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EFFECT OF SODIUM BENTONITE ON INDEX AND ENGINEERING PROPERTIES OF LIME STABILIZED CLAY

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Abstract – *An experimental study was conducted to investigate the effect of sodium bentonite on the lime stabilized expansion soil. The influence of lime and sodium bentonite on the index properties, compaction characteristics and unconfined compressive strength was analyzed. Soil was stabilized with the optimum consumption of lime and sodium bentonite was added at varying percentage such as 2,4,6 & 8% of the dry weight of soil. The laboratory tests were atterberg's limit tests, standard proctor compaction test and unconfined compressive strength test for both uncured and cured conditions. The optimum mix for the highly compressive clay was found to be 8% of lime with 4% of sodium bentonite. This study showed that, on addition of lime and sodium bentonite, the consistency limits were altered, maximum dry density was decreased and the unconfined compressive strength of the soil enormously enhanced. Sodium bentonite provided larger surface area for the pozzolanic reaction to take place between lime and soil.*

Key Words: Stabilization of soil, Expansive clay, lime stabilization, sodium bentonite, Index properties, Engineering properties.

1.INTRODUCTION

Construction of engineering structures on weak or soft soil is considered as unsafe. Expansive soil usually has the potential to demonstrate undesirable engineering behavior, such as low bearing capacity, high shrinkage and swell characteristics and high moisture susceptibility. Characteristics and high moisture susceptibility.

So the expansive soil will undergo volumetric changes due to the variation of water content in it. The finer particles of the expansive soil lead to the water holding capacity. Soil stabilization is the process which improves the engineering properties of soil and make its stable. The main objective of soil stabilization is to improve the strength and stability of soil and mainly to lower the construction cost.

The stability and bearing capacity of soil is depending on the shear strength which is directly proportional to the type and condition of the soil. In some of the situation where to material do not have the desired engineering properties, but when they mixed together, they produced satisfactory material. The new stabilized material will be more stable and fulfill the desired condition.

2. NEED FOR STUDY

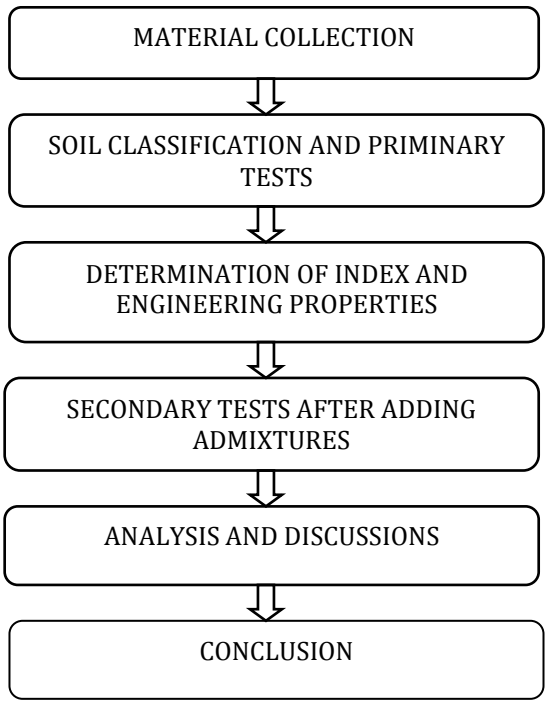
Soil stabilization broadly refer to any chemical or mechanical treatment given to a mass of soil to improve or maintain its engineering properties. Lime treated are most commonly used to upgrading a poor quality soil. Soil stabilization find many purpose. The first most obvious one is strength improvement.

Soil stabilization help increase the strength of the existing soil to improve its capacity for load bearing. Dust control and soil water proofing are two other reasons why soil stabilization is done. The other purpose of soil stabilization, soil water proofing, preserve the natural strength of a soil by obstructing the entry of surface water.

3. OBJECTIVE OF THE STUDY

The proposed project aims at understanding the influence of sodium bentonite on the index and engineering behaviour of lime stabilized soil.

4. METHODOLOGY



5. MATERIAL COLLECTOION

Fig 5.1: Clay Soil

Fig-5.2: Lime Powder

Fig-5.3: Sodium Bentonite clay

6. SOIL CLASSIFICATION

Since less than 50% of soil retained on 75 micron sieve, the soil is classified based on its grain size. The engineering behavior of the small particles would differ from relatively large particles that forms the basis of using size of the particle as a criterion for classifying soil. So in order to classify the soil size of the particles should be known for the purpose sieve analysis is used to determine the size of the particles. In India Bureau of Indian standards has adopted the soil classification system called IS classification system of soil. So we are going to classify the soil based on the IS.

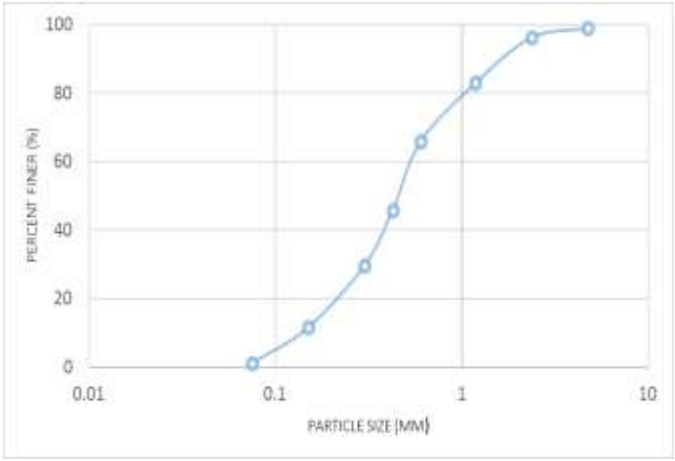


Chart-6.1: Particle Size Distribution curve

The result of dry sieve analysis shows that the course grained particles present in the sample are Well Graded in nature.

7. PRELIMINARY TESTS

7.1 Preliminary Tests for Soil

SI.NO	NAME OF THE TEST		RESULT	UNIT
1	Liquid limit		63	%
2	Plastic Limit		28	%
3	Shrinkage Limit		18.3	%
4	Free Swell Index		45	%
6	Standard proctor compaction test	O.M.C	9	%
		Maximum dry density	1.95	g/c.c

Table-7.1.1: Preliminary Test Results for virgin soil

7.2 Preliminary Test for Lime

7.2.1 pH Test

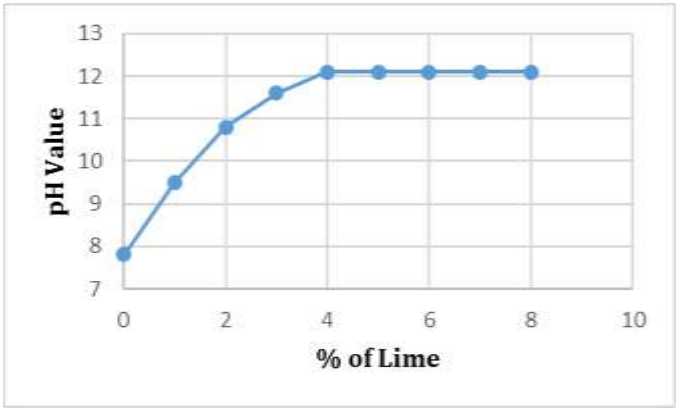


Chart-7.2.1.1: pH Value Curve

According to above graph the initial consumtion of lime is founded as 4%.

8. SECONDARY TESTS

The secondary test is to be conducted for adding lime and sodium bentonite to the clay soil in 0th day and 7 th day curing.

8.1 Influence of lime on the index properties of soil

8.1.1 Effect of lime on the Liquid Limit

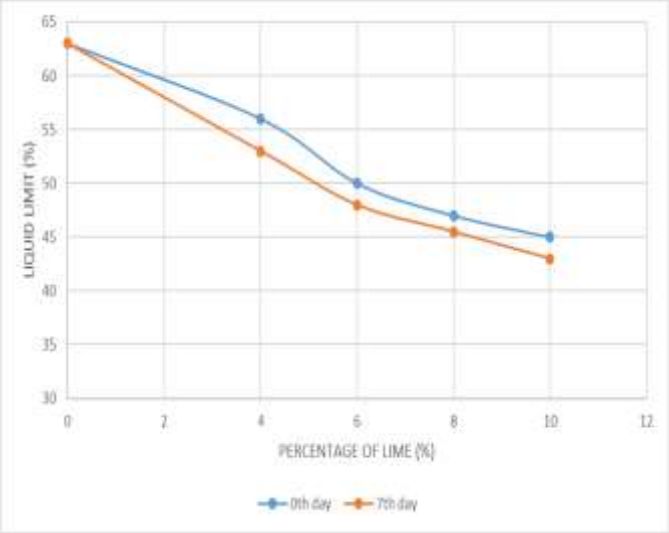


Chart-8.1.1.1: Liquid Limit values for Soil + Lime

8.1.2 Effect of lime on the plastic limit values of soil

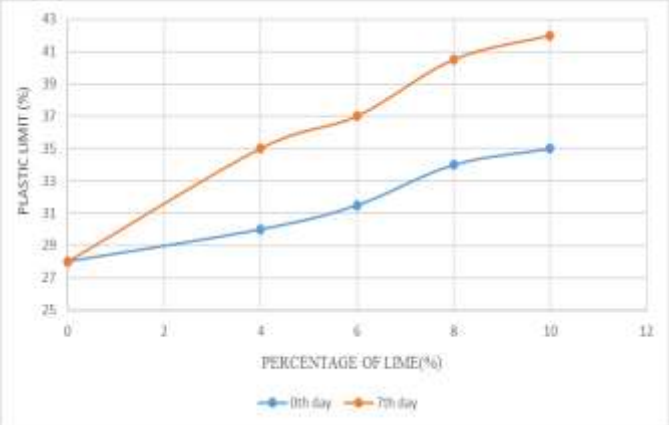


Chart-8.1.2.1: Plastic Limit values for Soil + Lime

8.1.3 Effect of lime on the Plasticity Index of soil

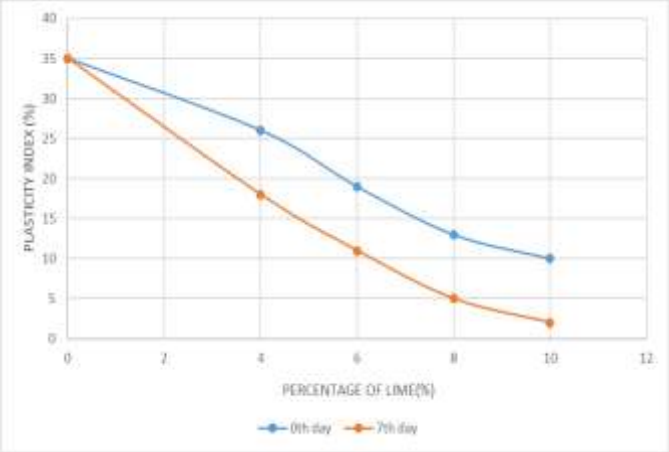


Chart-8.1.3.1: Plasticity index values for Soil + Lime

8.1.4 Effect of Lime on the Shrinkage Limit of Soil

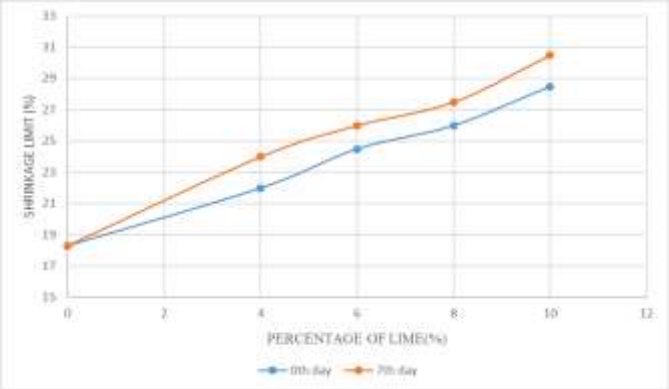


Chart-7.1.4.1: Shrinkage Limit values for Soil + Lime

8.1.5 Influence of lime on the compaction characteristics of soil

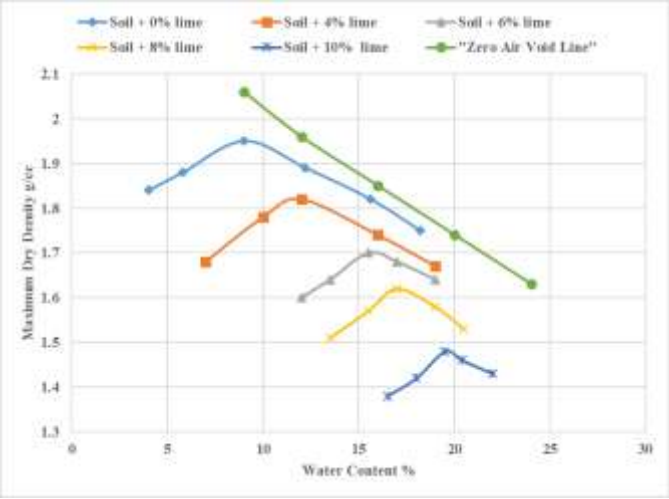


Chart-8.1.5.1: Compaction curve for soil with lime

% of lime	OMC (%)	$\gamma_{d,max}$ (g/cc)
0	9	1.95
4	12	1.74
6	15.5	1.7
8	17	1.62
10	19.5	1.48

Table-8.1.5.1 Variation of $\gamma_{d,max}$ and OMC of Soil with % of Lime

8.1.6 Influence of Lime on the Unconfined Compression Strength of soil

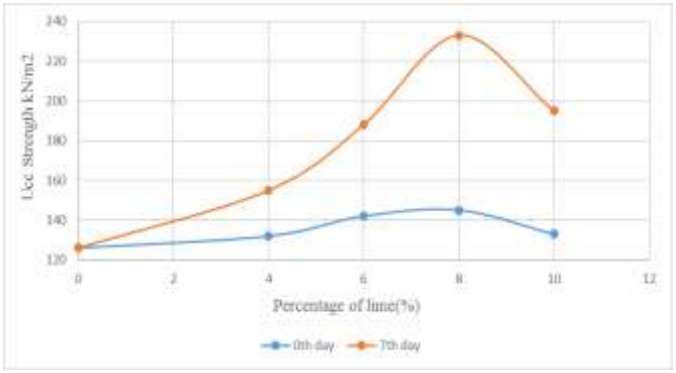


Chart-8.1.6.1 Effect of Curing on Unconfined Compressive Strength

From the above charts, it was found that with the increase in the percentage of lime, liquid limit, plasticity index and maximum dry density decreased and plastic limit, shrinkage limit and optimum moisture content of soil increased. The unconfined compressive strength of reached its maximum and decreased after optimum percentage.

8.2 Influence of sodium bentonite on Index Properties of Lime Stabilized Soil

8.2.1 Effect of Sodium Bentonite on Liquid Limit of Lime Stabilized Soil

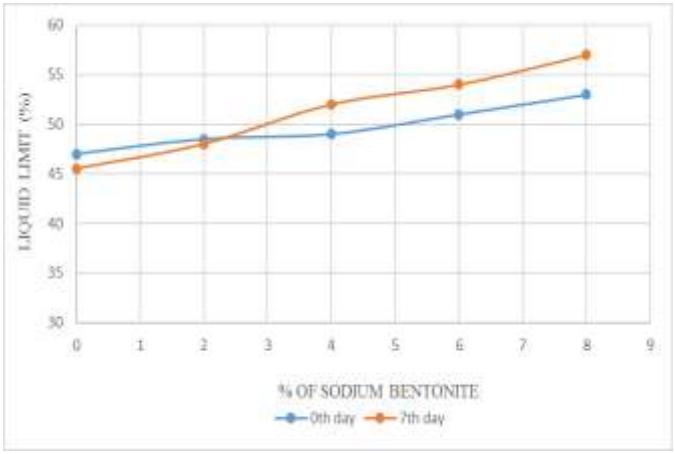


Chart-8.2.1.1 Liquid Limit Variation for Soil + Lime Sodium Bentonite

8.2.2 Effect of Sodium Bentonite on Plastic Limit of Lime Stabilized Soil

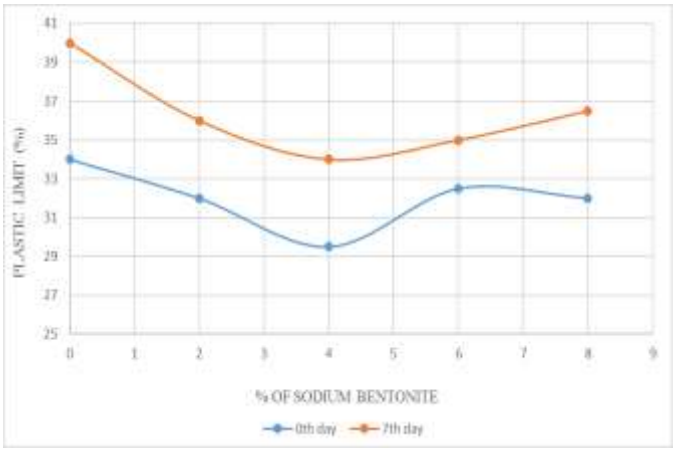


Chart-8.2.2.1 Plastic Limit Variation for Soil + Lime + Sodium Bentonite

8.2.3 Effect of Sodium Bentonite on Plasticity Index of Lime Stabilized Soil

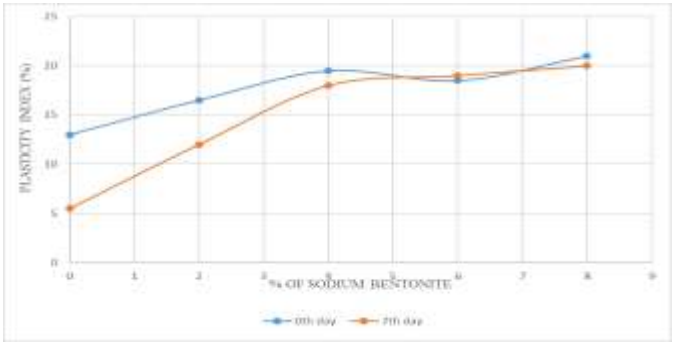


Chart-8.2.3.1: Plasticity Index for Soil + Lime + Sodium Bentonite

8.2.4 Effect of Sodium Bentonite on the Shrinkage Limit of Lime Stabilized Soil

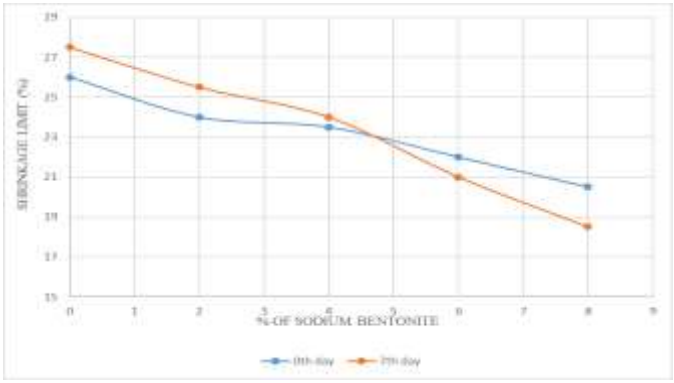


Chart-8.2.4.1: Shrinkage limit variation for Soil + Lime + Sodium Bentonite

8.2.5 Influence of Sodium Bentonite on Compaction Characteristics of Lime Stabilized Soil

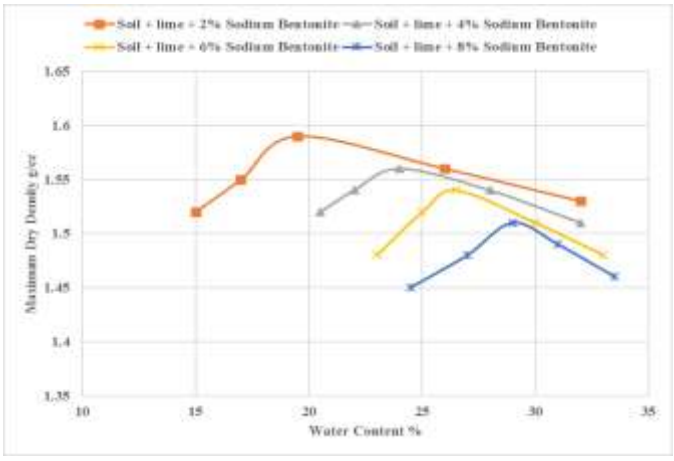


Chart-8.2.5.1 Compaction Curves for Soil + Lime + Sodium Bentonite

% of sodium bentonite	OMC	$\gamma_{d,max}$ (g/cc)
2	19.5	1.59
4	24	1.56
6	26.5	1.54
8	29	1.51

Table-8.2.5.1 Variation of $\gamma_{d,max}$ & OMC of Lime Stabilized Soil with % of Sodium Bentonite

8.2.6 Influence of Sodium Bentonite on Unconfined Compressive Strength of Lime Stabilized Soil

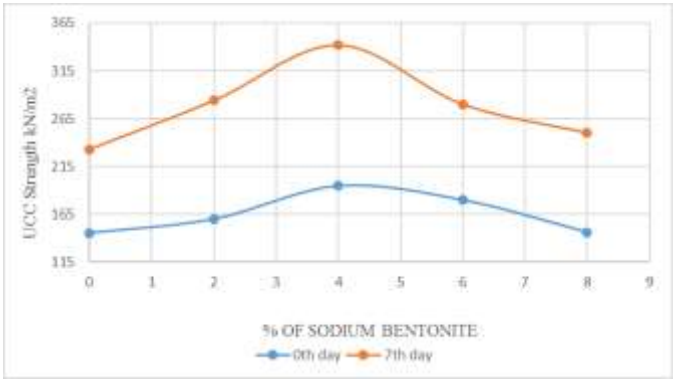


Chart-8.2.6.1 Effect of Sodium Bentonite on UCS value of Lime Stabilized Soil

From the above charts, it was found that with the increase in the percentage of sodium bentonite in lime stabilized soil, liquid limit, plasticity index and maximum dry density decreased and plastic limit, shrinkage limit and optimum moisture content of soil increased. The unconfined compressive strength of reached its maximum and decreased after optimum percentage.

9. CONCLUSIONS

To study the effect of sodium bentonite on the lime stabilized soil, index tests, compaction tests and unconfined compressive strength tests were carried out. For a comparative study, tests were conducted on uncured and 7 days cured soil. Based on the analysis of the results, the following conclusions maybe drawn,

- Addition of sodium bentonite on lime stabilized soil alters the index and engineering properties of soil.
- In both, uncured and cured conditions, the addition of sodium bentonite to lime stabilized soil greatly increased the unconfined compressive strength of the soil.

- Consistency limits of the soil was improved since liquid limit decreased and plastic limit vale increased for the optimum mix of lime and sodium bentonite. The compaction characteristics was also altered with the decrease in maximum dry density from 1.95g/cc to 1.56g/cc.
- The maximum unconfined compressive strength was attained for Soil + 8% Lime + 4% Sodium Bentonite, as 195kN/m2 for uncured condition and 342kN/m2 for cured condition.
- Thus strength of the engineered clay soil was enhanced by 171% as that of the actual UCC strength of the soil.
- Sodium bentonite provided larger surface for reaction of lime during curing period, which results in high reactivity of soil and thus increases the strength to a great extent. Cured samples result in improved strength as the curing period ensures proper completion of pozzolanic reaction between soil and lime.

REFERENCES

[1] Mir Amid Hashemi et al, 'Lime-treatment of sand improved by bentonite addition', European Young Technical Engineers Conference, January 2012.

[2] S.V.Neethu and S.Remya, 'Engineering Behavior of Nanoclay Stabilized Soil', Proceedings of Indian Geotechnical Conference, December 22-24, 2013, Roorkee.

[3] Zaid Hameed Majeed, Mohd Raihan Taha and Ibtehaj Taha Jawad, 'Stabilization of Soft Soil Using Nanomaterial', Research Journal of Applied Science, Engineering and Technology, 2014, pp.503-509.

[4] Punmia B.C , 'Soil Mechanics And Foundation' , Laxmi publication (P) Ltd. New Delhi,17th edition.

[5] IS : 1498 – 1970-Classification and Identification of soils for general Engineering purposes.

[6] IS : 2720a (Part VII) :1965-Methods of Test for soil (Determination of water content-dry density relation using light compaction).

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