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Effect of Addition of Granular Tire on the Swelling Behaviour and CBR Value of Expansive Soils

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***Abstract*: The deposits of expansive soils exist throughout India and in areas where expansive soils predominate, mitigation efforts usually focus on reducing the swell potential of the soil to eliminate the detrimental effects due to excessive heave and swell pressures on typical engineering structures such as road pavement layers, building foundations, and retaining structures. Early studies investigated the use of the granular waste tire rubber (GWTR) as an alternative geometrical in civil engineering applications. Currently, a very small percentage of waste tire rubber generated in India is beneficially used for civil engineering projects. Beneficial use of GWTR in civil engineering applications is desirable not only from a sustainable point of view but also since GWTR is a relatively light-weight material, which makes it ideal for use in embankment fills and retaining wall backfills. It shall be pertinent to mention here that during our studies in original soil samples granular tire pieces were added in incremental % of 5% every time and CBR values were unaffected while on the addition of lime in incremental % of lime in equal increments of 2% along with the granular tires changed the scenario altogether. In this study, the effect of scrap tire rubber on the compaction, one-dimensional swell- consolidation response and CBR value of an expansive soil from Jhansi, U.P. was investigated systematically in the laboratory. The granulated tire was mixed in 15%, 20% and 25% by weight of expansive soil. The optimum water contents of the soil and expansive soil rubber (ESR) mixture were approximately the same. The addition of different percentage rubber by weight to the soil decreased the maximum dry unit weight of the expansive soil rubber (ESR) mixture due to the lower specific gravity of the rubber material. All specimens were prepared at the same optimum moisture contents and different maximum dry densities obtained from Heavy compaction tests. Typical swell-consolidation test results for the materials tested had shown that the compression and recompression indices increased by 35% and 23%, respectively, with the addition of granulated tire rubber. In contrast, both the swell percent and the swelling pressure were significantly reduced for the ESR mixture due to the addition of waste tire rubber, by weight, to the natural soil. CBR test results had shown a significant drop in CBR value due to the addition of granulated tire but at 20% granular tire the CBR value was approximately equal to the CBR value of raw expansive soil. As there was no improvement in CBR value due to the addition of granular tire so to improve CBR value lime is added in 4%, 6% and 8% by weight of ESR mixture containing 20% granular tire. Test results had shown a continuous increase in CBR value with the increase in lime content.**

***Keywords*: Granular Waste Tire Rubber (GWTR), Expansive Soil Rubber (ESR), CBR.**

1. Introduction

The use of lightweight materials has gained importance in recent days in engineering practices particularly in the field of additive soil improvement and construction field. They need not be virgin materials essentially, instead of materials from landfills, waste materials which are otherwise a disposal problem can be used and it shall yield dual benefits. First is their disposal problem is solved, second is they can be used very well for fruitful purposes. Since these materials can be used very well after suitable modification or otherwise, they have got an edge over the unconventional materials which are being used abundantly nowadays through their engineering properties are well defined. The trend is gaining pace in road construction and pavement construction with sufficient improvement benefits. To quote a few of such materials, Fly ash, Rice husk ash, shredded tires, polythene, nylon fibers, and coir fibers are gaining importance. Since the need for the hour is sustainable development with a solution to environmental issues these materials are of utmost importance to civil engineers and this confirms the statement that no material is a waste material for civil engineers. The present research was undertaken by the scholar to use granular rubber recycled from the waste tire for various geotechnical applications. Tires are produced from62% vulcanized rubber polymer, 31% carbon black and in small quantities some other organic and inorganic additive for improvements.

2. Literature Review

[1] Basma & Tuncer, (1991) examined the impact of Lime on volume change and compressibility of Expensive soils. In this investigation, the Lime was added to the soils at 0 to 9 or 12 percent. The soil lime examples were restored for 1 hr, 7 days, and 28 days, after which they were exposed to research facility tests.

[2] Cocka, (2001) examined the impact of high-calcium and low-calcium class C fly remains for adjustment of a broad soil.

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In the examination, an assessment of the expensive soil-lime, extensive soil-concrete, and expensive soil-fly debris frameworks were exhibited. Lime and concrete were added to the expensive soil at 0–8% to set up gauge esteems. Both high-calcium and low-calcium class C fly cinders were added to the expensive soil at 0–25%. Test examples were exposed to grain size circulation, consistency points of confinement, and free swell tests. Examples with fly debris were restored for 7 days and 28 days, after which they were exposed to odometer free swell tests.

[3] Al-Rawas et al., (2004) evaluated the impact of lime, concrete, blends of lime and concrete, Sarooj (counterfeit pozzolana) and warmth treatment on the growing capability of sweeping soil. All stabilizers caused a decrease in both swell weight and swell percent aside from Sarooj, which brought about an expansion in swell weight at the increments of 6% and 9%. With the expansion of 6% lime, both the swell percent and swell weight were diminished to zero. The investigation likewise demonstrated that calcinations of the soil at 740 and 780 0C for 30 and 60 min brought about the decrease of the expanding potential to zero.

3. Results

A. Compaction of Soil with GTR

1) Effects of GTR on the M D Unit Weight

The variety of most extreme dry unit weight with the expansion of various GTR substances to the soils is displayed in figure 1. True to form, the most extreme dry unit weight diminishes with an expansion in GTR content attributable to GTR as lightweight material.

Table 1

S.No.	GTR %	MDD
1	0	1.85
2	5	1.78
3	10	1.73
4	15	1.69
5	20	1.62
6	25	1.54

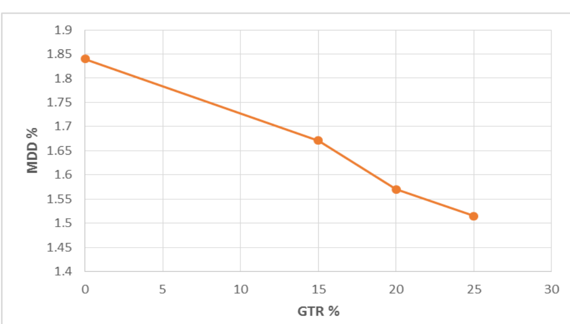

Fig. 1. Variation of M D unit weight of soil with different % of GTR

For the expansive soil used, the M D unit weight goes down from 1.84gm/cc to 1.515gm/cc (17.39%) with a change from 0% to 25% GTR content.

2) Effects of GTR on the OMC

As depicted in the past segment, the expansion of GTR to broad soil lessens the most extreme dry unit weight for the equivalent compactive exertion; notwithstanding, it has less effect on the ideal dampness substance of the soil. In spite of the fact that not huge but rather there is a decline in OMC with the expansion in the GTR content in the soil.

Table 2

S.No.	GTR %	OMC%
1	0	16.8
2	5	16.6
3	10	16.4
4	15	16.5
5	20	16.0
6	25	15.8

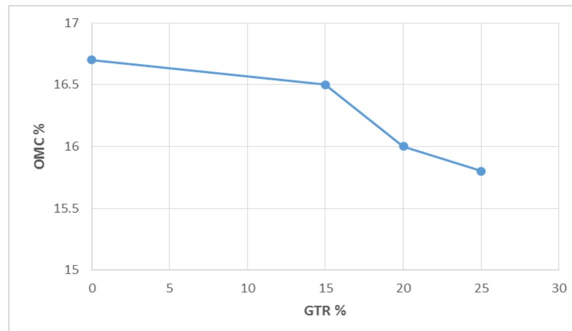

Fig. 2. Changes of OMC of soil with different percentages of GTR

B. Swell Index of Soil with GTR

Table 3

S.No.	GTR %	Free Swell%
1	0	95
2	5	80
3	10	72
4	15	60
5	20	55
6	25	40

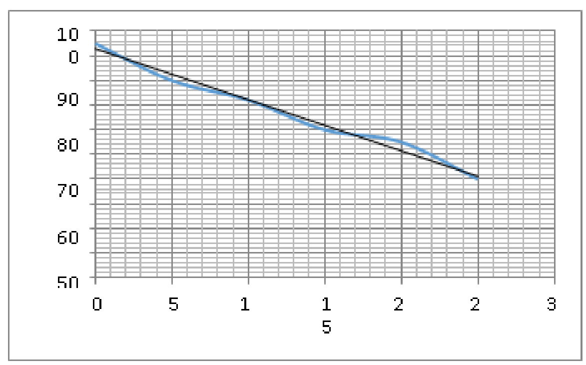

Fig. 3.

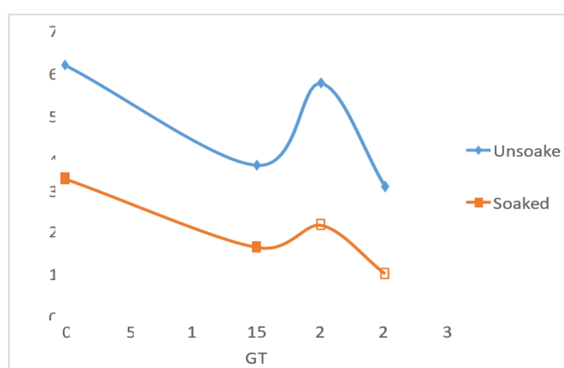

Fig. 4. Changes of CBR value of soil with various % of GTR

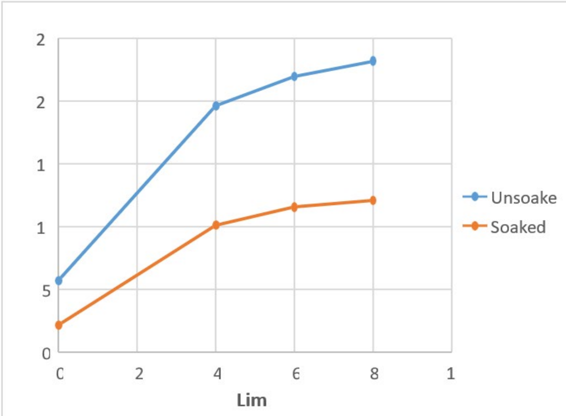

Fig. 5. Changes of CBR value of soil with various % of lime

4. Conclusion

This examination was unavoidably exploratory in nature and principally imagined dependent on a theory that GTR can be utilized for geotechnical applications as a swell- contract modifier of expensive soils. Something beyond concentrating on the adjustment of the soil's swell-contract attributes, the impact of GTR on the general conduct of the soil was additionally researched by performing compaction CBR and compressibility tests. This exploration is a stage forward in the critical utilization of GTR in geotechnical applications. The following ends can be drawn from this investigation.

It was seen that with the increase of GTR quantity, the dry unit weight of soil diminishes. Here was a decrement in OMC was also observed due to the addition of GTR in soil, but it was not significant.

Further it was seen that the expansion of GTR prompts the decrease in the greatness of expanding and shrinkage of expensive soils. An expansion of GTR from 0% to 25% diminished the free growth from 95% to 40%, for example, a decrement of 55% by the expansion of GTR.

The CBR estimation of the broad soil-elastic blend was seen to diminish for 15% GTR. Further expansion of demonstrated augmentation in CBR esteem for 20% GTR and again a decrement of CBR esteem were watched for 25% GTR. From the examination, it was seen that 20% is the ideal GTR content, as further expansion of GTR makes issues in test arrangement and in testing. Tests tried with 4%, 6%, 8% of lime at 20% GTR demonstrated a nonstop increment in CBR esteem both in un drenched and in doused condition.

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References

[1] Elshorbagy, W. A. and Mohamed, A. M. O. (2000), "Evaluation of using municipal solid waste compost in landfill closure caps in arid areas," Waste Management, vol. 20, pp. 499- 507.
[2] Goodhue, M. J., Edil, T. B. and Benson, C. H. (2000), "Interaction of foundry sands with geosynthetics," Journal of Geotechnical and Geo-environmental Engineering, ASCE, vol. 127, no. 4, pp. 353-362.
[3] Chen, F. H. (1988), "Foundations on expansive soils," Developments in geotechnical engineering, vol. 54.
[4] Nelson, J. D and Miller, D. J., (1992), "Expansive soils, problems and practice in foundation and pavement engineering."
[5] Puppala, A. J. Wattana Santicharoen, E. and Hoyos, R. (2003), "Ranking of four chemical and mechanical stabilization methods to treat low-volume road subgrades in Texas," Transportation Research Record, no. 1819, pp. 63-71.
[6] Rajkumar Joshi and Sirajuddin Ahmed, "Status and challenges of municipal solid waste management in India: A review," Joshi & Ahmed, Cogent Environmental Science (2016), 2:1139434.
[7] Rao, S. M., Reddy, B. V. V. and Muttharam, M. (2001), "The impact of cyclic wetting and drying on the swelling behavior of stabilized expansive soils," Engineering Geology, vol. 60, pp. 223-233.