Statewide Implementation of the SPG Specification for Chip Seal Binders in Service

_TxDOT Implementation Project 5-6616_
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Tom Freeman, Jon Epps
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WASHTO
Subcommittee on Materials & Construction
OUTLINE

• Motivation & Objective

• Recommended SPG Specification

• Work Plan (Implementation Project Progress)

• The End of the World?
MOTIVATION & OBJECTIVE

• Increase performance and reduce cost

• Improve chip seal binder spec & selection
  – performance-related tests
  – @ temperatures that cover entire in service range for specific climate
  – consider aging during critical 1st year
  – reduce variability in grades
  – possibly adjust due to traffic

• Implement SPG in TX in 4 year, staged effort
  – Replace Seal Coat Binder Tier Selection Table & Item 300 Seal Coat Binder Properties in service
Asphalt Binder
Specification History
Classification of Asphalt Binders - HMA

3 classification systems
1. Penetration 1962 (-)
2. Viscosity 1972 (x)
3. Performance 1997 (SHRP Superpave)

historical development

-20 C Low pavement temp
25C Avg pavement temp
60C High pavement temp
135C Construction temp

Temperature

Long-term aging
Short-term aging
Original

Stiffness
2 classification systems
1. Penetration 1962 (-) 
2. Viscosity (1972) x
Classification of Asphalt Binders – Chip Seal Emulsions

1 classification systems
1. Penetration 1962 (-)
DEVELOPMENT OF SPG

• TxDOT Research Project 0-1710 (45 field sections)
• TxDOT Research Project 0-6616 (30 field sections)
• NCHRP Research Project 14-17 (3 field sections)
• SPG spec for chip seal binders *in service*
  – Method B for emulsion residue recovery
  – + shear strain sweep with new threshold
  – X m-value
  – MSCR not added
• SPG specification part of system to be used *with*
  – design guidelines
  – quality control procedures
  – construction techniques
## RECOMMENDED SPG w/AASHTO Standards

**with PP 72 Method B Recovery**

- **FP ≥ 230 by T 48**
- **RV ≤ 0.15 Pa*s @ 205°C by T 316**

<table>
<thead>
<tr>
<th>Performance Grade</th>
<th>SPG 67</th>
<th>SPG 70</th>
<th>SPG 73</th>
</tr>
</thead>
</table>

| Average 7-day Maximum Surface Pavement Design Temperature, °C | <67 | <70 | <73 |

### Original Binder

- **Dynamic Shear, T315**
  - $G*/\sin\delta$ Minimum: 0.65 kPa
  - Test Temperature @10 rad/s, °C

- **Shear Strain Sweep, T 315**
  - % strain @ 0.8$G^*$, Minimum: 17.5
  - Test Temperature @10 rad/s linear loading from 1-50% strain, 1 sec delay time with 20-30 measurements, °C

### Pressure Aging Vessel (PAV) Residue (AASHTO PP1)

- **PAV Aging Temperature, °C**
  - 100

<table>
<thead>
<tr>
<th>Creep Stiffness, T 313 S, Maximum: 500 MPa</th>
<th>-16</th>
<th>-19</th>
<th>-22</th>
<th>-25</th>
<th>-16</th>
<th>-19</th>
<th>-22</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Temperature @ 8s, °C</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dynamic Shear, T 315 G*, Maximum: 2.5 MPa</th>
<th>25</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Temperature @10 rad/s, °C</td>
<td></td>
</tr>
<tr>
<td>with AASHTO PP 72 Method B Recovery</td>
<td>Performance Grade</td>
</tr>
<tr>
<td>-----------------------------------</td>
<td>--------------------</td>
</tr>
<tr>
<td><strong>FP ≥ 230 by T 48</strong></td>
<td>SPG 70</td>
</tr>
<tr>
<td><strong>RV ≤ 0.15 Pa*s @ 205°C by T 316</strong></td>
<td>-16</td>
</tr>
<tr>
<td>Avg 7-day Max <strong>Surface</strong> Pavement T, °C</td>
<td>&lt;70</td>
</tr>
<tr>
<td>Min <strong>Surface</strong> Pavement T, °C</td>
<td>&gt;-16</td>
</tr>
</tbody>
</table>

- Method B for Emulsion Residue Recovery
  - Thin Film on Silicone Mat
  - 60 °C for 6 hrs
**RECOMMENDED SPG w/AASHTO Stnds**

<table>
<thead>
<tr>
<th>Performance Grade</th>
<th>SPG 70</th>
</tr>
</thead>
<tbody>
<tr>
<td>-16</td>
<td>-19</td>
</tr>
<tr>
<td>&lt;70</td>
<td></td>
</tr>
<tr>
<td>&gt;-16</td>
<td>&gt;-19</td>
</tr>
</tbody>
</table>

**Original Binder**

- \( G^*/\sin\delta \geq 0.65 \text{ kPa by T 315} \)
  - Test Temperature @ 10rad/s, °C
  - \( 70 \)

- \( 0.8G_i^* \geq 17.5\% \) strain by T 315
  - Test Temperature @ 10rad/s w/ 1-50%, °C
  - \( 25 \)

\( + \delta \leq 80 \) where \( G^*/\sin \delta = 0.65 \text{ kPa for UTI} \geq 89 \)
### RECOMMENDED SPG w/AASHTO Stnds

<table>
<thead>
<tr>
<th>Performance Grade</th>
<th>SPG 70</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-16</td>
</tr>
<tr>
<td></td>
<td>&lt;70</td>
</tr>
<tr>
<td></td>
<td>&gt;-16</td>
</tr>
</tbody>
</table>

### PAV Residue

<table>
<thead>
<tr>
<th>Condition</th>
<th>SPG 70</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S \leq 500$ MPa by T 313</td>
<td>-16</td>
</tr>
<tr>
<td>Test Temperature @ 8s, °C</td>
<td></td>
</tr>
<tr>
<td>$G^* \leq 2.5$ MPa by T 315</td>
<td>25</td>
</tr>
<tr>
<td>Test Temperature @10 rad/s, °C</td>
<td></td>
</tr>
</tbody>
</table>
WORK PLAN

• Conduct Technical Briefings w/TxDOT & Industry
  – User-Producer Group
  – Association of General Contractors (AGC) of TX
  – Texas Asphalt Pavement Association (TxAPA)
  – Industry
  – TxDOT

• Determine SPG Requirements in TX based on climate
  – Adjust based on traffic or service level ($T_{\text{high}}$) or other considerations ($T_{\text{low}}$)
• Determine SPG Grades & Monitor Performance near construction & @ 1-year (including embedment depth)
  – 2013 - 29 binders & 19 sections
  – 2014 - 16 binders & 14 sections & Shadow Spec
  – 2015 - ~20 sections in ≥ 2 districts
  – 2016 - ~15 sections statewide
2X 73-19
67-22
61-19

2X 73++-22
76-19
70-19
67-16
64-16

3X 73++-22++
3X 67-22++

70+-25++
70+-22++
73++-19++
70+-22++
67-25++

67+-22++
70+-22++
73++-22++
73+-28++
70+-28++
67-19++

+: exceeds requirement by 1 grade
++: exceeds requirement by > 1 grade
70+-31++
SPG Parameters Correlated to SCI Score (2013)

**G*/sin δ @ T_{high} correlated to SCI_{BL} (2013)**

- DSR High Temperature Limit
- G*/sin δ = 0.65 kPa

**Stiffness @ T_{low} correlated to SCI_{AL} (2013)**

- BBR Low Temperature Limit
- S = 500 MPa

Green: Pass
Red: Fail
Yellow: Tentatively Pass
δ @ Interpolated Continuous SPG Grade

Suggested Phase Angle Threshold = 80°

Red: Unmodified Binders
Blue: Modified Binders

Highway Sections (HS)
WORK PLAN

• Verify SPG
  – Validate that PAV simulates critical 1st year
  – Review 10 uncorrelated (lab ≠ field) 0-6616 sections
    • Validated critical 1st year field performance

• Revise SPG
  – Consider 3°C vs 6°C increments, single maximum surface temperature, & traffic effects
  – Further explore exclusive use of DSR w/predicted low temperature property & LAS for intermediate temperature
  – Add high temperature property & threshold to ensure modification = \( \delta \leq 80 \) @ continuous \( T_H \) for UTI \( \geq 89 \)
  – Verify thresholds
## Project Research and Project Samples Tested as SPG (< summer 2013)

<table>
<thead>
<tr>
<th>Current Grade</th>
<th>Surface Performance Grade of Multiple Project Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC-20-5TR</td>
<td>67-16 70-13 70-16 70-19 73-16 73-19 76-16 79-19</td>
</tr>
<tr>
<td>CRS-2</td>
<td>64-10 67-13</td>
</tr>
<tr>
<td>CRS-2P</td>
<td>70-10 76-16 79-16</td>
</tr>
<tr>
<td>AC-10</td>
<td>61-19 64-16 64-19</td>
</tr>
<tr>
<td>AC-15P</td>
<td>70-19 73-13 73-19 73-22</td>
</tr>
</tbody>
</table>

Current specifications allow a significantly wide variation in properties, enough for multiple proposed SPG grade binders. Data from Research Project and Implementation Efforts
## AC-SPG Summary 2013 Samples

<table>
<thead>
<tr>
<th>AC Grade</th>
<th>SPG</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC-10</td>
<td>61-13, 61-19</td>
</tr>
<tr>
<td>AC-10-2TR</td>
<td>64-16, 67-16, 67-19, 67-22, 70-28</td>
</tr>
<tr>
<td>AC-15P</td>
<td>67-25, 70-28, 70-31, 73-25</td>
</tr>
<tr>
<td>AC-20-5TR</td>
<td>70-22, 70-25, 73-19, 73-22, 73-25, 76-19</td>
</tr>
<tr>
<td>AC-20XP</td>
<td>73-19</td>
</tr>
<tr>
<td>AR</td>
<td>79-25</td>
</tr>
</tbody>
</table>
WORK PLAN

• Modify SPG based on feedback from TxDOT districts & briefings

• Document effort including estimated economic impact of implementation
How am I going to get my polymer?

• Rule of 89
  – If Temperature Spread > 89°C
  – Phase Angle (δ) < 80°
    (at the temperature where $G^*/\sin \delta = 0.65$)
How would I call for a material using the Spec?
Possible SPG Grades

- SPG 73-25
- SPG 70-19
- SPG 67-16
- SPG 64-25
- CRS-2(SPG 73-25)
- CRS-2(SPG 70-19)
- HFRS-2(SPG 67-16)
- CHFRS-2(SPG 64-25)
Effects of SPG Specification

Like the REM song says, is it:

“The End of the World as We Know It?”
NO!

• Select Binders based on Climate
• Modify Climate Grade based on traffic or other considerations
• Can select hot applied or emulsion (both would have to meet the same binder or emulsion residue properties)
Effects of SPG Specification

- Every material will meet some grade.
- SPG is a tighter spec and we will get less variability.
- Current higher performing binders will still be higher performing binders – we will have a way to say they are higher performing.
- Current Tier Table is replaced by a better system based on performance.
Effects of SPG Specification

• Remember the rest of that REM verse:

   It’s the End of the World As We Know It, AND I FEEL FINE.
THANK YOU
BACKUP
SPG Binder Specification
2004---300-054
2014---300-001
<table>
<thead>
<tr>
<th>Surface Performance Grade</th>
<th>SPG 64</th>
<th>SPG 67</th>
<th>SPG 70</th>
<th>SPG 73</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average 7-day Max pavement surface design temperature, °C</td>
<td>-25</td>
<td>-13</td>
<td>-19</td>
<td>-22</td>
</tr>
<tr>
<td>Min pavement surface design temperature, °C</td>
<td>&gt;-25</td>
<td>&gt;-13</td>
<td>&gt;-19</td>
<td>&gt;-22</td>
</tr>
</tbody>
</table>

**Original Binder**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Flash point temp, T 48, Min, °C</td>
<td>230</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity, T 316: Max 0.15 Pa*s, test temp., °C</td>
<td>205</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Original Performance Properties**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic Shear, T 315: G*/sind, Min 0.65 kPa, Test temp @ 10 rad/s, °C</td>
<td>64</td>
<td>67</td>
<td>70</td>
</tr>
<tr>
<td>Shear Strain Sweep, T 315: % strain @ 0.8 G*, Min: 17.5 MPa Test temp. @ 10 rad/s linear loading from 1–50% strain, 1 sec. delay time with measurement of 20–30 increments, °C</td>
<td>25</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Phase angle ($\theta$), Max, @ temp. where G*/sind = 0.65 kPa</td>
<td>80</td>
<td>–</td>
<td>80</td>
</tr>
</tbody>
</table>

**Pressure Aging Vessel (PAV) Residue (R 28)**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PAV aging temperature, °C</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Creep stiffness, T 313: S, Max 500 MPa, Test temp. @ 8 sec., °C</td>
<td>-25</td>
<td>-13</td>
<td>-16</td>
</tr>
<tr>
<td>Shear Strain Sweep, T 315 G*, Max: 2.5 MPa Test temp. @ 10 rad/s linear loading at 1% strain, 1 sec. delay time, °C</td>
<td>25</td>
<td>25</td>
<td>25</td>
</tr>
</tbody>
</table>

1. Temperatures are at the surface of the pavement structure. These may be determined from experience or may be estimated using equations developed by SHRP or LTPP, but modified to represent surface temperatures. Surface-grade high temperatures are generally 3°C to 4°C greater than those determined for Superpave PG binders.

2. The referee method will be AASHTO T 316 using a #21 spindle at 50 r/min, however alternate methods may be used for routine testing and quality assurance.

3. Phase angle is determined at the temperature where G*/sind = 0.65 kPa. For routine testing and quality assurance, the phase angle can be interpolated from testing at two temperatures, one above and one below where G*/sind = 0.65 kPa.
# Table 7A
## Surface Performance-Grade Emulsified Asphalt

<table>
<thead>
<tr>
<th>Grade</th>
<th>Test Procedure</th>
<th>HFRS-2(SPG xy)</th>
<th>CRS-2(SPG xy)</th>
<th>CHFRS-2(SPG xy)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Min</td>
<td>Max</td>
<td>Min</td>
</tr>
<tr>
<td>Tests on emulsions:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Viscosity, Saybolt Furol at 50°C, SFs(^2)</td>
<td></td>
<td>T 72</td>
<td>150</td>
<td>400</td>
</tr>
<tr>
<td>Storage stability test, 24 h., %(^2)</td>
<td></td>
<td>T 59</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Demulsibility, 35 mL, 0.02 N CaCl(_2), %</td>
<td></td>
<td>T 59</td>
<td>60</td>
<td></td>
</tr>
<tr>
<td>Demulsibility, 35 mL, 0.8% dioctyl sodium sulfo succinate, %</td>
<td></td>
<td>T 59</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Particle charge test</td>
<td></td>
<td>T 59</td>
<td>positive</td>
<td>positive</td>
</tr>
<tr>
<td>Sieve test, %(^2)</td>
<td></td>
<td>T 59</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Residue recovery</td>
<td></td>
<td>PP 72, Procedure B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residue, %</td>
<td></td>
<td>65</td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td>Tests on recovered residue:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residue properties</td>
<td></td>
<td></td>
<td>Meet the specified SPG in Table 17A(^3)</td>
<td></td>
</tr>
<tr>
<td>Solubility in trichloroethylene, %</td>
<td></td>
<td>T 44</td>
<td>97.5</td>
<td>97.5</td>
</tr>
<tr>
<td>Float test, 60°C, sec.(^4)</td>
<td></td>
<td>T 50</td>
<td>1,200</td>
<td></td>
</tr>
</tbody>
</table>

1. \(X\) is the average 7-day maximum pavement surface design temperature, and \(y\) is the minimum pavement surface design temperature used in Table 17A.
2. This test requirement on representative samples is waived if successful application of the material has been achieved in the field.
3. Meet original performance properties and PAV residue requirements only
4. If Float test is less than 1,200 sec. using PP 72, Procedure B, for residue recovery, then use T 59 for residue recovery.
TxDOT 0-6747

- WFS 2012
- SPG 67-19 required by climate
- $\delta @ T_{\text{high}} \sim 90$ for AC10s

<table>
<thead>
<tr>
<th>Binder</th>
<th>Field Performance</th>
<th>SPG High Temperature Grade</th>
<th>AADT</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC10</td>
<td>Good</td>
<td>64</td>
<td>270</td>
</tr>
<tr>
<td>AC10</td>
<td>Bleeding</td>
<td>64</td>
<td>460</td>
</tr>
<tr>
<td>AC10</td>
<td>Bleeding</td>
<td>64</td>
<td>690</td>
</tr>
<tr>
<td>AC10-2TR</td>
<td>Good</td>
<td>64</td>
<td>840</td>
</tr>
<tr>
<td>AC10-2TR</td>
<td>Bleeding</td>
<td>64</td>
<td>1350</td>
</tr>
<tr>
<td>AC10-2TR</td>
<td>Bleeding</td>
<td>64</td>
<td>2300</td>
</tr>
<tr>
<td>AC10-2TR</td>
<td>Bleeding</td>
<td>64</td>
<td>3300</td>
</tr>
</tbody>
</table>
SPG Parameters Correlated to SCI Score (2011)
SPG Parameters Correlated to SCI Score (2013)

1. \( \frac{G^*}{\sin \delta} @ T_{\text{high}} \) correlated to SCI\(_{\text{BL}}\)
   - DSR High Temperature Limit
   - \( G^* \sin \delta = 0.65 \text{kPa} \)

2. Stiffness @ \( T_{\text{low}} \) correlated to SCI\(_{\text{AL}}\)
   - Green: Pass\(_{\text{field}}\)
   - Red: Fail\(_{\text{field}}\)
   - Yellow: Tentatively Pass\(_{\text{field}}\)
   - BBR Low Temperature Limit
   - 8–500 MPa

3. \( \% \gamma \) at 0.80\( G^* \) @ 25°C correlated to SCI\(_{\text{AL}}\)
   - Green: Pass\(_{\text{field}}\)
   - Red: Fail\(_{\text{field}}\)
   - Yellow: Tentatively Pass\(_{\text{field}}\)
   - Strain Sweep Limit
   - \( \% \gamma @ 0.80G^* = 17.5\%

4. \( G^* @ 25\text{C} \) (PAV-aged) correlated to SCI\(_{\text{AL}}\)
   - Green: Pass\(_{\text{field}}\)
   - Red: Fail\(_{\text{field}}\)
   - Yellow: Tentatively Pass\(_{\text{field}}\)
   - Shear Strain Limit
   - \( G^* \geq 0.5 \text{MPa} \)

Highway Sections:
- AMA-a
- AMA-b
- AMA-c
- AMA-d
- ATL-a
- ATL-b
- CBP-a
- CBP-c
- SIT-a
- SIT-a
- SIT-b
- SIT-c
- YLI-a
SPG Parameters Correlated to SCI Score

1. $G^*/\sin \delta @ T_{high}$ correlated to SCI
   - DSR High Temperature Limit: $G^*/\sin \delta \approx 0.65 \text{kPa}$
   - Green: Pass\text{field}
   - Red: Fail\text{field}
   - Yellow: Tentatively Pass\text{field}

2. Stiffness @ $T_{low}$ correlated to SCI
   - BBR Low Temperature Limit: $500 \text{MPa}$
   - Green: Pass\text{field}
   - Red: Fail\text{field}
   - Yellow: Tentatively Pass\text{field}

3. %$\gamma$ at $0.8G^*$ @ 25°C correlated to SCI
   - Strain Sweep Limit: %$\gamma$ at $0.8G^* = 17.5$
   - Green: Pass\text{field}
   - Red: Fail\text{field}
   - Yellow: Tentatively Pass\text{field}

4. $G^*$ @ 25°C (PAV-aged) correlated to SCI
   - Shear Strain Limit: $G^* = 2.5 \text{MPa}$
   - Green: Pass\text{field}
   - Red: Fail\text{field}
   - Yellow: Tentatively Pass\text{field}
Exclusive Use of DSR - Prediction of BBR Stiffness

stiffness comparison @ 8s loading time

stiffness comparison @ -13°C and -16°C

stiffness comparison @ -19°C and -22°C

stiffness comparison @ -25°C and -28°C
## RESULTS

<table>
<thead>
<tr>
<th>AMA AC20-5TR(73-19)</th>
<th>BBR-measured stiffness (Mpa)</th>
<th>SHRP Back-calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>-19°C</td>
</tr>
<tr>
<td>-19°C</td>
<td>303</td>
<td>296</td>
</tr>
<tr>
<td>-22°C</td>
<td>511</td>
<td>443</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CRP AC20-5TR(70-31)</th>
<th>BBR-measured stiffness (Mpa)</th>
<th>SHRP Back-calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>-31°C</td>
</tr>
<tr>
<td>-25°C</td>
<td>268</td>
<td>38</td>
</tr>
<tr>
<td>-28°C</td>
<td>405</td>
<td>64</td>
</tr>
<tr>
<td>-31°C</td>
<td>478</td>
<td>106</td>
</tr>
<tr>
<td>-34°C</td>
<td>573</td>
<td>173</td>
</tr>
</tbody>
</table>
4-mm DSR

Predicted vs. Measured Stiffness (MPa)-4mm DSR

- CRP AC 20-5TR (-21°C)
- AMA AC20-5TR (-19°C)

\[ y = 0.6667x + 147.31 \]

\[ R^2 = 0.8698 \]
# LAS Test Results

## Shear Strain Sweep

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<tr>
<th></th>
<th>%<a href="mailto:strain@0.8G">strain@0.8G</a>&lt;sub&gt;i&lt;/sub&gt;</th>
<th>%strain@peak stress</th>
<th>%<a href="mailto:strain@0.8G">strain@0.8G</a>&lt;sub&gt;i&lt;/sub&gt;</th>
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<tbody>
<tr>
<td>WAC AC20-5TR</td>
<td>18.44</td>
<td>15.82</td>
<td>5.98</td>
</tr>
<tr>
<td>TYL AC20-5TR</td>
<td>18.58</td>
<td>15.42</td>
<td>5.8</td>
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</tbody>
</table>

## Linear Amplitude Sweep

Linear Amplitude Sweep for WAC AC20-5TR @25°C

- Complex shear stress (Pa)
- Shear modulus (complex component) (kPa)

Linear Amplitude Sweep for TYLAC20-5TR @25°C

- Complex shear stress (Pa)
- Shear modulus (complex component) (kPa)
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
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
## Presentations & Publications

<table>
<thead>
<tr>
<th>Presentations</th>
<th>Publications</th>
</tr>
</thead>
<tbody>
<tr>
<td>3rd Symposium on Binder Rheology &amp; Pavement Performance - 2002</td>
<td>TRR Catalog of Practical Papers - 2002</td>
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<tr>
<td>Transportation Systems Workshop - 2012</td>
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δ @ interpolated continuous SPG grade

Average Phase Angle @ interpolated continuous SPG grade for each type of binders

<table>
<thead>
<tr>
<th>Binder Type</th>
<th>Phase Angle (°)</th>
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<tbody>
<tr>
<td>AC10</td>
<td>90</td>
<td>2</td>
</tr>
<tr>
<td>AC10-2TR</td>
<td>80</td>
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<tr>
<td>AC15P</td>
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<td>AC20XP</td>
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<td>AC20-5TR</td>
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<tr>
<td>A-R TYPEII</td>
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