Seal Coat Binder
Performance Specifications

Amy Epps Martin

87th Annual Transportation Short Course
October 2013
OUTLINE

• Motivation, Objective, & History

• Recommended SPG Specification

• Implementation Project
MOTIVATION & OBJECTIVE

• Need to improve seal coat binder specs
  – replace empirical tests (penetration, ductility) with performance-related tests applicable to both unmodified and modified binders
  – consider temperatures that cover entire in service range that are tied to specific climate
  – consider aging during critical 1st year
  – reduce variability in grades

• Developed Surface Performance-Grade (SPG) spec for seal coat binders in service
• Validated with 75 TX highway sections
Traditional Specification for Surface Treatment Binder RESIDUE Inadequate

- Develop Performance-Based Specification & Grade Selection Process for Surface Treatment Binder RESIDUE
  - Surface Treatment Distresses & Conditions
  - Superpave Equipment
  - Qualitative Performance Rankings & Corresponding Environmental Conditions

- Validate Specification
  - Laboratory Measured Binder SPG Grade
  - Observed Field Performance on 45 Highway Sections

TxDOT 0-1710 (3.5 yr+ project, 9/99 – 3/03) Superpave Binder Tests for Surface Treatment Binders
NCHRP 14-17
(2.5 yr+ project @ A&M, 4/08 – 12/09)
Manual for Emulsion-Based Chip Seals for Pavement Preservation

• Provide technology-based tools that promote sound engineering decisions and reduce the subjectivity in chip seal design and construction processes
• Create a manual which describes how to design and construct chip seals with a very high confidence level in the success of the resulting project

• A&M: Emulsion residue recovery, chemical & rheological binder characterization for 5 emulsions + 3 Highway Sections
TxDOT 0-6616 (2 year project, 9/10-8/12)
Validate Surface Performance-Graded (SPG) Specification for Surface Treatment Binders

Improve SPG Specification

• Standardize Emulsion Residue Recovery Method

• Explore Exclusive Use of DSR – Predict S, m-value

• Evaluate Additional Performance Parameters

• Further Field Validate SPG Thresholds on 30 Highway Sections
Emulsion Task Force (ETF) of FHWA Pavement Preservation ETG (formed 08, ~30 members, 2 X per year)

• Review Ongoing Research & Integrate Work

• Recommend / Propose / Evaluate Research Needs

• Advance Development of Performance-Based Methods & Specifications

• Facilitate Implementation / Adoption of Standards through AASHTO/ASTM

• Share Info w/Other ETGs
RECOMMENDED SPG

with AASHTO PP 72-11 Method B

<table>
<thead>
<tr>
<th>Performance Grade</th>
<th>SPG 64</th>
<th>SPG 67</th>
<th>SPG 70</th>
</tr>
</thead>
</table>

Average 7-day Maximum Surface Pavement Design Temperature, °C

Minimum Surface Pavement Design Temperature, °C

Original Binder

Dynamic Shear, AASHTO TP5
G*/Sinδ Minimum: 0.65 kPa
Test Temperature @10 rad/s, °C

Shear Strain Sweep
% strain @ 0.8G*, Minimum: 17.5 (25)
Test Temperature @10 rad/s linear loading from 1-50% strain, 1 sec delay time with measurement of 20-30 increments, °C

Pressure Aging Vessel (PAV) Residue (AASHTO PP1)

PAV Aging Temperature, °C

Creep Stiffness, AASHTO T 313/ASTM D6648
S, Maximum: 500 MPa (m-value, Minimum: 0.24)
Test Temperature @ 8s, °C

Shear Strain Sweep
G**, Maximum: 2.5 MPa
Test Temperature @10 rad/s linear loading at 1% strain and 1 sec delay time, °C
### RECOMMENDED SPG

<table>
<thead>
<tr>
<th>Performance Grade</th>
<th>SPG 67</th>
</tr>
</thead>
<tbody>
<tr>
<td>-13</td>
<td></td>
</tr>
<tr>
<td>-16</td>
<td></td>
</tr>
<tr>
<td>-19</td>
<td></td>
</tr>
<tr>
<td>-22</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Avg 7-day Max <strong>Surface</strong> Pavement T, °C</th>
<th>&lt;67</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min <strong>Surface</strong> Pavement T, °C</td>
<td>&gt;-13</td>
</tr>
</tbody>
</table>

- Method B for Emulsion Residue Recovery
  - Thin Film on Silicone Mat
  - 60 °C for 6 hrs
## RECOMMENDED SPG

<table>
<thead>
<tr>
<th>Performance Grade</th>
<th>SPG 67</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-13</td>
</tr>
<tr>
<td></td>
<td>&lt;67</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Original Binder

- $G^*/\sin\delta \geq 0.65 \text{ kPa}$
- Test Temperature @ 10rad/s, °C

- $0.8G_i^* \geq 17.5\% \text{ strain}$
- Test Temperature @ 10rad/s w/ 1-50%, °C

---

No specific recommendation is provided for SPG 67 in the table. The image also includes a logo for Texas A&M Transportation Institute.
## RECOMMENDED SPG

<table>
<thead>
<tr>
<th>Performance Grade</th>
<th>SPG 67</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-13</td>
</tr>
<tr>
<td></td>
<td>&lt;67</td>
</tr>
<tr>
<td></td>
<td>&gt;=-13</td>
</tr>
</tbody>
</table>

### PAV Residue

<table>
<thead>
<tr>
<th>S ≤ 500 MPa</th>
<th>-13</th>
<th>-16</th>
<th>-19</th>
<th>-22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Temperature @ <strong>8s</strong>, °C</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>G_{i}^* ≤ 2.5 MPa</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Temperature @10 rad/s, 1% strain, °C</td>
<td></td>
</tr>
</tbody>
</table>

OR Predict S from DSR Frequency Sweeps @6 °C
IMPLEMENTATION PROJECT

• 4 Years

• Implement SPG specification statewide to replace Seal Coat Binder Selection Table & Item 300 for seal coat binders *in service*

• Task 1 - Conduct Technical Briefings for Industry & TxDOT twice a year
IMPLEMENTATION PROJECT

• Task 2 - Document SPG Grade Requirements & Identify 2 Districts for 2014 Implementation

• Task 3 – Finalize SPG for 2014
### IMPLEMENTATION PROJECT

- **Task 4** – Produce Seal Coat Binder Utilization Map

- **Task 5** – Monitor Field Performance of Selected 2013 Field Sections

<table>
<thead>
<tr>
<th>Binder</th>
<th>SPG Grades</th>
<th>Districts</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC20-5TR</td>
<td>70-13, 67-16, 70-16, 73-16, 76-16, 79-16, 67-19, 70-19</td>
<td>AMA, ATL, BMT, BRY, BWD, FTW, LBB, LFK, PAR, SAT, SJT, TYL, WAC</td>
</tr>
<tr>
<td>AC15P</td>
<td>73-13, 70-19, 73-19, 73-22</td>
<td>CRP, LFK, PHR, SAT, WAC</td>
</tr>
<tr>
<td>CRS-2P</td>
<td>70-10, 70-16, 76-16, 76-19</td>
<td>BMT, BWD, LFK, PAR, WAC</td>
</tr>
<tr>
<td>CRS-2</td>
<td>64-10, 67-13</td>
<td>BWD</td>
</tr>
<tr>
<td>AC10</td>
<td>64-16, 64-19</td>
<td>AMA, CHS, SJT</td>
</tr>
<tr>
<td>AC10-2TR</td>
<td></td>
<td>AMA, BWD, LBB, ODA, SAT, SJT, WFS, YKM</td>
</tr>
</tbody>
</table>
IMPLEMENTATION PROJECT

• Task 6 – Finalize SPG for 2015
  – Check DSR+SAT for $T_{\text{low}}$ properties
  – Check PAV = 1 year aging
  – Consider 3 vs 6 °C, single $T_{\text{max}}$, traffic effects
  – Evaluate field performance monitoring + embedment depth + binder characterization
    • 2013: ten 6616 sections + 20 new sections
    • 2014: 20 sections @ 1 yr + 10 new sections in 2 districts
    • 2015: 10 sections @ 1 yr + 20-25 new statewide sections
    • 2016: 20-25 statewide sections @ 1 yr
IMPLEMENTATION PROJECT

• Task 7 - Implement SPG in 2 Districts in 2014

• Task 8 – Finalize SPG Based on Feedback from TxDOT & Industry

• Task 9 – Implement Statewide in 2015, Estimate Economic Impact, & Document Implementation
THANK YOU