Recycled Asphalt Shingles in HMA

Robert Lee

WHAT WE KNOW

Background

» Approximately 13 million tons of asphalt shingle waste is generated per year
  » Post manufacture (scrap): 1.5 million tons
  » Post consumer (tear-off): 11.5 million tons
» Less than 5% of shingle waste is recycled

WHAT’S NEXT

INTRODUCTION

WHAT WE KNOW

WHAT WE DID

WHAT WE’RE DOING

WHAT’S NEXT

Component

Organic Felt

Fiberglass Mat

Asphalt cement

30-36%

19-22%

Felt (Fiber)

2-15%

2-15%

Mineral aggregate (#30)

20-38%

20-38%

Mineral filler/stabilizer

8-40%

8-40%

There’s a lot of asphalt in shingles

Granular/aggregate

Waterproofing asphalt

Base (fiberglass or organic felt)

Waterproofing asphalt

Back surfacing

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**Shingle asphalt is stiffer than paving asphalt**

<table>
<thead>
<tr>
<th>Binder</th>
<th>PG Grade</th>
<th>AC %</th>
</tr>
</thead>
<tbody>
<tr>
<td>PG 64-22</td>
<td>67</td>
<td>5.2</td>
</tr>
<tr>
<td>RAP</td>
<td>87+</td>
<td>5.0</td>
</tr>
<tr>
<td>Shingles</td>
<td>96+</td>
<td>24.0</td>
</tr>
</tbody>
</table>

**Cost savings can be substantial**

<table>
<thead>
<tr>
<th>Price ($/Ton)</th>
<th>Type D PG 64-22</th>
<th>with 20% RAP</th>
<th>with 5% Shingles</th>
<th>with 15% RAP &amp; 5% Shingles</th>
</tr>
</thead>
<tbody>
<tr>
<td>$40.70</td>
<td>$36.71</td>
<td>$35.61</td>
<td>$32.62</td>
<td></td>
</tr>
</tbody>
</table>

**Value ($/ton)**

- RAP to Counties
- HMA-RAP
- HMA-RAS
- base RAP or RAS
- landfill costs for shingles
- backfill pvm edges RAP or RAS

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WHAT WE DID

SH 31, Navarro County – May, 1997

- Type C with AC-20
  - Section 1 – 5% man. waste
  - Section 2 – 5% tear-offs
  - Section 3 - Control
- Initial construction issues with tear-offs section
- Overall performance good ~ comparable to control
- Part of first research project in Texas

Performance Testing – Hamburg

5% RAS or 20% RAP

An addition of 5% RAS or 20% RAP in the mix gives roughly one grade bump in the binder as shown by the DSR.

<table>
<thead>
<tr>
<th>High Temp Grade</th>
<th>Type D</th>
<th>20% RAP</th>
<th>5% Shingles</th>
</tr>
</thead>
<tbody>
<tr>
<td>PG 64-22</td>
<td>67</td>
<td>71</td>
<td>74</td>
</tr>
</tbody>
</table>

That same addition of 5% RAS or 20% RAP in the mix shows the stiffness doubling as shown by the Hamburg
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Allow Manufactured Waste
- Memo - March, 2006
- Treated the same as RAP – counter flow drum
- Up to 15%

Added Residential Tear-Off Shingles
- Memo – Feb., 2009
- Asbestos certification and testing
- Deleterious material < 1.5%
- No direct flame for shingle material

Special Specifications
- Allows Manufactured Waste and Residential “Tear-Offs”
  - up to 5%
  - deleterious limited to 0.5%
  - 100% passing 3/8” sieve
- RAS can be combined with
  - RAP
  - WMA
  - Substitute Binders (lower binder grade)

**Table 1A**

<table>
<thead>
<tr>
<th>Mixture Description &amp; Location</th>
<th>Maximum Ratio of Recycled Binder to Total Binder (%)</th>
<th>Maximum Allowable % (Percentage by Weight of Total Mixture)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unfractionated RAP</td>
<td>Fractionated RAP</td>
</tr>
<tr>
<td>Surface Mixes</td>
<td>35</td>
<td>10</td>
</tr>
<tr>
<td>Intermediate Mixes</td>
<td>40</td>
<td>15</td>
</tr>
<tr>
<td>Base Mixes</td>
<td>45</td>
<td>20</td>
</tr>
</tbody>
</table>
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Considerations
- Shingle Type
- Processing
- Blending
- Storage

Processing
- Proper Grind Size
  - Easier to design mixes
  - Alleviates issues with laydown
  - Facilitates better mixing in the drum
  - Especially when running WMA

Most processors have gone to a finer grind since they first started.

Blending
- Pre-blend during production
- Blend during production

Storage
- Limited storage time
  - Processed material wants to stick back together
- Keep dry and/or drainable
- Can pre-blend with RAP or sand
Updated Test Procedure

- Metal
- Wood

WHAT'S NEXT

- The Set-Up
- Updated Specifications
- Additional Research

Small Business and Local Government Assistance

SMALL BUSINESS AND ENVIRONMENTAL ASSISTANCE DIVISION

Brian Christian
Division Director

Andy Gardner
Section Manager

» Tex-217F, Part III, “Determining Deleterious Material in Recycled Asphalt Shingles”
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What we saw

» Fatigue Cracking
» Drier Mixes
» Stiff Mixes
» Raveling
» Premature Failures

Some Contractors were more successful than others.

<table>
<thead>
<tr>
<th>Mix Type</th>
<th>Binder Ratio (%)</th>
<th>Maximum % Allowed (Percent by Weight of Total Mixture)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unfractionated</td>
<td>Fractionated</td>
</tr>
<tr>
<td></td>
<td>RAP S</td>
<td>I</td>
</tr>
<tr>
<td>Dense Graded</td>
<td>30</td>
<td>35</td>
</tr>
<tr>
<td>PFC</td>
<td>15</td>
<td>-</td>
</tr>
<tr>
<td>Supergave</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>SMA</td>
<td>15</td>
<td>20</td>
</tr>
</tbody>
</table>

Proposed Specs

Research - Issues That Effect Shingle Usage

» Particle size
» Moisture
  » Advera
» Source
  » Tear-Offs
  » Man. Waste
» Binder Stiffness
  » WMA
  » Lower Bottom End PG Grade
  » Rejuvenators
» Asphalt Prices and Economics

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Master Curves

Questions?