"STABILAZATION OF SOIL USING PLASTIC WASTE GENERATED FROM PLASTIC BAGS AND BOTTELS"

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Abstract:- Extensive complexion clay soils are the types of soils in which the volume changes with respect to the change in their water content. They have a geste of swelling and shrinking that is a serious hazard to structures erected over them. Extensive soils are abundantly being soil types in Ethiopia, particularly Addis Ababa. This paper shows the issues of an attempt to supports and stabilize extensive completion clay soil with plastic bottle strips. The plastic strips were prepared and added at three different mixing ratios (0.5%, 1.0% and 2.0%) by weight and in three different aspect rates (5.0 mm × 7.5 mm, 10mm × 15mm, 15mm ×20mm). The experimental results showed that there was a significant enhancement in shear strength parameters. The lump and desiccation cracking geste of the soil were also expressively reduced. There was a substantial reduction in the optimum moisture content and slight prolification in the maximum dry density. Stabilizing extensive complexion clay soils with waste plastic bottles contemporaneously solves the challenges of indecorous plastic waste recycling that is presently a teething problem in at most developing countries. The results attained from this study positively suggest that addition of this material in extensive soils would be effective for ground improvement/enhancement in geotechnical engineering.

Keywords:- Extensive Soil, Clay Soil, Plastic Strips, Soil Stabilization.

1. INTRODUCTION

Extensive complexion soils are types of soils show a significant change in volume once they come in contact with humidity. They expand when exposed to redundant water and shrink in hot rainfall conditions where there is a scare quantum of water. geste of sweeling and shrinkage of extensive complexion soils in turn affect the stability of structures that is erected over these soils causing a serious hazard it majoraly affects the bearing capacity and strength of foundations by uplift as they swell and may beget from cracks to discriminational movements to structural faiures [1].In order to make on extensive soil they need to be stabilized to reduce their lump and ameliorate their mechanical capacities. Soil Stabilization is the process by which the engineering parcels of the soil are bettered and its made further permeability and connection eventuality and increase the shear capacity. [2]. The system is substantially espoused for trace and plain stable. It is used to drop the soils unqualified characteristics similar as construction.They can easily linked in the field in dry season as they show deep crack of polygonal .

In order to make soil stabilization goes way over to encouraging operation of weak sol and reducing the uneconomical process of weak soil relief . Occasionally ,soil stabilization is used for mega city and suburban to make them further noise absorbing . [3].Different styles have been developed preliminary to stabilizes we can infelicitous soil . Some os these styles includes mechanical stabilization , cement stabilization , lime stabilization ,bituminous stabilization, chemical stabilization, thermal stabilization, as well as grouting stabilization by geotextile and fabrics.[4].Using plasticks for this purpose contemporaneously solves the challenges of indecorous plastic waste recycling gthat is presently a teething problem this in turn causes serious damage to beast factory and mortal lives. Polythene Terephathalate (PET) bottles are conventionally plastic bottles they presently are large employee.

2. Materials and Methods

2.1. Materials

The materials include plastic bags and bottels that were cutted into small three different size strips, using blades and scissors . Expansive soil that was sieved in the sieving machines using different size sieves.

2.2. Methods

2.2.1. Material Characterization

The characterization of soil sample taken for the study included flyspeck size distribution, Atterberg limit and specific gravity of soil tests .The sample soil taken was settled in order to take The bottles and strips were cleaned properly after collection and bags and bottels were cut into three different sized and shapes strips, manually using scissors and blades) **(Figure 1)**. The strip sizes are shown in **Table 1**.

out any other contaminations and gratuitous patches. It was also prepare for testing according. Once sample medication was done, sieve analysis and hydrometer analysis work conducted to study the flyspeck size distribution of the soil the test was done as per (7) and (8) respectively. We performed plastic limit test, liquid limit test and liquidity index test to check the behaviour of soil.

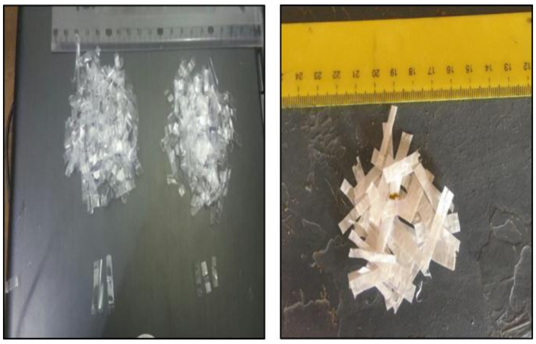

Figure 1. Strip preparation.

Table 1. Strip Sizes

Strip	Width (mm)	Length(mm)
1	5	7.5
2	10	15
3	15	20

By performing the Atterberg limit test. The test was carried out as per(9) using Casagrande outfit . Specific graveness of the soil on the other hand was determined from the specific gravity test in the laboratory . A specific gravity cup and vaccum pump by used to carry out the test as per (10). The specific gravity was taken as the rate of viscosity of the soil to the viscosity of water at same temperature.

2.2.2. Material Mixing Method and Proportions

The plastic strips, which are anticipated to act as soil mounts, were added to the soil in three different possibilities and percentages (0.5%, 1% and 2%) by mass of the soil. **Table 2** shows the treatment levels used for each of these strip while carrying out the study. Percentage by mass represents the rate of mass of plastic to mass of these soil sample taken as a percentage.

2.2.3. Methods of Testing Soil Properties

Free swell test, standard proctor compaction test, direct shear test, Unconfined Compressive Strength (UCS) test and California Bearing Ratio (CBR) test were carried out in order to study these changes of these particular plastic bottle and bags strips on the extensive clay soil. The various methods to determine specific standards used to perform these testes are listed in **Table 3.**

Table 2. Treatment Level

Strip Size (mm)	Treatment Level (%)
5*7.5	0.5
	1
	2
10*15	0.5
	1
	2
15*20	0.5
	1
	2

Table3. Test methods.

Test performed	Standard Used
Free Swell Test	[11]
Standard Proctor Compaction Test	[12]
Direct Shear Test	[13]
Unified Compressive Strength Test	[14]
California Bearing Ratio Test	[15]

The swelling and lumping of the soil sample was studied by conducting with the help of free swell test. In this test, a 10 g of oven-dried soil sample passing through a number of 40 sieve (425 μm) was put into a graduated free-swell jar which has capacity of 100 ml, and filled with water. The sample was kept undisturbed until it reached its maximum swelling level. Then the recorded value was calculated with respect to the original 10 ml volume and expressed in percentage. **Figure 2** shows free swell jars for settling. The MDD and OMC were determined by performing standard proctor compaction test. In this test, the soil was compact using a test mould and a rammer at different water contents until the wet density started decreasing **(Figure 3).**

Figure 2. Free swelling jars for settling.

Figure 3. Standard proctor compaction test mold and sample.

The response of consolidated and the drained soil samples for the direct shear test , and the results in shear strength of the soil were found by performing direct shear test . The test was conducted by screwing a instant at a controlled strength ratio on a single shear plane which is determine by configuration of the outfit. Generally, three samples were tested, each under a different normal cargo load, to demonstrate its effect of surcharge and structural load upon shear resistance and displacement both relegation. The shear results at the three normal loads are plotted on single graph and linearly fitted to obtain result the average shear strength (C) of the soil, whereas the angle of internal friction (φ) is calculated from the pitch (slope) of the line that is used to fit the shear strength values. **Figure 4** demonstrate the procedures of a direct shear test. Cohesive soils can be estimated grounded based on their shear resistance when confinement to compressive load with no confinement. The unconfined compressive strength (UCS) test was used to determine the shear capacity of the sample soil under contraction . The sample was extracted and cut into the standard cylindrical shape. The UCS machine was used to compress these and both the applied load and change in its length of the sample were recorded. The values were observed and computed to get the sample representative value. **Figure 5** shows the Unified Compressive Strength test machine and sample.

Figure 4. Direct shear test apparatus.

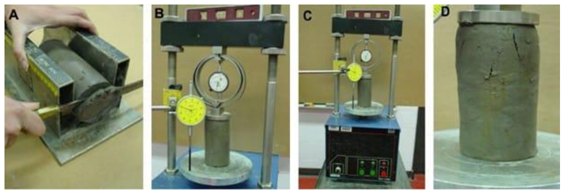

Figure 5. UCS test.

California Bearing Ratio test was performed to find the penetration strength of a compacted soil relative to crushed rock type , which is assumed to be an excellent base-course material. The results of a CBR test help to understand the parameters like shear strength and bearing capacity of a soil . The test follows a Indian Standard light weight compaction procedure combined with a doubled penetration that is applied by a machine that applies a plunger load. This test was used to simulate the effect of surcharge and excessive moisture on the compacted soil by putting a standard load that represents surcharge and soaking the mould for four days.

3. Results and Discussions

3.1. Characterization of Soil

The soil specific gravity which is the ratio of the mass of the soil vs equal volume of water weight. The test conducted is used to find out specific gravity in the extensive clay soil sample based on ASTM D8954.

3.2. Testing Reinforced Soil

3.2.1. Standard Proctor Compaction Test Results

The dry density of the soil mass changes with the water content for various types of soil and compactive efforts . with the increase in water content , moisture films are formed around the soil particles which increase in soil mass workability . As the soil particles are replaced by the water the unit weight of water the density begins to decrease . The mass of the compacted soil and the volume of mould gives the bulk density , and using water content we can find the dry density

.Compaction can be applied to improve the properties of an existing soil or in the process of placing the films .

The compaction was applied with different percentage of plastic content by the weight of the soil this was supported out with the same percentage of water content[5%,10%,15%,20%] **Figure 6.** The comparison of MDD and OMC is plotted at different water content and dry densities value. **Figure 7., Table 5.**

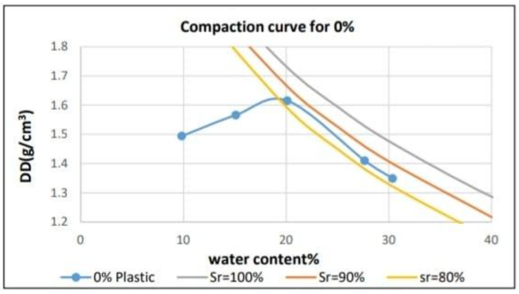

Figure 6. Compaction curve for plastic content.

Table 4. Compaction results for WC% and DD with plastic content.

W(%)	9.6	13.13	18.07	25.55	28.13
rd(g/cm3)	1.4126	1.529	1.624	1.470	1.411

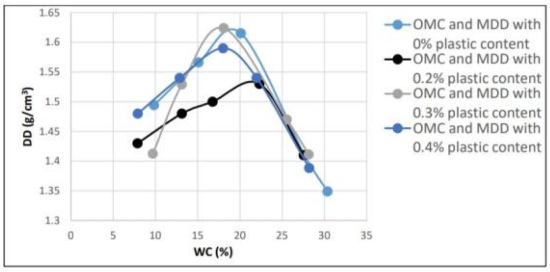

Figure 7. Comparison of DD with WC%

Table 5. The comparison of MDD and OMC.

Plastic %	OMC%	MDD (gm/cm3)
0%	15	1.56
0.2%	16.77	1.5
0.3%	18.07	1.62
0.4	16.77	1.5

3.2.2. Free Swelling Test Results

The main challenge of extensive soil is its volume variation in its different moisture conditions. As the water content increases, the soil begins to swell and its volume increases in a wide range from the actual volume. This property happens at a particle level, when the plastics strips was proposed to act as a physical agent and was anticipated to drop the swelling evenly of the soil. For the visual experiment during trails and the conclusion for free swelling test for the soil containing different chance of plastics strips . the reduction in swelling is a sole effect of the physical commerce between the soil and the strip. The free swell is observed to be 160 which accordingly to ASTM is classified as vertically largely extensive soil size of 5x7.5mm strip contain interpretation of swelling test results for each plastics strips **Table 6.**This test uses sample of 10gm in a standard graduated free swell jar the reason for the drop swell is eventually because of chemical reaction . The quantum of soil mass drop which is equal to the weight of plastic added as the drop mass of soil was replaced by swelling material the lump show some enhancement this soil plastic mixture might also have and effect in reduction in free swelling .

Table 6. Free swelling test results

Strip size (mm)	Treatment Level (%)	Swelling (%)
none	0%	150
5*7.5	0.5 1 2	133.4 124.2 110.5
10*15	0.5 1 2	129.3 118.7 110.5
15*20	0.5 1 2	130.4 125.9 111.5

3.2.3. Direct Shear Test Results

The strength parameters like cohesion and angle of friction can be obtained using this method. Other arrangement will ameliorate the shear capacity of the soil , it is delicated to the arrangement of the larger size strips in on the direct shear machine as the face area was closed to shear box . The shear capacity from the test is presented in terms of strength parameters cohesion and angle of internal friction . Both the enhancement change in shear capacity were recorded from cohesion and angle of internal friction the small value of frictional angle is assigned to the cohesiveness of the soil . The largest value of cohesion and angle of friction. For the collaborated soil was attained independently. This results were given for the strip size . **Table 7** gives the c and Q results attained for each treatment position and its size adding the plastic content for the same plastic strips size is increased both the cohesion and frictional angle.

Table 7. Direct Shear Test Results

Strip size (mm)	Plastic content (%)	Cohesion (kN/m2)	Angle of internal friction
5*10	0	32.4	47.27
	0.2	34.7	48.10
	0.3	35.4	48.25
	0.4	38.2	48.48
10*15	0	35.1	27.82
	0.2	47.3	29.02
	0.3	50.4	29.95
	0.4	53.7	32.00

3.2.4. Unconfined Compressive Strength (UCS)

The Unconfined compressive Strength is done to find compressive strength ,for this purpose four samples were compacted and their MDD and OWC with 0,0.2,0.3 and 0.4 percent of plastic bag addition .The height and diameter of the sampler were 120.7 and 102mm respectively. The sample were then placed in UCS testing machine and readings were obtain until cracks were observed in the sample **Table 8**.

After getting the results it is noticed that the strength of soil is increased as plastic bag percentage is increased. Therefore at 0.4% addition of plastic bags unconfined compressive strength was reached. We loses our maximum dry density at 0.4%. So UCS at 0.3% can be accepted as the optimum amount of stabilizer addition. So on the basis of it can be concluded that the plastic bags and bottels increases the cohesion of clay soil sample.

Table 8. UCS Results with different percentages of plastic.

Plastic content(%)	UCS (kpa)	Increase in UCS%	cohesion
0%	88	-----	44
0.2%	154	75%	77
0.3%	195	121%	98
0.4%	216	145%	109

3.2.5. California Bearing Ratio (CBR) Test Results

The CBR is the most utilized parameter for giving dimensions to the flexible pavement the analysis was carried with the help of same content of plastic(0, 0.2, 0.3 and 0.4%). The sample were compacted and their test was conducted till 12.9mm penetration **Table 9**.shows the penetration of plastic vs the CBR load value.

Table 9. WC(%) with corresponding plastic content.

Plastic	0%	0.2%	0.3%	0.4%
WC(%)	20.11%	22.31%	18.80%	18.1%

As it can be seen from **Table 10.** the increase in resistance to penetration is increased as percentage of plastic is increased which also cause increase in CBR ratio . at 0.4% the soil sample required more load which is 2.415KN to penetrate the soil specimen . The CBR value is achieved more at 0.4% plastic content but we are losing maximum dry density . hence the recommended is soil sample with 0.3% plastic content because it has better soil packing capacity with good CBR value . The CBR value for clay should be from (3-10 %) .

Table 10. Plastic content with CBR value and load penetration.

Plastic content (%)	CBR %	LOAD (N)
0	7.05	1594
0.2%	7.76	1695
0.3%	8.2	1795
0.4%	9.0	2415

4. Conclusions:-

The following conclusions are drawn grounded on the analysis and calculations of the results obtained. Any further a significant and borderline reduction was recorded in the optimum moisture content (OMC) and in the maximum dry density (ODD) results respectively. The angle of internal friction and the cohesion increased gradually as the reinforcement percentages and sizes increased. The swelling and the lumps of the soil was reduced significantly at high posibilities of strip content because of replacement in an equal mass of extensive soil by non-extensive plastic. Physical anchor has also some effect in reduction of the free swell. The swelling reduction similar for different sizes at the same percentage which shows that the dominant factor or constant that contributes to reduction in swelling is percent by weight of plastic content. The limited amount of plastic content and plastic size which results in optimum result can be selected based on the importance of the selection criterion for a specified engineering work.

In many erection works , stabilizing extensive clay with waste plastic bottles and bags strips is a good alternative as it enhance the volume variation problems of the soil. The strips were acting as reinforcements playing a role of capturing volume changes with change in water content. Incorporating waste plastic bottles in the construction industry also is a better way to solve the issue of insufficient plastic waste disposal which is a major problem.

The study advantageous suggest the possibility of utilizing these plastic material as tensile inclusions in extensive soil to increase the resistance to shear, CBR value and reduction in swelling. Many nations are now focussing on the use of these plastic waste. According to this paper observed that using the waste in soil stabilization provides better engineering properties to the soil. Indian has started using it in construction and building of road and pavement.

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