NCAT Pavement Test Track

Buzz Powell
Content

• MnROAD Partnership
• Pavement preservation
• Laboratory cracking test(s)
• Standalone studies
• 2015 Track status report.
Research Goals

• Help state DOTs implement positive change
• Promote real innovation for the industry.
NCAT+MnROAD Research Partnership

To facilitate high value pavement research that addresses national needs using full-scale pavement testing facilities in both warm and cold climates on flexible, rigid, and composite pavement structures.
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2015 Preservation Research

- NCAT Pavement Test Track (accelerated)
  - Thinlay, micro surface, Cape seal, scrub/chip seals
- Lee Road 159 (low ADT, high percent trucks)
  - Single/double/triple chips, scrub, FiberMat, sealing
  - Single/double micro surface, Cape x 3, sealing
  - Track thinlay, neat binder, ABR variants, CCPR base
- US-280 (high ADT, moderate percent trucks)
  - 159 + CCPR/CIR, OGFC, durable/friction micro, etc.
- Duplicate NCAT preservation sections at MnROAD.
Track Pavement Preservation

- Chip seal
- Scrub seal
- Scrub Cape seal
- Micro surface
- Thinlay
- Thinlay Scrub Cape seals.

Equivalent Single Axle Loadings (ESALs)

Percent of Total Lane Area Cracked

0 5 10 15 20 25 30 35 40 45 50

0, 2,500,000, 5,000,000, 7,500,000, 10,000,000, 12,500,000, 15,000,000, 17,500,000, 20,000,000

- Trigger
- HMA
- OGFC
- WMA-F
- WMA-A
- HRAP
- WRAP
- HiMA
Track Pavement Preservation
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Track Pavement Preservation
Lee Road 159 Low Traffic Preservation
Benefits of Preservation

- Life extending benefit
- Condition improving benefit
- $f$ (pretreatment condition)
Benefits of Preservation
Benefits of Preservation
Benefits of Preservation

- Preservation
- Rehabilitation
- Reconstruction
Benefits of Preservation
Benefits of Preservation
US-280 High Traffic Preservation
US-280 High Traffic Preservation
US-280 High Traffic Preservation
US-280 High Traffic Preservation
ABR Thinlays on Cold Recycle $F,E$

CCPR (KMA220)

CIR (3800CR)
HMA Thin Overlays on US-280

- 39 = ABR thinlay control
- 40 = CCPR with foam
- 41 = CCPR with emulsion
- 42 = Untreated (traffic loop)
- 43 = CIR with emulsion
- 44 = CIR with foam
Cracking Group (CG) Section Surfaces

- 20% RAP control \( N_1@20/0 \)
- High density control \( N_2@20/0 \)
- Low AC/density control \( N_5@21/0 \)
- Control + 5% RAS \( N_8@20/14 \)
- Control +15% RAP with PG58-28 \( S_5@33/0 \)
- Control with HiMA \( S_6@19/0 \)
- 15% RAP AZ rubber with ARB20 \( S_13@7/0 \)
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Standalone Research

- Use of fine/small blends
- Reduced design gyration levels
- Best use of RAP, RAS, and GTR
- Healthy (balanced) binder content
- Preventing reflective cracks.
Fine/Small Blends

- Similar rutting performance to coarse/large
- Longer path for crack propagation
- Higher effective binder content
- Better cracking/raveling performance
- Sustainability of using surplus stockpiles
- Pavement preservation treatment option.
Fine/Small Blends
Reduced Design Gyration Levels

- 139 to 125 to 100 to 80 to 60 gyrations...
- “Locking point” to prevent aggregate breakdown
- Often more gyrations for higher traffic mixes
- More gyrations can mean lower binder contents
- Lowering gyrations alone is not enough
- Remember that $V_{MA} = V_a + V_{be}$ ($G_{sb}$ is wildcard).
Finer Mixes with Lower $N_{des}$
Finer Mixes with Lower $N_{des}$
## Best Use of RAP, RAS, and GTR

<table>
<thead>
<tr>
<th>Purpose of Each Layer</th>
<th>N5 Control</th>
<th>S5 Higher RAP</th>
<th>S6 RAP+RAS</th>
<th>S13 Recyc Tires</th>
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</thead>
<tbody>
<tr>
<td>Durable, Rut Resistant Surface</td>
<td>20% RAP&lt;sub&gt;20&lt;/sub&gt;</td>
<td>25% RAP&lt;sub&gt;11&lt;/sub&gt;</td>
<td>5% RAS&lt;sub&gt;21&lt;/sub&gt;</td>
<td>VIRGIN 82-22&lt;sub&gt;12&lt;/sub&gt; SMA</td>
</tr>
<tr>
<td></td>
<td>67-22/82-16 DG</td>
<td>67-22/16-22 SMA</td>
<td>67-22/88-16 SMA</td>
<td></td>
</tr>
<tr>
<td>Stiff, Strain Reducing Middle</td>
<td>35% RAP&lt;sub&gt;39&lt;/sub&gt;</td>
<td>50% RAP&lt;sub&gt;41&lt;/sub&gt;</td>
<td>50% AGED&lt;sub&gt;26-24&lt;/sub&gt;</td>
<td>35% RAP&lt;sub&gt;37&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td>67-22/88-10 DG</td>
<td>67-22/82-16 DG</td>
<td>67-22/94-10 DG</td>
<td>82-22&lt;sub&gt;12&lt;/sub&gt; DG</td>
</tr>
<tr>
<td>Fatigue Resistant Base Layer</td>
<td>35% RAP&lt;sub&gt;39&lt;/sub&gt;</td>
<td>35% RAP&lt;sub&gt;34&lt;/sub&gt;</td>
<td>25% RAP&lt;sub&gt;24&lt;/sub&gt;</td>
<td>VIRGIN 88-22&lt;sub&gt;20&lt;/sub&gt; AZ</td>
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<tr>
<td></td>
<td>67-22/88-10 DG</td>
<td>94-28/94-10 DG</td>
<td>+76-22/88-16 DG</td>
<td></td>
</tr>
</tbody>
</table>

Green = Evotherm Q1 Additive, Blue = Astec Green Foamer
Best Use of RAP, RAS, and GTR

The graph illustrates the performance of different materials under Equivalent Single Axle Loadings (ESALs). The y-axis represents the percent of total lane area cracked, while the x-axis shows the equivalent single axle loadings. Different lines denote various treatments, including RAP (Reclaimed Asphalt Pavement), RAS (Reclaimed Asphalt Shingles), and GTR (Growing Tree Radicals). The graph highlights the benefits of using RAP, RAS, and GTR in terms of reduced cracking.
Best Use of RAP, RAS, and GTR

• HMA = 0.44 to 0.54
• CAB ≈ 0.15
• CR ≈ 0.36 tp 0.39
Healthy Binder Content

- RAP in the past ≠ current RAP ≠ future RAP
- “Reclaimed/recycled content” is not enough
- “Aged binder ratio” (ABR) is not enough
- Use “RAP binder ratio” and “RAS binder ratio”
- Post consumer RAS vs manufacturing waste
- Soft asphalts, rejuvenators, richer mix designs
- Discounting contribution of RAP/RAS binders.
Polymer Binders in Higher RAP Mixes
Preventing Reflective Cracks
Preventing Reflective Cracks
# Preventing Reflective Cracks

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Date</th>
<th>Type</th>
<th>Grade</th>
<th>Target Emulsion Rate (GSY)</th>
<th>Meas. Emulsion Rate (GSY)</th>
<th>Aggregate Type</th>
<th>Meas. Aggregate Rate (PSY)</th>
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</thead>
<tbody>
<tr>
<td>1st</td>
<td>8/8/2012</td>
<td>7 Chip Seal</td>
<td>CRS-2HP</td>
<td>0.26</td>
<td>0.28</td>
<td>Granite</td>
<td>23.0</td>
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<tr>
<td>2nd</td>
<td>8/8/2012</td>
<td>89 Chip Seal</td>
<td>CRS-2HP</td>
<td>0.34</td>
<td>0.28</td>
<td>Granite</td>
<td>16.0</td>
</tr>
<tr>
<td>3rd</td>
<td>8/9/2012</td>
<td>W10 Chip Seal</td>
<td>CRS-2HP</td>
<td>0.15</td>
<td>0.14</td>
<td>Granite</td>
<td>15.0</td>
</tr>
</tbody>
</table>
Preventing Reflective Cracks
Preventing Reflective Cracks
Status Report

- High level of construction quality achieved
- ≈2 million ESALs on Track with no early concerns
  - >4½ million ESALs on Track preservation sections
- ≈½ million ESALs on LR-159 with good results
- ≈1 million vehicles on US-280 with good results
- Weekly data collection on Track, 159, & 280
- Planning for MnROAD treatments summer 2016.
End-of-Cycle Track Conference

- High RAP/RAS balanced mix designs
- Nationwide pavement preservation
- Preventing reflective distresses
- Optimized structural design
- Implementation

Pavement Test Track Conference
March 6-8, 2018
The Hotel at Auburn University
and Dixon Conference Center

www.ncat.us