SOIL STABILIZATION USING LIME AND FLY ASH

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ABSTRACT

Now a days, inefficient properties of soils are a critical issue in engineering projects. In some cases, improve the characteristic of unsuitable soil is a fundamental step for making construction.Pavement structures on poor soil sub grades show early distress causing the premature failure of the pavement. Clayey soil usually have the potential to demonstrate undesirable engineering behaviour , such as low bearing capacity , high shrinkage and swell characteristics and high moisture susceptibility.

Stablilsation of these soil is a usual practice for improving the strength.Soil stabilization performed the use of technique to adding a binder to the soil in order to improve the engineering performance of soil .This study reports the improvement in the strength of a locally available cohesive soil by addition of both lime and fly ash. Researches were illustrated that adding the additives leads to progress in workability and mechanical behaviour of soil after stabilization lime and fly ash as local natural and industrial resources were applied for chemical stabilization.

Lime alone has traditionally been used in clay-bearing, highly cohesive soil whereas fly ash has been used to bind non-cohesive soil, granular or poorly cohesive soil. Fly ash is mainly used to stabilize the sub base or base course.

1. INTRODUCTION

The swelling and shrinkage characteristic of expansive soil depend 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 the 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 the foundations, buildings, roads, retaining structures, canal linings, etc. The expansive soil losses its chemical strength during the expansion condition.

The fly ash generally produced by the combustion of coal of the thermal power plant. The large numbers of power plant has been established across the world to full fill the demand of power.

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 fly ash has a significant effect on improving the soil properties. In soil stabilization with lime and fly ash, additives combined by specific moisture content, then apply for improving the soil properties in engineering projects. Investigator experiments on the physical and chemical reaction of stabilized soil revealed that, lime, fly ash, and mixture of lime-fly ash have short-term and long-term effect on the characteristic 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, 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 particles of clay and permanently transforms them into a strong cementious matrix.

Since, fly ash is a waste material from thermal power plants and shows pozzolanic characteristics, it is always encouraged to use fly ash for stabilization where easily and economically available.

Fly ash is extracted from flue gases of a furnace fired with coal and is non-plastic fine silt. Its composition varies according to the nature of coal burned. Many efforts are being directed toward beneficial utilization of this waste product in several ways. Fly ash has been used as a pozzolana to enhance The improvements noticed in some of the geotechnical properties of clayey soils only with fly ash are not adequate for its use in roadwork and foundation design .However, lime which is considered to be a good stabilizing agent for clayey soil may be added to fly ash in the stabilization of the soil to further improve the properties. Fly ash is a waste product of a thermal power plant where as lime is very cheap and readily available.

OBJECTIVES:

- To explore the effective usage of fly ash.
- To study the effect of lime and fly ash and increasing the bearing capacity of soil.
- To study the effects of lime and fly ash and decreasing the permeability of soil.
- To explore the possibility of using fly ash in road construction programme.
- To study the effect of lime and fly ash on proctor‘s density and OMC of clayey soil.
- To study the change in CBR of soil by the addition of lime and fly ash.
- To study the effect of curing period on the properties of clayey soil.

3.SELECTION OF MATERIALS

3.1RED SOIL

Red soils generally derived from crystalline rock. They are usually poor growing soils, low in nutrients and humus and difficult to cultivate because of its low water holding capacity. Red soils denote the third largest soil group of India covering an area of about 3.5 lakhs sq.km over the peninsula from Tamil Nadu in the south to Bundelkhand in the north and Rajmahal hills in the east to kachchh in the west.

3.2ALLUVIAL SOIL.

The term alluvium is not typically used in situations where the formation of the sediment can clearly be attributed to another geologic process that is well described. This includes lakes sediments, river sediments or glacially-derived sediments.

Alluvial soil is loose, unconsolidated soil or sediments which has been eroded, reshaped by water in some form, and re deposited in a non-marine setting.

3.3 CLAYEY SOIL

Clay soil is composed of tiny particles that are hard and able to become easily compacted. This compaction makes it difficult to plant or even shovel within the soil. Clay minerals are hydrous aluminium phyllosilicates that may contain varying amounts of iron, magnesium and alkali metals.

3.4 LIME

Hydraulic lime is a general term for varieties of lime,or slaked lime, used to make lime mortar which set through hydration thus they are called hydraulic.

Hydraulic lime provides a faster initial set and higher compressive strength. The terms hydraulic lime and hydrated lime are quite similar and may be confused but are not necessarily the same material.

The two basic types of hydraulic limes are

- Natural hydraulic lime
- Artificial hydraulic lime

3.5 FLY ASH

Fly ash is a by-product from burning pulverized coal in electric power generating plants. During combustion, mineral impurities in the coal fuse in suspension and float out of the combustion chamber with the exhaust gases.

Two types fly ash are commonly used in concrete.

- Class c
- Class F

Class c are often high-calcium fly ashes with carbon content less than 2 %;whereas class F are generally low calcium fly ashes with carbon content less than 5% but some times as high as 10%.In general, class c ashes produced from burning sub-bituminous are anthracite coals.

Performance properties between class c and class f ashes are varying depending on chemical and physical properties of the ash.

Many class c ashes when exposed to water will react and become hard just like cement but not class f ashes. Most, if not all, class f ashes will only react with the by-products formed when cement reacts with water. Class c and class f fly ashes were used in this research project.

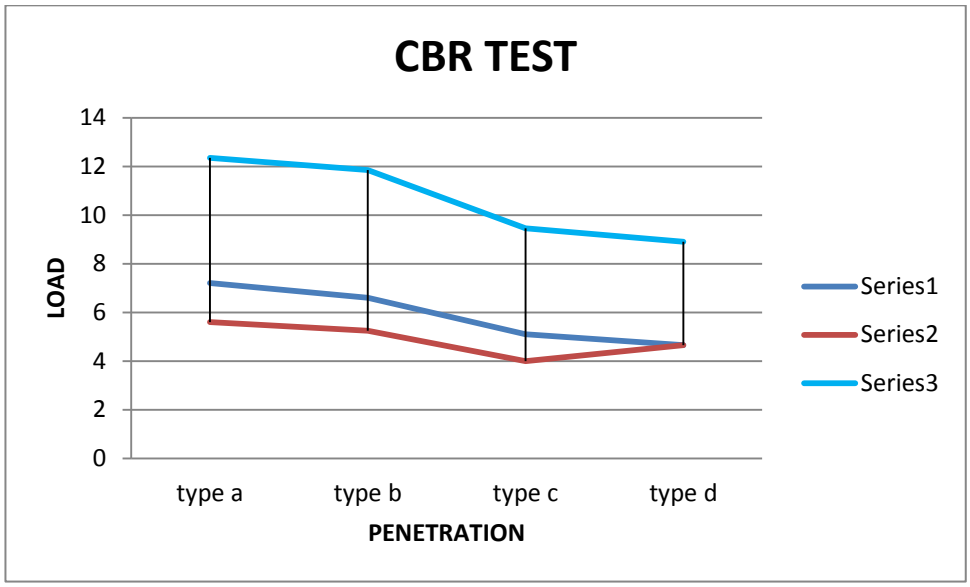
4.TEST FOR SOIL SAMPLES

1)specific gravity,2) liquid limit & plastic limit, 3)standard proctor test, 4)direct shear, 5)california bearing ratio, 6)california bearing ratio.

5.RESULT AND DISCUSSION

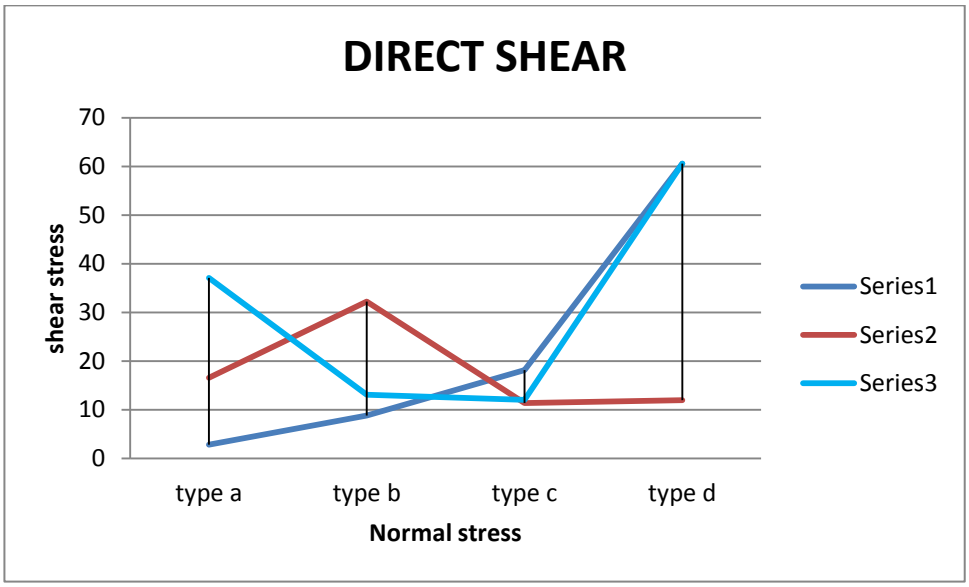
COMPRAISON OF VARIOUS SOIL SAMPLES

5.1CALFORNIA BEARING RATIO



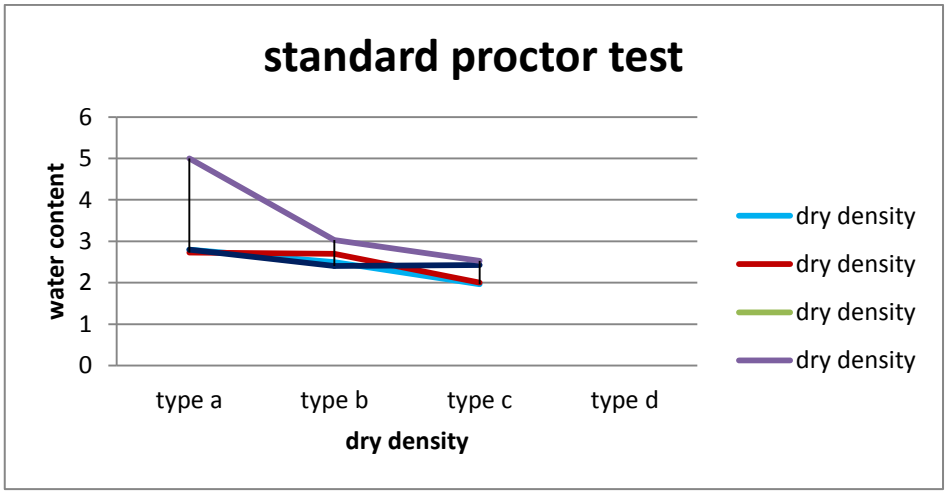
As per soil sample are tested in CBR test with lime and fly ash and the result shows that's clay soil , lime and fly ash soil good in stability.

5.2 DIRECT SHEAR:



As per soil sample are tested in direct test with lime and fly ash and the result show that's red soil good in stability.

5.3 STANDARD PROCTOR TEST



As per soil sample are tested in Standard proctor test with lime and fly ash and the result shows that's clay soil good in stability.

1).The specific gravity test should be done for various types of soil. From the result It is observed that it increase the strength by mixing the clay soil , lime and fly ash

2). From the liquid limt it shows the increase in strength by mixing the clay,lime and fly ash when compare red and alluvial soil.

3). From the plastic limt it shows the increase in strength by mixing the clay,lime and fly ash when compare red and alluvial soil.

4). From the standard proctor test it shows the increase in strength by mixing the clay,lime and fly ash when compare red and alluvial soil.

5). From the direct shear it shows the increase in strength by mixing the clay,lime and fly ash when compare red and alluvial soil.

6). From the CBR test it shows the increase in strength by mixing the clay,lime and fly ash when compare red and alluvial soil.

7). From the UCC test it shows the increase in strength by mixing the clay,lime and fly ash when compare red and alluvial soil.

CONCLUSION

From the results of the present study, it is concluded that, the soil stabilization using lime and fly ash is a very effective process for the strengthing of soil. During comparison the clay obtain maximum strength . since lime and fly ash are low cost material it obtains high strength and make the structure strong and durable.The test has been conducted in various soils such as clay soil ,alluvial soil,and red soil among these the clay soil is the best results and it can be used to strength the building and roads. Due to stabilization the soil the bearing capacity of the soil gets increasing and any foundation can be construction in the soil.

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