Research Project 27

Full-scale Monitoring of Mechanical and Exothermal Response of Tire-Soil Embankments

Recycled Materials Resource Center

University of New Hampshire

Federal Highway Administration

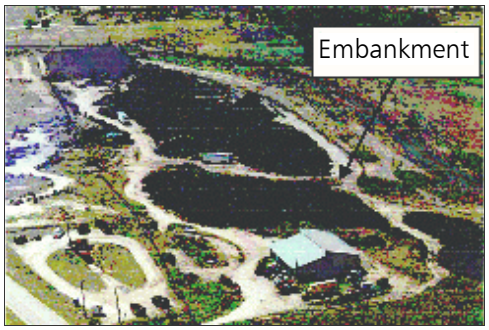
Project Objectives

This study will assess the thermal and mechanical response of tire shreds, whole tires, and various soil/tire shred mixtures that can be used as fill material for road embankments, specifically:

- the thermal response of different combination of soil, tire shreds, and tire-shred/soil mixtures.
- the deformability of different layouts of tire shred and soil in prototype embankments.
- the impact of soil moisture and potential gas generation in the thermal response of tire shred-soil embankments.

Project Progress

The United States currently recycles about 80% of the scrap tires produced each year, which is a great improvement compared to just 10 or 20 years ago. Yet the volumes of waste tires that could be recycled into transportation projects are so significant that comparatively small transportation projects could easily incorporate new scrap tires as well as reduce existing stockpiles. However, two major technical issues need to be addressed to gain confidence in the reuse of waste tires in transportation systems. First, can exothermic reactions lead to spontaneous ignition of tire shreds used as backfill materials? Second, how does the deformability of tire shred-soil embankments compare to that of soil embankments? It is believed that addressing concerns regarding exothermic reactions and deformability will lead to major technical, implementation, and commercialization achievements involving the beneficial reuse of tire shreds.



Aerial view of Front Range Tire Facility

To answer these questions, Dr. Zornberg has collaborated with Front Range Tire Recycle, Inc. to build a full-scale instrumented embankment out of soil and scrap tires to verify that the conditions for exothermic reactions in soil-tire shred mixtures can be avoided, and to show that the mechanical behavior of embankments can be improved using tire shreds. The actual embankment was constructed with three sections: soil only, soil-tire shred mixture, and alternating soil-tire shred layers. A series of embedded thermocouples monitor the internal temperature and allow the PI to monitor the heat transfer through the embankment. Changes in temperature due to rain water infiltration are also measured. Plate load tests will be performed on the embankment to measure and compare the field scale behavior of the different sections.

To date, the temperature data displays a diurnal trend that strongly correlates to solar heating, with the degree of heating diminishing with depth into the embankment. Following a rain event, the average temperature rose, but still showed a diurnal trend. This behavior is explained by heat generation within the embankment, superimposed on the solar heating signal. At this time it is not clear what reaction caused the temperature to rise because oxidation of the steel belts does not account for all the heat.

Project Partners

- Colorado Department of Transportation
- Texas Department of Transportation
- Central Lands Federal Highway Administration
- Front Range Tire Recycling, Inc.
- University of Sherbrooke

End Products

- An integrated field demonstration whose results are widely disseminated by the numerous agencies involved in the advisory board.
- Construction guidelines for tire shred-soil mixtures.
- Specifications for use of tire shred-soil embankments (e.g., CDOT, TxDOT).

Further Information

The Recycled Materials Resource Center (RMRC), a cooperative agreement between the University of New Hampshire and the Federal Highway Administration, is a national center that promotes the appropriate use of recycled materials in the highway environment. Its focus is on the long-term performance and environmental implications of using recycled materials.

For detailed quarterly progress reports for Project 27, as well as all RMRC funded research projects, please see: http://www.rmrc.unh.edu/Research/researchlevel2.asp.

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