Ohio Warm Mix Asphalt Demo
Preliminary Results

Presented by Cliff Ursich
Flexible Pavements of Ohio
NAPA’s 53rd Annual Meeting
January 28, 2008
Ohio WMA Demo. Project

• Ohio Department of Transportation (ODOT) COS/GUE Rt. 541
  – Contractor: Shelly & Sands, Inc.
  – Material Supplier: Mar-Zane, Inc.
  – Constructed September, 2006
  – WMA Technologies Demonstrated
    • Aspha-Min
    • Evotherm
    • Sasobit
Ohio WMA Demo. Project

- **Objective**: Assess the advantages of WMA over conventional HMA in regards to...
  - Reduced energy utilization
  - Reduced fume emanation during processing and placement
  - Opportunity for extending paving season
Ohio WMA Demo. Project

- Investigation:
  - Structural evaluation of existing pavement condition
  - WMA compaction behavior
  - Mix temperature (production & laydown)
  - Fuel usage (plant)
  - Emissions (plant and paver)
  - Mix extended performance
• FHWA Technical Working Group (TWG) protocol – Production Information
  – Plant type and model
  – Method of WMA introduction
  – Production rate(s)
  – Temperatures: aggregate, WMA discharge
  – Power usage of conveyance equipment
  – Silo usage: min. and max. storage time of mix
• FHWA Technical Working Group (TWG) protocol – **Laydown Information**
  – Mix delivery:
    • Haul distance and time
    • Vehicle type (i.e. end-dump, live-bottom, other)
    • Release agent: type, usage
    • Observations of mix behavior while dumping; mix sticking to truck bed?
    • Use of windrow or transfer vehicles
• FHWA Technical Working Group (TWG) protocol – Laydown Information (contd.)
  – Paving Equipment:
    • Paver type and model
    • Vibratory screed used?
    • Was screed heated?
  – Compacted thickness measurement
  – Mat temperature readings immediately behind screed
ODOT COS/GUE Rt.541

• FHWA Technical Working Group (TWG) protocol – Laydown Information (contd.)
  – Compaction / roller train
    • Type and model of compaction equipment
    • Rated weight
    • Vibratory rollers – amplitude and frequency used
    • Pneumatic roller – tire pressure
    • Rolling pattern for control and all WMA mixtures
ODOT COS/GUE Rt. 541

- FHWA Technical Working Group (TWG) protocol
  - Moisture content of mix at load out (sampled from haul vehicle)
  - All QC data
  - For each mix provide fuel consumption data for...
    - Plant
    - Paving train
Mix Composition – ODOT COS/GUE Rt.541

<table>
<thead>
<tr>
<th>Agg:</th>
<th>Size:</th>
<th>Type:</th>
<th>% of Composition:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse:</td>
<td>No. 8</td>
<td>Limestone</td>
<td>53</td>
</tr>
<tr>
<td>Fine:</td>
<td>Sand</td>
<td>Natural</td>
<td>32</td>
</tr>
<tr>
<td>RAP</td>
<td>Processed - ¾, + ¾</td>
<td>Limestone / Natural</td>
<td>15</td>
</tr>
<tr>
<td>Binder:</td>
<td>70-22M SBS Modified</td>
<td>Virgin: 5.3%</td>
<td>Total: 6.1%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mix:</th>
<th>Control</th>
<th>Aspha-Min</th>
<th>Evotherm</th>
<th>Sasobit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additive Amount:</td>
<td>0.3 % by wt. of total mix</td>
<td>5.3 % by wt. of total mix</td>
<td>1.5 % of total binder</td>
<td></td>
</tr>
</tbody>
</table>
## Bid Data – ODOT COS/GUE Rt. 541

<table>
<thead>
<tr>
<th>Mix Type:</th>
<th>Control</th>
<th>Aspha-Min</th>
<th>Evotherm</th>
<th>Sasobit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course Thickness (in.)</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
<td>1.25</td>
</tr>
<tr>
<td>Section Length (mi.)</td>
<td>3.03</td>
<td>2.70</td>
<td>2.70</td>
<td>3.07</td>
</tr>
<tr>
<td>Quantity (CY):</td>
<td>1,602</td>
<td>1,155</td>
<td>1,155</td>
<td>1,339</td>
</tr>
<tr>
<td>Unit Cost ($/CY):</td>
<td>113.75</td>
<td>135.00</td>
<td>147.75</td>
<td>129.00</td>
</tr>
</tbody>
</table>
## Preliminary Investigation – ODOT COS/GUE Rt. 541

<table>
<thead>
<tr>
<th>Mix Type:</th>
<th>Control</th>
<th>Aspha-Min</th>
<th>Evotherm</th>
<th>Sasobit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Voids (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>@ 300 °F</td>
<td>3.5</td>
<td>2.4</td>
<td>2.0</td>
<td>1.6</td>
</tr>
<tr>
<td>@ 240 °F</td>
<td>3.8</td>
<td>3.2</td>
<td>3.0</td>
<td></td>
</tr>
</tbody>
</table>
Production Facility: Mar-Zane Plant 13
### Production Data – ODOT
COS/GUE Rt. 541

<table>
<thead>
<tr>
<th>Mix Type:</th>
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<th>Aspha-Min</th>
<th>Evotherm</th>
<th>Sasobit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burner Tuning:</td>
<td>Performed</td>
<td>Performed</td>
<td>Performed</td>
<td>Performed</td>
</tr>
<tr>
<td>Fuel Type:</td>
<td>Nat. Gas</td>
<td>Nat. Gas</td>
<td>Nat. Gas</td>
<td>Nat. Gas</td>
</tr>
<tr>
<td>Ave. Production Rate (TPH):</td>
<td>165</td>
<td>168</td>
<td>167</td>
<td>167</td>
</tr>
<tr>
<td>Tons Produced:</td>
<td>1,367</td>
<td>1,139</td>
<td>1,207</td>
<td>835</td>
</tr>
<tr>
<td>Stack Gas Temp. (°F):</td>
<td>195</td>
<td>220</td>
<td>255</td>
<td>222</td>
</tr>
<tr>
<td>Mix Discharge Temp. (°F):</td>
<td>335</td>
<td>250</td>
<td>240</td>
<td>250</td>
</tr>
</tbody>
</table>
# Production Data – ODOT COS/GUE Rt.541

<table>
<thead>
<tr>
<th>FOSSIL FUEL USAGE</th>
<th>Control</th>
<th>Aspha-Min</th>
<th>Evotherm</th>
<th>Sasobit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tons Produced:</td>
<td>1,367</td>
<td>1,139</td>
<td>1,207</td>
<td>835</td>
</tr>
<tr>
<td>Fuel Usage (mcf):</td>
<td>387</td>
<td>283</td>
<td>412</td>
<td>198</td>
</tr>
<tr>
<td>Fuel Usage (cf per mix ton):</td>
<td>283</td>
<td>248</td>
<td>341</td>
<td>237</td>
</tr>
<tr>
<td>Reduction in Fuel Usage (%):</td>
<td>12</td>
<td>-21</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>
Paver Emissions Sampling – ODOT COS/GUE Rt.541
Paver Emissions Sampling – ODOT COS/GUE Rt.541

Sample Location 2 – Left Side Screed Discharge over Auger

Sample Location 3 – Right Side Screed Discharge over Auger
Paver Emissions Sampling – ODOT COS/GUE Rt. 541

Sample Location 4 – Center of Paver Hopper

Sample Location 5 – Left Front Operator Panel
Paver Emissions Sampling – ODOT COS/GUE Rt. 541

Sample Location 6 – Central Step Railing
Emissions Background Sampling – ODOT COS/GUE Rt. 541
Laydown Operations Preliminary Results – ODOT COS/GUE Rt. 541

Mat Placement Temperature (°F)

- **Control**: 309°F
- **Aspha-Min**: 246°F
- **Evotherm**: 232°F
- **Sasobit**: 257°F
Mix Performance Preliminary Results – ODOT COS/GUE Rt.541

Air Voids of Cores (3 Months after Construction)

<table>
<thead>
<tr>
<th>Warm Mix Type</th>
<th>On Wheel Path</th>
<th>Between Wheel Paths</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMA Control</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Aspha-min</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>Evotherm</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Sasobit</td>
<td>7</td>
<td>8</td>
</tr>
</tbody>
</table>
Mix Performance Preliminary Results – ODOT COS/GUE Rt. 541

Indirect Tensile Strength (0, 3, 12 month cores)
Contributors:

• **Shelly & Sands, Inc.**
  – Ed Morrison, Quality Control Manager
  – Harold Walton, Quality Control
  – Tony Ruggiero, Environmental QC Manager

• **Chief Environmental Group, Inc.**

• **Ohio Department of Transportation**
  – David Powers, Bituminous Concrete & Materials Engineer
  – Tim Dannemiller, Office of Production, District 5

• **Ohio University**
  – Dr. Shad Sargand, Dr. Ludwig Figueroa, Sang-Soo Kim

• **EES Group, Inc.**