Characterization of Leachate from Municipal Solid Waste (MSW) Landfilling Sites of Kuberpur, Agra

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Abstract

The present paper describes the characteristics of leachate generated from municipal solid waste landfilling sites of Kuberpur, Agra. The main objective of this study was to collected and analysed for various physic-chemical parameters to estimate its pollution potential. This paper provides a reliable and robust database to serve as a reference for the implementation of the most suitable technique for reducing the negative environmental effects of discharge leachate at Kuberpur site. 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.

Keywords- Landfilling, Leachate, Organic and Inorganic Constituents, Groundwater Contamination

I. INTRODUCTION

India currently is facing a municipal solid waste dilemma, for which all elements of the society are responsible. The community sensitization and public awareness is low. There is no system of segregation of organic, inorganic and recyclable wastes at household level. There is an adequate legal framework existing in the country to address municipal solid waste management (MSWM). What is lacking is its implementation.

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. 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.

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 every day of which 90 % is dumped in the open place [7]. 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, Lucknow1,200 tonnes and Ahmedabad- 2,300 tonnes [7].

II. MATERIALS AND METHODS

A. Study Area

The city of Agra is situated on the western bank of river Yamuna on National Highway (N.H- 2) at about 200 Km from Delhi in the state of Uttar Pradesh. Agra is geographically located at 27°12' N latitude and 78°12' E longitude. It has a strategic location, being at the confluence of three distinct geo-physical regions namely the plains of Uttar Pradesh, the plateau of Madhya Pradesh and the desert of Rajasthan. The administrative jurisdiction of the Agra Nagar Nigam includes an area of 141.0 sq. km with a population density of about 9,043 persons per sq. km as per 2001 census. The city is divided into 80 wards for administrative purposes. The population of Agra city is 12.75 lakhs as per Census 2001 with a decadal growth rate of 30.37 per cent and the

population projections for the year 2021 is 22.69 lakhs. Total MSW generation is 650(MT/day). The physical characteristics of MSW are 46.38% biodegradables and 15.79% recyclables. The chemical characteristics are 21.56% C/N ratio, 520 Kcal/kg high calorific value and 28% moisture.

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 Kuberpur Site. Leachate samples were collected in January end 2015 to October 2016 at monthly once as fresh samples from the Kuberpur landfilling site, Agra 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 (NO3−), Total Phosphorus (TP), Sulphate (SO4-) and heavy metals like Iron (Fe), Lead (Pb), Copper (Cu), Nickel (Ni) were analysed by standard water and wastewater methods.

III. RESULTS AND DISCUSSION

Characteristics of Leachate samples collected from Kuberpus site, Agra and they are analyzed for the Following parameters and the results of the leachate sample are below.

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 6.2 to 7.4 the average value of p.H. is 6.78
2) Total Solids: Total solids values of leachate samples of the land filling sites were varies 17260 mg/l to 9237 mg/l the average value of TS is 13750.9 mg/l
3) Suspended solids: Suspended solids values of leachate samples of the land filling sites were varies 4426 mg/l to 2078 mg/l the average value of TS is 3220 mg/l
4) Total Dissolved Solids: The total dissolved solids of leachate samples of the land filling sites varies from a minimum value of 7283 mg/L and maximum values of 13987 mg/L. The average value is 10727.6 mg/L
5) Total Hardness: The total hardness of leachate samples of the landfilling sites varies from a minimum value of 3107 mg/L and the maximum value of 4336 mg/L, the average value is 3764 mg/L
6) Chloride: The Chloride concentration of leachate samples of the land filling sites varying from a minimum value of 1621mg\L to a maximum value of 3162 mg\L, the average value is 2429.9 mg\L
7) Chemical oxygen demand: The COD values of leachate samples of the land filling sites varies from a minimum value of 16890 mg/L and the maximum value of 25780 mg/L, the average value is 21033.4 mg/L
8) Biochemical oxygen demand: The BOD values for 3 days of leachate samples of the land filling sites varies from a minimum value of 9722 mg/L and the maximum value of 16212 mg/L, the average value is 13026.8 mg/L
9) Nitrate: The Nitrate concentration of leachate samples of the landfilling sites varying from a minimum value of 15.1 mg\L to a maximum value of 19.9 mg\L, the average value is 17.21 mg\L
10) Sulphate: The Sulphate concentration of leachate samples of the landfilling sites varying from a minimum value of 31.09 mg\L to a maximum value of 42.3 mg\L, the aveage value is 37.36 mg\L
11) Phosphate: The Phosphate values of leachate samples of the landfilling sites were varies 42.09 mg/L to 57.1 mg/L the average value is 48.28 mg/L
12) Iron: The Iron concentration of leachate samples of the landfilling sites varying from a minimum value of 4.86 mg\L to a maximum value of 8.95 mg\L, the average value is 6.97 mg\L
13) Lead: The Lead concentration of leachate samples of the landfilling sites varying from a minimum value of 0.09 mg\L to a maximum value of 0.27 mg\L, the average value is 0.169 mg\L
14) Copper: The Copper values of leachate samples of the landfilling sites were varies 0.13 mg/L to 0.05 mg/L the average value is .102 mg/L
15) Nickel: The Nickel concentration of leachate samples of the landfilling sites varying from a minimum value of 0.27 mg\L to a maximum value of 0.89 mg\L, the average value is 0.574 mg\L

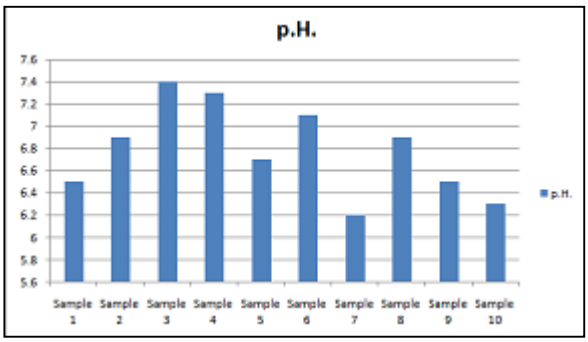

Fig. 1: Variation of pH

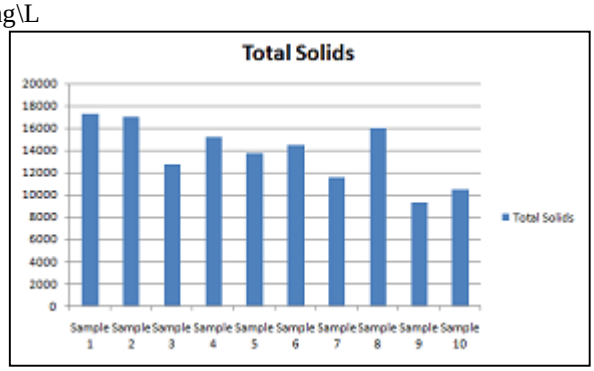

Fig. 2: Variation of Total Solids

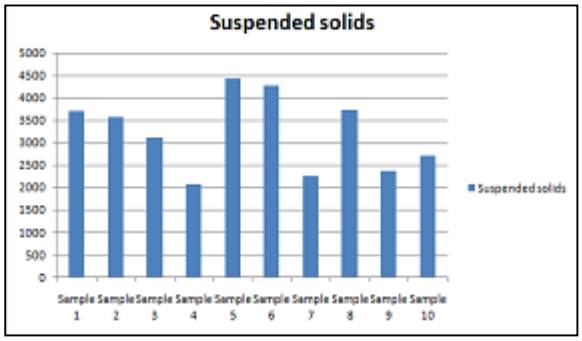

Fig. 3: Variation of Suspended Solids

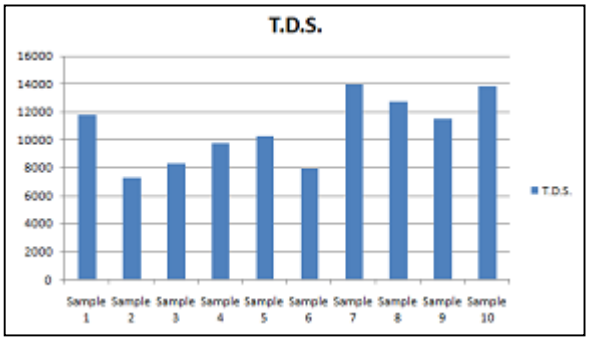

Fig. 4: Variation of T.D.S.

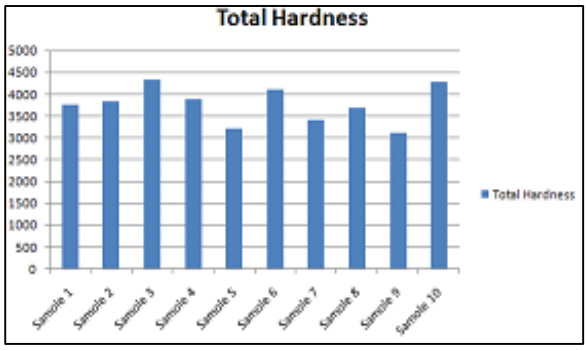

Fig. 5: Variation of Total Hardness

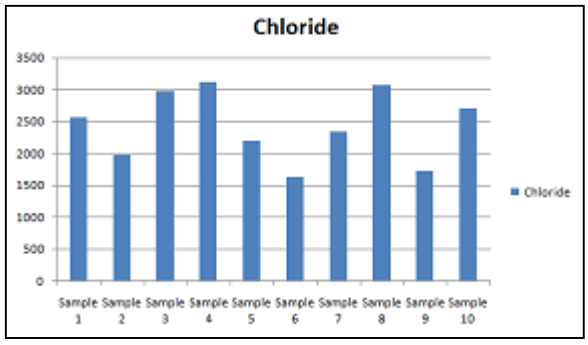

Fig. 6: Variation of Chloride

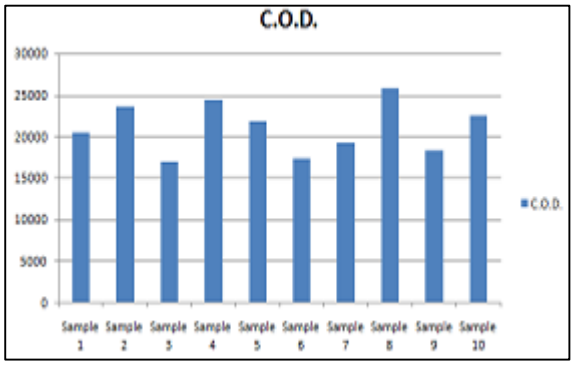

Fig. 7: Variation of C.O.D.

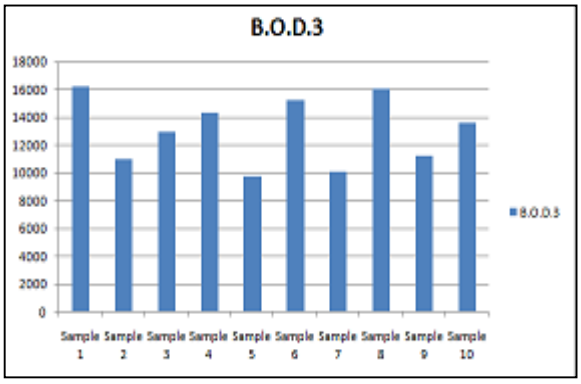

Fig. 8: Variation of B.O.D.

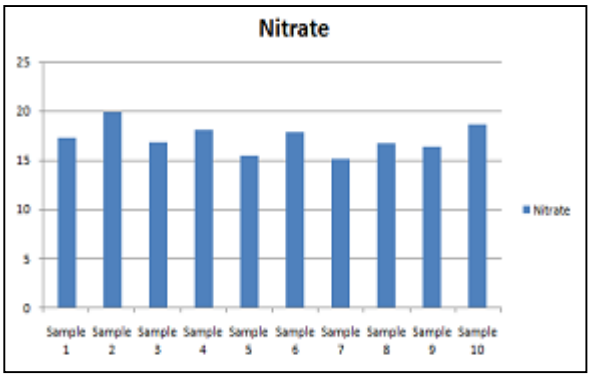

Fig 9: Variation of Nitrate

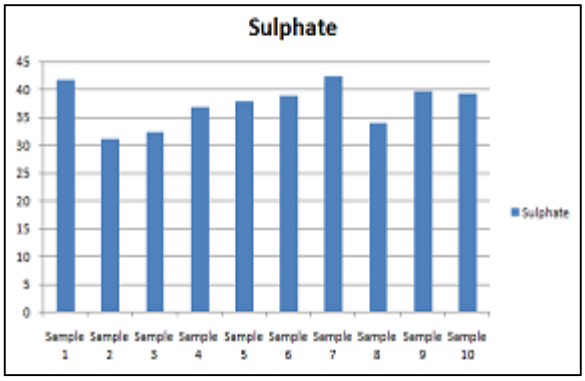

Fig 10: Variation of Sulphate

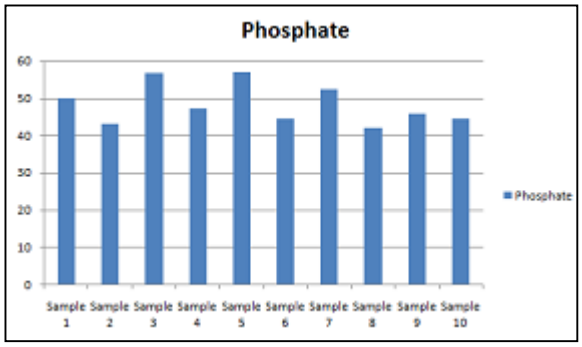

Fig. 11: Variation of Phosphate

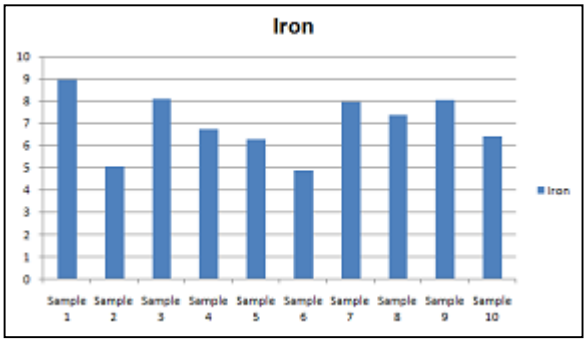

Fig. 12: Variation of Iron

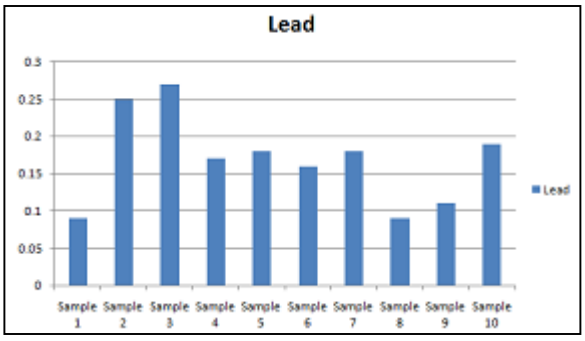

Fig. 13: Variation of Lead

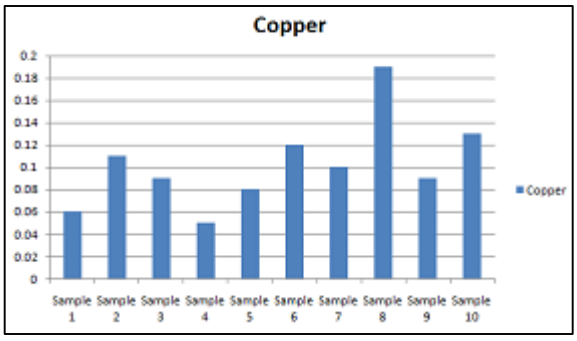

Fig. 14: Variation of Copper

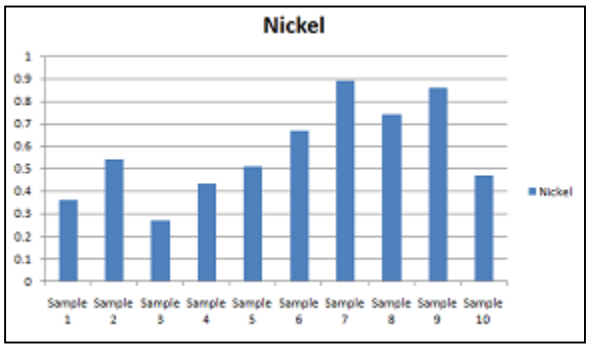

Fig. 15: Variation of Nickel

IV. CONCLUSIONS

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.

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

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.

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