Characterization of Leachate from Municipal Solid Waste (MSW) Landfilling Sites of Kalaburagi, Karnataka, India

Dr. Shashikanth R Mise[1] Veerannagoud[2]
[1]Professor [2]PG Student
[1]Department of Civil Engineering [2]Department of Environmental Engineering
[1,2]P.D.A College of Engineering Kalaburgi-585102

Abstract— The paper discusses the characteristics of leachate generated from municipal solid waste landfilling sites of Udnoor village, Kalaburagi district (Karnataka). Leachate samples were collected and analysed for various physico-chemical parameters to estimate its pollution potential. This study aims to serve as a reference for the implementation of the most suitable technique for reducing the negative environmental effects of discharge leachate. the landfilling sites of Udnoor village are engineered low lying open dumps. They have bottom liner and leachate collection system. Therefore, it has been found that leachate contains high concentrations of organic and inorganic constituents beyond the permissible limits. While, heavy metals concentration was in trace amount as the waste is domestic in nature. The data presented in this study indicated that the age of the landfill has a significant effect on leachate composition. the biodegradable fraction of organic pollutants in the leachate decreases as an outcome of the anaerobic decomposition occurring in the landfill.

Key words: Landfilling, Leachate, Organic and inorganic constituents, groundwater Contamination

I. INTRODUCTION

With the rapid industrialization and population growth, the status of our environment is degrading day by day. As the limits of urbanization are extending to far flying areas in India, the problem of solid waste management is causing a great concern to our environment. MSW generation, in terms of kg/capita/day, has shown a positive correlation with economic development at world scale. Due to rapid industrial growth and migration of people from villages to cities, the urban population is increasing rapidly. Waste generation has been observed to increase annually in proportion to the rise in population and urbanization. The per capita generation of MSW has also increased tremendously with improved life style and social status of the populations in urban canters [1]. As more land is needed for the ultimate disposal of these solid wastes, issues related to disposal have become highly challenging [2]. Seeing the scenario of increase in generation, improper utilization and disposal of waste in the country, the Ministry of Environment and Forest (MOEF) has Municipal Solid Waste (Management and Handling) Rules, 2000[3], which states that Municipal Solid Waste (MSW) is commercial and residential wastes generated in a municipal or notified areas in either solid or semi-solid form, excluding industrial hazardous wastes but including treated biomedical wastes. These solid wastes are generally disposed off in a low lying area called sanitary landfill area by the municipal authorities. These rules have specified many compliance for the management of solid waste for the State Committee and Pollution Board, which includes proper segregation of solid waste into biodegradable waste, recyclable and others i.e., non-recyclable wastes are stored in coloured bins at the source of generation and properly treated, recycled and disposed to landfill areas.

The quantity of municipal solid waste in developing countries has been consistently rising over the years [4]. Today more than 45 million tonnes/year of solid waste is generated from the urban centres of India which are collected inefficiently, transported inadequately and disposed unscientifically [5]. The generation is expected to rise to 125 million tonnes/ year by the year 2025 [6]. According to Ministry of Urban Affairs, Govt. of India estimate, India is generating approximately 100,000 metric tonnes of solid waste everyday of which 90 % is dumped in the open place [7]. In Delhi, the capital of India alone, more than 6,800 tonnes of MSW is generated every day and is expected to rise to 12,750 tonnes per day by 2020 [8]. The MSW generated per day in India's other major cities are Mumbai- 6,500 tonnes, Kolkata-3,670 tonnes, Chennai-4,500 tonnes, Bangalore-3,700 tonnes, Hyderabad-4,200 tonnes, Lucknow-1,200 tonnes and Ahmedabad- 2,300 tonnes [7].

II. MATERIALS AND METHODS

A. *Study Area:*

Gulbarga is an historical city located in north east of Karnataka. It is the administrative capital of Gulbarga District and is located at a distance of 613 km from state's capital Bangalore. It is the headquarters of the Gulbarga district. The city is located at 17□ 22' N and 76□ 47' E. Gulbarga was earlier known as 'Kalburgi', which means stony land in Kannada. Gulbarga was formerly in the Hyderabad state of Nizam and became a part of Karnataka State after re-organization of states. Recorded history of this district dates back to the 6th Century A.D. The district was ruled by various dynasties of kings. In 1948 Hyderabad state became a part of Indian Union and in 1956. Gulbarga is known for its historical monuments built during bahumani kings, religious places and is more importantly as a commercial hub for the Hyderabad Karnataka region. Gulbarga is primarily a regional market and service center for the district and also a education center and is home to the Jnana Ganga University and other education centers including Medical, Engineering, pharmacy, Dental, Law, Nursing and other Colleges. Gulbarga is served by a major rail line connecting Bangalore to Mumbai and New Delhi and has a national highway. The nearest airport is in Hyderabad. The city is at a distance 212 KM from Hyderabad, 360 KM from Hubli and 606 KM from Mumbai. The city is well connected by road and train to its neighbouring districts

B. *Sampling:*

To determine the quality of leachate, integrated samples was collected from landfill locations. Leachate sample for the

study was collected from the landfilling sites of Gulbarga city as shown in figure 3.2 i.e. first landfilling site is on ring Road at Udnoor Village having 28 acres of low lying land area. These sites are engineered low lying open dumps. They have bottom liner for leachate collection system. These landfilling sites were equipped with leachate collectors. Leachate samples were collected from the base of solid waste heaps where the leachate was drained out by gravity. Leachate samples were collected in October end 2015 to July 2016 at monthly once as fresh samples from the landfilling sites located 13 km from Gulbarga city. Various physico-chemical parameters like pH, Total Solids (TS) Suspended Solids (TSS), Total Dissolved Solids (TDS), Hardness, Biological Oxygen Demand (BOD3), Chemical Oxygen Demand (COD), Chloride (Cl^-), Nitrate (NO_3^-), Total Phosphorus (TP), Sulphate (SO_4-) and heavy metals like Iron (Fe), Lead (Pb), Copper (Cu), Nickel (Ni) were analysed by standard water and wastewater methods as shown below in table 4.

III. RESULTS AND DISCUSSION:

A. Characteristics of Leachate at Udnoor Site Kalaburagi:

Leachate samples collected from Udnoor site in KALABURAGI and they are analyzed for the Following parameters and the results of the leachate sample are tabulated in the table and the diagram showing the variation of different parameters are represented in Table 5.

1) pH (Hydrogen Ion Concentration):

The determination of the pH facilitates the broad and quick evaluation of the acidic/alkaline nature of leachate. The pH in study area ranges from 6.3 to 7.3 the mean value is 6.7 and the standard deviation value is 0.305 coefficient of variation value is 0.045.

2) Total Solids:

Total solids values of leachate samples of the landfilling sites were varies 16640mg/l to 8490mg/l the avg value of TS is 12062.3mg/l and standard deviation value is 2419.92 Coefficient of variation is 0.2006

3) Suspended solids:

Suspended solids values of leachate samples of the landfilling sites were varies 4290mg/l to 1990mg/l the avg value of TS is 2876.2mg/l and standard deviation value is 816.52 Coefficient of variation is 0.2838

4) Total Dissolved Solids:

The total dissolved solids of leachate samples of the landfilling sites varies from a minimum value of 6050mg/L and maximum values of 13003mg/L. The mean value is 9185.2mg/L and the standard deviation is 2056.48. And the coefficient of variation value is 0.2238

5) Total Hardness:

The total hardness of leachate samples of the landfilling sites varies from a minimum value of 2936 mg/L and the maximum value of 4048 mg/L, the mean value being 3599 mg/L and the standard deviation is 325.11 And the coefficient of variation value is 0.0903

6) Chloride:

The Chloride concentration of leachate samples of the landfilling sites varying from a minimum value of 1613mg\L to a maximum value of 3018 mg\L, the mean value is 2430.5 mg\L and the and the standard deviation value is 411.06 And the coefficient of variation value is 0.016.

7) Chemical oxygen demand:

The COD values of leachate samples of the landfilling sites varies from a minimum value of 16248 mg/L and the maximum value of 25100 mg/L, the mean value being 21024 mg/L and the standard deviation is 3173.9 And the coefficient of variation value is 0.0164 the

8) Biochemical oxygen demand:

The BOD values for 3 days of leachate samples of the landfilling sites varies from a minimum value of 9748 mg/L and the maximum value of 16566 mg/L, the mean value being 13306 mg/L and the standard deviation is 2353.2 And the coefficient of variation value is 0.1768

9) Nitrate:

The Nitrate concentration of leachate samples of the landfilling sites varying from a minimum value of 14.2 mg\L to a maximum value of 19.4 mg\L, the mean value is 16.32 mg\L and the and the standard deviation value is 1.66 And the coefficient of variation value is 0.1019

10) Sulphate:

The Sulphate concentration of leachate samples of the landfilling sites varying from a minimum value of 31.01 mg\L to a maximum value of 42.1 mg\L, the mean value is 35.48mg\L and the standard deviation value is 3.243 And the coefficient of variation value is 0.094

11) Phosphate:

The Phosphate values of leachate samples of the landfilling sites were varies 42.02 mg/L to 56.9 mg/L the avg value is 48.66 mg/L and standard deviation value is 4.678 Coefficient of variation is 0.096

12) Iron:

The Iron concentration of leachate samples of the landfilling sites varying from a minimum value of 4.82 mg\L to a maximum value of 8.16 mg\L, the mean value is 6.36 mg\L and the and the standard deviation value is 4.678 And the coefficient of variation value is 0.096

13) Lead:

The Lead concentration of leachate samples of the landfilling sites varying from a minimum value of 0.08 mg\L to a maximum value of 0.24 mg\L, the mean value is 0.166 mg\L and the and the standard deviation value is 0.05 And the coefficient of variation value is 0.33

14) Copper:

The Copper values of leachate samples of the landfilling sites were varies 0.04 mg/L to 0.11 mg/L the avg value is 0.075 mg/L and standard deviation value is 0.022 Coefficient of variation is 0.303

15) Nickel:

The Nickel concentration of leachate samples of the landfilling sites varying from a minimum value of 0.21 mg\L to a maximum value of 0.84 mg\L, the mean value is 0.539 mg\L and the and the standard deviation value is 0.18 And the coefficient of variation value is 0.351

Parameters	PH	TS	SS	TDS	TH	CL	COD	BOD_3	NO_3	SO_4	PO4	Fe	Pb	Cu	Ni
1	6.7	9430	1990	7440	3498	1613	21640	12090	16.9	34.8	48.4	5.83	0.23	0.1	0.49
2	6.6	8490	2240	6250	2936	2107	19400	12610	15.3	33.4	45.7	5.17	0.21	0.08	0.39
3	6.3	10330	2390	7940	3320	2394	16300	11084	15.2	32.9	44.8	4.93	0.08	0.05	0.34
4	6.4	11940	4290	7650	3530	2140	16248	9748	14.2	31.01	42.02	4.82	0.11	0.04	0.21
5	6.5	11400	3060	8331	3460	2418	17600	11616	14.8	35.28	49.21	5.91	0.21	0.06	0.57
6	6.6	12030	2018	10012	3660	2626	19270	12718	16.1	35.4	48.4	6.87	0.12	0.09	0.54
7	6.7	13248	2248	11000	3770	2440	22140	14612	15.48	34.91	44.82	7.64	0.16	0.06	0.67
8	6.8	12390	3140	9250	3848	2630	23850	15741	17.62	36.2	51.53	7.08	0.13	0.07	0.61
9	7.1	14725	3749	10976	3920	2919	24660	16275	18.21	39.8	54.82	7.24	0.17	0.09	0.73
10	7.3	16640	3637	13003	4048	3018	25100	16566	19.4	42.1	56.9	8.16	0.24	0.11	0.84
sum	67	120623	28762	91852	35990	24305	206208	133060	163.21	355.8	486.6	63.65	1.66	0.75	5.39
Max	7.3	16640	4290	13003	4048	3018	25100	16566	19.4	42.1	56.9	8.16	0.24	0.11	0.84
Min	6.3	8490	1990	6250	2936	1613	16248	9748	14.2	31.01	42.02	4.82	0.08	0.04	0.21

Table 5: Characteristics of Leachate from Udnoor Site

IV. CONCLUSIONS

[1] The concentration of heavy metals is high in leachate sample and the leachate contains more contaminants than domestic waste water and thus needs efficient treatment process before disposal.

[2] Leachate samples of landfilling sites were collected and analyzed for various physico-chemical parameters to estimate its pollution potential. It has been concluded that leachate samples contain high concentration of organic and inorganic constituents beyond the permissible limits.

[3] The age of the landfill has a significant effect on leachate composition. In older landfills, the biodegradable fraction of organic pollutants in the leachate decreases as an outcome of the anaerobic decomposition occurring in the landfill. The concentration of leachate contaminants at Udnoor site were comparative greater. Based on the characterization of landfill leachate, Udnoor village of landfilling site demonstrated low biodegradability.

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