Improvement of Sandy Soil by Plastic Bottle Strips

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Abstract— In this present study sandy soil was collected from Sabarmati River bank. The shear strength of normal sand and sand with plastic proportion was carried out and compare to each. The plastic wastes were collected in the form of waste water bottles, which cutting in the strip form with dimension 15mm by 25mm. This plastic strips were mix with soil in proportion of 0%, 0.15%, 0.25%, 0.50%.For investigate shear strength of a sample Box Shear Test was carried.
Keywords: Plastic Bottle Strips, River Sand

I. INTRODUCTION

Land requirement for construction industry is increasing day by day. Various lands which are not directly use for engineering purpose can be improved by various techniques. Soil improvement is the modification of existing site foundation soils or project earth structures to provide better performance under design and/or operational loading conditions. The term "Soil improvement" is open to different interpretations. First, it is an intention or objective, not the process of achieving it, although the term is often used in that sense. Second, improvement is a relative condition as to which aspect and to what degree there is improvement. Virtually all engineering construction involves the soil. In poor soil conditions there are five options viz; to bypass the poor soil by moving to a new site or using deep foundations to stronger ground, to remove the poor soil replacing it with better material, to design the structure to allow for the behaviour of the poor ground under load, to treat the poor soil to improve its properties. India is facing the problem of disposal of plastic waste. Plastic waste is non bio degradable waste, which is harmful for environment. The two most significant stumbling blocks are material variability and the costs associated with identifying and separating waste plastics into recognisable grade ranges. The more knowledge you have about the material you intend to recycle the easier it is to put into valuable second use applications. Plastics are highly engineered products manufactured in sophisticated and highly controlled manufacturing operations to meet clear specifications which correlate to a well defined set of physical properties. These properties are chosen to fit specific end-use applications and set the manufacturing specifications. In this research plastic waste is used for improvement of soil properties. Various experiments are carried out on sandy soil with various proportions of plastic wastes. A comparison of characteristics of sandy soil mixture with plastic waste to normal soil is carried out.

II. LITERATURE REVIEW

[1] Shiva Kumar, Vidyaranya, Shravan Bharadwaj, Prathibha K and Yuvaraj "Soil Stabilization Using Waste Plastic Strips" (2016)
The plastic strips were added in proportions by dry weight (0.05%, 0.1%, 0.15% and 0.2%) of the soils. The results showed that there is appreciable increase in strength and CBR value for the black cotton soils by the addition of plastic strips. The proposed method can be used for 25 small projects like implementing for construction of pavements for village roads. The thickness of pavement layer can be reduced by using waste plastic strips.
[2] Seyed Abolhasan Naeini, Hamidreza Rahmani "Effect of Waste Bottle Chips on Strength Parameters of Silty Soil" (2017)
Laboratory consolidated undrained triaxial (CU) tests were carried out to study the strength behaviour of silty soil reinforced with randomly plastic waste bottle chips. Specimens mixed with plastic waste chips in triaxial compression tests with 0.25, 0.50, 0.75, 1.0, and 1.25% by dry weight of soil and tree different length including 4, 8, and 12 mm. In all of the samples, the width and thicknesses of plastic chips were kept constant.
[3] Abhishek Patil, Girish Waghere , Niranjan Inamdar, Pranav Gavali, Roshan Dhore, Shreyash Shah "Experimental Review For Utilisation Of Waste Plastic Bottles In Soil Improvement Techniques" (2016)
The analysis was done by conducting "Tri-Axial Test & Direct Shear Test" on soil reinforced with Plastic Bottles Strips of size 1cm x 1cm. The comparison of test results showed that the soil sample using plastic strips gives better result than soil without plastic. The size and content of strips of waste plastic bottles have significant effect on the enhancement of strength of the soil. In this review paper, we have taken Black Cotton Soil. The soil is tested with 1% plastic by weight & with naturally obtained soil.
[4] Sachan, Ajanta and Gupta, Sharad "Effect of Agar Biopolymer on Shear Strength Behaviour of Sabarmati Soil" (2015)
In the current research, the agar biopolymer is used to strengthen the loose saturated Sabarmati sandy soil due to its gel forming capability and environment friendly nature. Sabarmati soil is treated by using different concentration of agar biopolymer (0.5%, 1%, 2% & 3%) at different curing time periods of 4hrs, 8hrs, 1day, 3days & 7days. Shear strength tests are performed on Sabarmati soil before and after its treatment at different agar concentration & curing time.

III. EXPERIMENTAL INVESTIGATION

Box shear test: Direct shear test or Box shear test is used to determine the shear strength of the soil. It is more suitable for cohesion less soils. In this present study three soil samples were collected from Sabarmati River at Gandhinagar district, Gujarat. Properties of this sand as per below table;

Properties	Value
Specific Gravity	2.66 To 2.77
Density (G/Sq.Cm)	1.40 To 1.51
Moisture Content (%)	1.34 To 3.52
Course Grain (%)	88 To 93

Table 1: Properties of Sabarmati River Sand

This soil mix with plastic strips and investigate shear strength.results are as below;

Normal Stress (kg/cm²)		Shear Stress (kg/cm²)		
Plastic mix				
0%		0.15%	0.25%	0.50%
1	0.1054	0.1454	0.1718	0.1719
2	0.2040	0.2641	0.2640	0.2508
3	0.3169	0.3895	0.3567	0.331

Table 2: Shear Strengths of Sample I with Various Plastic Proportion

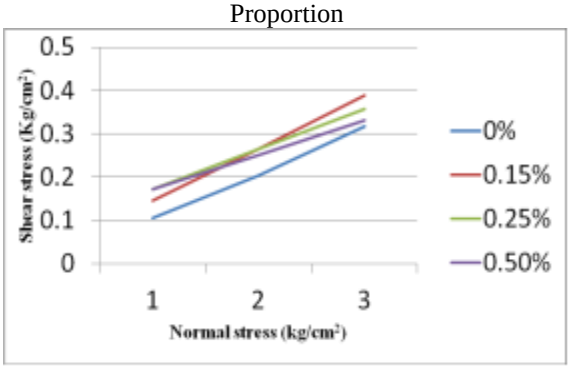

Fig. 1: Graph for normal strength vs shear strength for sample I

Soil sample with plastic proportion	Cohesion	Angle of internal friction
0%	0.04 0	33°
0.15%	0.06 0	39°
0.25%	0.07 0	40°
0.50%	0.072	41°

Table 3: Cohesion and Angle of Friction for Sample I

Normal Stress (kg/cm²)			Shear Stress (kg/cm²)	
1	0%	0.15%	0.25%	0.50%
2	0.1052	0.1128	0.1183	0.1385
3	0.1913	0.2229	0.2241	0.2650
4	0.2813	0.3437	0.3233	0.3960

Table 4: Shear Strengths of Sample II with Various Plastic Proportion

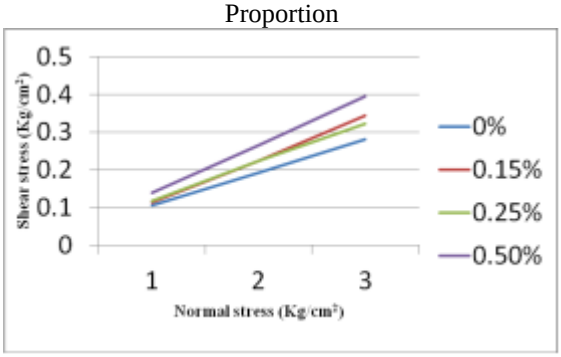

Fig. 2: Graph for normal strength vs shear strength for sample II

Soil sample with plastic proportion	Cohesion	Angle of internal friction
0%	0.02	34°
0.15%	0.04	36°
0.25%	0.04	38°
0.50%	0.04	40°

Table 4: Cohesion and Angle of Friction For Sample II

Normal Stress (kg/cm²)		Shear Stress (kg/cm²)	
Plastic mix			
0%	0.15%	0.25%	0.50%
1	0.097	0.2111	0.1053	0.2115
2	0.1919	0.3496	0.2201	0.3561
3	0.2839	0.4951	0.3304	0.3302

Table 6: Shear Strengths of Sample III with Various Plastic Proportion

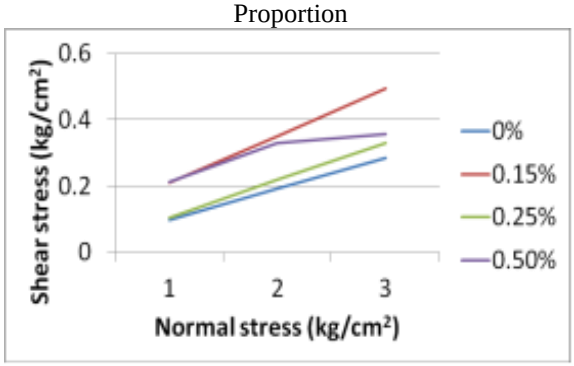

Fig. 3: Graph for normal strength vs shear strength for sample III

Soil sample with plastic proportion	Cohesion	Angle of internal friction
0%	0.02	30°
0.15%	0.06	40°
0.25%	0.06	36°
0.50%	0.05	43°

Table 7: Cohesion and Angle of Friction for Sample III

IV. Conclusion

As per above result and graph, cohesion and angle of friction were improve with increase as proportion of plastic strips increase. Soil bearing capacity increase with increase of angle of friction of sand.

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References

[1] Shiva Kumar, Vidyaranya, Shravan Bharadwaj, Prathibha K And Yuvaraj "Soil Stabilization Using Waste Plastic Strips" (2016)
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