Warm Mix Asphalt
With RAP
Common Issues in the Asphalt Paving Industry

- Construction Cost Increases
- Environmental concerns and sustainable development “Green Construction”
- Extension of paving season
- Improved product—Field Compaction
- Welfare of Workforce
Warm Mix Technology

Benefits

- Reduced Mixing Temperatures
- Reduced Emissions “Green Construction”
- Reduced Fuel Usage
- Paving Benefits
- Reduced Worker Exposure to Fumes
RAP Benefits

- Significant Cost Savings using just 10% Replacement
- Recycled Product-Saves valuable Resources “Green Construction”
- Quality
- Saves Energy
Warm Mix + RAP

- Significant benefits of using both products in mix at same time
- Question: Are both products compatible?
- What is the effect on mix quality?
Warm Mix + RAP

- Proven Track Record
- European Experience
- US Experience
European Experience

- Warm Mix Scan Tour
  - Warm Mix allowed the use of more RAP
  - Benefits of Warm Mix with high RAP
    - Viscosity reduction aided in compaction
    - Decreased temperatures decreases aging of binder in return helps to compensate for aged RAP binder
    - Better density results with less roller passes
    - Worker Exposure
European Experience

- Norway
  - Kolo Veidekke typically runs 7 to 8 percent RAP in all mixes
  - Kolo Veidekke has stored Warm Mix in Silo for 48 hours that included RAP. This mix was still able to be placed and compacted
Germany

A case study was presented where a 45 percent RAP mix was used with asphalt.

Netherlands

Warm Mix is routinely placed with 50 percent unfractionated RAP
Coarse Aggregate must be DRY

- Aggregates used in Europe have relatively low water absorptions, < 2%
- Aggregates routinely used in the US have higher water absorptions
- Best Practices should be used to minimize the moisture content in aggregate
US Experience

- North Carolina-Blythe Construction
  - Superpave Mix Design Utilizing 10 RAP along with Aspha-Min
  - Stack Test Results-Reduced Emissions
    - VOC’s down 35 percent
  - Very good Density Results
    - Took 30 cores all passed
Project Locations
Field Trial
STH 100 Oak Creek, WI
June 19-20, 2006

- Sasobit
- Evotherm
Milwaukee Tank Farm
Additive Blending
Mix Design

- Used existing WisDOT approved mix design
- 14% RAP, 4.6% Added AC
- SUPERPAVE 12.5mm E-3
- BINDER PG 64-28
- SPECIFIED THICKNESS 1-3/4"
- NORMAL MIX TEMP. 320 F
Muskego Plant
Muskego Plant Emissions Testing
Field Trial #1
Emissions Results

- $\text{NO}_x$ 14\% decrease from HMA
- VOC increased from HMA
- $\text{CO}_2$ 5\% decrease from HMA
Field Trial #1
Fuel Consumption

10% decrease from HMA

*Additional fine tuning needed to have efficient fuel combustion
Field Emissions Testing
Asphalt Fumes (at the paver)

- Sasobit
  43% - 91% Lower than HMA

- Evotherm
  22% - 82% Lower than HMA
Field Testing

231°F
Laboratory Testing
# Field Results (Mix-Overall)

2006 Ryan Road - 12.5mm E3

<table>
<thead>
<tr>
<th>Property</th>
<th>JMF</th>
<th>HMA #1</th>
<th>HMA #2</th>
<th>HMA #3</th>
<th>SAS#1</th>
<th>SAS#2</th>
<th>SAS#3</th>
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<td>3.5%</td>
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<td>5.20%</td>
<td>5.19%</td>
<td>5.17%</td>
<td>5.23%</td>
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## Field Results (Mix-Average)

2006 Ryan Road - 12.5mm E3

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<tr>
<th>Property</th>
<th>JMF</th>
<th>HMA</th>
<th>SAS</th>
<th>EVO</th>
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<td>5.19%</td>
<td>5.22%</td>
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Field Results (Running Average)
Final Product
Final Product
Field Testing
Implementation Goals

- Encourage more field trials with:
  - Higher traffic
  - Larger size with representative production of WMA
  - Built in conjunction with a control section
  - Monitored for a minimum of three years by the agency
  - Data collection guidelines, developed by the WMA TWG can be found at:
    http://www.hotmix.org/view_article.php?ID=537

- The factors affecting the economic viability of WMA need to be identified and tracked.
Questions ?