



INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

STRENGTH BEHAVIOUR OF MARINE CLAY TREATED WITH RICE HUSK ASH

Dr.D S V Prasad*, H Venkateswarlu, N Janardhan Rao, J Chaitanya Kumar

* Civil Engineering Department, B V C Engineering College, Odalarevu, AP, India

Civil Engineering Department, B V C Engineering College, Odalarevu, AP, India

Civil Engineering Department, B V C Engineering College, Odalarevu, AP, India

Civil Engineering Department, B V C Engineering College, Odalarevu, AP, India

ABSTRACT

The amount of wastes has increased year by year and the disposal becomes a serious problem. This paper presents the effects of rice husk ash on, liquid limit, plastic limit, compaction characteristics and California Bearing Ratio on marine clay soil. The marine clay collected from Kakinada, East Godavari Dt, Andhra Pradesh was mixed with rice husk ash waste from 0 to 25% at an increment of 5%. From the analysis of test results it was found that, specific gravity decreases, liquid limit, plastic limit, optimum moisture content, maximum dry density and California bearing ratio are increased with an increase in RHA up to 20% addition beyond it is not much effective.

KEYWORDS: Marine Clay, Rice Husk Ash, Atterbergs Limits, California Bearing Ratio .

INTRODUCTION

Transportation and Communication facilities are necessary for any developing countries like India. The technology of road construction depends mainly upon the vehicular pattern, construction materials and sub grade condition. Sub grade is an integral part of the road pavement structure as it provides the support to the pavement from beneath. The main function of the sub grade is to provide adequate support to the pavement and for this the sub grade should possess sufficient stability under any adverse climate, loading and deformation loading conditions. The performance of these soft fine grained deposits under different conditions of environment varies over wide limits. Due to the poor sub grade conditions formation of fractures, fissures, rutting and the phenomena of pumping, blowing and consequent cracking of cement concrete pavements occur. Effects of marine clay have appeared as cracking and break-up of pavements, railway and highway embankments, roadways, building foundations, irrigation systems, water lines, canal and reservoir linings. The estimated damage was very expensive to the pavements running over the marine clay sub grades. So considerable changes have to be made in the construction of various coastal and offshore structures. In order to improve the engineering behavior of these soils, several improvement techniques are available in geotechnical engineering practice. The selection of any of these methods to overcome any problem can be proved to be efficient only after the comparison of that with other techniques, then it can be said that the particular method is well suited for a specific system. In general, the soils which are existing in the coastal corridors are Soft Marine Clays formed by the deposits and generally weak and possesses high deformation values in nature. It is essential to study the various techniques for the improvement of marine clays, especially in case of infra-structure development. Anitha G Pillai et al., has carried out the effect of sulphate content of clay sample by different methods and the following conclusions have been drawn. Sulphate content of the order of 0.5% obtained for the marine clay sample is of serious concern while considering stabilization of these clays using lime. All the three methods give comparable results. Dr. D. Koteswara Rao et al., (2011), is observed that the liquid limit, plastic limit and the plasticity index were significantly high and the OMC was below the plastic limit from the chemical analysis, the marine clay was found to possess significant proportion of carbonate content, organic matter content, cation exchange capacity and marginally alkaline. From the experimental results, U.U Triaxial test of a remoulded marine clayey soil sample, the value of Cohesion and Angle of internal friction were estimated as 0.12kN/m² and 3.50 respectively. From the vane shear tests it was also observed that with the increase in moisture content, the unit cohesion of the soil sharply dropped down to a value as low as 6 kPa. The load carrying capacity of the Marine Clay is high at its OMC to compare with FSC. It is observed from the test results that the time required for 90% consolidation is 311.6 days and from the test results that the marine clay is fall under the category of moderately swelling soil and the Swell Pressure is 160 kN/m². Dr. D. Koteswara

Rao, G.V.V. Rameswara Rao and P.R.T. Pranav (2012), has studied the effect of Rice Husk ash and Lime on strength properties of marine clay and observed that, liquid limit of the marine clay has been decreased by 16.21% and further decreased by 29.86%, plastic limit improved by 7.40% and further improved by 16.29%; plasticity index has been decreased by 29.78% and further decreased by 56.38% ; OMC decreased by 18.52% and further decreased by 42.63% ; MDD has been improved by 17.00% and further improved by 12.70% ; CBR increased by 282.0% and has been further improved by 449.14% ; DFS value of the marine clay has been decreased by 72.80% on addition of 25% Rice Husk Ash and it has been further decreased by 77.28% when 9% lime is added. The soaked CBR of the soil on stabilizing is found to be 9.632 and is satisfying standard specifications and finally concluded from the above results that the stabilized marine clay is suitable to use as subgrade material for the pavement construction and also for various foundations of buildings. Sandeep and Nithya (2013), conducted series of Unconsolidated Undrained and Consolidated Drained triaxial tests at confining pressures of 50 kPa, 100 kPa and 150 kPa and from the results Cochin marine clay designated as CH (Inorganic clays of high plasticity) from plasticity charts. From Unconsolidated Undrained triaxial tests, cohesion value of untreated marine clay was 32.5 kN/m² and maximum value of cohesion was obtained 47 kN/m². From Consolidated Drained triaxial tests, cohesion value of untreated marine clay was found to be 11.25 kN/m² and maximum value of cohesion was obtained as 23.75 kN/m² (percentage increase 111%) on addition of 5% Class F fly ash. Consolidated Drained triaxial tests were done on marine clay with optimum percentages of additives after 7 and 14 days of curing. Considerable strength increment was observed for treated soil samples after the curing period. Dilip Shrivastava et al., (2014), have study the feasibility of using Rice Husk Ash with lime as soil stabilization material. A series of laboratory experiment has been conducted on 5% lime mixed black cotton soil blended with Rice Husk Ash in 5%, 10% 15% and 20% by weight of dry soil. The experimental results showed a significant increase in CBR and UCS strength. The CBR values increases by 287.62% and UCS improved by 30%. The DFS of the black cotton soil is reduced by 86.92% with increase in Rice Husk Ash content from 0% to 20% respectively. From this investigation it can be concluded that the Rice Husk Ash has a potential to improve the characteristics of black cotton soil. From the available literature it is found that limited research has been done to study the effects of rice husk ash waste on different geotechnical properties of marine clay . In the present study has been undertaken to investigate the effects of RHA waste on index properties, compaction properties and California Bearing Ratio (CBR) of marine clay soil .The economy of stabilization has also been studied by strengthening the marine clay subgrade of a flexible pavement. This is a relatively simple technique for ground improvement and has tremendous potential as accost effective solution to many geotechnical problems.

MATERIALS AND METHODS

Details of various materials used during the laboratory experimentation are reported in the following section.

Marine Clay

The soil found in the ocean bed is classified as marine soil. It can even be located onshore as well. The properties of marine soil depend significantly on its initial conditions. The soil collected from Kakinada, East Godavari Dt as shown in the fig.1. The soil was air dried before the commencement of experiments. The properties of the marine clay are Specific Gravity=2.31, Liquid limit = 41%, Plastic Limit = 17.05, MDD = 1.29 g/cm³, OMC = 66.66% Coefficient of uniformity (C_U) = 4.7, Coefficient of gradation (c_g) = 3.07 and CBR = 1.97.



Figure: 1 Marine Clay

Rice Husk Ash

<http://www.ijesrt.com>

© International Journal of Engineering Sciences & Research Technology

The stabilizer materials used in this study was Rice Husk Ash. Rice milling generates a by-product known as husk. This surrounds the paddy grain. During milling of paddy about 78% of weight is received as rice, broken rice and bran. Rest 22% of the weight of paddy is received as husk. This rice husk is collected from local Rice Mill from Amalapuram, East Godavari district as shown in the fig.2. The properties of rice husk are Specific Gravity=1.16, MDD = 1.15 g/cm³, OMC = 38.46% Coefficient of uniformity (C_u) = 11.18, Coefficient of gradation (c_g) = 1.13, Angle of internal friction (ϕ) = 26.58° and CBR = 14.55.



Figure: 2 Rice Husk Ash

LABORATORY EXPERIMENTATION

All the geotechnical properties were tested based on Indian Standard procedures. Various tests were carried out in the laboratory for finding the index and other important properties of the marine clay and rice husk ash used during the study. Compaction and CBR tests are conducted by using different percentages of rice husk ash are mixed with marine clay for finding optimum percentage of rice husk ash. The details of these tests are given in the following sections. The laboratory experiments were conducted as per the IS code specifications.

Specific Gravity: The specific gravity of the soil has been determined using the density bottle method, as per IS: 2720- (part III section I, 1980).

Grain Size Distribution: Sieve analysis has been conducted as per IS: 2720 (Part IV 1965).

Liquid Limit: The test has been carried out using the standard Casagrande liquid limit apparatus as per IS: 2720- (Part V-1965).

Plastic Limit: The plastic limit has been determined according to the IS: 2720- (Part V-1970).

Heavy Compaction: Compaction has been carried out as per the IS: 2720- (Part VIII-1980).

California Bearing Ratio (CBR) Tests: The California Bearing Ratio (CBR) tests were conducted in the laboratory by using a standard California Bearing Ratio (CBR) testing machine. According to IS: 2720 (part 16) 1979. Different samples are prepared in the similar lines for CBR test using marine clay and rice husk ash material and the details of which are given in table 1 and in the Fig .3.



Figure: 3 California Bearing Ratio Test Apparatus

Table.1 Different Percentages of Rice Husk Ash Mixing in Marine Clay

Base Material	Admixture	Different % of RHA
Marine Clay	Rice Husk Ash	0,5,10,15,20,25

RESULTS AND DISCUSSION

Index Properties: The results of specific gravity tests on marine clay treated with different percentage of rice husk ash shows that there is a decrease in specific gravity from 2.31 to 1.98 with increase in percentage of ash from 0 to 20% fig.4. The results of liquid limit tests on marine clay soil treated with different percentage of rice husk ash can be seen that with increase in percentage of ash the liquid limit of marine clay goes on increasing from 41% to 66%, when RHA waste is increased from 0 to 20% is effective beyond also there is a increase in liquid limit as shown in the fig.5. The results of plastic limit tests on marine clay treated with different percentage of RHA waste , it can be seen that with increase in percentage of ash waste, the plastic limit of soil goes on increases from 17.05 % to 23.05 % when ash is increased from 0 to 20% as shown in fig.6.

Compaction: All the marine slay soil samples were mixed with varying percentages of RHA waste material by weight. From the test results maximum dry density increases from 1.295 g/cc to 1.64 g/cc at 20% of RHA and increase in MDD by 26.64%, beyond which it decreases as shown in fig.7. However water content continuously decreases as shown in the fig. 8.

California Bearing Ratio (CBR): The results of soaked CBR tests on marine clay soil treated with different percentage of RHA are shown in Fig. 9. From the results it can be seen that with increase in percentage of ash waste, the soaked CBR of soil goes on increasing from 1.97 to 3.43 when RHA is increased from 0 to 20%. There is 75% increase in soaked CBR at this percentage of RHA as compared to untreated marine clay.

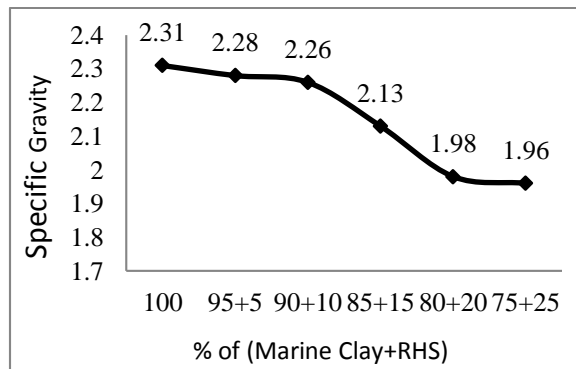


Fig: 4 Variation of Specific Gravity with Different Percentages of (Marine Clay+RHA)

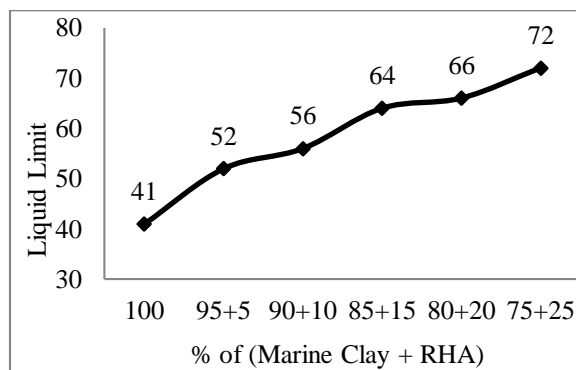


Fig: 5 Variation of Liquid Limit with Different Percentages of (Marine Clay+RHA)

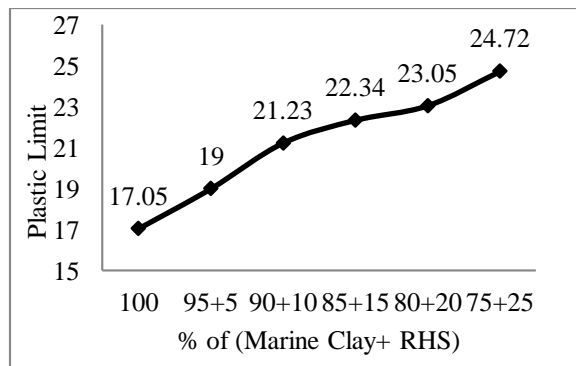


Fig: 6 Variation of Plastic Limit with Different Percentages of (Marine Clay+RHA)

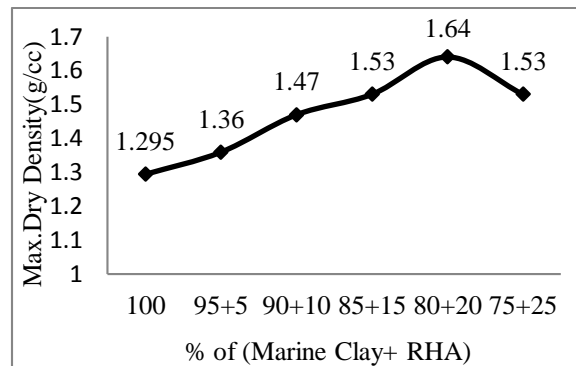


Fig: 7 Variation of Maximum Dry Density with Different Percentages of (Marine Clay+RHA)

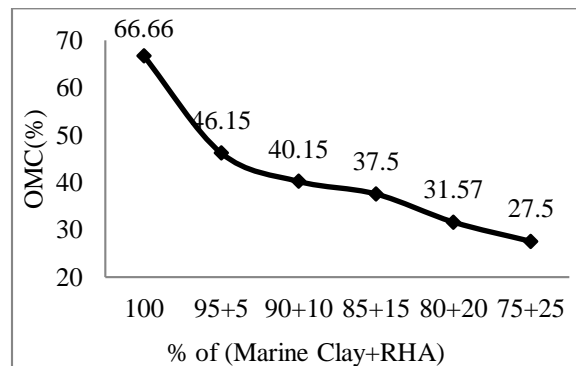


Fig: 8 Variation of OMC with Different Percentages of (Marine Clay+RHA)

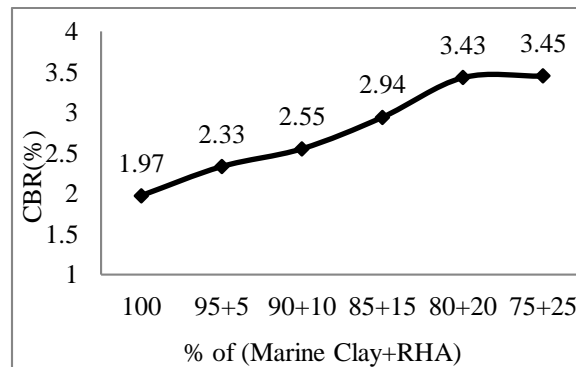


Fig: 9 Variation of CBR values with Different Percentages of (Marine Clay+RHA)

CONCLUSION

The specific gravity decreases from 2.31 to 1.98 for the marine clay up to the addition of 20% of rice husk ash beyond that the addition of rice husk ash not shows much improvement in the specific gravity.

The liquid limit continuously increases for the marine clay due the addition of rice husk ash, because of high water absorbing capacity of the add mixture(RHA).

The plastic limit of the marine clay increases from 17.05 to 23.05 up to the addition of 20% of rice husk ash, beyond the addition of add mixture not much effective.

The compaction parameters, maximum dry density and optimum moisture content values are increased from 1.29g/cc,66.66% to 1.64g/cc,31.54% up to the addition of 20% of rice husk ash respectively and beyond the addition of rice husk ash decreases the compaction parameters.

The CBR values are increased from 1.97 to 3.43 up to the addition of 20% of rice husk ash and beyond it is not much effective.

From the above conclusions the optimum percentage of RHA is 20%.

REFERENCES

- [1] Anitha G Pillai, Benny Mathews Abraham, A. Sridharan, "Determination of Sulphate Content in Marine Clays", / International Journal of Engineering Research and Applications (IJERA) ISSN: 2248, Vol. 1, Issue 3, pp.1012 -1016, www.ijera.com.
- [2] M. N. Sandeep and K. Nithya(2013), "Triaxial Testing And Analytical Modeling of Marine Clay Stabilized With Fly Ash", Proceedings of Indian Geotechnical Conference December 22 -24, 2013,Roorkee,Page1 of 8
- [3] D. Koteswara Rao ,Dr. G.V.R. Prasada Raju ,Ch. Sowjanya & J. Purnachandra Rao(2011), ,"Laboratory Studies on the Properties of Stabilized Marine Clay from Kakinada Sea Coast, India ", International Journal of Engineering Science and Technology (IJEST), ISSN : 0975-5462, Vol. 3 No. 1 Jan 2011, pp.421-428.
- [4] Dr. D. Koteswara Rao, G.V.V. Rameswara Rao, P.R.T. Pranav(2012), "A Laboratory Study on the Affect of Rice Husk Ash & Lime on the Properties Of Marine Clay", International Journal of Engineering and Innovative Technology (IJEIT), ISSN: 2277 -3754,Volume 2, Issue 1, July 2012,pp.345-353.
- [5] Dilip Shrivastava,A K Singhai and R K Yadav(2014)," Effect Of Lime And Rice Husk Ash On Engineering Properties Of Black Cotton Soil", Int. J. Engg. Res. & Sci. & Technology, ISSN 2319-5991 www.ijerst.com,Vol.3,No.2,May,2014,pp.292-296.