Minutes of TRB Superpave Asphalt Binder
ETG Meeting of November 13 & 14, 2000
Tampa, Florida

Meeting Issues
- Superpave 2005 - Long Range Plan
- Layout of the Future Binder Specification
- Mixture & Aggregate ETG - Report

The meeting opened with self-introductions by everyone present. Attendees list is attached.

Ted Ferragut presented the Superpave Long Range Plan for 2005 developed as a requirement of AASHTO resolution AR-5-98. He briefly discussed the details of the issues that were addressed by the TRB Superpave committee at the meeting held in October 30 & 31, 2000. The plan calls for the Superpave mix design system to be fully implemented by the year 2005. He also reviewed the FY 2002 proposed projects to keep on schedule for 2005. A major change to the 2005 plan is to use the AASHTO 2002 design models to replace the Superpave models, due to delays in the Superpave models development. This change will allow the plan to stay on schedule for 2005. Details are attached. The major issues addressed were as follows:

1. Material Characterization - Modified Binders
2. Mix Design – to predict Rutting, Fatigue Cracking, thermal cracking and moisture damage through laboratory tests and mechanistic models.
3. Moisture Sensitivity – not accepted by the committee
4. Simple performance tester – has been developed and will be commercialized
5. Superpave Models Contracts – will not be completed by 2002
6. Performance Related Specifications

John D’Angelo presented a review of the current Superpave asphalt binder specifications and the expected future direction for changes in the specifications.

He reviewed the existing Superpave binder specifications and pointed out the major issues that should be addressed by the Binder ETG. These issues include the following items:

1. Constructability issues, tenderness
2. Mixing and Compaction temperature
3. High Temperature specifications
4. Fatigue Cracking specifications
5. Aging and Stability of modified materials

He recognized the outstanding work done by the binder ETG to address past efforts to refine the Superpave binder specifications. For example, the new low temperature specification using the Bending Beam Rheometer and Direct Tension Tester to address the above issues, the future specifications should use the existing equipment and minimize the effect on the time to test.
Finally, he said that we should focus on having the performance based Superpave binder specifications that will address these issues by the year 2005.

**John Bukowski** summarized the activities of Mix & Aggregate Expert Task Group from their September, 2000 meeting. He briefly explained the issues that were discussed in the meeting. Important issues that were focused are as follows:

1. Implementation of RAP in the Superpave System – work is completed and this study recommends the use of RAP as outlined in MP-2 specifications.
2. Simple Performance Tester – ETG will continue to work with Dr. Witzack contractor to validate the simple performance tester.
3. NCHRP 9-19 Superpave Support and performance models - The ETG concurs with using the AASHTO 2002 as an interim and continuing development of new models for Superpave.
4. Aggregate Issues – ETG recommends to the TRB Superpave committee a proposed project to do a synthesis specifically focusing on consensus properties, and looking at new aggregate tests within the Superpave system. NCHRP 9-25 looking at VMA is underway.
5. Dust to Asphalt ratio issues – ETG recommends not changing the dust to Asphalt ratio and suggests that further study be conducted.
6. Gradations issues – Optimization process of gradation will be reported in the next ETG meeting
7. New Standards – ETG has recognized the need of two new standards to improve the superpave system those are: a) A standard for 4.75 mm nominal maximum aggregate size mix design b) A Standard for field verification of Superpave Asphalt-aggregate Mixtures
8. Dynamic Angle Calibration device for Gyratory Compactor – ETG has formed a team to work with Tom Harman and the industry people to evaluate this device.

He briefly discussed other issues and listed a number of projects that the Mixture and Aggregate ETG is currently focusing on. See the attached for details. The next Asphalt-aggregate mixture meeting is on April 3 & 4, 2001 in Arizona.

**Technical Discussion Topics**

- **Binder Equipment**
  - RTFOT validation of metal rods procedure - report
  - Temperature control and the Rotational Viscometer experiment - Experiment
  - DTT Sample preparation – new method
  - LAST Review of proposed new specifications to AASHTO - update
  - PAT Review of proposed new specifications to AASHTO - update

- **Specifications**
  - Binder Grading – short term aging proposal
  - Grade Bumping - update
  - High Temperature Task Force – Refinement proposal
  - Fatigue Tests for asphalt binders - update
Satish Ramaiah reported test results from a validation study of the MRTFO Test method as proposed by NCHRP 9-10. The MRTFO test methods recommend the use of a metal rod (6.35mm diameter, 30 mm long) in each glass container during aging in Rolling Thin Film Oven. This modification was intended to increase the aging of polymer-modified asphalts in the RTFOT. The proposed changes to AASHTO T240-97 are attached. This study was conducted to determine the effect of operators, Method of aging and metal rods on aging. Experimental Design included two asphalts (Novaphalt, AMRL 182) three operators, two conditions (with & without metal rods) and three replicates. Statistical Analysis on test results was conducted by Dr. Antle & Raj Dongre to determine the effect of Operator, Method and Metal rods on short-term aging. The results indicated that the rods did not increase aging of modified asphalts; in fact, the rods reduced the aging of the samples tested. Analysis of Variance results showed that the Metal rods effect was very significant, and dominated the results. Effect of method was significant, but was small compared to Metal rods. Operator effect was insignificant. It was concluded that, the metal rods do not improve aging of modified binders and unmodified binders. A summary of ANOVA results is attached.

Action: Consensus of the group was to conclude the MRTFOT validation study. A copy of the completed report of MRTFOT validation study will be submitted to Hussain Bahia and NCHRP 9-10 panel.

Raj Dongre presented a planned experiment to evaluate the rotational viscometer temperature controller. This experiment was designed to address the issue of current temperature control requirement of ±0.1°C. Manufacturers of rotational viscometer claim that the controller can only control ±1.0°C. The objective of this experiment was to determine the effect of variation in asphalt sample temperature on the repeatability of dynamic viscosities measured using rotational viscometer and to determine if the available ±1.0°C is adequate. Experiment design included two asphalt binders, Brookfield Rotational Viscometer and five shear rates. He briefly explained the testing protocol that will be used for this experiment. Details of the presentation are attached. Several discussions continued on this topic. Dave Anderson volunteered to provide the available test data at different shear rates, which will provide enough information to satisfy the above experimental requirements.

Action: Raj will obtain the test data from Dave Anderson to conduct the mathematical analysis. The results of the analysis will be discussed in the next meeting.

Susana Ho presented the results from a study conducted by University of Calgary, Canada. The study was entitled “The Impact of Sample Preparation on Direct Tension Test of Asphalt binders. The objective of this experiment was to determine the sources of errors and to establish a sample preparation method that will allow the asphalt materials to maintain a fluid state for a short period when poured into the molds. The asphalt in the mold was controlled to cool very slowly by sitting on top of heated ceramic tiles. She described the established sample preparation method and
presented the test results obtained from trained operators, and newly trained operators. In summary, she said that the new established sample preparation method would improve the repeatability of test results. Details of the presentation are attached.

**Action:** Ms Ho will evaluate her new method with additional asphalts and prepare a detailed written procedure for review of the ETG.

**Jack Youtcheff** reported the research conducted under NCHRP 90-04 project entitled Investigation of Modified Asphalt Systems carried out at Turner-Fairbanks Highway Research Center (TFHRC). He presented the results from an evaluation of the Laboratory Asphalt Stability Test (LAST) and Particle Additive Test (PAT) test procedures. He recommended based on the test results that, the commercially available Millipose filter system with 20u filters and a “polar” solvent should be used to conduct PAT. Also, discussed were the testing parameters for LAST that are being evaluated. See the attached for details.

**Action:** Jack Youtcheff will submit a report on PAT in two months and evaluation of LAST will be completed in within nine months.

**Dave Jones** proposed an 8-hour binder classification system. The system would use the RTFO residue to establish the aged condition of the binder based on shift factors for the binder. Microwave aging can be used to establish the shift factors. Details of his presentation are attached.

**Action:** Dave Jones will submit a written document to John D’Angelo detailing the proposed 8-hour binder classification procedure. This document will be reviewed by the members and the discussions will continue in the next meeting to determine whether to go with the proposal. Several suppliers will work with DOT’s to try the system.

**Gayle King** discussed issues related to traffic grade bumping procedures. Gayle king and Gerry king have been putting together recommendations on grade pumping procedures. His recommendations for increasing the high temperature were was to consider traffic speed and load. Any new grade bumping procedure should be confirmed and adjusted using Superpave mixture performance tests or accepted wheel tracking proof tests. He briefly discussed the current grade bumping procedure practiced by the State DOT’s. He said that, based on the survey the States are using both AASHTO software and the new LTPP binder software to bump the grades. He suggested that we need provide guidelines to the state DOT’s as to which of these two grade bumping procedure is better. Gayle King asked the group to provide any information, data, and comments/input regarding the grade bumping procedure that will help to answer the following questions:

1. Which of the two methods (AASHTO and LTPP) is appropriate for grade bumping based on traffic loads?
2. How do we adjust the G*/sinδ factor?

**Action:** Gayle king and Gerry Reinke with other volunteers will evaluate the grade bumping procedures and submit the recommendations to the ETG for further review. Discussions will continue in the next meeting.
**Joe Gundersen** made a presentation of the use of PG binders in Indiana. Indiana has been using PG binders for several years. In this time, they have felt that the recommended binders for their area are softer than those they have previously used. A study of the viscosity of the PG binders compared to the old AC 10s and 20s used in Indiana does indicate that the PG grades are softer. Indiana has done little to no grade bumping, however, they are looking into a method to grade bump binder based on the study results.

**Raj Dongre** gave an update on the activities of High Temperature Task Group. The objective of the group was to refine the high temperature specification parameter to adequately account for elastic recovery of conventional and modified binders. The approach is to evaluate binders with known performance history, characterize the binders rheologically and by the Repeated Creep Recovery Test (RCRT). The data will then be analyzed to develop a refined high temperature parameter and validate refined high temperature parameter with wheel tracking and field performance data. He briefly discussed the proposed three models for repetitive creep recovery and compared those three different models. He presented the preliminary results of comparison of repetitive creep with field data from Nevada I-80 project. The preliminary results indicate that the repetitive creep was not modeled well using dynamic testing results. He concluded saying that the group will continue to try and model the creep recovery with DSR data without changing the current testing scheme used for determining the G*/sinδ.

**Action:** High Temperature Task Group (HTTG) will continue the work to correlate repetitive creep with field data. HHTG will conclude this task and report the information in the next meeting.

**Jack Youtcheff** gave an update on NCHRP 90-07 entitled Complex (Modified) Binders Controlling Mix Performance with New Complex Binder Protocols. This program is funded through TEA-21 Polymer Asphalt Research and NCHRP/AASHTO. The two main goals of 90-07 project is to:

1. Validate and refine Superpave binder specifications through the evaluation of a diverse suite of modified binders
2. Build on previous SHRP binder validation study conducted by FHWA

Ten new asphalt modifiers were used in this study. He presented the preliminary results obtained from Hamburg wheel tracker device. The results from this study will be used in supporting various current and future research efforts, understanding the performance of various polymer modified asphalt systems in fatigue and permanent deformation and in validation/verification of the Superpave specification. Details are attached.

**Hussain Bahia** presented the proposed 9-10 binder fatigue criteria. He reported the initial ideas and approaches to determine the fatigue failure criteria. The objective this program was to develop a binder fatigue test. He discussed briefly the hypothesis, criteria, testing program, failure mechanisms and data interpretation for determining the fatigue factor. He explained that that there is a good relationship between the dissipated energy per cycle at the initial stage with the damage accumulation. Accumulated damage was measured using DSR. He presented the initial test results.
for different asphalt binders. He described the approach to determine the failure criteria by integrating the pavement structure, traffic speed to energy levels. In summary, the three proposed binder fatigue criteria are as follows:

1. The 20% deviation from the damping energy
2. Area between the damping and fatigue
3. Maximum dissipated energy ratio.

In addition, he showed how the energy levels, pavement structure and traffic speed can be incorporated into the specifications. The future work is will be focused on looking at selecting energy levels and defining the type of failure related to pavement performance. Details are attached.

Gayle King presented data indicating that fatigue is a criterion that has to be addressed by the binder specifications. He also, shared data related to the 9-10 fatigue criteria indicating that it may be a good starting point for development of a specification criterion. See the attached.

Gerry Reinke presented the results of an investigation using the dynamic shear rheometer to determine the complex modulus of bituminous mixtures. The primary goal of the investigation was to determine the ability of a DSR, testing rectangular slices of mix, to produce $G^*$ results comparable to those obtained by the SST. Mixes used the same PG 58-28 binder. Six specimens were tested using the SST and two specimens were used for slice testing. Testing of mix samples using both pieces of equipment and generating master curves at 10 Hz and 0.01% strain produced virtually identical values of complex shear modulus ($G^*$) at the critical temperatures for pavement rutting. He showed several comparisons of SST vs. the DSR slice testing data on several SPS-9 projects, which all indicated the identical results. Comparisons of SST vs. DSR data are attached.

Dave Anderson reported on a fatigue study done at Pennsylvania State University. The study investigated the procedure developed under NCHRP 9-10. Repeated shear at various temperatures with one, two, and three mm gaps were tested for 16 hours. Data was presented for four different binders aged in the RTFO. He briefly discussed the criteria, fatigue mechanisms, and analyses that were considered to evaluate the fatigue criteria. The study indicates that at higher temperatures, those where the binder has a modulus of 5 MPa the time sweeps developed as a fatigue test under 9-10 are controlled by flow distortion at the edge of the sample in plate plate testing. At lower temperatures, the flow is eliminated and the test may be an indicator of fatigue properties. Conclusions from the testing to-date are as follows:

1. Polymer modified binders improve fatigue resistance.
2. Repeated shear failure is a complicated process with two possible mechanisms
   a. At Low stiffness – instability flow domination
   b. At High Stiffness – micro cracking domination
3. Currently available constant strain rheometers cannot be used for fatigue cracking testing unless it has controlled loop.

Details of his presentation are attached.
Action: A fatigue task group was formed to investigate and develop a fatigue criterion for inclusion in the binder specification. The group will include FHWA, Gayle King, Dave Anderson, Hussain Bahia, Bob Kluttz, and Bruce Cline.

Mike Harnsbeger presented the results from an investigation of the Modified German Rotating Flask. This test procedure is to be considered as an alternate to the RTFOT. The objective of this research was to obtain more material for testing and achieve the same aging as the RTFO test method. He briefly explained the test procedure and the mechanism of German Rotating Flask. A 200 g asphalt sample is placed in a Morton flask attached to a rotary evaporator for 210 minutes at 165°C, with 2000 ml/min air being supplied continuously. The flask is rotated at 20 rpm. A copy of “Standard Method of Test for Modified German Rotating Flask (GRF) Equivalent of Rolling Thin Film Oven Test (RTFOT) for Conventional Asphalts” is attached. He showed the test results of eight SHRP asphalts and three modified asphalts comparing the RFTOT and GRF aging methods. The results agreed well between the two methods with an exception for mass loss. Mass loss as measured in the RTFOT was a little higher than the GRF method. Details are attached.

Action: TE-39 will obtain equipment necessary to evaluate this procedure. The ETG will request that WRI continue to look at the GRF and additionally evaluate an accelerated long-term aging procedure using the GRF.

Closed session: In the closed session the members agreed that each of the action items was necessary to complete the Superpave Binder Specification. The major unfinished areas in the binder specification include a new high temperature criteria blind to modification, a fatigue criterion, and an improved and shortened aging process for the binders.

The next Binder ETG meeting is planned for April 3rd & 4th, 2001. It will be held in Tempe Arizona. Additional details will follow the minutes.