International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 07 | July-2016 www.irjet.net p-ISSN: 2395-0072

EFFECTIVE REUSAGE METHOD OF WASTE MATERIAL – DISPOSED PLASTICS

Pavithra.P.K[1], Sowmiya.P[2], Uma Devi.S[3], Sivapriya S.V[4]

[1]*Undergraduate Student,Department of Civil Engineering, SSN College of Engineering, Tamil Nadu, India*
[2]*Undergraduate Student, Department of Civil Engineering,SSN College of Engineering, Tamil Nadu, India*
[3]*Undergraduate Student, Department of Civil Engineering,SSN College of Engineering, Tamil Nadu, India*
[4]*Associate Professor, Department of Civil Engineering, SSN College of Engineering, Tamil Nadu, India*

Abstract -*As per survey conducted by Central Pollution Control Board, the quantum of plastic waste generation is estimated to be 15343 tons per day. Plastics being non-biodegradable material could retain in soil for long time, thus changing its properties. When plastic has gathered in an area it begins to change the properties of the .The reuse of plastics has become a great challenge to the civilians. So, the use of plastics is considered to have a promising future in the geotechnical aspect making soil to have good strength and permeability. This investigational study involves study of plastics as a strengthening agent to the soil and the study of permeability nature of plastic embedded soil*

Key Words: River Sand, Plastics, Dry Sieve, Specific Gravity, Permeability, Direct Shear

1. INTRODUCTION

Previous experimental study focuses into structural behaviour of soil when it was reinforced with various materials like solid plates, perforated plates, continuous wire, and rectangular shaped fibres comprised of aluminium or mild steel.

Shewbridge (1989) studied the shear strength properties of the soil through direct shear tests with varying reinforcement types.He found out the stiffness and bond strength on the reinforced sand and found that reinforcement increases the strength of the sand.

Choudhary et al., (2010) studied on the feasibility of reinforcing soil with strips of reclaimed HDPE and found out that reinforcing sand with waste HDPE strips enhances its resistance to deformation and its strength.

Anas et al., (2011) studied the behaviour of plastic strips with different D/B ratio to reinforce the soil and found out the ultimate load for soil mixed with optimum amount of plastic strips.

Pragyan et al., (2013)suggested that expensive methods for stabilization can be replaced by the reinforcement with plastic strips which will make the construction process economical and also make the proper arrangement of plastic waste conserving the various component of the environment.

Mishra et al., (2013) analysed that the fibre inclusion changes the behaviour of waste recycled product from brittle to ductile and observed that the ratio of split tensile strength and unconfined compressive strength increases with increase in fibre content.

Poweth et al., (2014) studied on the effect of plastic granules on the properties of soil and found out that the shear stress is maximum when 0.25% of plastic is added and can be used as an effective method in disposing waste plastic materials.

In earlier investigation plastics were used in the form of reinforcement and the behavioural nature of the soil was thus found out for the same.

The present study involves plastics as a substitute for the soil particles and the properties has been found for the same for different number of layers.

2.DESIGN DETAILS:

The river sand collected from Thiruporur, Chennai was dried keeping in oven at 100^0C for 24 hours. Organic matters were removed by physical means.

Properties of soil:

The specific gravity of the virgin soil was determined to be 2.62.

The dry sieve analysis was mainly done to identify the type of soil and its nature (Fig- 1). The soil is classified as poorly graded Sand (SP). Then standard proctor compaction test was performed on the soil and the unit weight of sand was found out to be 18kN/m^3. The angle of internal friction for the soil was found to be 37.65^0 and the permeability for the soil was found to be 0.01625cm/s.

Plastics of unit weight 14.70KN/m^3 and majorly composed of polyvinyl chloride was used. The diameter of plastic used is 0.6cm as this can be easily cut with the help of a punching machine.

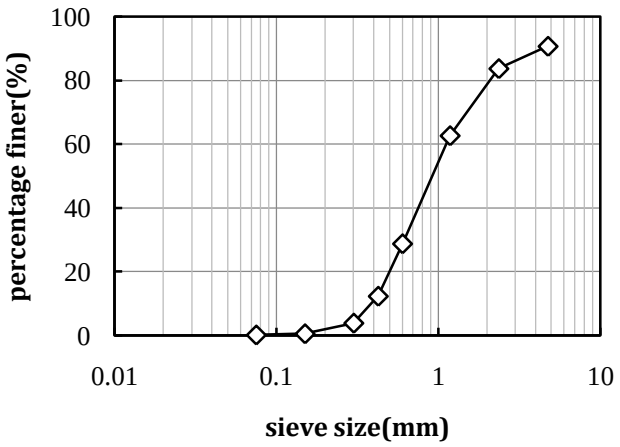


Fig-1: Dry Sieve Analysis

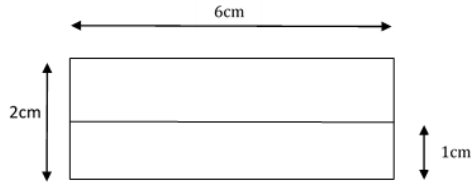
3.EXPERIMENTAL METHODOLOGY:

It has been concluded in studies by Anas et al.,(2011) that plastic strips has given sufficient strength to the soil depending upon the D/B (D- depth and B- width) ratio and plastic proportion used .

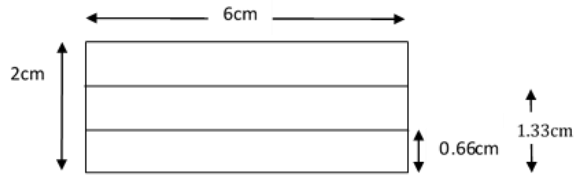
In this study, plastics are used as a substitute for soil particle by varying its relative position with respect to base of the test mould. In order to make the plastics in par with the soil particles, they were punched in circular shape with the help of a punching machine.

The punched plastics were then kept horizontally between the sand layers. Plastics were first kept at the middle layer (Fig- 2a) of the sand constituting 1% of the total sand weight.

It was kept in two layers at one-third and two–third height (Fig-2b) from the bottom of the test mould. The strength and permeability characteristics for the soil were found.



a. Plastics in single layer



b. Plastics in double layer

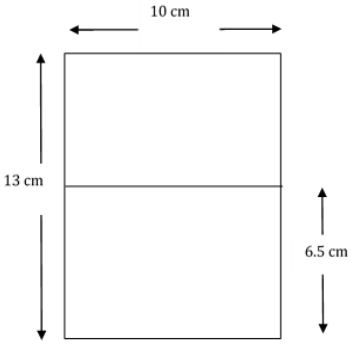
Fig-2 : Layer of plastics in Direct shear test

3.1Direct shear test:

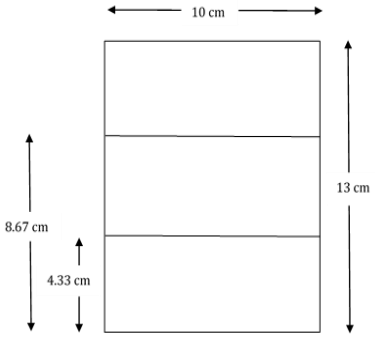
As per IS2720 (PART XIII):1986 code, the horizontal shear load was applied at a constant rate of strain of 0.2mm/minute. The reading of the proving ring, the vertical displacement dial gauge and the horizontal displacement dial gauge was noted at regular time intervals. Several specimens are tested at varying confining stresses to determine the shear strength parameters.

3.2Constant Head Permeability:

In this test, water is forced by a known constant pressure through a soil specimen of known dimensions and the rate of flow is determined. The sample is prepared according to IS: 2720(PART-XVII):1986(Fig-3).



a. Plastics in single layer



b. Plastics in double layer

Fig-3 : Layer of plastics in Permeability test

4. RESULTS AND DISCUSSION:

4.1 Direct shear results:

4.1.1 Sand with plastics kept in single layer:

The punched plastics weighing 1% of the total weight of sand was kept at mid depth of the soil that is a layer of plastics were kept at a depth of 1cm from the base of the shear box. A number of identical specimens were tested

under increasing normal loads and maximum shear force is recorded. The increasing normal loads applied were 0.1 kg/cm^2, 0.4kg/cm^2 and 0.6kg/cm^2. The shear strength and angle of internal friction of modified river sand was found to be 43.45^0.

It was seen that the angle of friction for the soil with single plastic layer was greater than virgin river sand by 27.78%, thus indicating greater shear strength than ordinary river sand.

4.1.2 Sand with plastics kept in two layers:

Similarly, the punched plastics weighing 1% of the total weight of sand was kept at one-third and two-third depth of the soil that is two layers of plastics were kept at a depth of 0.68cm and 1.36cm from the base of the shear box. The angle of internal friction of two layer plastic substituted soil is found to be 53.91^0

It was seen that the angle of internal friction for the soil with double plastic layer was greater than that of ordinary river sand by 43.18% and greater than virgin sand with virgin sand with single layer plastic by 24.07%(Fig-4).

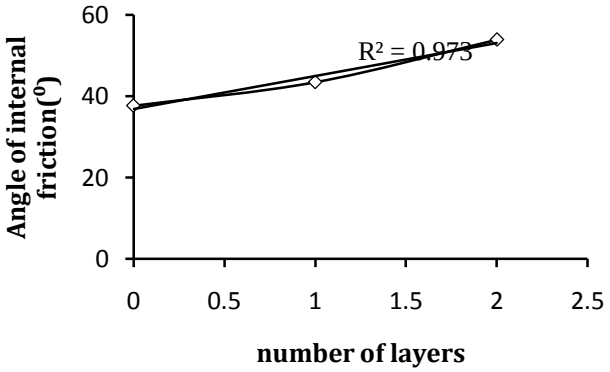


Fig-4: Influence of plastics in direct shear

This shows that there is a linear increase in shear strength with the numbers of plastic layers.

4.2 Permeability test results:

4.2.1 Sand with plastics in single layer

A layer of punched plastics weighing 1% of the total weight of sand was kept at a height 6.5cm from the base of the cylinder. The permeability of sand with single layer plastics at mid depth is 0.02153cm/s.

The permeability value for virgin soil with single layer of plastic is greater than virgin river sand by 32.49%.

4.2.2 Sand with plastics in two layers:

Similarly, the punched plastics weighing 1% of the total weight of sand were kept at one-third and two-third depths from the base of the shear box that is 4.3cm and 8.8cm height from base of the cylinder. The permeability of sand embedded with plastics in two layers is 0.0196cm/s.

The permeability value for virgin soil with two layers of plastic is greater than virgin river sand by 20.61%.The permeability value for virgin sand with two layers of plastics is less than virgin sand with single layer of plastic by 8.96%.

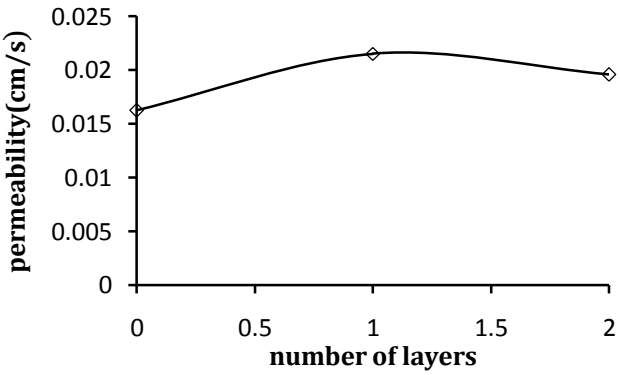


Fig-5: Influence of plastic in permeability test

There is a decrease in permeability value when the number of layers is increased .However; it shows higher value when compared to that of virgin soil. This is mainly due to the voids formed along the plastics. (Fig-5).

5. CONCLUSION

The proper reuse of plastic in current scenario is a challenging job. With the increase in number of layers the shear strength increases linearly. In permeability test, the permeability value decreases with increase in number of plastic layers in a soil profile. Therefore, it is suggested to use plastic substituted sand as a pond liner underlay whose desirable qualities like greater shear strength is satisfied and good permeability.

REFERENCES

[1] A.K. Choudhary, J.N. Jha and K.S. Gill, AStudy On CBR Behavior Of Waste Plastic Strip Reinforced Soil, Emirates Journal for Engineering Research, 15 (1), 51-57 (2010).

[2] AlyAhmed ,KeizoUgai and Takeshi Kamei (2011)," Investigation of recycled gypsum in conjunction with waste plastic trays for ground improvement", Construction and Building Materials, 25(1), 208–217.

[3] Anas Ashraf, Arya Sunil, J. Dhanya, Mariamma Joseph, Meera Varghese and M. Veena(2011) "SOIL STABILISATION USING RAW PLASTIC BOTTLES" Proceedings of Indian Geotechnical Conference, 489 – 492.

[4] Andersland, O. B., and Khattak, A. S. (1979). "Shear strength of kaolinite fiber soil mixtures." Proc., Int. Conf. on Soil Reinforcement, Vol. 1, Association Amicale des EngenieursAnciensEleves de L'EcoleNationale de Ponts et Chausees, Paris, France, 11-16.

[5] Gray, D. H., and Ohashi, H. (1983). "Mechanics of fiber reinforcement in sand." J. Geotech. Engrg., ASCE, 109(3), 335-353.

[6] IS: 2720 – Part XIII- 1986 Indian Standard methods of tests for soils-Determination of shear strength. Bureau of Indian Standards, New Delhi.

[7] IS: 2720 – Part XVII- 1986 Indian Standard methods of tests for soils-Determination of permeability. Bureau of Indian Standards, New Delhi.

[8] http://www.wasteonline.org.uk.

[9] Pragyan Bhattarai, A. V. A Bharat Kumar, K.Santosh, T. C. Manikanta & K. Tejeswini,Engineering Behavior Of Soil ReinforcedWith Plastic Strips, International Journal ofCivil, Structural, Environmental and Infrastructure Engineering Research and Development (IJCSEIERD) ISSN 2249-6866 Vol. 3, Issue 2, Jun 2013, 83-88

[10] Priti Mishra, Jha Ajachi R.B., MohnishSatrawala, Harsh Amin, Experimental Study On Waste Recycled Product (W.R.P.) And Waste Plastic Strips (W.P.S.) As Pavement Sub-Base Material, International Journal Of Scientific & Technology Research ,Volume 2, Issue 12, December 2013 ISSN 2277- 8616.

[11] Shewbridge, S. E., and Sitar, N. (1989). "Deformation characteristics of reinforced sand in direct shear." J. Geotech. Engrg., ASCE, 115(8), 1134-1147.

[12] Mercy Joseph Poweth ,FemeedaMuhammedHaneef ,Melvin T,Jacob ,Remya Krishnan ,SheethalRajan. "Effect of Plastic Granules on the Properties of Soil".Mar Athanasius College of Engineering, Kothamangalam.