International Journal of Innovative Research in Engineering & Management (IJIREM)
ISSN: 2350-0557, Volume-10, Issue-2, April 2023
https://doi.org/10.55524/ijirem.2023.10.2.17
Article ID IJIR2357, Pages 96-98
www.ijirem.org

A Study On Stabilization of Soils by Using Egg Shell Powder

Dr. K. Harish[1], Ch.Sandeep Reddy[2], Ade Yuvaraju[3], Pabba Prabhudeva[4], Kamepalli Hemalatha[5], Valluri Bramham[6], and Pinni Srinivas[7]

[1,2]Assistant Professor, Department of Civil Engineering, PACE Institute of Technology & Sciences, Ongole, Andhra Pradesh, India
[3,4,5,6,7] Students, Department of Civil Engineering, PACE Institute of Technology & Sciences, Ongole, Andhra Pradesh, India

ABSTRACT- Using alternative materials, which have better engineering quality than traditional materials and are more cost-effective, has received a lot of attention recently. One of the most crucial components in many building projects, such as earth canals and earth dams, is soil. The fact that soil might offer all the resistant qualities required for a project highlights the value of several techniques used to enhance soil quality. The vast majority of construction projects employ clay soil. Because clay soils, especially soft clay soils, have good plastic qualities, their shear strength, compressive strength, and volume changes decrease as moisture content rises. Structures generally suffer permanent harm as a result of these issues, which emphasises how crucial soil improvement is. The use of such refuse and industrial wastes and their subsidiary products as alternatives to construction materials may effectively contribute to environmental preservation and minimize their negative effects on the Environment, especially in light of the millions of tonnes of waste produced annually across the nation, which not only poses the problem of disposal but also adds to environmental contamination and health risks. In the current study, eggshell powder was utilized as a waste to mix with soil in order to examine clay soil's index characteristics, compaction, and shear strength at various mixed proportions. The shear strength of soils that had already been tested was then contrasted with experimental specimens that had been combined with various ratios of eggshell powder.

KEYWORDS-Stabilization, Soil, Eggshell Powder.

I. INTRODUCTION

The behavior of the soil greatly affects the structure above it. Soil as a building material is spread from borrowed areas collected as embankment material, which are generally clay soils. Clay behavior that is very sensitive to increasing water content and high shrinkage. The conditions of the soil where shrinkage occurs can also affect the bearing capacity of the soil. Eggshell powder (ESP), which is a waste from the food industry, was considered as a clay mixture material to increase the bearing capacity of soil and the strength parameter of clay. Overall, previous ESP studies have found that this improves soil strength. With a proper mixing method, the good properties of and ESP are expected to increase the use of ESP in clay stabilization.

The main objective of this research aims to lessen shrinkage and swelling, increase soil strength, workability, shear strength, and permeability.

Eggshell Powder (ESP) has not been in use as a stabilizing material and it could be a good replacement for industrial lime, since its chemical composition is similar to that of lime. Chicken eggshell is a waste material from domestic sources such as poultries, hatcheries, homes and fast food centres. This amounts to environmental pollution. Eggshell waste falls within the category of waste food, they are materials from the preparation of foods and drinks, if subjected to adequate scrutiny, and they could be suitable for soil stabilization. The use of lime for stabilization is becoming expensive, requiring an economical replacement. Literature has shown that eggshell primarily contains lime, calcium, and protein. It has been in use as a source of lime in agriculture, which confirms that lime is present in a considerable amount in eggshell. Results of the Maximum Dry Density (MDD), California Bearing Ratio (CBR), Unconfined compression test and Untrained triaxial shear strength test all indicated that lime stabilization at 7% is better than the combination of 4% ESP + 3% lime [1]. They uncovered that the CBR value increments by including the Egg shell powder as an admixture at an extent of 5% to 45%. It achieves a most extreme CBR estimation of 7.8% at 20%, concerning original soil without including the admixture and accomplishes an estimation of 1.0%. [2]. AMU.O. O studied the effect of egg shell powder on the stabilizing potential of lime on an expansive clay soil. He conducted a series of tests to determine the optimal percentage of lime – egg shell powder combination. The optimal quantity of lime was gradually replaced with a suitable amount of egg shell powder. Result indicated that the lime stabilization at 7% is better than the combination of 4% egg shell powder + 3% lime [3]. Okonkwo.u.n had study and aimed at determining the effects of egg shell ash on strength properties of cement stabilized lateritic soil. All proportions of cement and egg shell ash contents were measured in percentage by weight of the dry soil. The compaction test, California bearing ratio, unconfined compressive strength and durability test were carried out on the soil-cement egg shell ash mixture [4]. In this experimental investigation, the impact of RHA on the expanding soil's geotechnical qualities is looked into and examined. The results indicate that there hasn't been much progress in the application of RHA stabilised soil. The study's conclusion can be summed up as follows: With the

addition of RHA to the soil, the specific gravity of the soil lowers. The percentage increase in RHA raises the soil's liquid and plastic limits. Also, it was shown that the addition of RHA reduces the soil's maximum dry density (MDD) since RHA has a lower specific gravity. After stabilising with RHA, the soil's optimal moisture content (OMC) rises as a result of a pozzolanic interaction between the soil's CaOH and RHA. With an increase in RHA, the soil's maximum allowable shrinkage reduces. With the addition of RHA, the soil's tendency to swell lessens, preventing fractures from forming on the pavement's surface. At an optimal value of 5% RHA content and 2% lime, the CBR and UCS values are raised to a high limit. It is also concluded that these optimal percentage values of RHA and lime can be recommended for construction in order to improve strength through practical stabilization. However, if lime and RHA are added to the soil beyond this limit, it will not be beneficial or workable [5]. The unconfined compressive strength of regular soil improves when egg shell powder is added to it, reaching a value of 200 KN/m2 in this study's presentation of the findings of the addition of waste plastics combined with egg shell powder to increase soil stabilisation. When eggshell powder was added, the increase was 20%, or 400 KN/m2.Hence, adding 20percent of total of eggshell powder to soil results in a 60% increase in soil strength. [6]. Although it is commonly available and minimally manufactured, rice husk ash (RHA) is a pozzolanic substance that may be utilised to stabilise soil. When rice husk is burned at a controlled temperature, ash is created, and between 17% and 25% of the weight of the rice husk is still ash. This article describes the findings of an experimental investigation done on three different soils that were amended with varying concentrations of rice husk ash. Samples were brought in from several Iraqi locations. Atterberg limits, specific gravity, compressibility, an unconfined compression test, and a consolidation test were all part of the testing programme done on the clayey soil samples mixed with various percentages of rice husk components. After the addition of 9% RHA, it was discovered that the liquid limit of the three soils had dropped by around (11–18) % while the plasticity index had decreased by approximately (32–80) %. With increasing rice husk content, treatment with rice husk revealed a general decrease in the maximum dry unit weight, with minimum values at 9% rice husk content. The ideal moisture content often increased as the RHA level did. With an increase in rice husk content for the soil, the unconfined compressive strength significantly increases and reaches its maximum at RHA between (6 - 8) % [7]. It is useful to utilise coconut coir fibre to enhance soil properties because it is affordable, readily available locally, and environmentally benign. The stabilising impact of coconut coir fibre (natural fibre) on soil characteristics has been experimentally explored in this work. With this in mind, an experimental investigation is carried out using locally accessible, pricey soil that has been diluted with varied amounts of coconut coir fibre. For California bearing ratio (CBR) testing, soil samples are prepared in the CBR mould with and without coconut coir fibre at their maximum dry density (MDD), which corresponds to their ideal moisture content (OMC).0.25%, 0.50%, 0.75%, and 1% of the dry weight of the soil is taken as the percentage of coconut coir fibre, and laboratory tests are carried out using unsoaked and soaked coconut coir fibre in accordance with each percentage. The results of the tests show that soil's CBR value rises with increasing coconut coir fibre content, both when the soil is dry and when it is wet. The CBR value of soil containing 1% Coconut coir fibre rises from 3.9% to 8.6% when it is soaked and from 8.1% to 13.2% when it is not. When the CBR of the mix increases with the addition of coconut coir fibre, the pavement's thickness decreases, lowering construction costs and resulting in more economical highway building. This is due to the combined influence of coconut coir fibre, a natural fibre that transforms the soil's brittle behaviour into ductile behaviour. [8]. By dry weight of the soil, 3% lime, 15% bagasse ash, and 15% bagasse ash combined with 3% lime were used to stabilise the expansive soil that was taken from Addis Abeba's Bole sub-city and classed as an A-7-5 soil on the AASHTO classification scale. California bearing ratio (CBR) tests, compaction, and the influence of the additions on the soil were all examined. The results show that for all additives, the maximum dry density (MDD), whereas the optimum moisture content (OMC) and CBR value increased. Yet, the CBR value was significantly increased when the soil was stabilised with a mixture of lime and bagasse ash. This demonstrates the potential for employing bagasse ash as an additive in expansive soil stabilised with lime. [9]. Erdal Cokca investigated the impact of fly ash on expanding soil. Fly ash is divided into two main classifications, Class C and Class F. In ionised conditions, the fly ash can offer a variety of divalent and trivalent cations that can encourage flocculation of scattered clay particles. Hence, effective cation exchange employing fly ash may be able to stabilise expansion. He conducted research with soma fly ash and added it to expanding soil at a rate of 0 to 25 percent. His testing results also showed that the sample's plasticity index, activity, and swelling potential all dropped as curing time and percentage increased, with 20% being the optimal percentage [10].

II. METHODOLOGY

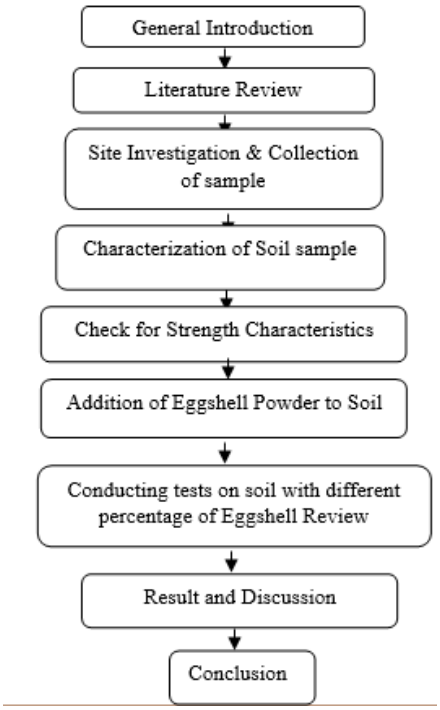

Figure 1: Step by Step Methodology

III. RESULTS AND DISCUSSION

The outcomes of the experiments done on the original soil and soil treated with 5%, 10%, and tests, 15% eggshell powder. The basic geotechnical inquiry used in the experimental investigations has assisted in understanding the clay soil. Standard Proctor Test, California Bearing Ratio Test, Liquid & Plastic Limit, Specific Gravity Test are among the tests done on the various combinations. A pictorial graph is used to help visualize the outcomes of each experimental research of a certain combination profile after a table is used for test reading.

From the experiments conducted with optimum percentage of ESP andthe obtained results were shown below

Table 1: California Bearing Ratio

Clay soil (%)	EGG SHELL POWDER (%)	CBR (%)
100	0	2.62
95	5	2.66
90	10	2.72
85	15	2.69

Table 2: Liquid & Plastic Limit

Clay soil (%)	EGG SHELL POWDER (%)	SPECIFIC GRAVITY(G)
100	0	2.72
95	5	2.74
90	10	2.78
85	15	2.81

The maximum CBR Value is 2.72%

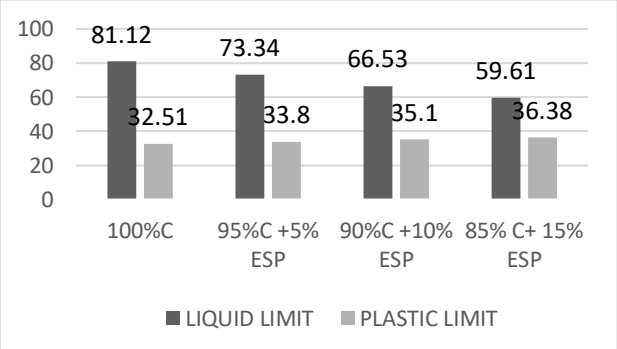

Figure 2: liquid & plastic limit of clay soil

Table 3: Specific Gravity of Clay Soil

Clay soil (%)	Egg shell powder (%)	Liquid limit (%)	Plastic limit (%)
100	0	81.12	32.51
95	5	73.34	33.8
90	10	66.53	35.1
85	15	59.61	36.38

Various Specific Gravities of clay soil is represented in above table.

The average specific gravity (G) of clay soil is 2.72**.**

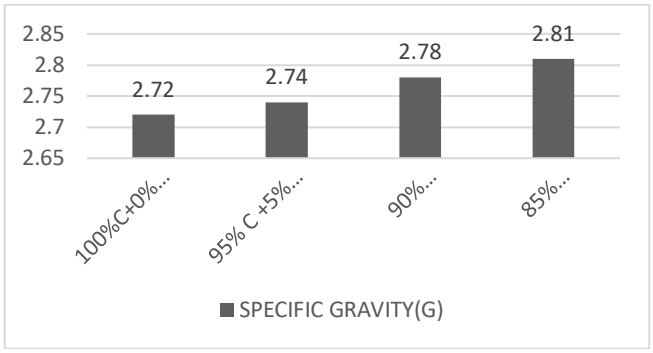

Figure 3: Specific Gravity of Clay Soil

IV. CONCLUSION

We can utilize the eggshell waste as a useful soil stabilizing material. By using the eggshell powder as a soil stabilizer, we can minimize the waste disposal problem of eggshell.

This replacement also increased the strength of treated soil. Thus, it can be concluded that egg shell powder is an ideal material to replace lime in the soilstabilization process owing to its similar chemical compositions and properties.

Egg shell powder was found to be a very good alternative in replacing the costly lime used for soil stabilization.The use of egg shell powder in soil stabilization will reduce the disposalproblems of egg shell as well as make the stabilization process economically and sustainable.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES

[1] Amu O O, Fajobi A B and Oke B O, 2005. Effect of eggshell powder on the stabilizing potential of lime on an expansive clay soil, Journal of Applied Science, 5(8), pp 1474-1478.

[2] Olarewaju A J Balogun M O and Akinlolu S O, 2011. Suitability of eggshell stabilized lateritic soil as subgrade material for road construction, Electron Journal of Geotechnical Engineering, 16, pp 899–908.

[3] IRC SP: 72 (2007), - “Guide lines for the design of flexible pavements for low volume rural roads & quot; Bureau of Indian Standards, New Delhi.

[4] IRC-37 (2012), - “Guide lines for the design of Flexible Pavements”, Bureau of Indian Standards, New Delhi.

[5] IRC-78 (2002), - “Guide lines for the design of Rigid Pavement”, Bureau of Indian Standards, New Delhi.

[6] IS 383 (1970), - “Specification for Coarse and Fine aggregates from natural Sources”, Bureau of Indian Standards, New Delhi.

[7] IS: 2720 - Part III (1987), - “Methods of Tests for Soil - Determination of Specific Gravity”, Bureau of Indian Standards, New Delhi.

[8] IS: 2720 - Part V (1985), - “Methods of Tests for Soil: Determination of liquid limit and plastic limit”, Bureau of Indian Standards, New Delhi.

[9] Amu O. O, Fajobi A. B, and Oke B.O (2005). “Effect of Eggshell Powder on the Stabilizing Potential of Lime on an Expansive Clay Soil.” Research Journal of Agriculture and Biological Sciences, 1(1), pp 80-84.

[10] Amu O.O and Salamy B.A, (2010).” Effect of Common Salt On Some Engineering Properties of Eggshell Stabilized Lateritic Soil.” ARPN Journal of Engineering and Applied Sciences, 5(9), pp 64-73.