iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 **Issue:** IV **Month of publication:** April 2022

DOI: https://doi.org/10.22214/ijraset.2022.41299

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue IV Apr 2022- Available at www.ijraset.com

Soil Stabilization by Using Inorganic Waste

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Abstract: ***Soil stabilization is a process which improves the physical properties of soil, such as increasing shear strength, bearing capacity etc. which can be done by use of controlled compaction or addition of suitable admixtures like bituminous, lime and waste materials like plastic ,fly ash, phosphor gypsum etc. This new technique of soil stabilization can be effectively used to meet the challenges of society, to reduce the quantities of waste, producing useful material from non-useful waste materials. Plastic such as shopping waste bottles and bitumen is used to as a reinforcement to perform the CBR studies while mixing with soil for improving engineering performance of sub grade soil. Plastic strips obtained from waste plastic were mixed randomly with the soil. A series of California Bearing Ratio (CBR) tests ,unconfined compressive strength test(UCS) were carried out on randomly reinforced soil by varying percentage of plastic and bitumen respectively with different proportions. Results of CBR tests demonstrated that inclusion of waste plastic strips in soil with appropriate amounts improved strength and deformation behavior of sub grade soils substantially.***

Keywords: CBR, Plastic bottle, Plastic bag, Bitumen, Soil Stabilization

I. INTRODUCTION

Inorganic waste is a type of waste that does not contain organic compounds. This waste is generally very difficult to decompose by microorganisms. Glass, aluminum cans, dust, and metal are some examples of inorganic waste. In this process we are working on Black Cotton Soil. Mainly there are three types of stabilization methods i.e. Mechanical stabilization, Chemical stabilization and Polymer stabilization. Black Cotton Soils are major problematic soils for tropical countries like India. The poor temperate zone standards and difficult to use for road and air field construction because they are often expansive due to the presence of large percentage of expansive clay minerals . These soils swell when in contact with water and shrink on drying .The Black Cotton Soil is characterized by very low bearing capacity, high compressibility, low permeability and high volume change under changing moisture conditions. They tend to lose strength further upon wetting and other physical disturbances. For the purpose of enhancing the engineering properties of this soil by mechanical or chemical means or both, soil stabilization will be conducted by adding a Bitumen Road Waste to the soil. Soil stabilization with bitumen is one of the oldest methods used to improve soil properties. When bitumen mixed soil it binds the particles together by providing cohesive strength to the soil mass (i.e. cementation action) and acts as waterproofing agent. The Black Cotton Soil which is very fertile and suitable for agriculture but not good for construction of civil engineering structures because of its low bearing capacity and intensive shrink-swell process which results in development of cracks. With the rapid industrialization and bursting population and decrease of available land, more and more number of buildings and other civil engineering construction has to be carried out on available Black Cotton Soils which are having poor shear strength. Hence, a great diversity of ground improvement techniques such as soil stabilization is needed to be employed to improve behavior of soil.

II. LITRETURE REVIEW

1) *Tarun Kumar 2013:* This study is carried out on the development of the roadways which is very important and required to be strong enough to support different loads. To meet these challenges plastic wastes are used in the forms of strips of various sizes for identifying the required percentage amount of plastic strips and providing the alternative way for disposing the plastic wastes. To study this reinforcing effect of mixed plastic strips in soil, a series of standard proctor and unsoaked CBR tests have been conducted and based on this it is observed that the maximum dry density of plastic mix soil decreases with increase of percentage of plastic strips, and for CBR increases with increase of percentage of plastic strips within a certain limit. Based on this conclusion should be drawn is that by increasing the amount of plastic contents , the value of the MDD decreases whereas the value of OMC increases. There is increase in CBR value for soil with increasing the percentage of plastic strips. The maximum CBR value is obtained when the percentage of the plastic strips is 0.8% of dry weight of soil. Hence 0.8% of strips having length of 2cm is considered as required amount.

2) *Mercy Joseph Poweth 2014:* This work presents a study on the effect of plastic granules on the properties of soil. Utilizing the waste plastic as granules in the soil solves the problem of disposing the waste and it does not show any considerable reduction in the strength of soil. Experiments were done by taking an available weak soil as sample. These tests are conducted on soil with varying percentage of plastic granules and without adding it and comparing those results. Data presented includes dry density, shear strength, CBR value, permeability. The experiment reveals that properties of the soil does not change considerably. The proposed technique can be used as an effective method to dispose the waste plastic.
3) *Pragyan Bhattarai 2014:* This paper reflects that plastic wastes can be used in stabilization of soil which is concluded from various tests conducted on fiber reinforced soil with varying fiber content and different aspect ratio and profound analysis of their results depicts that it can be used in the fields. Therefore, it is of utmost importance considering the design and construction methodology to maintain and improve the performance of such pavements. In this paper, different means of plastic waste as shopping bags and other plastic material which is locally available are used so as a reinforcement to perform the CBR studies while mixing with soil for improving engineering performance of sub grade soil. In this the Plastic strips which are collected for stabilization of soil were mixed randomly with the soil. With this a series of California Bearing Ratio (CBR) tests were carried out randomly reinforced soil in which the percentage of plastic strips with varying percentage of plastic strips with different lengths and proportions were carried on. And the results and conclusion were summed up which shows that use of plastic in soil in an appropriate amount really aids in improving the strength of soil and also helps in modification of soil properties which might be in term of strength of sub grade soil.
4) *K. Geetha Manjari (2017):* Presented paper on Compressibility and permeability behavior of plastic waste mixed Sand'. According to their investigation, they provided experimental results on the one-dimensional compression test and permeability for plastic waste mixed sand. Based on experimental test results, it was observed that the compressibility and permeability reduced significantly with addition of a small percentage of plastic waste to the soil. In his analysis, to investigate the effects of plastic waste on the engineering properties of soils, a series of tests were performed on sand. One-dimensional consolidation test was performed for different percentages of plastic waste mixed sand.
5) *Devashish kushwah 2017:* 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.
6) *Sayli D. Madavi 2018:* For the construction of any civil engineering structure the foundation is very important as it supports the structure and to achieve this strength stabilization of soil is required. Soil stabilization is done by addition of suitable admixtures like cement, lime, sand, fly ash. It is required to incorporate the new techniques of soil stabilization which can be effectively used to meet the challenges of society, to reduce the quantities of the waste and producing useful material from the non-useful material which cannot easily recycled. This study reviews the experimental program conducted for stabilization of black cotton soil in the Amravati, a Capital of newly formed Andhra Pradesh state. They performed series of CBR testing to find out optimum amount of plastic content is required for obtaining maximum CBR value. It can be concluded that CBR percentage goes on increasing up to 4% plastic content in the soil and thereon it decreases with increasing the plastic content. Hence, we can say that 4% of plastic content is the optimum content of plastic waste in the soil. Thus, using plastic as a soil stabilizer is an economical and gainful usage because there is lack of good quality soil for various constructions. These techniques can be serves the purpose of reducing pollution and meet the challenges of Amravati, and also to the whole society, producing useful material from non-useful waste materials.
7) *Firake Dipeeka B 2018:* In the present work the use of polypropylene fibers for improving properties of black cotton soil. The comparison of properties of soil with addition of varying percentages of fibers by dry weight of soil and having different aspect ratios is also carried out. The addition of polypropylene fibers resulted in increase in optimum moisture content and decrease in maximum dry density. Direct shear tests conducted on soil shows increase in value of cohesion and decrease in value of angle of internal friction. With the inclusion of the fibers increase in CBR value and unconfined compressive strength is observed.

8) *Dinesh Sellakuty 2018:* Soil is a most essential component of the earth's ecosystem. But now a day's the soil is getting polluted due to disposal of waste plastic materials by human beings. For engineering consideration's, black cotton soil is one of the challenging material for construction purpose, which will not easily get stabilized due to its high potential of shrinking and swelling as an effect of change in moisture content. It will minimize the stability and shear strength of black cotton soil when compared to other types of soil. This paper explains stabilization of black cotton soil through application of PET (Polyethylene Terephthalate) bottles which is efficiently used to come across the challenges of society, to reduce the quantities of plastic wastes, to improve the physical properties of soil, such as shear strength, bearing capacity through controlled compaction. PET (Polyethylene Terephthalate) bottles are used in different proportion (3%, 5%, and 7%) in size is less than 0.5 mm. Then index Properties test, Standard Proctor, Unconfined Compressive, Moisture Content and California Bearing Ratio are conducted to find the properties of soil which will increases the bearing capacity of soil.

9) *Rebecca Belay Kassa 2020:* This paper shows the outcomes of an attempt to reinforce and stabilize expansive clay soil with plastic bottle strips. The plastic strips were prepared and added at three different mixing ratios (0.5%, 1% and 2%) by weight and in three different aspect ratios (5 mm × 7.5 mm, 10 mm × 15 mm, 15 mm × 20 mm). The experimental results showed that there was a significant improvement in shear strength parameters.

10) *S. Datta 2021:* The purpose of the assessment is to assess the waste material is to evaluate the waste material with an audit on the modification of clayey soil utilizing crushed concrete aggregates. This proposal presents the outcomes of an assessment that explored the utilization of wrecked concrete in the adjustment of extensive clayey soil. In this study, the California bearing ratio (CBR) tests were done on the clay soil mixed with coarse aggregates of similar size and extents. The soil samples were made and analyzed first with no coarse aggregates, then by mixing coarse aggregates in changing percentages by weight, for example, 0%, 30%, half, and 70%.

III. CONCLUSION

The laboratory UCS and CBR tests conducted on the two soils stabilized with mixtures of bitumen and cement revealed that the soil samples experienced increase in strength as the proportion of cement content increased and proportions of bitumen in the mixture reduced. In nutshell, stabilizing expansive clay soil with waste plastic bottle strips is a reliable alternative as it improves the volume fluctuation problems of the soil. The strips were acting as reinforcements playing a role of arresting volume changes with change in water content. Incorporating waste plastic bottles in the construction industry also is a crucial way to solve the issue of insufficient plastic waste disposal. The laboratory results presented in the study favorably suggest the possibility of utilizing plastic material as tensile inclusions in expansive soil to increase the resistance to shear, CBR value and reduction in swelling. However, a better understanding of the interaction mechanism in soils reinforced with the plastic material would be essential.

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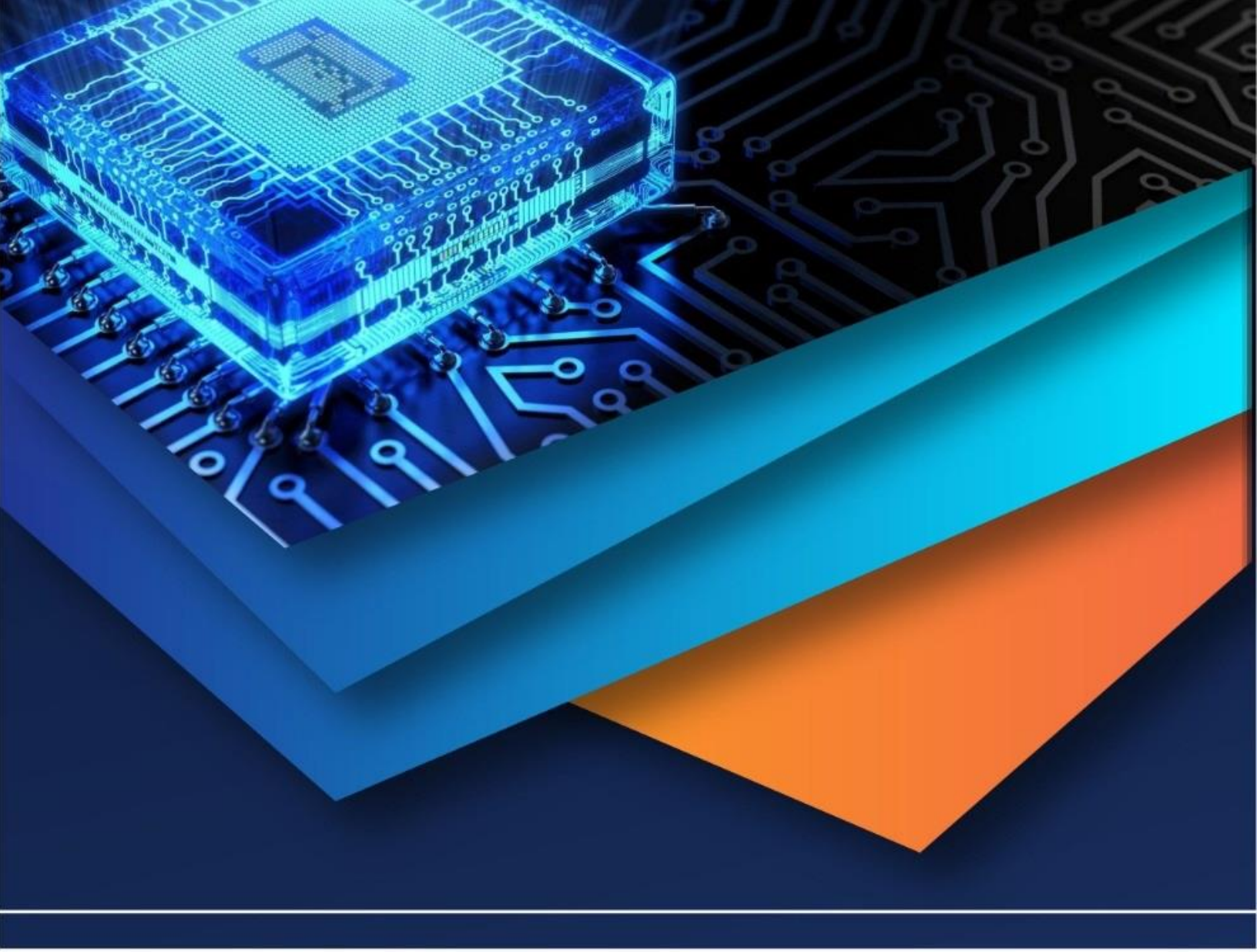

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