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STABILIZATION OF FINE SAND MIXED WITH BOTTLE CAP STRIPS AS ADMIXTURE TO ENHANCE THE PROPERTIES OF PERMEABILITY OF FINE SAND

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Abstract — ***This research paper concerned with the stabilization of fine sand with bottle cap plastic waste as admixture. As the fine sand has very low bearing capacity and compressive strength along with nil cohesion, thus the construction of any structure on fine soil required stabilization. Fine sand is of prime importance since it can be used for various construction works and highways, airfields and helipads projects. The amount of wastes has increased year by year and the disposal becomes a serious problem. This investigation deals with the stabilization of fine sand with bottle cap plastic waste as additive. Present research paper work has been taken up by addition of Square Pieces of bottle cap plastic waste 0.15%, 0.25%, 0.50% and 1.0% having size 5mm respectively as admixture. The varying percentage bottle cap plastic waste 0.15%, 0.25%, 0.50% and 1.0% respectively were mixed with fine sand of density 1.66 gm/cc. Falling-Head Permeability Tests were performed on different mix compositions. The result show the more addition of plastic bottle cap waste increase the permeability of soil.***

Keywords-Fine Sand, Permeability Test, Waste Bottle Cap Plastic.

I. INTRODUCTION

In many countries all-over the world, fine sand is found in ample. It is being unnoticed for the use of construction of embankment of roads because of its low bearing capacity and greater compressibility. The advancement of a soil at a site is necessary due to rising cost of the construction of the road in this situation the properties of soil can be advanced by soil stabilization.

There is a great scope of stabilization of Fine Sand with the admixture of bottle cap plastic wastage and for construction of embankment and pavements, airfields and helipads. The main purpose of the present investigation is to develop a mix composition which can be economically used for stabilization of fine sand in any type of environment. The laboratory studies have been done on fine sand using Square Pieces of bottle cap plastic waste. The test specimens were prepared in the laboratory by direct mixing of the Square Pieces of bottle cap plastic waste in fine sand. The Square Pieces of bottle cap plastic waste can be easily available from various construction sites and manufacturing units. If this waste can be used efficiently then we can obtain an economical mix of fine sand and Square Pieces of bottle cap plastic waste as a construction material. The laboratory tests studies have been done on by direct admix of fine sand with pieces of bottle cap plastic waste. Many researchers like Ankit et al. (2016), Kapil et al. (2016), Punitetval. (2013), Purohit D.G.M. et al. (2009), AwadALKarni et al. (2012), jain O.P. et al. (1979), V. Mallikarjuna et al. (2016), Kevin M. (1978) and Wayal A.S. et al. (2012) have worked on stabilization of soils.

II. MATERIALS USED

2.1. Fine Sand

Fine sand is found in abundance in western Rajasthan (India). The sand used in present study was brought from location near from Luni town, at about 20-25 km away from Jodhpur, Rajasthan on Jodhpur–Pali Highway. Fine sand is fine grained, uniform clean sand as per Unified Soil Classification System. Particle size ranges between 75 μ to 4.75 mm which is fine to coarse sand, round to angular in particle shape as per Indian Standard Classification system.

2.2. Bottle Cap (LDPE)

Low density polythene Plastic Bottle Cap of Blue color which is used as cap of bottle liner is used in the present study which has a thickness of 275 microns. The extent of polymerization of LDPE varies from product to product. It was also taken care that the film shall be uniform in color, texture and finish, substantially free from pin holes and undispersed raw materials, streaks and particles of foreign matter, no other visible defects such as melt fracture, holes, tears or blisters. Table 1 presents the properties of plastic waste material.

Figure 1:- Plastic Waste Bottle Cap Strips Used In The Study.

Table 1:- Properties of LDPE Bottle Cap

S. No.	Property	Value
1.	Aspect ratio of strip (l/b)	1.3
2.	Thickness	275 microns
3.	Density at 27ºC (gm./cc)	0.923
4.	Melting point	199ºC

III. TEST PROGRAM AND PROCEDURE

The laboratory investigation on dune sand stabilization with waste plastics of bottle cap as admixture was performed. This work is done for beneficial utilization of waste plastic square pieces of Bottle cap and a mix proportion that can be mixed with fine sand as a best stabilizer with limited detrimental effects.

The objective of the present study is to evaluate the use of fine sand as a construction material after stabilizing it with waste plastics of bottle cap as admixture. The present study has been undertaken with the following objectives:

1. Determination of particle size distribution of fine sand.
2. To study the effect of moisture content on dry density of fine sand.
3. To study the changes in performance of permeability of fine sand mixed with waste bottle cap plastics in different proportions.

3.1. Sieve Analysis or Particle Size Distribution Test

The grain size distribution is found out by conducting sieve analysis test. The test was carried out with Indian Standard Sieve size 4.75 mm, 2.0 mm, 1.18 mm, 600 µ, 300 µ, 150 µ, 75 µ, pan and weigh balance in the laboratory. In sieve analysis there is a nested column of sieve with wire mesh screen. A representative sample of 1000 gm of fine sand have been taken for the analysis and poured into the top sieve which has the largest screen opening of 4.75 mm. The sieves are arranged in descending order from top to bottom according to their opening size. The base is a round pan, called the receiver. The sample was shaken for 10 minutes on sieve shaker. After the shaking, the weight of material retained on each sieve was weighed. Percentage passing through each sieve was calculated and plotted against particle size. The cumulative percentage passing of the sample is found by subtracting the percent retained from 100%.The particle size distribution curve plotted on semi-log scale is shown in Fig. 2.

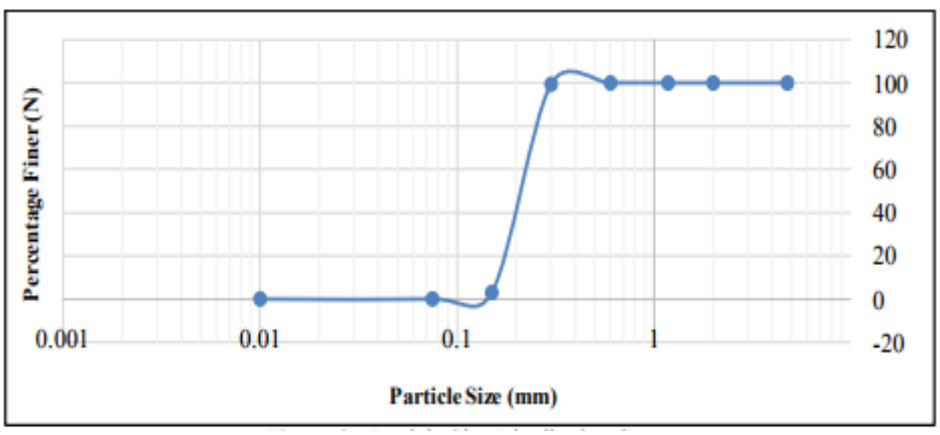

Figure 2:- Particle Size Distribution Curve

Table 2:- Properties of Fine Sand.

S. No.	Property	Test Media (Fine Sand)
1.	Coefficient of Uniformity (C_u)	1.33
2.	Coefficient of Curvature (C_c)	1.06
3.	Mean Diameter (D_{50}) mm	0.22
4.	Effective Size (D_{10}) mm	0.15
5.	Fine Soil Fraction (75 µ)	0.10%

3.2. Standard Proctor Test.

According to IS 2720 (Part VII), in the proctor test the mould recommended is of 100 mm diameter, 127.3 mm height and 1000 ml capacity. About 3 kg of air dried samples were taken for the test. The soil is compacted by 25 blows of the rammer of 2.6 kg mass, with a free fall of 310 mm and a face diameter of 50 mm. the soil is compacted in three layers. The mould is fixed to a detachable base plate.

The result shows that initial decrease of dry density with addition of water is due to capillary tension which is not fully counteracted by the compacted effort and hold the particle in loose state resisting compaction. Dry density further increase with water content and then decrease with further increase in water content. The maximum dry density is obtained as 1.66 gm/cc at O.M.C 12.34%.

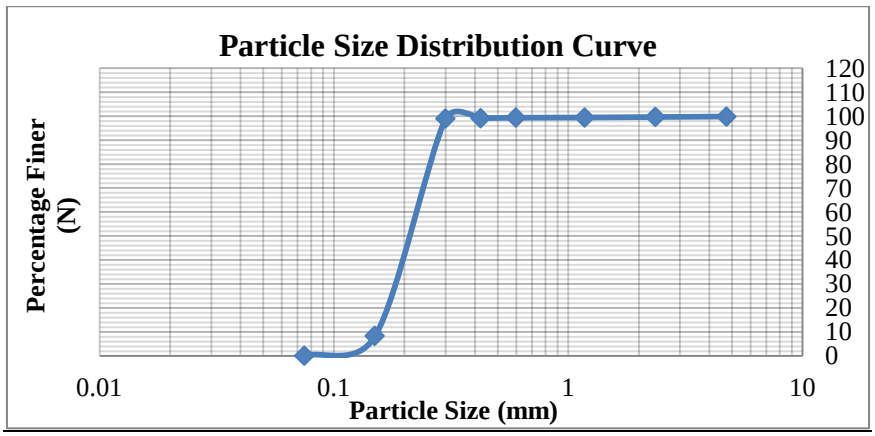

Fig 3:- Dry Density v/s Water Content Curve.

3.3. Variable Head Permeability Test

Permeability is the measure of the ease with which water can flow through a soil sample. Test investigations were carried out on variable head permeameter with mix compositions of 1.66 gm/cc dry density fine sand and bottle cap plastic waste in varying percentages of 0.15%, 0.25%, 0.50%, 1.0% respectively. A conclusion from the test results obtained that coefficient of permeability (k) increases with increase in percentage of bottle cap plastic waste and increase in size also. The test results of variable head permeability tests are given in table 6 and fig. 5.

Table: 3 Variation of Coefficient of Permeability k (cm/sec) with Mix Composition

S.No.	Percentage (%) Admixture	Coefficient of Permeability (cm/sec)
1.	**0.15%**	**1.21×10^{-3}**
2.	**0.25%**	**1.23×10^{-3}**
3.	**0.50%**	**1.42×10^{-3}**
4.	**1.0%**	**1.52×10^{-3}**

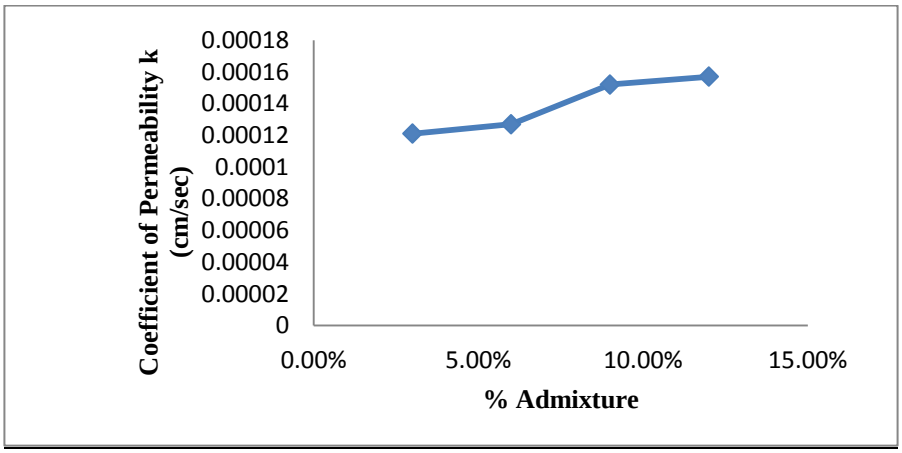

Fig: 4 Variation of Coefficient of Permeability k (cm/sec) with Mix Composition

IV. CONCLUSIONS

In this investigation we have used waste bottle cap plastic in different proportions to study its effect on various geotechnical properties of fine sand of Western Rajasthan. The results of the testing program clearly show that the engineering properties of the fine sand improved considerably due to stabilizing with waste bottle cap plastic. In the present investigation, as we are increasing the quantity of admixture of waste bottle cap plastic materials, the performance of permeability increases. So we have stopped the further increment of admixture. Further study can be done by addition of more amount of admixture.

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