

Recycling Asphalt Materials

ASPHALTPRO

PRODUCTION - PROFESSIONALS - PRODUCTS

CCPR in Indiana Uses Collaboration

- **High-RAP Recycling**
- **Burner Emissions Control**
- **Pugmill Maintenance Checklist**
- **7 Habits of Highly Effective Safety Leadership**
- **Your Mechanic Determines Spring Startup Success**

**FEBRUARY 2025
WWW.THEASPHALTPRO.COM**

High-RAP Recycling

BY JILL N. MCCONAGHIE

Using asphalt to pave U.S. roadways is nothing new. But what has fast become a fresh focus for the paving industry are new ways to sustainably develop and maintain those roadways.

From transport agencies to contractors, minimizing carbon footprint without sacrificing performance has become an industry imperative. The National Asphalt Pavement Association (NAPA) included sustainability in its 2023-2025 Strategic Plan, and National Highways, the primary transportation agency in the United Kingdom, has established a goal of net zero emissions from construction and maintenance of roadways by 2040.

Asphalt is not only prominent in global usage—ResearchAndMarkets.com estimates it will reach 225.9 million tons by 2030—but it also remains one of the world's most recycled materials. NAPA's "Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage 2022" extrapolated, in the United States alone, 98.1 million tons of reclaimed asphalt pavement (RAP) were used in mixes in 2022, a 75.2% increase in usage since 2009.

Critically, positive environmental outcomes are a direct byproduct of increased RAP use. Per NAPA, incorporating RAP in asphalt mixes also reduced greenhouse gas (GHG) emissions by 2.7 million metric tons of CO₂e in 2022, equivalent to the annual emissions of 600,000 passenger vehicles. The solution to more sustainable roadways is more than a one-to-one swap of virgin materials for RAP.

RAP is produced by removing existing damaged roadway surface material that has aged due to exposure to high traffic and environmental conditions. With milling anywhere from the top 2 inches of surface all the way to full-depth reclamation of up to 10 inches of material, RAP can take on many shapes and compositions. When processed properly, RAP is screened, crushed and fractionated to create a homogenized pile that can be used in an asphalt mix.

Typically, the binder within the RAP particles has aged over time and has lost its key functional characteristics. It no longer be-



According to FHWA's "User Guidelines for Waste and Byproduct Materials in Paving Construction," from FHWA, roadway milling produces over 45 million tons of RAP in the U.S. annually. *Photo courtesy of Sripath Technologies*

have like virgin binder. In such a case, the RAP particles behave like black rock and are effective only as a replacement for aggregate. In the past, this has resulted in limited use of RAP in an asphalt mix.

In its document "Asphalt Pavement Recycling with Reclaimed Asphalt Pavement (RAP)," FHWA defines a high-RAP mix as any containing over 25% RAP, and NAPA's research showed a national average of 22.2% RAP usage through 2022 in the United States. Of RAP produced in Europe, a document at the National Library of Medicine titled "The Challenges of Using Reclaimed Asphalt Pavement for New Asphalt Mixtures: A Review," shows 51.4% was used in hot-mix or warm-mix applications with 9.63% finding its way to landfills.

Over recent years, the availability of asphalt rejuvenators or recycling agents has

helped contractors incorporate higher levels of RAP into asphalt mixes. An effective rejuvenator rapidly penetrates the RAP particles and restores the functional properties of the aged binder. This allows the bitumen in RAP to behave as an effective binder, allowing higher levels of RAP to be incorporated into the mix. This also results in the need for reduced levels of virgin bitumen.

The interest in high-RAP mixes that meet desired performance requirements through balanced mix design (BMD) approaches has grown considerably. BMD is a method engineers use to formulate asphalt mixes that addresses multiple modes of distress taking into account mix aging, traffic conditions, location and climate. It typically involves balancing the fracture toughness and rutting resistance properties.

This approach also affords mix designers with the opportunity to incorporate higher amounts of RAP into their mixes through the use of an effective rejuvenator or recycling agent. The result can be mixes that incorporate high amounts of RAP, up to 100% in some instances, when dosed with an effective rejuvenator.

A good recycling agent not only supports high-RAP content in mixes, but it also preserves roadway performance and durability, lowers the amount of virgin bitumen required, and helps reduce the overall cost. The result is often a more sustainable approach to paving alongside a more economical and high-performing material.

Roadways incorporating high amounts of RAP are becoming more commonplace across the paving industry as departments of transportation and contractors focus on achieving their sustainability goals. To achieve these objectives, it is essential to utilize an effective rejuvenator that helps restore the functional properties of the aged RAP binder and helps reduce the overall carbon footprint.

Not all recycling agents are created equal when it comes to performance. Some are less effective in restoring the functional properties of the aged RAP binder than others. In addition, some can pose challenges that run counter to sustainability goals.

Biobased oils, such as Sripath's ReLIXER, have a strong track record as an effective asphalt rejuvenator or recycling agent. Such rejuvenators can effectively restore the functional properties of the aged RAP binder. Made from bio-based oils produced

Figure 1. Using 100% RAP Mixes in New York City

| Lab Data (Compacted using Marshall) | | | | | | |
|-------------------------------------|-----------------------|---------------|-------------|--|--|--|
| Additive | Marshall Air Voids, % | Stability, kN | Flow mm | | | |
| 0.55% ReLIXER | 3.9 | 2110 | 9.9 | | | |
| Specification | 3.5 to 5.5 | >1500 | 8.0 to 12.0 | | | |

| 1-Year Field Core Data | | | | | | |
|------------------------|-------------------|-------------------|-------------------|------------------------|--------------------------|--------------------------|
| Additive | Avg. Air Voids, % | SCB | | Hamburg Wheel Tracking | | |
| | | Avg. Air Voids, % | JC @ 25 °C, kJ/m² | Avg. Air Voids, % | Rutting @ 10k cycles, mm | Rutting @ 20k cycles, mm |
| 0.55% ReLIXER | 4.2 | 4.3 | 0.71 | 4.1 | 10.9 | 14.6 |
| Specification | 3.5-5.5 | 3.5-5.5 | 0.50 | 3.5-5.5 | <12.5 | Tertiary |

from cultivated crops that do not impact food sources, such rejuvenators are uniquely designed with sustainability in mind.

Leading rejuvenators, like ReLIXER, have comprehensive certified Environmental Product Declarations (EPDs) easily accessible online. Such rejuvenators have a negative value for Global Warming Potential (GWP). As an example, the GWP for ReLIXER is -1.45, demonstrating the product's ability to help reduce the environmental impact and overall carbon footprint.

A variety of real-world applications have demonstrated ReLIXER's ability to increase RAP mix content without compromising roadway surface performance. One demonstration trial conducted in New York City showed a 100% RAP mix dosed with ReLIXER exhibited outstanding mix properties without the need for any virgin binder. The 100% RAP mix dosed with just 0.55% ReLIXER met or exceeded spec-

ifications when evaluated for compaction (Marshall Test), rutting (Hamburg Wheel Tracking Test), and cracking resistance (Semi-Circular Bending Test).

High-performing sustainable products are a growing priority for contractors looking to keep up with demand for environmentally friendly paving solutions. These measures encompass the entire lifecycle including energy and water consumption, waste management, and recycling capabilities from cradle to gate and, ultimately, the roadway application itself.

By considering asphalt mix based on a balanced mix design concept, the resulting sustainability impact can be felt across the lifecycle of the roadway: incorporation of high amounts of recycled pavement material, use of an environmentally friendly recycling agent, and reduction of carbon emissions resulting from repair and maintenance **AP**

LEARN MORE

Additional References

Check out the National Asphalt Pavement Association's 2023-2025 "Strategic Plan" here: <https://www.asphaltpavement.org/about/strategic-plan> and the National Highways' "Net zero highways: Our zero carbon roadmap for concrete, steel and asphalt" here: <https://nationalhighways.co.uk/media/2prpkf4e/net-zero-roadmap-for-concrete-steel-and-asphalt.pdf>

Get your copy of "Asphalt Pavement Industry Survey on Recycled Materials and Warm-Mix Asphalt Usage 2022" from the NAPA store here: https://go.asphaltpavement.org/hubfs/NAPA%20Store/IS138-2022_RAP-RAS-WMA_Survey_%20WITH%20APPENDICES_508.pdf

Find FHWA's "Asphalt Pavement Recycling with Reclaimed Asphalt Pavement (RAP)" here: <https://www.fhwa.dot.gov/pavement/recycling/rap/>

Review "The Challenges of Using Reclaimed Asphalt Pavement for New Asphalt Mixtures: A Review" here: <https://pmc.ncbi.nlm.nih.gov/articles/PMC7560297/>

Read more about ReLIXER in "Our Focus on Sustainability" at <https://sripath.com/sustainability/> and "ReLIXER Technical Overview" at <https://sripath.com/resources/documents/>.