Spray Paver applied Bonded HMA

ND Asphalt Conference
April 5-6, 2016

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Why are we here?

- TALK ABOUT WHAT SPRAY PAVING IS
- ADVANTAGES OF SPRAY PAVING
- RESEARCH PROJECTS
- QUESTIONS

Have you ever seen this?

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Have you ever seen this?

ARE YOU GETTING WHAT YOU ARE PAYING FOR?

Pay Quantity

Effective Quantity

WHAT CAN YOU DO TO ASSURE THAT YOU ARE GETTING THE TACK COAT YOU WANT?

SPRAY PAVER

What is a Spray Paver?

Spray Paver = Paver + Distributor in one machine

Spray Paver

- 3 Processes
  - Spray emulsion
  - Lay hot mix
  - Smooth the mat

Application of emulsion

Application of HMA

EBL applied with spray paver

- **Undisturbed before HMA**
- **Much higher shot rate**
- **Higher polymer content**

Application of Tack – Placement of Mix

Construction – Spray Paver Equipment

Vogele Spray Jet Paver

RoadTec SP-200 Spray Paver

CAT

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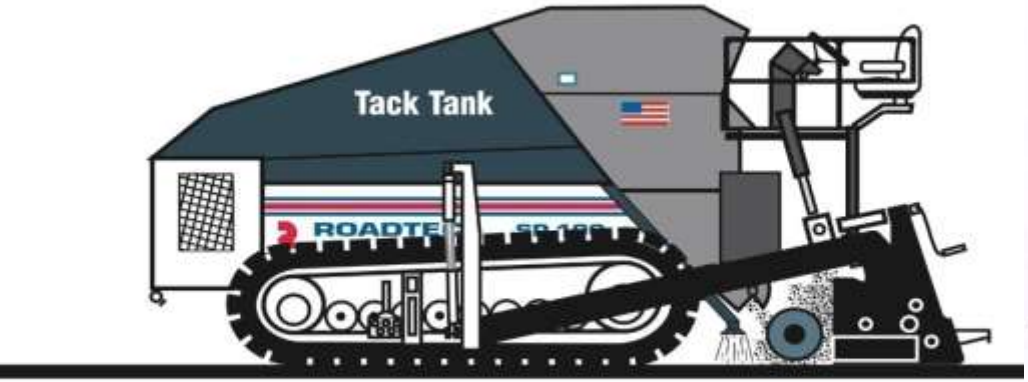
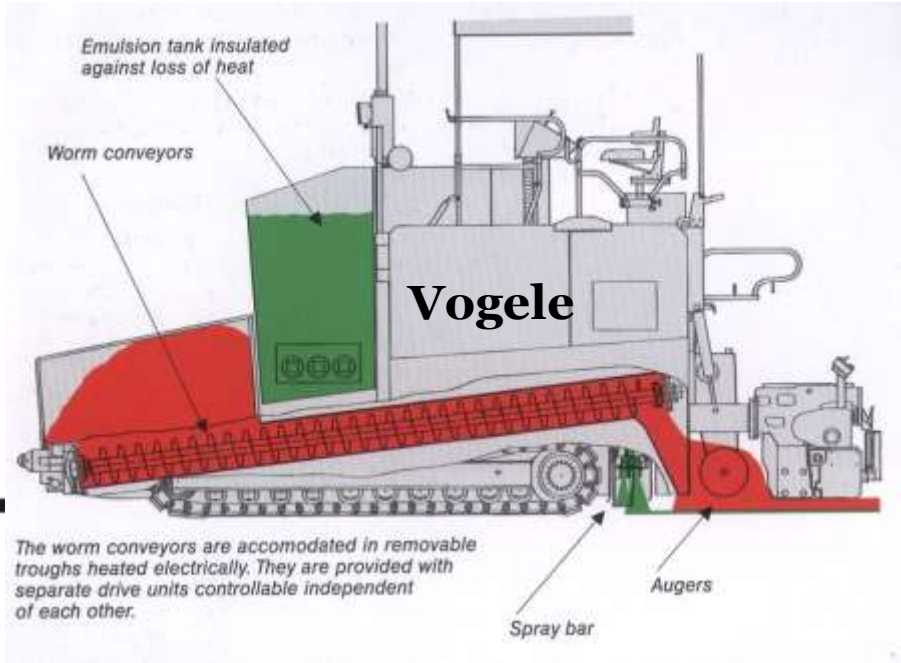
Spray Pavers

- 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**



ROADTEC STEALTH PAVER WITH TACK TANK



Why do pavements debond?

- Lack of or 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?

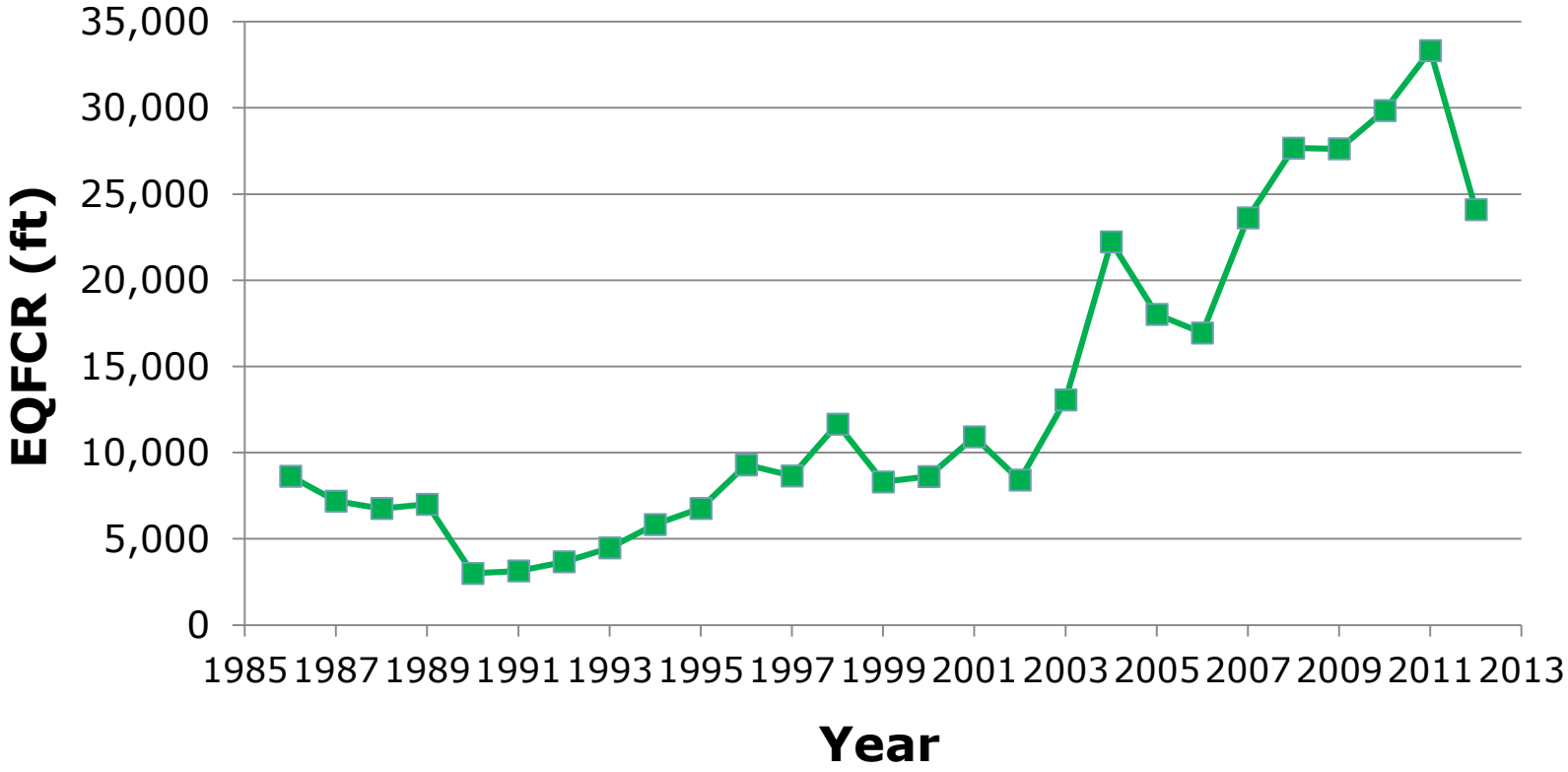
- Construction practices necessitate driving on the tack coat to place the mix
- Tracking of the tack from the surface may result

Kansas DOT Experience

Paying for tack on equipment tires

Kansas DOT Experience

Increase in Fatigue Cracking



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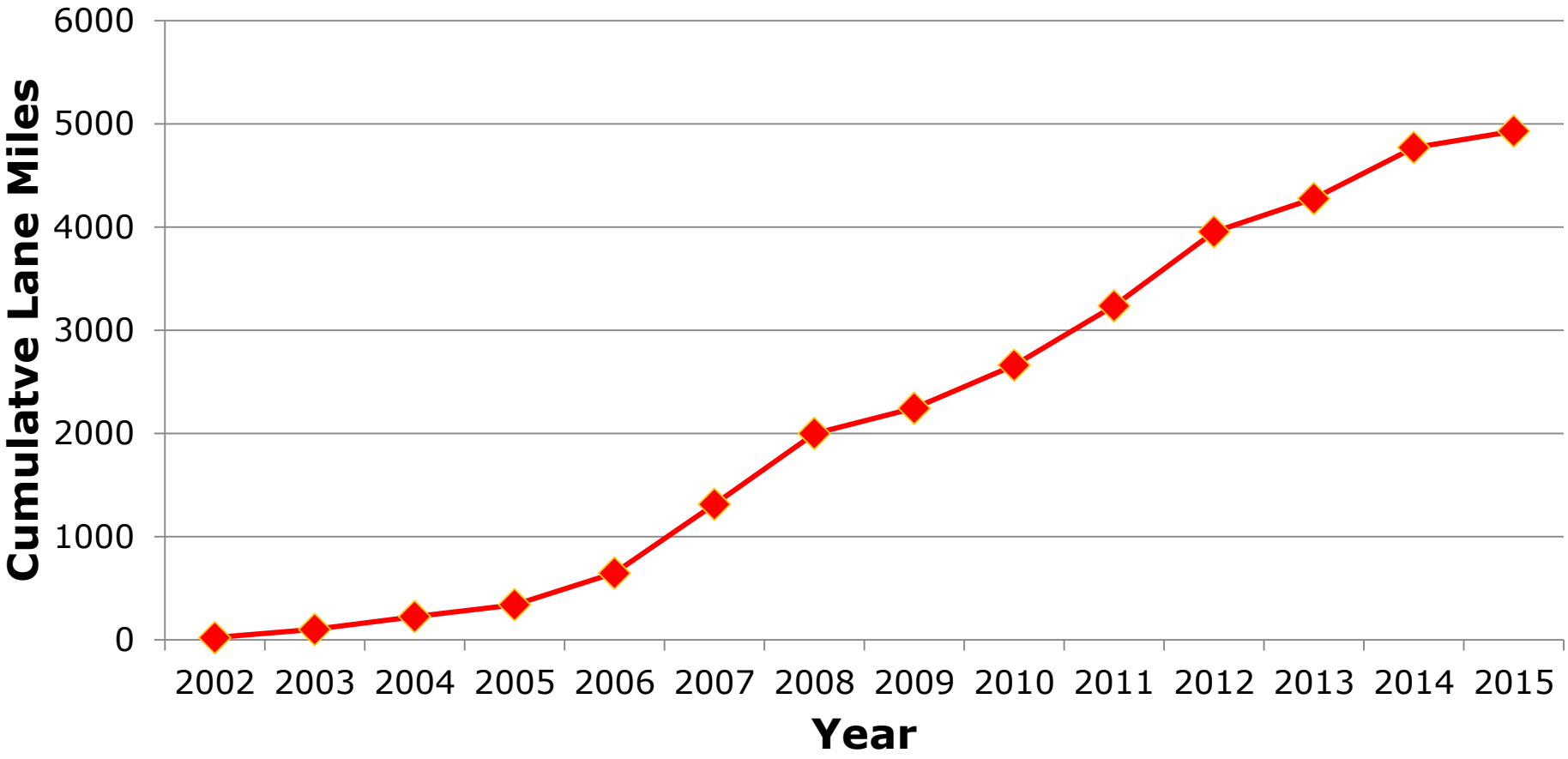
Kansas DOT Experience

Loss of bond - reducing life of our overlays

Kansas DOT Experience

Ultrathin Bonded Asphalt Surface (UBAS)

Lane-Miles overlaid with UBAS



Expectations for Dense Graded HMA placed with a Spray Paver

- Keep the tack on the road
- Better fatigue cracking resistance
- Seal off the roadway
- More flexible pavement

Concerns for Dense Graded HMA placed with a Spray Paver

- Effect on HMA volumetrics
- Is the EBL getting on the Pavement?
- EBL Break Time
- Trapped moisture
- Cost
- Industry Buy-In

Effect on HMA volumetrics

- Sample taken
  - Behind the Paver
  - From Truck Bed

- No statistical difference in volumetric properties

EBL Uniformly Placed?

- Look for shiny pavement completely across spray bar
- Have contractor move the spray paver forward shooting only EBL. Verify that spray pattern is uniform

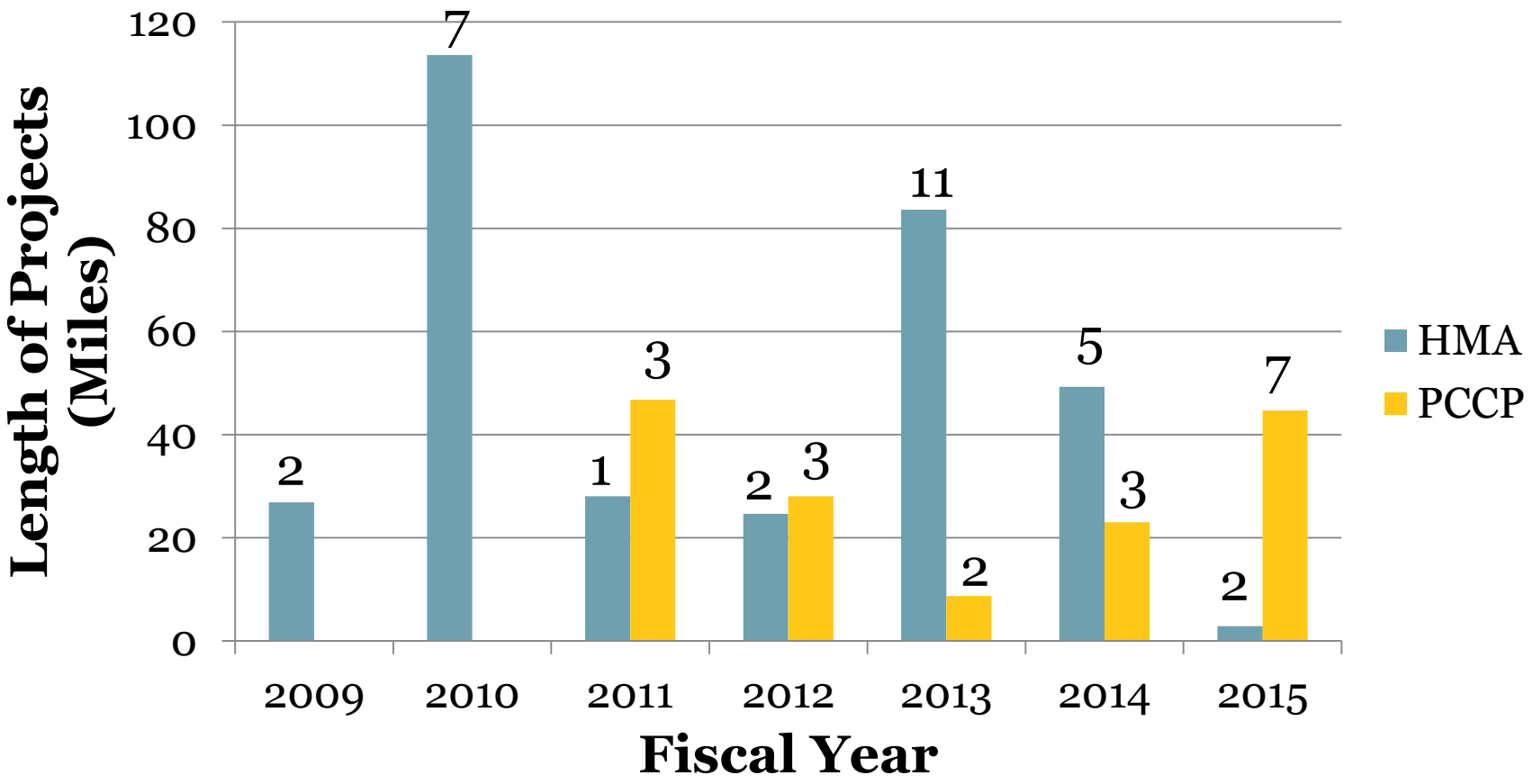
EBL Break Time and Moisture

- Continue to observe
- Pavement Performance was not affected
- Modified Lottman Results not affected

Cost Comparison

- 2015
  - 7 Projects with both EBL and SS-1H Bid
  - Average EBL unit cost is $557/ton
  - Average SS-1H unit cost is $576/ton
- 2012
  - EBL cost $50/ ton more than SS-1HP
  - That’s a $7500 increase to project costs

HMA Placed with Spray Pavers



Industry Buy-In

- KDOT is currently using Spray Paver on HMA overlays of PCCP
- Spray paving on HMA overlay of HMA pavements is done on a project basis with Research Test Sections included
- Data from the Research to determine if increased use of Spray Paver is warranted

How does applying a much higher rate of a polymer modified tack coat, undisturbed before the HMA placement, effect the cracking performance over time (vs a typical distributor applied tack coat)?

Field Performance Data

Route T, Franklin County, MO

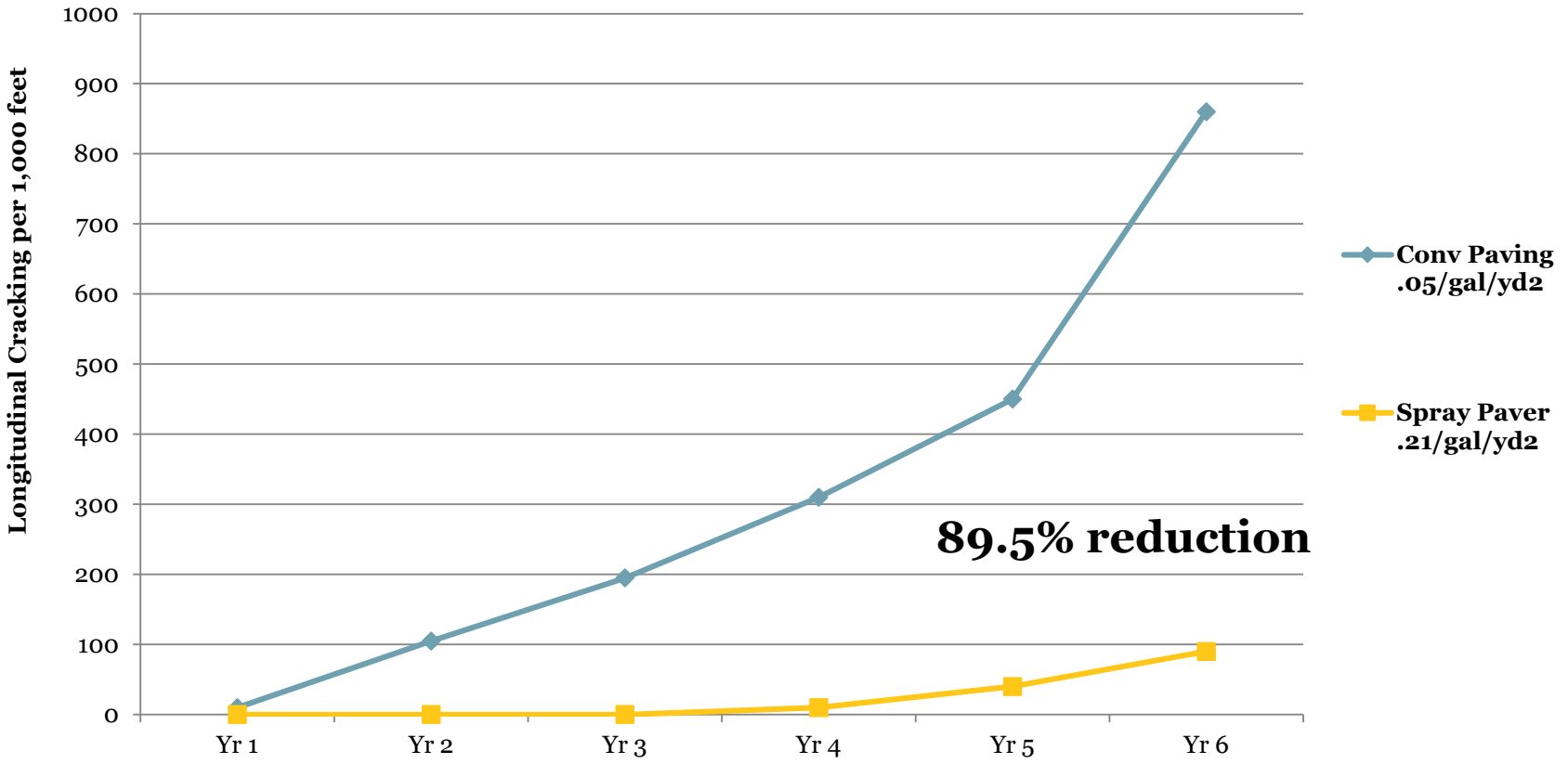
- Constructed: October 2008
- Contractor: N.B. West
- Project length: 3.5 miles (test sections)
- Surface: Composite, HMA over PCC
- Mix: 1 ¾" Bonded BP-1 HMA w/ PG64-22
- Tack:
  - Test sections at 0.1, 0.15, and 0.2 gal/yd2 PMAE at 65% AC
  - Test sections at 0.1 gal/yd^2 thru distributor and 0.1 and 0.15 gal/yd^2 CSS-1h thru SP-200
- Equipment: RoadTec SP-200 spray paver

June 2009

Route T Franklin Co Test Sections Pre-paving Condition (no milling occurred)

2008

MoDOT Route T – 2008 Construction
Longitudinal Crack Length at 6 years
1 ¾" BP-1 over HMA/PCC Composite



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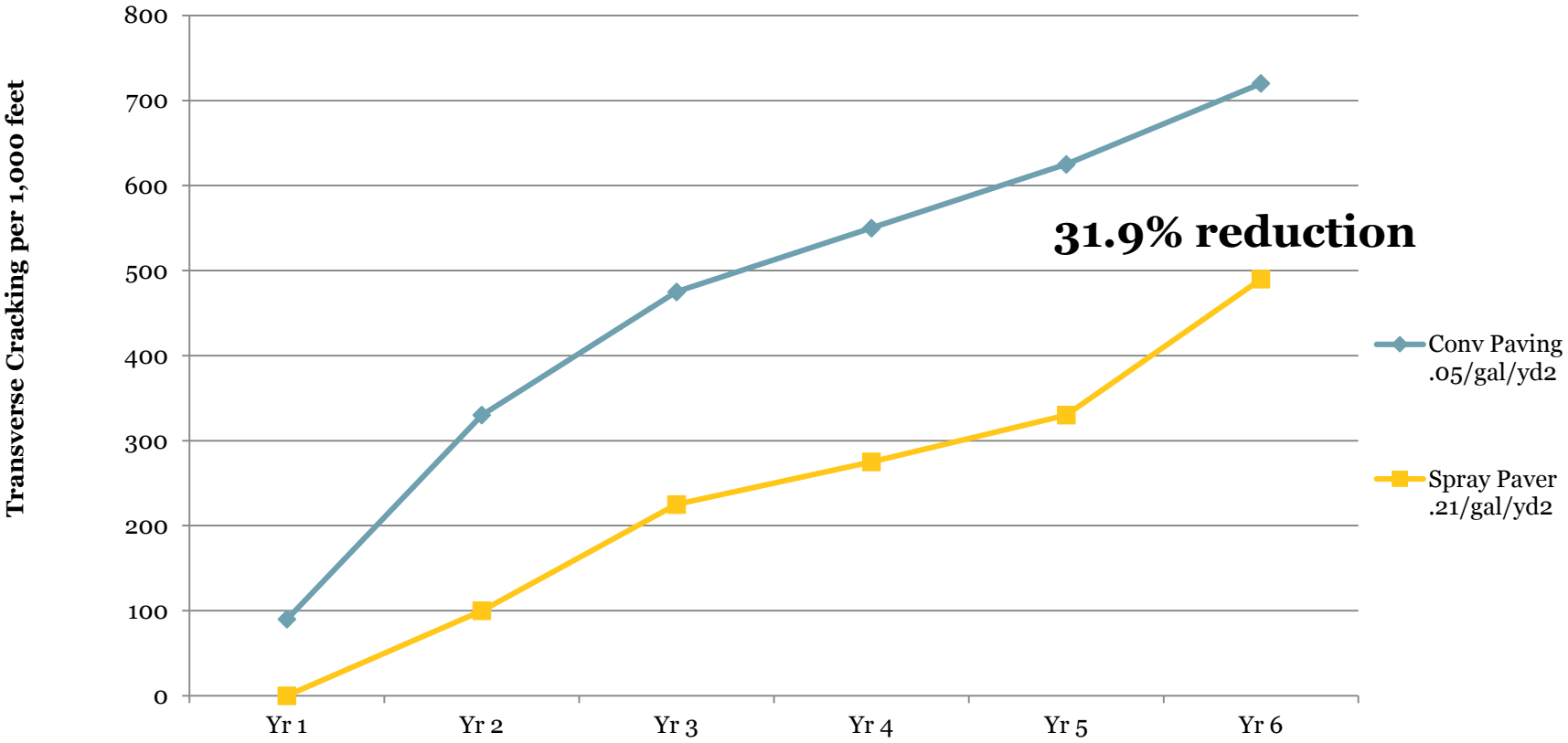
MoDOT Route T – 2008 Construction
Transverse Crack Length at 6 years
1 ¾" BP-1 over HMA/PCC Composite



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MoDOT Route T Pavement Condition Surveys

1 3/4" BP-1 over HMA/PCC Composite
Reflective Cracking within First Two Years

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

2014

0.21 gal/yd2 (0.14 res) PMAE Tack

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KDOT US-36 Washington Co. Pavement prior to paving - 2009

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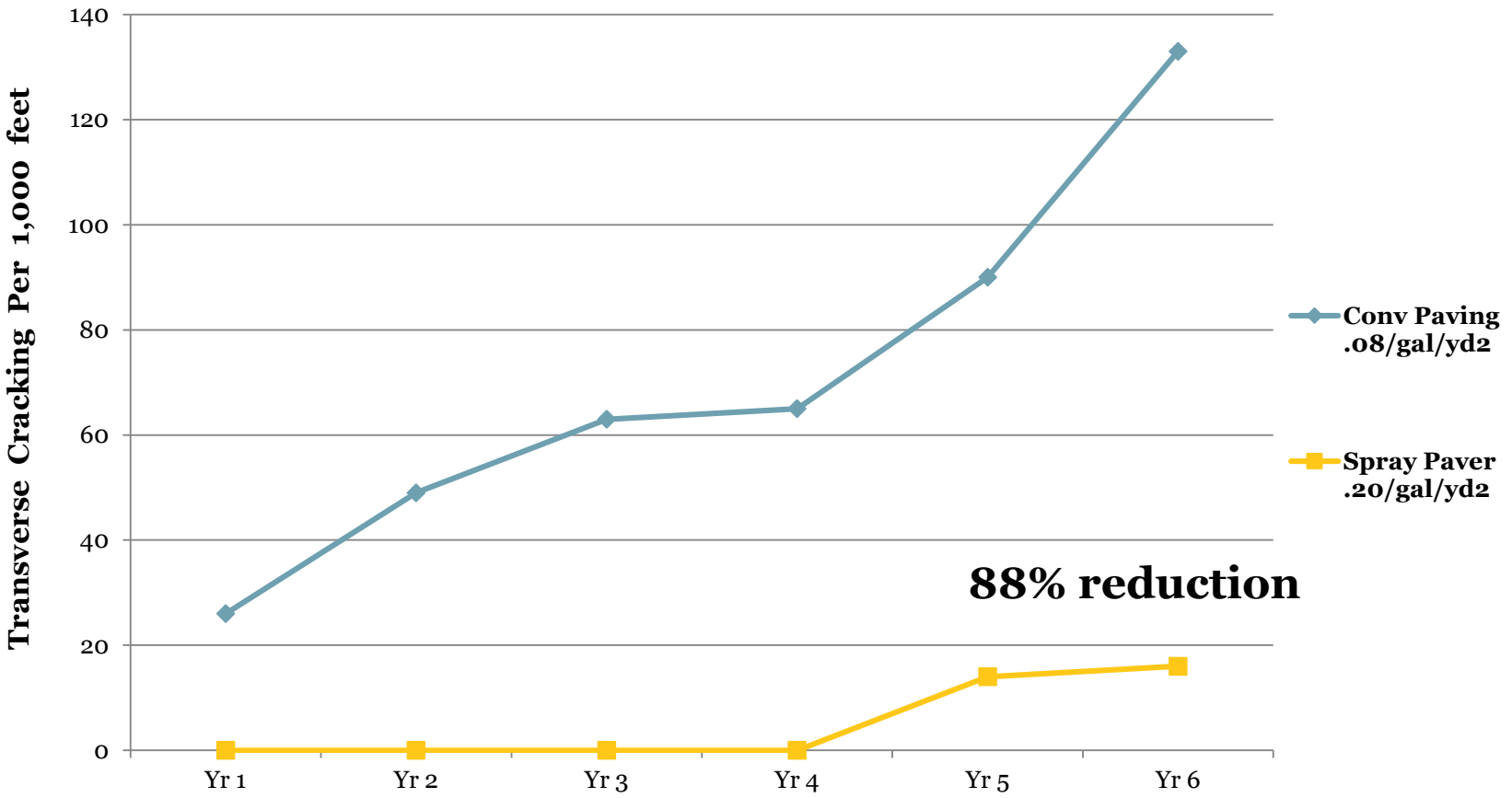
KDOT US-36 Washington Co – 2009 Construction
½" Mill, 1 ½ " SR-12.5A, PG 58-28
Transverse Crack Length at 6 years



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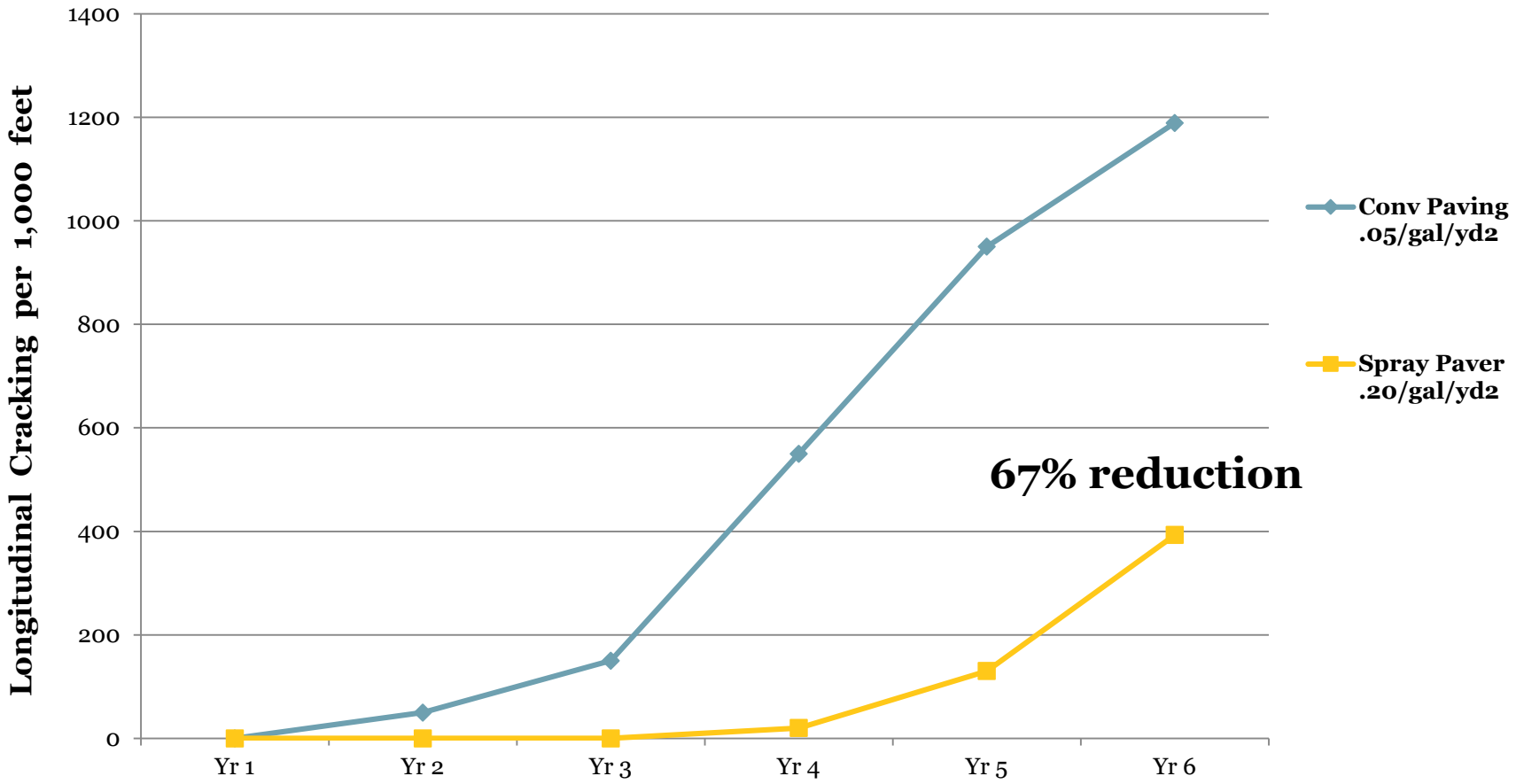

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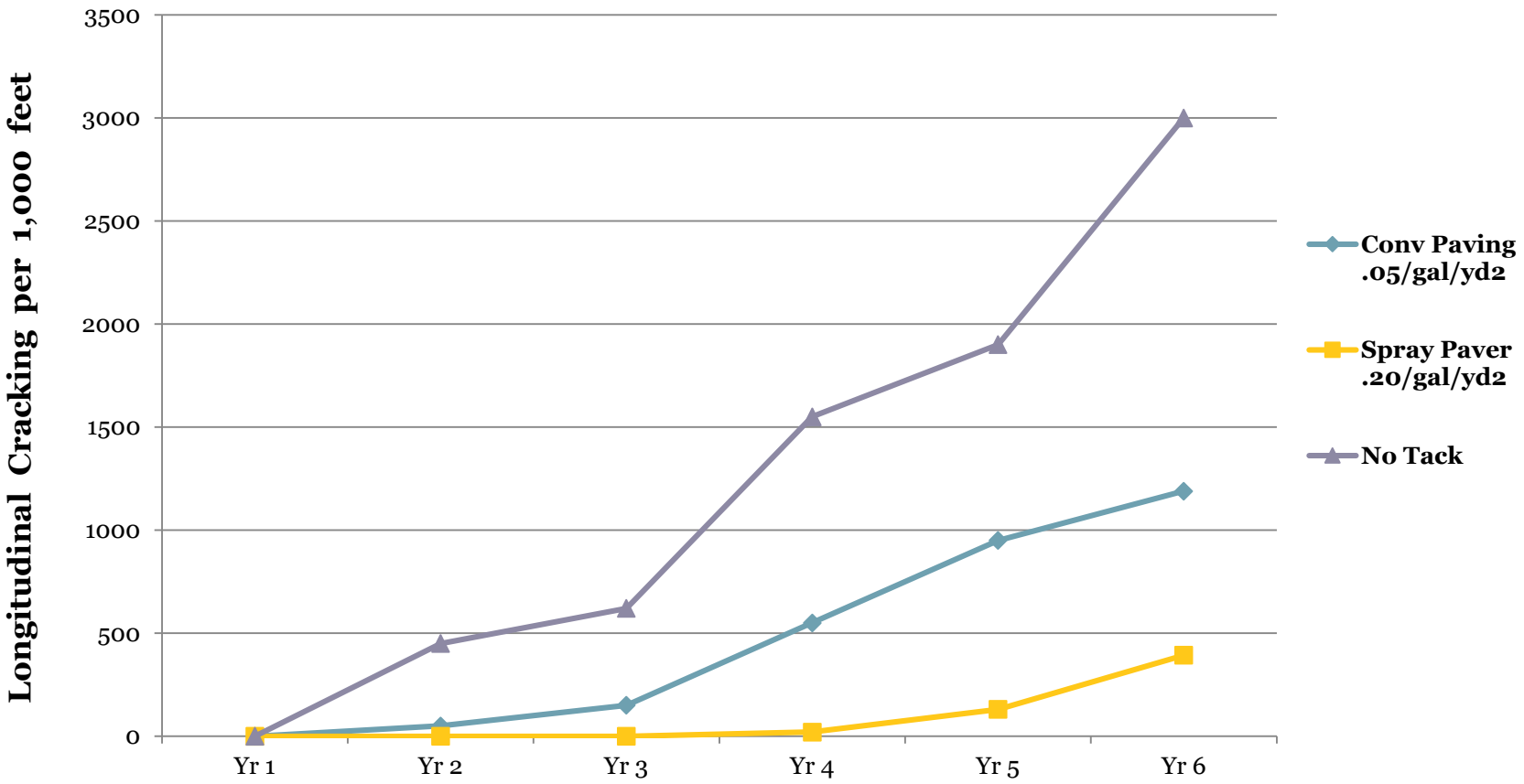
KDOT US-36 Washington Co – 2009 Construction
½" Mill, 1 ½ " SR-12.5A, PG 58-28
Longitudinal Crack Length at 6 years (w/no tack)



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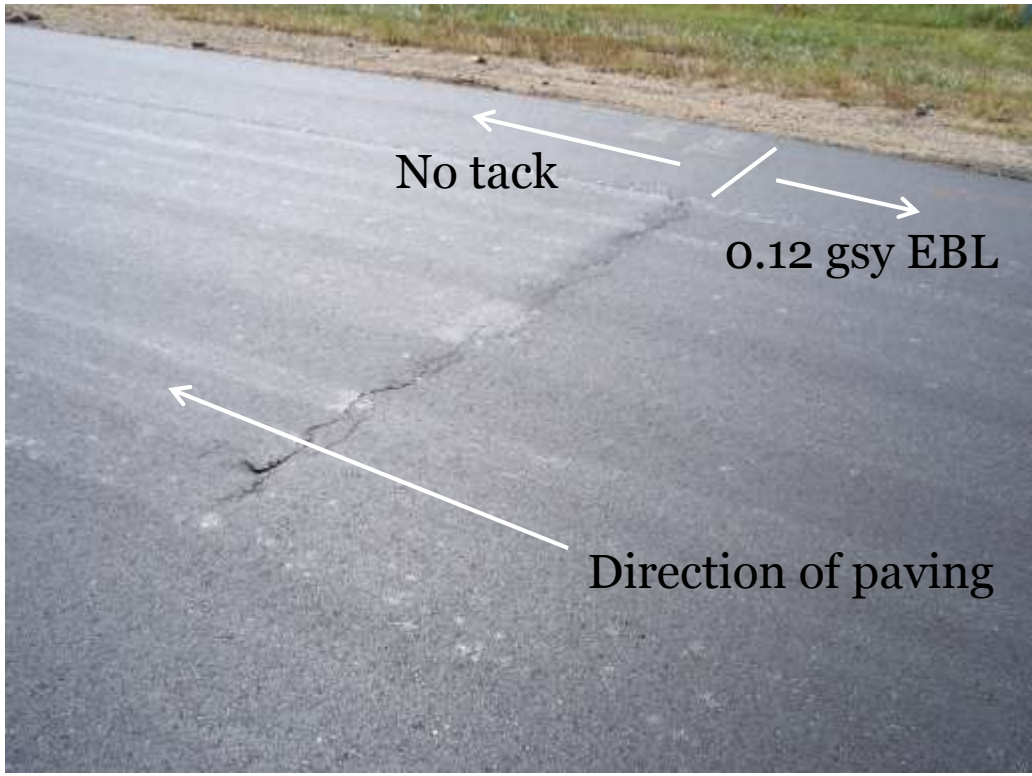
Tack vs No Tack – a field experiment

2009 Washington KS project - US 36

- 0.12 gal/yd2 EBL through spray paver
- Short section – shut off tack
  - Transverse tear from the mix sliding with no tack



No Tack over a Milled Asphalt Surface
US 36 Washington Co. KS 2009

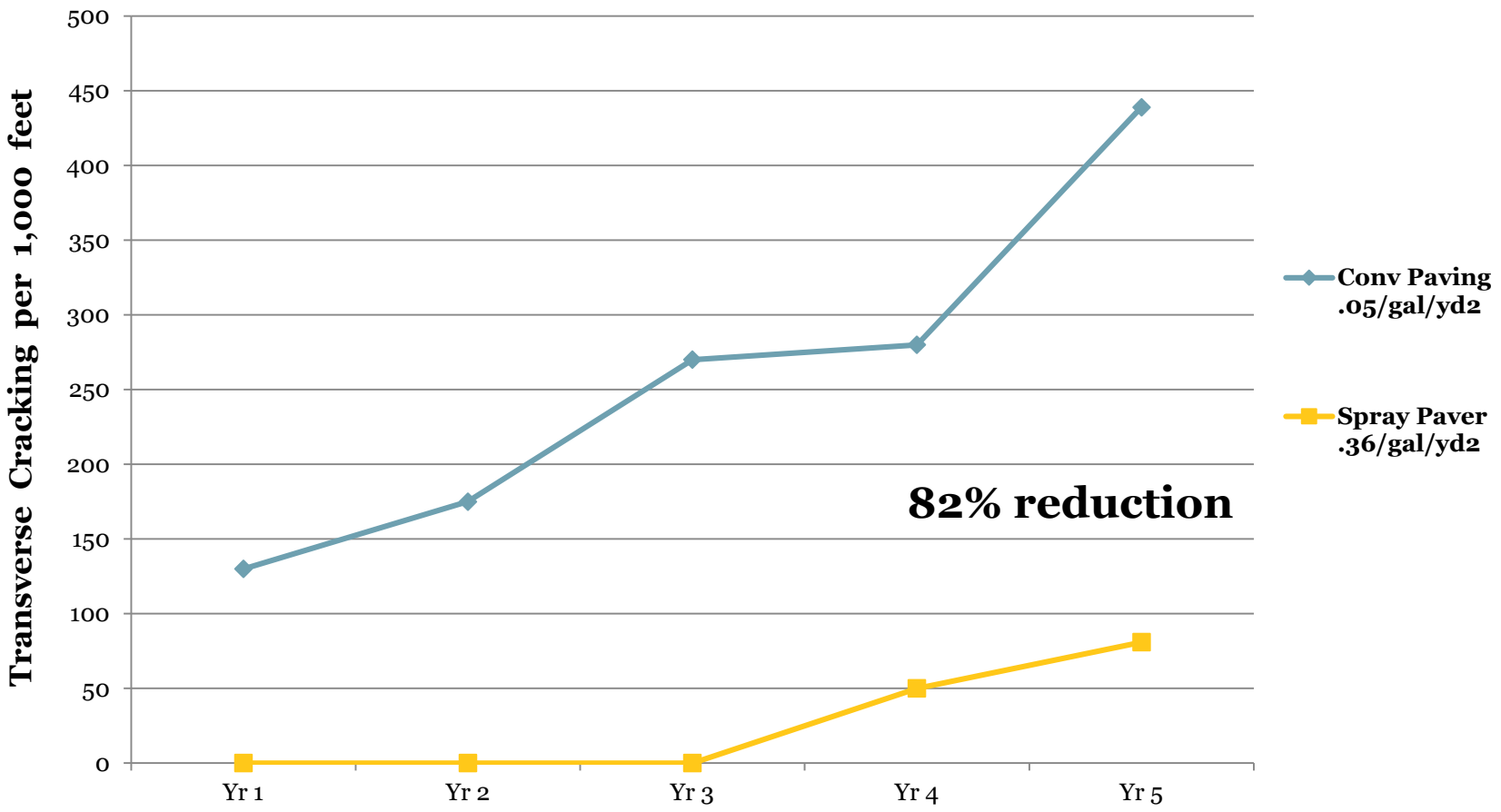
No tack over a milled surface – 2 years later

- US 36 Washington County, KS
- Fatigue cracking in the inside wheel path
- Effect of unbonded overlay

KDOT US-36 Marshall Co – 2010 Construction

1" Mill, 1" SR-9.5A, PG 70-28

Transverse Crack Length at 5 years



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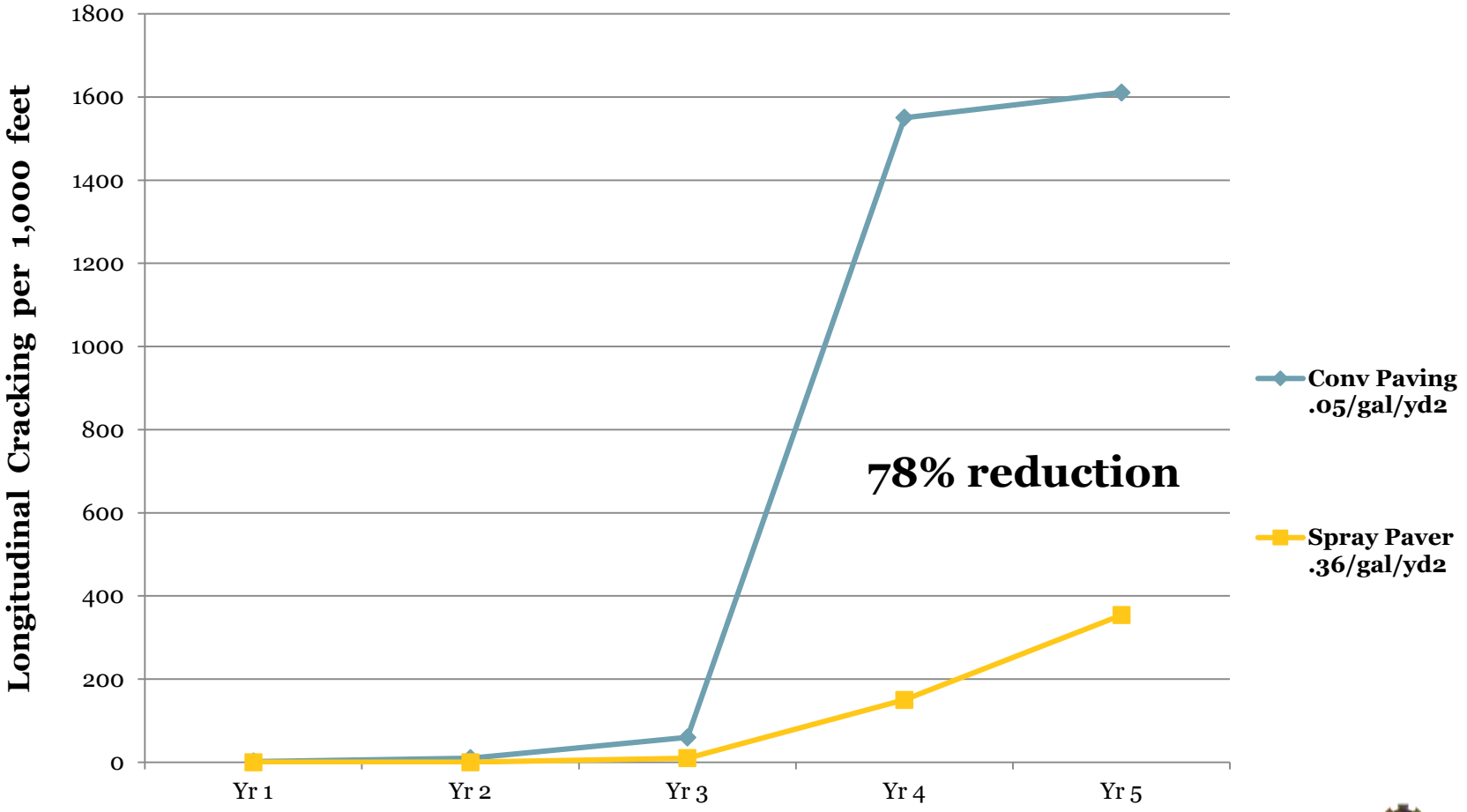

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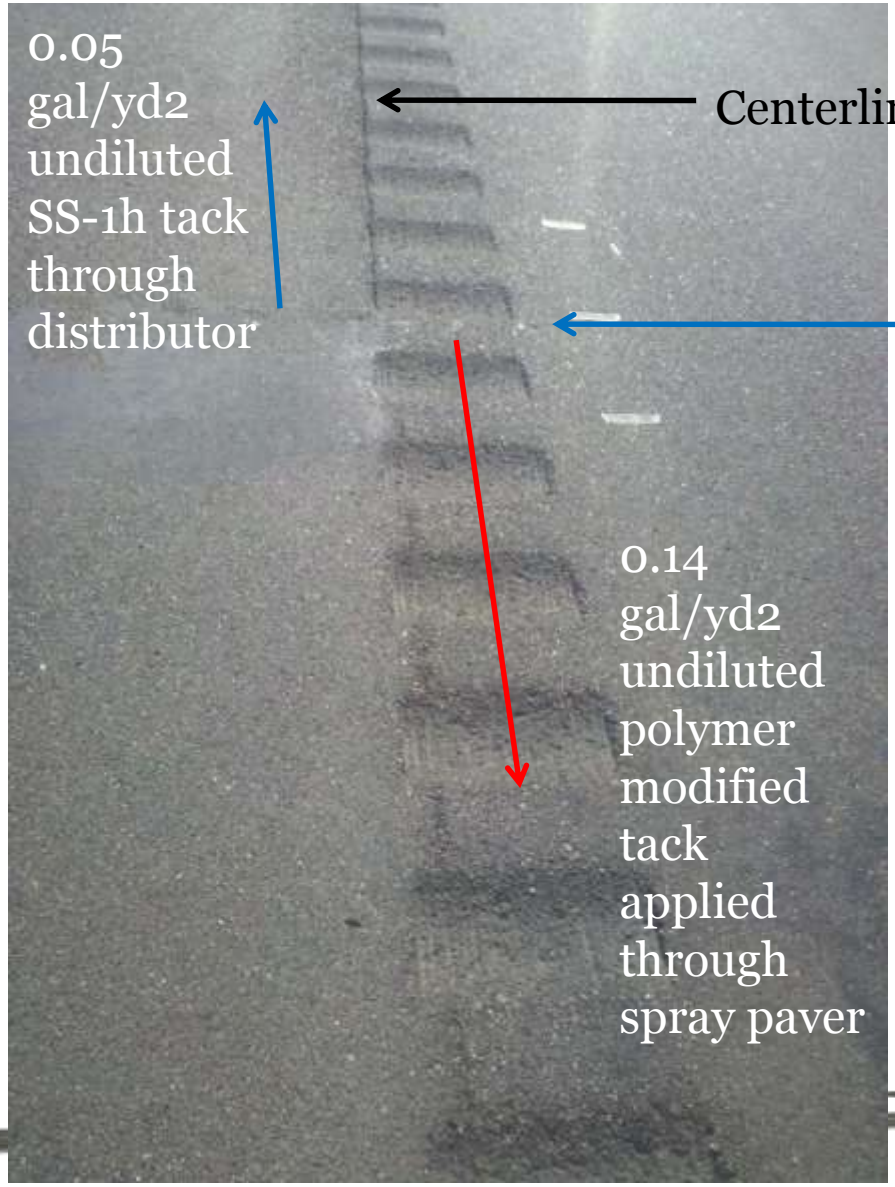
KDOT US 36 Marshall Co. (Const. 2010)



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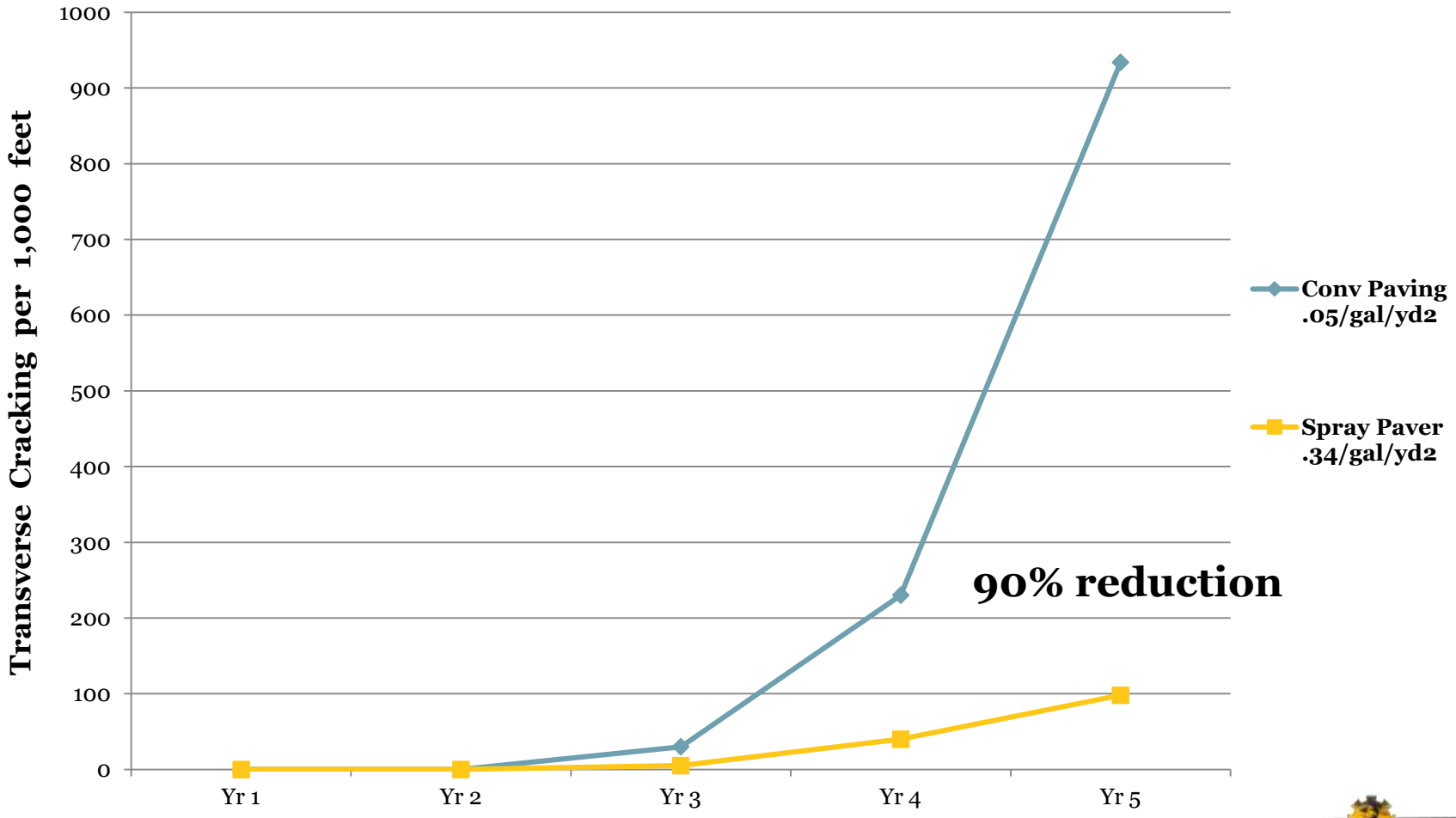
KDOT US-36 Nemaha Co – 2010 Construction

4” CIR, 1 1/2” SR-12.5A, PG 70-22

Transverse Crack Length at 5 years



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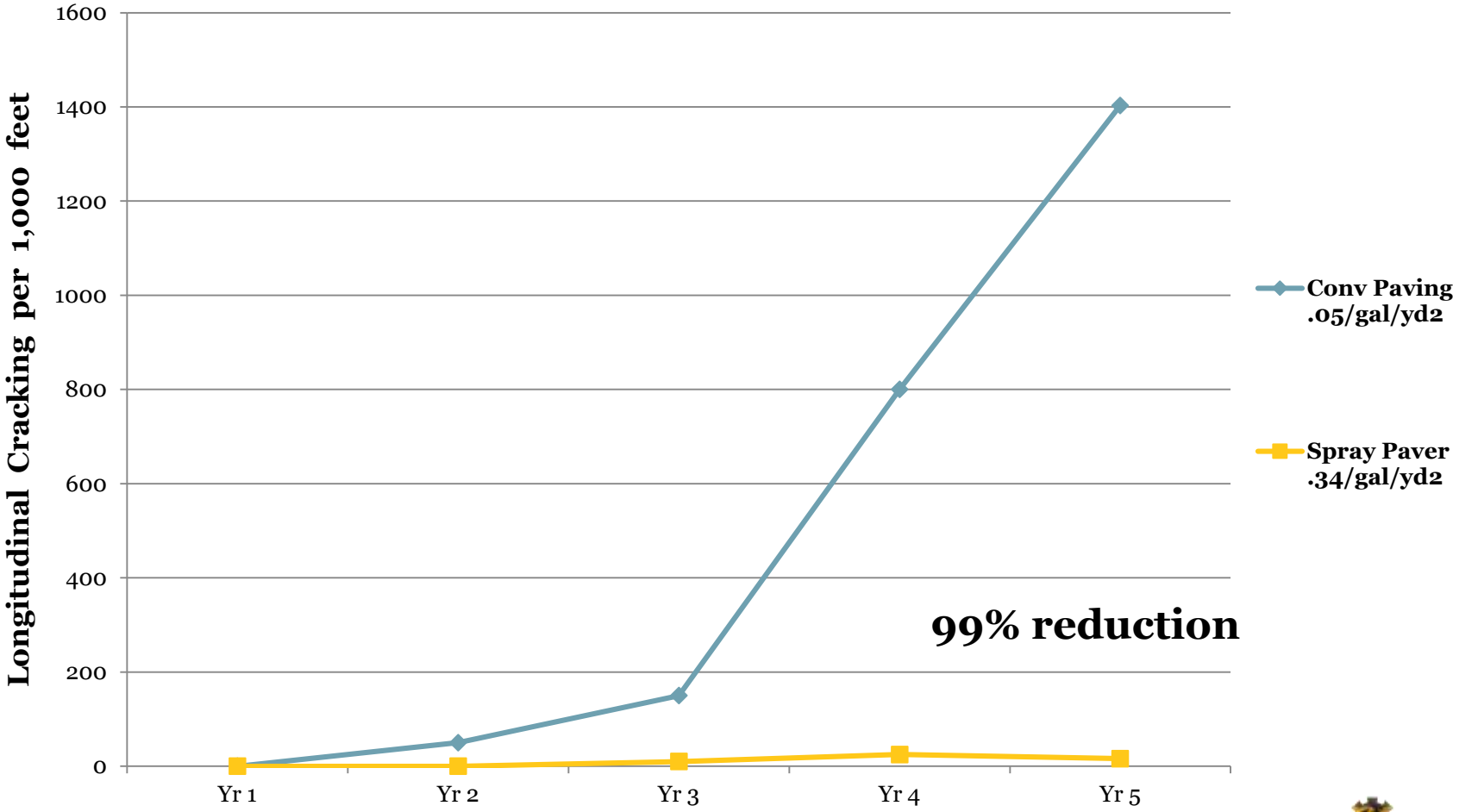
KDOT US-36 Nemaha Co – 2010 Construction

4” CIR, 1 1/2” SR-12.5A, PG 70-22

Longitudinal Crack Length at 5 years



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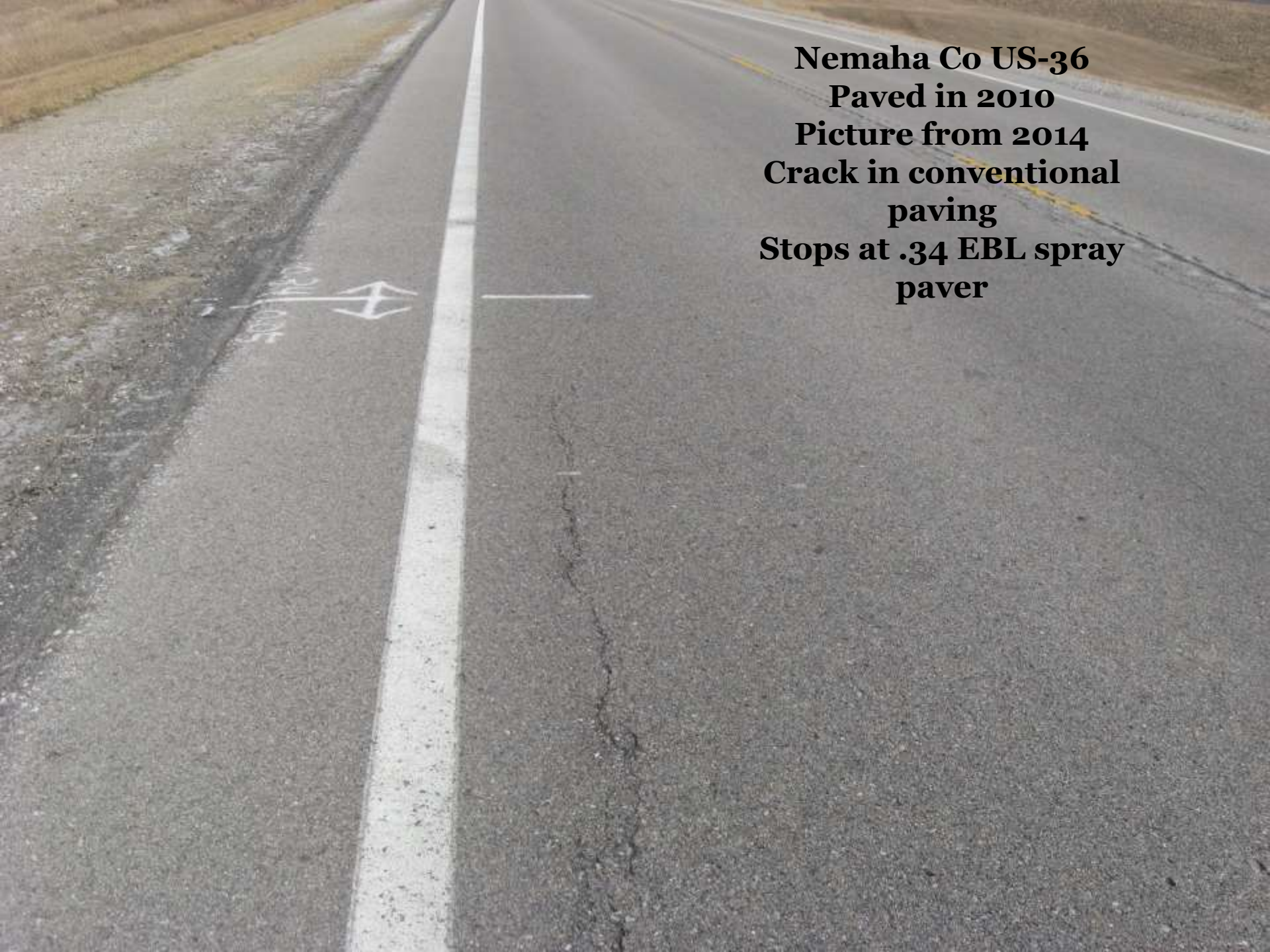


Nemaha Co US-36
Paved in 2010
Picture from 2014
Crack in conventional paving
Stops at .34 EBL spray paver

Summary of Crack Reduction

- **Transverse Cracking – 73% reduction**
- **Longitudinal Cracking – 83% reduction**

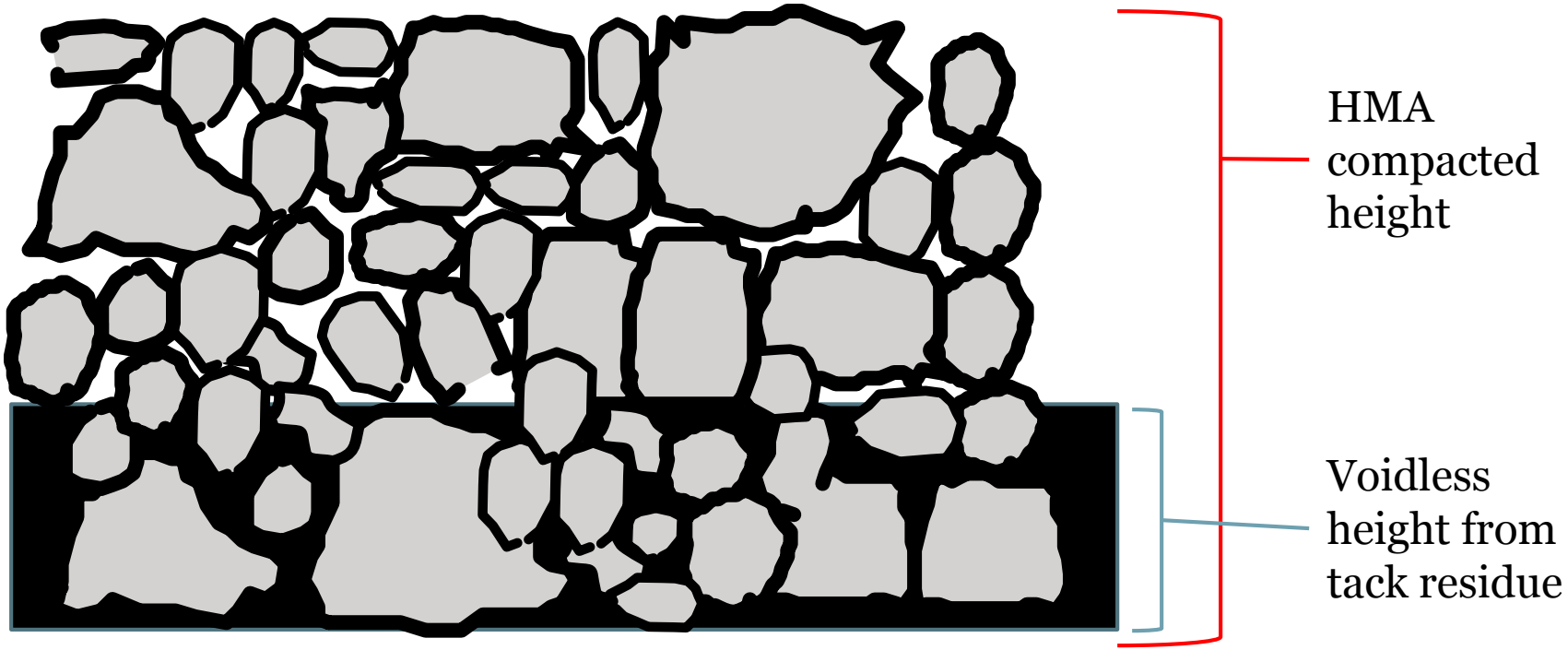
- **(Projects that are at least 5 years old with research/control sections)**
- **Projects had various lift thicknesses, mill/no mill, mix type, and binder grade**

NCAT Results – Conventional vs Spray Paver

- 2009 PFC surface placed with conventional tack
  - Surface cracks after 2.2M (cracking/pumping at 6.5M)
- 2009 bonded PFC surface placed with spray paver
  - Surface cracks after 4.1M (very good at 6.5M)

Saturation at Interface Creates Voidless Height in HMA

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

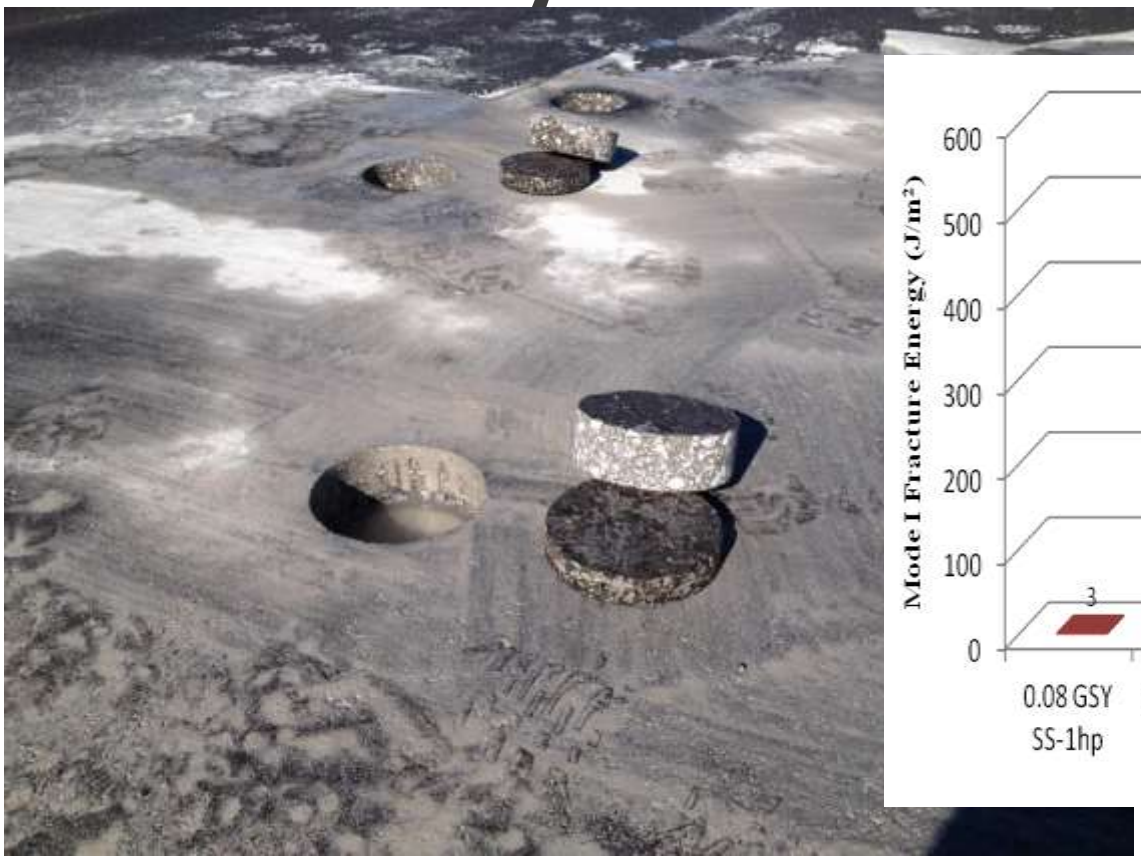


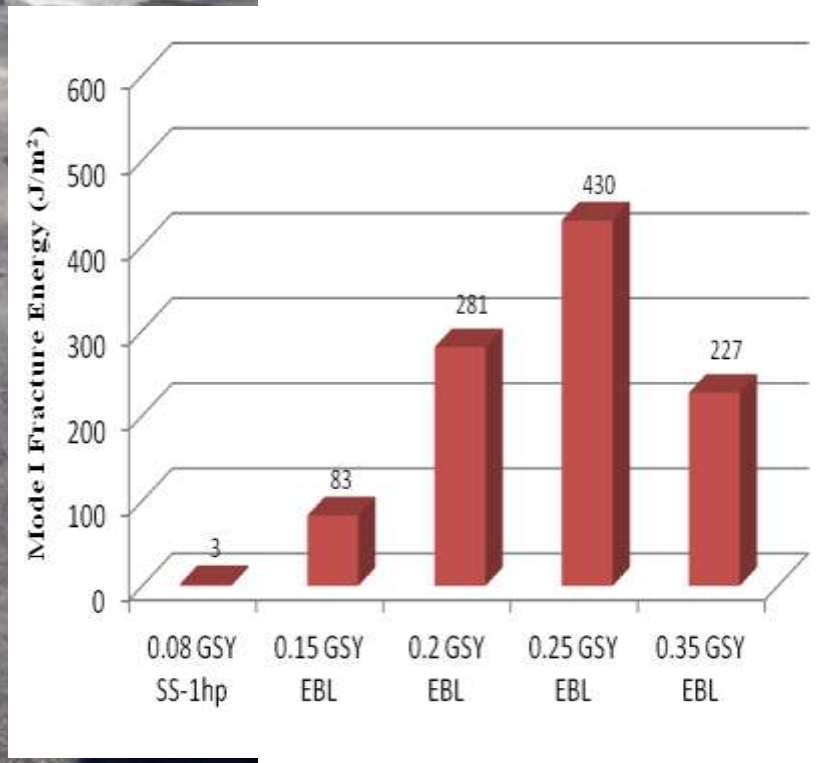
REASONS TO USE A SPRAY PAVER

1. BETTER BOND THAN CONVENTIONAL TACK
2. CAN PERFORM UNDERSEAL AND OVERLAY IN ONE ACTION
3. BETTER CRACK PERFORMANCE IN FIELD TRIALS
4. AESTHETICS
5. ELIMINATES THE POTENTIAL FOR PUBLIC TO GET TACK ON THEIR VEHICLES

BETTER BOND

University of Illinois Research (I-35)





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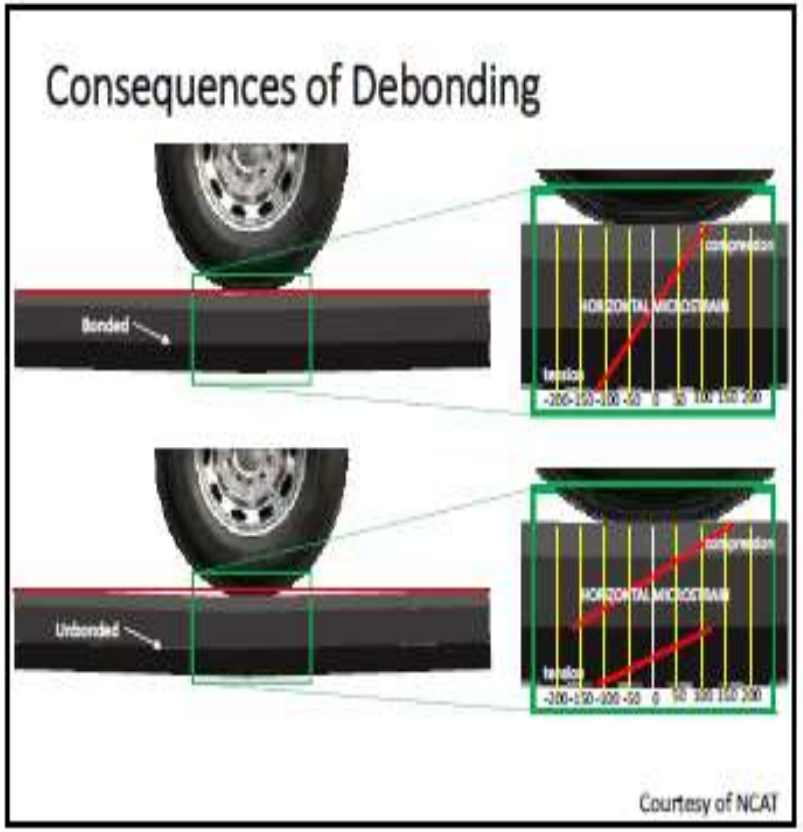
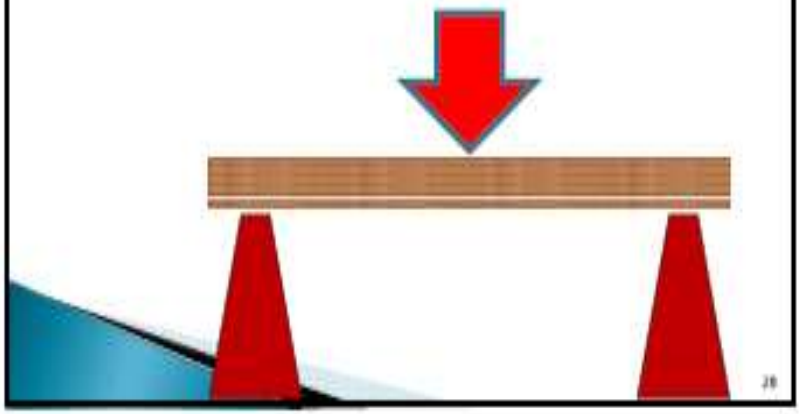
Better Bond

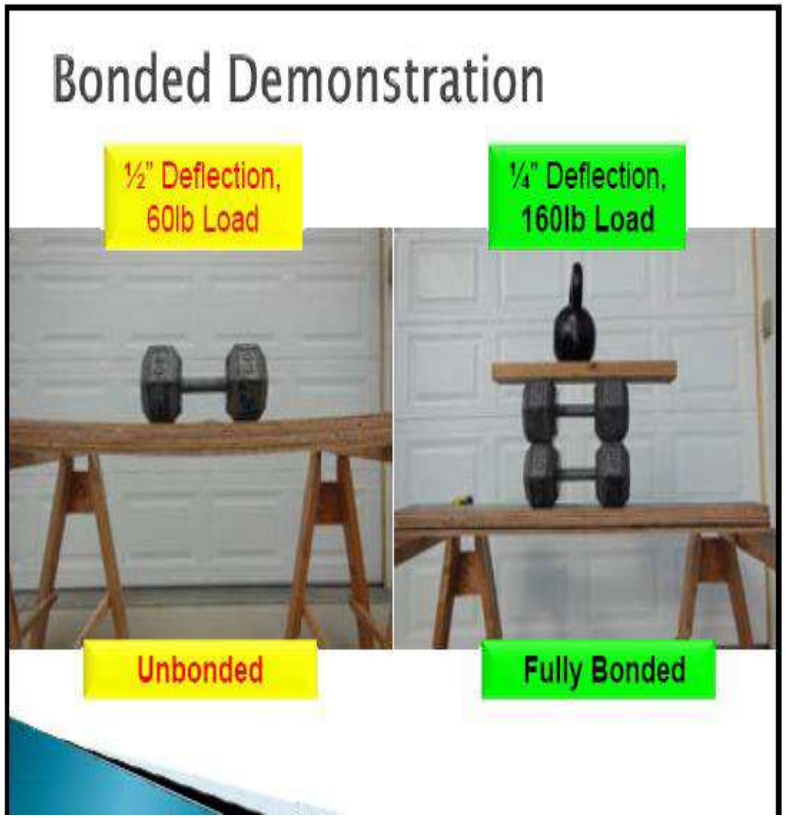


Bonded Demonstration

- Up to 5 sheets (layers)
- 48" x 4" x 11/32"
- 60, 100, or 160 pound loadings
- Various Bonding Configurations



Better Bond



Bonded Demonstration Highlights

- 2 bonded layers had less deflection than 5 unbonded with the same loading (60#).
- 5 unbonded layers deflected 4x more than 5 bonded with the same loading (60#).
- *5 bonded layer with over 2½x the load deflected half as much as 5 unbonded.*

CAN PERFORM UNDERSEAL AND OVERLAY IN ONE ACTION

AESTHETICS

Conventional Paving

Spray Paving

PROTECT PUBLIC IN URBAN SETTING

-Concerned about public driving across tack when leaving businesses or residences.
-No need to spray tack in front of paving train and wait for it to break.
-No complaints from public about getting tack on their vehicles.
-Still need to protect mat from traffic with flaggers until rolled.
-Much shorter time to flag entrances.

Cost of Early Cracking

- Crack Seal – Average $5,500/mile
- Chip Seal – Average $32,000/mile
- Striping – Average $6,000/mile
- Total = $43,500/mile
- $500,000 spent on 11.5 mile HG Co project within 1 year alone
- User delay cost
- Bad publicity

Where have spray pavers been used?

- Thousands of projects have been paved over the last 15 years in the US
- Almost every state has done a spray paver project

What type of HMA mixes and shot rates have been used?

- SuperPave/Dense graded, Open Graded, NovaChip (Gap graded)
- ½ inch to 2.5 inch lifts
- Shot rates have ranged from .15 to .46 gallons per square yard
- Have never seen flushing or rutting with dense graded mixes

Cost of Tack

- **Recent KDOT projects**:
  - Harvey I-135
    - SS-1HP – $479.47
    - EBL (like CRS-2P) - $445.18/ton
  - Miami Co US-69
    - SS-1HP – 575.00
    - EBL - $550.00

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Questions?