VDOT Virginia Department of Transportation

Virginia Center for Transportation INNOVATION & RESEARCH

Research Brief
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I-81 Pavement Recycled In Place Performs Well After Three Years on Interstate Freight Corridor

Perspective After many years of service, asphalt pavements on highways with a high volume of truck traffic, such as Interstate 81, can undergo substantial deterioration deep within the pavement structure. It may require large amounts of time and money — plus extensive traffic management — to remove the deteriorated layers and bring in new materials to replace them. Often the resources required are so great that traditional full reconstruction is not a practical option. In such cases, the pavement repairs are limited to removing the top asphalt layer(s) and overlaying the section with a new asphalt driving surface.

In 2011, the Virginia Department of Transportation (VDOT) used in-place pavement recycling on a 3.66-mile section of southbound I-81 in the agency's Staunton District as an alternative to traditional repairs, such as overlay or reconstruction.

Previously used only on lower volume roads, in-place recycling involves milling or pulverizing the existing pavement material and mixing that material with additives to allow its reuse as a structural layer. Pavement recycling is known to be time- and cost-efficient and more friendly to the environment than traditional pavement rehabilitation methods.

On-site mobile plant mixes reclaimed asphalt in cold central-plant recycling process.

VDOT used three recycling processes on this I-81 project in Augusta County: cold central-plant recycling, full-depth reclamation and cold in-place recycling. Using all three processes in a single interstate pavement rehabilitation project was a "first" in the United States.

Researchers from the Virginia Center for Transportation Innovation and Research (VCTIR), VDOT's research division, documented the recycling mix designs, field evaluation and quality assurance procedures, construction and materials testing used in this project.

The I-81 in-place pavement recycling project was completed quickly and cost-effectively. Because of its engineering excellence and innovation, the project earned several prestigious national awards. Nearly three years of good performance proved the success of the pavement produced with these in-place recycling processes. The surface and deep structure of the rehabilitated section are expected to remain sound for years to come.

The traffic management plan VDOT developed for this project was as successful as it was unique. In this plan, a forced detour diverted passenger vehicles off I-81 to a nearby primary road and kept trucks in one lane on the interstate through the work zone. While detoured traffic flowed, the contractor repeatedly was able to work for up to five days at a time in the closed lane.

Innovative traffic management routes passenger vehicles to a primary road and channels trucks through the work zone in one lane.

The research study recommends that VDOT pursue in-place recycling on suitable asphalt pavement sections. These may include interstates, high-volume primary roads and secondary roads. The study also recommends that VDOT consider traffic management plans similar to the one used in this project for other pavement rehabilitation projects, whether recycling or traditional.

For the full report, search 15-R1 at vtrc.virginiadot.org. For more information about the study, contact Brian K. Diefenderfer, Ph.D., P.E., VCTIR senior research scientist, Brian.Diefenderfer@vdot.virginia.gov.

Background and Construction Before the pavement recyling project began, fatigue cracking was the primary cause of deterioration in this section of I-81 pavement. Because most trucks used the right lane, the lower structural layers were in worse condition than those in the left lane. Previously, VDOT completed mill and overlay repairs of both lanes, but the lanes required further repair within 18 months to two years. VDOT's Staunton District wanted to determine if pavement recycling would provide a longer-lasting solution.

Using the recycling processes, in fewer than 20 work days, the contractors completed the full-depth rehabilitation in the right lane and a less extensive rehabilitation in the left lane.

In the right lane, the contractors milled most of the existing asphalt material and took it to an on-site cold central-plant recycling mobile plant to add hydraulic cement and foamed asphalt. Removing the upper material allowed access to repair the deficiencies deep within the aggregate base and subgrade. Through full-depth reclamation, the existing aggregate base layer and the top of the subgrade were mixed in the roadbed with hydraulic cement and lime kiln dust to create a new stabilized base. Only four to six hours after placing this new base, the contractors were able to top it with the recycled materials from the cold central-plant recycling process.

Full-depth reclamation mixes base aggregates and soil with stabilizing additives.

In the left lane, which had less underlying damage, the contractors milled the existing surface layer and then used the cold in-place recycling process to recycle the upper half of the remaining asphalt material directly in the roadbed, using hydraulic cement and foamed asphalt.

The contractors topped each lane with a dense-graded asphalt concrete intermediate course and later added a surface course of stone-matrix asphalt.

Research and Benefits VCTIR researchers developed information on materials behavior that will help VDOT in the design and specification of future in-place pavement recycling projects. For instance, they tested the pavement with ground penetrating radar and a falling weight deflectometer. The test results helped the researchers calculate structural layer coefficients for the recycled pavement materials. Their calculations led them to recommend that VDOT consider increasing the structural layer coefficients used when designing pavement with these materials. Since structural layer coefficients influence the design thickness of pavement layers, this could result in a more cost-effective pavement design.

VCTIR researchers collected materials before, during and after project construction. Tests on the materials included gradation, resilient modulus, indirect tensile strength, dynamic modulus and flow number. The researchers compiled a database of the recycled materials' structural properties, which can be used directly in mechanistic-empirical pavement design procedure calculations.

The researchers took rut depth and ride quality measurements seven times, between five and 34 months after construction. Throughout the evaluation period, rut depths were negligible and ride quality was *excellent* according to VDOT criteria. All field performance tests demonstrated that the section of interstate pavement rehabilitated by the three in-place recycling methods continued to perform well after nearly three years of high-volume truck and passenger vehicle traffic.

The benefits to VDOT of using the in-place pavement recycling methods described in this study include more durable pavements, faster construction with less impact on traffic and sustainable reuse of materials.

Cold in-place recycling equipment mills existing asphalt, mixes in stabilizing additives and places the recycled mixture back down in a single pass.

The Virginia Center for Transportation Innovation and Research (VCTIR) is proud to contribute to VDOT's reputation as a national transportation leader. VCTIR greatly appreciates the cooperation and support of VDOT and the Federal Highway Administration.

Virginia Center for Transportation Innovation and Research—VDOT's research division since 1948
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