Members in Attendance
Andy Mergenmeier
Tim Aschenbrener
Don Brock
Jim Musselman
Cecil Jones
John D'Angelo
Dean Maurer
Johns Epps
Randy West
Andrea Kvasnak (Reporter)
Gerry Huber (Chairman)
Mike Harnesberger
Becky McDaniel
David Lippert
Dave Newcomb
Jack Weigel
Audrey Copeland

Friends and Guests in Attendance:

Name	**Company**
Hamid Moussavi	CALTRANS
Haiping Zhou	Mactec
Terrie Bressette	CALTRANS
Nahid Hosseinzadah	CALTRANS
Larry Rouen	CALTRANS
Bill Moses	CALTRANS
Brandon Milar	Cal APA
Jack VanKirk	Basic Resources Inc
Hongbin Xie	Graniterock
Scot Schwandt	Wisconsin APA
S. David Lim	CALTRANS
Ron Sekhom	CALTRANS
Dan McLind	CALTRANS
Joelu Avarez	Bedford Logistics
Tim Denlay	Knife River Corp
Art Padilla	CALTRANS
Al Ochoa	CALTRANS
Tom Carter	Teichert Aggregates
Peter Vacura	CALTRANS
Mary Stroup-Gardiner	CP2
Jim St. Martin	APA of CAL
Gary Hicks	CP2 Center
Tony Limas	Granite Construction
Shakir Shatnawi	CALTRANS
Peter Sebaaly	Univeristy of Nevada
Ray Bonaquist	Advanced Asphalt Technologies

March 5, 2008
Gerry opened the meeting by greeting CALTRANS representatives and California contractors. He discussed the intention of inviting California asphalt representatives which was to address some of the questions that contractors and state agencies have about the use of RAP.

John D'Angelo explained that the RAP ETG was initiated as the result of two things; the green movement and higher asphalt prices. Increasing the usage of RAP in the U.S. would coincide with the goals of the green movement and help offset the increased price of RAP. The status of RAP usage prior to the initiation of the RAP ETG was state agency projects tended to be more restrictive with the use of RAP than commercial projects. The RAP ETG is charged with the task of identifying if there are better procedures for building pavements with RAP and determining why the RAP usage for state agency projects is not as high as commercial projects.

After Gerry Huber and John D'Angelo's introduction, members of the RAP ETG and guests introduced themselves. Following the introductions, Gerry Huber defined the purpose and goals of the RAP ETG. When defining the goals and aims of the RAP ETG he recited the statement summarized at the top of every RAP ETG agenda. The statement reads, "The purpose of this ETG 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." After reading the statement, he opened the floor for comments and questions concerning the purpose and goals of the RAP ETG. Jon Epps asked for clarification on the title of the ETG, HMA Recycling Expert Task Group Meeting, specifically about if the group was limited to just HMA. The response was the group is focused on RAP in HMA and WMA, but not cold mix. Cold mix designs and construction practices tend to differ significantly from HMA/WMA mix designs. In-place recycling methods are considered under the Pavement Preservation task force.

The group then reviewed the perceived needs for encouraging greater RAP usage that were identified at the first meeting. The top ten issues that require addressing that were reviewed were:

1. Study to evaluate and/or develop a performance test that can be used as a guideline for evaluating RAP
2. Development of a best practices manual for mix design and construction which will highlight the advantages of RAP and include guidelines for producing a quality mix with varying levels of RAP
3. Develop a method to characterize RAP which avoids hazardous solvents that will address how to quantify Gsb, Pb, and binder grade of blends
4. Evaluation of whether or not binder grade changes are necessary
5. Evaluation of the degree of co-mingling of binders (RAP/virgin) in plants

6. Documenting field performance of high rap mixes
7. Replicating RAP and virgin plant heating in labs
8. Getting states with no or low % RAP specs up to speed with current practices
9. Variability of RAP—(aggregate, asphalt content, modification, binder characterization)
10. Processing/fractionating RAP

Jon Epps suggested that the group may want to consider including the use of asphalt rubber since it is an important recycling issue for many states. He also recommended that the group consider the energy savings associated with the use of RAP. He mentioned that there was an investigation into energy savings associated with the use of RAP conducted several years ago. More recently, Granite has begun to explore energy savings. Dave Newcomb mentioned that NAPA has been researching the cost and energy savings associated with using RAP in asphalt pavements. Don Brock mentioned that there can be huge energy savings by increasing RAP from 15-50% and that emission concerns with using higher percentages of RAP due to superheating of the virgin aggregate can be counteracted by dropping the temperature with a warm mix technology. Other members and guests expressed an interest in exploring green house gases and emissions along with other environmental issues.

One last issue that was recommended for the group to consider is polymers in RAP mixes. Many states use polymer modified binders which could result in RAP sources containing polymers along with virgin asphalt.

Cecil Jones gave a presentation on the status of the state agency survey. He was pleased to report that there was 100% participation. In total there were 51 responses, Ontario responded along with all 50 states. Most states do allow some percentage of RAP. Cecil would like to do another survey at the end of the 2008 construction season to measure the advancement in higher RAP usage. Randy West agreed with Cecil that this first survey is a great tool for determining the current RAP usage status and re-polling states periodically will help the RAP ETG determine if the goal of increased RAP usage is occurring. Randy West also stated that it is a good tool for identifying which states have low or no RAP usage that could benefit from information compiled by the RAP ETG. John D'Angelo suggested that for the next survey that the group may want to identify the person in charge of asphalt pavements in a state and send the survey to that person. It was suggested that the group contact municipalities because they might use greater percentages of RAP. It was pointed out that the majority of mixes being placed are surfaces and some of the obstacles of RAP usage are more significant in the surface mixes. These obstacles include friction.

CALTRANS voiced some concern that there are not answers to the top 10 research needs and the group was asking for increased RAP usage. John D'Angelo explained that the top 10 lists issues that the RAP ETG has heard as reasons for not using higher percentages of RAP. Many of these issues have been addressed in certain areas of the country and high RAP content mixes have been produced, placed, and performed successfully. It was noted that we are not pushing for everyone to use 30% right now,

that is a long term goal. An immediate goal is to have all states allowing and using between 10-20% RAP. Andy Mergenmeier commented that one reason some states do not allow RAP is the state agency is not willing to accept the risk associated with possibly placing a poorly designed RAP mix. One way to overcome this is by transferring the risk via the contract from the state agencies or municipalities. Gerry Huber commented that often the risk seems greater because of the lack of experience with RAP mixes and that a better understanding of RAP could help overcome the fear of RAP mixes.

Ray Bonaquist spoke about the variability of RAP. Information came out of NCHRP 9-33 project on the mix design manual. AAT has recently developed a mix design manual and software. The method for evaluating the variability of RAP can be found in chapter 5 in the manual. Agencies limit RAP because of binder changes, homogeneity, excessive fines, variability of RAP stockpiles. If contractors have a method of determining how much RAP is appropriate based on the variability of their stockpile the risk of producing a poor quality mix due to RAP variability is reduced. The tool developed by AAT uses information obtained during the materials characterization procedure and includes information such as gradation and asphalt content. He did note that the method is a project-pile specific tool and cannot be performed once and applied to all RAP mixes. He requests that members of the RAP ETG encourage contractors to try it and give AAT feedback.

Audrey Copeland and Andrea Kvasnak presented on field studies conducted as part of a cooperative research project between FHWA and NCAT. Thus far there have been high RAP demonstration projects in North Carolina, South Carolina, Wisconsin, and Florida. The highest tonnage job was Florida. The Florida demonstration job will be interesting to monitor since the original virgin binder selected was deemed not soft enough and after constructing the test strip the virgin binder was switched to a softer grade. All of the projects used a warm mix asphalt technology. The double barrel green system was used for all but the Wisconsin project which utilized Advera WMA. The North Carolina nd South Carolina projects were low tonnage on low volume roads. The Wisconsin project was a low tonnage project in an industrial park. TABLE 1 summarizes the RAP percentage and date of construction for each projected visited in 2007. There are several future projects planned in Minnesota, Illinois, Delaware, and other states.

TABLE 1. High RAP Demos

State	RAP Percentage	Date
NC	40%	September 2007
SC	30% and 50%	October 2007
WI	25%	November 2007
FL	45%	December 2007

John D'Angelo presented on NCHRP 9-46 RFP. The contract should be awarded next week.

Peter Sebaaly presented on Asphalt Research Consortium (ARC) Research on RAP. The ARC will be developing a system to evaluate the properties or RAP materials, both aggregate and binder materials. As part of the research endeavor, ARC will evaluate the effects of extraction/recovery methods on aggregates and binder. Three extraction methods will be used on four aggregate sources and two binder sources. The extraction methods that will be used are reflux, centrifuge, and ignition oven. NCAT will be teaming up with ARC by evaluating two of the aggregate sources. ARC is interested in input from RAP ETG. Consortium website is http://www.ARC.UNR.edu. Comments about the workplan should be sent to John D'Angelo and/or John Bukowski.

Andrea Kvasnak presented on Jo Daniel's work at the University of New Hampshire. Jo has a project in which she is investigating the validity of using the dynamic modulus to back-calculate the blended binder grade. She has another study to evaluate blending of binder. Five blending scenarios are being considered. The study is ongoing. The group would like some clarification on the black rock study. Jo is also looking at how the MEPDG works with RAP mixes.

Becky McDaniel gave a presentation on the North Central Superpave Center (NCSC). Becky has a study underway that is looking at plant produced RAP mixes. She is working with a contractor who is willing to vary the RAP percentage and binder grade. Mix testing is conducted on the various mixes and the results compared. The mix testing that she is using are indirect tensile strength, dynamic modulus, and shear modulus. Binder is extracted from the mixes and tested. The virgin binder and mix recovered binder properties after RTFO are similar to one another. The similarities could be because the virgin binder is artificially high because RTFO does not exactly match field aging. The Abson method was also used so the solvent could still be in extracted binder making it softer. Asked if she is doing any work on the chemical compatibility and she said no. Epps said resilient modulus could be used. John D'Angelo suggested that varying the asphalt content would be informative; look at optimal -0.5 and -1% asphalt content to see if the method is sensitive to changes in coating. Don Brock said you really need to know your equipment and take into account the different plant types. May need a longer mixing time. Mike Harnsberger suggested using infrared on the toluene and alcohol extracted asphalt to see if there is any remaining solvent in the binder. That carbon bromide bond should show up to check for remaining solvent. The alcohol comes off way before the toluene.

Andrea Kvasnak presented on NCAT research. There are RAP sections at the NCAT test track that contain 20% and 45% RAP. The study looked at keeping the RAP percentage constant but varying the virgin binder grade to see if polymer modified binders are feasible with RAP mixes and if binder bumping is needed. Thus far the section are performing well after about 5 million ESALs. There are several laboratory studies underway at NCAT. One study is evaluating the methods available for indirectly characterizing RAP binder. These methods use results from mix tests to determine the effective binder properties. The methods under review are dynamic modulus, DSR with torsion beams, BBR with mix beams, and indirect tensile relaxation. Another study

underway is concentrating on producing documentation to aid in encouraging RAP use and supplying guidelines for designing RAP mixes.

Ray Bonaquist presented on AAT RAP research. AAT is using dynamic modulus results to evaluate homogeneity of RAP mixes. Maryland has not made the homogeneity testing a standard however the SHA continues to send contractors to AAT to evaluate plant material. Continuum Damage fatigue is being done on long term aged material. John D'Angelo said SMA is least sensitive to RAP. Gayle King's theory is the m-value is related to cracking. AAT is collecting data m-value. NCHRP 9-43 project is posing the question about whether or not the RAP percentage needs to be lower for WMA because there is less heat to melt the binder off of the RAP. AAT would like help in modifying predictive models and field verification to estimate the variability of RAP.

David Lippert presented on SEM. Saw some cracking around RAP particles. Study is on going.

Gerry Huber opened the floor to discuss the list of 10 obstacles. One of the obstacles is evaluating RAP mixes is not a short term project since the major issues are associated with aging of the material. The group discussed ideas on how to accelerate the aging process. Jim Musselman mentioned the heat box used in Florida to accelerate pavement aging. Gerry Huber suggested we use it at the NCAT test track. Randy West suggested doing a hot in place section going across the pavement to oxidize it.

Jon Epps thinks top down cracking is a concern along with thermal cracking. Thermal cracking involves time, temperature aging.

Dave Newcomb does not think it is a good idea to restrict ourselves to conventional technologies. Jon Epps agreed that we are limiting ourselves by not looking at new technologies.

Peter Sebaaly said that moisture, thermal cracking, and durability are the real distresses of concern with high RAP mixes. John D'Angelo commented that we should look at Rey Roque's top down cracking work to evaluate issues with RAP. John D'Angelo also commented that dynamic modulus testing can be used to evaluate blending and that low temperature cracking can be evaluated using TSRST, creep, and strength tests. An important aspect to using these tests is to document field performance and compare to lab testing.

Don Brock commented that fractionation could help with not only controlling the mix but reducing segregation that could be leading to top down cracking.

Jon Epps commented on gaps in RAP information. He thinks we can get some effort going to get some performance data for SPS sections. He also felt that asphalt binder chemical compatibility issue should be explored since it can influence test results. The third issue to pay attention to is energy savings and the conservation of materials. You can make big changes by putting an emphasis on conservation and lower emissions.

Mike Harnsberger agreed that asphalt compatibility is a significant issue. Compatibility is a bigger issue in some areas than others. Tar sands have some serious problems with it.

Tim Aschenbrener feels that an emphasis on thermal cracking and top down cracking when evaluating performance is needed. Thinks there is a big gap in characterizing RAP. Randy West commented that Peter Sebaaly's study on aggregate properties is addressing the characterization of RAP aggregates. It is the path to get us answers but not completely comprehensive since only 4 aggregates. Many of the group felt it is more important to look at mix performance and not so much emphasis on the binder blending issue. We need to find a balance of a performance test that is cheap and doesn't take a long time. We need to get away from the idea that quality control is acceptance testing. John D'Angelo commented that AMPT tells about dynamic modulus and repeated load permanent deformation. You can get a little bit of information about durability when you test at high frequencies and age the specimens prior to AMPT testing.

One person suggested that mix designs be certified. North Carolina certifies mixes. Don Brock commented that recipe mixes may be the way to go to facilitate the use of RAP. Are we at the point to certify plants?

What should we do as an ETG to get states with low or no RAP usage to use more? Look at Cecil's survey and identify states that are not using a lot of RAP and why they are not using a lot of RAP. We can make a specific appeal based on that reason. Could put together a webinar. We need to give areas with low or no RAP usage a specific procedure for specific gravity. We need to market a process to help agencies

User producer groups could help us get the low states up to speed on using typical amounts of RAP.

March 6, 2008

Terrie Bressette presented on RAP in HMA in California. Hamid is the lead person. A report has been written on the SPS sites with RAP. CALTRANS is going to try 5% shingles in upcoming projects. CALTRANS is going to use shingles with manufactured defects and not tear offs. Don Brock commented that tear offs are where the majority of asphalt is compared to the rest of the shingle.

Jim Musselman spoke about Florida's experience with RAP. Even though they have implemented Superpave their mixes have not changed all that much. Florida has been assuming that there is complete blending and has been doing this for 20 years and have not had problems with performance. The only live piles in Florida are ones that are fractionated. Florida uses 12% rubber by weight of binder. They are considering using dense graded surfaces with recycle.

Gerry Huber spoke about water quality related to RAP. There is a paper that was published that will be available on the RAP ETG website. The test used during the

evaluation is like the micro-deval. It tumbles material in water for about 7 days and then test the water.

Gerry Huber spoke about air quality. Air quality was a concern in parallel flow plants, since we have gone to counter flow the RAP is no longer subjected to hot exhaust gases and is not a problem. Don Brock talked about problems with light oils being released at old plants. Control feeds were used to address issues with emissions in the 1980's and 90's for batch plants running RAP mixes. Any fumes that comes off of the RAP or virgin material in a counter flow plant are sucked through the burner and can run very clean. Rubberized asphalt wouldn't affect emissions in the counter flow plants.

Don Brock presented on RAP and WMA. He feels that the WMA technology allows for greater RAP percentages in mixes. His discussion of WMA was concentrated on the double barrel green method. Mike Harnsberger asked if there is evidence of foaming. John D'Angelo said there is data. Mike Harnsberger also commented that oil fields change over the years of production so oil changes over time.

Open Table

City of LA has been doing high recycling, as much as 50-100%. The city of LA might be a source of information for existing high RAP pavements. The green book has had RAP in the document since the early 80s. The green book has up to 15% and greater than 15%. Local agencies are getting 20-30% RAP. LA is doing cold in place and full depth on a regular basis. One of the perceived obstacles to using higher percentages in CA is the dust to binder ratio. Requirement in green book is that if greater than 15% RAP is used, you have to meet the neat binder grade which has deterred people from using greater percentages. CA needs to have good specifications that are realistic. Green book is a local agency specification book in southern California. Huber suggested that the Bailey principle might be a good tool for VMA in a mix. Max dust to binder ratio is 1.2 in CA. AASHTO allows states to move dust ratio up to 1.6 which many states have done so and had successes. Coarse graded mixes you can go to the higher ratios.

California is going through some major specification changes. Since the changes to conventional mixes is going on the increase of RAP usage may not occur as quickly because contractors may be hesitant to try RAP while changing other aspects of the mix. The RAP in California is owned by the contractors.

Contractors often hesitate in taking advantage of the technology out there. Don Brock thinks it is because they do not truly understand the aggregate. An advantage in CA is that a lot of the contractors are vertically integrated. In southern CA most of the contractors are recycling. Towards the northern CA is a little bit behind where they are in the south because they depend on CALTRANS specs. RAP is an option in the standards.

CALTRANS will work with John D'Angelo to set up a RAP workshop. John Epps thinks we should be specific of who we want to invite and find out what their barriers are so that we can address those barriers specifically.

Dean Maurer commented on issues with ownership in PA. In the rural areas maintenance people feel they have already paid for the material once and to give it away is ridiculous.

Caltrans will give us their questions and then we will address them.

Louisiana has done a RAP study looking at performance. UNR recently completed a RAP study for AAPTP.

LTPP projects need to be reviewed again since they had 30%+ RAP. I-70 East of Indianapolis there is a RAP and control that Becky can supply information on. John D'Angelo suggested contacting Dave Lippert about getting case study information from Illinois.

Action Item:

1. Organize a workshop for California. Handled by Caltrans, FHWA, southern California, and northern California. Audrey is responsible to make this happen.
2. Develop a best practices manual based on current best practices. Put it together as an ETG document that could be given to AASHTO as a provisional standard. John D'Angelo will be responsible for this and work with Audrey. Jim Musselman will volunteer to be the DOT person. Have a presentation for the subcommittee of materials about the activities of the RAP ETG. Audrey thinks that there can be something together by September 30th of 2008 (target date). Terrie Bressette would like to be involved in the process. Dave Newcomb said that he will also be involved also. Jack Weigel was volunteered to join the group. John D'Angelo will get Jack involved.
3. CALTRANS will send questions to Andrea and Andrea will disperse to ETG.
4. Create a new polished website. No one was assigned this task. Andrea is working on a bare bones website that is easier to navigate.
5. Have a list of performance tests to address certain criteria. Becky McDaniel volunteered to lead. Peter will help. A good starting place is the WMA website. Audrey will send out her revised version of that document. Target date of May.
6. Get someone to talk about chemical compatibility for next time. Someone from WRI will address this at the next ETG. A presentation and talk at the next ETG meeting
7. Get someone to talk about environmental. Dave Newcomb put together a presentation addressing environmental issues. Would like to put it on the website also besides just presenting at next meeting
8. Case study info pooled together by Andrea. Also talk to Kent Hanson and look into other case studies listed above.
9. Andrea send out possible dates in end of October/ early November check to make sure that it doesn't conflict with user producer groups and WMA conference.