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# EVALUATION OF PROPERTIES OF BLACK COTTON SOIL STABILIZED WITH RUBBER TYRE POWDER

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## ABSTRACT

This paper investigates strength characteristics of soil replaced partially with scrap tyre rubber. Scrap tyre rubber have been used as a stabilizer for various civil engineering applications. In this present study the main objective is to know how much the combination of scrap tyre rubber can be utilized for the improvement of strength properties of soil. The second objective is to find the variation of optimum moisture content and maximum dry density with increase in percentage replacement of scrap tyre rubber. The third objective is to find the optimum concentration of scrap tyre rubber based on the CBR ratio test results. This study involves the determination of optimum concentration of scrap tyre rubber by replacing the soil with different percentages and conducting CBR Ratio test for each percentage. Scrap rubber in 0, 5, 10 and 15%. It is found that at 10% replacement of soil by Scrap rubber the CBR ratio got maximum result. This study shows Scrap tyre rubber can be used as stabilizers for improving the properties of soil.

**Keywords:** Scrap Rubber, CBR, Moisture Content, Maximum Dry Density, Stabilization.

## I. INTRODUCTION

Soil stabilization can be used for the improvement of weak soil. The use of waste materials for soil stabilization has greater advantages since it reduce the disposal problems as well. Waste tyres are being generated and dumped causing an increasing threat to the environment. Rubber waste is chemically inert with all types of soils and are also a cheap alternative to expensive chemical stabilizers to manufacture and difficult for the application as stabilizer. By utilizing rubber wastes, the adverse impact on environment can also be reduced. These are abundantly available in nearby tyre repair workshops for free of cost.

In the present investigation attempt is made to analyze strength behavior of black cotton soil on replacement of scrap rubber tyre. By utilizing these waste materials adverse effects on the environment can also be reduced. The re-use of waste materials is a primitive step in creating a sustainable future, and due to increasing waste disposal cost, the re-use of waste and recycled materials is increasing worldwide and becoming more popular in civil engineering.

## II. OBJECTIVES

The main objectives of the study include the following:

- To find the effect of addition of scrap tyre on the behaviour of soil.
- To analyse plasticity characteristics, compaction characteristics and strength properties of soil based on the results obtained.
- Analysis and interpretation of results.

## III. SCOPE OF WORK

The Scope of the work is as follows:

- To stabilize the soil with waste material
- To make the work less expensive
- To reduce accumulation of waste

## IV. LITERATURE REVIEW

- **R. Ayothiraman, Ablish kumar meena (2011)- Improvement of subgrade soil with shredded waste tyre chips proceedings of Indian geotechnical conference**

This paper aims at studying the suitability of shredded tyres for its use in pavement engineering, i.e. to stabilize the subgrade of the pavements. It discusses about CBR value of soil-tyre mixture and the results are presented. The shredded tyre material used is of size 10 x 20 mm. The shreds had a thickness ranging from 2 to 3 mm and don't contain any steel wire or nylon fibres. From the experiment they found that dry density reduces with increase of % tyre waste, however, there is no significant change in OMC. Tyre waste material mixed with soil showed improvement in CBR value with its addition up to 2% and there onwards decreased with further increase in tyre content in unsoaked /soaked condition. Hence the optimum value of waste tyre content is2% in unsoaked and soaked conditions.

- **Binod tiwaril, Beena ajmera, Suzanne moubayed, Alexander lemmon, and Kelby styler (2012)- Soil modification with shredded rubber tires-ASCE, Geo congress.**

In order to evaluate the effect on the compaction characteristics of the soil to be modified with shredded rubber tires, several different types of soils were prepared in the laboratory. The types of soils tested include (a) a poorly graded sand prepared from Ottawa sand, (b) a well graded sand prepared from concrete aggregate, (c) a silty sand (d) a poorly graded sand with silt both prepared by mixing silt in construction sand, and (e) a fatclay.

Optimum moisture contents and maximum dry unit weights were obtained for different amounts of shredded rubber tires, in particular, 10%, 20% and 30%, in different types of soil. The shredded rubber tires used in this study were obtained from Home Depot and were coarser than 2.75 mm. The test results showed that 10% mixture of tire aggregate with soil showed a consistent increase in dry unit weight compared to the soil without any tire aggregates, irrespective of the type of soils used. On the other hand, 20% mixture yielded lowest amount of optimum moisture content.

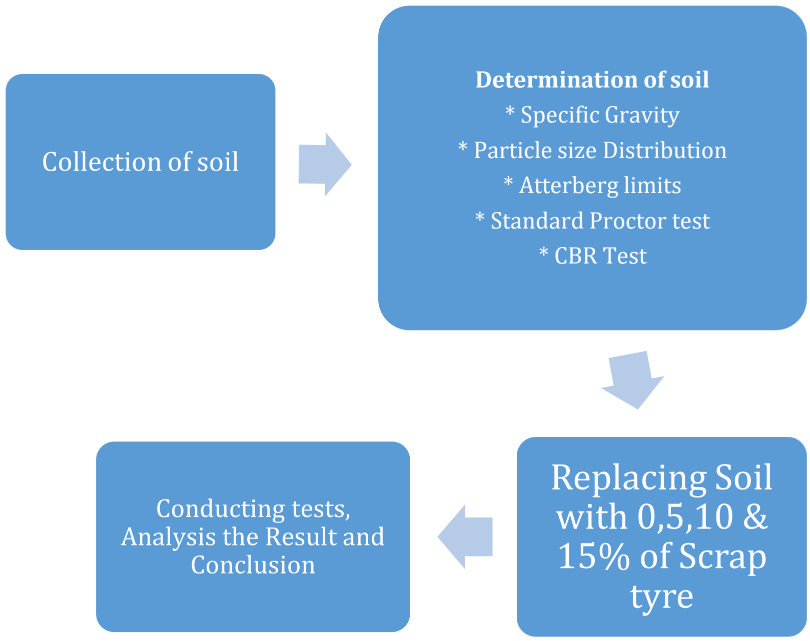
- **Ghatge sandeep hambirao, Dr.P.G.Rakaraddi (2014) - Soil stabilization using waste shredded rubber tyre chips- - IO SR Journal of Mechanical and Civil Engineering(IO SR JMCE)**

The tests were conducted on black cotton soil and sheddi soil. Ordinary Portland cement is used as the binding agent. The shredded tyre material used is of size 10mm to 25 mm in length. The shreds have a thickness ranging from 2 to 3 mm and they don't contain any steel wire or nylon fibres.

Unconfined Compressive Strength Test sand California bearing ratio tests are conducted for black cotton soil and shedi soil with 2% and 4% cement with the varying rubber percentage i.e 0%,5%,10% and 15%.for 2%cement, maximum unconfined compressive strength at the rubber content of 5%and curing period of 14 days for black cotton soil is 74 KPa where as for shedi soil it is 201kPa. This indicates that the increase in the curing period leads to an increase the unconfined compressive strength at an optimum mix of5% shredded rubber. This indicates that there is an increase in the stiffness of the stabilized soil is not only due to the hydration of cement with time but optimum rubber content. that there is an increase in the bearing capacity of the stabilized soil due to the hydration of cement with time and optimum rubber content.

## V. METHODOLOGY

Methodology of present study is shown below:



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## VI. MATERIAL USED FOR EXPERIMENT

The various materials used are Black Cotton soil and scrap tyre powder.

### 6.1 Scrap Tyre Powder

Shredded tyre material was obtained from waste generated from tyre re-threading industries. Rubber shreds are produced in tyre cutting machines. These cutting machines can slit the tyre into two halves and can separate the side walls from the tread of the tyre. Slit tyres have a lot of exposed steel belts. The shredding process results in exposure of steel belt fragments along the edges of the tyre shreds. Shredded rubber tyre Powder is availaible at Mandipet.

**Fig 6.1:** Scrap Tyre Powder

### 6.2 Black Cotton Soil

Black cotton soil is the Indian name given to the expansive soil deposits in the central part of the country. **Black Cotton Soil** of pertaining Sieve size as per IS standards gathered from Mukhanahalli Patna excavated from an open exhuming at a profundity of 1.2m underneath earth surface. These soils have been formed from basalt or trap and contain the clay mineral montmorillonite, which is responsible for the excessive swelling and shrinkage characteristics of the soil.

**Fig 6.2:** Black Cotton Soil

## VII. RESULTS AND DISCUSSION

### 7.1 INDEX AND ENGINEERING PROPERTIES OF A BLACK COTTON SOIL

**Table 7.1:** Index Properties of Soil

| SL NO | PROPERTIES | VALUE |
|---|---|---|
| 1 | Color | Black |
| 2 | Specific Gravity | 2.42 |
| 3 | Plastic Limit | 30% |
| 4 | Liquid Limit | 58% |
| 5 | Maximum Dry Density | 1.62 g/cc |
| 6 | Optimum Moisture Content | 22.0% |
| 7 | CBR Value | 3.15% |

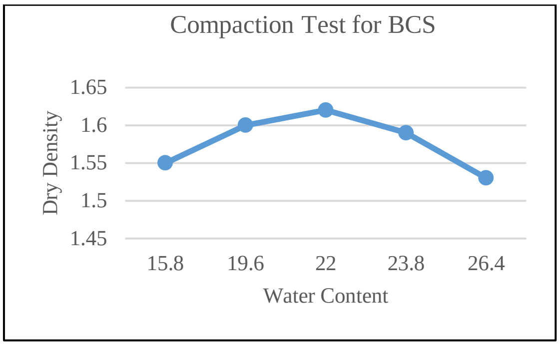


**Fig 7.1:** Compaction Test for BC Soil

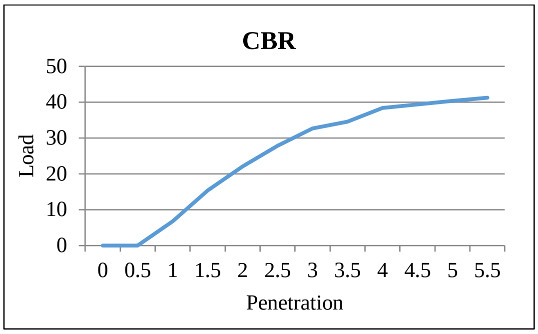


**Fig 7.2:** CBR test for BC Soil

**7.2 PROPERTIES OF BLACK COTTON SOIL IS REPLACED BY VARIFYING PROPORTION OF SCRAP RUBBER TYRE POWDER**

**TRIAL 1: BLACK COTTON SOIL + 5% OF SCRAP RUBBER TYRE POWDER**

**Table 7.2:** Properties of Black Cotton Soil Replaced By 5% Scrap Rubber Tyre Powder

| SL NO | PROPERTIES | VALUE |
|---|---|---|
| 1 | Plastic Limit | 28% |
| 2 | Liquid Limit | 56% |
| 3 | Maximum Dry Density | 1.86 g/cc |
| 4 | Optimum Moisture Content | 20.68% |
| 5 | CBR Value | 7.0% |

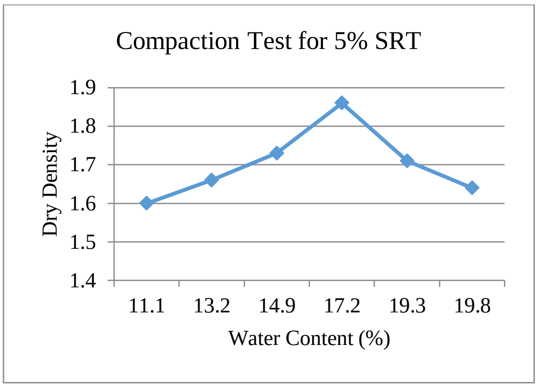


**Fig 7.3:** Compaction Test for BC Soil Replaced By 5% of Scrap Rubber Tyre Powder

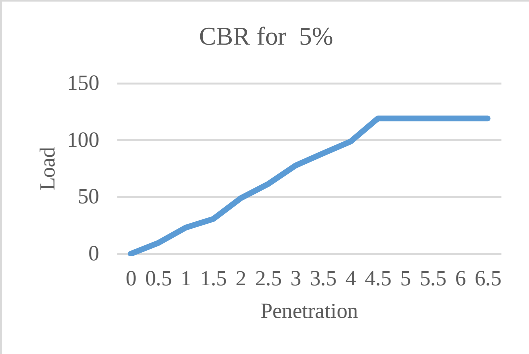


**Fig 7.4:** CBR Test for BCS Replaced By 5% of Scrap Rubber Tyre Powder

**TRIAL 2: BCS + 10% OF SCRAP RUBBER TYRE POWDER**

**Table 7.3:** Properties of Black Cotton Soil Replaced By 10% of Scrap Rubber Tyre Powder

| SL NO | PROPERTIES | VALUE |
|---|---|---|
| 1 | Plastic Limit | 25% |
| 2 | Liquid Limit | 55% |
| 3 | Maximum Dry Density | 1.88 g/cc |
| 4 | Optimum Moisture Content | 20.0% |
| 5 | CBR Value | 9.67% |

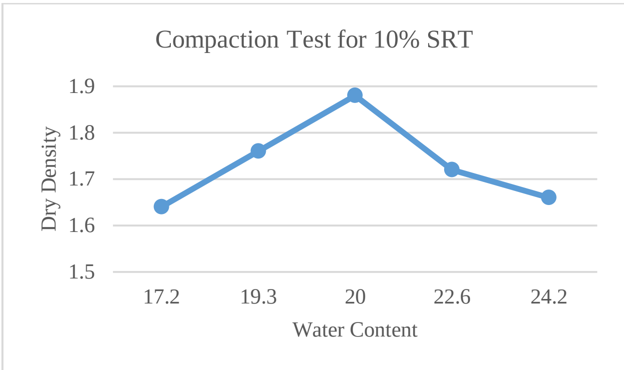


**Fig 7.5:** Compaction Test for BCS Replaced By 10% of Scrap Rubber Tyre Powder

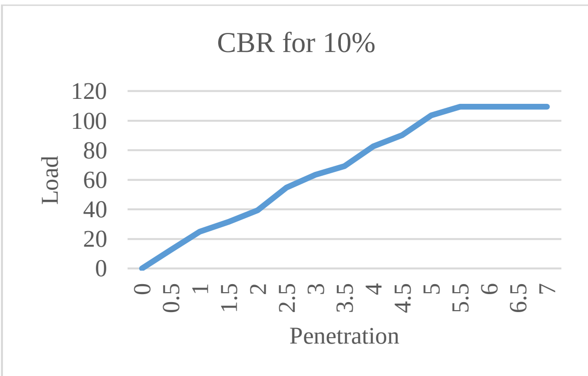


**Fig 7.6:** CBR Test for BCS Replaced By 10% of Scrap Rubber Tyre Powder

**TRAIL 3: BCS + 15% SCRAP RUBBER TYRE POWDER**

**Table 7.4:** Properties of Black Cotton Soil Replaced By 15% Scrap Rubber Tyre Powder

| SL NO | PROPERTIES | VALUE |
|---|---|---|
| 1 | Plastic Limit | 26.5% |
| 2 | Liquid Limit | 56.5% |
| 3 | Maximum Dry Density | 1.63 g/cc |
| 4 | Optimum Moisture Content | 21.21% |
| 5 | CBR Value | 6.93% |

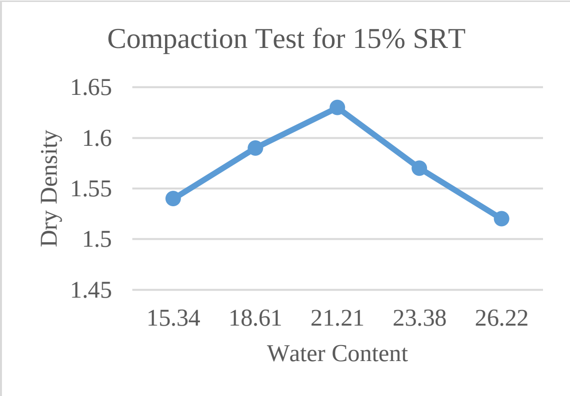


**Fig 7.7:** Compaction Test for BCS Replaced By 15% of Scrap Rubber Tyre Powder

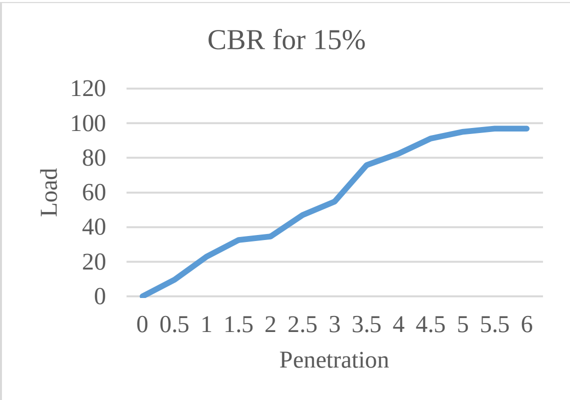


**Fig 7.8:** CBR Test for BCS Replaced By 15% of Scrap Rubber Tyre Powder

**Variation graphs of Evaluated Properties**

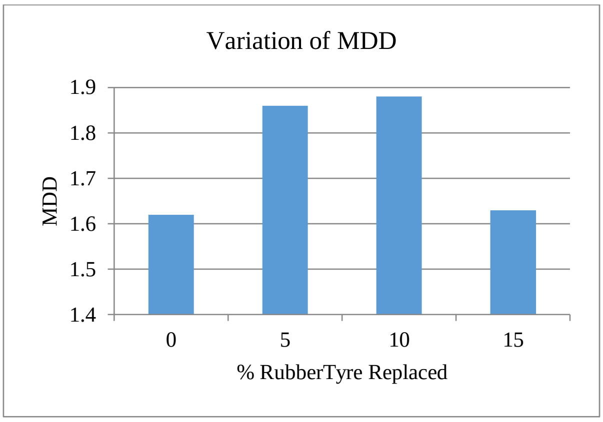


**Fig 7.9:** Variation Graph of MDD

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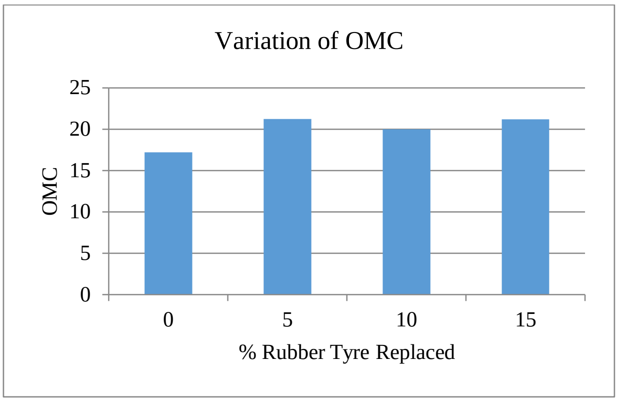


**Fig 7.10:** Variation Graph of OMC

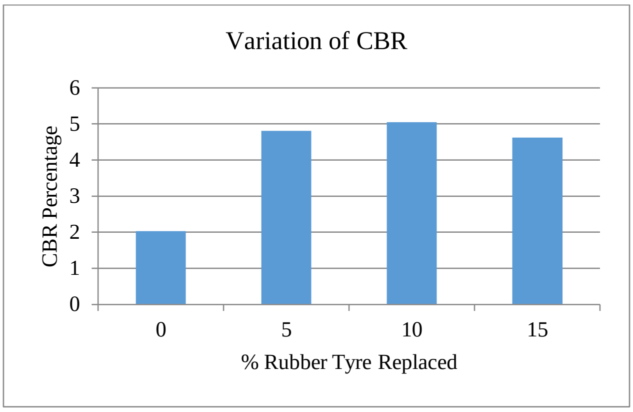


**Fig 7.11:** Variation Graph of CBR

## VIII. CONCLUSION

- Scrap rubber tyre cost are effective and available locally proves to be economical.
- Plastic limit decrease from 30 to 25% for optimum dosages of 10% scrap rubber tyre powder.
- Decrease the liquid limit was observed from 58 to 55% for an optimum dosage of 10% of scrap rubber tyre powder.
- The OMC value decreases from 22% to 20% for 10% of scrap rubber tyre powder.
- The MDD & OMC value decreases generally for 15% scrap rubber tyre powder.
- The load bearing capacity was determine the Californian bearing ratio. Due to increase in strength CBR value increase from 3.15% to 6.13% for scrap rubber tyre powder.

## IX. REFERENCES

[1] Soil Stabilization Using Waste Shredded Rubber Tyre Chips , Ghatge Sandeep Hambirao and P.G.Rakaraddi , Published 2014, IOSR Journal of Mechanical and Civil Engineering.

[2] Strength and F O S Performance of Black Cotton Soil Treated with Calcium Chloride; Dr. K.V. Manoj Krishna and Dr. H.N.Ramesh.

[3] Stabilization of Black Cotton Soil by using Scrap Rubber Tyre Powder; C H Kusuma Keerthi and Sumanth Doodala.

[4] Experimental Investigation on Black Cotton Soil Mixed with Tyre Waste Kushappa M Kabade, Bhagyashree Shinde and Akshata Beerappagol.

[5] Rajvinder kaur,(2019):" Tire rubber powder as a soil stabilization".

[6] Rushikesh V.Langote (2017):" Performance of black cotton soil stabilization with scrap tire shreds".

[7] B. Sri Vasavi, (2016):" Performance on stabilization of expansive soil by using crumb rubber powder & cement".

[8] P.Arti sudam (2016):" Behavior of soil by using tire powder".