Stabilization Of Clayey Soil Using Synthetic Polymer And Biopolymer

Dr. T.Palani [1] ,B.Illakiya [2],B.Hanitha[3], R.Haritha[4], J.Meenakshi[5], Mr.K.Kaviarasan[6] M.E., Mr.R.Praveen Kumar[7]
[3, 4, 5] Dept of Civil Engineering
[1]Professor, Dept of Civil Engineering
[2 ,6]Assist. Professor, Dept of Civil Engineering
[1, 2, 3, 4, 5, 6, 7] T.J.S Engineering College,
Peruvoyal, Thiruvallur distric -601102.

Abstract- *In India, a major portion of total land area is covered by clayey soil. Of this, a large proportion is expansive soil. Structures constructed over this expansive soil may be severely damaged due to its high swell -shrinkage behavior. So such soils need to be stabilized to increase its strength, durability and to prevent erosion. Various studies have been carried out on expansive soils to improve its properties. Soil stabilization is one of the promising techniques used to improve the geotechnical properties of soil and has become the major practice in construction engineering. This project aims to conduct a study to check the improvements in properties of clayey soil by adding polypropylene fiber and xanthan gum. By varying percentage of reinforcement (0%, 0.5%, 1% and 1.5%), the soil parameters such as UCS and DRY DENSITY may be studied. These values are compared to that of a control specimen.*

Keywords- Swell, Liquid Limit, UCC, OMC, Polypropylene fiber,xanthan gum and clayey soil.

I. INTRODUCTION

Soil stabilization in a broad sense includes various methods used for modifying the properties of soil to enhance its engineering performance. By stabilization the major properties of soil, i.e., volume stability, strength, compressibility, permeability, durability and dust control is improved, which makes the soil suitable for use. There are different methods of stabilization, which include physical, chemical and polymer methods of stabilization. Physical methods involve physical processes to improve soil properties. The most effective chemical soil stabilization is one which results in non-water-soluble and hard soil matrix. Polymer methods of stabilization have a number of significant advantages over physical and chemical methods. These polymers are cheaper and are more effective and significantly less dangerous for the environment as compared to many chemical solutions. In the present study two difficult soils, expansive soil and dispersive soil are considered for effectiveness of synthetic polymer and biopolymer stabilization.

1.1 Needs And Advantages:

Soil properties vary a great deal and construction of structures depends a lot on the bearing capacity of the soil, hence, we need to stabilize the soil which makes it easier to predict the load bearing capacity of the soil and even improve the load bearing capacity. The soils may be well-graded which is desirable as it has less number of voids or uniformly graded which though sounds stable but has more voids. Thus, it is better to mix different types of soils together to improve the soil strength properties. It is very expensive to replace the inferior soil entirely and hence, soil stabilization is the thing to look for in these cases. Soil properties vary a great deal and construction of structures depends a lot on the bearing capacity of the soil, hence, we need to stabilize the soil which makes it easier to predict the load bearing capacity of the soil and even improve the load bearing capacity.

- Improves strength of soil
- Reduce anti-desertification of soil
- Cheap and reliable
- Improves water retaining capacity.

1.2 Materials Used

1.2.1 Soil:

Soil used for the study is clayey soil. It has been collected from T.J.S campus, Tamil Nadu. It is a soil of high plasticity. The high plasticity index indicates high swell potential, the most problematic soil type under light structures.

1.2.2 Reinforcement:

II. POLYPROPYLENE:

Polypropylene fibre is used in this study and it is a synthetic material. Fibers used for this study has a length of 12mm were purchased from the market. Polypropylene fibers are hydrophobic, non-corrosive and resistant to alkalis, chemicals and chlorides.

XANTHAN GUM:

Xanthan Gum powder is also used in this study and it is a biopolymer. Xanthan gum is known to perform better in terms of lowering permeability. The use of biopolymer can significantly reduce CO2 emission ,effective dust control, moisture retention capacity and anti-desertification.

2.1 Properties Of Clayey Soil

Table - 2: Properties of clayey soil

Sl NO.	PROPERTY	VALUE
1	USCS Classification	CI
2	Specific Gravity(G)	2.7
3	Liquid Limit(WL)	46.4%
4	Plastic Limit(WP)	44%
5	Water Content	28.5%
6	Maximum Dry Density	1.28gm/cc^2
7	Optimum Moisture Content	21.55%
8	Free Swell Index(F.S.I)	79%
9	Unconfined Compressive Strength(qu)	2.376kN/m^2

PREPARATION OF POLYPROPYLENE SAMPLE AND XANTHAN GUM SAMPLE

The soil sample should be oven dried at approximately 105°C and then ground. Content of fiber to be added in the soil is herein decided by equation 3. The different values adopted for the percentage of fiber reinforcement are 0%, 0.5%, 1% and 1.5% and 0.5%,1%, 2% is adopted for Xanthan Gum The adopted content of fibers was first mixed into the air-dried soil sample in small increments by hand, making sure that all the fibers were mixed thoroughly, so that a fairly homogenous mixture is obtained, and then the required water was added.

$$\rho f = \frac{V_f}{V}$$

Where,

ρf = ratio of fibre content,

Vf = weight of the fibre,
W= weight of the air-dried soil

2.2.2 Comparison of Compressive Strength with the addition of PP fiber and Xanthan Gum

Unconfined Compressive Strength test were carried out to find the variation in the strength characteristics of a soil stabilized with PP fiber.

The UCC test has been conducted on soil sample with the addition of 0%, 0.5%, 1% and 1.5% of fiber content.The chart-1 represent the variation of UCS on the addition of fiber and Xanthan Gum.

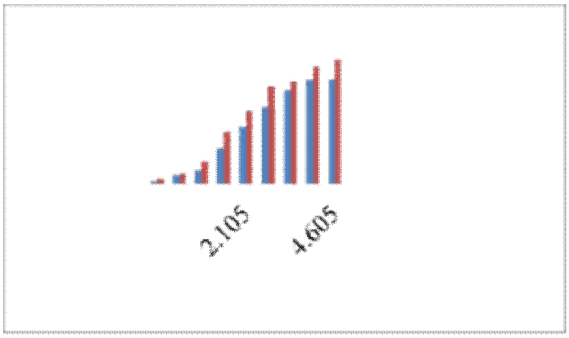

Chart - 2: Comparison of UCS values with fiber content and Xanthan Gum

2.2.3 Comparison of Dry Density with the addition of PP fiber and Xanthan Gum

The Standard Proctor Compaction test has been conducted on soil sample with the addition of 0%, 0.5%, 1% and 1.5% of fiber content. From the graph (chart -2)

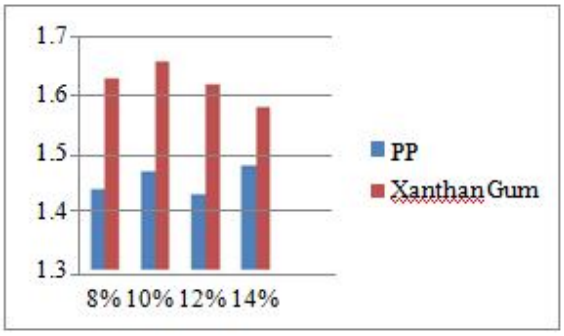

Chart-2

III. CONCLUSION

- From this investigation, it is clearly indicated that the free swell index value of the reinforced soil decreased drastically which means that the soil is not subjected to any volumetric changes with the addition of fiber.
- The maximum dry density of the soil increases with the addition of fiber content up to 1% of fiber and then decreases with the addition of 1.5% fiber. This is due to the fact that the dry unit weight of fiber is more than that of the soil.
- This strength of clay soil was improved due
- to the addition of polypropylene and xanthan and can be concluded that xanthan and can be used effectively for the stabilization of clayey soil.
- Due to increase in the fiber content and Xanthan Gum, the liquid limit of reinforced soil increases due to the replacement of soil grains by fiber.
- The Liquid Limit of Xanthan is higher than that of addition of polypropylene.
- The addition of 1% of Xanthan Gum is more effective than 1.5% Polypropylene

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