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Buying Time, Extending Service Life

Stress Absorbing Membrane Interlayer Delays Reflective Cracking in Asphalt Pavement

One of the most difficult challenges the Ontario Ministry of Transportation (MTO) faces in the preservation of its provincial highway network is reflective cracking in asphalt pavement. For this reason, MTO continually seeks new technologies used to mitigate pavement surface cracks. In 2009, the ministry trialed its first use of Stress Absorbing Membrane Interlayer (SAMI), an innovative pavement treatment with positive results. The trial application was conducted on a 12.75 km section of Highway 62, near Madoc north of Belleville.

Ontario's most common pavement structures consist of unbound granular base layers overlaid with a bituminous surfacing system. These may be made of one or more layers of hot mix asphalt or a bituminous seal coating system, chip seal or graded-aggregate seal. Over time, physical deterioration of an overlay takes place as a result of movement at crack locations in the underlying pavement layers. Fatigue, thermal, and age cracking can occur due to traffic loading, temperature and oxidation of the asphalt binder, respectively. Further, traffic induces reflective cracking in the overlay which allows water to penetrate and further deteriorate the pavement structure.

Most overlay treatments have been inadequate for mitigating reflective cracking. MTO has typically used rout and seal as a short term solution to keep water out of surface cracks. Depending on the extent of surface cracking, the ministry may apply a microsurface overlay to extend pavement service life until full rehabilitation can be performed. Pavement cracks typically propagate through a new overlay in a few seasons.

SAMI is a surface treatment applied to pavement to inhibit cracking. It consists of a combination of polymer modified asphalt emulsion, and chopped fibreglass strands, which are sprayed onto the pavement surface. Its application is similar to conventional chip seal coating. After applying the fibre membrane, an application of stone chip aggregate is placed before a final pavement overlay is applied. SAMI acts as a highly resilient waterproof membrane, sealing the existing surface and controlling reflective cracking. SAMI absorbs some of the pavement strain that occurs when vehicle loads are applied on the top of the overlay pavement; with excellent ductility, SAMI limits crack propagation in the overlay associated with shear strain in pavement.

Developed in the United Kingdom in the late 1980's, SAMI has been used by road authorities around the globe since its inception. In North America, SAMI was first used in 2003 in Niagara Falls, New York. Canada's first use of the treatment was in 2005 for a municipal application in York Region north of Toronto. Since then, SAMI has been used in other Ontario municipal contracts, such as Norfolk, Bruce, Grey and Simcoe Counties and the Cities of Markham and St. Catharines.

Are you getting enough fibre?

During early municipal applications, an Ontario company, Norjohn Contracting and Paving Limited collected and compared SAMI and control core samples. After one year, although no reflective cracking was visible on either surface, coring revealed upward crack propagation in the overlay of the control section, while no crack propagation was visible in the core extracted from the SAMI section. Based on Norjohn's results, indicating that SAMI use delays crack propagation, MTO staff decided to trial SAMI on a provincial highway. >

Chopped fibreglass strands, 5 to 10 cm in length, used for SAMI application.

Fibreglass strands mixed into binder emulsion.

Stress Absorbing Membrane Interlayer Delays Reflective Cracking in Asphalt Pavement, *continued*

A load of 40 separate fiberglass spools capable of covering 25,000 m2.

SAMI being applied to the highway surface to mitigate reflective cracking.

Example of Fibermat type B applied as a SAMI over a milled surface and awaiting a hot mix cap. Note the severity of the cracking to be inhibited by this interlayer.

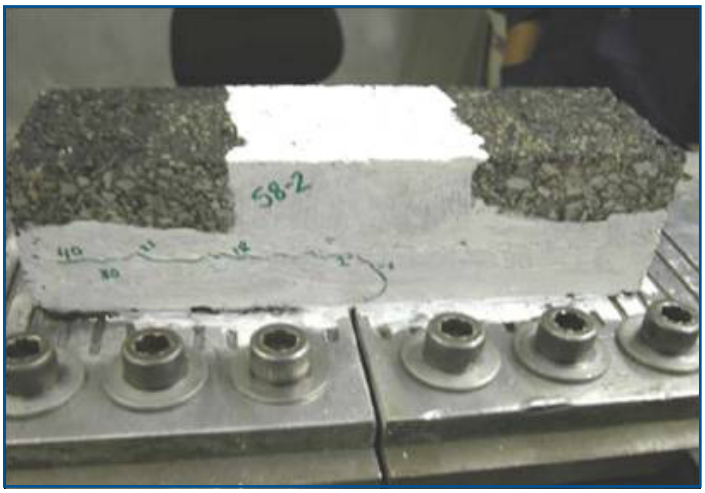
SAMI Trial on Highway 62

In 2009, the ministry selected Highway 62, a secondary highway south of Madoc with severely cracked 30 year-old pavement, for its first SAMI trial. CoCo Paving, the successful bidder, subcontracted Norjohn Contracting and Paving Limited, to execute the SAMI paving contract.

The Highway 62 application of SAMI was placed by a specially developed trailer. This trailer applies material 4 m wide (in 300 mm increments) and is computer-controlled to ensure consistent distribution of all SAMI components. Chopped fibreglass strands between 5 and 10 cm long are pneumatically pushed into a binder emulsion to ensure proper encapsulation and random layering to form a fabric within the binder. The binder is a polymer-modified cationic rapid setting emulsion applied at rates varying between 1.6 and 2.0 lt/m2 depending on the size of the aggregate. As a general rule, 10 per cent more binder is applied to ensure proper encapsulation of the fibre. The membrane residual binder rate exceeds 1.0 kg/m2; in most circumstances, this is sufficient to ensure pavement waterproofing. After the binder emulsion is applied, conventional, clean, single-size aggregate chips are applied. The chips are used as a protective layer which allows construction traffic to travel on the surface without destroying the membrane.

SAMI Trial Results

Since 2009, the ministry has conducted annual pavement distress surveys on the Highway 62 section to gauge SAMI success. To date, the Highway 62 section is performing well with only minimal reflective cracks. The pavement on Highway 62 was very distressed prior to the SAMI application so negligible visible cracks at this time indicate that SAMI is delaying crack propagation successfully. The ministry has further tested SAMI on Highway 41, south of Denbigh, and on Highway 17, east of Sturgeon Falls; visual distress surveys on these section will take place in the spring 2012.



Cracking occurred at the membrane interface rather than vertically as in control samples.

Stress Absorbing Membrane Interlayer Delays Reflective Cracking in Asphalt Pavement, *continued*

No visible crack propagation in core hole of section after using fibre-reinforced interlayer.

Upward crack propagation.

Limitations and Benefits

A few challenges exist when applying SAMI and are similar to traditional seal coat technology including; the migration of loose stones, and temperature restrictions for placement. When SAMI is used, less aggregate – a surface coverage of only 80 per cent – is required for a road resurfacing project because the membrane acts as a protective surface for asphalt binder awaiting a hot mix asphalt top coat. Costs associated with SAMI applications are relatively competitive compared to other reflective cracking mitigation systems. Industry experience suggests that SAMI can extend the service life of pavements three-fold – diverting the cost of pavement rehabilitation and extending highway service life.

A New Tool

The encouraging outcomes of the ministry's initial applications of SAMI resulted in the 2010 development of a new special provision to be included in future MTO contract tenders. Contractors now have the option to bid on using either the fibre SAMI or a Geotextile mat SAMI treatment processes when treating asphalt cracking on Ontario's highways.

While SAMI was developed specifically to address reflective cracking, monitoring and laboratory testing demonstrate its ability to inhibit, not prevent reflective cracking. Reflective cracking remains a difficult pavement defect to correct in the long term. The ministry will continue to seek and test innovative methods to address pavement cracking. In the meantime, SAMI is a new tool for delaying extensive pavement rehabilitation. ●

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