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Review Study of soil behavior mix with waste Plastic

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ABSTRACT
Infrastructure is a major sector that propels overall development of Indian economy. The foundation is very important for any structure and it has to be strong enough to support the entire structure. For foundation to be strong the soil around it plays a very important role. Expansive soils like black cotton soil always create problems in foundation. The problems are swelling, shrinkage and unequal settlement. Plastic wastes have become one of the major problems of the world. Use of plastic bags, bottles and other plastic products is exponentially increasing year by year. Due to which we are facing various environmental problems. Therefore the correct way disposing off of the plastic waste without causing any ecological hazard has become a real challenge today. A review paper in presented here to focus on soil stabilization methods by using waste plastic products in past studied. We will study soil behavior mixed with various waste plastic constitute in different percentages such as 5%, 10% and 15% mix by weight of concrete.

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I. INTRODUCTION

The Properties of a soil are very uncertain when it is subjected to variable moisture. It shows huge volumetric change when exposed to dry and wet conditions. This is due to presence of active clay mineral. When water occupies large space in the voids of soil the strength of soil changes. These changes create challenges for civil engineers doing work on site specially while constructing foundations. Though black cotton soil is unfit for infrastructural development, they are useful to protect environment and waste disposal. For the construction of any kind of structure resting on weak soil, various available methods are used to improve the bearing capacity and reduce the settlement of soils. One of the methods is using plastic fiber. The concept reinforcement of soil by using fibers was developed in the 19th century. The main objective of reinforcing the soil was to upgrade its properties. The reinforcing consumption of plastic in India. The consumption of plastic in different forms is increasing by an average of 10% every year. Rate of generation of waste in Indian cities ranges between 0.20-0.87 Kg/day, depending upon the region's living standard and the size of the city. About 1.3% per capita per year waste generation is increasing by about 1.3 % in India. Every year about 8 million tons of plastic is dumped into the world's ocean.

Plastic waste classification Plastics waste is of two types:
Pre-use plastic (production scrap)

material introduced in the soils alters the strength and deformation characteristics of the soil. Plastic is considered as one of the best invention in many aspects of life. The amount of plastic waste is increasing year by year. Due to this the need of plastic waste management has increased so that it can be used as soil stabilizer and in other ground improvement techniques as it behaves like reinforcing material. Hence to make the development path sustainable the use of plastic waste in geotechnical engineering needs to be encouraged. By doing so, Properties of soil will be improved and reuse of plastic can also be made efficiently.

1 Data on Generation of Plastic waste and Plastic Consumption: The consumption of Plastic in India is about to reach 200 lakh tones by the year 2020 due to growing use of different forms of the commodity. In 2016 about 140 lakh tonnes were the Post-useplastic Pre-use plastic that plastic which does not fulfil the desired requirement during casting and assembly i.e. material that has the mismatching colour, undesirable hardness, or wrong processing characteristics are called Pre-use plastic waste. This material is easy to use for other applications and has the property to get recycled. Pre-use plastic waste is the ultimate source of plastics which are suitable for reprocessing from manufacturers of plastic products. Processing of Pre-used plastic is less as compared to post-use hence Pre-use is more valuable then Post-use plastic.

Post-use plastic Post-use plastic waste suitable for recycling generally falls into one of five main categories: Plastic bottles, pots, tubs and trays , Plastic film, Rigid plastics, such as crates, pipes and moldings Plastic foams, such as expanded polystyrene (EPS), Flexible plastics, such as strapping and cable sheathing

II. LITERATURE REVIEWS

Akshat Malhotra and Hadi Ghasemain et al in 2014 studied the effect of HDPE plastic waste on the UCS of soil. In a proportion of 1.5%, 3%, 4.5% and 6% of the weight of dry soil, HDPE plastic (40 micron) waste was added. They concluded that the UCS of black cotton soil increased on addition of plastic waste. When 4.5 % plastic waste mixed with soil strength obtained was 287.32KN/m2 which is aximum because for natural soil it was 71.35KN/m2.

Achmad Fauzi *et.al.* (2016) used two soil samples R2 and R24 collected from various sites of Kuantan. Waste cutting HDPE and crushed waste glass were used as additives. The variations of additive contents were 4%, 8 %, 12 % by dry total weight of soil sample respectively. They evaluated engineering properties like sieve analysis, Atterberg limit, Specific gravity, Standard Compaction, soaked California bearing ratio and tri-axial test of the soil sample before stabilization and after stabilization. The result showed that on addition of waste HDPE and glass there was an increasein PI, about 10% for R24 and 2% for R2 samples respectively. The value of optimum water content decreases and MDD increases when content of waste HDPE and glass were increased but there was an increase in CBR value.Authors also observed that there was a decrease in the value of cohesion and increase in friction angle of R2 and R24 samples with additives.

A.I.Dhatrak *et.al.* (2015) calculated the engineering properties by mixing waste plastic. It was observed that for construction of flexible pavement to improve the sub grade soil of pavement using waste plastic bottles chips is an alternative method. In a proportion of 0.5%, 1%, 1.5%, 2%, and 2.5% of the weight of dry soil, plastic waste was added to calculate CBR value.He concluded that using plastic waste strips will improve the soil strength and can be used as sub grade. It is economical and eco-friendly method to dispose waste plastic.

Anas Ashraf *et.al.* (2011) studied on the possible use of plastic bottles for soil stabilization. The analysis was done by conducting plate load tests on soil reinforced with layers of plastic bottles filled with sand. The bottles cut to halves placed at middle and one third position of tank. The test results showed that cut bottles placed at middle position were the most efficient in increasing strength of soil.

Bala Ramudu Paramkusam *et.al.* (2013) performed an experimental study to investigate the stabilization effect of waste plastic on dry density and CBR behavior of red mud, fly ash and red mud, fly ash mixed with different percentage of waste plastic (PET) content. Based on light compaction tests, authors concluded that MDD value of the red mud, fly ash mixed with plastic increases as the waste plastic increases till 2%, further increase in plastic waste reduces the MDD value. OMC value remains same in each case. A marked increase in CBR value was also observed on adding 0.5%, 1.0%, 2.0%, of waste plastic and was found to be decreased after inclusion of 3% and 4%. Increase of CBR value indicates that the thickness of pavement can be reduced by addition of waste plastic content up to 2%.

Choudhary, Jha and Gill et al in 2010 demonstrated the potential of HDPE to convert as soil reinforcement by improving engineering properties of sub grade soil. From waste plastic HDPE strips are obtained and mixed randomly with the soil and by varying percentage of HDPE strips length and proportions a series of CBR tests were carried out on reinforced soil. There results of CBR tests proves that inclusion of strip cut from reclaimed HDPE is useful as soil reinforcement in highway application.

Chebet et al in 2014 did laboratory investigations to determine the increase in shear strength and bearing capacity of locally available sand due to random mixing of strips of HDPE (high density polyethylene) material from plastic shopping bags. A visual inspection of the plastic material after tests and analysis indicates that the increased strength for the reinforced soil is due to tensile stresses mobilized in the reinforcements. The factors identified to have an influence on the efficiency of reinforcement material were the plastic properties (concentration, length, width of the strips) and the soil properties (gradation, particle size, shape).

Jasmin Varghese Kalliyath *et.al.* (2016) studied the effect of plastic fibers. Various tests such as Standard Proctor, UCC were carried out with different samples of silty clay. Authors observed that the replacement of 0.5 % waste plastic fiber to the expansive clayey soil reduce its OMC and increased maximum dry density but UCS of the soil was found to be increased. The test results also showed that with 1% replacement, MDD and UCC were less than the 0.5 % replacement but greater than the untreated soil. Further increase in the plastic replacement showed decrease in the MDD and the UCS. The increase in the MDD of the soil with 1% replacement is due to the decrease in the number of voids with the addition of plastic which leads to effective compaction and also increase in the cohesion. Thus authors concluded that optimum percentage of plastic was 0.5 % for optimum results.

Mercy Joseph Poweth *et al*. (2014) investigated the effect of plastic granules on weak soil sample with plastic and without plastic granules in varying percentage. The percentage of waste plastic was taken as 0.25%, 0.5 %, 0.75%. Maximum dry density was obtained when 0.25 % plastic was added and OMC was less than the soil without plastic for this percentage of soil. Further CBR value decreases when 0.25 % plastic is added but it was found to be increased for 0.75 % of plastic. Authors also observed that for the same percentage of plastic, shear stress was maximum. Pragyan bhattarai et al (2013) studied about the Engineer-ing behaviour of soil reinforced with plastic strips. The indi-cate that the plastic strip reinforcement act as an efficient stabi-lizing agent. From this study it is clear that the plastic strip contained soil specimen have much strength as compared to the unreinforced soil specimen. The CBR value increases by the addition of plastic strip in the soil with different percent-age. The study reveals that addition of plastic waste as a strip is cost effective method of soil stabilization.

Rajkumar Nagle et al in 2014 performed CBR studies for improving engineering performance of sub grade soil. They mixed Polyethylene, Bottles, Food packaging and shopping bags etc as reinforcement with black cotton soil, yellow soil and sandy soil. Their study showed that MDD and CBR value increases with increase in plastic waste. Load bearing capacity and settlement characteristics of selected soil material are also improved.

Subhash, K. *et.al*. (2016) conducted experimental study on soil stabilization using glass and plastic granules mixed with varying percentage. Modified Proctor tests were carried out to study OMC and CBR. They concluded that there is a decrease in MDD on addition of glass and plastic in varying percentages. The MDD of 1.53 gm/cc was obtained at 6% of glass and plastic. The maximum OMC was obtained as 22.6% at 6% mixing of additive. Further, an increase in the OMC was observed, maximum value of OMC was obtained as 22.6% at 6 % glass and plastic additive with the soil. An increase in the UCS from 0.609 Kg/cm2 to 3.023 Kg/cm2 which is about 5 times as that of virgin soil. Maximum CBR value was 7.14 %, which is 2 times of CBR of virgin soil.

III. CONCLUSION

From the studies conducted by various researchers, it can be concluded.

1. The plastic inclusions can improve the strength thus increasing the soil bearing capacity of the soil.
2. Every year a lot of plastic waste is generated and occupied a lot of space. It is necessary to find a solution for the problem. Based on literature, one of the solutions is use of plastic waste in soil reinforcement and stabilization.
3. Results of various researchers give positive indication to the possibility of using the versatile plastic products such as plastic bags, bottles, containers and packaging tapes etc. for reinforcement and stabilization of soil. Successful application could help to reduce the amount of plastic waste which is disposed off to landfills and contribute to sustainable development by providing low-cost material to the resource intensive geotechnical industry.
4. Disposal of plastic waste without environmental hazards has become a real challenge for our society. Therefore, the use of plastic waste as a soil stabilizer is a cost effective and profitable use.
5. Use of plastic waste as reinforcement is recommended to reduce the quantities of plastic waste, which creates the disposal problem. Successful application of plastic waste could help to reduce the amount of plastic waste which is disposed of to landfills and contribute to sustainable development by providing low cost material to the resource intensive geotechnical industry.
6. Nominal research has been done in India to determine the availability of feasible waste materials and the suitability of these materials for Indian roads. The results are better and more durable with a higher strength and reduction of permeability of the soil. However further study is needed:
   i. To optimize the percentage of plastic waste content.
   ii. Large scale test is also needed to determine the boundary effects influence on the test results.
7. Reinforcing sand with waste HDPE strips enhances its resistance to deformation and its strength. However further study is needed to optimize the size and shape of strips and to assess the durability and aging of the strip. Large scale test is also needed to determine the boundary effects influence on test results.
8. Various models are proposed to predict shear strength parameters. Additional experimental results are needed to validate these proposed design models and further modifications are required. Available models are limited in scope involving some parameters either difficult to estimate or some value is suggested applicable to particular soil fibre studied. Yet, no complete model is available to account for all parameters affecting strength of Randomly Distributed Fiber Soil (RDFS).
9. Utilization of waste HDPE and Glass were eliminates need for expensive borrow material and promotes cost saving through decreasing of pavement thickness, solving disposal problems.

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