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MODEL STUDY ON MUNICIPAL SOLID WASTE LEACHATE CHARACTERISTICS USING 1-DIMENSIONAL COLUMN METHOD UNDER RAINFALL CONDITIONS

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ABSTRACT

Open dump sites are the most common way of Municipal Solid Waste(MSW) disposal option in India. Water percolating into the MSW open dump site principally by rainfall comes in contact with MSW which enhance the decomposition process, thus get contaminated and leach out the dumpsite. The Groundwater and soil contamination due to leaching from non-engineered MSW dumpsite mainly attributes conventional and non-conventional contaminates including heavy metals. In this work, column study method has been used to extract leachate from the MSW depending upon its density and exposure to rainfall conditions. Therefore three columns were used for MSW Leachate extraction which is tested for various chemical parameter tests like pH, EC, TDS, Chloride, Alkalinity, Hardness, Sulphate, Manganese and Heavy metals.

Key Words: Column Method, MSW, Leachate characterization

INTRODUCTION

In past few years Environmental Geotechnology has emanated as an incorporative science, aiming, analyzing, solving the geotechnical problems engross the influence of environmental factor. Soil pollution occurs from various sources, which includes improper method of waste disposal, acid rain, etc. In recent years, Municipal Solid Waste (MSW) disposal has been paid much attention which is one among the environmental factors that affects the soil properties. Improper disposal leads to the production of Leachate. Leachate is defined as the liquid that is produced when water or anyother liquid has percolated through solid waste which contains suspended materials and number of dissolved materials(AikHeng Lee, 2010). Leachate is generated by numerous factors such as Groundwater Infiltration, Precipitation, Leachate infiltration(StigMorling, 2007).(Banar et al.,2006)In the

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Concentration of contaminants in MSW Leachate , rains have direct effect on it. Research studies(AdnanAish, 2014) founded that the concentration of pollutants in the leachate during summer season were higher because through the waste layers the minimum amount of moisture percolates. During rainy seasons, the water penetrate through the landfill beds which dissolve constituents and more quantities of diluted leachate extracted (Shalini et al., 2012)Due to lack of moisture in landfill, lowest degradation occurs during the dry season and highest degradation occurs during the rainy season. In this study , an attempt is made to study the MSW leachate characteristics using column method under rainfall conditions.

LITERATURE REVIEW

Mudo Puming,2016 have studied the chemical properties of leachate, in which all the chemical parameters like turbidity, chloride, copper, iron, chromium, BOD, COD were tested. Large amount of chloride indicates the presence of domestic waste. High turbidity indicates the presence of clay, silt and other organic materials.

H.S.Nanda, 2011 have studied the impacts of MSW disposal , in which the influence of leachate decreases with depth. This is due to the chemical reactions between leachate and soil particles.As the variety of solid waste disposal and size of landfill increases the amount of leachate production also increases.

AikHeng Lee 2010, have studied the characteristics of leachate from sanitary landfill site. The study reveals that waste decomposition in landfill is influenced by climatic conditions like precipitation and temperature.Increase in temperature accelerate decomposition when the precipitations slow down decomposition to anaerobic condition.

Adnan Aish, 2014 have studied the MSW leachate characteristics using column experiments. Their experimental study indicates that the concentration of contaminants present in the leachate increased with certain time and then it started to get decreased.

MATERIALS AND METHODOLOGY

In this study, MSW have been collected from dumping site of Kazhupurapakkam in Tamil Nadu embrace 5Km radius of solid waste. The solid wastes were dumped into this area about 5years. The density of the landfill is 700Kg/m3. The main aim of this study is to assess MSW Leachate characteristics using column method under rainfall condition. In order to prepare leachate , the municipal solid wastes are collected in the container and transferred to the laboratory ,whose density is 200Kg/m3, the average is 450 Kg/m3. The experiment was performed by taking three columns made up of PVC pipe 53cm Long and 8cm inner diameter were used to stimulate the MSW leachate production. Thus,the volume

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of each column is 0.02m3. A gravel layer was placed at the bottom of the column. The aim of this gravel layer was to allow the drainage of leachate at the bottom of the column. Later, MSW samples were created and filled into each column by calculating the following equation.,

$$W=DxV$$

D is the Density of MSW, kg/m3

V is the volume of MSW, m3

W is the Weight of MSW, Kg

W=450x0.02=9kg

Therefore, 9Kg of MSW sample consist of 60% of organic matter, 10% plastics, 8% glass, 10%paper, 5% metals and 7% others. To fill up each column with waste, MSW sample is prepared using 5.4kg of organic matter, 0.9kg of plastics, 0.72kg of glass, 0.9kg of paper, 0.45Kg of metals and 0.63kg of other materials were all taken. The prepared MSW were distributed into the column uniformly.In order to stimulate the annual precipitation the water is to be added to the top of the column.The amount of water added to the column is calculated by using the following equation,

$$L=P(1-C)-E$$

L is the Leachate water depth, in mm

P is the precipitation , in mm

C is the leachate co-efficient

E is the evaporation, in mm.

The leachate co-efficient is 0.1.The leachate penetration is mainly during the rainy season. The average rainy days in Kazhupurapakam is 49 days.Based on this data, the water is added to the column containing MSW within 49 days to form leachate.

Table1 The rainfall and evaporation at rainy season

MONTH	PRECIPITATION (mm)	EVAPORATION (mm)
SEPTEMBER	114	144
OCTOBER	229	118
NOVEMBER	285	83
DECEMBER	144	65
TOTAL	772	410

The amount of leachate water ,

L1=772(1 - 0.1) – 410 =293.8mm in rainy season.

Table 2 The rainfall and evaporation at experimental season

MONTH	PRECIPITATION (mm)	EVAPORATION (mm)
FEBURARY	9	48
MARCH	9	85
TOTAL	18	133

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Since, the experiment was carried out in summer time , amount of leachate water evaporated during the summer season will be:

L2=18(1-0.1)-133= -116.8mm

(-ve sign indicates the evaporation water)

The total amount of water added to each column is calculated as.,

L=293.8-(-116.8) = 410.6mm

According to this, the amount of water to be added to the top of each column is calculated as .,

W=LxA

W is water to be added, L

L is the Depth of Leachate , mm

A= Area of the column surface, m2

The Surface area of the column is 0.02m3

The amount of water (W) that will be added=410.6x0.02 =8.212L

The total amount of water 8.212L is split up into 7 patches were the experiment period is carried out for 50days. Each patch of water consists of 1.17L which is to be added for every 7days. Leachate sample is then collected for every 7 days and tested for various chemical parameters like pH, EC,TDS, Total Hardness, Alkalinity, Sulphate(So_4^-), Manganese, Chloride (Cl^-).

RESULTS AND DISCUSSION

The characteristics of MSW leachate prepared under the condition of Kazhupurapakkamis founded with high concentration as shown below in Table 3. The pH value starts to get decreased with increase in time. The main reason for the reduction of pH value its due to the degradation of carbohydrate in the leachate that to form the fatty acids. Increase in sulphate concentration is due to the breakdown of organic substances. Hardness of leachate decreases due to the leaching action where the pH is low.

Table 3 Variations of Leachate character with relation to time

Parameter	Unit	7days	14days	21days	28days	35days	42days	49days
pH	-	9.2	8.3	7.9	6.9	5.9	5.5	5.3
EC	µS	197	181	173	152	130	116	116
TDS	ppm	136	150	162	165	153	140	147

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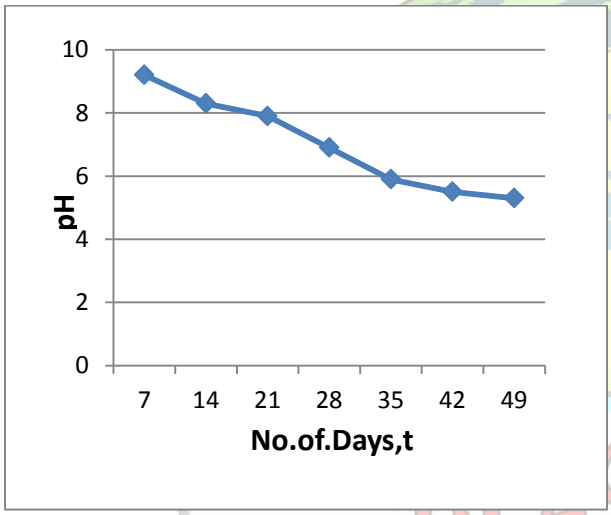
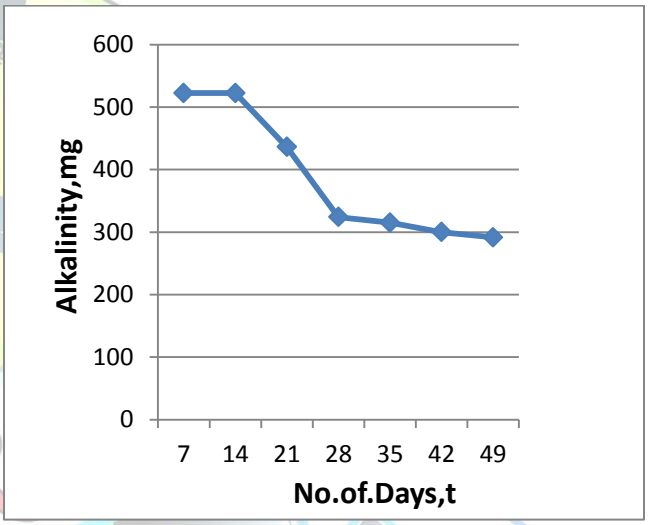
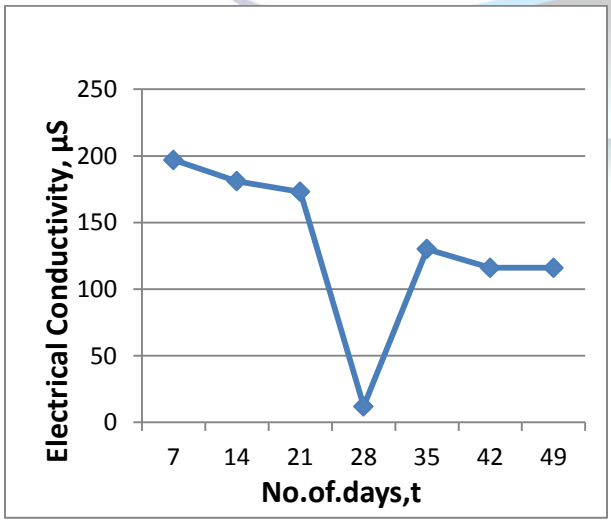
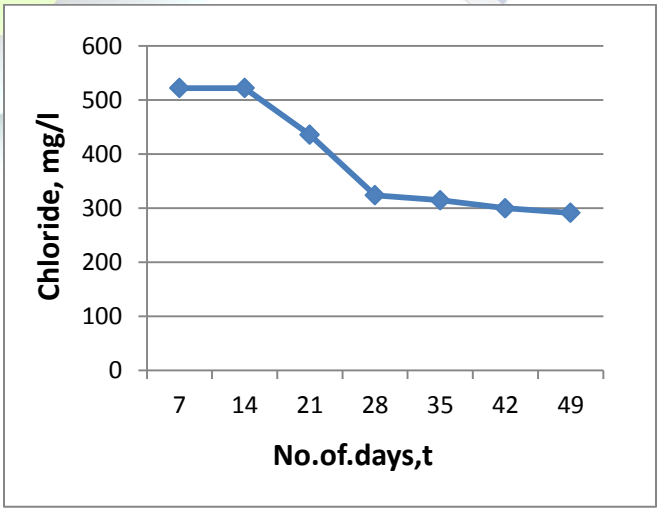
Alkalinity	mg/l	522.3	522.3	436	324	315	300	291.4
Total Hardness	mg/l	732	719	620	637	650	675	685.95
Sulphate	mg/l	799	825.4	917.85	1011.66	10323	11000	12000
Manganese	mg/l	81	72	65	55	42	48	53
Chloride	mg/l	43	54	68	59	44	40	38









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CONCLUSION

Column Experiment under rainfall condition were conducted to characterize the MSW Leachate characteristics. Three columns were taken and each column is characterized for 49 days. As the time increases pH value decreases that shows the presence of high concentration of contaminants. When the concentration gets increased, it creates the major issues on both soil and groundwater.

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