WMA Energy Savings and Emission Reductions
Preliminary Report on NCHRP 09-47A

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Advanced Materials Services, LLC
24% Average Reduction
15 Projects
6 Technologies

Production Temperature below boiling point of water

Emulsion Technology
Boeing 787 Dreamliner

$3,400,000 investment = 20% less fuel
Fuel Usage

Temperature Reduction, Degree F

CO₂ Emissions

Temperature Reduction, Degree F
Rapid River, MI

Bituma PF Drum
Astroflame & Used Oil

Advera™ WMA

Evotherm™ 3G
## Rapid River, MI Fuel Savings

<table>
<thead>
<tr>
<th>Mix</th>
<th>Temp 0°F</th>
<th>Agg % Moisture</th>
<th>DTH/ton Tank</th>
<th>DTH/ton Stack</th>
<th>% Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMA</td>
<td>300</td>
<td>3.6</td>
<td>0.274</td>
<td>0.285</td>
<td>NA</td>
</tr>
<tr>
<td>WMA - A</td>
<td>269</td>
<td>4.1</td>
<td>0.187</td>
<td>0.248</td>
<td>13%</td>
</tr>
<tr>
<td>WMA - B</td>
<td>269</td>
<td>3.9</td>
<td>0.225</td>
<td>0.237</td>
<td>17%</td>
</tr>
</tbody>
</table>

DTH = decatherm = 1,000,000 BTU
## Griffith, IN Fuel Savings

<table>
<thead>
<tr>
<th>Mix</th>
<th>Temp 0°F</th>
<th>Agg % Moisture</th>
<th>DTH/ton NG Meter</th>
<th>DTH/ton Stack</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Historic HMA</td>
<td></td>
<td></td>
<td>0.28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HMA</td>
<td>300</td>
<td>3.2</td>
<td>0.226</td>
<td>0.194</td>
<td>19%</td>
</tr>
<tr>
<td>WMA - C</td>
<td>277</td>
<td>3.5</td>
<td>0.224</td>
<td>0.212</td>
<td>0.9%</td>
</tr>
<tr>
<td>WMA - D</td>
<td>256</td>
<td>3.8</td>
<td>0.212</td>
<td>0.196</td>
<td>6.2%</td>
</tr>
<tr>
<td>WMA - E</td>
<td>268</td>
<td>3.8</td>
<td>0.201</td>
<td>0.151</td>
<td>11.1%</td>
</tr>
</tbody>
</table>

DT = decatherm = 1,000,000 BTU

HMA 0.28 DT/ton prior to tuning; 19% savings
### Griffith, IN

#### Electrical Usage

<table>
<thead>
<tr>
<th>Mix</th>
<th>Avg. Production Temperature, F</th>
<th>Drum, amps</th>
<th>Drag Slat, amps</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMA</td>
<td>300</td>
<td>37</td>
<td>81</td>
</tr>
<tr>
<td>WMA - C</td>
<td>277</td>
<td>39</td>
<td>87</td>
</tr>
<tr>
<td>WMA - D</td>
<td>256</td>
<td>40</td>
<td>91</td>
</tr>
<tr>
<td>WMA – E</td>
<td>268</td>
<td>40</td>
<td>89</td>
</tr>
</tbody>
</table>
New York, NY

McCarter Batch Tower
with Dillman Duo Drum
Ecostar IIB & Nat Gas

Cecabase RT
Surfactant
SonneWarmix
Synthetic Wax
BituTech PER
Organic technology
## New York, NY Fuel Savings

<table>
<thead>
<tr>
<th>Mix</th>
<th>Temp °F</th>
<th>Agg % Moisture</th>
<th>DTH/ton NG Meter</th>
<th>DTH/ton Stack</th>
<th>Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMA</td>
<td>332</td>
<td>3.1</td>
<td>0.260</td>
<td>0.299</td>
<td>NA</td>
</tr>
<tr>
<td>WMA – F</td>
<td>240</td>
<td>3.4</td>
<td>0.236</td>
<td>0.235</td>
<td>20.9</td>
</tr>
<tr>
<td>WMA – G</td>
<td>252</td>
<td>2.4</td>
<td>0.216</td>
<td>0.198</td>
<td>32.0</td>
</tr>
<tr>
<td>WMA - H</td>
<td>253</td>
<td>3.6</td>
<td>0.211</td>
<td>0.210</td>
<td>29.2</td>
</tr>
</tbody>
</table>

DT = decatherm = 1,000,000 BTU
13 WMA TECHNOLOGIES

Graph showing the relationship between WMA Delta F and % Fuel Savings.
Stack Emissions Sites

Rapid River, MI

Griffith, IN

New York, NY
The bar chart illustrates the CO₂ emissions in pounds per ton for different types of asphalt in Michigan, Indiana, and New York. The data shows varying levels of CO₂ emissions across the states, with Michigan having the highest emissions overall.
EPA Emission Factor, Oil, 0.055 lbs/ton

<table>
<thead>
<tr>
<th></th>
<th>Michigan</th>
<th>Indiana</th>
<th>New York</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMA</td>
<td>0.064</td>
<td>0.021</td>
<td>0.031</td>
</tr>
<tr>
<td>WMA A</td>
<td>0.064</td>
<td>0.022</td>
<td>0.024</td>
</tr>
<tr>
<td>WMA B</td>
<td>0.058</td>
<td>0.023</td>
<td>0.019</td>
</tr>
<tr>
<td>WMA C</td>
<td>0.022</td>
<td>0.015</td>
<td></td>
</tr>
<tr>
<td>WMA D</td>
<td>0.021</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WMA E</td>
<td>0.015</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
SO₂

EPA Emission Factor
Waste Oil
0.058 lbs/ton

EPA Emission Factor
Natural Gas

lb/ton

Michigan

Indiana

New York
Formaldehyde Frequency Distribution

- EPA AP-42
- NCHRP HMA
- Industry HMA
- NCHRP WMA

Observed Frequency, %

Formaldehyde Emissions, lbs/ton

0 0.001 0.002 0.003 0.004 0.005 0.006 0.007 0.008
Unintended Consequence of FTIR Formaldehyde Testing
CONCLUSIONS

• WMA reduces fuel consumption and plant emissions.
• Quantifying actual reduction is difficult due to impact of other factors – i.e. aggregate moisture.
  – 3% savings/10 °F is a good average.
• Accurate stack emission testing requires experienced contractors with reference method analyzers.
• Emissions should be reported in mass/unit production for comparisons to be meaningful.
• Emission reductions should mirror magnitude of fuel savings.
• Look for inconsistencies in your data and expect the unexpected.
• Implement Best Practices, including burner tuning, before any WMA energy and emission evaluation.
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