

## 0-6738: Performance Studies and Future Directions for Mixes Containing RAP and RAS

### Background

In the last several years, reclaimed asphalt pavement (RAP) and recycled asphalt shingles (RAS) have been widely used in asphalt mixes in Texas. The use of RAP/RAS can significantly reduce the initial cost of asphalt mixtures, conserve energy, and protect our environment. However, there are always two main concerns: variability of RAP/RAS and durability (or cracking) of RAP/RAS mixes. Past studies in Texas have clearly indicated that both RAP and RAS have acceptable variability following the best practices for handling RAP/RAS. This study focused on the durability problems of RAP/RAS asphalt mixes. Specifically, the major objectives of this study were to:

1. Evaluate the impact of RAP/RAS used in hot-mix asphalt and warm-mix asphalt (WMA) on durability/performance problems of the mixes through laboratory evaluation and field survey.
2. Evaluate the impacts of RAP/RAS mixes' performance and identify approaches for improving the durability problems in terms of mix design.
3. Investigate the cost-benefit ratio of RAP/RAS mixes.

### What the Researchers Did

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

- Investigation of recycled binder impacts on blended binder properties.
- Laboratory evaluation on durability problems of RAP/RAS mixes.
- Investigation of oven-curing conditions for RAP/RAS/WMA.
- Field survey and forensic study on test sections with RAP/RAS mixes.
- Life-cycle cost analysis on RAP/RAS mixes.

### What They Found

From this study, researchers found the following:

- More RAP/RAS can be used in the asphalt mixes if rejuvenators are allowed in the asphalt mixes.
- Based on the laboratory evaluation, WMA, stone matrix asphalt, and Superpave mixes containing RAP/RAS may exhibit similar cracking resistance to their control mixes.
- Practical laboratory aging time for molding plant-mixed and laboratory-compacted samples and the size of container for sampling plant mixes were recommended for individual mechanical testing.
- Based on the field survey results, RAP/RAS mixes can have similar or better performance than virgin mixes provided that they are designed following the balanced mix design procedure.
- Increasing virgin binder content through decreasing design air voids significantly improved reflective cracking performance of the RAS mix.
- However, cracking performance of asphalt mixes is strongly related to the existing pavement structure. Therefore, it is recommended to develop a RAP/RAS mix design system for project-specific conditions, including traffic, climate, and existing pavement conditions.

#### Research Performed by:

Texas A&M Transportation Institute

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- Researchers used a forensic study to investigate the reasons for bad performance of field test sections. The forensic study allows the Texas Department of Transportation (TxDOT) different options to avoid problems occurring in the future.
- Continuous field monitoring of existing field test sections significantly benefits TxDOT.

- Increase the design density of RAP/RAS mixes (add more virgin binder into RAP/RAS mixes).
- Evaluate blending among virgin, RAP, and/or RAS binder by extracting the binders from recycled materials.
- Use the balanced mix design procedure for RAP/RAS mixes, as described in Figure 1.

### What This Means

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

- Use rejuvenators for higher recycled binder contents. Select carefully the rejuvenator dosage. The rejuvenator dosage can be determined based on the specification requirements for both high and low PG grades of blended asphalt binders (i.e., RAP/RAS/virgin binder/rejuvenator).
- Use soft virgin binders (i.e., PG XX-28 or PG XX-34) for RAP/RAS mixes.

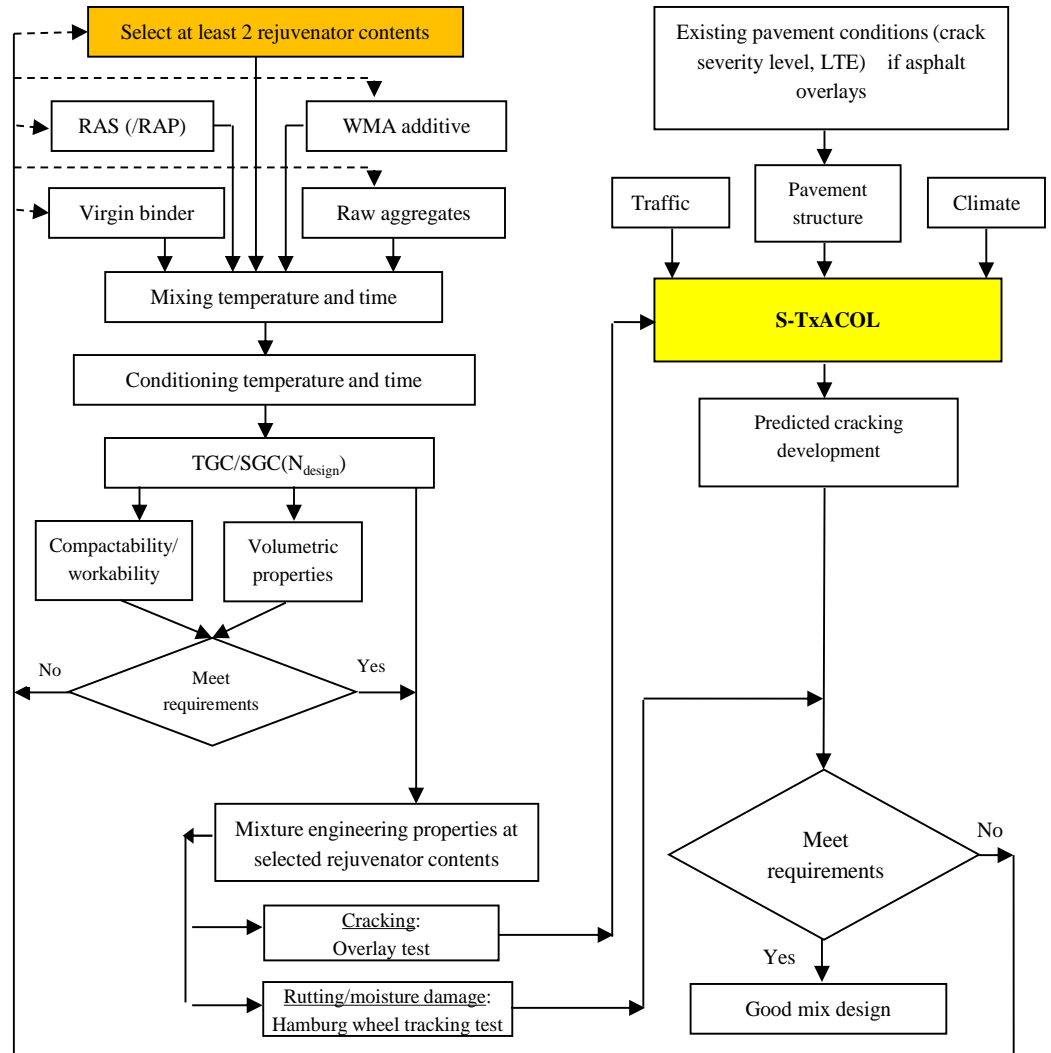


Figure 1. Balanced Rejuvenator/RAP/RAS/Virgin Binder Mix Design for Project-Specific Service Conditions.

### For More Information

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