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SOIL IMPROVEMENT WITH LIME

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Abstract : *Design of Pavement is based on the premise that minimum specified structural quality will be achieved for each layer of material in the pavement system. Each layer of road must resist shearing. It should avoid excessive deflections that cause fatigue cracking within the layer or in overlying layers, and prevent excessive permanent deformation through densification. As the quality of a soil layer is increased, the ability of that layer for load distribution over a greater area is generally increased so that a reduction in the required thickness of the soil and surface layers may be permitted. The most common improvements of different layers are achieved through stabilization include better soil gradation, reduction of plasticity index or swelling potential, and increases in durability and strength. In wet weather, stabilization may also be used for construction operations to provide a working platform. This study focuses on the subsequent construction aspects of treating soils with lime.*
Keywords *– Lime, Maximum Dry Density, Optimum Moisture Content, Stabilization, Unconfined Compressive Strength.*

I. Introduction

Lime stabilization is a method of chemically transforming unstable soils into structurally sound construction foundations. Lime stabilization is particularly important in the construction of highway for modifying subgrade soils, subbase materials, and base materials. The improved engineering characteristics of materials which are treated with lime provide important benefits to portland cement concrete (rigid) and asphalt (flexible) pavements. Lime stabilization creates a number of important engineering properties in soils which includes improved strength;

improved resistance to fracture, fatigue, and permanent deformation; reduced swelling; and resistance to the damaging effects of moisture. The most substantial improvements in above said properties are seen in moderately to soils with high plasticity, such as heavy clays. Then soil stabilization occurs when lime is added to a reactive soil to generate long-term strength gain through a pozzolanic reaction. That reaction produces stable calcium silicate hydrates and calcium aluminate hydrates as the calcium from the lime reacts with the aluminates and silicates solubilized from the clay. This pozzolanic reaction can continue for a very long period of time, even decades -- as long as enough lime is present and the pH remains high (above 10). As a result of this, lime treatment can produce high and long-lasting strength . Lime in the form of quicklime (calcium oxide – CaO), hydrated lime (calcium hydroxide – Ca[OH]2), or lime slurry can be used to treat the soils. Hydrated lime is created when the quicklime chemically reacts with water. It is hydrated lime that reacts with particals of clay and permanently transforms them into a strong cementious matrix.

II. Experimental Work and their Results

Different tests are performed in this project, which are listed below:

- Modified Procter Test
- Unconfined Compressive Test
- Plasticity Index (PI)

Soil used for these experiments was classified as sandy soil. Then the Modified Procter Tests were performed to find the maximum dry density and optimum moisture content for virgin soil and for soil with different percent of lime. The unconfined compressive tests were performed in the laboratory to find the effect of lime with different percentage on soil. The results of tests are given below:

2.1 Procter Compaction Test
2.1.1 Virgin Soil Sample

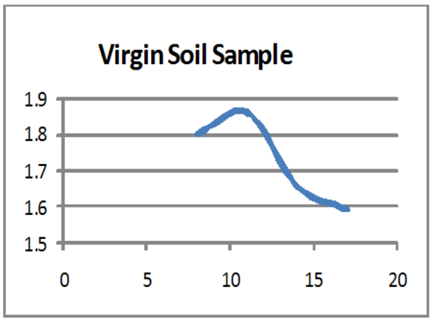

Fig No. 1. Graph of Virgin Soil Sample
X-axis: Moisture Content (%)
Y-axis: Dry Density (g/cm^3)

2.1.2 Soil With 3% Lime

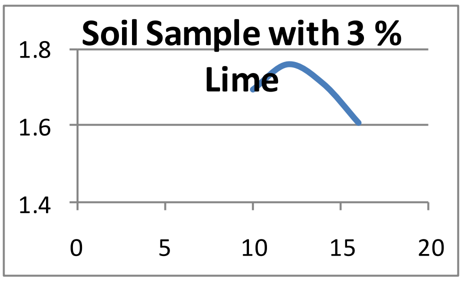

Fig No. 2. Graph of Soil Sample with 3% Lime
X-axis: Moisture Content (%)
Y-axis: Dry Density (g/cm^3)

2.1.3 Soil With 6% Lime

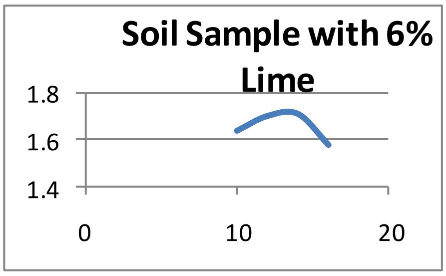

Fig No. 3. Graph of Soil Sample with 6 % Lime

X-axis: Moisture Content (%)
Y-axis: Dry Density (g/cm^3)
2.1.4 Soil With 9% Lime

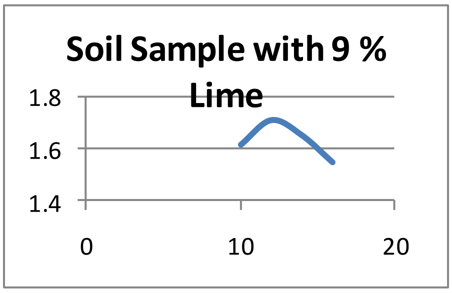

Fig No. 4. Graph of Soil Sample with 9 % Lime
X-axis: Moisture Content (%)
Y-axis: Dry Density (g/cm^3)

Table No . 1. Results of Modified Procter Test

S. No	Soil and Lime	Maximum Dry Density	Optimum Moisture Content
1	Virgin Soil	1.87 g/cm^3	10%
2	Soil With 3 % Lime	1.78 g/cm^3	12.5%
3	Soil With 6 % Lime	1.711 g/cm^3	12.6%
4	Soil With 9 % Lime	1.714 g/cm^3	12.7%

2.2 Unconfined Compression Test

Table No. 2. Results of Unconfined Compression Tests

S. No	Soil and Lime	Unconfined compressive strength
1	Virgin Soil	2.12 kg/cm^2
2	Soil With 3 % Lime	4.35 kg/cm^2
3	Soil With 6 % Lime	5.18 kg/cm^2
4	Soil With 9 % Lime	4.24 kg/cm^2

Fig. No. 5. Effect on Unconfined Compressive

Strength with Variation of Lime in Soil
X-axis : %age of Lime
Y-axis : Unconfined Compressive Strength

III. Discussion of Result

1. The above test results reveals that the Soil with Lime is more stable than the Virgin soil . OMC increases with increase in %age of Lime as Lime absorbs some water at the start of reaction . The value of MDD decreases with increase in lime % age .
2. The above test results state that the Soil gains compressive strength on addition of lime , but it continues only upto a certain % age of lime & than starts decreasing as with increase in %age of lime reactions b/w soil & lime starts decreasing & one point comes when all the reactions completes & value of unconfined compression starts decreasing .

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