SOIL STABILIZATION USING LIME AND QUARRY DUST

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ABSTRACT-

When poor quality soil is available at the construction site, the best option is to modify the properties of the soil. This has managed to the improvement of the soil stabilization techniques.The feasibility of using quarry dust to investigate the possibility of stabilization of soil using lime and quarry dust. Soil stabilization incorporates the various methods employed for modifying the properties of a soil to improve its engineering performance.It involves the use of soil, soil minerals and stabilizing agent or binders to improve its geotechnical properties such as compressibility, strength, permeability and durability.In the present investigation the extensive laboratory testing was carried out on clay soil and on clayey soil reinforced with lime quarry dust. Modified Proctor's test was carried out on plane soil and soil mixed with different percentage of quarry dust and the optimum percentage of quarry dust is obtained.The organization of stabilization depends upon the type of soil available, field condition and amount of Lime and Quarry-Dust. The use of Lime and Quarry-Dust in stabilization is not very popular in India due to some complications stuck between engineers and non-availability of standardized data. But, recently some roads were stabilized by using of Lime and Quarry-Dust constructed in various parts of India, which are acting very good.

Keywords:*Expansive Soil, Atterberg Limits, Compaction Test, CBR Test, Lime and Quarry-Dust.*

1. INTRODUCTION

1.1. General*:*

The swelling and shrinkage characteristic of expansive soil depends upon the percentage of moisture content in it. So the expansive soil undergoes volumetric changes due to the variation of water content in it. The finer particles of the expansive soil lead to water holding capacity. The percentage of moisture content inside the expansive soil depends upon the seasonal variation.

The swelling and shrinkage characteristics of the expansive soil causes the differential movement, resulting in severe damaged to foundations, building, roads, retaining structures, canal linings, etc. The expansive soil losses its chemical strength during the expansion condition.

The quarry dust generally produced by blasting of quarry. The large number of quarries has been produced quarry dust to construction purpose.

Chemical stabilization introduced the use of technique to add a binder to the soil to improve the geotechnical performance of land such as mechanical and chemical characteristics of soil. Some studies are reported that, different additives such as cement, lime, fly ash, silica fume and rice husk ash have been used for chemical stabilization of soft soils.

Chemical stabilization is applied as a cost effective, environmental friendly and efficient method for soil treatment. It is also well known that stabilizing soil with local natural, industrial resources particularly lime and quarry dust has a significant effect on improving the soil properties.

In soil stabilization with lime and quarry dust, additives combined by specific moisture content, and then apply for improving the soil properties in engineering projects. Investigator experiments on physical and chemical reaction of stabilized soil revealed that, lime quarry dust and mixture of lime and quarry dust have short term and long term effect on the characteristics of soil.

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, sub base 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 the damaging effects 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 the 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 aluminates and silicates solubilized from the clay.

The pozzolanic reaction can continue for 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 quick lime, hydrated lime, or lime slurry can be used to treat the soils. Hydrated lime is created when the quick lime chemically reacts with water. It is hydrated lime that reacts with particles of clay and permanently transforms them into a strong cementious matrix.

Since quarry dust is a waste material from quarries and shows pozzolanic characteristics, it is always encouraged to use quarry dust for stabilization where easily and economically available.

Quarry dust is extracted from the quarries is a non-plastic fine silt. Its composition varies according to blasting done in quarries. Many efforts are being directed toward beneficial utilization of this waste product in several ways. Quarry dust has been used as a pozzolana to enhance the improvements noticed in some of geotechnical properties of clayey soils, only with quarry dust are not adequate for its use in road work and foundation design. However lime which is considered too be a good stabilizing agent for clayey soils may be added to quarry dust in stabilization of the soil to further improve the properties. Quarry dust is a waste product of quarries whereas lime is very cheap and readily available.

2. MATERIALS

2.1 MATERIALS USED

The details of the various materials and chemicals used in the laboratory experimentation are reported in given sections.

2.2.1 SOIL

The black cotton soil collected from **Bahadurpally** near **Medchal**, **Medchal-Malkajgiri** district, **Telangana** state India. The properties of soil are presented in the table. All the tests carried on the soil are as per IS specifications.

2.2.2 ADMIXTURES

Lime and Quarry dust are used as admixtures. The properties of admixtures are shown below

2.2.2.1 LIME

Lime is calcium-containing inorganic mineral in which carbonates, oxides and hydroxides predominate. In the strict sense of term, lime is calcium oxide or calcium hydroxide. It is also the name of the natural mineral CaO which occurs as product of coal seam fires and in altered lime stones xenoliths in volcanic ejecta.

2.2.2.2 QUARRY-DUST

Quarry-dust is also known as rock dust, rock powder, and also rock flour, consists of finely crushed rock.

3. METHODOLOGY

The compaction tests were done to assess the amount of compaction and the water content required. The water content at which the maximum dry density is attained is obtained from the relationships provided by the tests. The California Bearing Ratio test is conducted for the soil by adding plastic strips with varying percentage of 0.2 i.e.0.2%, 0.4%, 0.6% etc. and determines the strength of soil until the strength reaches the highest level and stop at the interval when strength decreasing from the highest. Plot the graph and calculate the bearing value for 2.5mm penetration and

5mm penetration and value of 2.5mm penetration and 5mm penetration is recorded. Then finally plot a graph of Percentage of Plastic content and CBR value and obtained the maximum CBR value corresponds to percentage of plastic content.

3.1 Tri-Axial Test:

Today Tri-axial test is the most commonly used Strength Test in research laboratory. In this test the solid specimen,Cylindrical in shape, is subjected to direct stresses acting in 3 mutually perpendicular directions. This test gives shear Strength parameters of soil.

3.2 Direct Shear Test:

This is the simple and commonly used test on soil. This test is used to determine the shear parameters of soil by using shear box apparatus.

4. EXPERIMENTAL INVESTIGATIONS

4.1 Scope of work:

The experimental work consists of the following steps:

1. Specific gravity of soil
2. Determination of soil index properties (Atterberg's Limits)

a. Liquid Limit
b. Plastic Limit
c. Plastic Index

3. Differential Free Swell

4. California Bearing Ratio

A. Geotechnical Properties of untreated Laterite soil

Property	Value/Description
Specific Gravity	2.75
Liquid Limit	77.35%
Plastic Limit	39.47%
Plasticity Index	38.88%
Unified Soil Classification System (USCS)	CL
Maximum Dry Density (MDD)	1.485g/cc
Optimum Moisture Content (OMC)	32.25%

B. Atterberg's Limits

Liquid Limit = 77.35%
Plastic Limit = 39.47%
Plasticity index= 38.88%
Plasticity of Laterite soil was found--. So according to unified soil classification system (USCS) soil is classified as inorganic soils.

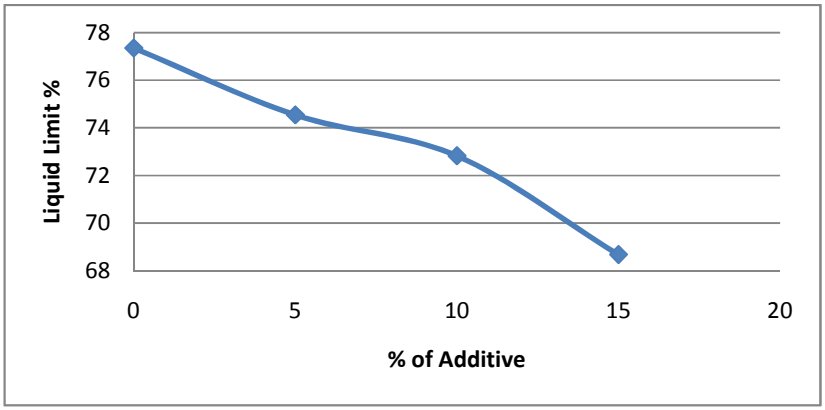

Fig.1. Shows Liquid Limit curve for Black Cotton Soil

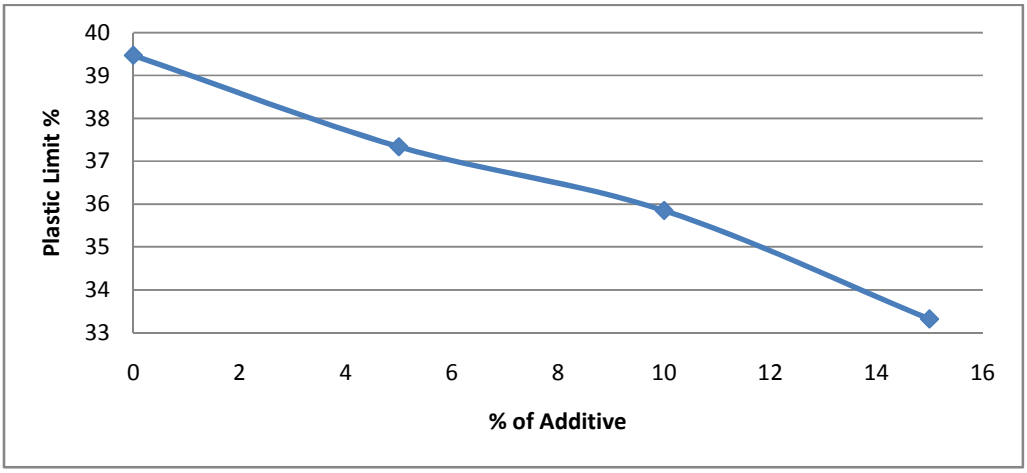

Fig.2. Shows Plastic Limit curve for Black Cotton Soil

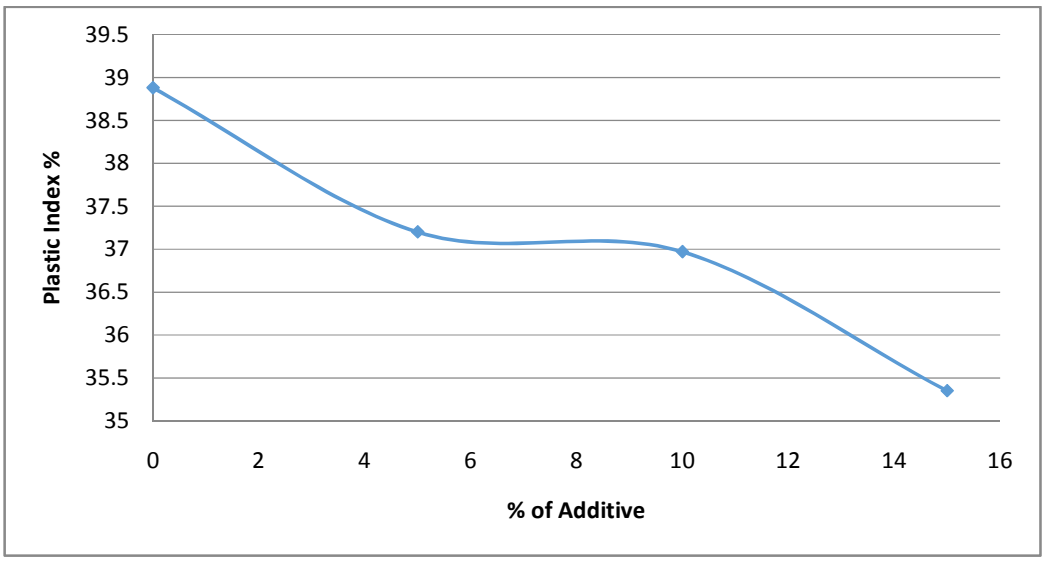

Fig.2. Shows Plastic Index curve for Black Cotton Soil

Effect of Additives on Atterberg Limits

The decrease in liquid limit values for different percentages of additives (Lime & Quarry Dust) added to the expansive soil is presented in the Table 2. The decrease in the values of liquid limit upto 10% of Additives as shown Fig 1. Beyond 10% there is normal decrease in liquid limit values for additives, tried in this investigation. For additive treatment there is maximum decrease in the values of liquid limit. There is normal decrease in the values of plastic limit with increase in percentage of additives.

The reduction in the plastic limit values and liquid limit values cause a reduction in values of plastic index.

3. Differential Free Swell Test

Additive Name	% of additive	DFS %
Lime and Quarry Dust	0	110
	5	80
	10	70
	15	65

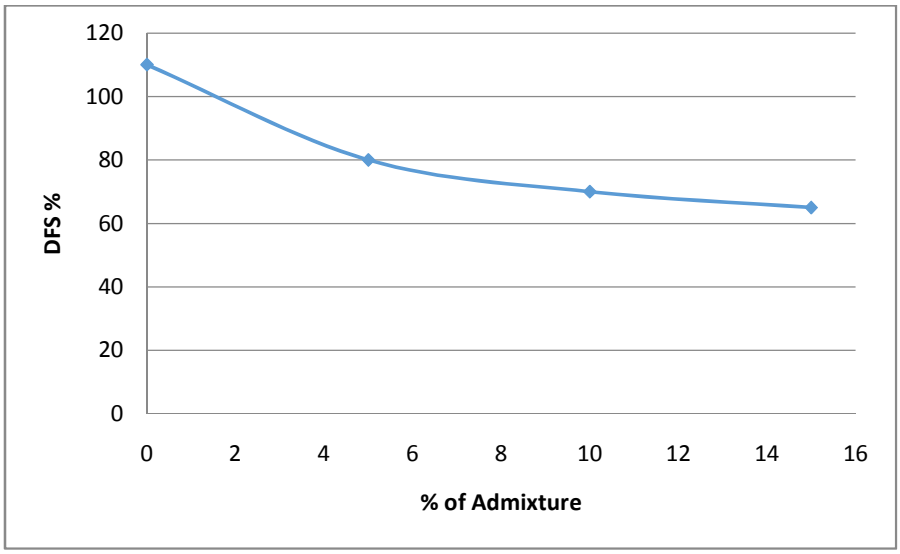

FIG 4Variations in DFS

Effects of Additive on DFS

The variation of DFS for different percentages of additive is shown in the Table & Fig. There is a significant decrease in DFS values upto 5% of the additive, after that the change is marginal. The reduction in the values of DFS at 5% additive is at the 37% for additive treatments respectively in comparison with untreated soil.

C B R test on the BC soil and with Geogrids.

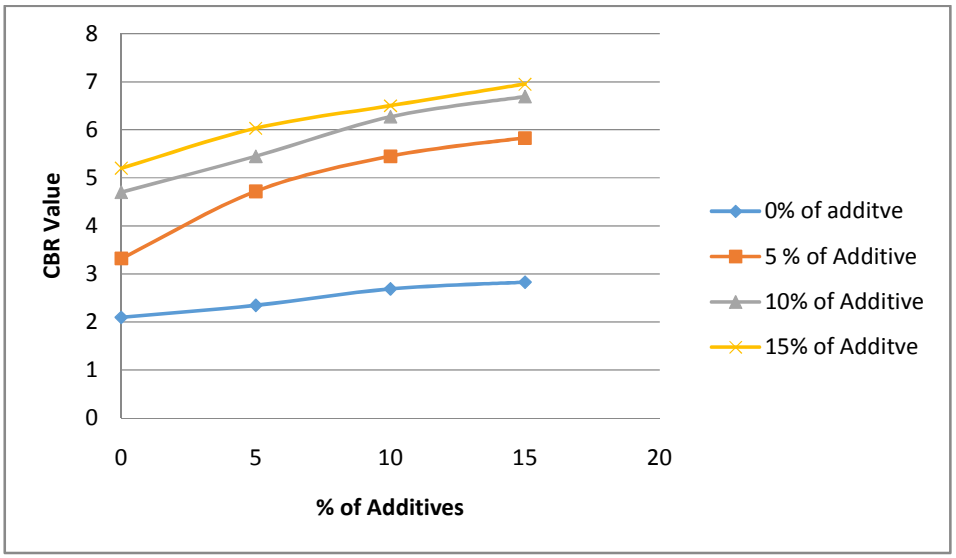

Fig 5 Variations on CBR

.Generally, the CBR for 2.5 mm penetration is high. However if the CBR for 5.0 mm penetration is greater than that 2.5 mm penetration the test is repeated. If the results are unchanged, the value of for 5.0 m penetration is used for defining CBR value.

Test Results

1. Based on CBR Test on soil(with strips of length 2.5cm), with strips reinforcement of 0 .00 %, 5%, 10%, and 15%, the increase in CBR Test values was found to be 2.10, 3.32, 4.70, and 5.20 respectively explained above.
2. Based on CBR Test on soil(with strips of length 5cm), with strips reinforcement of 0 .00 %, 5%, 10%, and 15%, the increase in CBR Test values was found to be 2.35, 4.72, 5.45, and 6.03 respectively explained above..
3. On comparing the results from CBR test conducted on lateritic soil with adding different percentage of plastic strips, it is found that the values of CBR Test CBR Values are increases up to certain percentage and decreases vice versa.
4. From above results using 5cm length of plastic strips with percentage of 10% is to be recommended for sub grade design and embankment construction.
5. Overall it can be concluded that plastic strips reinforced soil can be considered to be good for sub grade and embankment design.

CONCLUSION

1. From the laboratory studies, it is observed that the liquid limit values are decreased by5.85% for 10% of Additive.
2. Liquid Limits values are decreased by 9.17% for 10% of Additive.
3. There is a decrease in values of plastic index with respective addition of additive because of the decrease in both liquid limit and plastic limit values. Plastic index is decreased by 5% for 10% of additive.
4. The Differential free swell values are decreased by 37% for 10 of Additive.
   The CBR values are increased by 124% and 135% of 2.5 and 5.0 penetration for 10% of additive.

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I am Dhara. Naveen Kumar student of final year belonging to Department of Civil Engineering have undertaken and completed aproject on SOIL STABILIZATION USING LIME AND QUARRY DUST

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