HMA Recycling Expert Task Group Meeting

December 16th & 17th, 2009
Seattle, Washington

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.

Wednesday, December 16th

1:15 – 1:45 pm Welcome – Huber and Kvasnak
- Introductions
- Approval of April 09 minutes
- Review Purpose of ETG
- Current ETG Follow up Listing
- RAP Research Corner (see below for explanation)

1:45 – 2:15 pm Washington State RAP Usage – Baker

2:15 – 2:45 pm Illinois RAP Experience – Lippert

2:45 – 3:15 pm Summary of High RAP performance in Florida – Musselman

3:15 – 3:30 pm Break

3:30 – 4:15 pm Summary of Historic RAP Pavement Performance – West

4:15 – 5:00 pm Energy Savings and RAP Asphalt Properties – Robinette

5:00 – 5:30 pm Binder Blending of Shingle Mixes -- Bonaquist

Thursday, December 17th

8:00 – 8:45 pm Recycling Shingles Pooled Fund Study – Williams

8:45 – 9:00 am Mixture ETG Meeting - RAP Updates – Corrigan

9:00 – 9:15 am Update of Addressing RAP obstacles – West

9:15 – 10:00 am Update of States with Low/No RAP Usage – Jones
- RAP Survey
- Identify Agencies with Low RAP Limits
- Identify States with Low Usage
    - Identify Restrictions
- Identify Information Needed

10:00 – 10:15 am Break

10:15 – 10:35 am Discussion of Increasing RAP – Kvasnak
- Update on RAP Brochure – Kvasnak
- How to Increase RAP Usage and Ensure Pavement Performance – Newcomb

10:35 – 11:00 pm RAP Blending Study – Copeland

11:00 – 11:30 am RAP Research at Rowan University – Mehta

11:30 – 12:00 pm Update of NCSC RAP Study on Low Temperatures – McDaniel

12:00 – 1:15 pm Lunch (on your own)

1:15 – 1:30 pm Discussion of Aggregate Extraction Study – Kvasnak

1:30 – 1:45 pm Identify Ongoing RAP Research

1:45 – 2:05 pm WMA containing RAP – Kvasnak

2:05 – 2:35 pm Performance of High RAP Pavements – Kvasnak and Copeland

2:35 – 3:05 pm Summary of RMRC RAP Research -- Daniel

3:05 – 3:15 pm Break

3:15 – 3:45 pm Guidance Document – Copeland
- Status of revisions
- Plans on Addressing Identified Concerns

3:45 – 4:15 pm Discussion of AASHTO T 283 for High RAP Content Mixes -- Kvasnak
- Summary of Georgia Moisture Susceptibility
- AASHTO T 283 Data Summary for High RAP Content Mixes

4:45 – 5:00 pm Summary of RAP ETG Meeting – Huber

RAP ETG Minutes December 16, 2009

G. Huber welcomed everyone. C. Jones made a motion to approve the minutes from the April 2009 meeting. R. Sines seconded the motion.

G. Huber proposed including recycled asphalt shingles (RAS) in our scope. R. Sines, R. McDaniel, and C. Jones agreed that RAS should be included within our scope. R. West agreed that it is an important issue but cautioned against incorporating too many issues within our scope since we may not be able to properly address all issues. J. Musselman was concerned that including RAS within the scope would complicate the issue. G. Huber stated that the Recycling Shingles Symposium did not have a lot of recommendations for the use of shingles in mixes and he thinks there needs to be more guidance. D. Brock pointed out that one of our original objectives was to increase RAP and we should not lose focus. J. Musselman moved to vote on including the scope to include asphalt shingles. C. Jones seconded the motion. The group voted 10 yeas to 2 nays for including RAS in the scope.

Tom Baker -- WSDOT RAP Usage (see presentation)

T. Baker summarized the construction of several high RAP content pavements in Washington.

- J. Musselman asked if WSDOT typically mills and T. Baker said they do both mill and overlays.
- J. D'Angelo asked if they are still putting an aggregate layer on top of the old pavement and then paving over that. T. Baker said WSDOT stopped using OGFC on top of RAP pavements because they were not performing well. There are pavements that are frost susceptible and they will put a rock cap (free draining and a lot of voids to reduce freeze-thaw issues) before paving.
- T. Baker stated that WSDOT did have issues with RAP balls in WMA. They are not requiring fractionating, but they do require screening.

Jim Musselman -- Summary of High RAP Performance in Florida (see presentation)

J. Musselman presented information from Florida on the performance of high RAP pavements in Florida.

- J. D'Angelo speculated that the thick tack coat for the OGFC might be helping because it seals the RAP pavement. J. Musselman said they are not aggressive with the track coat.
- J. Musselman said there are gaps in data and that should be kept in mind when reviewing the data. He did state that there was no indication in the data that RAP should not be used in high percentages
- Data is going to J. Daniel's graduate student for his MS.

Randy West – Performance Studies of Asphalt Pavements with Greater than 25% RAP (see presentation)

R. West summarized available information on high RAP pavements from the LTPP SPS-5 study.

- M. Harnesberger suggested looking at the sum total of the transverse cracks so there could be a difference in the extent of cracking.
- R. McDaniel said there are crack maps available for all of the surveys.
- R West is investigating the cause of fatigue cracking for the sites that exhibited poor performance.
- J. D'Angelo pointed out that for the reported California asphalt content might just be the virgin asphalt.
    - Montana might be in the same case
- J. Daniel asked if R. West looked at the sections that are performing the same.
- J. Musselman is concerned that we are spinning it too much.
- LTPP has an ETG and R. McDaniel said that FHWA is working with the regional contractors to do one last round of surveillance before it goes out of service.

Andrea Kvasnak – Discussion of Current RAP Research

Passed out action item lists and current RAP research. Lee Gallivan requested that the RAP research will include recently completed RAP research.

Chris Robinette – Energy Savings and RAP Asphalt Properties (see presentation)

C. Robinette discussed properties of RAP and RAS recorded for several projects constructed by Granite. He also discussed energy and greenhouse gases associated with asphalt paving.

- C. Robinette commented that based on their historical data, RAP variability does not increase HMA variability.
- J. Musselman asked how does Granite characterize their shingles. C. Robinette responded that three samples are obtained and evaluated. Asphalt is recovered from the shingles and tested in the DSR. If the properties of the asphalt exceed the limit for the DSR, the binder properties are extrapolated.
- C. Robinette commented that energy savings can be up to 16% for mixes containing RAS. RAP and asphalt shingles reduce environmental impact
- This work has been submitted to TRB for presentation and publication and has been accepted for at least presentation.

Ray Bonaquist – Blended Binder Properties of Shingle Mixes (see presentation)

R. Bonaquist discussed a recommended method for characterizing mixes containing RAS.

- R. Bonaquist commented that one of the major issues with RAS is grading the recovered binder. The critical high temperature of RAS often exceeds the limitations of a DSR. To determine the critical low temperature, the BBR has to be set to a very low temperature

and the m-value is typically very low. The AAT solution is to evaluate a blended binder (50% virgin, 50% RAS) and develop a blending chart.

- D. Brock commented that the method presented was a good approach.
- R. Sines pointed out if you do not grind shingles fine enough they do not melt and blend with the rest of the virgin asphalt

Francois Chaignon – Behaviour of Asphalt Mixes Incorporating Recycled Asphalt Shingles (see presentation)

F. Chaignon presented on a study that evaluated the impact of RAS on low temperature properties of 11 mixes.

- R. Chaignon reported that in the study, the incorporation of shingles does not influence low cracking TSRST temperatures. However, RAS effected the rheology of the mixes. The study indicated that the RAS improved the rutting and fatigue resistance.
- R. Bonaquist said he has conducted IDT for RAS mixes and also has not seen great changes. The critical value of the RAS is controlled by the m-value. The TSRST is a S driven test.

December 17, 2009

Chris Williams – Recycling Shingles Pooled Fund Study (see presentation)

C. Williams discussed the RAS research being conducted at Iowa State which includes the Shingles Pooled Fund Study lead by the Missouri Department of Transportation. The pooled fund participants include FHWA, MO, IA, IN, MN, and WI.

- R. Bentson discussed some of the Illinois Tollway paving that has included RAS. He commented that 5% tear-off shingles have been used in binder and base courses.
- J. D'Angelo asked what are the long term characteristics of the RAS mixes
    - Be interesting to look at that to see what is really going on
    - Another big issue would be the top down cracking that they see in Florida

Matt Corrigan – Mix ETG Update (see presentation)

M. Corrigan gave an update on the activities of the Mix ETG. At this time, there are no RAP or RAS related issues being addressed as part of the Mix ETG.

Randy West – Top 10 Obstacles

R. West reviewed the top 10 obstacles to increased RAP usage that the RAP ETG had identified. He said that we still need recommendations for evaluating performance of asphalt mixtures containing RAP.

- H. Bahia asked why are we looking to add additional tests for RAP. R. West commented that he felt that additional performance testing should be considered when evaluating high RAP content mixes.
- R. Bonaquist commented that one of the problems with testing is there are not a lot of standard tests; however, he agrees that for high RAP mixes we need other performance tests.
- H. Bahia asked if mixture testing is conducted is it still necessary to conduct extraction and recoveries to characterize the individual components.
- J. D'Angelo said it is a combination of both, we need to look at volumetrics, components, and mix. We should establish relationships between individual component properties and performance since a battery of tests cannot be conducted all of the time. He commented that one solution could be to do as the French and only do the mix design once with extensive mix testing. As long as no major changes are made to the mix design within five years, the process is not repeated.
- H. Bahia said that data showed that there is no real problem with using high percentage of RAP.
- J. D'Angelo said that he agrees that there are mixes that work, but we need to look at more than just one test and there are a lot of different questions that need to be answered.
- H. Bahia is worried that we are putting more hurdles in front of people with using RAP even though we are seeing good performing RAP mixes.
- R. West said he thinks that the data from LTPP indicates that there is more occurrence of fatigue cracking and if we want equal or better performance we need to address long term durability.
- D. Brock thinks that we paralyze ourselves with "what ifs". He said we are mostly milling up Superpave with good aggregates and we are combining it back with good similar materials.
- J. Epps said maybe a better question is, if you were a contractor who had a 20-40 year warranty what would you do?
- M. Harnesberger said that they have some test sections in MN modified with and without elvaloy. The sections all have 20% RAP. Looked at using different virgin binders one soft and one standard. The sections are three years old. G. Reinke was also involved in the project. Some transverse cracking has occurred.
- J. Epps said there should be a mechanism in place to update the best practices regularly
    - Next issue was characterizing the raw materials
        - Kvasnak and Hajj work
        - UNR-NCAT report
        - Bonaquist, HMAT
    - In terms of binder stiffness, the direction we seem to be going in is using the indirect methods.
- J. D'Angelo said we need to get a better feel for how RAP changes properties.
- There is information available on long term performance information
    - J. Michael and R. West's LTPP SPS-5 summary
        - Will be NCAT report
    - UNH will have a report at the end of the summer on long term performance.
- There is information available on replicating plant reproduction, such as NCHRP Report 452 and the future NCAT report on RAP heating.

- Information on variability of RAP and effects on mix are available from NCAT, NCHRP 09-33 work, and ICAR 401-1/98 .
    - RAP can be just as consistent as virgin aggregates.

Cecil Jones – A Strategy for Encouraging More RAP Usage by Certain Agencies (see presentation)

C. Jones presented the findings of the second survey sent to states requesting information on allowable and used RAP percentages.

- J. D'Angelo asked how can we have fatigue cracking in the surface since it is a bottom up issue. There may be durability concerns. Maybe we need to put definitions out there about what the distress is.
    - C. Williams said in IA they allow 30% but no one uses it.
        - They have an upcoming RAP project to evaluate fatigue cracking, contractors reluctant to properly manage stockpiles
- Federal Lands does not allow RAP in the surface lift. They previously had issues with RAP variability, but no longer believe this is an issue. Their current issue is how to determiner G_{sb}.
- Training sessions in Alaska would be helpful
    - Steve Dombrowski offered to help with this effort.
- Nevada needs information about cracking and fatigue resistance. E. Hajj evaluated 30% RAP mixes for the Nevada DOT and it showed there was a drop in fatigue resistance. R. West stated that the strain levels may not have been appropriate.
- It was suggested that the Best Practices Manual be sent to New Mexico:
        - RAP Panel Best Practices
        - R. McDaniel suggested someone attend their paving conference to spread RAP information at a local level
- Oklahoma would benefit from RAP materials management guidelines. R. West suggested that we meet with contractors and DOT and discuss mistakes made in the past and future solutions.
- Rhode Island would benefit from the LTPP information.
- Federal Lands is happy with their progress to date.
- Tennessee should be sent the LTPP information gathered by J. Michael and R. West.
- R. McDaniel is going to be talking about RAP in Tennessee in the spring.
- Suggestions for spreading RAP information were made and included:
    - Attending local paving conferences, annual asphalt conferences, asphalt user producer groups
    - Give a webinar on best practices, LTPP data, etc.
    - Send a letter to the chief engineer, state that we know what their issues are, identify available information, and offer to meet in person to discuss further.

Andrea Kvasnak – Discussion of RAP Documentation

A. Kvasnak led a discussion on available and upcoming RAP documentation.

- NCAT and UNH are working on a FAQ.

    - The long version will be available at www.MoreRAP.us and a short version will be printed as a pamphlet.
- D. Newcomb suggested that the FAQ be organized by mix design, management practices, etc… instead of contractor, DOT and that Green information be added.

Audrey Copeland – RAP Binder Blending Study (see presentation)

A. Copeland summarized a binder blending study that was conducted by Dongre Labs in cooperation with FHWA. The research is focused on the qualities of the blended binder of high RAP mixes and polymer modified mixes.

- R. West asked what were the binders used in the study. J. D'Angelo commented that it was recovered binders.
- G. Huber commented that we are not seeing the changes that we expected. One material seems to be prominent until a certain point and then the other becomes more prominent.
- It was asked if the RTFO bottles were scraped. A. Copeland responded that she would need to ask R. Dongre if the bottles were scraped. J. D'Angelo commented that the material was poured from the bottles but not scraped.
- There was a question about how the RAP material was heated. A. Copeland commented that she would need to check with R. Dongre on how he handled the RAP material.
- R. Bonaquist commented that the production aging is significantly less than the mechanical aging for laboratory mixes. The plant aging is less from what he has see
- R. Bonaquist said to look at the prediction intervals. The prediction intervals give you a good idea of how good the model is.

Yusef Mehta – RAP Research at Rowan University (see presentation)

Y. Mehta summarized binder blending research that has been conducted at Rowan University.

- R. West asked how were the correction factors determined. Y. Mehta said they extracted the asphalt and burned the residue. R. West asked what is a typical correction factor. Y. Mehta commented that New Jersey typically uses the virgin correction factor.
- R. Bonaquist pointed out that using three samples will not give you good results for variability and that more than three should be used
- G. Reinke showed pictures from dry blending of virgin and RAP in a batch plant and commented that the water on RAP can help steam distill the RAP asphalt off.
- J. Musselman asked if the RAP used in the study was a stiff RAP and Y. Mehta commented that he did not know.
    - We do not know.
- R. West questioned whether or not you have transfer in a short blend time before the binder is added and D. Brock agreed with him.
- G. Reinke pointed out that what we learn in the laboratory may not be a really good predictor of what is actually happening in the plant.

Rebecca McDaniel – Investigation of Low High Temperature Properties of Plant Produced RAP Mixtures (see presentation)

R. McDaniel gave an update on the low temperature research being conducted at the North Central Superpave Center

- G. Huber asked if the mixing temperature was the same for both binders and RAP.
- J. D'Angelo suggested looking at portions of the mastercurve not on a log-log scale. He suggested that the difference in the second dynamic modulus master curve is the fines content.
- G. Reinke indicated that the tail in modulus mastercurves often does not predict well because that is where the model falls apart. He said that it is where the model falls apart because the mix modulus is too low.

Dave Lippert – Illinois Research (see presentation)

D. Lippert summarized the research that has been conducted within the Illinois DOT evaluating the quality of RAP.

- G. Reinke asked if they ever tried conducting the MicroDeval on the RAP itself. D. Lippert responded that they had not tried to conduct a MicroDeval on RAP due to concerns about effects on the equipment. G. Reinke said an ignition oven would eliminate the need to do the extraction. D. Lippert commented that the MicroDeval results for the ignition oven extracted aggregate were worse
- D. Newcomb said Missouri has a limit of RAP usage in the surface.
- D. Newcomb said one solution is to use finer material in the surface to avoid issues with friction.
- J. Musselman said they went through the same thing in FL. He said they tried segregating RAP piles and it became a nightmare. Florida now blends sources of good and bad RAP and cannot tell the difference.

Jo Daniel – Recycled Materials Research at UNH (see presentation)

J. Daniel gave an overview of the ongoing recycling research at the RMRC. One project is identifying and collecting information on RAP performance for several case studies. The other project summarized was a RAS study underway.

- RAP Performance Case Studies :
    - N. Binghamwill help with obtaining information for the Alaska.
    - S. Diefenderfer may be able to help with Virginia.

Audrey Copeland – Guidance Document (see presentation)

A. Copeland reviewed the RAP Guidance Document.

- J. D'Angelo suggested that we reference R. Bonaquist's indirect method for evaluating binder properties on page 16.
- The group decided to keep information about reducing number of extractions out of the document.
- The correction factors for the ignition oven were discussed (pg 19 and 20).
    - The group felt we need to tell them how to choose a correction factor.

    - J. Musselman suggested that we do something similar to what we are doing for the Gmm method and suggested using a regional assumed value.
    - R. Bonaquist recommended that you use the virgin number as a starting point.
- The group discussed whether we should mention that some states specify RAP from State DOT projects for State jobs.
    - A. Mergenmeier is worried people will think that it is under best practices and that state jobs should only allow RAP from milled state roads.
    - J. D'Angelo agrees with A. Mergenmeier that there is no difference and that we should point out that it is not necessarily needed.
    - J. Musselman said to state that specifying RAP is based on engineering needs.
    - A. Mergenmeier said that you should list out what the engineering examples are.
    - J. Mussleman's suggestion is to de-emphasize it. Only mention it once.
- Review of LTPPBind protocols for assessing binder requirements was discussed.
    - A. Mergenmeier suggested that they follow the LTPPBind protocols for that specific project.
    - R. West stated that we should remind people that a -22 is not always needed, sometimes that is just what is available even though the -22 might be more than needed for the area.
    - Ron Sines pointed out that he likes seeing the reliability for the binder grades.
- The group discussed classifying RAP amounts based on binder replacement.
    - J. Daniel suggested that this should be up front.
- There was a discussion on estimating the RAP G_{sb}.
    - G. Huber said that somewhere we need to speak to the use of G_{se} which in effect says that there is zero absorption. We need to give an example and that any error with an estimation is much smaller than the error with using the G_{se}.
    - R. West said that we should reference A. Kvasnak's TRB paper on determining G_{sb} of RAP aggregates.
    - R. West said we also need to point out that the errors are conservative.
    - J. Musselman said he would not mention adjusting the VMA and G. Huber agrees.
- R. West is going to review the section on long-term performance and include any necessary information from the LTPP summary conducted by NCAT.
    - Randy review the section and get back to Audrey.
- The group discussed whether we should recommend including RAP in Pavement Management Systems.
    - J. D'Angelo said we should not include it and G. Huber agreed with him.
    - R. McDaniel said it fundamentally bothers her.
    - V. Gallivan said it should be left out.
    - P. Sebaaly said he thinks it is a good idea.
    - It was suggested that we just put a recommendation for future work, it is key to have data from a PMS.
- R. West suggested that we address RAP variability compared to that of virgin aggregate. He has fractionated versus non-fractionated RAP data too that might be good to include in the document.
    - R. West wrote an article that looked at variability for the median sieve and 0.075 sieve (Better Roads).

        - The mean of the RAP at each sieve standard deviation is lower than mean standard deviation for virgin aggregate.
        - We do not need to be saying that RAP creates more variability since the data shows that it has lower variability than virgin aggregate.
    - R. West thinks that there are some advantages to fractionating however it does not necessarily improve consistency.
    - J. Musselman asked what R. West meant by non-fractionated.
        - R. West said it would be millings, and crushed and screened

OPEN DISCUSSION

- G. Huber mentioned that we need to transfer our information to AASHTO. At the next RAP ETG we need to review the specifications. A. Kvasnak will ask E. Harrigan if the group can review the recommended specification from NCHRP 09-33.
- A. Copeland suggested numbering task groups within the RAP ETG.
    - G. Huber is responsible for numbering the task groups .
    - R. McDaniel requested that we get items a week ahead.
    - J. Musselman suggested having a Go-To-Meeting for ongoing research information in advance before we come together. It would shorten the meeting and bring the group up to date on current research.
- It was decided that we have a subcommittee of the ETG take a look at the current AASHTO criteria for shingles. R. Sines will be the chairman. G. Huber will be part of the group. The subcommittee will present their findings and recommendations at the next RAP ETG.
- P. Sebaaly suggested that we form four hour course on RAP best practices. J. Musselman stated that he thought it was a great idea. A. Copeland pointed out that NHI is updating their recycling course.
- A. Mergenmeier asked about recommendations for recovering binder and it was decided to put it as an item for the next meeting.
    - Put as item for next meeting
- R. West commented that NCAT is starting a new study together with the Alabama DOT for QC of RAP mixes. He is looking at using just the indirect tensile test. R. West needs high RAP project information.
    - The simple idea is to use ITS

ACTION ITEMS

Mark Harnesberger –Find out if there is a report on the Minnesota RAP sections

Don Brock – Submit TRBA report to Andrea to post on the website

Audrey Copeland and Andrea Kvasnak -- Compile the WSDOT reports and post on the RAP ETG website

Andrea Kvasnak – Add list of recently completed and ongoing RAP research to RAP ETG Website

Andrea Kvasnak -- Organize a session next time that compiles information about discussing indirectly characterized binders. Information should be sent ahead of time to ETG members around the end of March 2010.

Randy West – Lead the development of a presentation that can be taken to states that addresses stockpile management and cracking

Cecil Jones and Ron Sines – Write draft letter to send to Chief Engineers about ideas for overcoming obstacles for higher RAP usage

All -- Send Andrea Kvasnak additional questions and top five questions for the FAQ

Andrea Kvasnak -- Send electronic version of FAQ to ETG members

Audrey Copeland – Find out procedure the FHWA chemistry department uses to evaluate the recovered binders

Audrey Copeland – Write a summary of the FHWA/Dongre Labs binder blending study

Jo Daniel – E-mail Andrea the list of states that she needs help getting data from for the case studies report

Andrea Kvasnak – Ask Ed Harrigan if the RAP ETG can review the final recommendations from the NCHRP 09-33 work that was sent to AASHTO

Ron Sines and Gerry Huber – Review current shingles standards and present findings and recommendations at the next RAP ETG.

All – Send indirect tensile data to Randy West for high RAP content mixes

Randy West – Review long-term performance in RAP Best Practices Document