Introduction to Warm Mix Asphalt
John I. Duval, P.E., LEED AP
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Overview
- WMA Snapshot circa 2011
- What is Warm Mix Asphalt?
- Why Warm Mix Asphalt is the Future of our Industry
- WMA Success Stories

WMA Snapshot circa 2011
- 22 WMA Technologies @ www.warmmix.org
- NCHRP 9-43 "Mix Design Practices for WMA"
- FHWA Reported WMA Tonnage for 2010
  - 47.6M tons of WMA produced in the US
  - 13.2% of total asphalt production
- FHWA Performance Metrics for WMA
  - 40 DOTs have WMA Specification by 2011
  - 30 DOTs achieve WMA production targets by 2012
- IARC assesses asphalt cement and its emissions as
  - Group 2B "Possibly carcinogenic to humans..."
Mayors Climate Protection Agreement

1054 cities as of 10/28/11

Alaska Cities

Anchorage
Juneau
North Pole
Shishmaref
Sitka

Warm Mix Asphalt Definition:

a work in progress (Feb. 23, 2011).

- Warm Mix Asphalt (WMA) technologies generally allow a reduction in the temperature at which asphalt mixes are produced and placed, thus helping the environment and workers health and safety. WMA technologies can also be used as a compaction aid extending the paving season in colder climates when produced at normal temperatures at which the hot mix asphalt mixes are produced.
  - WMA – When ambient temperatures are consistently above 50 Degrees F, the asphalt mix temperatures are typically reduced by 25 degrees F to 50 degrees F (depending on technology used, mix plant configuration, NIRAP used, and construction conditions).
  - Cold Weather WMA Application – When ambient temperatures are consistently below 50 Degree F, the asphalt mixes are typically produced at near normal or slightly reduced temperatures of hot mix asphalt (depending on technology used, NIRAP used and construction conditions) and is intended to facilitate field placement and compaction at colder temperatures.
- Authored by many Members of the WMA Task Force

Warm Mix Asphalt “Re”-Definition

- Warm Mix Asphalt (WMA) technologies generally allow a reduction in the temperature at which asphalt mixes are produced and placed, thus helping the environment and workers health and safety. WMA technologies can also be used as a compaction aid extending the paving season in colder climates when produced at normal temperatures at which the hot mix asphalt mixes are produced. WMA technologies can also be used as a compaction aid and is typically used for the following applications:
  - WMA – When ambient temperatures are consistently above 50 Degrees F, the asphalt mix temperatures are typically reduced by 25 degrees F to 50 degrees F (depending on technology used, mix plant configuration, NIRAP used, and construction conditions).
  - Cold Weather WMA Application – When ambient temperatures are consistently below 50 Degree F, the asphalt mixes are typically produced at near normal or slightly reduced temperatures of hot mix asphalt (depending on technology used, NIRAP used and construction conditions) and is intended to facilitate field placement and compaction at colder temperatures.
Warm Mix—An Attempt to Define


What is Warm Mix?

2005: There were three WMA technologies:
- Aspha-min – foam zeolite
- Sasobit – wax
- Evotherm – surfactant

2009: ~10 WMA technologies

2011: ~22 WMA technologies with many differences including:
- WMA mechanism—additive or process
- Effective temperature range for production and compaction

2015: ??
WMA Additives / Foaming Systems
- Advera
- Aspha-Min
- Evotherm
- LEA-CO
- Low Emission Asphalt
- Rediset WMX
- Sasobit
- WAM Foam
- Cecabase RT
- Qualitherm
- ECOBIT
- Thiopave

Source: www.warmmixasphalt.com

There are three categories (types) of WMA Technologies:
- Chemical
- Organic
- Foaming

WMA Plant Temperatures

Source: NAPA
Why Warm Mix?
• Reduced Emissions (IARC/Worker Safety)
• Reduced Energy Consumption (Save $)
• Increased Durability (?)
• Increased Crack Resistance
• Cold Weather Paving (Extended Season)
• Longer hauls
• Compaction Aid
• Increased usage of RAP

Reduced Emissions / Paver
• Limestone
• PG76-22
• T mix: 240°F
• ΔT: 95°F

Reduced Emissions / Plant

Source: Pinchin Environmental 2005
Reduced Emissions / Plant

- Hot Mix
- Warm Mix

Increased Durability

- Warm Mix Asphalt
- Hot Mix Control

(TxDOT Cores After 1 Year)
Increased Crack Resistance

Stress Crack

TxDOT Overlay Tester

Increased Crack Resistance

Source: Texas Transportation Institute
Extended Season Paving

Mix contained 40% RAP PG 64-22
WMA mix temperature behind the screed

Ground temperature at 7 a.m. was < 15°F

Extended Season Paving

Mix contained 40% RAP PG 64-22
Compaction

Extended Season Paving

Mix contained 40% RAP PG 64-22
Excellent joint compaction

Air voids of cores all > 90% of Gmm
Time Available for Compaction

**HMA at 50°F Air Temp**
- Delivery Temp: 500°F
- Surface Temp: 45°F
- Cessation Temp: 175°F
- Time Available: 20 minutes

**WMA at 50°F Air Temp**
- Delivery Temp: 300°F
- Surface Temp: 45°F
- Cessation Temp: 150°F
- Time Available: 32 minutes

**WMA at 35°F Air Temp**
- Delivery Temp: 300°F
- Surface Temp: 35°F
- Cessation Temp: 150°F
- Time Available: 28 minutes
Increased Usage of RAP

<table>
<thead>
<tr>
<th>Property</th>
<th>40% RAP</th>
<th>50% RAP</th>
<th>60% RAP</th>
<th>Superpave Specification</th>
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<tbody>
<tr>
<td>Mix Production Temperature, °F</td>
<td>230</td>
<td>249</td>
<td>not applicable</td>
<td></td>
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<tr>
<td>Viscosity, Pa-s</td>
<td>1.297</td>
<td>1.017</td>
<td>1.2 Pa max</td>
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<tr>
<td>G*/sin δ at 60°C, kPa</td>
<td>2.34</td>
<td>1.03</td>
<td>2.0 kPa max</td>
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<td>G*/sin δ at 80°C, kPa</td>
<td>1.08</td>
<td>0.42</td>
<td>0.5 kPa max</td>
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<td>Penetration, (dmm)</td>
<td>15</td>
<td>23</td>
<td>not applicable</td>
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<tr>
<td>BBR Stiffness (MPa)</td>
<td>222</td>
<td>148</td>
<td>200 MPa max</td>
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<tr>
<td>Pressure Aging Vessel G* x sin δ, kPa</td>
<td>3,043</td>
<td>3,218</td>
<td>3,500 kPa max</td>
<td></td>
</tr>
</tbody>
</table>

Success Stories—Asphalt Rubber

- I-5 Near Orland, CA
- Heavy Traffic
  - 26,000 AADT
  - 28% Trucks
- ½” RHMA-O WMA
- Open Graded Friction Course
- Asphalt Rubber
  - PG64-16 Base
  - 16,000 Tons WMA
Success Stories—Asphalt Rubber
Load Out Temp 290°F  Windrow Temp 280°F

Success Stories—Asphalt Rubber
Breakdown Rollers  250-260°F at Breakdown

Success Stories—Increased RAP
City of Portland
Mix:
W' NMAS 100 Gyrations 50 % RAP
PG 70-22ER
HMA Production Temp 335°F
Success Stories—Increased RAP
City of Portland

- WMA Production 255F
- WMA Density >= 94% Gmm
- Crew Reports
  - Very workable and less exhausting to work with WMA compared to HMA

Success Stories—Airport Pavement
Anchorage Intl Airport—RON Aprons

- Base Layer—PG 58-34, ¾” NMAS Superpave

Source: AKDOT&PF

Success Stories—Airport Pavement
Anchorage Intl Airport—RON Aprons

- Pavement Stiffness for WMA Equal to HMA

Source: AKDOT&PF
Embrace WMA.
It is the future of our industry!

Thank You!

John I. Duval, P.E., LEED AP
Principal Engineer
Duval Engineering LLC
john@duvalengineering.com