Evaluation of Hybrid Binder Use in Asphalt Mixtures in Louisiana

Project Number:

22BLSU04

Start Date:

04/01/2022

Principal Inverstigator(s):

Momen Mousa

Louisiana State University

Lead Institution:

Louisiana State University

Funding Source(s):

Tran-SET

Louisiana State University

Total Project Cost:

$ 58,832

Developing Asphalt Mixtures with hybrid binders in Louisiana

Currently, the Louisiana Department of Transportation and Development (LaDOTD) primarily relies on Styrene-Butadiene-Styrene (SBS) modified asphalt binders to produce and place asphalt mixtures that resist climate- and load-induced distresses on relatively higher-volume roads and facilities. Yet, recent studies indicated supply shortage of styrene-butadiene polymers for the asphalt industry and recommended that alternate asphalt modifiers be considered during supply shortages, including a very interesting alternative: hybrid binders. This study aims to identify and evaluate whether different hybrid binders can perform competitively versus other modified asphalts currently used in Louisiana's highway applications. This study will also assess the feasibility of using Hybrid Rubber Modified Asphalt (HRMA) mixtures in Louisiana through laboratory testing and structural analysis to predict the field performance of these mixtures. The implementation of this research will reduce the fatigue and rutting distresses in asphalt pavements, which are common problems in South-Central United States. The results of this research will be used to implement and optimize the use of HRMA mix in asphalt pavements in South-Central United States, and to reduce costs. This research will impact state DOTs, highway contractors, transportation, and the public at large.

Problem Statement

Modification of asphalt binders is not a new concept and has become progressively more common over the past several decades. Currently, the Louisiana Department of Transportation and Development (LaDOTD) primarily relies on Styrene-Butadiene-Styrene (SBS) modified asphalt binders to produce and place asphalt mixtures that resist climate- and load-induced distresses on relatively higher-volume roads and facilities. In 2008, a Florida Department of Transportation commissioned economic study included information regarding the supply shortage of styrene-butadiene polymers for the asphalt industry. This was not new information, just corroboration of well-known industry facts. Both reports recommended that alternate asphalt modifiers be considered during supply shortages, including a very interesting alternative: hybrid binders. A hybrid binder, as described here, is a blending of SBS polymer with digested ground tire rubber (GTR) to produce a cross-linked storage stable polymer-modified asphalt (in some states called Terminal Blend Crumb Rubber). As a consequence of this type of hybrid binder, the use of waste tire rubber in Louisiana pavements would continue and possibly increase. Polymer modified Asphalts (PMAs) are normally formulated with about 4% ± SBS. If the percent SBS was reduced and substituted with equal or more GTR, which is more readily available, a likely substitute for the standard PMA could be obtained. It is well-recognized that both asphalt rubber binders and polymer modified binders can improve the performance of mixtures over the same mixtures produced with unmodified binders. Therefore, it is important to identify and evaluate whether different hybrid binders can perform competitively versus other modified asphalts currently used in Louisiana's highway applications. With the hybrid binders showing promising results when used in other states, this technology may provide LaDOTD with another alternative to modify asphalt binders and produce mixtures with a similar or better expected performance when compared to the performance of typical SBS-modified asphalt mixtures.

Objectives

The proposed research methodology will identify and evaluate whether different hybrid binders can perform competitively versus other modified asphalts currently used in Louisiana's highway applications. This study will also assess the feasibility of using Hybrid Rubber Modified Asphalt (HRMA) mixtures in Louisiana through laboratory testing and structural analysis to predict the field performance of these mixtures. To achieve these objectives, several Superpave mixtures will be prepared using different hybrid binders. The dynamic modulus as well as the performance of these mixtures against rutting and cracking will be evaluated in the laboratory. In

addition, the field performance and cost-effectiveness of these mixtures will be predicted.

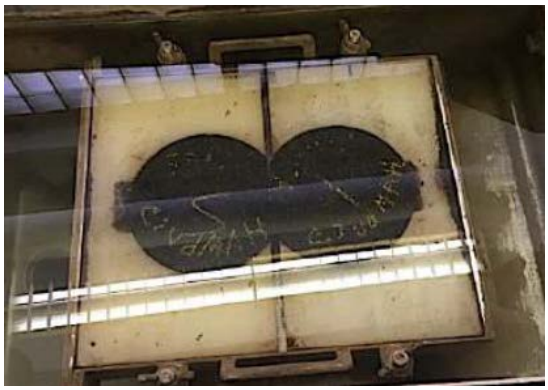

Figure 1. Loaded Wheel Tracker (LWT) Specimen

Intended Implementation of Research

Workforce Development, Education, and Outreach: This research project will provide funding to one master student at Louisiana State University. This will help recruit and train future leaders in the Transportation Sector. The research team will also prepare educational materials on the guidelines for HRMA mix design to be incorporated in courses at LSU and share it with other universities. The educational material will also be summarized and disseminated to government entities and the industry. Results of this work will be also disseminated at national conferences such as TRB and ASCE. This project will offer one summer internship to high school students within the High School Student Research (HSSR) Intern Program organized by Dr. Adam Melvin at LSU.

Anticipated Impacts/Benefits of Implementation

In this project, local virgin and recycled materials in Louisiana would be used to produce HRMA mixtures to be used in asphalt pavements. The success of this project is to show better performance and higher cost effectiveness of HRMA mixtures when compared to conventional mixtures in Louisiana. The results of this study will provide solutions for fatigue and rutting failures in asphalt pavements in Region 6 enhancing the durability and service life of the road infrastructure.

Web links

- Tran-SET's website https://transet.lsu.edu/research-in-progress/

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 Dr. Momen Mousa (Tran-SET Program Manager) directly at transet@lsu.edu.