A HMA design that is modified to be produced, placed and compacted at 50-100F less than conventional HMA

http://www.warmmixasphalt.com/
Potential Benefits of WMA

• **Improved workability**
  – Easier compaction, allows for extended hauls and construction season
  – Facilitates night work, especially thin-lift applications using polymer modified asphalt binders

• **Reduced binder aging**

• **Reduced heating/energy requirements**
  – Lower emissions during production
    • Visible and non-visible
  – Less fumes during handling

• **Less plant wear**
WMA Benefit: Reduced Emissions

Table 4. Reported reductions in plant emissions (percent) with WMA.\(^{(10, 11, 12)}\)

<table>
<thead>
<tr>
<th>Emission</th>
<th>Norway</th>
<th>Italy</th>
<th>Netherlands</th>
<th>France</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO(_2)</td>
<td>31.5</td>
<td>30–40</td>
<td>15–30</td>
<td>23</td>
</tr>
<tr>
<td>SO(_2)</td>
<td>NA</td>
<td>35</td>
<td>NA</td>
<td>18</td>
</tr>
<tr>
<td>VOC</td>
<td>NA</td>
<td>50</td>
<td>NA</td>
<td>19</td>
</tr>
<tr>
<td>CO</td>
<td>28.5</td>
<td>10–30</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>NO(_x)</td>
<td>61.5</td>
<td>60–70</td>
<td>NA</td>
<td>18*</td>
</tr>
<tr>
<td>Dust</td>
<td>54.0</td>
<td>25–55</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

*Reported as NO\(_2\)  
NA—not available

- SO\(_2\) - related to acid rain
- VOC, NO\(_x\) - ground level ozone
- CO\(_2\) – climate change

From: Warm-Mix Asphalt: European Practice
Ozone Non-attainment Areas

Ground level ozone is considered to be a respiratory irritant. It is caused by chemical interaction between sunlight, nitrous oxides (NOx) and volatile organic compounds (VOC’s).
Estimated Increase in Atmospheric CO₂ Concentration

Carbon Dioxide vs Time

PPM of CO₂

1880 1900 1920 1940 1960 1980 2000 2020
HMA vs WMA, Reduced Smoke

Astec Double Barrel Green
Control Temp = 320°F
WMA Temp = 270°F
Warm Mix Asphalt-Approaches

- Chemical additives
- Foaming
  - Additives
  - Processes, plant modifications

www.warmmixasphalt.com
WMA Technologies*

• Chemical Additives:
  – Akzo-Nobel Rediset™ WMX
  – Arkema Group-Cecabase RT®
  – Asphaltan®
  – MeadWestvaco-Evotherm™
    • REVIX™
  – Sasol Wax Americas - Sasobit®
  – Shell Thiopave™

• Foaming-Admixtures:
  – PQ Corporation-Advera®
  – Aspha-Min®
  – McConnaughay Technologies- “Low Emission Asphalt”

• Foaming-Plant Modification:
  – Astec-Double-Barrel® Green
  – Terex® WMA System
  – Gencor-Ultrafoam GX™
  – BP (in USA)-WAM-Foam

* New materials/processes becoming available, see www.warmmixasphalt.com
Chemical Additives

- Make the asphalt “wetter” so it more readily coats and lubricates aggregate particles
- May include additives such as waxes that reduce the asphalt binder viscosity at elevated temperatures
- Some may be added directly to asphalt binder, others are added to the mixture during production
Evotherm Injection

Injection Point into AC line feeding the drum
Sasobit®

Pneumatic feed
Foaming Admixtures

- Release small amounts of steam at temperatures above 212°F (100°C), foaming the asphalt binder
- Admixtures include synthetic zeolites or moistened fine aggregates
  - Zeolites: Advera®, Aspha-Min®
  - Moistened fine aggregates: LEA
Synthetic Zeolites

- Synthetic particles consisting of crystalline hydrated aluminum silicate containing a latticed internal void structure (~20%)
- Water is stored in the internal voids, gradually released as steam
- Only 0.25-0.3% by weight of total mixture is typically used

From Wikipedia
Zeolite Addition
Plant Modifications-Foaming

• Two-stage mixing
  – Used in Norway (WAM-Foam) where it is common for plants to have different (hard and soft) asphalt binders available for blending
  – First, soft binder is mixed with aggregates, followed by coating with foamed hard asphalt

• Provide water injection system, mixing chamber to foam the asphalt binder before it contacts the aggregates
Plant Modifications-Astec “Double Barrel Green”
# WMA Temperature Reduction

<table>
<thead>
<tr>
<th>WMA Technology</th>
<th>Process Type</th>
<th>Decreases Production Temperatures by 30 to 50°F (17 to 28°C)</th>
<th>Decreases Production Temperatures by More Than 50°F (28°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Double Barrel® Green</td>
<td>Foaming</td>
<td>XX&lt;sup&gt;1&lt;/sup&gt;</td>
<td>X&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Evotherm™</td>
<td>Chemical Additive</td>
<td>XX</td>
<td>XX</td>
</tr>
<tr>
<td>(LEA) Low Energy Asphalt</td>
<td>Foaming</td>
<td>XX</td>
<td>XX</td>
</tr>
<tr>
<td>Rediset™ WMX</td>
<td>Chemical Additive</td>
<td>XX</td>
<td>X</td>
</tr>
<tr>
<td>REVIX™</td>
<td>Chemical Additive</td>
<td>X</td>
<td>XX</td>
</tr>
<tr>
<td>Sasobit</td>
<td>Organic Additive</td>
<td>XX</td>
<td>X</td>
</tr>
<tr>
<td>Synthetic Zeolite</td>
<td>Foaming</td>
<td>XX</td>
<td>X</td>
</tr>
<tr>
<td>WAM-Foam</td>
<td>Foaming</td>
<td>XX</td>
<td>XX</td>
</tr>
</tbody>
</table>

<sup>1</sup>Frequently observed;  <sup>2</sup>Observed

*Courtesy Brian Prowell, PhD, PE*
Questions about WMA

- **Performance**
  - Short-term
    - Rut resistance
    - Moisture sensitivity
  - Long-term
    - Layer stiffness
    - Durability
- **Economics**
  - Do cost savings in fuel, equipment, labor overcome increased costs?
- **Specifications**
  - Binder qualities/selection
  - Laboratory procedures
  - Sampling/conditioning methods

*These are promising technologies that we can expect to see more of in the future!*
TxDOT WMA Approach

• More widespread use of WMA in Texas than elsewhere
  – Expect over 1 million tons in 2009
  – Is being used with all mixture types

• Statewide Special Provision to primary HMA Specification Item enables contractors to use WMA and/or for TxDOT to require it
  – Defines WMA as produced between 215 and 275F
  – WMA can be used as a compaction aid
Warm Mix Research-National Level

- NCHRP 09-43, Mix Design Practices for Warm Mix Asphalt
  - Advanced Asphalt Technologies, LLC
  - PI: Dr. Ramon Bonaquist
  - 3-year project, anticipated completion in March 2010

- NCHRP 09-47, Engineering Properties, Emissions, and Field Performance of Warm Mix Asphalt Technologies
  - 3-year project, anticipated completion in March 2011
http://www.warmmixasphalt.com/

Warm-mix asphalt: The wave of the future

Warm-mix asphalt is the generic term for a variety of technologies that allow the producers of hot-mix asphalt pavement material to lower the temperatures at which the material is mixed and placed on the road. Reductions of 50 to 100 degrees Fahrenheit have been documented. Such drastic reductions have the obvious benefits of cutting fuel consumption and decreasing the production of greenhouse gases. In addition, potential engineering benefits include better compaction on the road, the ability to haul paving mix for longer distances, and the ability to pave at lower temperatures.

Read more about the benefits of Warm Mix Asphalt

Upcoming Events

- July 16-18 - 2008 Pavement Performance Prediction Symposium, Laramie, WY
  The symposium, presented by Western Research Institute in cooperation with the Federal Highway Administration, is dedicated to the topic of recycled and warm mix asphalt pavements. For more information, contact Steve Salmons at WRI, or call 307-721-2306. Visit website.

- July 27-30 - NAPA's Midyear Meeting
  The inaugural meeting of NAPA's Warm-Mix Asphalt Task Force will take place at NAPA's Midyear Meeting in Colorado Springs, Colorado. Learn more.

- November 11-13 - International Conference on WMA
  The International Conference on Warm Mix Asphalt will be held in Nashville, Tennessee. View the flyer.
Warm Mix Asphalt: Best Practices

- NAPA Quality Improvement Series (QIP) 125
  - Stockpile Moisture Management
  - Burner Adjustments and Efficiency
  - Aggregate Drying and Baghouse Temperatures
  - Drum Slope and Flighting
  - Combustion Air
  - RAP usage
  - Placement Changes
WMA Scan-2007

• Summary of scanning tour visit of European countries in May 2007
  – Reviewed processes, mix design and construction practices, performance, limitations, and benefits
  – Belgium, France, Germany, Norway
  – Included industry & government engineers

• PDF available at no charge from:

  http://www.warmmixasphalt.com/
Asphalt is the sustainable material for constructing pavements.

From the production of the paving material, to the placement of the pavement on the road, to rehabilitation, through recycling, asphalt pavements minimize impact on the environment. Low consumption of energy for production and construction, low emission of greenhouse gases, and conservation of natural resources help to make asphalt the environmental pavement of choice. More...