Asphalt Rubber Research and Development

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Chairman RPA TAB
Retired from ADOT after 35 Years

Ixtapa, Mexico
April 3rd, 2008
Phoenix, Arizona failed streets in the 1960’s. McDonald’s goal to maintain failed streets until reconstruction.
Early Asphalt Rubber Chip Seal Circa 1970

Early Asphalt Rubber Slurry Seal Application Circa 1970
Early Chip Seal Spray Application Of Asphalt Rubber Circa 1975

Early Chip Seal Conveying Crumb Rubber Into Distributor Truck Circa 1975
Stress Absorbing Membrane (SAM)

- Aggregate Chips
- Asphalt-Rubber Membrane
- Existing Pavement
Stress Absorbing Membrane Interlayer (SAMI)

Asphalt-Rubber Membrane & Aggregate Chips

Surface Course

Asphalt Overlay

SAMI

Cracked Pavement
By Early 1980’s Numerous Research Reports On Asphalt Rubber Seal Coats, SAM’s & SAMI’s Documenting Reducing Reflective Cracking
By 1985 AR Mix Design Research & Development, Gap Graded & Open Graded

- Reduce Reflective Cracking
- More Durable Surface
- Reduce Raveling
- Good Rut Resistance
- Good Skid Resistance
- Good performance in Hot & Cold Climates
Raveling
Arizona Desert Areas

Mountain Areas
1990’s Development of AR Standards
Arizona and ASTM

80 percent Asphalt
20 percent Ground Tire Rubber

Rubber & Asphalt Mixed together hot to form a binder

Binder pumped into plant and mixed with hot aggregate, hot mix paved as normal

Complies with ASTM 6114 Asphalt-Rubber Spec.
Crumb rubber

Minus No. 10 mesh is used; free of wire and other contaminants; up to 0.5% fiber.
AR Open Graded (ARFC) and Gap Graded (ARAC)
Develop Standard Gradations
HMA Dense Graded Surface

Asphalt Rubber Gap Graded Mix

Asphalt Rubber Open Graded Mix
Arizona DOT % Cracking vs. Years of age

% Cracking

Years

HMA

AR

HMA Dense graded mixes

AR mixes
SHRP Research
I-40 After
Asphalt Rubber Overlay of Concrete
I-40 SHRP test section
50 mm asphalt rubber
placed in 1990
pavement condition in 1998
Virtually no cracks

I-40 SHRP test section
100 mm dense graded
Mix placed in 1990
Cracked pavement condition
In 1998
7 Asphalt Binders

2 in AR-GAP
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2 In HMA 70-22

4 In PG 70-22 HMA Control

Air Blown SBS LG CR-TB TP PG 70-22 + Fibers PG 70-22 SBS 64-40 Air Blown SBS LG TP

1 2 3 4 5 6 7 8 9 10 11 12
4 Inch 6 In
ALF Test Results 2004


- Control
- Terminal Blend
- SBS Polymer
- Asphalt Rubber

Cumulative Crack Length (m) vs. Number of Load Passes

- Control L2
- CR-TB L5
- SBS LGL4
- CR-AZL1
Mu Meter test values all values above 45 good skid resistance
Texas Research on Reduce Splash & Spray

Open Graded

Concrete
California & Arizona Research on Noise
AR Open Graded Quietest Surface
ARFC Las Vegas
Summer 2007
## Asphalt Rubber Binder Costs & Usage

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Projects</th>
<th>Total Tons of AR</th>
<th>Average Low Bid $/Ton</th>
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<tbody>
<tr>
<td>1985</td>
<td>3</td>
<td>900</td>
<td>506</td>
</tr>
<tr>
<td>1990</td>
<td>6</td>
<td>5600</td>
<td>409</td>
</tr>
<tr>
<td>1992*</td>
<td>9</td>
<td>9700</td>
<td>351</td>
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<tr>
<td>1995</td>
<td>41</td>
<td>29000</td>
<td>255</td>
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<tr>
<td>2000</td>
<td>54</td>
<td>36000</td>
<td>275</td>
</tr>
<tr>
<td>2005</td>
<td>47</td>
<td>32000</td>
<td>297</td>
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* 1992 Patents on asphalt rubber expire
<table>
<thead>
<tr>
<th>Year</th>
<th>HMA</th>
<th>AR Gap Graded</th>
<th>Open Graded</th>
<th>AR Open Graded</th>
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<tbody>
<tr>
<td>1996</td>
<td>1.60</td>
<td>2.93</td>
<td>1.85</td>
<td>2.72</td>
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<td>2000</td>
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<tr>
<td>2005</td>
<td>1.69</td>
<td>3.05</td>
<td>1.96</td>
<td>2.55</td>
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</tbody>
</table>
HMA Dense Graded Average Overlay Thickness
140 mm – 5.5 Inches

Arizona Use of AR Mixes

Asphalt Rubber
Hot Mixes
Average Overlay Thickness
45 mm – 1.7 Inches

HMA % of Miles With Fatigue Cracking
20%

Asphalt Rubber % Of Miles With Fatigue Cracking
2%
Arizona DOT Pavements Surfaced With Asphalt Rubber since 1988

Asphalt Rubber Paved Surfaces 1988-2005
19500 Lane Kilometers

About 45% Of ADOT System Paved With Asphalt Rubber

Over 20 Million Tires Recycled Since 1988

Arizona DOT Pavements Surfaced With Asphalt Rubber since 1988
Arizona Asphalt Rubber Benefits

Less Reflective Cracking
Less Maintenance/More Durable
Less Raveling
Good Rut Resistance
Good Skid Resistance
Smooth Ride, Less Noise
Good in hot & cold climates
Less Splash & Spray Better Drainage
Cost Effective, Energy Efficient
Good Engineering Use for Old Tires
ASTM Standard Type Asphalt
ARFC in China
Open Graded
ARAC in China
Lawrence of China?
Gobi Desert George?
Thank You