A Study on Compaction, Strength Characteristics and Hydraulic Properties of an Problematic Soil Stabilized With Industrial Wastes

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***Abstract*: Expansive soil is a soil which is problematic for civil engineers due to it's low strength & cyclic swell shrink behavior. Stabilization using solid wastes is one of the different methods of treatment, to improve the engineering properties and make it suitable for construction. The useful effects of some important solids wastes obtained from laboratory works and expansive soil stabilization has been discussed in this paper.**

***Keywords*: Soil Sample, Solid Waste, Stabilization, Swell Shrink.**

1. Introduction

The basic of foundation is the soil. In various conditions, the, base layer, road service layer and building materials cannot be used directly on the soil. The land value is at top and improvement of soil at a site unavoidable as there is huge demand for high rise buildings .Therefore, it is required to improve the quality of the soil.

Industrialization is increasing fast and also a great amount of land is there, the exploitation of industrial wastes is increasing due to its demand and supply which is coming from factories. The wastes, cement kiln dust, silica fume, rice husk, fly ash, granite which are good soil stabilization admixture. Soil Stabilization is done improve soil properties so it can have the required strength.

Clay soils generally show different properties of engineering. They tend to have less shear strength which decreases upon wetting & physical disturbances. The plastic and compressible strength increase when wetted, shrink and dried. Under constant load the cohesive soils can creep when the shear stress is approaching its shear strength, making them towards sliding. They develop tend to have low resilient modulus values & large lateral pressures. Soil stabilization is done to improve their properties of engineering.

This study shows the geotechnical properties of clay soil i.e stabilized with broken glass through laboratory tests. The waste materials area a threat to the environment because they will pollute in the locality. The rising cost of the land, and huge demand for high rise buildings makes the improvement of soil at a site unavoidable. Therefore, it is required to revamp the quality of the soil.

These works shows the use of industrial waste as stabilizer to improve the properties of the soil with and without the addition of the industrial waste and determine appropriate quantities of the industrial waste required for adequate stabilization of the clay soil.

2. Objectives

- Increased shear strength. Reducing permeability and shrinkage cracks.
- To compare and find optimum percentage of stabilizer to be added in soil for stabilization of expansive soil.
- To evaluate the engineering properties of expansive soil for different proportions.
- To find the ways to use industrial waste by products in soil stabilization, thus reducing the cost of stabilization.

3. Literature Review

Laxmikant Yadu, R. K. Tripathi (2013): They put forward the fly ash gives better geotechnical properties to the soil by using it in soil stabilization. Fly ash possesses pozzolanic nature so it is technique used in chemical stabilization .This study shows the results of fly ash and GBS , found 3 % fly ash and 6 % GBS mixture is the optimum percentage .Which should be used as an additive for the soft soil.

Abd EL-Aziz and Abo –Hashema (2013): They had stabilized expansive clay using lime and homra (crushed clay bricks or calcined–clay waste).They had found that, soil stabilized with lime - homra shown significant increase in CBR, cohesion (C), angle of internal friction(Ø) and decrease in plasticity, swelling, MDD and consolidation settlement.

J. Olufowobi, A. Ogundoju, B. Michael, O. Aderinlewo (2014): They put forward stabilistion of soil using powdered glass is found by using the % quantity of the powdered glass required in achieving the best results in terms of the clay soil properties lies between 5% and 10% by mass of the soil.

Oormila T. R., Preeti. T. V. (2014): They put forward the evaluation of soil properties like unconfined compressive strength test and CBR test. The sample of soil was collected and added to it, varying percentages of GGBS (15%, 20%, 25%) &

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fly ash (5, 10%, 15% and 20%) was added to know the variation in its real strength. From these results California Bearing Ratio test was conducted with the maximum fly ash, optimum GGBS and combination of maximum fly ash with varying GGBS. Results obtained showed that, it was found to be maximum GGBS (20%) gives the optimum increment in the CBR results when compared with all the other combinations.

Krishna Kumar, Dr. Sneha Gupta (2018): This study shows that the voids of soil can be reduced and the compression strength can be increased by increasing the GGBS%. The SG is elevated and the soil gets denser. GGBS reduces the swelling of the soil that is due to sulphate. Lime was used up to 5%, RHA, and GGBS 15% and FAF 20%. Then the soil property can be changed maximum.

Pandian, N. S., Krishna, K. C. and Sridharan, A: They deduced that when mixed fly ash up to 100% to black cotton soil at an increasing level of 10% and found that CBR values of black cotton soil increased up to 20% addition of fly ash beyond it, California bearing ratio is decreased. It is again changed and increased and the maximum value is obtained when the percentage of fly ash was 70%.

Katti, B. K., and Sankar, A.V.S. 1989: They did the tudy on the stabilization of lime and brick aggregates and concluded that the ratio strength characteristic of expansive soil using the California bearing ratio. The CBR value of the stabilization of brick lime was more as compared to the lime stabilization.

4. Methodology

The Index properties of the soil were determined in the Laboratory as per IS codes.

A. Materials used

- BCS – Black Cotton Soil is also said to be Expansive soil. It is said to contain high amount of clay minerals and is expected to change in volume with respect to change in moisture content.
- Fly ash is smooth, powdered glass obtained from coal fired electric generator. It is hardened while suspended in exhausts and is contained by precipitators (Electrostatic). They are generally spherical in shape and come in sizes ranging from 0.5 μm - 100 μm. It consists of SiO2, Al2O3, Fe2O3.

The general properties of soil are determined using specified tests done by different parts of IS 2720 which are as

1. Sieve analysis test
2. Specific Gravity test
3. Atterberg's Limit
   - Liquid limit
   - Plastic limit
   - Shrinkage limit
4. Compaction test
   - Optimum Moisture Content
   - Dry Density
5. Unconfined compression test

5. Conclusion

Based on the results of the above study, it appears that the selected soil can be effectively stabilized with the addition of fly ash at 15 % or 20% GGBS by dry weight of soil. Optimum Water absorption should not increase more than 20%. The water absorption in the black cotton soil and fly ash brick is 12.3 %. The fly ash brick and black cotton soil has compressive strength more than 9.14 %. CBR of fly ash is 70% for black cotton soil. Industrial wastes examined for this study have been shown create positive changes in soil properties. This allows for a more economical additive material to be used instead of the binders. The use of waste also contributes to the reduction of environmental pollution.

Acknowledgment

The students would like to express an acknowledgement to the Dr. H.K.Ramaraju Head of civil engineering department of Dayananda Sagar College of Engineering Bangalore, For providing the facilities like such as the geotechnical Laboratory and Advanced Geotechnical Laboratory to accomplish this study .The students also wishes to acknowledge cooperation given by Laboratory Technicians and Faculty Sridhar H. N of Dayananda Sagar College of Engineering, Bangalore to complete this study.

References

[1] R. K. Tripathi and Laxmikant Yadu, (Feb-2013) "Stabilization Of Soft Soil With Granulated Blast Furnace Slag And Fly Ash," in IJRET, Volume 2 Issue 2.

[2] Preeti T. V. and Oormila T. R., (2014), "Effect of Stabilization Using Flyash and GGBS in Soil Characteristics", IJETT, Volume 11, Number 6, May 2014, pp. 284-289.

[3] A.Ogundoju, B. Michael, J. Olufowobi, O. Aderinlewo (2014), "Soil Stabilisation Using Powdered Glass," JEST, Vol. 9, No. 5, 541–558.

[4] Abo-Hashema, and Abd EI-Aziz, (2013), "Measured Effects on Engineering Properties of Clayey Subgrade using Lime-Homra Stabiliser," IJPE, 14(4), 321-332.

[5] Krishna, K. C., Pandian, N. S., and Sridharan, A. (2001) "California Bearing Ratio Behavior of Soil/Fly ash Mixtures" JTE, 29(2), 220–226.

[6] Divya Krishnan K, V. Janani, R. Annadurai, P. T. Ravichandran, Manisha Gunturi, (Feb 2015),"Soil Stabilization with Phosphogypsum and Fly Ash –A Micro Level Study", IJCRGG, Vol. 7, No. 2, pp. 622-628.