FACT SHEET

HMA Mixtures Containing Recycled Asphalt Shingles (RAS): Low Temperature and Fatigue Performance of Plant-Produced Mixtures

RESEARCH PROJECT TITLE

HMA Mixtures Containing Recycled Asphalt Shingles (RAS): Low Temperature and Fatigue Performance of Plant-Produced Mixtures

STUDY TIMELINE

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MORE INFORMATION

Click here for the full final report.

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Introduction or What was the Problem?

Many state transportation agencies are interested in using recycled materials like Recycled Asphalt Shingles (RAS) and Reclaimed Asphalt Pavements (RAP) in new paving mixtures because they contain valuable asphalt binder. One of the main obstacles in utilizing RAS and/or higher amounts of RAP is that it is unknown how much of the aged asphalt binder contained within them will blend, or be activated, in a new mixture. Depending on this quantity of blending, the resulting mixture performance could be impacted in terms of resistance to distresses. More blending of the aged material may result in a stiffer mixture which could be more prone to cracking but also more rut resistant. Since the asphalt binder used to produce RAS is a stiff air blown asphalt, the impact could be more severe when compared to the addition of RAP. Several studies have evaluated the blending in terms of whether it occurs or not. No studies have endeavored to quantify in a numerical sense how much blending is occurring. As an alternative, several studies have taken advantage of mechanical tests to evaluate the effect of using more recycled materials in mixtures with respect to distress.

Methodology or What was done?

Extracted and recovered binders from each RAS and RAP were blended with a virgin binder in several assumed percentages which translate to different degrees of blending ranging from 0 to 100% for the mixtures. Each blended binder was tested in the Dynamic Shear Rheometer (DSR) to obtain a shear modulus (G*) data for subsequent construction of a binder master curve at a reference temperature of 20°C. This provided a set of G* master curves for each RAS and RAP blend showing the effects of assumed blending. Next, for each mixture, a dynamic modulus (E*) master curve at a reference temperature of 20°C was obtained using the Asphalt Mixture Performance Tester (AMPT). The E* master curve of the control mixture was also measured and used to calibrate the Hirsch model. This calibrated Hirsch model was then used to estimate a set of E* master curves for each mixture from its corresponding set of (G*) master curves and various mixture properties. Each measured E* master curve was then compared to its corresponding set of estimated E* master curves to quantify degree of blending.

To validate the results of the degree of blending analysis and to assess the cracking susceptibilities of mixtures, the following tests were carried out: four-point flexural beam fatigue, Semi-Circular Bending Beam (SCB), and Disc-Shaped Compact Tension (DCT).

Conclusion or What are the next steps?

In this study, a new method to quantify the amount of blending that occurs between aged RAS and RAP binders was developed. Using this method, it was estimated that around 20% to 40% of RAS binder from manufacturer's shingle waste was activated in the mixture, whereas less than 20% was activated for RAS binder from tear off shingles. Activation of RAP binder was estimated at 40 to 60%. Four-point beam fatigue, SCB, and DCT test configurations were implemented to further investigate the degree of blending results from a cracking perspective. In all cases a consistent trend was observed between the results of mixture cracking tests and the PG of the proposed degree of binder blending.

What are potential impacts?

The results provide DOTs with a method to quantify the amount of blending that occurs when using RAS and RAP in paving mixtures.