Development of Warm Mix Asphalt Policies and Specifications in Minnesota

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MnDOT

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Motivation to Use WMA

- **Environmental**
  - Lower greenhouse gas emissions
  - Lower fuel consumption

- **Operational**
  - Better compaction
  - More comfortable working conditions
  - More uniformity

- **Performance**
  - Can use RAP and/or shingles with WMA
  - Eliminates bumps in overlays
  - Reduced binder aging – reduced cracking
WMA EXPERIENCE IN MINNESOTA
Oil Gravel

Early WMA by Another Name

TRB LVR Conference (1995) – Demo Project Outside MnROAD
Cell 32 (1998) – Cold Mix Paving Practice
Cell 28 (1999) – Oil Gravel (luke warm mix) / Large Stone Base
Cell 26 (2000) – Oil Gravel (warm mix) / Reclaimed Base
Cell 27 (2000) – Oil Gravel (warm mix) / Large Stone Base
Several County Roads throughout Minnesota in 1990’s

- Oil Gravel requires solid base
- Some Fatigue and Rough Ride
- No Transverse Cracking or Rutting
Olmsted & Goodhue Counties

- First known true WMA jobs in MN (2007)
  - Revix (Evotherm 3G) technology
  - Olmsted CR 104
    - 5 mile stretch
  - Goodhue CSAH11
    - 537 tons placed in 4,200 feet of the EB lane
Crow Wing County

- County Road 108 (2008)
  - 2913 tons WMA, 272 tons HMA
  - 58-34 HMA vs. 58-28 WMA
  - Estimated 5 years of extended service life
    - Life cycle cost analyses are favorable for WMA
    - ASCE Cold Regions paper 2009

- County now allows alternate bids on several projects
  - 20,000 tons WMA in 2009 (CR 2)
2008 MnROAD Construction

- 6 Cells on Mainline
- Wear and Non-Wear
- 12.5 mm NMAS
- Traffic Level 4
- PG 58-34
- 20% RAP from MnROAD
- No requirements for WMA technology
WMA vs. HMA
WMA vs HMA
WMA vs. HMA
Laboratory Performance Testing

Hamburg Rutting

Texas Overlay Tester

![Hamburg Rutting Graph]

![Texas Overlay Tester Bar Graph]
MnROAD Field Performance

- 1 transverse crack in 5 test sections
  - Over instrumentation area (inadequate compaction)
- 25% reflective cracking on 3” WMA overlay
- Ride quality: all cells < 1.1 m/km ("good")
- Rutting: all cells < 0.2 inches rutting
- So far, so good
MnDOT Trunk Highway 95

- Late season paving (2009)
  - Contractor was delayed, needed to finish paving before winter
  - Supplemental Agreement – MnDOT paid extra $0.60 per ton for WMA
  - Business as usual (mostly)
    - Good density 2\textsuperscript{nd} day after going back to HMA rolling pattern
District 3 and 7 Projects in 2010

First “regular” MnDOT projects requiring WMA

S-1 (2360) PLANT MIXED ASPHALT PAVEMENT – USE OF WARM MIX ASPHALT TECHNOLOGIES

The provisions of the attached 2360 Plant Mixed Asphalt Pavement (Gyratory Design) Specification is hereby modified as follows in order to use Warm Mix Asphalt (WMA).

All provisions for the production and placement of WMA will be the same as the conventional HMA mixtures as stipulated in 2360 Plant Mixed Asphalt Pavement (Gyratory Design) Specification except as noted below.

S-2.1 MIXTURE DESIGN

The contractor is responsible to use the same design used to produce the Hot Mix Asphalt, then modifying it to accommodate products or processes to meet the Warm mix criteria. This modification process will be limited to the same as described by the WMA Technical Working Group and found at [http://www.warmmixasphalt.com/ WmaTechnologies.aspx](http://www.warmmixasphalt.com/WmaTechnologies.aspx).

Recycled Asphalt Shingles will not be allowed in any mixes on this project.

S-3.1 MIXTURE QUALITY MANAGEMENT

The Warm Mix Asphalt produced will not be allowed to exceed temperatures greater than 275 °F. Any WMA over that temperature will not be allowed to be used.
Pavement Surface Temp

MOBA Pave-IR

12 sensors spaced 1 foot apart, reading interval = every 6 inches
Production Temperature Change

235°F WMA

275°F WMA

Paver Stops
This picture is HMA

WMA paving did not see same segregation at end of truck
WMA Technologies Used in MN

- Maxam AquaBlack
  - Installed on several plants
  - 15~100% of production was WMA
- Revix / Evotherm 3G
  - Easy for contractors
- Advera
  - 1 project

*MnDOT does not endorse any particular proprietary product or technology*
MnDOT Policy & Specification

- 2009 & 2011 Position Memos
- Permissive Spec
  - RAP & RAS are allowed
  - No changes in mix design
  - Labs must be aware of compaction temps for QA
  - No pre-approved products list
- www.dot.state.mn.us/materials/bituminous.html
<table>
<thead>
<tr>
<th>Question</th>
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<tbody>
<tr>
<td>What is Warm Mix Asphalt?</td>
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<tr>
<td>The contractor has approached us (local agencies) about substituting WMA for HMA. Should we use WMA on our project?</td>
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<tr>
<td>Should we pay an additional cost for warm mix?</td>
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<td>Are there any pavement performance issues with WMA?</td>
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<td>With the increased use of RAP and/or shingles, are we getting complete blending between the recycled and virgin binders?</td>
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<td>Are there any different procedures required for QC/QA testing?</td>
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<td>How do I perform a WMA mix design?</td>
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<td>Can modified binders be used with WMA?</td>
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<td>What traffic levels can WMA be used on?</td>
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<tr>
<td>Where can I get more information on WMA?</td>
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Technology Transfer

- Conferences
- Workshops
- Technical Meetings
- State & Local Agencies
- Contractors
- University Researchers
- Consultants
- Federal Highway Administration
Implementation Support

- Write publications
  - Research briefs, conference papers, magazine articles
- Answer phone calls, email inquiries, surveys
  - University graduate students, NCHRP, US EPA
- Advise Michigan Tech undergraduate student project
- Support MnDOT, local, & other state agencies
  - Write specs, observe construction, QC/QA testing, monitor performance
Lingering Questions

- Have not heard of any catastrophic failures with WMA
- How much RAP / RAS can be used?
  - Inadequate blending
  - Long term durability
- Long term performance
  - Moisture damage, thermal cracking, rutting, reflective cracking
Summary

- WMA should meet all Superpave requirements
- Warm mix is the future of asphalt mixtures
- Technology providers coming forward
- Industry and agencies must work together to make it happen
- Advantages far outweigh concerns
Questions?

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