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A Study on the Effects of Microsilica, Lime and Synthetic Fibre in Enhancing Strength Properties of Kuttanad Clay and Marine Clay

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***Abstract*— Marine clay and Kuttanad clay are the most problematic clay having high plasticity index and both are unstable beneath pavements and superstructure. Soft clays can be strengthened by means of stabilization technique. The objective of this paper is to expose the possibilities of microsilica, lime and synthetic fibre in kuttanad clay and marine clay improvement and comparison of the results. This paper contains various tests such as index soil properties and to check the strength gain through CBR test. The properties of stabilized soil such as compaction characteristics and California bearing ratio were evaluated. Various percentage of Micro silica (5,10,15&20), lime (3,6,9), fibre(0.5,1&1.5) have been used to modify the engineering properties of both soil.**

Keywords—Kuttanad clay, Lime, Marine clay, Micro silica, Synthetic fibre.

I. INTRODUCTION

Rapid industrialization increases the volume of waste materials and the non-availability of conventional earth material have forced the engineers to utilize the waste product of industries which reduces problems for their disposal. In this connection utilization of by- products like micro silica needs special attention. Micro silica fume is an industrial waste product from the smelting process of silicon metal and ferrosilicon alloy production. It is ultra fine powder, contain high amount of siliceous particles, an excellent material for road construction. Micro silica has been used in combination with cement materials in construction field or used for soil stabilization and given great contains particles of fine sand to silt sizes.

Construction over soft soil is one of the most facing problems in many parts of the world. The old usual method adopted is to remove the soft soil and replace with stronger materials. In early days, areas having weak soil deposits were avoided while fixing up the alignment. But with scarcity of land and other resources, we do not have the choice of land and hence roads and embankments have to be built on weak soil deposits. The high cost of this method leads the researchers to look for an alternative methods and one of these methods is the process of the soil stabilization.

II. SCOPE AND OBJECTIVE

In the present study, an attempt is made to study how micro silica, lime, fibre may be effectively utilized in combination with kuttanad clay and marine clay to get an improved quality of composite material. In this study aims at investigation of various technical properties like specific gravity, liquid limit & plastic limit, particle size distribution and compaction characteristic of material individually. The main objective of this research is to focus on improving the engineering properties of the subgrade soil.

III. MATERIALS USED

In present Study the materials used are Kuttanad clay, Marine clay, Micro silica, Lime and Fibre. The properties of Kuttanad clay and Marine clay used in study are given below in Table 1 and Table 2.

TABLE 1 - INDEX PROPERTIES OF KUTTANAD CLAY

Colour	Dark brown
Liquid limit	120 %
Plastic limit	46 %
Plasticity index	74 %
Soil type	MH
Specific gravity	2.67
Dry density	1.57g/cc
Optimum moisture content	31 %

TABLE 2 INDEX PROPERTIES OF MARINE CLAY

Colour	Dark
Liquid limit	89%
Plastic limit	47 %
Plasticity index	42 %
Soil type	CH
Specific gravity	2.35
Dry density	1.42 g/cc
Optimum moisture content	29 %

A. Micro Silica

The micro silica used in this study was procured from BSS in powdered form.

B. Lime

The lime used for stabilizing soil was locally available hydraulic lime.

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C. Synthetic fibre

polypropylene fiber is used in this study. This material has been chosen due to its low cost and hydrophobic and chemically inert nature. Propylene fiber used in this study has physical properties such as specific gravity of 0.91, and an average length of 12 mm respectively.

IV. LABORATARY STUDIES

The soil samples of stabilized and unstabiized soil for Proctor Compaction Test and CBR test were prepared as per standard procedure.

A. Proctor Compaction Test [IS: 2720 (Part 7) – 1980]

To assess the amount of compaction and the water content required in the field, compaction tests are performed on the same soils in the laboratory. The empty mould with the base but without collar is weighted. About 2.5 kg of air dried soil passing 4.75 mm sieve is taken in a mixing pan. A small quantity of moisture is added to the soil and the soil is placed in the mould with collar attached, to about half full. The surface of the soil is made smooth and compacted with 25 evenly distributed blows of 2.6 kg hammer using 30.0 cm fall. Each compacted layer is scratched at its surface with a straight edge. The collar is removed and the soil is trimmed off with the straight edge. Before removing the collar, it is rotated to break of the bond between it and the soil. The mould surface is cleaned and the mould is weighted with the sample.

The dry density- moisture content relations are plotted for each test. Variation of maximum dry density and optimum moisture content for unstabilized and stabilized subgrade soils at different stabilizer contents are summarized in table 3.

Table 3 Effect Of Micro Silica, Lime And Fibre On Dry Density And Omc Of Kuttanad Clay

Microsilica (%)	Lime (%)	Fibre (%)	OMC (%)	Dry density
0	-	-	29	1.42
5	-	-	30	1.41
10	-	-	30	1.41
15	-	-	30.1	1.4
20	-	-	31	1.39
-	3	-	34.2	1.383
-	6	-	35	1.38
-	-	0.25	35	1.37
		0.5	35	1.37
		0.75	35	1.369

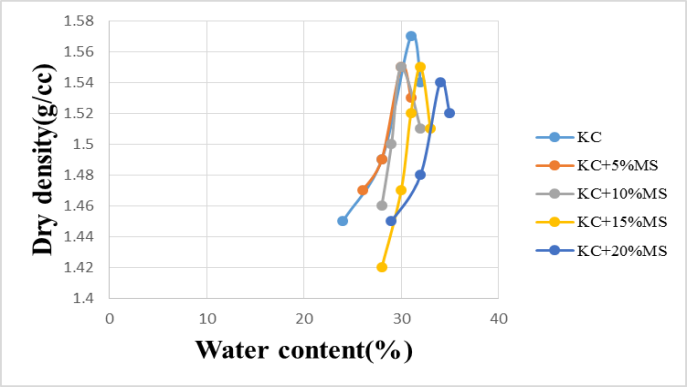

Figure 1 Results of compaction test on Kuttanad clay

Table 4 Effect of Micro Silica, Lime And Fibre On Dry Density And Omc Of Marine Clay

Microsilica (%)	Lime (%)	Fibre (%)	OMC (%)	Dry density
0	-	-	31	1.57
5	-	-	30	1.55
10	-	-	30	1.55
15	-	-	32	1.55
20	-	-	34	1.54
-	3	-	36	1.53
-	6	-	38	1.49
-	-	0.25	36	1.48
		0.5	36	1.74
		0.75	36	1.47

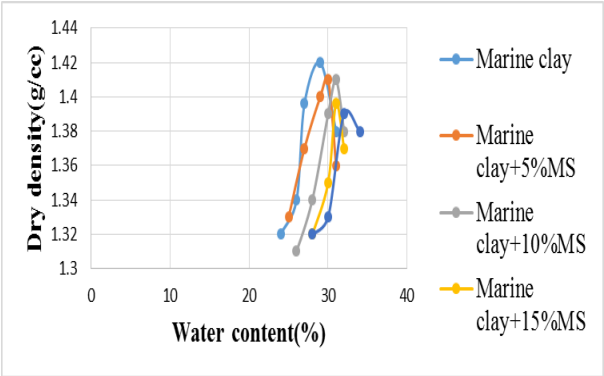

Figure 2: Results of compaction test on Marine clay

B. California Bearing Ratio Test

The California Bearing Ratio tests are conducted on kuttanad clay and marine clay, as per IS 2720 part 16 (1979). The tests were conducted under a constant strain rate of 1.25mm/min. The proving ring reading is noted for 50 divisions, and loading was continued until 3 (or) more readings are decreasing (or) constant. Mould diameter is 150 mm and height is 175 mm with detachable perforated base plate (IS: 2720-XVI). Corresponding to its optimum moisture content (OMC) in the CBR, soil was taken and mixed thoroughly with water. Then soil was compacted to its maximum dry density obtained by laboratory Modified Proctor test Proctor density as per IS: 2720, Part VII-(1974). Leveling of top surface of the specimen in the CBR mould was done and a filter paper and a perforated metallic disc were placed over the specimen.

Table 5 Effect of Micro Silica, Lime And Fibre On Cbr Value Of Kuttanad Clay

Microsilica (%)	Lime (%)	Fibre (%)	CBR (%)
0	-	-	3.3
5	-	-	3.53
10	-	-	4.36
15	-	-	4.85
20	-	-	3.89
-	3	-	5.41
-	6	-	4.92
-	-	0.25	5.62
		0.5	6.8
		0.75	6.3

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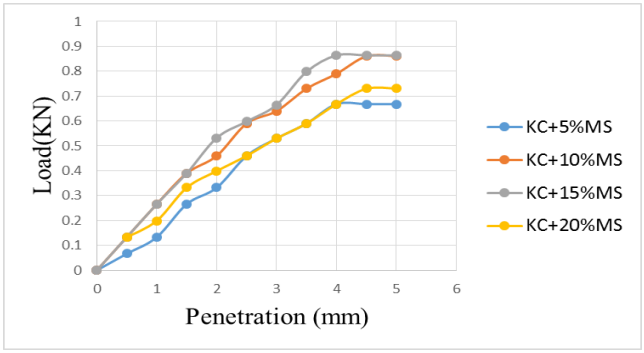

Figure 3: Influence of Kuttanad clay with different percentage of MS

The variation in California bearing ratio value of the kuttanad clay with with addition of 10%MS and 3% lime was shown in figure.

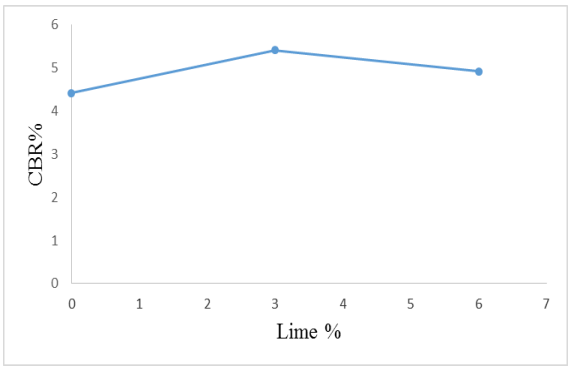

Figure 4: Influence of Kuttanad clay+10%MS +different ppercentage Lime

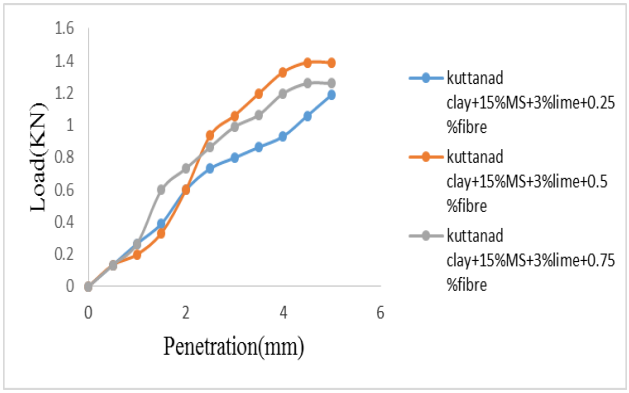

Figure 5: Influence of Kuttanad clay+10%MS+ 3% Lime+ different percentage of fibre

TABLE 6 EFFECT OF MICRO SILICA, LIME AND FIBRE ON CBR VALUE OF MARINE CLAY

Microsilica (%)	Lime (%)	Fibre (%)	CBR (%)
0	-	-	2.56
5	-	-	4.31
10	-	-	6.32
15	-	-	6.87
20	-	-	5.55
-	3	-	7.73
-	6	-	6.83
-	-	0.25	8.73
		0.5	9.22
-	-	0.75	8.75

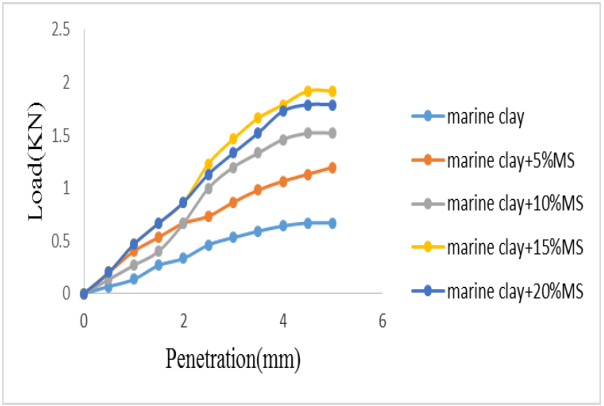

Figure 6: Influence of Marine clay with different percentage of MS

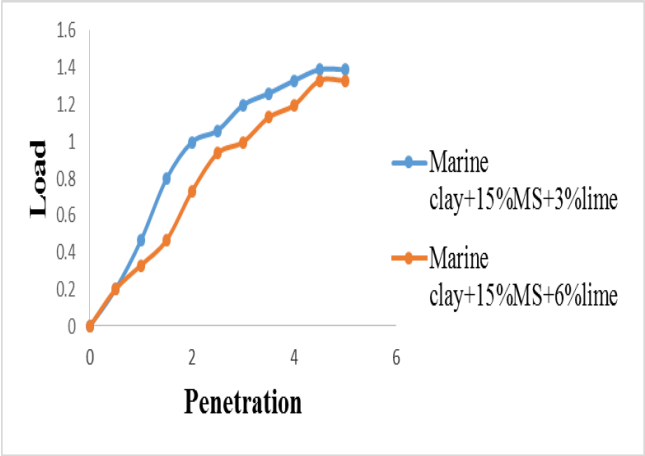

Figure 7: Influence of Marine clay+10%MS +different percentage Lime

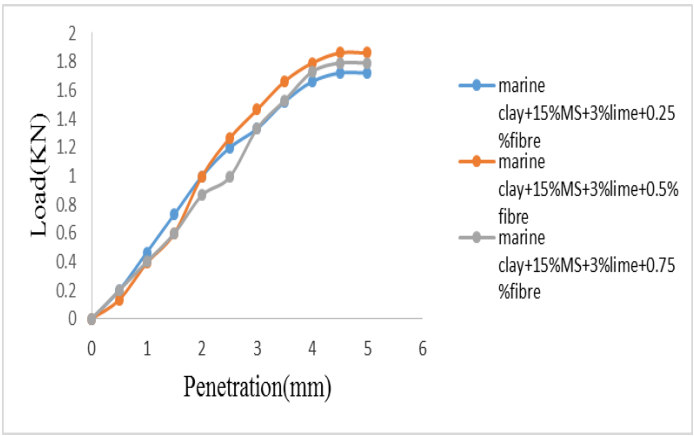

Figure 8: Influence of Marine clay+10%MS+ 3% Lime+ different percentage of fibre

V.CONCLUSION

When both the clays are stabilized with MS, lime and fibre, there is change in strength charecteristics of soil as compared to unstabilized soils which is attributed to the change in soil nature due to flocculation and agglomeration. Variation in dry density and moisture content of both clay depends on nature of soil and type as well as stabilizer percentage

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- It is observed that there is remarkable influence on strength and CBR values of clay at 15% MS + 3% Lime + 0.5% fibre which is an optimum percentage.
- As in the case of MS, the C.B.R. increases up till addition of 15% MS content but on further addition of MS content i.e. 20%, the value of C.B.R. reduces drastically.
- The CBR values for marine clay ranges between 2.58% to 9.22% in unsoaked condition.
- The CBR values for kuttanad clay ranges between 3.39% to 6.8% in unsoaked condition

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REFERENCES

[1] Al-Rawas and Al-Sarmi, H. "Effect of Lime, Cement and Sarooj (Artificial Pozzolan) on the Swelling Potential of an Expansive Soil from Oman", Building and Environment, Vol. 40: 681–687, 2005.

[2] J.M Kate "Effect of Fly Ash and Lime Additives on Swelling of Expansive Soil", Proc. Indian Geotechnical Conference (IGC 2005), pp. 291–294,2009

[3] A. J Chavan, "Use of plastic waste in Flexible pavements" International Journal of Application or Innovation in Engineering &Management (IJAIEM.) Volume 2, Issue 4, ISSN 2319 – 4847, pp 540-552, 2013.

[4] Nadgouda, K.A. "The Effect of Lime Stabilization on Properties of Black Cotton Soil", Indian Geotechnical Conference, 2010.

[5] Sudheesh Thiyyakkand " Effect of Organic Content on Geotechnical Properties of Kuttanad Clay", Journal of Geotechnical Engineering, Vol. 16, 2011

[6] Rabindra Kumar Kar "Consolidation Characteristics of Fiber Reinforced Cohesive Soil", (EJGE), Vol. 17, 2012

[7] Hassen Mosa Jafer"Stabilization of soft soil subgrade layer by using lime-micosilica fume mixture", Euphrates journal of agricultural science, pp.44-53, 2013