Tack Coat Effect on Field Performance

December 2, 2014
Wisconsin Asphalt Paving Association
Madison, WI
You might have a bonding problem if ...
You definitely have a bonding problem if ...
You might have a bonding problem if ...

- Longitudinal cracking near the wheel path
Why do pavements debond?

- Lack of tack coat
- Non-uniform application of tack
- No adjustment in rate for surface type or condition
- Dirt, debris and dust contamination of surface
Why do pavements debond?

- Construction practices necessitate driving on the tack coat to place the mix
- Tracking of the tack from the surface may result
Tack Coat - Constructability vs Performance

- Traditional distributor placed tack coat construction dictates:
  - Low application rates
    - Curing of the tack
    - Traction for paving equipment
  - Use of non-tacky hard binders to reduce tracking
Tack Coat Paradigms

Heavy application of tack coat may -

• create a slip plane
• flush to the surface of the new overlay
What options are available to place tack uniformly without disturbing during construction?

- Modify the process to keep all construction equipment and trucks off the tack during construction
- Spray paver
What is a Spray Paver?

Spray Paver = Paver + Distributor in one machine
Spray Pavers

- Due to the distributor plus paver in one,
  - Different types of emulsion can be used
  - Dilution of emulsion is not required
  - Application rates are not limited by construction
Spray Paver Experimentation (Field)

- What happens if significantly higher application rates are used?
- What forms of distress will appear or possibly be delayed?
- What effect does significantly different types of tack have on performance?
- Surface type effect on application rates (PCC, AC, milled)?
Field Performance Data
Route T, Franklin County, MO

- Constructed: **October 2008**
- Contractor: **N.B. West**
- Project length: **3.5 miles (test sections)**
- Surface: **Composite, HMA over PCC**
- Mix: **1 ¾” Bonded BP-1 HMA w/ PG64-22**
- Tack:
  - Test sections at 0.1, 0.15, and 0.2 gal/yd² PMAE at 65% AC
  - Test sections at 0.1 gal/yd² thru distributor and 0.1 and 0.15 gal/yd² CSS-1h thru SP-200
- Equipment: **RoadTec SP-200 spray paver**

June 2009
MoDOT Route T Project – Oct 2008
1 3/4” BP-1 overlay over composite pavement

<table>
<thead>
<tr>
<th>Route 100 Ext</th>
<th>0±00</th>
<th>63±10</th>
<th>67±37</th>
<th>106±40</th>
<th>128±74</th>
<th>129±43</th>
<th>190±17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Section 1</td>
<td>0.08 gsy CSS (distributor)</td>
<td>Test Section 2</td>
<td>0.13 gsy PMAE (spray paver)</td>
<td>Test Section 3</td>
<td>0.1 gsy CSS (spray paver)</td>
<td>Test Section 4</td>
<td>0.1 gsy CSS (spray paver)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Test Section 1</th>
<th>30±68</th>
<th>71±20</th>
<th>98±05</th>
<th>128±74</th>
<th>129±43</th>
<th>190±17</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test Section 2</td>
<td>76±50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MoDOT Route T 2008 @ 68 months
1 ¾" BP-1 over HMA/PCC Composite
Transverse Crack Length/1000' vs Time
West Bound Lane

Trans. Crack Length, ft./1000' section

Months

0 10 20 30 40 50 60 70

0 200 400 600 800

0.02 CSS - dist
0.03 CSS
0.05 CSS
0.07 PMAE
0.09 PMAE
0.14 PMAE
MoDOT Route T 2008 @ 68 months
1 3/4" BP-1 over HMA/PCC Composite
Longitudinal Crack Length/1000' vs Time
West Bound Lane
Route T Franklin Co Test Sections 11/12
Pre-paving and 4 years later

2008 2012

0.21 gal/yd² (0.14 res) PMAE Tack
Route T Franklin Co Test Sections 11/12
Pre-paving and 6 years later

2008

0.21 gal/yd² (0.14 res) PMAE Tack

2014
1 ½” SR-12.5A over a Milled Surface

<table>
<thead>
<tr>
<th>Test Section</th>
<th>Test Section</th>
<th>Test Section</th>
<th>Test Section</th>
<th>Test Section</th>
<th>Test Section</th>
<th>Test Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>10</td>
<td>9</td>
<td>7</td>
<td>5</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>40% RAP</td>
<td>40% RAP</td>
<td>25% RAP</td>
<td>25% RAP</td>
<td>25% RAP</td>
<td>25% RAP</td>
<td>25% RAP</td>
</tr>
<tr>
<td>0.35 gal/yd2</td>
<td>0.25 gal/yd2</td>
<td>0.12 gal/yd2</td>
<td>0.20 gal/yd2</td>
<td>0.16 gal/yd2</td>
<td>0.08 gal/yd2</td>
<td>No Tack</td>
</tr>
<tr>
<td>EBL</td>
<td>EBL</td>
<td>EBL</td>
<td>EBL</td>
<td>EBL</td>
<td>EBL</td>
<td></td>
</tr>
<tr>
<td>Test Section</td>
<td>Test Section</td>
<td>Test Section</td>
<td>Test Section</td>
<td>Test Section</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25% RAP</td>
<td>25% RAP</td>
<td>25% RAP</td>
<td>25% RAP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.12 gal/yd2</td>
<td>0.20 gal/yd2</td>
<td>0.16 gal/yd2</td>
<td>0.08 gal/yd2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSS-1h</td>
<td>CSS-1h</td>
<td>CSS-1h</td>
<td>CSS-1h</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
KDOT US 36 Washington Co 2009 at 43 months
½ Mill, 1 ½" SR12.5A, PG58-28
Transverse Cracking/1000' section vs Time
KDOT US 36 Washington Co. at 43 months
½" Mill, 1 ½" SR12.5A, PG58-28
Longitudinal Cracking/1000' section vs Time

Residual Rate
- 0.05 CSS-1h
- 0.07 CSS-1h
- 0.10 CSS-1h
- 0.12 CSS-1h
- 0.05 EBL
- 0.08 EBL
- 0.10 EBL
- 0.13 EBL
KDOT US 36 Washington Co. at 43 months
½" Mill, 1 ½" SR12.5A, PG58-28
Longitudinal Cracking/1000' section vs Time
No Tack over a Milled Asphalt Surface
US 36 Washington Co. KS 2009
No tack over a milled surface – 2 years later

- US 36 Washington County, KS
- Fatigue cracking in the inside wheel path
- Effect of unbounded overlay
KDOT US 36 Washington County
No Tack Section 2014
KDOT US 36 Marshall Co. (Const. 2010)

- 1” mill, 1” SR9.5A
- PG70-28 binder
- 5 test sections
  - 4 spray paver shot rates
    - 0.11 gal/yd² EBL
    - 0.18 gal/yd² EBL
    - 0.26 gal/yd² EBL
    - 0.36 gal/yd² EBL
  - 1 Distributor applied shot rate
    - 0.05 gal/yd² SS-1h

0.05 gal/yd² undiluted SS-1h tack through distributor

0.14 gal/yd² undiluted polymer modified tack applied through spray paver

Centerline joint

Transition from tack to polymer modified tack section
KDOT US 36 Marshall Co. 2010
Transverse Cracking at 43 months
1" Mill, 1" SR9.5A, PG70-28

Transverse cracking, ft/1000'

Months

0.11 EBL
0.18 EBL
0.26 EBL
0.36 EBL
0.05 Tack
KDOT US 36 Marshall Co. 2010
Longitudinal Cracking at 43 months
1" Mill, 1" SR9.5A, PG70-28

Longitudinal Cracking, ft/1000'

Months

0.11 EBL
0.18 EBL
0.26 EBL
0.36 EBL
0.05 Tack
KDOT US 36 Nemaha County 2010

- 4” CIR with emulsion
- 1 ½” SR12.5A
- PG70-22 binder
- 4 Test sections
  - 3 spray paver shot rates
    - 0.11 gal/yd2 EBL
    - 0.22 gal/yd2 EBL
    - 0.34 gal/yd2 EBL
  - 1 distributor applied control section
    - 0.05 gal/yd2 CSS-1h
KDOT US 36 Nemaha Co. 2010
Transverse Cracking at 41 months
4" CIR w/ 1 ½" SR12.5A, PG70-22

Transverse Cracking/1000' Test Section, ft

Months

0.05 CSS-1h
0.11 EBL
0.22 EBL
0.34 EBL
KDOT US 36 Nemaha Co. 2010
Longitudinal Cracking at 41 months
4" CIR w/ 1 ½" SR12.5A, PG70-22

Months

Longitudinal Cracking/1000' Section, ft

- 0.05 CSS-1h
- 0.11 EBL
- 0.22 EBL
- 0.34 EBL
Saturation at Interface Creates Voidless Height in HMA

- Higher tack rate creates an asphalt rich interlayer at the interface with the existing pavement

Bonded to existing pavement surface
MoDOT Route T @ 41 months
Transverse Cracks vs Voidless Height

*Assumes 0.03 gsy absorption
KDOT US 36 Washington Co at 31 months
Transverse Cracks vs Voidless Height
All CSS-1h sections

R² = 0.7364

*Assumes 0.03 gsy absorption
US 36 Marshall County, KS @ 43 months
Transverse Cracks vs Voidless Height

\[ y = -229.71x + 350.26 \]
\[ R^2 = 0.7683 \]
US 36 Nemaha County, KS @ 41 Months
Transverse Cracks vs Voidless Height

\[ y = -138.18x + 223.83 \]
\[ R^2 = 0.9666 \]
Observations from Field Performance

• Based on field project data,
  • Correlation of bond energy to longitudinal cracking resistance exists
  • Correlation of voidless height to transverse cracking exists
  • General trends favor higher application rates (than standard tack rates) and polymer modified tack
    • Improved mix performance; more resistance to transverse and longitudinal cracking
  • Field data from more projects are being gathered
Questions?