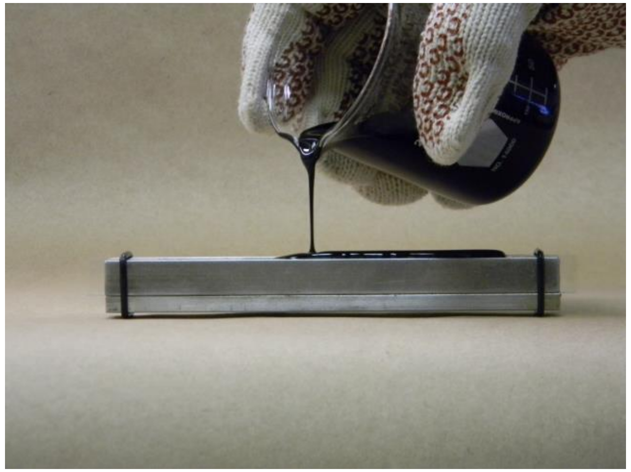
ASPHALT INSTITUTE







ASPHALT INSTITUTE

AIEI

ASPHALT | INNOVATE | ENLIGHTEN | IMPLEMENT

WTRC

Western Transportation Research Consortium

High Polymer Modified Asphalt Binders and Mixtures: *A Strategic Look at Gaps and Implementation Opportunities*

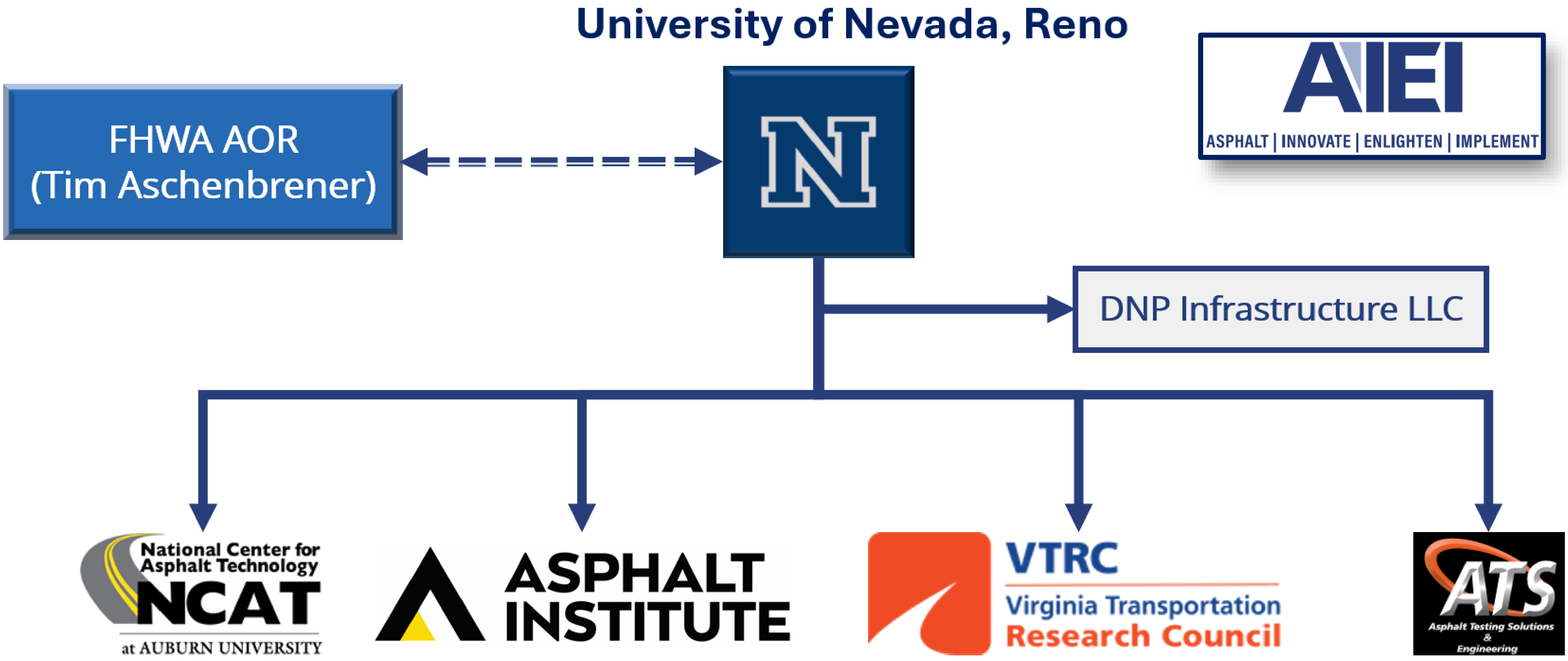
Jhony Habbouche, Ph.D., P.E.

Western Regional Engineer, Asphalt Institute

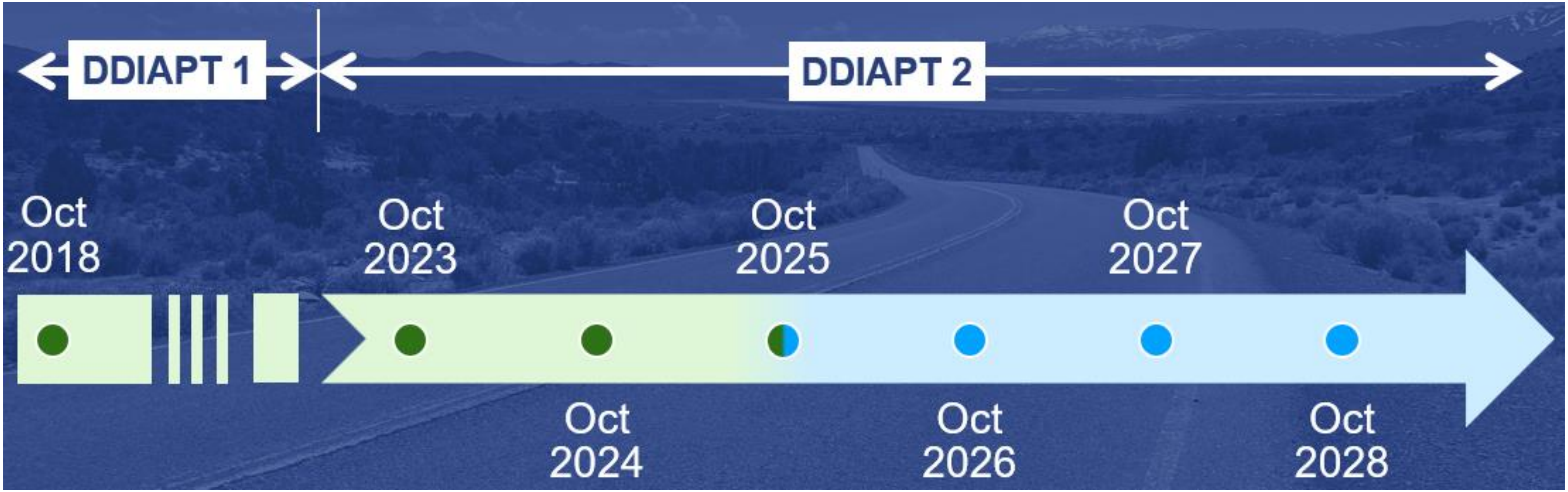
Western Transportation Research Consortium (WTRC) – Virtual Discussion

Day 2 - Wednesday, February 4th, 2026

Introducing the AIEI Program and Team



AIEI Timeline



HP Gap Analysis - Project Team

ASPHALT INSTITUTE

A Strategic Look at Gaps and Implementation Opportunities for High Polymer Modified Asphalts

Jhony Habbouche, Ph.D., P.E., *AI*

David R. Johnson, P.E., *AI*

Ilker Boz, Ph.D., P.E., *VTRC*

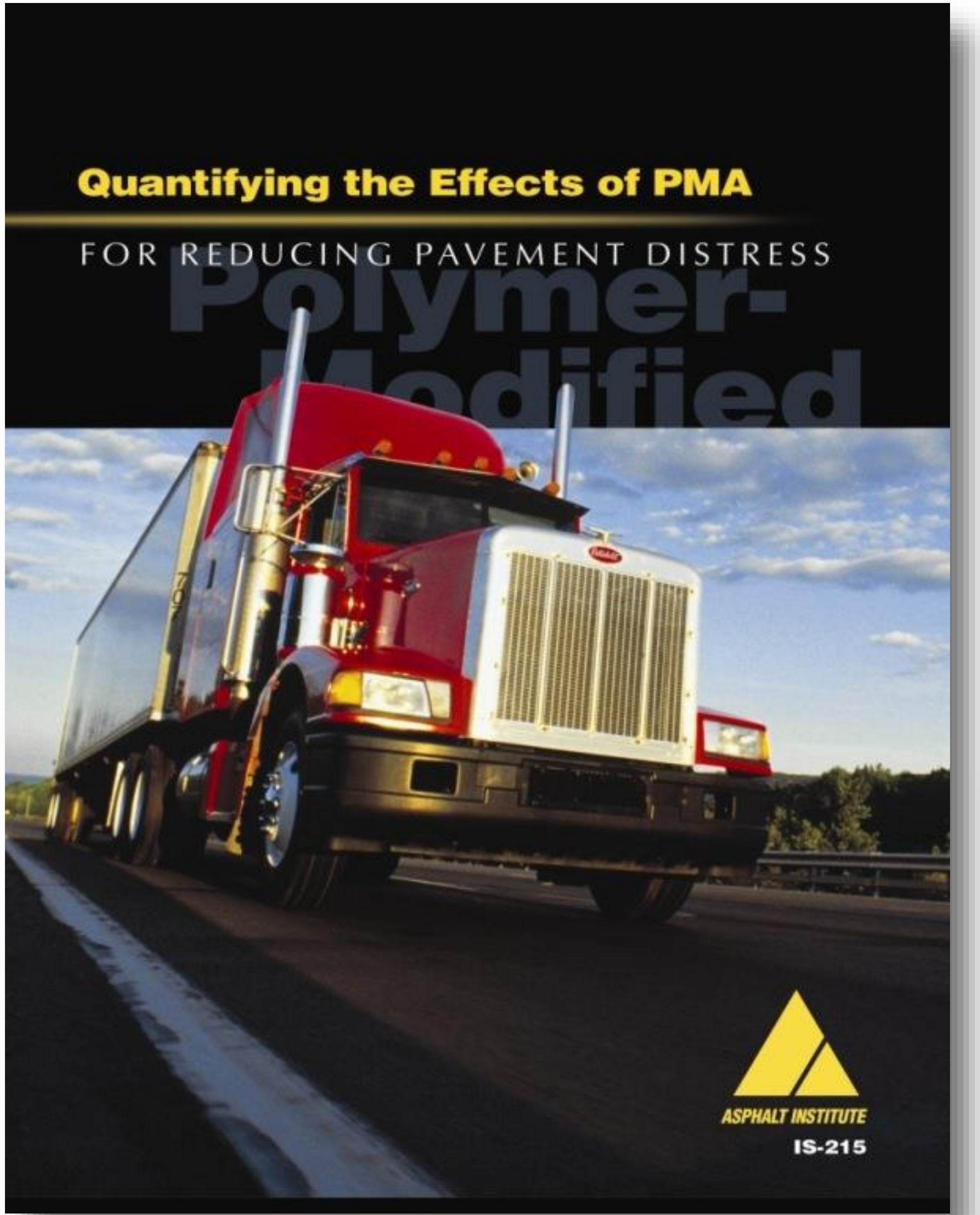
Stacey D. Diefenderfer, Ph.D., P.E., *VTRC*

Elie Y. Hajj, Ph.D., *UNR*

Timothy Aschenbrener, P.E., *FHWA*

Lots of Research and Practice on PMA!

ASPHALT INSTITUTE



Quantifying the Effects of PMA for Reducing Pavement Distress

- This study (published in 2005) used national field data to determine enhanced service life of pavements containing polymer modified binders versus conventional binders.

Lots of Research and Practice on PMA!

ASPHALT INSTITUTE

Use of Polymer-Modified Asphalts (PMA) in Dense-Graded Mixtures: Internet Survey and Tools to Measure Return on Investment

Kevin D. Stuart[a], Walaa S. Mogawer[b] and Shane Underwood[c]

[a]*Consultant, Phoenixville, PA, 19460*

[b]*University of Massachusetts Dartmouth, North Dartmouth, MA, 02747*

[c]*North Carolina State University, Raleigh, NC 27695*

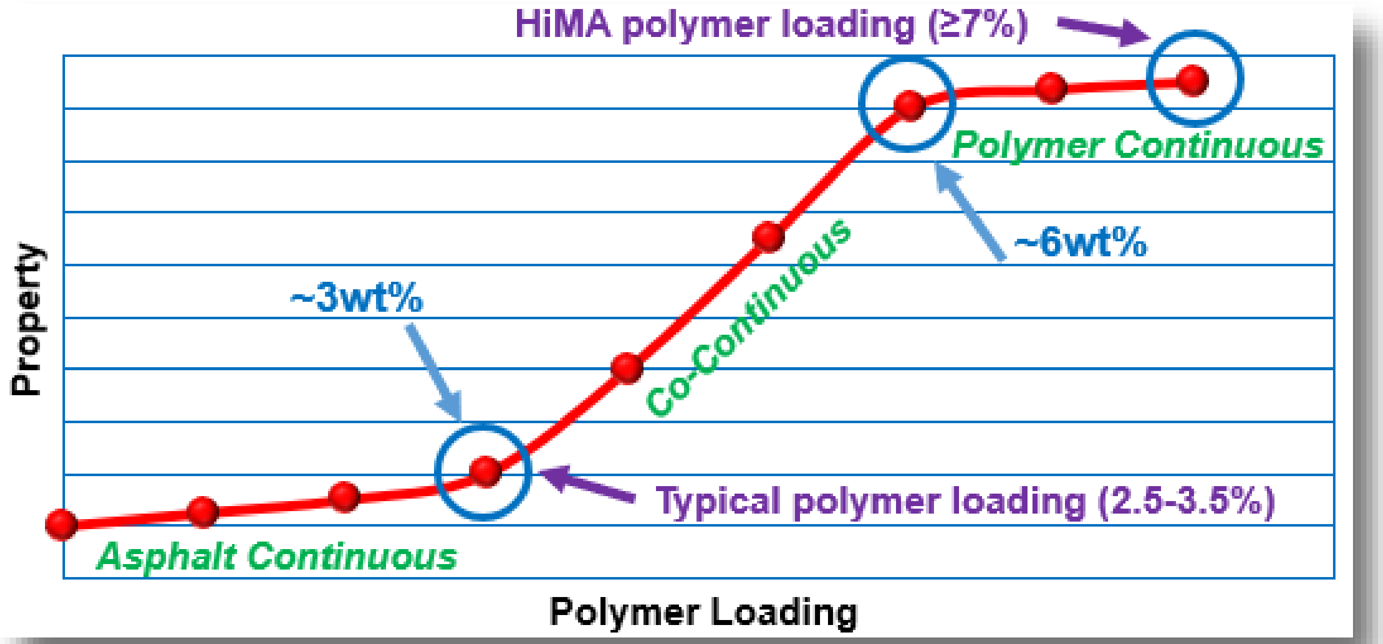
Use of Polymer-Modified Asphalts (PMA) in Dense-Graded Mixtures: Internet Survey and Tools to Measure Return on Investment

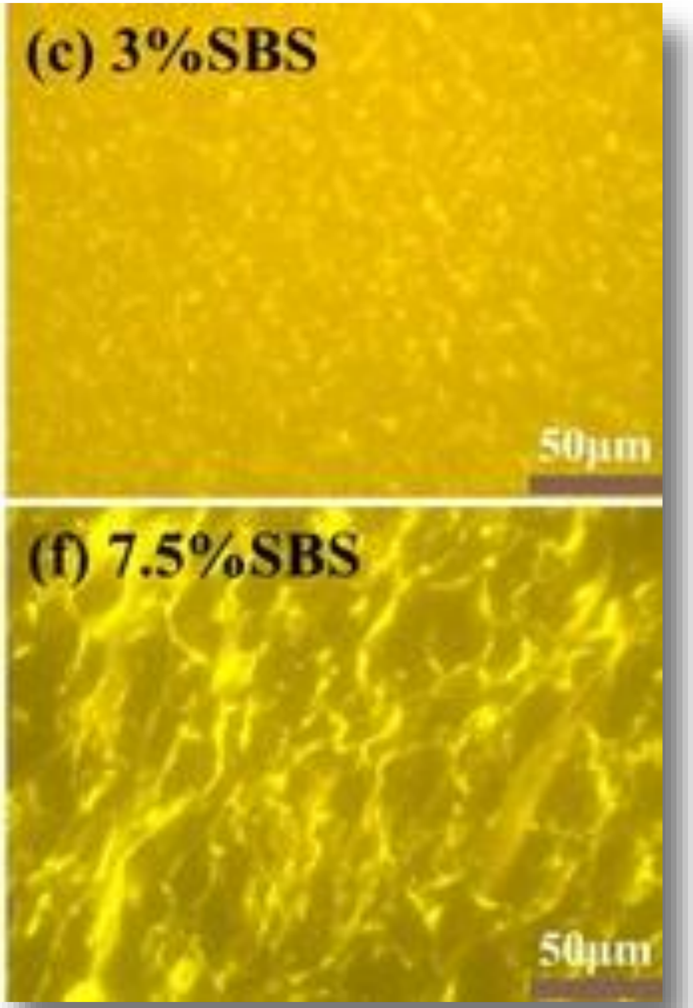
- The primary objective of this study was to recommended one or more tools that highway agencies can use to ensure that there will be a sufficient return on investment when using PMAs in dense-graded mixtures.

What Makes Asphalt Binders "High Polymer"?

ASPHALT INSTITUTE

- **Definitions may vary:**
  - ❑ **Polymer Type** (SBS, SB, SBR, Terpolymer, etc.)
  - ❑ **Polymer % often > DOUBLE standard dosage**
    - ➢ PMA (2.5%-3.5%)
    - ➢ HP (>5-6%); HiMA™ >7.0%
  - ❑ **Final properties based on dosage/neat asphalt grade**

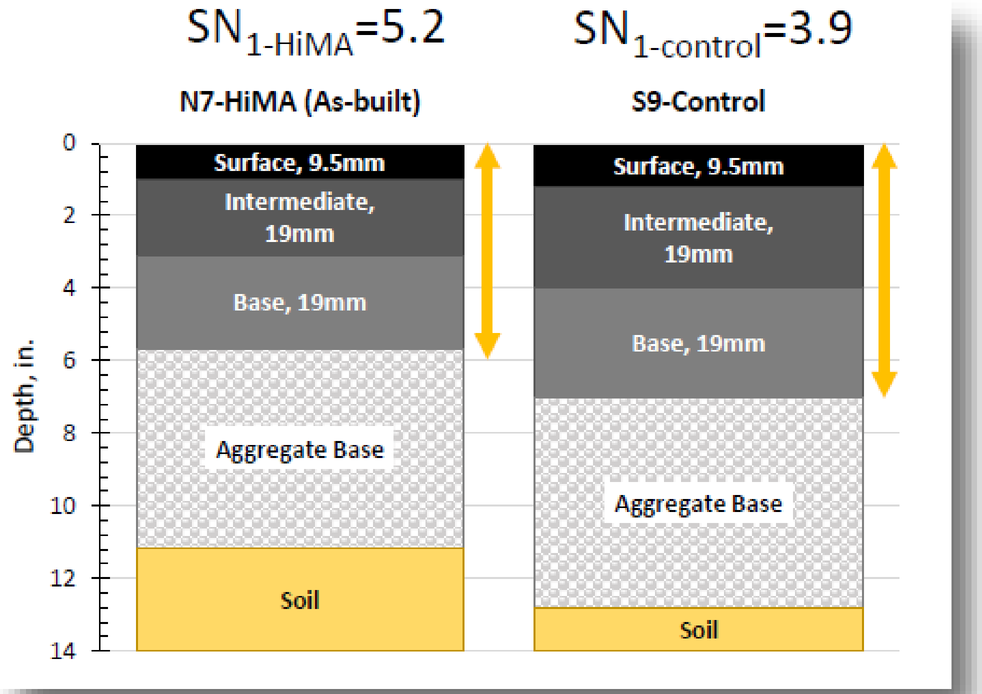


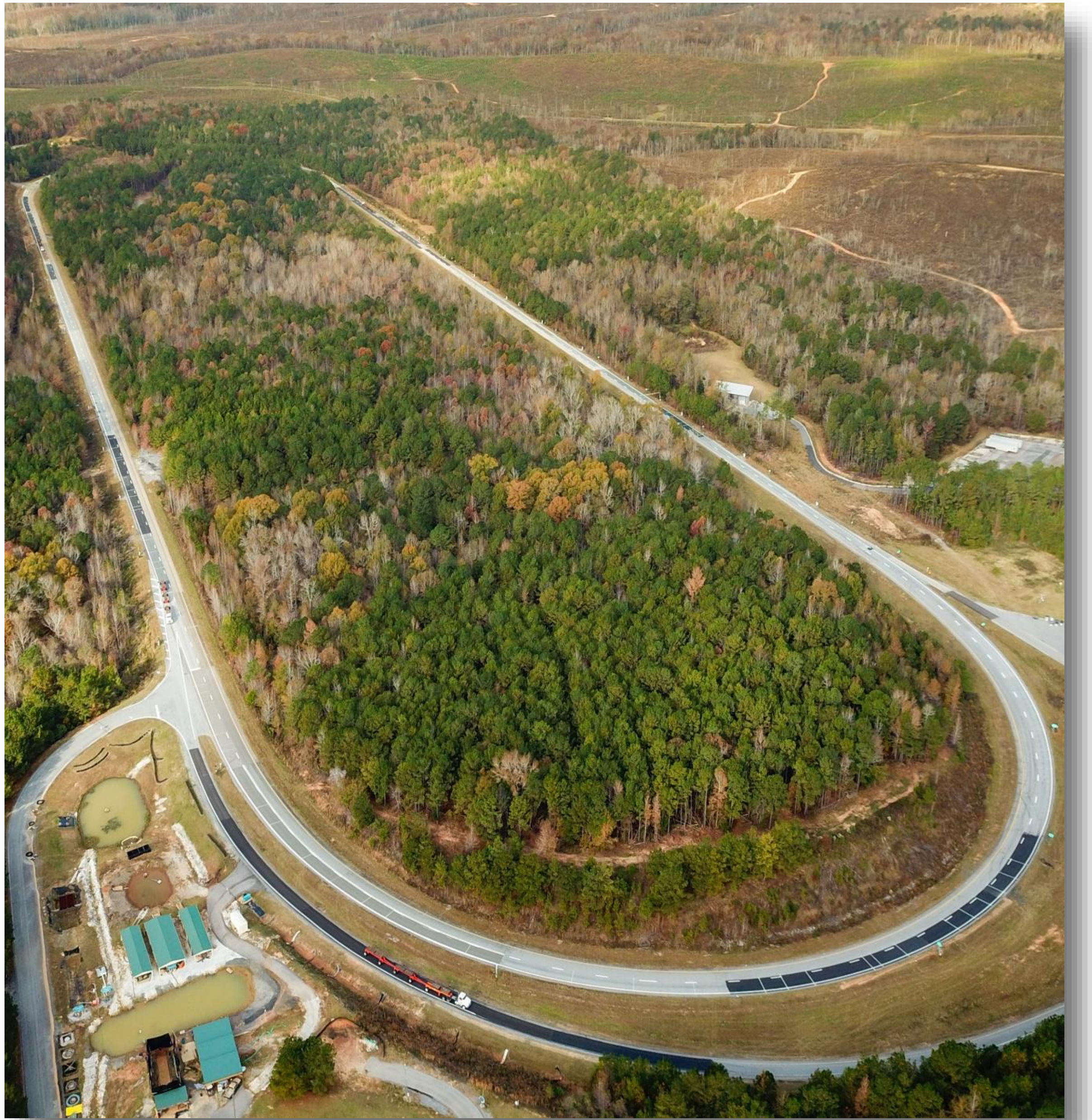


Zou et. al (2023)

NCAT, Auburn, AL (2009-2015)

- **Recommendation to use an AASHTO structural layer coefficient 70% higher for HiMA™:**
  - ❑ Built in 2009
  - ❑ 2 cycles, 20 million ESALs
  - ❑ Excellent performance





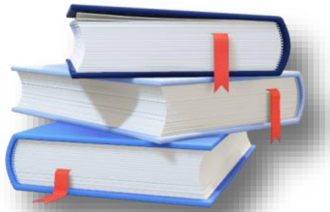
Structural Coefficient for HP Mixtures

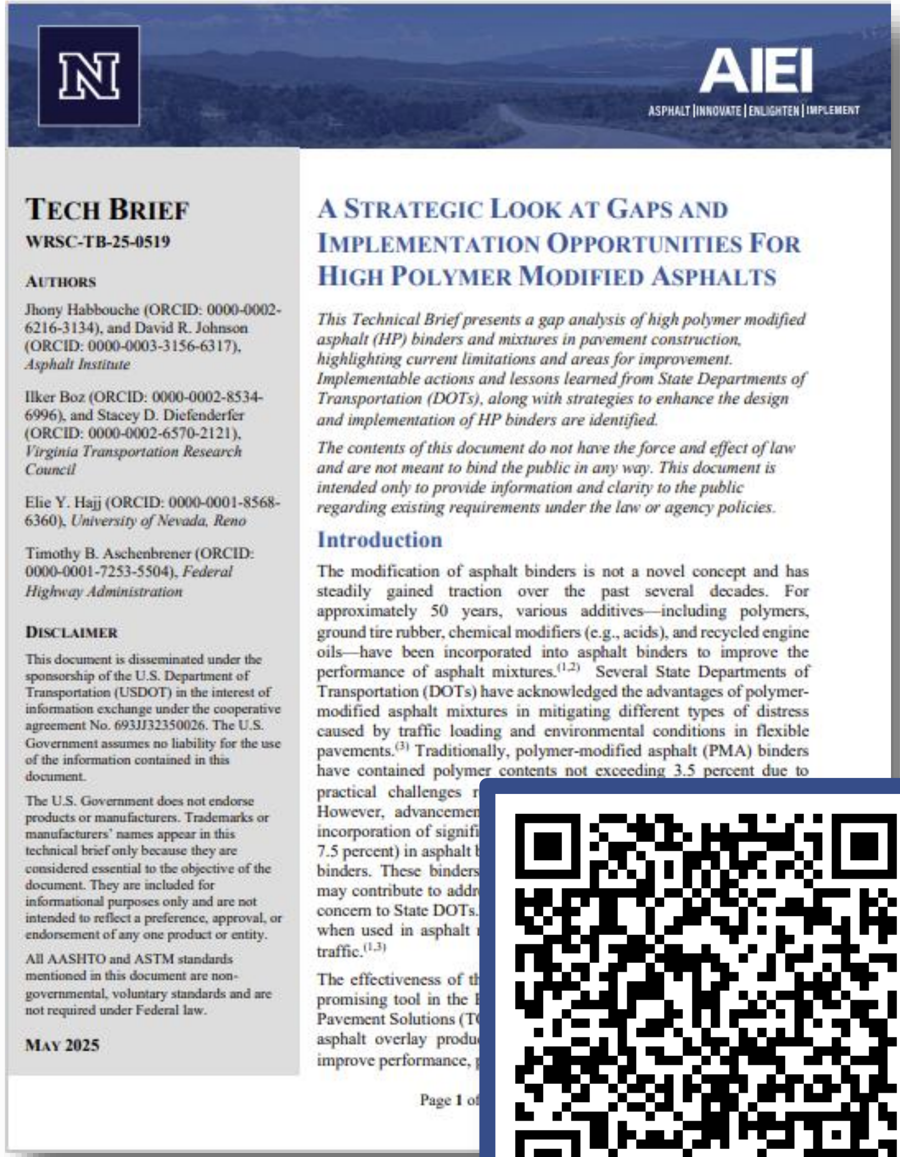
ASPHALT INSTITUTE

- **For Florida DOT:**
  - **0.54** for HP mixtures compared to **0.44** for PMA mixtures
  - Based on performance properties of binders and mixtures and mechanistic-empirical simulations and analyses *(bottom-up fatigue cracking, rutting, shoving, and reflective cracking)*
- **NCAT Test Track** *(2010 and 2015 Sections)*:
  - **0.75 and 0.92** for HP mixtures → **0.44 and 0.54** for PMA mixtures
  - Based on in-situ strain measurements & lab fatigue performance

Objective and Scope of Work

- **Facilitate and conduct a comprehensive gap analysis on the use of HP binders and mixtures and identify critical limitations, gaps, and needs through a S.W.O.T analysis:**
  - ➢ Identify and put forth positive practices and lessons learned by DOTs.
  - ➢ Complement the work completed under FHWA EDC-6 TOPS program





AIEI
ASPHALT | INNOVATE | ENLIGHTEN | IMPLEMENT

TECH BRIEF
WRSC-TB-25-0519

AUTHORS

Jhony Habbouche (ORCID: 0000-0002-6216-3134), and David R. Johnson (ORCID: 0000-0003-3156-6317), *Asphalt Institute*

Ilker Boz (ORCID: 0000-0002-8534-6996), and Stacey D. Diefenderfer (ORCID: 0000-0002-6570-2121), *Virginia Transportation Research Council*

Elie Y. Hajj (ORCID: 0000-0001-8568-6360), *University of Nevada, Reno*

Timothy B. Aschenbrener (ORCID: 0000-0001-7253-5504), *Federal Highway Administration*

DISCLAIMER

This document is disseminated under the sponsorship of the U.S. Department of Transportation (USDOT) in the interest of information exchange under the cooperative agreement No. 693JJ32350026. The U.S. Government assumes no liability for the use of the information contained in this document.

The U.S. Government does not endorse products or manufacturers. Trademarks or manufacturers' names appear in this technical brief only because they are considered essential to the objective of the document. They are included for informational purposes only and are not intended to reflect a preference, approval, or endorsement of any one product or entity.

All AASHTO and ASTM standards mentioned in this document are non-governmental, voluntary standards and are not required under Federal law.

MAY 2025

A STRATEGIC LOOK AT GAPS AND IMPLEMENTATION OPPORTUNITIES FOR HIGH POLYMER MODIFIED ASPHALTS

This Technical Brief presents a gap analysis of high polymer modified asphalt (HP) binders and mixtures in pavement construction, highlighting current limitations and areas for improvement. Implementable actions and lessons learned from State Departments of Transportation (DOTs), along with strategies to enhance the design and implementation of HP binders are identified.

The contents of this document do not have the force and effect of law and are not meant to bind the public in any way. This document is intended only to provide information and clarity to the public regarding existing requirements under the law or agency policies.

Introduction

The modification of asphalt binders is not a novel concept and has steadily gained traction over the past several decades. For approximately 50 years, various additives—including polymers, ground tire rubber, chemical modifiers (e.g., acids), and recycled engine oils—have been incorporated into asphalt binders to improve the performance of asphalt mixtures.[1,2] Several State Departments of Transportation (DOTs) have acknowledged the advantages of polymer-modified asphalt mixtures in mitigating different types of distress caused by traffic loading and environmental conditions in flexible pavements.[3] Traditionally, polymer-modified asphalt (PMA) binders have contained polymer contents not exceeding 3.5 percent due to practical challenges r
However, advancemen
incorporation of signifi
7.5 percent) in asphalt b
binders. These binders
may contribute to addr
concern to State DOTs.
when used in asphalt
traffic.[1,3]

The effectiveness of th
promising tool in the I
Pavement Solutions (T
asphalt overlay produ
improve performance,

Page 1 of

Critical Review of HP Binders and Mixtures

ASPHALT INSTITUTE

HIGH POLYMER-MODIFIED ASPHALT MIXTURES: A BATTLE OF STRATEGIES

BY **DR. JHONY HABBOUCHE, PH.D., P.E.** | DECEMBER 14, 2024

SHARE

Thinner pavements vs. longer lifespans

By Dr. Jhony Habbouche, Ph.D., P.E.

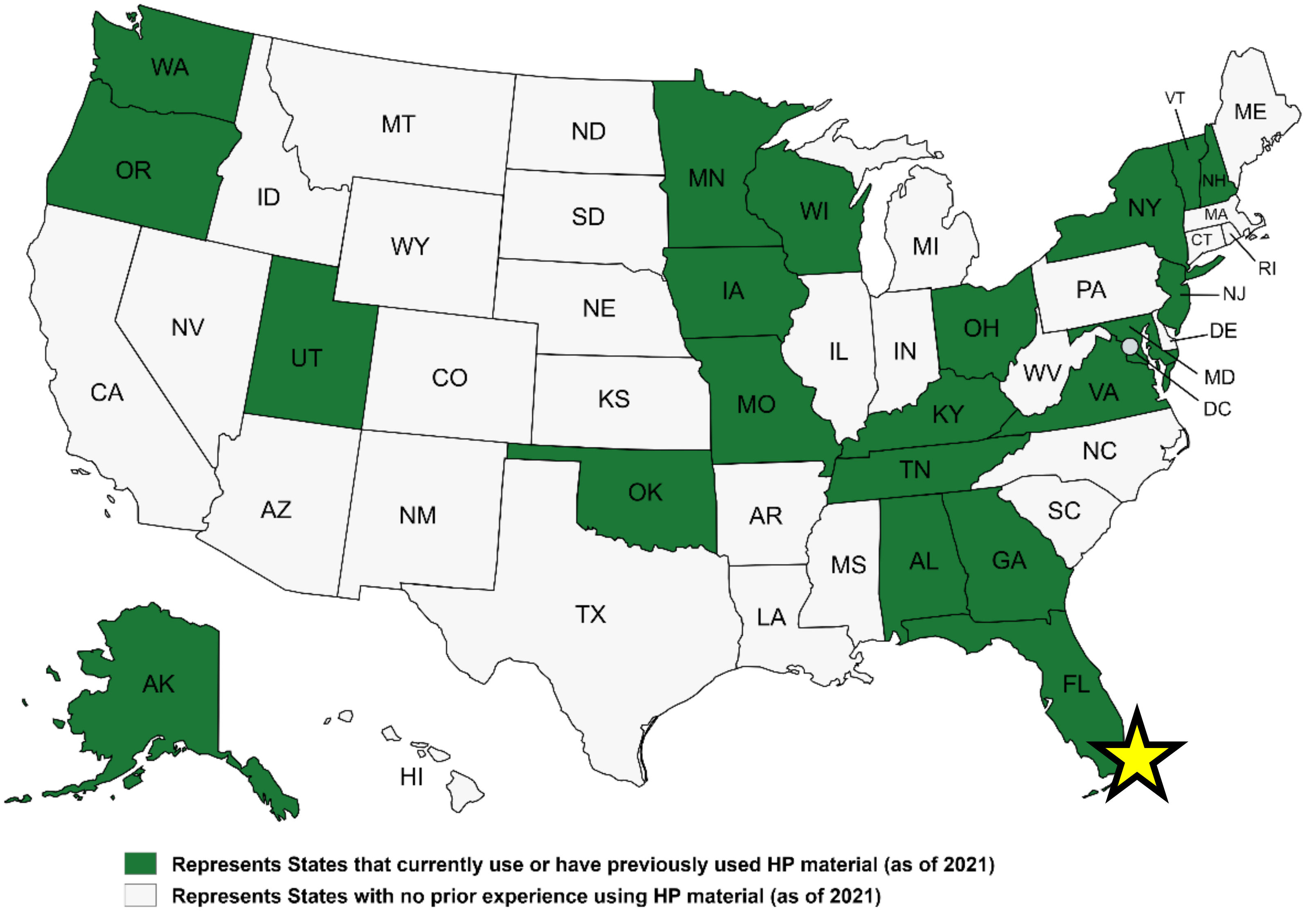
Articles

A critical review of high polymer-modified asphalt binders and mixtures

Jhony Habbouche, Elie Y. Hajj, Peter E. Sebaaly & Murugaiyah Piratheepan

Pages 686-702 | Received 16 May 2018, Accepted 14 Jul 2018, Published online: 02 Aug 2018

HP Technology: State-Of-The-Practice



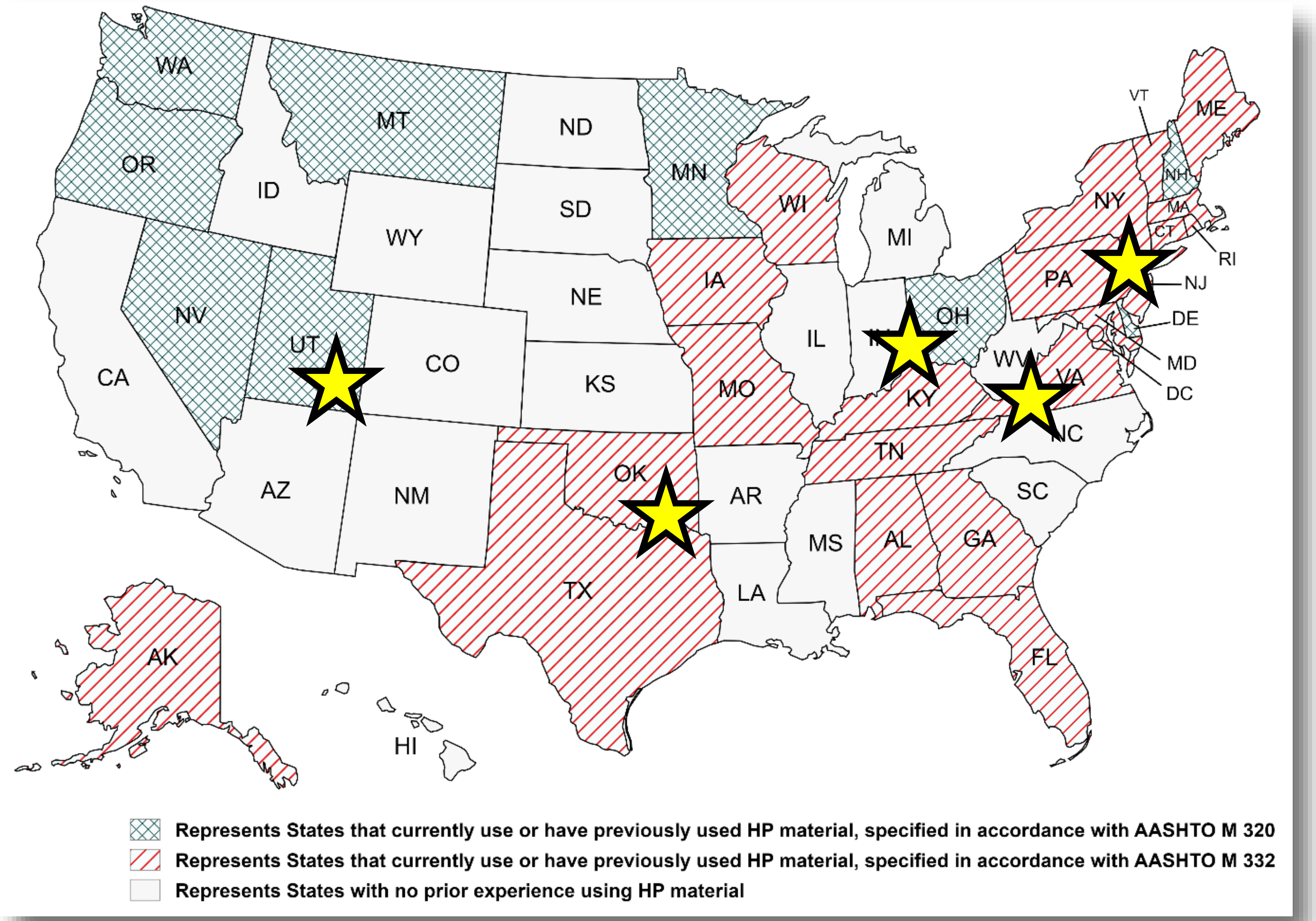
Habbouche et al. (2021), State of the Practice for High Polymer-Modified Asphalt Binders and Mixtures

VDOT

Accurate as of 2021

HP Technology: Review of State DOTs

ASPHALT INSTITUTE



Task 1:
Review of Literature and DOT Specifications

AIEI
ASPHALT | INNOVATE | ENLIGHTEN | IMPLEMENT

Accurate as of 2025

HP Technology: Selected Specifications

State	AASHTO Standard	Binder Properties	Mixture Properties
New Jersey	M 332 T 350 M 320	PG 76E-28 $J_{nr,\ 3.2} \leq 0.1$ kPa^{-1} & $R_{3.2} \geq 90\%$ at 76°C PG 94-22	Requirements based on intended application PG 94-22 designed for use in hot-applied chip seals
Ohio	M 320 T 301	PG 88-22 (reported as PG 88-22M) $R_e \geq 90\%$	n/a
Oklahoma	M 332 T 350	PG 76E-28 $J_{nr,\ 3.2} \leq 0.5$ kPa^{-1} & $R_{3.2} \geq 95\%$ at 76°C	n/a
Utah	M 320 T 301 T 313	PG 76-34 $R_e \geq 90\%$ $\Delta Tc \geq -1.0$°C	Use of high binder content by requiring high density compaction based on low void mix design for all applications, including both thin and thick asphalt layers.
Virginia	M 332 T 350	PG 76E-28 $J_{nr,\ 3.2} \leq 0.1$ kPa^{-1} & $R_{3.2} \geq 90\%$ at 76°C	n/a

n/a denotes not available.

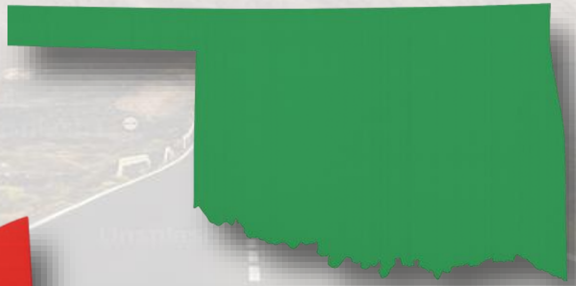
Selected States – Usage and Costs

State DOT	Cost Increase Compared to PMA(%)	Usage / Notes
New Jersey	+32%	~4.8 million tons placed over 6 years; cost varies with project size and technology availability. Continued use due to strong performance (fatigue, reflective cracking, rutting).
Ohio	+7-10% (large projects); +10-20% (small projects)	HP used since 2014; costs depend on tonnage, plant modifications, and project size. Used at intersections, bridge decks, and now exploring full-depth & thinner overlays.
Oklahoma	+21-31%	~307,887 tons (5 years; ~22 miles/year). Cost variation due to plant adjustments, location, and bidding. Used in structural overlays and as interlayers.
Utah	+6.6% ***Note:* SMA → +27.0%**	~27,595 tons placed since 2021; 525,000 tons planned (2024–25). Costs depend on trucking distance, location, and production adjustments. HiMod used in overlays and structural layers.
Virginia	+23-40% (≥ 8,000 tons); +13-87% (< 8,000 tons)	~94,293 tons placed since 2014. Cost variation by project size and plant setup. Used for reflective cracking and fatigue mitigation.

Selected States – Virtual Visit Memos

New Jersey

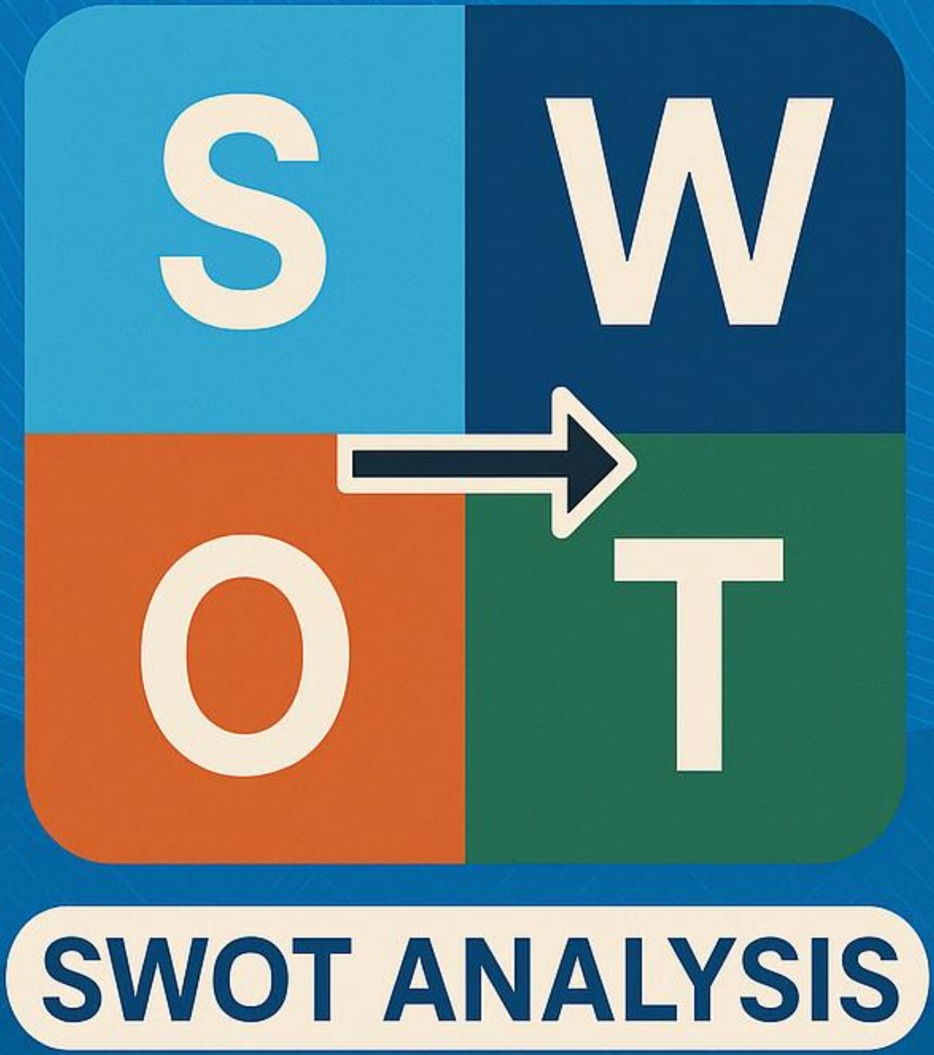
Ohio



Oklahoma

Utah

Virginia



AIEI
ASPHALT | INNOVATE | ENLIGHTEN | IMPLEMENT

A Strategic Look at Gaps and Implementation Opportunities For High Polymer Modified Asphalts

Tech Brief
WRSC-TB-25-0519

Authors

Jhony Habbouche (ORCID: 0000-0002-6216-3134), and David R. Johnson (ORCID: 0000-0003-3156-6317), *Asphalt Institute*

Ilker Boz (ORCID: 0000-0002-8534-6996), and Stacey D. Diefenderfer (ORCID: 0000-0002-6570-2121), *Virginia Transportation Research Council*

Elie Y. Hajj (ORCID: 0000-0001-8568-6360), *University of Nevada, Reno*

Timothy B. Aschenbrener (ORCID: 0000-0001-7253-5504), *Federal Highway Administration*

May 2025

This Technical Brief presents a gap analysis of high polymer modified asphalt (HP) binders and mixtures in pavement construction, highlighting current limitations and areas for improvement. Implementable actions and lessons learned from State Departments of Transportation (DOTs), along with strategies to enhance the design and implementation of HP binders are identified.

The contents of this document do not have the force and effect of law and are not meant to bind the public in any way. This document is intended only to provide information and clarity to the public regarding existing requirements under the law or agency policies.

Introduction

The modification of asphalt binders is not a novel concept and has steadily gained traction over the past several decades. For approximately 50 years, various additives—including polymers, ground tire rubber, chemical modifiers (e.g., acids), and recycled engine oils—have been incorporated into asphalt binders to improve the performance of asphalt mixtures.[1,2] Several State Departments of Transportation (DOTs) have acknowledged the advantages of polymer-modified asphalt mixtures in mitigating different types of distress caused by traffic loading and environmental conditions in flexible pavements.[3] Traditionally, polymer-modified asphalt (PMA) binders have contained polymer contents not exceeding 3.5 percent due to practical challenges related to mixing, storage, and workability. However, advancements in polymer technology have enabled the incorporation of significantly higher polymer contents (approximately 7.5 percent) in asphalt binders, referred to herein as high polymer (HP) binders. These binders exhibit substantially enhanced elasticity that may contribute to addressing certain pavement failure mechanisms of concern to State DOTs.[4,5] HP binders also offer additional advantages when used in asphalt mixtures subjected to heavy and slow-moving traffic.[1,3]

The effectiveness of the HP binder technology was highlighted as a promising tool in the Every Day Counts (EDC)-6: Targeted Overlay Pavement Solutions (TOPS) program toolbox, featured alongside other asphalt overlay products.[6] Its inclusion aimed to enhance safety, improve performance, preserve investments, and realize cost savings.

Page 1 of 16

HP Technology – S.W.O.T Analysis

ASPHALT INSTITUTE

STRENGTHS

WEAKNESSES

People

- **Variability in Expertise:** Differences in experience levels among DOTs, contractors, and researchers can lead to inconsistent implementation.
- **Limited Contractor Familiarity:** May require specialized handling, mixing, and placement techniques, which may not be widely understood.

HP Technology

- **Lack of Standardized Definition:** The absence of a formal definition for HP binders and mixtures among State DOTs creates inconsistencies in specifications and performance expectations.
- **Higher Initial Cost:** Increased material costs compared to conventional asphalt binders may limit widespread adoption.
- **Specification Variability:** Lack of standardized definitions and performance-based specifications across different agencies.
- **Potential Workability Concerns:** Higher polymer content may impact mixture compaction and field performance.
- **Optimization Challenges:** Issues related to polymer dosage, aggregate compatibility, tank storage stability, shelf life, and long-term durability in varying environmental conditions.

HP Technology: *Nomenclatures !!!*

ASPHALT INSTITUTE

High modulus asphalt (HIMOD or HMAC)
Stiffness

Highly polymer modified binder (HiMA)
Proprietary

High polymer binder (HP)
Non-proprietary (AI, VTRC, FDOT)

High polymer grade (HPG)
TxAPA

Highly-modified asphalt mix (HiMod)
UDOT

HP Technology – S.W.O.T Analysis

ASPHALT INSTITUTE

STRENGTHS
WEAKNESSES
OPPORTUNITIES
THREATS

- **Supply Chain and Material Availability:** Limited production capacity for high polymer-modified binders may create procurement challenges.
- **Budget Constraints:** Higher upfront costs may deter State DOTs with limited funding.
- **Workforce Training Needs:** Adoption may require additional training for engineers, inspectors, and contractors to ensure proper field implementation.
- **State Priorities:** Potential changes in infrastructure policies or funding priorities could impact adoption rates.

Key Strategies for Implementing HP Mixes

ASPHALT INSTITUTE

🔧 Performance-Based Approach

Prioritize MSCR, elastic recovery, and phase angle over polymer %.

Supports innovation and cost-effective sourcing.

📍 Application-Specific Use

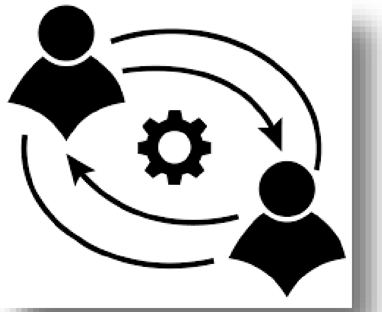
Tailor HP mixes to distress types (e.g., NJ, VA, OH, OK).

Not a substitute for poor structural design or maintenance

💰 Cost-Benefit Evaluation

Weigh higher initial cost vs. extended service life and reduced maintenance.

Use life-cycle cost analysis and project-specific comparisons.



🔁 Feedback Loop

Integrate lab testing, field data, and spec updates for continuous improvement.

Social Media Platforms - *Connect with Us*

ASPHALT INSTITUTE

Instagram
@AsphaltInstitute

LinkedIn
@asphalt-institute

Facebook
@AsphaltInstitute

Twitter
@Asphalt_Inst

Youtube.com/user/AsphaltInstitute

2026 AI Members – Priceless Support

ASPHALT INSTITUTE

AJAX, All States Materials Group, American Thermal, Amrize, Andrie, Arkema, A.C.I. Asphalt Cutbacks Inc., Asphalt & Fuel Supply, Asphalt & Wax Innovations

Asphalt Hawaii, Asphalt Materials, Inc., Asphalt Processors Incorporated, Associated Asphalt, Astec Heatec, Atlas, Avista Oil Group, BASF, bitubel, Bitumar

blue tide, bp, Bright Star Energy, Butterfield Enterprises, LLC, BWC Terminals, Calumet, Canadian Asphalt, Cargill, Cenovus Energy, Centennial Energy, LLC, CertainTeed

Certerra Analytical – PRI, Colas, Construction Partners Inc., Cook Chem, Corrie MacColl, CountryMark, CRH, Crafco Inc., Delek US, Dow

Dynasol Group, Ergon Asfaltos México, Ergon Asphalt & Emulsions, Ergon Asphalt Partners, Eurovia USA, ExxonMobil, Imperial, Flint Hills Resources

GAF, GLC General Liquids Canada, Gibson Energy, GIP Materials Engineering, Granite, GCAT, Greenmantra Technologies, Gunvor, HB Chemical, HF Sinclair

Hunt Refining Company, ICL Phosphate Specialty, Idaho Asphalt Supply, Inc., IKO, Ingevity, Innophos, Inter-Chem, its

Interstate Asphalt, Irving, Jebro Inc., Johns Manville, Kirby, KMI Kokosing Materials, Inc., Kraton, Lanxess, LCY catalyze innovation

LG Chem, Malarkey Roofing Products, Marathon Petroleum Company LP, Mathy Construction Co., McAsphalt, McCall, MGQ Terminal, Mountain States Asphalt Inc.

New Jersey Asphalt Terminal, Nouryon, Owens Corning, Payne+Dolan, Peckham Industries, Inc., Phillips 66, Pioneer Oil, LLC, Polyco, Polyglass

Ponderosa Solutions, Rawlings Creek Resources, LLC, RheTech Colors, Russell Standard, Safety-Kleen, SJR San Joaquin Refining Co., Sasol, Seneca Petroleum Company

S&S, Shrieve, Slurry Pavers, Inc., Solstice, Soprema, Sprague, Starchem USA, Suit-Kote

Suncor, SWT Group, Tamko Building Products LLC, Trafigura, TRCC, TSRC Specialty Materials LLC, United Refining Company, U.S. Oil & Refining Co., Valero

Vance Brothers, Vecenergy, Vista, Vitol, VSS Emultech, Warner Petroleum Corporation, World Oil, Wright Asphalt, yellowline asphalt products ltd.

ASPHALT INSTITUTE

Thank You!

QUESTIONS?


AIEI

ASPHALT | INNOVATE | ENLIGHTEN | IMPLEMENT

TECH BRIEF

WRSC-TB-25-0519

AUTHORS

Jhony Habbouche (ORCID: 0000-0002-6216-3134), and David R. Johnson (ORCID: 0000-0003-3156-6317), *Asphalt Institute*

Ilker Boz (ORCID: 0000-0002-8534-6996), and Stacey D. Diefenderfer (ORCID: 0000-0002-6570-2121), *Virginia Transportation Research Council*

Elie Y. Hajj (ORCID: 0000-0001-8568-6360), *University of Nevada, Reno*

Timothy B. Aschenbrener (ORCID: 0000-0001-7253-5504), *Federal Highway Administration*

DISCLAIMER

MAY 2025

A STRATEGIC LOOK AT GAPS AND IMPLEMENTATION OPPORTUNITIES FOR HIGH POLYMER MODIFIED ASPHALTS

This Technical Brief presents a gap analysis of high polymer modified asphalt (HP) binders and mixtures in pavement construction, highlighting current limitations and areas for improvement. Implementable actions and lessons learned from State Departments of Transportation (DOTs), along with strategies to enhance the design and implementation of HP binders are identified.

Introduction

The modification of asphalt binders is not a novel concept and has steadily gained traction over the past several decades. For approximately 50 years, various additives—including polymers, ground tire rubber, chemical modifiers (e.g., acids), and recycled engine oils—have been incorporated into asphalt binders to improve the performance of asphalt mixtures.(1,2) Several State Departments of Transportation (DOTs) have acknowledged the advantages of polymer-modified asphalt mixtures in mitigating different types of distress caused by traffic loading and environmental conditions in flexible pavements.(3) Traditionally, polymer-modified asphalt (PMA) binders have contained polymer contents not exceeding 3.5 percent due to practical challenges related to mixing, storage, and workability. However, advancements in polymer technology have enabled the incorporation of significantly higher polymer contents (approximately 7.5 percent) in asphalt binders, referred to herein as high polymer (HP) binders. These binders exhibit substantially enhanced elasticity that may contribute to addressing certain pavement failure mechanisms of concern to State DOTs.(4,5) HP binders also offer addi[...] when used in asphalt mixtures subjected to heavy [...] traffic.(1,3)

The effectiveness of the HP binder technology was [...] promising tool in the Every Day Counts (EDC)-6: [...] Pavement Solutions (TOPS) program toolbox, feature[...] asphalt overlay products.(6) Its inclusion aimed to [...] improve performance, preserve investments, and reali[...]

ASPHALT INSTITUTE

Jhony Habbouche, Ph.D., P.E.

Western US Regional Engineer

Asphalt Institute

Cell Phone: (859) 537-7063

Email: jhabbouche@asphaltinstitute.org