Potential of Waste Plastic (PET) Bottles Strips as Reinforcement Material for Clayey Soil

Ammaar Noor Memon[1], Aneel Kumar Hindu[1], Noor Ahmed Memon[2], Mutahar Ali Amur[1], Umair Hussain Memon[1]

[1]*Civil Engineering Department, Mehran-UET, Jamshoro, Pakistan*
[2]*Civil Engineering Department, QUEST, Nawab Shah, Sindh, Pakistan*

***Abstract*: One of the most often visible type of plastics in open dumps and landfills is the waste plastic bottles made of Polyethylene Terephthalate (PET). It causes serious environmental problem until and unless completely decomposed. On the other hand, construction of any structure on weak or problematic soil is highly risky. To reinforce the soil with synthetic material is considered as one the reliable techniques which not only improves soil performance but also leads to the use of waste plastic bottles as a construction material instead its dumping causing environmental hazards. This research study aimed to assess the potential of the PET strips as reinforcement in the clayey soil. The strips of 8mmX35mm were mixed in the soil with 0.5%, 1.0%, 1.5% and 2.0% by dry weight of the soil to investigate soil bearing strength. The results are encouraging and showed a pronounced enhancement in bearing strength as it was obtained as high as two times due to PET strips (1.5%) when compared to that of the soil without strips.**

***Keywords*: Soil reinforcement, Plastic Strips, Bearing Strength.**

I.INTRODUCTION

Soil in the foundation of any Civil Engineering structures plays a vital role. If the soil present is expansive, it is highly risky to construct any structure on that soil. These soils expand up when come into the contact of moisture. Repeatedly, these clayey soils cause the cracking, fracture and breaking up of many civil engineering structures which include buildings, canal lining, embankments, and pavements. When geotechnical engineers face such problems, improvements are needed to alter or modify these unwanted geotechnical properties the soil. Large deposits of expansive soil are present in the city of Jamshoro which is located approximately 150 km in the north-east of Karachi, a city of Sindh, Pakistan. There is high chance of the failure if any of the structure is constructed by directly using this soil and if replaced with other soil it will be highly costed. Thus, to make economical there is the technique to stabilize and reinforcement of expansive soil to improve and modify the geotechnical properties of soil [1]. However, on the other side there is growing concern about to utilize the waste materials and the reinforcement technique of soil. Plastic waste is one of the most complex material which last longer and needs to 100 to 600 years or even longer to completely decompose. One of the most repeatedly observed type of plastic waste is open landfills and dumps are plastic bottles. Bottled water is the fastest growing beverage industry in the world. It is reported that annual consumption of plastic bottles in the world are approximately 10 million tons and it grows about 15% every year [2]. Numerous Studies have been carried out by using various reinforcement materials to be used effectively in different soils. Studies highlighted that coconut coir Fibers [3-8], glass fibers [9-10], rubber tire [4], fishing net fiber (Grid type) [11], sisal fibers [12], carpet waste fibers [13], human hair [14], jute fibers [15], palm fibers [16] are used for reinforcement of various soils. However, few types of plastic wastes are used of which the use of waste plastic high density polyethylene (HDPE), waste plastic bags [17], polypropylene fibers [18-19] have been reported.

II. MATERIALS & METHODS

A. Base Soil

Locally available shale soil has been collected from the vicinity of Mehran UET Jamshoro. The passing of the Sieve #40 has been used for this research stud.

B. PET Strips

Used mineral water plastic bottles of single brand were collected and the have been cut in to the strip of approximate length of 35mm and width of 8mm with the help of the cutter made for this specific purpose.

C. Soil-Strip Composite

The PET strips were mixed with the soil by 0%, 0.5%, 1.0%, 1.5% and 2.0% by the dry weight of the soil.

III. RESULTS

A. Compaction Test

A series of the standard proctor tests have been carried out on the un-reinforced and reinforced soil with various contents of the PET strips. However, it has been observed from the figure given below that the maximum dry density of the soil is decreasing with smaller value by the increasing the PET strip content in the soil.

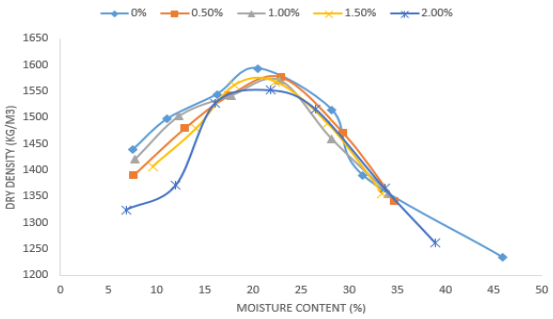

Figure 1: Moisture-Density Relationship

B. CBR Test

The number of the samples were prepared to determine the Soaked California Bearing Ratio (CBR) of the soil with various content of the PET strips at their respective maximum dry density (MDD) values. The samples were prepared in three layers with 56 blows. The samples were placed in water tank for about 96 hours and then were tested for the CBR. However, the figure given below shows the increase in the CBR value with increase in the PET strip reinforcement up to 1.5% and then there is decrease in the CBR value.

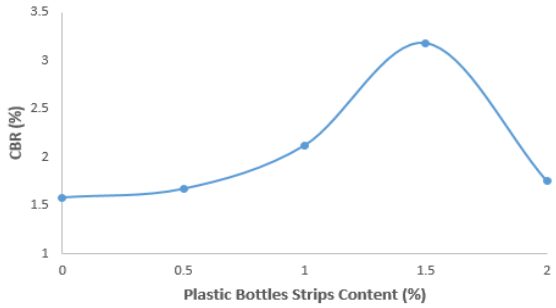

Figure 2: Soaked CBR

IV. CONCLUSIONS

On the basis of the above results, this study concludes that the reinforcement of the clayey soil with PET strips is a useful technique to improve the soaked bearing capacity of the soil. However, in this research study it has been observed that the CBR value has been increased by twice of that unreinforced soil by adding 1.5% of the PET strips. More experiment studies may be carried out on other type of plastics as reinforcing materials with various sizes in weak and problematic soils.

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