Better Asphalt Cement Initiative

MTO Partnership Develops Testing to Improve Asphalt Cement

Ontario’s Ministry of Transportation (MTO) regularly develops and implements new materials and technologies to improve highway sustainability. The 2011 Asphalt Cement Initiative trials reflect MTO’s sustainability-based approach with 33 trials conducted to address premature cracking on Ontario’s highways. After consultation with asphalt suppliers, these trials were designed to evaluate different ways to improve the performance of Hot Mix Asphalt (HMA) before MTO adopts new warranty criteria for cracking.

Since 1997, MTO has been using Superpave Performance Graded Asphalt Cement (PG) a grading system that characterizes asphalt based on high and low temperature performance. Previously, the ministry used penetration grading which was limited to measuring asphalt cement consistency at a single temperature. Despite the significant improvement PG grading offers over penetration grading, asphalt with the same PG grade can perform differently across Ontario’s regions. Premature cracking isn’t linked to a single direct cause, but a culmination of climate, pavement design, traffic levels, construction and material selection. MTO sought a more effective method of asphalt characterization to reduce the occurrence of premature cracking.

In collaboration with Queen’s University, MTO constructed a series of trials on highways 655, 417 and 427 to investigate and develop new tests. Collectively known as Laboratory Standards these tests focused on developing an accurate characterization of fatigue resistance, elasticity and low temperature cracking in asphalt cement. To ensure that the Laboratory Standards tests met MTO’s requirements for reliability and effectiveness these highways were selected for unique conditions. Highway 655 is a rural undivided secondary highway located in northern Ontario. The cold climate, consistently low traffic volume and remoteness presented a significantly different context in comparison to the other highways. While Highway 417 has a rural designation, it differs from Highway 655 due to its status as a divided freeway, located in eastern Ontario, with a warmer climate and higher traffic volume. Lastly, Highway 427 was selected based on its status as an urban divided freeway and very high traffic volume with underlying concrete pavement.

As a result of the trials, the ministry articulated a new performance specification in 2010 that requires asphalt cement to meet specific warranty conditions for pavement cracking. Prior to implementing the new performance specification and to assist in complying with these requirements, industry asked MTO to construct trials to evaluate the options available for achieving better performing HMA.

MTO selected 33 contracts to supplement conventional PG grading with one of three methods for specifying better quality asphalt. The first method requires using the Double Edged Notched Tension test (DENT) and the Extended Bending Beam Rheometer method (Ex BBR). Through the DENT and Ex BBR tests, MTO sought to remedy the shortcomings PG grading carries in measuring the resistance of asphalt cement’s ductile properties to fracture and physical hardening in sustained low temperatures. The second method requires using certain aspects of the Multiple Stress Creep Recovery (MSCR) test to evaluate the asphalt cement for polymer modifier and the elastic...
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properties of the polymer. Despite the test’s primary use for assessing high temperature grade asphalt cement, it can be useful in determining polymer content and indications of potential rutting. Finally, the last method included focuses on specifying the use of a lower, low temperature grade of asphalt. Although each method has a unique focus, all of the contracts were mandated to include the Ash test to examine the effects of contaminants from recycled engine oil residue that is used as an asphalt modifier.

Data was collected from 30 of the 33 contracts tendered and performance was monitored using video footage from Automated Road Analyzers (ARAN) from 19 completed trials. As a high speed profiler with adaptive technology, ARAN video provides the ministry with faster access to pavement crack assessments conducted throughout the province. Results from the footage has allowed the ministry to compare six different criteria including Ash (%), MSCR and non – recoverable creep (k/Pa), grade loss (°C), Lower Temperature Limiting Grade (LTLG), Critical Crack Tip Opening Displacement distance (CTOD) with initial field performance. Despite the ministry’s ability to process data from most of the trials, it is still too early to draw conclusions on pavement performance or definite trends. However, there has been enough progress made through these initial trials to warrant further testing as exhibited in the photographs below of different sections of Highway 403.

Projects in 2012 and 2013 continue to limit recycled engine oil residue using the Ash test. Samples are being sent to the ministry’s Materials Engineering and Research Office (MERO) for possible future testing. Asphalt cement will also be tested for crack resiliency through the DENT test, the MSCR test, and characterized using the ExBBR test. Since the inception of the 2011 Asphalt Cement Initiative Trials, previous trials and subsequent contracts, MTO has garnered significant attention for its efforts to prevent premature cracking.

An independent review published in 2012 and funded jointly by the ministry and Ontario Hot Mix Producers Association stated that Ontario’s low temperature test is better at predicting cracking than the PG grading test but relatively equal when testing field aged asphalt. It also concluded that the PG long term aging test does not predict field aging. Furthermore, in another report published in 2012, the Federal Highway Administration found Ontario’s fatigue test was the best at predicting fatigue cracking out of the nine tests evaluated.

Given the promising indications from the trials and external partnerships, the ministry’s strategy for 2013 remains the same - trials will continue to be monitored along with the re-examination of Ontario’s PG grade selection method and latest test developments, including Queen’s University’s modified lab aging protocol.

MERO will be looking at other factors that impact pavement performance such as construction practices including compaction, segregation and inter lift bond. The composition of HMA will be analyzed with emphasis on air voids and asphalt cement content. Lastly, the design of pavements will be assessed with emphasis on thickness and the presence of fibres. One of these studies is being conducted in collaboration with Waterloo University through MTO’s Highway Infrastructure Innovation Funding Program grants. The focus of the Waterloo University partnership is on the impact of asphalt cement type and content as well as air voids on fatigue resistance of HMA.

The construction of the trials and the continued collaboration by the ministry with industry and academia has raised asphalt cement quality ensuring that Ontario’s highways are sustainable. Continuing related research with external partners and monitoring of the 2011 Asphalt Cement Initiative Trials through the early life of the pavements will provide an even greater understanding of premature cracking on Ontario’s highways and allow for the development of more tools to limit the occurrence.

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Reports on Ontario Asphalt Cement:
