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Soil Stabilization Using Crumb Rubber Powder

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ABSTRACT- Because there are more used car tyres produced each year, disposing of them has become a significant environmental issue on a global scale. Utilizing used tyres will reduce the effect on the environment and increase resource preservation. The stabilisation of soils using CRP (5%, 10%, 15%) is discussed in this article. The conduct and effectiveness of the stabilised soil were evaluated using the soil properties, compaction, California bearing ratio (CBR), and direct shear test. When soil and CRP are combined, it is seen that the maximum dry density and ideal moisture content decline as the percentage of crumb rubber in the soil increases. Bearing capacity and tensile strength are barely affected by blending. Nevertheless, the numbers stayed within reasonable bounds.

KEYWORDS: Plastic Strips, Stabilizer, Stabilization

I. INTRODUCTION

There is a shortage of land for construction in today's world as a result of the rapid rise of urbanization and modernization. The construction of buildings and roads is done on land with expansive clays due to the rising worth of land and the limited availability of sites. The properties of the soil on which the road was constructed determine its stability. If the soil is excellent at a shallow depth below the top of the ground, construction can be done at a reasonable cost. In this situation, footings or raft foundations can be used as shallow supports. However, foundations such as pile foundations, deep foundations, and well foundations can be used if the soil present at the surface is weak and a powerful stratum is present at deeper depths. These underpinnings are not cost-effective, as well as a solid base. Small buildings cannot afford such foundations. Even at higher depths, the soil's condition can occasionally be very poor.

These expansive soils occupy about 20% of the land in India. These also go by the name "Black Cotton Soil." Due to the presence of a mineral named montmorillonite, these soils exhibit swell-shrink behavior. When flooded, expansive soils have very low shear strength and experience significant volumetric change. Since these soils are so fragile, no building or roadway should be built on top of them. Before any structure or pavement must be constructed over it, the soil's properties must be improved.

II. SCOPE

- The aim of this study was to investigate the possibility of the utilization of industrial waste crumb rubber to stabilize soils. By using the waste tyre (crumb rubber) one can reduce the harmful effect on environment and provide sustainable soil for construction.
- To study the index properties and Engineering properties to classify the un-stabilized soil.
- To study the effect of crumb rubber on OMC and MDD, cohesion and friction angle of soil.
- To study the effect of crumb rubber on swelling, permeability and CBR values of soil.
- The main objective of the investigation is to evaluate optimum CRP for stabilization of the Expansive soil.

III. MATERIALS

A. Black Cotton Soil

These extensive soils occupy about 20% of India's land area. "Black Cotton Soil" is another name for these. Because these sediments contain a mineral called montmorillonite, they exhibit swell-shrink behaviour. Expansive soils experience significant volumetric change when moist and dry and have very low shear strength when saturated. These soils are so fragile that nothing can be built on top of them, including roads. Before any building or pavement can be put on top of the earth, its properties must be improved.

B. Red Soil

Red soil is a variety of soil that forms beneath deciduous or mixed forests in warm, moist climates. It has thin organic and organic-mineral layers on top of an alluvial red layer that is resting on a yellowish-brown leached layer. The source of red soil is typically crystalline limestone. They typically have poor growth potential, are deficient in humus and nutrients, and are challenging to cultivate due to their poor water holding ability. The third-largest soil category in India is identified by its red soils, which occupy about 10.6% of its total land area.

These soils generally lack calcium, magnesium, phosphates, and nitrogen. These grounds are in danger from intense leaching. On the uplands, they are thin, poor, gravelly, Light-colored soils that are sandy or stony and can support the growth of food crops like bajra. The fertile loam in the

lower lowlands and valleys, however, is rich, deep, and dark in colour. This loam is suitable for growing high-quality crops like cotton, wheat, legumes, tobacco, jowar, linseed, millet, potatoes, and fruits with irrigation. These have limited forest development and are excellent for dry farming.

C. Methodology

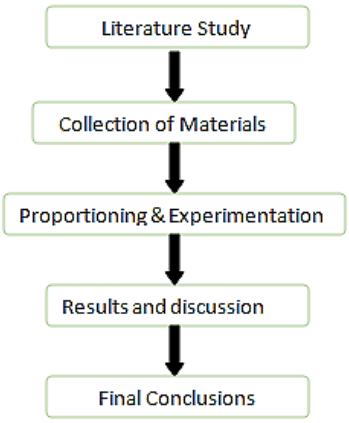

Figure 1: Methodology

D. Crumb Rubber Powder (CRP)

Recycling used rubber can increase wealth while having a positive effect on the environment. CRP is employed as an additive to enhance the technical capabilities of problematic clay used in the local tile manufacturing industry in an effort to decrease the impact of waste rubber on the environment. CRPs that were reduced to 1.18 mm in size were used in the study (IS sieve). To provide the issue clay that is currently on the market the necessary engineering qualities and to make the roofing tiles lighter, CRP is employed as an addition in the current study.

Figure 2: Crumb Rubber Powder (CRP)

E. Properties of Soil

To explore the qualities of soil and soil combined with increasing amounts of crumb rubber (0, 5, 10, 15 and 20%), laboratory tests were performed on soil specimens. The evaluations were performed in accordance with Indian standards. IS: 2720 Different properties tested in laboratory are

- Index properties
- Engineering properties

F. Index properties

Index properties refer to soil characteristics that are not of main geotechnical engineering concern but are representative of engineering characteristics. This comprises

- Particle Size Analysis: This technique divides soils into several fractions based on the soil particles that are present. On a graph of a particle size distribution curve, it may be seen.
- Specific Gravity: It can be defined as the ratio of the weights of an equal volume of distilled water and a given volume of soil solid at a particular temperature, both weights being obtained in air.
- Atterberg's Limit: Consistency limits, or Atterberg's limit, are the water contents at which soil transitions between different states. The liquid limit, plastic limit, and shrinkage limit are three of Atterberg's limits that are helpful for engineering applications. These restrictions are given as a percentage of water content.

Liquid limit**:** A widely accessible method can be used to measure the minimum water content at which the soil is still in a liquid state but has a minimal resistance to flowing.

- Plastic limit: The plasticity index is calculated as the difference between the L.L. and P.L. values. It is defined as the minimal water content at which soil will just start to crumble when water is spun into a thread about 3 mm in diameter.

IV. RESULTS AND DISCUSSION

The experimental outcomes demonstrate that soil stabilization with crumb rubber powder (CRP) enhances shear strength, reduces plasticity, and improves load-bearing capacity. CRP-filled voids create a flexible matrix, leading to improved resilience against cyclic loading. This approach offers a sustainable solution for improving soil properties and repurposing waste rubber.

A. For Black Cotton Soil

Table 1: Specific gravity of black soil

Trail NO.	1	2	3
Weight of empty bottle (w1) in gems.	660	661	662
Weight of bottle+ dry soil (w2) in gems.	860	862	862
Weight of bottle + dry soil + water (w3) in gems.	1659	1660	1660
Weight of bottle + water (w4) in gems.	1542	1541	1543
specific gravity	2.409	2.451	2.409
Avg. specific gravity	2.423		

B. For Red Soil

Table 2: Specific gravity of red soil

Trail NO.	1	2	3
Weight of empty bottle (w1) in gems.	660	665	660
Weight of bottle+ dry soil (w2) in gems.	860	865	860
Weight of bottle + dry soil + water (w3) in gems.	1670	1675	1670

Weight of bottle + water (w4) in gems.	1540	1545	1540
specific gravity	2.85	2.82	2.85
Avg. specific gravity	2.84		

C. For Black Cotton Soil

Final volume of soil specimen in the jar containing distilled water,Vd=25.5 ml
Initial volume of soil specimen in the jar containing distilled water, V10=14ml
Free Swell Index = Vd-V10/V10*100
= **(**25.5-14)/14*100
= 82.14%

D. For Red Soil

Final volume of soil specimen in the jar containing distilled water,Vd=12ml
Initial volume of soil specimen in the jar containing distilled water, V10=10ml
Free Swell Index = Vd-V10/V10*100
= **(**12-10)/10*100
= 20%

E. Liquid limit: for black cotton soil

Table 3: Liquid limit for black cotton soil

Sample No.	1	2	3
No. of blows	45	30	26
Container No.	76	52	33
Weight of empty con in gems	31	29	31
Weight of cont. + wet soil in gems.	41	42	48
Weight of cont. + dry soil in gems.	38	38	43
Weight of soil solids	7	9	12
Weight of pore water	3	4	5
Water content (%)	42.85	44.44	41.66

Liquid limit as obtained from graph = 44.9%
(corresponding to 25 blows)

V. CONCLUSION

The shear strength of the black cotton soil is increased with the addition of 10% crumb rubber powder.
The shear strength of the red soil is decreased with the addition of crumb rubber powder.
From the investigations, addition of 10% of crumb rubber powder to the soil increases CBR value.
If the percentage of rubber powder increases more than 10%, the soil strength gradually decreases.
This investigation evaluates 10% is the optimum rubber powder for the stabilization of black cotton soil.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES

[1] Dr. P.G. Rakaraddi and Gatge Sandip Habirao, "Soil Stabilisation Using Shredded RubberTyre Chips", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE), Volume 11, Issue 1 Ver. V (Feb. 2014), PP 20–27.

[2] "Soil Stabilisation Using Rubber Tyre," International Research Journal of Engine Technology (IRJET) e-ISSN: 2395-0056 Volume: 02, Dec-2015, by Umar Jan, Vinod K. Sonthwal, Ajay Kumar Duggal, Er. Rattan, and Mohd Irfan

[3] The investigations on the geotechnical properties of problem clay stabilised with crumb rubber powder were carried out in 2012 by Purushotham G. Sarvade and Prashant R. Shet. December 2012 issue of the Bonfring International Journal of Industrial Engineering and Management Science.

[4] "Stabilisation of soil using crumb rubber powder and cement," B. Sri Vasavi, Dr. D. S. V. Prasad, and A. C. S. V. Prasad.Innovative Research and Technology Journal, Volume 2, Issue 8, 2016