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EFFECT ON PROPERTIES OF SOIL USING WASTE PLASTIC FIBRES

Sagar E. Shinde[1], Azim A. Shaikh[2] ,Shubham D. Kulkarni[3]

[1,2,3] *Department of Civil Engineering, Guru Gobind Singh Polytechnic, Nashik (India)*

ABSTRACT

Due to rapid urbanization and globalization there is a huge amount of generation of waste plastics all around the world. According to survey conducted by Central Pollution Control Board(CPCB) 2014-15estimate 15000 tonnes plastic waste collected in India everyday (51.4 Million tonnes every year). Out of this quantity 27% gets treatment and remaining 73% disposed at dump site.This cause huge amount of environmental problems. The world's annual consumption of plastic materials has increased from around 5 million tonnes in the 1950's to nearly 100 million tonnes. Thus, presently 20 times more plastic is produced as compared to 50 years ago. This paper proposes a partial solution to a major item which cause environment hazard i.e. Plastic.The main objective of this study is to investigate the use of waste plastic fibre materials in Geotechnical Engineering applications and to evaluate the effects its partial use on various properties like specific gravity, Compaction, Shear Strength etc. Experiments were done by taking an available weak soil as sample. The results obtained are compared between normal soil samples and soil with Waste plastic Fibre (1.00%, 1.50%, and 2.00% partial replacement).

Keywords: Compaction, CPCB, Fibre , Geotechnical, Plastic, Polypropylene ,Shear Strength, Specific gravity.

I. INTRODUCTION

Plastics are durable and degrade very slowly. The chemical bonds that make them so durable tend to make them resistant to most natural processes of degradation. Thus it causes huge amount of hazard to ecosystem. Soil is natural material which is unconsolidated accumulation of various minerals and form due to chemical or physical weatheringof parent rock. It is a natural body called the pedosphere which has four important functions: it is a medium for plant growth; it is a means of water storage, supply and purification; it is a modifier of Earth's atmosphere; it is a habitat for organisms. Soil is a highly Complex, Heterogeneous and Unpredictable material on earth surface. The properties of soil change not only from one place to other but also at the place with depth and with achange in the environmental, loading and type, drainage and the conditions under which it exists. So, to work with soils, we need to have proper knowledge about their properties and factors which affect their behavior. Commencement of Civil engineering project work most probably depends on kind of ground strata available on site. Hence it is important that the available ground strata should be improve by removing poor material and replacing it

by a suitable material, or soil in-place can be improve by using any suitable ground improvement methods (soil stabilization). Soil stabilization a general term for any physical, chemical, biological, or combined method of changing a natural soil to meet an engineering purpose.In other words stabilization of soil simply means to enhance the Engineering property of soil such as Shear Strength, Compaction, permeability etc. In this project experimental work has been done to determine the effect of waste plastic fibre as an admixture in soil to enhance the property of soil.This work is focused on the review of performance of plastic fiber as a soil stabilization material.

II. SCOPE AND OBJECTIVE

Due to rapid urbanization and globalization there is an huge amount of generation of waste plastics all around the world. This has resulted in the municipal solid waste, an ever growing fraction of plastic materials which were used for a short time and then dumped. There is an urgent requirement to find alternative uses of reuse plastic bag waste to increase the usage time of the plastic material and hence save the ecosystem hazard. The concept of using soil masses with waste plastic fibre may be relatively, a new development..The objective of this project is to analyze the effect of using plastic fibers in soil on the stability of soil in a cost effective manner. The three different replacement percentages of plastic fibers 1.00%, 1.50%, 2.00%) will be tested

Fig. 2.1:Shreding of waste plastics Materials

III. .MATERIALS USED

- **Soil:** Experiments were done by taking an available soil as sample. The soil used for the study was collected from PathardiGaon in Nashik district(M.S). The content in soil (fine Sand = 45.15%, silt = 23.90% and clay = 30.95%). They are characterized by medium shrinkage and swelling properties. Because of its swelling and shrinkage characteristics, the soils have been a challenge to the civil engineers. The clayey soil is very hard when dry, but loses its strength completely when in wet condition. Rich proportion of Laterite is found in soil from mineralogical analysis.

- **Plastic fiber:**Waste Plastic in form of Polypropylene were obtained from Industrial areas at Ambad and Satpur MIDC Nashik . After proper cleaning and Processing, the plastic were shred (Break) into fibers each of average thickness of 3mm. These plastic particles are usually considered to be waste materials.

IV. METHODOLOGY

The experimental work consists of following tests:

1. Physical Characteristics of Plastic Fibre Materials.
2. Determination of Specific gravity.
3. Particle size distribution by sieve analysis .
4. Standard Proctor compaction test to determine MDD and the corresponding OMC.
5. Determination of the shear strength (Direct Shear test).

V. EXPERIMENTAL INVESTIGATIONS AND RESULTS

1. General Characteristics of Plastic Fibre Materials:

Table 1: Properties of Plastic fibre

Sr No	Parameter	Values
1	Type of Plastic	Polypropylene
2	Fibre type	Machine shredded Single particle fibre
3	Unit weight	1.23 g/cm3
4	Average diameter	3mm
5	Average length	15 mm
6	Burning point	590^0C
7	Acidic and alkali resistance	Very good
8	Dispensability	Excellent

2. Specific gravity of soil: The specific gravity of soil is the ratio between the weights of the soil solids in air to the weight of equal volume of water. The specific gravity of soil sample was determineusing pycnometer bottle method. Specific gravity is always measured in room temperature and reported to the nearest 0.1 decimal and room temperature ofapproximately 27^0C.

Table 2: Summary results of Specific gravity

Particulars	Sample 1	Sample 2	Sample 3	Average	% Increase with Resp. to Normal Soil
Specific Gravity of soil	2.62	2.58	2.63	2.61	--
Soil 99.00% + 1.00% plastic	2.61	2.65	2.63	2.63	0.766
Soil 98.50% + 1.50% plastic	2.62	2.64	2.66	2.64	1.14
Soil 98.00% + 2.00% plastic	2.63	2.65	2.72	2.647	1.41

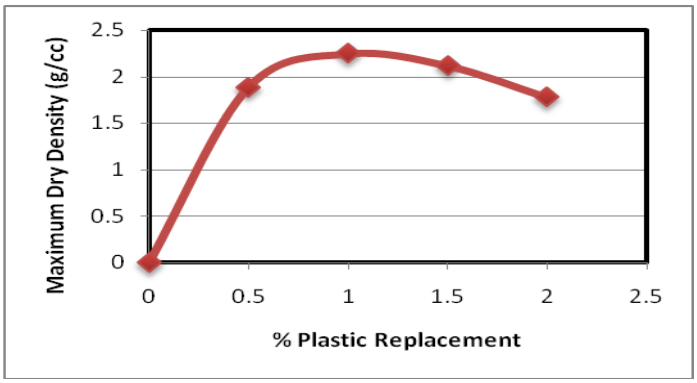
3. Particle size distribution by sieve analysis of soil : The results from sieve analysis of the soil when plotted on a semi-log graph with particle diameter or the sieve size as the abscissa with logarithmic axis and the percentage passing as the ordinate gives a clear idea about the particle size distribution.

D_{10} = 95µ D_{30}= 120µ and D_{60} = 300µ.

4. Standard Proctor test: The optimum moisture content(OMC) and the maximum dry density(MDD) of the soil samples for various percentage of plastic Fibre materials (1.0 %, 1.50%, 2.0%) were determined by performing the Standard Proctor test. The dry density was determined and plotted against the corresponding water content to find the optimum moisture content and the corresponding maximum dry density. The tests were conducted as per the procedure specified in IS 2720 part VII- 1980. The values of OMC and MDD of various %of plastic Fibre materials are given below in tabular form.

Table 3: Summary results of Standard Proctor Test

Sr No	Sample	Dry Density (g/cc)	Water Content (%)
1	Normal soil sample	1.89	7.9
2	Soil 99.00% + 1.00% plastic	2.25	9.90
3	Soil 98.50% + 1.50% plastic	2.12	11.50
4	Soil 98.00% + 2.00% plastic	1.78	15.80

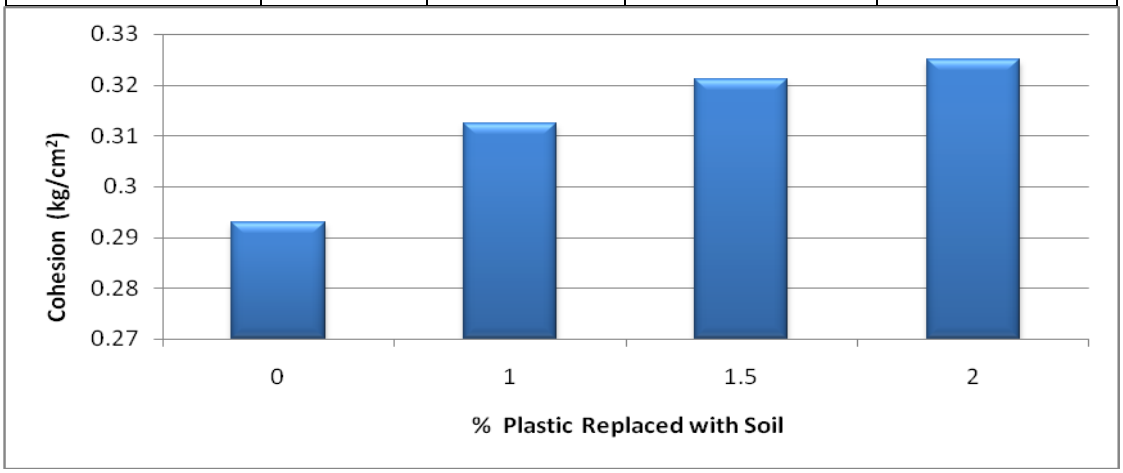


5. Determination of the shear strength:

Direct Shear Test: This test is used to find out the cohesion (c) and the angle of internal friction (φ) of the soil, these are the soil shear strength parameters. The shear strength is one of the most important soil properties and it is required whenever any structure depends on the soil shearing resistance. The test is conducted by putting the soil at OMC and MDD inside the shear box which is made up of two independent parts. The following result were obtain during the test.

Table 4: Summary results of Direct Shear Test

Parameter	Normal Soil	Soil 99.00% + 1.00% plastic	Soil 98.50 + 1.50% plastic	Soil 98.00% + 2.00% plastic
Cohesion C (kg/cm^2)	0.293	0.3125	0.3210	0.3250
Angle of Internal Friction Ø	45.62^0	46.52^0	47.30^0	47.55^0



VI. CONCLUSION

This project is focused on the review of effect of Waste plastic fiber from industries as a soil admixture on properties of soil. The study suggests that if shredded plastic fiber if properly mixed and applied, can enhance the engineering properties of soil such as shear strength, compaction etc required for stabilization. On the basis of this project the following conclusion were obtained.

1) Based on Specific gravity of a soil- With mixing of 1% fibers, specific gravity of the soil increases by 0.76%. (Table 2) Strength of the soil is directly proportional to specific gravity, more is the specific gravity more will be the strength of soil. Hence strength of soil found to be increased .
2) Based on direct shear test ,soil with plastic fiber of 1 %, 1.50% and 2.00%, the increase in cohesion was found to be 6.65%, 9.55% and 10.92% as compared to Normal soil sample.
3) Based on Standard Procter Test - maximum dry density (MDD) is obtained when 1.00% plastic was added in the soil and optimum moisture content (OMC) corresponding to 1.00% of plastic replaced by soil mass. Further the experimental results of compaction tests indicate that MDD of plastic fibre in soil decreases with increasing fibre content above 1%. As plastic fibre does not absorb water, OMC is independent of the amount of fibres.
4) Based on overall results and discussion it can be concluded that the engineering properties of soil are enhanced by using waste plastic fibre material as an admixtures in various proportion. Use of plastic fibreup to certain percentage as partial replacement in soil Mass can increased the strength and capability of soil to stabilized on sloping ground.

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