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CHARACTERIZATION AND DETERMINATION OF LPI OF LANDFILL LEACHATE COLLECTED FROM NAGARAM DUMPSITE OF NIZAMABAD CITY, TELANGANA STATE, INDIA

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ABSTRACT

In this paper, Physical and chemical characteristics of landfill leachate collected from Nagaram dumpsite in Nizamabad city were studied. The landfill of Nizamabad city is an open dumpsite without any bottom liner system and any leachate collection system. Hence the landfill leachate generated finds the path in the surrounding environment. The results of this study suggest the urgent need for monitoring the landfill leachate and treatment procedures at the dump site. For the characterization of landfill leachate, samples were collected during wet and dry seasons of the annual cycle. To estimate the pollution potential of leachate samples LPI values were determined. LPI is one of the tools to identify the level of pollution.Analysis of leachate samples are carried out as per standard methods.

KEY WORDS : Landfill, Leachate, Solid waste, Contamination and leachate pollution index.

INTRODUCTION

To understand the quality of groundwater, it is important to evaluate the characteristics of landfill leachate. Every landfill is unique depending on waste disposing there, environmental setting and its design and development (Chain *et al.,* 1976). Physicochemical characteristics of landfill leachate represent the level of risk to groundwater and soil quality in turn to the environment and public health. One of the extreme sources of environmental pollution is landfilling i.e., indiscriminately disposing the solid waste at an open low lying land area (landfill. Land filling is a potential threat to the public living around the landfill.

MATERIALS AND METHODS

Study area

The landfill of the study area is located in a Nagaram village in Nizamabad City. The dumping site is spread over 55 acres. Solid waste dumped at the site mainly includes Domestic, Municipal, Industrial, Agriculture, Hospitals, Construction and Demolition waste, further it also includes waste from adjacent vegetable markets, other non-veg markets, and slaughterhouses. Nagaram is the village were the people of different levels of income groups are living and some industries,temples and hospitals are there.

A view of Nagaram Dumpsite

Sampling and analysis of landfill leachate

Landfill leachate varied significantly with space, time, design and development of dumpsite

(Bohdziewicz *et al.*, 2008). Samples were collected and analyzed in the dry season and wet season of the annual cycle. Since the landfill site was not equipped with a leachate collection system the leachate samples were collected at the base of the landfill randomly from 5 different locations further that were mixed before sending for analysis. After the sampling, the samples were immediately transferred to lab Stored at 4 °C. The analysis was started without delay based on the priority to analyze parameters, as prescribed by the standard methods APHA (1994) The physicochemical parameters examined includes pH, electrical conductivity (EC), total dissolved solids (TDS), total dissolved volatile solids (TDVS), fixed dissolved solids (FDS), chemical oxygen demand (COD), biochemical oxygen demand (BOD), sodium (Na^+), potassium (K^+), ammonia (NH^{+4}), nitrate (NO_3^{-}). EC and pH were recorded using a Systronics conductivity meter, mode 306 and µ pH system 361(Systronics) respectively (Baun *et al.*, 2000; Alloway *et al.*, 1997). TDVS and FDS were estimated by using the oven-drying method. The estimation of COD was done by reflux titrimetry, while BOD was calculated by oxygen determination by Winkler titration. Na^+ and K^+ by flame photometry (Systronic-128), while NH^{+4}, NO_3^- were determined by using Perkin-Elmer UV/VIS Lambda 2 spectrophotometer. The concentrations of chromium (Cr), copper (Cu), nickel (Ni) and lead (Pb) were determined by using an atomic absorption spectrophotometer (AAS) (Singh *et al.*, 2015; Singh *et al.*, 2015).

All the experiments were carried out in triplicate and the results were found reproducible within ± 3% error. The data were statistically analyzed by setting up and calculating a correlation matrix for the various parameters using the Statistical Package for Social Sciences (SPSS) software package.

RESULTS

Landfill leachate samples were collected at the dumpsite of Nagaram. The sampling was done for complete two seasons of the annual cycle, i.e. dry season January to May and wet season June to December.

Leachate Pollution Index

LPI values indicate the contamination potential due to leachate produced from the landfill sites in the particular areas and act as an important tool for

Table 1. Characteristics of Landfill leachate in dry and wet seasons

Parameters	Nagaram S1 (dry)	S2 (wet)	Standards at SW Disposal
Temp (°C)	28.9	18.7	-
pH	4.26	4.94	5.5-9.0
TDS	27458	27469	2100
BOD	18547	20478	100
COD	23580	20569	300
$NH_4 – N$	1958	2134	50
EC	22351	24781	1000
TH	1685	1988	250
TA	5698	5974	-
Total Fe	58.97	51.42	-
Cd	0.054	0.047	3.0
Cr	0.29	0.23	3.0
Zn	2.36	1.92	5.0
Pb	1.57	1.44	0.1
Cu	0.71	0.69	-
Ni	0.19	0.25	-
Cl^-	2147	2596	600
F^-	659	526	-
Na^+	489	587	-
K^+	1243	1345	-
Ca^{+2}	824	823	-
Mg^{+2}	214	263	-
SO_4^{2-}	428	517	-
NO_3^-	289	241	-
NO_2^-	69	52	-
Phenols	0.041	0.035	-
Silicon (Si)	210	184	-

identifying and measuring the hazards caused due to percolation of the leachate in soil strata as well in aquifers (Abu-Rukah *et al.*, 2001). The characteristics of leachate changes over time, the LPI value will also differ (Archana *et al.*, 2014). Hence, the LPI value would correspond to the leachate samples analyzed at a particular time for a specific landfill site. The LPI is calculated using the equation:

$$LPI = \Sigma^{n}_{i=1} W_i \times P_i$$

Where: LPI= the weighted additive leachate pollution index; n= number of leachate pollutant variables used in calculating LPI; W_i= the weight for the $_i$th pollutant variable; P_i= the sub-index value of the $_i$th leachate pollutant variable.

$$\Sigma^{n}_{i=1} W_i = 1$$

If the data for all the leachate pollutant variables is not available then LPI can be calculated using the following equation:

$$LPI = \Sigma^{n}_{i=1} W_i \times P_i / \Sigma W_i$$

Where: m= number of leachate pollutant

variables when data is available (m<18,Ó W_i<1)

These LPI values are much higher than the standard LPI value of the treated leachate disposal limit of 12.561 to disposable solid waste (3,5). Higher values (35.543) of LPI signify that leachate produced from dumping sites of Nagaram of Nizamabad is highly contaminated and proper treatment techniques must be ensured before discharging the leachate.

DISCUSSION

Physicochemical characteristics of leachate depend upon the waste composition and water content in total waste there in the dumpsite (Barjinder *et al.*, 2013). In the dry season a high concentration of nitrate was observed in the leachate samples. The high values of TDS in leachate samples indicate the presence of inorganic materials in the samples the high COD and BOD values indicate the high organic materials in the leachate samples (Agrawal *et al.*, 2011). The presence of nitrogen is probably due to the deamination of amino acids during the decomposition of organic material (Barjinder *et al.*, 2013; ASTM *et al.*, 2008). The presence of trace amounts of lèad indicates the disposal of lead batteries chemicals used for photograph processing lead-based Paints and pipes at the landfill site. LPI signifies the level of pollution concentration of a landfill (APHA *et al.*, 1995). The indexing method leads to computation of a single value which varies from 5 (best value) to 100 (worst value), which expresses the overall pollution potential due to leachate contamination in form of an increasing scale index wherein higher values indicate higher levels of pollution leading to environmental degradation

CONCLUSION

The present study revealed that the landfill leachate shows moderately high concentrations of EC, TDS, BOD, COD, Sodium, Potassium, Ammonium, Nitrate, Chromium, Copper, Nickel and Lead which deteriorates the nearby groundwater and soil quality of landfill sites. Hence it is suggested to design a liner system at the bottom of the landfill, leachate collection system to remove leachate from landfill and it is also recommended for the treatment measures to be adapted based on scientific principles including recycling methods. The findings of the study suggest that computation of leachate pollution potential and its variations with LPI can be used as a reliable evaluation

Table 2. LPI of the leachate from Nagaram dumping site

Parameter	Sampling conc.'s		Individual pollution rating (pi)		Weightage (wi)	Overall pollution rating (wi × pi)	
	S1	S2	S1	S2		S1	S2
pH	4.26	4.94	31	14	0.055	1.705	0.77
TDS	27458	27469	63	63	0.050	3.15	3.15
BOD	18547	20478	66	68	0.061	4.026	4.148
COD	23580	20569	83	81	0.062	5.146	5.022
$NH_3 – N$	1958	2134	100	100	0.053	5.3	5.3
TKN	-	-	-	-	-	-	-
Total Fe	58.97	51.42	6	5	0.045	0.27	0.225
Cr	0.29	0.23	5	5	0.064	0.32	0.32
Zn	2.36	1.92	6	6	0.056	0.336	0.336
Pb	1.57	1.44	10	9	0.063	0.63	0.567
Cu	0.71	0.69	6	6	0.05	0.3	0.3
Ni	0.19	0.25	6	6	0.052	0.312	0.312
Cl^-	2147	2596	16	19	0.048	0.768	0.912
Hg	-	-	-	-	-	-	-
As	-	-	-	-	-	-	-
Phenol	0.041	0.035	5	5	0.057	0.285	0.285
Cyanide	-	-	-	-	-	-	-
TC*	6.5×10^6	8.6×10^6	100	100	0.052	5.2	5.2
				Total value	0.768	27.748	26.847
				LPI		36.130	34.957
			LPI (Mean of two samplings)				35.543

method since they give similar trend as individual leachate quality parameters for seasonal and site specific variations. Results from this study, demonstrate the importance of evaluating LPI to assess the potential impact of a pollutant discharge on aquatic resources and demand for the proper management of solid waste in Nizamabad city.

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