Florida’s Experience with Crumb Rubber

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Slides Courtesy of FDOT
State Materials Office
FL GTR Topics

- Background
- Implementation
- Specifications
- Quality Control/Acceptance
- Applications
- Performance
- Usage
- Successes/Challenges
- New Changes
1988 State of Florida Legislation

- Comprehensive solid waste legislation
- Established County Solid Waste Authorities
- Directed state agencies to increase use of recycled products
  - Florida DOT
    - Recycled plastics (fence posts)
    - Motor oil
    - *Ground tire rubber*
Implementation Activities
1988 - 1990

- Research
  - FDOT – in-house
  - University of Florida
  - NCAT “State of the Art” Report

- Constructed Experimental Projects

- Identified potential Uses:
  - 2 HMA applications
  - 1 SAMI application

- Emissions study
  - Emission and Worker exposure levels
Implementation

- Constructed Demonstration projects - 1993
- Implemented on all projects - January 1994
Specifications

- **Ground Tire Rubber**
  - 20, 40 & 80 mesh

- **Binder Types**
  - ARB-5 (5% GTR)
  - ARB-12 (12% GTR)
  - ARB-20 (20% GTR)

- **Applications**
  - Open-graded friction courses
  - Dense-graded friction courses
  - Asphalt Rubber Stress Absorbing Membrane Interlayer
GTR Specifications

- Physical requirements
- Chemical requirements
- Must be produced from ambient grinding methods
  - Better surface texture
- Gradation

919-3 Physical Requirements.
The physical properties of the ground tire rubber shall be determined in accordance with FM 5-559, and shall meet the following requirements:
- Specific Gravity: 1.06 to 1.20
- Moisture Content: Maximum 0.75%
- Metal Contaminants: Maximum 0.01%
- Gradation: The gradation shall meet the limits shown in Table 919-1 for the type of rubber specified.

<table>
<thead>
<tr>
<th>Table 919-1</th>
<th>Gradations of Ground Tire Rubber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sieve Size</td>
<td>Type A</td>
</tr>
<tr>
<td>% Passing</td>
<td></td>
</tr>
<tr>
<td>No. 16</td>
<td>---</td>
</tr>
<tr>
<td>No. 30</td>
<td>---</td>
</tr>
<tr>
<td>No. 50</td>
<td>100</td>
</tr>
<tr>
<td>No. 100</td>
<td>50-80</td>
</tr>
</tbody>
</table>
Typical Tire Grinding Process
Asphalt Rubber Binder Specification

- Recipe specification:
  - Amount of GTR
  - Type of binder
  - GTR size
  - Reaction temperature
  - Reaction time
  - Minimum viscosity
## Asphalt Rubber Binder Specifications

<table>
<thead>
<tr>
<th>Binder Type</th>
<th>ARB 5</th>
<th>ARB 12</th>
<th>ARB 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rubber Type</td>
<td>TYPE A (or B)&lt;sup&gt;(1)&lt;/sup&gt;</td>
<td>TYPE B (or A)&lt;sup&gt;(2)&lt;/sup&gt;</td>
<td>TYPE C (or B or A)&lt;sup&gt;(2)&lt;/sup&gt;</td>
</tr>
<tr>
<td>Minimum Ground Tire Rubber (by weight of asphalt binder)</td>
<td>5%</td>
<td>12%</td>
<td>20%</td>
</tr>
<tr>
<td>Binder Grade</td>
<td>PG 67-22</td>
<td>PG 67-22</td>
<td>PG 64-22</td>
</tr>
<tr>
<td>Temperature Range</td>
<td>300 - 335°F</td>
<td>300 - 350°F</td>
<td>335 - 375°F</td>
</tr>
<tr>
<td>Minimum Reaction Time</td>
<td>10 minutes</td>
<td>15 minutes (Type B)</td>
<td>30 minutes (Type C)</td>
</tr>
<tr>
<td>Unit Weight @ 60°F&lt;sup&gt;(3)&lt;/sup&gt;</td>
<td>8.6 lbs/gal.</td>
<td>8.7 lbs/gal.</td>
<td>8.8 lbs/gal.</td>
</tr>
<tr>
<td>Viscosity Range&lt;sup&gt;(4)&lt;/sup&gt;</td>
<td>4.0 - 6.0 Poises @ 300°F</td>
<td>10.0 - 15.0 Poises @ 300°F</td>
<td>15.0 - 20.0 Poises @ 350°F</td>
</tr>
</tbody>
</table>
Open-Graded Friction Courses

- All high speed, multi-lane roadways
  - Minimize hydroplaning

- FC-5
  - ARB-12
  - Polish resistant aggregate
  - Stabilizing fibers (mineral or cellulose)
  - Placed ¾” thick

- Improve durability
  - Minimize raveling
  - Increased binder content
    - Less Construction draindown
  - Increased film thickness
FC-5 Nassau County
Open Graded Friction Course - FC 5
Raveling OGFC
I-75 Marion County
Dense Graded Friction Courses

- **FC-9.5, FC-12.5**
  - Superpave mixes
  - ARB-5
  - Fine graded mixes
  - Polish resistant aggregate
- **Improve rutting resistance**
  - Increased binder stiffness (PG 70-22)
Dense Graded Friction Course
SR-121 Alachua County
Asphalt Rubber Membrane Interlayer (ARMI)

- Asphalt Rubber Stress Absorbing Membrane Interlayer (SAMI)
  - Used to prevent moisture intrusion and reflective cracking
  - Used over milled asphalt surfaces and cracked & seated concrete pavements
Asphalt Rubber Membrane Interlayer

- **ARB-20**
  - PG 64-22
  - 20% GTR (20 Mesh)
- **Application Rate**: 0.6 – 0.8 gal/sy
- **Cover material**: No. 6 Stone
  - One aggregate layer thick
Application of ARB-20
Application Rate 0.6 – 0.8 gal/sy
I-10 Gadsden County
Quality Control/Acceptance Requirements

- Minimum viscosity requirement
  - Incoming shipments
  - Storage tank
- Dip-N-Read rotational viscosimeter
Performance

- Improved short-term raveling performance of OGFC
- Improved cracking resistance of OGFC
  - Unexpected benefit
- Improved rutting resistance
  - FDOT APA study
  - Relatively minor
### Florida

**2010 Census:**
- 18.5 million people

**Generating Annually:**
- 15 Million automobile tires
- 900,000 truck tires
- 19.5 Million Passenger Tire Equivalents (PTE’s)
19.5 Million PTEs
2011/2012 Usage

- Unmodified Asphalts – 33%
  - 100,440 tons (liquid)
  - PG 67-22 and 4 Recycling Agents

- Polymer Modified Asphalt – 51%
  - 159,582 tons (liquid)
  - PG 76-22

- Asphalt Rubber – 16%
  - 49,925 tons (liquid)
  - ARB-5, ARB-12, ARB-20
Why has Florida’s Program been Successful?

- Lower rubber percentages
  - Minimal impact on production operations
    - Minor equipment changes
  - Minimal impact on paving operations
    - Increased laydown temperatures
- Supplier terminal blending
- Constant market
- FDOT/Industry cooperation
Challenges

- Short Term Storage
- Long Term Storage
- Settlement
- Multiple Binders / Limited Tankage
- Handling Heavy Binders
- Mix Properties
Current Status

- **FDOT using more PG 76-22 with SBS polymers**
  - Used on all high volume roadways
  - Reduction in GTR usage
  - Continue to use asphalt rubber on all other facilities

- **Joint Task Group: Improve & use GTR**
  - Evaluating “hybrid” binders for last year
  - Considering a PG 76-22 w/GTR
  - Minimum GTR content

- **ARMI research and rutting**

- **FDOT committed to using GTR!**
New GTR Changes for July 13

- PG76-22R: replaces ARB-5 & ARB-12
  - Min of 7.0% GTR
  - Phase angle: Max 75°C
  - Polymer optional: SBS or SB
  - Waived solubility
  - DSR – 2mm gap
  - Separation Test: ASTM D7173 7°C max

- GTR: 100% pass #30, removed ambient grind requirement
Thank You....