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Developing Trends in Rubberized Asphalt

U.S. EPA SMM Web Academy Webinar Series
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Dramatic Increase in Cost
Rubber Costs Less

Crude Oil, Gas and Asphalt Costs

$/Gallon

Asphalt
Crude Oil
Gasoline

Relative Cost of Rubber

[Graph showing the cost of crude oil, gas, asphalt, and rubber over time from July 1996 to July 2011. The graph highlights the relative increase in crude oil and gas prices compared to rubber.]
Rubberized Asphalt is Triple Green

Recycled Materials Have To Perform Better, Save Money, and be Sustainable
Three Ways To Save With Rubber

1. Reduce Thickness
   Asphalt-Rubber
   18-22% Rubber Content

2. Substitute Virgin Polymers
   Rubberized Asphalt
   8-12% Rubber Content

3. Less Maintenance Over Time
   Asphalt-Rubber, Hot Mix and Chip Seals
**1. Reduce Thickness**

<table>
<thead>
<tr>
<th>City of Hemet, CA Design Alternatives</th>
<th>Design</th>
<th>Cost</th>
<th>Savings from Rubberized Asphalt Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional Option A</td>
<td>135 mm (5.3 in) conventional asphalt overlay</td>
<td>$363,000</td>
<td>$124,000*</td>
</tr>
<tr>
<td>(not feasible due to curb and gutter)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conventional Option B</td>
<td>90 mm (3.5 in) conventional asphalt over 330 (13 in) mm Class 2 aggregate base</td>
<td>$646,000</td>
<td>$382,000*</td>
</tr>
<tr>
<td>(reconstruction)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Rubberized Asphalt Option - 39 mm (1.5 in) A-R HMA over 48 mm (2 in) conventional HMA.*
2. Substitute Virgin Polymers

<table>
<thead>
<tr>
<th>Cost of Components</th>
<th>Neat</th>
<th>Polymer</th>
<th>ASTM A-R</th>
<th>PG Rubber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neat Content in Binder</td>
<td>100%</td>
<td>97%</td>
<td>80%</td>
<td>88%</td>
</tr>
<tr>
<td>Rubber/Polymer Content in Binder</td>
<td>0%</td>
<td>3%</td>
<td>20%</td>
<td>10%</td>
</tr>
<tr>
<td>Additive</td>
<td></td>
<td></td>
<td></td>
<td>2%</td>
</tr>
<tr>
<td>Neat Cost</td>
<td>$550</td>
<td>$533</td>
<td>$440</td>
<td>$484</td>
</tr>
<tr>
<td>Rubber or Polymer Cost</td>
<td></td>
<td>$108</td>
<td>$80</td>
<td>$40</td>
</tr>
<tr>
<td>Additive Cost</td>
<td></td>
<td></td>
<td></td>
<td>$1.6</td>
</tr>
<tr>
<td>Binder Material Cost/Ton</td>
<td>$550</td>
<td>$642</td>
<td>$520</td>
<td>$526</td>
</tr>
</tbody>
</table>
3. Less Maintenance Over Time

Arizona DOT, Materials Group,
Maintenance Cost, Dollars Per Lane Mile

Years
$/Ln Mile

Regular Asphalt
Rubberized
<table>
<thead>
<tr>
<th>Sieve size</th>
<th>Field Blend – Asphalt Rubber</th>
<th>Terminal or Field Blend– Rubberized Asphalt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% Passing</td>
<td>% Passing</td>
</tr>
<tr>
<td>2.36-mm (#8)</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>2.00-mm (#10)</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>1.18-mm (#16)</td>
<td>75-95</td>
<td>100</td>
</tr>
<tr>
<td>600-μm (#30)</td>
<td>30-60</td>
<td>90-100</td>
</tr>
<tr>
<td>300-μm (#50)</td>
<td>5-30</td>
<td>&gt;20</td>
</tr>
<tr>
<td>150-μm (#100)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>75-μm (#200)</td>
<td>0-5</td>
<td>-</td>
</tr>
</tbody>
</table>
Evaluation of Ground Tire Rubber in Asphalt Binders and Mixtures
## NCAT PG Results

<table>
<thead>
<tr>
<th>Rubber Product</th>
<th>Dosage Rate, %</th>
<th>True Grade</th>
<th>Performance Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>-30 Liberty</td>
<td>10%</td>
<td>80.7 – 23.6</td>
<td>76 – 22</td>
</tr>
<tr>
<td>-20 Liberty</td>
<td>10%</td>
<td>83.1 – 24.6</td>
<td>82 – 22</td>
</tr>
<tr>
<td>-20 Liberty</td>
<td>15%</td>
<td>87.9 – 21.3</td>
<td>82 – 16</td>
</tr>
<tr>
<td>Crackermill</td>
<td>10%</td>
<td>82.8 – 23.1</td>
<td>82 – 22</td>
</tr>
<tr>
<td>Cryo-Hammer</td>
<td>10%</td>
<td>82.2 – 23.2</td>
<td>82 – 22</td>
</tr>
<tr>
<td>Cryo-Hammer</td>
<td>15%</td>
<td>86.7 – 19.3</td>
<td>82 – 16</td>
</tr>
<tr>
<td>-30 Liberty Fines</td>
<td>10%</td>
<td>79.8 – 20.4</td>
<td>76 – 16</td>
</tr>
<tr>
<td>-16 Powderizers (1mm gap)</td>
<td>10%</td>
<td>76.3 – 21.8</td>
<td>76 – 16</td>
</tr>
<tr>
<td>-16 Powderizers (2 mm gap)</td>
<td>10%</td>
<td>84.7 – 21.8</td>
<td>82 – 16</td>
</tr>
<tr>
<td>Virgin Binder</td>
<td></td>
<td>69.2 – 24.7</td>
<td>67 – 22</td>
</tr>
</tbody>
</table>
RTR Alternative Modifier

• About 3 x RTR loading is needed compared to SBS for similar properties.
  – Example: 3% SBS content = 9% RTR Content

• Suppose SBS costs $2.00/Pound and RTR Costs $0.50/Pound
  – Example:
    – 3 Pounds SBS = $6.00,
    – 9 Pounds RTR = $4.50

• Project with 1000 Tons of Modified of Binder
  – SBS at 3% = 30 Tons Needed @ $2.00 = $120,000
  – RTR at 9% = 90 Tons Needed @ $0.50 = $90,000
Tire Rubber Performs In A Wider Range Of Temperatures than Asphalt
Performance Grade of Tire Rubber

- 140 C Softens and losses strength
- -70 C Glass transition
  - A PG 140-70?
Interaction Between Asphalt and RTR
• In 2008, a substantial price spike in asphalt costs struck the paving industry nationwide.
• The use of Reclaimed Asphalt Pavement and Recycled Asphalt Shingles increased to solve the problem of high asphalt costs.
• The performance of RAP and RAS is measured through mix tests, not the liquid binder.
• This is a significant opportunity for Recycled Tire Rubber, as long as it costs less than asphalt and does not increase the liquid requirement (add cost) at the asphalt mix plant.
• Research Published at the LTRC, (Sam Cooper and Louay Mohammad), work underway at several Universities and with-in suppliers to the asphalt industry

• Rubber particles pre-treated with useful liquids before packaging, or co-packaged with low melt processing aids or powders before delivery to mix plant

• GA DOT using a co-packaged “Plant Mix” rubber
Mix Performance Tests Are More Common with the Use of RAP and RAS
RTR Blended with Reactive Type of Polymer
Blended RTR Being Added
To Plant at RAP Collar
Emerging Technologies

PELLETIZED ASPHALT-RUBBER

ASPHALTITE COVERING

HYDRATED LIME
PelletPAVE™

Providing Asphalt-Rubber Technology for Pavement Maintenance

Cost Effective and Convenient

Emerging Technologies
Draindown Test for SMA & PFC
RTR for Polymer Mixes Work Well in Porous Asphalt

Video Courtesy of Seneca Petroleum Co and Modified Asphalt Solutions
Reduce Noise at the Source

A rubberized asphalt surface placed over concrete reduced the tire noise by 13 dB(A) in a quiet pavement project in Phoenix, AZ.

Rubberized asphalt has the potential to help agencies reduce noise and the cost of sound walls by reducing the height requirement.
US 183 – Williamson Co.
South Bound near San Gabriel River

Dense Grade (Type C)

PFC Mix
Rubberized Asphalt Performs Better, Saves Money, and is Sustainable
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