

ADVANCEMENTS IN WARM-MIX ASPHALT (WMA) PERFORMANCE

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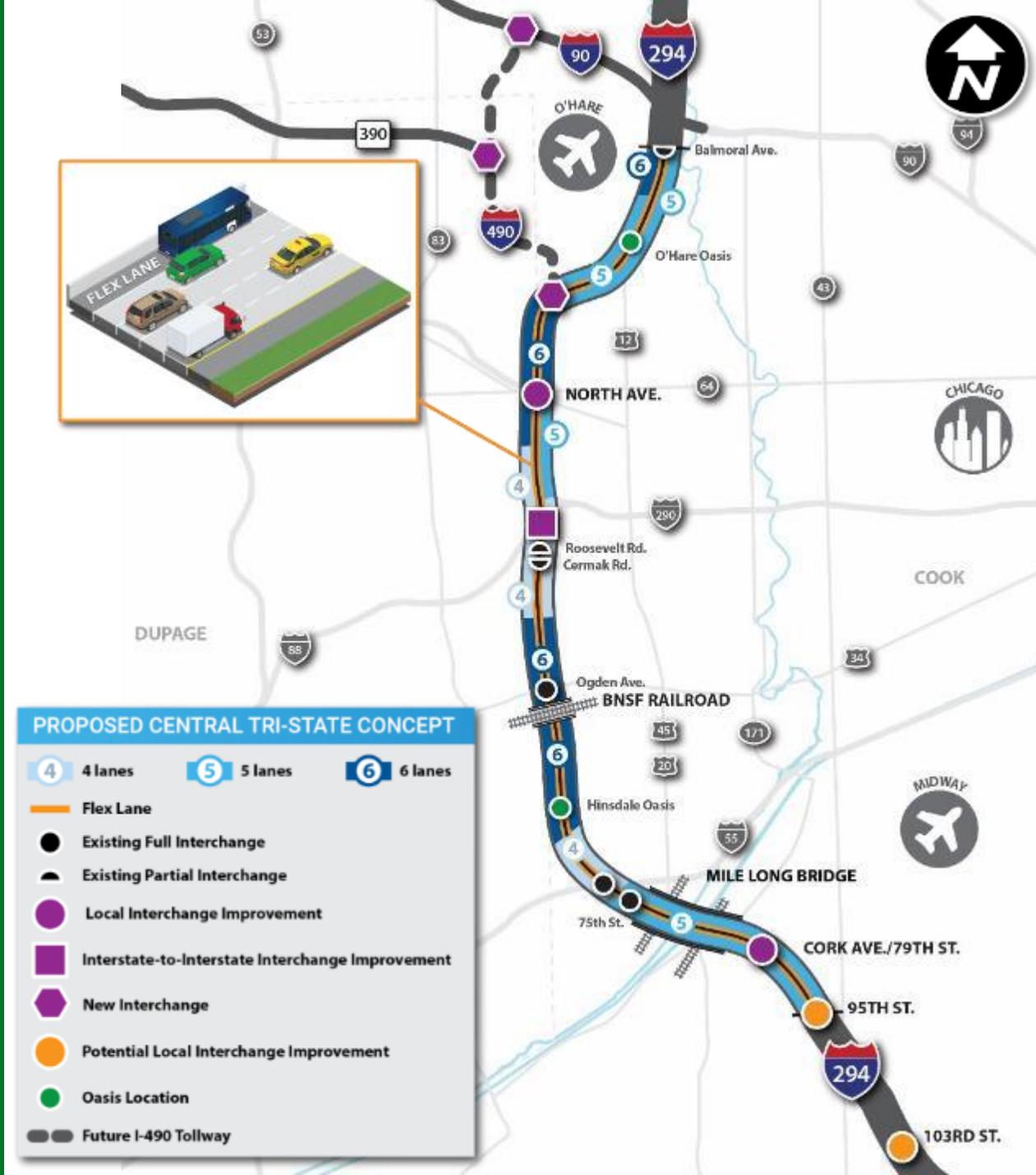


UPCOMING ASPHALT WORK

Central Tri-State Tollway (I-294)

95th Street to O'Hare International Airport

- North end – Completed to the O'Hare Oasis; under contract down to St. Charles Road (complete - early 2023)
- South end – Under contract from 95th Street to Hinsdale Oasis (complete - end of 2022)
- Middle section – Five multi-year contracts. Bids coming in June-August 2022
 - Roosevelt Road to St. Charles Rd
 - Ogden Avenue to Cermak Road
 - 47th Street to Ogden Avenue
 - Hinsdale Oasis to 47th Street
 - Flagg Creek to Hinsdale Oasis

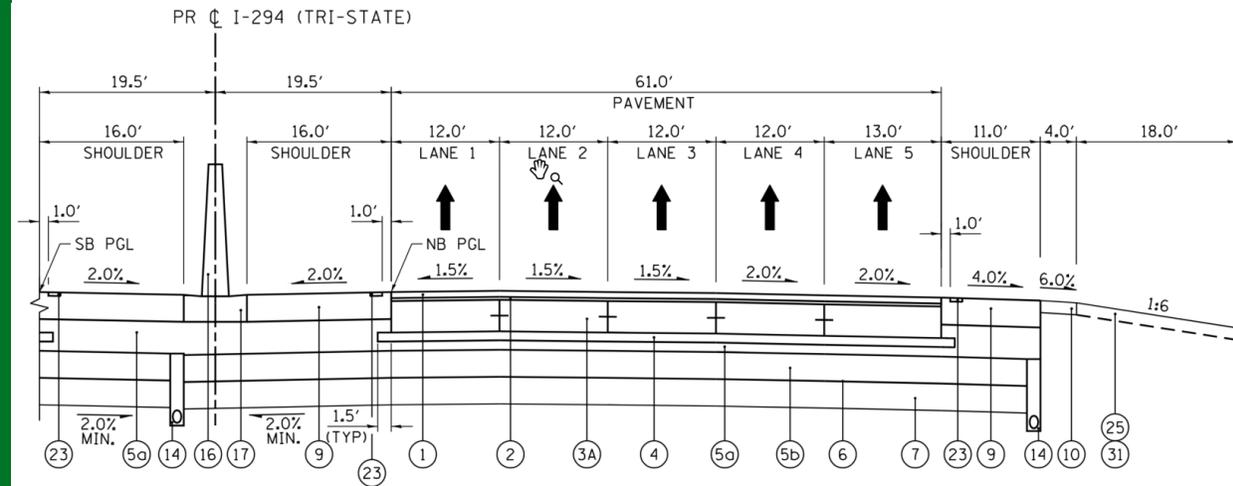


UPCOMING ASPHALT WORK

Central Tri-State Tollway (I-294)

95th Street to O'Hare International Airport

- 22 miles, 10 lanes, four shoulders
- 3 inches of asphalt stabilized subbase – more than 250,000 tons
- 9-inch WMA shoulders – 2-inch unmodified SMA, 3-inch N70 Binder, 4-inch N50 Binder
- 6-inch WMA shoulders – 2-inch N70 Surface, 4-inch N50 Binder
- Temporary pavement
- Composite pavement overlay – Northbound and southbound contracts (anticipated 2023) – 1.25 inch of IL-9.5 SMA Binder, 1.75 inches of IL-12.5 SMA-F Surface, more than 250,000 tons



UPCOMING ASPHALT WORK

Systemwide

I-490 Tollway

- Connect Jane Addams Memorial Tollway (I-90), Illinois Route 390 Tollway and Central Tri-State Tollway (I-294)
- 6 miles of interstate roadway
- 3 inches of asphalt stabilized subbase
- 10-inch and 6-inch WMA shoulders – 2-inch N70 surface, remainder N50 binder

Asphalt overlay on North Tri-State Tollway (I-94), 2022

- Half Day Road to Atkinson Road
- 6 miles of overlay
- 4" of SMA on mainline
- N70 surface on shoulders



WMA ADVANCEMENTS

- ✓ Sustainable
- ✓ Performance-driven
- ✓ Economical
- ✓ Research and trials, Tollway shoulders
- ✓ Contractor cooperation and leadership



CONTRACTOR OPTIONS

Fractionated reclaimed asphalt pavement

Reclaimed asphalt shingles

Warm-mix asphalt

Ground tire rubber – Terminal blend and dry-process crumb rubber

Future contractor options



FRACTIONATED RECLAIMED ASPHALT PAVEMENT



Higher Asphalt Binder Replacement (ABR)



Fractionation is critical

Fractionation

- Ensures uniformity
- Prevents segregation

RECLAIMED ASPHALT SHINGLES

Economical and sustainable, but affects performance

Maximum 5 percent

Stone matrix asphalt draindown improvement



WARM-MIX ASPHALT

Sustainable path forward

**Compaction assistance in
low temperatures**

Several approved products

Continue to improve practices



GROUND TIRE RUBBER

Proven performer

**Styrene-Butadiene-Styrene (SBS)
equivalent**

**Contractors most often select dry-
process plant added ground tire
rubber**



E-TICKETING

Pilot project upcoming on Central Tri-State Tollway (I-294) ramp contract

Required for PCC and WMA

Specific requirements similar to paper tickets, but full electronic interfacing required

Training of contractor and Tollway staff

Use of e-Ticketing strongly encouraged on other contracts



HAULHUB

e-Ticketing Portal

Integrates real-time ticketing data from:

- Asphalt producers
- Ready-mix producers
- Aggregate producers

Producer e-Ticketing vendor connectivity

Currently used by several asphalt producers

On-boarding producers to integrate asphalt, concrete and aggregate e-tickets

Centralized system (agency-owned data)



ADVANCEMENTS IN WARM-MIX ASPHALT

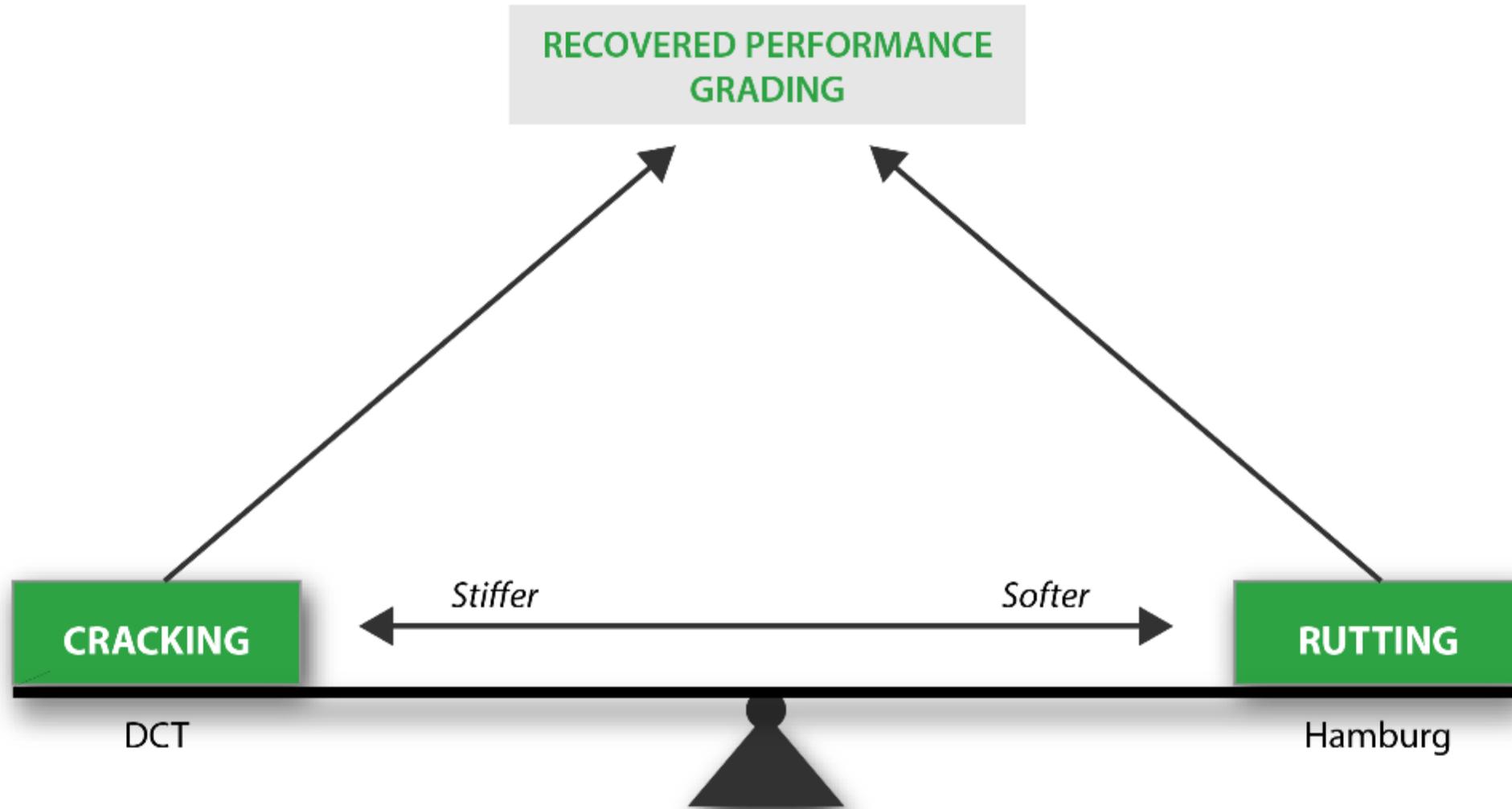
Continual improvements and advancements

Looking to the future

- New methods of mix acceptance
- New products
- New technologies



PERFORMANCE-BASED BALANCED MIX DESIGN



ABR AND ASPHALT BINDERS

Performance-Based Balanced Mix Design

Reclaimed Asphalt Material <i>(as permitted in Tollway tables 7 & 8)</i>		RAP ¹ /FRAP/RAS	FRAP/RAS	Category 1 ² / FRAP with RAS
ABR		0-17%	18-33%	34-50%
Allowable Mix Options	SMA and IL-4.75 ^{3/}	SBS/SBR 70-28 GTR PG 70-28 PG 58-28 10% Dry GTR		SBS/SBR 64-34 GTR PG 64-34 PG 52-34 ^{5/} 10% Dry GTR
	Unmodified SMA and Binder & Surface Course		PG 58-28 ^{6/8/}	PG 52-34 ^{4/5/6/9/}
	Asphalt Stabilized Subbase			PG 58-28 ^{6/7/}



DCT REQUIREMENTS

Performance-Based Balanced Mix Design

Tollway Table 11 – DCT Requirements

Mixture Type		Minimum Fracture Energy
SMA	Friction Surface	775 J/m ²
	Surface	700 J/m ²
	Binder	650 J/m ²
	Unmodified	500 J/m ²
Mainline Binder Course	N _{design} > N50	425 J/m ²
	N _{design} = N50	450 J/m ²
Surface Course N_{design} ≤ N70		450 J/m ²
Shoulder Binder Course		425 J/m ²
Asphalt Stabilized Base		N/A
IL 4.75		450 J/m ²

HAMBURG REQUIREMENTS

Performance-Based Balanced Mix Design

Tollway Table 10 – Hamburg and Stripping Inflection Point Requirements

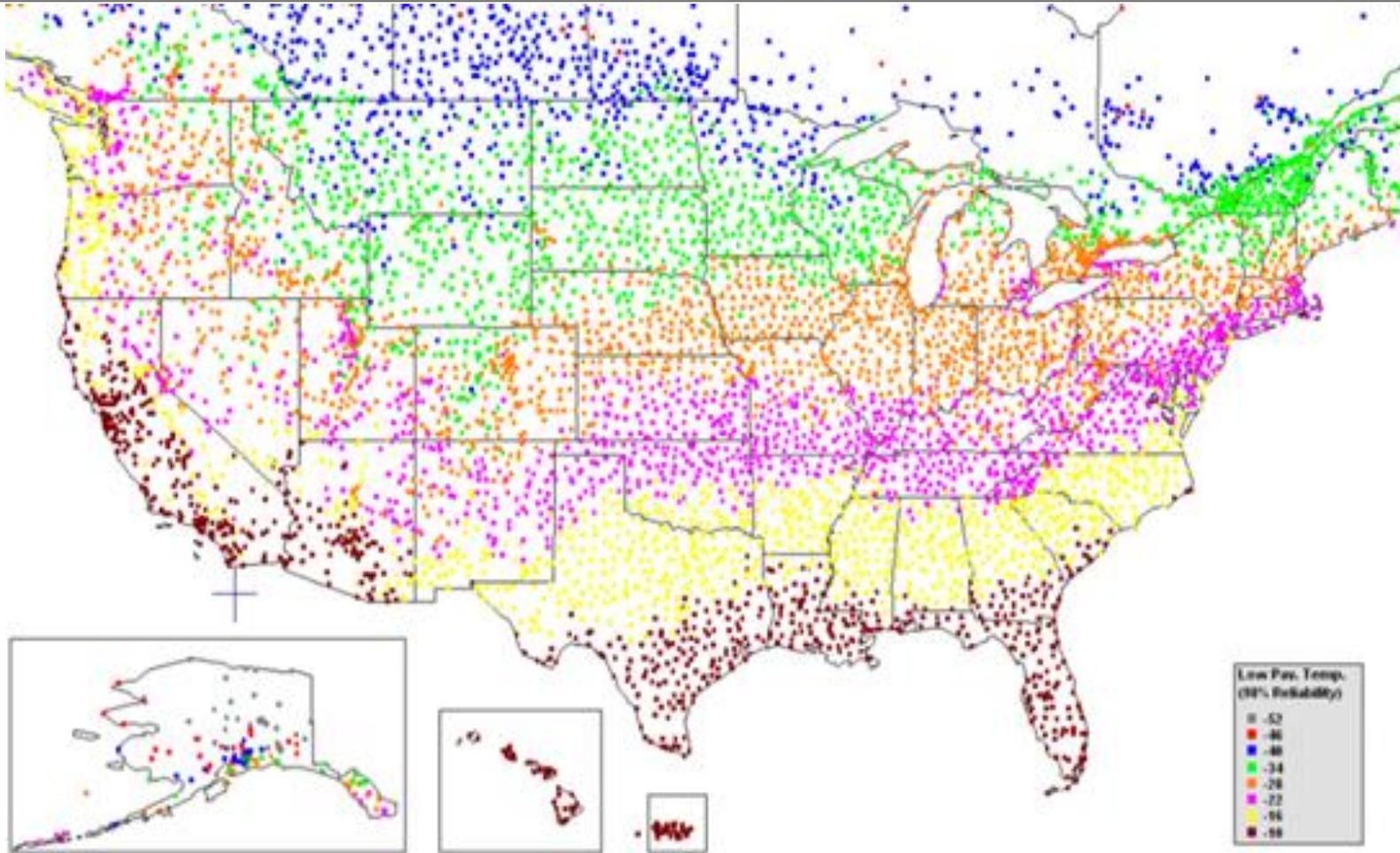
Mixture Type	Maximum Rut Depth	Max. Rut Depth Recorded at # Wheel Passes	Min. # of Wheel Passes at Stripping Inflection Point¹
SMA²	6 mm	20,000	15,000
Unmodified SMA	9 mm	15,000	10,000
IL -4.75	12.5 mm	15,000	10,000
Mainline Binder Course N _{design} > N50	12.5 mm	15,000	10,000
Mainline Binder Course N _{design} = N50	12.5 mm	10,000	7,500
Surface Course N _{design} ≤ N70	12.5 mm	10,000	7,500
Shoulder Binder Course	12.5 mm	7,500	5,000
Asphalt Stabilized Subbase	12.5 mm	7,500	5,000

1. If the stripping inflection point does not meet minimum requirements, the designer has the option to perform the Tensile Stripping Ratio (TSR) test per article 1030.04 (c)

2. Calculation of the stripping inflection point is not required for SMA with less than 4.0 mm rut depth at 20,000 passes

RECOVERED PERFORMANCE GRADING

Performance-Based Balanced Mix Design



98 percent reliability map of climate dependent low PG

ΔT_c AND THE PRESSURE AGING VESSEL

Binder parameter that correlates to “aging” durability

Variations in Implementing ΔT_c

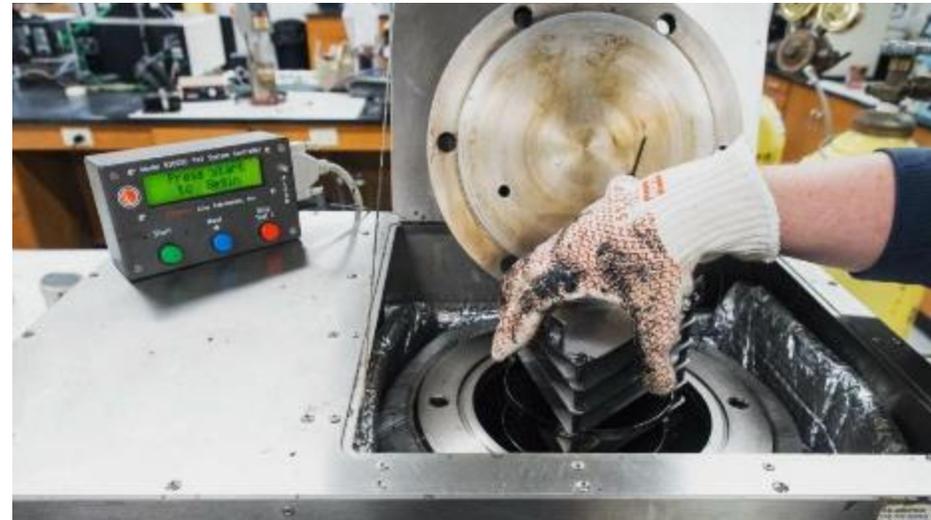
- Pass/fail criteria
- Aging condition

1PAV

- No additional testing required beyond M320

2PAV

- More representative of surface aging condition
- Better identifies certain modifiers
- Significantly more work for binder testing



NORTH TRI-STATE TOLLWAY (I-94) OVERLAY

Half Day Road to Atkinson Road

Recovered performance grading

- Contractor performed
- Informational purposes
- Accredited laboratory
- Design and production



PERFORMANCE-BASED BALANCED MIX DESIGN

Proposed Trial

To move towards performance-based mix design, a trial is needed

- Requirements
 - Mainline modified SMA: PG 70-28
 - Shoulder surface: PG 64-28
 - Shoulder and mainline dense-graded binder: PG 64-22
 - Meet DCT and Hamburg requirements for each mix as currently specified
- Specification relaxing
 - ABR (FRAP and RAS) limits removed
 - Asphalt binder – free to use any approved product
 - Air void design target allowed a +/-0.5 percent range

Any interested contractors?

Contact Tollway Materials



MIXTURE REJUVENATORS

Approved rejuvenators

- Ingevity Evoflex CA-7
- Sripath ReJUVN8/ReLIXER

Softened asphalt mixtures and improved performance characteristics

Shoulders only

Mix design

- Determine dosage that results in softening the virgin binder one AASHTO M320 performance grade
- Allow for the use of this virgin binder and rejuvenator at higher levels of ABR, similarly to a softer binder

Approved product list/trial process



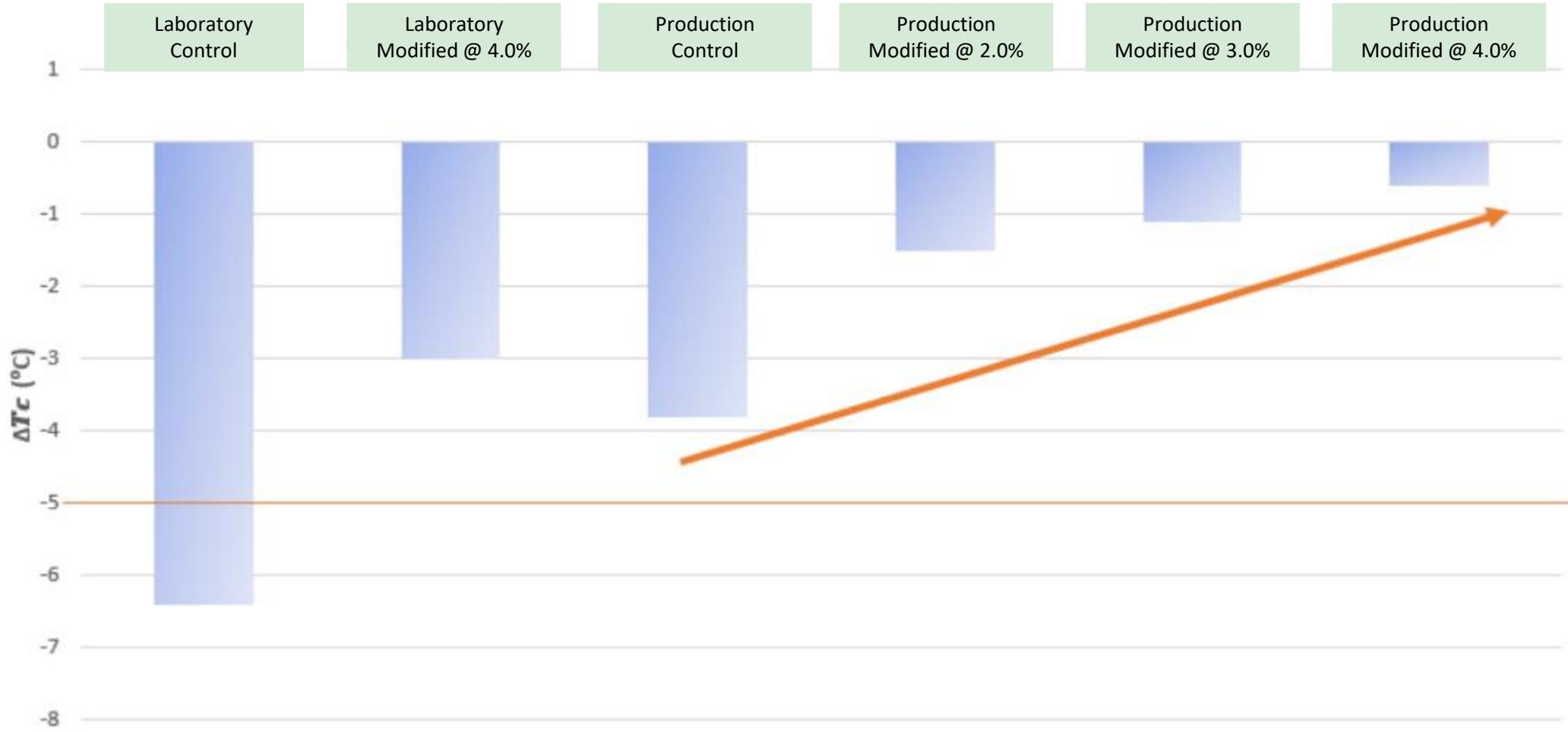
MIXTURE REJUVENATORS

Recovered PG Results



MIXTURE REJUVENATORS

ΔT_c Results



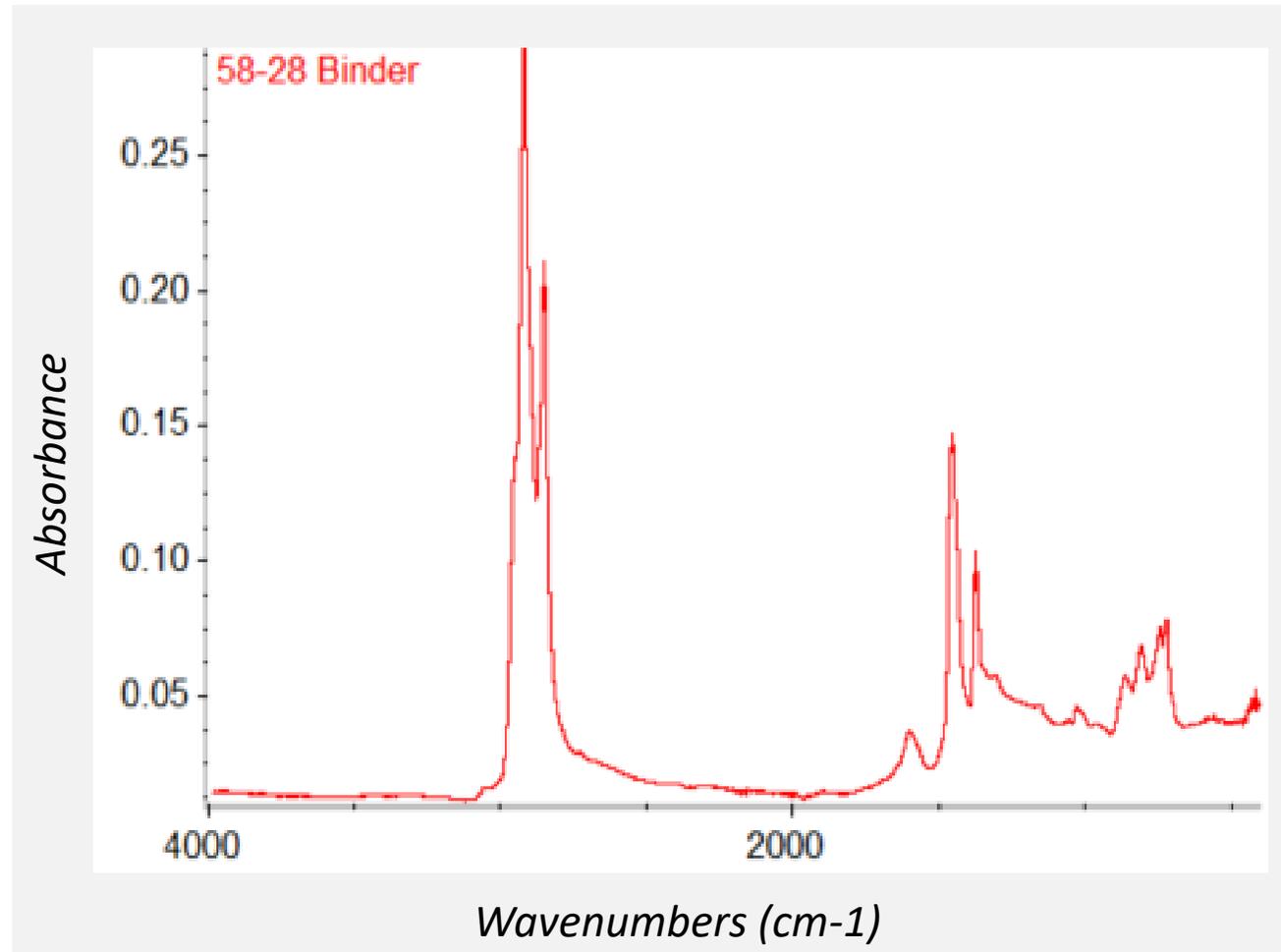
FOURIER TRANSFORM INFRARED SPECTROSCOPY

Identifies chemical compositions with infrared radiation

- Capable of building libraries of chemical “fingerprints”

Applied to identify asphalt binders, additives and contaminants

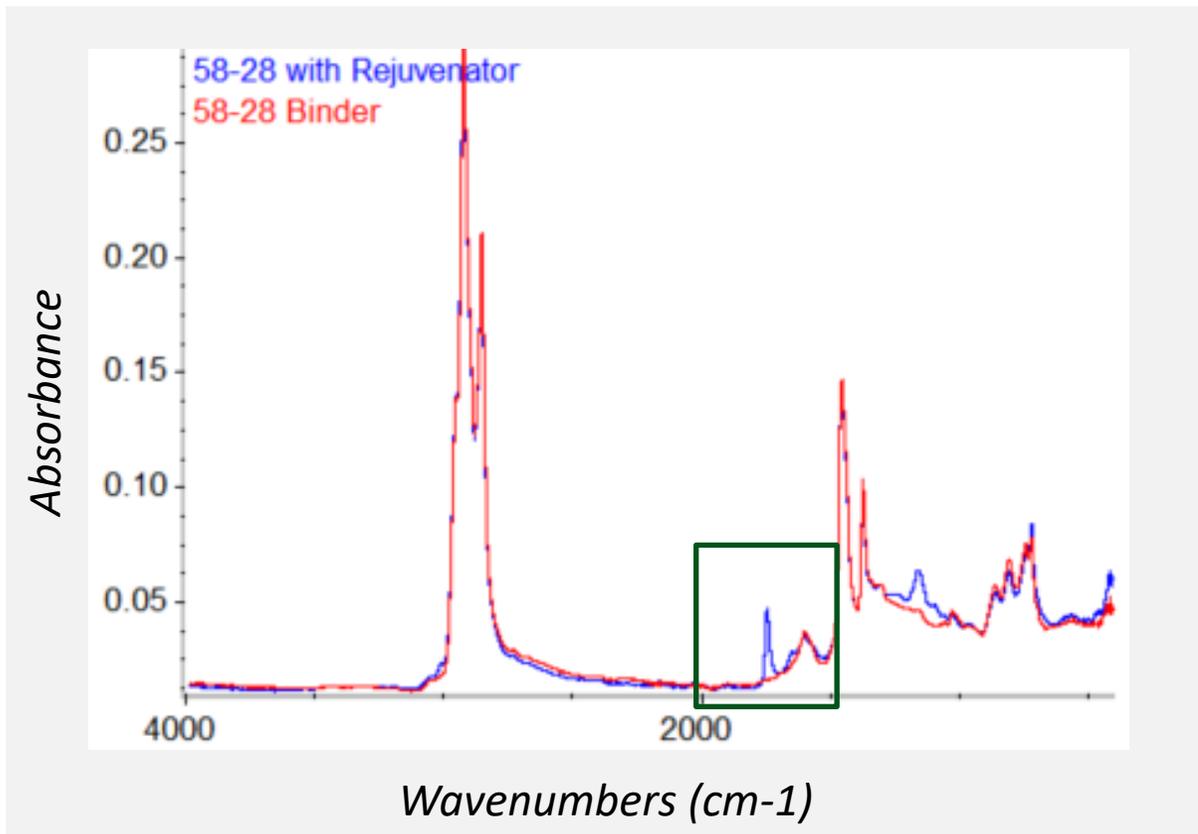
Can also quantify how much of an additive is present in a given asphalt binder



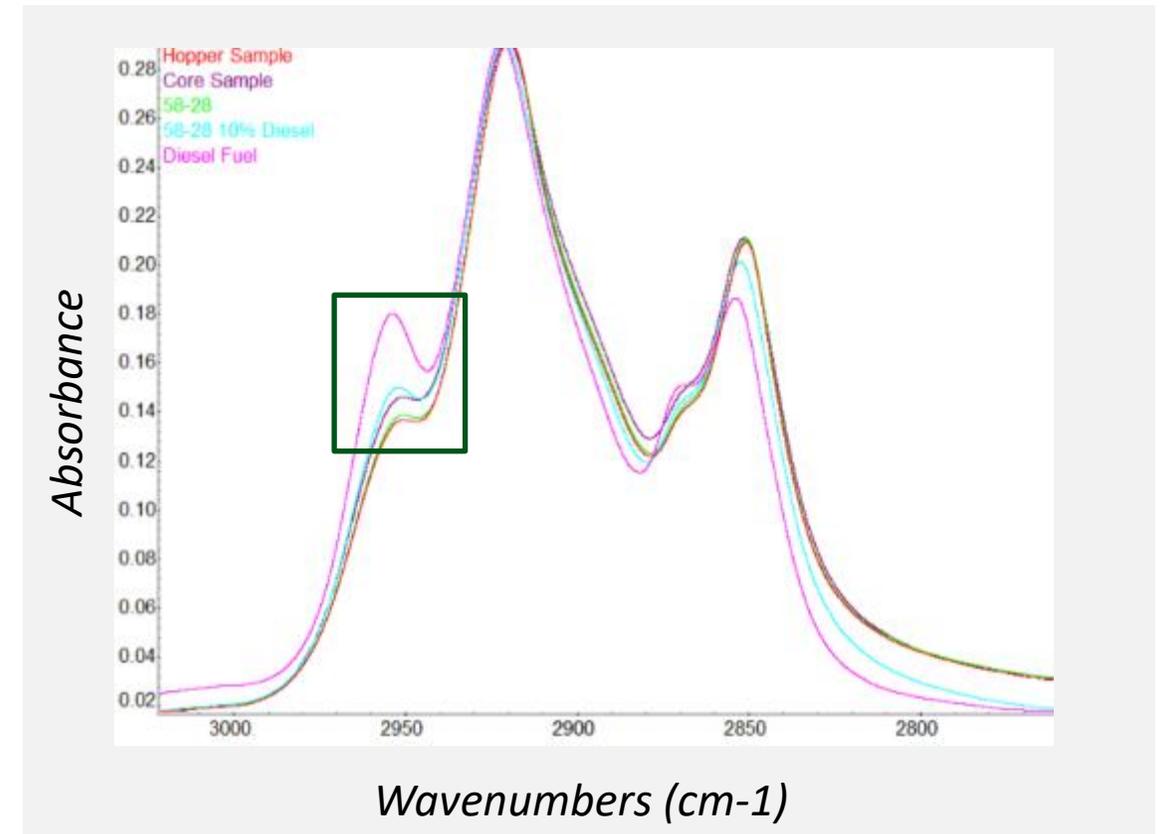
FOURIER TRANSFORM INFRARED SPECTROSCOPY

Additives and Contaminants

Detecting the presence of rejuvenators in asphalt binder



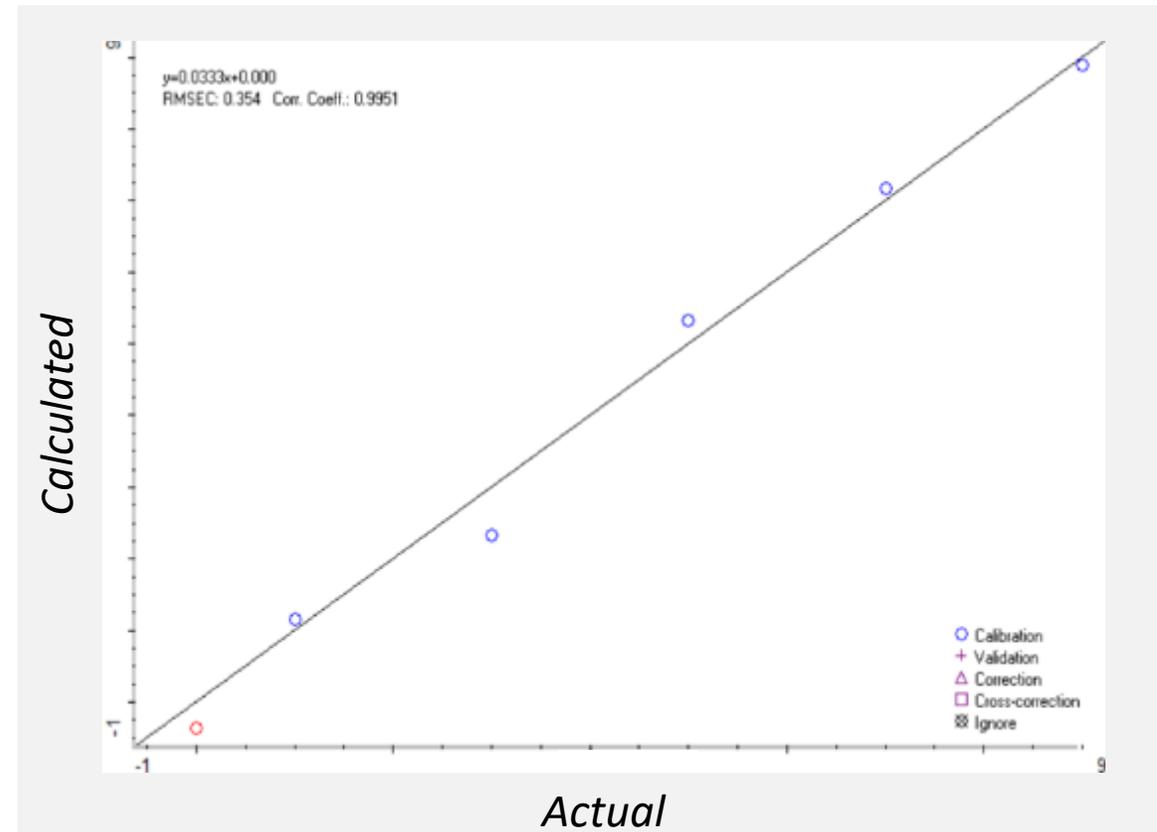
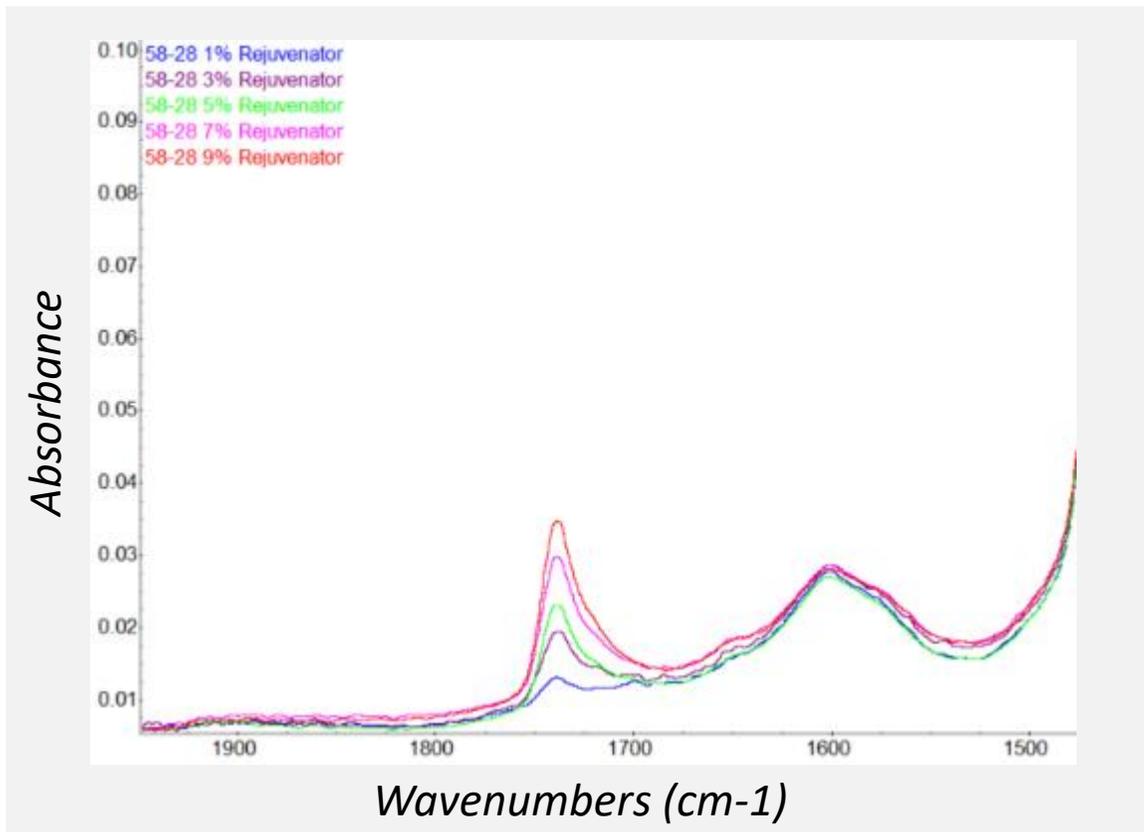
Detecting diesel contamination in asphalt binder



FOURIER TRANSFORM INFRARED SPECTROSCOPY

Additive Rate Determination

Quantification of rejuvenator in asphalt binder



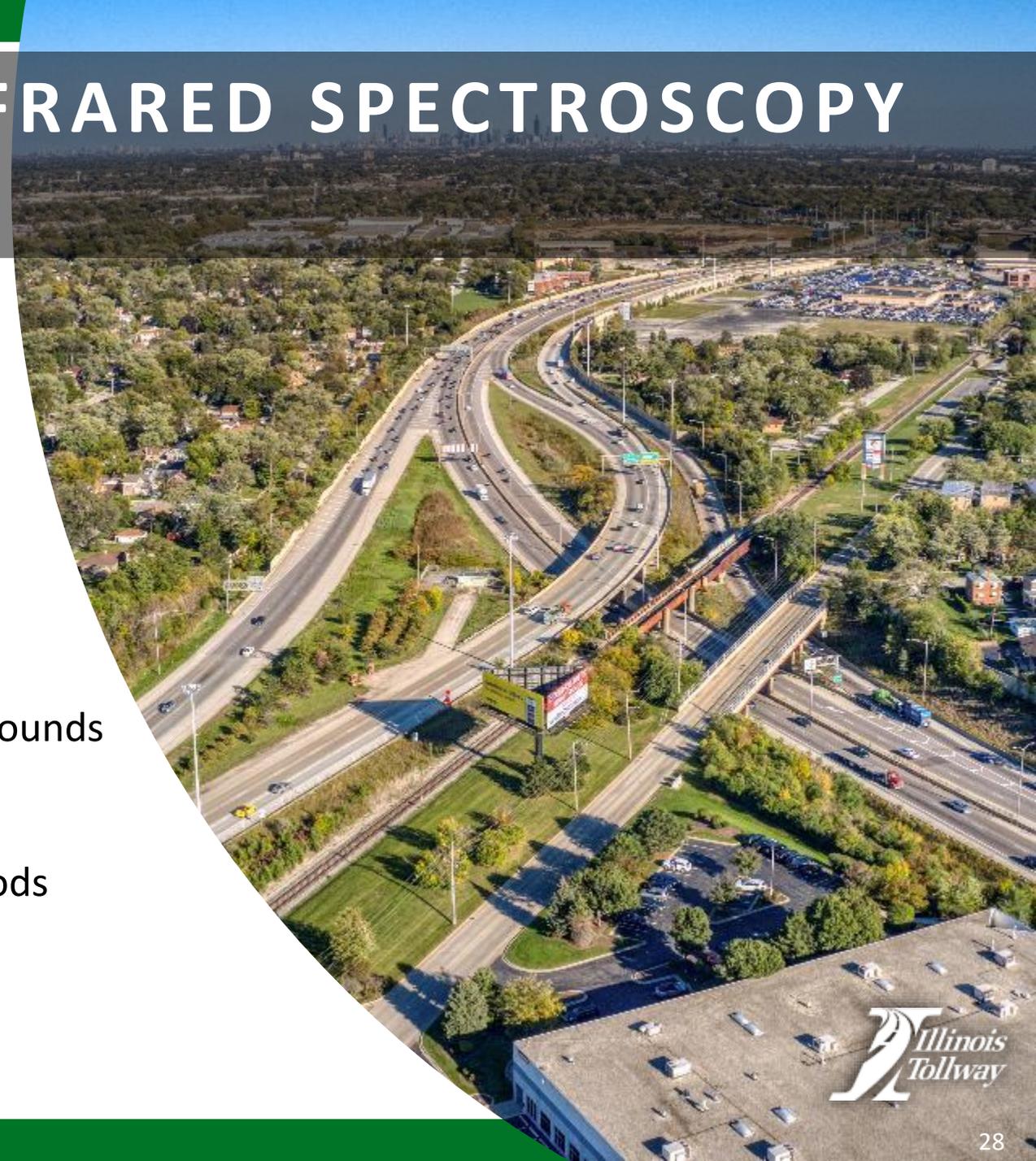
FOURIER TRANSFORM INFRARED SPECTROSCOPY

Research Request for Proposal

Research Request for Proposal (RRFP) #22-03

Utilization of FTIR for Material Characterization and Forensic Analysis

- Literature review
- Develop materials library for bituminous materials
- Investigate viability of testing non-bituminous compounds
- Identify and quantify aging and chemical changes from rejuvenators
- Drafting of Tollway special provisions and test methods



MIX DESIGN ANNUAL RECERTIFICATION

Tollway Test Procedure (TTP) 005

To be allowed for all mixes except mainline SMA or IL-4.75

No source changes

QC/QA records indicating good performance

Annual passing DCT and HWT in design and production

Minimal allowable JMF changes

THE ILLINOIS STATE TOLL HIGHWAY AUTHORITY
CONSTRUCTION BULLETIN No. 21-02
SUBJECT: Asphalt Mix Design Recertification

QUALITY CONTROL/QUALITY ASSURANCE AND INDEPENDENT ASSURANCE

Continuing with the use of QC/QA for asphalt, with an independent assurance (IA) component

IA WMA verification testing

- IA auger samples – periodically sampling per TTP 015 and density readings
- IA testing must fall within the tolerances from AJMF
- Failure triggers an investigation by the materials engineering consultant (MEC), CM, and contractor

Parameter	Precision
Percent Passing #200 sieve	±2.0%
Asphalt Binder Content (Dense Graded mixtures)	±0.4%
Asphalt Binder Content (SMA mixtures)	±0.3%
Air Voids	±1.5%
Field VMA	-1.0 to + 2.0%*
Density	Passing

* Compared to mix design minimum





THANK YOU