INDOT Research

TECHNICAL *Summary*

Technology Transfer and Project Implementation Information

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Construction of Tire Shreds Test Embankment

Introduction

It is estimated that there are more than 500 million tires stockpiled across the United States, and 270 million more are generated each year. A significant number of them are disposed in landfills, left in empty yards and even dumped illegally. Tires have characteristics that make them not easy to dispose, and potentially combustible. For these reasons, there is a strong need to find beneficial ways to recycle or reuse tires. Civil engineering applications constitute one of the major markets for scrap tires. They have been used in various areas such as leachate collection systems, landfill cover, artificial reefs, clean fill for road embankment, road bed support and similar projects. Using tire shred material for civil engineering application has several advantages. Most important property is that tire shreds are lightweight material. There are many benefits of using shred tires as lightweight fill in embankment or retaining wall since tire shreds are non-biodegradable and thus more durable. Also it is inexpensive compared to other lightweight material.

The present research project consists of construction of test tire shred and soil embankment as well basic laboratory tests for material property characteristics and instrumentation of the embankment. The instrumentation includes settlement monitoring using nine settlement plates, vertical and horizontal inclinometer monitoring, temperature monitoring and groundwater quality analysis. The objective of this project is to evaluate the feasibility of using a mixture of tire shreds and soil as fill material for embankments on the basis of field instrumentation and tests.

Findings

Based on the investigation and monitoring of the tire shred and soil embankment test site, the following observations and conclusions are made.

(1) At State Rd. 31 in Lakeville, IN. a tire shred and soil embankment was constructed. The fill material was a 50/50 mixture by volume of tire shred and soil. The total volume of the embankment after compaction was approximately 813 m^3. The height and length of the embankment were about 2 m and 20 m respectively.

(2) Monitoring using nine settlement plates at three different sections was conducted for a year after opening the road for traffic. The maximum settlement was approximately 12 mm and the settlement stabilized after 200 days of traffic.

(3) Vertical and horizontal inclinometer monitoring was conducted to check lateral movement and differential settlement for one year. Maximum lateral movement was about 5 mm. No evidence of significant differential settlement has been observed.

(4) Samples of groundwater were analyzed for metals which apply to a secondary drinking water standard and standard of maximum contaminant level for drinking water according to Indiana Department of Environmental

Management (IDEM). Except for manganese, all levels have been well below the standard limits. However manganese is not a health concern.

(5) To check for the possible development of exothermic reactions that might lead to the initiation of fires in the embankment, the temperature was observed for a year. No evidence of internal heat generation has been detected. This confirms that the use of tire shred and soil mix is a proper way to prevent self-heating of the tire shreds.

(6) Observations show no signs of slope stability problems, cracking on the road or erosion.

Implementation

(1) Based on the above findings and observations, using a mix of tire shreds and soil in embankments or fills is very promising and should be promoted. Performance of the test embankment was quite satisfactory. Advantages of this material include the fact that it is lightweight, relatively cheap, easy to compact, free-draining and relatively compressible. Additionally, this use is beneficial to the environment in that a waste material is recycled.

(2) Given the characteristics of soil-tire shreds mixer, these mixer can be used as backfill material for retaining structures. Since tire shreds are lightweight, they induce low horizontal stresses thus reducing the thickness of retaining structures. Similar cost savings will be possible for MSE walls as well.

(3) Based on the experience of the construction of the test embankment in this project, a special provision for the embankment constructed of shredded tires and granular fill is provided.

(4) To prevent self-ignition, floating of the tire shred in a soil matrix is desired. The minimum mixing ratio that produces such an arrangement can be determined by vibration compaction tests. The mixing ratio producing a minimum overall void ratio is the minimum mixing ratio leading to this arrangement. Other mixing ratio can be explored in order to increase the strength of other result mixture.

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