

FHWA Asphalt Binder Expert Task Group Meeting

February 22 and 23, 2010

Beckman Center

Irvine, California

A total of 64 individuals attended the meeting (20 members, 2 contract personnel, and 42 friends and visitors). Members of the FHWA Asphalt Binder ETG that were in attendance at the February 2010 meeting included:

Gaylon Baumgardner, Paragon Technical Services (Chairman)

John Bukowski, Federal Highway Administration (Secretary)

Chris Abadie, Louisiana Department of Transportation

Dave Anderson, Consultant

John D'Angelo, Consultant

Darren Hazlett, Texas Department of Transportation

Gayle King, GHK, Inc.

Mihai Marasteanu, University of Minnesota

Bob McGennis, Holly Asphalt

Bruce Morgenstern, Wyoming Department of Transportation

Ioan Negulescu, LSU

Gerald Reinke, Mathy Construction

Henry Romagosa, ICL Performance Products LP

Geoff Rowe, ABATECH

Fred Turner, WRI, Acting for Ray Robertson

Kevin Van Frank, Utah Department of Transportation

Ludo Zanzotto, University of Calgary

Liaison Members: Dr. Edward Harrigan, NCHRP
 Mr. Mark Buncher, Asphalt Institute
 Dr. David Newcomb, NAPA

Meeting Coordinator: Lori Dalton (SME, Inc.)

Meeting Notes: Harold L. Von Quintus, (ARA, Inc.)

[Attachment A is the meeting agenda, Attachment B includes a listing of the ETG members, and Attachment C includes a listing of the Binder ETG Working committee members]

“Friends” of the FHWA Asphalt Binder ETG that were in attendance included:

Haleh Azari, ARML
Hussain Bahia, University of Wis.-Madison
Satish Belagutti, FHWA/ESC, Inc.
Alexander Brown, Asphalt Institute
Audrey Copeland, FHWA
Matthew Corrigan, FHWA
William Criqui, Road Science, LLC
Raj Dongré, DLSI
Mike Farrar, WRI
Frank Fee, NuStar Asphalt
Lee Gallivan, FHWA
Nelson Gibson, FHWA
Beth Griffin, DuPont
John Haddock, Purdue University
Elie Hajj, University of Nevada at Reno
Tom Harman, FHWA
Mike Harnsberger, WRI
Rick Holmgreen, Conoco Phillips
Bob Humer, Asphalt Institute
Sang-Soo Kim, Ohio University
Bob Klutz, Kraton Polymers
Dallas Little, Kraton Polymers

Shauna Tecle Marian, US Oil
Richard May, Shell Sulphur Solutions
Jeff Mentel, Malvern Instruments
Ala Mohseni, Consultant
Karissa Mooney, NuStar Asphalt
Chuck Paugh, FHWA/ESC Inc.
Katherine Petros, FHWA
Don Powell, San Joaquin Refining Co.
Simon Prout, Malvern Instruments
Judie Ryan, Wisconsin DOT
Shadi Saadeh, CA. State Univ./Long Beach
Delmar Salomon, Pavt. Preservation Sys.
Scott Sension, Anton-Paar
Ed Starbuck, San Joaquin Refining Co.
Bob Staugaard, Asphalt Pavt. & Recycling
Darin Tedford, Nevada DOT
Nam Tran, NCAT
Eric Weaver, FHWA
Randy West, NCAT
Jack Youtcheff, FHWA

Monday, 22 February 2010

1. Call to Order – Gaylon Baumgardner (Paragon Technical Services), Chairman

Welcome and Introductions – Chairperson Gaylon Baumgardner called the meeting to order at 8:05 AM and welcomed all participants. An attendance sign-up sheet was distributed for all members and visitors to log their attendance at the meeting.

Secretary Bukowski reported that copies of the meeting agenda are available but are the same as submitted to ETG members prior to the meeting. A few changes to the agenda have been requested, which will be noted later in the meeting.

Chairman Baumgardner thanked NCHRP and Edward Harrigan for hosting the meeting and FHWA-HIPT for sponsoring the Binder ETG meeting webcast to those who couldn't attend.

2. Approval of the September 15-16, 2009 Meeting Minutes – John Bukowski (FHWA)

Secretary Bukowski noted that the minutes from the Sept. 2009 Binder ETG meeting were sent to ETG members prior to this meeting. A final copy will be made available shortly after this ETG meeting. Secretary Bukowski asked for any revisions to the meeting minutes.

Chairman Baumgardner reviewed the agenda and noted some changes to facilitate the travel schedule of some members.

3. Review of Action Items from Last Meeting – John Bukowski (FHWA), Secretary
Bukowski reviewed the action items from the September 15 and 16, 2009 Asphalt Binder ETG meeting. The following is a listing and status of the action items from the Sept. 2009 ETG meeting.

1. John D'Angelo to prepare a draft stand alone specification for the MSCR test method, including precision and bias statements and submit to the ETG by December 15th 2009.

UPDATE: Action item is not included on the agenda. John Bukowski reported that this MSCR test method is being balloted to remove from AASHTO M 320, table 3 and make it a standalone specification. John D'Angelo reported that the final ballots for this item are being tabulated, but was unsure about the results from the ballots. Bob Kluttz thought that the ballots had already been tabulated and received a new copy from AMRL and the new version is MP19. John Bukowski said that, usually it will come back to Tech section after the ballot to see if there are any negatives to be addressed. He felt that there will be debate and discussion on this topic, because a number of agencies are confused about putting the criterion in table 3 of the specification. He felt adding the criterion to Table 3 downplays the value and significance of the MSCR.

2. Mike Anderson will submit the implementation recommendations of the Asphalt Institute for MSCR test method to the ETG for review for the next ETG meeting by December 15th 2009.

UPDATE: Action item included on the agenda and the report will be given by John D'Angelo. Bukowski reported that he has not seen the final implementation plan, but that a few implementation items have been posted on the website. He asked John D'Angelo if there were any changes to the previous implementation recommendations for the MSCR draft. D'Angelo noted that these will be discussed later in the meeting and during his presentation.

3. John D'Angelo will prepare a proposed study of cylindrical mix DSR fatigue vs. conventional mixture fatigue testing four point bending beam fatigue and any other commonly used mix fatigue tests and forward to the ETG Chair for distribution to the members.

UPDATE: Action item is not included on the agenda. D'Angelo reported he thought this item had already been done. Gaylon Baumgardner noted that D'Angelo was to propose a study and experiment. D'Angelo reported that an experimental study and plan had not been developed. D'Angelo noted that the bending beam is an empirical test and it is difficult and complex to get a comparison between the different test procedures – all you are going to get is a comparison of test procedures and he does not see any value from this type of study. D'Angelo recommended that this not be continued; all it gives you is a general ranking. Baumgardner summarized and noted the reason behind this action item and the reason for requesting this study.

4. Gerald Reinke will draft procedures concerning PAV de-gassing (Method A and Method B) and will send out the proposed procedures to the ETG members for review and comments by December 15th 2009 for the next ETG meeting.

UPDATE: Action item included on the agenda and the report will be given by Reinke.

5. John D'Angelo to lead the task group force to draft a test procedure for best practices for the use of poly phosphoric acid by December 15th 2009. The task group includes John D'Angelo, Gerry Reinke, Gayle King, Terry Arnold, Henry Romagosa, Olga Puzic, Jean-Valery Martin, Fran Miknis, and Mike Anderson.
UPDATE: Action item included on the agenda and the report will be given by D'Angelo.
 6. John D'Angelo & Raj Dongre to prepare a research needs statement on the use of reclaimed/recycled motor oils and its effects on mixture performance and Olga Puzic will help provide the references by December 15th 2009.
UPDATE: Action item included on the agenda and the report will be given by D'Angelo.
 7. Gerald Reinke and Geoff Rowe to prepare a proposal for continued BBR temperature saturation with Lion Oil asphalt as the control asphalt and include at least three additional asphalt sources to investigate micro-cracking and healing based on results from the wax study that was conducted from the previous ETG; by December 15th 2009.
UPDATE: Action item included on the agenda and the report will be given by Rowe.
 8. FHWA will report data on DSR mold testing at the next ETG meeting. DSR test results will be from the binders from the molds with retention times of 0, 0.5, 1, 2, 4, and 8 hours on RTFO and PAV aged conditions.
UPDATE: Action item included on the agenda. Matt Corrigan and Kevin Van Frank will give the report.
 9. David Anderson and Darin Hunter will work together to discuss the DSR temperature equilibrium issues and the discussions will be continued at the next meeting.
UPDATE: Action item included on the agenda.
 10. Hussain Bahia will prepare a draft AASHTO procedure for the linear amplitude sweep test in the binder yield energy test and will be distributed to the ETG members for review and comments by January 15, 2010.
UPDATE: Action item included on the agenda.
 11. WRI will make a presentation on DSR testing using the smaller sample 4 mm plates at the next ETG meeting.
UPDATE: Action item included on the agenda. Mike Farrar will give the report.
- 4. High Temperature Task Group**—John D'Angelo (Consultant) and Mike Anderson (Asphalt Institute). Mike Anderson not in attendance.

Presentation #1 Title: *Understanding and Implementing the Multiple Stress Creep Recovery (MSCR) Test and Specification*; John D'Angelo

Summary of Presentation:

D'Angelo noted that there many questions about the implementation of MSCR test method which Asphalt Institute has been working and this presentation was to provide the status of

implementation and to initiate discussions if there are any additional issues need to be addressed regarding MSCR. . D'Angelo presented Table 3 that is proposed in M 320. He mentioned that the proposed M320 Table 3 will look exactly the same with all the notes if it becomes a standalone specification. The test procedure is already in place and published. The biggest difference with MSCR specification is that there is no grade bumping, to address the traffic loading and is accomplished by the Jnr value, because grade bumping significantly changes the properties of the binder. D'Angelo reported that some individuals have reported that Jnr does not work, but he disagrees with those comments based on their data. His presentation was grouped into five areas; Percent recovery and its use, repeatability and reproducibility activities, educational activities, implementation activities, and implementation guidance.

D'Angelo defined and explained the rationale for percent recovery. The percent recovery measurement/term can be used to identify and quantify the effect of polymers in asphalt. Even highly modified binders have some delayed elastic response. There was discussion between Dave Anderson and D'Angelo regarding some of the terms included in the presentation and their definitions (delayed elastic response, percent recovery, etc.).

Geoff Rowe asked how the Percent recovery vs. Jnr curve was to validate polymer modification. D'Angelo noted that the line came from looking at know formulations with different polymers blended and tested at different temperatures. This represents the accumulation of a lot of materials plotted on the graph – lots of suppliers and manufacturers of polymer modified binders and drew a limit where the know binders with no polymers did not meet the criteria. D'Angelo noted that a stepped table or scale has been proposed to be included in the specification was based on requests from agencies, and will be added to AASHTO test procedure. Henry Romagosa noted that there is no AASHTO specification on that item, but there are guidelines that agencies can follow.

D'Angelo included a slide in the presentation that compared different modified asphalt binders. He also presented a summary of the fatigue evaluation. In summary, D'Angelo's opinion is that the MSCR appears to identify not only the polymer amount, but what the polymer is doing to the binder. Other test procedures or methods do not have this capability.

D'Angelo acknowledged the laboratories that participated in the repeatability and reproducibility study. These included the FHWA, MTE Services, Paragon Technical Services, PRI Asphalt Technologies, Kraton Polymers, Nevada DOT, and the Asphalt Institute. D'Angelo also overviewed the range of materials that were included in the study.

- Variability in recovery is unaffected by the recovery magnitude.
- Variability of Jnr appears to be a function of the Jnr magnitude.
- Standard deviations of the test results are small for this test method.

D'Angelo overviewed the workshops (Rocky Mountain and the Northeast Asphalt User Producer Groups) and other meetings that have been sponsored to date to understand and implement the MSCR test and specification. The workshops went well and were focused on the background, justification, basics and testing considerations. He mentioned that the Asphalt Institute is committed to conduct more of these workshops in the coming months. As part of the

educational activities, D'Angelo recommended the preparation of a technical bulletin or brief that would define the use and purpose of the MSCR test and specification. In fact, the technical bulletin is in the process of being prepared by the FHWA.

D'Angelo also overviewed the experimental study to determine the repeatability and reproducibility of the test method. All DSR manufacturers can run the test but the data will have to be transferred to a data analysis routine. No script is available to analyze the MSCR data from the DSR. Baumgardner asked if all manufacturers have the script to analyze the data. Karissa Mooney replied that only some of the older instruments do not have the script; all others have the data script.

D'Angelo mentioned that there is an Implementation guidance document that Asphalt Institute has put together, which describes how to do implementation for State agencies. He expects to Table 3 to replace Table 1 in M320 specification. Implementation should start this year. Individual agencies will have to determine their own standard test temperature.

D'Angelo presented an overview of the implementation guidance or plan for AASHTO M320. This topic or part of the presentation resulted in a lot of discussion. D'Angelo noted that there is no straight comparison between the binder characterization using the different methods or specifications. D'Angelo used an example for the implementation discussion; PG76-22 is the standard binder used all across the U.S, so it may be over-conservative in some areas or conditions? D'Angelo opinion is that the MSCR really starts to tell you the rutting resistance of the binder. Dave Anderson asked if you define the climate temperature and other information for the shadow testing. D'Angelo replied that this has been discussed in other meetings. The climate temperature is the design temperature for the binder.

D'Angelo also noted that the criteria of $G^* \sin \delta$ on the PAV aged material for Heavy, Very Heavy and Extreme grades is now changed from 5000 kPa to 6000 kPa. This was changed because of the binder that were tested at PG 70's and 76's will be now be run at the design temperature of 64°C and the PAV testing will have to be conducted at much colder temperatures and the binders will not pass the PAV criteria and this value was raised to 6000 kPa.

Kevin Van Frank stated that there is confusion about the design or climate temperature regarding temperature with depth; in other words, what temperature is selected for the climate temperature. D'Angelo replied climate temperature is the pavement temperature 1 inch below the surface for 95% reliability.

Rowe asked about the grade definition and the reproducibility of the stepped function or scale that had been recommended (the D'Angelo curve), and what is the lower limit on the extreme part of the curve. D'Angelo went back to the Table of MSCR % Recovery minimum values and it was 45%.

D'Angelo summarized the round robin test program and what will be need to be done to bring the agencies up to speed on what they will be looking at and what they will be testing.

D'Angelo presented notes to user agencies for implementing the AASHTO M320.

- AASHTO M320 Table 3 should be used without modification.
- Shadow testing is only indicative of current products and formulations.
- MSCR recovery is not currently included in Table 3 as a specification.
- MSCR recovery should replace other "Plus" tests.
- Do not expect a strong correlation between MSCR recovery and Table 1 "Plus" test.
- Regional implementation is preferred.
- Table 3 is an improvement to the current system (Table 1).

ETG Discussion, Comments, and Questions:

Gerald Reinke believes that for some locations and conditions, when you are adding a small amount of modifier, you will meet the Jnr value but not the percent recovery specification.

Percent recovery is only there for those that want to ensure that the polymer is there. Recovery is not always required – below 2 or above 4, percent recovery is not needed.

Gayle King asked if we building traffic speed into the system and do we need to build LTPP Bind into this process? D'Angelo replied yes, eventually. LTPP Bind makes a recommendation for bumping the grade depending on traffic speed and other conditions. It works quite well at normal traffic conditions; you should consider stiffness rather than temperature variations.

Frank Fee suggested that this be considered as an action item – relationship to recovery. It is in the test procedure, but not specified; there is no cross referencing. There should be some relationship or cross referencing between the two. Bukowski summarized; the action item is to take the elastic recovery specification to AAASHTO. Baumgardner asked how can we get a recommendation to those States who use Percent Recovery. John said, that is why they put the table into the test procedure. Fee commented that it is a lot easier to get these items into the procedure now, rather than later.

ACTION ITEM #1: John D'Angelo to prepare a recommendation to AASHTO for a footnote to be added to MP 19 referring to TP 70 percent recovery guidelines. The deadline for this action item is before summer of 2010.

Presentation #2 Title: *Precision Estimates of TP70-5 – Multiple Stress Creep Recovery (MSCR) Test*; Haleh Azari (ARML)

Summary of Presentation:

Haleh Azari summarized the precision estimates for the MSCR test procedure and the basis for estimating the precision of the test method. The coefficient of variation was used for estimating precision. Azari summarized the results from the analyses in terms of a single-operator precision and multi-laboratory precision (coefficient of variation and acceptable range of two test results). These were presented in a tabular format [the numbers in red on the slides are the Asphalt Institute values previously reported]. As part of the presentation, Azari reported the total number of laboratories participating in the study, the number of outliers, and the total number of tests or

data points included in the analysis. The following summarizes some of the findings and conclusions presented by Azari.

- High correlation between the average and standard deviation.
- No correlation between the average value and coefficient of variation.
- Jnr-diff and R-diff have very low reproducibility.

Azari briefly overviewed future work for this topic. In summary, the next step is to include the PSP binder; PG 70-28 in the analysis which will out this fall.

ETG Discussion, Comments, and Questions:

Gayle King and John D'Angelo discussed the comparison of repeatability on the precision estimates of R-diff and R-0.1. D'Angelo comment; temperature and stress are only an estimate, and for some binders, slight deviation in these parameters will make large differences in the test results. D'Angelo's example; 0.1 and 3.2 kPa - must consider the actual difference. In terms of the difference, this only catches unusual materials, even though it has high variability. Some binders are sensitive to small changes in temperature, and this was intended to catch those binders.

Mike Anderson's data showed that at low stress levels, the variability did increase. Bob Klutz commented that comparing a controlled environment to a less controlled environment - the multiple laboratory values are not changing that much. Baumgardner comment; the new specification might need to be reviewed because Jnr difference information is not in the current specification.

Dave Anderson commented that the number of outliers were dependent on the coefficient of variation (COV) values – it seems that the number of outliers appears to be quite large. D'Angelo agreed with Dave Anderson in that they are large, but not necessarily unusual for a new test. After more agencies become familiar with the test, the variability will decrease. Some of the users may also have a faulty spreadsheet. Dave Anderson recommended that outliers be red-flagged. Frank Fee asked if you are collecting the information on what rheometers are used and how those values are being calculated and recorded. Haleh said that AMRL has that information. Karissa Mooney replied that they were calculating on the script provided and had the Asphalt Institute validate that data script.

Gerald Reinke believes that this is not a difference in Jnr but is a representative of the stress sensitivity of the material. He suggests that we should go back to using that terminology. He believes that this may be an error included in the data reported.

Frank Fee asked if there are standard test and calibration procedures. There was much discussion on proper calculation procedures. Azari replied that the data checks should have caught most of the incorrect calculations that were submitted during the study. Reinke commented that variability might be from whether the agency is using their own procedure or the manufacturers script in reporting the data and making the calculations. Azari did not believe that was the source of the outliers and errors.

Gayle King noted that you cannot use this test method for some emulsions that are very soft. They obtained negative percent recovery values when temperatures were outside the range of the rheometer.

5. Binder Study on RAP Blending—John D’Angelo (D’Angelo Consulting)

Presentation Title: *How Does RAP Really Blend in HMA and WMA*

Presentation Summary:

John D’Angelo overviewed the presentation and explained need to look more fundamentally as to what is happening to the mix when RAP is added to HMA and WMA mixtures.

D’Angelo presented an overview on the amounts of RAP allowed for use by agencies for different mixtures (surface versus base mixtures). D’Angelo summarized that we need to look closer at what is happening in RAP mixtures. Can we explain some of the strange test results on testing RAP mixtures? He referred to Rebecca McDaniel’s study on testing RAP mixtures made through a plant; the stiffness measured was softer than expected. Was this finding or observation an anomaly or can it be fundamentally explained? D’Angelo overviewed his perspective on how to identify RAP in a mix and verify the blended properties of the RAP mixture.

ETG Discussion, Comments, and Questions:

Clarification was made that the SARA analysis is a chemical analysis to look at saturates, aromatic, resin and asphaltenes fractions. A suggestion was made to replace those by four fractions that are in ASTM that are basically the same fractions.

When you mix aggregate and binder in the lab do you get the same type of mixing for RAP that you get for the aggregates? Is the film thickness the same? It appears that the binder would adhere to aggregates differently than RAP and that might affect the film thickness. Belief that the film thickness for RAP aggregate is less than compared to the virgin aggregate. D’Angelo wasn’t sure whether he agreed or disagreed. This is a complicated issue when you start mixing different materials together, and trying to determine whether it is neat or RAP asphalt. It was thought that maybe we are just coating the RAP with new binder.

Asked, why do we need to know whether RAP and Virgin is mixing? The real reason to know is for the blend charts, because they assume 100% blending, which is probably not the case. D’Angelo commented; the area of the weakest link is fatigue testing. Are our estimates reasonable of what is taking place? If we had a better understanding of the blending, we might be able to establish a better mix testing plan to ensure the blending is taking place in the laboratory and through the plant. Dongre comment, one observation is when you use the blending charts, you lower the binder grade. This now softens the mix and may hurt you rather than help you, in terms of the mixture properties. Dongre’s opinion is that RAP will have a thicker film rather than the neat asphalt.

Frank Fee asked how are you distinguishing this issue of isolating this highly polarized oxidized material in the RAP, and how much of the old binder has become viable in terms of asphalt

rather than just the old binder on the rock (black rock) because we are not getting complete blending? Unsure how this could be achieved. The problem is getting the hard component out of the process. How do you relate that to what is viable in terms of the asphalt? D'Angelo answered that you will see differences in that recovered material. The recovered binder is the issue.

One thought was that highly oxidized material is what remains on the rock. John D'Angelo corrected that the highly polar materials stay behind, so what you test is the softer asphalt and only the softer materials of the mix.

Noted that there is a more fundamental question or concern. You get heterogeneous material when mixing two materials, but we have no way to look at that material when RAP and virgin asphalt are combined. However, dynamic modulus versus percent recovery will be different when you start looking at the two materials in different states.

Why are you blending in the virgin material? If you want to see the effect, why not leave the virgin binder out and mix different amounts of RAP and different times keep it hot and take out the coarse aggregate and extract the coarse aggregate only and see if there is any change in the properties of material of the extract of coarse aggregate over the mixing times. Because when we are designing the RAP we want to determine what is the nature of the binder in the RAP and how we are going to mix it. Noted that this could be done, but the problem is that you would miss the solvent effect of the virgin binder to give better heat transfer to mix with the RAP material.

Asked if it is worth the effort, during the extraction process, to try some shorter extraction with a weaker solvent and do first extraction and then use heavier solvent to remove harder asphalt and see what you get? One reply was that you have to use caution when using partial extractions with different solvents. Must be careful about the solvent you used.

Randy West asked how does this experiment help us with mixture design and testing. D'Angelo replied that fatigue and low temperature cracking is where it will help. This will help address the question of whether this is black rock or something different. West's opinion is that we do not have good or accurate enough tests for judging the impact of RAP on mix tests that are mix specific. D'Angelo commented that this is not to circumvent the mix tests but to supplement them and use them more effectively.

We need to be working towards how we identify properties of RAP in mix design and performance. D'Angelo agreed with comment, and is trying to eliminate one of the variables through this experiment.

Baumgardner asked where do we go from here, and who is going to work on this? D'Angelo replied that he has talked to some of the ETG members on this topic. D'Angelo requested ideas from ETG on whether this is worthwhile and if it is, how do we go forward? In addition, do we do this as an ETG coordinated effort? Audrey Copeland noted that FHWA has a current study looking into binder blending and how it relates to mix properties. Results from a high RAP field study in Florida and test results using procedure to measure mixture dynamic modulus, it appears

that we are not achieving full blending. The on-going study at FHWA and data on laboratory simulation will be reported back to the ETG.

Frank Fee suggested getting a group to look into this. Bukowski noted that there is a RAP ETG that would need to be involved in this effort. Others commented this is becoming a binder issue and that is the reason for bringing this up to this ETG.

Frank Fee asked D'Angelo will put together an item on what needs to be done. It was asked if the efforts would involve mixture testing. D'Angelo replied; not at this time. The first part is to confirm that we see differences in the binder and the second part is related to the mix.

ACTION ITEM #2: John D'Angelo was requested to summarize the issues needed to be addressed for a RAP study. All comments to be provided back to Baumgardner prior to the next meeting.

6. DSR Specimen Preparation—Matt Corrigan (FHWA) and Kevin Van Frank (Utah DOT)

Presentation #1 Title: *Effect of Steric Hardening on DSR Test Results*

Matt Corrigan gave the first presentation, but acknowledged others in the opening introduction to this presentation (Mike Anderson and John Bukowski).

Presentation Summary:

Matt Corrigan first acknowledged all participating in this effort, which included; Dave Anderson, Satish Belagutti, and Mike Beavin. He started the presentation with an overview and summary on the history of this topic (test results and studies), dating back to the SHRP program. Corrigan requested that Dave Anderson make any additional comments related to the binder fatigue study that was conducted by PSU on this topic (time dependent property for steric hardening). Dave Anderson commented that this is continuous loading with no rest period, not repeated loading, so the properties are not destroyed by shear. Tests were performed at the equiv-viscous temperature.

Corrigan overviewed the experiment; what materials were included and tested, and the conditions of the materials during testing. The purpose of the experiment was to define the extent that steric hardening impacts test results; not to determine if steric hardening occurs.

Corrigan summarized the test procedures, specimen preparation, and time differences that the specimens were kept in the mold for the experiment. He presented the results from this experiment in terms of graphs that show the binder property as a function of time held in the mold. In the interest of time, Corrigan only focused on a few of the test results to give an example of what was done. He concluded with a summary of results from the experiment, that for the limited binder type used in the study, the time specimens were kept in the silicone mold had no statistical effect on the DSR test results. Corrigan cautioned about extending this finding to other binders because steric hardening is binder specific and the results for other binders could be different. Consequently, there is insufficient data to suggest changing the AASHTO test procedure to allow longer than 2 hours.

ETG Discussion, Comments, and Questions:

Commented that it appears that the findings from this study support the hypothesis that steric hardening is unimportant within this scale of factors or experimental parameters. However, what we have yet to determine is the effect of wax; these are different mechanisms. Suggested testing one or two original materials will help us understand whether wax crystallization could be a problem.

Ludo Zanzotto disagreed and commented that steric hardening is important; time is specified in most test procedures because of the time effect on testing asphalt. Any study should include the time parameter. Dave Anderson agreed with Zanzotto, and commented that if steric hardening is unimportant why not eliminate time from penetration testing. If you conclude that steric hardening is unimportant, how can you discount the data previously presented by Dave Anderson. Dave Anderson also disagreed with the other comment that steric hardening and wax crystallization are different. Dave Anderson's opinion is that they are indifferent in terms of the binder properties being measured.

Presentation #2 Title: *DSR Aging Study – Time held in Silicone – Mold Vs Stiffness*

Kevin Van Frank (Utah DOT) gave the second presentation on this topic area.

Presentation Summary:

Kevin Van Frank gave the background for his presentation and overviewed the study experiment and matrix in terms of what binders were included in his test program. Van Frank showed the test results from testing of his selected binders at different aging times and with different aging conditions. Van Frank showed the results from the variability analysis using an ANOVA to determine whether the results were different between different storage and aging times. His conclusion was that storage time did not make a difference in the test results.

ETG Discussion, Comments, and Questions:

Baumgardner asked if the task group was ready to make a recommendation; either keep it the same or suggest a revision. Van Frank replied; I would recommend that we drop the constraint on the laboratory time and allow them to test within a shift given that we can demonstrate that it makes any difference.

Dave Anderson asked if we should remove the time limit for the penetration test. Van Frank replied; no. Dave Anderson commented that if time is a factor in the penetration test and it should be important for the DSR.

Corrigan asked if we are you using the 1S values that have been reported and what storage times were used to determine those values. Van Frank noted that there was no time limit. Dave Anderson commented that the 2.8 number is there because you are comparing two samples and believes that is not what Van Frank was doing. Van Frank agreed with Anderson's comment. But if you looked at the data on a piece by piece basis, the 2-f statistics values suggest that they are different. Shauna Tecle Marian made a comment that they are looking at a similar program to gather data to determine the effect of time, and she is willing to share that data with the group at the next ETG meeting.

Baumgardner commented that there enough disagreement in this group that we are not prepared to recommend an changes to AASHTO. Is this something that ETG wants to continue to look at or wait until we get the data from Shauna and discuss it? Gayle King noted that wax is the other issue or controversy. King noted that the ETG does not have access to the data at present time. This data should tell us that information. His opinion is that if there is no change over time, then wax is a non-issue.

Baumgardner asked if there is such controversy that we cannot recommend a change to the current test protocol, where do we go from here? Karissa Mooney commented that this is a laboratory issue. If you cannot manage your lab properly to get the test results back in a timely manner, then you are not managing your laboratory. Much agreement with that comment.

Baumgardner noted that this issue is still undecided. If anyone has data to make a recommendation, present it at the next ETG meeting for discussion and possible draft recommendation for the time to perform the DSR test.

ACTION ITEM #3: DSR specimen preparation task group (Matt Corrigan (lead), Dave Anderson, Kevin Van Frank, and Gerald Reinke) to draft a recommendation for time to perform the DSR test (from preparation of specimen to completion of DSR test). The task group will consider an evaluation of effects of steric hardening on MSCR results. As a second part of this action item, Baumgardner asked any member with data on this topic to share it with the task group and ETG prior to the next meeting. (Shauna Tecle Marian volunteered to share their data with the ETG at the next meeting.)

7. Update on ABDC Device—Sang-Soo Kim (Ohio University)

Presentation Title: *Asphalt Binder Cracking Device (ABDC): Update*

Presentation Summary:

Sang-Soo Kim presentation was divided into two parts. The first was a summary of results from the ILS plan and the second part was on reducing the variability of the ABCD test procedure through the use of different specimen preparation techniques.

He started with an overview of the binders included in the ILS plan (ASTM C 802). The overview included what was tested, testing condition, and number of laboratories involved for comparing the data to other testing efforts (BBR was used in comparison to the ABCD). Kim summarized the test results from all laboratories involved in the plan in terms of critical or cracking temperature and its variance, as well as for the strain jump and its variance. He tabulated the precision of both devices as determined from this experiment. The precision of the devices was presented in degrees C temperature differences rather than percent difference. Kim does not like to use the percent difference and used actual temperature differences in the presentation.

Kim identified and listed some of the major sources of error, which included trimming the specimen (they are now working on a no-trimming process) and the ring design without the cover. He noted that these major sources of error are a training issue in using the device. He then presented the procedure, experiment, and data or test results when using the no-trimming technique and open ring ABCD. Kim showed photographs of closed and open rings, and the ABCD pouring device used in the experiment.

Kim summarized the important parameters identified from the ANOVA on what is affecting the test results or potentially adding to the variability of the test procedure. He concluded with a comparison of the trimmed and no-trimming specimen preparation techniques. His findings and conclusions related to using the no-trimming procedure are; the ABCD cracking temperature is not significantly affected, the repeatability of the ABCD strain jump at fracture is significantly improved, a significant reduction in specimen preparation time, and the between lab variability is expected to be reduced.

ETG Discussion, Comments, and Questions:

Raj Dongre commented that he tried the no-trimming procedure but determined that you cannot get a consistent cross section which may result in a difference in test results. They always had an issue with the no-trimming procedure, so they went to using a constant cross section by over filling and then trimming. Second point is if you look at your variability data you could be half a grade off. If you remember the T-critical that we did using SAR our maximum repeatability was 1°C. Thus, Dongre recommended changing between-lab and within-lab variability the actual temperature difference to a percentage change because 3°C is a large temperature difference.

Bob Kluttz commented on the syringe that was used for filling the ABCD device and why it was selected. Kim commented; we tried 5 different types of pouring devices and the syringe was more accurate. Dongre commented that he is unsure whether using a syringe in filling the device is a good idea. His point was related to the melt index that was previously noted as an issue because of high shear. Some believed that this should not be a problem.

ACTION ITEM #4: Sang Soo Kim will forward the draft test procedure for the “ABCD test procedure” to the subcommittee on Materials Tech Section 2b (Eileen Sheehy; New Jersey DOT).

8. Task Group Report on PPA and Modification—John D’Angelo (D’Angelo Consulting)

Presentation Title: *Polyphosphoric Acid Modified Asphalt Binders – Usage, Why, How*

Presentation Summary:

John D’Angelo’s presentation focused on a review of recent studies and the PPA workshop that was held in April 2009. It was grouped into two areas; usage of PPA and why use PPA. D’Angelo started with a review of PPA experience in the U.S. that was summarized from the workshop. He then identified several previous studies (FHWA, Baumgardner, Arnold, and Dongre) that focused on determining the PPA reaction with the binder and polymer. Moisture sensitivity and fatigue cracking were two important topics identified in the presentation.

D'Angelo plans to take the papers and survey information accumulated from the PPA workshop and draft a TRB circular and best practices document by late spring of this year.

ETG Discussion, Comments, and Questions:

Bob McGennis noted that there is a parallel on-going effort in this area. AAPT is sponsoring a symposium in this area and has asked for written papers. McGennis asked everyone to consider a paper or presentation could be done on this subject. Frank Fee asked whether D'Angelo was getting the workshop participants to assist in writing the TRB circular and best practices document. D'Angelo replied that he is responsible for writing the circular but is planning to have the other participants review it.

9. Motor Oil Modification: Research Needs Statement—John D'Angelo (D'Angelo Consulting)

Presentation Title: *UTI (Useful Temperature Interval) of Performance Grade Asphalts*

Presentation Summary:

John D'Angelo noted that he was asked to put together a research needs statement on the use of motor oil modification for asphalt binder. The purpose of this presentation was to present that research needs statement. D'Angelo distributed a preliminary draft of the research needs statement to the ETG members for discussion and comment.

D'Angelo made a short presentation on some of the issues to be included in a research needs statement. In summary, modifications with motor oil types are being used to extend the lower temperature of the binder grade. After discussion with a number of others, D'Angelo prepared the initial draft of the research needs statement. D'Angelo requested that the ETG members provide any comments.

ETG Discussion, Comments, and Questions:

In response to comments about extending the low-temperature properties of binders, Raj Dongre commented that the way we determine the m-value is driving the base asphalt. Use of the m-value only allows you to extend the asphalt some, as per the specification. D'Angelo commented that it is not only the specification that drives the m-value.

Henry Romagosa commented that it will be critically important to define specific terms and issues addressed by this research statement, and asked; what is the definition of recycled oil? D'Angelo replied that this should be part of the discussion to identify what should be included so that we get what we need. Noted that consistency between these materials is important. These materials are highly variable. Karissa Mooney asked if metals content are part of the problem statement, because this is one item that they have run into regarding the variability of these materials? The research needs statement should note that metal content. D'Angelo replied that a chemical analysis needs to be included in the research statement.

Jack Youtcheff noted that one of the concerns with motor oils that have associated with detergents might give rise to stripping problems.

Noted that one concern in this problem statement is low cracking temperature, what about flushing? It is felt that the high temperature MSCR should take care of that problem, if that is a problem we can include in the problem statement. Recommended that a linear viscoelastic analysis of the materials be added to the research needs statement.

What are the economics of the recycled oils? One opinion is that the study must consider the economic impact of trying to use recycled oils, and they are largely used as fuels without extra processing. D'Angelo replied with a different example or purpose of the study; when you use these materials in asphalt, what are the performance issues? The problem statement is not to encourage their use, but rather deal with the issues when used, then what are the effects.

Need to identify or explain the terminology used in the research statement, whether this is something different than base oil or refined base oil, and why these materials are being considered for use.

Everything cannot be included in the study. However, suggested that the study include materials that are strongly s-controlled and m-controlled. Consider materials with very different crude sources with temperature relaxation properties. There was a lot of discussion on what to include; the key issue is preparing the research needs statement without dictating the work to be done. This is only a research statement and should give direction but not specify everything to be done and considered.

Ed Harrigan commented that from the NCHRP point of view the panel will use an outcome basis format for preparing this type of research statement. You can write the outcome you expect and then leave it at that, which puts all of the work on those that prepare a proposal. This makes it easier for the panel to discriminate in the proposers. Dave Anderson agreed with Harrigan that this needs to be an outcome-based research statement, rather than a task driven statement.

It was noted that this study is much needed. Bahia noted that there is a group which believes that these materials do cause physical hardening. He believes that this issue needs to be addressed quickly. Ludo Zanzotto commented that the evaluation is not simple and results will vary. He explained some of the issues. His point was that this research will need to be done differently than under a standard NCHRP project. Opinion is that this is a very complicated and diverse study.

Baumgardner requested that the ETG members review the draft statement and provide comments to D'Angelo as soon as possible.

10. ALF Binder Aging Fatigue Study—Nelson Gibson (FHWA)

Presentation Title: *Summary of Binder Fatigue Findings from FHWA ALF Plus Full-Scale Accelerated Aging Activities*

Summary of Presentation:

Nelson Gibson summarized the full-scale accelerated fatigue and aging activities from the ALF study at FHWA. This is a follow-up ALF study and is being presented to get the ETG input. Gibson started the presentation with an overview of the background of the study and definition of the intermediate temperature.

Gibson summarized the experiment and the binders and materials included in the test program. The experiment included both fatigue cracking and rutting, but he only presented the fatigue cracking results. Gibson showed a summary of the ranking of the fatigue cracking tests for the 100 and 150 mm thick sections. He then overviewed the forensic investigation conducted on Lanes 11 and 12 to determine whether there were cracks on the underside of the pavement that have yet to be exhibited at the surface of the pavement. They found no visible cracking at the surface or bottom of the pavement. Conclusion was that the seismic testing was able to assist in ranking the different lanes or mixtures relative to fatigue cracking. He also showed a comparison of measured and predicted fatigue cracking using the MEPDG.

Gibson reviewed the three different binder parameters used in the analysis; stiffness reduction (time sweep, stress sweep, large strain time sweep surrogate), strength (binder yield energy), and fracture (critical tip opening displacement). Big difference between time sweep and stress sweep results in comparison to field results. Stress sweep ranked the materials in a different direction. The large strain sweep surrogate used was the binder yield energy test. He reviewed the laboratory scale viscoelastic continuum damage that was used to estimate fatigue performance.

Gibson then reviewed his statistical comparison of the data using the Kendall's tau score for judging each candidate parameter. Kendall's tau score is a composite value used in comparing data sets and is a measure of association. Gibson reported that the stress sweep was the only binder parameter that went in the wrong direction for both the field and ALF tests using both statistical analyses. He also noted that none of the binder tests were more important than the structural related parameters of thickness and modification. A summary of the findings provided by Gibson are listed below.

- Similar PG graded binders exhibit different fatigue cracking performance.
- Effects of construction variation had minimal effect in the MEPDG.
- Composite structure with wet process crumb rubber has the ability to arrest or slow propagating cracks.
- Fibers appeared very effective in reducing fatigue cracking.
- Binder tests cannot readily provide insight for structural effects, fiber modified mixtures and composite pavements.
- There are properties that are more discriminating than $G^* \sin \Delta$ based on full-scale fatigue cracking tests.

Gibson acknowledged the participation of the state DOTs and industry groups that were involved in this study.

Gibson also presented an overview of the ongoing accelerated aging study to double the amount of data points that they now have. In summary, aging at a constant temperature of 74°C for 8 weeks was used to age the mixtures in place and to compare the fatigue cracking results. Within the experiment they observed both top-down and bottom-up fatigue cracks.

ETG Discussion, Comments, and Questions:

A question was asked about the slide that shows the load passes versus cumulative cracking at beginning of presentation. Why did you stop at a different number of cycles for each section? Point to be made is that the grades are different relative to the stretch grades, which could be a different material (the terpolymer was the one that Fee was referring to). Gibson recognized that, but ranked all mixtures at a constant rate or amount of distress. The stretch grade did not turn out to be the grade expected.

Asked if the design or asphalt contents differed? Gibson replied; no, they had the same design, the only one that was different was with the gap graded mix.

Asked how can we rank materials that are being deflected differently or have different deflections? Opinion is that deflections are important related to any structural analysis and comparison of data. Gibson replied that he did not take that into account for the comparisons made.

Dave Anderson asked at what temperature was the test conducted? Gibson replied, at the intermediate test temperature. Dave Anderson's comment was again related to terminology ductile and its meaning. The assumption was no rutting, but Gibson said there was rutting. Dave Anderson asked; how can you conclude that it is fatigue cracking and is not related to the deformation/rutting? Gibson responded that the rutting was not "harsh or intense," but evenly distributed to base and HMA; overall, the rutting is small.

Chris Abadie commented on the PSPA data and variation in thickness relative to cracking regarding the relationship between these two parameters. Is the PSPA variability related to the variation in layer thickness? It was mentioned that the variation in thickness is given in the report. Tom Harman pointed out that the data quality is rich, but there are only a few data points. His point is that these test sections were designed for standard climate conditions in Virginia; not sure if the aging makes these a valid comparison with the other sections.

11. Ground Tire Rubber (GTR) Modified Binders—Gaylon Baumgardner (Paragon Technical Services)

Presentation Title: *Performance Graded Ground Tire Rubber Modified Asphalt Binder*

Summary of Presentation:

Gaylon Baumgardner explained the rationale for this effort. Examined the MSCR regarding crumb rubber modification of binders. Crumb rubber modified asphalt differs from other modifiers so the MSCR is different. Baumgardner is proposing the ETG discuss and debate the current MSCR on the DSR gap; in terms of how the gap affects the results relative to the size of the crumb rubber particles. As part of his presentation, Baumgardner included the Performance-Graded Asphalt Binder Using Multiple Stress Creep Recovery, AASHTO MP 19-10.

Baumgardner presented data from the DSR comparing the 2 mm and 1 mm gaps for determining the $G^*/\sin\delta$. The outliers included on the graph comparing the two gaps are the binders with the larger particles. Thus, Baumgardner recommended and used the 2 mm DSR gap, since all other test results were the same between. The question to be resolved is what particle size and what gap size should be used, and is the gap related to the particle size?

Baumgardner recommended that the ETG look at MP19-10 with the 2 mm gap for all testing and designate the maximum rubber particle size.

ETG Discussion, Comments, and Questions:

Dave Anderson asked if the precision and bias statements that are in the two subject test protocols can be used. Anderson's opinion is that they are probably different and someone should look into that precision and bias statement to ensure it is adequate for the 2 mm gap.

Is this proposed specification for the tire rubber that has been partially solubilized at high temperature? Baumgardner replied applicable to any modified crumb rubber. This is not a proposed specification, rather a recommendation that we might use with MP-19 with these changes to test any rubber modified binder. Klutz responded that the particle size will change making it different. Thus, the question that we need to answer is whether one universal specification is sufficient for all materials.

If using GTR then if States starts implementing MSCR we desperately need something like this.

Ludo Zanzotto commented that there is never any reduction in particle size. His experience is that it increases in size because of absorption of oil. Baumgardner agreed with that comment.

Darrin Hazlett asked how much crumb rubber is needed to qualify for this method. Texas put a minimum on the material so that they can report to their legislature that they used so much material. Baumgardner noted that is why they included one of the notes at the bottom of the table.

Henry Romagosa asked if there is a different percent recovery requirement for these materials. Maybe if you put a little bit of GTR in the mixture, then need a different standard.

John D'Angelo noted that there is a fairly good relationship between Jnr and rutting potential. The percent recovery portion reasonably identified that there was a different material in the binder. But, that relationship between the test tests and performance decreases when using actual

field data. The relationship becomes very crude. The point made by D'Angelo is that this was a simple test to indicate that there was an additive in the binder which delayed the elastic response.

Asked how do you make this a level playing field because there are a lot of different materials in GTR? Bob Kluttz replied that we are not recommending adding any percent recovery to the specification. Baumgardner replied, yes use the same specification or requirement, the only difference is to use a 2 mm gap with crumb rubber.

Baumgardner noted that this will be worked on prior to the next ETG meeting.

ACTION ITEM #5: Task Group will prepare and distribute recommendations to be added to the TP 70 MSCR criteria for evaluating GTR modified asphalt. In addition the task group will make suggestions to address MP 19-10 with respect to GTR modified binders in terms of the gap/particle size limitations. [Task group members include: Gaylon Baumgardner, Audrey Copeland, John D'Angelo, Darin Hazlett, and Chris Abadie]

ACTION ITEM #6: Matt Corrigan will lead a round robin group to evaluate the precision and bias for the 2 mm gap testing of GTR modified binders. Volunteers for this task group to do some of the testing included, Bob McGennis, Gaylon Baumgardner, Chris Abadie, Randy West, and Tom Bennert.

12. PAV Degassing—Gerald Reinke (Mathy Construction)

Presentation Title: *PAV Standard Practice D6521*

Presentation Summary:

Gerald Reinke reviewed a summary from the last ETG meeting. Mike Anderson, Dave Anderson, and Gerald Reinke worked on this standard relative to degassing. Question to be answered is where to put the notation to degas or not to degas? Should it be a further statement in the PAV practice, such as:

- Do not perform vacuum degassing of the PAV residue if only the BBR and PAV DSR tests are to be performed?
- Perform vacuum degassing of the PAV residue if the direct tension test is to be performed.

In addition, should there be a statement in the scope of the BBR and DSR test procedures stating; for performing the BBR and DSR, vacuum degassing should not be performed. The suggested statement in the scope of the direct tension test method stating; vacuum degassing of the PAV residue is required.

ETG Discussion, Comments, and Questions:

Bob Kluttz has a strong preference for not including that information in the practice, but suggests putting in a statement that says perform vacuum degassing only as required per specification. BBR test method would say non-degassing PAV residue and Direct Tension test method would require degassing of the PAV residue.

Reinke asked if this should be referred to in the footnotes in the test specifications. Dave Anderson replied that you do not run the test on degassed materials for the BBR. D'Angelo replied that you need it in the specification. Dave Anderson asked; why do you need it in the specifications? The test procedure notes whether you use degassed or not degassed material in the test method. D'Angelo said that for contractual purposes it should be include in the specifications. Dave Anderson considers this a redundancy. Reinke asked; what is wrong with including it as a footnote in the specification and that is his recommendation (include it in the test specification as a footnote).

Darrin Hazlett thought that the degassing procedure was not necessary. If you run the degassing procedure with the BBR, can you use the data? A summary of the ETG discussion; if you are not running the direct tension procedure, do not use the degassing procedure.

Karissa Mooney asked; after you remove the PAV can, what do you do? The degassing solved a lot of problems with testing polymer modified materials with degassing. Dave Anderson responded; when you take the sample from the PAV, the materials need to be forwarded to one vessel or pan and stirred. His opinion is that we are not changing anything here. Mooney asked; is there a unified temperature for stirring, prior to testing? Dave Anderson replied; yes, in the new write up. D'Angelo disagreed; that is not what the current procedure says. Dave Anderson noted that the re-write addresses that problem. Baumgardner noted that there has to be a recommendation to AASHTO to clear things up. Dave Anderson has clarified those items.

Baumgardner ended the discussion with the assignment to Gerald Reinke and Dave Anderson to prepare the suggested wording to R 28 (PAV) to address the de-gassing requirement.

ACTION ITEM #7: Gerry Reinke and Dave Anderson will prepare and distribute suggested wording to R 28 (PAV) to address the de-gassing requirements and distribute to the ETG prior to the next meeting.

13. WRI Binder Aging—Michael Farrar, Changping Sui, William Tuminello, and Thomas Turner (WRI, Asphalt Research Consortium)

Presentation Title: *Update/Status: 4 mm Diameter Parallel Plate DSR*

Summary of Presentation:

The presentation was made by Mike Farrar. His presentation was grouped into six areas: highlights from the 2010 TRB paper, machine compliance measurements, interconversion, creep compliance, torsion bar, and future work.

Farrar started with an overview of the methodology for using small diameter samples (4 mm) for testing asphalt binders with the DSR. He included a comparison of the corrected and uncorrected machine compliance in the dynamic shear modulus master curve (G^*). WRI used super glue to check the machine compliance using the dynamic strain sweep test. Differences were noted when using the dynamic stress sweep test. The reason for that difference is probably related to inertia.

Farrar briefly discussed the spectrum interconversion process used to transform the relaxation spectrum to the retardation spectrum and vice-versa.

Farrar explained and discussed the thermal stress build up in the system for estimating fracture. This explanation was based on the difference between the torsion bar versus 4 mm DSR regarding temperature differences. Correcting for temperature explained some of the data dispersion, but not all. Farrar then summarized future work in this area and acknowledged the individuals and agencies providing support to this work.

Future work includes: perform 4 mm DSR on recovered binder from cores and binder from thin film aging studies, complete low temperature shear creep and tensile creep tests and compare the results to BBR data, include emulsion residue in terms of how well can BBR $S(t)$ and the m -value be estimated from intermediate temperature DSR, include crack sealant (down to -40°C because it is a softer material), adapt ARC binder fatigue tests to 4 mm plate DSR, and adapt ARC DSR binder healing tests to 4 mm plate DSR. Farrar reported that he liked Mihai Marasteanu (University of Minnesota) thesis on this topic.

ETG Discussion, Comments, and Questions:

Gayle King asked if we are we talking about a lot of cost and effort in going to the 4 mm DSR in terms of training technicians. Farrar replied that it is the same as running the 8 mm plates; there is no real difference. You can test on a strain or stress controlled rheometer. However, you do need a research grade rheometer. Farrar asked for opinions on the approximate costs for a research grade rheometer running the 4 mm rheometer. The values provided ranged from about \$55 to 60K.

Bob Kluttz asked; why can't you put the 4 mm plates into a regular DSR? Farrar responded that his opinion was that you could from his experience.

Dave Anderson asked; how are you running the torsion bar on the plain binder, are you using insert or planting on the binder? Farrar replied that the fixtures have a clamp that is spring loaded with a torque wrench clamping onto the binder. Dave Anderson noted that the clamping may have an effect on the test results, or at least on the repeatability of the data. They used the inserts and the variability in the test results of the binder increased.

ACTION ITEM #8: Continue with the evaluation and analysis of using 4 mm DSR specimens, and prepare recommendations or identify changes to the current test protocol for including the 4 mm specimens.

Tuesday, 23 February 2010

Call to Order – Gaylon Baumgardner (Paragon Technical Services)

Baumgardner called the meeting to order at 8:05 AM, and asked that anyone that did not sign the attendance sheet yesterday to sign it. The meeting was being transmitted via the webcast to those that could not attend in person.

14. DSR Temperature Equilibrium—Dave Anderson (Retired, Consultant) and Darrin Hunter (Anton Parr, USA).

Presentation Title: *Thermal Equilibrium in the DSR*

Summary of Presentation:

Dave Anderson noted that other names should be acknowledged as part of this work and presentation, which include; John Casola and Darrin Hunter.

Anderson first presented the question at hand and gave an overview of specific challenges dependent on temperature that are significant. The important question is does the current test method give sufficient time to allow temperature of test specimen to attain equilibrium, and if the answer is no, what is the consequence?

Anderson then overviewed his perspective on this issue in terms of temperature differences on the G^* value. Temperature equilibrium time is device dependent and used an example to illustrate the wait time of 10 minutes that is insufficient and its effect of G^* versus time. He showed test results from two rheometers to demonstrate the differences. Anderson identified and presented three issues that need to be resolved:

1. Determination of t_{cg} which needs to be quantitative and can be repeated.
2. Is current wait time universally acceptable? The current 10 minute delay is not the cushion time.
3. Can reference fluid be used for determining t_{cg} ?

Definitions are important related to the test procedure; gradients versus equilibrium. Anderson emphasized that he is not talking about gradients or the offsets – only equilibrium. Anderson provided definitions for target test temperature, thermal equilibrium, and specimen thermal equilibration time. These definitions were demonstrated on a graph of time versus binder property.

Anderson overviewed the experimental program and the starting assumptions used in the test program. Three assumptions were listed:

1. Thermal lag that occurs as the temperature is changed caused the temperature of the specimen to lag behind the temperature indicated by the DSR temperature display.
2. Thermal equilibrium within the test specimen is reached when the measured value for G^* reaches a constant value.
3. Thermal gradients between test specimen and DSR probe are accounted for by “offset” and are not topic of this presentation.

Anderson showed some of the test data and the analysis used to evaluate the test results. His conclusion was that when two consecutive DSR temperatures are within 0.1°C of the target temperature, this defines t_{TT} and there is no need to verify this value.

The other question addressed by the data is; at what point in time does G^* become constant? Anderson defined this value based on a 7-point average absolute deviation which was used to determine when the G^* value remains constant. He included an example of test results that showed the application criteria for determining t_{TT} and t_{cg} using this criterion.

Anderson presented the recommended protocol for determining the critical time values for temperature equilibrium. He also recommended that a cushion of 5 minutes be added to ensure constant or equilibrium temperature; $t_{se}+5$ minutes. The final part of the presentation was to identify the remaining issues of this topic, which include:

- Can reference fluid be used to determine thermal equilibrium?
- How important is the sample preparation technique?

ETG Discussion, Comments, and Questions:

John D'Angelo recommendation is to forget about the reference fluid relative to the remaining issues. Dave Anderson agreed with D'Angelo's recommendation. However, he would like to discuss this with Darrin Hunter. Bob Kluttz noted some issues with thermal difference that Anderson had discussed during the presentation. There was disagreement between Kluttz and Anderson on this issue. John Casola commented that this item or temperature issue is more sample dependent and noted that Kluttz and Anderson are discussing are two different things or issues. Casola commented that Kluttz was asking about isothermal issues, but Kluttz disagreed with that comment – he is not talking about isothermal issues.

D' Angelo asked about the running calculation (average absolute deviation) and if that is what Anderson was doing? Anderson replied; yes it is.

Eileen Sheehy, asked about using multiple temperatures, what impact does that have on the equilibrium value? Anderson responded that the value you get for the wait time is different than when you first start the test as compared to going to a different temperature during the test. Sheehy's question was related to checking at each test temperature; in other words, do you check for each temperature and then average all of the equilibrium times.

Bob Kluttz comment; when you are initially loading your machine for the first time, the equilibrium time can be quite different depending on how you mount the sample. Anderson agreed with Kluttz regarding the temperature used to mount the sample and emphasized that you do not do this every day. It is dependent on the mounting type, operator and machine. Anderson also noted that the equilibrium time gets shorter with the greater number of temperatures used in the test. This discussion was related to the recommended protocol suggested by Anderson.

No action item needed for this topic for the next ETG meeting. However, Dave Anderson will prepare a procedure to be forwarded to AASHTO on the temperature equilibrium time.

15. Fatigue Task Group Report—Hussain Bahia (University of Wisconsin at Madison) and Haifang Wen (Washington State University)

Presentation Title: *Update of Fatigue Task Group from the ARC Update – Binder Fatigue; Asphalt Research Consortium*

As part of the presentation and discussion, Bahia distributed a copy of the draft Standard Method of Test for “Estimating Fatigue Resistance of Asphalt Binders Using the Linear Amplitude Sweep.”

Presentation Summary:

Bahia first gave a background and summary from the last ETG meeting. He noted that the binder yield energy is a good test but the test results are difficult to analyze for modified asphalts. His opinion is that repeated load testing is a better test method.

Bahia reported that the task group met to discuss the testing and analysis issues on the yield energy test. He reported that the yield energy is an empirical but simple test that can be used to determine or discriminate between different binders. Bob Kluttz asked; are you reporting first yield, second yield, final yield or what value are you referring to? Bahia recommended that the ultimate yield be used.

Bahia overviewed the calculation of yield energy through an equation that would be given to all DSR manufacturers so that it can be programmed into their device. Raj Dongre asked; what strain rate is used in the test? Bahia replied; 0.1 strain per second. Dongre thought that value was fast. Bahia was unsure. Dongre asked; can this be slippage between the plates. Bahia answered; there is no slippage. Kluttz concurred with that answer; no slippage between the plates.

Bahia stated that we are not recommending the yield energy test for fatigue performance. Dave Anderson asked; where will this be used – fatigue or what? Bahia noted that he and the task group is not making any recommendations as to how it will be used or interpreted. The task group was only asked to put together an AASHTO standard, which is what they did. This can be easily used to differentiate between modified and unmodified binders but we are not making any recommendations.

Bahia continued his presentation with the recommended second test for fatigue, which is “linear amplitude sweep”. This method is intended to evaluate the ability of an asphalt binder to resist fatigue damage by employing cyclic loading at increasing amplitudes in order to accelerate damage.

Baumgardner asked if the binder yield energy test protocol is ready to be forwarded to Section 2b (to Eileen Sheehy) .What do we do with the test protocol, if it is not a fatigue test? Bahia said the draft is ready.

Kluttz asked if it is worthwhile to get this test into AASHTO and ASTM as a test procedure. Gerald Reinke disagreed with this test because it is empirical similar to the forced ductility test. His initial opinion was that you would only end up with a SHRP plus-type test. Disagreement that this should be an AASHTO procedure.

Dave Anderson also does not think it is appropriate for putting it into a formal test procedure. Anderson agrees with Reinke.

Frank Fee's opinion is that this will take a large effort even for a provisional test. There was a lot of discussion and disagreement on the amount of work needed to standardize the test protocol. While there is interest in this test, the Binder ETG was not ready to see this as an AASHTO procedure at this time.

Baumgardner asked if this is a better test than the MSCR? In other words, will the MSCR do the same. Percent recovery is a side issue that has not been tested. D'Angelo disagreed with that comment; it has been significantly tested. The answer to that question resulted in a lot of debate and discussion.

Chris Abadie commented that we are looking for a fatigue testing temperature range and wanted to hear Bahia's suggestion on this issue. Bahia reply is that the test is done at the intermediate temperature and there is only a small data set, but does not see a direct relationship between the yield energy and fatigue or results from other tests. Abadie asked whether Bahia looked at and compared the results from the MSCR and this test. Bahia did not remember; but he does not necessarily agree with the relationship between fatigue and elasticity so they did not look at that item.

Gerald Reinke noted that Bahia stated that this test is not a simple test to evaluate, and if this test is nothing different than a forced ductility test, why do we need another test that provides the same information? This is a path to specification proliferation and we do not need it. Reinke's comment resulted in a lot of discussion on the value of different tests.

Baumgardner suggested need to complete a comparison between the MSCR and yield energy. Dave Anderson asked; why are some individuals recommending that this test procedure continue to go forward? One reason is related to ASTM interest in the procedure.

Kluttz commented that this test does not fit into classical fatigue, but does fit into the dissipated energy model used by Rey Roque (University of Florida). Dongre replied that all they are doing is trying to determine what portion of the curve that the energy term fits into this formulation and asked, what is dissipated energy? Bahia related to defining dissipated energy, and how it is used in mixture and binder testing.

No action was taken to agree on a recommendation from the ETG on this issue.

Cyclic Test Development and the Linear Amplitude Sweep test was the next item covered by Bahia. The test method is composed of two tests; the first is a stress relaxation frequency sweep test, and the second is an amplitude sweep loading scheme or amplitude sweep test. These are the two tests needed for the Visco-Elastic-Continuum-Damage (VECD) analysis. Bahia reported that the standard for the tests has been developed or prepared along with all of the equations. The draft for this test method was distributed to the ETG members.

The binder analysis and equations are similar to those used for mixtures, so there is some continuity between binders and mixtures regarding what we are trying to achieve. Bahia showed the damage function included in the interpretation of test data, which was developed by Shaprey. Dallas Little and Yagrook Kim have continued its use. The damage function equation was programmed into a simple spreadsheet. Bahia noted that the pavement structure needs to be included in the explanation and analysis of binder fatigue. The fatigue constants for the binder can be determined from the two tests included in the presentation and noted above in the minutes.

Raj Dongre asked how input results into the fatigue analysis. Bahia replied that he is not recommending the specification parameters – keep the specification as is but add an item that qualifies fatigue from the binder for calculating A and B for the binder. Bahia then gave an example in answering Dongre’s question as part of his presentation. D’Angelo agrees with Bahia’s recommendation, but you might want to use the 85% reliability level (or some other reliability level) rather than just an average value of the strain component. The other item to potentially look at would be the slope and intercept from the test for heavy duty pavements – those with a flat slope or low intercept. For a thinner pavement the slope can be less flat or have a higher intercept. Bahia acknowledged that this can be done but you remove looking at the structure. Bahia agrees with D’Angelo’s point in terms of trends.

Frank Fee commented that what you are looking at is the same as for the mixture area. He suggests that Bahia should work under the concept that this is simply a ranking process for the binder related to fatigue, because it allows the mixture designer to consider it once you have this information. But how do you write a purchase specification for the binder in terms of fatigue? Bahia replied that you do it with the A and B terms.

Geoff Rowe asked how much testing has been completed on the split between neat and polymer modified binders. Bahia replied that 3 to 6 neat or base binders, the rest have been polymer modified binders. The data have been published in the ARC reports. D’Angelo commented that when the MSCR was developed they looked at what was happening to the base binder when different cross linking and modification was added. D’Angelo also suggested doing some correlations between the mixture and binder using this test method. Bahia recommended that the test be standardized.

Rich May suggested a three step process for an incremental increase in strains in the example used by Bahia in his presentation. Bahia agreed with that suggestion. Bahia also agreed with the other comments about mix designers just wanting the A and B terms from the binder.

Bahia showed and reviewed the example spreadsheet used for the binder fatigue analysis. He commented that you can enter any tensile strain related to Rich May’s suggestion. Bahia overviewed the process used to determine or ensure the test results were reasonable. He thanked Gerald Reinke for participating in the inter-laboratory comparison of the test. Shauna Teclé Marian asked what type of sample was used. Bahia replied; the PAV condition. He noted that you need to test at the worst case condition.

Bahia continued with his presentation of data from testing binders that had been retained from Michigan mixtures that were tested by Prof. Kutay at MSU and Prof. Mogawer at UMass. Bahia emphasized that he is not implying that shear is the same as a compression-tension test; it only gives you a similar ranking. Bahia's issue or challenge is to ensure the binder test results give the same ranking as the mixture test results.

Bahia provided an overview of where we go from here or what they recommend for the next steps.

- Continue testing for validation using LTPP, more mixtures tests for which binders have been retained, and more modified mixtures (this relates to the ARC work).
- The linear amplitude sweep test appears to be a good candidate to replace/complement the existing binder fatigue specification.
- Work with the TFHRC group in terms of sharing binders.
- Have drafted an AASHTO test standard or procedure with using the DSR and can provide the spreadsheet and demonstrate how to use it. Training for analysis tools will be made available.
- Begin to develop the specification limits once an adequate amount of data is collected.

D'Angelo cautioned about using the ALF, because of the thin structures based on the loadings. The dent test was really a ductility test and do you really want to go looking for dent test. This discussion was centered on using the double-edged notched test from Canada.

Baumgardner requested that before we go into discussion, he is going to change the action item – he suggests going forward with test to AASHTO as a procedure for people to use but wanted to get Bahia's suggestion about the previous Binder yield energy (BYE) test. Bahia reply is that he was unable to convince industry to move from the forced ductility test. His position on this was that the Amplitude Sweep test is for fatigue and BYE test is for other PG plus specifications until the transition takes place into no PG plus. He agrees with Van Frank that we cannot continue to use tests that cannot be applied or do not give us the right information.

ETG Discussion, Comments, and Questions:

In summary, Bahia noted no additional comments in terms of moving the test forward. Reinke performed the test and really likes it; it is doable and you get information on mixtures by choosing different strain levels that make sense; you can start to compare it, the test results, to fatigue data; and there are more opportunities for it than just binders.

Kluttz noted the AASHTO and ASTM issue, but likes the idea of co-development. Bukowski noted that their preference is to go with AASHTO because of sponsorship. There was a lot of discussion on this issue and whether it is possible. AASHTO is always given first preference.

Dave Anderson asked; how can this method be merged into the endurance limit concept? Bahia said the A & B terms does not address endurance limit however the mixture side they have figured a way to relate it to the endurance limit. Rich May disagrees with the earlier D'Angelo comment, because this is a great opportunity if this gets implemented by strain level rather than through the A and B terms, and it provides a means for merging it with the endurance limit

concept. He prefers to show strain levels rather than A and B in the specification. Bahia agrees, but it is up to the ETG. These comments resulted in a lot of discussion on the topic of how that gets done. In summary, all agree with the concept, however, is it with A and B or through a strain level.

Baumgardner requested that Bahia prepare a paper that summarizes comments from the ETG. Baumgardner noted that additional comments and questions should be directed to Bahia.

ACTION ITEM #9: Hussain Bahia will postpone the action to forward the Binder Yield Energy Test method to AASHTO, but continue work to evaluate correlation/comparison of Binder Yield Energy to MSCR/percent recovery at high temperature. Prepare a summary of the issues, comments, and questions on this topic from the ETG. Establish criteria to determine if MSCR or Binder Yield Energy Test is a better surrogate test to replace the various SHRP Plus procedures.

ACTION ITEM #10: Gaylon Baumgardner will forward the test protocol “Estimating Fatigue Resistance of Asphalt Binders Using the Linear Amplitude Sweep” to the AASHTO technical section to replace the existing fatigue test and coordinate with Rick Harvey.

16. Warm Mix Asphalt BBR Study—Gerald Reinke (Mathy Construction) and Geoff Rowe (ABATECH)

Presentation Title: *Development of Work Plan to Consider Reduction in Properties with Temperature Saturation; Evaluation of the BBR Test with Mixtures Containing Waxes – Proposed Work Item*

Summary of Presentation:

Rowe noted that, at the last ETG meeting test results were presented that looked at BBR tests on both binder and mixtures made with Lion asphalts as a control and various modifiers. It was noticed from that study that there were some issues with the BBR. At the last ETG meeting tasked with developing a work plan including three additional binders to investigate micro-cracking and healing that may be accruing in the BBR.

Rowe provided an overview what was tested and explained at the last ETG meeting. He summarized the results from the test and analysis of the test data. A summary from the previous work:

- Stiffness was not increasing with continued temperature saturation; rather it was increasing and decreasing in an unexpected manner.
- This same effect was observed in both the binder and mixture tests.
- When heated and allowed to cool, the effect in the mix was reversible.
- This occurred in the control binder, as well as for the wax modified binders.
- These issues occurred at -18°C, but not at -12°C.

For the next step, Rowe suggested repeating the study with BBR using three base binders, and listed the different issues and testing conditions under consideration. He provided a summary of the experiment being proposed by the task group, which includes:

- Consider one or two binders, a single aggregate.
- Produce different grades using the same base binder (for example, -18 and -28 grades).
- Perform BBR on binder and mix beams at grade test temperature and $\pm 6^{\circ}\text{C}$ for different conditioning times (0, 2, 4, 8, 16, and 32 days).
- Perform DC(t) on specimens using 5 replicates at 0, 2, 4, 8, 16, and 32 days.

ETG Discussion, Comments, and Questions:

Mihai Marasteanu provided some suggestions based on the testing that was done by one of his students. He recommended that the proposed work be done.

Gayle King commented that Marasteanu ran a lot of BBR beams for them, and agrees that the m-value has a lot to do with identifying asphalt with wax. King suggested that Rowe consider some of the binders and materials that were used in these previous testing efforts. At the end of the BBR test, there is damage but stiffness alone does not detect that damage. King suggested that this is being done for binders that have exhibited block cracking, which is related to aging the asphalt. He noted that they have not reheated and tested the specimens. Rowe asked King about sample condition related to micro-cracking in some of the BBR beams. King replied that they aged the binder for 20, 40 and 60 hours in the PAV; and aged the loose mix for 4, 24 and 48 hours and then re-compacted and prepared the mix test specimens. Running the beams at the test temperature below the PG grade temperature is when they are seeing the softer values.

Dave Anderson asked how do you know that micro-cracking has occurred in the test specimens? King reviewed his observations in terms of m-value and modulus. Anderson noted that you cannot assume by just looking at the properties to ensure micro cracking or damage is present. Anderson commented that he has a problem with micro-cracking. King revised his wording of damage, and noted that he has lots of data that he will provide to Rowe. Rowe asked Dave Anderson; do you think Marasteanu's acoustic test can detect the presence of micro-cracks or damage. Marasteanu opinion was that if it is micro-crack it could be done. Ludo Zanzotto's opinion is that you can separate crystallization based on their results regarding the temperature saturation concept that Rowe had previously recommended.

Raj Dongre asked if you take a BBR mix beam and artificially induce a crack would you get a higher m-value and lower stiffness? Damage will soften the specimen, so the m-value will increase. Dongre believes that the damage actually occurred in the BBR specimen prior to 5 hours and then stiffened. King noted that they are seeing the curve that Rowe presented on the mix with modifier 5 at 16 days; the stiffness and m-value being reduced. There was disagreement between D'Angelo and Dongre on how the properties will change when the BBR specimen has been damaged. This has to do with the relaxation modulus of the materials that did not change significantly. D'Angelo noted that the damage may have occurred somewhere else rather than from loading. He hypothesized that damage could be from non-loading parameters, such as aging, etc. King also noted that they are looking at other things, not thermal loadings or cracking, it is from aging or shrinkage of the materials.

Rowe suggested that a group be put together to prepare a summary of results and put together a proposal based on how to investigate it in the future. Baumgardner agreed but will let the ETG decide on whether this should be continued.

Dave Anderson's opinion is that some additional testing is warranted if something is happening within the 10°C increment because the binders are never tested at the grading temperature. It is his opinion that this is important.

D'Angelo asked; are you using the total deflection when you calculate the stiffness? Rowe replied yes.

King commented that they are looking at their data in black space. Marasteanu suggested looking at the nonlinear effects as part of the data analysis. He suggested using the creep and recovery portion from the test. Marasteanu noted that if the values are different at the highest deflection that could be a result of nonlinearity. King also suggested looking at other binder properties; both the S- and m-values, and their correlation with Glover's method. It does not work when using Glover's short method. Rowe asked King if he was using black space in analyzing his BBR data or the standard s- and m-values. King replied they were more frequently using the s- and m-values, rather than black space.

Baumgardner summarized the action item for Rowe; put group together and decide if we do this, how to do this, and an experimental plan in terms of number of specimens and materials included in the test program. Rowe suggested circulating all these comments together into a document that can be added or edited to put these mechanisms forward. King noted that they would appreciate any recommendation and comments on converting this into an aging study or to consider the effects of aging in the plan.

ACTION ITEM #11: Geoff Rowe will prepare a proposal for the low temperature BBR binder mixture study. Proposal will be brought back to the ETG for consideration and review at the next meeting

Next Meeting – Date and Location

Bahia recommended that the next Binder ETG meeting be held in Madison, Wisconsin around 20 Sept. 2010, because the RILEM meeting will be held that week in Madison. The ETG meeting would be hosted by the University of Wisconsin and the same venue would be used as for the RILEM meeting or conference.

Chairman Baumgardner asked member input for the dates of the next ETG meeting. The dates of the binder ETG meeting are tentatively set to be the afternoon of Sept. 21st and all day on Sept. 22nd 2010 at The University of Wisconsin, Madison, WI.

17. Summary of Action Items – John Bukowski (FHWA)

John Bukowski summarized the action items that were identified from this meeting, which are:

1. John D'Angelo to prepare a recommendation to AASHTO for a footnote to be added to MP 19 referring to TP 70 percent recovery guidelines. The deadline for this action item is before summer of 2010.
2. John D'Angelo was requested to summarize the issues needed to be addressed for a RAP study. All comments to be provided back to Baumgardner prior to the next meeting.
3. DSR specimen preparation task group (Matt Corrigan (lead), Dave Anderson, Kevin Van Frank, and Gerald Reinke) to draft a recommendation for time to perform the DSR test (from preparation of specimen to completion of DSR test). The task group will consider an evaluation of effects of steric hardening on MSCR results. As a second part of this action item, Baumgardner asked any member with data on this topic to share it with the task group and ETG prior to the next meeting. (Shauna Tecle Marian volunteered to share their data with the ETG at the next meeting.)
4. Sang Soo Kim will forward the draft test procedure for the "ABCD test procedure" to the subcommittee on Materials Tech Section 2b (Eileen Sheehy; New Jersey DOT).
5. Task Group will prepare and distribute recommendations to be added to the TP 70 MSCR criteria for evaluating GTR modified asphalt. In addition the task group will make suggestions to address MP 19-10 with respect to GTR modified binders in terms of the gap/particle size limitations. [Task group members include: Gaylon Baumgardner, Audrey Copeland, John D'Angelo, Darin Hazlett, and Chris Abadie]
6. Matt Corrigan will lead round robin study to evaluate the precision and bias statement for 2 mm gap standard DSR testing of GTR modified binders. Volunteers for this task group to do some of the testing included: Bob McGennis, Gaylon Baumgardner, Chris Abadie, Randy West, and Tom Bennert.
7. Gerry Reinke and Dave Anderson will prepare and distribute suggested wording to R 28 (PAV) to address the de-gassing requirements. [Note: Gerald Reinke put notes in the tables included in the specification (this is the de-gassing study). Decision was that it would go into the footnotes, but let Reinke recommend where it should go and how it is written. Reinke and Anderson will resolve the issues related to this item.]
8. Continue with the evaluation and analysis of using 4 mm DSR specimens, and prepare recommendations or identify changes to the current test protocol for including the 4 mm specimens.
9. Hussain Bahia will postpone the action to forward the Binder Yield Energy Test method to AASHTO, but continue work to evaluate correlation/comparison of Binder Yield Energy to MSCR/percent recovery at high temperature. Prepare a summary of the issues, comments, and questions on this topic from the ETG. Establish criteria to determine if

MSCR or Binder Yield Energy Test is a better surrogate test to replace the various SHRP Plus procedures.

10. Gaylon Baumgardner will forward the test protocol “Estimating Fatigue Resistance of Asphalt Binders Using the Linear Amplitude Sweep” to the AASHTO technical section to replace the existing fatigue test and coordinate with Rick Harvey.
11. Geoff Rowe to prepare a proposal for the low temperature BBR binder mixture study. Proposal will be brought back to the ETG for consideration and review at the next meeting.

Gayle King asked that he and Mike Anderson be included on the agenda for the next ETG meeting to discuss the block cracking–aging issue. This agenda item is related to information from the FAA study and the need to look at block cracking to understand this fracture mechanism. Discussion topic includes the need for tools to identify pavements or mixtures where block cracking starts to occur in time so that preventive maintenance or preservation activities can be planned. John Bukowski asked Gayle King send in request to add this topic for the next meeting.

Meeting Adjournment

The meeting was adjourned by Chairman Baumgardner at 11:45 AM on February 23, 2010

ATTACHMENT A

FHWA Binder ETG Meeting Agenda—Draft February 22 & 23, 2010 Irvine, California

Day 1—February 22, 2010

8:00 am	Welcome and Introductions	Baumgardner
8:15 am	Action Items from last meeting	Bukowski
8:30 am	High Temperature Task Group	D'Angelo/ M. Anderson
9:00 am	Binder Study on RAP Blending	D'Angelo
9:30 am	DSR Specimen Preparation	Corrigan/ Van Frank
10:00 am	Break	
10:30 am	Fatigue Task Group report	Bahia, Wen
11:30 am	Update on ABCD Device	S. Kim
Noon	Lunch	
1:00 pm	Task Group Report on PPA and Modification	D'Angelo
2:00 pm	Motor Oil Modification - Research Needs Statement	D'Angelo/ Dongre
2:30 pm	ALF Binder Aging Fatigue Study	Gibson
3:00 pm	Break	
3:30 pm	DSR Temperature Equilibrium	Anderson/Hunter
4:15 pm	PAV Degassing	Reinke
5:00 pm	Adjourn for the Day	

Day2—February 23, 2010

8:00 am	WMA BBR Study	Renke/Rowe
8:45 am	WRI Binder Aging	TBD
10:00 am	Break	
10:30 am	GTR modified binders	Baumgardner
11:30 am	Rap-Up/ Adjourn	

ATTACHMENT B

ASPHALT BINDER EXPERT TASK GROUP MEMBERS

<p><u>Chairman:</u> Gaylon Baumgardner Executive Vice President Paragon Technical Services, Inc. 2829 Lakeland Drive, Suite 2000 Jackson, MS 39232-7611 Phone: 601-933-3217 Cell: 601-842-3743 Fax: 601-933-3363 Gaylon.baumgardner@ptsilab.com</p>	<p><u>Secretary:</u> John Bukowski FHWA Deputy Director HIPT Federal Highway Administration 400 7th Street, SW. Washington, D.C. 20590 Phone: 202 366-1287 Fax 202-493-2070 John.Bukowski@dot.gov</p>
<p><u>Members :</u></p>	
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<p>Henry Romagosa ICL Performance Products LP 5296 Hillsden Drive Holladay, UT 84117 Phone: 801-274 0955 Cell: 801-245 0429 henry.romagosa@icl-pplp.com</p>	<p>Geoff Rowe ABATECH, Inc. P.O. Box 356 Blooming Glen, Pennsylvania 18911 Phone: 215-258-3640 Fax: 267-261-8481 growe@abatech.com</p>
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ATTACHMENT C

ASPHALT BINDER ETG WORKING COMMITTEE MEMBERS

<p><u>Aging Task Group:</u></p> <ul style="list-style-type: none"> • Gayle King • Jim Barnett • Laurand Lewandowski • Jan Negulescu • Gerald Reinke 	<p><u>Moisture Damage Task Group:</u></p> <ul style="list-style-type: none"> • Bob McGennis • Chris Abadie • Ken Gryzbowski • Dean Weitzel
<p><u>Low Temperature Task Group:</u></p> <ul style="list-style-type: none"> • Mihai Marasteanu • Jim Barnett • Raj Dongre • Bob Kluttz • Gerald Reinke • Sang-Soo Kim 	<p><u>Modification Task Group:</u></p> <ul style="list-style-type: none"> • Laurand Lewandowski • Mark Buncher • Carissa Mooney • Mihai Marasteanu • Henry Romagosa
<p><u>Validation Task Group:</u></p> <ul style="list-style-type: none"> • Gerald Reinke • Mark Buncher • Gayle King • Mihai Marasteanu • Henry Romagosa 	<p><u>PPA Best Practice Task Group:</u></p> <ul style="list-style-type: none"> • John D'Angelo • Terry Arnold • Mike Anderson • Gayle King • Jean-Valery Martin • Fran Miknis • Olga Puzic • Gerald Reinke • Henry Romagosa
<p><u>GTR Modified Asphalt Task Group:</u></p> <ul style="list-style-type: none"> • Gaylon Baumgardner, Lead • Chris Abadie • Audrey Copeland • John D'Angelo • Darin Hazlett 	<p><u>Round Robin Precision & Bias Group:</u></p> <ul style="list-style-type: none"> • Matt Corrigan, Lead • Chris Abadie • Gaylon Baumgardner • Tom Bennert • Bob McGennis • Randy West