Recycled Asphalt Shingles in HMA and Other Applications

A Presentation at the 80th Annual Meeting of the Northeastern States Materials Engineers’ Association
Wednesday, October 20, 2004

On Behalf of the Recycled Materials Resource Center, University of New Hampshire
Presenter: Dan Krivit
Dan Krivit and Associates
RMRC Project 22
By Mn/DOT and OEA

- Overcoming the Barriers to Asphalt Shingle Recycling
- Minnesota Department of Transportation (Mn/DOT)
- Minnesota Office of Environmental Assistance (OEA)
RMRC Project 22

• April 13 – 14, 2003
  Second Asphalt Shingles Recycling Forum
• http://www.projects.dot.state.mn.us/uofm/shingles/index.html
Who’s in the audience today?

- State engineers
- Local county, city, town engineers
- Private operators:
  - HMA producers
  - Paving companies
  - Recyclers
- With shingling recycling experience
- Any attending April 2003 Forum?
Multiple Applications

- HMA
- Aggregate base and sub base (unbound gravel)
- Dust control
- Cold patch
- Ground cover
- Fuel
- New shingles
Summary Highlights

• History of experience:
  – State engineers
  – Private operators
• Substantial body of literature
• High quality HMA can be maintained *
Resources

- Mn/DOT & RMRC handout packet
- *Forum* web page
- RMRC web page
- SWMCB web page
- OEA web page
Summary Highlights

• QA/QC critical **

• Use in HMA can be very cost effective:
  – Cheaper alternative to landfilling
  – $0.50 to $3.30 per ton of HMA
Summary Highlights

• Risk from asbestos can be managed
RMRC Project 22
By Mn/DOT and DKA *

- Review of past literature and demonstration projects
- Broad partnership / outreach
- New field demonstrations
- Environmental testing for asbestos
- *Forum* in April 2003
- Spec development
Definitions

- **Manufacturer Asphalt Shingle Scrap**

- **Tear-Off Asphalt Shingle Scrap**
  (Private residential homes only *)

- **Recycled Asphalt Shingles**
  (Crushed & screened)
Scrap and Product Quality Specs

- Free of debris / trash / foreign matter
- Tear-off scrap must be asphalt shingles only, no nails
## Recycled Asphalt Shingles in the Northeastern States
### DOT Specs and State Beneficial Use Determination (BUD) Licenses
(Draft summary as of 10-19-04)

<table>
<thead>
<tr>
<th>State</th>
<th>State DOT Specs</th>
<th>State BUD License</th>
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<tbody>
<tr>
<td>CT</td>
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<td>NJ</td>
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<td></td>
<td>5% manufacturer scrap only</td>
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<td>NY</td>
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<td>PA</td>
<td>PADOT spec 5% manufacturer scrap,</td>
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<td>Draft spec for tear-off scrap</td>
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<tr>
<td>RI</td>
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<tr>
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<td>BUD license,</td>
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<td>VT Agency of Natural Resources</td>
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</table>

**Notes:**
- **M:** Manufacturer scrap is allowed / recycled
- **T:** Tear-off waste is allowed / recycled
# Recycled Asphalt Shingles in Other States

**DOT Specs and State Beneficial Use Determination (BUD) Licenses**  
(Draft summary as of 10-19-04)

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<th>State BUD License</th>
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<tbody>
<tr>
<td>FL</td>
<td>Tear-off spec under development</td>
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<tr>
<td>GA</td>
<td>5% manufacturer or tear-off scrap</td>
<td></td>
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<tr>
<td>IL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IN</td>
<td>5% manufacturer scrap</td>
<td></td>
</tr>
<tr>
<td>IA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MI</td>
<td>50% recycled content(1)</td>
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<tr>
<td>MN</td>
<td>5% manufacturer scrap only</td>
<td>BUD permit by rule for both M and T</td>
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<tr>
<td>NC</td>
<td>5% manufacturer scrap only</td>
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<tr>
<td>OH</td>
<td>&quot;certain percentage of recycled material&quot;</td>
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</tr>
<tr>
<td>TX</td>
<td>manufacturer or tear-off scrap</td>
<td></td>
</tr>
<tr>
<td>WA</td>
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</tbody>
</table>

**Notes:**  
M: Manufacturer scrap is allowed / recycled  
T: Tear-off waste is allowed / recycled
Mn/DOT Specification

- Currently limited to manufacturer asphalt shingle scrap (MASS)
- Tear-off roofing shingles explicitly excluded (discussions underway)
- Certification process for assuring quality of supply
Mn/DOT Spec

- Maximum 5%
- Considered a type of RAP:
  - 5% shingles + 25% RAP = 30% max RAP
- QA/QC standards apply (blending charts)
Mn/DOT “Draft Spec on File”

- Gradation
  - 100% passing the ¾” sieve, and
  - 95% passing the #4 sieve
- Shingles stockpiled separately
- Pre-blending is prohibited
- Crushed & recycled shingles introduced with RAP at same time
Mn/DOT Draft Spec on Files
(See SWMCB handouts of March 4, 2004)

- Certification from:
  - Manufacturer
  - Processor
- Sample for review
- List of pre-approved sources and processors from MN/DOT
Scrap Shingle Certification Sheet

Manufacturer

S.P.No: __________________________ Project: __________________________

Manufacturer of Shingle Scrap:

Name: ________________________________________________________________

Address: _______________________________________________________________

Contact: _______________________________________________________________

Phone: ________________________________________________________________

We the undersigned, certify that a portion of the shingle scrap to be used on this project, was directly from one of our manufacturing plants to the processor listed below and is shingle man waste material. We certify that this material is not tear-off or re-roof material which has been used. We also certify that the material supplied to the processor consisted of only organic and/or shingles and contains no asbestos or other hazardous material.

Name of Processor Shingle Scrap Was Supplied To

Address

Manufacturer of Shingle Material ___________________________________ Date

Date
### Scrap Shingle Certification Sheet

**Processor**

<table>
<thead>
<tr>
<th>S.P.No:</th>
<th>Project:</th>
</tr>
</thead>
</table>

**Manufacturer of Shingle Scrap:**

<table>
<thead>
<tr>
<th>Name:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Address:</td>
<td></td>
</tr>
<tr>
<td>Contact:</td>
<td></td>
</tr>
<tr>
<td>Phone:</td>
<td></td>
</tr>
</tbody>
</table>

We the undersigned, certify that all of the shingle scrap to be used on this project came from manufacturing facility or facilities and is not tear-off or re-roof material. We certify that this shingle material contains only shingles, not other material was added or introduced into this shingle scrap.

Processors of Shingle Material

**Date**

**Note:** Processor must submit certification from all manufacturing facilities which provided or vouchered for shingle scrap material to be used on this project.
Bituminous Roadways, Inc.
Inver Grove Heights, MN
Dust control demo
Mn/DOT’s Perspective on Shingle Recycling

March 4, 2004

Roger Olson, Research Operations Engineer

Building upon ongoing research and development efforts by Mn/DOT, OEA and RMRC
Shingle - History

- Mn/DOT tests (with University of Minnesota)
- Willard Munger Trail (1990)
- Scott County Hwy 17 south of Shakopee, MN (1991)
Scrap Asphalt Shingles

- Mn/DOT’s most recent specifications, Combined 2360 / 2350, allows 5% manufactured shingle scrap in hot mix

- Shingles considered as RAP

- At discretion of HMA producer
Shingle Processing

- Can be added like recycled asphalt pavement (RAP)
- Steps include: grinding, sizing and grading
- Contaminants must be removed
- Certification of supply required
- Manufactured waste only at this time
TH 25 Test Section
(Since 1991)
## Test Results

<table>
<thead>
<tr>
<th>Description</th>
<th>Percent Shingles</th>
<th>PG Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>TH 25 (control)</td>
<td>0%</td>
<td>73 - 20</td>
</tr>
<tr>
<td>TH 25 (test #1)</td>
<td>5%</td>
<td>75 - 20</td>
</tr>
<tr>
<td>TH 25 (test #2)</td>
<td>7%</td>
<td>79 - 15</td>
</tr>
<tr>
<td>CSAH 17 (control)</td>
<td>0%</td>
<td>77 - 22</td>
</tr>
<tr>
<td>CSAH 17 (test)</td>
<td>10%</td>
<td>75 - 24</td>
</tr>
</tbody>
</table>
Ongoing Mn/DOT Shingle Project Co-Sponsored By:

• Minnesota Office of Environmental Assistance (OEA)

• Recycled Materials Resource Center (RMRC)
For More Information

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Recycled Asphalt Shingles

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Steve Peterson
Technical Coordinator
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Hennepin County Mill & Overlay
Project: France Avenue:
Between 80th & 90th Streets

- Surface cracking on old bituminous pavement required mill & overlay repair
Crews report “Traffic can use surface more quickly than normal mixes”
Hennepin County

France Ave.
80th St. to 90th St.
Specified PG 58-28

Extraction Results:
SB 30% RAP, no Shingles:
PG 67.6-27.0
PG 68.1-27.9

NB 25% RAP, 5% Shingles:
PG 66.5-27.9
PG 67.6-28.4
• Increase the use of shingle-derived asphalt in county projects.

• Include shingle derived asphalt material as an alternative bid item in our annual bituminous contract.
SWMCB Web Sites


And

RMRC Project 13
By Chesner Engineering

• Shingles have been used in HMA for over 15 years
• At least 10 states have a spec
• Draft AASHTO spec in process
Recycled Asphalt Shingle as an Additive in Hot-Mix Asphalt

RMRC Training Workshop for Northeast States
September 13-14, 2004
Manchester, New Hampshire

Henry Justus
States Using RAS (1999 data)

<table>
<thead>
<tr>
<th>Color</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>General Use</td>
</tr>
<tr>
<td>Pink</td>
<td>Alternate to Bidders</td>
</tr>
<tr>
<td>Blue</td>
<td>Case-by-case Approval</td>
</tr>
<tr>
<td>Green</td>
<td>Potential for Use</td>
</tr>
<tr>
<td>Yellow</td>
<td>Considered Questionable</td>
</tr>
<tr>
<td>Grey</td>
<td>Not Recommended</td>
</tr>
<tr>
<td>White</td>
<td>Not Yet Evaluated by State</td>
</tr>
</tbody>
</table>

(Justus, September 2004)
States Reporting Use of Recycled Asphalt Shingle in Hot-Mix Asphalt

- California*
- Florida
- Georgia
- Indiana
- Illinois
- Iowa
- Minnesota

- New Jersey
- North Carolina
- Pennsylvania
- Texas
- Wisconsin*
- Nova Scotia
- Ontario

(Justus, September 2004)
Engineering Performance Advantages

• Reduce Need for Virgin Binder
• Add Fibrous Reinforcement
• Modify PG Grade Binder
  High Temp Performance
  Low Temp Performance
• Reduce Landfill Needs

(Justus, September 2004)
Engineering Performance
Disadvantages

- Hotter Mix Requirements
- Stiffer Mix
- Possible contamination

(Justus, September 2004)
American Association of State and Highway Transportation Officials (AASHTO)

(Justus, September 2004)
Specification - SOM Review

- Manufacturing and Post Consumer Shingle
- 100% passing the ? inch Sieve
- Maximum Addition Rate Contractor Option
- Gradation must meet the requirements of the mix design

(Justus, September 2004)
AASHTO Specification-cont.

• RAS < 5% the PG of Virgin Binder dictated by the Climatic Conditions
• RAS > 5% the PG of the Virgin Binder established based on a virgin-shingle binder blending evaluation

(Justus, September 2004)
AASHTO Specification- cont.

• Deleterious Material- Maximum of 0.50% cumulative (metal, glass, paper, rubber, wood, nails, plastic, soil, brick, tars and other contaminating substances)

• Asbestos level established by the State or Federal Environmental Protection Agency

(Justus, September 2004)
• NCHRP Rpt. 452 “Incorporation of RAP in the Superpave System”
• <15% RAP, no change in PG Grade
• >15% RAP, Assess the Effect of RAS on the Virgin Binder
• The Draft AASHTO specification recommends a similar approach.
• < 5% RAS, no change in PG Grade
• > 5% RAS, Assess the Effects of RAS on the Virgin Binder

(Justus, September 2004)
THOMAS E. BAKER
360.709.5401
Office City: TUMWATER
MailStop: 47365
bakert@wsdot.wa.gov
DKA / AES
Fiber Tests

RMRC Project:
Environmental Testing of Airborne Particles at
The Shingle Processing Plant
April 2003
Asphalt Shingle Recycling and Asbestos

- Concern
- Regulation
- Sampling
- Approval

Ruesch, April 2003

Second Asphalt Shingles Recycling Forum
April 2003
Data

- Iowa (1791), no hits*
- Maine (118), no hits
- Mass (2288 composites), 11 hits < 1%, 1 - 2%
  - 69 tarpaper (2 < 5%, 2 < 1%), 109 grind (2 < 1%)
- Florida (287), 2 hits > 1%
  - 17 grind
- Missouri (6), no hits
- Hawaii (100), 1 hit > 1%
- Minnesota (156), no hits
- Minnesota (50 tarpaper), 1 hit - 2-5%
- We still want more data!
  - PLM & TEM correlation, Hits

Ruesch, April 2003
Minnesota Approach

- Regulatory status under NESHAP

Single family  
vs  
Commercial & Institutional

- Overcoming the Barriers to Asphalt Shingle Recycling, Environmental White Paper Report, MnDOT, 2002

Ruesch, April 2003
Model Sampling Protocol

• Visual Screening
  – Layers, composite, thick

• Specified Frequency
  – Incoming loads

• Grind
  – Per job

• Relationship w/ haulers, end markets
  – Contract, agreement, awareness, certify

Ruesch, April 2003
Thank You

- Paul Ruesch, USEPA
  ruesch.paul@epa.gov
Asbestos Risk

• Incidence of asbestos is extremely low:
• Average content was only:
  – 0.02% in 1963
  – 0.00016% in 1973

(NAHB, 1999)
Summary Highlights

• Risk from asbestos is negligible to non-existent
• Two rounds of sampling for total:
  – Dust (1999)
  – Fibers (2002)
• Common sense and best management practices can help prevent employee exposure
Air Fiber Sampling Rationale

- Used roofing shingles from private, single-family homes exempt from NESHAP
- Demonstration was limited to exempt material only
- Only site of new exposure is at the shingle recycling (e.g., grinding) site
NESHAP *Exempt* Materials

- Homes under 5 units per building
- NOT commercial / institutional
- *NOT facilities* as defined by NESHAP
- No non-asphalt shingles
  (e.g., cementitious shingles, transite or other construction waste)
OSHA Regulations

• U.S. Occupational Safety and Health Administration standards:
  – 1910 for general industry
  – 1926 for construction work

• Administered and enforced in Minnesota by the Minnesota Department of Labor and Industry
Sampling Results

- PEL was not exceeded
- Peak (excursion) levels under standard
- Peak exposure during cleaning
- Worst case total *fibers* measured at 0.06 fibers per cubic centimeter (f/cc) of air
- Well within asbestos PEL
Key Conclusions

1. Previous waste sampling indicates negligible asbestos in used asphalt roofing shingles
2. Asbestos is more likely from commercial roofing waste, mastic, caulk or felt
3. Any new exposure to asbestos would be at shingle recycling (e.g., grinding) operation
4. Private, residential, *shingle family* homes are *exempt* from NESHAP
Key Conclusions

5. MN OSHA sampling in 1999 indicated total *dust* within PEL standards

6. AES sampling in 2002 indicated total *fibers* within PEL standards

7. Operators can reduce employee risk to dust and fiber exposure

8. Personal respirators are probably *NOT* necessary
Recommendations – Supply Management

1. Limited supply during *Phase Three* demonstration to clean, *NESHAP-exempt, asphalt shingles only*
2. Suppliers must certify incoming loads
3. Shingle recycler/asphalt producers must certify HMA derived from shingles as compliant with these requirements
Recommendations – Dust Management

1. Shingle recycling operators should develop dust management and employee hazard prevention plans

2. Equipment manufacturers should consider development of shrouds and other dust control devices as options
Thank you

- RMRC web page:
  www.rmrc.org
- Dan Krivit and Associates
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  DKrivit@bitstream.net