Pooling Our Research: Using Recycled Shingles in Asphalt Pavements

Why a Pooled Fund Study?
Each year, the United States manufactures and disposes of an estimated 11 million tons of asphalt shingles. One million tons consist of waste discarded during the shingle manufacturing process, or post-manufacturer waste. Ten million tons are post-consumer waste from shingles torn off houses when roofs are replaced.

For the past 25 years, departments of transportation have been using recycled post-manufactured asphalt shingles in hot mix asphalt. Using recycled asphalt shingles reduces the cost and environmental impacts of processing and transporting virgin asphalt materials, and conserves valuable landfill space. Minnesota has been a national leader in the use of RAS, developing its first specification in 1996.

MnDOT has also been at the forefront of researching post-consumer RAS, and in 2003 completed several demonstration projects in partnership with local agencies. However, concerns about the quality of post-consumer RAS, which can contain contaminants such as nails, wood and asbestos, require that RAS be tested and processed carefully before use. More research was needed to determine how to process post-consumer RAS and determine its effects on the performance of HMA. To facilitate this research via demonstration projects nationwide, in 2009 MnDOT and several other states initiated Pooled Fund Study TPF-5(213).

What is the Pooled Fund Study’s Goal?
The goals of this pooled fund study are to:

- Develop best practices and establish specifications for the use of post-manufactured and post-consumer RAS in HMA, including guidelines for quality assurance and control in sourcing, processing and incorporation to achieve a final product meeting state HMA requirements.
- Conduct demonstration projects, laboratory testing and field surveys to evaluate the performance of RAS in HMA at varying percentages, climates and traffic levels, including the effects of blending RAS binders with virgin and recycled asphalt pavement binders on low-temperature cracking, rutting and fatigue.
- Create a comprehensive database on the performance of RAS in HMA applications.

What Have We Learned?
Researchers conducted a literature review of nationwide applications of manufactured and tear-off shingles, focusing on specifications, case studies, demonstration projects and environmental safety. Member states involved in this study have developed quality control and assurance procedures for sourcing and processing RAS, and have conducted their own demonstration projects for both post-manufactured and post-consumer RAS to develop mix design criteria and construction specifications. These specifications generally allow up to 5 percent post-manufactured RAS in HMA when used with RAP, and also set the required percentage of virgin binder and place limits on the percentage of allowable deleterious content.

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As part of this pooled fund study, MnDOT evaluated MnROAD test sections using post-manufactured and post-consumer RAS. Researchers conducted laboratory and field tests to evaluate the effects of binder grade and content as well as RAP or RAS source and content on the performance of HMA mixtures, especially on low-temperature cracking and stripping. Results published in the 2010 report “Incorporation of Recycled Asphalt Shingles in Hot-Mixed Asphalt Pavement Mixtures” confirmed MnDOT specifications requiring at least 70 percent new asphalt binder and led to provisional specifications allowing for the use of up to 5 percent post-manufactured and post-consumer RAS in both surface and base mixes for plant-produced asphalt mixtures under Specification 2360.

What’s Going On Now?
Researchers are conducting dynamic modulus and low-temperature cracking laboratory tests on samples provided from state demonstration projects to characterize binder qualities and evaluate the performance of mix designs. Preliminary results of fracture energy tests evaluating cracking have been promising, suggesting that RAS mixtures have the potential to perform well in the field.

Researchers are also conducting field performance surveys of cracking and other distress on demonstration project test and control sections. MnDOT researchers are continuing to monitor RAS performance on the MnROAD demonstration project. States also regularly conduct workshops to communicate RAS research results and issues. An intensive one-day workshop hosted by the Colorado Department of Transportation in April 2011 brought industry and public partners together to discuss roles and responsibilities in implementing RAS quality control and assurance.

What’s Next?
Once all member states have finalized their demonstration projects and researchers have completed testing of materials from each of these projects, researchers will synthesize and analyze the results and present the findings in a comprehensive final report to be published in September 2012. Results will include a statistical analysis of the effects of RAS percentage and binder and mixture properties on laboratory and field performance. Continued research is needed to evaluate how recycled asphalt binders blend with those in virgin asphalt.

“This study helped us get a much better sense of how shingles affect the quality of our mixes and led to a significant change in MnDOT specifications.”

—Greg Johnson,
Assistant State
Bituminous Engineer,
MnDOT Office of
Materials and Road
Research

“This project has benefited not just our understanding of recycled asphalt shingles but of recycled asphalt in general.”

—Jim McGraw,
Chemical Lab Director,
MnDOT Office of
Materials and Road
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Using the Asphalt Pavement Analyzer, MnDOT researchers found that the rut depth of tear-off shingle mixtures did not vary significantly with RAP content, while that of manufactured waste shingle mixtures did, indicating that tear-off shingles have a greater stiffening effect on mixtures.

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For more than 25 years, FHWA’s Transportation Pooled Fund Program has been providing state DOTs and other organizations the opportunity to collaborate in solving transportation-related problems. The TPF Program is focused on leveraging limited funds, avoiding duplication of effort, undertaking large-scale projects and achieving broader dissemination of results on issues of regional and national interest.