Asphalt Modifiers: Practical Solutions for Florida’s Pavement Challenges

Extending pavement life and performance under Florida conditions

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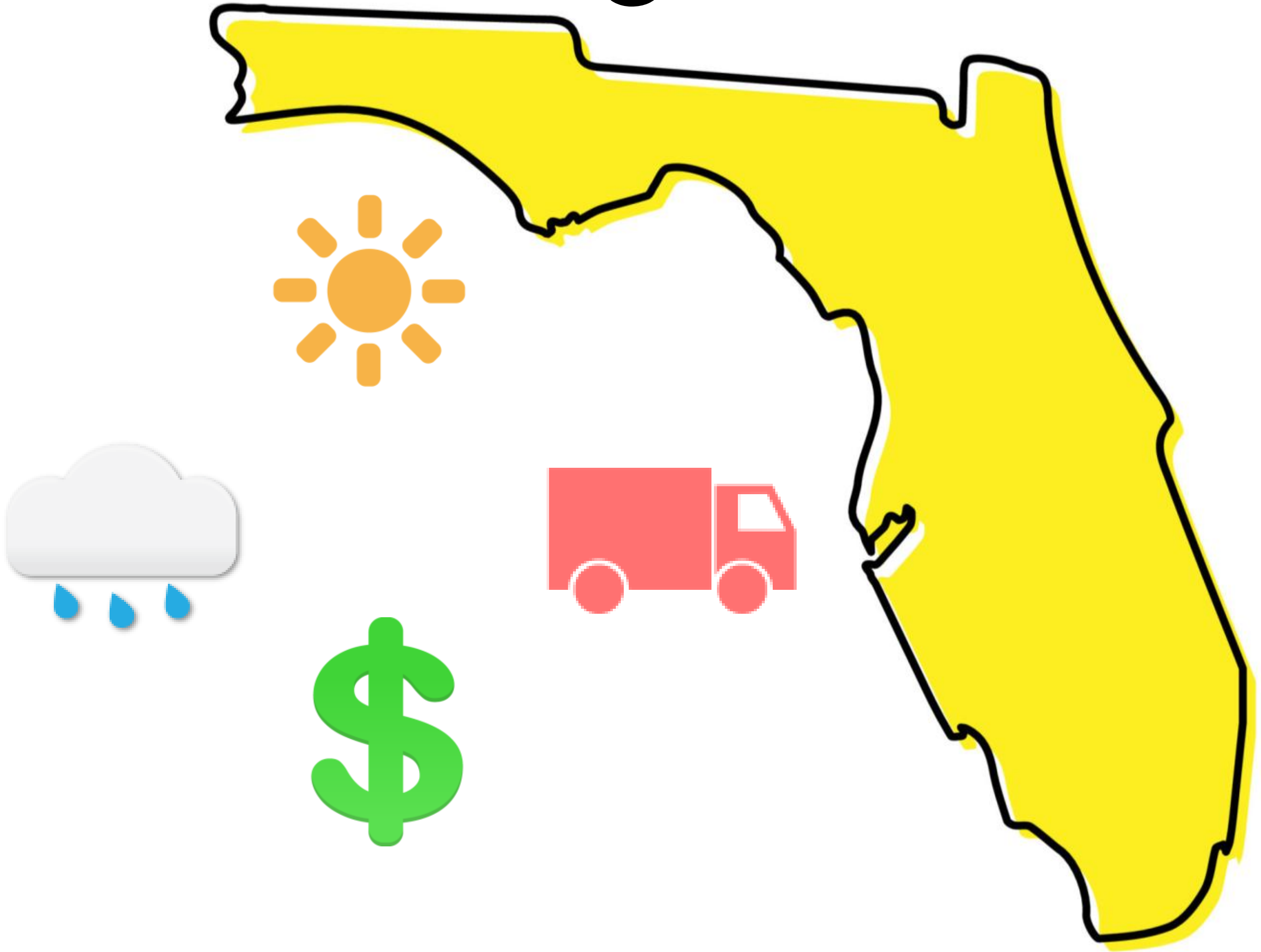
The Florida Pavement Challenge

- High heat and UV exposure
- Heavy rainfall → moisture infiltration
- Shallow water tables, softer subgrades
- Rapid oxidization, binder hardening
- Heavy truck and tourism traffic
- Funding constraints and resurfacing cycles



Common Pavement Distresses

- Rutting in wheel paths
- Raveling and oxidation
- Reflective and thermal cracking
- Stripping and base failure
- Fatigue cracking on local roads

FDOT Specification Framework

916 BITUMINOUS MATERIALS.
(REV 1-14-10) (FA 2-2-10) (7-10)

SECTION 916 (Pages 828-842) is deleted and the following substituted:

SECTION 916
BITUMINOUS MATERIALS

916-1 Superpave PG Asphalt Binder:

916-1.1 Requirements: Superpave PG asphalt binders, identified as PG 64-22, PG 67-22, and PG 76-22, shall meet the requirements of 916-1.2, AASHTO M 320 Table 1 and the following additional requirements:

1. The mass loss AASHTO T 240 shall be a maximum of 0.5% for all grades.
2. The spot test AASHTO T 102 with standard naphtha shall be negative for all grades. As an exception to this requirement, the PAV Residue (AASHTO R 28) at 110 ºC shall meet all the requirements for the particular grade.
3. The smoke point FM 5-519 shall be a minimum of 260ºF for all grades.
4. The intermediate test temperature at 10 rad/s. for the Dynamic Shear Rheometer test AASHTO T 315 shall be 25ºC for all grades.
5. An additional high temperature grade of PG 67 is added for which the high test temperature at 10 rad/sec for the Dynamic Shear Rheometer test AASHTO T 315 shall be 67ºC.
6. All PG asphalt binders having a high temperature designation of PG 67 or lower shall be prepared without modification.
7. All PG asphalt binders having a high temperature designation higher than PG 67 shall be produced with a styrene-butadiene-styrene (SBS) or styrene-butadiene (SB) elastomeric polymer modifier and resultant binder shall meet all requirements of this Specification; in addition the phase angle at 76ºC (AASHTO T 315) shall be a maximum of 75 degrees.
8. The maximum viscosity AASHTO T 202 shall be 2400 poises for PG 64-22 and 3600 poises for PG 67-22.

All hot mix asphalt (except hot mix asphalt containing 20% RAP or greater) shall contain Superpave PG asphalt binder grade PG 67-22 unless otherwise specified in the plans and/or Specifications for the hot mix asphalt product.

For all PG binder used in all hot mix asphalt, silicone shall be added to the PG binder at the rate of 25 cm^3 of silicone mixed to each 5,000 gallons of PG binder. If a disbursing fluid is used in conjunction with the silicone the resultant mixture containing the full 25 cm^3 of silicone shall be added in accordance with the manufacturer's recommendation. The blending of the silicone with the PG binder shall be done by the supplier prior to the shipment.

All PG binder and asphalt rubber binder for Friction Course mixes and for other hot mix asphalt products containing RAP shall contain 0.5% heat stable anti-strip additive by weight of PG binder unless specifications for the hot mix asphalt product requires testing by FM 1-T 283 and the test results indicate it is not required, or the mixture contains hydrated lime. Where FM 1-T 283 indicates an anti-strip additive is required, it shall be from 0.25 to 0.75%. The anti-strip additive shall meet the requirements of 916-5. The anti-strip additive shall be introduced into the PG binder by the supplier during loading.

Section 916: Binder material requirements

Section 334: Superpave Asphalt Concrete

SECTION 334
SUPERPAVE ASPHALT CONCRETE

334-1 Description.

334-1.1 General: Construct a Superpave Asphalt Concrete pavement with the type of mixture specified in the Contract Documents, or when offered as alternates, as selected. Superpave mixes are identified as Type SP-9.5, Type SP-12.5 or Type SP-19.0.

Meet the requirements of Section 320 for plant and equipment. Meet the general construction requirements of Section 330, except as modified herein, including the provision for Quality Control (QC) Plans and QC Systems as specified in Section 105.

334-1.2 Traffic Levels: The requirements for Type SP Asphalt Concrete mixtures are based on the design traffic level of the project, expressed in 18,000 pound Equivalent Single Axle Loads (ESAL's). The five traffic levels are as shown in Table 334-1.

Table 334-1
Superpave Traffic Levels

Traffic Level	Traffic Level ($1x10^6$ ESAL's)
A	<0.3
B	0.3 to <3
C	3 to <10
D	10 to <30
E	≥30

The traffic levels for the project are as specified in the Contract Documents. A Type SP mix one traffic level higher than the traffic level specified in the Contract Documents may be substituted, at no cost to the Department (i.e., Traffic Level B may be substituted for Traffic Level A, etc.).

334-1.3 Gradation Classification: The Superpave mixes are classified as fine and are defined in 334-3.2.2.

The equivalent AASHTO nominal maximum aggregate size Superpave mixes are as follows:

Type SP-9.5 .... 9.5 mm
Type SP-12.5 .... 12.5 mm
Type SP-19.0 .... 19.0 mm

334-1.4 Thickness: The total thickness of the Type SP asphalt layers will be the plan thickness as shown in the Contract Documents. Before paving, propose a thickness for each individual layer meeting the requirements of this specification, which when combined with other layers (as applicable) will equal the plan thickness. For construction purposes, the plan thickness and individual layer thickness will be converted to spread rate based on the maximum specific gravity of the asphalt mix being used, as well as the minimum density level, as shown in the following equation:

$$\text{Spread rate (lbs/yd}^2) = t \times G_{mm} \times 43.3$$

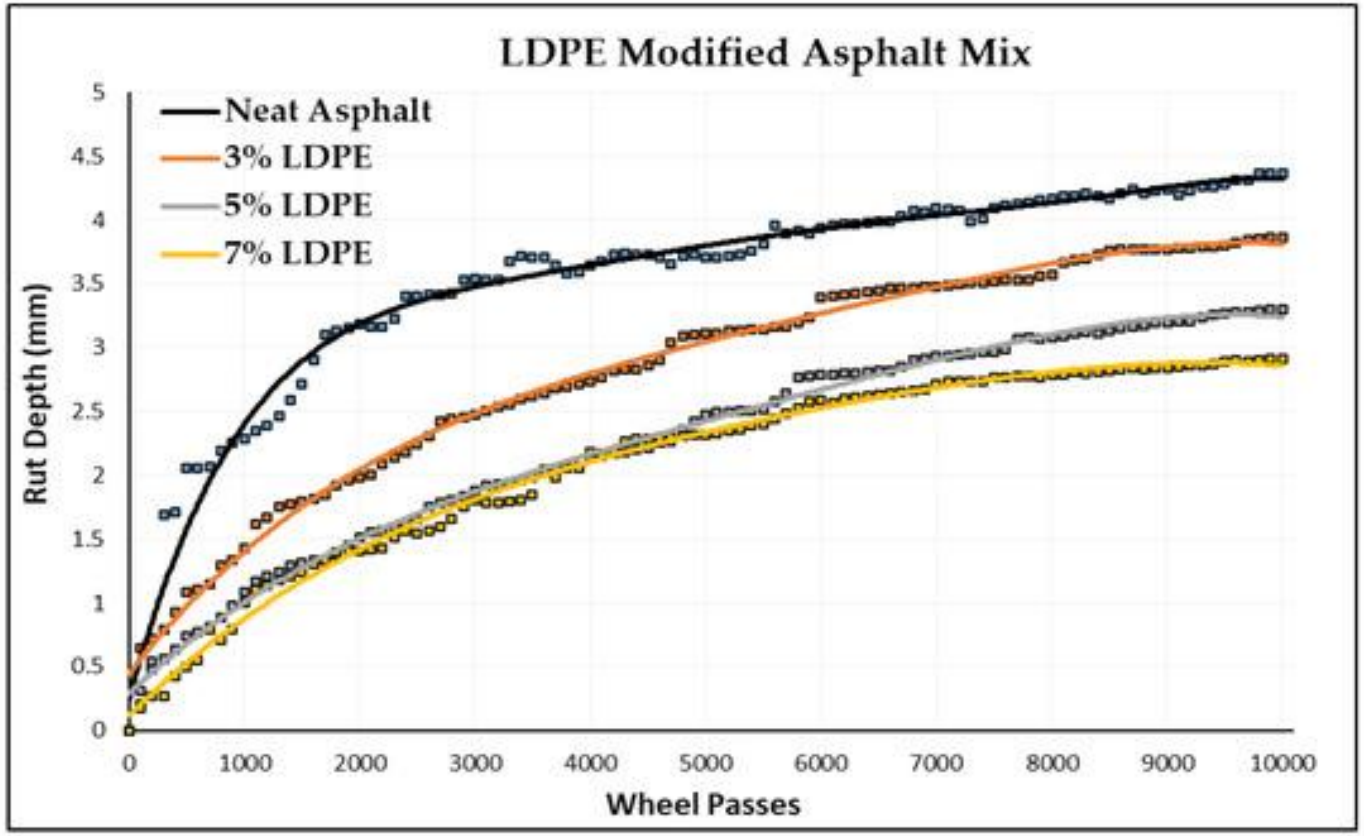
Where: t = Thickness (in.) (plan thickness or individual layer thickness)
G_{mm} = Maximum specific gravity from the verified mix design

FDOT Binder Grades

Frame work (Section 314/916)

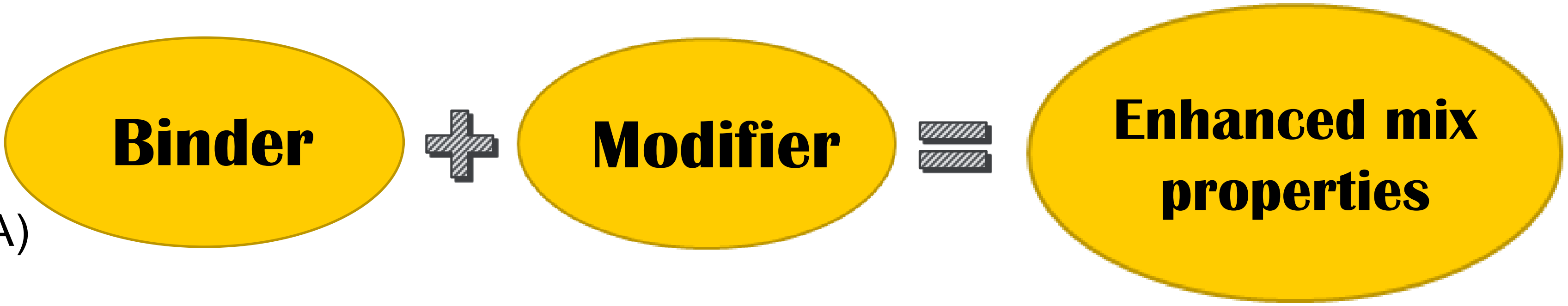
- PG 67-22 (standard)
- PG 76-22 (polymer)
- PG 82-22 (special)

Rutting ↓ 40–50%
Cracking ↓ 30%
Life extension +5–8 years



What are asphalt modifiers?

Definition: Chemical or physical additives blended into asphalt binders and mixes to improve performance properties; flexibility, strength, resistance to aging



Common types

- Polymers (SBS, SBES, EVA)
- Crumb rubber (CRM)
- Chemical rejuvenators
- Warm-Mix additives

How modifiers solve real pavement problems

Issue	Mechanism	Example Modifier
Rutting	↑ stiffness at high temp	SBS, CRM, EVA
Cracking	↑ elasticity	SBS, SBES, EVA
Aging	↓ oxidation rate	Rejuvenator
Moisture damage	↑ adhesion	Polymer + anti-strip
Rap Blending	Restores binder chemistry	Rejuvenator

Polymers

Effects: Improves durability, enhances performance, and reduces thermal susceptibility

Uses: Pavement preservation, joint/ rumble strip impermeability, solvent resistance.

Thermoplastic Elastomers (TPEs): Such as styrene-butadiene-styrene (SBS) and styrene-ethylene-butylene-styrene (SEBS)

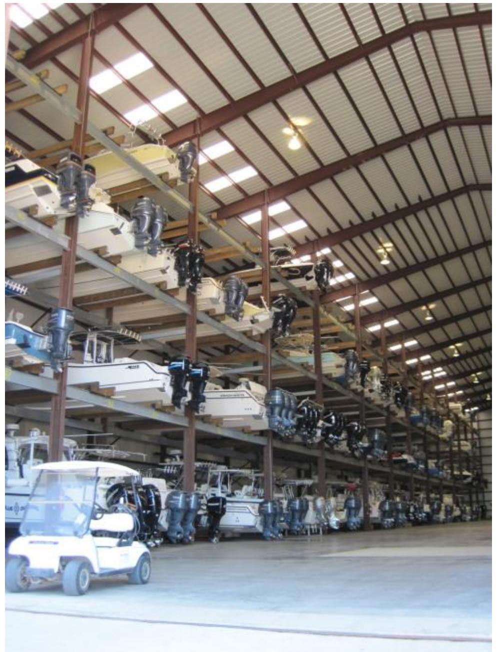
Thermoplastic Plastomers: Such as ethylene-vinyl acetate (EVA)

Recycled Polymers: Recent studies have explored the use of recycled materials, such as polystyrene and polyvinyl chloride (PVC)

J Band ; Associated Asphalt

Polymers- Specialty applications

- Airports
- Bus routes (Disney)
- Weigh stations (FDOT)
- Agricultural farms/ factories
- Horse and Buggy routes (St. Augustine)
- Marinas
- Mastics and crack filler
- Emulsions and pavement preservations
- Joint and rumble strip solutions
- Replacement for concrete in intersections.
- Race tracks (Barber Motorsports Park)



Rubber

Effects: Improves durability, noise reduction, environmental impact, and cost effectiveness

Uses: wet or dry processing into HMA from 8%-22%.

Incorporating crumb rubber into asphalt increases its elasticity and flexibility, leading to enhanced resistance to cracking and rutting, especially under extreme temperature variations and heavy traffic loads.

Chemical Rejuvenators

Reclamite; Pavement Technology

Effects: Extends pavement life, improved performance, cost effectiveness, environmental sustainability

Uses: Topical application on existing pavment, mixed with RAP

Mineral Oil-Based Rejuvenators: These are derived from crude oil and include products like paraffin oil and lubricating oil. They primarily enhance low-temperature cracking resistance through physical dilution.

Bio-Based Rejuvenators: These are derived from agricultural products and are gaining popularity due to their environmental sustainability. However, their chemical compatibility with asphalt can vary, and they may not always restore the necessary maltene balance effectively.

Compound Rejuvenators: These formulations often include reactive compounds that can repair degraded polymer modifiers and improve both low- and high-temperature properties of aged asphalt.

Warm Mix Additives

Effects: Lower production temps, longer hauling, maintains workability, lower emissions

Uses: added to HMA at asphalt plant

Evotherm M-1; Ingevity

Water-based additives: These additives introduce water to the asphalt mixture, which converts to steam during heating, increasing aggregate surface area and improving coating.

Chemical additives: These include emulsifiers and surfactants that reduce viscosity, improving wettability and lubricity of the asphalt binder.

Foaming agents: These agents introduce water that turns into steam, causing the asphalt binder to expand rapidly into foam, facilitating placement and compaction.

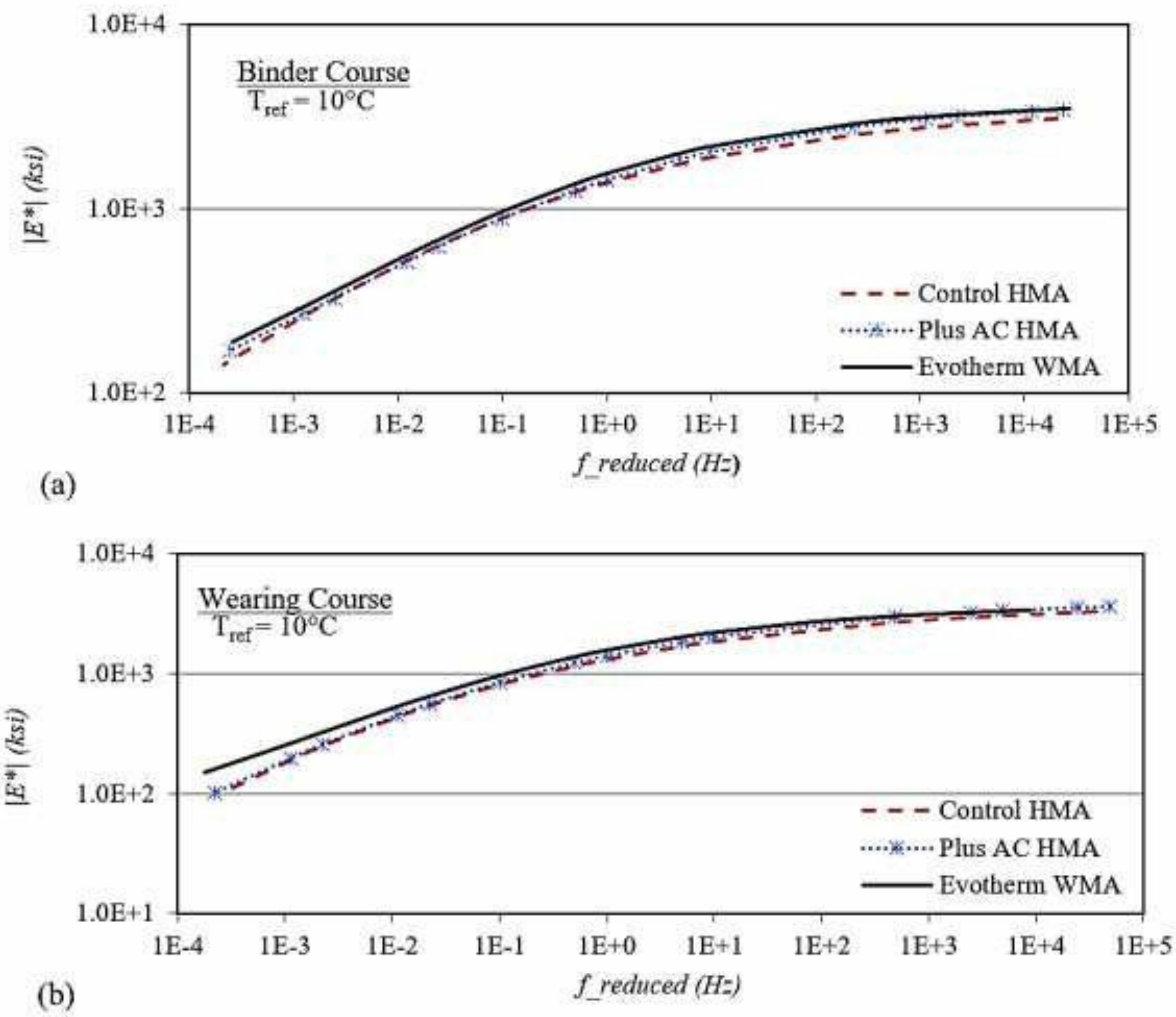
Organic additives: Derived from waxes and fatty amides, these additives help improve lubrication and reduce friction.

Surface-active agents: These are typically used to improve the coating of aggregates with the asphalt binder. .


Yeah, science!

Binder Rheology and PG Performance

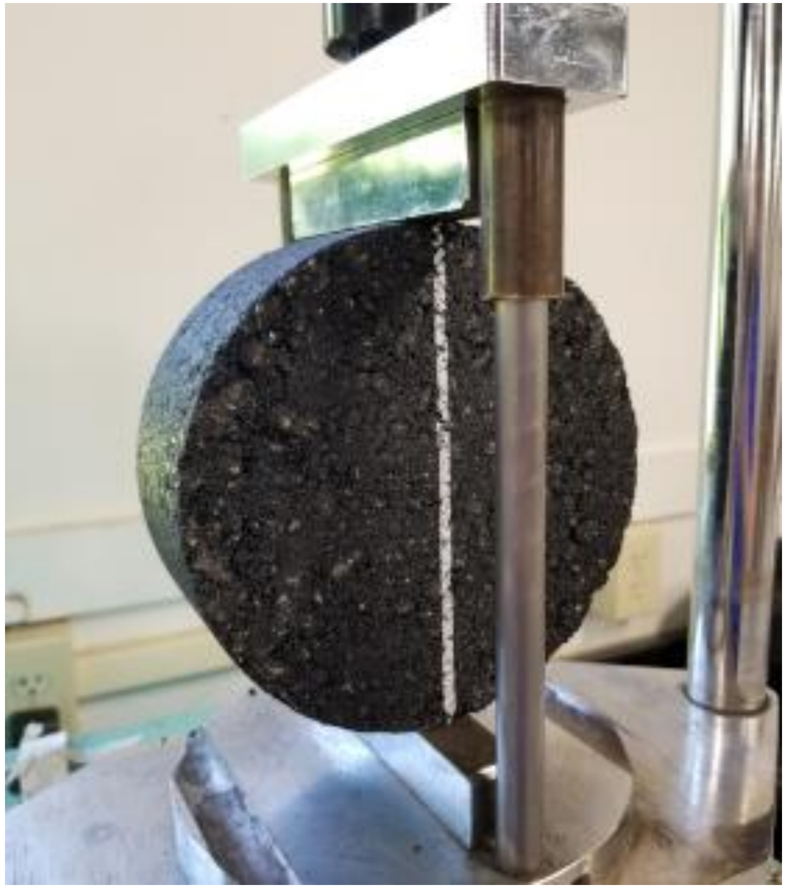
- Key rheological parameters: G*/sinδ (rutting), G*sinδ (cracking)
- Modifiers broaden effective temperature range
- Compare PG 67-22 vs. PG 76-22 vs. CRM binders



Mixture-Level Performance Tests

Hamburg Wheel Tracking → rut depth <10 mm @ 20,000 cycles

IDEAL-CT → CT index >65 for cracking resistance



Dynamic Modulus & Flow Number tests confirm stiffness balance

Aging and Durability

- Simulated aging via RTFO + PAV
- Modified binders show 30–40% slower oxidation

Field data: ΔTc degradation rate reduced significantly (loss of relaxation properties of asphalt binders)

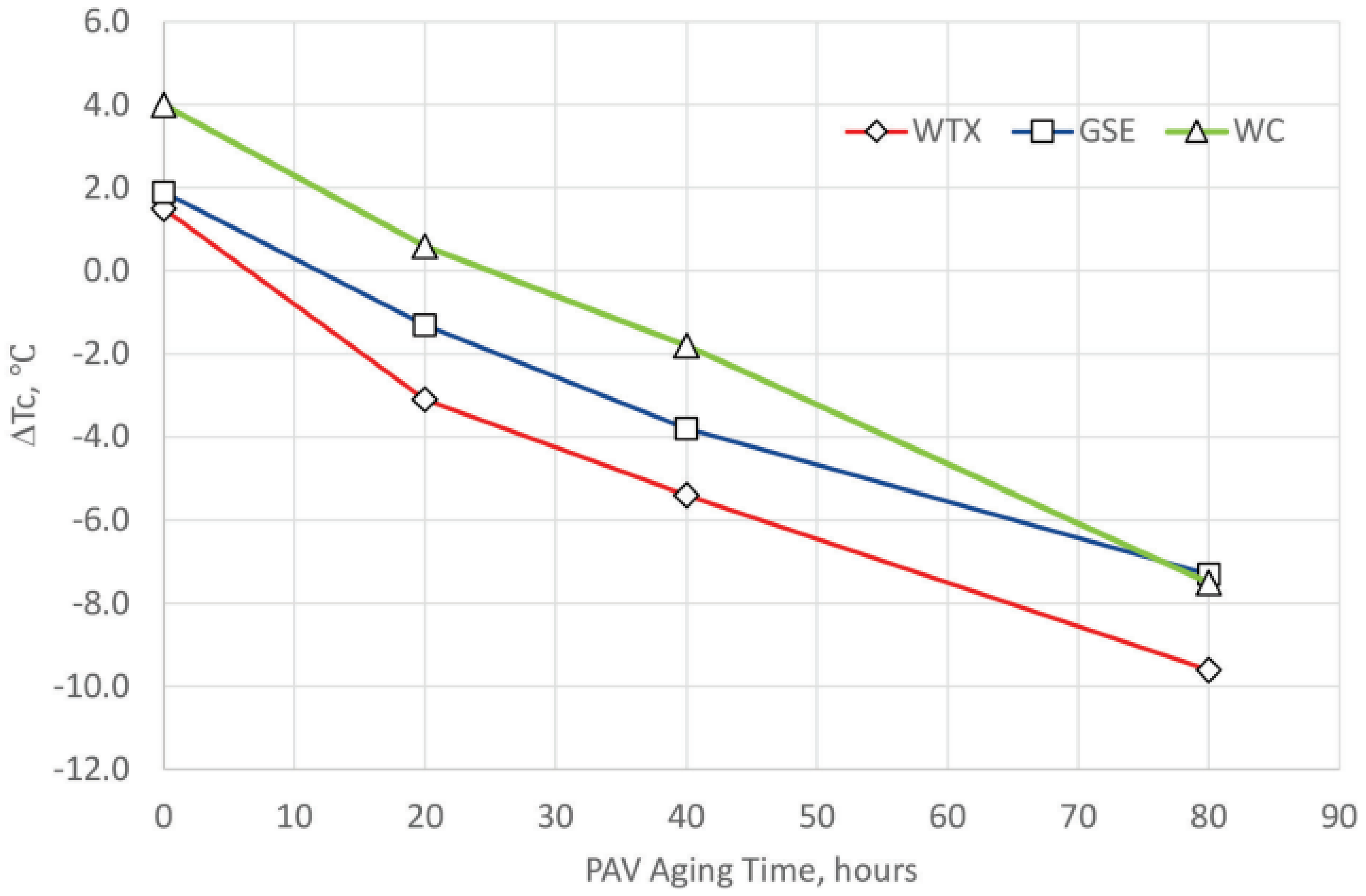


Figure 13. Effect of PAV Aging Time on ΔT_c (1)

Balanced Mix Design (BMD)

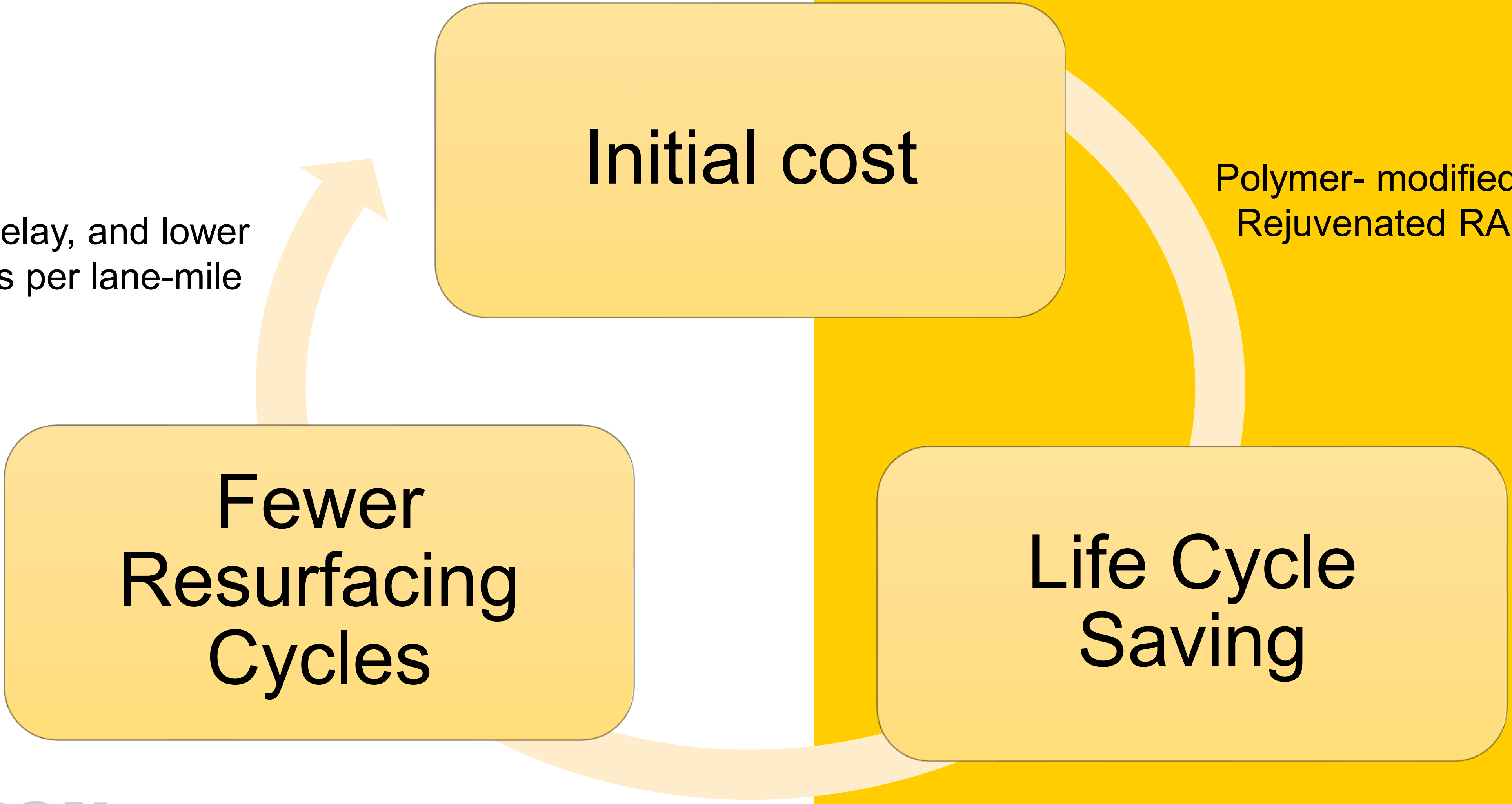
Combines volumetric design + performance testing

Modifiers achieve “balanced” rutting and cracking targets

Typical thresholds: Hamburg <10 mm, IDEAL-CT >65

Ergon Asphalt & Emulsions | CRAFCO INC An Ergon Company | Associated Asphalt An Ergon Company

Cost benefit analysis



Polymer- modified + 10-20%
Rejuvenated RAP – 10-15%

+ 40-60% Service life

Lower user delay, and lower overall dollars per lane-mile

Environmental and sustainability benefits

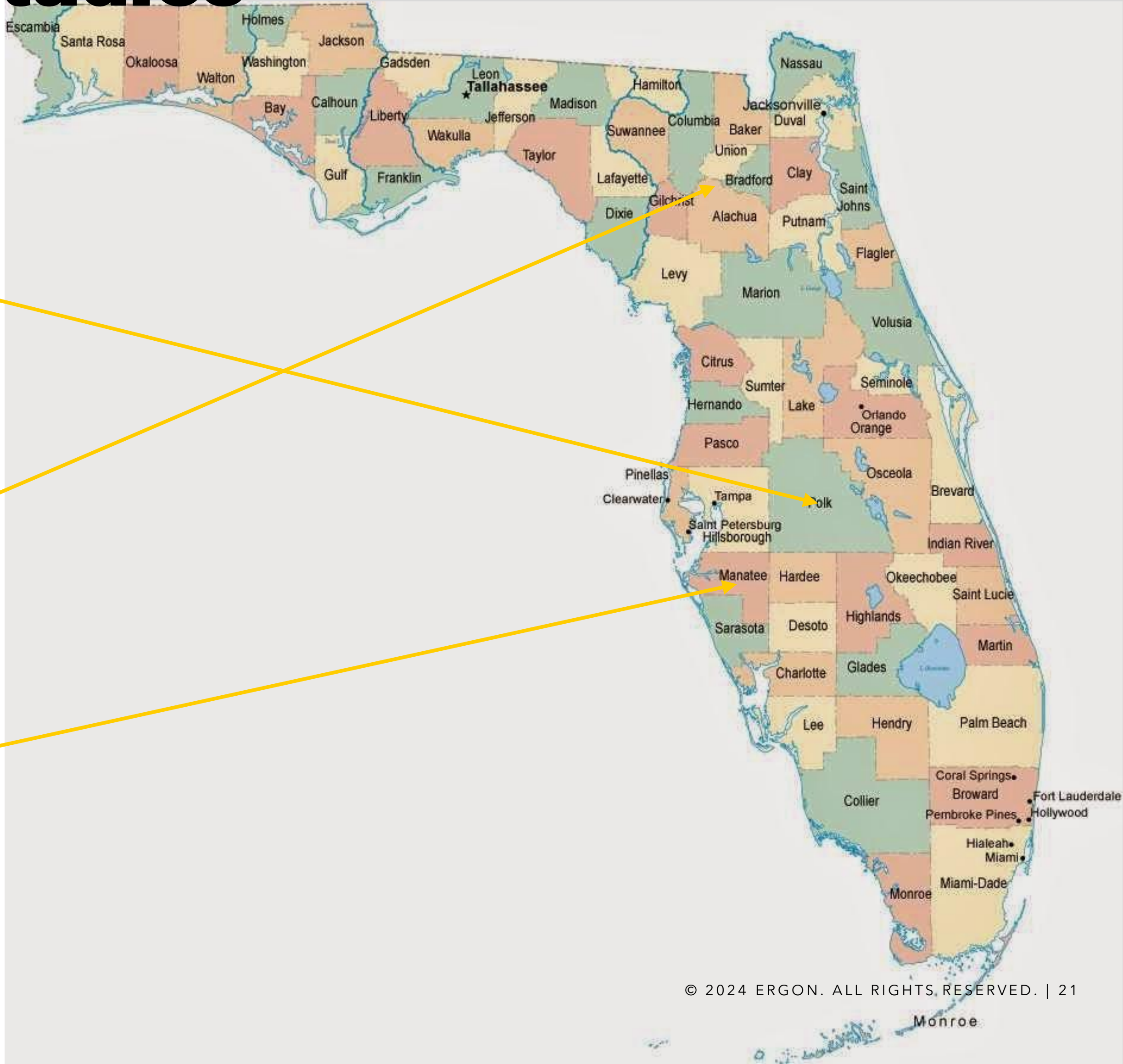
- Lower energy use (warm-mix: –30°C mixing temp)
- Supports RAP and rubber recycling
- Reduces lifecycle CO_2 emissions by 20–25%
- Fewer work zones = reduced community impact

Implementation and Specification Guidance

1. Select modifier based on distress mechanism
2. Verify binder PG and modifier compatibility
3. Conduct Hamburg Wheel & IDEAL-CT testing
4. Use FDOT-approved sources (APL-listed materials)
5. Monitor mix temperature and storage stability

Florida Performance case studies

- Polk County
  - 1.5" overlay with PG 76-22 binder. 38% rutting reduction compared to PG 67-22. PCR after 3 years: 91 (vs. 78 control)
- FDOT District 2
  - Crumb Rubber Modified asphalt. Fatigue cracking reduced 25% after 5 years. Constructability acceptable at 165°C
- Manatee County
  - Rejuvenated 30% RAP mix. ΔTc improved from –5.4°C → –2.1°C. Cost savings ≈ 18% per ton



Additional Florida Examples

County	Modifier	Key Results	Years
Brevard	SBS Polymer	45% rut reduction	4
District 7	Warm-Mix	25% energy reduction	2
Miami-Dade	CRM	20% fatigue reduction	5

Recommendations for Country Agencies

1. Identify key failure mechanisms
2. Pilot modified mixes (PG 76-22 or rejuvenated RAP)
3. Track performance; rutting, cracking, and costs
4. Share data regionally
5. Consider spec updates or performance based bidding

Key takeaways

- Florida's climate accelerates pavement distress
- Asphalt modifiers deliver measurable improvements
- Local case studies show 40–60% life extension
- Don't stop at just modified HMA. Consider modified emulsions and joint/ rumble strips solutions
- Align with FDOT specs for proven success.

Better Pavements. Longer Life. Smarter Investment.


Thank you.