

A Study on Effect of Leachate on Different Filter Materials

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Abstract - Landfill leachate is defined as any contaminated liquid which is usually generated principally by precipitation percolating through the waste deposited in the landfills. Once the rain water comes in contact with the solid waste, the rain water becomes contaminated and it flows out of the waste called leachate. It usually consists of many organic, inorganic and suspended particles. The composition of leachate varies widely depending on the age of landfill, type of waste, climatic conditions and the landfilling technology. Usually landfill leachate is characterized by high value of BOD, COD, ammonia, methane, sulphides, and heavy metals as well as strong colour and bad odour. Leachate from municipal solid waste landfills can cause serious threat to surface water, ground water, soil and environment. The risk of leachate leakage is mainly due to the inappropriate material in the liner system of landfill. Underdesigned landfill liner allow the leachate to easily pass through the soil strata and mix with the groundwater. The main goal of this project is to find out the most effective material for the liner system of the landfills. For this purpose, leachate samples were collected and analysed for various physico-chemical parameters to estimate its pollution potential. Then this leachate is passed through different filter medias such as tyre chips, coir pith and sand and the effects of leachate on different filter medias was estimated.

I INTRODUCTION

Due to rapid urbanization and population growth, our environment is degrading day by day. Waste generation has been increasing rapidly due to the rise in population. In developing countries, the wastes are generally deposited in low lying areas called landfills. One of the major pollution problems caused by the municipal solid waste landfill is leachate. The rainwater which percolates through the landfill and dissolves the organic and inorganic substance of solid waste produces leachate. The landfill leachate discharge may lead to severe environmental problems. Leachate may percolate through landfill liners and subsoil causing groundwater pollution. The leachate may also migrate into surrounding soil and changes the geotechnical properties of soil. The pollutants in MSW landfill leachate can be grouped into four namely; dissolved organic matters, inorganic components, heavy metals and particular organic components. When leachate passed through the landfill liners, the insoluble organic and inorganic materials may get accumulated within the pore space of the drainage media. This will results in decrease in porosity and hydraulic conductivity. Moreover, the leachate components may combined with the microbial activity results in chemically and biologically induced clogging. As a result the the period of effective functioning of the leachate drainage system will reduces. One of the

main objectives in the design of the landfill should be the proper management of leachate migration. Modern landfills are highly engineered that utilize liners to minimize the negetive impact of the solid waste. Liner systems are usually designed to be reliable and robust, remaining active for years.

The use of tyre chips, coir pith and sand in bottom drainage layer of landfill has been given global attention. This paper presents the study on the use of tyre chips, coir pith and sand mixed with coarse grained rubbles as the drainage material in the liner system of the landfill.

II OBJECTIVES

- To study the effect of leachate on various filter medias.
- To identify the most suitable and effective material for drainage layer.
- To identify the most suitable material which reduces the clogging of leachate on drainage layer.
- To check whether the usage of natural drainage materials can be reduced.

III MATERIALS

The following are the materials used for this study;

1. Course grained rubbles
2. Tyre chips
3. Coir pith
4. Sand
5. Leachate

1. COURSE GRAINED RUBBLES

Here we are using course grained rubbles in which gravel and sand predominates. Rubbles are broken stones of irregular size, shape and texture. Coarse grained rubbles were collected from Thonnakkal.



Fig 1 course grained rubble

Table 1 properties of course grained rubbles

PROPERTY	VALUE
Specific Gravity	2.66
Maximum Dry Density	1.734g/cm ³
Minimum Dry Density	1.463g/cm ³
Hydraulic conductivity	0.07cm/s
Angle of internal friction	38 ⁰
Size	4 to15mm

2. TYRE CHIPS

Tyre chips or scrap tyre is a solid waste that includes any unwanted or discarded tyre has been removed from its original use. This means that tyres which are no longer suitable for use on vehicles due to wear or damage can be recycled to serve a new economic purpose. Tyre chips were collected from automobile workshop, near Attingal.

Table 2 Properties of tyre chips

PROPERTIES	VALUE
Density	56gm/cc
Specific Gravity	1.12
Hydraulic conductivity	15cm/s
Angle of internal friction	30 ⁰
Cohesion	Negligible

3. COIR PITH

Coir pith is a by-product of the coir fibre processing industry. The composition and properties of coir pith vary depending on maturity of coconut, method of extraction and disposal, period between extraction and use and environmental factors. Coir pith was collected from Murukumpuzha.

Table 3 properties of coir pith

PROPERTIES	VALUE
Specific gravity	0.87
Water Absorption	10%
Aspect Ratio	105
moisture retention capacity	600% - 800%
Density	0.8g/cc
C:N Ratio	24:1

4. LEACHATE

Leachate is the liquid residue resulting from the various physical, chemical, and biological processes taking place within the landfill. Leachate sample for the study were collected from Attingal. Various physico-chemical parameters were analysed to determine the pollution potential of leachate sample.

Table 4 Properties of leachate

PROPERTIES	VALUE
Chloride	625mg/l
Dissolved oxygen	40 mg/l
Sulphides	88 mg/l
Nitrites	12.5 mg/l
p ^H	8.42
Electrical conductivity	1.956Ms/cm
Total dissolved solid	450g/l

5. SAND

Experiments were carried out on locally available cohesionless soil collected from Trivandrum district, Kerala.



Fig 2 sand

Table 5 Properties of sand

PROPERTIES	VALUE
Specific Gravity	2.616
Liquid Limit	48.2%
Angle of Internal Friction	35 ⁰
Maximum Dry Density	1.82g/cc
Minimum Dry Density	1.45g/cc
Optimum Moisture Content	24%
Hydraulic Conductivity	0.04cm/s

IV METHODOLOGY

Leachate samples are collected from MSW plant. In this study, the leachate samples were collected from Attingal municipal treatment plant. Laboratory tests were conducted on the leachate and analyse the various physico-chemical parameters of the leachate samples. Then the leachate sample is passed through different filter medias and estimate the effects of leachate on different filter medias. Filter medias includes tyre chips, coir pith and sand.

Table 6 Weight of material in each layer

PROPERTY	GRAVEL	SAND	COIR PITH	TYRE CHIPS
SPICIFIC GRAVITY	2.66	2.55	0.87	1.12
MAX DRY DENSITY (g/cm ³)	1.734	1.82	1.15	1.02
RELATIVE DENSITY (%)	75.7	52.96	61.9	60
WEIGHT (gm)	1211.2	847.36	990	960



FIG 3 Experimental setup

V RESULT AND DISCUSSION

REFERENCE

The following results were obtained from the study.

A. Properties of leachate in different filter medias.

PROPERTIES OF LEACHATE	CONDITIONS		
	TYRE CHIPS IS SANDWICHED BETWEEN GRAVELS	COIR PITH IS SANDWICHED BETWEEN GRAVELS	SAND IS SANDWICHED BETWEEN GRAVELS
Chloride	524.98mg/l	399.988mg/l	474.98mg/l
Dissolved oxygen	38 mg/l	36 mg/l	376mg/l
Sulphides	84 mg/l	78 mg/l	80 mg/l
Nitrites	12 mg/l	10 mg/l	11.5 mg/l
p ^H	8.41	8.39	8.40
Electrical conductivity	0.583Ms/cm	0.439Ms/cm	0.719Ms/cm
Total dissolved solid	311g/l	236g/l	387g/l

B. Permeability of drainage layer in different filter medias.

CONDITION	COEFFICIENT OF PERMEABILITY (cm/s)
Tyre chips is sandwiched between gravels	K= 3.83x10 ⁻⁴
Coir pith is sandwiched between gravels	K= 2.81x10 ⁻⁴
Sand is sandwiched between gravels	K= 3.4x10 ⁻⁴

IV CONCLUSION

- This study revealed the possibility for the use of tyre chips, coir pith, and sand as a reliable material in the drainage layer of the liner system.
- It has been concluded that the leachate sample contains high concentration of organic and inorganic constituents. It also have high alkalinity, TDS and conductivity.
- Both tyre chips and coir pith were found as effective material in reducing the amount of organic, inorganic and suspended particles in the leachate. They also improves the physico-chemical parameters of the leachate.
- Tyre chips have high hydraulic conductivity than coarse grained rubbles and sand which makes them suitable material for drainage layer.
- Coir pith have a very high water holding capacity and thus it reduces the quantity of leachate generation.
- Coir pith has the least permeability value. Thus it also helps to reduce the migration of leachate into the soil.
- Thus coir pith is more effective than sand and tyre chips and sand as drainage material in the liner system.

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