Bonded Pavement Experimentation

- 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)?
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
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 ¾” BP-1 overlay over composite pavement

<table>
<thead>
<tr>
<th>Route 100 East</th>
<th>Test Section 1</th>
<th>Test Section 2</th>
<th>Test Section 3</th>
<th>Test Section 4</th>
<th>Test Section 5</th>
<th>Test Section 6</th>
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<tr>
<td></td>
<td>0.08 gys CSS</td>
<td>0.13 gys PMAE</td>
<td>0.13 gys PMAE</td>
<td>0.1 gys CSS</td>
<td>0.15 gys CSS</td>
<td>0.15 gys CSS</td>
<td>0.1 gys CSS</td>
<td>0.14 gys PMAE</td>
<td>0.11 gys PMAE</td>
<td>0.14 gys PMAE</td>
<td>0.19 gys PMAE</td>
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<td></td>
<td>(distributor)</td>
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<td></td>
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<td>106±40</td>
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</table>
MoDOT Route T 2008 @ 68 months
1 3/4" BP-1 over HMA/PCC Composite
Tranverse Crack Length/1000' vs Time
West Bound Lane

Trans. Crack Length, ft/1000' section vs Months

- 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

0.21 gal/yd² (0.14 res) PMAE Tack
1 ½” SR-12.5A over a Milled Surface

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<td>9</td>
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<td>40% RAP</td>
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<td>0.12 gal/yd2</td>
<td>0.20 gal/yd2</td>
<td>0.16 gal/yd2</td>
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<td>EBL</td>
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<tr>
<td>25% RAP</td>
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<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>
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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
1/2" Mill, 1 1/2" 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
- 0 Tack
No Tack over a Milled Asphalt Surface
US 36 Washington Co. KS 2009
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

Transition from tack to polymer modified tack section

Centerline joint

18
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

Road Science™
Division of ArrMaz Custom Chemicals
KDOT US 36 Marshall Co. 2010
Longitudinal Cracking at 43 months
1" Mill, 1" SR9.5A, PG70-28

Months

Longitudinal Cracking, ft/1000'

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 1/2" SR12.5A, PG70-22

Graph showing transverse cracking over time.
KDOT US 36 Nemaha Co. 2010
Longitudinal Cracking at 41 months
4" CIR w/ 1 ½" SR12.5A, PG70-22

Longitudinal Cracking/1000' Section, ft

Months

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.
MoDOT Route T @ 41 months
Transverse Cracks vs Voidless Height

Transverse crack length, ft/1000' section

Voidless height, cm

R² = 0.7902

*Assumes 0.03 gsy absorption
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?