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STUDY ON BLACK COTTON SOIL STABILIZATION USING RICE HUSK ASH

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Abstract
This document is an account of study done on stabilization of 'Black cotton soil' using additive, Rice Husk Ash. Our attempt is to stabilize the soil and get desired result at optimum value. The soil used in the study is taken from Jhansi district of Uttar Pradesh in India.
Keywords: Black cotton soil, Rice Husk Ash, Free swell index, Strength, Stabilization.

Introduction

Soil is the accumulation of mineral particles resulting from the physical-chemical decomposition of rocks, which includes air, water, organic matter and other materials/substances. It is a porous and heterogeneous earthy material. Its behavior (geometric behavior) is mainly affected by changes in density and moisture content.
Expansive soils have the ability to shrink and swell and are therefore problematic soils; Due to the change in moisture content. All continents on Earth differ in the proportions of this type of soil. This soil causes destruction, as many countries have reported; Especially India. India has a large portion of land covered by this soil, which is called "black cotton soil".
"Black cotton soil" causes cracks on the surface and opens up in dry seasons. Although these cracks disappear in the next season, i.e. winter, the uneven surface remains. Black cotton soil has low resistance and is prone to irregular volume changes.

Problems due to black cotton soil

In India, where we experience significant temperature variation throughout the year, "black cotton soil" presents a challenge to engineers. They are highly compressible and plastic, when saturated; Therefore, said soil suffers from extensive consolidation settlements when foundations are placed on said soil.

Methods of stabilization of expansive soils

To avoid swelling and shrinkage behavior in expansive soils, the soil must be stabilized using different methods.
To stabilize bulbous soils there are two methods: mechanical stabilization and mixed stabilization.

Rice husk ash

Milling rice produces a by-product known as husk. This surrounds the grain of rice. During rice milling, about 77% of the rice weight is obtained in the form of rice, and the remaining 23% of the rice weight is obtained in the form of husks. This husk contains approximately 70-75% volatile organic matter and the rest, 20-25% by weight of this husk, which turns into ash during the cooking process, is known as rice husk ash (R.H.A.).
India is a major rice producing country. About 25 million tons of R.H.A. It happens annually. This R.H.A. It poses a major environmental threat causing damage to the land and the environment into which it is discharged.
Rice husk ash (R.H.A.) is generally considered pozzolanic. Use R.H.A. As one of the components of cement materials, it depends on its interaction with the lime that forms the cement material. Lime may

be present as the main component of the mixture. The development of mechanical strength is affected by the nature of the silica, the carbon content and the fineness of the ash. Various methods of disposal are being considered through commercial use of rice husk ash (RHA).

Uses of Rice Husk Ash

In Lightweight Fill

The ash appears to be a very suitable light weight fill and would not present great difficulties in compaction, provided its initial moisture content is kept within permissible limits (less than 50 percent or so). The very high angle of internal friction of the material will mean that its stability will be high. Due to soil erosion and shearing under heavy rollers, lack of cohesion may lead to problems in construction work(s). To overcome these problems, it is desirable to place a 3 to 5 inch thick blanket layer of cohesive material for every 2 to 3 ft.

As a Stabilizer

The Rice Husk Ash (RHA) appears to be an inert material with silica (in crystalline form). As suggested by the structure of the particles, it is very unlikely that it would react with lime (CaO) to form silicates of calcium. It is also highly unlikely that, it would react similarly as fly ash (which is more finely divided) reacts. So, Rice Husk Ash (RHA) will give good results when it is used as a stabilizing material.

Other Uses

The low density of the compacted Rice Husk Ash over a wide range of moisture contents, coupled with high permeability and small pore size makes the material very suitable as a final filter for water supply, in first sight. Un-burnt rice husk can be used as a first stage filter. Since it is cheaper, it can be placed frequently, if the need arrives. The low compacted RHA finds its use in light weight concrete.

Rice Husk Ash Soil Stabilization

Rice Husk Ash (RHA) can be used as a single additive for the purpose of soil stabilization. However 'Rahman' has made an attempt in this direction to derive the effects of 'Rice Husk Ash' on various geotechnical properties of 'Black Cotton soil'. The research concluded that the well burnt Rice Husk Ash (RHA) has appreciable effect on the geotechnical characteristics of soil being tested.

During the research on Rice Husk Ash stabilization on soil, the liquid limit (wp) and plastic limit(wp) increases with increase in Rice Husk Ash, but the plasticity index(IP) decreases. The maximum dry density (M.D.D.) of stabilized soil decreases with increase in percentage of Rice Husk Ash content, while the optimum moisture content (O.M.C.) increases. The unconfined compressive strength (U.C.S.) increases with increase in Rice Husk Ash (RHA) content.

Literature Review

Clayey soils exhibit significant volumetric expansion in the presence of water. 'Black cotton soil' is formed through expensive physical – chemical alteration. Illinite, Kaolinite, Montmorellonite are more prone to changes in their volume. The montrimollionite content is the predominant clay mineral content in 'black cotton soil'. Major area of the world's nations is covered with these soils. Indian black cotton clays are typical examples of soil covering an area about 20 % of total land area.

VI. Objectives of Study

1. To study the effect of rice husk ash (RHA) as an additive on soil swelling in terms of free swelling coefficient and resistance coefficient.
2. A comparative resistance study was carried out with 4 different percentages of rice husk ash (10%, 15%, 20%, 25%).
3. A comparative study of resistance was carried out with the fixed proportion of rice husk ash (optimal proportion).
4. Study the suitability of stable soil for flexible pavements.

Property Range of average values I Specific gravity (G) 2.65 - 2.9 II Liquid limit (%) 40 - 100 III Plastic limit (%) 20 - 50 IV Shrinkage limit (%) 8 - 18 V Plasticity index (%) 20 - 50 VI Maximum dry density (tonnes/m3) 1.3 - 1.7 VII Optimal moisture content (OMC) (%) 18 - 30 VIII Color Dark gray / Black IX Free swelling index (%) 70 - 300 Value 1.2-4.0

Results and discussion

The most important property of weak soil deposits is shear strength, which gives a measure of the load it can withstand before failure. When any construction work is carried out above ground, we take into account shear resistance parameters as they play an important role. Pressure characteristics were also determined to study the effect of R.H.A. Produced in the soil.

Unlimited compression force

The U.C.S test was carried out on soil amended with "rice husk ash" and untreated lime, to achieve differences in shear strength. The test was performed after the sample was rehydrated and cured for 28 days. Curing is important for hydration reactions to occur, because it gives all the strength to the soil. The test results are shown in Table 5.1 and Figure 5.1. By adding lime, the free compressive strength of the soil increases. We achieved greater strength by replacing a small portion of the soil with Rice Husk Ash (R.H.A.). As the percentage of rice husk ash (R.H.A) increases, there is an improvement in resistance; Which can be well understood by the fact that R.H.A. It is more effective as a stabilizer, compared to other additives. This, in combination with the pozzolanic activity of "rice husk ash", has been found to give good strength. The optimum dosage of "Rice Husk Ash" (R.H.A.) is found to be around 5%, above which replacing "soil" with "Rice Husk Ash" significantly reduces the resistance.

Compaction Characteristics

Compression tests were carried out in accordance with the provisions of "IS 2720" for untreated materials as well as "R.H.A." Mixtures. The results obtained are shown in the following table. It is found that there is a decrease in dry density with increasing "rice husk ash" and O.M.C content. It increases with increasing percentage of "rice husk ash". The specific gravity (G) of rice husk ash is low compared to that of soil, so we see a decrease in dry density when rice husk ash is added.
The increase in optimal moisture content (O.M.C.) can be attributed to the fact that more moisture is needed for chemical reactions to occur.

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