

Bi-Monthly Progress Report:

Project Number and Title: 2.1 Asphalt Mixtures with Crumb Rubber Modifier (CRM) for Longevity and Environment

Research Area: NEW MATERIALS FOR LONGEVITY AND CONSTRUCTABILITY

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Co-PI(s): George E. Veyera, Professor of Civil and Environmental Engineering, URI

Reporting Period: June-July 2019

Date: 8/05/2019

Overview:

Provide overview and summary of activities performed during previous two months....

The URI team had previously performed a research on the feasibility of using Crumb Rubber Modifier (CRM) in 1996, and the GRA learned that adding CRM to the paving asphalt mixtures showed the same or better performance on rutting and fatigue cracking resistance compared with conventional hot mix asphalt (HMA). To confirm the benefits of CRM and to set up the experimental design, a series of literatures reviews was conducted. In addition, tests were also conducted to evaluate the rheological properties of asphalt binder containing CRM and to compare with straight asphalt binder and Warm Mix Asphalt (WMA) binder. WMA mixtures with Reclaimed Asphalt Pavement (RAP) were also prepared, the AMPT test was conducted, and master curves were developed.

Provide context as to how these activities are helping achieve the overarching goal of the project...

The project goal is to develop asphalt mixtures with CRM that provide durable and sustainable pavements compared with the traditional HMA pavement. Thus, the URI team began investigating a new generation of asphalt mixtures with CRM for longevity of the pavement. Figure 1 shows the flowchart of the research of WMA containing CRM and RAP to improve durability and to extend the life of the transportation infrastructure.

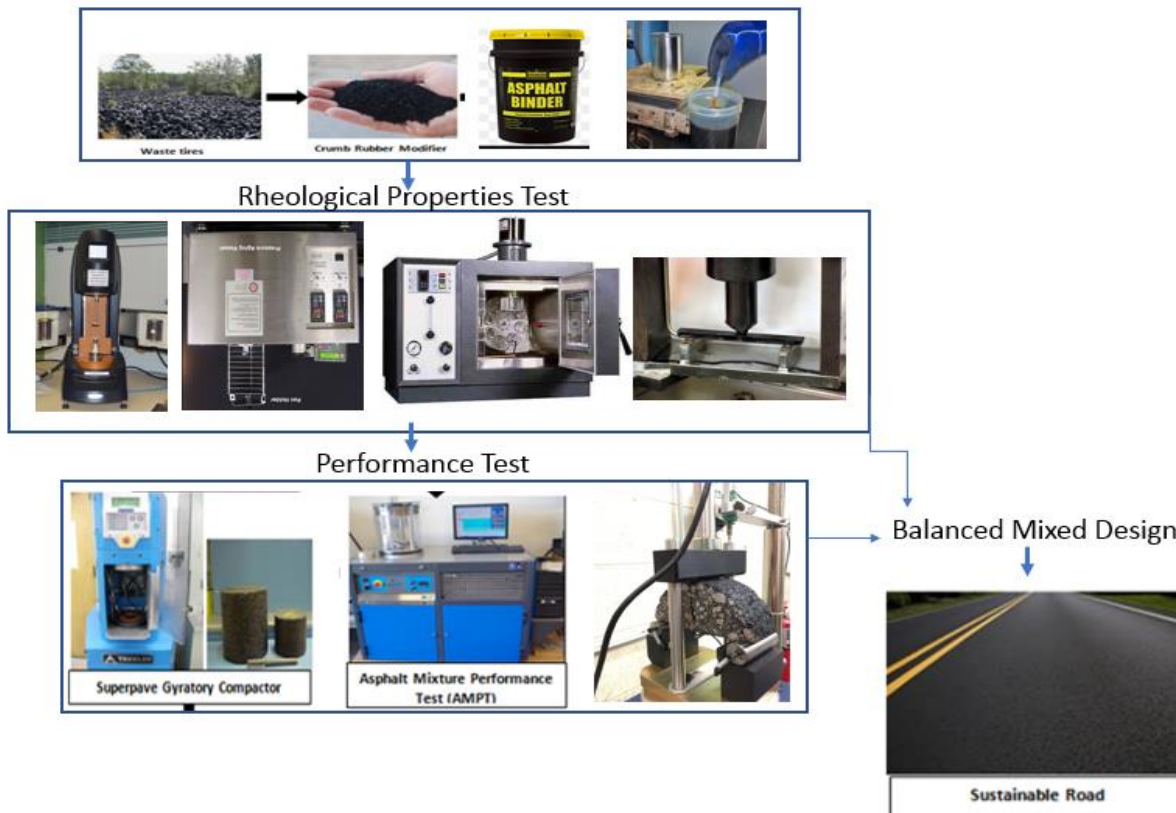


Figure 1: Flowchart of the Research Project

Describe any accomplishments achieved under the project goals...

Adding CRM to asphalt binder increases the viscosity and as a result, the compaction temperature of asphalt rubber mixture should be higher. However, it was learned that WMA guarantees to lower the viscosity and lowers the compaction and mixing temperature. Thus, a preliminary study was conducted with a WMA additive, i.e., Evotherm, which is a promising additive approved by New England Asphalt User and Producer Group (NEAUPG). It was found that using the Evotherm additive improves both the short-term and long-term pavement performance compared with the traditional asphalt binder. HMA and WMA specimens containing RAP were prepared at the Optimum Binder Content (OBC) and Indirect Tensile (IDT) strength tests were conducted. Results indicated that the HMA mixtures have 13 % higher tensile strength than WMA with same amount of RAP. Both HMA and WMA specimens with and without RAP were prepared to predict the asphalt pavement performance for the dynamic modulus and the master curves. The results showed that the WMA-RAP mixtures can improve asphalt mixture stiffness and perform better in terms of rutting resistance compared with the HMA mixtures with and without RAP. It was also observed that WMA mixtures without RAP showed poor rutting resistance performance compared with the HMA with and without RAP. This study also examined test section of RI Rt. 102, which was reconstructed in 2015 using WMA-RAP mixtures. It was found that both HMA section and WMA section showed the same performance to date.

Describe any opportunities for training/professional development that have been provided...

A graduate student is working on the project, the research and results of which will provide the basis for her Master's Thesis in Civil and Environmental Engineering.

Describe any activities involving the dissemination of research results (be sure to include workshops, seminars, and conferences attended/held for dissemination of information regarding this project) ...

- Submitted a technical paper to 2020 TRB Conference, entitled "Implementation of Warm Mix Asphalt contained Reclaimed Asphalt Pavement in Rhode Island," by Shrestha, N., Lee, K., and Veyera, G. E. (2019). Committee AFS80 - Stabilization of Geo-materials and Recycled Materials.
- A one-page extended abstract was accepted by the US-Korea Conference on Science, Technology, and Entrepreneurship (UKC 2019), entitled as "Investigation on Rheological Properties of Warm Mix Asphalt." Prepared by Shrestha, N., Lee, K., and Veyera, G. E., Chicago, August 14-16, 2019.
- Prof. Lee presented a technical paper entitled "Balanced Mix Design for Sustainable Pavement with Warm Mix Asphalt," on behalf of the research team at the 11th International Committee on Pavement Technology (ICPT), at Seri Pacific Hotel, Kuala Lumpur, Malaysia, on July 11th, 2019.
- Farahmarzi, M., Shrestha, N. and Schumacher, D. submitted a technical paper to 2018–2019 T&DI/ASCE-LTPP International Data Analysis Contest, entitled "Determining the Effect of Climate and Loading on Fatigue Cracking and Roughness of Asphalt Pavement Using InfoPave" on 7/1/19.

Participants and Collaborators:

What organizations have been involved as partners on this project?

- University of Rhode Island, Dept of Civil and Environmental Engineering
- Material Section of Rhode Island Department of Transportation
- Design section of Rhode Island Department of Transportation
- Connecticut Transportation Institute

Have other collaborators or contacts been involved? If so, who and how?

Name of Technical Champion: Paul C. Petsching, P.E.
Title: Senior Civil Engineer
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What students have participated in the project? (Include class standing, major, role in the research)

Neha Shrestha, CVE MS student, Literature review and conducting a pilot study on WMA mixtures containing RAP

Changes:

Discuss any actual or anticipated problems or delays and actions or plans to resolve them...

The purchase and/or loan plans of the Laboratory Foamed Machine have been postponed. However, the URI research team is working on the WMA mix design containing RAP. But the performance prediction of WMA-RAP mix design has been delayed due to the lengthy process of purchasing AASTHware Pavement ME Design (PavementME) software.

Discuss and changes in approach and the reasons for the change...

If the pilot WMA study will be successful, we plan to add TAP into CRM mixtures.

Planned Activities:

Description of future activities over the coming months.

CRM will be added in the WMA mixtures with and without RAP at different percentages. A series of performance tests will be conducted using the Asphalt Mixture Performance Tester (AMPT), the Semi-Circular Bending Test (SCBT), and the Asphalt Pavement Analyzer (APA), at different loading frequencies and different temperatures. Through these activities, we will be able to predict the pavement field and develop a Balanced Mixed Design (BMD) for WMA asphalt mixtures containing CRM and/or additives, e.g., Evotherm. The URI research team will also explore WMA with the lab-scale foamed asphalt plant using competitive research funds. The pavement performance prediction will be conducted using AASHTOWare Pavement ME Design (PavementME) software.