**BACKGROUND**

- Chip seals are the most common surface treatments in Texas.
- Current specification’s properties are not correlated with field performance and do not consider entire range of temperatures and long-term aging.
- A surface performance-graded (SPG) specification was developed in previous research projects.

**OBJECTIVE**

- Achieve statewide implementation of the SPG specification for chip seal binders in service.
- Compare the laboratory characterization results and field performance for chip seal binders.
- Explore additional tests to include in the SPG specification.

**METHODOLOGY**

- **2013 & 2014 Chip Seal Binders**
  - AC10, AC10-2TR, AC15SP, AC20-5TR
- **Emulsion Recovery**
  - AASHTO PP 72-11 Procedure B
  - 6 h at 60 °C
- **SPG Tests**
  - DSR, Shear Strain Sweep, BBR
  - PAV Aging: 100 °C, 20 h
- **About 1 year after construction**
  - Aggregate Loss & Bleeding
  - PHI ~ 0.85
  - 0.2%<G*/kPa
  - Pass/fail: SCI ≥ 270
- **Lab Vs Field (Pass/Fail)**
  - Pass/fail: Pass map grade
  - Individual Property
  - Evaluation

**CURRENT SPG SPECIFICATION FOR STATEWIDE IMPLEMENTATION**

<table>
<thead>
<tr>
<th>SPG 64</th>
<th>SPG 67</th>
<th>SPG 70</th>
</tr>
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<tbody>
<tr>
<td>-25</td>
<td>-13</td>
<td>-16</td>
</tr>
<tr>
<td>-13</td>
<td>-16</td>
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<td>-16</td>
<td>-19</td>
<td>-22</td>
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<td>-19</td>
<td>-22</td>
<td>-25</td>
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</tbody>
</table>

**TEST TEMPERATURE (°C)**

- Dynamic Shear, T 315:
  - G*/sinθ, Min 0.65 kPa,
  - Test temp @ 10 rad/s, °C
  - 64
  - 67
  - 70
- Shear Strain Sweep, T 315:
  - % strain @ 0.8 G*, Min: 17.5
  - Test temp @ 10 rad/s linear loading from 1–50% strain, 1 sec. delay time with 20–30 measurements, °C
  - 25
  - 25
  - 25
- Phase angle (θ), Max, @ temp. where G*/sinθ = 0.65 kPa
  - 80
  - 80
  - 80
  - 80
  - 80
  - 80
- PAV aging temperature, °C
  - 100
  - 100

**LABORATORY CHARACTERIZATION OF 2013 & 2014 BINDERS**

<table>
<thead>
<tr>
<th>Binder Type</th>
<th>SPG Grade Measured</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRS-2</td>
<td>67-19</td>
</tr>
<tr>
<td>CRS-2P</td>
<td>70-22, 73-19, 73-22</td>
</tr>
<tr>
<td>AC10</td>
<td>61-13, 61-19</td>
</tr>
<tr>
<td>AC10-2TR</td>
<td>64-16, 67-16, 67-19, 67-22</td>
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<tr>
<td>AC15SP</td>
<td>67-22, 70-25, 70-28, 70-28, 76-28</td>
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<tr>
<td>AC20-5TR</td>
<td>70-19, 70-25, 70-25, 73-19, 73-22, 73-25, 76-19</td>
</tr>
</tbody>
</table>

**COMPARISON OF LABORATORY RESULTS TO 2013 FIELD PERFORMANCE**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Existing SPG Limit</th>
<th>Laboratory vs. Field Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSR</td>
<td>G*/sinθ, Min 0.65 kPa</td>
<td>Pass&lt;sub&gt;LAB&lt;/sub&gt;–Pass&lt;sub&gt;HAB&lt;/sub&gt;: 17 Correlated 89%</td>
</tr>
<tr>
<td>BBR</td>
<td>5 @ 8 °C, T&lt;sub&gt;DUR&lt;/sub&gt;</td>
<td>Max 500 MPa Pass&lt;sub&gt;LAB&lt;/sub&gt;–Fail&lt;sub&gt;HAB&lt;/sub&gt;: 8 Correlated 42%</td>
</tr>
<tr>
<td>Strain Sweep</td>
<td>% γ @ 0.8G*, 25°C</td>
<td>Min 17.5% Pass&lt;sub&gt;LAB&lt;/sub&gt;–Fail&lt;sub&gt;HAB&lt;/sub&gt;: 7 Correlated 58%</td>
</tr>
</tbody>
</table>

**CONCLUSIONS & RECOMMENDATIONS**

- SPG specification correlated well with field performance except in colder climate (AMA district).
- Phase angle threshold was added to original SPG to ensure modified binders contain sufficient polymers.
- Implementation of SPG specification will continue through 2017.
- Review of creep stiffness threshold will be based on further field evaluation of sections in colder climate.