STABILIZATION OF SOIL

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ABSTRACT

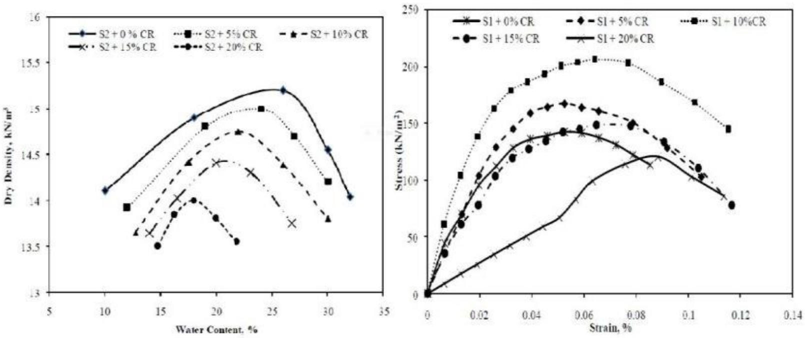
Searching for the best soil stabilizers to overcome problems occur by the soft soils are still being the main concern, not only to achieve the required soil engineering properties but also by considering the cost and the effect to the environment. The objective of this paper was to review the techniques that had been done for soil stabilization based on experimental studies. Investigation on various materials had been done in order to evaluate their effectiveness as soil stabilizer, which involved the use of sodium hydroxide additive, fly ash geopolymeric binder, various ashes and cementitious binders. Thesematerials were discussed in this paper and their effectiveness for stabilizing soft soils were observed from the obtained results,only in term of strength, based on unconfined compressive strength (UCS) test and California Bearing Ratio (CBR) test that had been conducted. The strength of soft soils was significantly increased with the used of these materials and supposed they had the potential as effective soil stabilizers in field application.

I. INTRODUCTION

In recent times global population has increased significantly, available resources are incapable of fulfilling the demand caused by the population growth. Researchers are striving to create new technologies and methods to improve the techniques that are being used to utilize the resources. Thus it becomes necessary to employ such techniques to make the best use of resources. Civil engineering aspect of proper utilization includes land stabilization through which we can modify land with inferior engineering properties into land which hasadequate engineering properties. Stabilization in broad sense incorporates the various methods employed for modifying the properties of a soil to improve its engineering performance, which can be done by various methods. Soil stabilization can be categorized under two main categories, mechanical and chemical stabilization. Mechanical stabilization includes soil remoulding, grade improvement and compaction while chemical stabilization includes mixing of admixtures to improve soil properties, these admixtures can be divided into two categories traditional admixtures and non-traditional admixtures. Current paper is a review paper highlighting the performance of various traditional and non-traditional additives when used for soil stabilization.

II. CRUMB RUBBER WITH SOIL

Shiva Prasad and P.T. Ravichandran studied the effect of crumb rubber on the behaviour of soil they used two different soils and conducted proctor test and unconfined compressive strength test to analyse the maximum dry density and strength values of soil. **Figures 1**



Figures 1 : Showing variation of MDD and UCS values with crumb rubber

They used crumb rubber ranging from 425 micron to 600micron and prepared a soil rubber mix of varying crumb rubber percentage (5%, 10%, 15%, and 20 % by weight) results obtained from proctor test shows decrease in MDD and OMC with the increase in crumb rubber percentage this could be due to light weight nature of rubber. UCS test showed increase in strength values with increased rubber percentage up to 15% .the percentage improvement in UCS values was 45% for soil S1 up to 10% crumb rubber and 80% for soil S2 up to 15% crumb rubber. Figures 1 showing variation of MDD and UCS values with crumb rubber

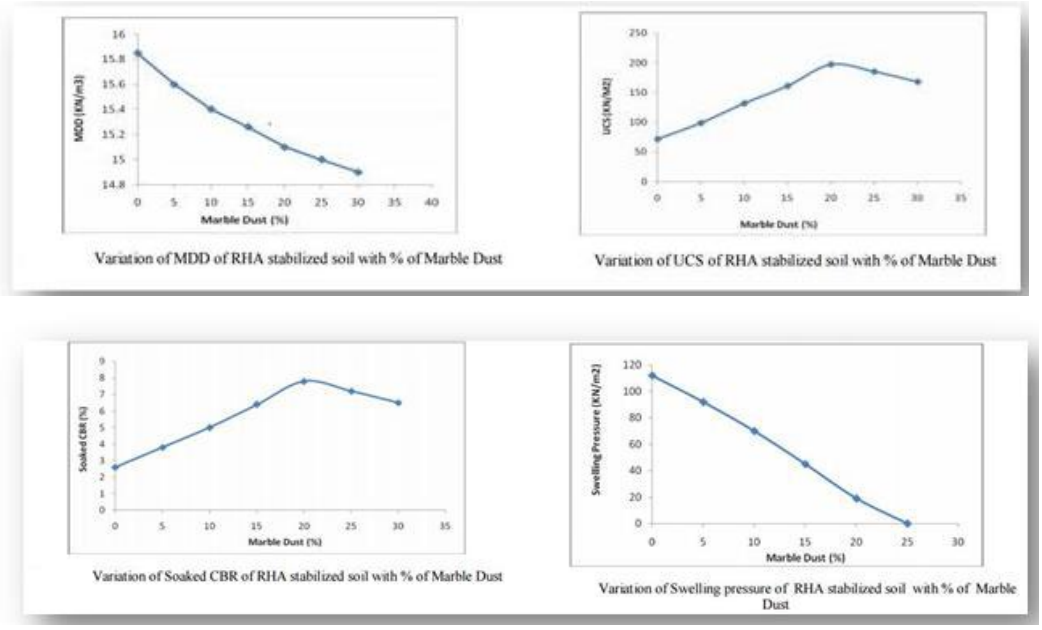
2.1 Soil Stabilization with Flyash and Rice Husk Ash

Dr. Robert M. brooks, Temple University, Philadelphia used rice husk (passing through 150micrometer sieve) with class 'c' FLYASH to investigate the improvement in strength of a CH soil, UCS, CBR tests were performed. UCS value increased from 660kPa to 1300kPa when RHA content was increased from 0 to 12%, UCS value increased for increased RHA up to 12% for any fly ash content, similar results were obtained for CBR values it increased from 1 to 10 with the increase of RHA up to 12% for any fly ash content results showed that failure stress and failure strain increased by 106% and 50% when the fly ash was mixed up to 25% increasing from 0%, UCS and CBR values improved by 97% and 47% respectively when fly ash content was increased from 0% to 12%.

2.2 Marble Dust and Rice Husk Ash with Expansive Soil

kshaya Kumar et.al studied the behaviour of expensive soils after mixing marble dust and rice husk ash with it, optimum percentage of RHA was found out to be 10% based on unconfined compressive strength test. MDD values kept on decreasing and OMC kept on increasing after rise husk ash was applied. 228% of increase inUCS value was recorded and maximum value of marbledust for RHA stabilized expensive soil was recorded as 20%, any further increment decreased UCS value.293% increase in CBR value was recorded. Optimum value of marble dust was also 20%. Swelling pressure decreased from 112kN/m² to 19kN/m² when marble dust percentage was increased from 0% to 25%. Improvement in durability was recorded when marble dust was added with RHA stabilized soil, without marble dust RHA stabilized soil didn't pass durability test. For best results ratio of soil, RHA, marble dust proposed by author is 70:10:20. Figures 2 indicating the variation of MDD (1), UCS (2), CBR (3) and SWELLING (4) with increase in marble dust percent with RHA stabilized expensive soil

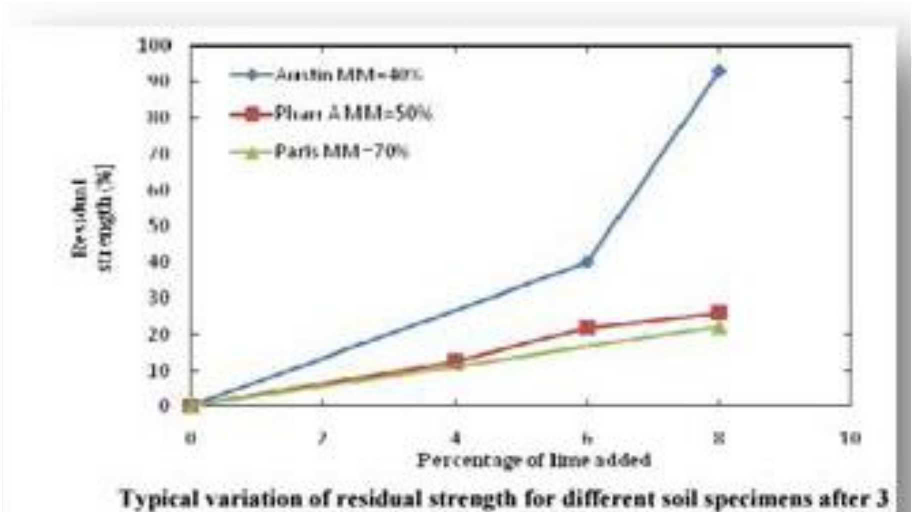
Figures 2:



Figures 2: the variation of mdd (1), ucs(2), cbr(3) and swelling(4) with increase in marble dust percent with rha stabilized expensive soil

III. LIME WITH MONTMORILLONITE DOMINANT CLAYS

Aravind pedarla and srinivas chittoori treated montmorillonite dominant clay with lime. UCS test was performed on soils having montmorillonite percentage 40% 50% and 70% treated with lime. Samples were subjected to alternate drying at 104^{0}f for 48 hours and wetting for 24 hours. Durability was checked by performing UCS test on sample and calculating residual strength till failure or 21 cycles. Variation is shown in figures 3.



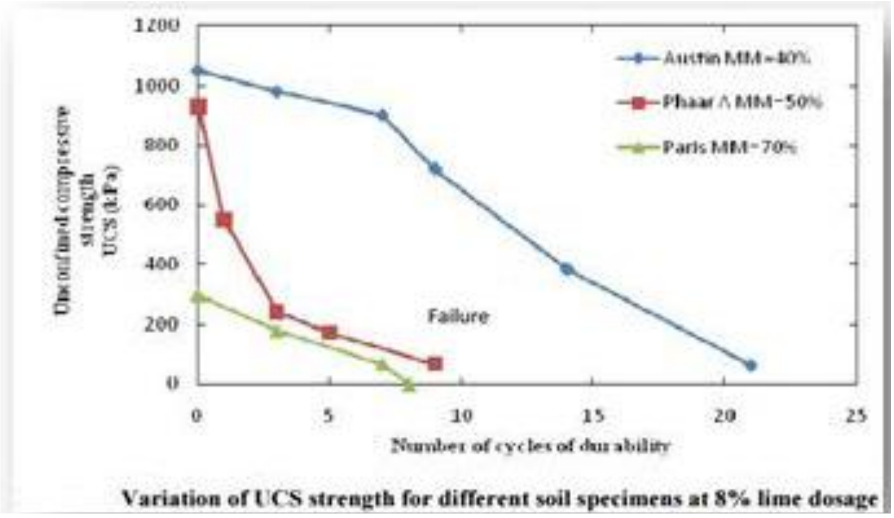


Figure 3.(a), (b) : The variation of UCS and Residual Strength

For soil having 40% montmorillonite stabilized successfully for 8% of lime, while soils with 50% and 70% MM content failed in less cycles and were not successfully stabilized for high lime content.

Table 1: Unconfined compressive strength test in kPa

Unconfined compressive strength test in kPa

SOIL SAMPLES	*PARENT SOIL*	*WITH 6%LIME*	*WITH 8%LIME*
MM 40%	248	272	1046
MM 50%	248	689	930
MM 60%	186	-	265

Authors concluded that high percentage of montmorillonite also influence stabilization along with PI of soil sofor soils with more than 50% montmorillonite content cannot be stabilized with 8 % of lime content otheradditives or combination of additives should be checked for stabilization.

IV. EXPANSIVE SOIL WITH WASTE GRANULATED BLAST FURNACE SLAG

Anil Kumar Sharma and P.V. Shivapullaiah used GGBS a waste material as an economical and eco-friendly method to stabilize expensive soils. Proctor tests were conducted after 7, 14 and 28 days and values of OMC andMDD were found for different proportion of black cotton soil and GGBS (0% 10% 20% 30% 40% 50% 60%70% 80% 90%and 100%). UCS value increased with GGBS up to 20% (after 7, 14days) and up to 40% (testsperformed after28 days) any further increment in GGBS decreased the strength of soil mix. This may be due toloss in cohesion due to the added granular blast furnace slag when mixed more than 40%, clay particle contentreduced and increase in strength due to binding properties of pozzolanic compounds, because it was observedthat strength of GGBS 100% is greater than any GGBS-soil mix indicate that GGBS is bounded by pozzolaniccompounds. Figure shows variation in strength value with percentage increase in GGBS content. Figure 4:

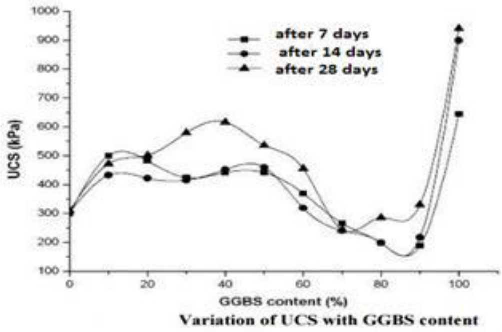


Figure 4: Variation in strength value with percentage increase in GGBS content

V. USE OF INDUSTRIAL WASTE IN SOIL STABILIZATION

K. Muthukkumaran et.al used Phosphogypsum an industrial waste from phosphatic fertilizer industry andbottom ash a granular waste product from thermal power plants mixed them with montmorillonite soil andstudied the effect on soil properties. Tests were performed for index properties, swelling potential and strengthvalues percentage of Phosphogypsum and bottom ash was increased up to 8% by weight. Results have shownsignificant decrease in liquid limit which brought the plasticity index below A line, this indicated that additiveturned a clayey soil into silt soil, swell pressure reduced by 35% when soil was mixed with PG alone and 48%reduction when 4% of combined additives were used in stabilization. UCS values increased five times for 6% ofadditives and crossed the minimum required strength value of 350kPa. Effect of PG was more in improvementof soil properties.

VI. CONCLUSION

Traditional additives like cement, lime, fly ash can improve soil properties by themselves. Non-traditionaladditives like rice husk ash, crumb rubber, marble dust, blast furnace slag can also improve soil properties butare less efficient. But combining two or more non-traditional additive can improve their effectiveness. RHAimparted strength combining marble dust increased the durability of soil specimen. Non-traditional additivesshould be used as soil stabilizer as they provide an economical alternative and also help in waste disposal.

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