

Pavement**MARCH 2025****Project Title:**Partnered Pavement Research
Center (PPRC) 20: Mechanistic-
Empirical Design**Task Number:** 3761**Start Date:** June 30, 2020**Completion Date:** September 30, 2023**Task Manager:**Junxia Wu
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New Rubberized Hot Mix Asphalt Materials with Reclaimed Asphalt Pavement/Reclaimed Asphalt Shingles, Part A for Structural Layers in Flexible Pavements

Evaluation of Using up to 10% Reclaimed Asphalt Pavement (RAP) in Rubberized Hot Mix Asphalt-Gap-Graded (RHMA-G) Mixes.

WHAT WAS THE NEED?

The California Department of Transportation (Caltrans) Standard Specifications Section 39, "Asphalt Concrete," includes rubberized hot mix asphalt-gap-graded (RHMA-G), which is Caltrans' preferred surface mixture at elevations below 3,000 feet. In 2020, RHMA-G accounted for 41% of the asphalt concrete tonnage placed by Caltrans. However, current Caltrans Standard Specifications for RHMA-G do not address the use of reclaimed asphalt pavement (RAP) in RHMA-G. There has been growing interest in incorporating RAP into RHMA-G mixes because it can reduce environmental impacts, costs, and the use of virgin resources for RHMA-G production. However, concerns remain that adding RAP may compromise field performance, particularly by increasing cracking, potentially offsetting the initial environmental and economic gains.

This research studied the feasibility of incorporating RAP into RHMA-G while maintaining the recycled tire rubber content used by Caltrans. Due to the limited knowledge about impact of RAP on RHMA-G performance, the Caltrans Pavement & Materials Partnering Committee (PMPC) Asphalt Task Group convened a team to study the use of RAP in RHMA-G in 2020.

WHAT WAS OUR GOAL?

This study aimed to evaluate the impact of adding 10% RAP, by aggregate replacement, on the properties and expected field performance of RHMA-G mixes.



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WHAT DID WE DO?

Between 2022 and 2023, Caltrans built five pilot projects to assess the impact of incorporating RAP on RHMA-G properties, including material properties, simulated performance, and environmental impact. Each pilot included a control section (without RAP) and a test section with 10% RAP.

During production, the research team collected samples of both mixes and conducted laboratory testing at the UCPRC laboratory. Lab tests evaluated five mechanical properties that could potentially be impacted by RAP: fatigue resistance, stiffness at varying temperatures and loading times, rutting resistance, moisture resistance, and fracture cracking resistance.

The research team also used CalME (a flexible pavement design software) to model the expected field cracking performance of the mixes with and without RAP based on mechanical properties.

Additionally, the research team conducted a cradle-to-gate life cycle assessment (LCA) using eLCAP (Caltrans' environmental LCA tool for pavements), to determine effects of addition of 10% RAP on the global warming potential and primary energy demand of RHMA-G production.

WHAT WAS THE OUTCOME?

Test results indicated minor impacts on the mechanical properties of RHMA-G due to addition of 10% RAP. Aside from a few exceptions related to changes in total binder content, the effect of RAP addition was negligible considering project-to-project differences. CalME modeling showed RAP addition had a negligible or comparable impact on pavement cracking performance. From a constructability standpoint, adding RAP did not create any problems. The LCA showed that 10% RAP in RHMA-G can reduce greenhouse gas emissions associated with RHMA-G production by up to 5%.

WHAT IS THE BENEFIT?

Adding RAP into RHMA-G has potential environmental and economic benefits, including:

- **Reduced virgin aggregate production:** Utilizing RAP helps preserve California's natural resources and lower energy consumption during mix fabrication.

- **Binder reclamation:** Reclaiming binder from RAP lowers the need for virgin binder.
- **Waste diversion:** Diverting RAP from landfills reduces waste.
- **Decreasing production costs:** Replacing virgin aggregates and binder with RAP materials reduces overall production costs.

LEARN MORE

To view the complete report: <https://escholarship.org/uc/item/2np2f69j>