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STUDY OF STABILITY OF SOIL WITH USING PLASTIC FIBER

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Rapid improvements in the engineering world have influenced the lifestyle of human beings to a great extent. But the day to day activities of mankind are augmenting risks to the environment in the same proportion. Use of plastic products such as polythene bags, bottles etc. is increasing day by day leading to various environmental concerns. Therefore, the disposal of the plastic wastes without causing any ecological hazards has become a real challenge. Plastic wastes have become one of the major problems for the world. The harmful gas which is being produced by them leads to tremendous health related problems. So, effective engineering implementation of this has become one of the challenging jobs for engineers. In recent years, researchers from various fields have attempted to solve environmental problems caused by the production of non-biodegradable wastes like plastic. Using a geotechnical viewpoint, this paper proposes a partial solution to a major item which piles up in the wastages i.e. Plastic. But the primary objective of this project is to examine the potential capability of stabilizing soil using plastic fiber. Various tests such as Standard Proctor, CBR were carried out with different samples to determine the effect of plastic fibers in silty clay. The initial results obtained were promising and supporting the fact of achieving stability of the soil. The advantages of this study results in three folds- Utilization of natural resource (silty clay), Economy, and waste management. Mixing of plastic waste fiber with expansive soil helps to mitigate the volume change behavior of soil.

Keywords: *Soil, Plastic cover, Stabilization, Optimum moisture content (OMC)*

INTRODUCTION: -

Soil stabilization means the improvement of stability or bearing power of the soil by the use of controlled compaction, proportioning and/or the addition of suitable admixture or stabilizers. The basic principles of soil stabilization are:

a. Evaluating the properties of given soil.

b. Deciding the lacking property of soil and choose effective and economical method of soil stabilization.

c. Designing the stabilized soil mix for intended stability and durability values.

Stabilization can increase the shear strength of a soil and/or control the shrink-swell properties of a soil, thus improving the load bearing capacity of a sub-grade to support pavements and foundations. Stabilization can be used to treat a wide range of sub-grade materials from expansive clays to granular materials. The most common improvements achieved through stabilization include better soil gradation, reduction of plasticity index or swelling potential, and increases in durability and strength. In wet weather, stabilization may also be used to provide a working platform for construction operations. These types of soil quality improvement are referred to as soil modification. Benefits of soil stabilization are higher resistance values, reduction in plasticity, lower permeability, reduction of pavement thickness, elimination of excavation, material hauling and handling, and base importation, aids compaction, provides all-weather access onto and within projects sites. The determining factors associated with soil stabilization may be the existing moisture content, the end use of the soil structure and ultimately the cost benefit provided. As good soil becomes scarcer and their location becomes more difficult and costly, the need to improve quality of soil using soil stabilization is becoming more important. Soil stabilization using raw plastic bottles is an alternative method for the improvement of subgrade soil of pavement. It can significantly enhance the properties of the soil used in the construction of road infrastructure.

WHAT IS CONSTRUCTION OF WASTE PLASTIC MATERIAL

Plastic fiber when mixed with soil behaves like a fiber reinforced soil. Plastic fiber materials are produced plentifully such as polyethylene terephthalate (PET) plastic bottles, polypropylene of plastic sack, and polypropylene of carpet. But such materials have been used little for engineering purposes. These plastic fibers in the form of randomly mixed with soil and the behavior of the soil is similar to fiber reinforced soil. Soil reinforcement technique is one of the most popular techniques used for improvement of poor soils. Metal strips, synthetic geotextile, geogrid sheets, natural geotextile, randomly distributed, synthetic and natural fibers are being used as reinforcing materials to soil. Further, the soil reinforcement causes significant improvement in tensile strength, shear strength, other properties, bearing capacity as well as economy. This is a relatively simple technique for ground improvement and has tremendous potential as accost effective solution to many geotechnical problems

RESEARCH SIGNIFICANCE

For many years, road engineers have used additives such as lime, cement and cement kiln dust to improve the qualities of readily available local soils. Laboratory and field performance tests have confirmed that the addition of such additives can increase the strength and stability of such soils. However, the cost of introducing these additives has also increased in recent years. This has opened the door widely for the development and introduction of other kinds of soil additives such as plastics, bamboo, liquid enzyme soil stabilizers etc.

Soil stabilization using plastic fibers is an alternative method for the improvement of soil. It can significantly enhance the properties of the soil used in the construction of road infrastructure and other structure. Results include a better and longer lasting road with increased loading capacity and reduced soil permeability. This new technique of soil stabilisation can be effectively used to meet the challenges of society, to reduce the quantities of waste, producing useful material from non-useful waste materials that lead to the foundation of sustainable society. It can be effectively used in strengthening the soil for road embankments and in preparing a suitable base for the upper pavement structure. Since it increases the bearing capacity of soil considerably, the land use can be increased. It can lower the road construction and maintenance costs while increasing the overall quality of its structure and surface.

The promise that soil stabilization technology can actually improve the mechanical qualities of soil so that stronger, more durable structure can be built has prompted around the world to conduct extensive testing to verify that this new technology is truly cost-effective. The result is that this new advance in soil stabilization technology is increasingly being used in both constructing and improving/rehabilitating soil structure worldwide.

METHODOLOGY

Soil material: The soil types in the study were Silty-clay soil and sandy soil. Soil collected from the ITM University campus was used in this study for Laboratory testing. the maximum dry density and maximum water content of soil as determined from the relative tests.

Plastic fiber material: The plastic fiber material was sourced from a local market was used in this study for Laboratory testing of different percentage with different types of soil. The tests were conducted at various waste plastic contents of 0%, 5%, 10% and 15%.

IV. RESULTS

Soil Characteristics:

Test was conducted to find various characteristics of the soil sample. The results obtained are tabulated.

Natural Moisture Content	***27%***
Liquid Limit	***26.7%***
Plastic Limit	***23%***
Plasticity Index	***4%***
Specific Gravity	***2.17***
Sieve Analysis	***GM-GW***
Optimum Moisture Content	***8%***
Maximum Dry Density	***18.24%***

Engineering Property Tests:

Tests were conducted on untreated sample and Samples 0%, 5%, 10% and 15%. replacement of soil with plastic fibers. The tests were conducted as per the procedure specified in IS 2720 part VII- 1980.the standard proctor test and CBR tests were conducted. The results from the CBR test are given below.

1. Unsoaked Soil Sample

The CBR value is determined.

CBR Unsoaked Soil Sample

Penetration (mm)	Load (kg) – Pure Soil	Load (kg) – 0.05% Plastic Fiber Mix Soil	Load (kg) – 0.10% Plastic Fiber Mix Soil	Load (kg) – 0.15% Plastic Fiber Mix Soil
0.5	280	285	289	293
1.0	293	300	310	315
1.5	297	307	325	334
2.0	304	318	338	350
2.5	315	340	349	367
3.0	330	370	360	382
4.0	380	410	390	396
5.0	400	430	435	440

CBR Value: Unreinforced Soil at 2.5 mm penetration = 23.0%
0.05% Plastic reinforced at 2.5 mm penetration = 24.8%
0.10% Plastic reinforced at 2.5 mm penetration = 25.5%
0.15% Plastic reinforced at 2.5 mm penetration = 26.8%

2. Soaked Soil Sample

Penetration (mm)	Load (kg) – Pure Soil	Load (kg) – 0.05% Plastic Fiber Mix Soil	Load (kg) – 0.10% Plastic Fiber Mix Soil	Load (kg) – 0.15% Plastic Fiber Mix Soil
0.5	164	177	183	9
1.0	169	182	189	188
1.5	173	187	194	194
2.0	179	193	199	198
2.5	182	198	206	207
3.0	194	204	214	216
4.0	215	227	223	229
5.0	238	243	246	248

CBR Value: Unreinforced Soil at 2.5 mm penetration = 13.3%
0.05% Plastic reinforced at 2.5 mm penetration = 14.5%
0.10% Plastic reinforced at 2.5 mm penetration = 15.0%
0.15% Plastic reinforced at 2.5 mm penetration = 15.1%

CONCLUSIONS

Use of plastic products such as polythene bags, bottles, containers and packing strips etc. is increasing day by day. The disposal of the plastic wastes without causing any ecological hazards has become a real challenge to the present society. Thus using waste plastic fiber as a soil stabilizer is an economical and gainful utilization since there is scarcity of good quality soil for embankments and fills. Thus this project is to meets the challenges of society to reduce the quantities of plastic waste, producing useful material from non-useful waste materials that lead to the foundation of sustainable society.

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