

Asphalt roofing shingles constitute nearly **two-thirds of the roofing market** for both new homes and roof replacements. Annually, roof installation generates an estimated **7 to 10 million tons** of shingle tear-off waste and installation scrap. More than 60 manufacturing plants across the U.S. generate another **750,000 to 1 million tons** of manufacturing shingle scrap.

Asphalt roofing shingles have great recycling potential because they are plentiful in the construction and demolition (C&D) waste stream; they are generated separately from other wastes and, hence, easy to isolate; recycling technology is available; and the use of recycled shingles in pavement can yield cost savings. However, shingle recyclers must deal with issues such as potential asbestos content, differences in shingle properties between manufacturing scrap and tear-off waste, pavement engineering concerns, and equipment and collection needs. Currently, almost all recycled asphalt shingles are used in paving.

WHAT IS ROOFING WASTE?

The installation of new asphalt shingle roofs and reroofing generate the same waste materials; however reroofing produces much larger quantities. As the table below shows, shingles dominate the reroofing waste stream.

The Re-Roofing Waste Stream

MATERIAL	% BY WEIGHT
tear-off waste shingles	85-90
metal flashing/detailing	5-10
wood sheathing	<5
"tar" paper	<5
paper packaging	<1
nails	<1

Asphalt shingle roof replacement can generate waste at rates of **at least 2 to 5 pounds per square foot** of roof area. Generation rates vary by the number of layers and the type of shingle.

The Asphalt Shingle's Components

Asphalt shingles are made from four basic materials:

	% by weight
♦ fiberglass or cellulose felt backing:	2-15%
♦ asphalt cement:	19-36%
(on a fiberglass matt base: 19-22%)	
(on a cellulose felt base: 30-36%)	
♦ mineral granules (aggregate):	20-38%
♦ mineral filler/stabilizer:	8-40%

The asphalt cement and aggregate content of shingle waste make recycled shingles a desirable additive or feedstock substitute in pavement materials.

THE RECYCLING PROCESS

All recycling operations involve three basic steps:

- 1) Removal of non-shingle wastes that interfere with processing or end uses;
- 2) Grind shingles to ¼" - 2½", depending on the intended end use. A magnet typically removes small metal pieces such as nails; and
- 3) Use processed shingles in paving materials.

Residual wastes such as wood sheathing, cardboard, and metal flashing and nails are also potentially recyclable.



Asphalt shingles processed into 1/2" minus particles, ready for transport to asphalt plant.

Asphalt plant in Carroll County, Maryland. Processed shingles weighed and mixed in pug mill for use as asphalt paving.



Profile: Asphalt Roof Recycling Center, Inc.

Location:	Mount Airy, Maryland
Local landfill tip fee:	\$40-65/ton
Tip fee for shingles:	\$30/ton
End-uses/Products:	2" minus: temporary roadways ½" minus: non-spec road hot mix asphalt (HMA) additive
Loads accepted:	Asbestos-free commingled residential shingle loads. Wood, metal flashing, rolls of tar paper, paper wrappers, and cans are removed by the processor.
Asbestos:	Shingles are visually inspected and very old or suspicious loads undergo lab testing.
Permit:	Roofing waste processing permit, no long-term storage of waste allowed.
Contact:	Don Katzenberger or Walt Johnson at (301) 831-0888

RESOURCES & REPORTS:

In addition to the resources below, local and state recycling coordinators or state-level departments of transportation can provide assistance and information. For the most current information, periodicals such as *Bicycle* (610/967-4135), *Resource Recovery Report* (202/362-6034), and *Waste Age's Recycling Times* (202/364-3722) often include articles and updates on the industry.

Asphalt Roof Recycling Center, 1005 Rising Ridge Road, Mt. Airy, MD 21771; phone (301) 831-0888. In addition to the asphalt shingle recycling operation profiled in this brochure ARRC also offers consulting services. (Photos in brochure provided by Michelle Johnson at ARRC.)

California Integrated Waste Management Board (CIWMB), *Construction & Demolition Recycling Program fact sheets on Asphalt Roofing Shingle Recycling*, August 1997 (3pp each). (916)255-2326 or <http://www.ciwmb.ca.gov>. The CIWMB has published four different fact sheets on asphalt shingle recycling opportunities.

Construction Materials Recycling Association, P.O. Box 644, Lisle, IL 60532; phone (630) 548-4510; fax (630) 548-4511; e-mail turley@xsite.net. CMRA distributes the *Construction Material Recycler* which covers asphalt shingle recycling as well as other aspects of the industry.

Minnesota Department of Transportation, Office of Materials and Road Research; Report # 96-34 *Minnesota's Experience Using Shingle Scrap in Bituminous Pavements*, October 1996 (30pp). Contact Roger Olsen (651) 779-5517 or <http://mnroad.dot.state.mn.us>. Contains results and analysis of test pavement performance and various mix designs.

NAPA—National Asphalt Pavement Association; *SR 179: Uses of Waste Asphalt Shingles in HMA, State of the Practice*, January 1997 (19pp). (301) 731-4748 or www.hotmix.org. Evaluates pavement mix design, equipment, operational, and economic considerations involved in using recycled shingles in pavement mixtures from the paver's perspective.

NAHB Research Center; *Residential Construction Waste Management, A Builder's Field Guide*, January 1997 (30pp). (301) 249-4000 or www.nahbr.org. A general resource for builders interested in reducing disposal of construction waste or developing a waste management plan.

NCAT—National Center for Asphalt Technology, Auburn University; *Final Report: Evaluation of Roofing Shingles in HMA*, March 1997 (54pp). Contact Doug Hanson: (334) 844-6240 or www.eng.auburn.edu/center/ncat. Contains literature review and discussion of results of recycled-content pavement mixes.

NRCA—National Roofing Contractors Association; *OSHA Asbestos Standard CFR 1926.58*, 1996 (19pp). Contact Tom Shanahan: (847)299-9070 or www.nrca.net.

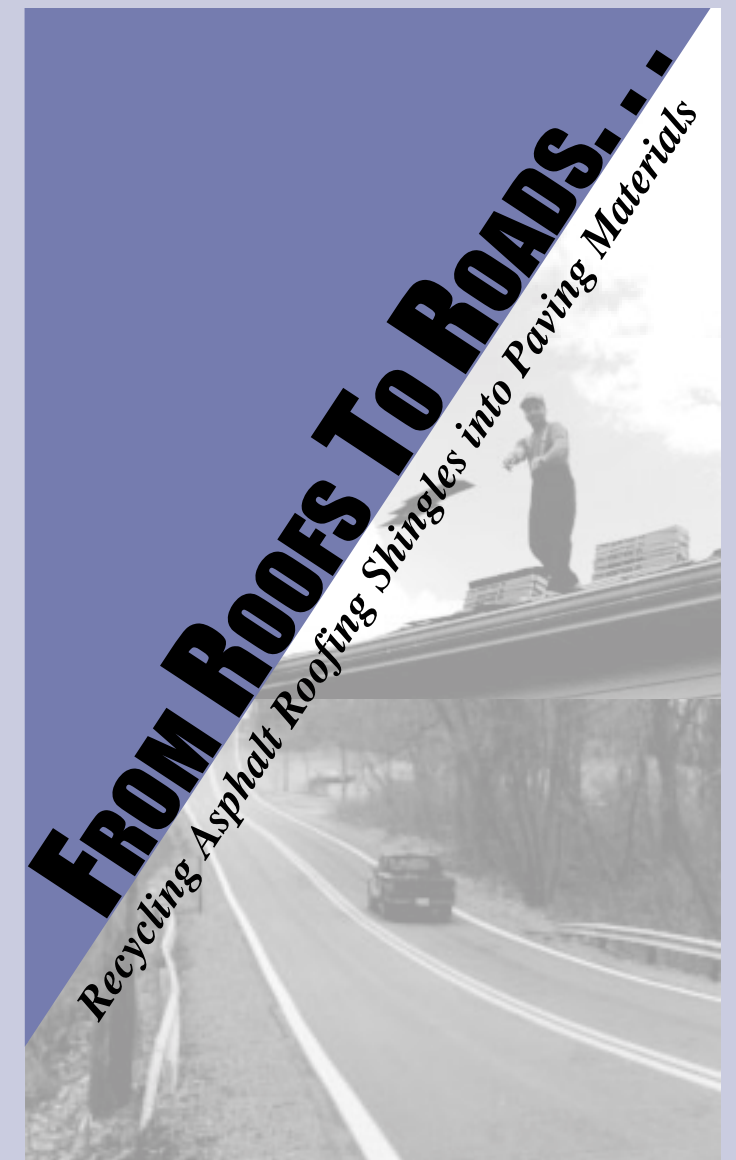
Texas Transportation Institute, The Texas A&M University System; Report # FHWA/TX-97/1344-2F *Roofing Shingles and Toner in Asphalt Pavements*, July 1996 (115pp). Contact Joe Button, P.E.: (409)845-9965 or <http://tinet.tamu.edu>. Contains discussion of previous shingle-content pavement research, lab analysis of TX samples, and materials specifications and construction guidelines.

University of Massachusetts Transportation Center; *Use of Recycled Materials and Recycled Products in Highway Construction*, August 1995 (208pp). (413) 545-3728. Contains literature review and summary of state recycling policies and activities for selected waste materials.

RECYCLING EQUIPMENT MANUFACTURERS:

Astec Industries, Inc., Chattanooga, TN (423) 867-4210
CMI, Inc. (Maxigrind), Oklahoma City, OK (405) 491-2237

Prepared under a cooperative agreement with the U.S. Environmental Protection Agency, 1998. Funding of this brochure by EPA does not constitute endorsement or recommendation for use of the businesses, products, or services listed or described in this brochure. Printed on recycled paper with soy-based inks.



Information and guidance for builders, remodelers, solid waste planners, and recyclers of construction waste.



400 Prince George's Boulevard, Upper Marlboro, MD 20774-8731
<http://www.nahbr.org>

END-USE OPTIONS

The primary end-use for recycled shingles is paving. Paving falls into 2 main categories—that which meets state specifications (spec) and that which does not.

Spec vs non-spec roads: State-funded paving must meet state specs which are based on Federal pavement performance standards and local climatic conditions and reflect engineering intended to maximize pavement durability. Paving projects not using state or federal funds, such as those controlled by either local authorities or private parties, are *not required* to meet state specs but often *voluntarily* follow the state specs rather than develop their own, separate specs.

The following options represent spec-based end-use options, although non-spec pavement can also apply these standards.

Aggregate Base Course—Course-ground shingles (2½” minus) can be added to aggregate materials as part of the lower pavement layers—the sub-base, base, or binder courses.

Hot Mix Asphalt (HMA)—Fine ground shingles (½” minus) can be added at 5% by weight of HMA for use in the wear/surface course. Shingles are added to HMA in the same manner as recycled asphalt pavement (RAP). The shingles can replace some virgin asphalt and aggregate. This substitution, however, usually requires the use of a softer virgin asphalt to offset the effect of adding the harder asphalt in the recycled shingles.

Temporary Roads, Driveways, or Parking Lots

Coarse-ground shingles (2½” minus) can be used for dust control on bare ground; as an economical alternative to ground covers such as gravel, stone, or wood chips in low traffic areas; and on non-spec roads such as farm lanes, rural roads, or temporary construction surfaces.



Course-ground shingles used as a driveway.

Cold Patch Mix—Shingles can be ground to ½” minus size and used alone or combined with virgin asphalt or other materials for use as a cold patch material. In some instances, these patches last longer than virgin patch materials.

Expansion Joints—Fine ground shingles (½” minus) combined with virgin asphalt can be used as expansion joints for concrete pavements.

New Roofing Material—Using fine ground shingles (½” minus) as a material input in the manufacturing of new roofing shingles is still in the experimental phase. Problems surround the control of the quality of recycled shingles as a feedstock and the assimilation of recycled shingles into the manufacturing process.

BENEFITS OF RECYCLING

Save Money—Roofing contractors may be able to reduce their disposal expenses by tipping roofing waste for a lower fee at a recycler, typically \$5 to \$20 less than at landfills. *Pavement contractors* and *Departments of Transportation* can reduce material costs by replacing a percentage of virgin asphalt and/or aggregate with less expensive recycled shingles.

Improve Pavement—The addition of recycled shingles to aggregate base, hot mix asphalt (HMA) and cold patch materials has been shown to:

- ♦ increase pavement’s resistance to wear,
- ♦ increase pavement’s resistance to moisture,
- ♦ decrease deformation and rutting, and
- ♦ decrease thermal and fatigue cracking.

(See **RESOURCES** on reverse for technical reports.)

Meet State Recycling Goals—Shingles represent a discrete and identifiable portion of the C&D waste stream. State and local governments may thus be able to increase recycling rates by supporting and encouraging shingle recycling operations (NOTE: not all states count C&D waste toward recycling goals).

Use Resources Efficiently—Recycled shingles can replace a percentage of virgin asphalt and/or aggregate, thereby reducing the amount of raw materials needed to produce new pavement.

WHERE ARE SHINGLES RECYCLED?

The table below provides a list of states that either have shingle recyclers operating within the state or have state pavement specifications that specifically allow the use of recycled shingles in pavement materials—*Check with your state or local Recycling Coordinator for the most current information on recyclers in your area.*

STATES WITH SHINGLE RECYCLING OPERATIONS AND/OR STATE DOT SPECS ALLOWING RECYCLED SHINGLES		
State	State DOT Specs/Rules On Recycled Shingle Usage*	Material Recycled
FL	under development	T
GA	5% manufacturer scrap	M
IL		T
IN	5% manufacturer scrap	M
IA		T
ME		T
MD	5% manufacturer scrap	M, T
MA		T
MI	50% recycled content ¹	
MN	5% manufacturer scrap	M
NH		T
NJ	5% manufacturer scrap	
NC	5% manufacturer scrap	M
OH	“certain percentage of recycled material”	T
PA	5% manufacturer scrap	M, T
WA		T

*: “%” represents percent by weight allowed as an additive to hot mix asphalt
M: manufacturer scrap is recycled T: tear-off waste is recycled

¹: shingles not specifically mentioned in the spec, but in practice both M & T are routinely allowed in certain hot mixes

POTENTIAL CHALLENGES TO RECYCLING

DOT Pavement Specifications/Standards (specs)—Pavement mix formulas are based on:

- *climate*, i.e., precipitation and hot/cold temperature extremes; and
- *traffic conditions* including types of vehicles and volume/types of traffic, e.g., rush hour, stop and go, or highway.

Because climate and pavement specs vary from state to state, state departments of transportation (DOTs) have needed to independently test the effect that adding recycled shingles has on a pavement’s performance. Test pavements with batches containing a maximum of 5% shingles by weight of mixture have performed at least as well as traditional pavement (both manufacturer scrap and tear-off were tested); however, under current technology, if shingles are added at a higher percentage, performance may begin to suffer (*see Resources for test pavement results*).

Manufacturer’s Scrap vs. Tear-off Waste: Scrap produced during the manufacturing process is of a uniform and guaranteed content. In contrast, tear-off waste may be composed of shingles of varying asphalt and aggregate composition, may be from multiple manufacturers, and has undergone weathering and aging from exposure to ultraviolet sunlight. **Most states have not allowed the use of tear-off scrap in DOT specs** for a variety of reasons, including:

- 1) adequate supply of manufacturer scrap;
- 2) potential asbestos-content in tear-off waste, &;
- 3) quality-control concerns regarding content and condition variability for tear-off waste.

Recyclers should work closely with their state and local environmental agencies to acquire proper permits and to ensure adequate testing for and handling of potential haz-mats.

Asbestos-Containing Roofing Materials (ACRM)—Between 1963 and 1977, three of the largest shingle manufacturers used asbestos in the fiber mat of their shingles, although the average asbestos content was only 0.02% in 1963 and 0.00016% in 1973. Plants were located in Massachusetts, New Jersey, Ohio, Tennessee, and Texas.

Because of liability concerns, manufacturers are reluctant to divulge asbestos-related production information and, thus, regional distribution of ACRM cannot be determined. As some shingles last up to 20 years and some roofs are covered by a double layer, reroofing projects may encounter ACRM through approximately 2016. Although only a small percentage of shingle production over a limited number of years involved asbestos, ACRM is a potential hazard that recyclers and regulators both must face.

Testing—Laboratory tests are required to quantify asbestos content, although a visual inspection can identify very old or suspicious loads with a possibility of asbestos content. Laboratory tests cost between \$15 and \$25 and may take up to 24 hours. Recyclers in Massachusetts, Maine, Maryland, and Washington have tested hundreds of loads and detected asbestos in only a handful of instances.

Regulations—OSHA regulates workplace exposure to asbestos (*see NRCA in Resources*). EPA regulates handling and disposal issues. Shingle recycling may require siting, waste handling, and/or processing permits, thus *recyclers should work closely with their state and local environmental agencies to acquire proper permits and to ensure adequate testing for and handling of potential haz-mats.*

Marketing Recycled Material—Finding paving companies willing to use recycled shingles is a challenge for recyclers. However, as virgin asphalt prices increase, recycled shingles may become an attractive option.

Mixed Waste Stream—Some recyclers may demand “clean” shingle waste loads, while others may accept commingled roofing waste loads and charge additional fees for sorting unwanted materials such as wood or flashing.

Equipment—Recycling of shingles typically requires modification of standard grinding, screening, and dust control equipment in order to process shingle waste material for the desired end use products. Recent advances in equipment design have overcome previous problems with blade wear and dust control. Some machines have even been designed to process roofing and other construction wastes (*see Resources for equipment manufacturers*).

Location, Landfills, & Tip Fees—Because transportation is a significant portion of disposal costs, roofers cannot afford to haul waste long distances. Local landfill capacity and tip fees also affect roofers’ disposal choices. Recyclers typically must charge at least \$30 per ton to cover processing costs. The differential between the recyclers’ charge and the landfill tip fee must be large enough to provide an *economic* incentive to generators to change their practice of landfill disposal.

Profile: Commercial Recycling Systems and Commercial Paving Co.

Location:	Scarborough, Maine
Local landfill tip fee:	\$60-85/ton
Tip fee for shingles:	\$34/ton
Equipment:	grinder, multiple screens, magnet
End-uses/Products:	1” & 3” minus: aggregate base material ½” minus: non-spec road HMA additive & cold patch

Loads accepted: Shingles must be free of wood, metal flashing, paper, and cans or an additional sorting fee is charged, although nails and tar paper are acceptable contaminants. All asbestos-content roofing is rejected.

Asbestos: Shingles are visually inspected and very old or suspect loads must undergo lab testing.

Permit: Solid waste processing permit with allowance to remove recyclable products.

CRS is an environmental services company involved in commercial and industrial recycling and paving which can provide information/assistance on permitting, operations, and equipment. Call Doreen Hendry at 207/883-3325.