ISAP 2014 SUNDAY WORKSHOP (W5)

A Step Forward Toward A Better Understanding of the Blending Between Recycled and Virgin Asphalts

We would like to cordially invite you to attend the workshop on "**A Step Forward Toward A Better Understanding of the Blending Between Recycled and Virgin Asphalts**," to be held in Raleigh, North Carolina, USA on June 1, 2014. This half day workshop is being organized by the Working Group 01 on "Hot Recycling of RAP" of the International Society of Asphalt Pavements (ISAP) Technical Committee (TC) – Asphalt Pavements & Environment (APE). This workshop is intended to facilitate exchange of information on compatibility and blending of virgin and recycled asphalt binders for better performing asphalt pavements. For more information about the workshop please visit the following links. A description of the workshop and the presentations are also presented below.

- http://www.ncsu.edu/mckimmon/cpe/opd/ISAP/workshops.html
- http://www.ncsu.edu/mckimmon/cpe/opd/ISAP/pdf/blendingWorkshop.pdf.

Organizer

Prof. Elie Hajj, University of Nevada, Reno

Time Period

8 am – 12 pm, Sunday, June 1, 2014

Workshop Description

Estimating how much the recycled and the virgin asphalt binders blend in an asphalt mixture is a complex problem that yet needs to be resolved. The resistance of an asphalt mixture with high amount of recycled binder to pavement distresses such as moisture damage, fatigue and low temperature cracking can be associated with the compatibility and the degree of blending between the virgin and the recycled asphalt binders. This workshop is to present current national and international studies on any of the following aspects:

- *The fundamental physical and chemical properties of virgin and recycled asphalt binders that would affect the degree of blending.*
- *Procedures for characterizing the degree of blending between virgin and recycled asphalt binders.*
- *Relationship between the degree of blending and the performance of an asphalt pavement.*

The workshop will consist of a number of presentations from different organizations along with enough time for questions and discussions. Details about the presenters and their topics will be disseminated soon.

PRESENTATIONS

1. ***Title:*** What is Happening during Recycling Process in the Mixing Drum? Degree of Binder Interaction Studied at Small Length Scale for RAP/RAS Recycling.
   Presenter(s): Sayeda Nahar, Alexander Schmets, and Tom Scarpas – Delft University of Technology, Netherlands; Sheng Zhao, and Baoshan Huang – University of Tennessee-Knoxville, USA.
   Abstract: When recycling RAP or RAS into new pavement structures, one obviously aims for mechanical performance properties that are comparable or even better, than the original material. Important (processing) parameters, which may influence the mechanical performance are: i) the type and percentage of fresh binder added, ii) processing time and temperature, iii) mechanical mixing characteristics of the mixing drum. It is commonly believed that the final mechanical performance properties are strongly related to the extent of mixing and blending of the fresh and RAP/ RAS asphalt binder.

   In this effort, the focus is on the evaluation of extent of interaction between RAP and RAS binder and virgin asphalt binder by studying the microstructures of the 'interaction zone' with atomic force microscopy (AFM). In principle, the study is on rejuvenation of aged (RAP) and highly aged (RAS) asphalt binders. In earlier studies, it was demonstrated that rejuvenation of the properties of an asphalt binder leads also to the reestablishment of the binder's virgin microstructural properties.

   It is found that the extent of interaction appears to be very different for RAP and RAS derived asphalt binders. Some possible scenarios that may explain the observed differences in 'rejuvenescence' between RAP and RAS are provided. Finally, recommendations on how the observed findings could be used to determine the optimum settings of the mixing unit are provided.

2. ***Title:*** A Methodology and Model to Address Miscibility and Microstructure Property Changes in RAP Binder/Rejuvenator Blends.
   Presenter(s): Ronald Glaser – Western Research institute, USA; Laurent Porot – Arizona chemical, France.
   Abstract: When an asphaltic binder is aging, its microstructure and properties are changing. And then to mobilize the aged binder in a mix, the use of fresh binder or rejuvenating agent will have to interact with the binder matrix homogenously and efficiently. Regardless to purchase specifications some additional evaluations are necessary to address the compatibility and characteristics of the new microstructure. For this purpose a specific methodology was developed, especially for the use of rejuvenating agent.

   The miscibility was simply addressed with the Exudation Droplet Test, a test which was developed earlier in the 90's. With different blends observations can be made on the migration of light components towards aggregates during manufacturing of a new asphalt mix. This will help control and predict the rejuvenator effect upscale at the mix plant.

   The microstructure is assumed to be characterized by simple suspension theory and the suspending phase by Newtonian fluid behavior using the simple fluidity model. These models were combined to obtain a model describing the observed viscosity at different blending proportions for ideal mixing. This helps to discriminate rejuvenating agent between a viscosity change alone or a more microstructure effect. These changes provide insight into the solubility behavior of the asphalt and rejuvenating system and address the issue of compatibility.

   The experiment was conducted on two different rejuvenating agents and clearly display additional behavior that purchase specifications cannot.

3. ***Title:*** Nano-Scale Evaluation of the Blending Between RAP and Virgin Asphalt Binders.
   Presenter(s): Munir Nazzal – Ohio University, USA.
   Abstract: Composite asphalt binders in mixtures with high RAP content have been studied during the past decade using tests that can only examine the macro-scale behavior. However, understanding the nano/micro-scale behavior of these binders is important as the typical asphalt binder thickness coating aggregates in an asphalt mixture is in the order of a few microns. In addition, the interaction and blending between the aged RAP binder and the virgin asphalt binder might occur at a nano or micro-scale; therefore, the evaluation of that blending should be done at the same scale.

   The focus of this presentation will be on the use of one of the nanotechnology techniques, Atomic Force Microscopy (AFM), to evaluate the blending between RAP aged binder and the virgin asphalt binder. To this end, various AFM based techniques (i.e., AFM tapping mode imaging, AFM nano-indentation, AFM force spectroscopy experiments) that can be employed to characterize the nano/micro-structural properties of asphalt binders will be introduced. In addition, the results of AFM experiments that were conducted to quantify the degree of blending between the RAP and virgin binders and to evaluate the effect of the different types of rejuvenators on that blending will be discussed.

4. ***Title:*** Influence of RAP content on complex modulus of asphalt binders and mixes and on binder blending within asphalt mixes
   Presenter(s): Cédric SAUZEAT – University of Lyon / ENTPE, France.
   Abstract: The main issue with asphalt pavement recycling is the assessment of the influence of aged bitumen in Reclaimed Asphalt Pavement (RAP) material on properties of blended binder in the final mixture. Blending charts or empirical laws, such as the "log-log" rule, are currently used to estimate grading parameters for material characterization. However, a true prediction method of linear viscoelastic properties is still missing.

   The presented approach focuses on the influence of RAP-extracted binder content on viscoelastic properties of bitumen blends obtained from different asphalt binders.
   Unaged bitumens were blended with a binder extracted from a well-known RAP material in different proportions (20%, 40% and 60%). Dynamic Shear Rheometer (DSR) and tension/compression (using a Métravib device) complex modulus tests were performed on unaged bitumens, produced blends of base bitumens and RAP-extracted bitumen. LVE properties of asphalt mixes, produced with the same materials and proportions of certain bitumen blends, were measured in tension/compression mode.

   Experimental results were modeled using 2S2P1D model, previously developed at ENTPE. A method to estimate viscoelastic properties of bitumen blends over the whole range of frequency and temperature is proposed. The ENTPE transformation (SHStS) to obtain properties of asphalt mixes from properties of binders was applied to verify the correspondence between LVE behaviors of related binders and mixes. From back analysis of data, a conclusion of partial blending could be given for intermediate and high percentage of RAP.