Florida Department of Transportation Research

Impact of Recycled Asphalt Shingles (RAS) on Asphalt Binder Performance

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Project Manager
Wayne Rilko
FDOT Materials Office

Principal Investigator
Reynaldo Roque
University of Florida

Current Situation

Recycled asphalt shingles (RAS) and recycled asphalt pavement (RAP) are abundant, and while their use in road construction has steadily increased, it is limited by concerns that increasing amounts of recycled materials may impact pavement performance. This is especially true of RAS, which contains severely aged asphalt binder. The challenge is that it is difficult to accurately characterize RAS and its effect on virgin binder properties, and currently there is no design guideline on RAS usage that guarantees the cracking performance of resulting RAS mixtures.

Research Objectives

University of Florida researchers evaluated the RAP/RAS effect on virgin binder performance, in terms of Superpave true grade and fracture energy density of the combined binders.

Reroofing generates 10 million tons of asphalt shingle waste each year in the U.S.

Project Activities

UF researchers adopted a mortar approach to assess the RAP/RAS effect on true grade and the binder fracture energy (BFE) test for fracture energy density (FED) of virgin binders. The mortar approach eliminates the need for solvent-based binder extraction and recovery. It was conducted by performing Superpave binder tests on blends of virgin binder and RAP/RAS fine fractions. The BFE test, which now has an AASHTO provisional standard, was developed in a recent FDOT research project (BDK75-977-27) to determine the FED of asphalt binders. This study employed two RAS sources, including tear-off (TO) shingles and manufacture waste shingles; three RAP sources; and six virgin binders, including two unmodified binders, two rejuvenated binders with aromatic oil extract and refined engine oil bottoms, and one polymer-modified binder.

Mortars with RAP-alone and RAS-alone were tested to obtain the RAP/RAS grade change rate (GCR), a parameter that can be used to predict the true grades of virgin and RAP/RAS binder blends. UF researchers found that the use of a shift factor in the existing AASHTO provisional draft resulted in unreliable GCR values, so they developed an alternative method that eliminates the use of a shift factor by considering the relationship between binder and mortar. The enhanced mortar approach accurately captured the RAP/RAS effect on virgin binder true grade. GCR results indicated that the allowable RAS content is nearly half of the allowable RAP content for a given virgin binder, while still meeting the desired true grade of the blends. The enhanced mortar approach can also be used to predict the grades of virgin, RAP, and RAS blended binders based on RAP-alone and RAS-alone GCR. Importantly, the soft virgin binder appears to effectively compensate for the stiffening effect of RAP but not for that of RAS. RAP increased the FED of soft virgin binders, opposite the trend observed for RAS, especially for the TO shingles. This raises concern regarding the cracking performance of asphalt mixtures with RAS, so evaluation of RAS effect at mixture level was recommended before allowing RAS usage in new pavements.

Project Benefits

A more thorough understanding of the behavior of recycled asphalt materials will mitigate the potential of premature pavement failure, while potentially allowing higher levels of recycling with benefits in performance and economy.

For more information, please see www.fdot.gov/research/.