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Experimental Investigation on Soil Stabilisation Using Rubber Crumbs on Expansive Soil

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Abstract— **To withstand the load soil is the basic foundation for the structure. Weak in the strength, high degree of expansion and contraction due to the presence of montmorilonite minerals causes differential settlement in a structure which leads to failure in the black cotton soil. To increase the engineering properties and to make it suitable for the construction purpose it is required to stabilize the soil. It can be done by various methods such as by using lime, cement, textile effluent, plastic, etc.**

In this study the stabilization is carried out by using increasing percentage of rubber crumbs along with lime under suitable test. The main objective is to increase the CBR value.

Index terms – **Compaction, CBR, Liquid limit, Plasticity Index, Expansive soils, Rubber crumbs, lime.**

I. INTRODUCTION

The black soilis often weak and has no enough stability in heavy loading. In this regard, it is necessary to stabilize the soil which helps to improve its engineering properties. Stabilization is being used for a variety of engineering works; the most common application is being in the construction of road and airfield pavements, where the main objective is to increase the strength or stability of soil and to reduce the construction cost by making best use of locally available materials. Stabilization is process of changing the chemical properties of soft soils by adding stabilizers either in wet or dry conditions to increase the strength and stiffness of the weak soils.

Soil stabilization is a way of improving the weight bearing capacity and performance of in situ sub soils, sands, and other waste materials in order to strengthen surfaces. The main objective of soil stabilization is to improve the California Bearing Ratio of insitu soils. The other prime objective of soil stabilization is to improve onsite materials to create a solid and strong sub base and base courses. Thus, the goal of soil stabilization is to provide a solid, stable foundation.
Lime reduces the plasticity index of highly plastic soils making them more reliable and easy to be handled and pulverised. The plasticity index of soils of low plasticity generally increase in the optimum water content and a decrease in the maximum compacted density, but the strength and durability increases.

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II. LITERATURE REVIEW

A lot of research work has been carried out in the materials used for soil stabilisation.Brajesh Mishrahad studied that the soil strength is effectivelyimproved by the use of different percentage of lime contents.Addition of lime to expansive soil brings major changes in compaction and strength behavior of expansive soil.

Umar Jan and Vinod kumar Vinpulkerni investigated soil stabilization using shredded rubber tyre and therir investigation.
helps in increasing the load carrying capacity of soil with reduced swelling potential due to the addition of rubber.

V.Mallikarjuna and T.Bindu Mani carried out soil stabilization by using proper proportions of plastic content which helps in increasing the CBR of the soil.

Dr.P.G. Rakaraddi had investigated using rubber crumbs and concluded that the increased CBR helps to reduce the total thickness of the pavement.

.Phani Kumar, D. Ganga, P. Swathi, Priyadarsini, Ch. Naga Bharath carried out investigation on soil stabilization using rubber tyre chips and concluded that the stabilization along with rubber tyre chips increases the CBR value which leads to increased strength.

III. . MATERIALS AND METHODS

A. *Black Cotton Soil*

The soil taken for investigation is Black cotton soil which is weak and is not suitable for the construction purpose and when it comes in contact with water it either swells or shrinks and resulting in moments of the structure which are generally not related to direct effect of loading. On account of its high volumetric changes it is not suitable for construction. It swells and shrinks excessively due to present of fine clay particles which is responsible for differential settlement of structure.so black cotton soil must be treated by using suitable admixtures to stabilize it.

Expansive Soil (Black cotton soil) investigated in this project is collected from thenearby site. The collected sample is dried and crushed to get the soil sample for conducting the soil tests. The index properties and engineering properties of the soil were found from the soil tests in accordance with the procedure mentioned in IS 2270 and are presented in Table 1.Sieve analysis is conducted to observe the grain size distribution of the soil. The grain size distribution curve is plotted and the effective size of soil, Uniformity coefficient (Cu) and Co-efficient of Curvature (Cc) are found. Specific

gravity is defined as the ratio of the unit weight of soil solids to that of water.

Fig.1. Soil sample

Table 1: Physical properties of expansive soil

S.No	Properties	value
1.	Grain size distribution	
	a) Gravel	4.1%
	b) Sand	82.1%
	c) Silt + clay	13.8%
	Uniformly Co-efficient (C_u)	4.42
2.	Co-efficient of Curvature(C_c)	0.66
3.	Atterberg limits	
	a) Liquid Limit	57%
	b) Plastic Limit	27.05%
	c) Shrinkage Limit	44.35%
4.	UCS	235.55KN/m^2
5.	Compaction characteristics	
	a) Maximum dry density	17.25g/cc
	b) Optimum moisture content	16%
6.	Flow Index	20.85
7.	Specific Gravity (G)	2.53
8.	Differential free swell index	70%
9.	pH value	7.73
10.	CBR value	2.6%

A. *Rubber crumbs*

For improving the engineering properties of the black soil, rubber crumb powder was chosen as an additive. Crumb rubber is a recycled rubber from automotive and truck scrap tires. The RCP which is used in the study are of 40 mesh down size (IS sieve). RCP is used as an additive in the present investigation to get desired engineering properties.

Fig 2 Rubber Crumbs of 30 meshes

B. *Lime powder*

Lime used for the construction is usually fine grained stabilization along with lime helps in increasing the strength, durability and also minimizes the moisture variations in the soil. Lime increases the strength of soil resulting in improvement in durability to traffic load and resistance to water, wind and freeze-thaw cycles. The stabilization of black cotton soil has been done with constant percentage of lime.(using 3% of lime as a constant for stabilizing the soil.

III EXPERIMENTAL INVESTIGATION

The experimental investigation was carried out in two phases. The black soil is collected, dried, grinded and stored in containers. Samples are prepared by adding different percentages of admixtures. Liquid Limit and Plastic Limit of the untreated and treated expansive soil were determined by following standard procedures as per IS: 2720 Part V [9]. Specific Gravity was determined by using pycnometer bottle method as per IS: 2720 Part III [10]. Optimum moisture content and maximum dry density of treated and untreated expansive soil with increasing percentage of RCP along with lime was determined as per IS 2720.In present investigation California Bearing Ratio test was carried out on prepared soil samples of untreated expansive soil and treated expansive soil with various percentages of RCP and lime mixture under unsoaked condition as per recommendations in IS 2720 Part XVI [13].

IV. RESULT AND CONCLUSION

To know about the effect of the stabilizing material suitable tests were conducted with increasing percentage of rubber crumb powder usually 5%, 10%, 15% along with 3% of lime as constant.

Tests conducted

A. Plasticity characteristics

To investigate about the effect of stabilizing material on the plastiscity characteristics it is observed that the plastic characters decreases with increasing percentage of stabilizing material.

B. Proctor compaction test

By increasing the percentage of stabilizing material it is observed that the optimum moisture content and dry density increases with increasing percentage of rubber crumbs powder with 3% of lime as constant.

C. California bearing ratio(CBR)

The primite objective of soil stabilization is to attain the increased CBR value which helps in increasing the suitability of soil for the pavement and other construction purpose.The soil with increasing percentage of rubber crumbs with 3% of lime as constant is tested to get CBR value of the compacted soil in an unsoaked condition.

Fig 3 Soil with stabilizing material

Table 2 Properties of stabilised soil

SAMPLE	LIQUID LIMIT (%)	PLASTIC LIMIT (%)	PLASTICITY INDEX (%)	MOISTURECONTENT (%)	DRY DENSITY (g/cc)	CBR (%)
Collected soil sample	48	22	8.68	6	15.09	2.5
3% lime + 5% RCB	46.5	30	12.5	17.5	15.79	4.9
3%lime + 10% RCB	45	33	11.75	18.32	17.20	5
3% lime + 15% RCB	43.5	35.5	11	19.75	18.00	5.2

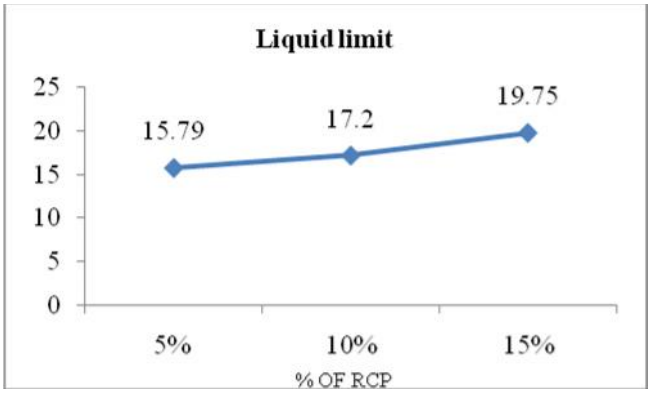

Fig. 4. Liquid limit of soil with 3% of lime as constant

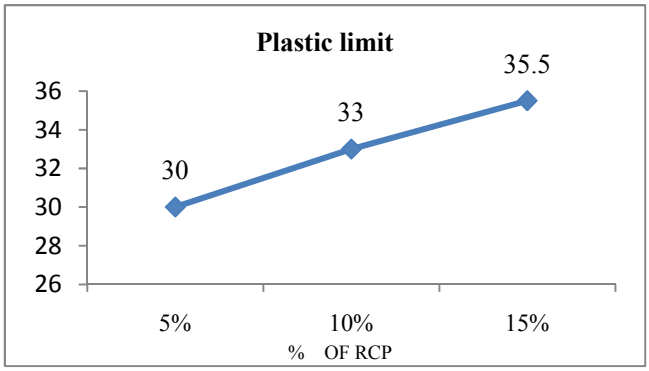

Fig.5. plastic limit of soil with 3% of lime as constant

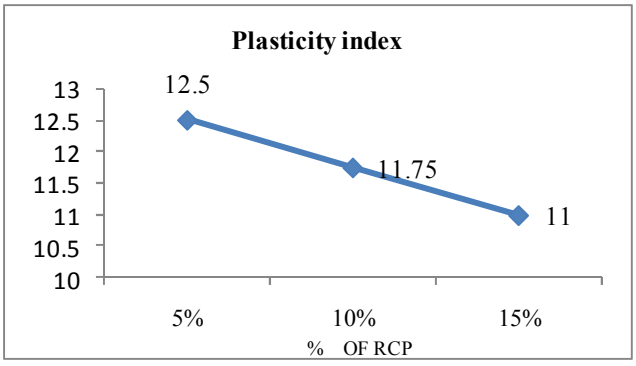

Fig. 6. Plasticity index with 3% of lime as constant

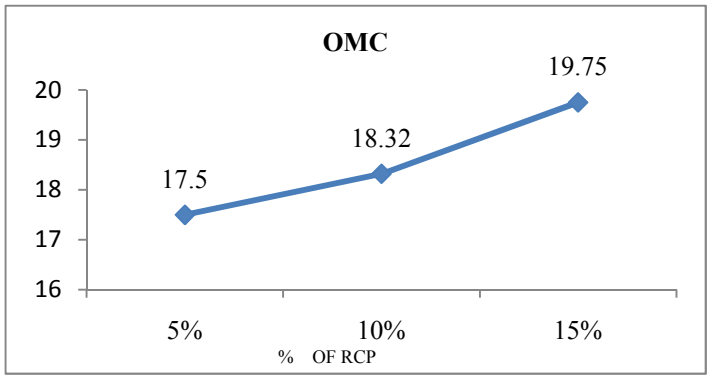

Fig.7. Optimum moisture content of soil with 3%of lime as constant

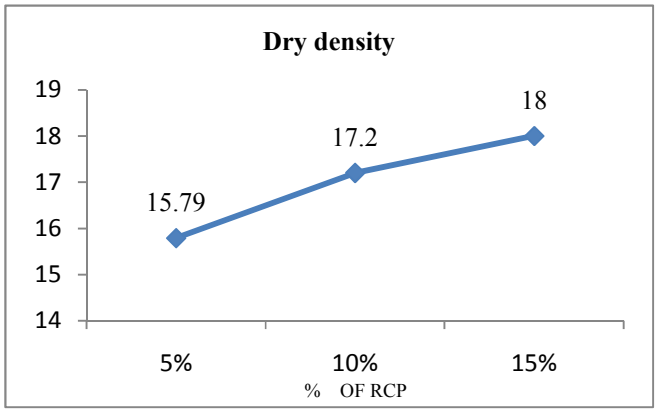

Fig.8. Dry density of soil with 3% of lime as constant

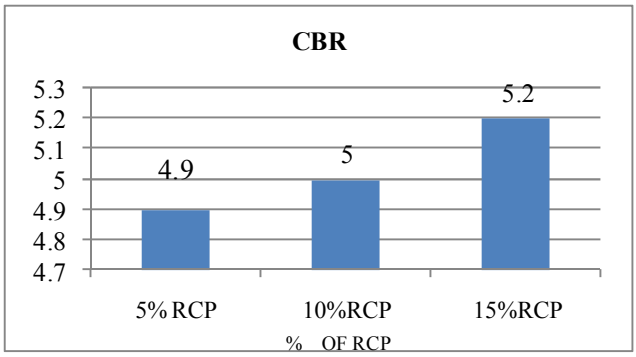

Fig.9.CBR value with 3% of lime as constant

CONCLUSIONS

Based on the experiments carried out on soil with increasing percentage of rubber crumbs powder (5%, 10%and 15%) along with 3% of lime as a constant the following observations were concluded

- Increased CBR value with increasing percentage of rubber crumbs at 3% of lime as constant .therefore increased CBR value leads reduced pavement thickness and increased stability.
- Optimum moisture content and maximum dry density increase with increasing percentage of rubber crumbs powder.
- Soil stabilized with rubber crumbs along with lime is more suitable for shallow foundation.
- Cost effective method of stabilization.
- Best solution for the environmental problem.
- New resource for the construction industry.

REFERENCES

[1] V. Mallikarjuna , T. Bindu Mani(2016) "Soil Stabilization using Plastic", International journal of research in engineering and technology , volume no : 5, issue no : 5, page no : 391-394.

[2] Brajesh Mishra(2015) "A study on Engineering behaviour of black cotton soil and its stabilization by use of lime",International journal of science and research.Volume no : 4, issue no : 11, page no : 290-294

[3] Umar Jan, associate prof. vinod kumar, vinpul kerni.(2015) "soil stabilization using shredded rubber tyre",International journal of civil and structural engineering research volume no : 3, issue : 1, page no : 57-60.

[4] Gatge Sandip Habirao , Dr.P.G.Rakkaradi "Soil Stabilization using Shredded Rubber Tyre Chips", IOSR Journal of Mechanical and Civil engineering (IOSR-JMCE) e-ISSN: 2270-1684, p-ISSN: 2320-334X, Volume 11,Issue 1 verv (Feb 2014), PP 20-27.

[5] P.T.Ravichandran, A.Shiva Prasad, K.Divya Krishnan, P.Kannan Rajkumar "Effect of Addition of Waste Tyre Crumb Rubber On Weak Soil Stabilisation", Indian Journal Of Science and Technology,vol 9(5), DOI:10.17485/ijst/2016/v9i5/87259, February 2016.

[6] Prasad, D.S.V., and Prasa Raju, G.V.R.(2009) "Performance of Waste Tire Rubber On Model Felxible Pavement", Asian Research Publishing Network Journal on Applied Science, vol.4, pp.89-92.

[7] Tanveer Asif Zerdi, Siddappa, Pranesh, Pallavi "Soil Stabilisation Using Lime Utilisation", Indian Journal of Research, May (2016) ISSN: 2250-1991, Vol.5, Issue 5.

[8] Purushotham, G.Sarvade and prashant R Shet, "Geotechnical Properties of Problem Clay Stabilized With Crumb Rubber Powder", Bonfring International Journal of Engineering and Management Science, vol.2, No.4, December 2012.

[9] Meei-Hoan Ho and Chee-Ming Chan,"The Potential of Using Rubber Chips as a Soft Clay Stabilize Enhancing Agent", Modern Applied Science, Vol.4, No.10, (2010).

[10] Kavish S. Mehta, Rutvij J. Sonecha, Parth D. Daxini, Parth B. Ratanpara, Miss Kapilani S. Gaikwad "Analysis of Engineering Properties of Black Cotton Soil & Stabilization Using By Lime."Miss K S. Gaikwad et al Int. Journal of Engineering Research and Applications, ISSN: 2248-9622, Vol. 4, Issue 5(Version 3), May 2014.

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