Executive Summary of Final Report for Project: HKA 1.1.16 Recycling Textile Fibres

Authors: **UsedFULLY – Dr Steve Bagshaw, Deborah Crowe**
Research Partners: **Scion & WSP NZ**
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Introduction

The Innovation Fund - *Hoe ki angitū* – was set up by NZTA Waka Kotahi to support the private and non-government sectors to develop and accelerate innovative solutions that will help to solve some of our big transport challenges. This project responds to the first Challenge under the fund, which was for projects investigating how

> *we might reduce the environmental impacts of transport infrastructure construction, operation and maintenance activities through accelerating the use of recycled materials and sustainable practices.*

This project received $182,238 to fund

> *trials to determine the feasibility of using recycled textile fibres in different types of asphalt, to understand why the application of polycotton fibre into chipseal has yielded such promising results, and to optimise the processing parameters to produce a reliable product at scale.*

Objectives of the project

Cellulose fibres are currently imported to be used in some asphalt mixes for roading purposes. UsedFULLY has already established a process to take end-of-life textiles and incorporate them into asphalt mixes in substitution for imported cellulose fibres, particularly, but not exclusively, in stone mastic asphalt.

The objective of this project was to determine whether a similar process could be used to incorporate the same end-of-life textile product into bitumen used as a binder in chipseals. Chipseals are a much more common road surface in New Zealand than stone mastic asphalt.

If this process is determined to be commercially viable, it could potentially reduce the environmental impacts of transport infrastructure construction by reducing bitumen usage by up to 15%. Bitumen is imported into New Zealand and derived from non-renewable sources.

If the process is also determined to deliver some improvement to the performance of chipseals, then it would reduce both the environmental impact and the financial cost of maintenance, as it would extend the lives of chipseals and enable maintenance to be carried out less often.

The process would also potentially deliver significant environmental benefits by diverting up to 20% of the end-of-life textiles which currently end up in landfill.

Methodology

A simple mechanical process was used to convert a range of different textile feedstocks into a range of micro-fibres of different lengths and thicknesses.

The various fibres were then mixed, as loose fibre, into bitumen in different proportions, to create a range of fibre modified bitumens. Model laboratory scale chipseals were then prepared using these fibre modified bitumen binders.

Both the fibre modified binders themselves, and the model chipseals made from them, were then tested at different temperatures:

- 0°C - the temperature at which chipseals are at risk of failure due to the bitumen binder cracking, and
- 45°C - the temperature at which chipseals are at risk of failure due to the bitumen binder softening and flowing.

This project was supported by Scion, which processed the fibre, and WSP New Zealand Research and Innovation Centre, which blended the fibre into the bitumen and tested the resulting fibre modified bitumen mixes and the model chipseals.

Key findings

The finest grade of recycled fibre was able to be blended into bitumen, to a weight of up to 10%, while still maintaining bitumen viscosity well below the maximum prescribed by the relevant NZTA standard.

When tested at a temperature of 0°C, the fibre modified bitumen's resistance to failure by cracking was 20% better than bitumen without fibre. When tested at 45°C, the modified bitumen's resistance to flowing was a dramatic improvement over bitumen without fibre – up to 500%. Fibre modified model chipseals also displayed improved performance over non-fibre modified model chipseals.

The project has therefore established that, under laboratory conditions:

- up to 10% of bitumen by weight can be replaced with appropriately processed recycled textile fibre and the resulting fibre modified mix used as a chipseal binder
- the performance of bitumen, containing up to 10% recycled textile fibre, used as chipseal binder, is significantly improved compared with pure bitumen in both the cold and hot conditions at which failure may occur.

This performance increase may reduce the need for maintenance where hot or cold conditions contribute to the deterioration of chipseals across the roading network.

Next steps

There are some aspects of fibre-modified binder that would be useful to investigate further:

- Examine possible in-service release of fibre from the fibre-modified binder.
- How to deploy the fibre-modified bitumen into the chipsealing process.
- How chipseals made with a fibre-modified binder would perform in a real-world environment. Monitored road trials will be necessary to evaluate this.

Wellington City Council, Auckland Transport and NZTA Waka Kotahi are aware of this project and may be prepared to support road trials at an appropriate time.