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Effect of Crushed Coconut Shells on CBR Values of Black cotton soil

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Abstract —*In order to cope with rapid increase in population and huge development in infrastructure the engineers are forced to carry out the various construction activities even on problematic soil. The demand for land has increased considerably for the past few decades. This has led to limited availability of land resources. In soil stabilization industry, the use of industrially manufactured soil improving additives (cement, lime etc) have kept the cost of construction high. In order to make problematic soils useful and meet geotechnical engineering design requirements researchers have focused more on the use of locally available cheaper materials from industrial and/or agricultural waste. Our research is aimed at assessing the effects of crushed coconut shell on the stabilization of Black cotton soil. Unsocked CBR test was conducted on black cotton soil with varying percentage of Crushed Coconut Shells (2.5%, 5%, 7.5% & 10%).*

Keywords- *Stabilization of soil, CBR Test, Crushed Coconut Shell, Geotechnical Engineering, Black cotton soil*

I. INTRODUCTION

The durability of road surface depends on the strength of the fill material and the sub-grade below it. The strength of the sub-grade is most commonly expressed as California Bearing Ratio (CBR), which is the ratio of test load to standard load at a specified penetration (in mm), by a standard plunger. The values of modulus of sub-grade reaction, thickness of pavement and resilient modulus of soil have been correlated with CBR value. In India the design of flexible pavement is primarily on the basis of the CBR value of sub-grade CBR (IRC: 37 - 2001). CBR value of soil may depends on many factors like maximum dry density (MDD), optimum moisture content (OMC), liquid limit (LL), plastic limit (PL), plasticity index (PI), type of soil, permeability of soil etc. Besides, soaked or unsoaked condition of soil also affects the value. Since sub-grade CBR is taken as the criterion for the design of flexible pavements, the thickness of the component layers (sub base and base course) will be reduced when the sub-grade CBR is high. Many techniques have been developed to strengthen the soil sub-grade for pavement. Most of them primarily involve strengthening using chemical admixtures, which are costly sometimes. In this study, the effect of adding crushed coconut shells (CCS) on the problematic black cotton soil was found out.

Coconut shells are naturaly available and it can be successfully utilized in industry for diferent use. Also it is ecofriendly, locally and cheaply available material. This research is based on checking its suitability as a soil stabilizing admixture for stabilisation of black soil. This paper presents an experimental study on the effect of Crushed Coconut Shells on the CBR values of soil. Different tests were conducted on black cotton soil with varying percentage of Crushed Coconut Shells (2.5%, 5%, 7.5% & 10%).

Stabilization may be defined as any process by which a soil material is improved and made more stable. Soil stabilization is the treatment of natural soil to improve its engineering properties. The goals of stabilization are therefore to improve the soil strength, to improve the bearing capacity and durability under adverse moisture and stress condition. In India about 51.8 million hectares of the land area are covered with Expansive soils (black cotton soil). The Black cotton soils are very hard when dry, but lose its strength completely when in wet condition. Expansive soils offer are a worldwide problem that poses several challenges for civil Engineers. The stabilization of the problematic soils is very important for many of the geotechnical engineering applications such as pavement structures, foundations, channel and reservoir linings, water and sewer lines to avoid damage due to settlement or the swelling action of expansive soil.

II. METHODOLOGY AND MATERIALS

Main purpose of research is to assess the effect of mixing crushed coconut shell in black cotton soil in order to increase the strength of soil. In present study, the Unsocked CBR test was conducted on black cotton soil with varying percentage of Crushed Coconut Shells (2.5%, 5%, 7.5% & 10%).

Dry Coconut Shells were collected from locally available waste fields and they were crushed manually in our institute lab using compaction rammers. Then the crushed coconut shells were passed through 4.75mm IS sieve and retained on 2 mm IS sieve.

The black cotton soil samples were collected from "Por" village near Vadodara (Gujrat, India). The geotechnical properties like maximum dry density (MDD), optimum moisture content (OMC), liquid limit (LL), plastic limit (PL) and specific gravity of soil samples were tested as per Indian standard specification (IS 2720) and as shown in table1.

Table 1: Basic Properties of Black Cotton Soil

Property	Value
COLOR	Black
SPECIFIC GRAVITY	2.18
LIQUID LIMIT (%)	60-70
PLASTIC LIMIT (%)	40-45
MAXIMUM DRY DENSITY (gm/cc)	1.68
OPTIMUM MOISTURE CONTENT (%)	14.45
CBR VALUE (%)	8.08

III. RESULTS AND DISCUSSIONS

The basic properties of the soil were determined which are shown in Table1. The Series of CBR Tests were conducted on black cotton soil without CCS (Crushed Coconut Shells) and with CCS in varying percentage. The percentages of CCS were taken as 2.5%, 5%, 7.5% & 10%. The results are shown in Table 2.

Table 2: CBR Test Values

Black Soil + % CCS	CBR value (%)
0	8.08
2.5	12.11
5	11.38
7.5	10.65
10	8.02

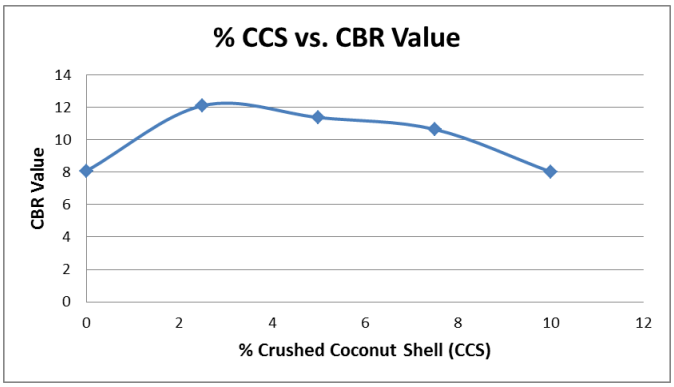

Fig 1: % CCS vs. CBR Value

Variation of CBR value with % CCS is as shown in figure 1. Maximum CBR value was obtained corresponding to 2.5% CCS which is 50% more than the CBR value of black cotton soil without adding admixture.

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