Evaluation of Fine Graded Polymer Asphalt Mixture Produced Using Foamed WMA Technology

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Outline

➢ Background
➢ Objective
➢ Testing Program
➢ Results
➢ Conclusion
➢ Recommendation
Thin overlays are gaining considerable attention as one of the most effective preventative maintenance techniques.

In Ohio, fine graded polymer asphalt mixture has been used in the construction of the thin overlays:

- It is produced at high temperatures (350-370 °F)
Background: Warm mix asphalt (WMA)

- WMA has received considerable attention to reduce energy consumption and pollutant emissions during production & placement.

- Foaming WMA technologies produced via a foaming nozzle have been gaining popularity among asphalt mix producers.
  - Minimize the impact of increased material costs identified with other WMA technologies.
Use of foamed WMA to produce fine graded polymer asphalt mixture can result in several benefits:

- Lower production and compaction temperatures.
- Allow the use of higher RAP percentage:
  - Cost reduction
  - Better rut performance

Despite the advantages of foamed WMA fine graded polymer asphalt mixture, there are some concerns:

- Durability
- Performance
Objective

- Evaluate the performance of fine graded polymer asphalt mixture containing RAP and produced with the foamed WMA technology used in construction of a thin overlay in a field project in Ohio
The field test section was part of a rehabilitation project on State Route 146 (SR 146) near Zanesville and Chandlersville Counties.

Description of Field Project
<p>| | |</p>
<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Mixture Designation</strong></td>
<td><strong>424B</strong></td>
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<tr>
<td><strong>Aggregate blend</strong></td>
<td><strong>11% No.8 Gravel, 18% No.9 Gravel, 20% Limestone , 41% Natural Sand</strong></td>
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<tr>
<td><strong>10% RAP</strong></td>
<td></td>
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<tr>
<td><strong>Binder type</strong></td>
<td><strong>PG76-22M</strong></td>
</tr>
<tr>
<td><strong>Binder content, %</strong></td>
<td><strong>7.5 (6.9 Virgin binder)</strong></td>
</tr>
<tr>
<td><strong>Mixing Temperature (°F)</strong></td>
<td><strong>325</strong></td>
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Testing Program

- Collect sufficient loose mixture for preparation of lab samples
- Conduct lab tests
- Conduct in-situ tests
- Obtain initial roughness measurement
LAB TESTS

- Modified Lottman
- Asphalt Pavement Analyzer
- Flow Number Test
- Dynamic Modulus Test
Sample Preparation -- $E^*, F_N$
Dynamic Modulus $|E^*|$ Test

- Interlaken SPT
- AASHTO TP-62
- Sinusoidal axial compressive stress is applied to a specimen
  - temperature and frequency

$$|E^*| = \frac{\sigma_0}{\varepsilon_0}$$

$$\phi = \omega t_i$$

<table>
<thead>
<tr>
<th>Frequency (HZ)</th>
<th>25, 10, 5, 1, 0.5, 0.1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temp. (°C)</td>
<td>4.4, 25, 38, 54.4</td>
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Flow Number

- Interlaken SPT
- A haversine axial compressive stress is applied
  - Loading: 0.1 Second
  - Rest Period: 0.9 Second
  - 54.4°C
- $F_N$: Number of cycles
  - Tertiary Failure
  - 10,000 cycles
Field Measurements

IRI Profiler

LFWD
Prima 100

Portable seismic pavement analyzer (PSPA)
RESULTS OF LAB TESTS
Moisture Susceptibility: Modified Lottman

![Graph showing moisture susceptibility over days 2, 3, and 6 with constant TSR values.]

- Day-2: TSR constant
- Day-3: TSR constant
- Day-6: TSR constant
The average total rut depth for the tested samples was 0.35 in.

This value is greater than the maximum acceptable rut depth of 0.2 in that ODOT specifies for heavy traffic mixtures.
The flow number for all tested samples was less than 200 cycles.

The relatively lower rutting resistance is mainly attributed to:

- The substantial amount of natural sand in the mixture.
- The use of foamed WMA technology since it reduces binder aging during the mixing.
Dynamic Modulus Results
PSPA Results

![Graph showing PSPA Modulus (ksi) vs. Test points]

- PSPA Modulus (ksi) axis
- Test points axis

The graph illustrates the variation of PSPA Modulus (ksi) across different test points.
LFWD Results

![Graph showing LFWD results with test points on the x-axis and ELFWD (ksi) on the y-axis. The graph displays a scatter plot with data points indicating the relationship between test points and ELFWD values.]
IRI Results

The graph shows the IRI (International Roughness Index) results in inches per mile (in/mi) plotted on a scatter plot. The x-axis represents the distance in miles, ranging from 0 to 100, while the y-axis represents IRI values ranging from 0 to 120. The data points are scattered across the graph, indicating variations in IRI values at different distances.
Conclusions

- The foamed WMA mixture showed acceptable resistance to moisture induced damage as indicated by the modified Lottman test.
- The evaluated mixture did not exhibit good rutting performance in the APA and flow number tests.
- The foamed WMA mixture had similar LFWD and PSPA moduli as those of good performing HMA mixtures.
Conclusions

- The PSPA test exhibited better repeatability and lower variability compared to the LFWD test.
- The foamed WMA test section showed very good riding quality as indicated by the IRI values that were obtained directly after the placement of thin overlay.
Thank you!!