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A Review on Soil Stabilization with Fly Ash and Rice Husk

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ABSTRACT: The objective of this paper is to upgrade expansive soil as a construction material using rice husk ash (RHA) and flyash, which are waste materials. Remolded expansive clay was blended with RHA and flyash and strength tests were conducted. The potential of RHA-flyash blend as a swell reduction layer between the footing of a foundation and subgrade was studied. In order to examine the importance of the study, a cost comparison was made for the preparation of the sub-base of a highway project with and without the admixture stabilizations. Stress strain behavior of unconfined compressive strength showed that failure stress and strains increased by 106% and 50% respectively when the flyash content was increased from 0 to 25%. When the RHA content was increased from 0 to 12%, Unconfined Compressive Stress increased by 97% while CBR improved by 47%.

I. INTRODUCTION

Clays exhibit generally undesirable engineering properties. They tend to have low shear strengths and to lose shear strength further upon wetting or other physical disturbances¹. They can be plastic and compressible and they expand when wetted and shrink when dried. Some types expand and shrink greatly upon wetting and drying – a very undesirable feature. Cohesive soils can creep over time under constant load, especially when the shear stress is approaching its shear strength, making them prone to sliding. They develop large lateral pressures. They tend to have low resilient modulus values². For these reasons, clays are generally poor materials for foundations³. The annual cost of damage done to non-military engineering structures constructed on expansive soils is estimated at \$220 million in the United Kingdom and many billions of dollars worldwide⁴.

Flyash⁵⁻⁷ was successfully used for stabilizing expansive clays. The strength characteristics of flyash stabilized clays are measured by means of unconfined compressive strength (UCS) or California Bearing Ratio (CBR) values. Depending upon the soil type, the effective flyash content for improving the engineering properties of the soil varies between 15 to 30%⁸⁻¹⁰. Rice Husk Ash (RHA) is obtained from the burning of rice husk.

II. MATERIAL

SOILS

The properties of the expansive clay used in this investigation are given in Table 1. As per the USCS classification system, the soil is a CH soil. A plasticity chart showing the location of the soil is shown in Fig. 1.

FLYASH

Class C flyash was used. Its constituents are listed in Table 2.

RICE HUSK ASH

In this investigation, RHA passing through No. 100 sieve (150 micrometers) was used. The chemical composition of RHA is listed in Table 3. The RHA had 90.2% silica content. This high amount provides good pozzolanic action.

EXPERIMENTS

UCS, CBR, compaction and swell-shrinkage tests were conducted.

III. TEST METHOD

Compaction

The tests were performed in accordance with ASTM D 1557. The specimens were of 102mm diameter and 116mm height. The degree of compaction of soil influences several of its engineering properties such as CBR value,



compressibility, stiffness, compressive strength, permeability, shrink, and swell potential. It is, therefore, important to achieve the desired degree of relative compaction necessary to meet the required soil characteristics.

UCS

The UCS tests were performed in accordance with ASTM D 2166. The sample sizes were of 40mm diameter and 0mm length. At the Optimum Moisture Content (OMC) and maximum dry unit weight values of the natural soil, the tests were performed.

CBR

The CBR tests were conducted in accordance with ASTM D 1883. The sample sizes were of 152mm diameter and 126mm length. At the OMC and maximum dry unit weight values of the natural soil, the tests were performed.

Swelling

Consolidation test (ASTM D 2435) setup was used for determining the cyclic swell-shrink behavior of the soil. The sample sizes were 76mm and 50mm in diameter and height respectively. The samples were prepared at Proctor's dry densities. The RHA was mixed with 15% flyash and compacted to dry unit weight of 5.5kN/m³ at a moulding water content of 120%. The compacted admixture was cured for 14 days and placed over the expansive soil. The efficacy of RHA as a cushioning layer between the foundation and subgrade was also tested using the consolidation test.

IV. CONCLUSION

1. Stress strain behavior of unconfined compressive strength showed that failure stress and strains increased by 106% and 50% respectively when the flyash content was increased from 0 to 25%.
2. When the RHA content was increased from 0 to 12%, CBR improved by 47%.
3. The optimum RHA content was found at 12% for both UCS and CBR tests.
4. The vertical movement of clay soils with cushioning material stabilizes after 3 cycles of swelling
5. When the RHA content was increased from 0 to 12%, CBR improved by 47%.
6. The optimum RHA content was found at 12% for both UCS and CBR tests.

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