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CHARACTERIZATION OF LEACHATE AT VARIOUS LANDFILL SITE OF DELHI, INDIA

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ABSTRACT

Leachate from a landfill varies widely in composition depending on the age of the landfill and the type of waste that it contains. It can usually contain both dissolved and suspended material. The present study deals with the concentration of various parameters of leachate collected from three almost saturated sanitary landfill sites at Bhalswa, Ghazipur and Okhla. it has been found that Bhalaswa landfill lechate have highest concentration of different parameters such as total dissolve solid, total solid and electrical conductivity i.e., 9636 mg/l, 10070 mg/l and 14632 mho/cm respectively. These results will be helpful in future for determination of impact on ground water due to percolation of leachate.

Keywords: Organic matter, Heavy metals, Lechate, Landfill

I. INTRODUCTION

Landfills are one of the major contamination threats groundwater resources not only in India but throughout the world [1]. Rapid industrialization and population explosion in India has led to the migration of people from villages to cities, which generate thousands of tons of Municipal Solid Waste (MSW) daily. Poor collection and inadequate transportation are responsible for accumulation of MSW at every nook and corner of Indian cities. During rainfall, the dumped solid wastes receivers' water and the by-products of its decomposition move into the water through the waste deposition [2]. The liquid containing innumerable organic and inorganic compounds is called "leachate". Leachate from open dumps finds its way into ground water. Moreover, the leachate production rate in practice is typically unstable, particularly during the initial stages of stabilization. The influence of leachate from each type of landfill depended on many factors, including the waste composition, leachate characteristics and precipitation. Leachate from a landfill varies widely in composition depending on the age of the landfill and the type of waste that it contains. It can usually contain both dissolved and suspended material [3]. The major potential environmental impacts related to landfill leachate are pollution of groundwater and surface water. The risk of groundwater the pollution is probably the most severe environmental impact from landfills because historically most landfills were built without engineered liners and leachate collection systems. More recently, regulations in many countries have required the installation of liners and leachate collection systems as well as a plan for leachate treatment) Reviewed the characteristics of leachate plumes down gradient of landfills. Researcher developed a technique to evaluate the leachate contamination potential of landfills on a comparative scale using an index known as Leachate Pollution Index (LPI) [4]. Hung [5] developed a model for

moisture movement and contaminant transport to predict quantity and quality of leachate from a fly ash landfill with different age refuses. Leachate is a liquid containing decomposed wastes, bacteria and other materials that drains out of the landfills [6]. It is a highly complex mixture of soluble, insoluble, organic, inorganic, ionic, non-ionic and bacteriological constituents in an aqueous medium. Because these constituents exist in an aqueous medium, the potential for migration to groundwater is very high [7]. The chemical composition of leachate depends on the nature and age of the landfill and the rate of leaching. Various analyses of leachate have all shown it to be a liquid with extremely high pollution capacity [8]. The type of leachate generated is strictly dependent on the waste involved. A typical composition of leachate is shown in Table 1.

Table 1: Composition of a Typical Leachate from a Sanitary Landfill

Components	Typical Value	Range
BOD_5	10,000	200 - 40,000
COD	30,000	300 – 90,000
Total Organic Carbon (TOC)	6,000	1,500 – 20,000
Total Suspended Solids (TSS)	500	200 – 1,000
Specific conductivity	6,000	3,000 – 9,000
Nitrate	25	5 - 40
Total Phosphorus	30	1 – 70
Alkalinity as $CaCO_3$	3,000	1,000 – 10,000
Total Hardness as $CaCO_3$	3,500	300 – 10,000
Calcium	1,000	200 – 3,000
Magnesium	250	50 – 1,500
Potassium	300	200 – 2,000
Sodium	500	200 – 2,000
Sulfate	300	100 – 1500
Chloride	2,000	100 – 3,000
Total iron	60	25 – 2,500
Zinc	50	25 - 250
Lead	2	0.2 - 10
PH	6.0	4.2 – 7.8

Source: Vesilind and Rimer, 1981

All value in mg/l except PH without unit and specific conductivity in MHO/cm.

The present study deals with the concentration of various elements in the leachate samples collected from three almost saturated sanitary landfill sites at Bhalswa, Ghazipur and Okhla. The generation of leachate from landfills is a well documented phenomenon and the real issue with respect to containment of waste material will move through clay lair over a given period.

II. MATERIAL AND METHOD

For treatment and processing of MSW, there are three compost plants two in Okhla operated by MCD and NDMC and one in Bhalswa operated by a private developer (M/s Excel Industries Limited). MCD set up a

mechanical compost plant at Okhla with a capacity of 150 tons per day in the year 1980. However, its operation had to be discontinued in the absence of a market in the neighbouring areas and also due to high operational cost of the plant. Further to this, MCD also set up another compost plant at Bhalswa landfill site with a capacity of 500 tons per day as a joint venture with a private developer.

2.1 Study Area

Delhi is located in northern India between the latitudes of 28^{o}-24'-17" and 28^{o}-53'-00" North and longitudes of 76^{o}-50'-24" and 77^{o}-20'-37" East. In general, the climate in Delhi is extreme. The population density in Delhi is around 9,294 persons/km^2 as per census of India 2001. It generates 6,000 metric tonnes of solid waste every day which is likely to increase to 18,000 metric tonnes per year by 2021. The generation rate is about 500 gm per person per day, which is almost 5 times the national average. The main waste generated in Delhi is from the markets for agricultural products, retail and commercial markets, hospital and nursing homes, slaughterhouses, industries and construction and demolition activities. Solid waste management in Delhi is mainly based on the disposal of the waste through the three operational landfills located at Bhalaswa, Okhla, and Gazipur. For conversion of biodegradable components of solid waste, the MCD has set up anaerobic, semi-mechanical compost plant near Okhla in 1980, and manual method of composting is practiced at Bhalaswa. All of these sites fall under the category of uncontrolled solid waste disposal facility. The below mention table shows detail of existing landfill sites used for characterization of leachate.

2.2 Details of the Existing Landfill Sites

Name	Location	Area (hectares)	Starting year	Initial amount of MSW T/day	MSW received T/day	End of landfill life
Bhalswa	North Delhi	26.22	1993	1200	3200	2005
Gazipur	East Delhi	29.62	1984	800	2100	2008
Okhla	South Delhi	22.89	1994	400	1200	2005

Fig. 1 Map of Delhi and Location of Landfill Site

After sampling of leachate, the samples were immediately transferred to the lab and were store at 4 ^{o}C temperature in Environmental lab in Jamia Millia Islamia. The analysis was started without delay in lab based on the priority to analyze parameters as per standard procedure. All the samples were analyzed for selected relevant physico-chemical parameters, heavy metals and total coliform (TC) and faecal coliform (FC) according to internationally accepted procedures and standard methods (APHA, 1994). Samples for TC and FC were aseptically taken from the wells and their estimation was done by membrane filtration technique. The chemical composition of leachate depends on many factors, such as initial composition of MSW, the degree of compaction, the hydrology of site, the climate and the finally the age of landfill. Following leachate characteristics are to be assessed for the samples of leachate collected from landfill sites:

pH Value, EC	Amm-N	Magnesium
TDS	Nitrate	VFA
VDS	Nitrite	DOC
TS	Chloride	Copper
VS	Sulphate	Chromium
FS	Phosphate	Cadmimum
COD	Sodium	Lead
BOD	Potassium	Nickel
TKN	Calcium	Zinc

These parameters were measured to assess the variations in the leachate quality. The samples were taken in the month of October, 2014.

III. RESULT AND DISCUSSION

The analysis on various parameters of leachate on the three landfill sites viz Gazipur, Okhla and Bhalswa are presented in the form of bar charts from figure 1 to figure 4 and table 3. The analysis was done on various parameters indicated in tables and samples were collected were analyzed in Jamia Millia Islamia lab.

Table 3. Parameters of Landfill Sites

S.No.	Parameters	GAZIPUR	OKHLA	BHALSWA
1	Cobalt (Co)	ND	ND	ND
2	Lead (Pb)	ND	ND	0.56
3	Nickel (Ni)	0.25	0.31	0.45
4	Zinc (Zn)	0.4	0.56	1.35
5	Chromium (Cr)	0.4	0.75	1.84
6	Cadmium (Cd)	ND	ND	ND
7	Copper (Cu)	0.6	0.54	0.95
8	pH	7.6	7.9	8.1
9	Iron (Fe)	7.5	10.2	41.6
10	Phosphate (P)	11.5	25.2	23.5
11	Organic Nitrogen (N)	18.4	26.5	25.5

12	Ammonical Nitrogen (NH3-N)	25.9	29.5	34.6
13	Magnesium (Mg)	37.8	46.4	37
14	Potassium (K)	40.2	59	39.16
15	Total Kjeldal Nitrogen (N)	46.2	53.3	46.1
16	Sulphate (SO4 Values as 1/10)	20.3	24.2	26.1
17	Chloride (Cl Values as 1/10)	38.4	56.8	49.1
18	Bichemical Oxygen Demand (3,27)	2757	2825	3300
19	Volatile Solids	3080	3225	3385
20	Chemical Oxygen Demand	4400	4560	5840
21	Total Dissolved Solids	9636	11135	11284
22	Total Solids	10070	11354	15900
23	Electrical Conductivity (at 25 Deg. C umho/cm)	14632	16153	31800

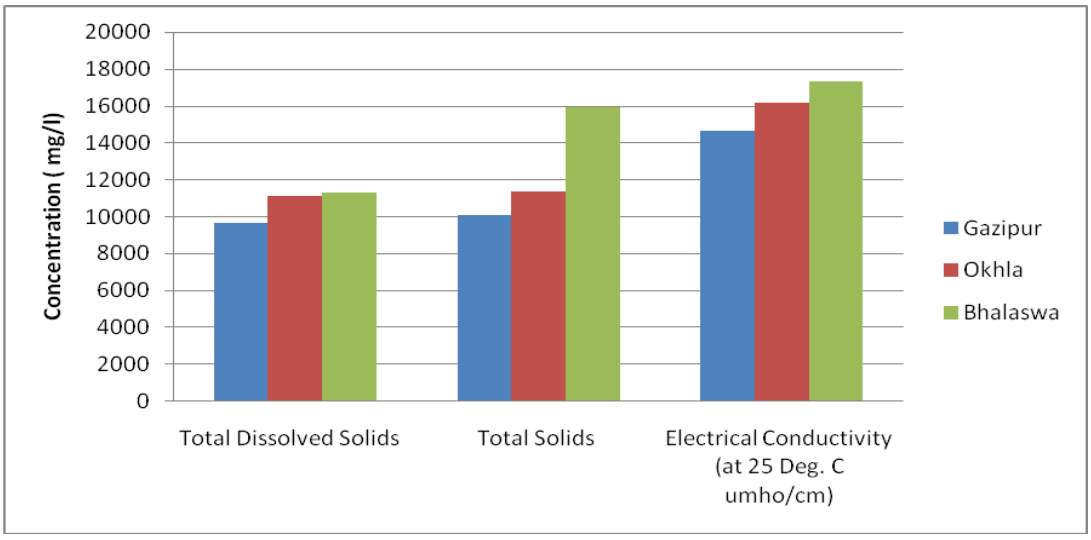

Fig.2. Characterization of Solids at All Three Landfill Site

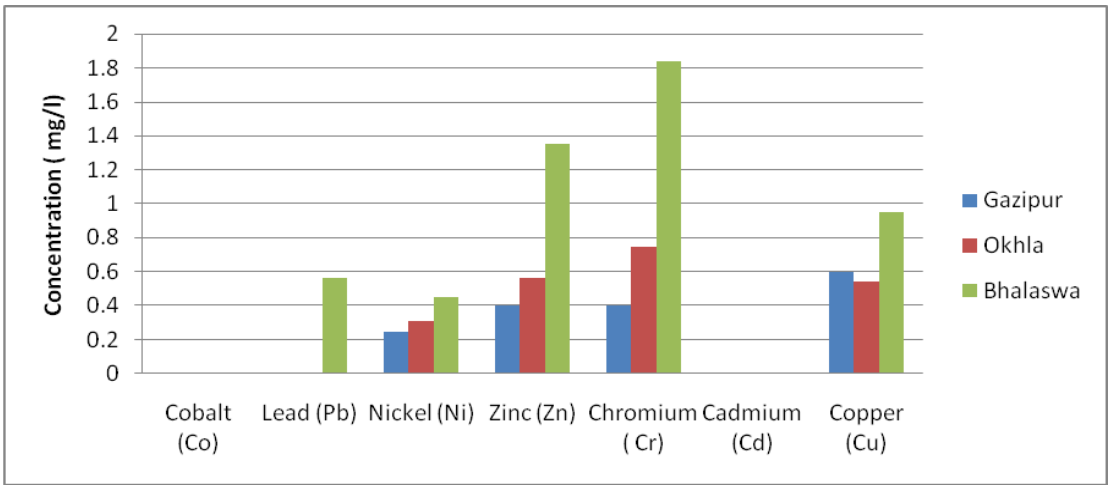

Fig.3. Variation of Heavy Metals at All Landfill Site

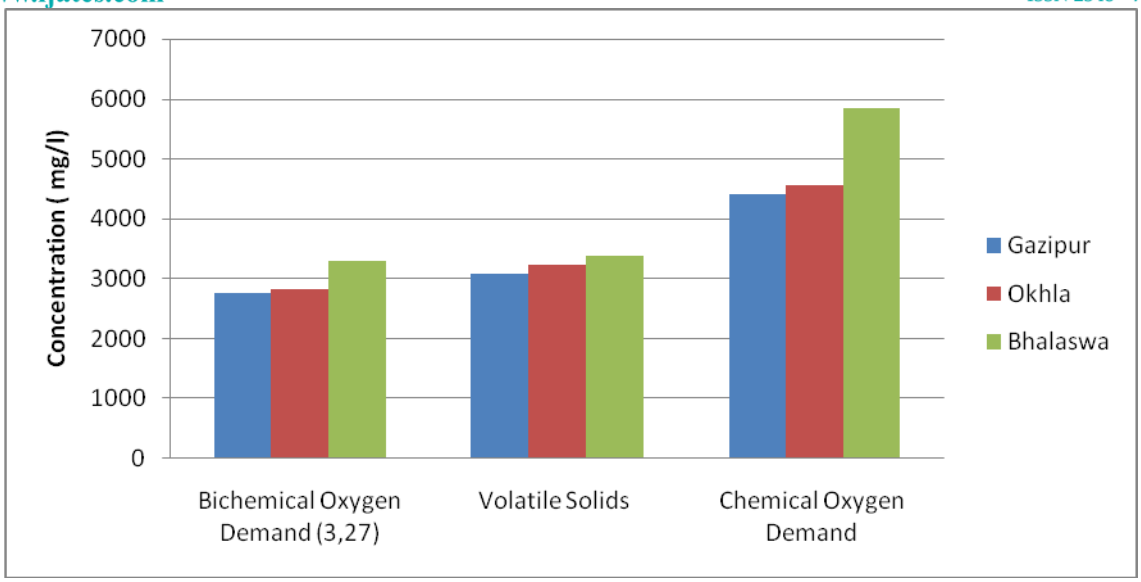

Fig. 4. Variation of Organic Matter

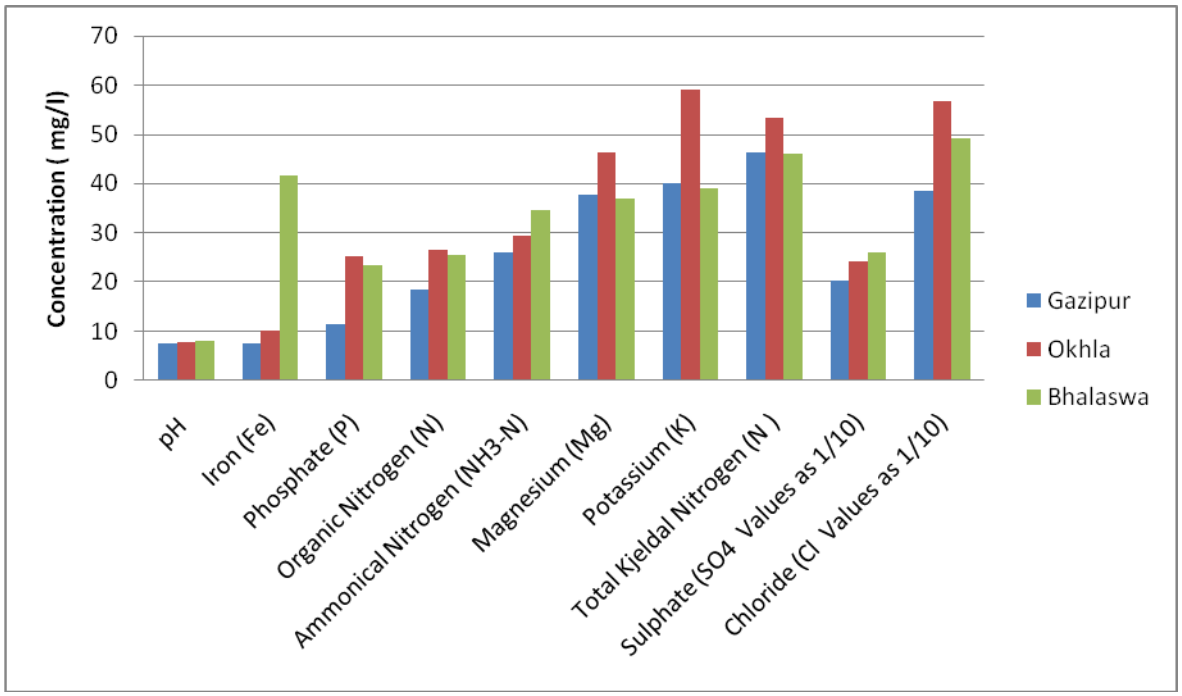

Fig.5. Variation of Salts, Acidity and Base

From the above result it has been found that Bhalaswa landfill lechate have highest concentration of different parameters such as total dissolve solid, total solid and electrical conductivity i.e., 9636 mg/l, 10070 mg/l and 14632 mho/cm respectively. Similarly concentration of heavy metals also quite high for Bhalswa landfill after that Okhla then Gazipur. BOD and COD of the Bhalswa landfill site is also quite high and its range between 3300 mg/l to 5840 mg/l, other landfill site have comparatively lesser BOD and COD contain. Some parameters have higher concentration in OKhla landfill site such as phosphate, organic nitrogen, magnesium, potassium in comparison to Gazipur and Bhalaswa landfill site.

IV. CONCLUSION

In this paper, lechate sampling has been done in the month of October for three landfill site of Delhi i.e., Gazipur, Bhalaswa, and Okhla and it has been found that the concentration of maximum parameters is higher in case of bhalaswa landfill site then Okhla and Gazipur. Some parameters are higher for Okhla landfill site such as phosphate, organic nitrogen, magnesium, potassium. These parameters will be quit use full for the analysis of ground water parameter and their effect on ground water.

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