VERMONT
AGENCY OF TRANSPORTATION

FACT SHEET

RAS as an FDR Mechanical Stabilizer

PROJECT TITLE

Recycled Asphalt Shingles as an Full Depth Reclamation Mechanical Stabilizer

STUDY TIMELINE

October 2023 – September 2025

INVESTIGATORS

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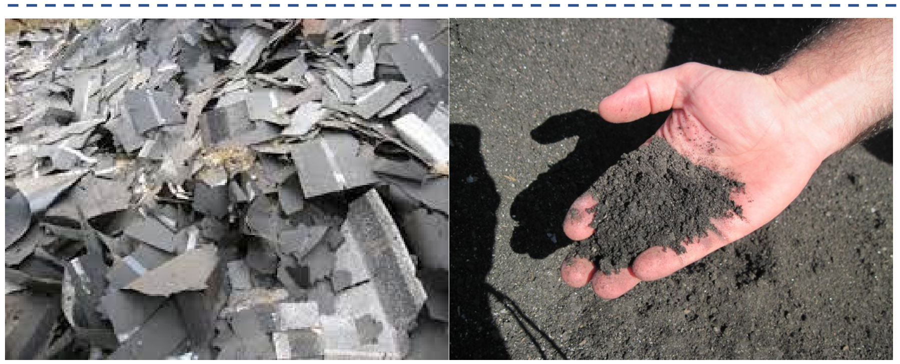
More information about the VTrans Research Program, including additional Fact Sheets, can be found at: http://vtrans.vermont.gov/planning/research

Introduction or Problem Statement

The use of recycled asphalt shingles (RAS) in transportation infrastructure has been extensively studied throughout the United States and elsewhere. An impediment in the use wide-spread use of RAS in asphalt concrete has been the increased premature cracking potential of such mixtures due to the aged and brittle nature of asphalt binder in RAS. This has resulted in restrictions on RAS usage in hot- and warm-mixed asphalts by many agencies. The Vermont state law (10 V.S.A. § 6605m) requires that asphalt shingles, predominantly generated as "Architectural Waste", be recycled. Due to concerns associated with their usage in asphalt concrete layers of pavement structures, their use within lower pavement layers needs to be explored.

The use of full-depth reclamation (FDR) for the rehabilitation of flexible pavements is preferred by many transportation agencies, including VTrans, due to cost and environmental benefits. Both are usually realized due to the "in-place" nature of the FDR process that does not require large quantities of materials to be transported off-site which in turn lowers costs and fuel usage as well as associated emissions. Often Portland and other hydraulic cements, emulsified asphalt, foamed asphalt and combinations of these materials are used as stabilizing agents in FDR to improve its structural contribution to the pavement and improve longevity of roadways using it. Most of the stabilizing agents used in FDR have high costs and carbon footprints. Due to the presence of asphalt binder, fibers and aggregate, RAS has potential to provide a degree of mechanical stabilization to the FDR layers. If RAS can be used to achieve similar stabilizing effects as non-recycled products, the lower costs and high environmental benefits of FDR can be further improved and simultaneously use of RAS in pavement infrastructure can be realized without performance concerns. To realize this goal of using RAS in FDR, two critical questions will be addressed in this research: (1) Can RAS be utilized in "as-is" condition from when it is generated as architectural waste or is there need for processing it to resize it? (2) Does RAS provide mechanical stabilization effects to FDR?.



Left: As produced architectural waste shingles; Right: resized processed waste shingles [image sources: Wisconsin Dept of Natural Resources and North Carolina Department of Environment Quality]

Methodology or Action Taken

This research study will undertake a laboratory experimental campaign and corresponding analysis to determine whether RAS can be utilized in "as-is" or resized condition to serve as stabilizing agent within FDR. This question is critical to answer since additional processing steps would have cost and logistics implications with respect to usage of RAS. A hypothesis is that the FDR process can provide some crushing effort towards breakdown of waste shingle sheets. To evaluate this hypothesis and to determine feasibility of using RAS in FDR an assessment is necessary to determine constructability of FDR stabilized using RAS, specifically in terms of compactability. This study will develop recommendations for determining suitable dosage of RAS that can be accommodated within FDR to realize appreciable mechanical stabilization effects. Further, it will also explore the use of recycling agents to provide additional stabilizing effect of RAS. Lastly, to quantify the stabilizing effects of RAS, the outcomes of laboratory characterization will be used in a pavement design and analysis system to determine life cycle cost benefits.

The laboratory experimentation effort will conduct mechanical characterization of RAS-stabilized FDR along with unstabilized control materials through measurement of resilient modulus and shear strength measurements. RAS will be evaluated for environmental contaminants, specifically, for PCB, PFAS, and PAH, including the use of Synthetic Precipitate Leaching testing (SPLP).

Conclusions or Next Steps

This project is at its initiation stage, the very immediate next step will be to conduct a comprehensive review of literature, develop experimental designs and sample materials from VTrans FDR projects for use in laboratory characterization.

Potential Impacts and VTrans Benefits

Results of this study will be in the form of recommendations for VTrans to revise FDR construction and material specifications to include RAS. The research results will also provide VTrans with quantitative measures associated with mechanical stabilization potential of RAS in FDR. Further, as a first step to implementation of using RAS in FDR, VTrans will have informaiton on optimal dosages as well as lab procedures that should be used to validate the dosage amounts. As an added outcome, this project will provide recommendations on suitable roadway rehabilitation candidate projects where RAS stabilized FDR would provide positive life cycle cost and pavement performance benefits. Ultimately, the results of this project will enhance the understanding of the risks or benefits associated with utilizing recycled products in FDR layers and their potential to impact pavement performance. This will ensure VTrans has the information needed to make prudent decisions regarding their asphalt pavements, as they strive to develop treatments that require less frequent maintenance and/or rehabilitation while lowering life cycle costs. The research project will conduct preliminary life cycle cost analyses comparing pavements rehabilitated using unstabilized FDR with those using RAS stabilized FDR. This research will also provide VTrans with a better tool to evaluate new materials and additives (e.g. recycling agents) resulting in improved materials. Use of RAS in FDR will allow VTrans to support Vermont's initiatives towards recycling additional construction waste materials and open up a new market for RAS in areas where inclusion in HMA is limited.