Strengthening of Clayey Pavement Subgrades using Fly Ash and Rubberised Coir Sheets

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***Abstract*: Better management of roads construction and its maintenance is a global problem nowadays. Poor subgrade properties are one of the major causes of pavement subgrade failures. Clayey soil is one such soil that covers 20% of the land in India. The subgrade is a significant part of the road structural system, when roads are inundated for a long time or repeatedly, the materials in each layer of road structure become saturated, and the original condition of subgrade soils will be compromised. The use of substandard materials and lack of maintenances led to the early depletion of the roads. The use of coir fiber substances in various disciplines of civil engineering has led to new methods for stabilization, strengthening, and reinforcement. The aim of the thesis is to study the strengthening characteristics of clayey subgrade when mixed with fly ash and coir fiber. Experimental investigations are done to determine Atterberg's Limits, Free Swell test, Standard compaction Test, California Bearing Ratio Test, Unconfined compression Test.**

Keywords: Coir Fibre, California bearing ratio, clay soil, fly ash

1. INTRODUCTION:

In a developing country such as India, road networks form the arteries of the nation. Pavement is a layered structure on which vehicles travel. It serves two purposes, to provide a comfortable and durable surface for vehicles, and reduces stresses on underlying soils. Clayey and silty soils have lower permeability that can influence the construction of embankmentsand sub-grades for roadways and rail-tracksClay soils are the heaviest of soil types and are often considered the hardest to work with. Soft clays are usually with low compressive strength and excessive settlement. Construction of roads on clayey subgrades can cause structural damage, heaving as well as swelling in waterlogged areas. In order to avoid all these problems initially, clayey soils are stabilized using admixtures. Soil stabilization can be carried out with a number of methods, particularly mechanical and chemical stabilization. In mechanical stabilization, the nature of native soil particles can be affected by using vibration or compaction or with the aid of different features, such as obstacles and nailing. The stabilization of soil via chemical stabilization frequently relies upon chemical reactions to acquire the preferred impact between stabilizers and soils. The usually used stabilizers are lime, cement, bitumen, ash or fly ash, etc. gasoline pulverized. Roads in Kerala have mostly the problems like formation of potholes, ruts, cracks, and localized depression and settlement, especially during the rainy season. These are mainly due to the insufficient bearing capacity of the subgrade in water-saturated conditions. In modern pavement design, geo-synthetics play a significant role. They are the most cost-effective tools for increasing the pavement life and reducing the maintenance of pavements.

Kerala has the largest coir production units and its immensely used in the areas of road construction it improves the lifespan of roads, reduces rutting, and reduces cracking and swelling. Coir geotextiles were extensively used in its applications successfully in various countries.

Major functions provided by coir geotextiles are filtration, drainage, separation, and reinforcement. They are biodegradable and economical. Most of the geo-synthetics used nowadays are synthetic in nature and are non-biodegradable leaving the possibility of ground and water contamination. Coir mat a natural product is being selected for this purpose to overcome the menace of land contamination.

This paper examines the use of rubberized coir sheets, which is an upcoming coir product, it's not yet used in the road construction process; the coir fibers are bonded by latex sprayed over them. 10 % and 20 % latex rubberized coir are used for this project work and it was brought from the Neyyatinkara coir cluster.

2. **Effect of coir geotextile on clayey subgrades: Sayida et al**[1] studied the rate of degradation is reported. The embedment period is varied from 0 to 135 days. The degradation rate is evaluated by conducting a wide-width tensile strength test and CBR test using coir samples before and after embedment of coir geotextile, Roads with clay the of high compressibility degraded at a slower rate compared to other soils.

Discussed the stabilization ofclayey subgrade when mixed with coir fibers (CF) randomly and fly ash (FA).

Shiva Prashanth Kumar Kodicherla et al.[2] concluded that 20% FA +1% CF resulted inan improvement of subgrade in terms of CBR.

P Sri Ram Karthik [3]**,** studied the stabilization with C fly ash and grade H2M9 coir mat, The CBR value was determined by placing a coir mat at more than a few depths in an ideal fly ash clay mix. The most CBR value acquired was 44% for coir mat positioned at the mixture of h/4th and h/2th depth from the pinnacle in standard fly ash - clay mix.

A. Ramesh[4] concluded that 15% fly ash and 1.5 cm length of 1.5%coir fiber have a noticeable influence on the CBR value of expansive soils compared to the results obtained on fly ash, and CF materials used separately.

3. PROCEDURE AND FINDINGS OBTAINED FROM WORKS OF LITERATURE:

CBR method of pavement design is the most popular method of pavement design. In this method, the thickness of pavement above a certain layer is based on the CBR of that layer. There are charts connecting CBR and thickness of pavement required given by IRC 37-2001. The experimental study involved performing laboratory CBR tests using rubberized coir sheets at differentdepths on clayey soil.

The subgrade was prepared in the CBR mold of an internal diameter 150mm and height (H) 175mm. compacting up to its Modified Proctor density and optimum moisture content.

The rubberized coir geotextiles were placed at depths 0.2H, 0.4H, 0.6H, and 0.8H where H is the height of the sample from the top. The durability test is also conducted by soaking the rubberized coir sheet by varying the pH of the solution, the soaking period estimated is around 25 days then comparing the CBR results obtained beforeand after soaking.

The un-soaked CBR value brought to be about 7 instances increased than that of virgin clay in way of placing coir mat at h/4 &; h/2 from highpoint and the soaked CBR acquired is to be 5 instances higher than virgin clay.

The ideal position for placing the coir geotextiles were at the top position of the subgrade and the least value was obtained at the bottom-most position. The use of coir geotextiles increases the subgrade strength and thus improves pavement life. The degrading rate of coir samples is less during the initial period and the rate increases rapidly after 30 days. The CBR value decreases with time due to the degradation of the coir geotextile.

4. CONCLUSION:

The main test that is to be carried out is the California Bearing test, CBR test is conducted by placing rubberized

Dev Harinder [5] conducted a study on black cotton soil, coir mats are placed between the subgrade and sub-base at a height of H/2, H/3, and H/4 position. The minimum rut depth of coir mats is occurring at the h/4 position with CC.

V. Anusudha[6] *s*tudied the effect of coir geotextiles when used as reinforcement at the interface of sub-base and subgrade, analyzing the pavement using ABAQUS, a maximum reduction of 38% and 24% in vertical strain was observed on top of the subgrade in the case of H2M5 and a maximum reduction of 30% and 18% in vertical displacement was observed in the case of H2M5 and H2M6 coir reinforced sections H2M6 coir geotextile reinforced sections.

Sheela Y. Evangeline et al.[7] conducted a study on the performance of coir geotextile reinforced and unreinforced roads, after three to 6 years of construction. Benkelman Beam Deflection (BBD), Field CBR, and Dynamic Cone Penetration (DCP). An improvement in in-situ CBR values wasobtained.

Chandrakaran et al.[8] studied the use of woven coir geotextiles as a reinforcing material in a two-layer pavement section. The inclusion of coir geotextiles enhanced the bearing capacity of thin sections', load-carrying capacity.

coir sheet at different depths and finding the optimum depth at which themaximum CBR value is obtained.

The depths are 0.2H, 0.4H, 0.6H, and 0.8H where H is the height of the sample from the top. The durability test is also conducted by soaking the rubberized coir sheet by varying the pH of the solution, the soaking period estimated is around 25 days then comparing the CBR results obtained beforeand after soaking.

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