National Center for Asphalt Technology

Test Track Update

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Wisconsin Asphalt Pavement Association
Wednesday, November 29, 2017
Mission
To provide innovative, relevant, and implementable research, technology deployment, and education that advances safe and sustainable asphalt pavements.

Quick Facts
• Established in 1986
• Largest research center at AU
• Funded through contracts
• Staff of 50 employees
NCAT Research Focus Areas

- Advancing Pavement Design
- Balanced Mix Design
- Sustainable Pavements
- Appropriate inputs for LCCA
- Pavement Preservation
- Safety and Pavement Friction
Test Track Overview

• Started operations in 2000
• 3-year Research Cycles
• 46 Test Sections, 200 ft. each
  – 26 sections in tangents
  – 20 sections in curves
• Test Sections are sponsored
• Increasing complexity over time
Test Track Timeline

2000: Surface Performance
2003: Mechanistic Models, Thickness Design, Structural Performance
2006: Perpetual Pavements
2009: Green Technologies
2012: CCPR Preservation
2015: Cracking

MnROAD - MnDOT: Sustainable Research through Innovative Research
With the current volumetric mix design system, we have no way of knowing if these materials help or hurt.
Top-Down Cracking Tests

Energy Ratio

SCB-LA

IFIT

OT-TX

OT-NCAT

Nflex Factor
Top-Down Cracking Sections

Cracking Group sections
- 7 200-ft. sections
- each section instrumented
CG Performance to Date
July 11, 2017
7.8 MESALs

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Rutting (mm)</th>
<th>Δ IRI (in/mi.)</th>
<th>Δ MTD (mm)</th>
<th>Cracking (% of lane)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N1</td>
<td>20% RAP (Control)</td>
<td>3</td>
<td>3</td>
<td>0.7</td>
<td>0.2</td>
</tr>
<tr>
<td>N2</td>
<td>Control w/ High Density</td>
<td>3</td>
<td>6</td>
<td>0.9</td>
<td>0</td>
</tr>
<tr>
<td>N5</td>
<td>Low AC, Low Density</td>
<td>1</td>
<td>3</td>
<td>0.7</td>
<td>0.1</td>
</tr>
<tr>
<td>N8</td>
<td>20% RAP 5% RAS</td>
<td>2</td>
<td>12</td>
<td>1.0</td>
<td>0.2</td>
</tr>
<tr>
<td>S5</td>
<td>35% RAP PG 58-28</td>
<td>2</td>
<td>0</td>
<td>0.8</td>
<td>0</td>
</tr>
<tr>
<td>S6</td>
<td>Control w HiMA</td>
<td>2</td>
<td>4</td>
<td>0.9</td>
<td>0</td>
</tr>
<tr>
<td>S13</td>
<td>AZ Rubber Mix</td>
<td>4</td>
<td>6</td>
<td>0.4</td>
<td>0</td>
</tr>
</tbody>
</table>
Field Performance and Structural Characterization of Full-Scale Cold Central Plant Recycled Pavements
Cold Central Plant Recycling

- Milling
- Fractionation
- CCPR Mixing (RAP+recycling agents)
- Conventional Paving
Structural Characterization of CCPR

- No current specific methodology for determining structural characteristics
  - Some studies evaluated fundamental characteristics
  - Very little study under heavy traffic conditions

- VDOT field project on I-81 began in 2011
  - Excellent performance through first 34 months
  - Desire to expand study to evaluate thickness effects and inclusion of recycled stabilized base layer on performance
  - Sponsored 3 sections during 2012 Test Track research cycle
<table>
<thead>
<tr>
<th>Section</th>
<th>N3-6”AC</th>
<th>N4-4”AC</th>
<th>S12-4”AC SB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Layer Description</strong></td>
<td>Lift 1-19 mm NMAS SMA with 12.5% RAP and PG 76-22 binder</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Binder Content, %</strong></td>
<td>6.1</td>
<td>6.0</td>
<td>6.1</td>
</tr>
<tr>
<td><strong>Air Voids, %</strong></td>
<td>4.3</td>
<td>4.7</td>
<td>4.2</td>
</tr>
<tr>
<td><strong>Layer Description</strong></td>
<td>Lift 2-19 mm NMAS Superpave with 30% RAP and PG 67-22 binder</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Binder Content, %</strong></td>
<td>4.6</td>
<td>4.6</td>
<td>4.7</td>
</tr>
<tr>
<td><strong>Air Voids, %</strong></td>
<td>7.1</td>
<td>7.4</td>
<td>6.7</td>
</tr>
<tr>
<td><strong>Layer Description</strong></td>
<td>Lift 3-19 mm NMAS Superpave with 30% RAP and PG 67-22 binder</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Binder Content, %</strong></td>
<td>4.4</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Air Voids, %</strong></td>
<td>6.4</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Layer Description</strong></td>
<td>CCPR-100% RAP with 2% Foamed 67-22 and 1% Type II Cement</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Layer Description</strong></td>
<td>Crushed granite aggregate base</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Layer Description</strong></td>
<td>Subgrade – AASHTO A-4 Soil</td>
<td>6” Crushed granite aggregate base and 2” subgrade stabilized in-place with 4% Type II cement</td>
<td></td>
</tr>
</tbody>
</table>
Rutting Performance

The graph shows the rutting performance over time with data points for three different types of asphalt mixtures: N3-6" AC, N4-4" AC, and S12-4" AC SB, along with ESALs (Equivalent Single Axle Loads). The graph spans from October 1, 2012, to November 14, 2017.

- **2012 Test Cycle**: The first test cycle covers the period from October 1, 2012, to November 29, 2013.
- **2015 Test Cycle**: The second test cycle covers the period from July 1, 2015, to November 14, 2017.

A break between test cycles is indicated, suggesting a change in testing or conditions.

The x-axis represents the date, while the y-axis shows the rut depth in inches. The data points are scattered across the graph, indicating variability in rutting performance over time.
Ride Quality

The graph illustrates the international roughness index (in./mile) on the vertical axis and the number of million ESALs (Equivalent Single Axle Loads) on the horizontal axis. Two test cycles are marked: 2012 Test Cycle and 2015 Test Cycle. The data points are categorized into N3-6”AC, N4-4”AC, S12-4”AC SB, and ESALs. A break between test cycles is also indicated.
Asphalt Modulus vs Date @ 68F
Asphalt Strain vs Date @ 68F
Perpetual Pavement Analysis – PerRoad Strain

Cumulative Percentile vs. Simulated Tensile Microstrain
VDOT Implementation

- I-64 Williamsburg, VA
- 7.08 miles
- 200,000 tons of RAP
- $10,000,000 savings

$88/\text{yd}^2$ vs. $42/\text{yd}^2$
VDOT CCPR Summary

• Sections continue to perform extremely well
  – No signs of surface cracking
  – Minimal rutting (< 0.3”)

• Structural metrics indicate predominantly healthy sections
  – N4 may be experiencing minor damage
    • Slightly decreasing AC modulus with increasing AC strain

• Perpetual analysis shows 2 to 2.5” AC increase meets Test Track criteria on aggregate base sections

• Recommend leaving S12 and N4 in place for 2018
Test Track Future (2018)

• Continue emphasis on sustainable materials
  – CCPR, other green technologies

• New Innovation Group
  – Deep pavement reconstruction
  – Soil stabilization

• Cracking Group Study
  – Link lab/field performance – balanced mix design

• Pavement Preservation

• Continue Mn/ROAD Partnership