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Review on Improvement of Engineering Properties of soil Using Waste Plastic Bottles Strips (Polyethylene Terephthalate)

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ABSTRACT: From the ages, researchers are trying to find the best and the cost-effective material for the soil stabilization including the virgin and waste materials of any kind which could be useful for the reason. But the research does not end and everyday some new idea is evolved. So I being an investigator when I began to think of some narrative method of stabilization of soil I through of using the waste plastic empty PET bottles of soft drinks etc being thrown in the waste by the people. One day when I came to know about the amazing figures (online), that about no. PET bottles in the world are inspired by the people and which are not being used (due to health reasons) it is strictly a enormous trouble to organize of such a huge superiority of such type of waste plastic. These are not being used and a vast load and a big problem for the civil administration as it creates a lot of problem in organizing their disposal. So to convert a shade into a supreme beneficial use I chose it as a mode of my research for soil stabilization in some diverse manner as it might have been used by some researches in a different way. So it is the topic of my research "Improvement of properties of clayey soil using waste plastic bottles strips".

Keywords: Soil Stabilisation, Fibers of Waste Plastics, Reinforcement, Polyethylene terephthalate, Maximum Dry Density, Optimum Moisture Content, Unconfined Compressive Strength. Soaked California bearing ratio test.

I. INTRODUCTION

The soil is feeble and does not have enough constancy to bear heavy loads. The endeavor of the study is to make use of waste material for stabilization of soil. A number of materials of reinforcement are accessible for stabilization of soil which is generally different type of fibre. For this project I have selected the use of waste plastic PET bottles of cold drinks which are usually found available as waste in plenty in every nook and corner of not only in our nation but in the entire world as these days each day is found of overwhelming it as a food. After consumption all the empty bottles are thrown into the waste baskets or in the open. These are not recyclable and create hazards in the surroundings and to leaves a gigantic unfavorable impact on the health of people. If these empty bottles are reused as a construction material instead of being burnt or disposed of in any other way. Their unique properties once again can be demoralized in a beneficial manner. The benefits of using scrap are particularly improved if they can be used to restore virgin construction materials made from in renewable sources.

The mixture of plastic strips with soil for embankment/ construction will not only provide alternative means of reusing this types of fiber to address economic and environmental concerns but also will help to solve geotechnical problems associated with low soil shear strength. If the PET waste are reused instead of being disposed of or burnt their exceptional properties can once again be beneficial in sustainable material stream. There are many available techniques for improving the mechanical properties of soil. The techniques employed to improve the properties of soil in respect of strength and other relevant characteristics of soil can be put into the following categories.

(i) Soil stabilization
(ii) Soil reinforcement with continuous planer members/sheets
(iii) Soil reinforcement with randomly mixed fibers /discrete members called ply soil.

II. PURPOSE OF REVIEW

The intention of this assess is to bring in and summaries journalism pertaining to the application of waste polypropylene fibers as strengthening in the soil by investigating the performance of experimental soil test samples. The assessment is restricted to published research reports, journal articles, and conference proceedings.

This reviews prepared to demonstrate the value added to basics by the use of geosynthetic reinforcement. In especial, the review is designed to illustrate the benefits derived from waste polypropylene fiber reinforcement, the conditions under which reinforcement is good, the polypropylene properties that are most influential for this function, and the mechanisms responsible for reinforcement. The ends of this unit are used subsequently to evaluate existing design procedures, to comment on developing application specifications.

All work reviewed in this division is taken at face-value, implying that the study has not been reviewed in the process of inspection. Every effort has been constituted to describe the details and conclusions as contained in the original references.

III. STUDIES ON STABILISATION OF SOIL USING WASTE MATERIALS

(i) Disposal of plastic waste in an environment is considered to be a big problem due to its very low biodegradability and presence in large quantities, In recent time use of such, Industrial wastes from polypropylene (PP) and polyethylene terephthalate (PET) were studied as alternative replacements of a part of the conventional aggregates of concrete. Plastic recycling was taking position on a significant scale in an India, As much as 60% of both industrial and urban plastic waste is recycled which obtained from diverse authors, Masses in India have released plastic wastes on a large scale have huge economic value, as a result of this, recycling of waste plastics plays a major function in providing employment.

(ii) The analysis was done by conducting plate load tests on soil reinforced with layers of plastic bottles filled with sand and bottles cut to halves placed at middle and one-third positions of tank. The comparison of test results showed that cut bottles placed at middle position were the most efficient in increasing strength of soil. The optimum percentage of plastic strips in soil was found out by California Bearing Ratio Test and using this percentage of plastic, plate load test was also performed. The size and content of strips of waste plastic bottles have significant effect on the enhancement of strength of the soil.

(iii) This study investigated the possibility of utilizing polyethylene shopping bags waste to reinforce soils to pave way for its use in civil engineering projects such as in road bases, embankments and slope stabilisation. The testing of direct shear test programme involved addition of solid strips as well as perforated strips with varied diameter of perforations to examine the effect of the openings on the strips. Laboratory results obtained favorably suggest that inclusion of this material in sandy soils would be effective for ground improvement in geotechnical engineering.

(iv) This study was based on finding out the existing waste management system with reference to PET bottles in Mumbai. The result indicated that an average 25,03,334 virgin PET bottles were used for packing carbonated soft drink and water bottles per month average consumption of Hotels, Airline and Caterers was 7.5kg/day, 70.25kg/day and 11.75kg/day respectively. These bottles were sold to recyclers at the rate of Rs 5-10/kg. These bottles were finally recycled into various productions like fibres, strapping, sheets etc.

(v) From the paper various conclusion in the aspect of strength, cost and other various field can be recommended. Plastic can be one of the material which can be used as a soil stabilizing agent but the proper proportion of this must be there, which aids in increasing the CBR of the soil and also when the aspect ratio is increased then the strength parameter is also increased but use of more Aspect ratio also decrease the CBR value. This shows that plastic strips can be used as a reinforcing material in stabilization of the sub-grade soil if used in right proportion. This can be used for stabilization of soil of embankment, pavement sub grade and other different fields as per the needs and flexibility. Further research is advisable for its more effectiveness (Pragyan Bhattarai *et. al.,* 2013).

(vi) After analyzing the test results it has been found that on adding plastic strips into the soil, it increases the CBR value and makes the sub grade impermeable. It has been found that the maximum CBR is obtained when plastic strips are cut in the Aspect Ratio 3 and have been added to the soil at a percentage of 0.5% by weight of soil. As a conclusion use of plastic strips as an admixture in road soil sub-grade soil has the following advantages

1. It will offer an economical soil stabilizer compared to cement, lime etc.
2. It will provide another method for plastic waste management (Tom Damion *et al.,* 2016) [2].

(vii) The aggregate mix is heated and the plastic is effectively coated over die aggregate. This plastic waste covered aggregate is mixed with hot bitumen and the resulted mix is used for road construction. The use of the innovative- technology will not only strengthen the road construction but also increase the road life as well as will help to improve the environment, Plastic roads would be a boon for India's hot and extremely humid climate, where temperatures frequently cross 50°C and torrential rains create havoc, leaving most of the roads with big potholes.

(viii) This paper was evaluated the engineering properties on utilizing waste plastic High Density Polyethylene (HDPE) and waste crushed glass as additive on sub-grade improvement. The soaked California Bearing Ratio (CBR) and Triaxial test to some clayey soil samples. Test results were shown that engineering properties and CBR on stabilized clayey samples were increased when the content of waste HDPE and Glass were increased (Achmad Fauzi, & Zuraidah Djauhari, (2016) [3].

(ix) The main objective of this paper is to explore the use of groundnut shell ash and waste fiber material in geotechnical applications and to evaluate the effects of groundnut shell ash and waste polypropylene fibers on the shear strength of unsaturated soil by carrying out direct shear tests and unconfined compression tests on the soil sample. Overall it can be concluded that the groundnut shell ash and polypropylene fiber reinforced soil can be considered to be good ground improvement technique especially in engineering projects on weak soils where it can act as a substitute to deep/raft foundations, reducing the cost as well as energy (Murali Krishna and Shekun Beedi, 2006) [4].

(x) The main objective of this study is to investigate the use of waste fiber materials in geotechnical applications and to evaluate the effects of waste polypropylene fibers on shear strength of unsaturated soil by carrying out direct shear tests and unconfined compression tests on two different soil samples.

The following are the conclusions from these tests

1. Strength of the soil is directly proportional to specific gravity, more is the specific gravity more will be the strength of soil.
2. Based on liquid limit of a soil - The value of the shrinkage limit in reinforced soil is less than that of unreinforced soil. Hence with the use of polypropylene fiber shrinkage reduces.
3. The value of shrinkage limit is used for understanding the swelling and shrinkage properties of cohesive soil. Lesser is the shrinkage more will the suitability of material for foundation, road and embankment as more will be the strength (Tiwari and Tiwari, 2016) [5].

In this research work, The physical properties of the "Plain Soil" as well as "Reinforced Soil" such as utmost Dry Density at Optimum Moisture Content, Direct Shear Strength Parameters and Unconfined Compressive Strength have been firm with the use of waste fibers polypropylene in variation of length and different percentage of waste fiber material by weight of the dry soil sample.

The following conclusions are drawn:

(i) In case of the compressibility, it is concluded that there is insignificant decrease in the maximum dry density (Υ_d (max)), with the addition of waste fibers of the polypropylene.

(ii) The direct shear strength parameters of the soil reinforced with waste fibres of polypropylene used for the improvement of the engineering properties of the soil with 20 mm length and 0.35% weight of polypropylene by weight of dry soil sample is found as 25.18% increase in the angle of internal friction (Φ) and 46.88% increase in cohesion (c).

(iii) The unconfined compressive strength (UCS) of the soil unbreakable with waste fibers of polypropylene used for the improvement of the engineering properties of the soil with 20mm length and 0.25% weight of polypropylene by weight of dry soil sample is found as 52.80% increase in UCS (Shish Pal *et al.,* 2015) [6].

An experimental study was carried out to investigate the dry density and CBR behavior of waste plastic (PET) content on stabilized red mud, fly ash and red mud fly ash mix. The study reveals that addition of waste plastic (PET) content in red mud, fly ash and red mud fly ash mix resulted in an appreciable increase in the dry density and CBR values. The benefit of adding waste plastic content beyond 2% does not improve the dry density and CBR values appreciably. The material can be used in base courses in constructing rural roads. There by leading to safe disposal of these waste materials in an environmentally friendly manner [7].

IV. FINDINGS FROM LITERATURE REVIEW (GAPS IDENTIFIED)

Following observations may be drawn from the broad overview of the literature presented in this chapter.

(i) Extensive research work is reported on use of oriented and randomly oriented fiber reinforcements using laboratory testing, while this brought out the positive improvement of geotechnical behavior of soil. However, little work is reported on the use of waste fiber Polyethylene Terephthalate materials.

(ii) Waste plastic bottles are effortlessly accessible in many parts of India and also having low cost reasonably to other material.
(iii) The impression has brought out the need for efficient investigations into the diverse aspects of reinforcement in particular considering the influence of types of waste fiber inclusions.
(iv) The bulk of works carried out in the field of sub-base or base improvements of the various types of pavements using coir geotextiles to organize erosion and watershed management. Only a few works have been reported concerning the consumption of polyethylene for the development of engineering properties of soil. Therefore, a range of systematic research work in this area is deficient.

V. NEED FOR PRESENT STUDY

The evaluation of literature shows that polyethylene terephthalate is a flexible material with eye-catching characteristics and advantages, as a consequence of this polyethylene terephthalate is now being used plentifully all over the world. Waste plastic bottles strips have high potency, less expenditure, extensive life and also, they are non-biodegradable, therefore, may be used for the development of engineering properties of the soil (stabilization of soil) and may be used to manage leakage. The use of waste plastic will result in declining the requirement of valuable land for the disposal of waste and it will also reduce the ecological impacts. Therefore, in this work an attempt is to be made for utilization of waste fiber material produced from polyethylene terephthalate for the enhancement of engineering properties of soil.

VI. CONCLUSION

From the above consideration it can be concluded that there is a dreadful need to utilize the waste plastic (PET) collect from a range of sources the waste all over the oppose for the stabilization of soil which will assist to the most extent to decline the necessity of priceless land for their removal and also diminish the dangerous environmental impacts.

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