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Use of Plastic as a Soil Stabilizer

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Abstract

Soil stabilization is a process of improving the physical properties of soil such as shear strength, bearing capacity. soil stabilization is also help in reducing permeability and settlement of the soil which is important factor to consider while construction of any structure. ultimately, the load of the structure is transfer to the soil. Bearing capacity of the soil is the most important factor to be consider while design the structure. Soil can be stabilized by mechanical method and/or chemical method. There are many chemical agents are available to stabilized soil like fly ash, lime, cement which improve the bearing capacity of soil but also increase the cost of the project. The new technique to improve the bearing capacity of the soil by using plastic as a soil stabilizer in economical way with the help of sand. Sand is act as inert filler. Sand and plastic help to achieve the bearing capacity of soil. Plastic is materials which cause almost every type of pollution which harm the environment. Plastic is a serious problem by which the whole is suffering. Plastic is a material which can improve the engineering properties of the soil. This is a new technique to control the pollution caused by the plastic and improve the bearing capacity of the soil in economical way. Soil stabilization can be utilized on roadways, bridges, airports where subsoil are not suitable for construction.

Keywords: *Soil stabilization, CBR value, Permeability,*
Admixtures, Settlement, OMC

INTRODUCTION

Soil stabilization is one of the most important factor to be consider while designing an infrastructure. Any kind of structure which is constructed of earth is ultimately transferred load to the earth. so that, to stabilized a soil is the first priority of the engineer.Shear strength and bearing capacity are the term which is necessary to be consider while stabilizing the soil. Shear strength is describing the magnitude which impact on the soil. The bearing capacity of the soil is the

maximum average contact pressure between the foundation and the soil. Soil stabilization is also help in reducing permeability, shrinkage and help for settlement which is another most important factor consider for designing the foundation and structure. Soil has a property to pass water through it which is called permeability. Soil is permeable in nature.

Soil can be stabilized by chemical method and mechanical method.

Mechanical method: in this method, soil is stabilized by the compaction with the help of machine/equipment.

Chemical method: Some admixtures are used to enhance the engineering properties of soil such as bearing capacity and shear strength.

Plastic is used as an admixture for soil stabilization add increase the bearing capacity and shear strength of the soil with the help of sand. Sand is act as an inert filler which fill the void present in a soil which help in enhancing engineering properties of soil.

In a previous time, soil is compacted with the machine for the stabilization. Now, admixtures are used for the stabilization and here plastic is used for the soil stabilization which is ecomical as compared to the other admixture. Plastic caused the harmful effect on environment. To reduce the harmful effect of plastic on earth and dispose the plastic is effective way. This is the eco-friendly technique.

Scope and objective:

Providing the economical solution for the soil stabilization.

Provide the eco-friendly solution for disposal of plastic.

Increase the engineering properties of the soil which is necessary for the construction.

Material Used:

Plastic

Sand

Soil

METHODOLOGY

1) Moisture Content
2) Specific gravity of soil.
3) Atterberg's limit.
4) Liquid limit
5) Particle size distribution.

6) Preparation of reinforced soil sample.
7) Determination of shear strength.

A. Moisture Content:

Soil tests natural moisture content of the soil is to be determined. ... The natural water content also called the natural moisture content is the ratio of the weight of water to the weight of the solids in a given mass of soil. This ratio is usually expressed as percentage. In outdoor natural environments, water is added to soil via rainfall or deliberate irrigation of plants. In either case, soil moisture increases as more pores become filled with water at the expense of air. If all the pores become filled with water, excess water through continuous soil pores, until the rain or irrigation ceases. Leaching will continue until the water films within the pores are held by the surface tension of soil colloids against the force of gravity. Such a situation is referred to as the soil being at "field capacity" with respect to soil moisture. A soil at field capacity has pores partially filled with air, surrounded by soil moisture films. Normally a soil at field capacity is optimal for plant growth and aerobic soil microorganisms, since both air and water are available.

B. Specific Gravity of soil:

The specific gravity of soil is defined as the unit weight of the soil mass divided by the unit weight of distilled water at 4°C. It is sometimes required to compare the density of the soil solids to the density of water. This comparison is in the form of ratio and is termed as the specific gravity of the soil.

The major measuring equipment in this test is pycnometer. There is a small hole at its apex of 6mm diameter. The leakage is prevented by having a washer between the cap and the jar. While closing the jar, it is screwed till the mark so that the volume of the pycnometer will remain constant throughout the calculation.

C. Atterbergs's limit:

The Atterberg limits are a basic measure of the critical water contents of a fine-grained soil: its shrinkage limit, plastic limit, and liquid limit. Depending on its water content, a soil may appear in one of four states: solid, semi-solid, plastic and liquid. Soils when wet retain water, and some expand in volume.

D. Liquid limit:

The liquid limit of a soil is the water content at which the soil behaves practically like a liquid, but has small shear strength. It flows to close the groove in just 25 blows in Casagrande's liquid limit device. From liquid limit test, the compression index may be estimated, which is used in

settlement analysis. If the natural moisture content of soil is higher than liquid limit, the soil can be considered as soft and if the moisture content is lesser than liquid limit, the soil is brittle and stiffer. The value of liquid limit is used in classification of the soil and it gives an idea about plasticity of the soil.

The liquid limit is the moisture content at which the groove formed by a standard tool into the sample of soil taken in the standard cup, closes for 12 mm on being given
25 blows in a standard manner. At this limit, the soils possess low shear strength.

E. Preparation of reinforced soil:

1) Step 1) Excavate soil
2) Step 2) Collect sand
3) Step 3) Melt plastic
4) Step 4) Mix soil with sand
5) Step 5) Mix melted plastic with soil and sand. Batching: In this step soil is batched with the sand. Burning: in this step, melting process of plastic start.

Mixing: in this step, the process of mixing plastic, soil and sand.

Placing: in this step, the reinforced is ready for placing.

F. Particle size distribution:

Particle size distribution, also known as gradation, refers to the proportions by dry mass of a soil distributed over specified particle-size ranges. Gradation is used to classify soils for engineering and agricultural purposes, since particle size influences how fast or slow water or other fluid moves through a soil. It works on the principle that when a beam of light (a laser) is scattered by a group of particles, the angle of light scattering is inversely proportional to particle size (ie. the smaller the particle size, the larger the angle of light scattering.

G. Shear Strength:

Shear strength is a term used in soil mechanics to describe the magnitude of the shear stress that a soil can sustain. The shear resistance of soil is a result of friction and interlocking of particles, and possibly cementation or bonding at particle contacts. Shear strength is a very important property of soils. The concept is used by geotechnical engineers in estimating the bearing capacity of foundations and in assessing the stability of retaining walls, slopes, and embankments and the design and construction of highway and airfield pavements. Direct shear test is a simple and commonly used test performed in a shear box to determine the shear parameters of soils. A graph is plotted between the normal stress and the shear stress and the y-

intercept and the slope of the failure envelope so obtained are taken as the shear parameters c and ϕ, respectively. The volume change behaviour and interparticle friction depend on the density of the particles, the intergranular contact forces, and to a somewhat lesser extent, other factors such as the rate of shearing and the direction of the shear stress. The average normal intergranular contact force per unit area is called the effective stress. If water is not allowed to flow in or out of the soil, the stress path is called an undrained stress path. During undrained shear, if the particles are surrounded by a nearly incompressible fluid such as water, then the density of the particles cannot change without drainage, but the water pressure and effective stress will change. On the other hand, if the fluids are allowed to freely drain out of the pores, then the pore pressures will remain constant and the test path is called a drained stress path. The soil is free to dilate or contract during shear if the soil is drained. In reality, soil is partially drained, somewhere between the perfectly undrained and drained idealized conditions.

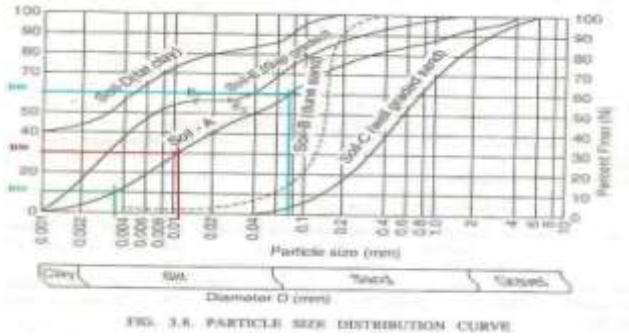

FIG. 3.8. PARTICLE SIZE DISTRIBUTION CURVE

H. CBR Test:

The Californian Bearing Ratio (CBR) test is a penetration test used to evaluate the sub grade strength of roads and pavements. The pressure up to a penetration of 2.5 mm is measured and its ratio to the bearing value of a standard crushed rock is termed as the CBR. Optimum moisture content/maximum dry density (OMC/MDD) – when placing soils as fill materials, it is important to achieve suitable compaction, primarily in order to reduce the susceptibility of a soil to settlement. Although the force increases with the depth of penetration, in most cases, it does not increase as quickly as it does for the standard crushed rock, so the ratio

decreases. In some cases, the ratio at 5 mm may be greater than that at 2.5 mm. If this occurs, the ratio at 5 mm should be used. The CBR is a measure of resistance of a material to penetration of a standard plunger under controlled density and moisture conditions. The test procedure should be strictly adhered to if a high degree of reproducibility is desired. The CBR test may be conducted

on a remoulded or undisturbed specimen in the laboratory. The test is simple and has been extensively investigated for field correlations of flexible pavement thickness requirement. The laboratory CBR apparatus consists of a mould of 150 mm diameter with a base plate and a collar, a loading frame and dial gauges for measuring the penetration values and the expansion on soaking. If a soaked (wet) measurement is desired, the specimen in the mould is soaked in water for four days and the swelling and water absorption values are noted. The surcharge weight is placed on the top of the specimen in the mould and the assembly is placed under the plunger of the loading frame. Load is applied on the sample by a standard plunger with diameter 50 mm at the rate of

1.25 mm/min. A load penetration curve is drawn. The load

values on standard crushed stones are 1,370 kgf (13.44 kN) and 2,055 kgf (20.15 kN) at 2.5 mm and 5.0 mm penetrations respectively. The CBR value is expressed as a percentage of the actual load causing the penetrations of 2.5 mm or 5.0 mm to the standard loads.

I. Why Plastic:

Plastic helps in increase the shear and tensile strength of soil.

Plastic have water resistance property. Plastic have a chemical resistance property.

J. Physical Properties of Plastic:

Plastic has transparency, flexibility, elasticity, water resistance, electrical resistance and soft when it is hot. Soil is a naturally occur material's that are used for the construction of all except the surface layers of pavement and threat are subjected to classification tests to provide a general concept of their engineering characteristics.

K. Why Sand:

Sand act as an inert filler which fill the void present in the soil. Plastic and sand make bond which is very hard in nature which helps in increase the engineering properties of soil.

RESULT:

Particular	1st test	2nd test	3rd test
Wt.of pycnometer	630	630	630
Wt.of pycnometer+soil(W2)	830	830	830
Wt.of pycnometer+soil+water(W3)	1700	1691	1701
Wt.of pycnometer+water(W4)	1570	1572	1572
SPECIFIC GRAVITY	2.85	2.47	2.82

Specific Gravity of soil=2.72.

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A. Plastic Limit:

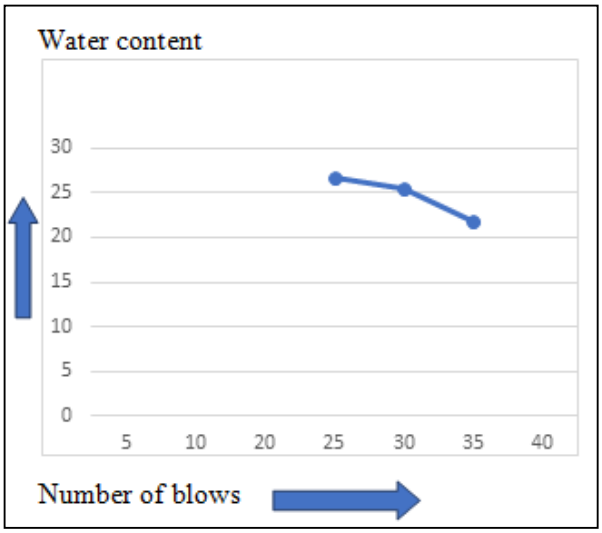
Sample number	1	2	3
Weight of container Wo g	10.6	10.6	10.6
Weight of container+wet soil W1 g	15.2	15.8	15.4
Weight of container+oven dry soil W2 g	14.7	15.3	14.9
Weight of water W1-W2 g	0.5	0.50	0.5
Weight of oven dry soil W2-Wo g	4.1	4.7	4.3
Water content=(W1-W2)/(W2-Wo)	11.67	10.63	11.62

Plasticity limit= 11.31%

B. Liquid Limit Test:

Sample number	1	2	3
Number of blows	35	30	25
Weight of container Wo g	10.6	10.6	10.6
Weight of container + wet soil W1 g	24.6	25.9	27.2
Weight of container + oven dry soil W2 g	22.1	22.8	23.7
Weight of water W1-W2 g	2.5	3.1	3.5
Weight of oven dry soil W2-Wo g	11.5	12.2	13.1
Water content (W1-W2)/(W2-Wo)	21.74	25.41	26.71

Liquid Limit =24.62



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C. Moisture content:

Wt.of Container (gm) (w1)	Moisture content (%)	Wt. of container + wet soil(gm) (w2)	Moisture content (%)
19	16.13	55	16.13
18	10.2	72	10.2
18	12.8	62	12.8

Moisture content = 13.04%

E. Core Cutter Test:

Volume of core cutter(WC) = 1021 cm3

Mass of core cutter + wet soil (WS) = 2500 gms Mass of wet soil (WS – WC) =1479 gms

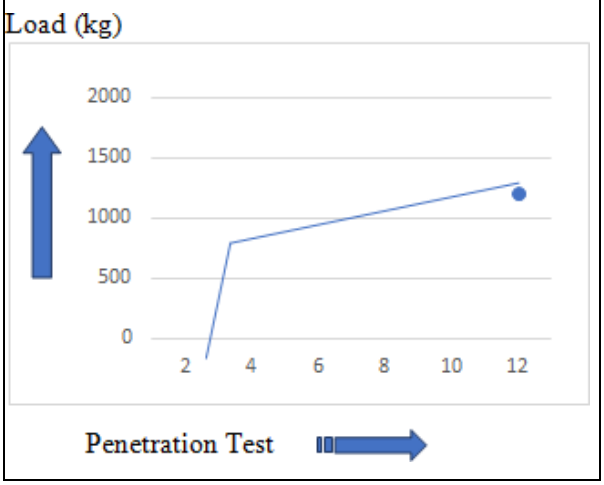
Bulk density =M/V 1479/1021 = 1.44g/cm3

Dry density = 1.44/(1+0.1367)

= 1.26g/cm3

F. CBR Test:

Sample Description	MDD gm/cc	OMC %	CBR %
Soil	1.62	19.6	1
Soil with Plastic	1.75	17.2	2.45



CONCLUSION

1) The objective of the project is to enhance the properties odd soil with the help of plastic and sand. The engineering properties of soil are improved to a very large extent by proper mixing of the plastic and sand with soil.
2) The soil is stabilized with the eco-friendly method.
3) The second objective of the project is to stabilize soil in economical way.
4) It enhances the shear strength and bearing capacity of the soil.
5) It reduces the permeability of the soil.

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