International Journal of Scientific Research and Engineering Development-– Volume 5 Issue 4, July-August 2022

Available at www.ijsred.com

RESEARCH ARTICLE OPEN ACCESS

Stabilization of Laterite Soil Using Egg Shell Powder

Akshatha B A*, Manasa S R**, Meghana M**, Lokesh C S**

*Assistant Professor, Dept. of Civil Engineering, Navkis College of Engineering, Hassan, Karnataka, India

Email: akshathabhandary90@gmail.com

**Assistant Professor, Dept. of Civil Engineering, NDRKFC, Hassan, Karnataka, India

Email: srmanasa14@gmail.com

**PG Student, Dept. of Environmental Engineering, UBDT College of Engineering, Davangere, Karnataka, India

**PG Student, Dept. of Civil Engineering, KVG College of Engineering, Sullia, Karnataka, India

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Abstract:

This study is intended at determining the geotechnical properties of eggshell powder stabilized lateritic soil with a view to determining its suitability of stabilizing agent for lateritic soil. Laboratory tests such as consistency limits, unconfined compressive strength, California Bearing Ratio were carried out with the various proportion of egg shell powder like 10, 15, 20, 25 and 30 % with lateritic soil mixed at OMC. The mixed soil and egg shell powder (ESP) mix is cured for 0, 7 and 14 days. The effect of curing on mixture of egg shell powder and lateritic soil for different time periods is tested and recorded. The result shows that ESP can be used as a stabilizing agent.

Keywords **— ESP (Egg Shell Powder), Compaction, CBR and Unconfined compression (UCC).**

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I. INTRODUCTION

Soil stabilization is done by pavements, sub base, sub grade, bases, run ways, etc. The various stabilizers like lime, bitumen, cement, etc. eggshell powder has not been commonly used. Hence it is necessary to study the properties of soil when eggshell powder is used as stabilizing agent. Eggshell powder could be a replacement for other types of stabilization. This study is aimed at determining the geotechnical properties of eggshell stabilized lateritic soil with a view to determining its suitability as stabilizing agent for lateritic soil.

Soil Stabilization is the process by which the engineering properties of soil layers can be improved or treated by addition of other soil types, mineral materials or by mixing the appropriate chemical additive into the pulverized soil and then carry out compaction. It is aimed at improving the soil density, increase its cohesion, friction resistance and reduction of plasticity index. However, it is a must to obtain adequate relevant information concerning the ground condition and soil properties relative to the grading and any layer of the soil. The process of improving engineering properties of the soil and thus making it more stable is called soil stabilization. There are various methods for soil stabilization like mechanical stabilization, cement stabilization, lime stabilization, bituminous stabilization, chemical Stabilization, thermal stabilization, electrical stabilization.

II. OBJECTIVE OF THE STUDY

- To determine the geotechnical properties of the lateritic soil such as plastic limit, liquid limit, plasticity index, and grain size distribution etc.
- To determine the optimum moisture content (OMC) and maximum dry density (MDD) for the soil sample.
- To determine the effects of eggshell powder added to lateritic soil at 10%, 15%, 20%, 25% and 30%.
- To determine the effects of curing of

different percentages of eggshell powder mixed at OMC with laterite soil.

III. REVIEW OF LITERATURE

Muthu, 2014 investigated on Soil samples stabilized with eggshell powder in proportions of 0.5% to 5.5% at 0.5% interval by dry weight. The index and engineering properties were carried out to access the behavior of soil with the addition of eggshell powder. The unconfined compressive strength test was carried outwith and without delay in compaction. Addition of eggshell powder to soil sample lead to increase in unconfined compressive strength. The maximum unconfined compressive strength was attained at 3% eggshell powder stabilization

Kavyashree, 2016 made a study on the effect of the lime (0, 6, 8 and 10%) and Eggshell powder (1% lime+9% ESP, 2% lime+8% ESP, 3% lime+7% ESP, 4% lime+6% ESP, 5% lime+5% ESP) on the some basic engineering properties of BC soil such as Unconfined compression test, Compaction, and California Bearing Ratio (CBR) of BC Soil. The optimal percentage of lime-ESP combination was attained at a 5% ESP+ 5% lime, which served as a control. Results of the, California Bearing Ratio(CBR), and triaxial compression test indicated that lime stabilization 10% is better than the combination of 5% ESP + 5% lime.

Yogeshkumari, 2016 investigated on clay soil sample stabilized with eggshell powder in proportions of 5%, 10%, 15%, 20% and 25%. Liquid and plastic limits as well as plasticity index, dry density, optimum moisture content and shear strength were carried out. It is observed that the addition of egg shell powder shows noticeable improvement in soil properties at 20% replacement of soil by egg shell powder and the same is taken as optimum dosage.

VI. EXPERIMENTAL INVESTIGATION

A. Materials

Laterite SoiFor this study laterite soil is collected from barrow pit Balladka located in Sullia, Dakshina Kannada. Table 1 shows properties of laterite soil.

Properties	Value
Gravel (%)	4
Sand (%)	55
Silt And Clay (%)	41
Liquid Limit (%)	56.95
Plastic Limit (%)	31.48
Shrinkage Limit (%)	14
Plasticity Index (%)	25.47
Specific Gravity	2.61
Maximum Dry Density (g/cc)	1.99
Optimum Moisture Content (%)	7.91
Unconfined Compression Strength (kN/m2)	152.46

TABLE I
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Egg Shell Powder

Waste Eggshells are the waste materials from hatcheries, homes and fast food industries and can be readily available in plenty. Eggshell waste disposal contributes to environmental pollution. Hence in this study waste material eggshells were collected from hotels, college hostel mess, bakeries etc. in plastic bags. Then eggshell were washed in clean water and then dried in sunlight. The dried eggshells were milled to 90µ and collected in air tight polythene bags.

FIG. 1 EGG SHELL POWDER

B. Methodology

In this project an attempt is made to find the best locally available material which satisfy the design and strength criteria of subgrade soils

Finding initial index and engineering properties of lateritic soil

Collection of eggshell and preparation of eggshell powder.

Finding the unconfined compressive strength, California Bearing Ratio (soaked and unsoaked) and consistency limits with the various proportion of egg shell powder like 4, 6, 8 and 10 % with lateritic soil mixed at OMC.

The mixed soil and ESP mix is cured for 0, 7, 14 and 28 days. The effect of curing on mixture of egg shell powder and lateritic soil for different time periods is tested and recorded

IV. RESULTS AND DISCUSSIONS

A. Atterberg Test

Liquid limit (LL), plastic limit (PL) and plasticity index (PI) tests are conducted on lateritic soil and laterite soil ESP mixture. It can be observed that LL, PL and PI with different percentage of ESP mixes reduce upto 38%, 21% and 60% respectively. From figure it is clear that the LL, PL and PI are fluctuating simultaneously with the addition of varying percentage of ESP.

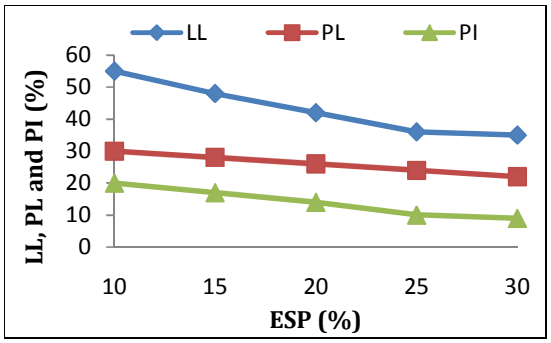

FIGURE 2: VARIATION OF LL, PL AND PI.

B. Proctor Compaction Test

The test procedure for compaction test has been standardized by IS: 2720 (Part VII)-1983 (light compaction) and IS: 2720 (Part VIII)-1983 (heavy compaction). In this study light compaction test is adopted.

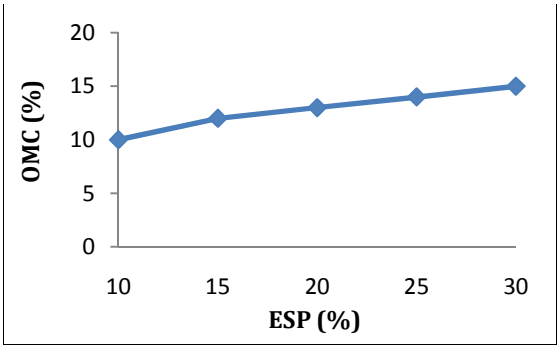

FIGURE 3: VARIATION OF OMC WITH ESP

MDD decreases from 1.99g/cc to 1.93g/cc It is shown in Figure 3 that the by increasing the content of ESP. The decrease in the value is because the addition of soil by the ESP which has relatively lowers specific gravity that is 2.33 compared to that of the laterite soil which is 2.61.

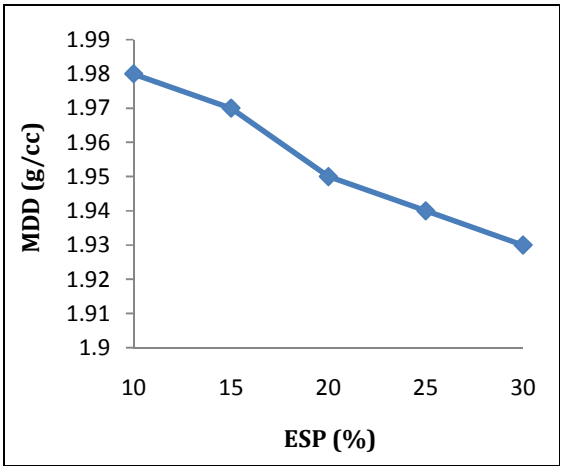

FIGURE 4: VARIATION OF MDD WITH ESP

Figure 4 shows that the variations of MDD in different percentage of ESP. it is observed that there is increase in OMC from 7.91% to 14.43% with the increase of ESP.

C. Unconfined Compression Test

Figure 5 shows the variation of UCC for 0, 7 and 14 days of curing. The UCC of soil increases by 66.03, 68.9 and 70.37% respectively with the increase in ESP percentage in soil for 0, 7, and 28 days of curing periods. Hence soil shows a tendency of increase in UCS value with addition of ESP.

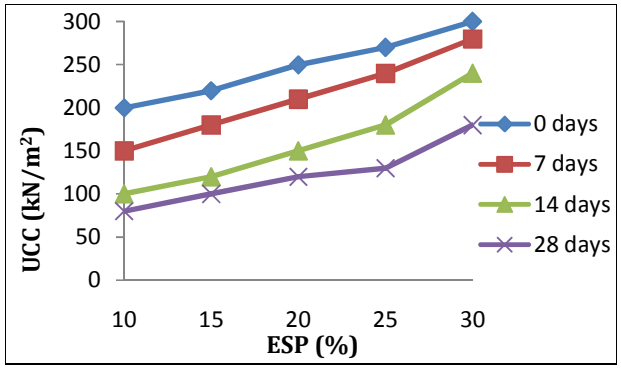

Figure 5: Variation of UCC for different curing days.

D. California Bearing Ratio

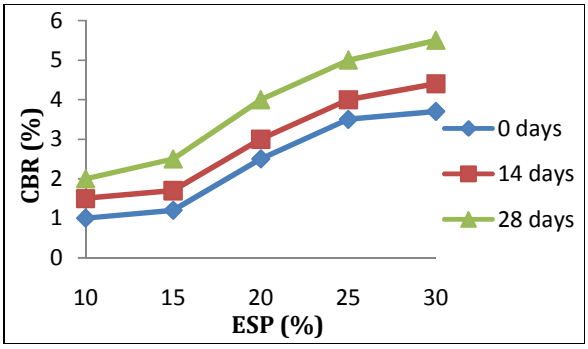

Figure 6: VARIATION OF CBR FOR DIFFERENT CURING DAYS**.**

Figure 6 shows the variation of CBR values for 0 and 7 days of curing. As the amount of ESP increasedthe CBR value gets increased from 0.47 to 3.89 % for 0 days and 0.62 to 4.05 % for 7 days of curing.

V. CONCLUSION

LL, PL and PI decreases with the increase in ESP percentage in the soil.

OMC increases from 7.91% to 14.43% with the replacement of varying proportion of ESP. MDD decreases from 1.99g/cc to 1.93 g/cc with the addition of soil by the ESP which has relatively lower specific gravity that is 2.33 compared to that of the laterite soil which is 2.61.

The UCC results indicate that the strength characteristics of the soil are improved with the addition of ESP upto 30% and CBR value gets increased with the addition of ESP.

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