Performance of Shredded Tyre Waste Based on Black Cotton Soil

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ABSTRACT:- Due to its poor bearing ability and tendency to shrink, black cotton soil makes a bad foundation material for paving. Various ground enhancement procedures have been used in the past to increase the load bearing capacity of black cotton soil. Rubber tyre shred (RTS) from waste has been used as the reinforcement material in the current investigation. Chemical solutions are used to RTS in order to establish an adhesive property between RTS and soil particles. 6%, 8%, 10%, and 14% by weight of soil of treated RTS has been combined with parent black cotton soil. These materials were put through Standard Proctor and California bearing ratio tests. This investigation comes to the conclusion that the bearing capacity characteristics may use a major upgrade.

Keywords:- Black cotton soil, Chemicals(Sodium hydroxide(NaOH), Dimethyl Sulfoxide, D-limonene), Maximum dry density, Shredded tyre waste, Standard proctor test, CBR test.

I. INTRODUCTION

Earth has been a preferred building material for civil engineers all around the world since it is readily available, inexpensive, and affordable despite having weak mechanical characteristics. Researchers have been working to enhance soil's mechanical qualities for decades in order to meet the needs of engineering structures. Sites that have been declared inappropriate are increasingly being used for the construction of novel, difficult structures as a result of the availability of new techniques or the ongoing development of new ones. Residential building development in cohesive soils may make the structure more prone to settlement. The bearing capacity, shear strength, and behaviour of the soil must be improved in order for the structure to resist the load disposal.

Black cotton soils can become inaccessible for all traffic with just 6mm of rain. The black cotton soils are difficult to clean up because of their plastic nature, which causes them to stick to wheels, animals' feet, and cultivation equipment. This soil's expansive character adversely impacts its ability to support weight. When dried, black cotton soil is so hard that the clods cannot be easily treated for use in road building by being easily crushed. This causes significant issues with the performance of the road as a result. Usually several years after construction, the harm will become evident if black cotton soil stabilisation is not used.

A popular technique for lowering the risk of shrink-swell is to replace expansive soil with a non-expansive substance. In the event that a soil or stratum is expansive.

RUBBER TYRE WASTE IS USED AS A SOIL STABILIZER

In the realm of study, solid waste management has drawn a lot of interest. Due to their non-biodegradable nature, accumulating waste tyres have emerged as an issue among the numerous solid wastes. Large quantities of used tyres need to be disposed of due to the increase in automotive production. The majority of discarded tyre rubber is used as fuel in a variety of sectors, including brick kilns, cement kilns, and thermal power plants. This kind of consumption is expensive and not environmentally friendly. Therefore, it is now vital to consider alternatives to the utilisation of scrap tyre rubber. The building industry sees waste tyre rubber as a promising material because of its light weight, elastic, absorbing energy, and insulating heat and sound. In order to safeguard the environment, the use of scrap tyre rubber in soil stabilisation has been considered as an alternate method of tyre disposal. The qualities of used tyres make them difficult to dispose of and perhaps flammable. Due to its incredibly adaptable and flexible nature, this technique has been gaining prominence in the field of geotechnical engineering.

 DOI : 10.35291/2454-9150.2023.0035

The Black Cotton Soil has qualities that cause it to inflate and shrink, as stated in the description. The volume of the soil changes as a result of shrinkage and swelling, creating cracks the structural system of the building or its base. The structure's durability and strength are being compromised by the fissures. Additionally, cracks are a major factor in many occurrences of structural failure. Similar to other soil types, black cotton soil has a very low load-bearing capacity, which contributes to numerous types of foundation failure, including punching failure and general shear failure. Due to their shrinkage and swelling characteristics, black cotton soils and other expansive soils are hazardous. Furthermore, these soils have extremely low bearing capacities that range from 49.05 kN/m^2 to 98.10 kN/m^2. Considering these kinds of soils when planning the footings.

II. LITERATURE REVIEW

Umesh Dhiman (2017) [1]: Performed review on black cotton soil mixed with rubber tyre chips. The significance of UCS is greater in contrast with that of parent soil. The maximum UCS value of 1.75kg/cm^2 has been seen by soil treated with 18% of tire scrap (R-425µ) passing 600µ.

Rishikesh V. Langone (2018) [2]: had done the performance of black cotton soil is stabilizing by utilizing waste shredded rubber tyre chips. The test CBR esteems increment through expansion in percentage of rubber tire shred and found to be maximum for 8% rubber tyre. The attachment esteems extensively decrease with expansion in level of rubber tire shred may be due orientation of rubber tyre.

Mr. Rajinder Kaur (2019) [3]: It has done the performance of black cotton soil is stabilized by utilizing tyre rubber powder. For the evaluation the exceptional crumb rubber powder has been selected. She was found that the strength of black cotton soil is increases with expansion of 10% crumb rubber powder. From the examination. expansion of 10% CRP to the soil increases CBR value.

III. MATERIAL

Black cotton soil that is highly compressible best describes the soil. By following numerous IS Codes and executing standard testing procedures, the index property of soil has been calculated. The index of black cotton soil are Specific gravity - 2.03, Liquid limit – 55.40%, Plastic limit – 22.49%, Plasticity index – 32.9%.

CHEMICALS: Sodium Hydroxide (NaOH), Dimethyl Sulfoxide (DMSO), and D-limonene are chemicals used to treat rubber tyre shred in order to improve its adhesive capabilities.

Fig.1 Rubber tyre shred

Fig.2 Black cotton soil

IV. EXPERIMENTAL INVESTIGATION

Conventional proctor tests and California Bearing Ratio (CBR) tests have been performed on black cotton soil with the use of treated rubber tyre shreds.

IV. TESTS USED FOR FINDING THE MDD & LOAD

A. STANDARD PROCTOR TEST:

The typical proctor test was run on black cotton soil with and without RTS at various concentrations. Maximum Dry Density (MDD) for various percentages of treated RTS has been determined. Shown in figure.3

Fig.3 Standard Proctor Test apparatus

 DOI : 10.35291/2454-9150.2023.0035

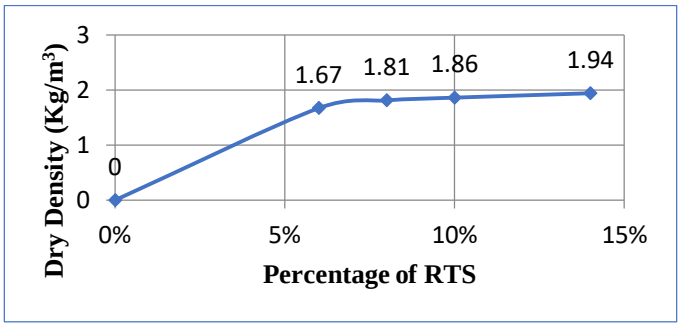

Fig.4 Variation of MDD with Different Percentages of Treated Rubber Tyre Shred

From figure, it is shown that when treated RTS is added to soil, MDD rises by roughly 6%, indicating a reduction in voids.

B. CALIFORNIA BEARING RATIO TEST

The California bearing ratio test is a penetration test used to gauge a road or pavement's subgrade stability. The findings of these tests are combined with empirical curves to calculate the thickness of the layers that make up the pavement. The most popular technique for creating flexible pavement is this one.

Fig: 4 CBR TEST APPARATUS

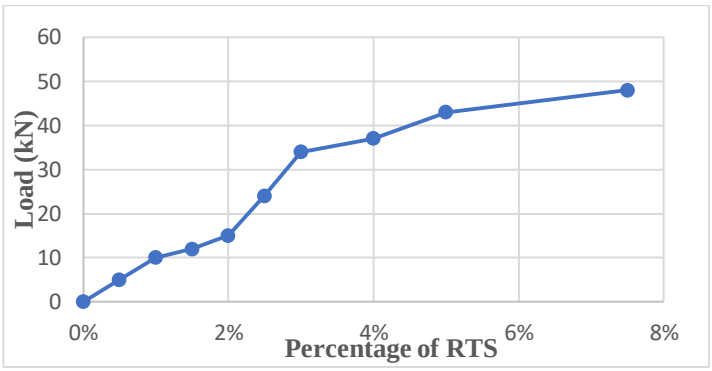

Fig.5 Variation of CBR with different percentage of Treated Rubber Tyre Shred

V. A VARIABLE PROPORTION OF SHREDDED TYRE WASTE REPLACES THE PROPERTIES OF BLACK COTTON SOIL:

In order to improve the geotechnical qualities of the black cotton soil, experiments are carried out on it with the addition of shredded tyre trash in varying percentages.

The below table shows properties of black cotton soil with the addition of 6% of the shredded tyre waste.

Table:1 Experimental values of Black cotton soil treated with 6% of shredded tyre waste

S.NO	PROPERTIES	RESULTS
1	Plastic Limit	28%
2	Liquid Limit	58%
3	Plasticity Index	30%
4	MDD	1.350g/cc
5	CBR Value	5.68%

The below table shows properties of black cotton soil with the addition of 8% of the shredded tyre waste.

Table:2 Experimental values of Black cotton soil treated with 8% of shredded tyre waste

S.NO	PROPERTIES	RESULTS
1	Plastic Limit	25%
2	Liquid Limit	55%
3	Plasticity Index	30%
4	MDD	1.412g/cc
5	CBR Value	7.82%

The below table shows properties of black cotton soil with the addition of 10% of the shredded tyre waste.

Table:3 Experimental values of Black cotton soil treated with 10% of shredded tyre waste

S.NO	PROPERTIES	RESULTS
1	Plastic Limit	26%
2	Liquid Limit	50%
3	Plasticity Index	24%
4	MDD	1.41 g/cc
5	CBR Value	8.25%

The below table shows properties of black cotton soil with the addition of 14% of the shredded tyre waste.

Table:4 Experimental values of Black cotton soil treated with 14% of shredded tyre waste

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S.NO	PROPERTIES	RESULTS
1	Plastic Limit	27%
2	Liquid Limit	57%
3	Plasticity Index	30%
4	MDD	1.39 g/cc
5	CBR Value	9%

VI. CONCLUSION

1. Soil stabilization method by using Shredded tyre waste successfully improves and existing poor and black cotton soil.
2. Shredded tyre waste cost is effective and available locally proves to be economical.
3. Plastic limit decrease from 28 to 25% for optimum dosages of 8% scrap rubber tire powder.
4. Decrease the liquid limit was observed from 48 to 58% for an optimum dosage of 6% of Shredded tyre waste.
5. Due to increase in strength CBR value increase from 5.68% to 9% for shredded tyre waste.

VII. REFFERENCE

[1] Umesh Dhiman (2017): "Performance of stabilization of soil using rubber Scrap".

[2] Rushikesh V.Langone (2018):" Performance of black cotton soil stabilization with scrap tire shreds".

[3] C H Kusuma Keerthi (2018):" Performance of stabilization of black cotton soil by using rubber powder".

[4] Rajinder kaur, (2019):" Tire rubber powder as a soil stabilization**".**

[5] California Bearing Ratio Test Procedure, CBR Test of Soil as per **IS: 2720 (Part 16): 1987**.

[6] The Indian Standard Equivalent of the Standard Proctor Test is called the light compaction test (**IS: 2720 (Part 7): 1974**).

[7] The IS codes to determine the different properties of soil are as follows: **IS: 2720 (PART 5): 1985.**

[8] Determination of liquid and plastic limit**. IS: 2720 (PART 8): 1983.**

[9] Maximum Dry Density and Optimum Moisture Content of Soil -**IS:2720 (Part 7).**

 DOI : 10.35291/2454-9150.2023.0035