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Soil Stabilization Using Industrial Waste Materials: With Special Reference to Plastic Bags

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ABSTRACT- The Stabilization entails any change which kind of modifies or renders the soil or any other substance. The purpose of Stabilizing soil is to increase the strength of soil and also as improve resistance for softening through water bond and these soil particles systematized, also water proofing the particles or both combined together. The use of cement and lime was used for very long time in previous times and it was working well and had enormous advantages but now the use of cement is used less because of the cost of cement and contrary effects on the environment from its manufacture. Stabilizing is quite different from modification which implies only a minor change in properties of soil or rock The increasing harm of emitting of co2 through cement manufacturing also the growing cost of additives has lead to the rise of growth of other stabilization such as plastic materials, ash of wood or rice cover, glass fiber, etc.

KEYWORDS- Polyethylene (Plastic bag strips); Soil stabilization; reduction of waste; environment friendly solution.

I. INTRODUCTION

Soil stabilization process is the most used process over a very long time. The purpose of soil stabilizing and strengthening the soil ascended after it was observed that few weak sections in the soil which were obstructing the movement of human nature were to be upgraded by mixture of certain ingredients as stabilizing like limestone. Stabilization of soil for any physical, biological, chemical or a assimilation of any methods applied to ensure the enhancement of particular characteristics of a natural soil to enable it meet the intended engineering requirements. The process of using cement and lime to stabilize the soil began a long time ago and has been well validated, but in recent times the use of cement is less recognized because of the expense of cement and adverse effects on the environment during its production. It can be imagined from the concept that about one ton of carbon dioxide (CO_2) is emitted while the production of a ton of cement is going on. This alongside the increasing cost of additives has given rise to the development of other stabilization additives such as plastic, wood ash, glass fiber etc. The group at risk from the unscientific disposal of solid waste include the population in areas where there is no proper waste disposal method. Many studies have been carried out in various parts of the world to establish a connection between health and hazardous waste [1].

The objectives of the study are:

- To improve the soil properties like shear strength and bearing capacity. Also, To provide alternate remedy for plastic waste disposal
- To Decrease cost of soil stabilization by using cheaper material.
- To convert the waste materials and environmental hazardous material into the beneficial material.

II. LITERATURE REVIEW

Soil stabilization can be explained as the change in soil properties through different cures given to a soil which may be physical or chemical to increase as well as improve the engineering properties of the soil. Stabilization of soil is to increase the strength of soil and also as improve resistance for softening through water bond and these soil particles systematized or both of the two. Soil improvement is the alteration of any property of a soil to improve its engineering performance [2]. The various techniques available by technology are surface compaction , drainage methods and mostly the two methods are discussed are mechanical and chemical stabilization.

Stabilizing agents:

- Cement.
- Lime.
- Fly Ash.
- Plastic bags.

Previous Studies:

Gill et al. verified that likely possibilities of high-density polyethylene as a soil reinforcer by improving the properties of sub grade soil. The test results showed that use of HDPE in the soil lead to reinforce in soil which was beneficial in roads construction [3].

Nsaif.[4] through research to study the way in which soil is reinforced by plastic waste materials determined that by involvement of plastic waste pieces with both clayey and sandy soil at different mixing ratios [4].

Hansaraj Dikkar.[5] conducted research to improve the properties of soil by adding plastic shopping bags with different quantities. The percentages of plastic content used were with variable amount [5].

III. MATERIALS AND METHODOLOGY

The materials used were collected from nearby to the university. The soil sample used undergone basic tests and was prepared according to the standards set up by ASTM. The below figure 1 shows the material used for the study.

Figure 1: Expansive soil

A. Expansive Soil

The expansive soils are found extensively in tropical areas. The presence of expansive soils greatly affects the construction activities in many parts of south-western United states, South America, Canada, Africa, Australia, Europe, India , China, and the Middle East[6]. The problem of expansive soils is widespread throughout the world. There are various countries that are facing problems with expansive soils and India is one of them. When these soils are partially saturated, there is increase in volume with the addition of water. They shrink on drying and develop cracks on surface. These soils possess a high plasticity index. Expansive soils are residual soils which are the result of weathering of parent rock.

B. Plastic Waste Strips

For the procedure to be conducted plastic bags were collected from all students in the university. Average density of material was at 783kg/m^3, tensile strength ranging from 13 to 19 MPa, with a thickness of forty micron. The plastic bags were made into strips of width 10mm and length of 15mm and were added to the soil at different proportions as 0.20%, 0.30% and 0.40%. From the result it was concluded that 0.30% of plastic content is ideal percentage which can be used as stabilizing agent for sizes of 10mm x 40mm and 15mm x 40mm. The plastioc strips are shown in figure 2 below:

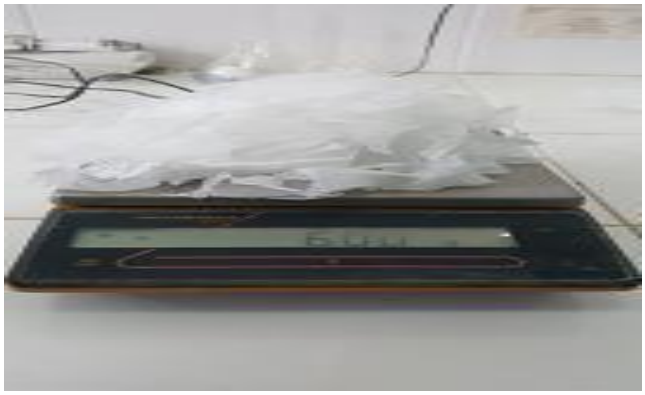

Figure 2: Plastic Strips

Direct shear tests, unconfined compression tests and CBR tests were conducted to investigate the strength characteristics of fiber-reinforced soil[7].

The experiment steps are discussed below:

The mixing of soil with plastic strips and it compacted form in mould can be seen in below Figure.3:

Figure 3: Plastic Strips with soil

C. Specific Gravity of Soil

The specific gravity is an important index property of soils that is closely linked with mineralogy or chemical composition and also reflects the history of weathering [8]. The test is performed to find specific gravity of soil. It is learned with the use of volumetric flask in the experiment process.

D. Liquid Limit

It is the water content at which the soil loses its strength and it behave as viscous material. The channel is made in the soil and then it is closed in 25 blows in liquid limit device which is shown in Figure For better results accuracy, test is carried out many times and also the number of blows are listed.

E. Plastic Limit

The plastic limit is conducted when the soil possess much water content and loses shape called as plastic limit of soil. This test is performed until the rolling out fine grained soil reaches 3mm by diameter, then water content is measured as it breaks down on reaching the diameter.

Other methodology includes:

- Standard Proctor Compaction Test
- Unconfined compression test
- California bearing ratio
- Volume shrinkage behavior of soil.

F. Unconfined Compression Test

This test is conducted to determine compressive strength and sensitivity of a cylindrical sample of cohesive soil. In this test for test sample specimens were compacted at the same water content above used and at plastic bag addition. Table.1 shows the UCS results with different percentages of plastic content.

Table 1: UCS Results with different percentages of plastic/percentage difference

Plastic Content	UCS(kpa)	Increase in UCS%	Cohesion
0 %	87	---------	43
0.2 %	153	75	76
0.3 %	192	120	97.4
0.4 %	215	144	107

The UCS results for failure due to stress at 0% and 0.4 % plastic content is shown in figure.4 and figure.5 respectively.

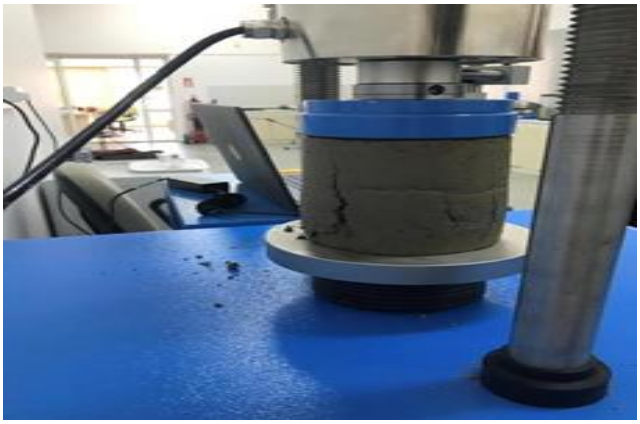

Figure 4: UCS result showing the failure under stress for 0% plastic content

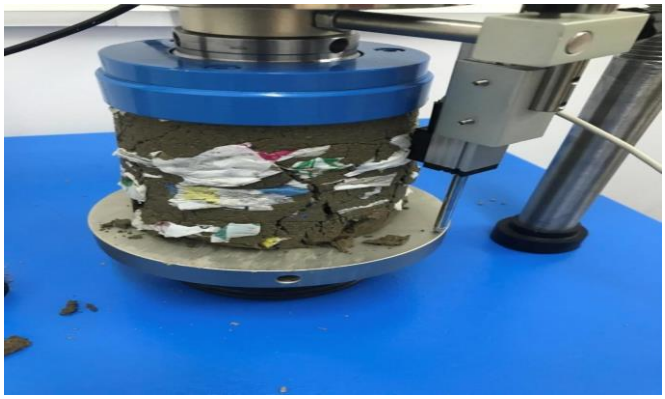

Figure 5: UCS result showing the failure under stress for 0.4% plastic content

IV. RESULTS AND DISCUSSION

In this chapter the analysis and discussion of the experimental laboratory work are discussed in order to achieve the general objectives of the thesis

- Atterberg analysis
- Compaction analysis
- Unconfined compression test (UCS)
- California bearing ratio test (CBR)
- Shrinkage test analysis

A. Atterberg Analysis

The comparison of liquid limit and plastic limit test involvement is the Atterberg analysis. These limits aim is to detect and measure the various major changes in fine grained soils based on water content. The results from liquid limit show in plasticity chart can confirm that soil has intermediate plasticity.

B. Compaction Analysis

Compaction is the process of densification of soil by reducing air voids. The degree of compaction of a given soil is measured in terms of dry density. The dry density is maximum at optimum water content. A curve is drawn between water content and dry density to obtain the maximum dry density and optimum water content. The major aims of this are to: increase shear strength and thus bearing capacity, increase stiffness and also reduce future settlement and reduce void ratio and permeability

C. California Bearing Ratio

The California Bearing Ratio (CBR) is expressed as the percentage of force per unit area required to Penetrate a soil mass with a circular plunger of 50 mm diameter at a rate of 1.25 mm per minute.

D. Unconfined Compression Test

This test is conducted to determine compressive strength and sensitivity of a cylindrical sample of cohesive soil. In this test for test sample specimens were compacted at the same water content above used and at plastic bag addition. The failure under stress for 0% plastic content and 0.4% plastic content are shown in below figure. 4 and figure.5 respectively.

E. Shrinkage Behavior of Soil Analysis:

This experiment is conducted to determine linear shrinkage of re-moulded soil. For this test mould is cleaned thoroughly and soil compacted at optimum water content and with different content of plastic bags staring with zero percentage. The volume is measured after putting into various of wet and dry cycles. For notice of crack and shrinkage behavior, we put 200 ml of water in each sample. The shrinkage samples at 0%, 0.2%, 0.3%, 0.4% plastic content is shown in figure. 6 below:
With 0% plastic and 0.2% plastic with 0.3% plastic and 0.4% plastic

Figure 6: Showing samples with (a)0%, (b)0.2%, (c)0.3%and (d)0.4%after drying/shrinkage.

V. CONCLUSION

The Plastic has become a threat to our environment as its production and usage has affected our lives very seriously. Plastic was supposed to be very important invention of

human technology as it helped and eased different problems. The recycling of plastic waste is a common problem because it is composed of more than one polymer. So, in order to reduce its effects, it is used in soil stabilization and also in construction of roads and pavements to improve the stability and durability. Also, this will lead to less environmental pollution. It was noted in the study that the CBR value goes increasing as the increase in plastic bag content. There waa major difference in properties in soil for 0% plastic bag content to 0.4%. The used of plastic is increasing no matter what the field or type of work it is and it has caused a big threat to our environment. It is important to find a suitable way to dump these plastic bags in a proper manner and also them in limit. Srinagar is also a place where plastic disposal has become a big issue and the people tend to dump it in clean areas or in that place which overall lead to environmental pollution. The use of these plastic in soil have increased the properties of soil, so if there is any cheapest method for its disposal, it is to be used in soil stabilization. Many studies have confirmed that adding the plastic to soil gives improvement in engineering properties of it. The process has started in many countries and India has also started to use in road construction and pavements.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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