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Stabilization of Lithomargic Soil Using Polypropylene Strips

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Abstract – - *Present day demand in construction has pushed the limits of engineering to a whole new level. We are coming up with ways to construct huge edifices on low bearing capacity soils. One of the such low bearing capacity soil is Lithomargic soil which is highly vulnerable to settlements when subjected to heavy loads. Searching for the best soil stabilizers to overcome the problem occurs by the clayey soils and sandy soils and are still being the main concern, not only to achieve the required soil properties but also by considering the cost and the effect on the environment. Lithomargic soil is locally known as Shedi soil, which is found in shallow depth usually under the lateritic soil. These soils tend to destabilize the pavements that are constructed on the embankment or the subgrade soil, as they do not have the required shear strength; Thus, it is made up of Lithomargic required to improve the properties of this soil before it can be used as a highway material. This paper focusses on the stabilization of soil using Polypropylene strips. The Polypropylene strips when introduced into the Lithomargic soil acts as a reinforcing agent and improves the shear strength by improving the friction component of the latter soil. Test result showed the highest value of maximum dry density (MDD) and lowest optimum moisture content (OMC) for the trial mixes, when compacted with 3% Polypropylene strips, which can be taken as the optimum dosage. The strength is evaluated based on unconfined shear strength, and the penetration resistance in California Bearing Ratio (CBR) test for the samples compacted at maximum proctor density for optimum dosage of Polypropylene strips in the Lithomargic soil.*

Key Words: **Stabilization, Lithomargic Soil, Polypropylene Strips.**

1.INTRODUCTION

The real time problem for Civil engineers on construction of foundation, road embankments and pavements arise when the soil is of softy soil. Without considering the category of soil, now a day's Civil engineers are taking up the challenges to construct structures. The western coastal belt starting from Cochin to Ratnagiri of Maharashtra, India has a wide range of Lithomargic soil richly available below the top lateritic formation. This Lithomargic soil as on wetting starts losing its strength. For a construction of durable roads, it requires a subgrade of suitable strength, which may not be always available near to highway construction lines; Thus, many a time it becomes essential to use abundantly available weaker soil strata which in turn requires to strengthen its property by adopting suitable stabilizing techniques. Highway and Geotechnical engineers are in search of alternative mechanization of strengthening the subgrade properties which are in cheap, eco-friendly and give a good result on improving the soil properties. This paper mainly focuses on using a polypropylene strip as a stabilizing ingredient to strengthen the Lithomargic soil properties.

1.1 About Polypropylene Fibers

Polypropylene packing strips or, polypropylene packing straps are 100% Virgin polymer. It is available in various sizes and colors in market. These are manufactured, with usage of right combination of polymers and high- quality fillers. These are primarily obtained as packaging wastages. They are highly chemically inert with all types of terrain, and also can be used as cheap alternative to stabilize the soil. In this thesis an attempt is made on to overcome the weak nature of Lithomargic soil by making use of Polypropylene packing strip as stabilizing materials as it is less expensive, and thus by doing this it also helps in reducing the adverse effect on environment and hence it results on waste management of waste polypropylene thrown out once after its lifecycle.

2. LITERATURE REVIEW

Various studies have been undergone to find out various other alternatives for increasing the stabilization of Lithomargic soil. By using cement and randomly distributed waste shredded rubber tyre chips was used as stabilizers for soil by Shriram Maratha, Bhavani Shankar Rao and Anil Kumar (2015)[1]. Here rubber acts as reinforcing material and cement as binding materials thus by increases the properties of soil. Gyanen et al (2013)[2] worked on "soil stabilization using fine and coarse fly ash as blending material". The study was done for weak black cotton soil. The results concluded that industrial wastages can also be used for soil stabilization. Anil Sharma (2015)[3] made a study on "Stabilization of Lithomargic Soil Using Alkali Activated Fly-Ash with GGBS". The results were tabulated for various

proportions of fly ash with varying during periods of 1, 3, and 4 weeks. In order to determine the behavior over compressive strength. The result showed good performance for 14M of NaOH solution with GGBS and fly ash had given maximum compressive strength. H.N. Ramesh (2016)[3]did study on "Effect of Flyash on the Strength Characteristics of Lithomargic Soil Treated with Lime and Sodium Salts". Different proportions of flyash were used for the study and result showed good illustrative results for 35% addition of flyash by weight. And also found by addition of 1% lime to optimum UPCL flyash to soil mixture, showed optimum increase in strength characteristics.

3. MATERIALS USED

Lithomargic soil was collected for our study from the Haleyangadi region near to Mulki of Dakshina Kannada district. Waste polypropylene fibre or the straps were used as stabilizer for the study and it was been bought from the Bunder Market in Mangalore Karnataka.

Fig 1: Polypropylene strips.

4. METHODOLOGY

The study was conducted by conducting various tests as per Indian standards. Standard test equipment and procedure available for this test was used in the present work for standard (IS: 2720 (PART 7)-1980. Hand compaction method was used in this study, for the purpose of calculating OMC and MDD (Max dry density). Graph is plotted between water content and dry density, from the peak of the graph OMC and MDD values are taken from the respective graphs. Tests were conducted to find UCC. Standard test equipment and procedure available for UCS test was used in the present work (IS: 2720 (part 10)-1973). The samples are prepared by static compaction method at the required maximum dry density at optimum water content. The volume of the steel tube was calculated as equal to the volume of the sample. Knowing the volume and density required the weight of the sample for mixes, whose combination percentages were chosen are determined and the water content corresponding to optimum moisture content was added. This was transferred to the steel tubing device. It was then compressed by pushing pistons simultaneously from both the ends, which was resulted in a sample of 38 mm diameter and 76 mm height. These samples were extracted with the help of a sample extruder.

Table 1: Geotechnical Properties of Lithomargic soil.

Parameter	Result
Gravel (%)	25
Sand (%)	75
Silt and clay (%)	0
Coefficient of Uniformity (C_u)	6.11
Coefficient of Curvature (C_c)	1.16
Type of soil	Sandy soil (C_u>6 and C_c=1 to 3)
Grade	Well Graded (S shaped curve)
Specific gravity	2.58
OMC (%)	16
Dry density(g/cc)	1.64
CBR (%)	5.79
UCC (kg/cm^2)	0.2196
Liquid limit	49

Fig 2: UCC specimen after failure.

Tests were conducted on 1%, 2%, 3% and 4% of polypropylene strips infused soil samples and the observations were noted. The CBR test has been done for un-soaked soil condition and the values denoted in this paper is for 2.5mm penetration.

5. RESULTS AND DISCUSSIONS

Based on the results of the various tests, mainly for strength determination in terms of UCS and CBR performed, the following major outcomes may be observed.

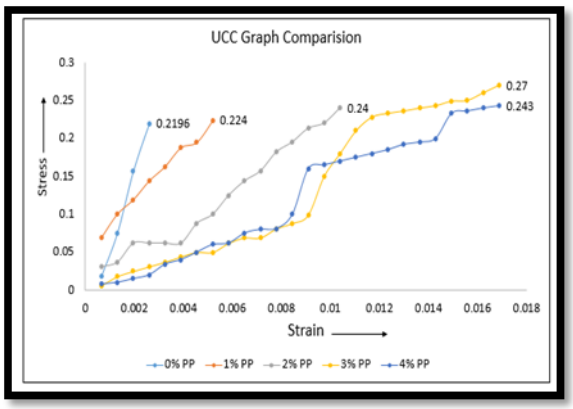

Fig 3: UCC comparison of different samples.

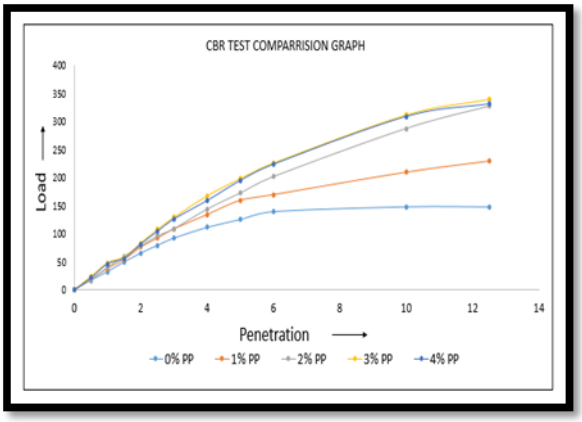

Fig 4: CBR comparison of different values.

It was noted that the UCC value of soil with 0% polypropylene strips was 0.2196 N.mm^2 and the UCC value for 4% PP strips was 0.243 N/mm^2. However, a maximum UCC value of 0.27 N/mm^2 was obtained with 3% PP strips. Also, the CBR value of soil with 0% polypropylene strips was 5.79% and the CBR value for 4% PP strips was 7.6%. However, a maximum CBR value of 7.85% was obtained with 3% PP strips.

All this shows that adopting Polypropylene strips would stabilize Lithomargic soil if used in right proportion. This can be used for stabilizing Lithomargic soil of embankments, pavement sub grade and other different fields as per the needs and flexibility.

5. CONCLUSIONS

From the above conducted experiment, it was found out that adding polypropylene strips to Lithomargic soil acted as a reinforcement and improved the shear strength of the soil and thereby increasing the bearing capacity of the soil. Polypropylene strips were added at concentrations of 1%, 2%, 3% and 4% and it was noted that the shear strength of the soil was improved at each percentage of addition. However, a maximum shear strength was observed at a percentage of 3%. At a concentration of 4%, the soil showed decreasing CBR results when compared to 3%. Hence, we can conclude by saying that addition of 3% Polypropylene strips to the soil is an optimum concentration and is an ideal amount. Also, the liquid limit of the soil was drastically reduced.

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