



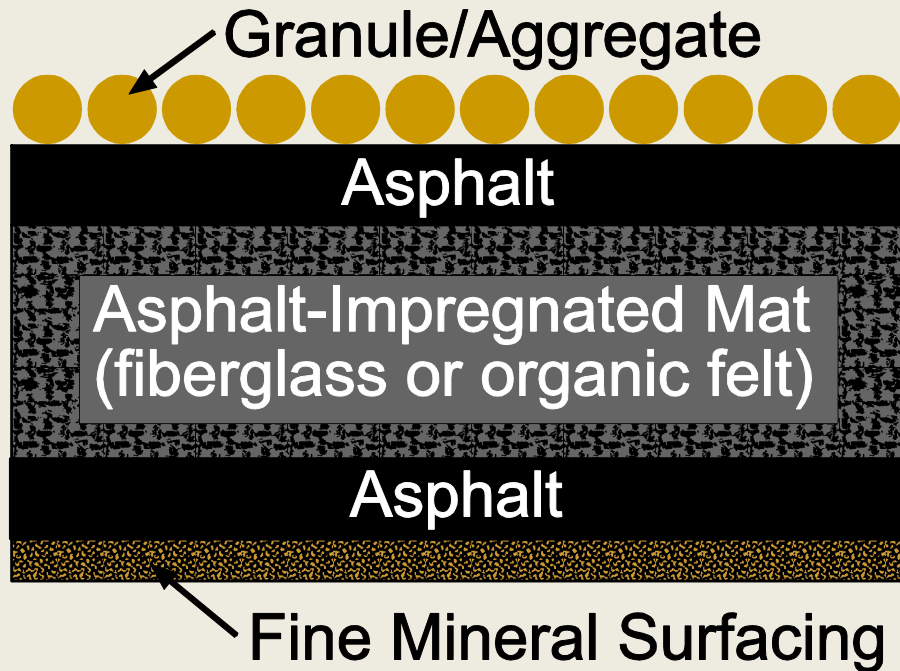
Recycled Asphalt Shingles Best Practices

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Why use asphalt shingles in asphalt pavement?



**All materials
commonly used in
asphalt pavements**

Sources

- Manufactures' waste
 - Limited ~1 MT annual
 - Not in every state
- Tear-offs
 - ~10 MT annual
 - Everywhere?
 - State regulations
 - Processors

Approximate Location of Fiberglass & Organic Shingle Manufacturing Facilities



Ref: Economic Impact Analysis of the Proposed Asphalt Roofing and Processing NESHAP, Final Report, USEPA, July 2001n



Tear-Off Shingles

- Too big a source to ignore
- Does require more effort
 - Permits & Licenses – varies by state
 - Testing
 - Contaminants
 - Processing
 - Sorting
 - Inspecting
 - Removing contaminants

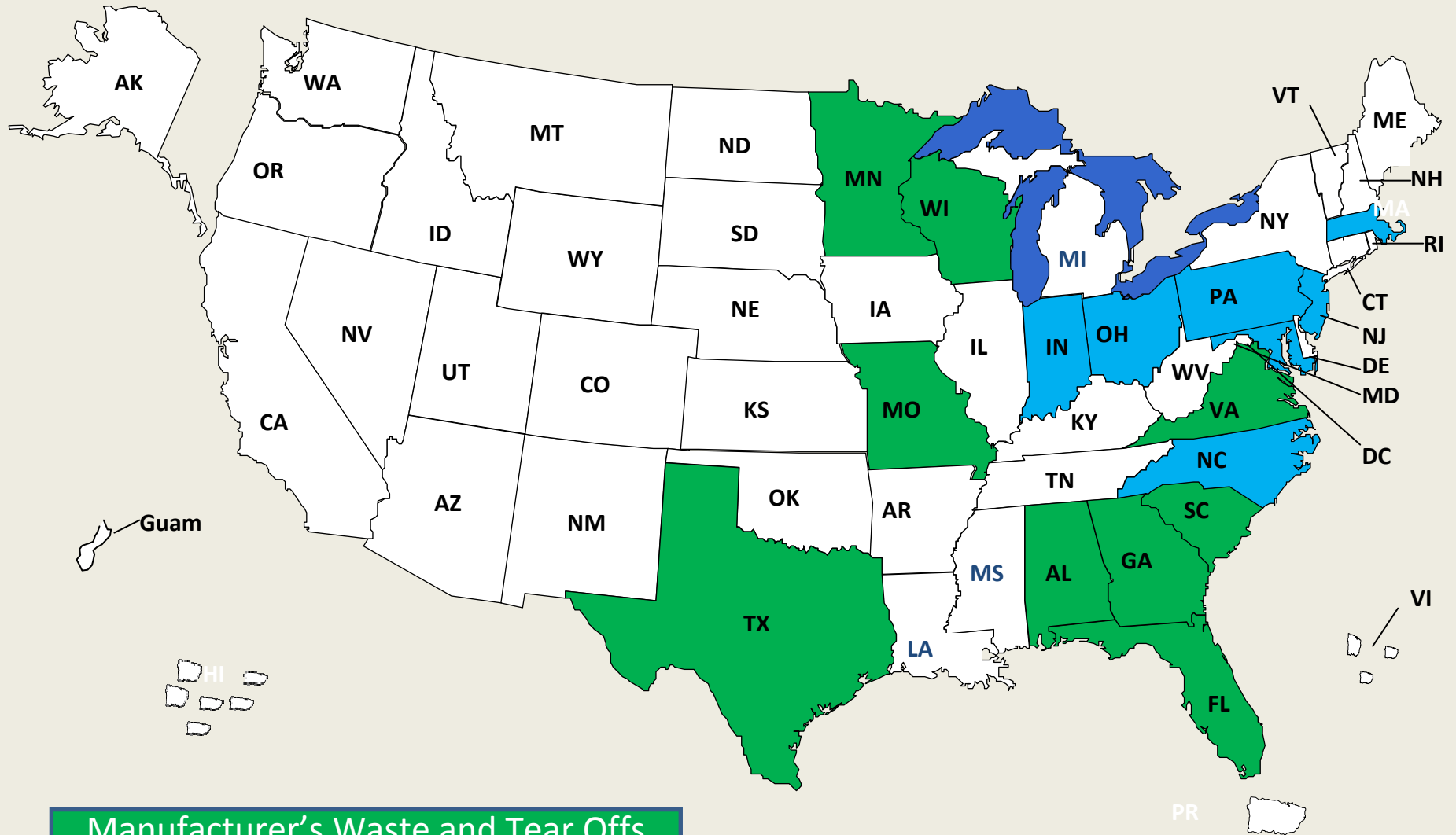


Spec what you want from processors



Courtesy David A. Bramble, Inc.

States Allowing RAS in Asphalt Mixes



Manufacturer's Waste and Tear Offs

Manufacturer's Waste

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Dem-Con Shingle Processing

Facility Timeline:

- 2006 - Ideas and Options
- 2007 - HMA Industry Meetings
- 2008 - Rollout of R&D
 - Nationwide Research
 - Equipment Trials
 - Process Flow Trials
 - Asbestos Sampling Trials
- 2009 - Developed a Full Scale Production Yard
- 2009 MnDOT Provisional Spec
- 2010 MnDOT Permissive Spec



Ref: Jason Haus – 4th Asphalt Shingle Recycling Forum

Inspection & Testing Plan for Tear-offs

- Type and quality of material that is acceptable.
- Criteria for rejecting loads.
- An asbestos management plan
 - depends on state asbestos testing requirements

Asbestos in Shingles

- Some shingle manufactures did use asbestos.
- Discontinued early 1980s.
- 27,000 samples analyzed (www.shinglerecycling.org)
 - Just over 1% contained asbestos
 - Usually other material in sample (mastic & felts)

Asbestos Testing Plan

- Need to comply with state & federal requirements
 - Contacts at www.shinglerecycling.org under State Experience
- Work with agencies to develop acceptable plan. May include:
 - Certified inspector
 - Testing frequency
 - What to do if ACM is detected

Start-up plan ideas

- Restrict supply to private residential homes.
 - Non-regulated under NESHAP.
 - Get certification from roofers.
 - Conduct spot inspections of roofers?
- Pave processing area
 - Easier cleanup if ACM detected.
- Separate tested and untested stockpiles.
 - Move stockpile when passes testing.

Processing

- Source separated
 - Requires roofer to sort material at site.
 - Relatively free of contaminants.
 - Will include nails – processing equipment can remove.



Ref: Krivit, D. (2007). *Recycling Tear-Off Asphalt Shingles: Best Practices Guide*. The Construction Materials Recycling Association

Processing

- Mixed roofing waste
 - Dump & Pick
 - Picking conveyors
 - Screens



Courtesy B. R. Amon & Sons, Inc.

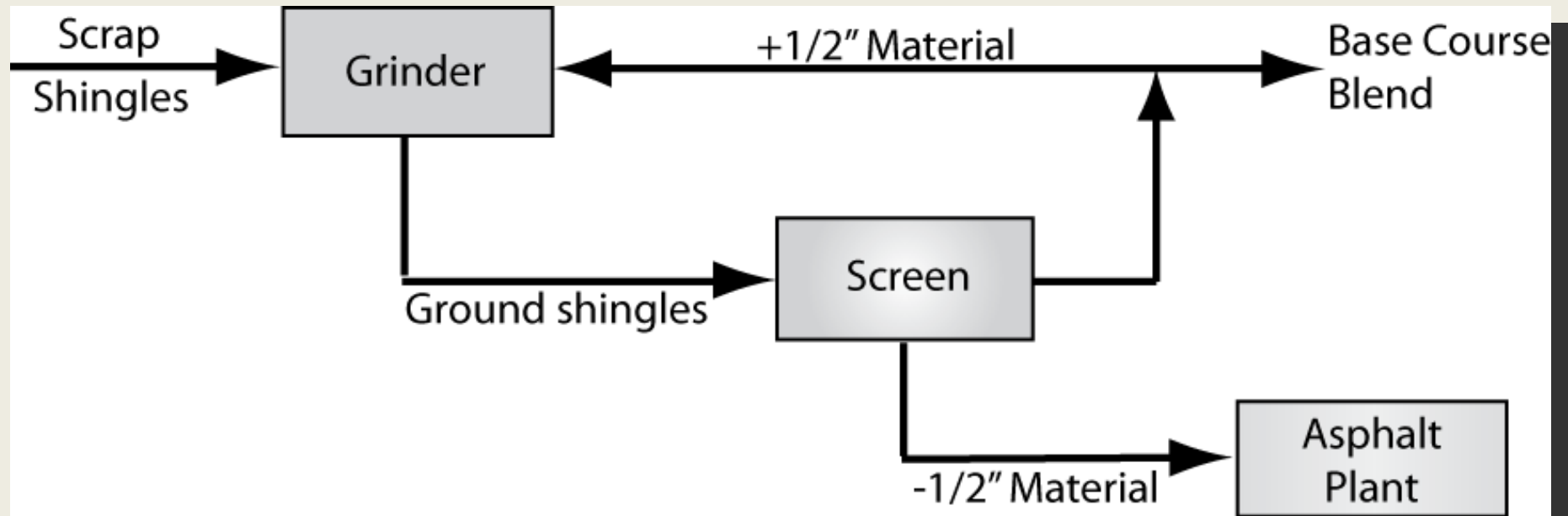


Ref: Krivit, D. (2007). *Recycling Tear-Off Asphalt Shingles: Best Practices Guide*. The Construction Materials Recycling Association



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Processing



Ref: Bob Ayers, Allied Blacktop (2003)

Equipment

- Many suppliers
- Magnet essential in recycling tear-offs



Ref: Krivit, D. (2007). *Recycling Tear-Off Asphalt Shingles: Best Practices Guide*. The Construction Materials Recycling Association



Courtesy B. R. Amon & Sons, Inc.

Shingles are tough on grinding equipment

- Surface granules & fill are hard.
 - Abrasive
 - Wear grinding chamber equipment
 - Create heat
- Need to spray shingles
 - Reduce heat
 - Control fugitive dust
 - Don't go overboard

Processing Shingles for Use in HMA



- Most significant concern is proper sizing of the ground Shingle particle
 - Finer is better!
- Oversized Shingles particles impact:
 - Contribution to P_{be}
 - Mat texture
 - Consistency of blend with carrier aggregate

Ref: Ron Sines, OMG, Use of Recycled Shingles in HMA Pavements, *Warm-Mix Asphalt & Recycling Symposium, June 9, 2009*

Good looking grind.



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Stockpiling/Storing Processed RAS

- Just in time processing
- Cover stockpiles
- Blend with sand
- Blend with RAP
- Lump breaker or grind before feeding into plant

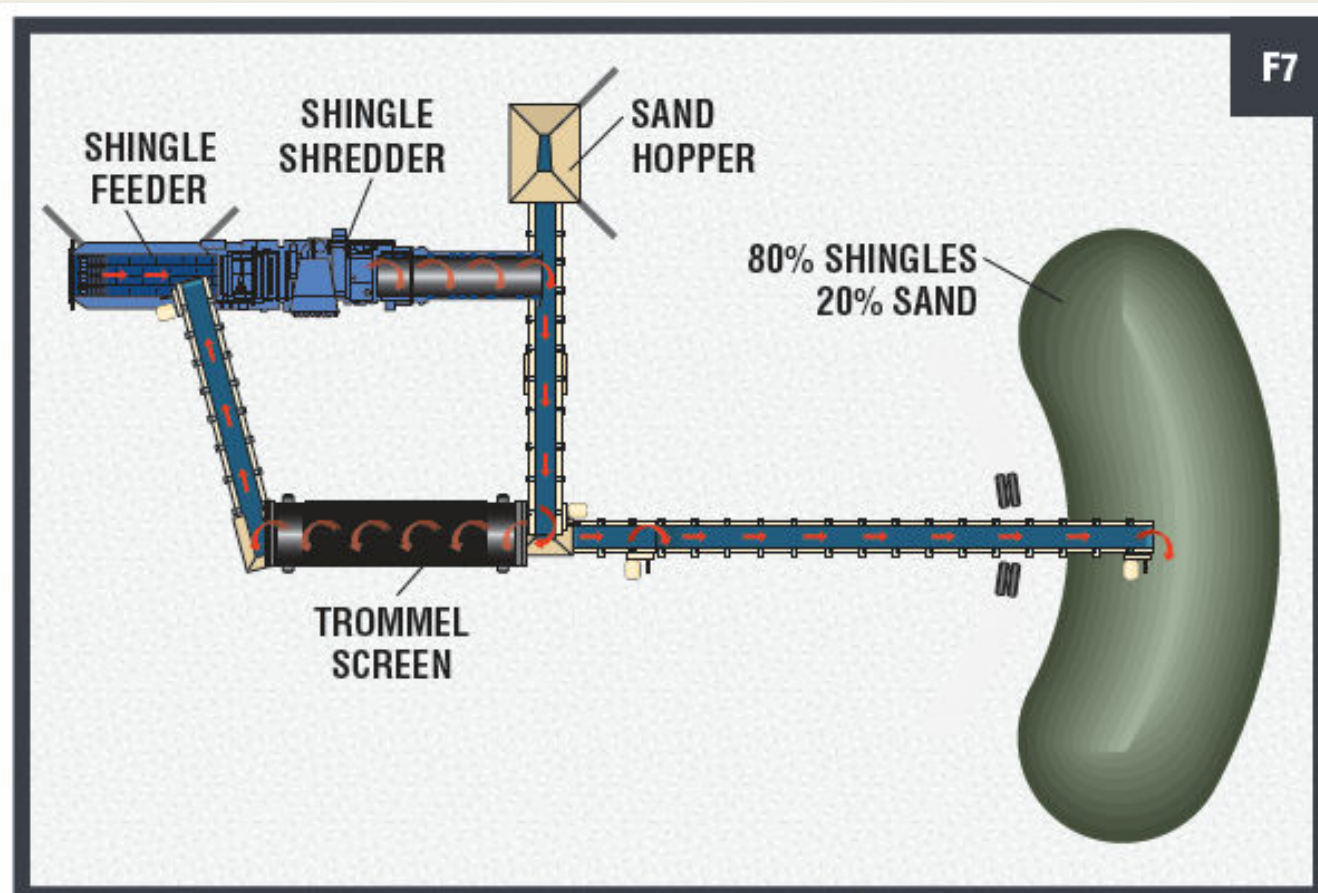
Covered RAS Stockpile



Courtesy Oldcastle Materials Group

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Blend w/ RAP or Sand



Ref: Astec Industries Technical Paper T-120

Feeding the Plant

- Same as RAP
- Scalping screen to remove oversize material and agglomerations.



Construction

- Most contractors report easier to get density
 - Higher AC contents
- Otherwise no difference.



Ref: Paul Lumm, 2006 National Conference, Materials and Energy Conservation for HMA

Mix Design

- Similar to RAP
- AASHTO Guidance
 - PP 53-09 Design Considerations when Using Reclaimed Asphalt Shingles in New HMA
 - MP 15-06, *Use of Reclaimed Asphalt Shingle as an Additive in Hot-Mix Asphalt*

AASHTO Standard Practice

- PP 53-09 Design Considerations when Using Reclaimed Asphalt Shingles in New HMA
 - Provides guidance on:
 - Design considerations
 - Binder Effects - < 70% Virgin asphalt may be different
 - Size affects contribution
 - » ½" 20-40%
 - » ¼" up to 95%
 - Some particles may act like aggregate requiring more virgin AC for coating

Determining Asphalt Content

- Extraction
 - Necessary if RAS binder properties are needed.
 - Will take longer
 - Usually only necessary when certain threshold is reached
 - 15 to 30 percent binder replacement
- Ignition oven
 - For asphalt content and gradation
 - Use smaller sample than with mix

Do the RAS and Virgin Binders Blend

- Limited research
- Generally don't get all the asphalt out of RAS
 - Values vary from 90-40%
 - AASHTO PP53-09 procedure based on volumetric comparison to virgin mix.
- Consensus is the finer the grind the greater the blending.
 - Some contractors grinding to $-3/8''$
 - Most specification $-1/2''$

Pooled Fund Study

- TPF-5(213) Performance of Recycled Asphalt Shingles in Hot Mix Asphalt
- Sponsoring Agency – Missouri DOT
- Partners – CA, CO, IA, IN, MN, MO
- <http://www.pooledfund.org/projectdetails.asp?id=441&status=4>

What mixes can I use them in?

- Dense graded
 - Mixes may be limited by specification
- Open-Graded
 - Has been used by some contractors
 - Allowed in Alabama DOT specification
- SMA
 - Newcomb et al showed good performance
 - LaFarge Canada reports good results 3% RAS
 - Allowed Alabama DOT specification

Conclusions

- Shingles are too valuable to throw away.
- Use manufacturers' waste if available
- Tear-offs
 - Work with roofers to get clean material.
 - Work with local agencies on sampling plan
- Performance
 - Improved rutting resistance
 - Reduced temperature susceptibility
 - Minimum affect on cold temperature properties

Conclusions

- Mix AC Content
 - Will reduce the amount of new asphalt required
 - Total asphalt contents often higher (0.2-0.4%)
- Plant production
 - Similar to RAP
- Mix design
 - Similar to RAP
- Construction
 - Use conventional equipment
 - Some contractors report easier density

Information Series 136



Guidelines for the Use of Reclaimed Asphalt Shingles in Asphalt Pavements



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