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Critical Appraisal on Use of Shredded Waste PlasticReinforcement for Sub-Grade Layer of Roads

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Abstract

Soil is a fundamental part of the world's environment. However, cur- rently, the soil is getting contaminated because of the disposal of waste plastic materials by individuals. Recycling plastic waste from non-recyclable plastic, es- pecially less than 50 microns has become one of the main challenges worldwide.From the 1950s to the 1970s, just a modest quantity of plastic was created, and thus, plastic waste was moderately reasonable. However, between the 1970s andthe 1990s, plastic waste generation more than tripled, reflecting a similar rise in plastic production. Today, we produce around 400 million tons of plastic waste consistently. The aim of this study is to recycle non-recyclable plastic, especiallyless than 50 microns, as reinforcing material for the improvement of Black cottonsoil. Black cotton soil is hard to stabilize due to its swelling and shrinkage prop-erties, when it meets water. This will limit the stability and shear strength of blackcotton soil when contrasted with different sorts of soil. This paper explains the stabilization of black cotton soil through the application of Micro Shredded PET (Polyethylene Terephthalate) Non-recyclable plastic, especially less than 50 mi-crons which are efficiently used to come across the challenges of society, to re- duce the quantities of plastic waste, to improve the Physical properties of soil, such as shear strength, bearing capacity through controlled compaction. Micro Shredded PET (Polyethylene Terephthalate) Non-recyclable plastic especially less than 50 microns used in different proportions. (0%, 0.25% 0.5%, and 0.75%,1%) Researchers have examined the properties of soil using different tests like Standard Proctor, Unconfined Compressive, Moisture Content, and California Bearing Ratio, etc.

Keywords: Soil Stabilization, Non-recyclable plastic specially less than 50 mi-crons, Black cotton soil.

1 Introduction

Soil is an essential component of the environment, and its quality plays a crucial rolein the construction and maintenance of infrastructure, including roads. However, the growing amount of plastic waste in the environment has raised concerns about its impact on soil quality and its potential negative consequences on infrastructure. The dis- posal of plastic waste has become a significant challenge worldwide, and its recycling has gained significant attention to reduce its environmental impact. In recent years, the application of recycled plastic waste as reinforcement material for soil stabilization has gained significant attention in the construction industry. One of the most challenging types of soil for road construction is black cotton soil, which exhibits swelling and shrinkage properties when exposed to water. The use of Micro Shredded PET (Poly- ethylene Terephthalate) Non-recyclable plastic, especially less than 50 microns, as re-inforcement material can improve the physical properties of soil and increase its shear strength and bearing capacity through controlled compaction. This paper presents a critical appraisal of the use of shredded waste plastic reinforcement for the sub-grade layer of roads, with a specific focus on the stabilization of black cotton soil. The paper discusses the challenges associated with plastic waste disposal, the properties of black cotton soil, and the potential benefits of using Micro Shredded PET Non-recyclable plastic to stabilize soil. The paper also provides an overview of the testing methods used to evaluate the physical properties of soil and the effectiveness of plastic waste as reinforcement material. Overall, this paper highlights the importance of soil stabilization in road construction, the potential benefits of using recycled plastic waste, and the need for further research in this area to develop cost-effective and sustainable solutions.

The following points were considered while reviewing the research work done sofar.

- Overview of the challenges associated with plastic waste disposal and the need for recycling to reduce its environmental impact.
- Requirement of soil stabilization and the importance of stabilizing soil in road con-
struction.
- Overview of the properties of black cotton soil and its challenges for road construction.
- Explanation of the use of Micro Shredded PET Non-recyclable plastic, especially less than 50 microns, as reinforcement material for soil stabilization.
- Discussion of the potential benefits of using recycled plastic waste for soil stabilization, including improving the physical properties of soil, increasing its shear strength, and bearing capacity.
- Overview of the testing methods used to evaluate the effectiveness of plastic waste
as reinforcement material for soil stabilization.
- Critical appraisal of the use of shredded waste plastic reinforcement for the sub- grade layer of roads and its potential for cost-effective and sustainable solutions.

2 Literature Review

There are many other researchers who have discussed the use of plastic waste for soil stabilization in road construction. Some of their views are:

Ahmed et al. [1] started by introducing the issue of plastic waste and its environmental impact. They noted that plastic waste is a major concern for many countries and high- lighted the potential of using waste plastic in road construction as a solution to this problem. The authors conducted a comprehensive review of existing literature on the use of waste plastic for soil stabilization in road construction. They searched various databases and selected studies that met their inclusion criteria. The studies were ana- lyzed and synthesized to identify trends, challenges, and potential opportunities associ- ated with the use of waste plastic in soil stabilization. After reviewing the studies, the authors concluded that waste plastic can be an effective material for soil stabilization in road construction. They found that the use of waste

plastic can improve the strength

and durability of the soil, reduce construction costs, and provide a sustainable solution for plastic waste management. However, they also identified some challenges such as the need for standardization and regulation, and the potential for negative environmen- tal impacts if not properly managed. Overall, the authors concluded that the use of waste plastic in soil stabilization for road construction is a promising approach that requires further research and development to address the identified challenges and to ensure its long-term sustainability.

The paper by Karmakar and Kundu [2] provides a comprehensive review of the use of waste plastic for soil stabilization in road construction. The authors started by discuss- ing the issues related to conventional soil stabilization techniques, which have been associated with environmental pollution and high costs. They then explained the bene- fits of using waste plastic for soil stabilization, which include enhancing the strength and durability of the soil, reducing the amount of plastic waste in the environment, and reducing the overall construction costs. The authors discussed the various types of plas- tic waste that have been used for soil stabilization, including polyethylene, polypropyl- ene, polystyrene, and polyvinyl chloride, among others. They also described the differ- ent techniques used for incorporating plastic waste into the soil, such as mixing, melt- ing, and shredding. The review paper also provided a detailed analysis of the mechani- cal properties of soil reinforced with plastic waste, including the effect on compaction, shear strength, and permeability. The authors analyzed the results of several studies to provide a comprehensive overview of the effectiveness of using plastic waste for soil stabilization in road construction. In conclusion, the authors of the review paper pro- vided evidence that using plastic waste for soil stabilization in road construction is an effective, sustainable, and cost-efficient solution. They recommended further research to optimize the use of plastic waste for soil stabilization and to investigate the long- term durability of the soil.

Ogunro et al. [3] evaluated the use of waste plastic bottles as reinforcement material for soil stabilization in road construction and found that it could improve the soil's shear strength and reduce its compressibility. The paper "Effect of Waste Plastic Bottles on the Geotechnical Properties of Lateritic Soil" examines the impact of waste plastic bot- tles on the geotechnical properties of lateritic soil. The problem that the paper addresses is the increasing amount of plastic waste generated globally and the need to find inno-vative ways to manage this waste. The authors proposed using waste plastic bottles to improve the geotechnical properties of lateritic soil, which is commonly used as a build- ing material in many parts of the world. The authors conducted several laboratory tests to evaluate the effect of adding waste plastic bottles on the geotechnical properties of lateritic soil. The tests included standard Proctor compaction test, California bearing ratio (CBR) test, unconfined compression test, and direct shear test. In the Proctor com- paction test, the authors determined the maximum dry density and optimum moisture content of the lateritic soil with and without waste plastic bottles. The CBR test was conducted to determine the strength of the lateritic soil under varying water contents and densities. The unconfined compression test and the direct shear test were conducted to evaluate the shear strength of the soil. The results of the laboratory tests showed that adding waste plastic bottles to lateritic soil increased the maximum dry density and decreased the optimum moisture content. The CBR values also increased with the ad- dition of waste plastic bottles, indicating improved strength. The unconfined compres-sion strength and the direct shear strength of the soil also improved significantly. Based on the results of the laboratory tests, the authors recommended the use of waste plastic bottles as a stabilizing agent for lateritic soil. They suggested that the addition of waste plastic bottles could enhance the strength and stability of the soil and reduce its suscep- tibility to erosion. The authors also recommended further research to evaluate the long- term performance of the waste plastic bottle-stabilized lateritic soil. In summary, the paper examines the use of waste plastic bottles

as a stabilizing agent for lateritic soil. The authors conducted several laboratory tests to evaluate the effect of waste plastic bottles on the geotechnical properties of the soil. The results showed that adding waste plastic bottles improved the strength and stability of the soil. The authors recommended the use of waste plastic bottles as a sustainable solution to manage plastic waste and enhance the geotechnical properties of lateritic soil.

In a study by Sivakumar and Krishnan [4], the use of shredded plastic waste was found to improve the shear strength and bearing capacity of soil. The researchers recom- mended further research to optimize the quantity and size of plastic waste particles to be added to the soil.

A study by Das et al. [5] found that the addition of shredded plastic waste to black cotton soil improved its California Bearing Ratio (CBR) value, indicating an improve-ment in its strength and load-bearing capacity.

In a study by Banerjee and Pal [6], the use of polypropylene waste for soil stabilizationin road construction was found to be effective in improving the strength and stability of the soil.

Sabarish and Santhosh Kumar [7] concluded the use of waste plastic bottles as rein- forcement material for black cotton soil. The researchers found that the addition of plastic bottles improved the compressive strength and stiffness of the soil.

Sahana et al. [8] found that, the use of plastic waste for soil stabilization in road con- struction is effective in reducing the soil's swelling and shrinkage properties.

Singh et al. [9] evaluated the use of recycled plastic waste for soil stabilization in road construction. The researchers found that the addition of plastic waste improved the strength and stability of the soil and recommended further research to optimize the par- ticle size and quantity of plastic waste.

Adeyemo and Adeyemi [10] concluded that the use of waste plastic bags for soil stabi-lization in road construction is found to be effective in improving the soil's strength and reducing its permeability.

Sharma and Pandey [11] evaluated the use of plastic waste as a reinforcement material for black cotton soil. The researchers found that the addition of plastic waste improved the soil's compressive strength and stability.

Wagh and Pawar [12] searched that the use of plastic waste as a reinforcement materialfor soil stabilization in road construction was found to be effective in reducing the soil's swelling and improving its strength and stability. The researchers recommended further research to evaluate the long-term performance of plastic waste-reinforced soil.

Adesina et al. [13], the use of shredded plastic waste for soil stabilization in road con-struction was found to be effective in improving the soil's strength, durability, and water resistance.

Banyal and Sharma [14] evaluated the use of waste plastic bags as reinforcement ma- terial for soil stabilization in road construction and found that it could improve the soil's strength and reduce its swelling and shrinkage.

Kumar and Vasantha Kumar [15], the use of plastic waste for soil stabilization in road construction was found to be effective in improving the soil's shear strength and reduc- ing its permeability.

Alomayri and Al-Sulaimani [16] evaluated the use of recycled plastic waste for soil stabilization in road construction and found that it could improve the soil's strength and stability, while also reducing construction costs.

Goyal et al. [17], the use of plastic waste for soil stabilization in road construction was found to be effective in improving the soil's strength and stability, while also reducingits permeability.

Singh et al. [18] discussed the use of plastic waste for soil stabilization in road con- struction and found that it could improve the soil's strength and stability, while also reducing

construction costs and environmental pollution.

Varshney et al. [19] said the use of shredded plastic waste for soil stabilization in road construction was found to be effective in improving the soil's shear strength and reducing its swelling and shrinkage.

Ambily et al. [20] evaluated the use of waste plastic bottles as reinforcement material for soil stabilization in road construction and found that it could improve the soil's strength and stability, while also reducing construction costs.

Conclusion

Following research gap was found after the review work is completed.

The use of shredded waste plastic as reinforcement material for soil stabilization has shown promising results in improving the physical properties of soil and increasing its bearing capacity. The application of Micro Shredded PET Non-recyclable plastic, especially less than 50 microns, as reinforcement material for black cotton soil stabiliza- tion has the potential to reduce plastic waste disposal while also improving road con- struction quality. However, further research is necessary to evaluate the long-term du- rability and effectiveness of using plastic waste as reinforcement material for soil sta- bilization. In addition, studies should also investigate the potential environmental im- pacts of using plastic waste in construction materials and the economic feasibility of this approach. Overall, this critical appraisal highlights the importance of soil stabiliza-tion in road construction and the potential for using recycled plastic waste as a cost- effective and sustainable solution.

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