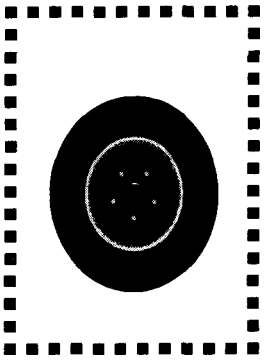
TIRE CHIPS IN BACKFILLS



NSRA Sustainable Development Agenda

PROJECT PROFILE: Recycling Tires: Tire Chip Utilization for Retaining Wall Backfill

Background

Scrap tires can be processed into tire chips which may replace conventional aggregate in civil engineering applications. Approximately 1.6 million scrap tires will be generated every year within the State and another 1.6 million scrap tires are in stockpiles. On and after September 1, 1998, land disposal of these scrap tires in any form shall be prohibited in the State of Nebraska.

HDR Engineering, Inc. was retained to develop a report on tire chip utilization in civil engineering applications under contract with the Nebraska State Recycling Association.

Tire Chips

Slow speed, shear shredders first reduce a whole tire to a "rough shred" size of three to six inches in width by three to twelve inches in length. The second phase processing reduces the rough shred to a smaller "chip," nominally two to three inches in width and length. Smaller chips have improved workability in civil engineering applications compared to the rough shred.

Physical Design Properties

The feasibility of substituting tire chips for a given soil component should be based on demonstrating the equivalency of the tire chip performance to that of the soil component. Design considerations for retaining wall backfill materials are presented in the table.

Property	Backfill Application
Shear Strength	For backfill lateral earth pressure coefficients
Unit Weight	For backfill earth pressures against walls
Compressibility	Under high normal stresses
Permeability	Lateral or vertical fluid flow
Filtration	In contact with soil materials
Leachability	In contact with groundwater or infiltration
Flammability	In deep tire chip backfills

Design considerations for backfills also include settlement of underlying soils and Poisson ratio. Tire chips have been successfully used as retaining wall backfill. The flammability potential in deep tire chip backfills may be minimized by: using larger size tire shreds, limiting amount of exposed steel belt, preventing contact between tire shreds, topsoil and fertilizer, etc.

Retaining Wall Backfill Design

A generic retaining wall design was prepared and analyzed following the recommendations of Humphrey. The analyses on overturning, sliding and bearing capacity for a retaining wall will be the same with a conventional backfill of granular soils or tire chip

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backfill. A geotextile should be used to separate a tire chip backfill from the surrounding soil. Tire chips have a low unit weight with low external earth-pressure coefficient such that its use as lightweight backfill reduces settlement and the lateral pressure on a retaining wall. Direct benefits include:

- Approximately 11,500 tires could be utilized per 100 lineal feet of generic 10-foot high wall.
- Tire chip retaining wall backfills produce less lateral earth pressure on the walls, resulting in structural cost savings, as well as potential backfill cost savings.

Specifications

A preliminary specification developed for the tire chip component is based on a performance requirement for the materials, a method specification for construction, and a per ton basis for measurement and payment. Tire chips may be handled, spread and compacted with conventional construction equipment. Specifications identify a maximum layer thickness and number of passes for compaction with a vibratory smooth drum roller or tracked dozer. Material property specification covers:

- Tire chip maximum size
- Compressibility
- Chip gradation
- Unit weight
- Maximum wire percentage

Regional Markets

Within the region only one tire processor operates a mobile plant, traveling to tire recycling projects, to process tires into rough shreds and chips. Cost of recycled tire chips are driven by:

- nominal tire chip size
- allowable amount of bead and belt wire
- transportation to project site

Cost savings for these specific tire chip applications will depend on local materials costs and additional design features, i.e., retaining wall size or geotextile filters. A tire chip wall backfill may provide additional potential savings from structural downsizing of the retaining wall due to reduced pressure.

Development Partners

This report was prepared by HDR Engineering, Inc. for the Nebraska State Recycling Association. Funding for this report was provided through the Nebraska Environmental Trust.

This report is based on a previous report, "Tire Utilization Study, Engineering Feasibility and Preliminary Design," prepared for the City of Lincoln, Nebraska. This previous report was funded through the City of Lincoln by the Nebraska Department of Environmental Quality Waste Reduction and Recycling Incentive Fund. This report will be reviewed by the University of Nebraska Center for Infrastructure Research.

For More Information

For more information or a complete copy of the report, Tire Chip Utilization Study - Civil Engineering Applications, please call NSRA at (402) 444-4188 or (800) 248-7328.

Resources Utilized:

Some of the resources utilized to establish historic tire chip performance and necessary material quality requirements include:

- ASTM 254992 Draft "Specification for Use of Scrap Tires in Civil Engineering Applications" prepared by Dr. D.N. Humphrey
- HDR, Final Report of the Department of Environmental Quality Scrap Tire Committee 1994
- Dr. D. N. Humphrey, "Civil Engineering Applications of Chipped Tires" 1995
- Dr. D. N. Humphrey, "Investigation of Exothermic Reaction in Tire Shred Fill Located on SR100 in Ilwaco, Washington" 1996
- "Processing of Scrap Tires: Technology and Market Applications" ASME Proceedings 1994