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SEASONAL VARIATION IN CHARACTERISTICS OF LEACHATE AT AMINBAZAR LANDFILL

Kainat Rahnuma[1], Tanjima Afrin[2] and Major Dr. Kazi Shamima Akter[3]

[1,2]Graduate Student, Department of Environmental, Water Resources and Coastal Engineering, Military Institute of Science and Technology, Mirpur-1216, Dhaka, Bangladesh
[3]Associate Professor, Department of Environmental, Water Resources and Coastal Engineering, Military Institute of Science and Technology, Mirpur-1216, Dhaka, Bangladesh

ABSTRACT

The contaminants from landfill leachate have a harmful influence on the environment thus landfill leachate is a major concern for the surrounding communities. This paper discusses the effect of seasonal variations on the leachate characteristics generated from the Aminbazar landfill site. Seasonal changes were proven to have a significant impact on leachate composition. Leachate samples were collected in monsoon and post monsoon and analyzed for a total of 16 parameters (pH, TDS, TSS, EC, BOD_5, COD, and so on) to estimate their pollution potential. Leachate has been shown to have a high concentration of organic and inorganic components that go beyond permissible limits. Heavy metals concentration was very low. Investigation showed that with seasonal variations, especially during monsoon, values of various parameters were higher than post monsoon, the reason being with rainwater, the waste components percolated down. Comprehensive research into leachate management is urgently needed since leachate finds its way to the nearby water body.
Key Words: *leachate, landfill, seasonal variation, wastewater, municipal solid waste*

INTRODUCTION

Increased population, as well as economic activities due to industrialization, are the main reasons of soared generation of solid waste in our country. Waste generation determined by Dhaka North City Corporation is 0.575kg per capita per day in the year 2018-19 (Waste Management Report 2018-2019). The old approach of using landfills, which is an unsustainable way to manage trash, is still used on a global scale (Wiszniowski et al., 2006). The majority of landfills are uncontrolled open dumps where trash is dumped (Mangimbulude et al.,2009). Due to the lack of suitable management methods for the wastes and their leachate, there has been concern that the surrounding aquatic habitats, including both groundwater as well as surface water, such as rivers and coastal areas, are contaminated by these solid wastes (Sadek and El-Fadel 2000). Protecting the soil, groundwater, and surface waters from contamination caused by leachate percolation in and around the dumpsites is crucial. Planning and implementing proper steps, such as using suitable lining systems and leachate treatment, will benefit from the knowledge of the leachate quality. Variables such as waste composition, temperature, moisture content, climatic variations, etc. may cause leachate quality to fluctuate from time to time and site to site (Alkalay et al., 1998).

Every monsoon, rainwater overflows into the Amin Bazar landfill. Therefore, during the monsoon and post-monsoon, there is a possibility that this dump site would pollute surface water flowing to the adjacent communities (Kamal, Malmgren-Hansen, and Badruzzaman 2004). During monsoon, local people cultivate fish in the waterbody near the landfill site, thus proper treatment should be ensured. The seasonal change in leachate quality is a significant barrier to effective landfill leachate treatment (Mangimbulude 2009). This study was done to identify seasonal variations in leachate quality so that the authority might establish year-round appropriate management strategies.

MATERIALS AND METHODS

Site Studies

The Amin Bazar waste dumping site (23º47'48"N and 90º17'50"E), one of the main dumping sites for Dhaka city wastes, is situated within the low-lying floodplain of the River Karanachhali in Savar Upazilla under the district of Dhaka alongside Dhaka-Aricha highway. The area around the dumping site is

mainly used for fisheries in monsoon and post monsoon when the areas are inundated by rainwater and flood. The area is used as a dumping site since 2007. Leachate is directly disposed to the flood plain areas which are inundated in monsoon and post monsoon and have an impact on these water bodies.

Leachate Collection

To determine the characteristics of leachate, leachate is collected in a ditch through a drainage system and then sent for chemical treatment and other treatments. Raw leachate was collected from the ditch located at Aminbazar. The location of the leachate collection is shown in figure 1. The Samples were collected in monsoon (June, July, and August) and post monsoon (September, October, and November). The collected samples were promptly carried to the laboratory and stored in 4°C. Before testing, samples were removed from the refrigerator and placed at room temperature for about 2 hours for conditioning. Total 16 parameters: pH, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Electrical Conductivity (EC), Total phosphorus, Ammonia Nitrogen (NH_3-N), COD, BOD_5, Fe, Cl, Pb, Zn, Cr, As, Cu and Ni were analyzed by standard testing method (APHA 1998).

Figure 1 Aminbazar landfill site area. (Source: Google map)

Analytical Work

To evaluate the quality of the collected sample, important parameters were measured in the Environmental Engineering Laboratory of MIST. Methods or Instruments that were used to analyze the samples are given in table 1.

Table 1 Methods used for testing

SL No	Parameter	Unit	Methods
1	pH		pH meter digital
2	TDS	mg/l	Electronic conductivity meter
3	TSS	mg/l	UV-vis Laboratory & portable spectrophotometer
4	EC	ms/cm	Electronic conductivity meter
5	Total phosphorus	mg/l	UV-vis Laboratory & portable spectrophotometer
6	NH_3-N	mg/l	UV-vis Laboratory & portable spectrophotometer
7	COD	mg/l	Manual
8	BOD_5	mg/l	Manual
9	Zn	mg/l	UV-vis Laboratory & portable spectrophotometer
10	Pb	mg/l	Atomic Absorption spectrophotometer
11	Cr	mg/l	Atomic Absorption spectrophotometer
12	As	mg/l	Atomic Absorption spectrophotometer
13	DO	mg/l	DO meter

RESULTS AND DISCUSSION

Leachate samples have been found to have higher concentrations of organic and inorganic elements that are above the allowable limit. The observation from Table 1 shows that total suspended solids, total dissolved solids, total phosphorous, ammonia nitrogen, COD, BOD_5, and Cl exceeded the allowable discharge limit in both seasons. The value of COD is found 1556 mg/l and BOD_5 is found 610 mg/l in monsoon and the values are 2500 mg/l and 765 mg/l in post monsoon respectively. In the post monsoon period, there was a higher concentration (at least two times) of these organic parameters because small volume of concentrated leachate was produced due to evaporation. But during monsoon, rainfall caused a large volume of diluted leachate resulting in a lower concentration of organic

compounds.(El-Fadel et al, 2002). Water quality and aquatic life are both impacted when water is contaminated with a lot of organic materials because biological aerobic decomposition quickly consumes a lot of dissolved oxygen (Dara SS, 2007). One of the main pollutants in leachate is Ammonia Nitrogen because it can remain in the aquatic environment for years and threatens both land and aquatic animals (Yenigün and Demirel 2013). The value of NH_3-N is found 1428 mg/l in monsoon and 965 mg/l in post monsoon. The values exceed the standard discharge limit in both seasons. If not properly treated before release, this ammonia-nitrogen excess leachate might have a negative impact on the quality of water.

Most of the parameters show a value beyond the permissible discharge limit. Heavy metal concentrations were in trace amounts, the source of these heavy metals might be from different types of waste such as batteries, plastics, electronic waste, paints, rubber, and steel pipes being dumped without segregation (Waste Management Report 2018-2019). Heavy metal concentrations were found higher in monsoon than in post monsoon except for total chromium. Long-term exposure to heavy metals could help these heavy metals accumulate in fish (Rajeshkumar & Li, 2018). Additionally, it was found that those who lived close to the dump sites revealed elevated rates of disorders linked to increased exposure to these metal contaminants (Tchounwou et al. 2012)

Table 2 Characteristics of raw leachate during monsoon and post monsoon

SL No	Parameters	Unit	Average value (monsoon)	Average Value (post monsoon)	Inland surface water standard (ECR 1997)
1	pH		8.14	8.01	6 to 9
2	TDS	mg/l	7001	6410	≤2100
3	TSS	mg/l	357	195	≤150
4	EC	ms/cm	12.61	11.66	≤1200
5	Fe	ppm	3.2	1.3	≤2
6	Total phosphorus	mg/l	140	78.4	≤8
7	NH_3-N	mg/l	1428	965	≤50
8	COD	mg/l	1556	2500	≤200
9	BOD_5	mg/l	610	765	≤50
10	Cl	ppm	1375	1050	≤250
11	Copper	ppm	0.0039	0.0028	≤0.5
12	Zinc	ppm	1.69	1.65	≤5
13	Arsenic	ppm	0.1387	0.1391	≤0.2
14	Nickel	ppm	0.0042	0.0036	≤1
15	Total Chromium	ppm	0.0108	0.0138	≤0.5
16	Lead	ppm	0.0004	0.0001	≤.1

CONCLUSION

In order to properly assess the environmental impact of leachate during different seasons of the year, this study was undertaken to find the overall characteristics of leachate in monsoon and post monsoon. The higher concentration of organics in post monsoon than in monsoon recommends that different treatment strategies should be obtained for various meteorological conditions. Since the treated leachate is then discharged to the local water bodies, the treatment plant must employ appropriate techniques to produce the highest level of treated leachate.

REFERENCES

Alkalay, D. et al. 1998. 'Review: Anaerobic Treatment of Municipal Sanitary Landfill Leachates: The Problem of Refractory and Toxic Components'. *World Journal of Microbiology and Biotechnology* 14(3): 309–20.

APHA. 1998. 6 *Standard Methods for the Examination of Water and Wastewater*. American Public Health Association.

Dara SS. *A TEXTBOOK OF ENVIRONMENTAL CHEMISTRY AND POLLUTION CONTROL*. http://www.software602.com/.

ECR. 1997. *The Environment Conservation Rules*. Bangladesh Dep Environ Ministry For Gov People's Republic Bangladesh.

El-Fadel, M, E Bou-Zeid, W Chahine, and B Alayli. *Temporal Variation of Leachate Quality from Pre-Sorted and Baled Municipal Solid Waste with High Organic and Moisture Content*. www.elsevier.com/locate/wasman.

Kamal, Mir Mostafa, Anders Malmgren-Hansen, and A B M Badruzzaman. 2004. 'ASSESSMENT OF POLLUTION OF THE RIVER BURIGANGA , BANGLADESH , USING A WATER QUALITY MODEL Mir'.

Mangimbulude, J.C., Van Breukelen, B.M., Krave, A.S., Van Straalen, N.M., Roling, W.F.M. 2009. 'Seasonal Dynamics in Leachate Hydrochemistry and Natural Attenuation in Surface Run-off Water from a Tropical Landfill'. 29(829e838).

Rajeshkumar, Sivakumar, and Xiaoyu Li. 2018. 'Bioaccumulation of Heavy Metals in Fish Species from the Meiliang Bay, Taihu Lake, China'. *Toxicology Reports* 5: 288–95.

Sadek, S, and M El-Fadel. 2000. 29 J. Nat. Resour. Life Sci. Educ *The Normandy Landfill: A Case Study in Solid Waste Management*. http://www.JNRLSE.org.

Tchounwou, Paul B., Clement G. Yedjou, Anita K. Patlolla, and Dwayne J. Sutton. 2012. 'Heavy Metal Toxicity and the Environment'. *EXS* 101: 133–64.

'Waste Management Report 2018-2019'.

Wiszniowski, J. et al. 2006. 'Landfill Leachate Treatment Methods: A Review'. *Environmental Chemistry Letters* 4(1): 51–61.

Yenigün, Orhan, and Burak Demirel. 2013. 'Ammonia Inhibition in Anaerobic Digestion: A Review'. *Process Biochemistry* 48(5–6): 901–11.