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Soil Stabilization on Problematic Soil with Traditional Stabilizer

Soundarya M.K, Bhuvaneshwari.S

Abstract: ***The tumble down behaviour of super structure and substructure is caused due to the problematic soil which is more prone to shrink-swell process. In this event to contrive, a substitute which is naturally available has been blended with virgin soil. The basic Engineering properties has been studied which shows more positive results towards Atterberg's Limit. The mould is embossed with the soil with lime at different proportion of 0 %, 2%, 4% and 8 %. The strength of the soil was studied with help of unconfined compression test. For 8% lime, UCC value is 2250 kPa in 28 days which shows the formation of cementitious material. An attempt made in this paper is to show the firmness of soil and lime.***

Keywords: Lime, Atterberg`s Limit, Unconfined Compressive test

I. INTRODUCTION

Due to the Rapid Industrialization and Urbanization, there is a need to construct the buildings, hydraulic structures and foundation systems in the area left over. The clay soil (expansive soil) is experienced with swell- shrink scenario so that structures constructed over the soil will result in settlement, failure of structures by cracks, etc., Coarse grained soils always depends upon mineralogical composition whereas fine grained soils mainly influenced by nature and characteristics of minerals in large extent. The properties of clay soil hinge on the type of minerals namely Kaoline, Iilite, Montmorllite etc.,

The clay minerals are formed by chemical weathering by the formation of crystalline particles of colloidal nature (2μ). In nature, clay minerals have high specific surface. Due to this large specific surface, more water is attracted towards the clay particle. The mineralogy states that clay which is made up of crystal sheets with repeating atomic structure- Tetrahedron (Silica Sheets) and Octahedral (Aluminum Sheets). The attraction of water toward clay is formed due to the bond between negatively charged clay and cations in water. This property is to be removed by addition of some additives, which alters its chemical composition and in turn decreases the swelling behaviour of soil. It also increases the strength of the soil. Lime being traditional additive was chosen for this project. When soil comes in contact with water, exchange of cations occurs immediately. By modifying the structure of clay which is composed of double layer with ion exchange of calcium present in lime. Lime on reaction with silica tetrahedron and aluminum octahedron, lattices of clay minerals increases the alkaline nature of the soil, which in turn improves the behaviour of soil.

II. PROPOSED METHODOLOGY:

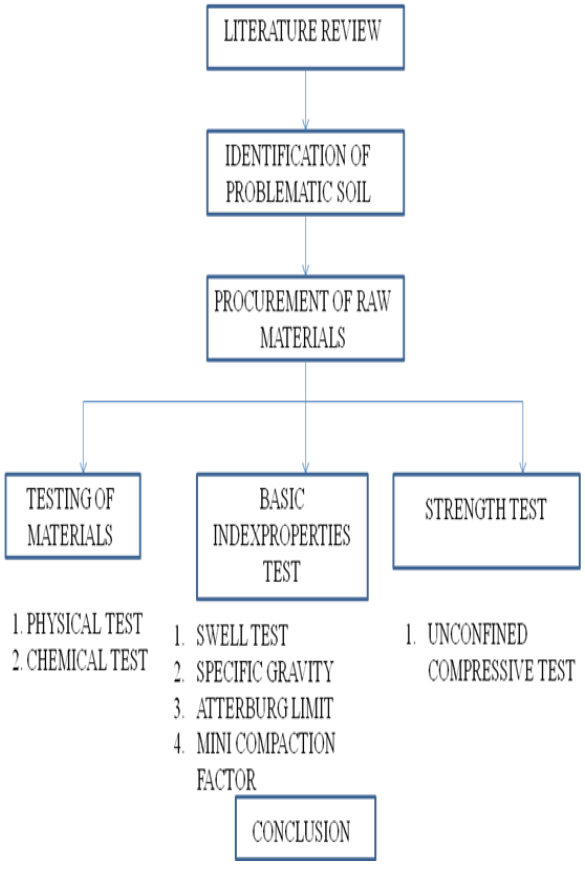

Fig.1. Framework of Research

The Research work should follow some sequence steps based on the scientific & engineering reasons to achieve constructive results. The primary essence of this research work is to understand the engineering properties of soil followed by strength criteria using unconfined compressive test.

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* Correspondence Author
Soundarya.M.K*, Assistant Professor, Department of Civil Engineering, Vels Institute of Science, Technology and Advanced Studies, Chennai, Tamilnadu, India Email: mk.soundaryaa@gmail.com
Bhuvaneshwari.S Associate Professor, Department of Civil Engineering, SRM Institute of Science and Technology, Chennai, Tamilnadu, India

III. RESULT ANALYSIS

A. *RAW SOIL*

The soil from Siruseri, Chennai was observed for its swelling nature behaviour. Figure 1 represents the study area in Google Map.

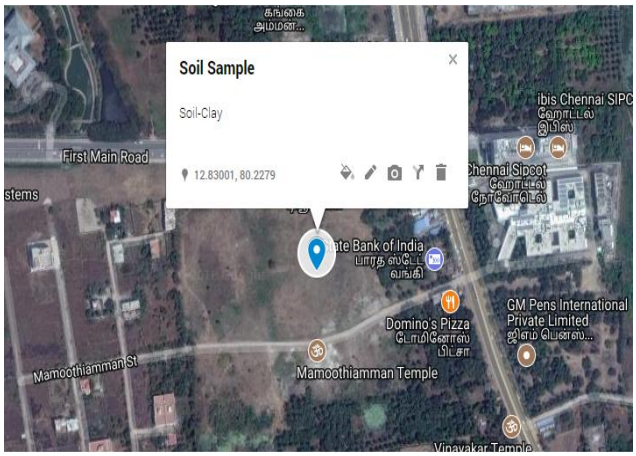

Fig.1. Google Maps Shows the raw soil collected spot

The Sedimentation analysis, Consistency test, UCC test has been followed out in order to analyze the basic engineering properties of soil and table 1 show the Engineering properties of Siruseri soil.

Table- I: Index properties of Siruseri soil

Soil Properties	Values
Consistency limit a) Liquid Limit (LL) (%) b) Plastic Limit (PL) (%) c) Shrinkage Limit (SL) (%)	 76.16 23.05 8.50
Specific Gravity (G)	2.71
Grain distribution Clay (C) (%) Silt (M) (%) Sand (S) (%)	 66 33 01
Compaction test characteristics Maximum dry unit weight (kN/m^3) Optimum moisture content (%)	 14.1 28
Differential free swell (%)	108

B. FREE SWELL TEST

The differential free swell test is conducted with the help of IS 2720 (Part 40):1970 Initially, one beaker is filled with soil and kerosene to cease the swelling behaviour of clay soil at that instant, and other beaker is filled with soil and distilled water to measure swelling capacity of the soil. The virgin soil has its swelling nature of about 100% which reduces abruptly to 65% on addition of lime, the traditional additive. The percentages of swelling capacity of soil blended with lime at various proportions were shown in Table 2.

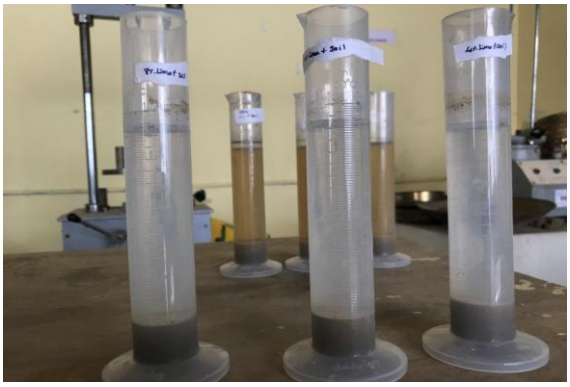

Fig. 2. Free swell Test on 2% Lime, 4% lime and 8 % lime with soil in distilled water

Table- II: Differential Free Swell Percentage of Soil blended lime

S.No	Designation of Soil Sample	Free swell percentage (%)
1.	Virgin soil	108
2.	2 % Lime blended Soil	80
3.	4 % Lime blended Soil	70
4.	8% Lime blended Soil	65

C. LIQUID LIMIT

With the help of IS 2720 Part5 is used to urge the Liquid Limit. The Casagrande`s apparatus which standard dimensions is used to determine the Liquid Limit. The flow curve was drawn with No. of blows in x-axis with log scale and Liquid Limit in y- axis. The liquid limit is the minimum water content corresponding to 25 no. of blows in the soil. From Fig.2 it is found that, on addition of lime , the liquid limit reduces considerably. The designation of R, A, B, C represents Raw soil, Soil + 2% Lime blended soil, 4% Lime blended soil and 8% Lime blended soil, respectively.

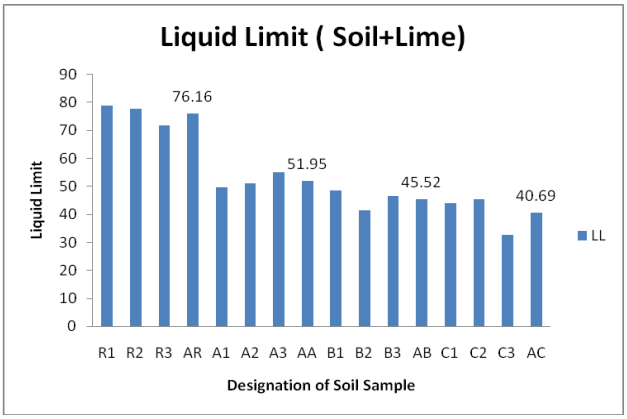

Fig.3. Liquid Limit of Lime blended soil

D. PLASTIC LIMIT

The methodology for conducting the plastic limit test is taken IS 2720, Part 6. The change in moisture content on preparation of 3mm thickness soil specimen thread was noted.

From the fig2, there is a radical increases in plastic limit on lime addition to soil. For soil+2 % lime, an peak value of average 41% has been observed.

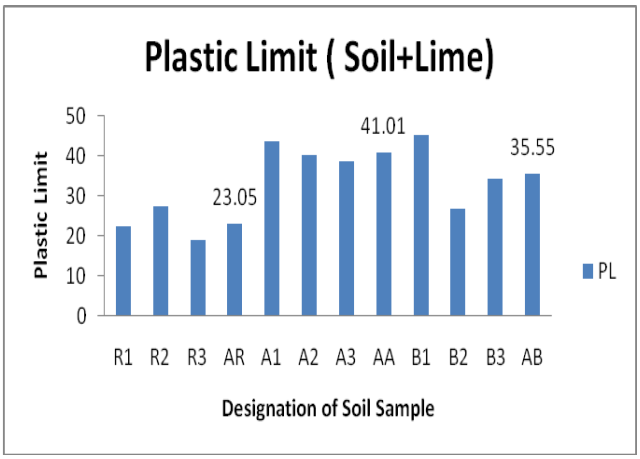

Fig.4.Plastic Limit of Lime blended soil

E. SHRINKAGE LIMIT

As shrinkage limit increases rapidly on addition of lime. The Thickness of clay particles and specific surface area reduces due to the flocculation of soil on addition to lime.

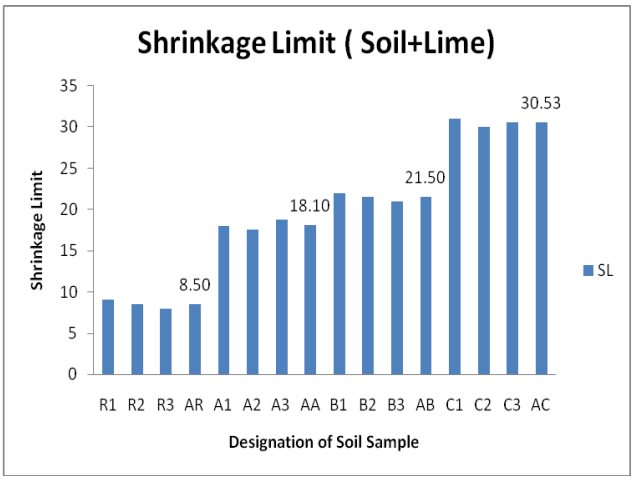

Fig.5. Shrinkage Limit of Lime blended soil

E. MINI COMPACTION TEST

The mini compaction test was conducted with assist of mould with internal diameter of 3.8l cm and external diameter of 4.61 cm and height of 10 cm. For raw soil, OMC value is 21% and dry density is 15 kN/m^3. On lime addition, the dry density decreases and optimum water content increases. The change of OMC is not much in 8% lime when compared to 2 % lime.

Table- III: Dry density and OMC from Mini compaction test

Designation	Dry density (kN/m3)	OMC%
2 % Lime blended Soil	14.8	22
4 % Lime blended Soil	14.5	24
8 % Lime blended Soil	14	28

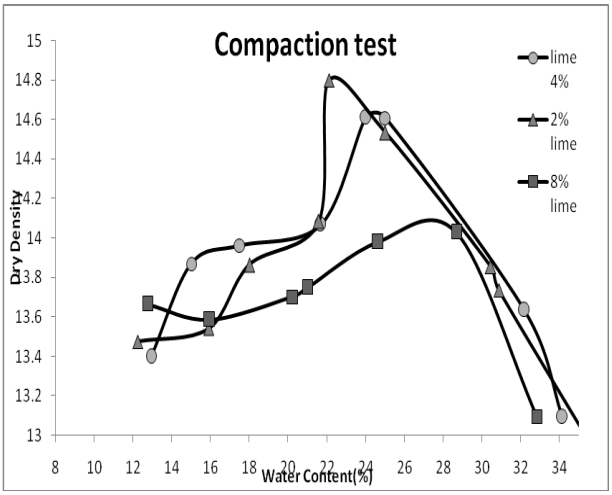

Fig.6.Compaction test of Lime blended soil

F. UNCONFINED COMPRESSIVE STRENGTH

With the intention to evaluate the strength aspects of soil blended lime at various proportions, UCC test has been conducted. Table 4 indicates the Variation of UCC Strength in 3 days and 28 days cured samples. The marginal strength gain shows that the pozzolonic reaction leads to formation cementitious compounds. The UCC value is 250kPa for virgin soil and 2250 kPa for 8% lime treated soil in 28 days curing period. The plot fig. 5 shows the variation of strength with different proportion of lime and soil.

Table- IV: UCC Strength Variation

UCC (kPa)		
% Lime	3 days	28 days
0	250	250
2	275	675
4	500	1275
8	1000	2250

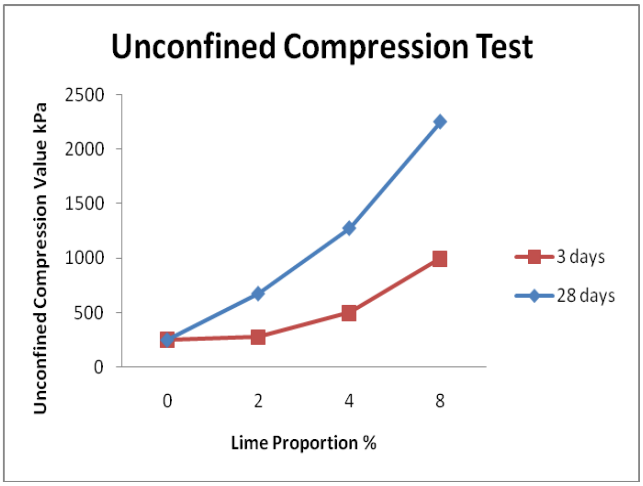

Fig.7.Unconfined Compression test of Lime blended soil

IV. CONCLUSION:

From the results, the following summary has been drawn,

1. Atterburg`s Limit has been modified, resulting in formation of cementitious compuind on addition of traditional stabilizer.
2. The Liquid Limit diminishes and Plastic limit value accelerated to an extent on addition of lime which shows the cementitious material formation.
3. The Unconfined Compression value shows the mechanisms of pozzalonic nature varies as curing period prolongs.

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AUTHORS PROFILE

Soundarya.M.K, working as Assistant Professor, Department of Civil Engineering, Vels Institute of Science, Technology and adveanced Studies. Area of Interest is Soil Stabilization