Shredded Scrap Tires as Drainage Materials in Landfill Cover System

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ABSTRACT: Shredded Scrap tire serve as good drainage material and have durability since tires are made up of such material that are indestructible. Over 280 million use, bikes, truck and automobiles tire discarded each year nationwide. Disposal of whole tires in landfills was the common practice in many countries for many years. However whole tire tend to float to the surface. Breaking the landfill cover and causing increased leachate production which can contaminate groundwater. Because of this many states have banned the disposal of tires in landfills. This paper provides the evaluation of the feasibility of using shredded scrap tires in civil engineering applications. Laboratory test were done to characterize the permeability values for different mix ratio of soils and shredded scrap tires. Using scrap tires structure needs data on engineering properties of tires derived material.

Key words: Scrap tires, Recycling, Protective covers, Shreds, Land fill, Drainage material, Civil Engineering.

1. INTRODUCTION

A scrap tire is a type of solid waste that includes any unwanted or discarded tire regardless of size that has been removed from its original use. A scrap tire is any tire that has been removed from its original use and includes all whole scrap tires and pieces of scrap tires which are readily identifiable as scrap tires by visual inspection and still contain wire .Over 280 million used automobiles, truck and especially tire discarded each year nationwide disposal of whole tires in landfills was the common practice for many years. The state of Illinois requires tires to be shredded before being placed in landfills. Currently 2,4 billion tires are stockpiled nationwide. Shredded scrap tires have been used in leachate collection system for landfill drainage material solely based on their high hydraulic conductivity.(Ahmed and Lovell, 1991; Duffy, 1996; Hall, 1991; Edil et al.,1992)

The purpose of the drainage layer is to allow infiltrated water to drain from the overlying cover soil layer so that it is prevented from seeping into the underlying barrier layer and the waste. The drainage layer minimizes the generation of leachate in the landfill and also prevents build-up of a hydraulic head within the cover. This is critical because a large hydraulic head may cause the slopes to become unstable. Thus the most important engineering property for the use of shredded scrap tires as the drainage material in landfill cover is the hydraulic conductivity.

2 PROBLEM DUE TO SCRAP TIRE DEPOSITION IN NATIONWISE

Scrap tire the most problematic source of waste that covering the large volume and their life long durability consequently-

- Scrap tire have good resident for mosquito and other insects that can spreads diseases such as encephalitis, dengue, malaria and west nile virus.
- These tire provide good breeding groups for rat, snakes, ticks and other vectors.
- Critical problems occurs presenting fire hazards when stored improperly.
- When these tires burned illegally creates dangerous oils and shoots into air.

These characteristics which make waste tires such a problem also make them one of the most re-used waste materials as the rubber is very resilient and can be reused in other products. Approximately one tire is discarded as per person per year. Tires are also often recycled for use on basketball courts and new shoe products. However material recovered from waste tires also known as crumb which is generally only a cheap filler material and is rarely used in high volumes.

3. EXPERIMENTISATION

3.1 Soil Sampling

- The soil used for this experiment is taken from field of village Narhi apart 15 Kilometer from **M.M.M.** .Engineering College Gorakhpur.-Uttar Pradesh.
- The soil samples were collected from a depth of about 0.3 to 0.4 m below the ground surface.

The engineering, and grain size distribution curve of the soil is given in Table 1

Table 1

SI.NO.	PROPERTY		VALUE
1.	I.S. Classification		CL
2.	Grain size Analysis	Gravel	0%
		Sand	40.0%
		Silt	32.0%
		Clay	28%
3.	Specific gravity		2.92
4.	Plastic limit		15
5.	Liquid limit		34
6.	Plasticity index		19
7.	Optimum moisture content (%)		19.927
8.	Maximum dry density (g/cc)		1.204
.9.	CBR (After 4 days soaking, For pressure range 2 to 4 kg/cm2)		1.8
10.	Permeability (cm/sec)		$1.603x10^{-5}$

3.2 Tire chips characterization

The tire chips used in this study were obtained from automobile shop in Gorakhpur. The tires were shredded in the range from (1.5-2.0) inches excluding wire mesh. These chips were randomly mixed with soil sample. Tire chips and tire shreds are non-reactive under normal environmental conditions.

Fig : 1 Shredded Scrap Tires

3.3 Test procedure

Compact the soil into the mould at a given dry density and moisture content by a suitable static or dynamic device for remolded sample. Place the specimen centrally over the bottom porous disc and filter paper. Fill the annular space between the mould and the specimen with an impervious material such as cement slurry or bentonite slurry to provide sealing against leakage from the sides.

Place a filter paper, porous stone and washer on top of the soil sample and fix the top collar.

Connect the stand pipe to the inlet of the top plate. Fill the stand pipe with water.

Connect the reservoir with water to the outlet at the bottom of the mould and allow the water to flow through and ensure complete saturation of the sample.

3.4 Observations and calculations

Calculate the coefficient of permeability of soil using the following equations....

$K_T = 2.303\ aL/(At)\ \text{Log}\ 10\ (h_1/h_2)$ (variable head method)

Where

K_T = coefficient of permeability at test temperature T ^{0}C (cm/sec)

a = cross section area of stand pipe (cm^2)

L = effective length of the soil sample (cm)

A = cross sectional area of soil sample (cm^2)

T = time required for the head to fall from h_1 to h_2 (sec)

h_1 = initial head of water in the stand pipe above the water level in the reservoir (cm)

h_2 = final head of water in the stand pipe above the water level in the reservoir (cm)

K_T = QL/(Aht) (constant head method)

Where

K_T = coefficient of permeability at test temperature T ^{0} C (cm/sec)

Q = quantity of water collected in time t (cc)

L = effective length of the soil sample (cm)

A = cross sectional area of soil sample (cm^2)

h = constant hydraulic head (cm)

Fig. 2 Permeability Test Apparatus

4. PERMEABILITY PERFORMANCE ASSESMENT

Table:2 Variation of Permeability with SST%		
S. No.	**Soil+SST %**	**Permeability(cm/sec)**
1	Soil+0% SST	$16.09x10^{-6}$
2	Soil+5% SST	$9.76x10^{-6}$
3	Soil+10% SST	$7.264x10^{-6}$
4	Soil+15% SST	$4.519x10^{-6}$
5	Soil+20% SST	$3.247x10^{-6}$
6	Soil+25% SST	$2.4005x10^{-6}$

Different percentage at which SST was mixed with soil and its permeability is given in Table 2 and Fig 3 from the table and graph it is clear that permeability decreases when tire aggregate increases to the soil.

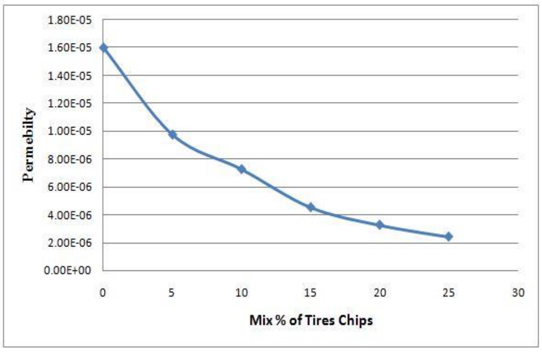

Fig. 3 permeability vs. mix% of tire chips

5 CONCLUSIONS AND ANALYSIS

This paper provides the evaluation the feasibility of using shredded scraps in civil engineering application.

Shredded tire used as drainage material in cover system for landfill as the tire aggregate increases to the soil, the permeability of soil tire decreases significantly.

The purpose of this document is to provide Municipal Solid Waste Landfill owners/operators with guidance in the use of tire chips in the design and construction of leach ate collection systems at municipal solid waste landfills.

The tire chip size can ranges from 1.5-2 inches can posses' satisfactory properties for drainage material in landfill covers system However, site specific testing using the actual tire chips size is recommended for different-different soil for particular purpose.

I believe that for better result each kind of soil sample require particular size of tire chip size. Therefore , future experiment include narrowing down the scope of result up to 25% increment of tire aggregate to less than 5%tire aggregate in soil.

It is the greatest challenges of this century that no country can develop without sustainable development. The use of scrap tire shreds in civil engineering would reduce the magnitude of the current tire disposal problem by converting a waste into a beneficial material.

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