

## **CHARACTERISTICS OF THE LEACHATE FROM MSW LANDFILL, BANGALORE**

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**ABSTRACT:** Bangalore city generates about 4,500 metric tons of municipal solid waste every day in that 75% is disposed in the landfill. The landfill leachate discharge may lead to serious environmental problems. Leachate may percolate through landfill liners and subsoil causing pollution of ground water and surface waters resources. The aim of this research study is to identify the characteristics of the leachate from landfill in Mavallipura. Landfill leachate contains various pollutants that can be categorized into four groups such as dissolved organic matter, inorganic macrocomponents, heavy metals, and organic compounds. The pH of the leachate is considered as alkaline as the pH is 7.6 in Mavallipura landfill leachate. The results showed that the highest metal concentration that exists in the leachate was Iron which is about of 12 ppm. BOD<sub>3</sub> and COD of the leachate are 1500 mg/L and 10400 mg/L, respectively. The leachate characteristics indicate favourable growth of algae in natural water contaminated with leachate with the alkaline condition and with the presence of magnesium as nutrient, which has been confirmed in the nearby surface pond.

**Key word:** Bangalore, BOD, Characteristics, COD, Leachate, Magnesium.

### **INTRODUCTION**

At present, deposition of municipal and industrial wastes in landfills is considered as the most wide spread and safe method for waste disposal solid wastes. But the scarcity of the available landfill sites and the large amount of generated leachate from these sites are the major problems of municipal solid waste disposal with landfilling method [1].

A landfill is designed to inhibit degradation of waste to protect the environment from harmful contamination. Sanitary landfill is the scientific dumping of municipal solid waste due to which maturity of the waste material is achieved faster [2]. Generation of leachate from sanitary landfill is a complex combination of physical, chemical and biological processes whereby waste age has effect to performance of landfill that generate leachate [3]. The major potential environmental impacts related to solid waste landfill leachate are pollution of surface water and ground water. The risk of ground water pollution is probably the most severe environmental impact from landfills because historically most landfills were built without engineered liners and leachate collection and treatment systems [4]. Generally, it is accepted that landfills undergo at least four phases of decompositions: (a) an initial aerobic phase, (b) an anaerobic acid phase, (c) an initial methanogenic phase, (d) a stable methanogenic phase [4]. Once the refuse is very well decomposed, the rate of oxygen diffusion into the landfill may exceed the rate of microbial oxygen depletion. Thus, over time the anaerobic landfill is hypothesized to become an aerobic ecosystem. The leachate characteristics such as pH, BOD<sub>3</sub>, COD, ammonia, microorganisms, heavy metals and phosphate are varied from site to site and seasonally at each site [5]. Leachate contains high concentration of nutrients. Its release into natural ecosystems can cause eutrophication and changes in the natural biodiversity [6].

This paper presents the results of leachate composition and characteristics such as pH, BOD<sub>3</sub>, COD, heavy metals of a municipal solid waste (MSW). One sample was collected from the Mavallipura landfill area itself and another sample from a surface pond near the same landfill area located in Bangalore. The concentration of magnesium is also measured as it is one nutrient for the growth of algae.

### **LANDFILL LEACHATE COMPOSITION**

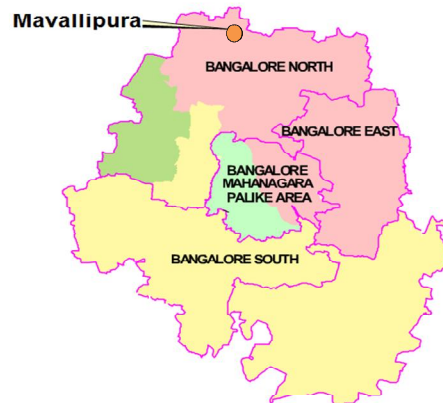
Pollutants in MSW landfill leachate can be classified in to four groups:

- Dissolve organic matter, quantified as Chemical oxygen Demand (COD), Total organic carbon (TOC), volatile fatty acids (that accumulate during the acid phase of the waste stabilization) [7].
- Inorganic macrocomponents like calcium, magnesium, sodium, potassium, ammonium, iron, manganese, chloride, sulphate and hydrogen carbon.
- Heavy metals like chromium, cadmium, lead, iron, nickel, zinc, copper.

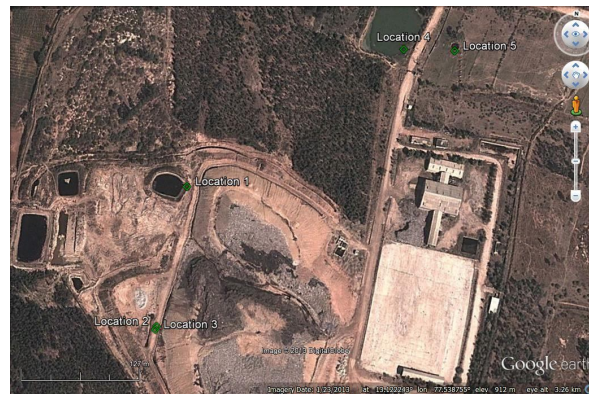
- Organic compounds originated from household or industrial chemicals and present in relatively low concentrations. These compounds include among others a variety of aromatic hydrocarbons, phenols, chlorinated aliphatic, pesticides, and plasticizers [7].

### MAVALLIPURA SITE AREA AND SAMPLING POINTS

The Landfill is situated at survey no.108, at Mavallipura village, Hesaragatta zone, Bangalore North, Karnataka state. This site has been used as processing site for the municipal solid waste generated from the Bangalore city. Fig.1. shows the Mavallipura site location in Bangalore. Fig. 2. gives the leachate locations point in the Mavallipura site using GPS. Fig.3 shows leachate accumulated in the surface water pond in the landfill area.



**Fig. 1** Mavallipura site location in Bangalore  
(courtesy: BBMP, <http://www.bbmp.gov.in/index.>)



**Fig. 2** Leachate locations in the Mavallipura site using GPS



**Fig. 3** Landfill leachate in Mavallipura site (Sample1)

**LEACHATE SAMPLING AND ANALYSES**

One sample of Leachate was obtained from the surface pond in the landfill area where leachate from the waste was accumulated over period of time. Another sample was from a aged water pond in the downstream of the landfill . The samples were collected in labeled clean bottles that were rinsed thrice prior to sample collection. Sample of leachates were stored in incubator at 4°C before proceeding for the analysis according to “Standard methods for examination of water and wastewater” unless otherwise stated (APHA, 1998) [8] . Suspended solids and turbidity were determined using a portable data logging spectrophotometer, and results were expressed respectively in mg/l and NTU. pH of the leachate was analyzed using pH meter. Dissolved solids, temperature and conductivity, Total dissolved solids, ORP were metered in situ. Atomic Absorption Spectrophotometer was used for metals analyses after samples were digested, using concentrated trioxo nitrate and the volume made up to 50ml with deionized water. Dissolved oxygen (DO) was determined by Azide modification of Winkler’s method. Open reflux method utilising potassium tetra-oxo chromate in boiling concentrated tetra-oxo sulphate solution in the presence of silver catalyst was used to determine COD. Nitrate Nitrogen was determined by Chromotropic acid method while phosphate was analysed by stannous chloride method. Biochemical Oxygen Demand (DO) was determined by Winkler’s method. Sodium and Potassium by flame photometer method, Calcium and Hardness was determined by EDTA titration, Oil and grease was determined by gravimetric method. Other compounds founds in landfill leachate like borate, sulfide, arsenate, selenate, barrium, lithium, mercury and cobalt etc . However, in general, these compounds are found to be very low concentrations and are only of secondary importance.

**RESULTS AND DISCUSSION**

Table 1 shows the results the characteristics of the leachate from Mavallipura landfill and old pond near land fill site. As for metals, high concentrations of iron in the leachate, followed by zinc, nickel were observed. The concentrations of chromium, copper, cadmium and lead were low.

**Table 1.** Characteristics of the leachate

Details	Mavalipura (Sample 1)	Old Pond (Sample 2)
pH	7.6	8.1
Colour	Dark black	Light green
Odour	Medium	Very Low
Temperature, °C	29	29
Conductivity, µS	3870	2500
TDS, µS	1935	1250
TSS	4202	1697
Settable Solids, ml/L	80	NA
COD, mg/L	10400	1080
BOD <sub>3</sub> , mg/L	1500	105
Sulphate, mg/L	4	10
Chloride, mg/L	7800	250
Calcium, mg/L	400	0
Hardness, mg/L	13000	1500
Alkalinity, mg/L	11200	2000
Magnesium, mg/L	2916	364.5
Iron, mg/L	11.16	0.16
Copper, mg/L	0.151	BDL
Silver, mg/L	0.035	0.026
Chromium, mg/L	0.021	BDL
Cadmium, mg/L	0.035	BDL
Lead, mg/L	0.3	0.053
Zinc, mg/L	3	1
Nickel, mg/L	1.339	BDL
Turbidity, NTU	100	440
D O, mg/L	6	2.7
Sodium, mg/L	3710	1676
Potassium, mg/L	1672	1078
Oil & Grease, %	4.155	0.055

**Table 2.** Characteristics of leachate[9].

<b>BOD<sub>3</sub>/COD</b>	<b>Age of fill</b>	<b>COD</b>
≥ 0.5	Young (< 5yr.)	>10,000
0.1-0.5	Medium (5 yr -10yr)	500-10,000
<0.1	Old(>10 yr)	<500

From Table 2, it shows that BOD<sub>3</sub> was 1500 mg/l and the value of COD was 10400 mg/l . The ratio of BOD<sub>3</sub>/COD is 0.144 for Mavallipura landfill and for surface sample BOD<sub>3</sub>/COD ratio is 0.097(BOD=105mg/L, COD=1080mg/L). The value of COD and BOD<sub>3</sub>/COD can characterize the age of the landfill according to the leachate constituents (Table 2). Thus, the value of COD and BOD<sub>3</sub>/COD from Table 2 was compared with Table 1. It shows that the leachate sample in this study was collected from the landfill with the age more than 10 years. The pH value of the leachate was 7.6 and 8.1(Table 1) which was considered as alkaline. It is thus clearly seen that both COD and BOD values of the surface water pond have considerably reduced. The reduction in the BOD/COD value in the case of surface water pond is much higher indicating that the reduction is mainly due to reduction in the BOD value. Even assuming that the surface water pond is only contaminated with the leachate partially to dilution the reduction BOD/COD value shows that it is due to by plant such as algae. As such the surface water pond is characterized not only by smaller BOD and COD values but also by lower BOD/COD ratio.

Algae are the population of microscopic single and multiple-celled aquatic plants that live in water. When populations of algal cells multiply, thereby clouding or giving color to a pond, it is called an algal bloom. Algae produce oxygen through photosynthetic action and are the primary source of oxygen in a body of water. Other sources of oxygen include other aquatic plants and oxygen interchange at the air-water interface, especially caused by wind driven wave action. Oxygen is also continuously being removed from the pond. It is removed by respiration of aquatic animals, by the biological oxygen demand (BOD) of organisms such as bacteria that break down non-living organic material, and even by a chemical oxygen demand (COD) caused by chemical processes such as decay of dead plants and animals. The presence of algae for the production of oxygen and as a base resource is essential for any healthy body of water [10].

Not all trace elements are toxic and in small quantities many are essential for plant growth (Fe, Mn, Mo, Zn). However, excessive quantities will cause undesirable accumulations in plant tissue and growth reductions. It is now recognized that most trace elements are readily fixed and accumulate in soils, and because this process is largely irreversible, repeated applications of amounts in excess of plant needs eventually contaminate a soil and may either render it non-productive or the product unusable. Although plants do take up the trace elements, the uptake is normally so small that this alone cannot be expected to reduce appreciably the trace element [11]. The reduction in the concentration of trace elements may be mainly due to dilution of leachate by surface rain water percolating into the pond.

From the Table 1, it clearly shows that magnesium concentration was the highest and was about 2916 mg/L in Mavalipura landfill and 364.5 mg/L in pond. This along with alkaline environment as well the presence of high concentration of magnesium indicates that the characteristics of the leachate are suitable for the growth of algae. Since there is the source of sunlight, carbon dioxide and nutrients and the nutrient needed by the algae for growing is magnesium. This algae, identified as Spirulina, grew in thick mats on this pond for nearly 2 years and is therefore believed to be adapted to the organics and inorganics of the leachate[12]. The growth of algae was observed in water pond in downstream of landfill area which is shown in Fig.4.



**Fig. 4** Pond near landfill site (Sample 2, algae is present)

## CONCLUSIONS

- Comparison different chemical parameters in the ponds within the landfill and surface water pond in the downstream of landfill area, shows that the leachate from the landfill is leaked out into the pond within the landfill area due improper liners system and design of landfill itself.
- The values of COD and BOD indicates that the surface pond is old.
- The leachate from the pond is seeping through the soil and entering to the surface water bodies into the nearby surface water ponds as indicated by lower concentration of mainly chemical parameters in the surface water ponds.
- Further the reduction in the BOD/COD ratio of surface water pond indicates that it is due to growth of algae.
- Nutrient for algae is mainly magnesium ions.

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