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 scrape. 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

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>% BY WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>tear-off waste shingles</td>
<td>85-90</td>
</tr>
<tr>
<td>metal flashing/details</td>
<td>5-10</td>
</tr>
<tr>
<td>wood shingles</td>
<td>&lt;5</td>
</tr>
<tr>
<td>&quot;tar&quot; paper</td>
<td>&lt;5</td>
</tr>
<tr>
<td>paper packaging</td>
<td>&lt;1</td>
</tr>
<tr>
<td>nails</td>
<td>&lt;1</td>
</tr>
</tbody>
</table>

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:

- fiberglass/cellulose batt backing
- asphalt cement
- (on a fiberglass mat base: 19-22%) (on a cellulose felt base: 30-35%)
- mineral granules (for color)
- mineral filler/stabilizer
- asphalt cement and aggregate contents of shingle waste make recycled shingles a valuable additive or feedstock substitute in pavement materials

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

### 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 1/4" - 2 1/2", 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.

### 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* (202/863-6034), and *Waste Age*’s Recycling Times (202/364-3722) often include articles and updates on the industry.

**Asphalt Roof Recycling Center**

1055 Rising Ridge Rd, Mt. Airy, MD 21771; phone (301) 831-0888. In addition to the asphalt shingle recycling operation profiled in this brochure, NAHB offers consulting services. (Photo 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).** 1916025-2226 or http://www.ciwmbs.ca.gov The CIWMB has published four different fact sheets on asphalt shingle recycling opportunities.

**Construction Materials Recycling Association, P.O. Box 644, Laie, IL 60532; phone 630) 548-4510; fax (630) 548-4511; e-mail harley@exe.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 Scarp in Bituminous Pavement, October 1996. Contact Roger Olsen (651) 779-5117 or http://www.dot.state.mn.us. Includes results and analysis of test pavement performance and various mix designs.


A general resource for builders interested in reducing disposal of construction waste or developing a waste management plan.


**Texas Transportation Institute.** The Texas A&M University System; Report # FHWA/TX-97/334-2F Roofing Shingles and Toner in Asphalt Pavement, July 1996 (119pp). Contact Joe Button, P.E.: (409) 845-9965 or http://ttinet.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 1993 (28ppp). (413) 545-3728. Contains literature review and summary of state recycling policies and activities for selected waste materials.

### RECYCLING EQUIPMENT MANUFACTURERS:

- RECYCLING EQUIPMENT MANUFACTURERS:
  - Astec Industries, Inc., Chattanooga, TN (423) 867-4210
  - CMI, Inc. (Masstfold), Oklahoma City, OK (405) 491-2237

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**Information and guidance for builders, remodelers, solid waste planners, and recyclers of construction waste.**
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 at 5% by weight of HMA for use in the wear/binder course. This substitution, however, must be approved by the state. In Missouri, these ORF's are only being used at 2½” minus in the sub-base course.

Hot Mix Asphalt (HMA)—Fine ground shingles (2½” minus) can be added at 5% by weight of HMA for use in the wear/binder course. State and local governments may thus be able to increase recycling rates by supporting and encouraging shingle recycling operations (NOTE: not all state and local DOT’s have adopted recycled shingle programs). 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.

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.

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 state and local DOT’s have adopted recycled shingle programs). 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.

<table>
<thead>
<tr>
<th>State</th>
<th>State DOT Spec/Rules On Recycled Shingle Usage</th>
<th>Material Recycled</th>
</tr>
</thead>
<tbody>
<tr>
<td>FL</td>
<td>under development</td>
<td>T</td>
</tr>
<tr>
<td>GA</td>
<td>5% manufacturer scrap</td>
<td>M</td>
</tr>
<tr>
<td>IL</td>
<td>5% manufacturer scrap</td>
<td>M</td>
</tr>
<tr>
<td>IN</td>
<td>5% manufacturer scrap</td>
<td>T</td>
</tr>
<tr>
<td>IA</td>
<td></td>
<td>T</td>
</tr>
<tr>
<td>ME</td>
<td>5% manufacturer scrap</td>
<td>M, T</td>
</tr>
<tr>
<td>MD</td>
<td>5% manufacturer scrap</td>
<td>M, T</td>
</tr>
<tr>
<td>MA</td>
<td>50% recycled content</td>
<td>M</td>
</tr>
<tr>
<td>MN</td>
<td>5% manufacturer scrap</td>
<td>M</td>
</tr>
<tr>
<td>NH</td>
<td></td>
<td>T</td>
</tr>
<tr>
<td>NJ</td>
<td>5% manufacturer scrap</td>
<td>T</td>
</tr>
<tr>
<td>NC</td>
<td>5% manufacturer scrap</td>
<td>T</td>
</tr>
<tr>
<td>OH</td>
<td>“certain percentage of recycled material”</td>
<td>T</td>
</tr>
<tr>
<td>PA</td>
<td>5% manufacturer scrap</td>
<td>M</td>
</tr>
<tr>
<td>WA</td>
<td></td>
<td>T</td>
</tr>
</tbody>
</table>

POTENTIAL CHALLENGES TO RECYCLING

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

- climate, i.e., precipitation and hot/cold temperature extremes,
- 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 composition. 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 permiss and to ensure adequate testing for and handling of potential haz-mats.

Hot Mix Asphalt (HMA)—Fine ground shingles (2½” minus) can be added at 5% by weight of HMA for use in the wear/binder course. This substitution, however, must be approved by the state. In Missouri, these ORF's are only being used at 2½” minus in the sub-base course.

Cold Patch Mix—Cold patch shingles can also 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.

Asphalt-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 0.0016% in 1973. Plants were located in Massachusetts, New Jersey, Ohio, Tennessee, and Texas.

Because of liability concerns, manufacturers are reluctant to divulge asbestos-related 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, re-roofing 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 suspect loads with a reasonable degree of confidence. Laboratory asbestos content test 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 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 more attractive.

Mixed Waste Streams—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 grading, 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 roof 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) 1” minus & aggregate base material
2) ½” minus: non-road HMA

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.