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Utilization Of Natural Red Earth And Bottom Ash As Liner Material For Removal Of Pollutant For Landfill Leachate.

Pavithra M P,
Assistant Professor, School of Civil Engineering,
REVA University, Bengaluru, Karnataka, India

Pushpa Lumina,
Assistant Professor, School of Civil Engineering,
REVA University, Bengaluru, Karnataka, India

Dr. Harinath S,
Professor, School of Civil Engineering,
REVA University, Bengaluru, Karnataka, India

Shruthi N
Assistant Professor, Department of Civil Engineering,
Vijaya Vittala Institute of Technology, Bengaluru, Karnataka, India

Abstract

In India a large amount of solid waste is disposed. One of the method of disposal adapted in India is sanitary landfill. Landfill liners are constructed in the place before dumping the waste. A large amount of leachate is produced from the solid waste. Usually geosynthetic liners and clayey soils are used as materials for liners. In this study, low cost materials like natural red earth and bottom ash are used. Natural red earth is clayey type of soil that is abundantly available in the environment and very stable in all environmental conditions. Bottom fly ash is a by-product that is formed in coal induced power plant and other cement industries. It has the property to purify the pollutants and for the purpose of treatment. The pollutant removal efficiency using these materials is investigated in the temporary glass setup. Leachate quality was determined and heavy metal content, chemical oxygen demand (COD), organic matter, pH and other properties in the leachate sample is measured before and after treatment. The result showed that these materials were effective in pollutant removal.

Keywords: *Natural Red Earth, Bottom Ash, Liner Material, Landfill Leachate.*

Introduction

Landfill leachate is a highly polluted liquid found in the sanitary landfill. It is a liquid that leaches out from the solid waste that is dumped in a certain area. The composition of the landfill leachate depends on the age of the landfill and the type of waste it contains. It usually contains heavy metals, organic matters which can be either in dissolved or suspended from. (N.A.Muhamad Bashar, Ekrem Kalkan, etc.)[1,2]

Landfill leachate is generated due to precipitation or the moisture content present in the solid waste. This water leached out from the solid waste further percolates into the water and joins the soil layers. This water is a contaminated and a highly hazardous liquid termed as leachate. This highly

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contaminated liquid leads to rise of fungi, growth of bacteria during the decomposition process, thus during this stage temperature rises and pH of the water also changes. And later leading to the change in the chemical composition of the groundwater and the subsequent soil layers. The physical colour of the landfill leachate again matters with the age of the landfill. (Yucel Guney, Ummukulsum Ozel, etc) [3,4]. The typical colour of a landfill leachate is said to be blue black colour, with a very offensive and an acidic odour that can bring nausea and headache. It contains a large amount of organic and inorganic matter. The pH of the leachate is high as there are more amount of pollutants in it. The composition and the concentration of the pollutants depends on the age, type of the solid waste in the landfill. (N.A.Muhamad Bashar, Yucel Guney)[1,3]

Objectives

The objectives of the experiment are:

- To find out the initial characteristics of landfill leachate.
- To evaluate the efficiency of the removal of pollutants from leachate of different liner materials.
- To analyse the final characteristics of the landfill leachate after passing the liner material.
- To compare and suggest an optimum alternative material used in liner construction that can reduce the pollutants entering into the groundwater.

Methods

The leachate is collected from the nearest solid waste landfill site, Belahalli dumping yard. The collected leachate is stored at a particular temperature for further use. The initial concentration of the leachate is tested to know its composition. A glass apparatus with a mesh attached to the bottom is prepared for conducting the experiment.

Natural red earth are the locally available soils, like red earth are used for construction of liners for water and waste retention facilities. This locally available red earth predominantly contains quatz and kaolinite minerals. It is the most economically available liner material. The natural red earth was purchased from a local agricultural service firm from Bangalore.

Bottom ash is micron – sized, glassy powder residue as a result of coal combustion in power plants, cement industries. It is pozzolanic in nature and consists primarily of silica, alumina and iron. It is usually used in purification of waste industrial water and other treatment process. Bottom ash required for the project was obtained from a RCC mix plant.

Step 1: The individual removal efficiency of materials namely natural red earth, bottom ash, are to be found. Thus, the leachate is poured into these single layers and tested for the composition of heavy metals.

Step 2: A single layer with equal amount of each materials (Natural red earth + Bottom ash) is prepared and the leachate is passed through this layer. The percentage removal is calculated from the obtained initial and final values of the concentration of heavy metals present.

Set A : Natural Red Earth

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Set B: Bottom Ash

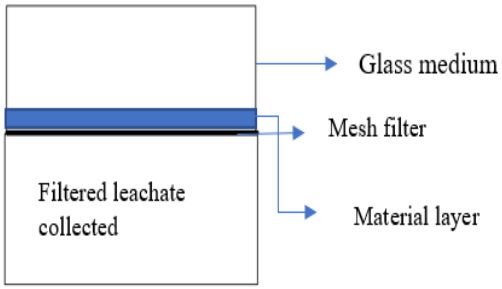

Figure.1: The experimental setup outline.

Result and Discussion

The leachate sample collected from the landfill site is tested to know its initial composition. The heavy metal components, chemical oxygen demand, organic matter and other pollutant concentration if found**.**

Sl. No	**Parameters**	**Unit**	**Results**
1	Lead as Pb	mg/L	2735
2	Zinc as Zn	mg/L	0.199
3	Total Chromium as Cr	mg/L	0.107
4	Nickel as Ni	mg/L	0.125
5	Copper as Cu	mg/L	BDL
6	Cadmium as Cd	mg/L	BDL
7	Chemical Oxygen Demand	mg/L	4400.0
8	Total Ammonia	mg/L	237.25
9	Magnesium as Mg	mg/L	320.76
10	Manganese as Mn	mg/L	1.41
11	Iron as Fe	mg/L	5.642
12	Potassium as K	mg/L	2735
13	Sodium	mg/L	2300

Table.1: Initial composition of leachate sample.

*BDL : Below detectable limit.
The report obtained after testing the initial leachate concentration was compared with standard requirements and the limit of heavy metals present.

Table.2: Final concentration of the leachate.

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SL. No	Parameters	Set A (mg/L)	Set B (mg/L)
1	Potassium (K)	1487.57	416.82
2	Chromium (Cr)	0.065	0.020
3	COD	2874.08	1892
4	Manganese (Mn)	154.68	18.29
5	Iron (Fe)	2.58	0.202
6	Sodium (Na)	1407.83	569.25
7	Ammonia	152.24	96.33

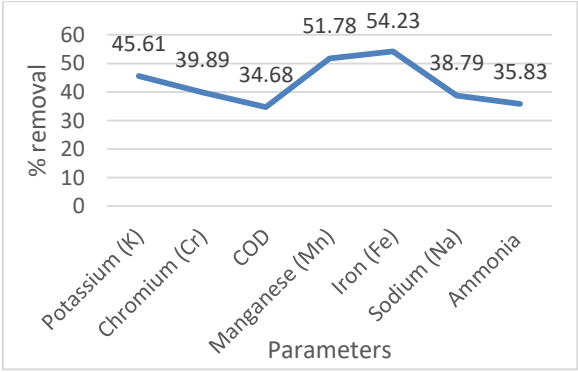
Once the final concentration of the filtered leachate sample is known. Then the next step is to find out the percentage of removal of the same. This gives us the removal efficiency.

Table.3 : Removal efficiency of heavy metals.

SL. No	Parameters	Set A	Set B
1	Potassium (K)	45.61	84.76
2	Chromium (Cr)	39.89	81.45
3	COD	34.68	57
4	Manganese (Mn)	51.78	94.3
5	Iron (Fe)	54.23	96.5
6	Sodium (Na)	38.79	75.25
7	Ammonia	35.83	59.4

Using the initial and final concentration of the each heavy metals the above removal efficiency is calculated.

The graph accordingly is plotted for each set of materials.



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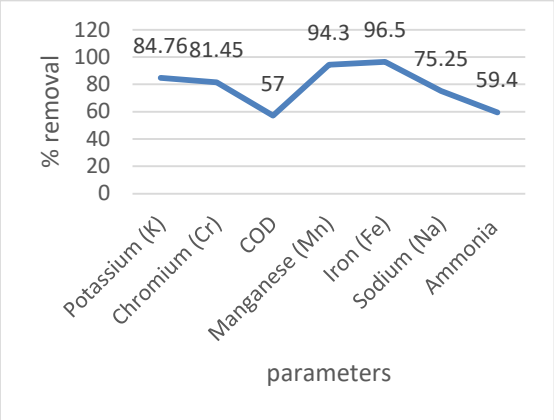
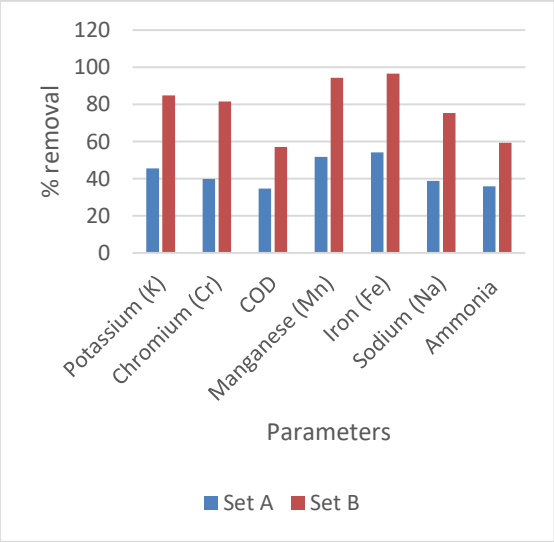
Graph.1: Removal efficiency of Natural red earth.

The above graph represents the efficiency of removal of the selected parameters by the use of natural red earth is plotted. It shows that the removal efficiency is very less for all the parameters in this particular materials. Where the highest percentage removal is iron i.e., 54.23%.



Graph.2: Removal efficiency of Bottom ash.

The above graph represents the parameters along the x-axis and % removal of the respective parameters in the Set C which is Bottom Ash. Bottom Ash as an individual material is found to be very effective in removing the manganese and iron at 94.3% and 96.5% respectively.



Graph.3: Comparison of removal efficiency between Natural red earth and bottom ash

The graph represents the removal efficiency of both the material for different materials for different parameters. It shows that Bottom ash has aver good percentage removal of the selected parametrs.

Conclusion

The initial concentration of the leachate sample shows that treatment is required to meet the ISO standards. The removal efficiency of the selected pollutants and the parameters are tested after passing

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the leachate sample through seven different setups. Bottom ash as an individual material is most efficient in removing the pollutants and treating the leachate.

Bottom ash is one of the wastes by product form coal induced industries, cement industries. This method of using bottom ash can also help as the disposal method of the waste from these factories. Thus, it is very economically available materials that can be used as the liner material.

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