Soil Stabilization Using Shredded Rubber Tyre

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***Abstract*— The qualities of the soil are crucial to construction. When the qualities of the soil are not ideal for building, we employ a technique known as soil stabilization to improve the qualities of the soil. Numerous methods of ground improvement can be used to increase the soil's capacity to support weight. Shredded rubber tires are being used in this project to enhance the soil's qualities. As the number of motor vehicles continues to climb, hundreds of millions of tires are thrown out year worldwide. Recently, there has been a lot of interest in the use of tires in geotechnical engineering to increase the bearing capacity of black cotton soil.**

For the experiment, shred rubber tires in various proportions (4%, 6%, 8%, and 10%) based on the weight of the soil sample. The strength behavior of soil reinforced with shredded rubber fiber that is incorporated at random has been the main focus of the inquiry. The major goals are to use locally available resources to lower construction costs and improve the strength or stability of the soil. It was discovered that adding shredded rubber improved the soft soils with high compressibility and poor strength. The samples were put through the standard proctor test and the California bearing ratio. The outcomes are contrasted with those of unreinforced samples, and conclusions are made about the applicability and efficacy of fiber reinforcing as a low-cost alternative to deep or raft foundation and on pavement subgrade soil.

The addition of shredded rubber and cement was found to improve the low strength and high compressible soft clay soils. We may conclude that shredded rubber fiber is a useful material for earth reinforcement. It is deemed dangerous to build engineering structures on soft or fragile soil. Numerous methods of ground improvement can be used to increase the soil's capacity to support weight. In this study, waste-derived shredded rubber was selected as the reinforcing material, and cement was added to the soil at three distinct percentages of fiber content—5%, 10%, and 15% by weight of soil—as a binding agent.

Key words:- Soil Stabilization, Black cotton soil, shredded rubber tyre, CBR.

I. INTRODUCTION

One of the main environmental issues facing the globe today is solid waste management. The amount of trash tires produced and accumulated in India is increasing, endangering the environment. Recycling of these non-hazardous solid wastes is highly desired in terms of sustainable development and eradicating the detrimental effects of these depositions. For over thirty years, researchers have examined the possibility of utilizing tire rubber from worn out tires in various civil engineering projects. There are applications for tires that have shown to be successful in preserving the environment and natural resources..

The need for infrastructure has grown recently, and practical foundation designs are no longer appropriate because of the ground's limited bearing capacity. As a result, soil stabilization has begun to take on new dimensions. According to Yilmez and Degirmenci [1] and Lee and Lee [2], stabilization is the process of essentially altering the chemical properties of soft soils by adding binders or stabilizers, either under wet or dry conditions, to increase the strength and stiffness of the initially weak soils. Improved research, supplies, and machinery have made soil stabilization a more widely used and economically viable technique of improving soil. Improved research, supplies, and machinery have made soil stabilization a more widely used and economically viable technique of improving soil.

The goal of the current study is to stabilize the shedi and black cotton soils. Shedi soil and black cotton are gathered from the Vidyagiri region of Bagalkot city and Haliyal Road in Dharwad city, respectively. Randomly dispersed shredded rubber tire chips (5%, 10%, 15%) and cement (2%, 4%), are also added. The laboratory conducted unconfined and CBR experiments for varying rubber mix proportions with black cotton and shedi soil. The strength of shedi soil and black cotton has significantly improved for the 5% rubber mixture. soil fortification Adding reinforcement to soils is a dependable and efficient way to improve their strength and stability.

The amount of rubber tire waste generated globally is made up of roughly 6-7% of India's total. Its serious position is highlighted by the country's trash creation, which exceeds 62 million tons annually (according to a 2016 Press Information Bureau study). Environmentalists around the world are disturbed by the massive volume of scrap rubber tires and tire tubes that are dumped. Due to consumer preference and the shorter life span of the recycled product, recycled rubber tires are not very useful. This can also result in numerous punctures and wear and tear on the recycled product.

If they can be made into chips, shreds, crumbs, or a powder that is easily combined with soil, one way to dispose of them is to stabilize their use with this substance. If the soil is stabilized, it can work better as a subgrade material for parking lots, retaining walls, and other constructions. If the goal is to use this trash in retaining structures, research on the variance in shear strength is necessary, but for usage in road pavements, one can examine the impact these tire crumbs have on the soil's CBR value.

Soil is an essential component in construction. The site's soil should be such that it can support the weight even under extreme circumstances. But occasionally, in normal circumstances, dirt is good. However, in unfavorable circumstances, the soil is unable to support the weight and either shears or fails in another way. We should thoroughly examine the soil, both in favorable and unfavorable conditions, in order to prevent this kind of failure. Often, the earth lacks sufficient stability under enormous loads due to its weakness.

II MATERIALS AND METHODOLOGY

Take soil samples at the chosen stabilizing location. Get rubber tire shreds from a reputable supplier or shred them yourself with the right tools. Make sure all material is labelled and kept in the right place.

To ascertain the soil samples' engineering properties—such as moisture content, permeability, shear strength, compaction characteristics, and particle size distribution—conduct preliminary experiments on them.

To learn more about the characteristics of the shredded rubber tire particles, such as their compatibility with soil and size distribution, do comparable experiments on them.

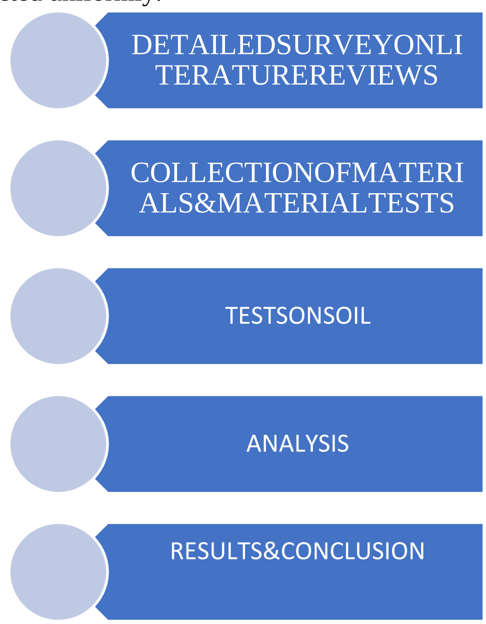
Create many soil combinations with different amounts of shredded rubber tire particles based on the findings of the laboratory tests. Think about things like the ideal ratio of rubber to soil and the intended increase in soil qualities.

In order to assess the impacts of various soil to rubber ratios, prepare a matrix of mixtures to be tested, making sure to include a range of compositions.

Assemble test specimens in accordance with the intended mixes. This could entail thoroughly combining the soil with the shredded rubber particles by hand or with a mixer.

Utilizing common compaction tools like a gyratory compactor or Proctor compactor, compact the prepared specimens. Use the compaction effort recommended by the test standards, or as determined by the intended use.

Press the mixture into several layers until the required density is reached, making sure that every specimen is compacted uniformly.



III RESULTS AND DISCUSSION

Sl.No	NAME OF THE EXPERIMENT	EXPERIMENT RESULTS
1	Liquid Limit	62.025
2	Plastic Limit	31.96
3	Plastic index	30.08
4	Sieve analysis	2.06
5	Free swell	80%
6	Specific gravity	2.64
7	Standard Proctor Test	20
8	CBR test	1.51%

TABLE I . TEST RESULTS FOR EXPERIMENTS.

IV CONCLUSION

•When the proportion of tire crumbs in the soil is increased, it is noted that the ideal moisture content of the soil somewhat decreases, however the difference is not very noticeable. After testing 12 blended soil samples (0% to 15% replacement of sand by red soil) with an increment of 5%, it can be said that the optimum use of red soil is 10% as a partial replacement of sand by red soil will give satisfactory results. The maximum dry density has somewhat erratic behavior, but it generally decreases as the amount of tires in the soil increases. This decrease can be the result of the tires' low specific gravity.

•The unsoaked CBR value does not significantly alter at 4% tire crumb, but at 8% tyre crumb, there is a notable increase of 122.6% above plain soil. This rise diminishes as the tyre content increases to 12% and 16%. This outcome closely resembled the findings of Priyadarshee Akash et al. (2015), who found that the clay+tyre mixture might improve by up to five factors.

•In this study, 8% rubber tire crumb combined with the soil may be considered the ideal tire crumb content for the maximum un-soaked CBR value; nevertheless, the results cannot be generalized because different soil types and tire sizes may yield different results.

•Although a large increase in the un-soaked CBR value is observed at a particular % rubber tyre crumb mixed in the soil but it does not assure to occur always as different studies show different patterns.

•The addition of tire crumbs was discontinued after the UCS value began to decline at 8% tire crumb content and then began to rise again from no tire content to 2% to 4-6% tire content. Later, variations in the failure point were noticed at 10% tire content. This can be the result of the soil's increased flexibility as a result of the increased tire content.

•At 4-6% tire crumb (medium-grained, passing 2 mm screen) concentration, a maximum shear strength of 0.021340 N/mm2 was measured, which was approximately 19.25% greater than that of plain soil.

•The aforementioned result is consistent with a previous study by Cetin et al. (2006), which used clayey soil with low compressibility and added fine- and coarse-grained tire chips (between 2 and 4.75 mm) to the clayey soil. The results showed that shear strength increased by 30% for fine-grained and by 20% for coarse-grained tyre chip mixtures.

•The UCS value did not significantly change, but it did gradually increase, indicating an improvement in the clayey soil's shear strength. This clayey soil can be used, in conjunction with medium-grained tire crumbs, as backfill behind retaining walls, bridge abutments, highway embankments, and other structures.

•Rubber tire particles were found to be erratically distributed, but they were also composed of fibrous structures that could maintain the rubber tire and soil particles bonded together for an extended period of time, even in the event that the tire crumbs eventually burst (caused by temperature fluctuations).

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