Enhancing the Performance of Asphalt Mixtures Containing High RAP Content with the Use Of Different WMA Technologies

Improving the mechanical and rheological performance of asphalt mixtures with high percentages of RAP by using different WMA technologies

Project Number:
19BLSU01

Start Date:
08/15/2019

End Date:
02/15/2021

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Funds Requested to UTC:
$34,999

Funding Source(s):
Tran-SET
Louisiana State University

Total Project Cost:
$105,094

The term Warm Mix Asphalt (WMA) refers to various technologies that allow reducing mixing and compaction temperatures of asphalt mixtures without negatively affecting their performance against common major distress types. WMA technologies include foaming process, chemical additives, and organic (wax) additives. Application of WMA technologies was found to reduce production and construction costs, extend construction season, improve field compaction, and enhance working conditions by reducing exposure to fuel emissions, fumes, and odors.surface treatment, and will reduce costs.

In this study, three additives/technologies will be evaluated to perform concurrently as a WMA technology and as a rejuvenator. To this end, Sasobit (organic), Evotherm (chemical), and Advera (foaming) will be used to prepare different asphalt mixtures with high contents of reclaimed asphalt pavement (RAP). The Louisiana Department of Transportation and Development (LaDOTD) allows only 15 to 20% of RAP in asphalt mixtures with a nominal maximum aggregate size of 0.5 in (12.5 mm) and 0.75 in (19 mm). The mixtures that will be produced in this study will contain 25 and 35% RAP to investigate the effects of using these WMA technologies on the performance of mixtures with high RAP content. The prepared mixtures will be short- and long-term oven aged and will then be tested against permanent deformation and moisture damage using the Loaded Wheel Tracker (LWT) test at high temperature and against cracking using the Semi-Circular Bending (SCB) test at intermediate temperature. Furthermore, the rheological properties of the extracted and recovered binders from the prepared mixtures will be evaluated using Dynamic Shear Rheometer (DSR) and will be correlated to the mixtures testing results. The results of these laboratory tests will be compared to those of a control HMA and WMA mixture to evaluate the effects of using WMA additives on the mix performance.

Problem Statement

The use of reclaimed asphalt pavement (RAP) in new asphalt mixtures has gained increasing popularity as an environmentally-friendly and cost-effective approach. The economic benefits of using RAP include a reduction in the use of virgin aggregates and transportation costs whereas the environmental benefits include lower consumption of non-renewable resources (aggregates), and reduction in gas emission otherwise required to produce virgin aggregates.

At the time, Louisiana Department of Transportation and Development (LaDOTD) allows only 15-20% of RAP for asphalt mixtures with the nominal maximum aggregate size of 0.5 in (12.5 mm) and 0.75 in (19 mm). Through the years, this limit has reached in some other states to 100% RAP at times; however, a consensus has not been reached by agencies regarding the maximum limit of RAP that can be added to the virgin mixture without compromising the performance of asphalt pavements. Contrary to its economic and environmental benefits, the introduction of the aged binder from RAP into virgin asphalt mixture increases the stiffness and reduces the relaxation capability of the asphalt pavements. Due to this, asphalt mixtures with high RAP contents exhibit higher susceptibility to intermediate- and low-temperature cracking.

Objectives

The accomplishment of the project objective in the research phase will require the following tasks:

Task 1: Conducting an in-depth literature review.

Task 2: Preparation of asphalt mixtures for testing.

Task 3: Evaluation of rutting and moisture damage resistance of short-term aged asphalt mixtures using LWT test at high temperature.

Task 4: Evaluation of cracking resistance of long-term aged asphalt mixtures using the SCB test at intermediate temperature.

Task 5: Evaluation of the rheological properties of the extracted and recovered binders from the

produced mixtures using the dynamic shear rheometer.

Task 6: Preparation and submission of the final report of the project that includes the problem description, objective(s), scope, methodology, results, conclusions, and recommendations.

Intended Implementation of Research

Education and Workforce Development: In this task, the research team is planning to:

• Fund one Ph.D. student at LSU from this research project. The student will be trained to prepare the HMA and WMA mixtures, prepare the samples for testing, and perform the data analysis under the PI's supervision;

• Develop and present a class module that explains the project idea, methodology and testing results to the undergraduate students at LSU and in Region 6;

• Prepare and present the project topic and its results to the LaDOTD pavement engineers to show them the impact of increasing the RAP content in HMA and WMA mixtures; and

• Deliver a webinar through Tran-SET on the project topic and findings for workforce development.

Outreach: In this task, the research team is planning to promote the outcomes of this project amongst K-12 students at sponsored events to attract them to pursue a degree in one of the STEM disciplines at the college level. During the technical phase of this project, other implementation activities might be added to the implementation phase plan. The T2 Plan for this project is attached to this proposal as requested.

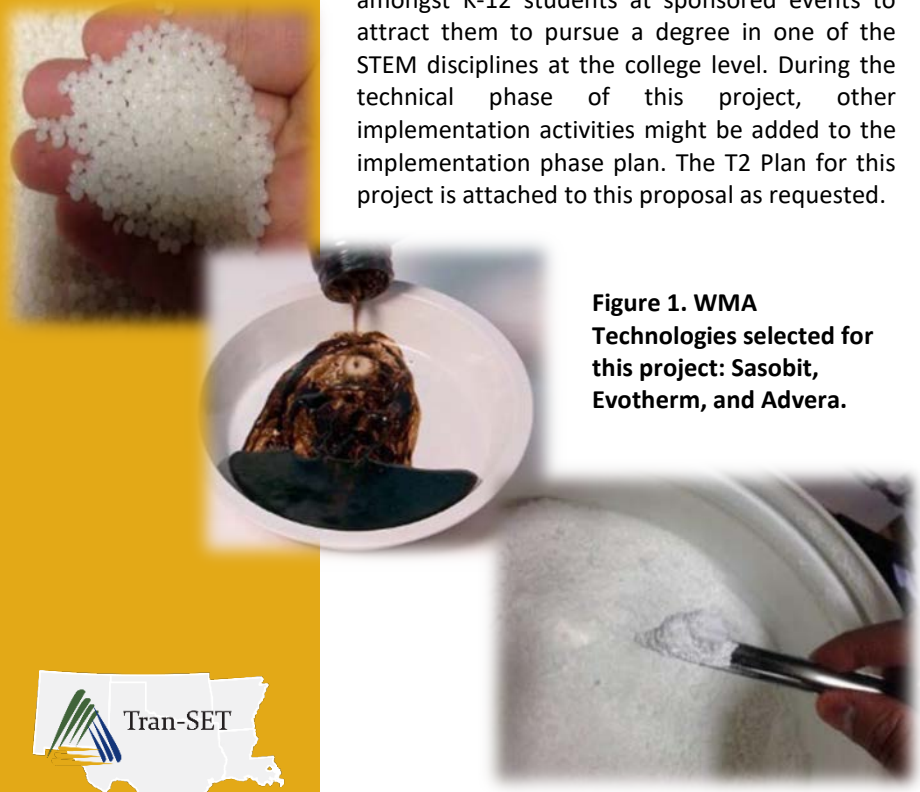

Figure 1. WMA Technologies selected for this project: Sasobit, Evotherm, and Advera.

Anticipated Impacts/Benefits of Implementation

The outcomes of this study are expected to enhance the performance of asphalt pavements in Region 6 and to improve their serviceability by using WMA additives in the produced mixtures with high-recycled materials contents. In addition, the use of WMA technologies is an environmentally-friendly alternative to produce more sustainable and low-cost asphalt pavements in the region. The findings of this study will have a significant impact on the performance of Region 6 mixtures against fatigue cracking and rutting which will minimize pavement failures and save taxpayers' money in the long-term. The findings of the proposed study can also be extended to other DOTs in the regions.

Web Links

- TranSET's website (https://transet.lsu.edu/research-in-progress/)
- TRB's Research in Progress (RIP) database (https://rip.trb.org/View/1644231)

Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

Learn More

For more information about Tran-SET, please visit Our Website, LinkedIn, Twitter, Facebook, and YouTube pages. Also, please feel free to contact Mr. Christopher Melson (Tran-SET Program Manager) directly at transet@lsu.edu.