Evaluation of Asphalt Rubber and Reclaimed Tire Rubber in Chip Seal Applications

Improving durability and service life of chip seal applications using rubber-modified emulsion and reclaimed rubber tires in the aggregate layer

The objective of this study is to improve the durability and to extend the life of chip seal applications in Louisiana using rubberized emulsion and reclaimed rubber tires in the aggregate layer. To achieve this objective, the study will review state practices in the use and construction of rubberized chip seal including both asphalt rubber and reclaimed rubber tires. Based on this review, job mix formula will be developed for rubberized chip seal and will be evaluated in the laboratory. Crumb rubber will be evaluated as an emulsion modifier as part of the aggregate stone. Construction, short-term field performance, and cost-benefit analysis of this new class of asphalt surface treatment will be evaluated to facilitate implementation in pavement preservation activities. Implementation of this research will enhance the performance of chip seal in pavement preservation activities, will improve the rideability of this surface treatment, and will reduce costs.

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Background

In order to avoid progressive deterioration and costly rehabilitation of the pavement infrastructure, many agencies, including the Louisiana Department of Transportation and Development (LaDOTD), have implemented pavement preservation programs, which not only arrest minor deteriorations but also reduce the risk of extensive deteriorations in the future. Pavements with age related distresses are commonly treated with preservation techniques such as the application of thin overlays and resurfacing. Chip seals, also referred to as seal coats or Asphalt Surface Treatment (AST), have been used for more than 50 years in the United States given its low initial cost compared to asphalt concrete (AC) overlays. Chip seals are typically favored on relatively low traffic roadways with the aim to reduce the permeability of the pavement surface, improve skid resistance, eliminate raveling, and retard oxidation.

Asphalt rubber chip sealing has been used by many state agencies (e.g., Arizona and California) as it has demonstrated unique advantages, such as: improved durability, cracking resistance, and resistance to reflective cracking. The use of crumb rubber in the aggregate layer can also improve durability and reduce traffic noise. However, the hot application of asphalt rubber at an elevated temperature of 375 to 425°F may be a safety concern. Thus, the use of rubberized emulsion may be considered as a promising alternative, since it is installed at the same temperature of a standard emulsion (140 to 160°F).

Project Summary

The objective of this study is to improve the durability and to extend the life of chip seal applications in Louisiana using rubber-modified emulsion and reclaimed rubber tires in the aggregate layer. To achieve the objectives of this study, the proposed research activities are divided into seven research tasks as follows:

Task 1: Review of state practices in the use of asphalt rubber chip seals;

Task 2: Development of job mix formula for rubberized chip seal;

Task 3: Laboratory performance evaluation of asphalt rubber chip seals;

Task 4: Field trials of asphalt rubber chip seals in pavement preservation;

Task 5: Evaluation of construction and short-term performance of rubberized chip seals;

Task 6: Cost-benefit analysis of rubberized chip seal; and

Task 7: Prepare and submit final report.

Status Update

An experimental program was completed to evaluate the rheological and molecular characterization of rubberized asphalt emulsion. One rubberized asphalt emulsion and an asphalt rubber (CRS-2TR and AC20-TR) and two conventional emulsions (CRS-2 and CRS-2P) were evaluated. The emulsions were characterized by conducting rheological and physical testing. Results showed that CRS-2TR and AC20-TR had lower carbonyl and sulfoxide indices indicating

better resistance to aging compared to conventional asphalt emulsions. Results of High-Pressure Gel Permeation Chromatography (HP-GPC) on the original, RTFO, and PAV-aged binder residues showed that CRS-2TR and AC20-TR had similar High-Molecular Weight (HMW) content compared to that of conventional asphalt emulsions indicating similar susceptibility to brittleness with age. Field construction of a test section is planned in 2019 in Chase, Louisiana.

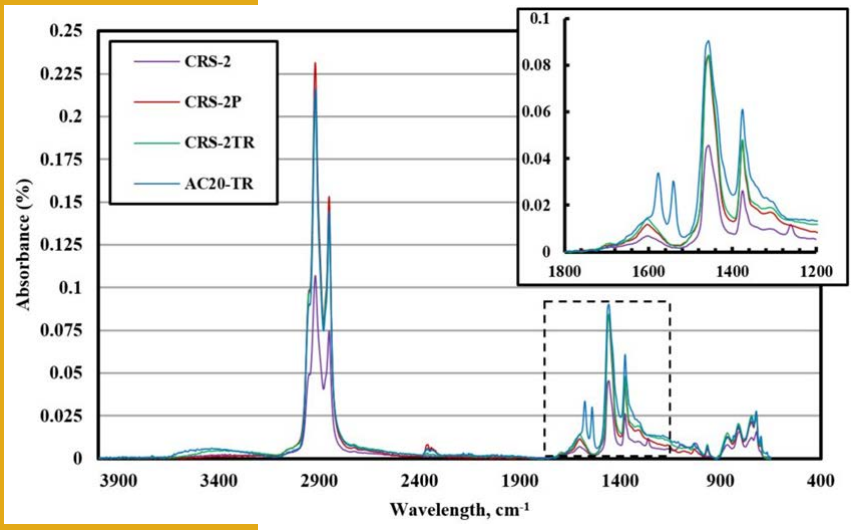

Figure 1. FTIR spectra of unaged binders.

As part of the field trials, the research team will assess the short-term performance of the projects constructed in this study during the first year. Performance data will be collected on a four-month basis to characterize evolution of failure (if any) in the different sections. Performance data will include cracking, aggregate loss, bleeding, and roughness. Based on the level of damage observed in the different sections, the research team will determine the suitability of the designs and the need to address noted deficiencies to avoid any issues noted during and after construction. The research team will also measure initial roughness, traffic noise, and aggregate loss after trafficking.

Figure 2. Field section before and after chip seal application.

Impacts

This project will research and develop innovative and cost-effective rubberized chip seal applications in order to improve surface quality and pavement performance. The implementation of this research will enhance the performance of chip seal in pavement preservation activities and will improve the rideability of this surface treatment. As part of the proposed activities, the research team will develop an implementation plan that presents a strategy to introduce the results into the state-of-the-practice, pavement preservation, and specifications of LaDOTD. The results of this research will be used to implement and to optimize the use of rubberized chip seal in Louisiana and to reduce costs. This research will impact LaDOTD, highway contractors, transportation and Louisianans at large.

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".

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