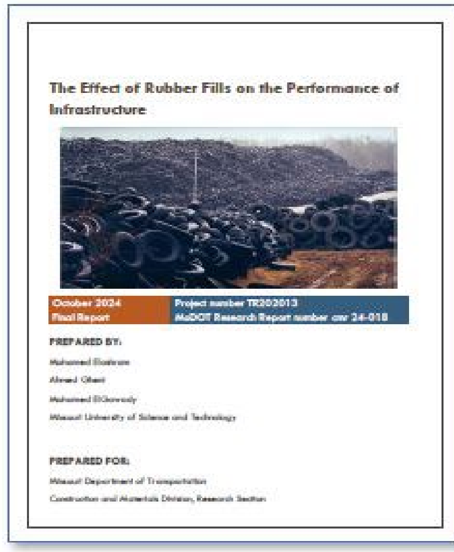
Research Summary

The Effect of Rubber Fills on the Performance of Infrastructure


The Effect of Rubber Fills on the Performance of Infrastructure

October 2024
Final Report

Project number TR202013
MoDOT Research Report number cmr 24-018

PREPARED BY:

Missouri University of Science and Technology

PREPARED FOR:

Missouri Department of Transportation
Construction and Materials Division, Research Section

In 2021, the United States generated nearly 500 million scrap tires. Due to environmental considerations, landfilling scrap tires is no longer allowed in many countries, and stockpiling tires is not a viable option due to them becoming fire hazards and breeding grounds for mosquitoes and vermin. An environmentally friendly method to recycle scrap tires is to shred them into tire derived aggregate (TDA). One of the promising applications for TDA is its use in soil improvement.

Using TDA alone has issues with self-ignition and high compressibility. However, mixing TDA with soil shows great potential as a light filling material. Several studies have examined only the effect of TDA content smaller than 1 inch on the shear strength behavior and compressibility of soil, especially sandy soil. This report addresses a gap in the literature by presenting the results of large-scale shear and compressibility testing of soil classified as clayey gravel and sand soil mixed with different percentages and types of TDA.

In conclusion, incorporating tire derived aggregate (TDA) into soil significantly alters the geotechnical properties of the mixtures, with notable differences depending on the type and amount of TDA used. Adding 25% TDA decreases the dry unit weight by approximately 13% for soil-TDA Type A mixtures and 31% for soil-TDA Type B mixtures. Cohesion decreases slightly by 6% with TDA Type A, from 2.84 psi to 2.67 psi, while it increases by 15% with TDA Type B, from 2.84 psi to 3.27 psi. The angle of internal friction increases by 16%, from 14.38º to 16.70º, with TDA Type A, but decreases by 19.5%, from 14.38º to 11.57º, with TDA Type B.

> *"This report addresses a gap in the literature by presenting the results of large-scale shear and compressibility testing of soil classified as clayey gravel and sand soil mixed with different percentages and types of TDA."*

Normalized lateral earth pressure at rest decreases by 14% with TDA Type A, from 79 to 68, and by 25% with TDA Type B, from 79 to 59, potentially leading to cost savings in retaining wall design. Shear resistance is slightly reduced by 12% with TDA Type A and by 2% with TDA Type B, while shear modulus increases significantly under higher confining pressures, by 30% with TDA Type A and 10% with TDA Type B. In terms of compressibility, mixtures with TDA Type B exhibit lower compressibility compared to those with TDA Type A, with axial strain increments of 3.00%, 7.30%, and 12.50% for 25%, 50%, and 100%

TDA Type A, respectively, and 1.05%, 1.47%, and 5.47% for the corresponding percentages of TDA Type B.

These results suggest that the choice between TDA Type A and Type B should be guided by the specific requirements of the project, as each type offers distinct benefits in terms of strength, stability, and compressibility.

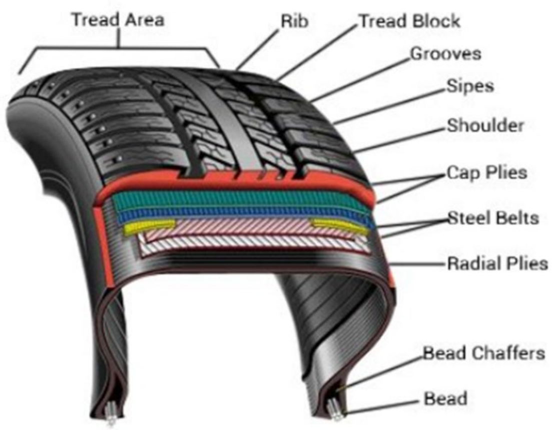


Figure 1: The components of a car tire.

Project Information

PROJECT NAME: TR202013—The Effect of Rubber Fills on the Performance of Infrastructure

PROJECT START/END DATE: October 2019-September 2024

PROJECT COST: $220,066

LEAD CONTRACTOR: Missouri University of Science & Technology

PRINCIPAL INVESTIGATOR: Mohamed ElGawady

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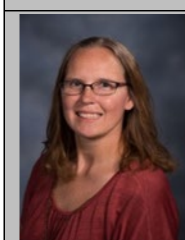
Project Manager



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