# Emulsion Task Force Update

PPETG
Emulsion Task Force Meeting
May 2-3, 2011

Colin Franco & Roger Hayner  Co-Chairman

# Emulsion Task Force Update

- Subcommittee's Breakout Session 5-2-11
  - Roger Hayner  gave an overview of the ETF
  - Subcommitte Meetings

# ETF Review & Update of Purpose of PPETG & ETF

Presented by Colin Franco, RI DOT

- Background:
  - PPETG parent group of "Emulsion Task Force"
  - Idea conceived in February 2008 under guidance of Jim Sorenson, FHWA
  - Identified need for industry expertise and involvement in on going research activities pertaining to asphalt emulsions and finished product systems
  - First meeting in April 2008

# ETF Review & Update of Purpose of PPETG & ETF

## Task Force Representation

- Members from
  - Industry: AEMA/ARRA/ISSA
  - Academics: CSU/TX A&M/U.Wisc./Cal State/ NC State
  - State DOT's: TX, IA, UT, RI, CA, LA
  - FHWA
  - National Center PP (NCPP)

# Subcommitee's

- **<u>Emulsion Testing & Residue Recovery Methods</u>**
  - Arlis Kadrmas – Chairman
  - Paul Morris
  - Laurand Lewandowski
  - Chris Lubbers
  - Roger Hayner
  - Barry Baughman
  - Gayle King
  - Hussain Bahia
  - Ammy Epps Martin

# Subcommitee's

- **Aggregate, Mix Design, Performance Testing, Cold Mix, Patching Mix and Emulsion Stabilization**
  - Gary Hicks – Co-Chairman
  - Jim Moulthrop – Co-Chairman
  - Hussein Bahia
  - Scott Schuler
  - Gayle King
  - Chris Lubbers
  - Laurand Lewandowski
  - Jack Youtcheff
  - Barry Baughman

# Subcommitte's

- **Approved Suppliers Certification**
  - Roger Hayner – Chairman
  - Arlis Kadrmas
  - Colin Franco
  - Chris Abadie
  - Kevin Van Frank
  - Jim McGraw
  - Asphalt *Institute Rep.*

# Subcommittee's

- **Inspection & Acceptance**
  - Colin Franco – Chairman
  - Roger Hayner
  - Delmar Salomon
  - Cris Abadie
  - Tom Wood

# Subcommittee's

- **Tack Coat, Fog Seals, Rejuvenating Seals Review (formed 7-26-10)**
  - Chris Abadie – Chairman
  - Gayle King
  - Mike Voth
  - Hussein Bahia
  - Roger Hayner

# Subcommittee's

- **Recycling & Stabilization Emulsions**

  (Formed 5-2-11)

  - Dragos Andrei
  - Steve Cross
  - Todd Thomas
  - Roger Hayner
  - Gary Hicks
  - Steve Muncy
  - Gerry Reinke
  - Blair Barnhardt

# ETF Review & Update of Purpose of PPETG & ETF

## Original Scope

- Review needs for Preservation Materials Research – Emulsions & Aggregates
- Evaluate existing R&D Roadmap Problem Statements in Area of Emulsions
- Evaluate Work Plans and Review Ongoing Research in PP Emulsion
- Coordinate and Share Activities and Results with Existing Superpave binder/mix/modeling ETG's

# ETF Review & Update of Purpose of PPETG & ETF

## Original Scope (cont)

- Facilitate adoption of New Findings and Research Results Through Appropriate AASHTO / ASTM Channels
- AEMA / ISSA / ARRA Coordination

# ETF Review & Update of Purpose of PPETG & ETF

## Original Scope Deliverables

- **Advance the Effort to Develop Performance Based Methods & Specifications for Emulsions**
  - Protocol for Design
  - Protocol for Performance
  - Protocol for Inspection & Acceptance

- **Encourage Adoption of Uniform National Standards**

# Residue Recovery & Testing Methods Update

Presented by Arlis Kadrmas

- Worked off Strawman Specification
- Recovery Method – Method B Standard Method - Thin Film at 6 hours at 60 C. Continue to look at shorter times (3 hrs) Residue similar to base?
  - Continue to discuss & evaluate alternative methods (DSR, Freeze Dry etc)
- High Float Discussion –Rheological testing to do away with float test, while still identifying properties of the emulsion
- Emulsion Viscosity - How important is field Viscosity? Include in Approved Suppliers Certification

# Residue Recovery & Testing Methods Update

- DSR/MSCR Testing
  - Original DSR Testing to remain the same
  - MSCR Testing (Th and Th-6)
  - Low Temperature
    - 4mm plate (Temp Sweep peak in G")
- PAV Aging
  - Effect of gradation
  - Carbonyl Data on Samples
- Sweep Test Discussion
  - Formulation vs. Field Testing

# Residue Recovery & Testing Methods Update

PLANS

- Emulsion Viscosity to Approved Supplier Certification
- Wyoming Field Emulsion Viscosity Test to AASHTO
- Add T h-6 to MSCR
  - Discussed relevance of 1000 kPa at Th and the Th-12

# Residue Recovery & Testing Methods Update

**GOALS**

- Pass along information and guidance to NCHRP 9-50 Group
- Suppliers to verify Strawman testing where necessary
  - DSR Stress Sweep (High Temperature)
  - DSR Frequency Sweep (Low Temperature)
  - Emulsion Viscosity comparison
- Revise Strawman
  - Conference calls to discuss changes as soon as possible

# Aggregate, Mix Design, Cold Mix, Patching Mix, Emulsion Stabilization and Performance Tests

Presented by Garry Hicks, new Co-chairman

- Limited Past activity
- **OBJECTIVES FOR 2011**
  - Summarize the current state-of-the-art from literature related to chip seals and slurry surfacing
  - Review:
    - Mix Design processes
    - Performance tests
    - Specification that represent the current best practices concepts
  - Identify areas of needed research to improve the recommended specifications

# Aggregate, Mix Design, Cold Mix, Patching Mix, Emulsion Stabilization and Performance Tests

## Plans for 2011

- Finalize the membership of the group
- Clarify the subgroup activities
  - Chip Seals
  - Slurry Surfacing
  - Emulsion Mixes
- Develop a work plan for the group
- Identify clear deliverables

# Approved Suppliers Certification

Presented by Roger Hayner

- Submitted to ASSHTO for ballot
- Comments:
  - Test within 48 hours of taking sample
  - Agency & Supplier must have QC plan in place to ship
  - Test tolerances not to be included. ETF will develop in future.
  - ASSHTO Accreditation – up to individual states
  - Ballot to be submitted this fall.

# Inspection & Acceptance

Presented by Colin Franco, RI DOT

Quality Assurance

- Agencies write specification to describe what they want
- Contractor meet Specification
- Contractor QC Testing – Ensure process is in compliance
- Independent Assurance
- State test to verify they receiving Product they want.

Plans:

- Test Methods: 6 methods to be reviewed and submitted by end of month.

# Tack Coat, Fog Seals, Rejuvinating Seals Review

Presented by Michael Voth, FHWA Federal Lands

Issues:

- Test Methods
  - Standardization of Bond Strength Test (simple shear and others) through AASHTO / ASTM
  - Need to research and define emulsion residue properties that affect bond performance
- Procurement Specifications
  - Pre-qualification of products
  - Uniformity of specifications across regions/states
  - Paying for tack: incidental or separate pay item?
  - Propriety products: balancing innovation and the need for competition

# Tack Coat, Fog Seals, Rejuvinating Seals Review

Issues:

- Construction
  - Application Rates
    - Road surface type (new, old, milled)
    - Thickness of overlay
    - Type of mix
    - Properties of tack material
  - Cost-benefit: need for bond on “thinner” vs. “thicker” overlays
    - Less than 1” – critical
    - Greater than 1” - important

# Tack Coat, Fog Seals, Rejuvinating Seals Review

## Goals - Short Term

Goal: Data Gathering – Develop a concise state of practice

## Plans – Short Term

Plans:

- Review Louisiana/NCHRP study, including state survey
- Ask for survey updates via AASHTO list-serve (which states are actively pursuing)
- Review research and implementation by Florida, Virginia, and others

# Tack Coat, Fog Seals, Rejuvinating Seals Review

## Goals - Short Term

Goal: Support development of draft AASHTO test method(s) for bond strength

## Plans – Short Term

Plans:

- Review Methods developed by NCAT , Florida, Road Science and others entities
- Promote/Assist with the write-up of a draft method

# Tack Coat, Fog Seals, Rejuvinating Seals Review

## Goals - Long Term

Goal: Address procurement and specification issues

Goal: Address construction issues

## Plans – Long Term

Plans:

- Leverage information from data gathering effort
- Prioritize issues
- As applicable, promote best practice
- As applicable, create pool fund study

# Tack Coat, Fog Seals, Rejuvinating Seals Review

## Goals - Long Term

Goal: Promote/Lead research to define performance related tack coat residue properties (and how to measure)

## Plans – Long Term

Plans:

- Pooled fund study
- NCHRP study
- Other sources

# Recycling & Stabilization Emulsions

Presented by Dr. Steve Cross

- Scope: Use of Emulsions in  Recycling and Stabilization
- Committee needs work Plan & Goal to make progress
- Need to communicate between meetings
- Need to stimulate our agencies & companies to support research
- Need to get support for funded support
- Challenge to Chairman & Committee

# Review of Chip Seal Research at NCSU

Presented by Dr. Richard Kim, NC State University

**PP Goals At NCSU**

- Develop & introduce more advance and performance based test and analysis methods to specification, design, and construction of pavement preservation treatments (PPT)
- Improve the performance of PPT by refining current and development new materials and construction techniques
- Extend the application of PPT to higher volume roads

# Review of Chip Seal Research at NCSU

## Pavement Preservation Projects at NCSU

Completed:

- Optimizing Gradation for Surface Treatments (HWY-2004-04)-**Aggregate**
- Qualifying the Benefits of Improved Rolling of Chip Seals (HWY-2006-06)-**Rolling**
- Performance Based Analysis of Polymer Modified Emulsions in Bituminous Surface Treatment (HWY-2007-06)-**Emulsion**
- Development of a New Chip Design Method (HWY-2009-01) **Performance Related Mix Design**

# Review of Chip Seal Research at NCSU

## Pavement Preservation Projects at NCSU

Ongoing:

- Development of a field Testing System for Asphalt Surface Treatment (HWY-2009-01) **Field QC Test**
- Fog Seal Effectiveness for Bitumen Surface Treatments (HWY-2010-02)-**Fog Seal**
- Extending the Use of Chip Seal to High Volume Roads by Using Polymer Modified Emulsions and Optimize Construction Procedures (HWY-2011-03)-**High Volume Application**

# Test Methods Developed at NCSU

| Test | Location | Performance Properties |
|---|---|---|
| MMLS3 Test | Lab | Aggregate retention, Bleeding |
| Laser Profiling Test | Lab, Field | Surface texture, Aggregate embedment depth |
| Surface Digital Imaging Test | Lab, Field | Bleeding evaluation |
| Crosssectional Digital Imaging Test | Lab | Surface texture, Aggregate embedment depth |
| Modified Sweep Test | Lab | Aggregate retention |

# Key Implementation Points

***Aggregate***

- Importance of uniform gradation (PUC as the specification)
- Fine content less than 1.5%

***Emulsion***

- Use of polymer modified emulsion strongly recommended
  - Excellent aggregate retention, bleeding, rutting, and low temperature performance of polymer-modified chip seals
- LCCA shows PME to be cost effective on condition that the service life of the PME is two years longer than that of an unmodified chip seal.

# Key Implementation Points – Cont'd

***Rolling***

- Pneumatic tire roller and combination roller recommended
- Optimal number of rolling coverage of three
- No rolling required for the bottom layer of triple seal
- Recommended Rolling Protocols:
  - Two roller case: Two combination rollers side-by-side
  - Three roller case: Two pneumatic tire rollers side-by-side followed by one combination roller

# Key Implementation Points – Cont'd

***Mix Design***

- AAR from the modified board test (305 mm by 508 mm board) – minimum three replicates
  - Traffic whip off factor
  - Wet aggregate
- Laser profiler to determine EAR using the 50% initial embedment depth
  - Aggregate absorption
  - Absorption into existing pavement surface

# Update on NCHRP 09-50 Project "Performance Specification for Binders in Chipseals"

- Emulsion Task Force wants to be involved
- Waiting on contract to be awarded
- More information to come

# A Brief Summary of the Results from NCHRP 14-17 "Manual for Emulsion-Based Chip Seals for Pavement Preservation"

Presented by Dr. Scott Schuler, Colorado

Objective: Replacing 'Art' with Science

- Turning Traffic Loose/Sweeping
- Surface Texture
- Surface Resistance
- Correct Emulsion on Job?

## A Brief Summary of the Results from NCHRP 14-17 "Manual for Emulsion-Based Chip Seals for Pavement Preservation"

Conclusions:

- The amount of water remaining in the chip seal (emulsion, chips, substrate) seems to have an effect on chip retention
- The modified Sweep Test may provide a means to Determine What Moisture Content is Appropriate Before Opening to Traffic/Sweeping
- Significantly higher chip loss was measured for test specimens fabricated with dry aggregate compared with saturated surface dry aggregates.

# A Brief Summary of the Results from NCHRP 14-17 "Manual for Emulsion-Based Chip Seals for Pavement Preservation"

Conclusions:

- Simple, Practical, Quantitative Methods were developed for:
  - Estimating When Traffic/Broom Ready
  - Embedment Depth
  - Surface Softness
  - Emulsion Viscosity
  - Surface Texture

# Fog Seals Laboratory & Field Performance

Presented by Todd Shields, INDOT & Adam Redman

- Research Objectives:
  - Conduct and Evaluate a field study to determine cosmetic and performance characteristics of a fog seal
    - Visual Appearance
    - Aggregate Retention
  - Compare and Evaluate three emulsions used for the fog seal process

# Research is Ongoing

- Still collecting and analyzing photographs
- Must further investigate imaging procedures for fog seal
  - Changed from initial 5 x 7 photographs
  - Currently evaluating 2 x 2 specific section
- Emulsion residue coverage on the chip seal might differ after a few months, a year, three years
- Initial surface wear may be complete
  - Evaluate wear in the creases and crevices

# Conclusions

- Visually it appears the fog seal is wearing off when you drive the roadway
- Imaging demonstrates the fog seal is in-place on the project, but worn off the surface only
  - "Caulking Effect"
- Emulsion residue properties are very similar

# Update on Cal Poly Recycling Center

Presented by Dr. Steve Cross

**PRRC Mission**:

- To advance pavement recycling and reclaiming
- To provide agencies and industry with the knowledge and tools needed to effectively use pavement recycling and reclaiming strategies

# PRRC Initiatives

- Education and Outreach
- Innovation and Research
- Sustainable Pavements Toolbox

# Visit us @ www.PRRCenter.org

- **News, information, help desk, etc.**
- **Register for training courses**
- **Join the Founders Circle**

For more information please contact:

**Dragos Andrei, Ph.D., P.E., Technical Director**
**909.979.6650 | dandrei@prrcenter.org**

# AASHTO T2 Submittal Status

Presented by Roger Hayner

- **Four Documents submitted to AASHTO T2 Section for Consideration in 2010**
  - "Standard Practice for Certifying Suppliers of Emulsified Asphalt"
  - "Recovering Residue from Emulsified Asphalt using Low Temperature Evaporative Techniques"
  - "Determining Asphalt Binder Bond Strength by Means of the Bitumen Bond Strength Test (BBS)"
  - "Performance-Graded Asphalt Binder for Surface Treatments (Surface PG Spec)"

# AASHTO T2 Submittal Status

**Standard Practice for Certifying Suppliers of Emulsified Asphalt "AASHTO PPXX"**

- **10 Ballots Affirmative, 3 ballots not returned**
- **Required Supplier laboratories to test RS-2 samples within 48 hours, originally required Agency**
- **Requested that Section 11.1 be revised that a "Supplier must have a QCP in placed prior to shipping"**
- **Requested that test tolerances not be included in this initial version but rather the ETF will develop for future**
- **AASHTO Accreditation requirement may be relaxed by State Agency**
- **Concurrent Ballot to be submitted this fall**

# AASHTO T2 Submittal Status

**Recovering Residue from Emulsified Asphalt Using Low Temperature Evaporative Techniques "AASHTO TPXX"**

- Eight Affirmative Ballots, 2 Negative, 3 not returned
- Motion for ETF to consider negative comments from GA and KY and include them in ballot
- Inadequate info on procedures of Methods A and B and questioned the need for Method A
- Concurrent Ballot this fall.

# AASHTO T2 Submittal Status

**Determining the Asphalt Binder Bond Strength by Means of the Bitumen Bond Strength Test "AASHTO TPXX"**

- 9 Affirmative Ballots, 1 Negative, 2 not returned
- Colin Franco and Andrew Hanz defended need and test method
- Tennessee submitted several editorial changes regarding their negative and question of readiness
- Modifications by ETF to be presented as a concurrent ballot later in 2011.

# AASHTO T2 Submittal Status

**Surface Graded Emulsified Asphalt and Cationic Emulsified Asphalt "AASHTO MPXX"**

- 9 Affirmative Ballots, 1 Negative, 3 not returned
- Questioned if Performance Grading of Emulsions and if necessary in light of pending research 09-50
- Opportunity for conflict with future research
- Tabled Ballot until 09-50 project completed

# Emulsion Applications Research Needs Survey Update

Presented by Andrew Hanz, UW Madison & Colin Frano, RIDOT

- Outline
  - Previous Results
  - Intent of New Survey
  - Summary of Detailed Responses
    - Common distress Types
    - Failure Modes
    - Testing Needed

# Additional Comments

- Material Properties – *Current Focus of ETF*
  - Aggregate (Gradation, Wear, Micro Deval)
  - Emulsion – Performance properties, adhesion/cohesion, viscosity
- Construction
  - Surface preparation and uniform application rate
- Current Specifications
  - References to Nevada DOT chip seal specifications and MTO material requirements are made.

# Modes of Failure and Mechanisms – Tack Coats

| Treatment | Failure Mode | Materials Related | Design or Construction Related |
|---|---|---|---|
| **Tack Coat** | Slippage | Bond Strength | Application Rate<br>Low Residue |
| | Delamination | Bond Strength<br>Cohesive Strength of Residue | Application Rate<br>Contamination |

# Modes of Failure and Mechanisms – Chip Seals

| Treatment | Failure Mode | Materials Related | Design or Construction Related |
|---|---|---|---|
| **Chip Seal** | Chip Loss | Emulsion Performance<br>Adhesion | Aggregate Quality<br>Premature Opening<br>Application Rate |
| | Bleeding | Emulsion Performance<br>Turning Movements | Application Rate<br>Gradation<br>Traffic Volume |

For both treatments design/construction guidance needed to reduce failures.

# Modes of Failure - Microsurfacing

- Distresses
  - Rutting/Shoving, Cracking, Ravelling, Flushing, Delamination
- Materials Related Failures
  - Emulsion Performance, Mix Performance
- Design/Construction
  - Mix Design, Surface Prep, Poor Placement
- Majority of Performance Controlled by Mix Design

# Conclusions

- Current ETF activities are working to provide test methods to performance of materials, particularly for chip seals and tack coats.
- Opportunity exists to provide further guidance:
  - Mix Design Criteria and Limits
  - Construction Guidelines
- Survey indicates these contribute significantly to failures.

# Discussion Points

- Format of Survey
  - What worked?
  - Quality of Responses
- Next Steps
  - Reporting and interpretation.  Draft submitted in need of revision.
  - Application of results to ETF Activities.

# ARC Project Emulsion Update:

## Improvement of Emulsions Characterization and Mixture Design for Cold Bitumen Applications

Presented by Andrew Hanz

- Overview
  - Testing Frame work – Based ETF Input
- "Non-Standard" Test Methods and Typical Results
  - Emulsion Viscosity - Rotational Viscosity
  - BBS Test on Emulsions & Residues
  - High Temperature Stress Sweep
  - Elastic Recovery in the DSR – To be tabled

# Strawman Specification - Emulsions

| Engineering Property | Test | Parameter(s) Measured |
|---|---|---|
| Sprayability and Potential for Drain-Out | Brookfield Rotational Viscometer | 1. Viscosity at spraying and surface temperatures.<br>2. Effect of Shear Rate. |
| Resistance to Early Raveling | Bitumen Bond Strength (BBS) Test | 1. Bond Strength at a Given Curing Time |

# Emulsion BBS Testing Challenges

- Curing Time vs. Moisture Loss
  - Setting equal curing time was not appropriate for High Float Emulsions.
  - Consider comparing materials at equal moisture loss.
- Establishing Precision and Bias for emulsions.
  - Material Types and Involvement of other labs.

# Strawman Specification – Emulsion Residue

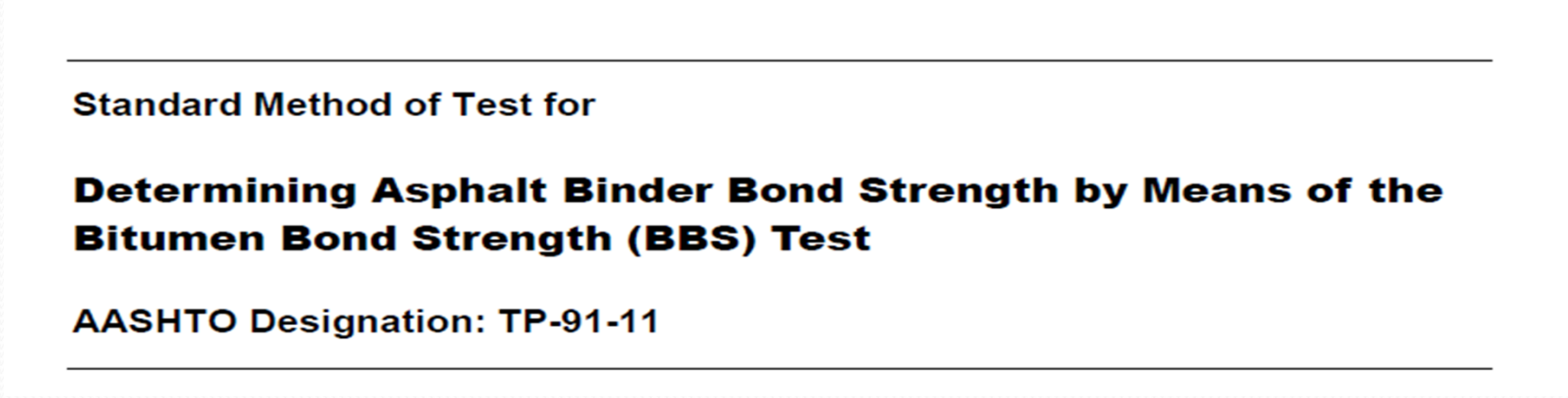
| Engineering Property | Test | Parameter(s) Measured |
|---|---|---|
| Resistance to Bleeding | DSR: High Temperature | 1. G* of the emulsion residue.<br>2. Stress Sweep. |
| Resistance to Raveling | BBS Test: Inter. Temp. | 1. Bond Strength of residue.<br>2. Moisture Damage. |
| Elasticity | DSR: Inter. Temp. | 1. % Recovery |
| Resistance to Damage | DSR: Inter. Temp. | 1. Strain Tolerance (LAS Test)<br>2. Effect of Aging |
| Resistance to LT Ravelling | DSR: Estimate Low Temp Properties. | 1. Estimate S(t) and m(t)<br>2. Effect of Aging |

# Research Challenges and Next Steps

- Establishing Precision and Bias Statement for AASHTO Standard
  - Material Selection
  - Involvement of Other Laboratories
- Investigate Moisture Conditioning
  - Temperature and Time.
- Relationship to performance for emulsion residues.
  - Do differences in bond strength and bond strength ratio have a significant impact on performance?

# Resources – BBS Test

AASHTO Standard – Approved by SCOM



Standard Method of Test for

**Determining Asphalt Binder Bond Strength by Means of the Bitumen Bond Strength (BBS) Test**

AASHTO Designation: TP-91-11

Training Materials

- Video: BBS for Evaluation of Emulsions (*In Progress)*
- Video: BBS for Evaluation of Emulsion Residues (*Post to web pending)*
- More information at: www.uwmarc.org

# Conclusions

- Tools are available to evaluate emulsions and emulsion residues:
  - Emulsions:  Brookfield and BBS
  - Residues:  BBS and DSR
- Research Challenges
  - Performance thresholds:  Define properties of a “good” emulsion.
  - Proper residue recovery and aging conditions.
  - Refine testing procedures.

# Submission of Standard Test Methods

- Complete
  - BBS Test for Emulsions and Binders (TP-91)
- Potential
  - Evaluation of Emulsion Viscosity using the Brookfield RV.

# Use of 4mm Plate-Plate DSR Geometry to Determine Low Temperature PG Grade of Recovered Binder

Presented by Gerry Reinke

Work Based on WRI Research

- "A new technique for measuring low-temperature properties of asphalt binders with small amounts of material" presented at TRB 2010
- "New Low-Temperature Performance Grading Method Using 4-mm Parallel Plates on a Dynamic Shear Rheometer" presented at TRB 2011

# Use of 4mm Plate-Plate DSR Geometry to Determine Low Temperature PG Grade of Recovered Binder

PROCEDURES:

1- Master Curve

2- GlassTransition G”

Review Both Procedures and Data

Low Temperature Test on Emulsion Residue Recovered at 60 C Using DSR Compared to Base Asphalt Results

# Strawman Specification Review

Presented by Arlis Kadrmas

| Strawman Specification for Chip Seal Emulsified Asphalt - Draft Revision August 2010 | | | |
|---|---|---|---|
| **Purpose** | **Test** | **Conditions** | **Report** |
| **Tests on Emulsified Asphalt** | | | |
| Residue Recovery | Low Temperature Evaporation - AASHTO XXXX - Method B | 6 hours @ 60ºC | % Residue |
| Emulsion Viscosity - Production | Brookfield Viscosity | 50ºC & 80ºC? - Shear Rate TBD | Viscosity for Placement |
| Emulsion Viscosity - Field Acceptance | Wyoming | Temperature - as received | Viscosity for Placement |
| **Tests on Residue from Low Temperature Evaporation** | | | |
| High Temperature | DSR | 52, 58, & 64ºC | G*,G*/sin delta, phase angle |
| | DSR - MSCR | Th and Th-12ºC @ 1.0,3.2&10kPa | %Recovery and Jnr |
| | DSR - Stress Sweep | Th | Sweep Data |
| Low Temperature | DSR - Frequency Sweep | 5ºC & 10ºC | Sweep Data |
| **Tests on Residue from PAV Aged Material (Optional)** | | | |
| Aging - Life Cycle Evaluation | UW Procedure for PAV - Frequency Sweep | 5ºC & 10ºC | Sweep Data |
| **Procedures Under Review for Chip Retention** | | | |
| Sweep Test | Modifed ASTM D7000 | 35ºC or Placement ºC & humidity | % Loss |
| Bitumen Bond Strength | UW Procedure | 35ºC & 30% H | Pull off tensile strength |
| Linear Amp. Sweep Test | Developing Procedure | 19ºC, Residue & PAV aged Residue | Cycles for failure at a given strain |

# ETF ACTION ITEMS

1. Subcommittees
   - Work Plans for 2011 Development
   - Review Goals & Change for Group
   - Develop Timelines
   - Assignment/Resposibilites/Task for Group
   - Submit by June 1, 2011
2. Tack Coats
   - Gather & Review Current State of the Art
   - Specifications / Survey Agencies Uses & Products
   - Capability of Testing within Group
   - Invite Dr. Mohommed to Present Next Meeting
   - Tack Coats – Shear  vs. Tension

# ETF ACTION ITEMS

3. Data Sharing
   - Improve Utilization of NCPP Website for ETF Data including Subcommittee's Reports/Work Product
   - Confirm Past Information and make it readily available
4. Review of NCHRP 14-17 Methods for Presentation to AASHTO – Will be on NCPP Website for review
5. Follow-up on Pooled Fund Efforts?
6. Update Strawman Specification Draft (Completed)
7. Revisions for Current AASHTO Submittals, as per T2 Request for fall Ballot

# Thank You