

Laboratory Investigation Of Expansive Soil Stabilized With Groundnut Shell Ash.

Rashmi Bade ¹, C.Aditya ², Mohd. Ayyub ³, Nishikant Chourasiya ⁴, Zahir Baig ⁵

Assistant Professor, Department of Civil Engineering, Anjuman College of Engineering & Technology, Nagpur, India¹

Former Student, Department of Civil Engineering, Anjuman College of Engineering & Technology, Nagpur, India²

Former Student, Department of Civil Engineering, Anjuman College of Engineering & Technology, Nagpur, India³

Former Student, Department of Civil Engineering, Anjuman College of Engineering & Technology, Nagpur, India⁴

Former Student, Department of Civil Engineering, Anjuman College of Engineering & Technology, Nagpur, India⁵

ABSTRACT: Soil stabilization can be explained as the alteration of the soil properties by chemical or physical means in order to enhance the engineering quality of the soil. The main objective of the soil stabilization is to increase the bearing capacity of the soil, its resistance to weathering process and soil permeability. The long-term performance of any construction project depends on the soundness of the underlying soils. Unstable soils can create significant problems for pavements or structures. Therefore soil stabilization techniques are necessary to ensure the good stability of soil so that it can successfully sustain the load of the superstructure especially in case of soil which is highly active. Black cotton soil which is also major type of expansive soil has a very weird property of swelling and shrinking in presence and absence of water or moisture. The best way to stabilise such type of soil is to disturb the soil sample by physically adding an additive. The additive added should be cheap, effective, environmental friendly and easily available in large quantity. In this paper an organic waste product which is readily available and is quite effective and cost friendly is used. The material used is the shell of groundnut which is easily available waste product in every household. The tests have shown that it increases the strength of soil effectively without affecting the foundation of the structure; attenberg test, proctor test and its specific gravity test have shown that the material used for stabilization is highly soil friendly and effective for civil engineers who have major problems dealing with expansive soils.

KEYWORDS: Organic stabiliser, Groundnut shell coverings, Disturbed soil samples, Expansive soil.

I. INTRODUCTION

In India nearly about 16-20% of land is covered by expansive soil deposits .this soil should be treated and improved for the better stability of civil engineering structure. In case of black cotton soil that is the expansive soil, and the problem of expansive soil is widespread throughout world this countries that are facing problems with expansive soil are Australia, The united state, Canada, China, Israel, India and Egypt and so many countries but they not in list. The clay mineral that is mostly responsible for expansiveness belongs to the montmorillonite group. Swelling soil which are clayey soil are also called expansive soil, when this soil partially saturated they increase in volume with the addition of water they shrink greatly on drying and develop cracks on the surfaces. Montmorillonite is a predominant mineral of black cotton soil. They are made of aluminium and magnesium. They are made of sheets of silica and alumina stacked one above the other forming sheet like structure with expanding lattice. The structure of some aluminium is by magnesium ion and the mineral becomes chemically active. The mineral has high activity, and has the Base Exchange capacity of more than 80%ml/100g compared the – VC charges on the clay minerals. They attract water molecules (dipoles) and various types of hydrated cation to surface causing the soil to increase the volume. In rainy season, this soil becomes very soft by filling up of water in this cracks and fissures. These soft soil reduce the bearing capacity of the soil in saturated condition, these soil have high consolidation settlement. These soils have high swelling nature. Due to this structure causes damages. When land are applied on these soil in wet condition these soil get shrinkage. These

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly Peer Reviewed Journal)

Vol. 5, Issue 1, Januray 2016

soil possess high plasticity index black cotton soil found in many parts of India belong to this category the colour of this soil varies from deep black to light black and the chestnut and it's dependent on the colour of this mechanical fractions. Generally these soils are rich in iron, lime, potassium calcium aluminium and magnesium carbonates but poor in nitrogen and phosphorus. The chemical test near Nagpur yields soluble matter 68.71% ferric oxide 11.24% alumina 9.3% water and organic matter 5.83% lime 1.81% and magnesium 1.79%. Therefore if these soil are used it should be treated and improved. One method is stabilisation of soil have so many methods just like stabilisation of soil with cement, stabilisation of soil with lime, stabilisation of soil with organic additives and stabilisation of soil with inorganic materials or additives etc. Soil stabilisation aims at improving soil strength and increasing resistance to softening the by water through bonding the soil particles together. The simplest stabilisation processes are compaction and drainage (if water drain out wet soil it becomes stronger). The other process is by improving gradation of particles size and further improvement can be achieved by adding binding to the weak soil. Soil stabilisation can be accomplished by several methods. All these method fall into two board category namely; soil stabilisation can be achieved through physical process by altering the physical nature of native soil particles by either induced vibration or compaction or by incorporating other physical properties such as barriers and nailing. The chief properties of soil which are of interest to engineers are volume stability, strength, compressibility, permeability and durability. For a successful stabilisation, a laboratory tests followed by field tests may be required in order to determine the engineering and environmental properties. Laboratory tests although may produce higher strength than corresponding material from the field, but will help to assess the effectiveness of stabilised materials in the field. Results from the laboratory tests, will enhance the knowledge on the choice of binders and amounts.

II. ENGINEERING PROPERTIES OF THE MATERIAL USED

Groundnut, or peanut, is commonly called the poor man's nut. Today it is an important oil seed and food crop. This plant is native to South America and has never been found uncultivated. The botanical name for groundnut, *Arachis hypogea* Linn, is derived from two Greek words, *Arachis* meaning a legume and *hypogea* meaning below ground, referring to the formation of pods in the soil. It is generally distributed in the tropical, sub-tropical and warm temperate zones. Groundnuts are not only rich in proteins which are easily digestible and consequently, a higher biological value, but are also rich in B-complex vitamins.. Various cultivars of groundnut tested in Andhra Pradesh, southern India have shown high contents of P and K, possibly due to varietal differences. The principal use of groundnut however, is in the production of oil. Groundnut shell is an agricultural waste obtained from milling of groundnut. Meanwhile, the ash from groundnut shell has been categorised under pozzolana, with about 8.66% Calcium Oxide (CaO), 1.93% Iron Oxide (Fe₂O₃), 6.12% Magnesium Oxide (MgO), 15.92% Silicon Oxide (SiO₂), and 6.73% Aluminium Oxide (Al₂O₃). The utilisation of this pozzolana as replacement for traditional stabilisers will go a long way in actualising the dreams of most developing countries of scouting for cheap and readily available construction materials. Groundnut shell ash has been used in concrete as a partial replacement material for cement with a measure of success achieved.

Indian engineers and artisans had deep knowledge about ground improvement and stabilisation techniques. Many of the old Indian techniques may not be relevant as modern methods and materials are more cost effective. But one must appreciate the old Indian knowledge which was centuries ahead of that available in rest of the world. There is a need to preserve this treasure of ancient Indian traditions. Stabiliser is deemed necessary the choice of which one to use will depend on a number of factors including:

- The part of the building on which the soil is used and its exposure to the elements
- The property of the soil which needs improving; e.g. dry strength, wet strength, water erosion, abrasion resistance, surface protection, etc.
- The level of improvement required
- The quantity of stabiliser required
- The cost and availability of the stabiliser
- Whether production of the stabiliser is carried out locally or whether it needs to be imported.

By considering the above organic nature of additives, it has been thought to select the material as additives namely GROUNDNUT.

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly Peer Reviewed Journal)

Vol. 5, Issue 1, Januray 2016

III. TESTS CONDUCTED

The following test series were conducted on soil samples

1) ATTERBERG LIMIT TEST

This lab is performed to determine the plastic and liquid limits of a fine-grained soil. The liquid limit (LL) is arbitrarily defined as the water content, in percent, at which a part of soil in a standard cup and cut by a groove of standard dimensions will flow together at the base of the groove for a distance of 13 mm (1/2 in.) when subjected to 25 shocks from the cup being dropped 10 mm in a standard liquid limit apparatus operated at a rate of two shocks per second. The plastic limit (PL) is the water content, in percent, at which a soil can no longer be deformed by rolling into 3.2 mm (1/8 in.) diameter threads without crumbling.

2) STANDARD PROCTOR TEST

These laboratory tests generally consist of compacting soil at known moisture content into a cylindrical mould of standard dimensions using a compactive effort of controlled magnitude. The soil is usually compacted into the mould to a certain amount of equal layers, each receiving a number of blows from a standard weighted hammer at a specified height. This process is then repeated for various moisture contents and the dry densities are determined for each. The graphical relationship of the dry density to moisture content is then plotted to establish the compaction curve. The maximum dry density is finally obtained from the peak point of the compaction curve and its corresponding moisture content, also known as the optimal moisture content.

Experimental results:-

Liquid Limit: The liquid limit (LL) is often conceptually defined as the water content at which the behaviour of a clayey soil changes from plastic to liquid.

Plastic Limit: The plastic limit (PL) is often defined as the water content at which the behaviour of the clayey soil changes from liquid to plastic.

10% Sample :-

TEST CONDUCTED	SOIL	GROUNDNUT
LIQUID LIMIT	68	47.51
PLASTIC LIMIT	37.3	40.95
PLASTICITY INDEX	30.7	6.55

Standard Proctor Test: The degree of compaction of a soil is measured in terms of its dry density. The degree of compaction mainly depends upon its moisture content, compaction energy and type of soil. For a given compaction energy every soil attains the maximum dry density at a particular water content which is known as optimum moisture content.

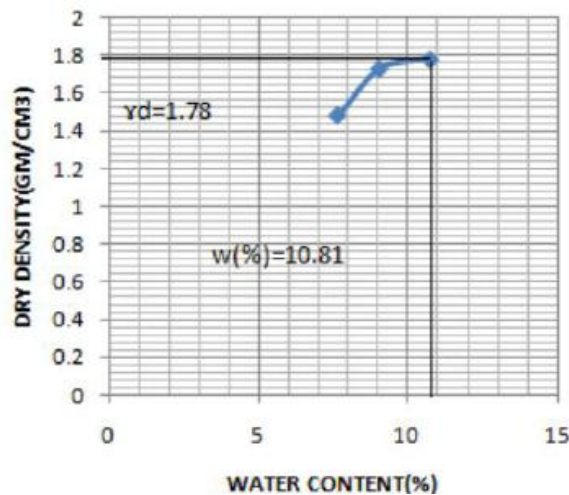
1. Optimum Moisture Content =-----15%

2. Maximum Dry Density = -----1.53gm/cc

International Journal of Innovative Research in Science, Engineering and Technology

(A High Impact Factor, Monthly Peer Reviewed Journal)

Vol. 5, Issue 1, Januray 2016



IV. CONCLUSION

It can be concluded that the by the decrease in plasticity index and increase in dry density improves the bearing capacity of clayey soil. The improved PI value is due to addition of groundnut shell ash as admixtures to the BC soil. It also reduces the hydraulic conductivity of BC soil. There will be no need of drainage layer after treatment of BC soil. In combination, the admixtures are beneficial for lower plasticity and higher silt content soils.

REFERENCES

- [1] Katti, R.K., Kulkarni, K.R. and Radhakrishnan, N., Research on Black Cotton Soils without and with Inorganic Additives, Indian Road Congress Road Research Bulletin, No. 10, 1966, 1-97.
- [2] Sivanna, G. S. et al, Strength and consolidation characteristics of black cotton soil with organic additives, report prepared by Karnataka Engineering Research Station, Krsihnarajasagar, India. 1976
- [3] Raju VR, 2010. Ground improvement - Principles and applications in Asia, pp. 43-65.
- [4] Petry T. M. and Little D. N. (2002): "Review of stabilisation of clays and expansive soils in pavements and lightly loaded structures: history, practice and future" Proc., of Journal of Materials in Civil Engineering, ASCE, 14, No. 6, 447-460
- [5] Amin Esmaeil Ramaji(2012)—A Review on the Soil Stabilisation Using Low-Cost Methods Journal of Applied Sciences Research, 8(4): 2193-2196, 2012 ISSN 1819-544X.
- [6] Bureau of Indian Standards (BIS). 1980. Methods of test for soils: Determination of water content-dry density relation of Indian Standard on soil engineering, IS 2720, Part 7, New Delhi.
- [7] Pankaj R. Modak, Prakash B. Nangare, Sanjay D. Nagrale, Ravindra D. Nalawade, Vivek S. Chavhan(2012) — Stabilization of black cotton soil using admixtures International Journal of Engineering and Innovative Technology (IJEIT) Volume 1, Issue 5.
- [8] Bade, R.G. (2012): "In-situ Improvement of soft clay deposit by chemical diffusion method", M.Tech (Geotech Engg.) Dissertation submitted to Nagpur University.
- [9] IS: 2720 (Part-V)-1987. "Indian Standard for Determination of liquid limit and plastic limit", BIS New Delhi
IS: 2720 (Part-VIII)-1983. "Indian Standard for Determination of Water Content-dry density relation using heavy Compaction", BIS New Delhi
- [10] Holtz, W.G., Gibbs, H. J.: Engineering properties of expansive clays. Trans ASCE. Vol.121, 1956.
- [11] Ingles, O.G.: Soil Stabilization, Ground Engineer's Reference Book. ed. F.G. Bell. Butterworths Heinemann Publishers 1987.
- [12] Phanikumar, B. R., Sharma, R. S., Rao, A. S., and Madhav, M. R. (2004): "Granular pile anchor foundation system for improving the engineering behaviour of expansive clay beds."Geotech. Test. J., 273, 279-287.