Stabilization Of Black Cotton Soils Using Flyash & Egg Shell Powder

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Abstract- The combined effects of two wastes Sludge and Rock dust on, compaction characteristics, California Bearing Ratio (CBR), Shear strength parameters and Swelling pressure of an expansive soil have been discussed in this project. The effect of molding water content on CBR of Sludge-Rock Dust stabilized expansive soil and the economy of Sludge and Rock dust stabilization has also been discussed.

Indexed Terms- Expansive Soil, Sludge, Quarry Dust, California Bearing Ratio, Economy

I. INTRODUCTION

In order for the foundation to be strong, the soil around it plays a very critical role. So, to work with soils, we need to have proper knowledge about their properties and factors which affect their behavior. The process of soil stabilization helps to achieve their required properties in a soil needed for the construction work. From the beginning of the construction work, the necessity of enhancing soil properties has come to the light. Ancient civilizations of the Chinese, Romans and Incas utilized various methods to improve soil strength etc., some of these methods were so effective that their Buildings and roads still exist. In India, the modern era of soil stabilization began in early 1970's, with a general Shortage of petroleum and aggregates, it became necessary for the Engineers to look at means to improve soil other than replacing the poor soil at the building site. Soil stabilization was used but Due to the use of obsolete methods and also due to the absence of proper technique, soil Stabilization lost favor. In recent times, with the increase in the demand for infrastructure, raw materials and fuel, soil stabilization has started to take a new shape. With the availability of better research, materials and equipment, it is emerging as a popular and cost-effective method for soil improvement.

Here, in this seminar, soil stabilization has been done with the help of Egg shell powder, fly ash and Quarry Dust mixed with the soil. The improvement in the shear strength parameters has been Stressed upon and comparative studies have been carried out using different methods of shear resistance measurement.

- Soil-forming processes: Soil formation, or pedogenesis, is the combined effect of physical, chemical, biological and anthropogenic processes working on soil parent material. Soil is said to be formed when organic matter has accumulated and colloids are washed downward, leaving deposits of clay, humus, iron oxide, carbonate, and gypsum, producing a distinct layer called the B horizon. This is a somewhat arbitrary definition as mixtures of sand, silt, clay and humus will support biological and agricultural activity before that time. These constituents are moved from one level to another by water and animal activity. As a result, layers (horizons) form in the soil profile. The alteration and movement of materials within a soil causes the formation of distinctive soil horizons. soil formation proceeds are influenced by at least five classic factors that are intertwined in the evolution of a soil. They are: parent material, climate, topography (relief), organisms, and time. When reordered to climate, relief, organisms, parent material, and time, they form the acronym CROPT.

- Weathering of parent material: The weathering of parent material takes the form of physical weathering (disintegration), chemical weathering (decomposition) and chemical transformation.

Generally, minerals that are formed under the high temperatures and pressures at great depths within the Earth's mantle are less resistant to weathering, while minerals formed at low temperature and pressure environment of the surface are more resistant to weathering. Weathering is usually confined to the top few meters of geologic material, because physical, chemical, and biological stresses generally decrease with depth. Physical disintegration begins as rocks that have solidified deep in the Earth are exposed to lower pressure near the surface and swell and become mechanically unstable. Chemical decomposition is a function of mineral solubility, the rate of which doubles with each 10 °C rise in temperature, but is strongly dependent on water to effect chemical changes. Rocks that will decompose in a few years in tropical climates will remain unaltered for millennia in deserts. Structural changes are the result of hydration, oxidation, and reduction.

Koteswara Rao. D, M.Anusha, P.R.T. Pranav, G.Venkatesh(4) suggested that the technology of road construction is subjected to changes to cope up with changing vehicular pattern, construction materials and sub grade condition. Ashkan Gholipoor Norozi, Siavash Kouravand and Mohammad Boveiri [5] suggested soil stabilization means alteration of the soils properties to meet the specified engineering requirements. Methods for the stabilization are compaction and use of admixtures. Lime, Cement was commonly used as stabilizer for altering the properties of soils. S. Bhuvaneshwari, R. G. Robinson, S. R. Gandhi (1) suggested Stabilization of Expansive Soils Using Fly ash. Often, large areas are covered with highly plastic and expansive soil, which is not suitable for such purpose.

- Definition: Soil stabilization is the process of altering some soil properties by different methods, mechanical or chemical in order to produce an improved soil material which has all the desired engineering properties.

Needs & Advantages:
- It improves the strength of the soil, thus, increasing the soil bearing capacity.
- It is more economical both in terms of cost and energy to increase the bearing capacity of the soil rather than going for deep foundation or raft foundation.
- It is also used to provide more stability to the soil in slopes or other such places.
- Sometimes soil stabilization is also used to prevent soil erosion or formation of dust, which is very useful especially in dry and arid weather.
- Stabilization is also done for soil water-proof; this prevents water from entering into the soil and hence helps the soil form losing its strength.
- It helps in reducing the soil volume change due to change in temperature of moisture content. Stabilization improves the workability and the durability of the soil.

Methods: There are two primary methods of soil stabilization.
- Mechanical Method of Soil Stabilization
- Chemical or Additive method of Soil Stabilization

- Mechanical method of Stabilization: In this procedure, soils of different gradations are mixed together to obtain the desired property in the soil. This may be done at the site or at some other place from where it can be transported easily. The final mixture is then compacted by the usual methods to get the required density.

- Chemical or Additive method of Soil Stabilization: In this procedure, the addition of manufactured products into the soil, which in proper quantities enhances the qualities of the soil. There are two basic types of additives during Chemical Soil Stabilization: Mechanical additives and Chemical additives.

Mechanical Additives, such as Rock dust, Soil cement, mechanically alter the soil by adding a quantity of material that has the engineering characteristics to upgrade the load bearing capacity of the existing soil. Chemical Additives, such as Sludge, Portland cement, Fly ash, Quick lime, Bitumen, etc. chemically alter the soil itself, thereby improving the load bearing capacity of the soil.

Scope of work: The experimental work consists of the following steps:
- Specific gravity of soil
- Determination of soil index properties (Atterberg Limits)
- Liquid limit by Casagrande’s apparatus, Plastic limit, Shrinkage limit
- Particle Size distribution by sieve analysis
- Free Swell Index
- Determination of the maximum dry density

(MDD) and the corresponding optimum moisture content(OMC) of the soil by Proctor Compaction test
- California Bearing Ratio

BLACK COTTON SOILS: A local expansive soil was used in the experimental study. The geotechnical properties of soil are:
1. Grain size: a) Sand size – 14% b) Silt size – 25% c) Clay size – 62%, 2. Specific Gravity: 2.38, 3. Color: Black, 4. Odor: Nil

II. TEST RESULTS

Liquid Limit: For the expansive soils the range of the liquid limits is 50 – 100%.
- Liquid limit for tested Black cotton (B.C) soil is 66%.
- Liquid limit as obtained from graph = 66(Corresponding to 25 blows)

Plastic Limit: For clay or Black cotton soils the plastic limit ranges from 20-65%.
- Plastic limit tested for Black Cotton soil is 50%

Shrinkage Limit: Shrinkage limit ranges from 9-14% for black cotton soils
- Shrinkage limit for tested Black Cotton soil is 9.678%

Compaction curve for Black Cotton Soil:
From the above graph, it is evident that:
a) Optimum Moisture Content (OMC) = 15%
Maximum Dry Density (MDD) = 1.68g/cc

III. EXPERIMENTAL RESULTS OF BLACK COTTON SOIL

1. Atterberg’s Limits: a. Liquid Limit – 60%, b. Plastic Limit – 50%, c. Shrinkage Limit – 9.67%, d. Plasticity Index – 10%,
2. Compaction Characteristics: a) OMC – 15% b) MDD – 1.68 g/cc.
- Fly ash: 1. The geotechnical properties of the fly ash are: a. Gravel size: 3%, b. Sand size: 81%, c. Silt size: 16%, 2. Specific Gravity: 2.82, 3. Color: Grey, 4. Odour: Nil

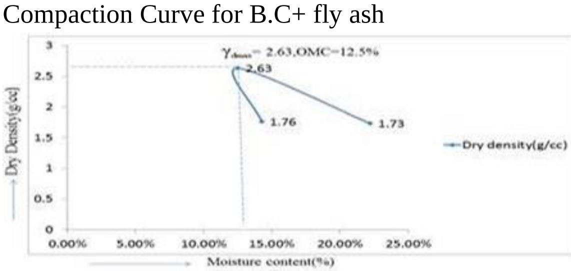
- Test Results:

Trail 1	B.C+10% fly ash	28	8	20
Trail 2	B.C+15% fly ash	28	9	20
Trail 3	B.C+20% fly ash	29	10	19
Trail 4	B.C+25% fly ash	30	11	19
Trail 5	B.C+30% fly ash	30	9	21

- Standard Proctor Compaction Test:

No. of Trails	Description	Max Dry Density (g/cc)	OMC (%)
Trail 1	B.C	1.68	15
Trail 2	B.C+5%eggshell powder	1.78	12.23
Trail 3	B.C+10%eggshell powder	1.81	19.57
Trail 4	B.C+15%eggshell powder	1.79	6.67
Trail 5	B.C+20%eggshell powder	1.77	6.67

Compaction Curve for B.C+ fly ash



From the above graph, it is evident that:
a) Optimum Moisture Content (OMC) = 12.5%
b) Maximum Dry Density (MDD) = 2.63g/cc

Egg shell powder: The geotechnical properties of sludge are:
i) Grain size: a) Gravel size – 3% b) Sand size – 81% c) Clay size – 1.92%ii) Specific gravity – 1

Standard Proctor Compaction Test:
- Optimum Moisture Content (OMC) = 6.67%
- Maximum Dry Density (MDD) = 1.79g/cc

CBR RESULTS OF MIXING B.C SOIL, FLYASH, EGGSHELL POWDER:

No. of Trails	Description	Max Dry Density(g/cc)	OMC
Trail 1	B.C	1.68	15
Trail 2	B.C+10% flyash	1.68	12
Trail 3	B.C+15% flyash	1.77	15
Trail 4	B.C+20% flyash	1.68	14
Trail 5	B.C+25% flyash	2.63	12.5

Penetration	Standard load in KN	Obtained load in KN
2.5MM	1370	1400
5.0MM	2055	2080
10MM	3180	3220
12.5MM	3600	3640

CONCLUSION

On the basis of present experimental study, the following conclusions are drawn

Fly ash:

- Based on the results from Proctor Compaction test on Pure Black Cotton Soil mixing with Fly ash of 10%, 15% up to 20% with 5% increment.
- It is found that the values of Proctor Compaction test show a net increment of its Dry Density from to 1.77g/cc, 1.78g/cc up to 2.63g/cc.
- The net decrease in Moisture Content was from 15% to 14.3%, 12.5% up to 10%.
- So, there is a net increment in Dry Density from 1.68g/cc to 2.63g/cc at 25% fly ash and net decrement in Optimum Moisture Content from 15% to 10% at 25% fly ash
- There is a net increment in Dry Density from 1.68g/cc to 1.81g/cc at 5% of egg shell powder mixing.
- There is a net decrement in Optimum Moisture Content from 15% to 6.67% at 20% eggshell powder Mixing

FUTURE SCOPE

1. We can determine CBR for different proportions of the black cotton soils using fly ash, egg shell powder and we can also add quarry dust in different proportions.
2. We Can find shear strength parameters such as a) Cohesion, b) Angle of internal friction(φ)c) Shear Stress d) Normal Stress e) Shear strength

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