Warm Mix Asphalt
---
The Future of Flexible Pavements

Caltrans
Warm Mix Asphalt
Demonstration
San Luis Obispo
May 7, 2008
General Trends

- Regulations
- Activism
- Higher Production Temperatures
- Increasing Energy Costs
Current Non-Attainment Areas

Counties Designated "Nonattainment"
for Clean Air Act's National Ambient Air Quality Standards (NAAQS) *

Legend **
- Yellow: County Designated Nonattainment for 3 NAAQS Pollutants
- Blue: County Designated Nonattainment for 2 NAAQS Pollutants
- Green: County Designated Nonattainment for 1 NAAQS Pollutant

*12/2007
Warm Mix Classifications

- Cold Mix
- Half-Warm Asphalt
- WMA
- HMA

<table>
<thead>
<tr>
<th>Temperature, °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
<td>200</td>
</tr>
<tr>
<td>300</td>
</tr>
<tr>
<td>400</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fuel/Ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
</tbody>
</table>
Brief History

1997 German Bitumen Forum
2000 Second Euroasphalt & Eurobitume Congress (Barcelona)
NAPA 2002 European Scan Tour
   – Germany and Norway
NAPA 2003-2008 Annual Meetings
World of Asphalt 2004
2005-2007 – Numerous U.S. Field Trials
2007 – FHWA/AASHTO Scan Tour
Advantages of Lower Temperatures

- Lower fumes and emissions (~30-90%)
- Lower energy consumption (~30%)
- Lower plant wear
- Decreased binder aging
- Early site opening
- Cool weather paving
- Compaction aid for stiff mixes
- Cooler working conditions
- Edge of mat is more vertical, making a better joint
- Eliminates bump at joint when overlaying concrete
- Eliminates the need for fume evacuation equipment on plant and paver
Warm Mix Asphalt
Technical Working Group

- Members: FHWA, NAPA, SAPA, AASHTO, State DOTs, NCAT, Contractors, Labor, NIOSH
- Mission: Evaluate and validate WMA and share information
- Purpose: Guidance for research and implementation of WMA
NAPA Warm Mix Asphalt Task Force

– Leadership and Communication for
  • Research
  • Development
  • Deployment

– Goals
  • Forum
  • TWG Input and Feedback
  • Identify Technical Gaps
  • Review Educational and Technical Materials
## Technology Providers

<table>
<thead>
<tr>
<th>Foaming Methods</th>
<th>Chemical Modifiers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advera - PQ</td>
<td>Evotherm - MeadWestvaco</td>
</tr>
<tr>
<td>Aspha-min - Hubbard</td>
<td>Rediset – Akzo-Nobel</td>
</tr>
<tr>
<td>Astec Double-Barrel Green</td>
<td>Revix – Mathy-Ergon</td>
</tr>
<tr>
<td>Low Emissions Asphalt - McConnaughay</td>
<td>Sasobit - Sasol</td>
</tr>
<tr>
<td>Terex</td>
<td></td>
</tr>
<tr>
<td>WAM Foam - BP</td>
<td></td>
</tr>
</tbody>
</table>
Applications

- Dense-graded mixes
  - Majority of projects
  - RAP – Wisconsin and Missouri
- SMA
  - Maryland – Washington Beltway
- Open-graded mixes
  - Florida
  - China
- Asphalt-Rubber
  - California
Chattanooga - Loadout

- Astec Double Barrel Green Control
  Temp = 320°F

- WMA
  Temp = 270°F
Yellowstone Paving

Control
Temp = 320°F

Warm Mix
Temp = 245°F
Production and Paving Notes

• Work to minimize aggregate moisture.
• Make sure the burner is tuned for the temperature.
• Keep baghouse temperature above condensation point.
• Consider superheating aggregate ahead of RAP.
• Follow normal placement practices.
Performance
Colorado I-70

Lab Voids, %

Control - A  |  Advera  |  Control - S  |  Sasobit  |  Control - E  |  Evotherm

0  |  0.5  |  1  |  1.5  |  2  |  2.5  |  3  |  3.5  |  4
Performance
Colorado I-70

<table>
<thead>
<tr>
<th></th>
<th>VMA, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control - A</td>
<td>16.6</td>
</tr>
<tr>
<td>Advera</td>
<td>15.6</td>
</tr>
<tr>
<td>Control - S</td>
<td>16.8</td>
</tr>
<tr>
<td>Sasobit</td>
<td>15.8</td>
</tr>
<tr>
<td>Control - E</td>
<td>16.2</td>
</tr>
<tr>
<td>Evotherm</td>
<td>15.6</td>
</tr>
</tbody>
</table>
Performance
Colorado I-70
Performance
Colorado I-70

Chart showing the comparison of Hamburg Rut Depth, mm, for different samples: Control - A, Advera, Control - S, Sasobit, Control - E, and Evotherm. The chart indicates that Control - S has the highest rut depth, followed by Control - E and Evotherm, while Advera and Control - A have lower rut depths compared to the others.
<table>
<thead>
<tr>
<th>Mix</th>
<th>Avg. Gmb</th>
<th>Avg. %Gmm</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMA control – Rt. 96B</td>
<td>2.278</td>
<td>94.1</td>
<td>1.43</td>
</tr>
<tr>
<td>LEA control – Rt. 96B</td>
<td>2.298</td>
<td>95.6</td>
<td>0.51</td>
</tr>
</tbody>
</table>
Reduced Emissions
Data provided by suppliers.

- **Aspha-min – North Carolina – 265°F**
  - 17.6% decrease in SO$_2$
  - 3.2% decrease in CO$_2$
  - 35.3% decrease in total hydrocarbons
  - 6.1% decrease in NO$_x$

- **Evotherm – Canada – 140°F**
  - 45.8% decrease in CO$_2$
  - 63.1% decrease in CO
  - 41.2% decrease in SO$_2$
  - 58% decrease in NO$_x$

- Direct comparisons are discouraged – different plants, different weather, different temperatures
Why we need Warm Mix

- Better air quality
- Better energy efficiency
- Better performance
- Better compaction
- Better working conditions
Conclusions

• Warm Mix is the Future of Asphalt Mixtures.
• Technology providers coming forward.
• Industry and agencies must work together to make it happen.
• Advantages outweigh concerns.
• Will add to versatility of the material.