ORIGINAL RESEARCH PAPER

Engineering

EXPERIMENTAL STUDIES ON THE STRENGTH BEHAVIOUR OF CLAYEY SOIL TREATED WITH COAL ASH, GROUNDNUT SHELL ASH & LIME

KEY WORDS: Clayey soil, Coal ash, Groundnut shell ash, Lime, Compaction, CBR,UCC

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ABSTRACT

The clayey soil is collected from Ponnepadam11.219677 N, 75.878844 E, a marshy land area. The collected soil is stabilized using coal ash, groundnut shell ash and lime in different combinations. The collected soil is stabilized using coal ash alone, a combination of coal ash and groundnut shell ash & a combination of coal ash, groundnut shell ash and lime. The effect of these admixtures on the clayey soil was investigated with respect to Modified proctor test, California bearing ratio (CBR) and unconfined compression test

The results shows increase in Optimum moisture content, UCC value and CBR value. There is also an increase in maximum dry density (MDD). It was also found that there was a tremendous increase in CBR value as well as in UCC value, when it is stabilized with a combination of coal ash , groundnut shell ash and lime. This indicates a potential of using coal ash, groundnut shell ash and lime as a combination to stabilize clayey soilThe clayey soil is collected from Ponnepadam11.219677 N, 75.878844 E, a marshy land area. The collected soil is stabilized using coal ash, groundnut shell ash and lime in different combinations. The collected soil is stabilized using coal ash alone, a combination of coal ash and groundnut shell ash & a combination of coal ash, groundnut shell ash and lime. The effect of these admixtures on the clayey soil was investigated with respect to Modified proctor test, California bearing ratio (CBR) and unconfined compression test

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I. INTRODUCTION

Expansive clays exhibit characteristics such as swelling & Shrinkage under different moisture conditions. This causes severe damage to the structures or pavements resting on them. This causes extensive cracks on road pavements; to rectify this damage cost implementation is very high.

Various additives are widely used for the treatment of cohesive soil in order to reduce the expansive properties, increase its strength and decrease plasticity index, swell & shrinkage potential. Easily available and cheap in cost materials are used in this project, they are also ecofriendly in nature. Various combinations of two admixtures are commonly seen. This paper describes the use of three admixtures that is coal ash, groundnut shell ash and lime to stabilize collected clayey soil. This experimental study describes a comparative study of stabilization of clayey soil with coal ash alone & a combination of coal ash and groundnut shell ash ,similarly a combination of coal ash ,groundnut shell ash and lime. The objective of this project is to compare the performance of clayey soil when stabilized with these additives & to find out the best combinations. Also optimum percentage of admixtures is found out which gives maximum strength to the collected soil and it is evaluated whether it is suitable for the pavement subgrade.

II. SCOPE AND OBJECTIVE OF THE PROJECT

1. To use waste materials such as coal ash and ground nut shell ash as a stabilizing material along with lime and to solve the problem of waste disposal.
2. To evaluate the strength characteristics of clayey soil for different proportions of coal ash, ground nut shell ash and lime in replacement of different percentages.
3. To study and evaluate few waste materials for their adequacy and bulk utilization through stabilizing a clayey subgrade soil.
4. To study the effects of stabilization on index and engineering properties of soil using three types of materials(CA,GSA&L) as admixtures
5. To compare of admixture based on their relative influence and optimum content on properties of subgrade soil.
6. To quantify degree of improvement admixture type and test conditions for utilization as subgrade

III. MATERIALS USED

Clayey soil

The expansive soil is collected from Ponnepadam 11.219677 N, 75.878844 E in the location of Panthirankavu, Kozhikode by using a technique known as disturbed sampling. Clayey soil is collected from below 1m from the surface. A yellow colour soil is seen up to a depth of 3m; below that depth a black colour clayey soil is obtained. The soil is greyish black & plastic clay. Disturbed sample is collected from a test pit below natural ground level in order to avoid the inclusion of organic matter

Fig 1: clay soil collected below a depth of 1m

Coal ash

Coal ash is the generic term referring to several very distinct materials produced when we combust coal to produce electricity. Coal ash offers our society extraordinary environmental and economic benefits without harm to public health and safety when properly managed. Coal ash is collected from Sree RagarajIspat Industries, Perundurai,Erode, Tamil Nadu

Fig 2:Coal ash

Groundnut shell ash

Groundnut shell ash is collected from Jagadesh Enterprises,

Tharanmani,Chennai, Tamil Nadu

Fig 3: Groundnut shell ash

Lime

The lime is purchased from the open market from authorized dealers in Calicut.

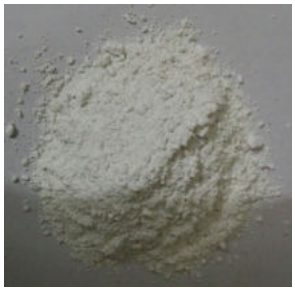
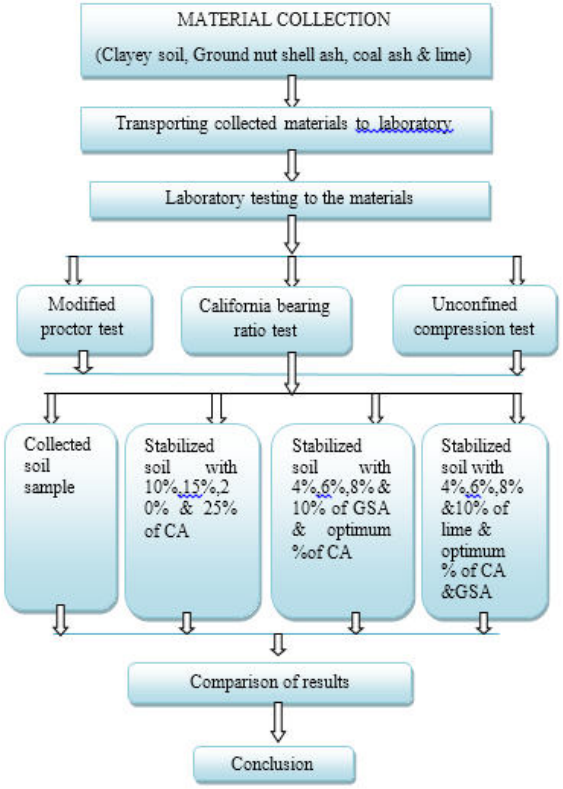


Fig 4: Lime

I. METHODOLOGY



V. TEST RESULTS

PROPERTIES OF CLAYEY SOIL

Name of test	Test results
Specific gravity	2.63
Hydrometer analysis	% clay= 56% %silt =37% % sand= 7%
Atterberg limits Plastic limit Liquid limit Shrinkage limit Shrinkage ratio	60% 47.125% 22.3%
Free swell index	50%
Modified proctor test OMC MDD	16% 1.61 g/cc
CBR value	6.17
Unconfined compressive strength	84.6 KPa

I. COMPACTION CHARECTERISTICS OF COAL ASH, GROUNDNUTSHELL ASH AND LIME

Heavy compaction is used for this experiment IS 2720(Part 8)-1980 recommends the specification od Modified proctor test or Heavy compaction.it is found that maximum dry density of the soil has decrease with the replacement of coal ash, groundnut shell ash & lime & there is an increase in optimum moisture content with the increasing replacement of coal ash , groundnut shell ash and lime.

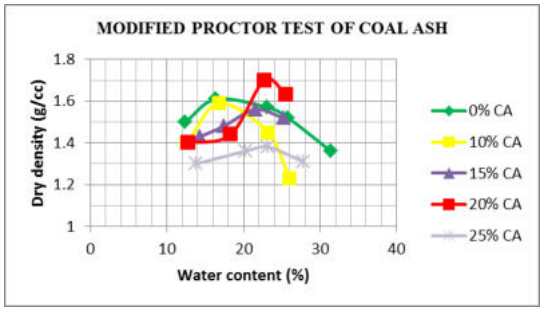


Fig 4: Modified test data for different percentage of Coal ash

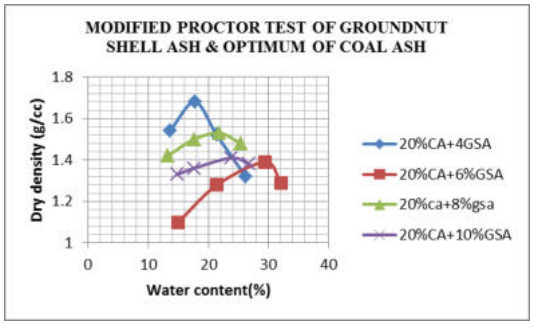
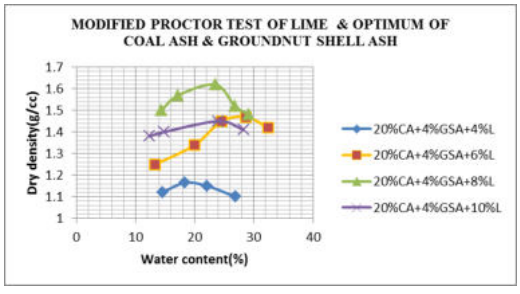


Fig 4: Modified test data for different percentage of Groundnut shell ash & optimum of Coal ash



.Fig 6: Modified test data for different percentage of Lime &

optimum of Coal ash & Ground nut shell ash

VVI.UNCONFINED COMPRESSION CHARACTERISTICS OF COAL ASH, GROUNDNUT SHELL ASH & LIME

The Unconfined compressive strength is obtained as per IS 2720(part 10)1991.The variation of unconfined compressive strength against coal ash is shown in fig 7. Unconfined compressive strength is highest at 20% of Coal ash content. Unconfined compressive strength has been increased to 242.33 kPa that is 2.86 times of untreated soil.

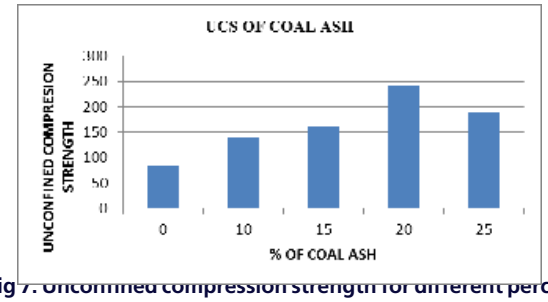


Fig 7: Unconfined compression strength for different percen t age of Coal ash

The variation of compressive strength is shown in the fig 8 of 20% CA+ various combination of groundnut shell ash. It is obtained that maximum compressive strength is at 20%CA+10%GSA that is 352.6 kPa. There is a decrease in compressive strength at 20% CA+8%GSA

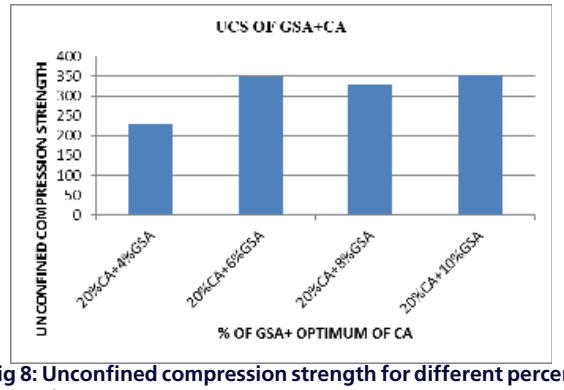


Fig 8: Unconfined compression strength for different percen tage of Coal ash & groundnut shell ash

The variation of unconfined compressive strength for 20% CA+10%GSA+ different percentages of lime is shown in the fig 9. The influence of lime along with optimum percentages of coal ash and ground nut shell ash has increased the strength to 4.34 times of the untreated soil. The maximum unconfined compressive value is for 20%CA+10%GSA+8%L that is obtained as 366.9 kPa.

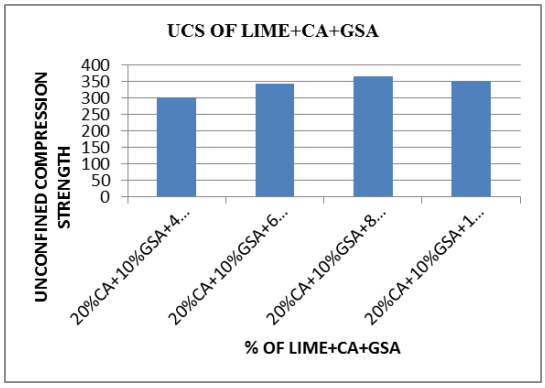


Fig 9: Unconfined compression strength for different percentage of Coal ash , groundnut shell ash and lime

VIII. CALIFORNIA BEARING RATIO OF COAL ASH, GROUN DNUT SHELL ASH& LIME

The Unsoaked CBR test is conducted as per IS 2720(part6)-1987.Fig 9 shows the variation of California Bearing ratio value against coal ash content. The CBR has been improved to 1.44 times at 20% coal ash content. The CBR ratio at 20% of coal ash is 8.9%

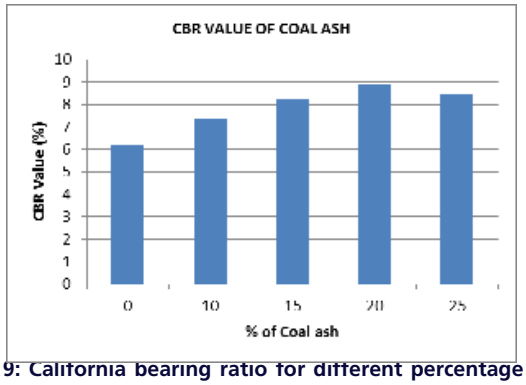


Fig 9: California bearing ratio for different percentage of Coal ash

As per fig 10 California bearing ratio increases from the combination of mix coal ash & groundnut shell ash from the natural soil value to 10.8%. But there is a decrease in CBR value at 20%CA+8%GSA. Maximum value of CBR is obtained at 20%CA+10%GSA that is 11.09%

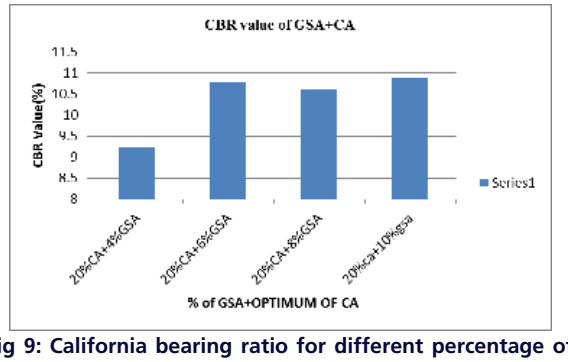


Fig 9: California bearing ratio for different percentage of Coal ash & GSA

As per fig 10 it shows the CBR values for the mix of 20%CA+10%GSA & different combination of lime. Maximum CBR value is obtained at 20%CA+10%GSA+8%L that is CBR has been improved to 2.46 times the untreated soil sample. The addition of lime along with the coal ash & ground nut shell ash led to more increase in CBR value; this is due to the formation of cementitious compounds.

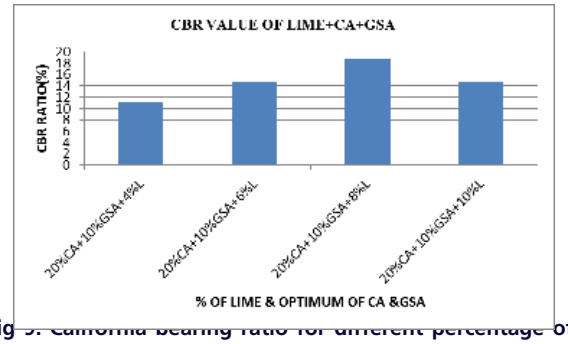


Fig 9: California bearing ratio for different percentage of Coal ash, GSA & Lime

Percentages of contents	CBR VALUE(%)
COAL ASH (CA)	
0%CA	6.17
10%CA	7.36
15%CA	8.23
20%CA	8.9
25%CA	8.45
COAL ASH (CA)& GROUND NUT SHELL ASH(GSA)	
20%CA+4%GSA	9.24
20%CA+6%GSA	10.8
20%CA+8%GSA	10.62
20%CA+10%GSA	11.09
COAL ASH (CA),GROUNDNUT SHELL ASH(GSA) & LIME(L)	
20%CA+10%GSA+4%L	11.2
20%CA+10%GSA+6%L	14.6
20%CA+10%GSA+8%L	15.18
20%CA+10%GSA+10%L	14.18

I. CONCLUSION

This project is done to evaluate the effect of combination coal ash, groundnut shell ash and lime on the engineering properties of the soil

- Maximum dry density of the soil same decreases with the increase in percentages of coal ash, groundnut shell ash & lime
- Optimum moisture content of the collected soil sample increases with the increase in percentages of coal ash ,groundnut shell ash & lime
- The optimum dosage of three materials is obtained at a combination of 20%Coal ash, 10% Groundnut shell ash &8% Lime
- Mix of 20% coal ash, 10% of groundnut shell ash and 8% of lime has improved the CBR value as well as UCS of the collected soil sample.UCS has increased 4.34 times as that of plain soil and also the CBR has increased 2.46 times as that of the plain soil.
- The addition of lime along with coal ash &groundnut shell ash has improved the strength properties of the soil hence it is suitable for the pavement subgrade

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