DRISI

CALTRANS DIVISION OF RESEARCH, INNOVATION AND SYSTEM INFORMATION

Research Results

Guidance, Tests, and Specifications for High RAP/RAS in HMA and RHMA Mixes

Development of testing procedures and specifications for high RAP/RAS in HMA and RHMA mixes.

Pavement

JUNE 2024

Project Title:
Partnered Pavement Research Center (PPRC) 20: Recycling

Task Number: 3819

Start Date: June 20, 2020

Completion Date: September 30, 2023

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WHAT WAS THE NEED?

Caltrans is interested in finding, developing, and implementing approaches to reduce life cycle cost and improve life cycle environmental performance. Two approaches offer the potential to advance these goals are the use of increased amounts of recycled asphalt pavement (RAP) and the use of recycled asphalt shingles (RAS) in hot mix asphalt (HMA) and rubberized hot mix asphalt (RHMA). This task was a continuation of a study investigating binder replacement rates in high recycled RAP and RAS content mixes without the need for binder extraction. On-going research identified potential concerns associated with the use of RAP/RAS, including the influence of the aged binder from the RAP/RAS on the virgin binder aging properties; the degree of blending during mix production and thereafter; and the addition of rejuvenators to restore the properties of highly aged RAP on the performance-related properties of binders and mixes. The degree of blending between virgin binders and RAP and RAP/RAS could be significant, particularly for mixes including highly aged RAP and RAS. Incomplete blending could alter the mix properties because of less available binder and partial activation of the stiff RAP and/or RAS binder. The effects of incomplete blending need to be better understood to be effectively considered in mix design procedures and performance-related testing.

WHAT WAS OUR GOAL?

The goal of this project was to develop guidelines for determining binder replacement rates in high RAP/RAS content mixes, without the need for binder extraction and performance-related tests, for use in routine mix design and construction quality control (QC)/ quality assurance (QA).

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WHAT DID WE DO?

The goal of this task was achieved through the following subtasks:

- Update literature review to include recently completed research.
- Complete testing of high RAP and RAP/RAS mixes to determine their performance properties.
- Complete testing of extracted and recovered RAP, RAP/RAS, and RAP/RAS/virgin binder blends to assess the effectiveness of different rejuvenators.
- Complete investigating the use of fine aggregate matrix mix testing to assess the fatigue performance of mixes and to predict binder properties.
- Investigate long-term aging effects of high RAP and RAP/RAS mixes using different laboratory-aging protocols.
- Monitor field performance of high RAP and RAP/RAS mixes, and use results to evaluate laboratory-aging protocols.
- Prepare a research report with recommendations for use of RAP and RAP/RAS as binder replacement, and, if applicable, recommendations for accelerated wheel-load testing.

WHAT WAS THE OUTCOME?

A pilot project for the inclusion of RAP and RAS in hot mix asphalt was built on State Route 49 in El Dorado County in November 2021. Four mixes were included in short test sections: (1) a control mix with no RAS or RAP, (2) a typically used mix with 10% RAP, (3) a mix with 3% RAS, and (4) a mix with 10% RAP and 3% RAS. The final report presented laboratory test results from plant mix produced for job mix formula (JMF) verification and from two QA samples taken during test section construction as well as observations of plant production and construction. The results showed that the mixes submitted for JMF verification and tested as part of QA all met the two performance-related specifications. Most of the QA samples had binder and mix testing results that were similar to or better than those of the JMF verification samples, though there were exceptions. There were no major problems during production or placement of the mixes.

WHAT IS THE BENEFIT?

Recommendations for use of RAP and RAP/RAS as binder replacements have been developed. These recommendations promote the use of RAP and RAP/RAS in asphalt mix designs, thus reducing construction costs and greenhouse gas production, leading to more sustainable pavements.

LEARN MORE

To view the complete report:
https://escholarship.org/uc/item/8h67s9z0