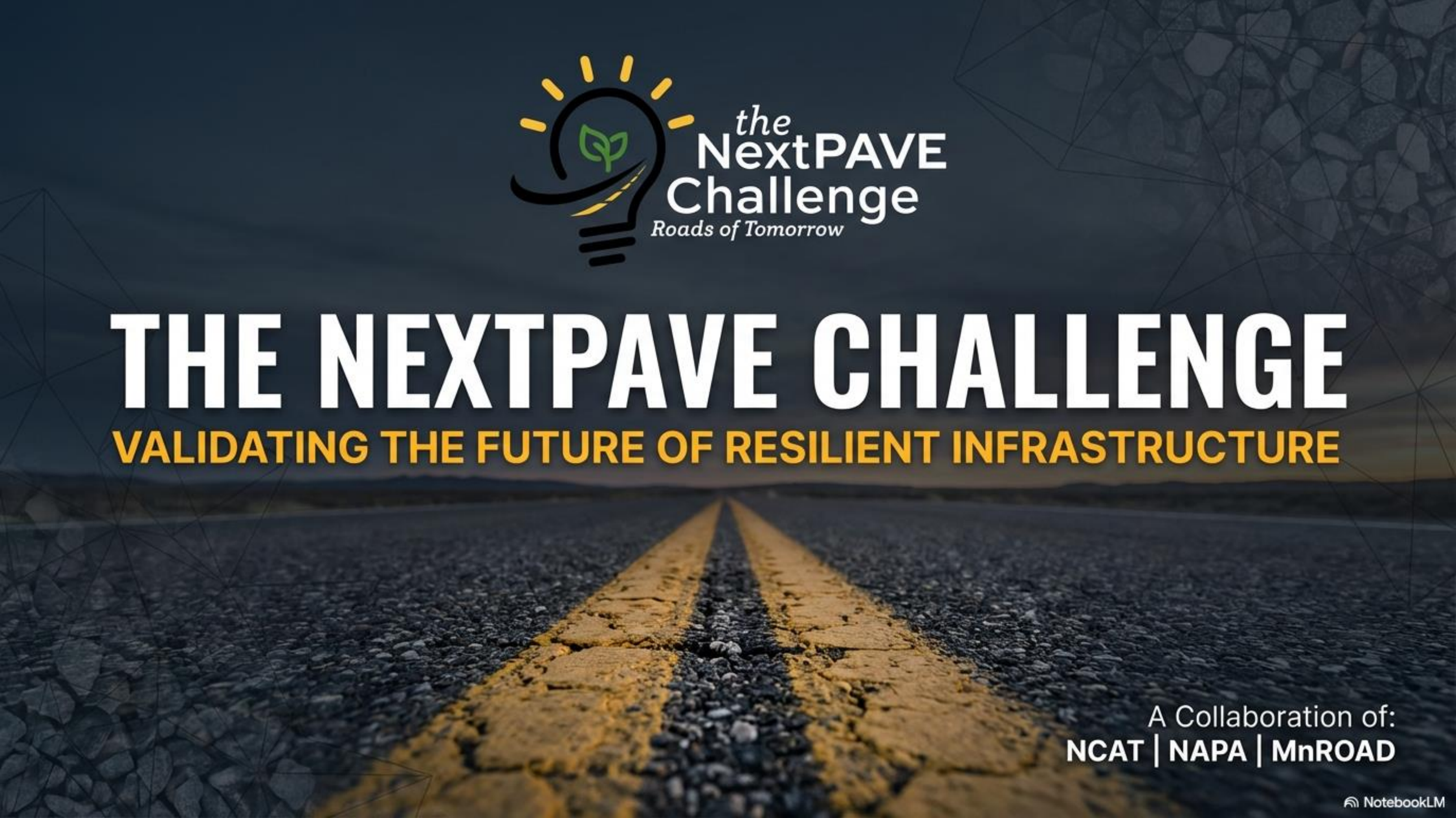

the NextPAVE Challenge
Roads of Tomorrow
THE NEXTPAVE CHALLENGE
VALIDATING THE FUTURE OF RESILIENT INFRASTRUCTURE
A Collaboration of:
NCAT | NAPA | MnROAD
NotebookLM

A COALITION FOR INNOVATION

National Center For Asphalt Technology
NCAT
AT AUBURN UNIVERSITY

NAPA
NATIONAL ASPHALT PAVEMENT ASSOCIATION

MnROAD
SAFER, SMARTER, SUSTAINABLE PAVEMENTS THROUGH INNOVATIVE RESEARCH

THE MISSION

To identify, evaluate, and advance high-potential pavement technologies through a structured, transparent, and rigorous process.

THE CONTEXT

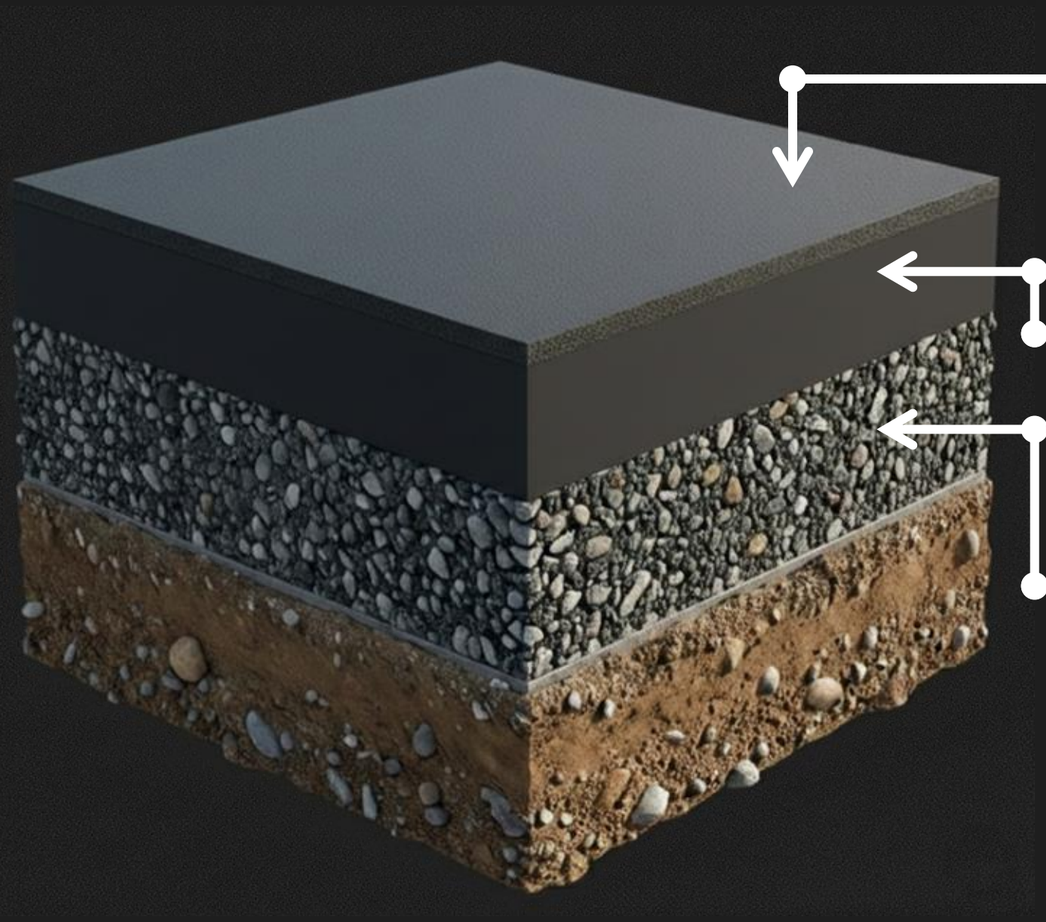
With 94% of U.S. roads paved in asphalt, the industry demands solutions that drastically reduce life-cycle costs and enhance long-term performance.

THE GOAL

Accelerate the adoption of market-ready solutions for durability, sustainability, and resiliency.

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INNOVATION AT EVERY LAYER



CATEGORY 1: ON THE ASPHALT

Surface rejuvenation, friction treatments, noise-reducing surfaces, and preservation.

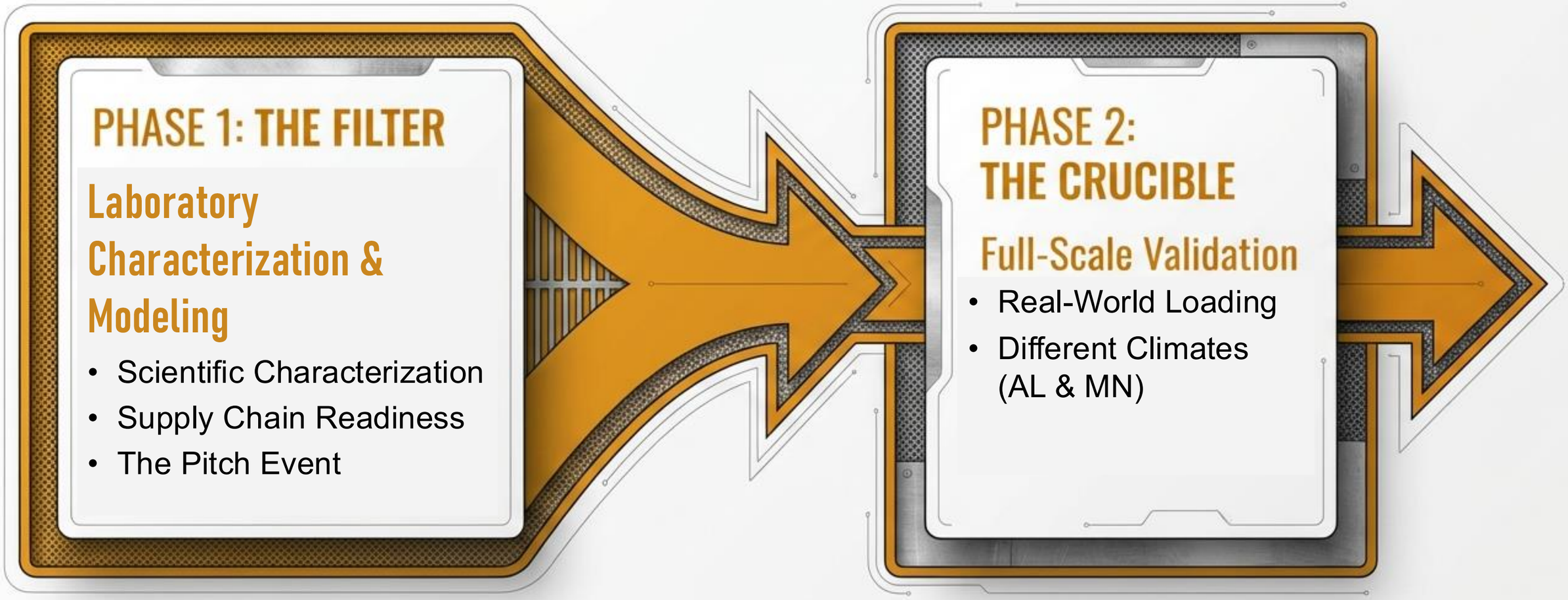
CATEGORY 2: IN THE ASPHALT

Mix additives, alternative binders, chemical additives, and recycled material facilitators.

CATEGORY 3: BELOW THE ASPHALT

Soil or base stabilization methods.

THE EVALUATION ECOSYSTEM



A rigorous, science-based pathway from the lab to full-scale national implementation.

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PHASE 1: LAB, LOGIC, & SCALABILITY

The Gatekeeper Phase ($25k Entry)



TESTING & MODELING

Laboratory characterization utilizing advanced pavement modeling (FlexPAVE™ & PerROAD).



SCALABILITY

Rigorous assessment of supply chain capacity to ensure technology can meet national infrastructure demand.



THE PITCH

Technology providers present to an independent panel of expert judges, supported by NCAT data.

Note: NDA participants are permitted for testing but cannot advance to Phase 2.

NotebookLM

PHASE 2: THE ULTIMATE STRESS TEST



NCAT Test Track (2027)

- Accelerated Heavy Truck Loading
- Extreme Southern Heat

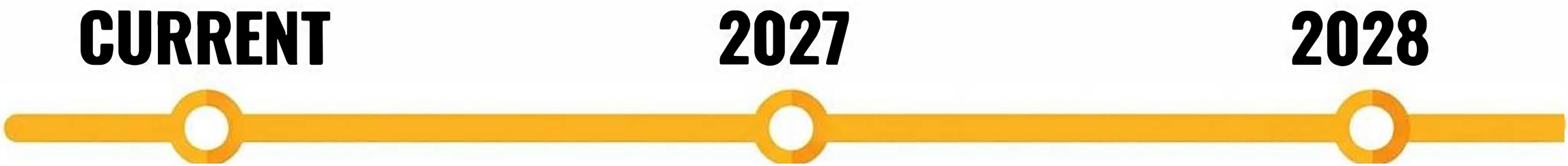
MnROAD Facility (2028)

- Freeze/Thaw Cycling
- Extreme Cold Weather Performance

Fully funded by a consortium of state highway agencies and private-sector sponsors seeking proven solutions.

NotebookLM

THE PATH FORWARD



Accelerating the development of pavement systems that last longer, cost less, and serve the future.

eng.auburn.edu/the-nextpave-challenge/

On the Asphalt

Corrective Asphalt Materials

PAVE, LLC

Pavement Technology, Inc.
Real Science. Real Results.

In the Asphalt

DOW

ingevity

Innophos

Cargill

ITERCHIMICA

ARKEMA

certainteed
SAINT-GOBAIN

Hi-Tech
ASPHALT SOLUTIONS

NEW RUBBER TECHNOLOGIES
Innovating Unique Compounds

aerogel coating
TECHNOLOGIES

necoPave

ChemCo Systems

PUMA
ENERGY

KRATON

DRIVEN
PLASTICS

Below the Asphalt

Zydex
Innovating for Sustainability

Tensar

ARKEMA

SURFACE TECH

TECHNOLOGY INFORMATION

The following technology overview slides were provided by the individual technology developers.

Each organization is solely responsible for the accuracy and content of its slide. Inclusion in the NextPAVE Challenge does not constitute an endorsement, recommendation or validation by NCAT, Auburn University or the NextPAVE Challenge Steering Committee.

Corrective Asphalt Materials

5–7 Years
Added pavement service life

50+ Years
Field performance documented

50M sq yds
Treated by CAM annually



Reclamite®

Maltene-Based Spray-on Rejuvenator

MRT

Maltene Replacement Technology
Restores asphaltene/maltene balance; penetrates up to 1" into the pavement

ROI

Maximum Life-Cycle Return on Investment
Best if applied within 1–2 years of new construction or overlay

APPLY

Sprayed like a Fog Seal
One pass, light coat of sand; traffic ~30 min

DOT

50+ Years on State & Local Roads
New pavements, state routes, county roads, city streets, chip seals & microsurfacing

DATA

Up to 63% Viscosity Drop
Springfield, MO study: 54% lower viscosity vs. untreated at 3 years post-treatment

www.correctiveasphalt.com • (800) 374-5560

Pavement Technology, Inc.
Real Science.
Real Results.

5–10 Year
Pavement life extension

NOx & VOC
Pollutants removed

LEED & ISI
Sustainability credits

U.S. Green Building Council & Sustainable Infrastructure



PlusTi™ A.R.A.-1 Ti®

Asphalt Rejuvenator / Sealer

America's First TiO_2-Enhanced Photocatalytic Rejuvenator/Sealer

MRT

Maltene Replacement Technology
Restores asphalt flexibility & extends pavement life 5–10 years

PCT

Photo Catalytic Technology
TiO_2 & sunlight remove nitrogen oxides (NOx) & volatile organic compounds (VOCs)

UHIE

Urban Heat Island Effect Mitigation
Solar-reflective surface reduces heat absorption & radiative forcing

H_2O

Stormwater & Microplastic Reduction
Super-hydrophilic surface supports stormwater management

www.pavetechinc.com • 1-800-333-6309



ePAVE is a two-component polymer modified Portland cement mortar applied to asphalt.

The first component is a dry ingredient powder, the second a liquid polymer emulsion resin.

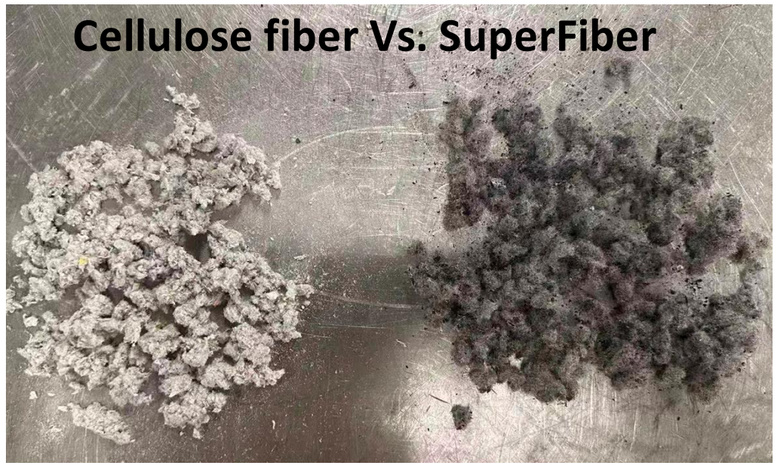
- Extends pavement life while mitigating urban heat island effects
- Rapid installation
- Quick return to traffic
- Protects against UV rays, rain, snow, road salt, chemicals, fuels and lubricants

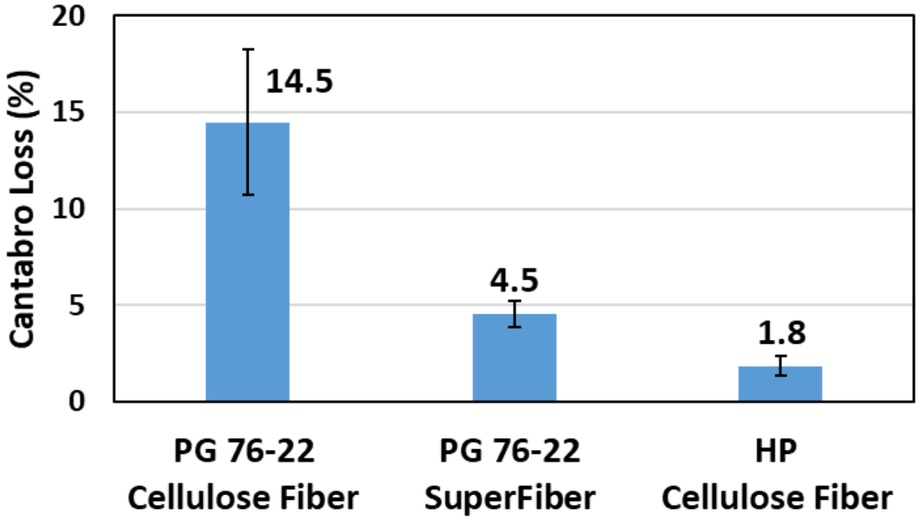


SuperFiber: A cost-effective strategy to improve OGFC Durability

- OGFC is prone to **premature failures** (i.e., raveling).
- High-polymer (HP) binder is commonly used to improve OGFC durability, increasing cost by about **$15 per ton**.
- SuperFiber is a proprietary synthetic stabilizing fiber designed to reduces raveling, improves fatigue resistance, and increases moisture durability.
- SuperFiber dosage in OGFC mixture is **0.3%.**
- Replacing the traditional cellulose fiber with SuperFiber could increase the cost by about **$3 per ton**.
- SuperFiber offers a cost-effective, high-performance solution for **extending OGFC service life** while maintaining excellent surface friction and drainage.

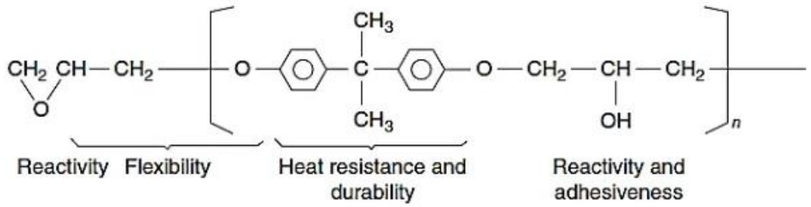
Hi-Tech ASPHALT SOLUTIONS





High Performance OGFC using Epoxy Asphalt Binder

ChemCo Systems







- The epoxy asphalt binder includes flexible epoxy polymer (thermoset) and mixture of specialized asphalts.
- Performance advantages of epoxy asphalt binder
  - Excellent rutting and shoving resistance
  - Excellent fatigue resistance and durability
  - Superior aging resistance to oxidation aging and resiliency loss
  - Providing high strength bond to the underlying substrate
- OGFC is prone to premature failures (i.e., raveling).
- Epoxy asphalt has been used as an extremely durable binder for OGFC mixtures in New Zealand and Netherlands.
- Lab testing and field trials from the New Zealand project suggest that OGFC surface life could increase by approximately 4 to 5 times.

Low Temp HiMOD and Next-Gen HP Polymers

Study Overview

Ingevity's Evotherm WMA technology in combination with a new innovative Kraton SBS Polymer will enhance the performance of HiMOD, which is widely used in Utah and currently being piloted by DOTs across the nation.

The HiMOD dense-graded mixture design in this study uses locally sourced aggregates and 20% RAP, designed to 1% air voids, utilizing a high performance (HP) binder (MSCR>90%R, <0.1 $Jnr_{3.2}$).

Objectives

1. **Reduce Traditional HiMOD Production Temperatures** - minimizing binder oxidation, hitting target density and cutting emissions.
2. **Reduce Polymer Loading** - using the new Kraton MD1199 HP Polymer at a reduced polymer loading with the same binder quality.
3. **Validate Field Performance** - prove both technologies together ensure successful production/construction and the longest-lasting, best-performing pavement.

KRATON™

EVOTHERM®
WARM MIX ASPHALT TECHNOLOGY

INNOVALT® Amplify

Innophos

A cost-efficient, upcycled additive that enhances the SBS polymer network

Easy-to-Use & Highly Compatible

Enhances Performance

Economical & Eco-friendly

Sample	Neat 58-28	+1.0% Linear SBS	+1.0% SBS + 1.5% Amplify
MSCR @ 64°C (T350)	Failed	Failed	V
% Recovery 3.2 kPa (T350)	0.0	3.7	44.7
Separation (D7173)	N/A	Passing	Passing

% RECOVERY

12x HIGHER!

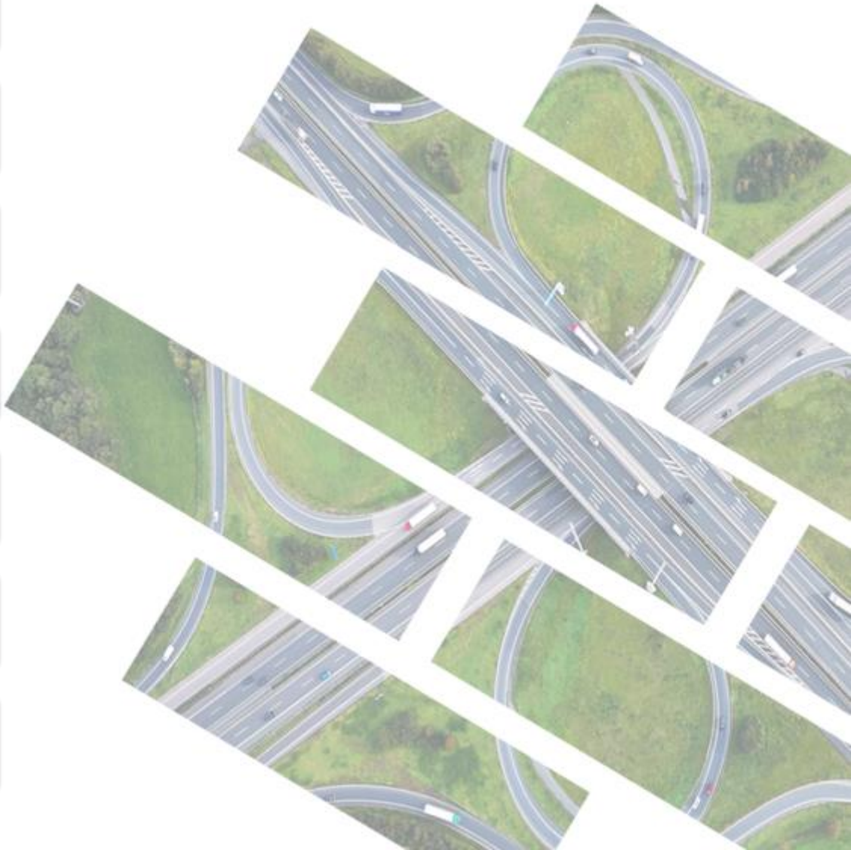
Blending Temp:
163 - 180 °C

Form:
Solid, granular

High Polymer Pavement Innovation with High Elasticity ELVALOY™ Copolymers

A reactive elastomeric terpolymer designed to enhance binder performance and enable more durable, high-performance pavements

- **Novel high-elasticity resin** designed for HP binder specifications
- **Low dosage (2–4 wt%)** required to meet high polymer (HP) specifications
- **Up to 4 PG grade bumps**
- **Faster processing** that boosts production throughput
- **Permanent chemical bond with binder** enabling long-term storage stability
- **Meets viscosity targets** for reliable field workability
- **Domestic manufacturing** supports Buy America alignment and reduces supply chain risk



High Elasticity ELVALOY™ Copolymers + rPE Modified Binder Targeting HP Binder Performance

Driven Plastics + Dow

Combines High Elasticity ELVALOY™ Copolymers from Dow with post-consumer recycled polyethylene (rPE) processed by Driven Plastics to develop a modified asphalt binder targeting High Polymer (HP) binder performance from a neat base binder.

NCAT will evaluate the system in a RAP and high-polymer mix design with increased asphalt content and lower design air voids, compared against NCAT's conventional HP binder benchmark.

Value to DOTs and Industry

- Creates a high-value reuse pathway for hard-to-recycle rPE
- Targets HP binder performance in a controlled modified binder system
- Supports rutting, fatigue cracking, and long-term aging performance
- Supports Buy America alignment and reduces supply chain risk



rPE material by Driven Plastics

Elvaloy™ copolymers for alloys by DOW

DRIVEN PLASTICS

ITERCHIMICA

ITERLOW 2000: The Two-in-One Solution for Sustainable Pavements

Advanced bio-based chemical technology trusted across 5,000+ miles of laid asphalt.

Dual-Action Mechanism



Dosage: 0.2% – 2.0%
(by binder weight)

Lab Test Results

WMA Technology (WMA vs. HMA)

-35°F
Reduction
in Mixing Temperature, from 310°F to 275°F

-15°F
Reduction
in Compaction Temperature, from 290°F to 275°F

+7.5%
Increase
In TSR, from 75.0 to 82.5%

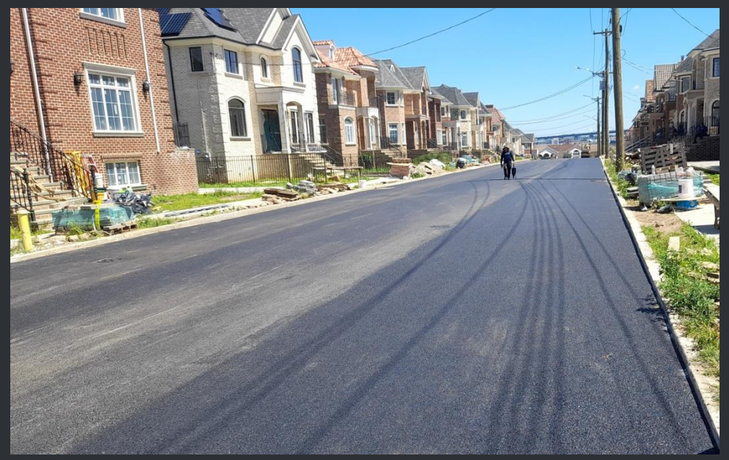
Rejuvenation (HMA vs. HMA+45% RAP+ITERLOW)

+20.3
N_f Cycles
increased from 225 to 245.3
(Tex 248-F)

+0.9
CT_{Index}
Increased from 14.6 to 15.5

Restored PG Grade
After 2 PAV cycles

Field Project in the U.S.



Application
1.5-inch surface lift

Binder
PG 70-22

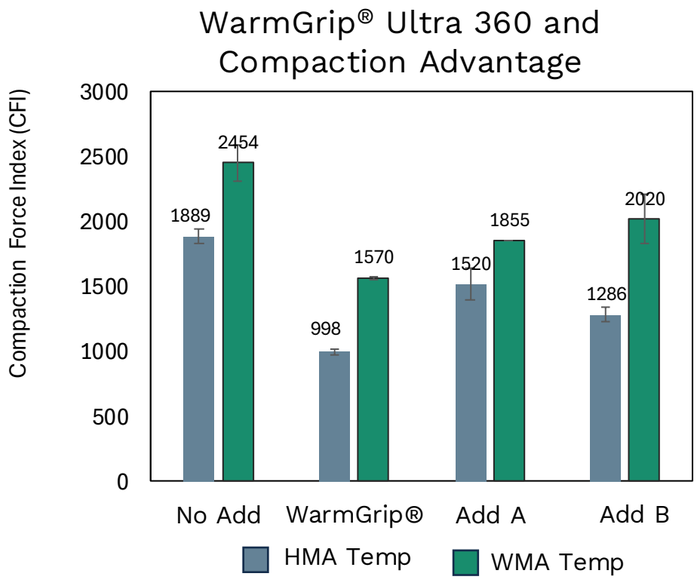
Dosage
0.5% by binder weight

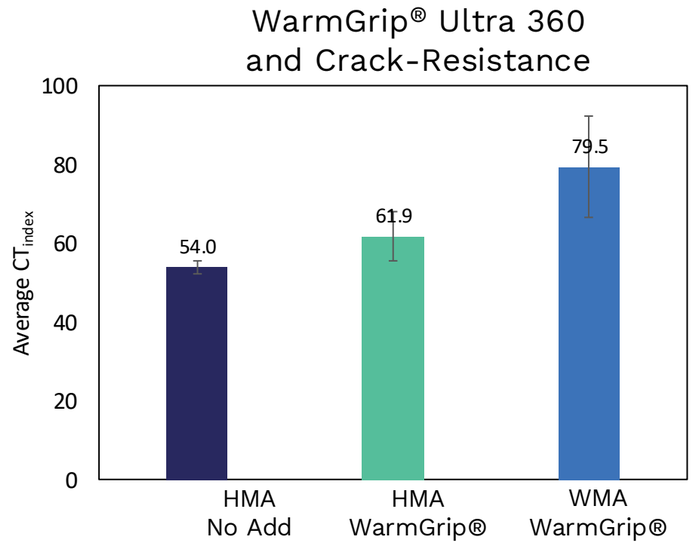
Temperatures
284±9°F Production
248±5°F Compaction

WarmGrip® Ultra 360

WARM MIX ADDITIVE – BALANCED PERFORMANCE

- WarmGrip® Ultra 360 offering balanced mix performance:
  - Excellent anti-stripping performance
    - NTPEP / PEAS published data
  - Improved RAP incorporation
  - Reduced compactive effort at WMA temp.
  - Geared to support BMD adoption and improving crack-resistant performance





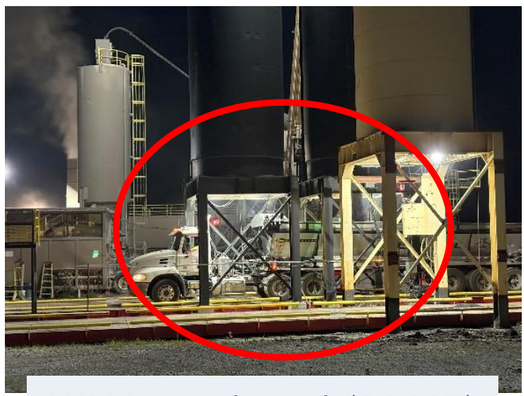
- True warm mix performance:
  - Capable of true warm mix
    - Maintains workability in the mix
    - Incorporates high RAP % (40+%)
  - Improves EPDs / blue smoke elimination
    - Immediate effect at lower temp production



HMA produced (340°F)



WMA produced (320°F) WarmGrip® Ultra 360



WMA produced (280°F) WarmGrip® Ultra 360

CarbonBind®

THE PRODUCT

ORIGIN

Oil produced from agricultural plant waste that would otherwise be burned for energy.

PROCESS

Proprietary chemical modification: extensive polymerization & cross-linking → viscosity increased by orders of magnitude → blended with conventional bitumen at Puma terminals.

THE ROAD

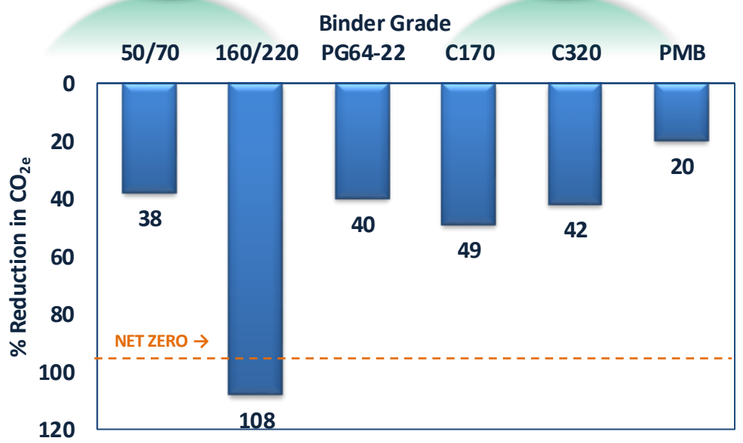
Finished binder meets AASHTO M320 / M332. Drop-in compatible — no changes to mix design, production, or paving.

POTENTIAL BENEFITS

CarbonBind® products are formulated to comply with typical Australian, European and US paving grade bitumen and polymer modified binder specifications.

Cost Effective

Net-zero Potential



PATENT PENDING | EPD VERIFIED | ISCC CERTIFIED

FIELD TRIALS

2021–22	Lab R&D complete; full-scale plant trials
DEC 2022	First PMB demonstrations — Australia
OCT 2023	Paving grade demo — Wiltshire, UK
NOV 2023	AfPA National Innovation Award
MAY 2024	Western Sydney International Airport
DEC 2024	First hard paving grade demonstrations

SUPPLY CHAIN

Feedstock

- *Agricultural waste oils*
- *Does not compete with food production*
- *~10× supply vs. tall oil pitch*

PRODUCTION

- *Puma terminals worldwide*
- *Integrated Trafigura network in US*

DELIVERY

- *Finished binder to spec*
- *No plant changes needed*
- *Available at US scale now*

Cargill Anova® Biosync™ Biobinder

THE PRODUCT

ORIGIN

Agriculturally sourced bio-based raw materials from renewable feedstocks, regrown every year. Not fossil-derived.

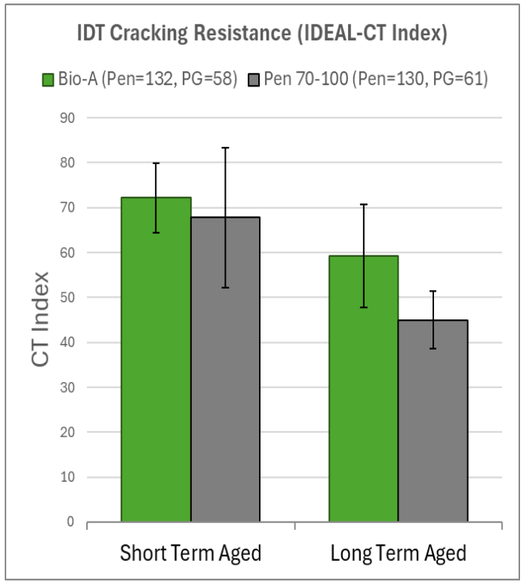
PROCESS

Purpose-built formulation from Cargill's bio industrial expertise. Blends directly into bitumen at 10 to 30% by weight via low-shear mixing.



POTENTIAL BENEFITS

- ❑ Enables >40% RAP content in mixes
- ❑ Negative overall GWP - verified EPD available
- ❑ Balanced cracking, rutting & moisture resistance
- ❑ Biogenic carbon locks CO_2 from atmosphere



•Pen 40/60 (PG64-22) + 10% bio content: final grade (Pen 70/100 or PG58-28)
•Control Pen 70/100 (PG58-28) - Similar grade to the biobinder

SUPPLY CHAIN OUTLOOK

FEEDSTOCK

- *Agricultural biobased sources*
  - *Regrown at least annually*
- *Industrial grade product*
- *Supply stability*

PRODUCTION

- *Cargill Bio-Industrial facilities*
  - *Global footprint*
- *Blended at bitumen suppliers, depots, or plant*
- *Blends at ~150°C with low-shear mixing*

DELIVERY

- *No special long-term storage requirements*
- *Drop-in: no plant modifications required*
- *Pumpable once heated to ~100°C+*

aerogel coating TECHNOLOGIES



RaC

Rubberized-Aerogel Composite

WHAT IT IS & WHY

A next-generation composite that boosts asphalt-pavement performance, resilience and sustainability — countering asphalt's core weakness, thermal susceptibility (less deformation and cracking), with superior insulation and durability across climates.

Dosing dry-added at the plant (RAP collar or feeder), 12–20 lb/ton (~10–18% of binder)

Making Smart Infrastructure with RaC

WHY RaC FOR PAVEMENTS

- **Reduces permanent deformation (rutting)** across all structural and climatic scenarios.
- **Substantially lowers thermal cracking** increasing service life above 50%
- **Improves fatigue resistance** and decreases lane-cracking percentage.

Three priorities: *performance enhancement · waste valorization · reduced environmental footprint.*

RaC ATTRIBUTES

Particle size	0.1 – 3 mm (pellets up to 10mm)
Surface chemistry	Hydrophobic
Bulk density	0.32 – 0.60 g/cm³
Color	Dark grey
Operating temperature	up to 250 °C



PROVEN IN THE FIELD

2021	Kaiteki — 50-ton sections, SW Fisher Industries plant
2024	VESTAR — 420-ton parking-lot retrofit, Queen Creek AZ
2025	Arizona DOT — 1,000 tons, US-60 lane-mile, Show Low AZ
2026	City of Phoenix & City of Mesa pilots (Jul–Sep)

★ **Recognition:** RAR 2025 — Best Innovation, Lisbon **Contact:** aCT@actinc-us.com

TRANSFORMING ASPHALT SHINGLE WASTE



PERFORMANCE	EASE OF USE	WORKER SAFETY	SUSTAINABILITY
Softens hardened, oxidized asphalt to improve PG grade	Handles and stores long-term like RAP without degradation	Pellets are safe to handle	Stable recycle market allow for stabilized supply chain
Improves crack-resistance, significantly reduces rutting	Seamless integration into HMA feeds, no special equipment	Eliminates airborne fiberglass fibers on job site	Significantly reduces need for virgin asphalt binder
Meets quality standards for durable HMA applications	Stable pellet form eliminates re-agglomeration issues		

STRICTLY PRIVATE AND CONFIDENTIAL

NAFCO – 100% RAP HMA Product

Opportunity Overview

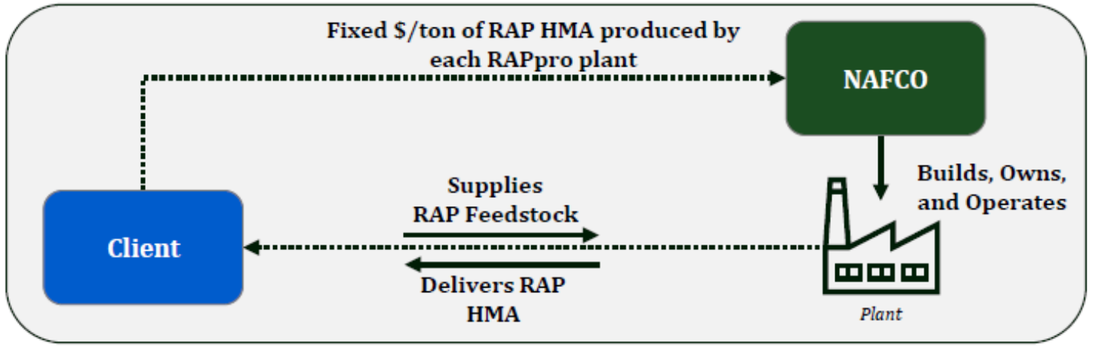
- NAFCO builds, owns, and operates HMA plants utilizing 100% RAP as aggregate feedstock.
- NAFCO's proprietary process and materials rejuvenate asphalt cement and maximize the utility of RAP, creating HMA with comparable performance to virgin HMA (as measured by IDEAL-CT and HWTT) at a significantly lower marginal cost.
- Plants consume no virgin aggregates and are agnostic to proximity to natural resources – a perfect fit for remote locations or temporary deployments near RAP stockpiles.
- Plants utilize recycled materials and proprietary technology for better margins and ~60% lower emissions.
- **NAFCO will deploy operating hot mix plants in 6 – 9 months at no capital cost to clients, enabling clients to offer a 100% RAP HMA product with superlative performance metrics.**

Technology



NAFCO's Role

- NAFCO partners with asphalt producers and pavers, providing RAP HMA production under a tolling-style service contract.
  - Clients and NAFCO work together to set product performance specifications for base and surface course.
  - NAFCO performs mix design lab work to establish necessary feedstock specifications required for consistent mix performance.
  - NAFCO provides capital to construct plants that will produce 100% RAP HMA for clients to sell into the market.
  - Clients provide RAP feedstock and crushing services to create reliable feedstock supply.
- **Plants are configurable for throughputs between 80 – 200 tons per hour, with lead times of 6 – 9 months from contract execution.**



For inquiries, please contact Kitty Shepherd at kshepherd@halftoneinvestors.com

New Rubber Technologies' ReviveRite™ Asphalt Modifiers

Introduction and Overview

ReviveRite™ asphalt modifiers are designed as a complete or partial substitute for linear or radial SBS in the binder portion of an asphalt mix. While derived from end-of-life tires, these materials differ substantially from GTR in chemical structure and as a result in technical and processing performance.

- ReviveRite™ has been formulated to improve AASHTO and PG grades at lower cost
- Provides similar physical property and processability characteristics as compared to SBS
- Exhibits weatherability and environmental advantages
- Paving applications are terminally blended

ReviveRite™ asphalt modifiers have been commercially deployed in road projects in the Midwestern United States. While quantifiable performance results are not yet available, third-party terminal, contractor and customer agency observations all indicate positive results to-date over multiple year installations.

Illustrative Formulations

Illustrative Formulation 1:

Base binder: Seneca Petroleum 58-28
Polymers: ReviveRite™ 5% and LCY3501 2%
Resulting binder grades: PG 70-28 (AASHTO M320) and MSCR 58E-28 (AASHTO M332)
Lab: Asphalt Testing Laboratory

Illustrative Formulation 2:

Base binder: Marathon Refning 67-22
Polymers: ReviveRite™ 4% and LCY3501 1.6%
Resulting binder grades: PG 76-22 (AASHTO M320)
Lab: Asphalt Testing Laboratory

Illustrative Formulation 3:

Base binder: Marathon Refining 64-22
Polymers: ReviveRite™ 10% and Zero SBS
Resulting binder grade: PG 76-22 (AASHTO M320) and True Grade 81.2-24.1 (AASHTO M320)
Lab: Asphalt Paving and Recycling Technologies (APART)

TerraSil

zydexgroup.com

Product Overview & Performance Benefits

Organosilane-based technology that creates a **hydrophobic** soil matrix, **reducing moisture** ingress through capillary action.

Easily diluted with water and applied during compaction or as a surface treatment.



- Permanent Water Resistance
- Eliminates Capillary Rise
- Prevents Freeze Thaw
- Reduces Expansivity
- Improves Compaction Density
- Improves Load Bearing Capacity
- Water Dilutable & Easy to Apply
- Non Leaching
- Environmentally Friendly

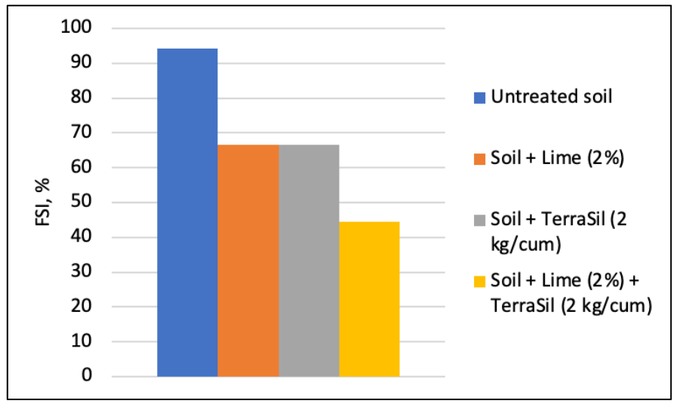
Importance to DOTs

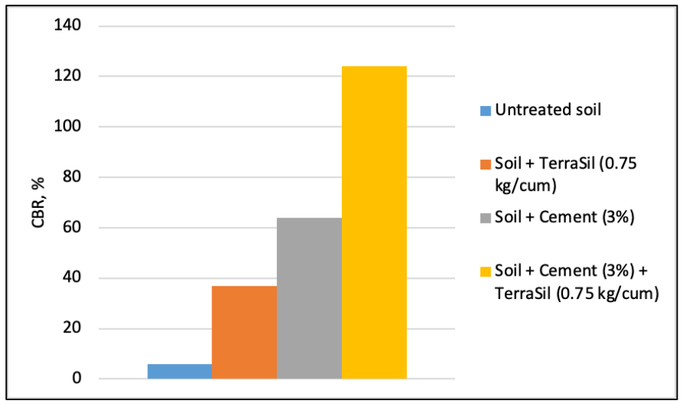
Enhances water resistance and helps keep subgrade and base layers dry

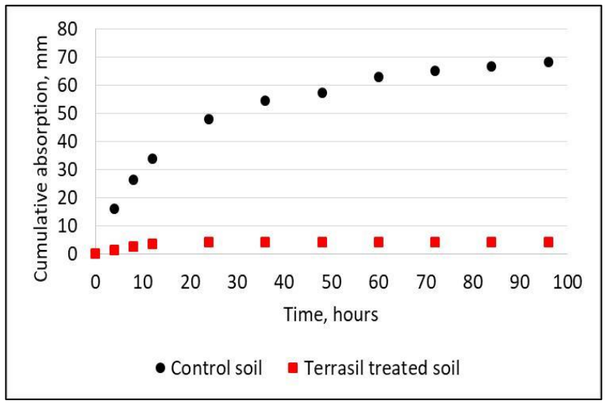
Improves long-term performance and **extends** pavement service life

Complements and is fully compatible with traditional stabilizers

Potentially reduces swelling of expansive soils while lowering content of stabilizing agent (e.g. lime)







Control soil Treated soil



Tensar HX-AE

Tensar’s most advanced high performing asphalt interlayer product



- A composite, comprising a stiff high-profile 3D multiaxial grid thermally-bonded to a non-woven paving fabric, providing three interlayer functions:
  - reinforcement,
  - stress absorption (SAMI),
  - interlayer barrier (waterproofing), once saturated with asphalt during installation.
- Enhance fatigue performance, increasing the life of reconstructed pavements or reducing asphalt layer thickness in new pavements.
- Designed to provide optimal performance for controlling reflective cracking in asphalt overlays and longitudinal cracking during longitudinal cracking in road widening.

Tensar
CMC

BONDTEKK®

Stronger Interlayer Bonding for Longer-Lasting Pavement



US-36, Nemaha Co., KS – Year 9



Spray Paver – 0.34 gal/yd²



Conventional Paving - .05 gal/yd²

Performance Highlights

- Improved bond between layers enhances cracking and rutting performance
- Tack rate increased ~4-6x
- Significant crack reduction during service life
- Minimal cost increase (~3%) adds 3+ years of service life

4-6x	~3%	3+ years
Tack rate increase	Minimal cost increase	Additional service life

ARMI™ — Flexible Reflective Crack Relief Interlayer

SURFACE TECH™



FLEXIBLE REFLECTIVE CRACK RELIEF INTERLAYER

ARMI™ is a 1-inch-thick Flexible Reflective Crack Relief Interlayer (FRCRI) — plant made, paver laid using locally sourced ACE XP™ aramid fiber. It stops bottom-up reflective cracking and is placed directly over deteriorated asphalt or concrete.

TEST-VERIFIED PERFORMANCE

2,000 με → 40,000+ cycles
Fatigue cycle range, lab tested

700 IDEAL-CT
at 7% air voids

HWT Compliant
Qualified paving platform

Same-Day Pave-Over
Fast return to service

Razor-Edge, Local Materials
Field-friendly placement

ARMI™

ACE XP™ POLYMER

7×	Up to 50%	1 inch	0.67 kg
Crack resistance improvement	Pavement life extension	FRCRI layer thickness	CO_2 / US mix ton (EPD)

PERFORMANCE

- Stops bottom-up reflective cracking
- Works over asphalt or concrete
- Restores ride quality & life

EASE OF ADOPTION

- Plant made, paver laid
- Locally sourced materials
- No third-party contractors

SUSTAINABILITY

- Fully recyclable pavement
- EPD-certified low carbon
- ESG reporting compliant

COST SAVINGS

- Lower cost vs. FDR / R&R
- No third-party contractor cost
- Reduced long-term maintenance