ADOT Experience with Warm Mix Asphalt

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ADOT - Materials Group
Overview of Presentation

- History of WMA in ADOT
  - Initial WMA Projects (2009 – 2010)
  - ADOT/AGC WMA Committee (2010)
  - Trial Specifications (Early 2011)
  - Evaluation of current WMA Demonstration Projects (2011)

- Challenges / Concerns

- Benefits

- Future of WMA in ADOT
WMA First Introduced on an ADOT project in Summer 2009

State Route 85
FNF Construction
¾” Dense Graded - Marshall Mix
PG 76-16 Binder / 1% Lime
1100 Tons of WMA w/ Advera
1600 Tons of WMA w/ Evotherm 3G
SR 85 – Evootherm 3G WMA

- Evootherm 3G WMA Additive – 0.65% by wt of binder
- HMA production temps 315 deg F
- WMA production temps 250 – 280 deg F
- Average Density = 91.4% (8.6% in-place voids)
SR 85 – Advera WMA

- Advera WMA Additive – 0.25% by wt of total mix
- HMA Production Temps 315 deg F
- WMA Production Temps 250 – 275 deg F
- Average Density = 93.5% (6.5 % in-place air voids)
SR 85 – Performance Testing

Hamburg Wheel-Tracking Testing
Average Rut Depth at 20,000 passes

- Control HMA 3.86 mm
- Evotherm WMA 3.97 mm
- Advera WMA 3.62 mm

ASU performed additional E* and TSR testing – similar HMA and WMA test results
History of WMA in ADOT

Second WMA project as a Change Order - August 2010

- Interstate 10 south of Tucson – Granite Construction
- 5 Lots of WMA production with a corresponding Control Lot for each WMA Lot
- ADOT Initiated a research project to gain information – AMEC Earth & Environmental, Inc.
I-10 Tucson
- Granite Construction
- AQUABlack Water Foaming System – Maxam Equipment
- ¾” Dense Graded – Marshall Mix with 20% RAP
- PG 70-10 Binder / 1% Cement
- 10,000 Tons of WMA placed
I-10 – Temperatures

HMA Production Temperatures averaged 300 degrees F

WMA Production Temperatures averaged 270 degrees F
# I-10 – Summary of Test Results

<table>
<thead>
<tr>
<th>Lot Numbers</th>
<th>Laboratory Air Voids (%)</th>
<th>In-Place Air Voids (%)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>WMA</td>
<td>HMA</td>
</tr>
<tr>
<td>3 and 4</td>
<td>4.8</td>
<td>4.1</td>
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<tr>
<td>7 and 8</td>
<td>5.2</td>
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<td>14 and 15</td>
<td>4.5</td>
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<tr>
<td>18 and 19</td>
<td>5.2</td>
<td>5.2</td>
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<tr>
<td>22 and 23</td>
<td>5.1</td>
<td>5.6</td>
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<tr>
<td>Average</td>
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<td>4.9</td>
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## I-10 – Performance Testing

<table>
<thead>
<tr>
<th></th>
<th>Lot Numbers</th>
<th>WMA (%)</th>
<th>HMA (%)</th>
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<tr>
<td><strong>TSR on Mixtures</strong></td>
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<tr>
<td>7 and 8</td>
<td>77</td>
<td>92</td>
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<td>18 and 19</td>
<td>62</td>
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<td>22 and 23</td>
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<td>72</td>
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<tr>
<td>Average</td>
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<td>76</td>
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<tr>
<td><strong>Immersion Compression Results on Mixtures</strong></td>
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<tr>
<td>7 and 8</td>
<td>79</td>
<td>88</td>
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<tr>
<td>18 and 19</td>
<td>87</td>
<td>86</td>
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<tr>
<td>22 and 23</td>
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<td>84</td>
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<tr>
<td>Average</td>
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<td>86</td>
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<tr>
<td><strong>TSR on Cores</strong></td>
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<td>7 and 8</td>
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<td>18 and 19</td>
<td>59</td>
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<td>Average</td>
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## I-10 – Performance Testing
### Hamburg Wheel Track Test Results

<table>
<thead>
<tr>
<th>Lot Numbers</th>
<th>Average Rut Depth (mm)</th>
<th>Average Number of Passes to Maximum</th>
<th>Pass or Fail</th>
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<tbody>
<tr>
<td></td>
<td>WMA</td>
<td>HMA</td>
<td>WMA</td>
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<td>3 and 4</td>
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<td>22 and 23</td>
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<td>Averages</td>
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<td>16895</td>
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WMA Committee

2010 – AGC/ADOT Warm Mix Asphalt Committee
- ADOT, Contractors, Suppliers, WMA Reps
- Look into option for WMA in ADOT specifications

Results of the Committee Work
- Trial Specifications
- Approval Process for WMA Technologies
- 3 WMA Demonstration Projects to be Constructed on ADOT highways in 2011
WMA Specifications

- WMA defined as Production Temperatures at 215 – 275 deg F.
- WMA technology can be added to conventional HMA mix design for volumetric properties
- Moisture Susceptibility Testing requirements - need to incorporate WMA technology
WMA Specifications

- WMA must meet ADOT’s PWL for the HMA standard specifications for Acceptance
  - Asphalt content
  - Mix volumetrics
  - Gradation
  - In-place voids
Requirements of WMA Technology Approval in ADOT

- Recognized WMA technology with production of at least 25,000 tons of WMA on other DOT highways
- Documentation from a minimum of 3 construction projects – mix design, test results, contact information
- Binder test results showing effect of WMA technology on the binder properties
- Partner with a Contractor and construct a test section on an ADOT project – meet all ADOT specifications during test section and show successful performance after construction
2011 Demonstration Projects

- Selected three projects to construct WMA test sections

- Get additional experience with different WMA technologies in different climatic regions, using different aggregate sources, traffic loadings, PG binders, etc.
Demonstration Projects

US 93 - Kingman District

I-40 - Flagstaff District

SR 84 - Tucson District
2011 Demonstration Projects

Each project will consist of 3 separate test sections with a different WMA technology in each – Contractor to select WMA technologies

Each test section to include two Lots of paving with WMA and one Lot of paving with HMA (Control)
  – Minimum of 2000 tons of WMA
  – Laboratory testing and field monitoring plan
  – WMA Representative must be present for test sections
WMA Demonstration Projects

- US 93– McCormick Construction
- WMA Test Sections were placed in October 2011
- ¾” Marshall Mix with 15% RAP
- 1% Lime
- PG 70-10 Binder
US 93 – WMA Test Sections

HMA Production Temps 300 – 310 deg F

- Sasobit – 2310 tons of WMA
  - 1.5% by wt of total binder
  - Production Temps of 255 – 275 deg F

- Evotherm 3G – 2840 tons of WMA
  - 0.5% by wt of total binder
  - Production Temps of 260 – 270 deg F

- Advera – 2400 tons of WMA
  - 0.25% by wt of asphalt mix
  - Production Temps of 250 – 265 deg F
US 93 - Laboratory Mix Voids (%)

- Sasobit
- Evotherm
- Advera

Control Lot
WMA Lot 1
WMA Lot 2
US 93 - Average In-Place Voids (%)

The bar chart compares the average in-place voids for Sasobit, Evotherm, and Advera across three lots:
- Control Lot
- WMA Lot 1
- WMA Lot 2

The void percentages are as follows:
- Sasobit: 6%
- Evotherm: 7%
- Advera: 8%
US 93 – Hamburg Wheel-Tracker

Rut Depth (mm) @ 20,000 passes

- Sasobit
- Evotherm
- Advera

Control Lot
WMA Lot 1
WMA Lot 2
US 93 – Tensile Strength Ratio (%)
US 93 – Index of Retained Strength
IMC (%)
Fann Contracting
Placed WMA Test Sections
in November 2011
I-40 - Flagstaff

- AQUABlack
- Advera
- Evotherm 3G
SR 84 – Casa Grande

WMA Test Sections will be placed in early December
- Sasobit
- Advera
- Evotherm 3G

NCHRP 9-47A to test/document the Sasobit WMA on this project
Challenges / Concerns

- Lack of Long Term Performance Data
- Specifications
- Concerns with aggregate moisture
- Concerns with rutting potential in mixes – less stiffening of the binder through the hot plant

➢ On-going NCHRP Research projects are looking into a lot of these issues
Benefits of WMA in ADOT

- Environmental impact
- Better Compaction
- Long hauls in rural areas
- Extend the paving season when needed in the high elevations
Next Steps for WMA in ADOT

- Complete WMA Demonstration projects
- Fully evaluate each test section – lab, field and performance
- Address concerns – make sure we are getting equal or better product with WMA
- Complete specifications to allow WMA as an option in ADOT 416 (Marshall Mix Design) and 417 (Superpave Mix Design) specifications
Thank You

Questions??

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