2013

TAC Environmental Achievement Award Submission

On behalf of: Alberta Transportation, Alberta Recycling Management Authority, City of Edmonton, University of Alberta, ISL Engineering & DeFord Contracting Inc.

Albertans discard more than five million scrap tires annually through the tire recycling program managed by Alberta Recycling Management Authority (Alberta Recycling). They also rely on coal to service nearly fifty percent of energy demands (Alberta Energy), generating large ash deposits. The productive use of scrap tire and bottom ash is an important environmental consideration in managing waste materials and an effective cost saving strategy for provincial and municipal governments.

Civil Engineering has embraced the application of recycled waste materials in a variety of civil projects, including the use of alternative materials for road construction. Use of recycled shredded scrap tires and industrial waste products, such as bottom ash, for purposes like embankment or base course for roadways reduces first, the waste stockpiled in landfills and second, the depletion of our non-renewable natural resources for soil and gravel.

For this project, we used nearly one million scrap tires in Alberta to produce roughly 8,000 tonnes of Tire Derived Aggregate (TDA) to be used as embankment fill material (Picture 1 in appendix), and pavement insulation layers for a pilot test road.

The nominated project aligns with the spirit and intent of the Transportation Association of Canada's Environmental Achievement Award. Embracing the main goal of environmental protection and cost benefit, a partnership was formed between Alberta Transportation, Alberta Recycling, the City of Edmonton and the University of Alberta to explore the feasibility of waste and recycled materials as alternative aggregates for road construction. The project marks the first use of TDA for road construction in Alberta and will provide the transportation industry with unique data and analysis specific to cold-climate regions.

Outline of Research Activity

Provincial and Municipal Governments are under pressure to use sustainable materials in civil works and to do so within conservative budgets. In a cross-ministerial decision, the Government of Alberta chose to evaluate and expand the application of waste materials for road construction. Based on the Government's research priorities, two waste materials (waste tire and bottom ash) were selected for evaluation. There is no precedence of TDA being used in Alberta roadway construction projects, and therefore the application of TDA requires testing and monitoring to analyze the long-term feasibility of the two alternative aggregates.

Project Objectives

- To evaluate the use of recycled and waste material for road embankment fill and insulation layers.
- To evaluate the performance of these materials in cold-climate regions.

- To develop guidelines and specifications for the application of TDA and bottom ash for roadway projects in cold climates.
- Facilitate knowledge transfer to the Transportation industry.

This type of project has the potential to divert thousands of scrap tires each year from landfills, underscoring the Alberta Government's *Too Good to Waste Strategy* of reducing waste sent to landfills and preserving land for future generations. For the nominated project alone, the equivalent of 825,000 tires were processed to produce the 8,250 tonnes of TDA material required for the project, saving approximately 103,125 m3 of landfill space (Alberta Recycling).

In climates similar to Alberta, road engineers must consider the protection of subbase against deep frost penetration, which can result in premature pavement degradation. Styrofoam is traditionally used as an insulation layer to guard against the effects of freeze and thaw cycles. However, the production of Styrofoam is damaging to the environment and costly. We retrieved waste bottom ash from local industry and used it as an alternative insulation layer to evaluate its feasibility with respect to costly and non-sustainable Styrofoam boards (Pictures 2 in appendix).

A further environmental consideration is that the production of TDA employs a less invasive process when compared with aggregate that has to be mined, such as gravel. To generate TDA, whole tires are put through a shredder and mechanically cut into a specified size without need to extract the metal or fibre, which are products of the tire.

Innovative Aspects of the project: Our approach

The collaborative efforts of the nominated team started with design and planning for the project, two years in advance of the construction in summer 2012. The University of Alberta collaborated with ISL Engineering and the City of Edmonton to design the test road and estimate the quantity of TDA required for the project. Alberta Recycling led the production and quality assurance of TDA and transported the material to the site (Picture 1 in Appendix). In the summer of 2012, the nominated team worked with DeFord Contracting Inc. to construct the multi-million dollar test road at the Edmonton Waste Management Centre (EWMC) facility, 15 km east of downtown Edmonton. The road will serve as an access road connecting the Anthony Henday Drive to the EWMC.

During construction, geotechnical and environmental sensors were installed within the embankment, environmental sensors were installed across the depth of the sections with insulation layers, and environmental and traffic load sensors were embedded in the pavement to allow for continuous performance monitoring of the recycle materials. The data is continuously and automatically collected every 15 minutes, which began the first day of construction. The thorough data acquisition system was used during construction to evaluate the constructability of the embankment made of TDA, and data will continue to be collected for long-term performance evaluation. Using the environmental

instrumentation in the road sections with insulation layers, we will be able to quantitatively establish the effectiveness of TDA and bottom ash in preventing frost penetration into the pavement system.

This is the first test road in Western Canada, and while the notion of TDA as a civil engineering product is not new to Alberta (it has been used as a drainage blanket in landfill cells) the application as an engineered material with well-understood and documented performance characteristics as aggregate material *is* new.

Cost Implications

The Alberta Recycling Management Authority leads Alberta's Tire Recycling Incentive Program. Approximately 90% of the money generated from environmental fees (remitted to Alberta Recycling from sellers of eligible tires that are sold in the province) fund the collection and recycling of the six million scrap tires processed annually through the Tire Recycling Incentive Program.

There are three specific incentives within the current Incentive Program that directly impacted the nominated project and will offer the same benefits for future projects.

- The "Transportation Incentive", which pays between $55 and $180 per tonne (depending on where the scrap tires were picked up in the province) to recyclers registered with the program.
- The "TDA Incentive" of $100/tonne (for the nominated project the program funded $825,000 to process the scrap tires into TDA)
- And up to 100% of the cost to transport the finished TDA material from the recycling facility to the municipal project site.

Significant cost-savings could be realized for municipalities through Alberta's Tire Recycling Incentive Program, which covers the cost of processing the TDA product and up to 100% of the transportation cost for delivery to a project site versus paying 100% of the cost to use gravel.

Applicability to Transportation in Canada

The nominated project offers a scientific evaluation of waste and recycled materials for road and pavement construction, with a unique focus on cold-climate response and performance. Results of the pilot project will substantially impact road design and construction considerations in Alberta, where extreme freeze-thaw cycles leave roads vulnerable to early degradation. Although we anticipate the success of TDA and bottom ash as embankment fill and insulation layers, long-term analysis is required to address special construction and design issues related to the use of waste and recycled materials in cold regions. The analysis will support the development of guidelines for pavement engineers working with these materials in the future and will be transferred to the transportation industry.

Further, the unique and highly successful collaboration between the University of Alberta, Alberta Transportation, Alberta Recycling Management Authority and the City of Edmonton can be used as a model for the transportation industry to resource similar projects throughout Canada. The combined efforts on behalf of all the nominated partners bolstered the start-up of the project and are relied on to achieve positive environmental and cost outcomes.

Conclusion

We have highlighted a pilot project that has utilized two abundant waste and recycled products for the purpose of transportation innovation in Alberta, diverting tonnes of waste material from landfills or unregulated stockpiles. With the support of recycling programs and initiatives, valuable new materials are created and substantial cost savings are transferred to municipal and provincial governments dedicated to exploring the use of recycled materials in road construction for the benefit of future generations.

Appendix

Picture 1. Embankment filled with TDA during construction, summer 2012.

Picture 2- Placement of bottom-ash as insulation layer to prevent frost penetration into the pavement.

Picture 3 – Stored TDA product for construction project at the Edmonton Waste Management Centre.