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Comparative Study on the Effect of Cockle Shell Powder on Laterite Soil and Clayey Soil

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Abstract: *Soil stabilization is physical or chemical process which improves the engineering properties of the soil and increase the stability of the soil. Main objective of this investigation has been focused on index and engineering properties of laterite soil and clayey soil reinforced with locally available cockle shell powder (CSP). The admixture CSP is added at a proportion of 12 to 20 % with an increment of 2 %. Reinforced earth technique is considered as an effective ground improvement method because of its cost effective and easy availability. Cockle shell powder is the most popular reinforcement materials used in the study on the soil reinforcement for expansive soil. Both the laterite and clayey soil will gain great strength with the addition of cockle shell powder. This improvement is due to an interaction between soils and the cockle shell powder which contain calcium oxide and calcium carbonate similar to chemical composition to cement additives. The effect of admixture on dry density, moisture content, plasticity, shear strength and UCS values of the laterite soil and clayey soil are determined in the laboratory. We can say it is a little bit of effective in using sea shells powder as admixtures when compared with other stabilizing agents.*

Keywords: CSP, clayey soil, laterite soil

I. INTRODUCTION

Most of low-lying area of Alleypey district in Kerala, mainly facing the problem of low shear strength and high compressibility. Hence stabilization of clayey soil is essential. Due to the weak soil characteristics which the soil possesses such as high settlements and low strength. Hence the need for enhancing the soil characteristics for construction activities arises. Which is one of the most unstable soils which has a low strength and stiffness index due to its high liquid limit. It is well known for failure of pavements and foundation structures constructed over it in the past. This is due to the weak soil characteristics which the soil possesses such as high settlements and low strength. Therefore, the soil strength can be improved by adding stabilizer or admixture to increase its strength. Soil stabilization change its physical and mechanical properties from its original soil. This paper focuses on index and Engineering characteristics of clayey soil treated with locally available waste material cockle shell powder. Clayey soils in its natural state generally have low bearing capacity and low strength due to high clay content. The strength and stability of clayey soil containing large amounts of clay cannot be guaranteed under load in the presence of moisture. The use of clayey soil consisting of high plastic clay content results in cracks in and damage to pavement, roadways, foundations or any civil engineering construction. The need to improve the strength and durability of clayey soil in recent times has become imperative, this has geared researchers towards using stabilizing materials that can be sourced locally at a very low-cost Laterites are soil types rich in iron and aluminium that are formed in tropical areas. Most laterites are rusty-red because of the presence of iron oxides. Cockle shell powder must not be hazardous to the environment, and it should be easily available and less expensive. This study is focused on the natural seashell wastes in stabilizing properties of weak soils by adopting cockle shell waste powder in the soil mixture. Here we reinforce the clayey soil and laterite soil using cockle shell powder, thereby improving its swelling potential, compaction characteristics and CBR value. CSP were mixed into the soil in 12, 14, 16,18, and 20% by dry weight.

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II. MATERIALS USED

2.1 Clayey Soil

Clayey soil taken are dark brown colour medium sensitive alluvial deposits spread over the Alappuzha in the state of Kerala in India. The soil sample was collected in sack and then air-dried. The sample was collected from a depth of about 1m below the ground level by open excavation.

Table 1: Basic Properties of Clayey soil

SL	PROPERTY	RESULT
1	Specific gravity	2.156
2	Water Content	49.96 %
3	Classification	OH
4	Plastic limit	53.80%
5	Liquid limit	57.50%
6	Plasticity index	3.7
7	Optimum moisture content	33.65%
8	Dry density	1.9gm/cc
9	Strength	26kg/cm^2

2.2 Laterite Soil

For the study Laterite soil was collected from Thiruvananthapuram district. The laterite soils are commonly found in the hilly areas *of Tamil* Nadu, Karnataka, Kerala, and Madhya Pradesh. The soil sample was collected in sack and then air-dried. The sample was collected from a depth of about 1m below the ground level by open excavation. The colour of laterite soil is mostly reddish. The iron composition of this soil is very high than other soils. Laterite is both a soil and rock type rich in iron and aluminium and is commonly considered to have found in hot and wet tropical area.

Table 2: Basic Properties of laterite soil

SL	PROPERTY	RESULT
1	Specific gravity	2.57
2	Water Content	20.20%
3	Classification	CL
4	Plastic limit	19.56%
5	Liquid limit	38%
6	Plasticity index	18.44
7	Optimum moisture content	14.60%
8	Dry density	1.9gm/cc
9	Strength	52kg/cm^2

2.3 Cockle Shell Powder

Cockle shell is a waste material that can be found near the seaside area. Cockle shell powder is a type of marine by-product that can be used for soil stabilization. Cockle shell contained 90% of calcium carbonate and 10% of dust and

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impurities. It has similar content of cement additives and lime binder which include calcium carbonate and calcium oxide. Cockle shell powder is the most popular reinforcement materials used in the study on the soil reinforcement for soft soil. This study is focused on the natural seashell wastes in stabilizing properties of weak soils by adopting cockle shell waste powder in the soil mixture. The use of cockle shell powder in soil stabilization will reduce environmental impact in carbon emission as well as by inserting the stabilizer in the subgrade layer enhance the durability of the soft soil.

III. EXPERIMENTAL WORK

3.1 Preparation of Sample

This work presents a comparison of the effect of cockle shell powder on laterite soil and clayey soil. The sample is kept in the oven for drying. Basic properties of soil are determined. The weight of soil sample taken for a test is replaced by a different proportion of the weight of CSP in varying amount of 12%,14%,16%,18% and 20%. The soil stabilised with CSP and the strength parameter like OMC-MDD and UCS were determined. By getting out on each result of all the comparison of the best suitable additive mix will be carried out.

3.2 Compaction Test

The modified proctor test was conducted as per IS 2720 (Part7) -1983. The soil was taken and various percentage of CSP were added. The appropriate quantity of water is added, CSP and clayey soil mixture was compacted in mould in 3 layers by modified proctor hammer of 2.6 kg. Again, the laterite soil was taken and various percentage of CSP is added, appropriate amount of water is added. CSP and laterite soil mixture was compacted in mould for 3 layers by a hammer of weight 2.6 kg. The MDD and OMC for different samples were determined.

3.3 Unconfined Compression Test

The UCS test were executed for different percentage of CSP (as per IS 2720 (Part 10)-1991. A cylindrical clayey and laterite sample is prepared. Use a strain rate of 0.5-1.0 percent per minute. Apply the load until failure planes have definitely developed.

IV. RESULTS AND DISCUSSIONS

According to experimental program, Compaction and UCS were performed on clayey soil and laterite soil with different percentage of CSP. The effect of OMC-MDD relationship and UCS values were considered. The outcomes are presented below.

Table 3: OMC-MDD and UCS value of clayey soil sample with varying percentage of cockle shell powder

SL/No	Clayey soil + (%) CSP	MDD (g/cc)	OMC (%)	UCS (kg/cm^2)
1	Soil + 0% CSP	1.9	33.65	26
2	Soil + 12% CSP	1.11	41.5	41
3	Soil + 14% CSP	1.13	44.78	48
4	Soil + 16% CSP	1.21	47.48	51
5	Soil + 18% CSP	1.13	46.77	31
6	Soil + 20% CSP	1.12	45	28

Table 4: OMC-MDD and UCS value of laterite soil sample with varying percentage of cockle shell powder

SL/No	Clayey soil + (%) CSP	MDD (g/cc)	OMC (%)	UCS (kg/cm^2)
1	Soil + 0% CSP	1.84	13.21	52
2	Soil + 12% CSP	1.79	14.6	72
3	Soil + 14% CSP	1.89	14.82	75
4	Soil + 16% CSP	1.9	16.73	109
5	Soil + 18% CSP	1.86	15.24	70
6	Soil + 20% CSP	1.79	14.82	60

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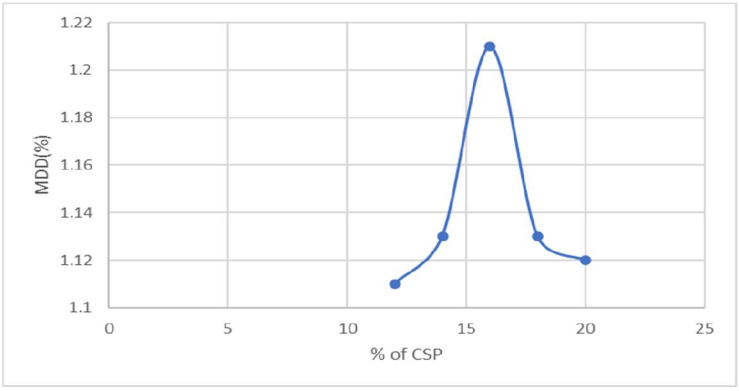
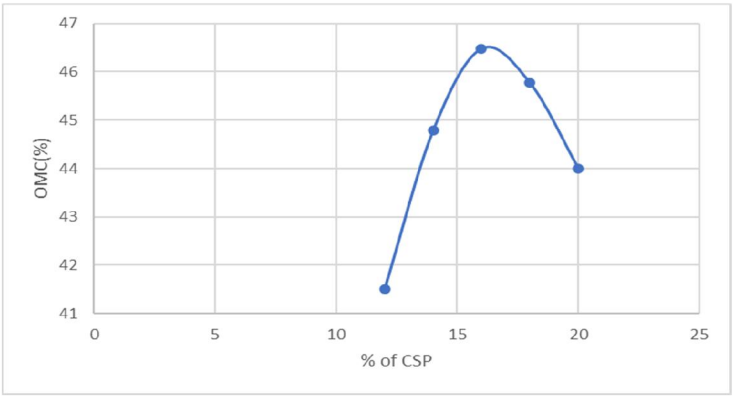
4.1 Compaction Test with CSP in Clayey Soil

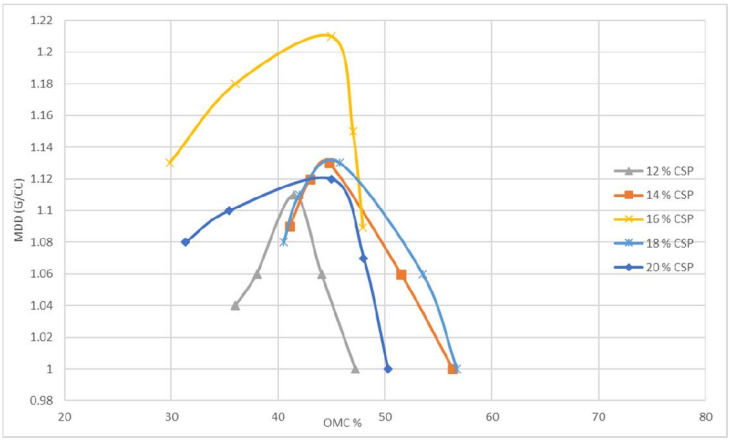
It was observed that Table 3 indicates, with the addition of CSP, MDD increases to optimum and then decreases and OMC also increases to the optimum then decreases. The sample containing 16 % of gives the maximum value of MDD and OMC.



Graph 1: Variation in MDD of clayey soil with different percentage of CSP



Graph 2: Variation in OMC of clayey soil with different percentage of CSP



Graph 3: Compaction curve of clayey soil with different percentage of CSP

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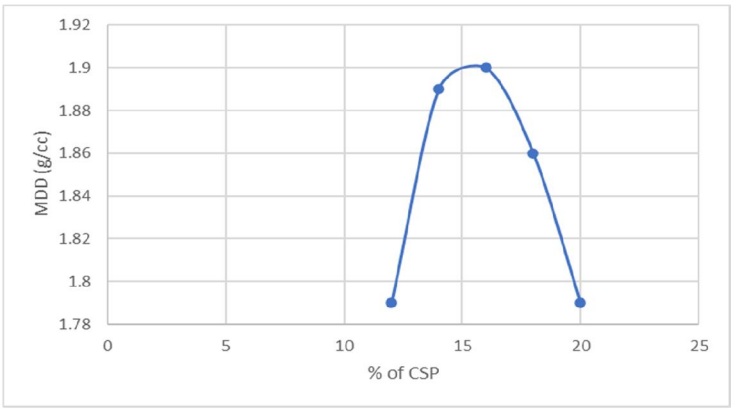
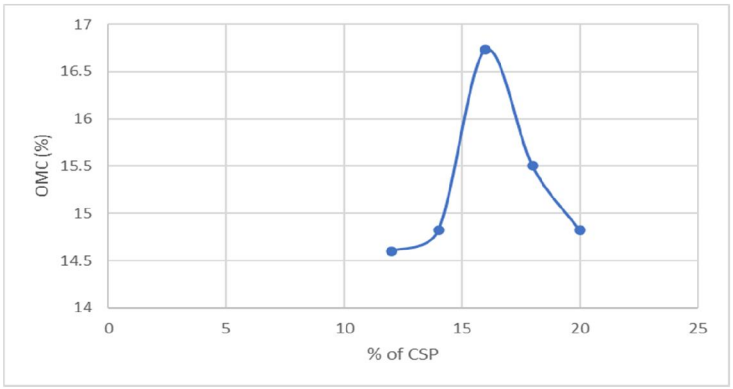
4.2 Compaction Test with CSP in Laterite Soil

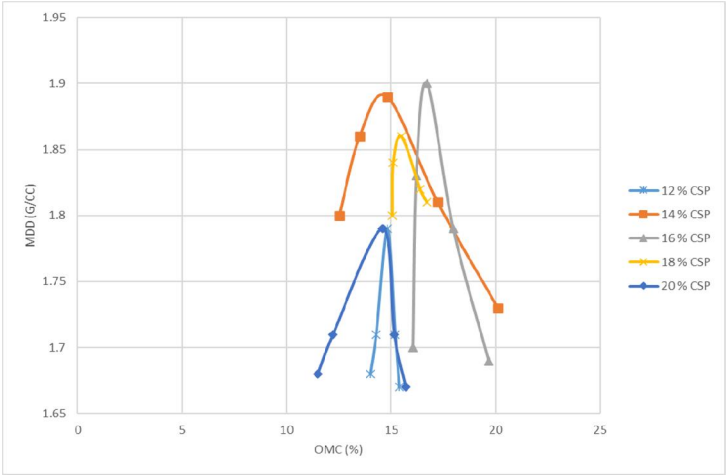
It was observed that Table 4 indicates, with the addition of CSP, MDD increases to optimum and then decreases and OMC also increases to the optimum then decreases. The sample containing 16 % of gives the maximum value of MDD and OMC.



Graph 4: Variation in MDD of laterite soil with different percentage of CSP



Graph 5: Variation in OMC of laterite soil with different percentage of CSP



Graph 6: Compaction curve of laterite soil with different percentage of CSP

4.3 Unconfined Compression Test

It is observed that UCS value increases to an optimum and then decreases by the addition of CSP. Clayey soil has low shear strength, by the addition of CSP its shear strength has increased.

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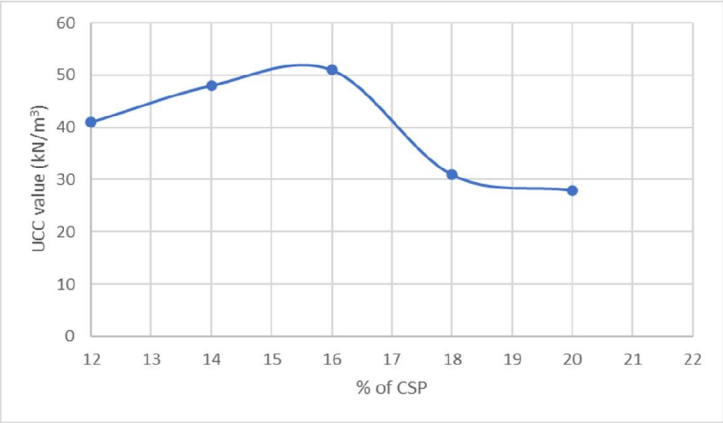
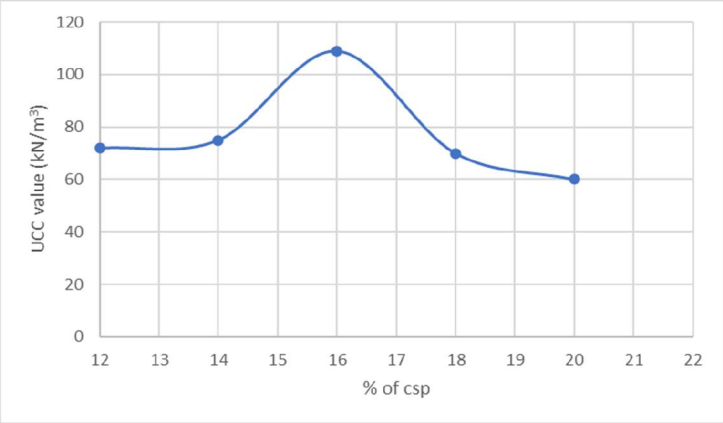


Graph 7: UCS value of clayey soil sample with varying percentage of CSP



Graph 8: UCS value of laterite soil sample with varying percentage of CSP

V. CONCLUSION

Following conclusions are drawn from the study conducted

The OMC and MDD are influenced by cockle shell powder inclusion, whereas the optimum moisture content increases and the maximum dry density increases to the optimum and then decreases. The UCS of soil is found to increase with the addition of cockle shell powder to the soil. The optimum UCS of 51 kg/cm2 is obtained for 16% of CSP in clayey soil and the optimum UCS of 109 kg/cm2 is obtained for 16 % of CSP in laterite soil. As the CSP increases UCS increases up to 16% and there after it decreases, we can say it is a little bit of effective in using cockle shells powder as admixtures when compared with other stabilizing agents.

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