Utilization of Scrap Rubber for the Performance of Soil on the Road Construction in Waste Management System

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Abstract
A most important problematic issue related with socio-economic progression of a country is the disposal of waste. One of the most challenging works is to dispose the rubber tyre waste in a safe manner. Hence we proposed a system of stabilization of soils by using scrap rubber from the waste at varying compositions. By using this phenomenon, we extend an enormous growth in the field of waste management and also in the soil conservation. The behaviour and performance of the stabilized soils are strengthened and measured by using the soil properties, compaction and liberated compression. From the experiments conducted on the soils, it was detected that extreme dry density and best humidity content reduces with increase in proportion of scrap rubber on soils. In order to the ecological difficulties and health hazards modelled by the innumerable uncontrolled and uninhibited scrap tyre piles around the world, most technologically advanced countries have put in place a legal framework to address this concern. Principles differ from country to country, but the chief goal of such regulation is to necessitate the removal of abandoned piles, provide for the environmentally safe disposal of newly generated waste tyres and also support new applications for tyre-derived material through the use of government grants.

Keywords: *rubber tyre waste, scrap rubber, tyre-derived material, soil conservation.*

I. INTRODUCTION

The process of Waste management is all the accomplishments and arrangements essential to achieve waste from its initiation to its final clearance. This comprises among other things, gathering, transportation, management and removal of waste together with observing and regulation. It also incorporates the permitted and supervisory framework that relates to waste management including guidance on recycling etc. Generally it denotes all kinds of waste, whether produced through the extraction of raw materials, the handling of raw materials into transitional and absolute products, the consumption of absolute products, or other human activities, comprising municipal, agricultural, and special. It is also projected to decrease adverse effects of waste on health, the environment or aesthetics. The growth of the industrial revolution made tremendous variations in the trade and transport field.

In the developing countries like India generally depend on the transportation division for their economic growth. There is an uninterrupted improvement and development in the usage of motor vehicles. The progression and usage of motor vehicles have not only affected noise pollution, air pollution etc. but also has produced complications in disposal the tyre's. Rubber does not decompose and as a result, cautiously practicable and ecologically sound clearance techniques have been found out. One of the usual and practical ways to consume these waste products is the construction of roads, highways and embankments. If these resources can be properly consumed in construction of roads, highways and embankments then the pollution issues caused by the industrial wastes can be prominently reduced. For the construction of roads and highways, enormous amount of soil is used. However the required amount of soil and raw material is not abundant easily. Consumption of several industrial wastes such as scrap rubber as a soil replacement not only resolves environmental difficulties but also affords a new source for construction industry.

II. LITERATURE REVIEW

The scope of this proposal was the Manufacturing possessions of soils may be essential to improve by accepting some sort of steadiness methods so as to make them suitable for construction. Stabilization of concrete sub grade soils has conventionally trusted on treatment with lime, cement, or waste materials such as fly ash, slags, Silica Fume, etc. Many scientists are looking for substitute materials for soil stabilization. The Studies have been accompanied with the scrap rubber to perceive the characteristics of scrap rubber when mixed with soil.

Mixed clay and fly ash models with used tyre acquired from retarding industry and hydraulic conductivity tests were accompanied using water gasoline as saturates. The power of soil-tyre chip mixture decreases once the rubber content exceeds 40% in the mixture because soil- tyre chip mixture performs less like reinforced soil and more like a tyre chip mass with sand inclusion. Decreasing head absorptivity tests were conducted on rubber mixed soil samples and it was perceived that when water invaded through samples, a slight increase in hydraulic conductivity was determined. It also demonstrated the shear strength and stress strain relationship of tyre chip and a combination of sand and tyre chips.

III. METHODS OF SELECTING MATERIALS

The proposal inhibits the experimental study was carried out on three soil samples S1, S2 and S3 collected at a depth of 0.9m below ground level. The elementary investigations executed comprises test for Specific Gravity, Wattenberg's limits, Grain Size distribution, Compaction characteristics and UCS. The geotechnical possessions of soils examined in the laboratory are tabulated in Table – 1. The constituent part size of scrap rubber that is used to alleviate the soil in this study was ranging from 445micron to 625micron. Definite gravity of scrap rubber acquired with a pycnometer test ranges from 0.9 to 1.0.

Table 1: Geo Methodological Properties of Soil

Parameter		Value		
		Sample 1	**Sample 2**	**Sample 3**
Particular gravity		2.1	2.2	2.3
Particle Size Distribution	Sand	4	5	6
	Silt	28	30	32
	Clay	72	65	57
Liquid limit		73	66	52
Plastic limit		35	29	26
Plasticity index		36	34	33
Shrinkage limit		4.7	4.9	5.6
Compaction Characteristics	Maximum Dry Density,(kN/m3)	15.4	15.3	15.2
	Optimum Moisture Content, %	24	25	27
Unconfined compressive strength, kN/m2		132	126	102

A. *Particle Size Determination Of A Soil*

The particle size of a soil can be determined by the following steps:

i) The dried sample is taken in a tray, soaked in water and mixed with either 2g of sodium hexameta phosphate or 1g of sodium hydroxide and 1g of sodium carbonate per litre of water, which is added as a dispersive agent. The soaking of soil is continued for 10 to 12hrs.

ii) The sample is splashed through 4.75mm IS Sieve with water till significantly clean water comes out. Reserved sample on 4.75mm IS Sieve must be oven-dried for 24hrs. This dried sample is sieved through 20mm and 10mm IS Sieves.

iii) The portion passing through 4.75mm IS Sieve should be oven-dried for 24hrs. This oven-dried material is riffled and about 200g taken.

iv)This sample of about 200g is splashed through 75µm IS Sieve with half litre distilled water, till considerably clear water comes out.

v) The material retained on 75µm IS Sieve is collected and dried in oven at a temperature of 105 to 120^{o}C for 24hrs. The dried soil sample is sieved through 2mm, 600µm, 425µm and 212µm IS Sieves. Soil retained on each sieve is weighed.

vi) If the soil passing 75µm is 10% or more, hydrometer method is used to analyse soil particle size.

B. *Compaction Characteristics*

The compaction tests were agreed out on virgin soil and soil- scrap rubber mixtures. The Standard Proctor tests were accompanied as per IS 2720 (Part-VII) on soil S1 and S2 with scrap rubber mixtures to regulate its compaction features, namely, the optimum moisture relaxed (OMC) and maximum dry density (MDD). The soil is varied with various amounts of scrap rubber of 5%, 10%, 15%, and 20%, by weight of soil and standard proctor test were accompanied on these mixtures. The compaction curve acquired from the tests for different percentage of soil 2- scrap rubber mixtures. The OMC and MDD values are obtained for the sample soils assorted with scrap rubber (5%, 10%, 15% and 20%) are précised in Table 2.

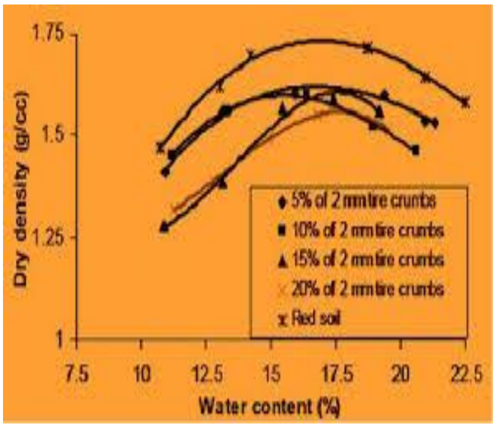

Fig.1: Compaction Curve for Soil 2 - Crumb Rubber Mixtures

From the Figure 1 and Table 2, it can be perceived that for both the soils, the extreme dry concentration of soil-scrap rubber mixtures decreases expressively with an increase of percentage of scrap rubber. This is due to the light weight nature of scrap rubber in comparison with soil. Correspondingly the water content also decreases with the increase in percentage crumb rubber in the soil. This may be due to the negligible water absorption capacity of the scrap rubber. In the field of construction business, soil compaction plays a very important role. It is used for maintenance of organisational individuals such as construction fundamentals, roadways, walkways, and earth recollecting buildings. For a particular soil type definite properties may believe it more or less desirable to achieve sufficiently for a specific condition. In common, the pre-defined soil must have sufficient strength, be reasonably incompressible so that future settlement is not important, be steady against volume change as water content or other factors differ, be tough and harmless against deterioration, and retain proper permeability.

Table 2: Max. Dry Density and Water Content of Soil-Scrap Rubber Mixtures

Soil	Scrap Rubber (CR),%	Compaction Characteristics	
		Max. Dry density(kN/m3)	Water content (%)
S1	0	15.32	26
	5	14.44	23
	10	14.24	21
	15	13.30	18
	20	13.12	16
S2	0	15.10	24
	5	14.90	22
	10	14.65	21
	15	14.32	20
	20	13.90	19
S3	0	15.25	26
	5	14.92	23
	10	14.76	21
	15	13.54	19
	20	13.20	17

C. UCS Value OF Soil-Scrap Rubber

Unconfined Compressive Strength (UCS)experiments were accompanied on the soil samples S1, S2 and S3 with different percentages of scrap rubber to regulate the UCS value and to estimate the suitability of soil alleviated with scrap rubber. The UCS tests were showed on soil sample-scrap rubber mixture organized at an OMC and MDD acquired corresponding to that particular soil-scrap rubber mixture. The soil was diversified with scrap rubbers of 5%, 10%, 15% and 20% by weight of soil and the test were directed on these soil- scrap rubber mixtures. The stress – strain curve acquired from the UCS tests for different percentage of soil1 + crumb rubber mixtures is shown in Fig. 2. The UCS value of the soil and soil+ crumb rubber mixtures were determined from the stress – strain relationship and are summarized in Table 3. The variation of UCS value with varying percentages of crumb rubber is shown in Fig. 3.

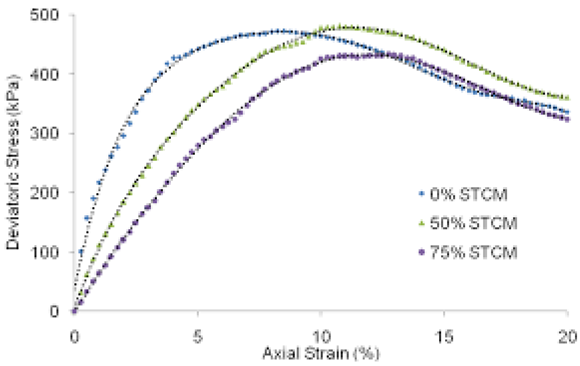

Fig.2: Stress – Strain Curve from UCS Tests

Table 3: UCS Values of Soil and Soil-Scrap Rubber

Soil	UCS Value (kN/m2)				
	Scrap Rubber %				
	0	5	15	20	25
S1	144	162	204	143	125
S2	102	142	175	182	164
S3	123	147	208	196	174

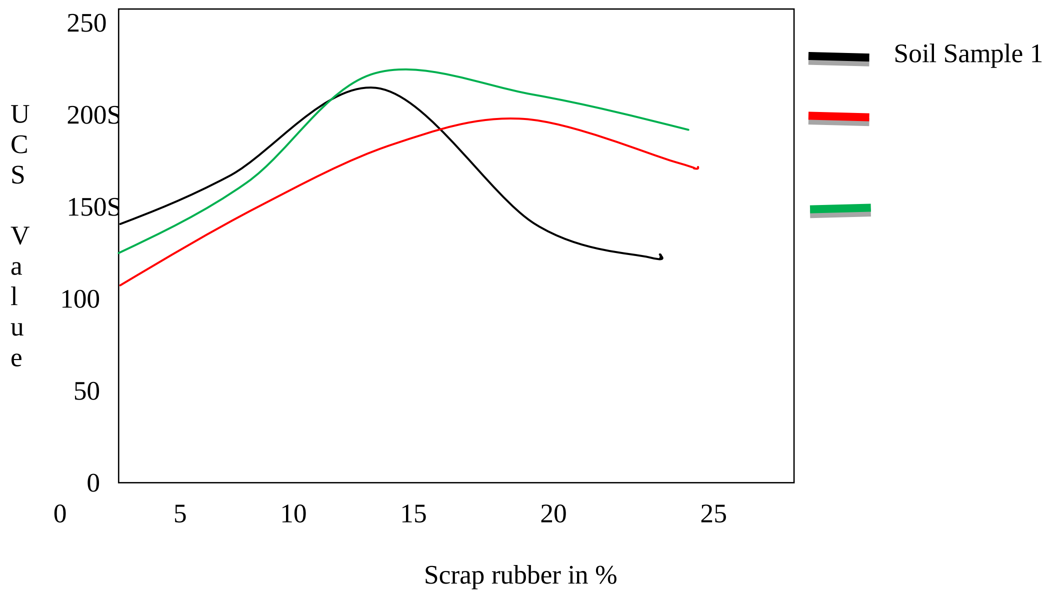

Fig.3: Variation of UCS Values with % of Scrap Rubber on Soil S1, S2 and S3

IV. CONCLUSIONS

From the Standard Proctor Compaction test, it was perceived that the maximum dry density decreased with the increase in percentage of scrap rubber for the soils S, S2 and S3 respectively. This could be due to light heaviness nature of scrap rubber waste. Waste scrap rubber-soil mixture exposed a development in UCS value for the soils S1, S2 and S3 up to 10%, 15% and 20% addition of scrap rubber separately. Further the accumulation of scrap rubber to soils lead to a reduction in UCS values. The percentage development in UCS value of soil S1 stabilized with 10% of scrap rubber was 45%, soil S2 stabilized with 15% of scrap rubber was 60% and soil S3 stabilized with 20% of scrap rubber was 80%. In the observation of industrial waste management, scrap rubber can be disposed safely in road embankments as a fill material. Nevertheless, it is suggested to study the effect of scrap-rubber chemicals on the soil to know its ecological influence.

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