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EFFECTS OF POLYURETHANE AND COCONUT CHARCOAL ASH IN SOIL STABILIZATION: A REVIEW

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ABSTRACT: ***In the rapidly growing world there is need to develop infrastructure, driven by global population growth is forcing societies to construct on any soil type accessible inside their region including clay soils. Though, because of the poor physical and building properties of weak soils, they are not appropriate for development purposes. Given many ground improvement techniques that are utilized to improve the properties of weak soils and to lessen the potential harms brought about by them, This paper discuss about the effects of polyurethane and coconut charcoal ash on soil stabilisation.***

Keywords: Weak soil, polyurethane, coconut shell ash, UCS, MD

I. INTRODUCTION

Rapid growth in the world's population especially on developing nation along with advancement in technologies have all drove towards the need to develop high elevated structures and other infrastructures as roads and bridges in coastal area where the soil types are weak, where mostly clay. Constructing these structures require suitable foundation soil. Whereas, weak soil are not suitable for such purposes. Appropriately, soil improvement is fundamental before development on such weak soil types can be attempted. For improving weak soils, for use as establishment material through different techniques for ground improvement.

Experts have endeavoured to apply a few strategies to improve the properties of earth and other weak soils utilizing lime or concrete. Anyhow the expense of cement makes this strategy restrictive. Furthermore, using cementitious materials likewise requires a restoring period that can keep going for a long time along these lines making development exceptionally moderate. Thus, utilizing concrete or time may not be the best choice particularly for street fixes/recovery work in urban regions that require the street to be opened to traffic right away.

Analysts have thought about utilizing waste materials to improve frail soils at an insignificant expense. Among many of the waste materials that have been used, include banana fibre, coconut charcoal ash, rice husk ash, sawdust, carbide slag, locust bean waste ash ceramic waste and GGBS (ground granulated blast furnace slag). However, the results from the application of using waste materials showed small strength improvement and required a curing period. The utilization of new methodologies has in like manner been endeavoured, for example, utilizing biomass bio exemplification geotextile and chloride mixes albeit each of these methods have their own constraint like curing time for biomass material. Bio exemplification may not be proficient in marine mud soils because of the minor size of the dirt particles which won't support the development of certain types of microorganisms. Likewise geosynthetics are not reasonable in such a case that the imperfection is distinguished after development it might require noteworthy extra work.

In such low bearing soils different strategies for ground improvement systems are utilized to improve the properties of marine clay and to lessen the unfavourable impact they cause to structures. Instances of ground improvement methods that are for the most part utilized incorporate jet grouting, chemical, permeation grouting, compaction grouting, soil mixing, deep densification (vibro-compaction and deep dynamic compaction), stone columns, blast induced compactions, reloading/surcharging, Geosynthetics and soil reinforcement, and (cement/lime) stabilisation amongst others.

This review will address the performance of various polymeric and natural additives used for soil stabilisation.

II. LITERATURE REVIEW

Saleh et al. (2018) studied the performance of marine clay stabilised with polyurethane, the untreated marine clay was characterised based on the result of tests conducted in the laboratory [1]. The test results shows moisture content of 67%, liquid limit and plastic limit of 65% and 26 %.proctor compaction test were carried out and values of optimum moisture content (OMC) of 25% maximum dry density MDD of 1440Kg/m3.UCS value recorded with the percentage of 1%, 2%, 3%, 4% and 5% respectively, these test revealed that in addition of 5% of Polyurethane improved the shear strength of marine clay more than 230%, from 70 to 250 kPa with decrease in cumulative strain of marine clay from 5.18% to 2.92% that correspond to more than 70% decrease.

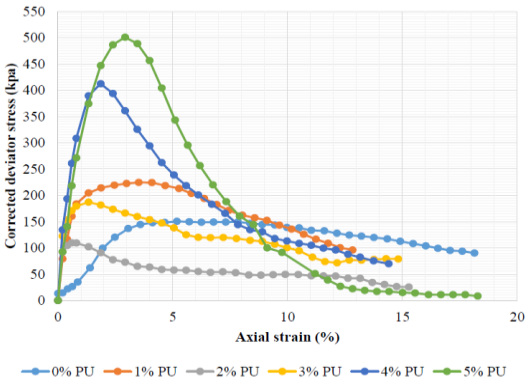


Fig1. UCS test result of marine clay at varying dose of Polyurethane

Sidek et al. (2016) studied the compressibility impacts of settled with the expansion of polyurethane froths and unstabilized soils are displayed by % compression and swelling index. The indices reduced between 40– 50% and the ratio of voids has also decreased by 30–50% with the addition of polyurethane foams [2]. These test were conducted on parent soil and stabilised soil samples of which soil 1, soil 2, soil 3 and soil+PU1, soil+PU2, Soil+PU3. There is a minimal volume change and settlement in the stabilized soils compared to the unstabilized soils. This depicts that the addition of PU foams significantly improves the soil structures and is suitable for rehabilitation work. With the addition of PU foams, we can reduce the operational and maintenance charges. In addition, PU foams are lightweight materials and efficiently react after 2–3 h of injection to the respective areas. It has been proved that this approach has provided profitable and reliable results. Overall, an understanding of the designation mechanisms of PU foams is beneficial for soil stabilization, which comprehends investigation of the relationships between the compressibility results of stabilized and unstabilized soils.

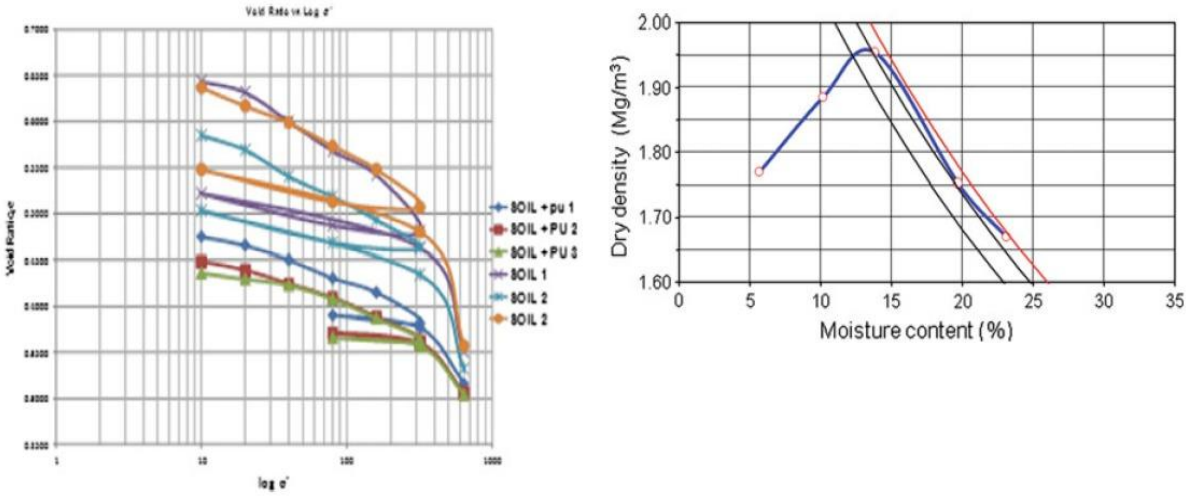


Fig 2.a) Showing the consolidation curves of stabilized soils and unstabilized soils, b) MDD and OMC

Athira (March-2017), Ashish Johnson et.al to explore the adequacy of coconut shell powder and lime in balancing out the broad soil concentrating on progress of compressive quality of expensive Soil when balanced out with various measurements of coconut shell powder 0% 3% 6% 9% and 12% and lime 3% 6% and 9%. UCS test was carried out by treating with discrete quantity of coconut shell powder and lime [3]. Samples with 3%, 6%, 9% and 12% were analysed. Results revealed that compressive strength was found to be maximum after 28 days of curing and an increase in MDD for soil sample treated with CSP and lime. In final the compressive strength of the expensive soil increased by 228% when treated with coconut shell powder and lime.

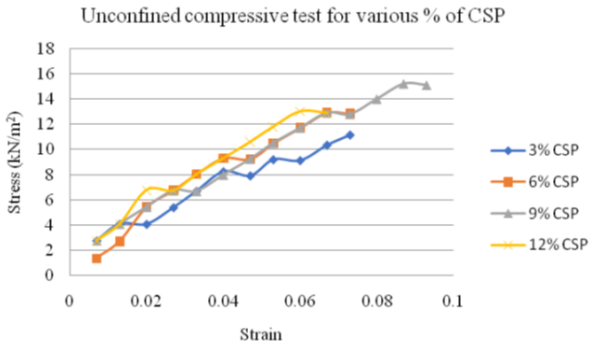
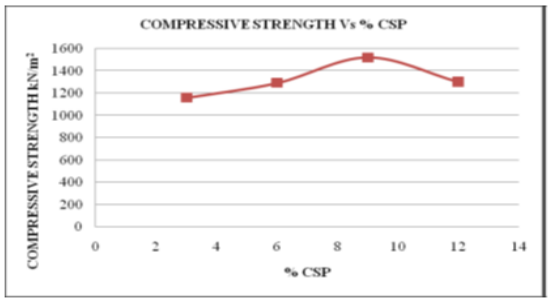


Fig. 3 Stress-Strain curve for various % of CSP



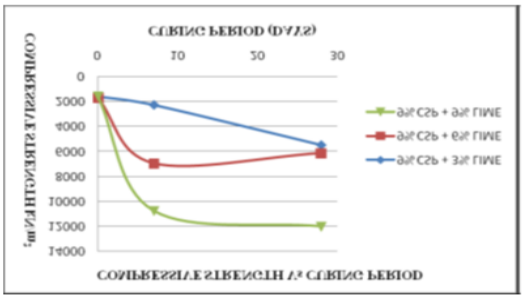


Fig. 4 a) Compressive strength Vs % CSP **4 b) Compressive strength Vs curing period**

Swaminathen et al. (2018) performed the CBR and UCS tests on the soil samples by using stone dust(SD), coconut shell ash (CSA), iron powder and Lime mixed with black cotton soil at various percentages (0%, 3%, 6%, 9%, and 12%) [4]. The OMC was obtained for 12% Coconut Shell Ash, 9% Iron Powder, 9% lime. The CBR test result was obtained 12% with addition of coconut shell ash, iron powder and lime.

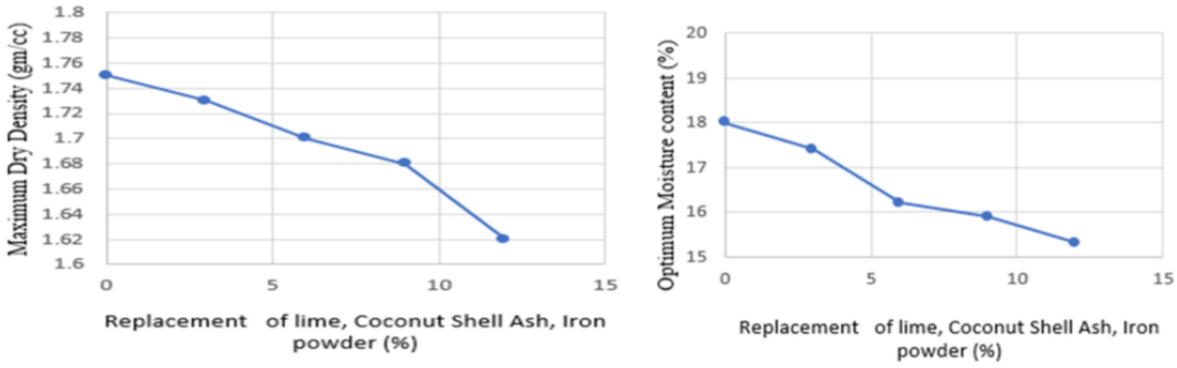


Fig.5 shows a) variation in MDD b) variation in OMC by replacement of lime, coconut shell ash, iron powder (%)

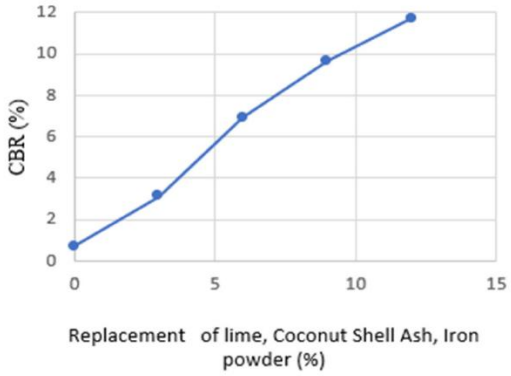


Fig 6 CBR(%) vs Replacement of lime, Coconut Shell Ash and iron powder

Bade et al. (2018) studied the performance on effect of coconut shell ash on properties of expansive soils by conducting proctor test, MDD and OMC obtained for various percentages 5%, 10% and 15%. It is seen that the decrease in the LL is significant up to 5% of admixture there is an increase in dry density [5].

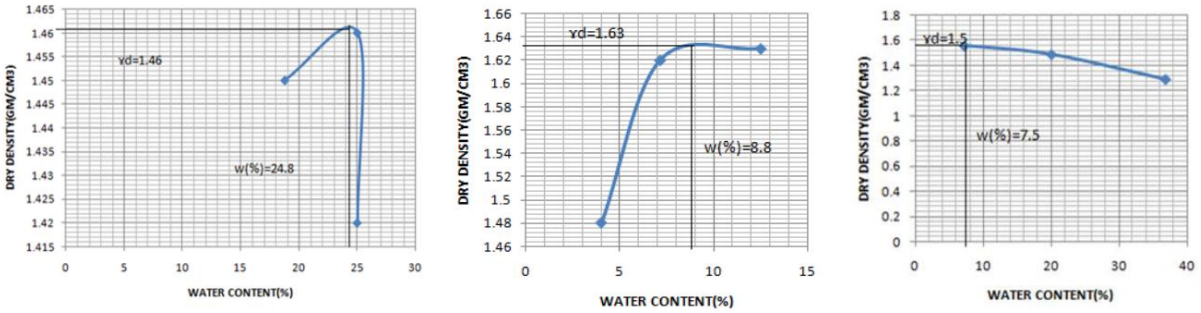


Fig. 7 a)MDD vs OMC 5% **b) MDD vs OMC 10%** **c) MDD vs OMC 15%**

III. CONCLUSIONS

Chemical additives like Polyurethane can improve soil properties. Natural additives like coconut charcoal ash also improve the properties but in less efficient. Combing two will also improve the soil properties in much efficient but it will require curing period of 7 to 21 days for the best performance results. Natural additives should be used as soil stabilizing agent as they provide an economical alternative and also help in waste disposal.

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