

EFFECT OF COCONUT SHELL POWDER ON THE STRENGTH OF SOIL

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ABSTRACT

Cocos Nucifera trees, otherwise known as coconut palm trees, grow abundantly along the coast line of Kerala. As a result coconut shells are abundantly available and it has been successfully utilised in many fields. This research is devoted to assessing its suitability as a stabilising agent in the field of ground improvement techniques. It mainly presents an experimental study on the effect of coconut shell powder on the strength of soil. Different tests were conducted on soil with varying percentage of coconut shell powder (1%, 2%, 3% and 4%). Data presented include optimum moisture content, maximum dry density and CBR value.

KEYWORDS: Soil Stabilisation, Coconut Shell Powder, California Bearing Ratio, Dry Density

INTRODUCTION

With rapid increase in population and huge development in infrastructure the demand for land has increased considerably for the past few decades. This has led to limited availability of land resources. Hence an engineer is forced to carry out the various construction activities even on problematic soil. There comes the importance of ground improvement techniques. Thus different soil stabilisations are gaining more importance in the present scenario.

Different soil stabilisers are used in this field. The over dependence on industrially manufactured soil improving additives (cement, lime etc) have kept the cost of construction financially high. In order to make deficient soils useful and meet geotechnical engineering design requirements researchers have focused more on the use of potentially cost effective materials that are locally available from industrial and agricultural waste in order to improve the properties of deficient soils.

Kerala is a land blessed with a lot of coconut trees. Coconut tree provide numerous advantages in which CSP is used as raw material for industrial production and other applications. The major applications of CSP are as follows,

- Raw material for Activated Carbon industries
- Compound filler in the manufacture of Phenolic molding powder (Bakelite plastic)
- Filler for synthetic resin glues
- Lost Circulation Material in Oil Well Drilling, etc.

The use of coconut shell powder in the field of soil stabilisation has not yet been properly exploited. Hence an experimental study on effect of CSP on strength of soil is made. It has different properties that make it suitable as soil stabiliser such as durability, high toughness, abrasion resistance etc. Coconut shell has long standing use and it is environmental friendly.

METHODOLOGY AND MATERIALS

The main purpose of the project was to evaluate the effect on soil properties especially the strength of soil due to the addition of coconut shell powder. Coconut shell powder was added in different percentages for experimental studies.

Soil

The soil samples were collected from Kothamangalam (Kerala, India). The geotechnical properties of soil samples were tested as per Indian standard specification (IS 2720) and as show in table1

Table 1: Basic Properties of Soil

Property	Value
EFFECTIVE SIZE (MM)	0.2
UNIFORMITY COEFFICIENT	7.5
COEFFICIENT OF CURVATURE	0.83
SPECIFIC GRAVITY	2.74
LIQUID LIMIT (%)	34
PLASTIC LIMIT (%)	27.69
PLASTICITY INDEX (%)	6.31
COEFFICIENT OF PERMEABILITY(CM/S)	$6.192 \times 10^{(-4)}$
MAXIMUM DRY DENSITY(G/CC)	1.48
OPTIMUM MOISTURE CONTENT (%)	24
COHESION(KN/M2)	8
CBR VALUE (%)	9

Grain size distribution curve is as shown below.

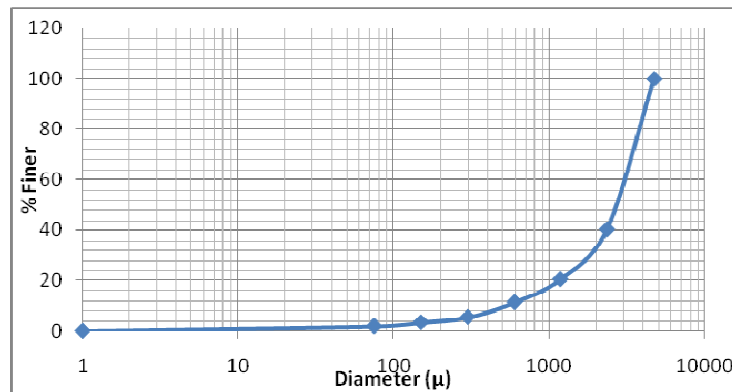


Figure 1: Grain Size Distribution Curve

Properties of Coconut Shell

Coconut shell collected were powdered using automatic compactor and the portion passing 4.75 mm sieve were used for tests carried out.

Table 2: Coconut Shell Compound (Dry Basis)

Compound	Percent
Cellulose	33.61
Lignin	36.51
Pentosans	29.27
Ash	0.61

Grain size analysis was performed for the sample of coconut shell powder. The particle size distribution curve thus obtained is as follows.

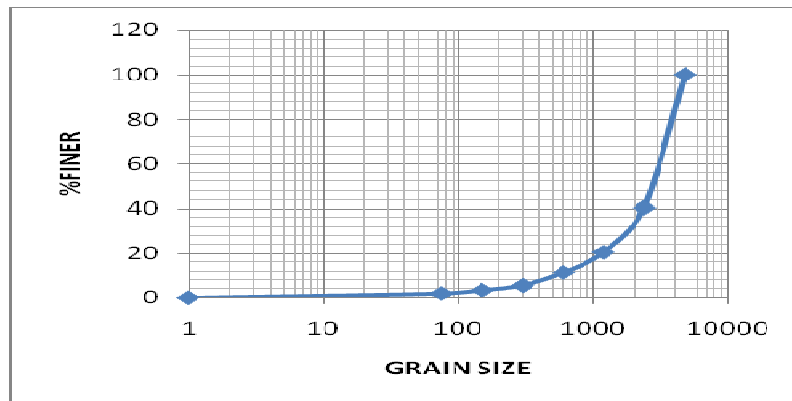


Figure 2: Grain Size Distribution of Coconut Shell

Then the specific gravity of coconut shell as determined by using pycnometer test was 1.23.

RESULTS AND DISCUSSIONS

The basic properties of the soil were determined. The experiments were conducted by using soil without CSP and with CSP in varying percentage. The percentages of CSP were taken are 1%, 2%, 3% and 4%. The results were compared among themselves.

Proctor’s Compaction Test

The optimum moisture content and maximum dry density of the soil samples for various percentage of CSP (0%, 1%, 2%, 3% and 4%) were determined by performing the Standard Proctor’s Test. The dry density was determined and plotted against the corresponding water content to find out the optimum moisture content and the corresponding maximum dry density. The values of OMC and MDD of various % of CSP are tabulated in Table 2.

Table 3: Proctor’s Test

% of CSP Added to Soil	Optimum Moisture Content (OMC in %)	Maximum Dry Density (MDD in g/cc)
0	24	1.48
1	26	1.68
2	23	1.48
3	25	1.52
4	25	1.43

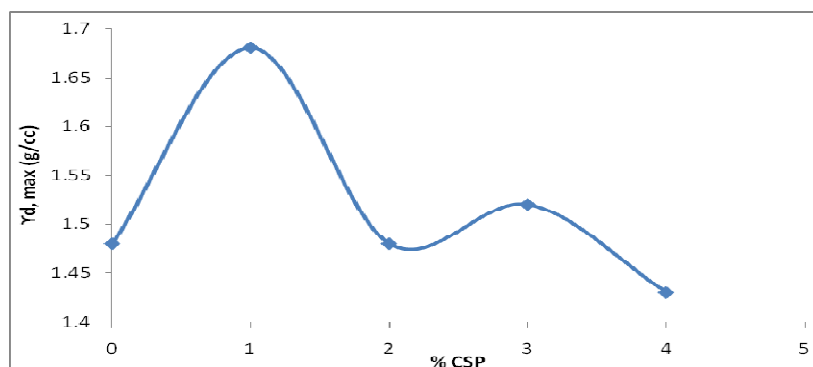


Figure 3: Maximum Dry Density Vs % CSP

Variation of MDD with % CSP is as shown in figure. Maximum MDD was obtained corresponding to 1% CSP.

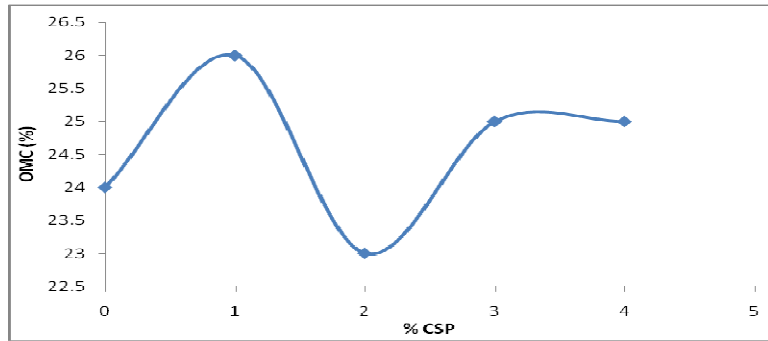


Figure 4: OMC Vs %CSP

The figure 3 shows the variation of optimum moisture content with % of CSP added.

California Bearing Ratio Test

California Bearing Ratio test is one of the most commonly used method to evaluate the strength of sub grade soil for the design of pavement thickness. The CBR values of soil samples for various percentages of coconut shell were determined.

Table 4: CBR Test

% of Coconut Shell Powder	CBR Value
0	8.27
1	3.31
2	15.57
3	3.7
4	3.4

Effect on CBR value Variation of CBR value with % CSP is as shown in figure. Maximum CBR value was obtained corresponding to 2% CSP.

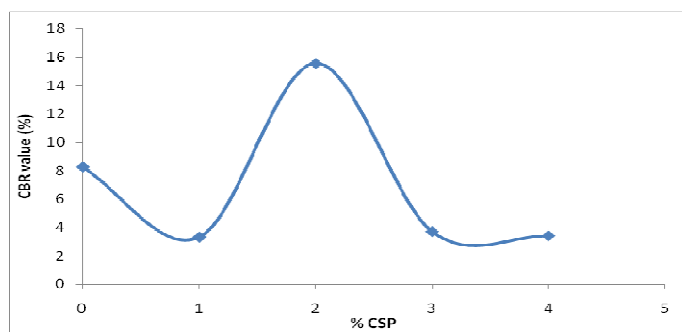


Figure 5: CBR Value Vs %CSP

CONCLUSIONS

The effect of coconut shell powder on soil samples were studied by conducting tests with various percentage(1%,2%,3%, and 4%) of coconut shell powder and the following conclusions drawn. Max dry density is obtained when 1%CSP was added to the soil and minimum OMC is obtained for 2%.

It can be recommended for short term stabilisation of slope. The only difficulty is powdering of shell. Further reserch is required to determine the optimum percentage.

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