VDOTs Reclamation Research

Brian Diefenderfer, PhD, PE

May 15, 2018
Overview

• Specifications
• Lab testing
• Field performance
Pavement Recycling

• A set of cost-effective and environmentally sensitive techniques for pavement rehab

• Benefits
  – 30 to 50 percent cost savings
  – 50 percent less greenhouse gases emitted
  – Fix deterioration causes rather than symptoms

• FDR, CCPR, CIR
VDOT Spec Highlights

• Quality control plan
  – Identify responsible parties for all phases of work
  – Develop contingency plans
    • Weather changes, deficient density, equipment breakdown, etc.

• Mix design

• Acceptance
  – Density (direct transmission), depth, gradation, dosage rate

• Payment
  – Typical for us is $7-8/SY
# Mix Design Requirements

<table>
<thead>
<tr>
<th>Property</th>
<th>FDR</th>
<th>CIR</th>
<th>CCPR</th>
</tr>
</thead>
<tbody>
<tr>
<td>LL, PL, PI, Soil Classification</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Target Gradation</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Target Moisture and Density</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Compressive Strength (cement only)*</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marshall Stability (emulsion only)</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Indirect Tensile Strength (foam only)</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Emulsion/foam properties</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Target Stabilizing/Recycling Agent Content</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

* Min 250, Max 450 psi
VDOT Recycling Research (Lab)

- **NCHRP 9-51 (completed 2016)**
  - Develop Pavement_ME design inputs
  - See NCHRP Report 863

- **NCHRP 9-62 (ongoing)**
  - Short term field quality tests
  - Phase 1 (lit review, stakeholder survey) completed
  - Phase 2 (lab evaluation of identified tests) underway
Dynamic Modulus (stiffness)

Higher temperature

Lower temperature
Repeated Load (rutting)

10 psi confining stress
70 psi deviatoric stress
VDOT Recycling Research (Field)

- I-81, 2011
- NCAT, 2012
- I-64, 2016-present
I-81

- South of Staunton, VA
- SB direction
- 3.7 miles
- FDR + CCPR right lane
- 29,000 AADT
- 29% trucks
I-81 Performance – Right Lane

- June 2017
  - 0.1 inches rutting
  - 44 inches per mile

- Current traffic
  - 13.5 million ESALs
NCAT Test Track Sections

**N3**
- 6-inch AC
- 5-inch CCPR
- 6-inch Agg Base
- Subgrade

**N4**
- 4-inch AC
- 5-inch CCPR
- 6-inch Agg Base
- Subgrade

**S12**
- 4-inch AC
- 5-inch CCPR
- 6-inch Agg Base
- 8-inch FDR
- Subgrade
Current Conditions

• No observable surface distresses for any of the sections after 20 million ESALs

• Perpetual type performance from Section S12
Section S12

- Recycled content
  - Layer 1 = 12.5%
  - Layer 2 = 30%
  - Layer 3 = 100%
  - Layer 4 = 100%

- Entire cross section
  - 80% recycled
I-64 Lane Widening Recycle Projects

• Segment II = 7.0 miles, Segment III = 8.3 miles

• New lanes
  – Import crushed concrete or RAP, stabilize in FDR process
  – OGDL, CCPR, 4 inches asphalt surface

• Existing lanes
  – FDR existing base materials
  – OGDL, CCPR, 4 inches asphalt surface
## I-64 Quantities

<table>
<thead>
<tr>
<th></th>
<th>Segment II</th>
<th>Segment III</th>
</tr>
</thead>
<tbody>
<tr>
<td>FDR existing lanes</td>
<td>345,000 SY</td>
<td>229,000 SY</td>
</tr>
<tr>
<td>Cement treated concrete/</td>
<td>146,000 tons</td>
<td>201,000 tons</td>
</tr>
<tr>
<td>RAP new lanes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CCPR</td>
<td>168,000 tons</td>
<td>196,000 tons</td>
</tr>
</tbody>
</table>

Total about a million tons
SN = 7.08, $83/SY

- 12-in AC
- 2-in OGDL
- 8-in Cement Treated Agg
- Subgrade

SN = 7.06, $40-61*/SY

- 4-in AC
- 6-in CCPR
- 2-in OGDL
- 12-in FDR/RC*
- Subgrade
I-64 Lane Widening Recycle Projects

• Segment II
  – Original design = $83/SY
  – Recycled design = $40-61/SY

• Segment III
  – Original design = $95/SY
  – Recycled design = $57-79/SY

• Total cost savings, $15+ million
Thank you!

brian.diefenderfer@vdot.virginia.gov