landfill at Hyderabad as given in Table 2. All samples were colourless and odourless and were slightly alkaline in nature with their pH ranging 7.5-7.8 at AN and 7.1-7.5 at G sites. The hardness in the groundwater samples ranged 605-1320 and 610-1110 mg/l in AN and G sites. The concentration of hardness was above the prescribed limit of 300 ppm in all samples collected from the two landfill sites. Hard water is high in dissolved minerals, both calcium and magnesium. As water moves through soil and rock, it dissolves small amounts of these naturally-occurring minerals and carries them into the groundwater supply. Water is a great solvent for calcium and magnesium; so if the minerals are present in the soil around well, and its water supply, it can end up with hard water (EPA, 1996).

The alkalinity values of groundwater samples ranged from 700 to 875 and 806 to 980 mg/l in AN and G sites, respectively and chlorides values of groundwater samples ranged 232-449 and 284-355 mg/l in AN and G sites, respectively which is much above the prescribed standards (NEERI, 1990).

The TDS values of groundwater sample ranged 900-1787 at AN and 705-1500 mg/l at G sites. TDS concentration in groundwater samples is decreased with the increase in the distance from the landfill sites. The TDS values at AN and G sites are higher may be possessing more depth in inturn huge quantity of solid waste might have dumped. The observed TDS values for groundwater samples collected at AN and G sites are exceeding the permissible limits of ICMR. The suspended solids values indicated the presence of organic and

Table 2: Physico-chemical analysis of groundwater samples

Parameter	*AN1*	*AN2*	*AN3*	*AN4*	*AN5*	*G1*	*G2*	*G3*	*G4*	*G5*
Colour (Hz)	Less	Less	Less	Less	Less	Less	Less	Less	Less	Less
Odour	Less	Less	Less	Less	Less	Less	Less	Less	Less	Less
pH	7.8	7.6	7.7	7.5	7.7	7.1	7.1	7.1	7.2	7.5
EC (Micromohs)	1186	1163	1233	920	790	1210	1098	536	500	498
Hardness (mg/l)	1320	1000	1010	800	605	1110	980	623	612	610
Alkalinity (mg/l)	800	875	710	712	700	980	973	899	875	806
Chlorides (mg/l)	449	349	239	239	232	350	355	345	305	284
TDS (mg/l)	1787	1300	1400	1050	900	1500	1205	755	705	755
Nitrates (mg/l)	21	24	32	33	25	31	43	41	39	38
COD (mg/l)	13	7	6.7	5	5	6.7	7.8	6.7	6.9	6.9
Fe (mg/l)	0.58	0.52	0.94	0.52	0.47	1.32	0.89	0.77	0.22	0.15
Zn (mg/l)	0.24	0.44	0.64	0.48	1.05	0.47	BDL	1.32	0.38	0.34
Mn (mg/l)	0.5	0.93	BDL	BDL	0.19	0.49	BDL	BDL	BDL	BDL
Cr (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Pb (mg/l)	0.44	0.27	0.17	BDL	BDL	0.24	0.12	BDL	BDL	BDL
Cu (mg/l)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

inorganic solids that can provide adsorptive sites for certain chemicals and biological agents (Esakku et al., 2006).

Nitrates are under control at AN and G sites. High concentration of nitrates are potent toxins that cause a wide range of health problems, including 'blue-baby syndrome' (Arzu et al., 2007). The COD of AN site is ranging from 15 to 17 and G 16 to 17 mg/l. The highest COD values were obtained in nearest groundwater sampling locations at both sites indicating contamination of groundwater with relatively oxidizable organic matter. The COD values decreased in the groundwater samples as the distance from the solid waste dumping sites increased. The leachate generated at MSW dumping sites might have percolated through the soil and combined with ground water (Loizidon & Kapetanios, 1993).

In the present study the Fe content of the groundwater sample ranged 0.47-0.94 at AN and 0.15-1.32 mg/l at G site. Fe concentration is beyond the limit of 0.3 mg/l as prescribed by ISI and ICMR for drinking water. The high concentration of Fe in the residual form may be due to the conversion of amorphous iron oxides into more stable crystalline iron oxides. Iron overload or hemochromatosis symptoms vary which include: chronic fatigue, arthritis, heart disease, cirrhosis, cancer, diabetes, thyroid disease, impotence and sterility (Jahid & Aktarul, 2006).

The Mn ranged from BDL to 0.93 at AN and BDL to 0.49 mg/l at G sites, respectively. The Pb values ranged from BDL and 0.44 at AN and BDL to 0.24 mg/l at G sites. Moderate to low levels of exposure may result in hearing loss, inhibit growth, and cause learning disabilities. There may be no signs of lead poisoning or the signs could mimic flu or other gastrointestinal disease. The symptoms include: cramps, irritability, fatigue, vomiting, constipation, sleep disorder, poor appetite, and trouble sleeping. Unlike other contaminants, lead will accumulate within the body over time, i.e., bioaccumulate (Varsha & Mane, 2005). The remaining heavy metals like Zn, Cr and Cu values are BDL at all sites.

The above investigation revealed that water quality parameters like hardness, alkalinity, TDS, Fe, Mn and Pb are beyond the permissible limits and found that the pollution of ground water is more at nearby landfill sites compared to distanced ones because as the moisture percolates through the landfill, it leaches (solubilizes) contaminants from the solid wastes and transports them to the ground water in the vicinity of the landfill. For those landfills which are located with relatively impermeable strata below the landfill as well as those that are constructed above normal grade for the area of the landfill, the leachate may appear on the surface of the ground as it seeps to the surface of the soil. These seeps can lead to surface and groundwater contamination by contaminants leached from the solid wastes (Peng & Zhichao, 2005) or as nonfermentable materials in typical MSW contain readily leachable components. Because of those components, leachate developed has a significant potential to pollute groundwater hydraulically connected to the landfill area (Anne & Fred, 2000).

Despite the best attempts at waste avoidance, reduction, reuse and recovery (recycling, composting and energy recovery), landfill and waste disposal sites are still the principal focus for ultimate disposal of residual wastes and incineration residues world-wide (Vrijheid, 2000).

Conclusions

From the present study it is concluded that total dissolved solids, hardness and iron values of groundwater samples in the downstream area of dumpsites are higher, indicating contamination of ground water due to leachate from the municipal solid waste landfill dumpsites. It is observed from this study that all the groundwater samples are contaminated and are not suitable for drinking purpose. This effect may persist for longer time. If necessary precautions are not taken, while dumping municipal solid waste on the low-lying areas, consequences can be very serious in terms of damage to the natural resources (water, soil). Hence prevention of groundwater pollution due to any cause plays significant role. Proper management of municipal solid waste disposal system is suggested to reduce the contamination of ground water.

A major concern with groundwater pollution is the fact that it may persist underground for years, decades or even centuries. This is in marked contrast to surface water pollution. Reclaiming polluted groundwater is therefore much more difficult, time consuming and expensive compared to remediation of polluted surface water.

Recommendation

Further dumping of garbage must be stopped at the earliest possible. The authorities should look for an alternative site immediately. The alternate site should be selected for secured landfill, and the dumpsite should be designed, maintained and operated in a scientific manner.

Municipal solid waste (sanitary) landfills represent significant causes of groundwater pollution. The "new generation", state-of-the-art, lined "dry tomb" landfills being constructed today can, at best, only postpone pollution.

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