Warm Mix Asphalt

2008 ODOT Field Trials

What is it?
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Why?

• Reduce production and laydown temperatures
• Reduce emissions
• Reduce energy costs
• Reduce aging of binder
• Other Possible Benefits:
  – Cool weather paving (extend season)
  – Compaction aid for stiff mixes

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WMA Technologies

• WAM Foam
• Zeolite
• Sasobit
• Evotherm
• Low Energy Asphalt
• FOAMING
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Why Foaming?

• Improved Workability / coating
• No Smoke, less Smell
• Longer Life Pavement
• 11% Less Plant Fuel
• 11% Higher Production
• Some decrease in cost

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Why Foaming?

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Unknowns with Foaming

• Production limitations
• Several different foam technologies
• Emissions
• Mix life
• Cost
• Quality Control
• Placement

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Astec

WATER IS THE ONLY ADDITIVE. WATER IS PUMPED FROM A TANK TO THE FOAM NOZZLES.

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Terex

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Gencor

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How much water?

About 1% $\text{H}_2\text{O}$ of liquid AC by weight.

1 ton mix – 2,000 lb.
5.3% AC liquid – 106 lb.
1 lb $\text{H}_2\text{O}$
Volume of liquid – 1.63 cu. ft.

1 lb. $\text{H}_2\text{O}$ when converted to steam = 30 cu. ft.
Expansion = $\frac{30}{1.63} = 18$
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Projects with Water Injection for Foaming

In 2008 6 projects were sold to:

1) Determine asphalt plant emissions data

2) Create projects with control sections of equivalent HMA mixes to compare performance and laydown.

3) On some, sell as alternate to determine if realistic cost savings.

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Projects with Water Injection for Foaming

One additional project was let as an alternate but was awarded as a hot mix due to the way multiple contractors bid the job for mix placement vs. mix producer.

One existing project not sold as WMA had it’s 301 base mix change ordered to WMA at a savings.

Total WMA tonnage – approx. 50,000 tons in 2008
# Warm Mix Asphalt

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### Projects with Water Injection for Foaming

<table>
<thead>
<tr>
<th>Dist</th>
<th>PID</th>
<th>Section</th>
<th>Length</th>
<th>Sale</th>
<th>Contractor</th>
<th>Stack Test</th>
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</thead>
<tbody>
<tr>
<td>4</td>
<td>77838</td>
<td>POR-224-13.42</td>
<td>4.9 mi</td>
<td>6/4/08</td>
<td>Shelly</td>
<td>Yes</td>
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<tr>
<td>4</td>
<td>25554</td>
<td>SUM-303-8.14</td>
<td>2.4 mi</td>
<td>6/4/08</td>
<td>Karvo</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>22640</td>
<td>LIC-40-0.58</td>
<td>5.7 Lmi</td>
<td>change order</td>
<td>Shelly</td>
<td></td>
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<tr>
<td>6</td>
<td>78156</td>
<td>PIC-62-0.00</td>
<td>7.64 mi</td>
<td>5/21/08</td>
<td>Kokosing</td>
<td>Yes</td>
</tr>
<tr>
<td>7</td>
<td>77424</td>
<td>DAR/MIA-49-0.00</td>
<td>9.75 mi</td>
<td>5/21/08</td>
<td>Valley/ Walls</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>25378</td>
<td>CLE-132-0.00</td>
<td>12.43 mi</td>
<td>6/4/08</td>
<td>Barrett</td>
<td>Yes</td>
</tr>
<tr>
<td>12</td>
<td>22896</td>
<td>CUY-176-12.76</td>
<td>0.59 mi</td>
<td>7/23/08</td>
<td>Karvo</td>
<td></td>
</tr>
</tbody>
</table>
# Warm Mix Asphalt

## 2008 ODOT Field Trials

### Projects with Water Injection for Foaming

<table>
<thead>
<tr>
<th>Dist</th>
<th>Contr.</th>
<th>Section</th>
<th>Project Cost</th>
<th>Item</th>
<th>Cubic Yards</th>
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<tbody>
<tr>
<td>4</td>
<td>Shelly</td>
<td>POR-224-13.42</td>
<td>1,411,473</td>
<td>Mill 1.5, place 1.75 446-2, 64-22</td>
<td>2512 WMA/1897 HMA</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Place 1.25 446-1, 70-22M</td>
<td>1539 WMA/1840 HMA</td>
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<tr>
<td>4</td>
<td>Karvo</td>
<td>SUM-303-8.14</td>
<td>962,912</td>
<td>Mill 1.5, place 1.5 448-1, 70-22M</td>
<td>1835 WMA/937 HMA</td>
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<tr>
<td>5</td>
<td>Shelly</td>
<td>LIC-40-0.58</td>
<td>- 3341</td>
<td>301 base only for WMA</td>
<td>6683 WMA</td>
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<tr>
<td>6</td>
<td>Kokosing</td>
<td>PIC-62-0.00</td>
<td>934,073</td>
<td>Mill 1.5, place 1.5 446-1, 64-22</td>
<td>2665 HMA/2928 WMA</td>
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<td>7</td>
<td>Valley</td>
<td>DAR/MIA-49-0.00</td>
<td>1,662,762</td>
<td>Place 0.5 448-1 64-22</td>
<td>1222 WMA</td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td>Place 1.5 448-1H, 70-22M</td>
<td>3433 HMA/3667 WMA</td>
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<tr>
<td>8</td>
<td>Barrett</td>
<td>CLE-132-0.00</td>
<td>2,263,252</td>
<td>Mill 2.0, place 1.75 446-2</td>
<td>3713 total</td>
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<td></td>
<td></td>
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<td></td>
<td>Place 1.5 446-1H 70-22M</td>
<td>3283 total</td>
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<tr>
<td>12</td>
<td>Karvo</td>
<td>CUY-176-12.76</td>
<td>255,843</td>
<td>Mill 0.5, place 1.0 424-B</td>
<td>1179 WMA</td>
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</tbody>
</table>
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General Project Requirements:
• Project split HMA/WMA with same JMF
• When stack test required: NOx, CO₂ and VOC
• Use Astec multi point water injection
• Perform QC lab compaction at 25 F less than design
• Field compact as needed for density measure
• Perform T 283 moisture damage testing each day
• Collect all QC, stack and fuel data and report to ODOT
POR-224

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SUM-303
PIC-62

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<table>
<thead>
<tr>
<th>Temp</th>
<th>% Density</th>
<th>Pay Factor</th>
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<tr>
<td>277</td>
<td>90.0</td>
<td>0.80</td>
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<tr>
<td>280</td>
<td>93.0</td>
<td>1.00</td>
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<tr>
<td>276</td>
<td>92.8</td>
<td>1.00</td>
</tr>
<tr>
<td>296</td>
<td>93.7</td>
<td>1.04</td>
</tr>
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</table>

CUY- 176
424 w/ PG76-22M

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### Fuel and Emissions

#### POR-224 Summary of Fuel and Emissions

<table>
<thead>
<tr>
<th></th>
<th>T 1 HMA</th>
<th>T 1 WMA</th>
<th>Percent Reduction</th>
<th>T 2 HMA</th>
<th>T 2 WMA</th>
<th>Percent Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Production tons/hr</td>
<td>430</td>
<td>330</td>
<td></td>
<td>452</td>
<td>478</td>
<td></td>
</tr>
<tr>
<td>Plant Fuel Usage</td>
<td>2.08</td>
<td>1.71</td>
<td>17.8</td>
<td>1.77</td>
<td>1.57</td>
<td>11.3</td>
</tr>
<tr>
<td>Plant Fuel Usage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temp ºF</td>
<td>290</td>
<td>261</td>
<td></td>
<td>298</td>
<td>260</td>
<td></td>
</tr>
<tr>
<td>NOx lb/hr</td>
<td>31.97</td>
<td>19.10</td>
<td>40</td>
<td>30.46</td>
<td>27.33</td>
<td>10</td>
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<tr>
<td>CO2 lb/hr</td>
<td>16599</td>
<td>11378</td>
<td>31</td>
<td>17258</td>
<td>15253</td>
<td>12</td>
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<tr>
<td>VOC lb/hr</td>
<td>8.7</td>
<td>6.39</td>
<td>27</td>
<td>6.92</td>
<td>6.54</td>
<td>5</td>
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</tbody>
</table>
## 2008 Warm Mix Asphalt

### Fuel and Emissions

<table>
<thead>
<tr>
<th>DAR/MIA-49</th>
<th>Summary of Fuel and Emissions</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Hot Mix</td>
</tr>
<tr>
<td>Production tons/ hr</td>
<td>301.07</td>
</tr>
<tr>
<td>Plant Fuel Usage gal/ton</td>
<td>1.64</td>
</tr>
<tr>
<td>Temp ºF</td>
<td>330</td>
</tr>
<tr>
<td>NOx lb/hr</td>
<td>21.04</td>
</tr>
<tr>
<td>CO₂ lb/hr</td>
<td>14,830</td>
</tr>
<tr>
<td>VOC lb/hr</td>
<td>5.9</td>
</tr>
</tbody>
</table>
Thank You!

david.powers@dot.state.oh.us
Office of Materials Management
Ohio DOT (dot.state.oh.us)
614-275-1387