

### FHWA Recycled Asphalt Pavement Expert Task Group

#### Recycled Asphalt Pavement Expert Task Group Purpose:

The primary objective of the FHWA Expert Task Group is to coordinate, develop, and improve national guidance and recommendations for the asphalt pavement recycling program. This group will provide feedback as well as encourage correct utilization of recycling technologies and address construction problems with current state-of-the-practice solutions.

A total of 56 individuals attended the meeting (16 members, 38 visitors, and 2 contract personnel). Attachment A is the meeting Agenda, Attachment B includes a listing of the ETG members, and Attachment C is the Proposed Organization of FHWA's RAP ETG. Members of the FHWA Recycled Asphalt Pavement ETG that were in attendance at the October 2010 meeting included:

Gerald Huber,	Heritage Foundation (Chairperson)
Audrey Copeland,	FHWA (Co-Chairperson)
Hussain Bahia,	University of Wisconsin-Madison
Don Brock,	Astec Industries, Inc.
John D'Angelo,	D'Angelo Consulting
Jon Epps,	Texas A&M University
Bob Forfylow,	LaFarge Canada, Inc.
Lee Gallivan,	FHWA
Mike Harnsberger,	WRI
David Lippert,	Illinois DOT
Becky McDaniel,	Purdue University
David Newcomb,	National Asphalt Pavement Association
Jim Pappas,	Delaware DOT
Ron Sines,	Old Castle Materials
Randy West,	National Center for Asphalt Technology
Richard Willis,	National Center for Asphalt Technology

Meeting Coordinator: Lori Dalton (SME, Inc.)

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

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

Jason Bausano, Mead Westvaco	Jay Lemon, Haskell-Lemon Construction
Mike Bergeron, Overland Corporation	Larry Lemon, Haskell-Lemon Construction
Tod Bigelow, Oklahoma DOT	Mike Maphies, Scotwood Industries, Inc.
Mark Blow, Asphalt Institute	Richard May, Shell Sulphur Solutions
Francois Chaignon, Colas, Inc.	Prem Naidoo, Akzo Nobel
Ryan Clark, Municipal Group of Companies	Terry Naidoo, Green Asphalt Technologies, LLC
Phil Collins, Scotwood Industries, Inc.	Roman Nowicki, Akzo Nobel
Matthew Corrigan, FHWA	Pran Shoo, University of Oklahoma

Ron Curb, Oklahoma DOT  
William Daly, Louisiana State University  
Stacy Diefenderfer, VTRC  
Waseem Fazal, FHWA  
Danny Gierhart, Asphalt Institute  
Greg Harder, McConnaughay Technologies  
Ellie Hajj, University of Nevada at Reno  
Mike Hemsley, Paragon Technical Services  
Zahia Hossain, University of Oklahoma  
Kenneth Hobson, Oklahoma DOT  
Larry Ilg, Oregon DOT  
Eric Kalberer, WRI  
Perer Keeve, Sasob Wax North America Corp.

Craig Parker, Silver Star Construction  
Dale Rand, Texas DOT  
Roger Sandberg, Maram Equipment, Inc.  
Jim Scherocman, Consulting Engineer  
Scott Seiter, Oklahoma DOT  
Annette Smith, PQ Corporation  
Nicole Smith, Oklahoma DOT  
Chris Westlund, Oklahoma DOT  
Jeff Withee, Louisiana State University

## **DAY 1: Tuesday, October 26, 2010**

- 1. Call to Order**—Chairperson Gerald Huber (Heritage Research) called the meeting to order at 8:00 AM.

**Welcome and Introduction** – Chairperson Gerald Huber (Heritage) welcomed the group to the meeting. Huber reported copies of the agenda are available and being passed around the room. Huber introduced Waseem Fazal with the FHWA. Fazal did the official welcome to the ETG meeting, as being part of the host committee. Huber, on behalf of the ETG, thanked Fazal and other that helped in setting up and organizing the meeting. He asked everyone to introduce themselves around the room.

Huber overviewed and read the purpose or scope of the RAP ETG.

### **2. Approval of Minutes from Last Meeting**

Huber turned this part of the meeting over to Audrey Copeland. Audrey Copeland stated a signup sheet is being passed around the room. She requested approval of the previous meeting minutes. Randy West identified a few comments and requested the track changes be removed from the official meeting minutes. Copeland agreed with that request and asked if there were any more comments or discussion of the minutes. There being none; Dave Newcomb made a motion to approve the meeting minutes. Hussain Bahia seconded the motion. The minutes passed and were accepted unanimously.

### **3. Chairperson's Report**

Huber announced the FHWA is sponsoring the meeting, and went over the membership of the ETG and verbally noted each member of the ETG. Huber reported the reason Jo Daniel is not attending the meeting – she is expecting a baby within the next couple of weeks. Huber also announced there are two other openings for DOT representatives on the ETG that have yet to be

filled. Huber asked for any comments on the membership list. None were given. Huber identified friends of the ETG and suggested that the DOT representatives might want to consider being on the ETG.

Huber also announced the MORERAP.us is the website for the ETG meeting. All of the presentations and meeting minutes are included on the website. Copeland added that all ETG members should have received an e-mail on the document related to standing committees and task groups that was distributed to the membership. The standing committees are permanent and identify specific areas. For example:

- Targeting low RAP content states is a standing committee. Randy West is the chairperson or leader for this standing committee.
- Another one is for a research needs statement. Jim Pappas is the person coordinating that standing committee.
- The RAP use survey is the other standing committee.

Copeland announced there will be reports and discussions on each of these later in the meeting. Copeland identified the task groups that are active during the task group activity (e.g. preparation of a document) but get dissolved after activity has been completed and accepted. Copeland reported that the ETG provides input and comment to the pool fund study, and opened the floor for additional discussion on ETG coordination. None were noted.

#### **4. Action Items**—Gerald Huber (Heritage)

The action items were not covered or reviewed at the beginning of the meeting.

### **5. Standing Committee Reports**

#### **5.1 Targeting Low RAP Usage State – Randy West (NCAT)**

##### Summary of Report:

Randy West gave the verbal report for this committee. He overviewed the purpose of this standing committee, and reported they do not have a formal organized plan of targeting low RAP states.

One item that came up at the last meeting was the Ron Sines letter, which was discussed. The conclusion reached was that the ETG cannot send this type of letter to the DOTs. However, individuals from the ETG can go to individual agencies regarding low RAP content usage. West reported; Alaska is one of the few states that do not allow RAP in any of their mixtures. He reviewed his visit to Alaska, and found that they did recently have a project which allowed 25% RAP in a mix. He gave a presentation to the Alaska DOT about allowing more projects with RAP. West announced that he and others on this standing committee are getting the word out. He mentioned this is the basic plan of the standing committee but asked for input from the ETG.

##### ETG Comments, Questions, and Discussion:

John D'Angelo gave his opinion; short bulletins on success stories is a key to getting agencies to allow more projects with higher amounts of RAP. He suggested it would be more successful to have academic, federal government, and states author these documents or articles. He also recommended down-playing the products from industry, because of the perceived bias view point. West agreed with D'Angelo and noted their (NCAT) news articles on RAP. He also noted their articles combined with NAPA were successful – at least in his opinion. D'Angelo suggested these articles going into FOCUS. Dave Newcomb suggested putting the articles into Roads and Bridges, HMAT, or other technical magazines and putting together a compendium of success stories in TRB, such as a circular. Newcomb also recommended that the website could be a place to publicize some of these articles. Copeland reported there are articles in Public Roads and those could also go onto the website. She requested a listing of the articles be uploaded onto the website. Copeland also suggested some of the articles be put into a Tech Brief type format that FHWA has used in the past. West agreed with that suggestion and volunteered to help Copeland for getting the articles together.

Jon Epps asked about the target audience for the articles. Huber replied; it is state personnel because city and county representatives tend to follow what the states do or implement. He also mentioned they have focused on answering questions about RAP and why agencies do not allow the use of RAP in many projects. Epps asked; how many states do not allow the use of RAP? Huber replied; within the past 3 years, there has been an increase use in RAP, and many agencies have raised their limits on RAP usage. Epps opinion; there are only a few agencies that do not allow the use of RAP in any mixtures. West also mentioned there are more states that still do not allow the use of RAP in surface mixtures.

Epps questioned whether the need or target of this committee is adequate. D'Angelo stated there are states that permit higher percentage of RAP, but do not actually use higher amounts of RAP. The intent is to get more states using higher amounts of RAP in the surface and other layers. West noted this is not just 10% percent usage but getting the percentage higher. Ron Sines commented; some states allow higher RAP amounts but contractors do not use higher amounts because of economic issues related to the states specifications. West agreed with that comment and gave a couple of examples. There was a lot of discussion on the target audience for this ETG and the products, as well as the focus of this standing committee. Epps recommended at the end to keep our target audience in mind.

Copeland asked West to overview the publication of the article that was submitted to the task group. This article was handed out at the meeting. West responded; this is an article related to frequently asked questions about the use of higher percentages of RAP. He commented; this article will be on the website which was meant to be a tri-fold publication. West asked for comments about the item and thanked Copeland for her work on this. West asked for comments by the end of the meeting on this item.

Copeland summarized the marching orders from the ETG, regarding publications. She asked West if lead persons were needed for each of these items.

1. FHWA tech brief
2. TRB circulars

### 3. Listing of Articles for success stories

Lee Gallivan suggested; these need to be short individual items, rather than looking at TRB committee chairperson type circulars that are typically much longer. McDaniel's reported; in terms of a TRB committee circular, the circular needs to be championed by an individual. **She volunteered for one of these.** Huber asked; what type of circular does she envision? McDaniel's answered; a summary of success projects regarding RAP.

The question most often asked is; how do these high RAP mixes perform? So we are looking at older projects with documented performance data; in other words show me the proof. Huber mentioned Jim Musselman's projects in Florida, and the summary Musselman prepared that document older projects. Musselman provided data on their performance in preparation of that summary. That project information and data is on the website. Huber noted this includes from 25 to 50% RAP in mixtures. Huber also mentioned the West project which compared the companion mixtures with and without RAP included in the LTPP program. Huber reported there is data out there, we are just not publishing it or getting the word out. There was more discussion on the focus of the group.

Waseem Fazad asked; is any mechanism being used to track the tonnage being used by agencies? If so, maybe we can add this item to the above list. Copeland replied; tracking by tonnage is not included. Jim Pappas replied; AASHTO is looking at doing something to track tonnage based on sustainability for RAP usage. John Bukowski mentioned; FHWA is working with NAPA and looking at tonnage in selected states on the use of RAP and shingles – he thought this information would be put together by next year. Dave Newcomb replied; the first of next year will be the earliest to have this summary. Bukowski reported; this summary is focusing on contractors and not agencies. D'Angelo mentioned; all contractors are not NAPA members and asked if that was considered. Newcomb replied; they are not targeting only NAPA members, they are going to some of the state associations to get total tonnage used. For the agencies that do not have a state association, they do have plans to get this information. It will not be error proof, but they are making an effort to get the more correct information. Dave Lippert commented; the answer can be yearly dependent, because of changes in construction operations from year to year. Bukowski mentioned; they basically have nothing right now and anything will be an improvement to start with.

Pappas reported; their study (Delaware DOT) focused on just RAP, rather than on other materials. Bukowski also noted they are trying to capture RAP usage, but he would hope that other materials usage could be captured in reporting on RAP usage and that it would continue – one does not replace the other. In summary, after the continued discussions, it was decided that:

- Copeland will lead the FHWA Tech Brief group.
- Articles for RAP and TRB Circular – Becky McDaniel volunteered to lead both groups. Epps mentioned; **TTI has a project with Texas DOT on RAP and their research did a literature review that can be made available to McDaniel's group.** Within the past 5 years to start with would be the time frame of articles, but the age of the projects would be much longer.

Action Items:

- Draft documents to increase the awareness on the benefit of increased percentages of RAP
  - Case studies, short histories, bulleted items in the form of an FHWA Tech Brief to be prepared – led by Audrey Copeland
  - List of RAP articles to be put on website – compiled by Becky McDaniel
  - Compilation of success stories (FDOT, LTPP SPS-5 sections) that target different topics for TRB Circular (AFK10 committee) – led by Becky McDaniel
- TTI has a project with the Texas DOT on RAP and as part of their research they did a literature review that can be made available to McDaniel's group. Jon Epps will make sure that McDaniel's has this information.

**5.2 Development of Research Needs Statements – Jim Pappas (Delaware DOT)**

Jim Pappas is the lead for this standing committee. The verbal report on two research needs statements were given by Randy West and Gerald Huber. Both research needs statements were distributed to the ETG at the meeting.

**5.2.1 Experimental Design for Field Validation of Tests to Predict Cracking in Asphalt Mixtures**

Randy West overviewed and reviewed where this one came from, and reported; we have multiple tests that can be used to evaluate performance. There is no shortage of tests that can be used. The gap is the missing link between the test result and performance. In other words, there is a shortage of linking the test results to performance, and that is the focus of this research needs statement. In other words, validation of the test results, rather than developing the test method.

West overviewed the research objectives of the project. Three were given or included in the research needs statement, which are:

1. Conduct a literature review to identify the most promising laboratory test methods and models to predict different modes of cracking.
2. Design APT experiments with a range of HMA mixtures representing properties that are expected to yield good to poor performance.
3. Develop plans for sampling, storage, transportation, and testing of the HMA mixtures in the APT experiments.
4. Develop an estimated budget to achieve the objectives and detailing the construction and operational cost of the experimental test sections and total cost for conducting the tests for each mode of cracking.

Audrey Copeland commented; we need to establish a date for finalizing the research needs statement. West replied; by the end of the day. John D'Angelo mentioned; this needs to go before the AASHTO SOM. D'Angelo agreed; this is the process to use – have the SOM recommend the statement to go forward.

Gerald Huber asked for discussion on this item to get feedback from the ETG and asked West; what he is asking the experimental plan to do? West replied; this research needs statement would use APT facilities to get the data. West discussed his vision on the experimental plan and it

would not just include the FHWA and NCAT facilities. It needs to include multiple facilities around the country with different climates. D'Angelo mentioned the issue of aging and the effect of aging on RAP mixtures – this needs to be considered in the experimental plan. In other words, we need to include aging in this experimental study to test real world conditions. West agreed with the aging point, but stated we cannot wait 10 years down the road to get our answer from the experimental plan. Huber noted there have been accelerated aging in RAP studies. D'Angelo also noted this was done at FHWA and it did change the ranking of mixtures. Aging did make a difference, but that experimental plan did not include RAP mixtures. The plan used accelerated techniques to simulate aging over time. Aging is an issue and how it is simulated. There was lots of discussion on this issue relative to procedures used to simulate aging of large sample sizes.

Huber commented; this research statement of 12 months is to develop a plan to accomplish the stated goal or objectives. Huber asked for comments from the ETG. Don Brock stated; relative to the aging issue, we are getting harder asphalts today than softer asphalts. He also stated; they have data to support the hypothesis – the additives being used are basically gone after about 5 to 10 years. He also stated; other public agencies are not using the local agency's specifications, because they need to save money. Brock's opinion was; if you are going to have a problem, the problem will generally show up in less than 3 years because of the tenderness issue. He also stated; if you are going to make a difference, you need to use harder asphalts.

West noted the time frame for review is one month or a couple of weeks. Huber noted that the research needs statement will be on the website, but is not on the site right now. It was only e-mailed to a couple of individuals. Huber asked if anyone in attendance wanted a copy to review.

Matt Corrigan asked; has the statement been put into the proper format? West noted that he tried to follow the NCHRP format or guidelines. Corrigan identified "research paying off" and "previous work in related areas" as two topics important to NCHRP for prioritizing the research – these need to be included and emphasized in the research needs statement.

#### 5.2.2 Use of Asphalt Shingles (Manufacturer Waste and Post Consumer) in Asphalt Pavement

Huber overviewed the background of this statement and the reason for preparing this research needs statement. He also mentioned; most of the previous work in this area has focused on tests and properties measured in the laboratory. There has been little field work. Huber asked one question: what is the impact of shingles on the properties of the HMA through the production process? He reported that Missouri has done most of the work in the post construction area for the shingles process. He stated; Missouri does not know the true effect, but it has not been catastrophic. D'Angelo mentioned the pool fund study and asked if anyone was familiar with the results? Becky McDaniel's and others replied; they were unsure. Jon Epps stated; there probably was insufficient data to answer the questions, because the effort was relatively small.

McDaniel noted one of their project statements in this area, is focusing on production – they are looking at what is in the standards and are trying to determine what may need to be changed. They are also looking at the difference between fiberglass and felt shingles, and suggesting the development of guide specifications when using these materials. McDaniel suggested that their research needs statement be reviewed and possibly combined with this research needs statement.

Jim Scherocman noted some of his experience in this area and the difference between the different shingles that are used; tear offs versus disposal of manufacture waste. The difference in asphalt content can be really important. Trying to get the binder content correct can be a real problem. Five percent shingles can make a difference of 2 % content in the binder content. Scherocman overviewed his experience and stated there are states that have experience with shingles that are now nearly 5 to 10 years.

Huber asked for other experiences and questions. One question from industry related to lowering or changing the specifications for HMA. Huber answered; the specifications really remain the same, because that does not change in the volumetric properties.

Another question from industry related to the impact on the use of RAS. He suggested that Dave Newcomb be contacted to get some of the basic information. Oregon is also sponsoring a study regarding RAS because of the pressure to use shingles. Don Brock stated there are a lot more tear offs than manufacturers waste. Tear offs are a lot easier to process but both should be shredded to 3/8 inch or the proper size. Brock noted; if he was writing a specification, he would concentrate on production and preparation of the RAS. Brock also noted; Bonaquist dynamic modulus is a good test to use to determine the impact of RAS. There was discussion on the amount of RAS between waste and tear offs; and the difference between fiberglass and felt shingles. Fiberglass is used more today and at a higher percentage in the south. Brock suggested that shredding the shingle is important to get the maximum benefit. Brock reported on one example in Florida that has lasted nearly 30 years when you do it right and use the proper processing. This older project is an entrance road to a plant.

Waseem Fazal asked about asbestos in the RAS. Brock replied; the asbestos issue was related to siding. None of the roofing shingles to his knowledge used asbestos. D'Angelo noted; the asbestos issue is more related to the tacking material used for shingles. His opinion; this is not a problem. Richard Schreck noted a correction to the previous statement; there ere are asbestos roofing shingles – his roof has this. But those are different; asbestos is not in asphalt shingles.

Huber reported there are not a lot of felt backed shingles produced in the US today, but they are still produced in Canada. There was a lot of discussion on this issue.

Huber came back to the post construction shingle issue and how much is available that relates to \$700 million going to landfills. This should be our motivation on this issue. Corrigan noted; two divergent issues – the environmental and sustainability issues preventing the use of these recycled materials; divergent paths in the environment area. His opinion; these two are not going to cooperate with one another. He believes a lot more work needs to be done. **Corrigan's comment was directed to WMA because of the lower production temperatures and suggested that the RAP and WMA work together in this area. He will do whatever needs to be done in getting these two together.**

Huber asked Pappas for his comment on the research statement area and what he would like to do. Pappas noted the pressures everyone is under to using and showing that they are trying to

save money in using more recycled materials. The discussion moved to the processing area again. D'Angelo discussed using a smaller shredded shingle. Brock agreed. Brock discussed the production temperatures being used with RAS and virgin materials. Pappas summarized; he believes that both statements would be fully supported by AASHTO. Epps asked McDaniel about getting the support from TRB management or leaders for taking these projects forward. **Tom Baker and Jim Moulthrop should be contacted about moving these research needs statement forward through TRB and AASHTO.**

### 5.2.3 Summary

Huber asked that the members provide their comments and suggestion for getting these statements put forth. Both RNSs need to be put in NCHRP template form with a focus on past work and pay-off to State agencies. Cracking RNS:

- There is concern about aging and properly capturing aging using APT facilities.
- Need accelerated aging process.

Shingles RNS:

- The RNS should be coordinated with the MO pooled fund study and AFK10 work.
- Cooperate with the WMA TWG to address recycled materials and lower production temperatures.

### 5.2.4 Action Item:

- Send any comments on the research statements to Jim Pappas, Randy West, and/or Gerald Huber within two weeks.

## 5.3 *RAP Use Survey – Jim Pappas (Delaware DOT)*

### Summary Report:

Copeland introduced this standing committee and stated; we need to have discussions on the RAP use survey completed by NCDOT. **Pappas stated; he will do this item.** John Bukowski mentioned; they already have a set of questions prepared. Copeland commented; we still need to make it reasonable, but may want to ask additional questions related to RAP. Corrigan reported; NCDOT ended up with 100 percent response. Copeland requested some discussion or recommendations from the ETG on what Pappas should do.

Lee Gallivan suggested going over the questions asked from the first survey. Epps suggested adding questions related to shingles. Dave Newcomb agreed with that suggestion and suggested asking about the type of shingles being used. Ron Sines opinion; the survey is giving some misleading information. We need to bring context to the information that agencies are providing. States are giving information in terms of what they believe is being used versus what is actually being used. Sines agreed with Newcomb's suggestion.

Copeland overviewed the questions that were asked in the first survey. She noted that the last survey did include WMA questions. Richard Schreck commented; the amount allowed is not that important because of plant location information. He mentioned; the format of the survey is important to capture the necessary information and to increase the amount of RAP percentages. Epps stated there are a few exceptions to what Schreck was discussing, but basically agreed with

his comment. Sines noted there are activities that can be done to increase the amount of RAP and RAS use in rural areas because of the value of the material added. Sines agreed with Schreck's comment and, in his opinion, it is true.

Brock mentioned the original mission of this committee: how do we prepare the material so that it can be used and to recommend items/activities to increase the use of RAP. He is unsure how successful we have been in that area. Pappas went back to the survey issue; how do we convey the information about marketing the successes, because of the reasons given for not using RAP and RAS.

Huber reported the RAP surveys have been done in 2007 and 2009, so next year is in the cycle. Huber summarized the comments he heard; move forward with the next survey. Jim Pappas requested Copeland send him the previous surveys, he will review those previous surveys, make some changes or revisions that might be necessary, send the revised survey questions out for review to others, and after receiving any comments – send the survey out. One suggestion from the ETG was to recover the specifications used for the raw materials. Schreck also reinforced that suggestion. No tolerance for failure being used by some agencies. Material preparation is a key area; some are not correctly preparing the materials. Standardize the specifications for the raw materials going into the HMA.

Scherocman commented; most contractors do not want to invest in the equipment because it is not used that frequently. Brock agreed with that comment, but you do not need that much tonnage to get the investment paid for. Mike Harnsberger replied; back to the data issue, as a group we should focus on helping agencies that had a problem with doing forensic investigations to determine the reason for the failure. Pappas agreed with that recommendation because some agencies will use the failure issue as an excuse for not using it. He suggested using that information in getting the material used.

Brock mentioned some of the production issues and suggested focusing on writing a specification to make it idiot proof on what is needed or ensuring adequate materials usage and then contractors can decide whether to invest in the equipment to meet the specification.

Other suggestions to the survey were given from the crowd or participants. Bob Forfyflow noted a couple of items that are disturbing to him based on some of the items being discussed and that might be included in survey. Contractors want to do the right thing – they do not want to build failures. Scherocman noted that all contractors are not created equal. Huber stated it was time for a break.

Action Item:

- Copeland will send Jim Pappas the previous RAP surveys. Pappas will review and modify the previous surveys and send the revised survey questions out for review to others, and after receiving any comments send the survey out to be conducted in 2011.
- Pappas will include survey questions on shingles and consider including a question on whether State agencies have specification for processing raw materials.

Break at 10:10 AM

#### **5.4 High RAP Performance from Previous Projects and Field Studies – Randy West (NCAT)**

##### Summary Report:

Randy West gave a verbal report for this standing committee. He reported three items to discuss; the first was related to the paper on the SPS-5 projects – it has been accepted for publication so it will be widely distributed.

West reported; the data on the mixtures from the SPS-5 projects is fairly minimal on the in place mixture properties. West stated; some sections did not perform well, but in most cases, they performed well. There is insufficient data to determine the reason for the poor performance. West also reported; many of these projects are nearing their service life and are expected to be rehabilitated in the near future. His suggestion; these sections be investigated prior to the rehabilitation – a forensic investigation. Becky McDaniel mentioned; some of the higher RAP mixtures were also included in the LTPP SPS-9 and GPS experiments.

West also reported on the RAP mixtures that were placed at the NCAT test track. He reported; some of the RAP mix sections have lower strains because of the higher mix stiffness values. West requested that Rickard Willis give a short verbal report on the performance of the RAP sections. Willis reported; all sections have performed well. They expect the RAP and WMA mixes will have higher endurance limits. West recommended; during the next round of testing at NCAT, sections be designed for higher tensile strains to compare WMA, RAP, and virgin mixtures. So far there is no cracking in sections with the higher RAP and WMA mixtures. Brock suggested; we move forward with publicizing those findings and emphasizing – the inexpensive mixtures are performing the best. West reported; Jo Daniels has a student that is working with the high RAP mixtures, but does not have any updates on their studies.

Huber asked West; what should be the next step to make this available or where do we go from here? West replied; they have submitted TRB papers and journal papers, but publication of these articles/papers is a year out. Huber asked; can anything be put on the website at this time? West replied; a summary of information can be put on the website. McDaniel's commented about the LTPP task groups; they are encouraging FHWA to complete a forensic investigation on selected sites as they go out of service. She will take this to the group in a couple of weeks to encourage them to do a more in depth analysis of the more important sections. She asked West to provide her with a listing of the sites that did not exhibit good performance. McDaniel's recommendation; complete an investigation on those sites to provide an answer of why. Mike Harnsberger also reported; they (WRI) have studied in detail one of the SPS-9 sites with a high RAP content.

Huber asked for other comments, questions, and suggestions. D'Angelo's opinion; for the NCAT sections that performed well – individuals will ask questions focusing on construction (was fractionated used, what variability was found, etc.) to build confidence in using the RAP. **He**

suggested including construction issues and items in the report. West agreed with that suggestion.

Action Items:

- Task group should explore the opportunity to get cores/in-place properties of LTPP sites before they are taken up/rehabilitated.
- Becky McDaniel's will talk to LTPP task group about an in-depth analysis of LTPP sections with RAP to encourage FHWA to complete a forensic investigation of selected sites as they go out of service.

**5.5 RAP ETG Website – Willis**

Richard Willis made the verbal report for this standing committee. The major item that needs to be discussed is making the website easily accessible for finding data and information to assist agency personnel in making a decision about using RAP and RAS mixtures. D'Angelo suggested adding examples of agency specifications that have been used successfully. Everyone agreed with this suggestion. West asked Dave Lippert about including their specifications on the website. Lippert replied; most agencies have their specifications on their own website which could be linked with the RAP website. D'Angelo suggested; information from different agencies specifications be summarized and put on the website. This could help answer questions – what do I do, for the agencies that have success, how did they do it, etc. This would be more than just a link. D'Angelo's opinion; a few good projects that worked well would be beneficial.

Huber asked the state agency members for opinions on taking photos of good performing projects and linking those to their specifications. Jim Pappas opinion; not sure about what a picture will tell you. Gallivan and others noted the importance of what the contractors are doing in terms of implementing the specifications in agencies that work. Much of the success could be related to how the contractors are interpreting the specifications. Quality control work and what the contractor does for controlling the mixture.

Copeland asked D'Angelo to lead the effort for getting a couple of the specifications together for the website. Corrigan mentioned; they are going through some of the same issues with WMA. This can be an administrative nightmare to do this and keep the information up to date. Corrigan suggested; directing the user to a site that is linked back to the DOT. D'Angelo commented that WMA is new but recycling is old and has been around for a long period of time. Richard Schreck agreed with D'Angelo; just the link does not really work because it does not give you sufficient information. It is also very hard to get to the proper link. Most of the agency specifications do not have sufficient information – only half of the information you really need.

Huber asked what if we take 2 states – get a contractor, state association, and the DOT to accumulate the information that is needed to see everything. Schreck mentioned; they have started to do this in Virginia. Gallivan volunteered to assist D'Angelo on this task. Dave Lippert volunteered to do this for Illinois. D'Angelo suggested Florida be the other state. Jim Warren and Jim Musselman are the two from Florida that need to be contacted. Texas was another agency suggested. Dale Rand and Harold Mullins are the two individuals to be contacted. Schreck suggested 6 be recommended and then screen those. Huber would suggest that the group of states

be from 2 to 3. Washington was another state that was recommended. Ron Sines suggested Ohio. Brock mentioned; Washington was not very aggressive toward the use of RAP. Most suggested that Utah was more aggressive towards the use of RAP. D'Angelo suggested Kevin VanFrank from Utah be contacted. Virginia was another state recommended.

Huber: In summary, it was decided and agreed that John D'Angelo would lead this group. Florida, Illinois, Texas, Utah, Virginia, and Ohio were the agencies suggested to start with (Washington was dropped from the list). Others volunteered for this group – Dave Lippert and Lee Gallivan.

#### Action Items:

D'Angelo will lead the group for getting information (e.g. portion of specs dealing with RAP) from states (FL, TX, IL, OH, UT, and VA) on projects with high RAP percentages that have exhibited good performance for the website. Lee Gallivan will assist. Dave Lippert will provide IL information.

## **6. Task Group Reports and Discussion**

### **6.1 RAP Variability – Randy West (NCAT)**

Randy West gave the verbal report and led the discussion. Two documents were mentioned in the verbal report: Best Management Practice for Managing RAP Stockpiles and a summary of test data related to variability or standard deviation of different sieve sizes. He mentioned the results on variability have been presented at numerous venues to get some feedback, but received little feedback on the recommended values. He has taken the silence on this issue that the recommended tolerances or variability are not that bad or not off base. West would be happy to send these documents to Copeland for distribution and presentations to the group if requested. Copeland reported the other document that was done by her on RAP State of Practice will be uploaded onto the website. This document was done about a year ago, but the report has not been posted to the website. **These three documents and presentations will be sent out and included on the website.**

West commented on the document that Ramon Bonaquist did and considered it to be very restrictive, because everything varies not just the RAP. This is the approach under NCHRP project 9-33, which only included RAP variability. Jon Epps asked; was this a Monte Carlo simulation? West replied; it was not a Monte Carlo simulation. Scherocman mentioned; the stockpiles he has seen are very large and suggested we may need to make recommendations that the testing be more frequent than what is currently done. These stockpiles can be highly variable and require an increase in the number of samples. West stated; one set of tests per 1,000 tons of mix was his recommendation. This seemed reasonable based on the survey results with contractors and state agencies. Copeland mentioned; the Best Practices document (by West) is on the website, but was unsure whether it was the most recent update. **West will send Copeland the most recent document to be distributed to members for review.** Huber also requested a couple of presentations to be included on the website. West reminded Huber that he (Huber) and Ron Sines were going to do a webinar on this subject, which has yet to be done.

Action Items:

- West to send Copeland the most recent document on Best Management Practice for Managing RAP Stockpiles and the results on the variability of RAP stockpiles (data and presentation by West) so that it can be distributed to RAP ETG members for review. RAP ETG members should submit comments to Randy by December 31, 2010.
- West, Huber and Sines will plan a webinar on RAP management best practices for FHWA or NCAT to host/facilitate.

**6.2 RAP State-of-Practice – Audrey Copeland (FHWA)**

Audrey Copeland reported this document (RAP State-of-Practice) is still going through the publication process at FHWA. However, it is available in draft form and has been sent to the RAP ETG members. She reported the draft version might change after it goes through the final review by FHWA.

Huber reported on planning the webinar of best practice and it seems appropriate to do a webinar that ties best practices into the state of practice document for agencies that have interest in using high RAP mixes. West commented that the two documents are complimentary to each other and doing a combined webinar or two separate ones would be good. West suggested that this be discussed in a separate section. **Huber summarized; Copeland, West and he will discuss this and decide on what to do.** Huber asked for any additional questions and comments on this issue. Bukowski stated; if this is done through TRB, they will charge for the service. West suggested this be done through NCAT – it will then be free. Bukowski suggested that Huber get with him regarding the process to be used. Huber agreed.

**6.3 Framework for Building/Monitoring High RAP Project – Lee Gallivan (FHWA)**

Copeland led the verbal report and reviewed the background for this task group and topic. She asked; where do we want to go with this? She also noted; Jim Musselman and Jim Pappas are the two on this task group. She opened it up for discussion. Huber commented; if someone wanted to consider using high RAP content mix, this would be a document to provide guidance on what to test and the process to be used to implement it. **Copeland recommended sending the document out for review again to get comments back.** This was done for the WMA which became a comprehensive document for getting started.

Dave Lippert reported; Illinois has recently been awarded a sustainability project and they are looking for projects. His opinion; this could include a project with different percentages of RAP that could be monitored over time. Jim Pappas suggested that academia needs to be involved because the amount of detail recorded will be greater.

Huber asked; where do we go with this? Bahia suggested preparing the document to provide guidance on going from low to higher RAP in intervals. His opinion; it be more than just a couple of sections. He envisions this to be on more of a project basis – a document that describes how to build it, how to design it, how to control it, etc. Mike Harnsberger agreed. Bahia mentioned; this is a part of the scope of some existing projects in documenting the effort or activities. Epps agreed and suggested using the WMA document in preparing the RAP document is the best approach. **Copeland will use the WMA document as a starting point. After the draft is**

complete, it will be sent out to the group for comment and suggestions. Epps requested; the document should describe what is trying to be accomplished – its purpose.

Action Item:

- Use the WMA document as a starting point for drafting the framework for building high RAP content mixes. Send out the document for review. The task group will consist of Jim Pappas, Jim Musselman, Mike Harnsberger, and Jon Epps.

**6.4 Recycled Binder Percentages for AASHTO M 323 – A Discussion**

Copeland started the report and discussion with an overview of this effort and reported there is a specific goal for this discussion. Rick Harvey requested that the RAP ETG provide input/guidance on revising M 323 to account for binder replacement. Lee Gallivan will lead this effort within the RAP ETG. The Standard Specification for Superpave Volumetric Mix Design M 323-07 was distributed to the ETG.

Gallivan started the discussion by summarizing the two procedures that need to be updated or prepared, which will be discussed after lunch.

11:45 AM Adjourned for lunch.

Copeland reminded the ETG; we are concentrating on the review of AASHTO M 323; Standard Specification for Superpave Volumetric Mixture Design. Gallivan continued with the report. There was continued discussion on the recycled binder percentages for AASHTO M 323. Starting with section 5.3 which addresses RAP usage; this is the section we are discussing and debating. Our goal is to decide – how to say determination of the recycled binder percentages. Gallivan noted; the lead in sentence to the best practices or state of practices document. Bahia commented; in this document, you do need to change the binder grade once you get above a certain percentage. Bukowski stated; that is not the question on the table. Bahia requested that maybe we need to change our question on this discussion. There was debate on what should be done, as opposed to the consequences of the decision and wording used.

McDaniel stated; from R-35 you need to know all of the properties of the RAP. The current standard states that if you are using less than 15% RAP, there is no change in binder properties or grade requirements. The item being debated is how to change the wording regarding the RAP contribution in the mixture design process. Corrigan's asked; just changing the words and not the numbers – is this correct or something we should recommend? Huber replied; the question is – replacing percent RAP with percent binder replacement. The other issue here as noted by Brock: do we need to change the grade of the liquid or why do we need to change the grade of the liquid? Huber noted; both questions need to be debated and discussed, but the second one by Brock is probably the one to be discussed later. Schreck commented; Virginia's experience would indicate that the numbers shown in Table 2 of AASHTO M 323 are incorrect. So why would we not speak to the overall issues with the document.

There was a lot of discussion and debate on what should be changed in the document and the issues or questions to be revised. Most of the discussion and debate was between Don Brock,

D'Angelo, McDaniel, West, and Schreck. One issue is; when will we have enough data to know if the grade needs to be changed versus the additional amount of virgin binder that needs to be added to higher RAP mixtures (table 4 in the State of Practice by Copeland). McDaniel stated the two issues with the current specification are: (1) for the first studies or projects, contractors did not fractionate the RAP; and (2) is the softer binder grade requirements. There was a lot of continued discussions and debate between Brock, Schreck, West, and McDaniel.

Corrigan reminded the group what we are trying to do even though this is great discussion on important factors. Mike Harnsberger commented; the question is how much binder needs to be added. We know for black rock no additional binder contribution; or all of binder contributes to mix. The answer is somewhere in between. D'Angelo commented; we are going back to some of the original discussion that led into the first chart that was quick and simple. D'Angelo was talking about Table 4 which is the binder selection guidelines for RAP according to AASHTO M323. Bukowski stated; if we are going to binder replacement, we need to talk about binder coming from RAP, shingles, or some other place. What we really need to decide; do we go to binder replacement and then decide what needs to be replaced. One question is related to binder grade determination versus binder replacement.

Most of this discussion was centered on when will we have sufficient data to make the decision to go with higher RAP mixtures using standard paving grade asphalts? Dale Rand commented on the economic perspective; once you get below the base grade, it no longer saves money, so it is not worth the benefit to use RAP. Huber asked Rand if Texas has a break point on lowering the grade of asphalt. Rand replied; everything is based on the Hamburg tests – all mixtures must meet the binder grade selected for roadway use (interstate versus low volume road). Ellie Hajj asked about the polymer modification in terms of using RAP. Brock replied; the RAP stiffens the binder as does the polymer for rutting.

Huber asked Bob Forfyflow about using RAP in cold weather environments (Canada experience). Forfyflow's comment; Table 4 basically holds true for most of their mixtures. They found the table to be fairly solid for western Canada. Low temperature cracking has not occurred for many projects. The amount of low temperature cracking is not any more than those without RAP. Ron Sines commented on New Hampshire's experience; when these mixes were first introduced, many of the RAP mixes were similar to the new mixtures, so there was no large difference. When you start adding other materials that have significantly different asphalt percentages, like RAS, however, that starts to make the numbers look funny. McDaniel's reviewed what Wisconsin DOT is currently using in terms of specifying binder replacement.

Copeland reported; a task force already exists on this issue. Bukowski stated; we need to take this to SOM this year. This is a rutting versus low temperature cracking issue on what to do. Huber summarized; this should be a binder replacement versus maximum percent binder values to be used. He believes that the Table 4 numbers need to be changed. He asked in the opinion of the group; do we want to change this to binder replacement? **The decision reached; Lee Gallivan will document the recommended changes and send it to the group for review.** Copeland told Gallivan he can start with the paragraph from the State of Practice document. End of April is when Rick Harvey needs the recommended changes or suggestions from the ETG. The tech

section ballot is what he needs this for, which is sooner. Other debate included; when is this due. Copeland, Larry Michael, and Jeff Withee volunteered to assist with this effort. Gerald Reinke commented; we have not talked about durability at all. The only test that has been mentioned is the Hamburg (by Rand). Reinke asked; how will we assess the change to the mix and whether it will have good performance – determining the mix properties?

Huber summarized the task force will be headed by Gallivan. The task force will prepare a draft and send it out for review. The task force includes; Gallivan, McDaniel, Corrigan, D'Angelo, Sines, Rand, West, Michael, and Withee.

Action Items:

- Task force (led by L. Gallivan) will prepare a draft on the recommended revisions to M 323. The recommended revisions will include a write-up of a procedure to evaluate issues and establish own requirements for RAP use. The draft recommendations are to be sent to the ETG for review. The recommendations to be sent to Rick Harvey in April prior to SOM ballot.

**7. NCHRP 9-46; High RAP Mix Design Update; Randy West (NCAT)**

Presentation Title: *NCHRP 9-46 High Rap Content Mix Design*

Summary of Presentation/Report:

Randy West gave the report and presented some of the recommendations on the Mix Design with High RAP Contents. West gave some comments on what is needed – the major issue being; what is the appropriate PG for the virgin binder, which has been the discussion topic for the past hour or so. West also noted one item of discussion will be the recommendations for performance based tests that can be used to determine susceptibility to distress. The key risk is the resistance to cracking and long-term durability.

West acknowledged the participants included in this study; NCAT, University of Minnesota (Mihai Marasteanu) and University of New Hampshire (Jo Daniel), and overviewed the schedule of the project. He reported there have been delays and gave the reasons for the delay. West overviewed the different tests that were considered in the project and the ones they are currently using to measure the mixture properties for evaluating those mixtures. Relative to fatigue testing – controlled strain versus controlled stress test was discussed. Key item is the fatigue test that is part of this project. West asked; do we need a fatigue type test? Other tests included dynamic modulus, flow number, and tensile strength ratios. Scherocman asked; does the direction of testing through the TTI overlay tester applies the strain in the correct notation in the field?

West noted the importance of having a hole in the membrane at the bottom of the test to prevent friction to allow the pressure in the specimen to vent out for dynamic modulus testing. He reported they are rerunning many dynamic modulus tests. West also reported none of the samples exhibited tertiary flow during flow number testing. West presented a flow chart that showed the RAP sampling and testing of the mixtures.

West showed a summary and analysis of the standard deviation of asphalt content and percent passing of selected sieves for the RAP data. West also summarized the methods used for handling the RAP for mix design. He pointed out multiple items to be careful about (drying the RAP to remove moisture, tends to crystallize the asphalt or significantly harden it). He also showed some of the preliminary results from RAP reheating. West also his recommendations for mix design for High RAP Contents.

1. Start mix design with standard virgin binder grade.
2. Determine optimum binder content in accordance with M 323.
3. Estimate the effective binder grade in the mixture using an indirect approach.
  - o If the effective binder content is suitable, then perform appropriate performance tests.
  - o If the effective binder content is too stiff, select a new virgin PG and repeat the previous step.

West reviewed the backcalculation of the effective binder grade, which results in a correct measure of the binder properties. After this step, you move on to mix properties. The proposed mixture properties or performance test options include:

- Moisture susceptibility (TSR or Hamburg – an agencies option)
- Permanent deformation (AMPT or APA)
- Fatigue cracking (AMPT or overlay tester)
- Low Temperature (SCB and BBR with mix beams)

West presented a summary of the procedure: sample and test RAP; conduct mix design as usual; use dynamic modulus test to check the effective binder grade, adjust virgin PG as needed; conduct performance tests as appropriate and check against criteria for standard mixes; majority of the process is conducted by routine mix design labs; and additional testing will add roughly one week and may initially require farming out to specialist labs.

#### ETG Comments, Questions, and Discussion:

Bahia asked; which of the tests are being conducted for the virgin mixtures from the lists of tests for RAP? His question; is a contractor being penalized because of using RAP? West answered; some of the tests are required for RAP and not virgin mixtures. Bahia asked; is there a strong relationship between VMA and performance? His question was more related to the additional tests required for performance and confirming adequacy of test criteria. West answered; yes, but the accuracy of the relationship is unknown. Gerald Reinke was going to ask the same type of question in terms of higher amounts of RAP. This is the area where we really do not have a track record. He recommends and supports the additional testing required, which in his opinion, is a small amount of costs related to the investment.

Jim Scherocman comment; you need to focus on the plant produced VMA and not the mix design VMA because of changes you get through the plant. D'Angelo – the other issue is the higher amounts of replacement binder. D'Angelo's opinion; not worried about rutting, but thermal cracking and fatigue cracking is the concern. This testing will help to confirm that our mix will be okay. These additional tests are needed for high RAP content mixtures.

Bahia voiced his concern about using different tests for different materials; why not use these tests for all mixtures. Reply was that these will be used for just high RAP content mixtures. West opinion; we need to get away from just using volumetric properties during the mix design process.

Huber agreed with Scherocman's comment, and noted Bahia's concern in terms of the relationship between VMA and performance. Huber supports coming up with a methodology to standardize the procedure to determine VMA for high RAP mixtures. We know that there is a relationship between asphalt content and performance, and VMA is related to asphalt content. Huber's comment; there is no more of a need or importance for performance tests for high RAP mixtures than for standard mixes.

Bahia's additional comment; we cannot agree on a test for a virgin mix, so how will we agree for high RAP mixes. West agreed we do not have the performance test defined. Huber also agreed but stated the criteria being developed is okay. Huber's opinion; these recommendations and tests would not be required on every mixture design. Richard Schreck recommended we go to those states that do mixture tests for the high RAP content mixtures. Some contractors and states go to high percentage RAP values that are different from a low percent RAP or non-RAP mix. In other words, how are they approving these high RAP mixes in the past – those agencies that have been using high RAP mixes for some time.

Action Item:

No action items from this report.

Break

## **8. Asphalt Research Consortium Update**

Presentation/Report #1 Title: *Reclaimed Asphalt Pavement Mixing and Compatibility* – Michael Harnsberger, Eric Kalberer, and Troy Pauli (WRI)

The presentation/report was made by Eric W. Kalberer.

Summary of Presentation/Report:

Eric Kalberer mentioned that this will be a broad overview of the project; no data specifics, because most of this work and status of activities were presented at the Peterson conference. His presentation was grouped into five areas: (1) the approach, (2) materials included in study, (3) RAP mixing, (4) Compatibility, and (5) plans for the future.

Kalberer reported and discussed the two parts to the study approach: (1) alternative methods for determining the degree of mixing found in asphalt-RAP mixtures, and (2) determining compatibility of asphalt-RAP mixtures. Kalberer overviewed the materials being used in the study program that were sampled from a three projects; Palm Dale, CA, South Carolina, and Manitoba.

Kalberer overviewed the different materials being used to extract the asphalt and how that asphalt is being used to determine: what part is being mixed into the final mixture, what part is black rock, and what part or amount blends with the virgin asphalt. This was a brief overview of their work related to RAP mixing.

Compatibility of the RAP and virgin asphalt and/or mix is being evaluated relative to NCHRP 9-43, which uses the Reversible Automated Flocculation Titrimetry. Kalberer used an example of blending two AC-20s with different percentages they form a totally different material with different viscosities.

Kalberer ended the report with a status of the different activities that are underway and those that are planned in early next year.

ETG Comments, Questions, and Discussion:

No questions were asked.

Action Item:

- Kalberer requested more time at the next RAP ETG meeting in the Spring to present data.

Presentation/Report #2 Title: *Estimating Effect of RAP and RAS on PG Grade of Binders* – Hussain Bahia and Dan Swirtz (University of Wisconsin at Madison)

The second presentation/report was made by Hussain Bahia. Bahia reported that some of this presentation was given to the Binder ETG.

Summary of Presentation/Report:

Bahia discussed the three different topics that will be included in his report to the ETG: (1) testing and analysis procedure to define the outcome of percent change in grade per 1 percent RAP binder, (2) verification of the results, and (3) combining shingles and RAP in collaboration with the RMRC.

Bahia reviewed the sample preparation procedure for the SRAP and RRAP mortar samples in flow chart form. He defined the hypothesis for the study – if identical gradation and identical total asphalt content are used, the difference in  $G^*$ ,  $\sin \delta$ ,  $m$  and  $s$  can be attributed to the RAP binder. The equipment used in the test program was the modified DSR to determine the effect or impact of the RAP binder. He also showed and briefly discussed the spreadsheet that was used for the analysis – the computations and outcome from the procedure. The outcome was an estimate for rate of change of LT grade.

Bahia showed and summarized the sensitivity of the Grade change rate to the RAP source. He also explained the verification procedure and equipment. The verification procedure was:

- Create and test an artificial RAP (2 PAV aged binder plus RAP aggregates)
- Compare the results against the binder using the blends.
- Compare the results for the true-grade values.

Bahia overviewed and discussed the results obtained from the experiment, including; the low temperature results (BBR), intermediate temperature results (DSR), and high temperature results. He showed the process used to select the DSR geometry for the high temperature tests. He also showed and explained the effect of conditioning time on the results as part of the verification process, the effect of the total binder content on the test results, and a comparison of results using extraction and recovery using the Purdue samples. Some of the interim findings reported were:

- Procedure can be used to estimate low and intermediate properties with limited application at high temperatures.
- Each RAP, RAS, and new virgin binder blend is unique – the characterization cannot be lumped together.

Bahia listed the further items to be studied: low temperature fracture testing and glass transition, workability concerns from the first part of the study, variability with the RAS, and verification using mixtures and not mortars. He summarized the fracture testing planned using the modified BBR – a notch in the middle of the BBR sample, and showed examples of the effect of RAP and RAS on the fracture properties or results from the test for RRAP-fresh binder and SRAP-blended binder.

ETG Comments, Questions, and Discussion:

Huber asked about the RAP and RAS blends shown in the colored chart during Bahia's presentation. Huber's opinion; what agencies should do – this should be the goal of what we recommend; as opposed to doing a complete evaluation of asphalt properties for each mix design. A possible technology transfer item from this work is guidance for agencies on how to develop charts for their local materials. Epps was surprised about the outcome from this chart. However, this graph was for low temperature cracking and not high temperature values. D'Angelo noted; the change in the low temperature properties is not as significant as for the high temperature properties. The RAS materials are a lot stiffer than for the RAP materials.

Action Item:

No action item from this report.

Presentation/Report #3 Title: *Manitoba- PTH 8 RAP Field Sections Update on Laboratory Sections* – Ellie Hajj (University of Nevada at Reno)

The third presentation/report was made by Ellie Hajj to provide an update of the Manitoba project.

Summary of Presentation/Report:

Ellie Hajj overviewed the test sections included in the project and gave a summary of each section in terms of the material properties. He also overviewed the items evaluated in the project and presented a summary of the different tests performed on the materials from the different test sections. He reported the test used to measure the resistance to fatigue cracking is the AMPT, and noted they have had problems with the AMPT. Presently, they are working with the manufacturer to work out some of the issues.

Hajj listed the test experiment matrix for the binders and mixtures. He also briefly explained the different evaluations being made from the experimental test results: blending chart process, RAP mortar procedure (University of Wisconsin-Madison), predicting binder properties from the Hirsh model, predicting binder properties from the Huet-Sayegh modified model, and predicted binder properties from Lytton, et al., model.

Hajj showed graphs comparing the actual PG and simulated PG grades in the graphs for the high critical temperature, intermediate critical temperature, and low critical temperature: most closely followed the line of equality.

Hajj summarized the different models identified in the early part of his report and showed preliminary results from using each of the models. He also overviewed and showed the predictions from using these models and how they solved for the different parameters in estimating the dynamic modulus and other properties of the material and in transferring the binder properties to the mix properties for different RAP percentages.

Hajj showed preliminary results using different percentages in the laboratory and field plant produced mixtures.

#### ETG Comments, Questions, and Discussion:

There was a lot of discussion on the effect of aging in the laboratory and whether it really simulates the field mixtures. Most of this debate and discussion was between Don Brock, John D'Angelo, Hussain Bahia, and Ellie Hajj. Bahia reminded everyone of what they are trying to do here: answer the question – how do these changes impact the performance grade of the asphalt, not how the binder or mix will perform. This discussion was on the difference between the actual PG between the different conditions (the table summary included in Hajj's presentation).

#### Action Item:

No action item from this report.

## **9. Pooled Fund Study Updates**

#### Summary of Report:

Copeland reported to the ETG there are two on-going pool fund studies; one is being conducted by Jo Daniels and the other being conducted by Chris Williams (the Missouri shingles pool fund study). No results are available at this time. She mentioned, however, test results and outcomes from the two experiments should be available for presentation at the next meeting.

#### Action Item:

- Copeland will include in the next meeting agenda a report from each of the pool fund studies (Northeast States pooled fund study on RAP update and Missouri fund study on RAS update).

Huber adjourned the meeting for Day 1 at 5:15 PM.

## **DAY 2: Wednesday, October 27, 2010**

Chairperson Huber called the meeting to order for the second day at 8:05 AM.

Huber made a couple of announcements, and again thanked the Oklahoma DOT and FHWA local hospitality committee for providing coffee, donuts, and other items during the breaks. He identified the remaining agenda items for this morning, and briefly introduced the first presentation.

### **10. Barriers for Expansion of RAP/RAS Usage in Oklahoma**

The authors for this presentation were: Ken Hobson (Bituminous Engineer, Oklahoma DOT); George Raymond (Construction Engineer, Oklahoma DOT); and Waseem Fazal (Pavement & Materials Engineer, FHWA-Oklahoma Division). Hobson and Raymond provided a perspective of future RAP use from the DOT, while Fazal provided the perspective from FHWA.

Hobson overviewed the past and present usage of RAP in Oklahoma. Oklahoma started with allowing a maximum of 40% RAP using an AC-20, with the exception of wearing surfaces – none was allowed in the surface wearing. The limit of the RAP was established by the penetration on the Abson recovered binder. In 1991, the limit was reduced to 25%, but they allowed RAP to be used in the wearing surface for low volume roadways (less than 1,000 ADT). Hobson gave their reasons for limiting the amount of RAP with some photographs of RAP projects that showed some of the construction/material defects they were concerned about.

Hobson overviewed present RAP usage in Oklahoma (2009). He reviewed the current specifications. RAP can be used in Superpave designed mixtures and is now allowed in surface courses, but only on roadways with less than 0.30 MESALs. In addition, Oklahoma limits the amount of RAP by the binder grade (25% for PG64-22, 15% for PG70-28, and 15% for PG76-28) and other items (shoulders are limited to 25% RAP and temporary detours are limited to 35% RAP). Hobson defined their fractionation of the RAP. He included a summary of the sieves sizes used in the FRAP (fractionated RAP) for both fine and coarse RAP. He also reported that the amount of natural sand and gravel limits included in their specifications are reduced by the amount of RAP included in the mix.

#### *RAP Usage in Oklahoma – DOT Perspective:*

Hobson overviewed the future usage of RAP and some of their research studies being conducted by Oklahoma University for increased RAP percentages and allowing RAP in all surface course courses. Some Oklahoma divisions still do not allow or use any RAP in HMA. The research is focused on helping to relieve some of the concerns for future use.

Hobson also summarized shingle usage in Oklahoma. In summary, they are not using shingles now and do not have specifications for their use in the near future. He also identified some of the barriers for expanded usage of shingles in Oklahoma. Cost, availability of RAS, lack of

performance data, lack of specifications, and lack of upper management support are the major barriers. Communications and education were other items noted by Hobson as being critical for the expanded use of shingles.

Audrey Copeland had a question; who is upper level management? Hobson answered; it is everyone above himself and the State Construction Engineer. Hobson indicated a 1 page synopsis of benefits of using RAS to take to management as selling point would be helpful. Copeland recommended he go to the RAS website ([www.shinglerecycling.org](http://www.shinglerecycling.org)) for getting information and other data on the benefits of using RAS. Brock stated and recommended; fractionated means splitting it at a higher level; ½ to ¼ inch and down. Fractionated means back to the same size as virgin material. In other words, treat the RAP just like you would treat the virgin aggregate stockpiles.

RAP Usage in Oklahoma – FHWA Perspective:

Waseem Fazal gave FHWA's Division Office perspective on future RAP use in Oklahoma. Fazal reported the use of RAP, if designed properly, can save funds and result in a good product – but there are local concerns. He commented on the partnership with all stakeholders to increase the percentage and confidence in RAP mixtures. They do have technical task groups to discuss specifications and other items including success and failures of projects – he considers this a great success and value for going forward. They (FHWA) also provide support to the Oklahoma DOT on other topics.

Fazal noted that quality control is the greatest barrier from their perspective, but also stated many of their (DOT) maintenance engineers want to use RAP for maintenance work. Other barriers include their availability or access to good quality aggregates and lower crude oil prices. He listed past bad experiences and fear of the unknown as other barriers to expanded use.

Fazal gave the perspective from FHWA-Local Division Office for the future use of RAP and RAS. He reported that FHWA is satisfied with the overall progress on the use of shingles.

RAP/RAS Usage in Oklahoma – Oklahoma DOT:

George Raymond, Oklahoma Construction Engineer, gave the third presentation under this topic. Raymond also welcomed everyone to Oklahoma and apologized for not being in attendance yesterday to officially welcome everyone.

Raymond stated there is reluctance to move forward with using more RAP in additional projects, because they are satisfied with existing HMA and use/availability of their local materials (e.g. good quality aggregates). He also stated he feels like the chef chief for making mixtures, and does not want to push the threshold. He fully supports the use of RAP, but is cautious with it expanded use. Raymond reported they have zero desire to start using different binders (beyond the three they already use), especially softer binders. Raymond stated this is not a political decision because most of the DOT's upper level management are engineers. He also reported it will be a tough sell for using tear offs, but they are interested in using manufacturers waste.

ETG Comments, Questions, and Discussion:

There was a question from the ETG regarding the use of RAP and value of RAP because of its maintenance application. Raymond replied; they do not have a dollar value; the dollar value mentioned was somewhere between \$7 to 10/ton. Brock noted that the value is probably close to \$40/ton.

McDaniel asked; what do they do for quality control and acceptance of RAP and other standard mixtures, and what is the difference between the two types of mixtures? Fazal answered the questions by giving some background on quality control being completed by contractors. McDaniel asked; what tests are you using? Hobson answered; density, gradation, air voids, etc. McDaniel asked about using or referring to the barrier of QC for using RAP. Fazal replied; QC was the contractor's responsibility. Raymond mentioned; they do have a problem with some of their local aggregates, and that is a concern with using RAP. McDaniel's point; why do you believe that the QA tests will not pick up a problem with RAP in mixtures and will pick up problems in standard mixtures?

Don Brock mentioned some of the problems many years ago by just throwing RAP into the mix. He mentioned that we have come a long way to improve the material by treating the RAP as a virgin aggregate. Lemon agreed and mentioned; it was his opinion that RAP got a bad name when they first started using it with rejuvenating agents and other materials that did not work. He suggests that everything prior to 2007 not be looked at, because it is not a quality material. After applying the best practices published by NAPA, FHWA, and others, the quality of the product has increased. His opinion; the use of RAP will pay for itself by a 10% value return in the investment – so for every 10 miles you pave, you get a free mile.

Richard Schreck stated we need to remember that RAP is only aggregate and asphalt, just like virgin mixtures. He also noted you need a system to check on the lesser quality materials; but the system should be blind to the materials being used. Raymond stated; you get what you inspect, not what you expect. He has an issue with what is being inspected versus the entire mixture. Fazal noted; they are not confident with current QC procedures. Newcomb noted; without QA you have a problem, independent of whether you are using RAP.

D'Angelo restated their (DOT) concerns; there are stockpiles of RAP but you are unsure where they came from and what the aggregate source is, so they prefer not to use that material. So his question is: are you are looking for something to check this for to be confident in? D'Angelo stated; this ETG is looking for where are the concerns about using RAP and higher percentages of RAP, so this can give the ETG on where to focus their efforts – tests that can start to evaluate some of the older RAP stockpiles. The concern is not with those RAP materials that are coming from existing or newer projects, the concern is with the large RAP stockpiles in urban areas where the source of the RAP is unknown, so what is needed – tests to increase confidence in using those materials.

West commented; assuming that fractionating will solve inconsistency issues and using a method specification – that is a wrong assumption. West opinion; to determine the variability of the RAP, you need to test it. Testing to define the standard deviation will define the variability in the materials. Schreck gave a unique example of drinking beers regarding the recycling of

aluminum cans. Most cans have some to 100% recycled aluminum. Raymond made a comment about the tests and having to be a rocket scientist to understand the tests results.

Scherocman's opinion and comment; you need to test the final product. You need to test and control what comes out of the plant, rather than what is going into the plant. His comment; we are missing something here about the quality of the input or output. Another comment from the Oklahoma DOT is checking the quality of the components of the mixture to satisfy Raymond's concern about using RAP. Raymond noted the warranty issue and the fight between the contractor and agency.

Action Items:

No action items from this presentation.

## **11. Informal Presentations**

### ***11.1 Application of Gel Permeation Chromatography (GPC) to Asphalt Binder Characterization*** – William Daly (Louisiana State University)

Huber briefly gave the background for this presentation in that it was requested from last meeting. William H. Daly made the presentation, and acknowledged the other authors of this presentation and work: Ionela Negulescu and Ionela Glover.

Summary of Presentation:

Daly overviewed the objectives of the study to ensure that the polymers were in the mixture being provided and that other processes were not being used to change the properties of the mix. The objectives of the project were:

- Develop experimental procedures for utilizing Gel Permeation Chromatography (GPC).
- Evaluate binder changes during processing sequence using GPC.
- Observe impact of RAP addition during processing.
- Follow aging process by coring pavement at annual intervals.

Daly defined the GPC process and provided a flow chart for the asphalt binder extraction process and its use on this study. He gave an explanation of and discussed the alternate extraction procedure for small scale samples. Daly overviewed and showed some of the test results in aggregating the asphaltenes from the maltenes in term of molecular weight and how that changes with time. He showed the test results from using mixtures with different amounts of RAP. He also showed some results for comparing the RTFO properties from those measured on asphalts extracted from roadway cores.

The conclusions from his presentation: the field samples containing RAP is less than predicted by the RTFO laboratory aging, and the experimental data is limited by the number of RAP samples available to their study. He requested or asked for additional samples from the ETG to increase the number of mixture/samples included in their study.

ETG Comments, Questions, and Discussion:

Epps commented; the asphaltenes dropped from the refinery and tank which does not make sense. Don Brock stated; when you use the 45 micro filter, you start to see some fine aggregates trapped in the filter. Eric Kalberer; agreed with Daly's observation; they have seen this in oils where aggregate has never been in the mix. He also agreed with Don Brock's comment; some of the really fine aggregates can go through the 45 micro filter. His opinion; you need to centrifuge to ensure that as much aggregate is removed as possible, but some of the smaller fines will not be removed even, when using the centrifuge.

Mike Harnsberger asked; how do you know that the polymer is there as the base asphalt changes in modifying different asphalts and whether this process was universally applicable to all asphalt or mixtures? Daly agreed this procedure is not universally applicable, but noted that this was not the only test they run. He was only presenting the GPC data. D'Angelo suggested Daly get one of the California crude sources. Harnsberger commented; some of the asphalt sources are no longer available.

Huber asked Daly; what information or data do you need from the group? Daly answered; RAP samples from around the country; where those samples came from, what problems/distresses were observed on the road, what was the PG binder from the road (that information on the PG binder is not critical, if unknown – still send the material; they can determine the PG grade), the age of the road, etc. The amount of sample that he needs is a small baggy type sample (a 303 can or about a half a pound). Larger samples would be appreciated, because that would allow them to do more testing.

Action Items:

- Send any RAP mix samples with additional information including where it came from, how long the RAP mix was down, and PG grade of recovered binder (if available) to Daly to increase his database for the study.

Break

**11.2 Evaluation of RAP Binder Blending Study; Part II – 2010** – Audrey Copeland (FHWA), Raj Dongre (DLSI), and John D'Angelo (D'Angelo Consulting)

Audrey Copeland and John D'Angelo gave the presentation.

Summary of First Part of Presentation:

Audrey Copeland acknowledged the individuals that have been involved in this study, including: Matt Corrigan, Satish Belagutti, David Heidler, Darnell Jackson, John D'Angelo, and Brad Wilhoit. She identified the two primary questions they are trying to answer from this study: Do we need to make a binder change, and how much additional virgin binder is needed?

Copeland identified low temperature cracking and durability as the key issue related to using RAP. She noted and reviewed the current AASHTO guidelines regarding M 323 – Standard Specification for Superpave Volumetric Mix Design. She also reviewed recent findings from the blending studies, and overviewed the Bonaquist study and Grzybowski study. She did not go into the details of the studies because they have already been reported on, but did note the take-away

from the FHWA study where they applied the Bonaquist method for blending – blending is not always happening and may be a concern with RAP and WMA, but the method for evaluating the mix blending has merit, and RAP may have less of an impact than originally assumed. Copeland overviewed the objectives of this study, which included 4 focus areas.

1. Quantify blending between RAP and virgin binder in RAP modified mixtures.
2. Demonstrate the composite effect of layers of RAP and virgin binder on the modulus of RAP-modified mixes.
3. Evaluate the behavior of RAP and virgin binder behavior on asphalt content and stiffness.
4. Propose new asphalt mixture evaluation method for RAP use.

She overviewed the approach taken under Phase or Study I and II. The approach for Study I is quantifying blending between RAP and virgin binder, which was presented to the RAP ETG in December 2009, so it will not be discussed in detail. The approach for Study II is the HMA validation study. Both have implications for evaluating RAP use based on mix properties. She noted that the presentation will focus on Study II and the implementation from the study.

Study I was the FHWA exploratory experiment. She just summarized it as a reminder of what was done (including the RTFO experiment) and overviewed what was learned from that first experiment. (This was the FHWA 2009 exploratory study). Items learned from the experiment:

- RAP binder and virgin binder blending
  - Not 100% blended with reasonable times and temperatures.
  - Blending may not be necessary to produce properties similar to blended binder because of composite effect.
- HMA Blending
  - Standard lab mixing, mixing separately, and plant produced mixes gave similar properties.

Copeland listed and summarized the objectives for the 2010 validation study, which was considered for the Study II. These included:

- Further verification of the binder and mix exploratory study.
  - Include other RAP and virgin combinations
  - Evaluate different size RAPs
- Demonstrate the extent of RAP and virgin binder blending in RAP modified HMA

#### Summary of Second Part of Presentation:

D'Angelo gave the presentation on the Phase II and the objectives for the 2010 validation study. He discussed and gave his opinion on the binder properties on the aggregate. Randy West asked; how do you know that? D'Angelo replied; it was just a hypothesis right now for the study. The study is to confirm or reject the hypothesis.

D'Angelo discussed the RAP in an asphalt mix, how it is distributed throughout the mix, and the blending that takes place between the RAP and virgin binder. He overviewed the 2010 validation experiment, the materials included in the experiment, the mixing process, the tests used, as well as other details of the experiment.

D'Angelo provided more details on the small size #4 and #3/8 Maryland RAP mixes. This included some of the properties of the RAP and mix composition. Mike Harnsberger noted; the  $G^*$ -sin delta was lower than the value for the individual components from the asphalt. Brock asked; if they superheated the aggregate to get a better transfer of materials. D'Angelo replied; the material was not superheated. Epps asked; what type of solvent was used? D'Angelo answered; it was a toluene ethanol solvent. The property reported for the virgin NuStar asphalt was the RTFO value. Huber commented; going back to the Harnsberger question – you really do not know how much aging was taking place. D'Angelo agreed – they are not seeing a large difference.

D'Angelo reviewed details of the #3/8 Maryland RAP mix. Ramond Bonaquist commented; the low temperature grade did not change (about a -30), while the high temperature grade did change between the different blends. Related to that comment, there was additional discussion and debate. The virgin NuStar was PAV aged to get to the -22 grade. The extracted asphalt was not PAV aged, just extracted and tested. In addition, the values reported for the aged material are not grades they are just values from tests. There was a lot of confusion on this slide, which caused a lot of debate and discussion.

D'Angelo showed some of the test results in terms of bar graphs for the different mixes: a bar graph comparing RAP  $G^*/\sin$  delta at 70C values; a bar graph comparing the MSCR Jnr at 64C results; binder contents of RAP and mix blends at 40% RAP blends; and  $G^*/\sin$  delta of RAP and mix blends at 40% RAP blend. D'Angelo mentioned the slide comparing the asphalt contents for the fine and coarse mixes for the different mixes has some incorrect information that will need to be corrected. The next slide compared the  $G^*/\sin$  delta at 70C for the virgin, fine and coarse materials for different mixes. D'Angelo reported and showed there was a good correlation between the  $G^*/\sin$  delta at 70C and MSCR Jnr at 65C.

D'Angelo summarized the findings from the 2010 study – basically, the findings confirm the 2009 binder blending findings.

1. RAP and virgin binders do not completely blend in a RAP modified HMA.
2. RAP aggregate has film thickness that is significantly greater than the virgin aggregate – based on binder content data.
3. The interface layer between binder and aggregate may be the key to modeling HMA.

D'Angelo commented; the tests recommended for use by Bonaquist provide the properties of the composite sample and does not determine or estimate the blending that really occurs – it gives you composite properties.

D'Angelo provided a summary of the future work that is being planned, which is: create an artificial RAP with 3/8 and minus #8 materials to include sand sizes; produce new mixes with virgin coarse and sand RAP and coarse RAP with sand virgin mixes; and measure asphalt content,  $G^*$ , MSCR, and chemical fractions. D'Angelo noted and explained – why this next phase? These reasons are the implications – are the blending charts and grade softening for high RAP mixes correct; and the real issue may be homogenous mixing of RAP and virgin aggregate

through the plant. His opinion to confirm through this next study is; the Bonaquist procedure is needed but the binder extraction is meaningless.

The next item addressed was; so what do we need to do? D'Angelo provided a discussion on two items: need to test the RAP modified HMA (extracted binder is misleading and current practice is time consuming and meaningless), and consider a test that can be used as a mix-design as well as a QC tool for RAP modified mixes (possibly the HMA sliver test using the BBR and a fracture test). D'Angelo gave his opinions on the tests to be used and what is needed regarding the BBR.

ETG Comments, Questions, and Discussion:

Scherocman asked; do you think the lesser film thickness will have an impact on the performance of the aggregate? D'Angelo disagreed, that there is no film thickness. Scherocman agreed with that statement, but wanted him to state that. D'Angelo had stated there is a film thickness prior to compaction, but after it is compacted together, there is no film thickness. D'Angelo's point; we can do a lot of testing to measure different properties, but what do the numbers really mean and how should they be interpreted? The slide showing the BBR HMA sliver data for -12C is wrong or incorrect; it is not PG – should be PM; polymer modified.

Scherocman commented; Ohio did some work in the late 1980's similar to what is being done here to find out if blending took place. He recommended D'Angelo take a look at the results from that study. D'Angelo agreed to look at that study.

Epps asked; are you trying to understand what is going on at the end of production and not during the travel and laydown time? D'Angelo agreed. Epps noted a caution regarding the occurrence of early rutting because of using binders that are too soft at the beginning. Brock noted; super-heating the aggregate can be important. There are differences – the RAP has moisture on it which turns to steam. The second difference is that the asphalt RAP becomes sticky after it starts to heat up from the superheated aggregate. Using the same temperature may not capture the effects that occur during production. D'Angelo agreed to consider trying this in the future work plan.

Action Items:

No action item from this informational presentation.

**11.3 Investigation of Low and High Temperature Properties of Plant-Produced RAP Mixtures** – Becky McDaniel (Purdue University)

Summary of First Part of Presentation:

Becky McDaniel reported the reported documenting the study has been drafted and review comments have been received. The final report is in the process of being finalized and submitted. McDaniel mentioned that she will briefly review the study for those that are unaware of it.

McDaniel summarized what they did. She reviewed the experimental plan and how the samples were prepared. Samples were provided to Hussain Bahia (University of Wisconsin at Madison)

and FHWA Turner Fairbanks laboratory. Additional requests have been received for more samples. Two binders (PG64-22 and a PG58-28) were used in the experimental plan; with four RAP percentages (0, 15, 25 and 40%). McDaniel summarized the basic mixture information on the mixtures and how the mixtures were produced (plant types, who did the designs, etc.). All of these mixes were used on non-state projects; most were used on commercial projects. McDaniel stated some of the mixes would not meet the agency's specifications (higher air voids, etc.).

Regarding the recovered binder – McDaniel's opinion; we should not be concentrating on the recovered binder – we need to know what it is. She showed some binder data in a tabular format. She recommended that the true grade of the virgin and recovered binders should be measured. This knowledge is important for critical cracking temperatures estimated from the BBR and DT results.

McDaniel explained the binder extraction/recovery work was done in two phases. The first phase included only one contractor, while the second phase included four contractors. She showed results and data from Phase I; mixture complex dynamic modulus values on plant produced mixtures. The presentation of this data resulted in multiple questions and discussion on that data. Ellie Hajj asked; was the final gradation the same for all mixtures? McDaniel answered; no. D'Angelo stated; there was a difference in air voids from the lab compacted test specimens, because these were plant produced mixtures. The air voids are low, but the asphalt contents are about equal. Huber replied, in response to Hajj's question on the gradation; the target gradation is not the same between the 0% and 40% RAP. They are similar but they are not the same. Epps asked; was the dynamic modulus test results on the bar graph all measured at 7 percent air voids. McDaniel answered; yes.

McDaniel showed a couple examples of the master curve for different test results. She also overviewed the statistical analysis that was completed in comparing the different mixtures within the sampling matrix. An ANOVA and comparison of the means was completed. She also reviewed the blending analysis that was completed using the Bonaquist approach. McDaniel's opinion; 100 percent blending never occurs, but the test results would indicate that the mixtures performs as if there was 100% blending. She provided one example for Mix 5B. This example showed good overlap or good blending between the different percentages. McDaniel showed results from the IDT strength test that was used in the analysis. She also showed some additional examples of the data. Hajj asked; were the mixtures were long-term aged. Becky answered; all mixes were long-term aged.

McDaniel reported on the mixture fatigue testing that is being completed by FHWA Turner Fairbanks. She stated; this is not a push pull test, but a tension test. Brock asked; were these mixtures still available on the roadway so that cores could be drilled for additional field testing. McDaniel replied; probably not because these mixtures were not placed on state routes. Huber stated; some are available, but their availability depends on the contractor that placed the mixtures. Brock's opinion; the low temperature properties might be about equal across the board now. Another question asked; did plant type have an effect on the test results? McDaniel was unclear about the answer to that question and will have to look at the data. Not sure whether plant type would have made a significant difference.

McDaniel gave the general conclusions from the project:

- Recovered Binder Tests
  - As RAP increases, high temperature grade increases.
  - As RAP increases, low temperature grade increases, but not as much as the high temperature grade.
  - Softer binder decreased high temperature and low temperature by half a grade or more.
  - Increasing RAP content 25% changed critical cracking temperature by no more than 2 degrees.
  - Extraction/recovered method did not appear to cause significant differences in test results.
- Dynamic Modulus
  - Increase in RAP content caused an increase in dynamic modulus, especially at the intermediate and high temperatures.
  - The statistics of the data generally showed no significant difference in PG64-22 mixes – sometimes 40% RAP was significantly different.
  - Softer virgin binder generally led to lower stiffness.
  - Modulus of PG58-28 mixes with 25 and 40% RAP were often significantly different.
- Blending – significant blending occurred in 3 of 4 cases.
- Low Temperature Cracking (IDT)
  - Slight effects on critical temperature at up to 25% RAP with PG64-22.
  - Critical cracking temperature of 40% rap with PG64-22 was slightly warmer but still around -22C.
- Based on the results and extensive testing and characterization of RAP stockpiles – Indiana DOT changed their specifications. IDOT allows up to 25% RAP before changing grade and also changed the percent RAP binder.

ETG Comments, Questions, and Discussion:

Epps requested McDaniel's to show the stiffness that was used for the RAP binders. Huber noted that one was a -10C. Dean Mauer asked; what was the binder percent replacement value? McDaniel answered; it was up to 25%. Scherocman asked; what is done for the higher percent RAP mixtures? Huber and McDaniel replied; the binder grade is lowered. Scherocman requested McDaniel to clarify – what is meant by binder replacement, in other words, what does it actually mean?

Epps commented; this is a great study and recommends it be continued in other states. Epps also asked; can the report be circulated to the ETG? McDaniel replied; circulation to the ETG will be up to FHWA. Copeland stated; it will be circulated to the ETG, but how and where it will be published is still up in the air.

Action Items:

- The report will be distributed to the ETG once it is approved and the final report is published through the FHWA.

## **12. Other Business**

### ***12.1 Old Business; Task Groups Discussion***

Copeland stated that there are no loose ends from this meeting and assignments have been made.

Newcomb noted that there is a Greener Pavements International WMA conference that will be held next October in St Louis. Deadline on Abstracts is the December 17<sup>th</sup>.

5<sup>th</sup> asphalt shingle recycling forum will be held from October 27 to 28, 2011 in Dallas, Texas.

### ***12.2 New Business***

Review AASHTO M 323 Standard/Table 2 and provide recommendations to AASHTO SOM Tech Section 2d for “Recycled Binder Percentages.”

### ***12.3 General Announcements***

None noted, other than those listed above.

## **13. Review and Discussion of Action Items from Meeting**

The following are the action items from the meeting.

1. Target Low RAP Usage States Standing Committee:
  - a. Draft documents to increase the awareness on the benefit of increased percentages of RAP.
    - i. Case studies, short histories, bulleted items in the form of an FHWA Tech Brief to be prepared – led by Audrey Copeland.
    - ii. List of RAP articles to be put on website – compiled by Becky McDaniel.
    - iii. Compilation of success stories (FDOT, LTPP SPS-5 sections) that target different topics for TRB Circular (AFK10 committee) – led by Becky McDaniel.
  - b. TTI has a project with the Texas DOT on RAP and as part of their research they did a literature review that can be made available to McDaniel’s group. Jon Epps will make sure that McDaniel’s has this information.
  - c. Review “Frequently Asked Questions” brochure from West.
2. Research Needs Standing Committee:
  - a. Send any comments on the research statements to Jim Pappas, Randy West, and/or Gerald Huber within two weeks. Randy West will remove track changer revisions/comments and place the statements on the website.
3. RAP Use Survey Standing Committee:
  - a. Copeland will send Jim Pappas the previous RAP surveys. Pappas will review and modify the previous surveys and send the revised survey questions out for review

- to others, and after receiving any comments send the survey out to be conducted in 2011.
- b. Pappas will include survey questions on shingles and consider including a question on whether State agencies have specifications for processing raw materials.
4. High RAP Performance Task Group:
    - a. Task group will explore the opportunity to get cores/in place properties of LTPP sites before they are taken up or rehabilitated.
    - b. Becky McDaniel will talk to LTPP task group about an in-depth analysis of LTPP sections with RAP to encourage FHWA to complete a forensic investigation of selected sites as they go out of service.
  5. RAP ETG Website Standing Committee:
    - a. D'Angelo will lead the group for getting information (e.g. portion of specifications dealing with RAP) from states (FL, TX, IL, OH, UT, and VA) on projects with high RAP percentages that have exhibited good performance for the website. Lee Gallivan will assist on this effort. Dave Lippert will provide IL information.
  6. RAP Variability Task Group:
    - a. West to send Copeland the most recent document on Best Management Practice for Managing RAP Stockpiles and the results on the variability of RAP stockpiles (data and presentation by West) so that it can be distributed to RAP ETG members for review. RAP ETG members should submit comments to Randy West by December 21, 2010.
    - b. West, Huber, and Sines will plan a webinar on RAP management best practices for FHWA or NCAT to host/facilitate.
  7. Framework for Building/Monitoring High RAP Content Mixes Task Group:
    - a. Use the WMA document as a starting point for drafting the framework for building high RAP content mixes. Send out the document for review. Copeland will lead the effort and task group. Other members of the task group are: Jim Pappas, Jim Musselman, Mike Harnsberger, and Jon Epps.
  8. Recycled Binder Percentages for AASHTO M 323 Task Group:
    - a. Task force (led by L. Gallivan) will prepare a draft on the recommended revisions to M 323. The recommended revisions will include a write-up of a procedure to evaluate issues and establish requirements for RAP use. The draft recommendations are to be sent to the ETG for review. The recommendations to be sent to Rick Harvey in April prior to SOM ballot. The task force includes: Gallivan (led), McDaniel, Corrigan, D'Angelo, Sines, Rand, West, Michael, and Withee.
  9. Pooled Fund Study Update: Copeland will include in the next meeting agenda a report from the pool fund study – Northeast States pooled fund study of RAP update and the Missouri study on RAS update.

10. Send any RAP mix samples with additional information including where it came from, how long the RAP mix was down, and PG of recovered binder (if available) to Daly to increase his database for the GPC study.
11. The final report for the low and high temperature properties of plant produced mixtures will be distributed to the ETG, once it is approved and the final report is published through the FHWA. Copeland will distribute the report.

Huber – noted that the format for this meeting is different and asked for comments on how it should be handled in future. Becky McDaniel noted that this format should be used in future. Others at the meeting also agreed.

#### **14. Next Meeting**

Tentative date, April 11 through 15 (that week) for the RAP and WMA ETGs. For sure there will be a co-meeting. It was mentioned that the Asphalt Institute meets that week. Audrey Copeland asked about the week before and after that week. After a lot of discussion, the month of May was discussed; weeks of May 9 or 16 were put forth. These two weeks will be discussed and put forth to the WMA TWG; stayed tuned for the final announcement of the meeting.

Larry Lemon issued a thank you for coming to Oklahoma and bringing the Oklahoma DOT management up to date on benefits of RAP.

#### **15. Adjournment**

Chairperson Huber adjourned the meeting at 11:40AM.

**Recycled Asphalt Pavement Expert Task Group Meeting Agenda  
October 26-27, 2010  
Oklahoma City, OK**

**Tuesday, October 26th**

8:00-8:15	Welcome, Roll Call (Introductions), and Purpose/Mission	Huber
8:15-8:30	Approval of Minutes from last meeting	Copeland
8:30-9:00	Chairman's Report Huber RAP ETG Organization Discussion	Huber/Copeland
9:00-10:00	<b>Standing Committee Reports</b>	
	• Targeting Low Rap Usage States	West
	• Development of Research Needs Statements	Pappas
	• RAP Use Survey Pappas (vice Jones)	
	• High RAP performance from previous projects and field studies	West
	• RAP ETG website	Willis
10:00-10:15	BREAK	
10:15-11:45	<b>Task Group Reports &amp; Discussion</b>	
	• RAP Variability	West
	• RAP State-of-Practice Copeland	
	• Framework for Building/Monitoring High RAP Projects	Copeland
	• Recycled Binder Percentages	Gallivan
11:45-1:00	LUNCH (on your own)	
1:00-2:00	Discussion: Recycled Binder Percentages for AASHTO M 323	ALL
2:00-3:00	NCHRP 9-46 High RAP Mix Design Update	West
3:00-3:15	BREAK	
3:15-4:15	Asphalt Research Consortium Update	TBD
4:15-5:00	Pooled Fund Study Updates	
	• Northeast States Pooled Fund Study on RAP Update	Daniel
	• MO Pooled Fund Study on RAS Update	Williams?

**Recycled Asphalt Pavement Expert Task Group Meeting Agenda  
October 26-27, 2010  
Oklahoma City, OK**

**Wednesday, October 27th**

- 8:00-9:00 Barriers for Expansion of RAP/RAS Usage in Oklahoma
- Ken Hobson, Bituminous Engineer, ODOT
  - John Lenard, Assistant Construction Engineer, ODOT
  - Waseem Fazal, Pavement & Materials Engineer, FHWA-Oklahoma Division

**Informational Presentations**

- 9:00-9:30 Using Gas Permeation Chromatography (GPC) to Predict Binder Grade Daly  
9:30-10:00 RAP Binder Blending Study Copeland/D'Angelo
- 10:00-10:15 BREAK
- 10:15-11:00 Low & High Temperature Properties of Plant Produced Mixtures McDaniel  
11:00-11:30 Other Business
- Old
  - Task Groups discussion
  - New
  - Review AASHTO M 323 Standard/Table 2 and provide recommendations
  - to AASHTO SOM Tech Section 2d for "Recycled Binder Percentages"
  - General Announcements
- 11:30-12:00 Review & discussion of action items from meeting Copeland  
Planning for next meeting Huber
- 12:00 Adjourn Huber

*All are welcome to stay for the Warm Mix Asphalt Technical Working Group Meeting starting at 1 PM!*

## Attachment B

### FHWA Recycled Asphalt Pavement Expert Task Group Members

Chairperson:

**Gerald Huber**

Heritage Research

Phone: 703-631-0004

[gerald.huber@heritage-enviro.com](mailto:gerald.huber@heritage-enviro.com)

Co-Chairperson:

**Audrey Copeland**

Federal Highway Administration

6300 Georgetown Pike, HRDI-11

McLean, Virginia 22101

Phone: 202-493-3097

[Audrey.copeland@fhwa.dot.gov](mailto:Audrey.copeland@fhwa.dot.gov)

Members:

**Hussain Bahai**

University of Wisconsin-Madison

1415 Engineering Drive

Madison, Wisconsin 53706

Phone: 608-265-4481

[bahia@engr.wisc.edu](mailto:bahia@engr.wisc.edu)

**Don Brock**

Astec Industries, Inc.

P.O. Box 72787

Chattanooga, Tennessee 37407

Phone:

[dbrock@astecindustries.com](mailto:dbrock@astecindustries.com)

**John D'Angelo**

Astec Industries, Inc.

P.O. Box 72787

8528 Canterbury Drive

Annondale, Virginia 27003

Phone:

[johndangelo@dangeloconsultingllc.com](mailto:johndangelo@dangeloconsultingllc.com)

**Jo Daniel**

University of New Hampshire

Phone: 603-862-3277

[Jo.daniel@unh.edu](mailto:Jo.daniel@unh.edu)

**Jon Epps**

Texas A&M University – TTI

3135 TAMU

College Station, Texas 77843-3135

Phone: 979-458-5709

[j-epps@tamu.edu](mailto:j-epps@tamu.edu)

**Mike Harnsberger**

Western Research Institute

Phone: 307-721-2334

[mharns@wyo.edu](mailto:mharns@wyo.edu)

**David Lippert**

Illinois DOT

Phone: 217-782-7200

[David.Lippert@illinois.gov](mailto:David.Lippert@illinois.gov)

**Becky McDaniel**

Purdue University

P.O. Box 2382

West Lafayette, Indiana 47906

Phone: 765-463-2317; ext. 226

[rsimcdamni@purdue.edu](mailto:rsimcdamni@purdue.edu)

**Andy Mergenmeier**

FWHA

Phone: 410-962-0091

[Andymergenmeier@fhwa.dot.gov](mailto:Andymergenmeier@fhwa.dot.gov)

**Jim Musselman**

Florida DOT

Phone: 352-955-2905

[jim.musselman@dot.state.fl.us](mailto:jim.musselman@dot.state.fl.us)

**Dave Newcomb**

National Asphalt Pavement Association  
5100 Forbes Blvd.  
Lanham, Maryland 20706  
Phone: 301-731-4748  
[dnewcomb@hotmail.org](mailto:dnewcomb@hotmail.org)

**Ron Sines**

Oldcastle Materials  
14 Monument Square, Suite 302  
Leominster, Massachusetts 01453  
Phone: 978-840-1176  
[rsines@oldcastlematerials.com](mailto:rsines@oldcastlematerials.com)

**Others**

**Phil Blankenship**

Asphalt Institute

Phone:  
[pblankenship@asphaltinstitute.org](mailto:pblankenship@asphaltinstitute.org)

**Bob Forfylow**

LaFarge Canada, Inc.  
10511 15<sup>th</sup> Street S.E.  
Calgary, Alberta, Canada T2J 7H7  
Phone: 403-292-1585  
[Bob.forfylow@lafarge-na.com](mailto:Bob.forfylow@lafarge-na.com)

**Jim Pappas**

Delaware DOT

Phone: 302-760-2400  
[james.pappas@state.de.us](mailto:james.pappas@state.de.us)

**Randy West**

National Center for Asphalt Technology  
277 Technology Parkway  
Auburn, Alabama 36830  
Phone: 334-844-6228  
[westran@auburn.edu](mailto:westran@auburn.edu)

**Lee Gallivan**

FHWA  
Office of Pavement Technology  
575 N. Pennsylvania St., Room 254  
Indianapolis, Indiana 46204  
Phone: 317-605-4704  
[Victor.gallivan@dot.gov](mailto:Victor.gallivan@dot.gov)

**Richard Willis**

National Center for Asphalt Technology  
277 Technology Parkway  
Auburn, Alabama 36830  
Phone: 334-531-3150  
[Willi59@auburn.edu](mailto:Willi59@auburn.edu)

## **Attachment C**

### **Proposed Organization of FHWA's RAP ETG**

#### **Standing Committees**

- **Targeting Low RAP Usage States**
  - Purpose: Identify agencies with low or no RAP, identify what is restricting contractors from using more RAP if it is allowed in a state, and assemble information to provide to state agencies with low or no RAP
  - Lead: West
  - Members: Sines, Musselman, Pappas (vice Jones)
  - Activities:
    - TRB Webinar "Design and Production of High Reclaimed Asphalt Pavement Mixes" <http://www.morerap.us/RAP%20Resources/webinar.html>
    - NAPA document How to Increase RAP Usage and Ensure Pavement Performance
    - Identify target states to go to and promote RAP usage
    - Pamphlet on RAP FAQ (West)
      - Review by Gallivan, Copeland, Corrigan, Newcomb, Sines
- **Coordinating Development of Research Needs Statements**
  - Purpose: To coordinate the RNS developed by the RAP ETG and present the RNSs to the appropriate AASHTO tech section.
  - Committee Lead: Pappas
  - Members: West, Huber, Copeland, ...
  - RAP RNS
    - Cracking – outline for broad project including ALF, labs, etc., lab prediction test, link to performance, Lead: West
    - WMA & RAP/RAS , Lead: Corrigan
  - RAS RNS
    - RAS use and processing (expanding on Chaignon's presentation at Shingle Forum), Lead: Huber
- **RAP Use Survey**
  - Lead: Pappas (vice Jones)
  - Members:
  - Survey was conducted in 2007 and 2009
- **High RAP performance from previous projects and field studies**
  - Lead: West
  - Members: Epps, Daniel, Musselman
  - Activities:
    - Request reports on performance of RAP mixes from state engineers
    - Contact states with 25% or more RAP for performance data
    - Analysis of LTPP SPS-5 RAP sections
- **RAP ETG website**
  - Lead: Willis?

- [www.moreRAP.us](http://www.moreRAP.us)

### **Task Groups**

- RAP variability document
  - Lead: West
  - Report title: Summary of NCAT Survey on RAP Management Practices and RAP Variability <http://www.morerap.us/RAP%20Resources/reports.html>
- RAP State-of-Practice
  - Lead: Copeland
  - Assist: D'Angelo, Musselman, Weigel, Newcomb
  - Develop a best practices manual based on current best practices of RAP
  - Final draft ready for publication
- Performance tests for RAP mixes
  - Lead: McDaniel
- Document with 6-10 case studies
  - Lead: McDaniel
  - Assist: Daniel
- Develop Framework for Building/Monitoring High RAP Projects (similar to WMA framework)
  - Lead: Copeland
  - Members: Musselman, Pappas
- RAP as percentage of binder
  - Leads: Gallivan/Copeland
  - Members: McDaniel, Sines, D'Angelo, Musselman, Corrigan, Mergenmeier, Williams
  - Framework recommendation to AASHTO for binder replacement/contribution

### **Other responsibilities for review and comment:**

- NCHRP 9-46 recommendations (West)
- Asphalt Research Consortium
  - Binder evaluation (Bahia)
  - Aggregate properties (NCAT rep, Haaj)
- NE States pooled fund study for RAP (Daniel)
- Missouri pooled fund study for RAS performance (Williams)