International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017),e-ISSN:2455-2585
International Conference on
Recent Explorations in Science, Engineering And Technology (ICRESET'19)
Volume-5, Special Issue-March, 2019.

STUDY ON THE SHEAR STRENGTH PROPERTYOF BLACK COTTON SOIL SUBJECTED TO LIME AND FLYASH STABILIZED SWELL CONTROL PROCESS

Jagedeswari.R[1], Priyadharshini.E[2]
[1]*Assistant Professor, Department of Civil Engineering, Kgisl Institute of Technology, Tamilnadu.*
[2]*Assistant Professor, Department of Civil Engineering, Kgisl Institute of Technology, Tamilnadu.*

Abstract— In this study the shear strength property of black cotton soil can be investigated by stabilized swell control process with combination of lime and fly ash for the percentage of 5%,10%,15%,20%,25%,30%,35%.in this study the stabilization of black cotton soil with lime and fly ash is done by standard proctor teat and unconfined compressive strength. From the test results the optimum moisture content (OMC) values is increases the maximum dry density decreased. So the shear strength calculated by Unconfined compressive strength with Respected OMC values and Maximum Dry density Values..

Keywords— Black Cotton soil, Lime, Fly ash, Optimum Moisture Content, Dry Density

I. INTRODUCTION

The black cotton soils possess low shear strength and undergo excessive volume changes making their use in the constructions very difficult. The properties of the black cotton soils may be altered on many ways viz. mechanical, thermal, chemical and other means. Black Cotton soils absorb water heavily, swell, become soft and lose strength. These soils are easily compressible when wet and possesses a tendency to heave during wet condition. Black Cotton soils shrink in volume and develop cracks during summer. They are characterized by extreme hardness and cracks when dry. These properties make them poor foundation soils and poor earth construction material. Among various admixtures available lime, fly ash and cement are most widely and commonly used for the stabilization of the black cotton soils. Black cotton soils are highly clay soil and grayish to blackish in color.

Lime has been widely used either as a modifier for clayey soil or as a binder. When clayey soils with high plasticity are treated with lime, the plasticity index is decreased .Fly ash is a pozzolan. It has been successfully used with granular and fine grained materials to improve soil characteristics.

Stabilization of course-grained soils having little or no fines can often be accomplished by the use of Lime and Fly ash combination. Lime and Fly ash in combination can often be used successfully in stabilizing granular materials. Lime and Fly ash stabilization is often appropriate for base and sub-base course materials. The water content of the fly ash stabilized soil mixture affects the strength. The maximum strength realized in soil-fly ash mixtures generally occurs at moisture contents below optimum moisture content for density.

II. FIELD INVESTIGATION AND METHODOLOGY

A. *Methodology*

5% of Lime by weight is mixed with black cotton soil and its Optimum moisture content(OMC) is calculated using Standard proctor compaction test. Later 10% of Lime by weight is mixed with black cotton soil and its Optimum moisture content is calculated. By this way the OMC of 15%, 20%, 25%, 30%, 35% were calculated. Later base on the OMC and their percentage of lime mix, a soil sample is prepared and tested for its shear strength in the Unconfined compression test. The same procedure is followed for both Fly Ash and Lime + Fly Ash.

B. Location and Soil Sample Collection

Soil samples were collected at SITRA region of Coimbatore at a depth of 6 feet. SITRA region is completely made up of black cotton soil. Coimbatore is 411.2metres above MSL and locating 11°1'6" N 76°58'21" Soil samples were collected at SITRA, Coimbatore and it is subjected to laboratory investigation for its physical properties.

III. LABORATORY TESTS ON BASIC SOIL PROPERTIES

The following laboratory tests were conducted and found the soil properties by various soil test

Table 1 Basic test for soil Sample

S. No	Property	Abbreviation	Values
1	Specific gravity	G	2.33
2	Initial moisture content	W	7.52 %
3	Unit weight of soil	γ	18.44 kN/m^3
7	Clay	C	42.08 %
8	Maximum Dry Density	γ_d	1.78g/cc
9	Unit Cohesion	C	0.98kN/m^2
10	Organic Content		40%
11	Relative Density		71.23%
12	Constant Head	k	0.046 cm/s
13	Falling Head	K	0.0006 cm/s
14	Liquid limit	W_L	38.6%
15	Plastic limit	W_P	7.55%
16	Plasticity index	I_P	31.4%
17	Shrinkage limit	W_S	3.56%

IV. LIME FLY ASH STABILIZATION

The main benefits of using lime to stabilize clays are improved workability, increased strength. stability. Workability is improved because flocculation makes the clay more friable; this assists combination for effective mixing and compaction. Lime increases the optimum water content for compaction, which is an advantage when dealing with wet soil. The compaction curve for lime-treated clay is generally flatter, which makes moisture control less critical and reduces the variability of the density produced.The addition of lime and fly ash reduces the swell characteristics but the shear strength properties will change. In this project the same swell controlling procedure is taken but the shear strength property study was taken into account and solutions have been developed. Inspite of existing techniques an attempt is made to study the shear strength of black cotton soil.

Sampling of soil and lime:

The black cotton soil sample collected from the site is used for sampling in the laboratory. The sampling were done based on the following soil – lime mixtures.

- Clay +5% (Lime+Flyash)
- Clay +10% (Lime+Flyash)
- Clay +15% (Lime+Flyash)
- Clay +20% (Lime+Flyash)
- Clay +25% (Lime+Flyash)
- Clay +30% (Lime+Flyash)
- Clay +35% (Lime+Flyash)

A. *Optimum Moisture Content*

This test is done to determine the maximum dry density and the optimum moisture content of soil using heavy compaction as per IS:2720 (Part 8) – 1983.

Table 2 Consolidated Values of Optimum Moisture Content Of Soil Mixtures

Mixtures	soil+5% (lime+fly ash)	soil+10% (lime+fly ash)	soil+15% (lime+flyash)	soil+20% (lime+fly ash)	soil+25% (lime+fly ash)	soil+30% (lime+fly ash)	soil+35% (lime+flyash)
OMC(%)	11	12	13	14	16	17	18
max.dry density(g/cc)	1.422	1.422	1.704	1.742	1.756	1.767	1.778

B. ***Unconfined compressive strength***

The primary purpose of this test is to determine the unconfined compressive strength, which is then used to calculate the unconsolidated undrained shear strength of the clay under unconfined conditions. According to the ASTM standard, the unconfined compressive strength (qu) is defined as the compressive stress at which an unconfined cylindrical specimen of soil will fail in a simple compression test. In addition, in this test method, the unconfined compressive strength is taken as the maximum load attained per unit area, or the load per unit area at 15% axial strain, whichever occurs first during the performance of a test**.**

Table 3 Consolidated Values of Unconfined Compressive strength

Mixtures	soil+5% (lime+fly ash)	soil+10% (lime+fly ash)	soil+15% (lime+fly ash)	soil+20% (lime+fly ash)	soil+25% (lime+fly ash)	soil+30% (lime+fly ash)	soil+35% (lime+fly ash)
UCC (qu) KN/m2	1.857	1.898	2.289	1.696	1.497	0.788	0.322
cohesive strength (cu)KN/m2	0.929	0.949	1.145	0.848	0.749	0.394	0.161

V. RESULTS AND DISCUSSION

The Table 3, explained about the consolidated result of Deformation Vs stress for Unconfined Compressive Strength of Different mixture of soil with lime and Fly ash.

Table 4 Consolidated Result (UCC Test)

Mixture	Soil+5% (Lime+Flyash)	Soil+10% (Lime+Flyash)	Soil+15% (Lime+Flyash)	Soil+20% (Lime+Flyash)	Soil+25% (Lime+Flyash)	Soil+30% (Lime+Flyash)	Soil+35% (Lime+Flyash)
Deformation	**Unconfined compressive stress(N/mm^2)**						
1	0.649	0.678	1.135	3.589	3.528	3.896	0.089
2	1.297	2.371	10.181	12.23	8.913	11.36	1.948
3	3.488	5.293	15.17	20.19	13.38	16.72	2.753
4	6.165	7.58	18.57	22.88	14.97	16.96	3.218
5	10.546	7.876	18.57	21.96	13.75	16.31	2.765
6	14.6	7.622					
7	17.7						
8	18.98						
9	18.33						

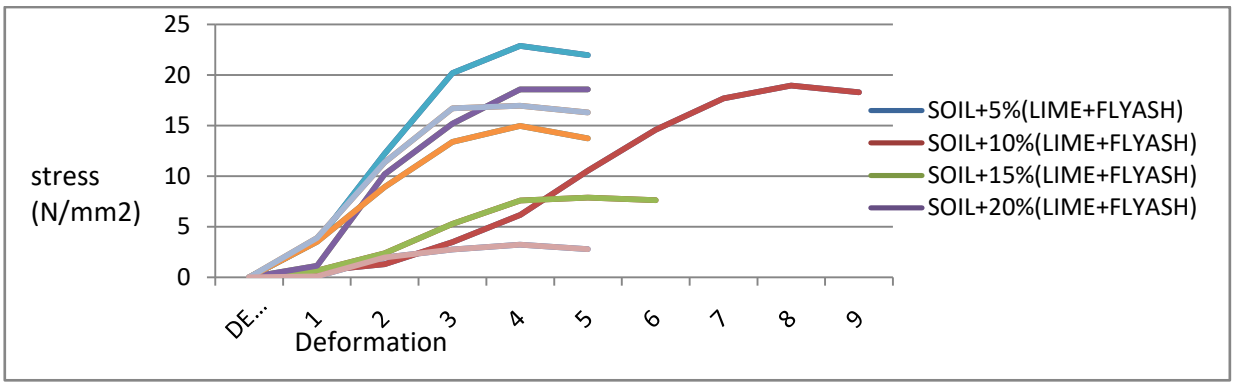

Figure 1 Graph for Consolidated Results (UCC Test)

VI. CONCLUSION

As swell potential reduces the shear strength increases to a certain limit. After addition of 20% of lime and fly ash the shear strength reduces. As lime and fly ash content increases the water content in the soil reduces to very low and the soil becomes cohesion less. So addition of lime and fly ash is useful only up to 20% after that the actual shear strength and frictional resistance of soil reduces which causes differential settlement.

.

REFERENCES

1. M.Jayakumar, Lau Chee Sing **"Experimental Studies On Treated Sub-Base Soil With Fly Ash And Cement For Sustainable Design Recommendations"** a journal of World Academy Of Science, Engineering And Technology.
2. Alper Sezer, Gozde Inan, H.Recep Yilmaz, Kambiz Ramyar **"Utilization Of A Very High Lime Fly Ash For Improvement Of Izmir Clay"** a journal of Building And Environment.
3. Zalihe Nalbantoglu **"Effectiveness Of Class C Fly Ash As An Expansive Soil Stabilizer"** a journal of Construction and Building Materils.
4. Yucel Guney, Dursun Sari, Murat Cetin, Mustafa Tuncan **"Impact Of Cyclic Wetting-Drying On Swelling Behaviour Of Lime-Stabilized Soil"** a journal of Building And Environment.
5. Amer Ali Al-Rawas, A.W.Hago, Hilal Al-Sarmi **"Effect Of Lime, Cement And Sarooj (Artificial Pozzolan) On The Swelling Potential Of An Expansive Soil From Oman"** a journal of Building And Environment.
6. Younoussa Millogo, Jean-Claude Morel, Karfa Traore, Raguilnaba Ouedraogo **"Microstructure, Geotechnical And Mechanical Characteristics Of Quicklime-Lateritic Gravels Mixtures Used In Road Construction"** a journal of Construction and Building Materials.
7. S.Kolias, V.Kasselouri-Rigopoulou, A.Karahalios **"Stabilisation Of Clayey Soils With High Calcium Fly Ash And Cement"** a journal of Cement and Concrete Composites