Asphalt Mixture Performance Testing: QA and the AMPT

Stacey Diefenderfer, PhD, PE

Northeast Asphalt User Producer Group
October 24, 2012
What Can the AMPT Evaluate?

- Cracking susceptibility
  - Modulus
  - Compliance
  - Strength

- Rutting susceptibility
  - Flow number

- Inputs for performance prediction
Why Consider AMPT Tests and QA?

- Fundamental properties
  - Modulus, compliance, strength

- Better correlation with field performance?
AMPT Discussion

• Pros:
  – Fundamental material properties
  – Pavement design inputs (DarWinME)

• Cons:
  – Equipment cost, manpower, and testing proficiency
  – Specimen preparation and testing time
  – Determining specification values
How Do We Integrate with QA?

Pavement Design

Mix Design

Construction
Pavement Design

• Provide input values for DarWinME
  – Dynamic modulus, creep compliance, IDT strength

• Knowledge of expected bidders/mixes used for project?

• Changes in specs/mixes over time from project prep to letting/construction?
Mix Design

• Can allow optimization of mix designs

• Mix design acceptance?
  – What are appropriate criteria?
  – Who performs testing?
  – Workload considerations?
  – Differences between lab-produced and plant-produced material?
Construction

• Provide data from as-placed material

• Material acceptance?
  – What are criteria?
  – Who performs testing?
  – Workload considerations?
  – Turn-around time?
  – Pros/cons regarding pills and cores?
Virginia’s Experience

• We don’t have an AMPT…yet (soon)
• We do have IPC loadframe performing testing under same software as AMPT
  – Dynamic modulus
  – Flow number
  – IDT dynamic modulus, creep compliance, strength
Virginia’s Experience

• DarWinME asphalt mixture catalog
  – Dynamic modulus, tensile strength, creep compliance

• Research and forensic testing
  – Rutting performance of RAP mixes
  – Long-term performance evaluations
    • SMA, WMA, and RAP mixes
  – Properties of poor-performing mixes
DarWinME Asphalt Mixture Catalog

- 29 asphalt mixtures currently
  - 7 9.5mm mixes
  - 4 12.5mm mixes
  - 4 19.0mm mixes
  - 11 25.0mm mixes
  - 3 SMA mixes
- As data is available, additional mixes will be added
RAP Rutting Evaluation

• Since 2008, Virginia allows up to 30% RAP in surface mixes

• May use PG64-22 + >20% RAP in place of PG70-22
  – Assumed that RAP will stiffen the mixture and provide equivalent performance
Flow Number (54°C, 206kPa)

- Flow Number, cycles

Specified Binder

- 64-22
- 70-22
- 76-22
Flow Number (54°C, 206kPa)
## SMA 10 Year Performance Review

<table>
<thead>
<tr>
<th>Mix</th>
<th>$% P_{be}$</th>
<th>% RAP</th>
<th>AADT</th>
<th>General Perf.</th>
<th>Roadway Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GP1</td>
<td>6.5</td>
<td>0</td>
<td>15,000</td>
<td>Good</td>
<td>Mainline interstate</td>
</tr>
<tr>
<td>GP2</td>
<td>6.3</td>
<td>0</td>
<td>14,000</td>
<td>Good</td>
<td>Rural primary with no signalized intersections</td>
</tr>
<tr>
<td>PP1</td>
<td>6.3</td>
<td>15</td>
<td>20,000</td>
<td>Marginal</td>
<td>Some signalized intersections; var. traffic speeds</td>
</tr>
<tr>
<td>PP2</td>
<td>7.2</td>
<td>0</td>
<td>22,000</td>
<td>Poor</td>
<td>Frequent signalized intersections, var. traffic speeds</td>
</tr>
</tbody>
</table>
SMA – E* Mastercurves

Graph showing the relationship between Modulus, psi, and Reduced Frequency, Hz for different materials labeled GP1, PP1, GP2, and PP2.
SMA – Flow Number (207 kPa, 54°C)

Flow Number, cycles

<table>
<thead>
<tr>
<th>Flow Number, cycles</th>
<th>GP1</th>
<th>GP2</th>
<th>PP1</th>
<th>PP2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1044</td>
<td>991</td>
<td>1054</td>
<td>345</td>
</tr>
</tbody>
</table>

Flow Number, cycles
Forensic Evaluation

- 9.5mm PG70-22 mix
- Placed early summer 2012
- Ruts up to $\frac{3}{4}$ inch measured by mid-summer, primarily in intersection areas
Forensic Mix – $E^*$ Mastercurves

- Forensic Mix
- SM-9.5 (PG64-22)
- SM-9.5 (PG70-22)
Where Do We Go From Here?

• DarWinME implementation
  – Anticipated 2013 in Virginia

• Continue building confidence in test methods, results, and meaning of results

• Performance-based specifications?
Acknowledgements:
Alex Apeagyei, Trenton Clark, Troy Deeds, Brian Diefenderfer, Donnie Dodds, Ben Earl, Kevin McGhee, Shane Moomaw, Hari Nair, Kim Snead
Thank You

For more info:
Stacey Diefenderfer
stacey.diefenderfer@vdot.virginia.gov