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EFFECT OF LIME AND FLY ASH ON UNCONFINED COMPRESSIVE STRENGTH (UCS) OF EXPANSSIVE SOIL

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ABSTRACT

In India, there is an increase in the number and capacity of the thermal power plants because of the increase in demand for electricity. Most of these thermal power plants use coals which are of inferior quality. These inferior quality coals produce huge amount of fly ash. The utilization of fly ash in India varies between 89-92% and the rest are disposed in ash ponds. The present work aims to find the effect of additives namely Lime and Fly ash on Compaction characteristics, Unconfined Compressive Strength (UCS), Here the Expansive soil is used in this study. First the soil were mixed individually with varying contents of lime and fly ash to find out their effects on the treated soil samples compacted at Optimum Moisture content (OMC) and Maximum Dry Density (MDD) were tested for Unconfined Compressive Strength (UCS) at different Curing periods. The Unconfined Compressive Strength (UCS) increases more with increase in Lime content rather than by increase in fly ash with cement content. The Unconfined Compressive Strength (UCS) increases with curing time.

Keyword : - *Expansive Soil, Fly ash, Lime, Compaction Characteristics, Unconfined Compressive Strength (UCS).*

1. INTRODUCTION

In India, there is an increase in the number and capacity of the thermal power plants because of the increase in demand for electricity. Most of these thermal power plants use coals which are of inferior quality. These inferior quality coals produce huge amount of fly ash. The utilization of fly ash in India varies between 89-92% and rests are disposed in ash ponds. These are disposed fly ash and even the fly ash which are utilized for reclamation of low lying areas has the tendency of leaching the heavy metal pollutants and thus polluting the groundwater. This groundwater pollution can be controlled by increasing the Cation Exchange Capacity (CEC) of sub soil through application of additives such as lime, fly ash, cement etc. so that the individual soil colloids can hold the pollutant cations at their exchange sites.

It is necessary to have the knowledge of Cation Exchange Capacity (CEC) of the soil in many areas of geotechnical engineering such as chemical stabilization, waste containment system etc. The addition of lime to a soil provides an excess of calcium ions which leads to replacement of all other cations with divalent calcium, Ca+2 leading to stabilization of soil. Soils with high value of CEC have the potential to retain more cations in waste containment system (landfill) and thereby reducing the risk of contamination of soil, subsurface soil and ground water. Also Cation Exchange Capacity (CEC) is used in Agricultural field as an indicator of fertility of soil.

1.1 Expansive Soil

Expansive soils are the swelling soils or shrink swell soils which have tendency to shrink or swell with the changes of moisture content. Expansive soils are predominant in many parts of the world. The variation of water content leads to

cracking of the structures which built on them. These soils also called regular soils in some part of the world. Expansive soils are vastly spread in the regions of middle India Andhra Pradesh, Madhya Pradesh, Gujarat, and Maharashtra and in some places of Orissa, expansive soils are available in the regions of Narmada, Tapi, Krishna and Godavari. In north western India the depth of availability of black cotton soil is very high.

1.2 Fly ash

Due to the rapid industrialization and growth of the population the power utilization has increased. The thermal power plants uses coal for production of power, and they grind it to powder from, before it ii brunt. After burning the coal the mineral residue left, this is collected from the exhaust gases by electro static precipitators. From this whole process the waste material is produced is called fly ash. The main problem with fly ash is safe management and disposal.

1.3 Lime

Liming of soil is the application of calcium (Ca) and magnesium (Mg) rich materials in various forms, including marl, chalk, limestone, burnt lime or hydrated lime to soil. In acid soils, these materials react as base and neutralize soil acidity and increase the pH level.

2. MATERIALS AND MEHODOLOGY

2.1 MATERIALS ARE USED

- Expansive soil
- Class F Fly ash
- Lime
- Cement

2.2 Test Procedures (Following tests were conducted using Indian standard code procedures)

- Specific Gravity
- Grain Size Distribution
- Atterberg's Limits
- Liquid limit
- Plastic Limit
- Plasticity Index
- Free Swell Index
- Light Compaction Test
- Unconfined Compressive Test
- Cation Exchange Capacity Test

2.3 Sample Preparation for UCS test:

In the experimental program first it necessary to know the maximum dry density of the soil and optimum moisture content. The main intention of the UCS test is to find the unconfined compressive of the soil that having enough cohesion to admit for determining in the unconfined state which is then possible to determine unconsolidated and undrained shear strength of the soil. The UCS test is determined as per IS: 2720 (Part 10) 1991. The soil sample was prepared from freshly developed soil sample and laid the samples for 7 days in a constant water content desiccator. For purposes of testing expansive soil specimen, we use 2.5 to 20 KN proving ring depends on the strength of the soil. After knowing the volume of the mould, the soil will be compacted to into the mould up to the maximum dry density and optimum moisture content was used. Then after compacting the soil specimen will be removed from the mould which having 3.8 cm diameter and

8.3 cm height. Then soil sample placed in the compressive testing machine without any side confinement and the stress strain values has been recorded. 36 In the present experiment I used 2.5KN, 5 KN, 10 KN, 20and 10 KN proving ring and noted down the values obtained from the proving ring with changes of strain. I determined unconfined compressive strength for different percentages of fly ash with binder as cement and different percentages of lime.

2.4 Cation Exchange Capacity (CEC)

CEC $(cmol)$ = N×1×0.25 × 1000 kg 140×$mass\ of\ soil\ take$n

3. RESULTS AND DISCUSSION

The standard test method for unconfined compressive strength of cohesive soil (IS 2720 Part 10) was used to evaluate the ultimate compressive strength of untreated and treated soil samples. Untreated control samples were also prepared and cured for three curing periods of 3, 7, and 14 days. After the curing period the sample was sealed and trimmed into required size. Unconfined Compressive test on soils treated with different percentage of fly ash, fly ash with binder as cement, and lime were also carried out. The treated sample were cured because of its greater improvement of strength. So, following table gives the variation of results of untreated and treated soil samples after curing periods.

3.1 UCS Curve of Untreated Soil

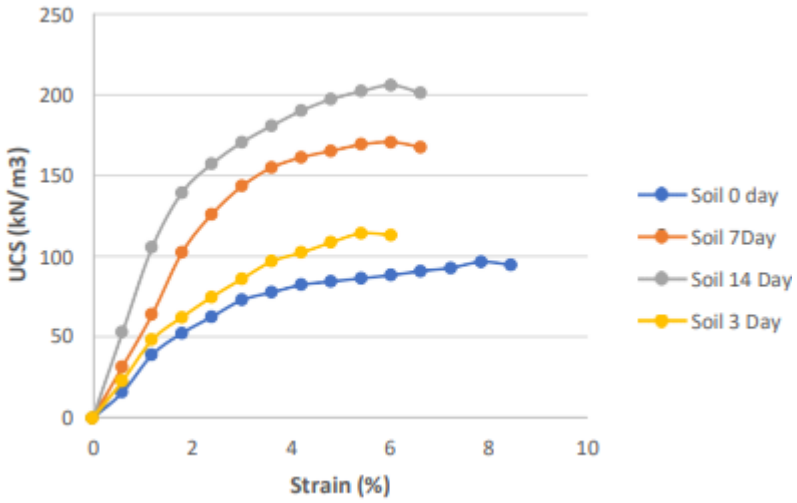

Chart -1 UCS untreated soil

3.2 UCS Curve of Untreated Soil

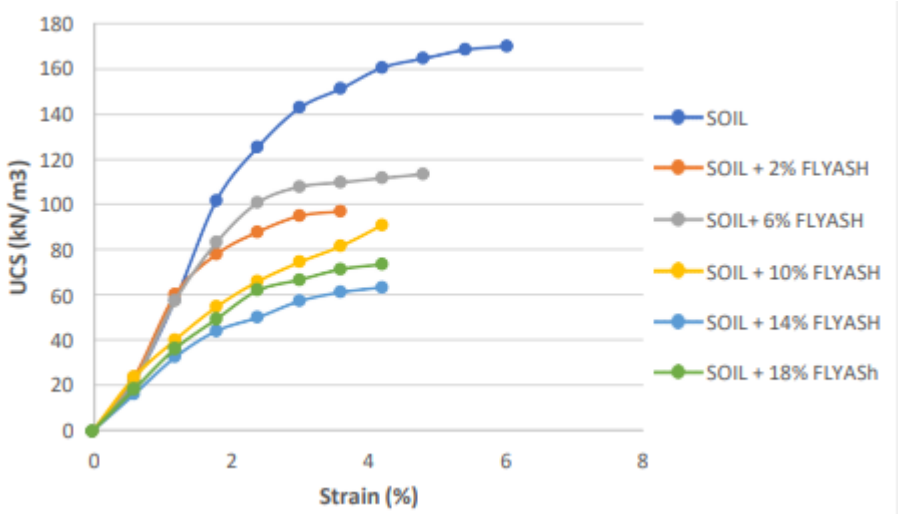

Chart -2 UCS treated soil

4. CONCLUSIONS

In compaction test the optimum moisture content(OMC) increases and MDD decreases with increased flyash content in the soil, But in case of unconfined compressive strength (UCS) increases with increases in curing period.

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