December 14, 2009 PPETG- Emulsion Task Force Meeting Notes

Roger Hayner, ETF Co-Chair – Mission Review and Goals of ETF

- Task Force originated at AEMA-ISSA-ARRA meeting February 2008 under guidance of Jim Sorenson
- Identified need for industry expertise and involvement in ongoing research activities pertaining to asphalt emulsions and finished product systems

Goals

- Review Needs for Preservation Materials Research- Emulsion & Aggregate
- Evaluate Existing R&D Roadmap Problem Statements
- Evaluate Consortium Work Plans and Review Ongoing Research’
- Make Recommendations and integrate work activities
- Coordinate and Share Activities and Results with Existing Superpave binder/mix/modeling ETGs
- Facilitate Adoption of New Findings and Research Results Through Appropriate AASHTO/ASTM Channels
- Advance the Effort to Develop Performance Based Methods & Specification for Emulsions
- Encourage Adoption of Uniform National Standards
- AEMA/ISSA/ARRA Coordination
- Priority focus on Chipseals & Microsurfacing Surface Treatments
- Development of a Matrix of Application Type vs. Design, Placement, Functional Performance, Durability Performance
- A set of deliverables will be more defined by each subcommittee group and developed through the ETF for Implementation through ETGs, AASHTO, ASTM, and User Producer Groups
- Performance Based Specifications for emulsions and emulsion mixes/processes

- Protocols to be developed for Design-Development
- Protocols to be developed for Performance
- Protocols to be developed for Inspection & Acceptance
- Matrix of Preventive Maintenance treatments/processes with known and unknown issues development
- Determine and quantify what specs exist now for each
- Do the existing specifications work
- What is missing in existing specifications
  - How do we obtain that which is missing?
  - Review of other existing capabilities for fit?
  - Define what new research is needed
  - Specification Development

**Colin Franco, ETF Co-Chair – Matrix Development**

Matrix spreadsheet has been developed with Emulsion Applications divided into several areas: Applications employing emulsions without other components (tack coat, fog seal and scrub), applications with aggregate or chip (sand seal, slurry seal, micro, chip seal), and other treatments including foamed asphalts and bonded wearing courses, and cold mixtures (Virgin, Recycled, paving and patching, and Cold In-place Recycling)

Quality assurance was defined as looking at the product from inception to final in-place performance properties. Including the following areas:
- Contractor QC
- Acceptance Testing
- Independent assurance

Emulsion Product Development – Each individual component of the system, including Asphalt, Water, and Surfactants when combined must meet select properties. Also includes Material Engineering and Design component development.

Manufacturer Testing Requirements section— Ensures consistency and compliance. Testing such as Saybolt Furol Viscosity, Demulsibility, Sieve Test, etc. used until other new performance tests developed.

Construction performance properties must be defined and quantified. Products must render themselves able to be constructed properly.

In-Service Performance Requirements were defined along Function and Durability guidelines including Adhesion to aggregate, rutting, fatigue cracking, etc..

Gayle King commented that there are a number of boxes that are missing from the matrix.

Arlis Kadrmas questioned if the goal was to develop a standard practice document for each applications like what ISSA has done for microsurfacing.
Overall Matrix would help to define the tests required to make the product successful. The testing will vary depending on where the applications are used (climate conditions, traffic levels and types, etc.). The matrix can help set the priorities with the limited amount of funding now available to agencies.

Scott Shuler – Discussed the chip seal failure at Arches National Monuments. The binder used was too stiff and chip loss is now evident on the project. Project area should have required a PG 67-70 graded binder and the actual binder was graded as a PG 80.

Action Items ->>>This issue to be further discussed with Mike Voth for more detail and facts involved at Federal Lands Division of FHWA.

Laurand Lewandowski – Pooled fund study can be used to collect field performance and tie to binder residue properties.

Andrew Hanz, Univ. Wisconsin Madison –“Emulsion Product and Distress Survey”

Andrew described the Survey that he and Colin Franco had developed and conducted prior to the ETF meeting. The intent of the survey was to take the product matrix and prioritize the areas that need more focus. They also wanted to define critical distresses and mechanisms of failure.

The survey received 4 agency and 5 industry responses prior to the ETF meeting. A 50% response rate was received so far.

The survey divided applications primarily into surface treatments and cold mix applications. Evaluation criteria point system used with a rating of 1- 5 points and the weighted average of results calculated.

Survey Results – Three areas of highest priority identified were tack coat, chip seal and microsurfacing.

Tack Coats
Main causes of failure in the field
  Application rates improper
  Slow setting emulsions
  Broken bonding

Other observed modes of failure
  Tracking
  Adhesive/cohesive failures

Needs to identify existing and potential new performance test methods

Chip seals
Failure
  Raveling
  Bleeding

Failure causes
  Inadequate binder stiffness
  Loss of adhesion
Inadequate set time

Binder properties
Curing time required before traffic release onto surface treatment
Adhesion between aggregate and emulsion can sometimes be an issue
Evaluation of laboratory aging characteristics needed

Testing needs
  Emulsion properties characterization
  Sweep tests to verify adhesion characteristics with aggregate
  DSR/BBR tests and PAV aging

**Microsurfacing**

Modes of failure
  - Raveling and stone loss
  - Slow or non-uniform curing rate
  - Re-emulsifying of emulsion

Failure Mechanism
  - Age related or construction techniques
  - Too stable emulsion
  - Asphalt emulsifier problems

Overall themes
Better material selection process needed
Evaluate entire system including finished mix for performance testing
QC/QA mix design processes needed

Chris Abadie- Commented on the LTRC Tack Coat Evaluations and indicated a
Final Report will issued in Spring 2010

*Action Items – Acquire a copy of the recent paper on subject for distribution to the ETF*

**Managing our pavements FHWA Initiatives – Chris Newman**

*FHWA – Office of Asset Management*

Chris discussed the changes that have occurred within the FHWA after the loss of Jim Sorenson.
FHWA will continue to support Pavement Preservation and it is part of the overall infrastructure improvement from the stimulus funding.
Many state agencies have used the stimulus money on preservation type projects.
Congressional Approach operates under the assumption of
  - One pot of money
  - Critical asset investment Plan
  - Moving away from just IRI as measurement
  - Maintenance, preservation, rehab and reconstruction now being considered as part of plan
Performance Based specifications desired
Taking more of a cradle to grave approach
Also, a “Proactive” approach rather than reactive to failures once already occurred.
FHWA ongoing activities
- TSP2 (Transportation Service Pavement Preservation Center)
- NCPP - Continued support for National Center Pavement Preservation
- Regional Forums and Partnerships continuing
- National ETG efforts will be continued
- Sustainability, recycling and adaptation is a key focus going forward.

Upcoming Meetings:
- National Meetings – International Pavement Preservation Conference – April 2010
- National Pavement Management Conference 2011

AASHTO Asset Management-Pavement Preservation Meeting scheduled in Spring 2010
Assessment of current state of highway system is ongoing as well as Corridor assessments.
Developing a Health Index – System Performance
- More of a planning tool
- More than IRI
- Cracking, Rutting
- Pavement Age, Last Major Rehab

Difficulty is that each agency has various levels of monitoring and documentation.
Trying to define for FHWA for the longer range as to how do we spend our money more effectively to make pavements last longer?

Colin Franco – How do we get information about states pavement performance (HPMS)?

Chris Abadie – It is hard to measure system performance with the current HPMS. Having the right data is critical. Quality of data varies from state to state.

Scott Shuler – Evaluating PMS can be extremely time consuming. There are large quantities of data that has to be mined. Need will be defined and through monitored specific projects.

ARC Project Emulsion Task Force Update – Hussain Bahia
University of Wisconsin-Madison, Modified Asphalt Research Center

Work is continuing to look at Construction properties (initially Chip Seals)
What properties are necessary to reduce early failures in the field?
- Storage stability of particular types of emulsion and defining the difference in residues
- Spray-ability and drain out-viscosity @ application temperatures
- Breaking/Setting Rate- change in bond strength
- Early Raveling-Bond strength at a given curing time

Evaluating use of Rotational Viscometer (Brookfield) to measure emulsion viscosity
- Evaluating steady state viscosity
- 50C, 50 RPM, #21 spindle
- How is it related to Saybolt-Furol viscosity

Found Viscosity is changing with time (drops over time) and Poor correlation with SFS (seconds)
Concepts for evaluation of viscosity
- Spray-ability at high shear strain- Application without runoff
- Drain out at low shear rate
How relevant is relationship to Saybolt-Furol Viscosity
Will test at various temperatures and shear rates (1-150 RPM) to define

Adhesion Test Evaluation over various stone substrates:
- Highly dependent on development of adhesion with particular stone
- Goal to develop simple test to measure bond strength/adhesion
- Also address aggregate/emulsion compatibility
- Use Sweep Test (ASTM D 7000) to evaluate

Bitumen Bond Strength (BBS)- New test method developed from research
Adhesion Test – PATTI Quantum Gold Testing Set Up
Hussain showed a graph of Tensile Strength and Loading Rate – COV within lab is 12%
- Have performed control tests at
  - 30% Relative Humidity
  - Temperatures 35 and 45 C
- Aggregate evaluated included Glass, limestone, Granite, Dolomite
- Time effect on cure rates
Results show big impact on cure time for tensile strength.
Also shows significant difference between modified and unmodified materials
Will need to determine relationship to Performance through actual field studies
Proposing two new tests for evaluation including Brookfield for viscosity and BBS for adhesion

Also proposed a new residue evaluation:
Resistance to bleeding using MSCR
Resistance to early and late raveling – proposed DSR evaluation of strain at 50%
Emulsion Residue Aging PAV 90-110C at 300 psi for 20 hours, no RTFO
Challenges in applying PAV
- Time and Temperature issues
  - Action Items – Need to define aging protocol
  - Action Items – Charles Glover has data on emulsion aging and ETF needs to get him to present his results at next meeting

Residue Performance Characterization – MSCR and DSR use Jnr for relating to bleeding.

Strain Sweep of residue @ 25C
CRS-2P Death Valley showed the showed the greatest strain tolerance.

Elastic Recovery Procedure
  - Action Item – Need more projects to validate
Proposing a single creep recovery test
Using an 8 mm parallel plate
Good correlation with Elastic Recovery
Looking to replace BBR with DSR data
  - Comparing Dynamic and Creep Measurements
  - Can use data at 10 and 20 Hz to compare to m-Value and Stiffness
Defined method for Low Temperature Testing Protocol
8 mm parallel plate
10C
0.1-100 rad/sec
Use G*, phase angle at 10 Hz

Discussion on 4th Year Work Plan
- Expand testing on various materials
- Improvements to the sweep tests
- Average least dimension
- Field validation
- Dense Cold Mixes

NCHRP Study Update – Amy Epps-Martin Project Update From TAMU
NCHRP 14-17 Project
(Report to be issued to NCHRP in February 2010)

Study was to provide technology based tools for emulsion evaluation.
Emulsion residue recovery Method comparison included:
  - Stirred can recovery
  - Hot oven with nitrogen blanket recovery
  - Warm Draft Oven recovery method
Chemical testing
Rheological testing
  - Surface Performance Grade- “SPG”
  - Strain sweeps

Stirred can is not replicated in the field – not recommended
All the recovery methods showed the water was removed
FTIR was used to look at carbonyl area – slight oxidation shown to occur during the recovery methods
  - More oxidation in Warm Draft Oven Method than others
Performed PG without RTFOT
Surface Performance Grade (SPG)
  - Use 6C increments
  - G*/Sin Delta at 0.65 kPa
  - Cold Temperatures Stiffness at 8 sec < 500 Mpa
Used eight emulsions plus Federal Lands Project
PG did not differ with recovery methods
Base and recovery methods produced very similar properties
Strain Sweeps
  - Stiffness developed during curing process
  - Strain tolerance to assess resistance to raveling
  - Strains 1- 50% evaluated
Strawman specification recommendations
Strain Sweep on Original Binder
% Strain @ 0.8 G*, minimum 25%
25C 10 rad/sec linear loading, 1- 50 %,

Emulsion Residue Specifications
Proposed SPG Specification Grades as a requirement and compared proposed SPG to PG grades for Federal Lands Study

Summary and Recommendations
Establishing thresholds will be difficult without more data
Strain sweep holds some promise
Move recovery method towards Warm Draft Oven
Continue to monitor existing projects

Have an upcoming Texas DOT project to look at field performance.

**Aggregate Mix Design Subcommittee – Mary Stroup-Gardiner**

Asked Scott Shuler to develop some sort of JMF for chip seals as a result of their study
Plan for performance testing – focus on construction control, preparation of emulsion supplier certification plan was needed to progress and next is to look at developing equipment certification standards.

**How are specs/test accepted? - Colin Franco**

Colin presented a flow chart to how specs/tests are accepted at AASHTO. A copy will be included in the minutes.
Sooner draft standards are prepared and presented to SCOM, the better chance they get reviewed and accepted.
**Action Items- Send any drafts to the committee by 1st quarter for any chance next year of acceptance.**

ASTM specification development and standards do not necessarily follow AASHTO.

Hussain Bahia – Wants to potentially put the adhesion test in the queue, but wants test to be vetted by peer review. Draft specification to be prepared and submitted to ETF subcommittee.

Recommendations were made to how the group would proceed with submitting draft specifications. Kevin Van Frank has a draft format for specifications. Need to go after provisional test procedures before we go to specifications.

Hussain – recommends that the ETF Co-Chair take the Adhesion Test to the AASHTO Committee as a proposed Test Method.
**Action Items – Hussain to Draft Adhesion Test in AASHTO Format with supporting documentation. A subcommittee would be formed with a chair to be elected. Darren Hazlett will chair the committee and members will include Arliss Kadrmas, Kevin Van Frank, Paul Morris, Laurand Lewandowski, Yetkin**
Yildrim, and Mary Stroup-Gardiner. The committee needs to be separate of who is actually presenting. Drafts will be sent out by end of year, with responses at end of January. A conference call will be held at the end of January to review responses and define forward plan. Amy Epps/Andrew Hanz will prepare Strain Sweep – Hussain Bahia /Andrew Hanz – Adhesion Tests –

**Federal Lands Study Update – Summary and Conclusions**

*Laurand Lewandowski & Gayle King*

- Project now complete and report issued
  - Ongoing monitoring of projects by Federal Lands will continue
- 2 Projects had emulsion residue grades vary considerably from desired grade
  - Created opportunity to identify effects of hard in cold and soft in hot application areas

- Phase II with Crater Lake
  - Revised protocol to use 6 hour recovery test in study and compare results
  - Included SBR and SBS in study
  - Repeatability of recovery methods good but method A hardens residue more than B.
- Revised strawman specification to reflect
  - Movement away from MSCR at Th to G*/Sin Delta
  - MSCR strain recovery near Th is not a viable indicator of polymer network strength
  - Elastic Recovery on DSR
  - Strain sweep results to date do not predict stone loss
- Two Sets of Emulsions Evaluated- Sweep Test Data
  - Good reproducibility within lab but poor between labs
  - Mass loss variability found between labs
  - No change in particle size over 2 month period indicating emulsion stability
  - Need to examine ASTM D7000 more closely
  - Will compare with NCHRP 14-17 work Schuler completing in effort to improve between lab reproducibility

Action Items – Have Richard Kim and Charles Glover present on their respective areas at our next meeting.

**Sweep Test Data FLS – Arlis Kadrmas**

Review of sweep tests results for two sets of emulsions. Good reproducibility within lab, but not between labs.

Several issues: Ultrapave showed much lower mass loss %
Representative pictures for a 3.9% and 18% loss.
Looked at differences between the emulsions sent to each lab.
There was no change in particle size over a two month period indicating variance was not due to emulsion stability but rather lab procedures.
Intralab R&R lab is very good
Need to examine ASTM D 7000 method more closely
Action Items – Compare to work Scott Shuler is doing to see if we can improve the reproducibility
**Pooled Fund Study – Gayle King**
How do we fund this effort going forward? Performance specifications need to be verified by field data. Next step is a pooled fund study through Transportation Pooled Fund Study (TPF) Mike Voth and Gayle King made a presentation at AASHTO Annual Meeting to request a TPF. Asking for a minimum of $20,000 per state with a goal of 10 states ($200,000) Utah DOT has offered to lead the project, oversee the technical issues. Kevin Van Frank to head up assisted by Pedro Romero at University of Utah.
This project would start with Chip Seal and Microsurfacing and then follow with the other technologies. Project needs commitment by other states for funding. Have Utah, Federal lands and FHWA financially on board to date. (~$60,000.00) $500,000/year is a more realistic target. Need to target a dollar amount and specific test plan. Action Items – Kevin Van Frank will prepare a specific proposal for the Pooled Fund Study. Need to have a tangible benefit with value to each client. Target end of February for draft proposal. Combine the recommendations from NCHRP 14-17 and Federal Lands Study.

**Monroe, Michigan Chip Seal Research Project**
**Jason Wielinski – The Heritage Research Group**
Research Objectives
Understand Chip Seal Performance in the winter and stone loss due to snow plow damage Evaluate and comparison of different materials (emulsions and aggregates with addition of diesel diluent) Can we develop laboratory test to predict field performance – aggregate retention?

Project looking at :
Aggregate retention
Emulsion Type
Aggregate Type
Influence of low level solvents(#2 Fuel Oil)
Role of polymer modification versus neat asphalt

Emphasis on winter
- Snowplow damage
- Cold weather performance

Project location – Monroe, Michigan
Rural route – Dixie Highway
Gets some heavy traffic, minor wheel path rutting noted
Fatigue cracking and transverse cracking also noted

One project with limited variables.
Single site (same climate, traffic, contractor, etc..)
Same manufacturing process for each emulsion type
- Cationic and Anionic
- Modified and neat
- Aggregate – crushed limestone
- Aggregate – partly crushed gravel

Anionic (HFRS-2)
Cationic (CRS-2)
Showed project schematic – two day construction
Alternate between limestone and gravel
Track field performance through aggregate retention
Results in:
- reduced friction
- Increased asphalt oxidation
- windshield damage

Identified specific location on the pavement for project monitoring and evaluation
The locations will be monitored over time by image analysis

Field Imaging Analysis
- Long Term Monitoring
- Monthly monitoring over winter
- Chip seal consistency
- Comparison of materials
- Do field results correlate to lab results

Image analysis is hard to differentiate between aggregate loss and bleeding

Only have one month of field data to date.

Laboratory Testing including varying:
- Testing temperature
- Curing Time
- Test Pad

Presentation included results on sweep test with varying conditions as comparison

**Summary of Action Items From Meeting:**
- Action Items - Discuss this with Mike Voth, Federal Lands Division of FHWA – Need to follow existing Federal Lands Study Project Sites
- Distribute copy of Tack Coat Study – LTRC, Chris Abadie provided AAPT Paper
- Action Items – Need to define aging protocols for Emulsion Residue
- **Action Items – Charles Glover has data on emulsion aging, ETF needs to get him to present his results at next scheduled meeting**
- Action Items- Send any proposed specification drafts to the committee by 1st quarter for any chance next year of acceptance. AASHTO Materials Committee
- Action Items – Draft Adhesion Test in AASHTO Format with supporting documentation. A subcommittee would be formed with a chair to be elected. Darren Hazlett will chair the committee and members will include Arliss, Kevin, Paul, Laurand, Yetkin, and Mary Stroup-Gardiner. The committee needs to be separate of who is actually presenting. Drafts will be sent out by end of year, with responses at end of January. A conference call will be held at the end of January to review responses and define forward plan. Amy/Andrew Strain Sweep Hussain/Andrew – Adhesion Tests –
- Action Items – Have Richard Kim and Charles Glover present on their respective areas at our next meeting. Based on Federal Lands Study
- Action Items – Compare to work Scott Shuler is doing to see if we can improve the reproducibility – ASTM D 7000 Sweep Test
- Action Items – Kevin Van Frank will prepare a specific proposal for the Pooled Fund Study. Need to have a tangible benefit with value to each client. Target end of February for draft proposal. Combine the recommendations from NCHRP 14-17 and Federal Lands Study.
• Subcommittees to have conference calls during first quarter – Have a conference call the week of March 15th – Roger H. to coordinate March 15th week call