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

TxDOT Implementation Project 5-6616

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OUTLINE

- Motivation & Objective
- Recommended SPG Specification
- Work Plan (Implementation Project Progress)
- The End of the World.

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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 Selection Table & Item 300 Seal Coat binders

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Asphalt Binder Specification History

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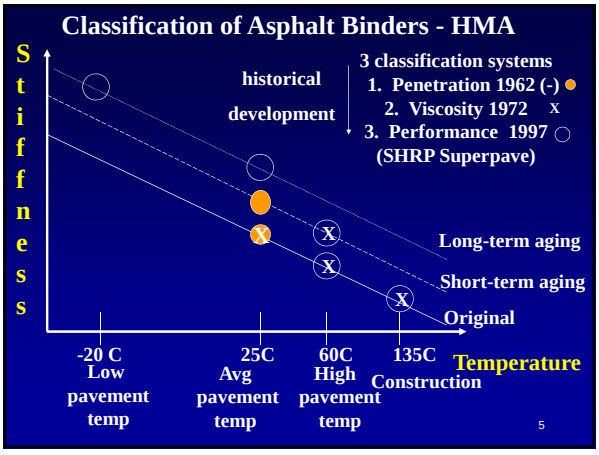
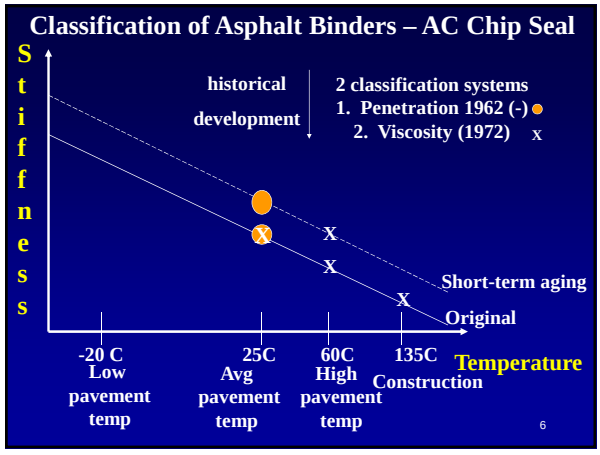
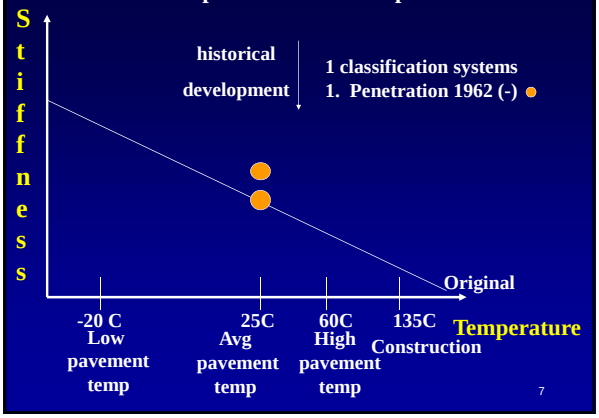




Classification of Asphalt Binders – Chip Seal Emulsions



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

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RECOMMENDED SPG

with AASHTO PP 72-11 Method B	Performance Grade											
	SPG 64				SPG 67				SPG 70			
	-13	-16	-19	-22	-16	-19	-22	-25	-22	-25	-28	-31
Average 7-day Maximum Surface Pavement Design Temperature, °C	<64				<67				<70			
Minimum Surface Pavement Design Temperature, °C	>-13	>-16	>-19	>-22	>-16	>-19	>-22	>-25	>-22	>-25	>-28	>-31
Original Binder												
Dynamic Shear, AASHTO TP5 G*/Sinδ Minimum: 0.65 kPa Test Temperature @10 rad/s, °C								67				
Shear Strain Sweep % strain @ 0.8Gi*, 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								25				
Pressure Aging Vessel (PAV) Residue (AASHTO PP1)												
PAV Aging Temperature, °C					100				100			
Creep Stiffness, AASHTO T 313/ASTM D6648 S, Maximum: 500 MPa Test Temperature @ 8s, °C	-13	-16	-19	-22	-16	-19						
Shear Strain Sweep Gi*, Maximum: 2.5 MPa Test Temperature @10 rad/s linear loading at 1% strain and sec delay time, °C								25				

RECOMMENDED SPG

with AASHTO PP 72-11 Method B	Performance Grade SPG 67			
	-16	-19	-22	-25
Avg 7-day Max Surface Pavement T, °C	<67			
Min Surface Pavement T, °C	>-16	>-19	>-22	>-25

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

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RECOMMENDED SPG

	Performance Grade SPG 67			
	-16	-19	-22	-25
	<67			
	>-16	>-19	>-22	>-25
Original Binder				
G*/Sinδ ≥ 0.65 kPa Test Temperature @ 10rad/s, °C	67			
0.8Gi* ≥ 17.5% strain Test Temperature @ 10rad/s w/ 1-50%, °C	25			

+ δ ≤ 80 where G/sin δ = 0.65 kPa for UTI ≥ 89*

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RECOMMENDED SPG

	Performance Grade SPG 67			
	-16	-19	-22	-25
	<67			
	>-16	>-19	>-22	>-25
PAV Residue				
S ≤ 500 MPa Test Temperature @ 8s, °C	-16	-19	-22	-25
Gi* ≤ 2.5 MPa Test Temperature @10 rad/s, 1% strain, °C	25			

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SPG Binder Specification
2004---300-054
2014---300-001

Table 17A
Surface Performance Grade (SPG) Specification

Surface Performance Grade	SPG 64	SPG 67					SPG 70					SPG 73				
	-25	-13	-16	-19	-22	-25	-13	-16	-19	-22	-25	-13	-16	-19	-22	25
Average 7-day Max pavement surface design temperature[1], °C	<64	<67					<70					<73				
Min pavement surface design temperature[1], °C	>-25	>-13	>-16	>-19	>-22	>-25	>-13	>-16	>-19	>-22	>-25	>-13	>-16	>-19	>-22	>-25
Original Binder																
Flash point temp, T 48, Min, °C	230															
Viscosity, T 316: Max 0.15 Pa*s, test temp., °C	205															
Original Performance Properties																
Dynamic Shear, T 315: G*/sind, Min 0.65 kPa, Test temp @ 10 rad/s, °C	64	67					70					73				
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 20–10 increments, °C	25	25					25					25				
Phase angle[2] (d), Max, @ temp. where G*/sind = 0.65 kPa	80	–	–	–	80	80	–	–	80	80	80	–	80	80	80	80
Pressure Aging Vessel (PAV) Residue (R 28)																
PAV aging temperature, °C	100	100					100					100				
Creep stiffness, T 313: S, Max 500 MPa, Test temp. @ 8 sec., °C	-25	-13	-16	-19	-22	-25	-13	-16	-19	-22	-25	-13	-16	-19	-22	-25
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	25	25					25					25				

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

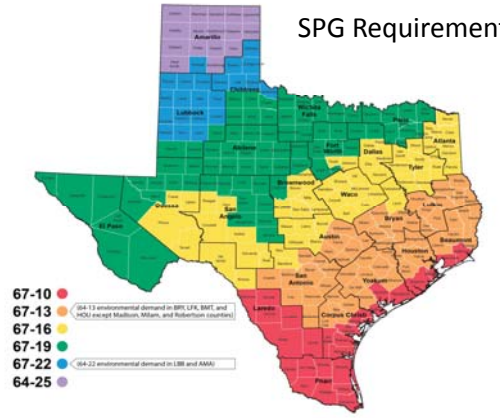
Grade	Test Procedure	HFRS-2(SPG xy[1])		CRS-2(SPG xy)		CHFRS-2(SPG xy)	
		Min	Max	Min	Max	Min	Max
Tests on emulsions:							
Viscosity, Saybolt Furol at 50°C, SFs[2]	T 72	150	400	150	400	150	400
Storage stability test, 24 h., %[2]	T 59		1		1		1
Demulsibility, 35 mL, 0.02 N $CaCl_2$, %	T 59	60					
Demulsibility, 35 mL, 0.8% dioctyl sodium sulfosuccinate, %	T 59			60		60	
Particle charge test	T 59			positive		positive	
Sieve test, %[2]	T 59		0.10		0.10		0.10
Residue recovery	PP 72, Procedure B						
Residue, %		65		65		65	
Tests on recovered residue:							
Residue properties		Meet the specified SPG in Table 17A[3]					
Solubility in trichloroethylene, %	T 44	97.5		97.5			
Float test, 60°C, sec.[4]	T 50	1,200				1,200	

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

WORK PLAN

- Conduct Technical Briefings w/TxDOT & Industry
- Determine SPG Requirements in TX based on climate
  - Adjust based on traffic
  - Other considerations

SPG Requirements



WORK PLAN

- Determine SPG Grades & Monitor Performance near construction & @ 1-year (including embedment depth)
  - 2013 - 30 binders & 26 sections
  - 2014 - ~25 sections & Plan Note
  - 2015 - ~20 sections in ≥ 2 districts
  - 2016 - ~15 sections statewide

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 ≥ 89
  - Verify thresholds

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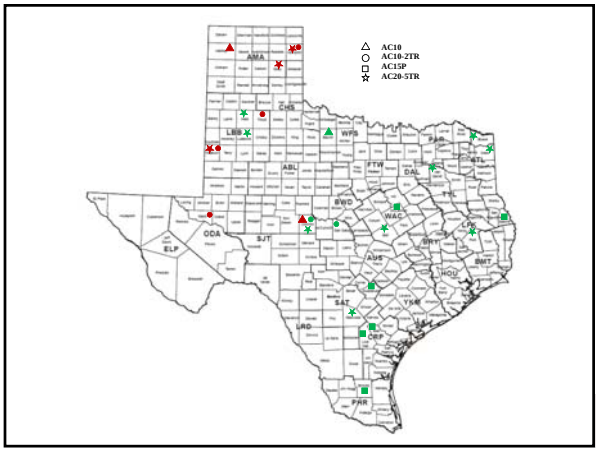
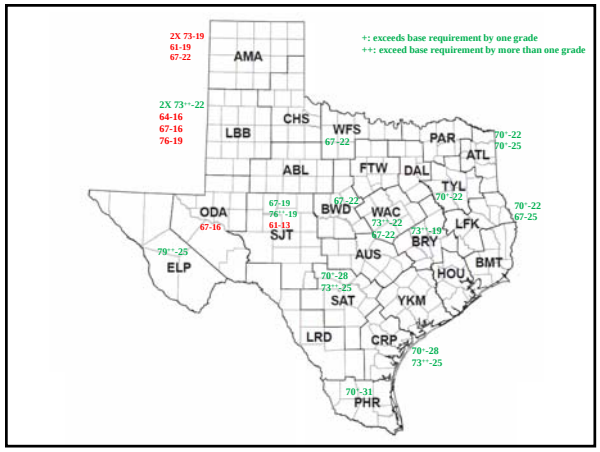
Project Research and Project Samples Tested as SPG (< summer 2013)

Curent Grade	Surface Performance Grade of Multiple Project Samples							
AC-20-5TR	67-16	70-13	70-16	70-19	73-16	73-19	76-16	79-19
CRS-2	64-10	67-13						
CRS-2P	70-10	76-16	79-16					
AC-10	61-19	64-16	64-19					
AC-15P	70-19	73-13	73-19	73-22				

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

Footer Text





AC-SPG Summary 2013 Samples

AC Grade	SPG
AC-10	61-13, 61-19
AC-10-2TR	64-16, 67-16, 67-19, 67-22, 70-28
AC-15P	67-25, 70-28, 70-31, 73-25
AC-20-5TR	70-22, 70-25, 73-19, 73-22, 73-25, 76-19
AC-20XP	73-19
AR	79-25

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WORK PLAN

- Modify SPG based on feedback from TxDOT districts & briefings
- Document effort including estimated economic impact of implementation

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How am I going to get my polymer?

- Rule of 89
  - If Temperature Spread > 89C
  - Phase Angle (δ) < 80 °
    (at the temperature where G*/sin δ = 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?"

Effects of SPG Specification

I would say NO!

- Select Binders based on Climate
- Modify Climate Grade based on traffic or other considerations.
- Can set hot applied versus 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.
- Tiered System "as we know it" goes away for a better tiered 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.

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THANK YOU

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