

Using Shingles In Pavement: Selected Research

Dust Suppression

Let Me Shingle Your Roadway

Iowa Department of Transportation
V.J. Marks and G. Petermeier, 1997

The bitumen of the waste shingles is very effective in providing a dust free granular surfaced roadway. It remains relatively dust free two years after treatment.

5% Shingle Mix Reduces Ruts

Evaluation of Use of Manufactured Waste Asphalt Shingles in Hot Mix Asphalt

Report 26, Chelsea Center for Recycling and Economic Development, University of Massachusetts; Rajib B. Mallick, Matthew R. Teto, Walaa S. Mogawer, July 2000

Study results show that volumetric and low temperature properties of hot mix asphalt with 3, 5 and 7 percent shingles are not significantly different from the properties of conventional hot mix asphalt used for surface courses. Mixes with 5 and 7% shingles show significantly lower rutting potential compared to mix without any shingles.

5% RAS Passes Density and Lab Tests

Use of Manufactured Waste Shingles in a Hot-Mix Asphalt Field Project

Virginia Department of Transportation and Virginia Transportation Research Council, G.W. Maupin, Jr, 2008

In 2006, a contractor requested that the manufactured waste shingles be allowed on an overlay paving project in southeast Virginia. The 4.1 mile two-lane section was paved using a surface mix containing 5% shingle waste and a surface mix containing 10% recycled asphalt pavement for comparison. Density tests were performed on the pavement, and various laboratory tests such as permeability, fatigue, tensile strength ratio, rut, and binder recoveries were performed on samples of mix collected during the construction of the section. Both the field and laboratory test results indicate that the behavior and performance of the two mixes should be similar.

5% RAS Allows HMA To Meet QC

Roofing Shingles and Toner in Asphalt Pavements

Texas Transportation Institute
J.W. Button, D. Williams, J.A. Scherocman, July 1996

Laboratory tests consisted of Hveem stability, indirect tension, resilient modulus at several temperatures, moisture susceptibility, TxDOT static creep, air void content, and voids in the mineral aggregate. The findings indicate that roofing waste is a viable waste stream that has utility in HMA. It should be possible to incorporate 5% or less roofing waste into typical HMA paving mixtures and have a product that will meet the standard quality control specifications.

RAS and RAP Optimized Thermal and Rut Resistance

Who Thought RAS Needed To Be Landfilled: Why Not Build A Road?

Transportation Association of Canada
S. Tighe, N. Hanasoge, B. Eyers, R. Essex, S. Damp, 2008

A laboratory study was performed in the John J. Carrick Pavement Laboratory at the University of Waterloo, investigating the use of RAS in a HL8 base course mix. Five asphalt pavement mix designs were considered:

- Mix 1 (control) – HL8, Virgin Material
- Mix 2 – HL8, 20% RAP Material
- Mix 3 – HL8, 20% RAP Material, 1.4% Shingles
- Mix 4 – HL8, 20% RAP Material, 3.0% Shingles
- Mix 5 – HL8, 3.0% Shingles

To compare the various mix designs the dynamic modulus test, resilient modulus test, Thermal Stress Restrained Specimen Tensile Strength Test, and French wheel rutting test were run for all five mix designs. Mixes with a percentage of shingles were found to have the lowest susceptibility to rutting (less than 4%), and the most resistance to thermal cracking.

www.BoulderCounty.org – For full copies of reports, and other technical resources on using recycled shingles in asphalt pavement.

www.shinglerecycling.org (maintained by the Construction Materials Recycling Association) – This national compilation of shingle research has dozens of studies, including performance evaluations.

Roofs to Roads

A project of Boulder County Resource Conservation Division

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Roofs to Roads

Paving Colorado's Roads with Recycled Asphalt Shingles (RAS)

A Guide for
Transportation Engineers,
Public Works Directors and
Streets Superintendents



View of N. 63rd Street – 5% shingles



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Paving with Shingles

Improved Pavement Quality

Adding recycled shingles to aggregate base, hot mix asphalt (HMA) and cold patch materials has been shown to:

- increase resistance to wear
- improve moisture resistance
- decrease ruts and deformations
- reduce thermal and fatigue cracking

See Selected Research (on reverse) for technical reports.

Cost Savings

Pavement contractors and Departments of Transportation have experienced cost savings by replacing virgin asphalt with less expensive recycled shingles. The Missouri DOT reports a cost savings of \$3–\$5 dollars/ton of laid asphalt. By using recycled shingles, MoDOT reduced the average asphalt content of mix designs by 1%, saving approximately \$20 million in 2009.

Resource Conservation

Recycled shingles can replace virgin asphalt and aggregate in asphalt mixes, reducing the amount of raw materials needed for asphalt paving projects.

Environmental Benefits

- **Greenhouse Gases emissions avoided.** For every one-mile length of two-lane road paved 1" thick with an asphalt blend incorporating 5% RAS, over 5,500 pounds of carbon dioxide emissions are avoided.
- **Reduction in waste entering Colorado landfills.** 300,000 tons of asphalt shingles enter Colorado landfills every year. The asphalt contained in tear-off shingles is a valuable resource that can be beneficially re-used.
- **Permanently recyclable material.** Asphalt pavements are permanently recyclable and recycled; pavements can be ground in place and blended into new HMA.

Widespread Shingle Use

State DOT Specifications Allowing Recycled Shingles

State	Draft Protocol	M, T
Colorado		M, T
Alabama	3-5%	M, T
Florida	5%	M
Georgia	5%	M
Illinois	5%	M, T
Indiana	5%	M
Iowa	3-5%	M, T
Maine	Case by case	M, T
Maryland	5%	M
Massachusetts	5%	M
Michigan	50% recycled content	M
Minnesota	5%	M
Missouri	7%	M, T
New Jersey	6%	M
North Carolina	6%	M
Ohio	% of recycled material	T
Pennsylvania	5%	M
Texas	5%	M, T
Virginia	5%	M, T
Wisconsin	% in upper and lower lifts	M, T

T = Tear-off Shingles from roofing demolition projects

M = Manufacturing Scrap

RAS Use in Boulder County

Boulder County requires the use of Recycled Asphalt Shingles at a 5% blend in the mix on certain paving projects. Section 403, Asphalt Pavement, is modified by Section 403.02, "Include RAS at 5%".

Specifications Allow RAS

AASHTO Standards

AASHTO Standard MP 15, Standard specification for Use Of Reclaimed Asphalt Shingles as an Additive in Hot Mix Asphalt (HMA), addresses reclaimed asphalt shingle material used as an additive in HMA.

AASHTO Specification PP53, Standard Practice for Design Considerations when Using Reclaimed Asphalt Shingles in New HMA. Guidance for designing new HMA which incorporates reclaimed asphalt shingles.

Missouri DOT's Specification for RAS

RAS may be used in any mixture specified to use PG 64-22 in accordance with AASHTO PP 53 except as follows:

- A maximum of 7 percent RAS may be used
- When the ratio of virgin binder to total binder in the mixture is less than 70 percent, the grade of the virgin binder shall be PG 52-28 or PG 58-28
- Shingles shall be ground to ½-inch minus
- Waste, manufacturer or new, shingles shall be essentially free of deleterious materials
- Post-consumer RAS shall not contain more than 1.5 percent wood by weight or more than 3.0 percent total deleterious by weight
- Post-consumer RAS shall be certified to contain less than the maximum allowable amount of asbestos as defined by national or local standards

Shingle Aggregate Gradation

Sieve Size Percent	Passing by Weight
3/8 in. (9.5 mm)	100
No. 4 (4.75 mm)	95
No. 8 (2.36 mm)	85
No. 16 (1.18 mm)	70
No. 30 (600 µm)	50
No. 50 (300 µm)	45
No. 100 (150 µm)	35
No. 200 (75 µm)	25

Help Bring Colorado's Roofs to Colorado's Roads

Ready to

Use RAS in a Paving Project?

We can help:

- Identify an appropriate paving project
- Provide specifications, technical guidelines or performance data
- Answer your questions
- Support your bid process
- Include your project in the state-wide list of projects using RAS

Contact Boulder County's

Roofs to Roads Project:

- Receive updates about shingle recycling and re-use efforts
- Learn about webinars, conferences, and educational opportunities on RAS
- Request information about RAS use that interests you (parking lots, dust suppression, HMA, etc.)

Roofs to Roads

Project of Boulder County Resource Conservation Division

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