

0-6614: Use of Recycled Asphalt Shingles in HMA

Background

In the last several years, both reclaimed asphalt pavement (RAP) and recycled asphalt shingles (RAS) have been widely used in paving Texas highways. Compared to RAP, RAS has two features: 1) much higher asphalt binder content, and 2) super stiff asphalt binder. Thus, the use of RAS can not only reduce the cost of asphalt mix paving significantly, but it also conserves energy and protects the environment. However, the super high stiffness of RAS binder causes strong concern on durability (or cracking performance) of asphalt mixes containing RAS. Another concern was the variability of processed RAS due to different RAS sources varying from manufacture waste shingles to a wide variety of tear-off shingles. To address these two major concerns (variability and durability), in 2010, the Texas Department of Transportation (TxDOT) initiated this research study at the Texas A&M Transportation Institute with objectives to:

- Define variability of processed RAS.
- Develop best practices for RAS processing and stockpile management.
- Evaluate methods of improving cracking performance of RAS mixes in the laboratory.
- Construct field test sections to validate laboratory test results.

What the Researchers Did

To achieve the study objectives, researchers completed the following tasks:

- RAS sampling and laboratory characterization in terms of gradation and asphalt content.
- Development of best practices for RAS processing and stockpile management through visiting and surveying RAS mix producers and RAS recyclers around Texas.

- RAS binder characterization and the characteristics of blended virgin and RAS binders.
- Laboratory evaluation of the influence of RAS contents on rutting/moisture damage and cracking resistance of mixes.
- Evaluation of approaches including increasing design density, using soft virgin binders, and rejuvenating RAS binders, for improving cracking resistance of RAS mixes.
- Construction and monitoring of field test sections with RAS around Texas.

What They Found

From this study, researchers found the following:

- Processed RAS, in terms of aggregate gradation and asphalt content, is consistent and has low variability when the six-step RAS processing and stockpile management are used.
- RAS binders are very stiff. Tear-off RAS binders with an average of high temperature grade of 175°C are

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much stiffer than manufacture waste RAS binders, which have an average high temperature grade of 131°C.

- Different from virgin/RAP binders blending, the virgin/RAS binders blending is nonlinear. However, for practical application, the linear blending chart can still be used for estimating continuous grade (high and low temperatures) of both virgin/RAS blended binders and virgin/RAP/RAS blended binders, if the RAS binder is limited within 30 percent of the total binder.
- RAS mixes, when properly designed and constructed, can have similar or better performance than virgin mixes.
- Both laboratory and field test sections indicated that use of softer virgin binder (i.e., PG xx-28 or PG xx-34) or design of mixes with higher density can improve the cracking resistance of RAS mixes.
- Laboratory test results showed that use of rejuvenators can also improve cracking performance of RAS mixes.
- The balanced RAS mix design system for project-specific service conditions, as shown in Figure 1, is validated through field test sections.

- Implement the balanced RAS mix design system for project-specific service conditions for designing mixes containing RAS.
- Construct field test sections in selected districts (e.g., Dallas/Fort Worth, Austin, Paris, Houston) to validate RAS rejuvenators that have shown significant improvement in engineering properties of RAS mixes.

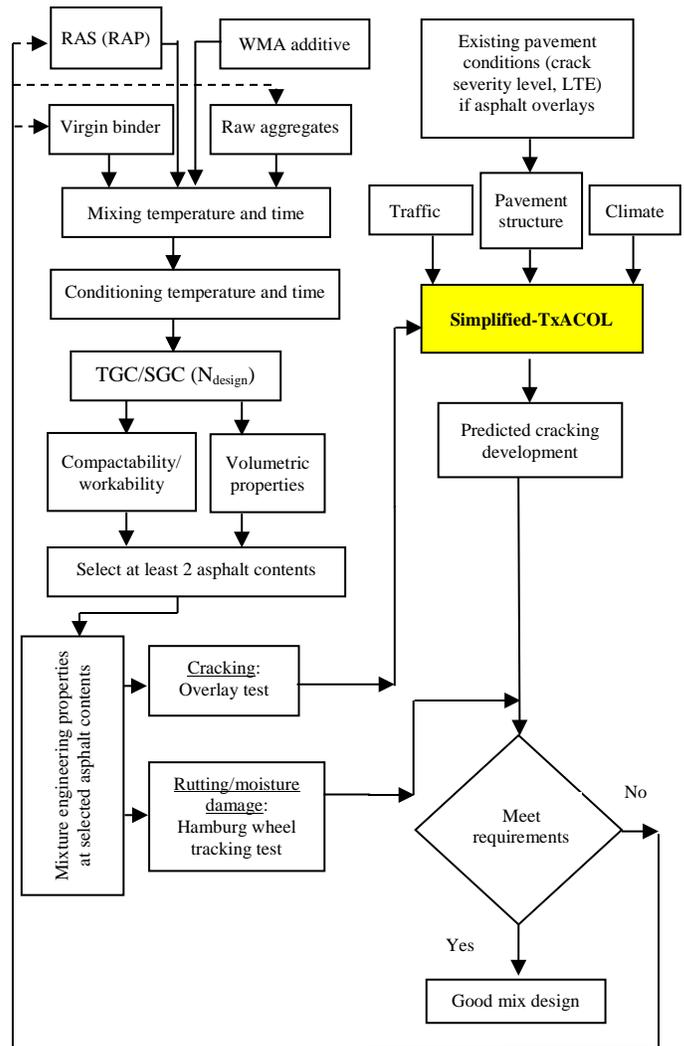


Figure 1. Balanced RAS Mix Design System for Project-Specific Service Conditions.

What This Means

Based on the findings from this study, researchers recommend the following:

- Implement statewide the best practices developed for RAS processing and stockpile management, RAS mix production, and field construction.
- Use soft binders (i.e., PG xx-28 or PG xx-34) or design the mix with 97.5 percent design density when the total binder replacement including both RAS and RAP is 20 percent and above.

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