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Soil Stabilisation Using Shredded Rubber Tyre: A Review

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1. INTRODUCTION

The clay often is weak and has no enough stability in heavy loading. In this regard, it is necessary to reinforce and or stabilize the soil. Stabilization in a broad sense incorporates the various methods employed for modifying the properties of a soil to improve its engineering performance. Stabilization is being used for a variety of engineering works, the most common application being in the construction of road and airfield pavements, where the main objective is to increase the strength or stability of soil and to reduce the construction cost by making best use of locally available materials. Stabilization is process of fundamentally changing the chemical properties of soft soils by adding binders or stabilizers, either in wet or dry conditions to increase the strength and stiffness of the originally weak soils.

Soil stabilization is a way of improving the weight bearing capabilities and performance of in situ sub soils, sands, and other waste materials in order to strengthen road surfaces. The prime objective of soil stabilization is to improve the California Bearing Ratio of in situ soils. The other prime objective of soil stabilization is to improve onsite materials to create a solid and strong sub base and base courses. In certain regions of the world, typically developing countries and now more frequently in developed countries, soil stabilization is being used to construct the entire road.

It is desirable from an engineering standpoint to build upon a foundation to ideal and consistent density. Thus, the goal of soil stabilization is to provide a solid, stable foundation. Density is the measure of weight by volume of a material and is one of the relied upon measure of the suitability of a material for a construction purposes. The more density a material possesses, the fewer voids are present. Voids are the enemy of the road construction, voids provide a place for moisture to go, and make the material less stable by allowing it to shift under changing pressure, temperature and moisture condition. Improving an in situ soil engineering properties is referred to as either soil modification or soil stabilization. The term modification implies a minor change in the properties of soil, while stabilization means that the engineering properties of the soil have been changed enough to allow field construction to take place.

Methods of Stabilization:

Properties of soil may be altered in many ways, among which are included chemical, thermal, mechanical and other means. The chief properties of a soil with which the construction engineer is concerned are: volume stability, strength, permeability, and durability.

It may be grouped under two main types:

i) Modification or improvement of a soil property of the existing soil without any admixture.

ii) Modification of the properties with the help of admixtures.

Compaction and drainage are the examples of the first type, which improve the inherent shear strength of soil.

Examples of the second type are: Stabilization with cement, lime, bitumen and chemicals etc.

Stabilizing Agents:

These are hydraulic (primary binders) or non-hydraulic (secondary binders) materials that when in contact with water or in the presence of pozzolanic minerals reacts with water to form cementitious composite materials. The commonly used binders are:

- Lime
- Cement
- Blast furnace slag
- Fly ash
- Pozzolanic Materials

In this present study scrap tyres will be used as a soil stabilizer.

Scrap Tires:

Scrap tires are being produced and accumulated in large volumes causing an increasing threat to the environment. In order to eliminate the negative effect of these depositions and in terms of sustainable development there is great interest in the recycling of these non hazardous solid wastes. Tire wastes can be used light weight material either in the form of powder, chips, shredded and as a whole. Applications of tire rubber proven to be effective in protecting the environment and conserving natural resources. They are used above and below ground water. Many work regarding the use of scrap tires in geotechnical application have been done especially as embankment materials. The reuse application for tire is how the tire are processing basically includes shredding, removing of metal reinforcing and further shredding until the desired materials are achieved.

Scrap tires perhaps rank among the most extensively researched and implemented recycled materials in recent years. Potentially usable forms include whole tires, sliced tires, tire chips, and smaller, soil-like particles referred to collectively as crumb rubber. However not all of the rubber is recoverable. The civil engineering market encompasses a wide range of uses for scrap tires. Tire shreds can be used to construct embankments on weak, compressible foundation soils. Tire shreds are viable in this application due to their light weight. For most projects, using tire shreds as a lightweight fill material is significantly cheaper than alternatives. It is estimated that 13.5 million tonnes of scrap tires are disposed of every year worldwide. These figures include all sorts of tires from car tires to trucks and huge tractor tires and earth moving tires.

In northern climates, excess water is released when subgrade soils thaw in the spring. Placing a 15 to 30 cm thick tire shred layer under the road can prevent the subgrade soils from freezing in the first place. In addition, the high permeability of tire shreds allows water to drain from beneath the roads, preventing damage to road surfaces.

2. SUMMARY OF LITERATURE REVIEW

Following observations may be drawn from the broad overview of the literature survey.

- The soil often is weak and has no enough stability in heavy loading. The aim of the study was to review on stabilization of soil using low-cost methods. Based on literature, shredded rubber tire is low-cost and effective to soil stabilization. Tire wastes can be used as lightweight material either in the form of whole tires, shredded or chips or in mix with soil. The overview has brought out the need for a systematic investigation into the various aspects of reinforcement.
- Reinforced earth technique has been gaining popularity in the field of civil engineering due to its highly versatile and flexible nature. In the recent years, this technique has been suggested for a variety of geotechnical applications ranging from retaining structures and earth embankments, foundation beds for heavy structures on soft grounds, viaduct bridges and other applications. Shredded waste tires have many beneficial engineering properties as a light weight fill material and when it is used in road base or sub base, shredded tire will improve drainage below the pavement and therefore should extend the life of the road.
- Construction of engineering structures on weak or soft soil is considered as unsafe. Improvement of load bearing capacity of the soil may be undertaken by a variety of ground improvement techniques. Shredded rubber tire as the reinforcement material for soil subgrade holds great promise. An attempt has been made in this thesis to take up this aspect.

Gaps Identified:

After studying the literature review following gaps is indentified.

- Shredded Rubber Tire had been used by the researchers in various types of soil but no work has been done by the researcher in the clay type of soil.
- The size of the shredded tire plays an important role in stabilization process. The variation in size can be done.
- The percentage of shredded tires used in stabilization process can be varied.

Need for Present Study:

- The review of literature shows that the rubber tire is a versatile material with attractive characteristics and advantages and as a result this material is now being used abundantly all over the world. The number of scrap tires worldwide is increasing every year due to the increase in the population of vehicles both in developed and developing countries. The number of scrap tires may further increase due to rapid economic growth in some developing countries such as India where the demand for vehicles has been increasing significantly. A large number of used tires are disposed of every year. A more productive, environmentally desirable use of these tires would be the construction of embankments and backfills with tire shreds or mixtures of tire shreds and sand (rubber sand).Such fills are lighter than traditional soil fills. Additionally, the present study shows that the strength of these materials is usually adequate for such applications. Reuse of large amounts of scrap tires is beneficial, and several researchers have devoted their attention to the use of scrap tires for civil and environmental engineering application. One of these applications is the use of shredded scrap tires as drainage material in landfill cover systems. Landfill cover design generally consists of three layers: the barrier layer, the drainage layer, and the cover soil layer. The purpose of the drainage layer is to allow any infiltrated water to drain from the overlying cover soil layer so that it is prevented from seeping into the underlying barrier layer and the waste. Tire shreds are very free draining. Even when they are compressed under the weight of overlying fill, they still have permeability greater than 1 cm/sec. With this high permeability, tire chips can be used as drainage layers in landfills and roads. A useful property of tire shreds is that they have a high insulating value. When combined with their good drainage properties, this means that tire shreds can be used to limit frost penetration beneath roads and to remove excess water during the spring thaw. Due to the special properties of tire shreds together with their wide-spread availability, they have been used as lightweight fill for numerous highway embankments and landslide stabilization projects, backfill behind bridge abutments, insulation and drainage layers beneath roads, and drainage layers in landfill liners.

Objectives of the study:

Objectives of present study are:

- To study the engineering properties of soil.
- To study the optimum moisture content and maximum dry density with different percentage of shredded tires.
- To determine the California Bearing Ratio (CBR) value with different percentage of shredded tires.
- Analysis and interpretation of results.

3. RESEARCH METHODOLOGY

Collection of the soil:

Soil of the sample shall be that of locally available soil type (Clay).

Scrap tires:

Scrap tires are to be procured from the local market (workshop) will be used for the purposed work.

List of Laboratory Test to be conducted:

Test to be conducted on the above mentioned soil samples are

- Specific Gravity (As per IS 2720: Part 3).
- Consistency of soil (As per IS 2720: Part 5).
- Maximum dry density and optimum moisture content (As per IS 2720)
- California Bearing Ratio of Soil (As per IS 2720: Part 16).

Test on Soil + Shredded Rubber Tire.

Shredded Rubber Tires are to be admixed with the clayey soil with size ranges from 15mm to 25mm (Width) and 30mm to 50mm (Length) at different percentages i.e. 4 percent,6percent and 8percent.Following tests are to be performed on the clayey soil admixed with shredded rubber tire.

- Optimum moisture content and maximum dry density (As per IS 2720).
- California Bearing Ratio (As per IS 2720: Part 16).

Expected Outcome"

It is expected that the proposed study will help in increasing the load carrying capacity of soil. It is also expected that this study will help in reducing the cost of construction of embankment in comparison to other stabilization methods. It will reduce the swelling potential of soil. Further this will also reduce the impact on environment.

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