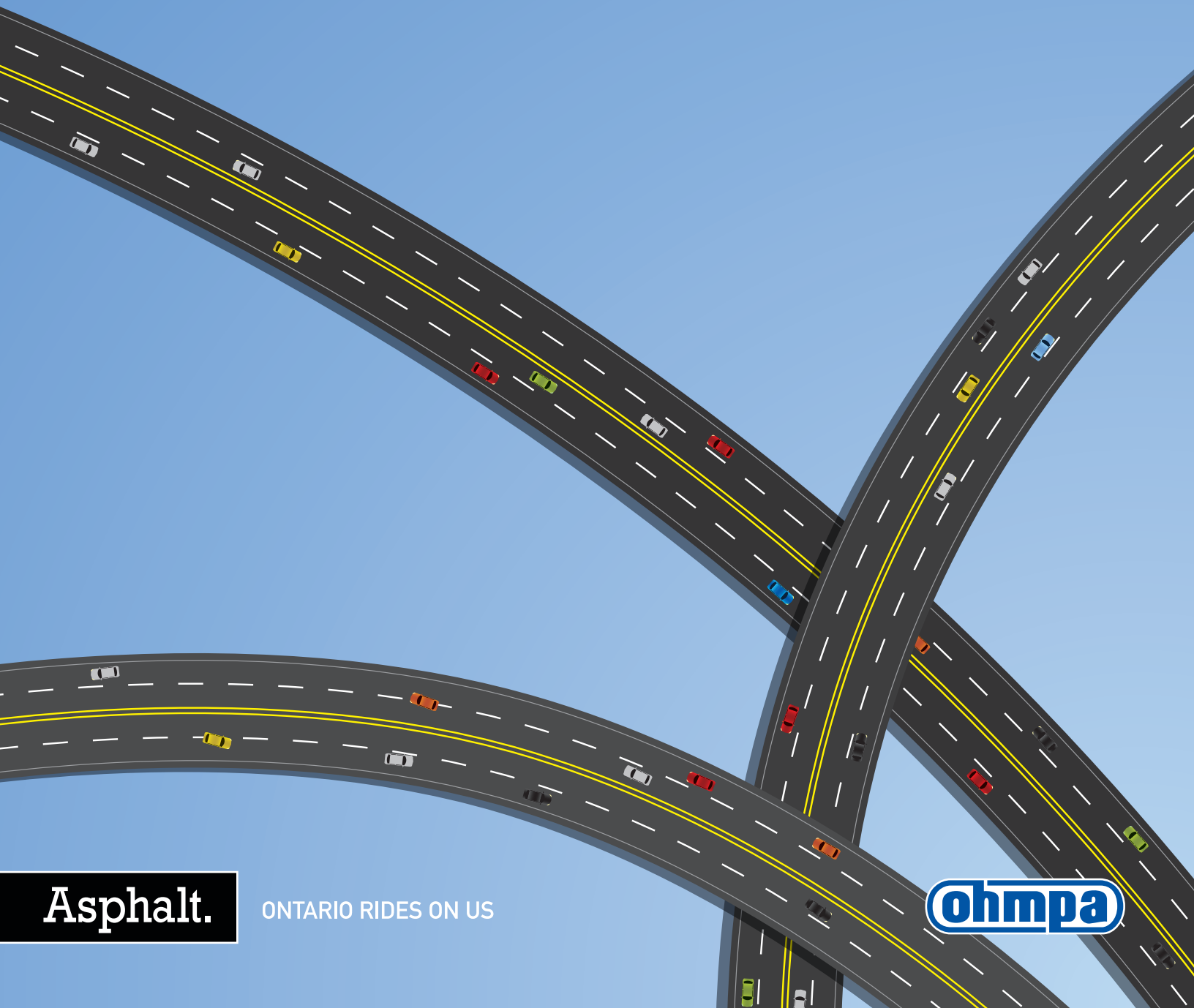


ONTARIO HOT MIX
PRODUCERS ASSOCIATION

QUALITY OF ASPHALT PAVEMENT
TASK FORCE



Asphalt.

ONTARIO RIDES ON US



QUALITY OF ASPHALT PAVEMENT **TASK FORCE**



In response to concerns about the quality of asphalt pavement in Ontario, OHMPA formed the Quality of Asphalt Pavement Task Force in late 2014.

Comprised of industry experts, consultants and academics, the group's purpose is to assess these concerns and propose workable solutions that are scientifically sound and practical.

Responding to this challenge, the Task Force has road owner's concerns in mind and draws upon the expert opinions of the group members.

Members of the Task Force are Bruce Armstrong (Canadian Asphalt), Hassan Baaj (University of Waterloo), Salman Bhutta (Engtec Consulting), Jim Karageorgos (Steed & Evans), Fernando Magisano (K.J. Beamish), Steve Manolis (Coco Asphalt Engineering), Kevin Martin (Fermar Paving), Murray Ritchie (They Murray Group) and Ludomir Uzarowski (Golder Associates). The group is chaired by Vince Aurilio, OHMPA Executive Director (Ex-Officio) and backed by OHMPA president Steve Smith of the Miller Group who acts as vice-chair.

After an internal review by industry, OHMPA extended an invitation to provincial and municipal stakeholders to collaborate with the Task Force. Provincial and municipal representatives of the Task Force are Becca Lane (MTO, Ex-Officio), Gary Kocialek (Peel, GTHA), Andrew Lewis (Windsor, Western), Charles Croll (Stirling-Rawdon, Eastern), David Euler (North Bay, Central/Near North), Patrick Seguin (Timmins, Northern), James Smith (OGRA, Ex-Officio).

The efforts of the Task Force are supported by OHMPA's technical director Sandy Brown.

Bulletins regarding top priority concerns have been published by the Task Force and are provided in this packet and are also available on OHMPA's website at www.ohmpa.org.

SPECIAL BULLETIN #2

Asphalt Cement Quality and Specifications

This bulletin focuses on asphalt cement quality and specifications as they relate to pavement cracking identified as a high priority issue in the inaugural bulletin of the Task Force (TF) released in March 2015. Presented is a summary of actual pavement cracking performance data and the corresponding correlations observed with the various tests used to assess the quality of the asphalt cement in their respective studies. It is important to note that comprehensive reviews of the latest studies and data will continue to be undertaken by the TF as they become available.

The attached matrix shows the correlation between asphalt cement properties and pavement cracking performance observed to date based on a number of Ministry of Transportation (MTO) trials. While it is acknowledged that asphalt cement quality affects cracking performance, based on the results of the studies it is clear that the asphalt cement binder properties measured in the trials are not sufficient to predict and control pavement cracking performance. In addition, the data infers that implementation of the Extended BBR does not appear to significantly enhance pavement cracking performance beyond the current specification provided that the low temperature PG rating of the binder is properly specified. In some of the studies, the low temperature of the pavement experienced during winter may have dropped below the low temperature PG rating of the binder. Moreover, the performance data shows that the rehabilitation treatment may have played a role in the distress.

MTO implemented major changes to asphalt cement specifications in 2012. These new specifications included DENT and MSCR Percent Recovery which assure polymer modification, and Ash Content intended to limit the use of certain additives such as Re-refined Engine Oil Bottoms (REOB), also known as Vacuum Tower Asphalt Extenders (VTAE). Since the implementation of the new specifications, it is noted that the pre-mature cracking attributed to the quality of asphalt cement have not been reported at the time of the release of this bulletin. While these specifications have been used on MTO highways for three years there has not been substantial use of polymer modified asphalt cement in municipal and private projects.

Any research considered should be properly validated. As the objective of the TF is to achieve better pavements, it goes without saying that the findings of the research and analyses will be an essential step to accomplish that goal. So, it is the consensus of the TF that while definitive causes are difficult to identify conclusively, the noted pre-mature cracking can be attributable in some cases to other issues such as poor mix design, irresponsible use of RAP, lack of or improperly applied tack coat, inadequate design of the pavement structure or construction related issues (insufficient compaction, aggregate segregation, poor drainage, etc.) and these factors need to be evaluated.

At this time, the TF strongly recommends the use of polymer modified asphalt cement where enhanced performance is required. Analysis of recent temperature data has also revealed that the PG Zones set out originally for Ontario should be re-assessed as some areas have been experiencing much lower temperatures leading to the selection and use of essentially the wrong low temperature PG.

A caution should be warranted on the use of prescriptive language to control modification technologies. Chemical analyses may actually not have been fully validated so far. Consequently, they could be subject to complications, or lead to potential errors, if they are used to assess conformance to specifications.

Work is ongoing to study improvement to the PG specifications. The TF is very supportive of ongoing research including the studies carried out in Ontario by the MTO. New proposed test methods should be properly validated prior to their implementation. The MSCR, for example, is being fully supported by industry primarily because the test has gone through rigorous testing, has been properly validated and polymer modified asphalts that meet the specified requirements of the MSCR test have been shown to be more strain tolerant. This bodes well for improving the performance of the asphalt cement and ultimately the HMA.

The Quality of Asphalt Pavement Task Force re-iterates that implementing the MSCR specification alone is not sufficient to ensure long term pavement performance. A composite approach addressing binder, mix, pavement design, and construction factors is required.

CRACKING PERFORMANCE CORRELATION MATRIX

TRIAL/STUDY	TEST CONDUCTED	CORRELATIONS WITH CRACKING	COMMENTS
Hwy 655 Ph 1 2003 6 trial sections (3,500 tonnes of HMA)	1 Hr BBR (M 320)	None	Correlation to transverse cracking after five years. Pavement temperature exceeded failure limits of binders. Binders were rated for -34°C (PG 64-34 & 52-34) were specified for region where pavement temperature drops below -34°C. One section passed Extended BBR LTLG and had good cracking performance after five years. Trial did not answer what would happen if PG minus 40 binders were specified so that failure limits of binders were not exceeded. Tests on recovered binders after five years showed excellent correlation to transverse cracking for both 1hr BBR and Extended BBR (recovered binder results).
	ExBBR LTLG (72 hr)	Moderate	
	ExBBR Grade Loss	Moderate	
	DENT	Poor	
Hwy 417 2006 7 trial sections	1 Hr BBR (M 320)	Poor	Correlation of MTO QA test results (at time of construction) to total cracking after eight (8) years in service (based on MTO ARAN cracking data).
	ExBBR LTLG (72 hr)	Poor	
	ExBBR Grade Loss	Poor-Moderate	
	DENT	Moderate	
Hwy 655 Ph 2 2007 8 trial sections	Review is outstanding pending availability of field trial results.		Trial results to be analyzed.
Hwy 427 2008 5 trial sections	Review is outstanding pending availability of field trial results.		Trial involved asphalt over concrete. Relevance to binder performance specification will need to be assessed.
Study of Pavement Performance in Eastern & NE Ontario 2009 20 pavement	Tests conducted on recovered asphalt. Both 1hr BBR (M320) and Extended BBR (72hrs) testing on recovered binders predicted similar performance cracking.		Virgin binders were not tested. Pavements were 8 to 20 years old when cored.
2011 MTO Acceptance Methodology Initiative 2011-2015 38 Contracts (results from 18 contracts representing 600,000+ tonnes are available for review at this time)	1 Hr BBR (M 320)	Moderate	Correlation on total cracking for mill and pave 2-lift pavements after three years (ARAN data) as there was insufficient data to correlate for other construction types. Correlation to longitudinal and transverse cracking showed similar results. Construction type appeared to influence cracking: Pulverize (3 lifts), FDR (2 lifts), and CIREAM (2 lifts) performed better than Mill (1, 2 and 3 lifts), Overlay (1 lift) and Pulverize (1 lift).
	ExBBR LTLG (72 hr)	Poor	
	ExBBR Grade Loss	None	
	DENT	None	
	MSCR % Recovery	Poor	
	Ash Content	None	

SPECIAL BULLETIN #3

Asphalt Cement Content

This bulletin deals with asphalt cement (AC) content and how it relates to pavement performance. It is the third in a series of bulletins from OHMPA's Quality of Asphalt Pavement Task Force.

The introduction of Superpave Technology in Ontario provided us with a possibility of improved volumetric mix design methodology and enhanced quality requirements for aggregates used in HMA mixes. Superpave designs have significantly improved the performance of our pavements in terms of resisting rutting, shoving and flushing on our high volume highways, major arterial roads as well as intersections and bus lanes. However, there has been growing concern over the last several years that the AC content of many Superpave mix designs have been reduced to below optimal levels. Asphalt content or more specifically Effective Asphalt Content of HMA mixes can significantly influence pavement performance in terms of fatigue and stress cracking and therefore there have been many owner agencies throughout North America looking at ways of increasing AC in their mixes.

This Bulletin will outline the various parameters that have been explored to try and increase the effective asphalt content and give direction to finding the proper solution for Municipal owner agencies.

The Ministry of Transportation (MTO) have long recognized the benefits of increased AC contents and have been innovative in their tendering and specifying practices to achieving this goal. MTO tenders call for fixed AC values for each mix type at time of bidding. The price of the HMA is then adjusted up or down based on the actual AC content used as determined by the acceptance testing results. As well, the MTO have limited the use of coarse graded surface mixes by limiting the range on the 4.75mm sieve.

Although these measures have been somewhat effective, the AC content of MTO designs has not significantly increased. This is due to two main factors. First, Ministry projects tend to be higher traffic category roadways and therefore the gyrations rates for those designs are at the higher levels. Higher gyration levels tend to reduce the amount of space available for AC in the mixes. Secondly, although Ministry tenders allow for payment of additional AC in the designs, there have been no further incentives or changes to the specifications to encourage or allow contractors to add more AC in the mixes.

This year, MTO has taken a further step by allowing the percent of Theoretical Maximum Specific Gravity at Ninital to be increased by 0.5% to $\leq 89.5\%$ at the Contractor's option. Although this is viewed as a hopeful step, it is unclear at this time how effective it will be in achieving the desired goal of increasing AC content.

Various other agencies in Ontario and across North America have been looking to modify their design and acceptance requirements in response to their own observed performance issues. Specifications are changing rapidly as agencies search for ways to improve durability.

The following is a list of parameters being considered when modifying specifications:

- Lowering gyration levels
- Increasing minimum VMA
- Lowering design air voids
- Lowering acceptance air voids
- Lowering gyrations + increasing VMA + lowering air voids
- Minimum film thickness
- Increasing Nini
- Minimum binder content by mass
- Maximum limits for recycled materials*
- Reducing acceptance for AC content and/or air voids
- Changing the binder grade*

These modifications are being made with the expectation that they may lead to higher effective asphalt contents in mixes for improved durability. However, evaluating the true cause and effect of any change can be difficult. Mixes designed to meet any new requirements may not always equate to more effective AC in the mixes.

Any change to design parameters can lead to unintended consequences. Before making any changes, agencies should consider mixture performance testing at the design stage to ensure new mixes: (1) Have good stability to resist rutting; (2) are fatigue resistant to reduce cracking potential and; (3) have good workability/constructability characteristics. There are several mix performance evaluation tools that are available for these purposes. While research continues in performance prediction modeling, local expertise should be used for selecting the appropriate tools and test methods.

Agencies should also consider the economic effects of any changes made to their specifications such as maintaining the use of local aggregates, the continued use recycled materials (RAP/RAS), and the overall cost of the HMA pavement which includes any additional production or laydown costs.

The objective of the Task Force is to achieve better pavements in Ontario. It is the consensus of the Task Force that, if done properly, increased effective asphalt content in HMA mixes will lead to more durable pavements. Over the next several months the Task Force will develop detailed recommendations for changes to specification and tendering documents that will assist agencies in accomplishing this goal.

** The next special bulletin of the Task Force will deal specifically with the responsible use of RAP/RAS.*

SPECIAL BULLETIN #4**The Responsible Use of Recycled Materials in Hot Mix Asphalt (HMA)**

This bulletin deals with fostering the responsible use of recycled materials, which includes Recycled Asphalt Pavement (RAP) and Recycled Asphalt Shingles (RAS), in hot mix asphalt (HMA).

Research has shown that the responsible use of RAP enhances pavement performance. In addition to RAP, both RAS consisting of post-industrial Recycled Shingle Tab (RST) and tear-off waste from roofs have been incorporated in HMA. In light of some recent performance issues with HMA in Ontario, the Task Force agrees that as an industry, we need to review the proper use of both RAP and RAS in HMA to ensure that quality asphalt pavements are being constructed.

The use of RAP in HMA has a long and proven track record in Ontario and around North America producing quality pavements while at the same time promoting sustainability and creating environmental benefits. In Ontario, the current specifications governing mix designs allow the use of RAP and RST in hot mix asphalt.

The Ontario Ministry of Transportation (MTO) and Municipal clients depend upon OPSS 1150, OPSS 1151-PROV and OPSS 1151-MUNI, which allow the use of RAP in binder course and surface course asphalt. The OPSS 1151-PROV currently allows the use of RST. Old RAS has also been used in some municipal work. Some municipalities and jurisdictions have further modified requirements for the use of RAP in the OPSS allowances.

The following items detail our consensus opinion including benefits and concerns on the use of RAP/RST in hot mix asphalt in Ontario:

1. The continued use of RAP/RST in hot-mix asphalt is environmentally responsible and offers good value and benefits to all the stakeholders.
2. Proper mix design and production adjustments of the virgin PGAC grade must be made for mixes with RAP in excess of 20%. It is the assessment of the Task Force that high RAP content mixes, not designed and constructed properly, can result in HMA that age hardens rapidly and shows brittle performance characteristics or premature cracking. The typical correction for this is one grade lower (softer) on both the high and low temperature grades of the virgin PGAC grade. For example,

if the final PGAC desired is 58-28 in a mix with greater than 20% and lower than 40% RAP, then the virgin PGAC grade should be PG 52-34.

Adjustments to the PGAC grades need careful review when RAP contents are in excess of 20% in a mix as outlined in OPSS.

3. Further research to ascertain the contribution and grade of the RAP/RST asphalt cement to be incorporated in the mix is being undertaken. Currently, Ontario mix design procedures assume that 100% of the AC in the RAP/RST is available for the mix design and is given full credit to the total AC content of the mix. The contribution range varies significantly between North American jurisdictions and the debate over how much blending occurs continues. It is generally believed that total blending does not occur particularly at the higher recycling contents levels. However it is also accepted that the recycled materials do not behave like "Black Rock" in the mix. The contribution of AC in the RAP/RST calculated as low as 60% has been used in some North American jurisdictions. NCHRP 9-12 assesses that not all AC from RAP is available (free AC), when proportions above 25% are used in HMA. It is the assessment of the Task Force that although all PGAC from RAP/RST is extractable using solvents, the 100% availability of this AC in produced HMA is questionable.
4. Some agencies in the United States have changed their recycling requirements from allowable percentage of RAP/RST to Recycle Binder Ratio (RBR) to better reflect the actual percent of binder contribution from the RAP/RST to the total AC in the mix. This becomes even more of a concern when RAP is fractionated into Fine RAP and Coarse RAP and Fine RAP is incorporated into the hot mix. From a mix design and production perspective, the availability of contributing AC from Coarse and Fine RAP can differ by as much as 1% in the final total AC content of the mix which in turn will affect the effective asphalt cement content. In this regard, the Task Force will evaluate with its stakeholders the use of RBR. >>

SPECIAL BULLETIN #4 *Continued*

5. Total commitment from the asphalt producers is required to ensure maximum allowable percentages of RAP are not exceeded during production of the mix and that mix designs are being adhered to. Proactive measures by owners and industry in monitoring and enforcing RAP/RST addition to the HMA are a necessity. It is highly recommended by the Task Force that owners should consider additional plant inspections during production to ensure both the quality of the RAP/RST stockpiles and that submitted mix designs and actual production correlate (i.e. allowing full time inspection access to the asphalt plant control room). These types of contract requirements are simple and cost effective and various municipalities in Ontario have started to use such measures to control the quantity of RAP and the quality of the HMA on their projects.

Industry is more than willing to work with road owner agencies with an 'open door' policy to further develop appropriate controls that ensure that the proper amount of RAP/RST is being utilized by the HMA producer at all times.

This bulletin is the last of an initial series of communiqués to be issued by the Quality of Asphalt Task Force. The bulletins have touched on the three most significant issues affecting asphalt pavement quality in Ontario. More in-depth discussion and recommendations on each of these topics will be issued in the future as the work of the Task Force continues.

For more information, please contact the OHMPA office at **905-507-3707** or by email at info@ohmpa.org

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