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Soil Stabilization Using Raw Plastic Bottle

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Abstract. This is about a statement that the physical properties of soil easily improved by the process of soil stabilization like bearing capacity and increasing shear strength that controlled by certain things like addition of suitable admixtures or compaction like lime, cement, and fly ash, phosphogypsum waste materials etc. The following years there is an drastic hike in the cost of additives to open door broad development particularly which deals with soil additives like bamboo, plastics so and so. It is easy to challenge the society using this soil stabilization technique that can reduce the waste quantity, useful materials can be produced from non-useful waste materials leads to use the plastic products like bottles and polythene bags. This creates lot of environmental concerns that automatically increases day by day. The plastic waste's disposal becomes a challenge and it should not cause any ecological hazards. The main economical utilization is to use the plastic bottles as a soil stabilizer that mat have a quality soil for embankments. This paper is about a short study on the use of waste plastic bottles for soil stabilization. It is analysed as per by the process of conducting engineering property and index property.

INTRODUCTION

Soil stabilization used as a technique to aim on an increased or maintained stability with in the soil mass and it relates to the chemical alteration of soil, which enhance its engineering properties. This prove to improve the stability and it bear with the power in a particular soil this also control all the compaction, proportion and addition of perfect mixtures or stabilizers. All over the world the soil stabilization techniques are used. Two kinds of methods are used for this process the Mechanical stabilization and Chemical or additive stabilization. Mechanical soil stabilization represents about the stabilization that not add to other chemical or admixtures which involves in the process of add on or remove on in a soil component. Very soon, it involved itself in a compaction process with the help of mechanical method it used in a electrical machines. This stabilization method are the index property of soil that comes under particle size with over all spreader as a curve in a uniform level it grades and gap grades with the soil that are poor bases to compact.

Chemical stabilization represents as a process of stabilization that happens by adding on some additives and chemicals. Compare on this there is variety of stabilization applications are there.

1. Soil lime
2. Soil bitumen
3. Soil cement
4. Bitumen
5. Fly ash, etc.

Two important structured plastic wastage presents in the mountain places, bottles and foil-type plastics there are called as grocery and large fibre bags. Bottles that not have residues is used directly as insulation the reason is that

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they have air that provides insulation. The abbreviated form of (PET) is from the transparent Polyethylene Terephthalate are come common with an increase and used in the process of mineral water, soda water and soft drinks. In few of the places the Khumbu means the imported empty bottles and clean spring water. The containers are mostly clear transparent, glossy, as well as some are green coloured one. In the peak of the mountain places when we bring these bottles are now a days prohibited for the reason it is pollutant aspects and it is not necessary to collect the system prohibition.

Necessity of work

i. The problematic soil's performance is increased.
ii. To provide a limited financial resource to complete the network road system.
iii. Utilize effectively to avail the soils and stabilizing agents.
iv. The use of industrial wastages encourages to build the construction of roads in low cost.

Objective of Research

It denotes by optimizing the stabilizer's proportion; It helps to learn the Engineering properties and Index properties effect in stabilizers along with the mixture of clay soil in an appropriate manner

Scope of Research

In the natural state lot of the soil are against shear load because of this the bearing capacity becomes low which shear the capacity.

i. The shear strength increases.
ii. The stabilization of slope improves.
iii. The settlement of structure reduces.
iv. The density of soil increases.

LITERATURE REVIEW

Gourav Dhane have explained these all are problematic soil that expands after the absorption of water and by removing the moisture it automatically shrinks. It decreases the specific gravity of soil at the same this happens with the increases in the percentage of fly ash. There is a decrease from 2.62-2.22 when the percentage of fly ash increases to the level from 10%-50%. The value of CBR increases along with both the high and low rate as 25-30% of fly ash. By adding the Swell percentage and swell pressure to fly ash this reduces the plastic characteristics of black cotton soil.

Karthick. S in the year 2014 found a stabilization process in the local red soil near the Tirupur district. There is few reasons for the stabilization that are the engineering properties of soil improves, like Strength- which increase the strength and bearing capacity, secondly the stability, volume that controls the swell- shrink which cause due to moisturizers, thirdly the durability in which the resistance increases to erosion, weathering or traffic loading. With regarding to the CBR values the pavement thickness are estimated also it compared with the economic impact of soil stabilization that used to fly ash. The laboratory tests are taken on the normal soil and stabilized soil like Grain size analysis, Specific gravity test, Atterberg's limits, UCC test, CBR test, direct shear test.

In Karnataka from Gadag district, the natural black cotton soils are taken. They used fly ash of class "F" stabilizing the block cotton soil in proportion varied from 5% to 30% increment. They find the index properties of both clay and fly ash. They conducted the standard proctor compaction test for stabilizing soil. From the test, it's found that dry density decreases with coarse, fly increases in ash mixture. The optimum percentage to be added to fly ash for stabilizing black cotton soil is found 20%.

The conducted a series of laboratory study of expansive clayey soil with thrfly ash material. The Atterberg's limit tests, UCC, standard proctor fitted test took into an action on expansive clayey soil. By adding the fly ash to

the Optimum Moisture Content & Maximum Dry Density, it increases with an expansive clayey soil. Class "C" fly ash was used. The not confined stressed strength of the given soil sample has increased with 15% of the natural sample. The optimum content of the fly ash content has found that 10% in addition of the natural soil sample.

The utilization of fly ash is lesser than its generation that act as subsequent in the place of adhesive free materials, which helps to construct the geotechnical and infrastructures. When the results found in the forthcoming years on fly ash in soil stabilization, it is easy to find out a big reduction in material costs. Fly ash is a best material that used in the application of geotechnical. As the unit weight is low, the fly ashes easily accept a fit part in the in soft soils. When the fly ash is added that alter the physical and compaction characteristics in granular and cohesive soils. By regarding the cation exchange process, the fly ash influences with expansive soils that cause some of the lowness of plasticity index, activity and swell potential. The result of the pozzolanic reaction forms a cemented combination that regards to the shear strength and low volume change. There should be a combination with the soil and fly ash improves the liquid and plastic limit. The strength of the Fly ash increases and shrinkage strains of expansive soils decreases. The conclusion of the fly ash treatment process is used to stabilize expansive soil.

MATERIALS AND METHODS

Methodology

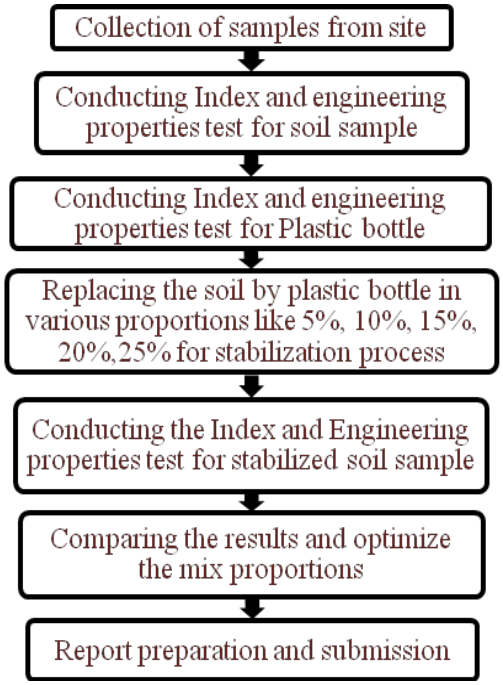

FIGURE 1. Methodology

Materials

Clay is a soil material or a powdered natural rock which combines have lots of clay minerals to trace the metal oxides and organic matter. Clays becomes plastic by the water content in it soon it becomes hard, brittle and non-plastic when we dry the clay. Clay forms in different colours, from white to dull gray or brown to a deep orange-red.Clay soils have been collected from sithalapakkam. During the travel found climatic factors like temperature, humidity, rainfall, these all needed one that goes beyond the clay soil formation and development. All are noticed to

have direct and indirect influence on the clay soil formation, development and its characteristics. The raw plastic bottle has been collected from Padi. The "Class b" Raw plastic bottle has been used for stabilizing agent

Methods

The following laboratory tests were conducted. The research was carried out on the normal and stabilized soil. The stabilization material used is raw plastic bottle is added to the soil in various proportions such as 5% to 25% with 5% increment. The soil properties are classified into two types,

i. Index properties
ii. Engineering properties

RESULTS AND DISCUSSIONS

General

The observation and the results which are obtained from series of laboratory test for clayey soil and stabilized soil with raw plastic bottle in various proportions are described below. And the optimum percentage of raw plastic bottle combined with clayey soil in the level order to enhance the behavior of clayey soil is derived by conducted laboratory tests which provided essential and sufficient information about geotechnical and physical properties of clay soil.

Laboratory test results

Laboratory tests were conducted on the virgin sample, raw plastic bottle and combination of virgin sample with raw plastic bottle in different proportions such as 5% to 25% with 5% increment. The tests conducted on samples are Shrinkage limit, Liquid limit, Specific gravity, Standard proctor compaction test, Plastic limit, unconfined compressive strength. The results obtained on these tests are discussed in detail manner below.

Test on virgin soil sample

The soil sample collected from Sithalapakkam. The sample thus collected was labelled that stored in laboratory. Then, the sample was air dried at room temperature and pulverised. The pulverised sample was used for conducting laboratory tests like Specific gravity, Liquid limit, Plastic limit, Standard proctor compaction test, unconfined compressive strength.

Specific gravity

The specific gravity test was conducted on clay soil using a density bottle. The laboratory test values which obtained are tabulated in Table 1. Using these value, substitute in specific gravity formula and obtained result.

TABLE 1. Specific Gravity of Virgin Sample

Trial	Bottle No	M1(g)	M2(g)	M3(g)	M4(g)	Specific Gravity, (G)
1	8	35.97	46.11	143.75	137.67	2.65
2	14	49.20	59.32	161.37	155.22	2.68

The specific gravity of clay soil sample is found to be 2.67

i. Liquid Limit

The liquid limit test helded on clay soil using Casagrande apparatus.

Liquid limit is known as water content corresponding to 25 blows, from the graph the liquid limit is found to be 39%

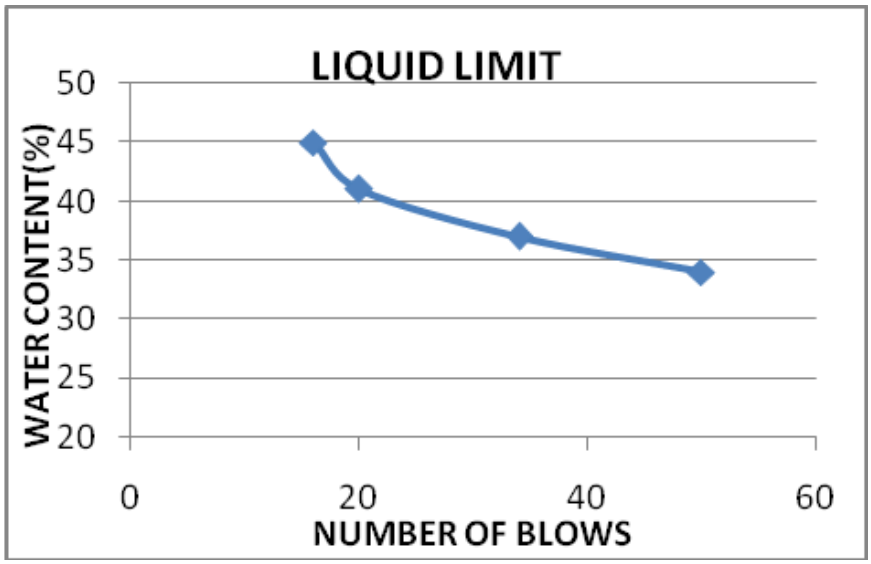

FIGURE 2. Flow Curve for Liquid limit

ii. Plastic limit

The plastic limit test was held on clay soil using. The laboratory test results for liquid limit are shown in Table.2

TABLE 2. Plastic limit of Virgin Sample

Trial	Weight of wet soil (g)	Weight of Dry soil (g)	Empty can weight (g)	Weight of water (g)	Weight of dry soil (g)	Water content (%)
1	87	85	75	2	10	20
2	94	91	75	3	16	18.75
3	58	57	45	1.5	12	16.8

From the test results, the plastic limit of clayey sample is found to be 16 %

Plasticity Index

Plasticity index = Liquid limit – Plastic limit = 39% - 16%

Plasticity index = 23%

iii. Standard Proctor Compaction test

The standard proctor compaction test was held in the clayey soil sample and test results are tabulated in Table 3 .For the test we have to take a soil sample of 3 kg and have to do the test by standard test procedure. From, the test we can able to get maximum, optimum moisture and dry density content by plotting the graph between moisture and dry density its shown in Figure. 2. Sample: clay Sample weight=3 kg Volume of mould= 988 m3

TABLE 3. Compaction Characteristics of Virgin Sample

Trial	Soil weight (g)	Moisture content (%)	Bulk density (kg/m3)	Dry density (kg/m3)
1	1930	12.43	1.953	1.737
2	2019	14.02	2.043	1.792
3	2035	15.90	2.059	1.770
4	1968	17.61	1.990	1.690

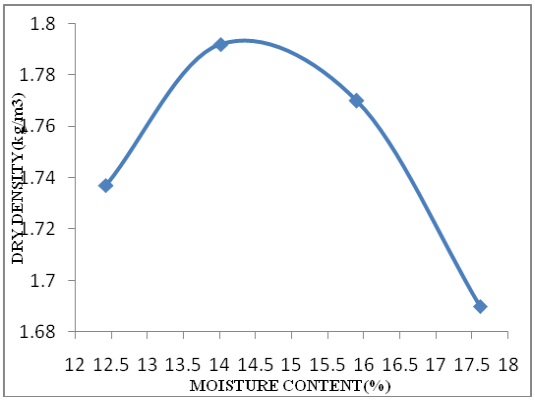

FIGURE 3. Compaction curve of Virgin Soil Sample

From the test results, the compaction characteristic of clayey sample is found to be optimum moisture content (OMC) is14.5% and maximum dry density (MDD) is 1.77 kg/m³.

Specific gravity of plastic

The specific gravity test was conducted on plastic using density bottle. The laboratory test values which obtained are tabulated in Table 4. Using these values, substitute in specific gravity formula and obtained results.

TABLE 4. Specific Gravity of raw plastic

Trial	Bottle No	M1(g)	M2(g)	M3(g)	M4(g)	Specific Gravity, (G)
1	8	35.98	45.99	123.02	117.21	2.38

The specific gravity of plastic is found to be **2.385**

Test in combination of virgin sample with plastic

The clayey soil sample are stabilized using plastic in variation proportions such as 5%,10%,15%,20% and 25%. On stabilized soil various tests were conducted and results are shown below.

i. Standard Proctor Compaction Test on Stabilized soil

The standard proctor compaction test was conducted on a clayey soil sample with plastic in various proportions such as 5%, 10%, 15%, 20% and 25% and test results are tabulated in Table 5 to 9. For the test we have to take a soil sample of 3 kg and have to do the test by standard test procedure. From, the test we can able to get maximum dry density and optimum moisture content by plotting the graph between moisture content and dry density its shown in Figure 4 to 8.

TABLE 5. Compaction Characteristics of soil + 5% plastic

Trial	Soil weight (g)	Moisture content (%)	Bulk density (kg/m3)	Dry density (kg/m3)
1	1932	13.00	1.960	1.730
2	2032	13.31	2.060	1.820
3	2049	15.65	2.070	1.790
4	1944	17.29	1.970	1.680

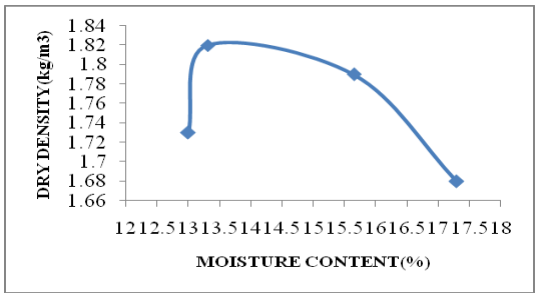

FIGURE 4. Compaction curve of soil + 5% plastic

From the test results, the compaction characteristics of plastic is found to be optimum moisture content (OMC) is13.8% and maximum dry density (MDD) is 1.76 kg/m³. Sample: Clay90%+plastic10% Sample weight= 3 kg Volume of mould=988m3

TABLE 6. Compaction Characteristics of soil + 10% plastic

Trial	Soil weight (g)	Moisture content (%)	Bulk density (kg/m3)	Dry density (kg/m3)
1	1890	13.19	1.910	1.680
2	1930	14.91	1.950	1.696
3	1978	15.74	2.000	1.730
4	1992	17.51	2.020	1.720
5	1963	19.02	1.980	1.660

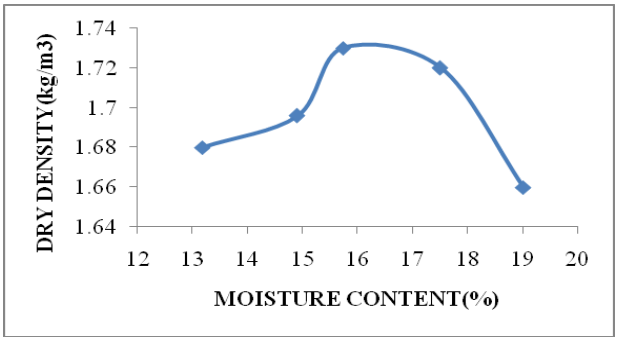

FIGURE 5. Compaction curve of soil + 10% plastic

From the test results, the compaction characteristics of plastic is found to be optimum moisture content (OMC) is 16.3% and maximum dry density (MDD) is 1.73 kg/m³.Sample: clay85%+plastic15% Sample weight= 3 kg. Volume of mould=988m3.

TABLE 7 Compaction Characteristics of soil + 15% plastic

Trial	Soil weight (g)	Moisture content (%)	Bulk density (kg/m3)	Dry density (kg/m3)
1	1850	9.90	1.870	1.710
2	1967	13.80	1.990	1.747
3	1974	14.66	1.997	1.742
4	1984	16.90	2.008	1.720
5	1946	18.60	1.969	1.660

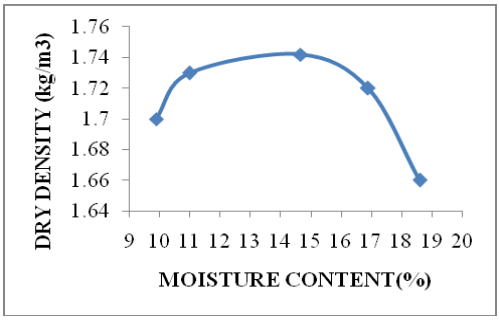

FIGURE 6. Compaction curve of soil + 15% plastic

From the test results, the compaction characteristics of plastic is found to be optimum moisture content (OMC) is 14.8% and maximum dry density (MDD) is 1.74 kg/m³.Sample: clay80%+plastic 20% Sample weight= 3 kg. Volume of mould=988m3.

TABLE 8. Compaction Characteristics of soil + 20% plastic

Trial	Soil weight (g)	Moisture content (%)	Bulk density (kg/m3)	Dry density (kg/m3)
1	1843	9.85	1.865	1.690
2	1919	11.00	1.940	1.750
3	2012	14.01	2.040	1.810
4	1984	16.50	2.000	1.742

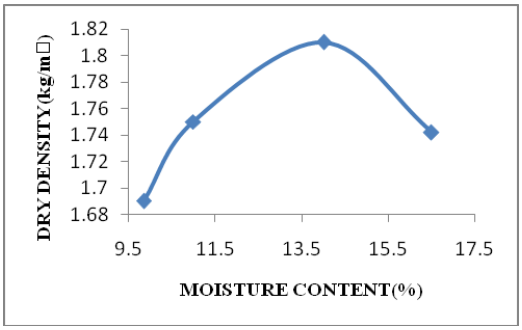

FIGURE 7. Compaction curve of soil + 20% plastic

From the test results, the compaction characteristics of plastic is found to be optimum moisture content (OMC) is 14.2% and maximum dry density (MDD) is 1.81 kg/m³.Sample: clay75%+plastic 25% Sample weight= 3 kg Volume of mould=988m3.

TABLE 9. Compaction Characteristics of soil + 25% plastic

Trial	Soil weight (g)	Moisture content (%)	Bulk density (kg/m3)	Dry density (kg/m3)
1	1837	10.89	1.850	1.660
2	1930	11.60	1.950	1.750
3	1981	13.40	2.000	1.760
4	1948	14.52	1.970	1.720

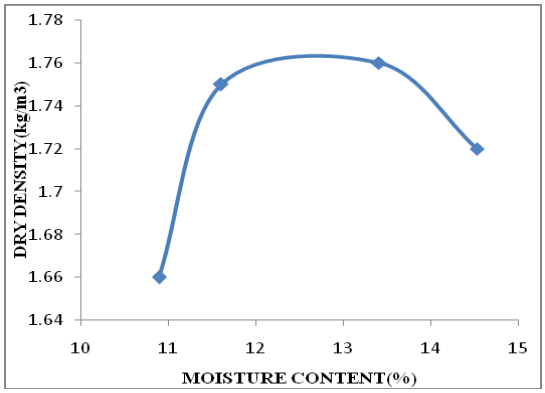

FIGURE 8. Compaction curve of soil + 25% plastic

From the test results, the compaction characteristic of plastic is found to be optimum moisture content (OMC) is 12.5% and maximum dry density (MDD) is 1.8765 kg/m³. The results of strength characteristics were tabulated for virgin soil sample and soil sample stabilized with plastic for various proportions such as 5%, 10%, 15%, 20% and 25%.

TABLE 10. Strength Properties of Soil-Plastic Mixtures

Trial	Proportions	Optimum moisture content (%)	Maximum dry density (kg/m³)
1	Soil	14.5	1.79
2	Soil+5% plastic	13.8	1.76
3	Soil+10% plastic	16.3	1.73
4	Soil+15% plastic	14.8	1.74
5	Soil+20% plastic	14.2	1.81
6	Soil+25% plastic	12.5	1.765

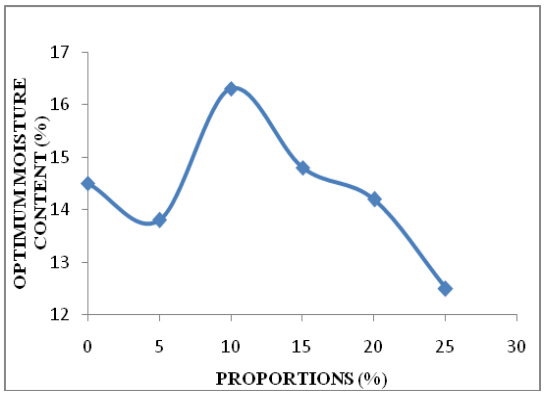

FIGURE 9. Variation in Optimum Moisture Content for Different Proportions

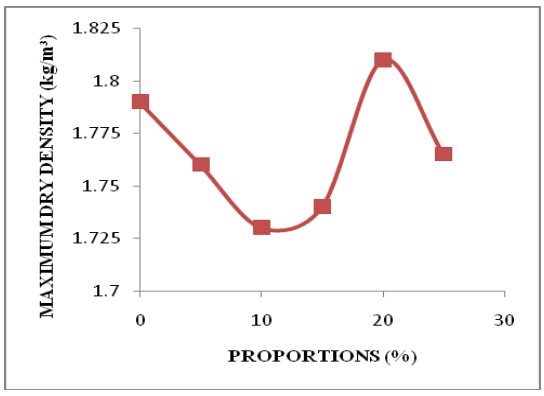

FIGURE 10. Variation in Maximum Dry Density for Different Proportions

Unconfined compression test on Virgin sample with plastic

The Unconfined Compressive Strength tests were held on clayey soil sample with raw plastic in various proportions such as 5%, 10%, 15%, 20% and 25%. From, the test we can able to get cohesion by plotting the graph between strain and stress shown in above figure

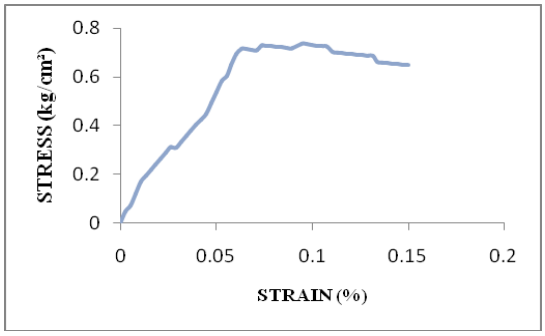

FIGURE 11. Unconfined compressive strength of soil + raw plastic 5%

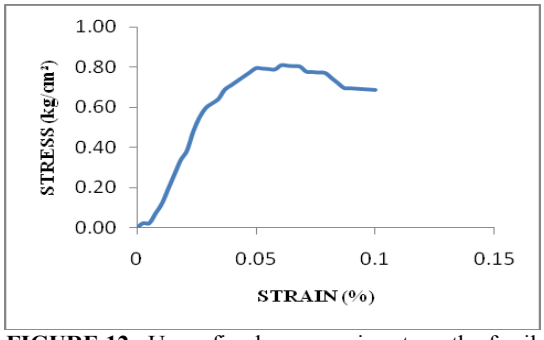

FIGURE 12. Unconfined compressive strength of soil + raw plastic 10%

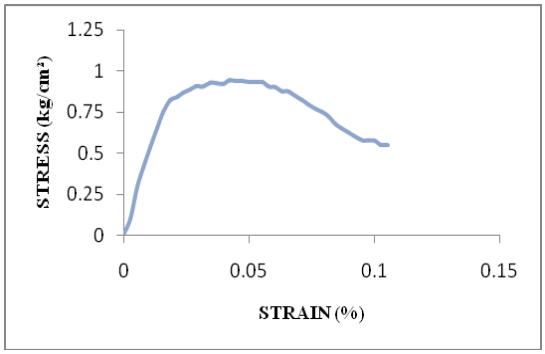

FIGURE 13. Unconfined compressive strength of soil + raw plastic 15%

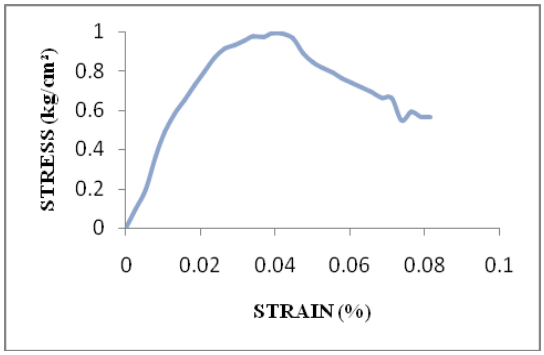

FIGURE 14. Unconfined compressive strength of soil + raw plastic 20%

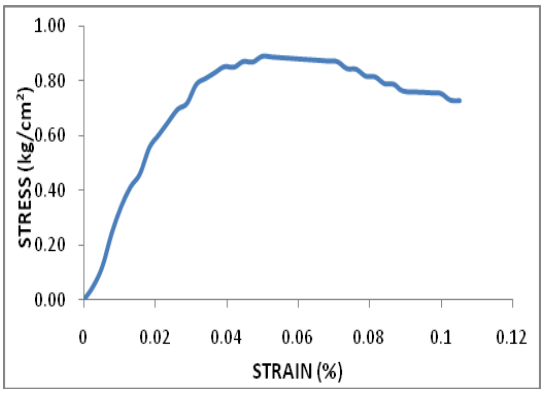

FIGURE 15. Unconfined compressive strength of soil + raw plastic 25%

The results of strength characteristics were tabulated for virgin soil sample and soil sample stabilized with raw plastic for various proportions such as 5%, 10%, 15%, 20% and 25%.

TABLE 11. Strength Properties of Soil-Plastic Mixtures

Trial	Proportions	Cohesion,C (kN/m2)
1	Soil	28.4
2	Soil+5% plastic	36.3
3	Soil+10% plastic	39.7
4	Soil+15% plastic	46.1
5	Soil+20% plastic	48.5
6	Soil+25% plastic	43.1

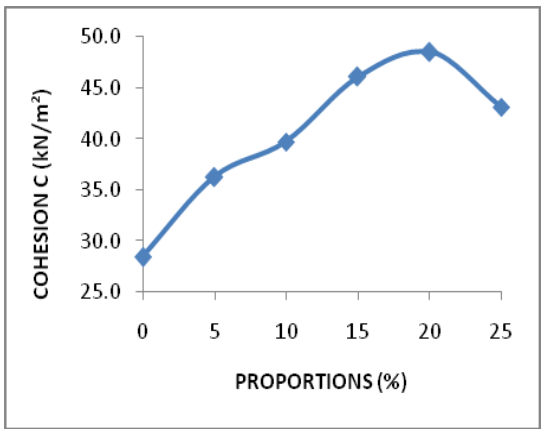

FIGURE 16. Variation in Cohesion for Different Proportions

From the strength charactertics results, it is found that initially the stabilizing proportion of 5 to 15% it decreased at attaining the proportion of 20% the compaction charactertics increases after that its decreased. It is observed that the optimum proportion for enhancing the compaction property of soil stabilized soil is found at 20%.

CONCLUSION

The effect of raw plastic on the clayey soil sample in compaction charactertics and strength behavior is studied by conducting the various tests on different proportions such as 5%, 10%, 15%, 20% and 25% and tests results were discussed below. The soil sample taken for the study is clayey soil. After conduction of initial tests, the clay sample is classified as a Low plastic Clayey soil (CL). The stabilizer used for the present study is Raw plastic strips. After studying the basic properties of soil and raw plastic, the soil is stabilized by means of addition of raw plastic on different proportions such as 5%, 10%, 15%, 20% and 25%. The following conclusions were derived from the present study.

- The cohesion and unconfined compressive strength of the soil sample has increased 70% at 20% of Soil and Raw plastic from natural soil sample.

- The dry density of the given soil sample has increased 5% at 20% of Soil and Raw plastic from natural soil sample.
- The Optimum moisture content of the given soil sample has decreased 8% at 20% of Soil and Raw plastic from natural soil sample.
- The Optimum Raw plastic to be added to Low plastic clay is found at 20%.

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