Updating MnDOT Guidance for Using Shredded Tires in Roadway Construction

What Was the Need?
Shredded tires (also called tire-derived aggregate), which have a number of applications in roadway construction, have been used in Minnesota for decades. MnDOT’s standards for TDA use are based on research from the late 1980s and early 1990s. Since that time, TDA has been used in multiple construction projects, primarily because of its geotechnical characteristics as a lightweight, drainable fill, but other applications are increasing. Because of TDA’s widespread use, MnDOT is interested in reviewing and updating its standards, where applicable, for using shredded tires in roadway construction.

What Was Our Goal?
This project sought to document the advantages and disadvantages of TDA use in recent years by synthesizing current research about its use in roadway construction. The particular focus of this study was on geotechnical applications: lightweight fill, retaining wall backfill, insulation layers, drainage layers and capillary moisture breaks.

What Did We Do?
Researchers conducted a comprehensive literature review of TDA use as a geotechnical material. This review included published research, test cases and actual construction projects. Most of the research comes from the United States, but the review also includes studies from Canada and Europe.

Researchers also summarized the state of practice regarding TDA use in highway applications based on this published literature.

What Did We Learn?
The literature shows that TDA is a relatively constructible material that has been used successfully as large shreds, shreds or chips in a variety of applications. The literature featured in the review covered a wide range of topics, including TDA layer thickness, recommended cover depth for several applications and TDA effectiveness as an insulating layer against frost or as an aggregate. Some of the most important elements for design decisions follow:

- **Geotextile encapsulation.** MnDOT’s current standard requires encapsulating TDA in a Type IV or V geotextile layer in accordance with Specification 3733. The literature review generally supported the use of geotextile. Covering the top of the TDA with geotextile limits the intrusion of soil into the void space between TDA particles, and complete encapsulation of TDA with geotextile confines the TDA laterally. In one Colorado test section, small sinkholes formed in an embankment, which may have been caused by the lack of geotextile encapsulation.

- **Size of tire chips.** ASTM D6270, Type A TDA has been used for insulation, drainage and wall backfill projects. Successful applications for the larger ASTM D6270, Type B TDA and larger rough shreds are lightweight embankment fill, backfill abutment walls and below-grade drainage. These shreds have also been mixed with soil.
In the 1990s, TDA’s impact on water quality was a significant concern. While laboratory studies suggest that in extreme conditions, chemicals from TDA can leach into groundwater in concentrations that exceed drinking water standards, field studies conducted since then—including a MnDOT project—have mitigated this concern somewhat and indicate that TDA fills should not affect off-site soil or groundwater quality. TDA use in water, however, is still not recommended.

This project also summarized the physical properties of TDA materials for use in design. While specific properties vary with chip size and material, typical ranges for pavement design parameters follow: dry density (generally 35 to 60 pounds per cubic foot, about one-third to one-half of typical soil); specific gravity (1.13 to 1.36, depending on metal content); compressibility (about 20 to 30 percent strain under typical loading conditions); thermal conductivity (low because of the low thermal conductivity of rubber); and permeability (high).

What’s Next?
MnDOT will use these findings as it updates its guidance for using shredded tires in roadway construction. Minnesota law explicitly references that guidance, so changes to it will impact state regulations.

MnDOT is also coordinating with the Minnesota Pollution Control Agency, whose standards cover both private and public projects (unlike MnDOT, whose focus is on public projects). These efforts will attempt to bring MnDOT and MPCA standards and state law into agreement.

While the literature review successfully synthesizes published research, additional information that is unpublished is probably available. Contacting tire recyclers to learn about data that they have collected about using shredded tires in infiltration media or surveying DOTs nationwide to collect information about how they use shredded tires may both be warranted.