

Asphalt Performance for 26 Canadian and US Agencies

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Laying it down, testing it later

State transportation officials take an unusual U-turn on use of a controversial asphalt additive


BY JACK SULLIVAN | PHOTOGRAPHS BY WEBB CHAPPELL

TRANSPORTATION AND ENGINEERING officials from across New England gathered at the University of Massachusetts Dartmouth in June for what was being called an emergency “pavement summit.” The officials had learned a major asphalt provider had been adding recycled engine oil to its product as a binder for several years without telling anyone.

The asphalt company insisted the recycled oil worked just as well as other binders, saved

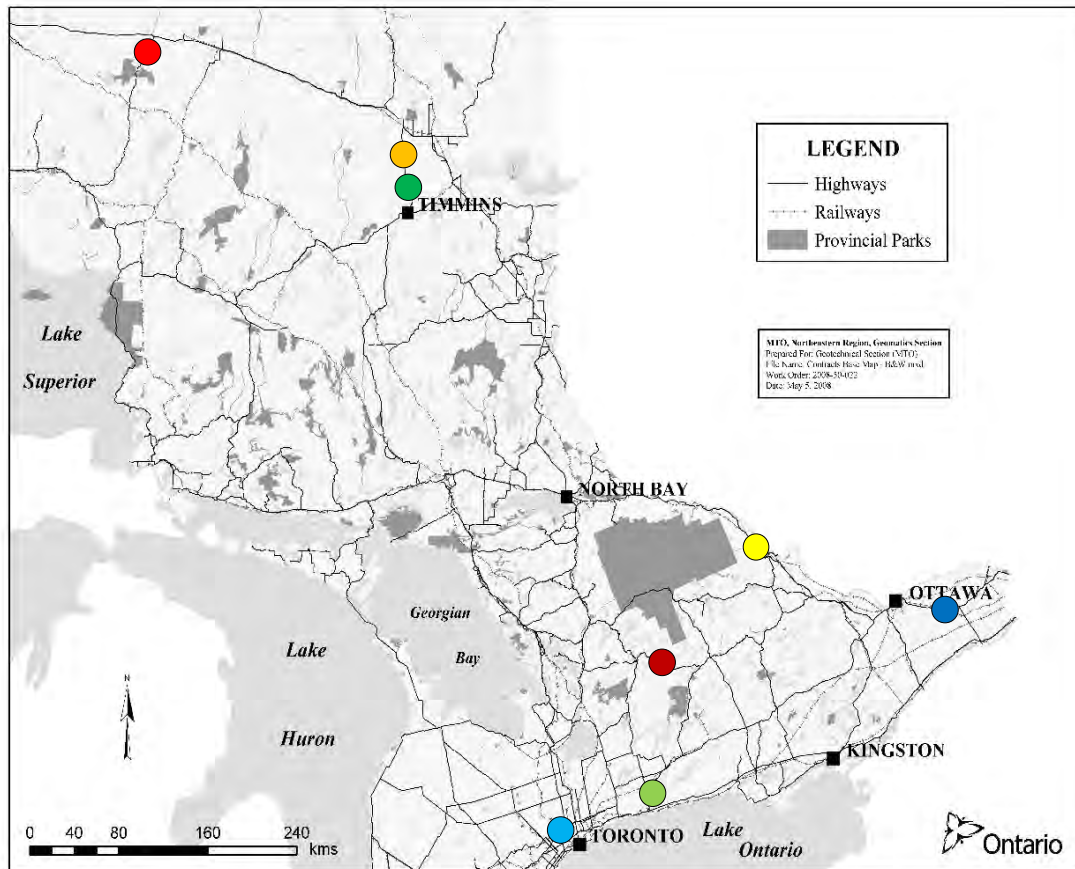
money, and was good for the environment. But many state officials at the summit said they were hearing reports that recently paved roads were cracking prematurely. There was little definitive information tying the road breakdowns to the recycled oil in the asphalt, but some studies out of Canada said the product couldn’t stand up to cold weather.

Officials from Bitumar, the Montreal-based asphalt provider, and Norwell-based Clean



Workers lay down asphalt on Union Street in Hingham, one of many road projects using used asphalt containing recycled engine oil.

Ontario's Dedicated Pavement Trials



- Bracebridge (7)
- Hearst (4)
- Petawawa (6)
- Timmins I (7)
- Casselman (7)
- Timmins II (8)
- Toronto (5)
- Durham (5)

Total: 49 Sections

Timmins Pavement Trials (2003 and 2007)

Section 9: Low physical/oxidative hardening. Stable sol-type binder that is free of oil exudation (sweating). **Little to no cracking.**



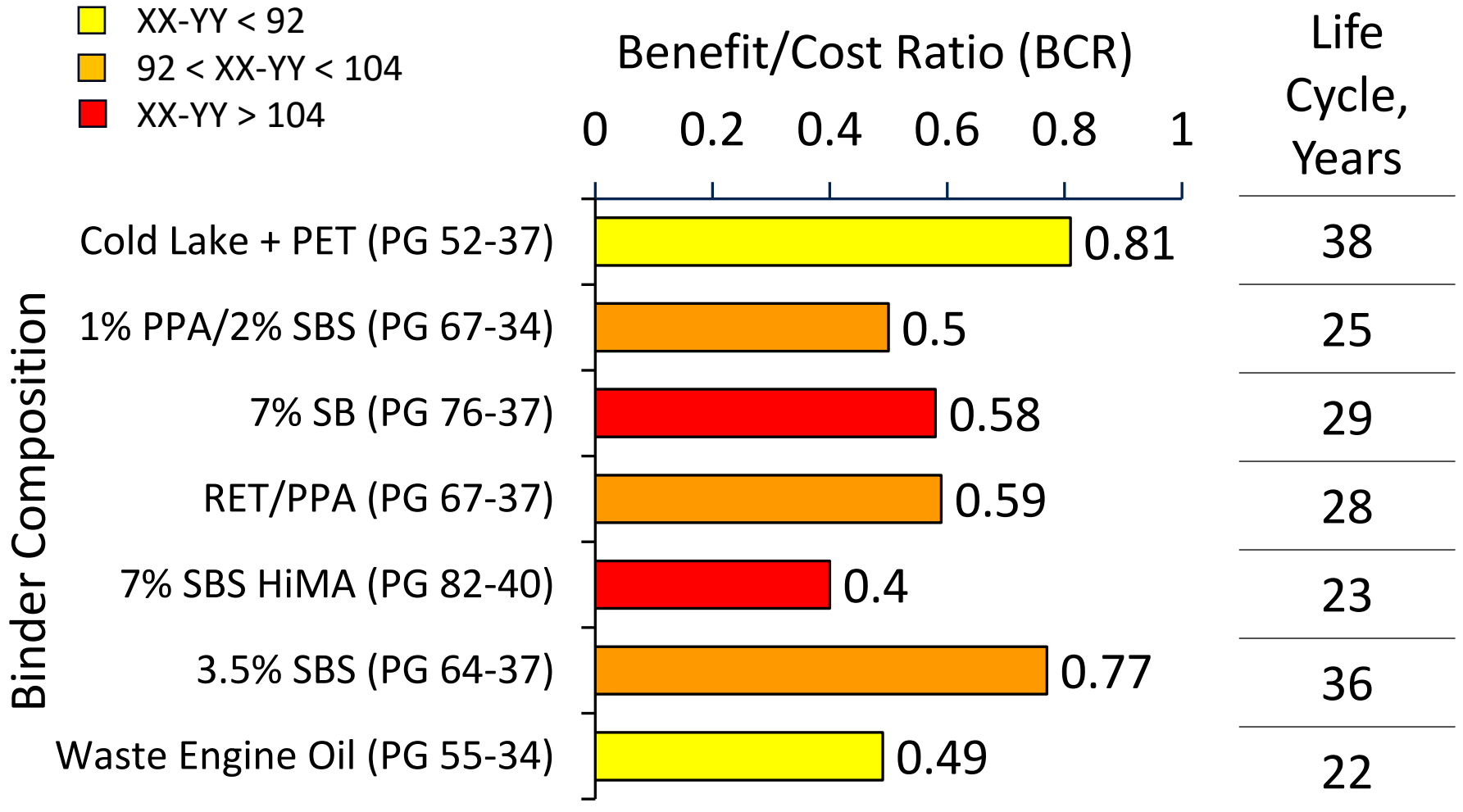
Straight Cold Lake +
0.3% PET fiber,
Lifespan = 38 years
(PCI 50)

Section 4: High physical and oxidative hardening. Gelled binder that exudes oils. **Major cracking and moisture damage.**

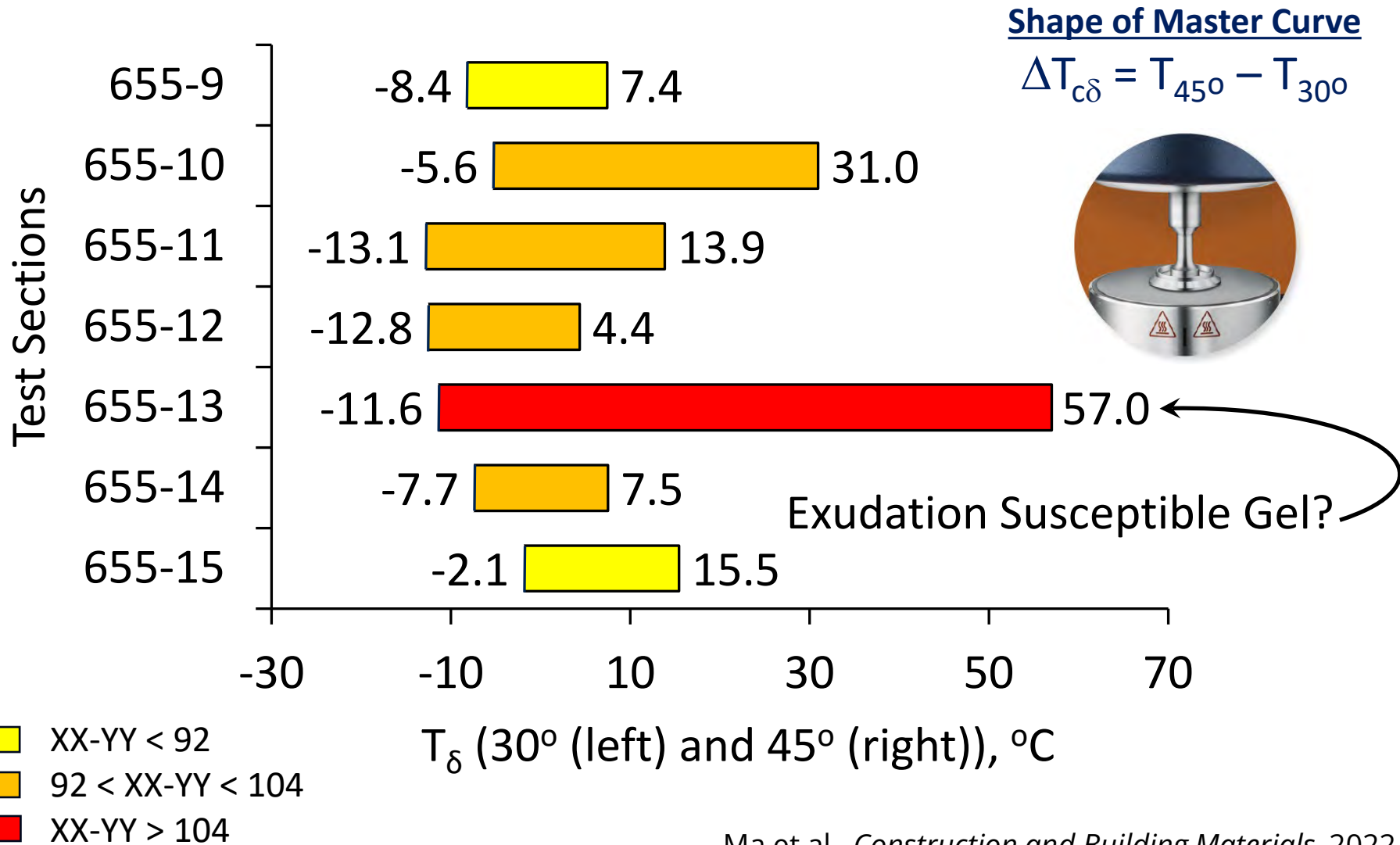


SBS + REOB, Lifespan = 14 years (PCI 50)

Highway 655 Phase II, 7 Sections (2007)



Specifying Point and Shape Parameters for the Phase Angle Master Curve

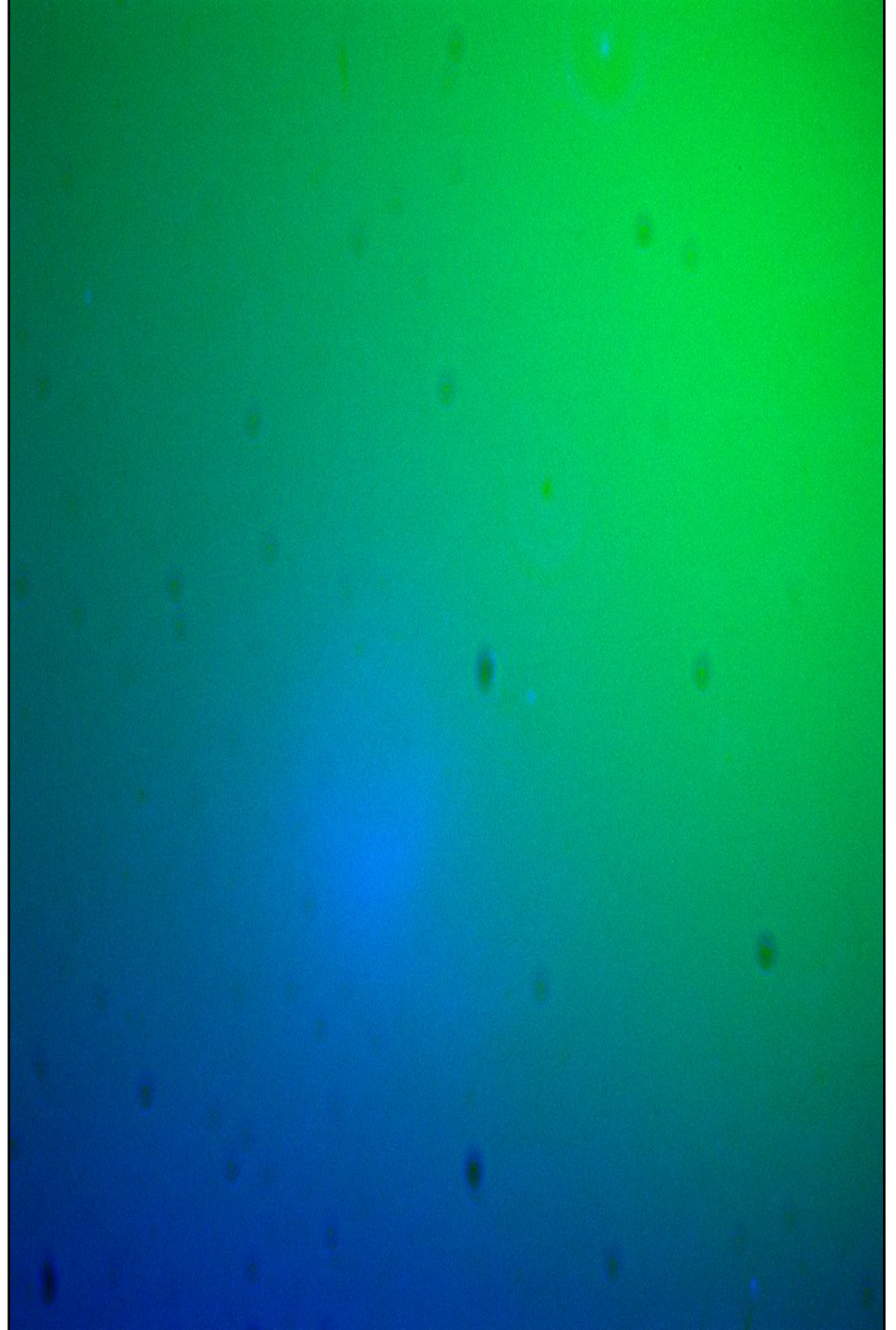


655-9 Cold Lake, Alberta Binder

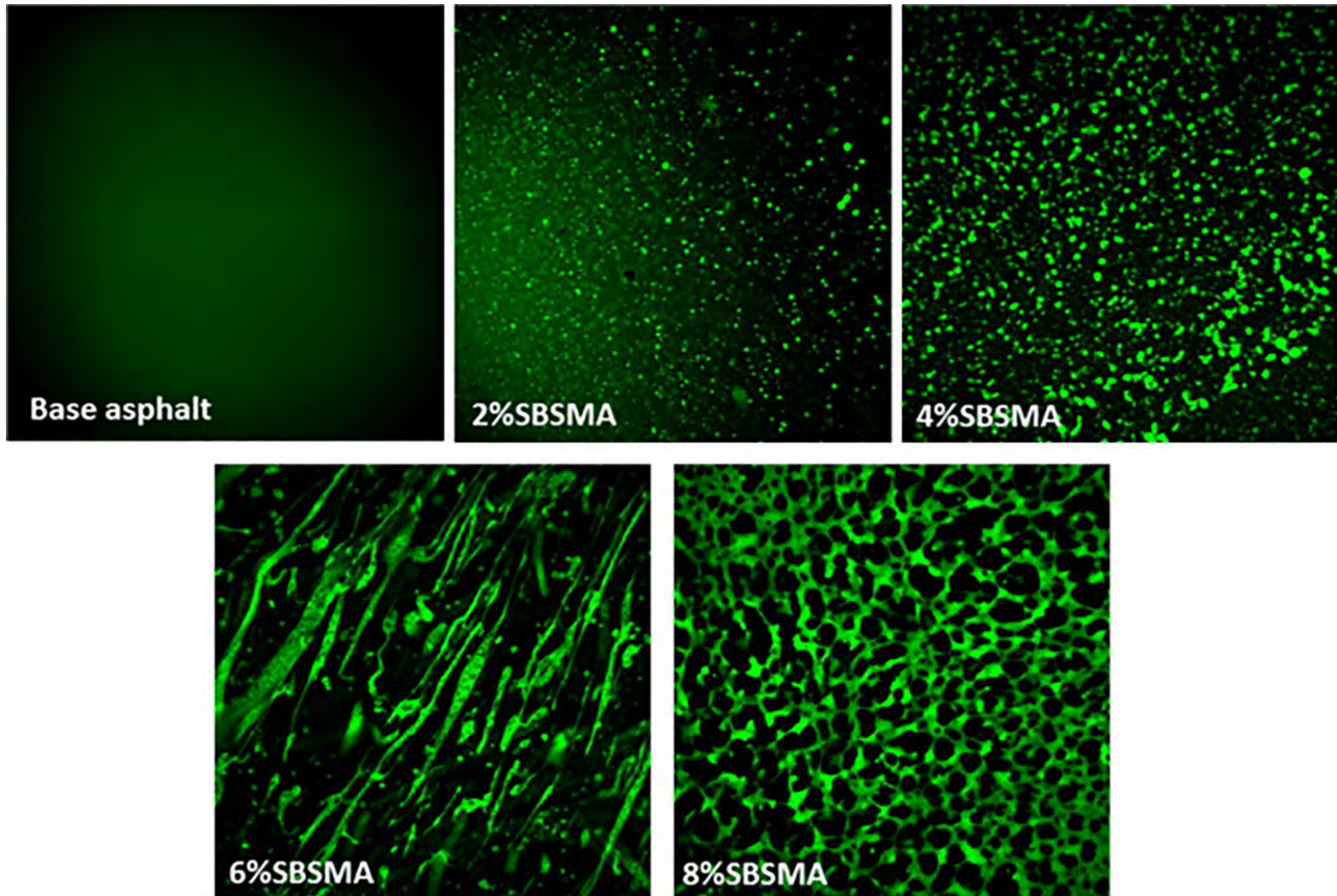
Phase Contrast
and
Fluorescence
Microscopy

PG 52-37

Compatible
Phase Structure
(Sol-Type Binder)



High SBS and Phase Inversion (Gelation)



PMA Enhancer or Customer Loyalty Additive?



Home | Hydrolene Low Temperature Enhancement

[Overview](#)
[Features & Benefits](#)
[SDS](#)

This Hydrolene Low Temperature Asphalt Enhancement Series will prove beneficial where greater impact on low temperature properties is required. With a relatively small amount of Hydrolene you can economically custom blend almost any low temperature grade of asphalt. Hydrolene can also help expand the total temperature range of your polymer modified asphalt.

| Typical Properties | ASTM Method | AROMATIC OILS | | | | | | | PARAFFINIC OILS | |
|---------------------|-------------|---------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------------|--------|
| | | H50T | N90T | H100T | H125T | H180TN | H225T | H600T | SP125 | SP250 |
| Viscosity, cSt 60°C | D2170 | 28.80 | 104.0 | 207.0 | 159.0 | 294.2 | 348.0 | 429.0 | 22.3 | 151.0 |
| Flash, CDC, °C (°F) | D92 | 210 (410) | 230 (445) | 248 (480) | 246 (475) | 280 (536) | 268 (514) | 292 (560) | 236 (455) | 312.00 |
| Pounds Per Gallon | D1250 | 7.99 | 8.07 | 8.11 | 8.14 | 8.00 | 8.02 | 8.02 | 7.25 | 7.42 |

(Click image to enlarge)

“Hydrolene can also expand the total temperature range of your polymer modified asphalt.”

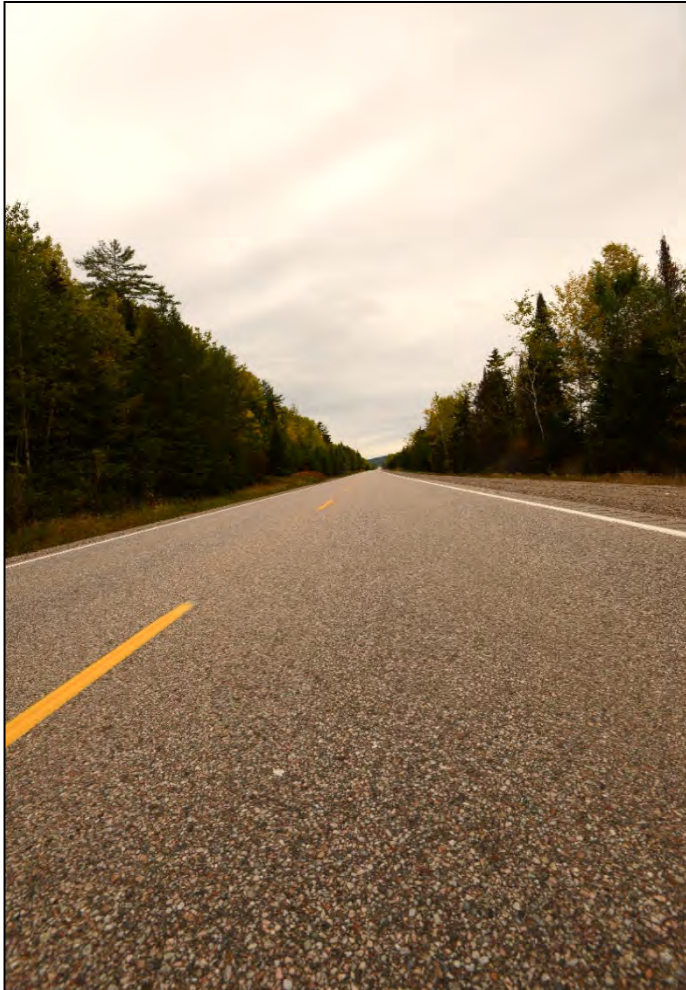
Modus Operandi



1. Ban all known offenders:
 - Waste engine and other oils
 - Bad reclaimed asphalt pavement (bad RAP)
 - Waxes
 - Pig manure
 - Others ...
2. Control sample chain of custody.
3. Test extracted and recovered binder for correct properties and against reasonable acceptance criteria.
4. Neither underdesign nor overdesign!

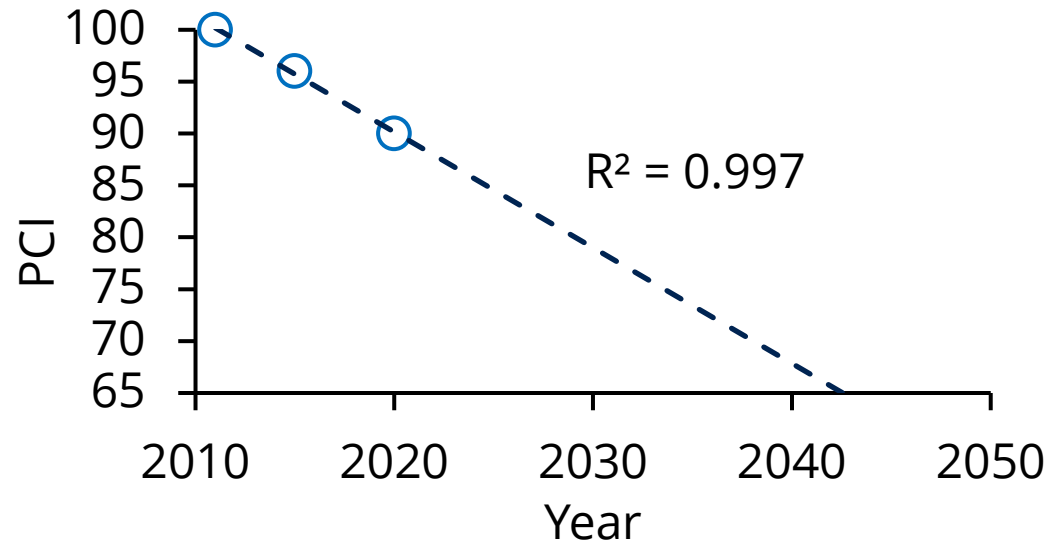
Getting it Right on Highway 17, Deux-Rivières, ON

Alberta binder, 0 cracks/10 km (2011-2021)



$T_{\min} = -37^{\circ}\text{C}$

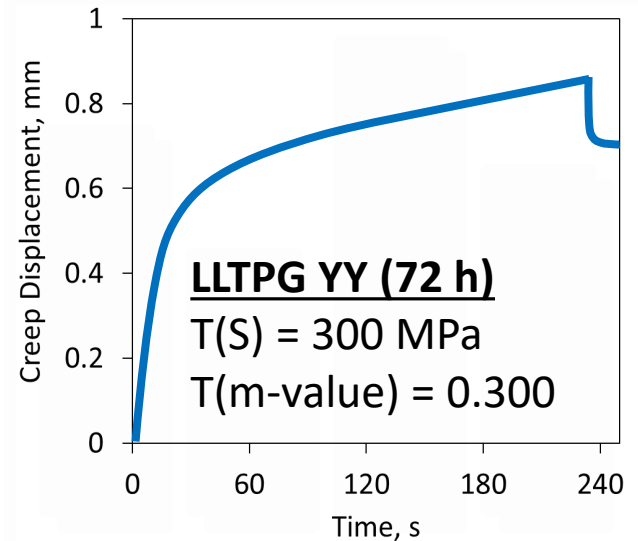
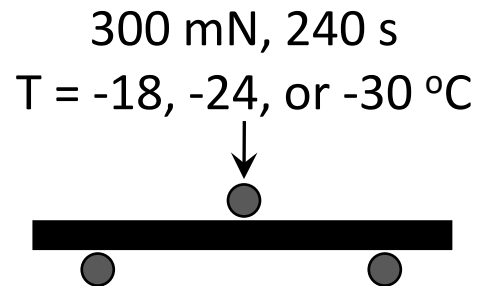
**Predicted Life ~ 32 Years (PCI = 65)
or ~ 64 Years (PCI = 30)**



5.4 % PG 58-34 binder

AASHTO T 406-23 Extended Bending Beam Rheometer Test (EBBR)

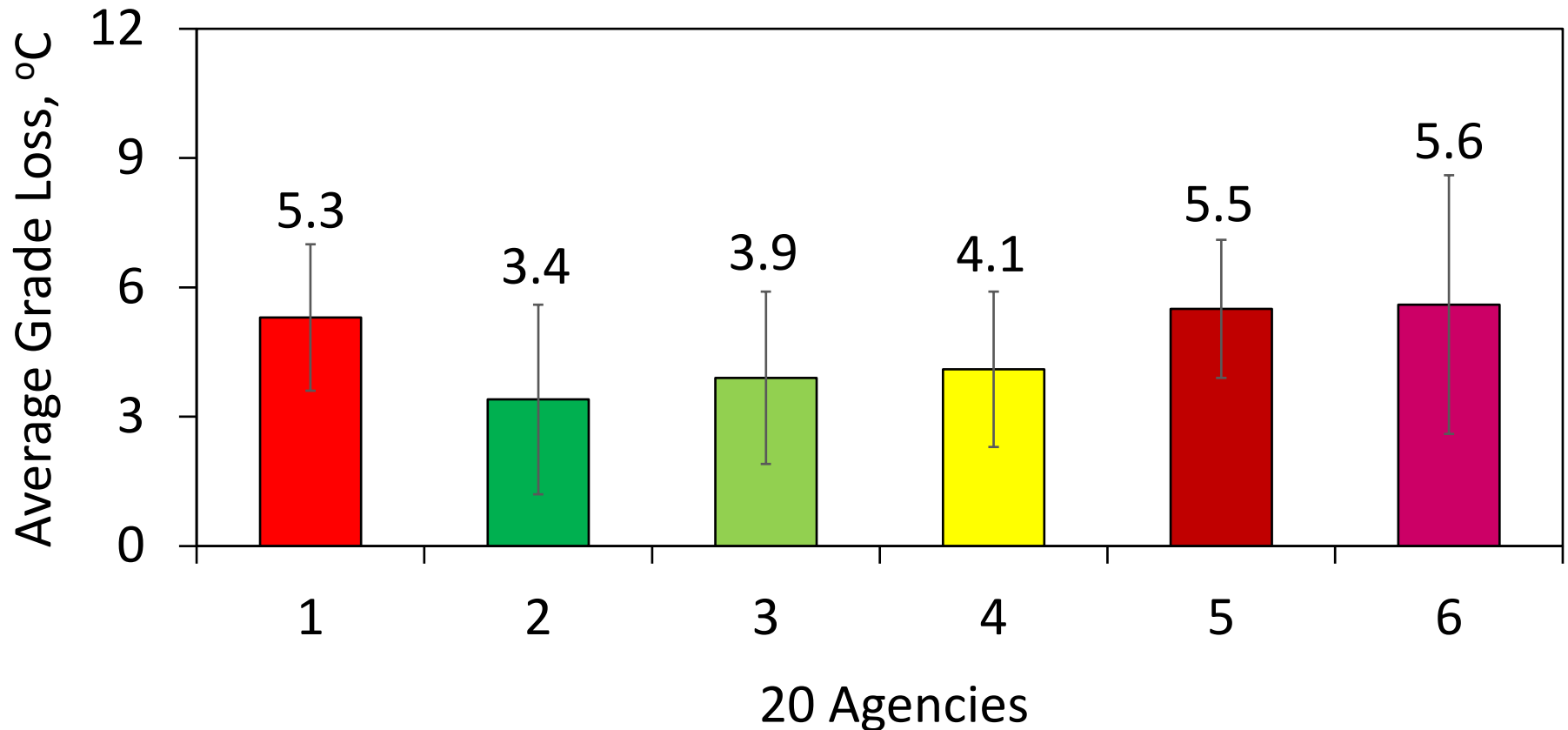
1. Conditions at $T + 10$ and $T + 20$ and measures grades after 1, 24 and 72 h of cold conditioning.
2. Measures grade loss from 1 h.
3. Sensitive to gel formation and exudation.



AASHTO T 406-23 EBBR Grade Losses (EBBR LLTPG (72 h) - BBR LTPG (1 h))

297 Samples/20 Agencies

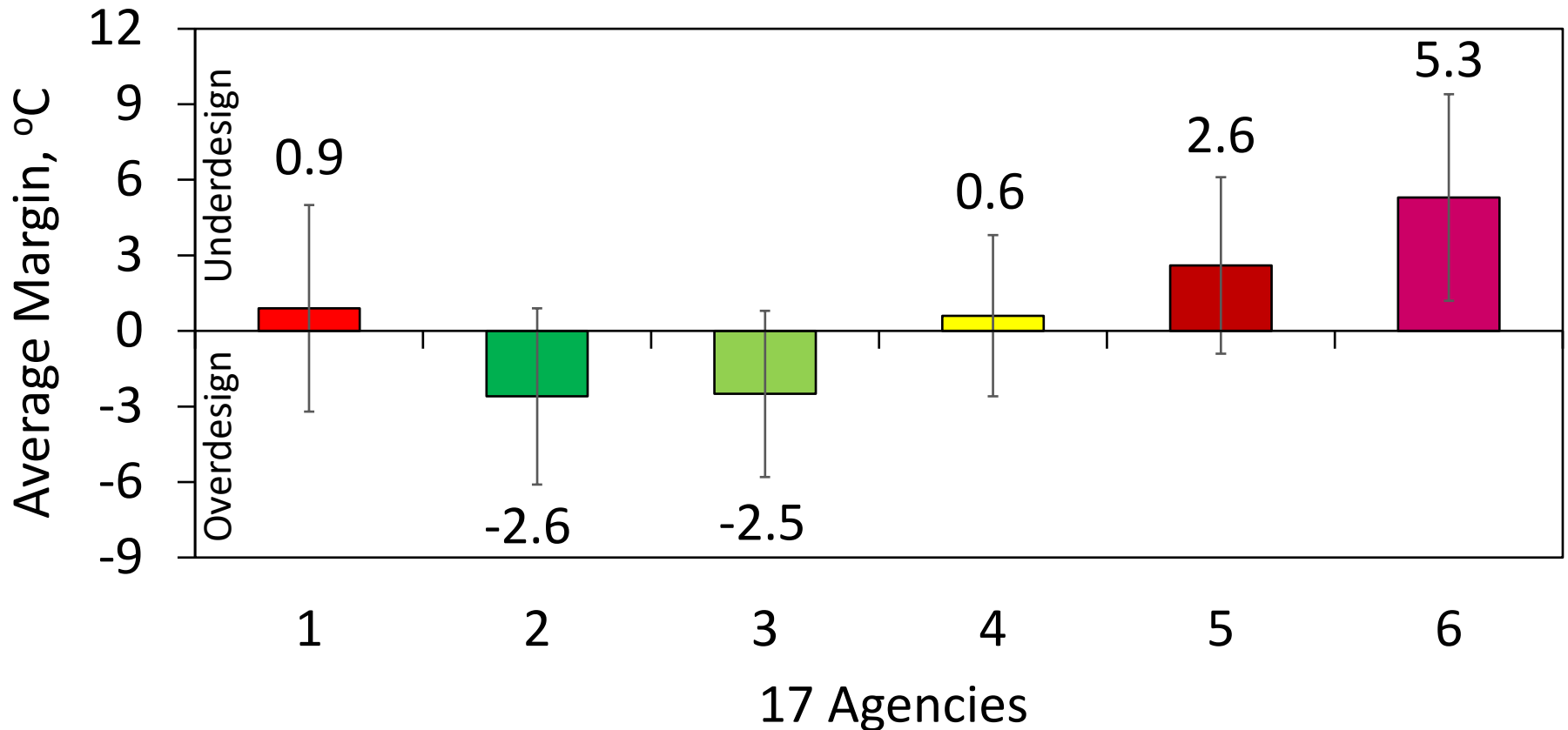
[6 = average \pm SD for 15 US agencies (n = 135)]



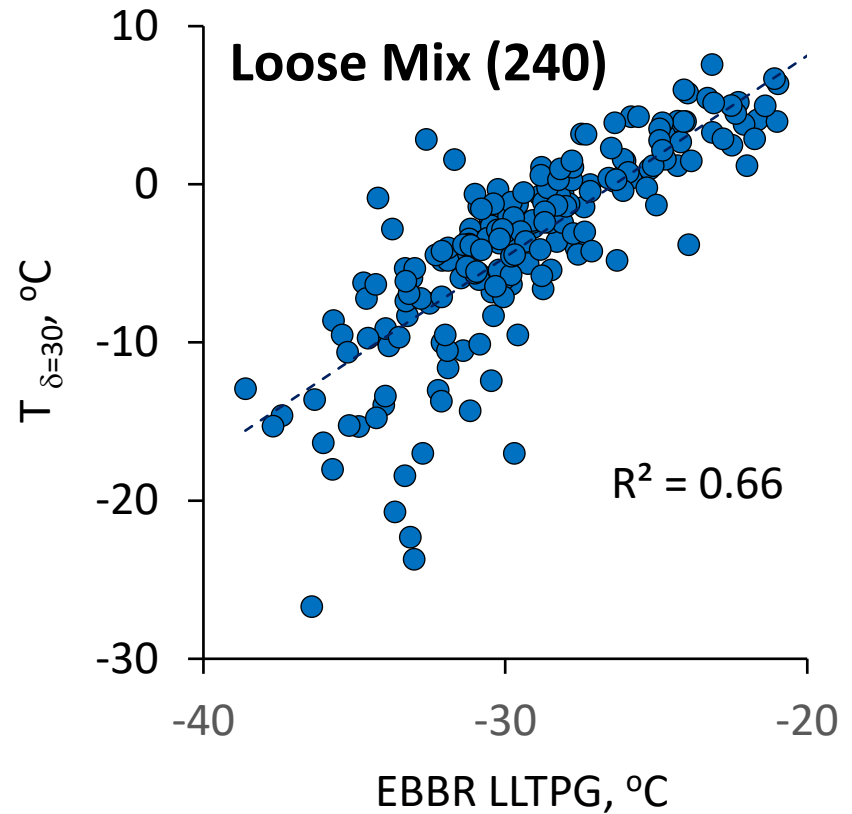
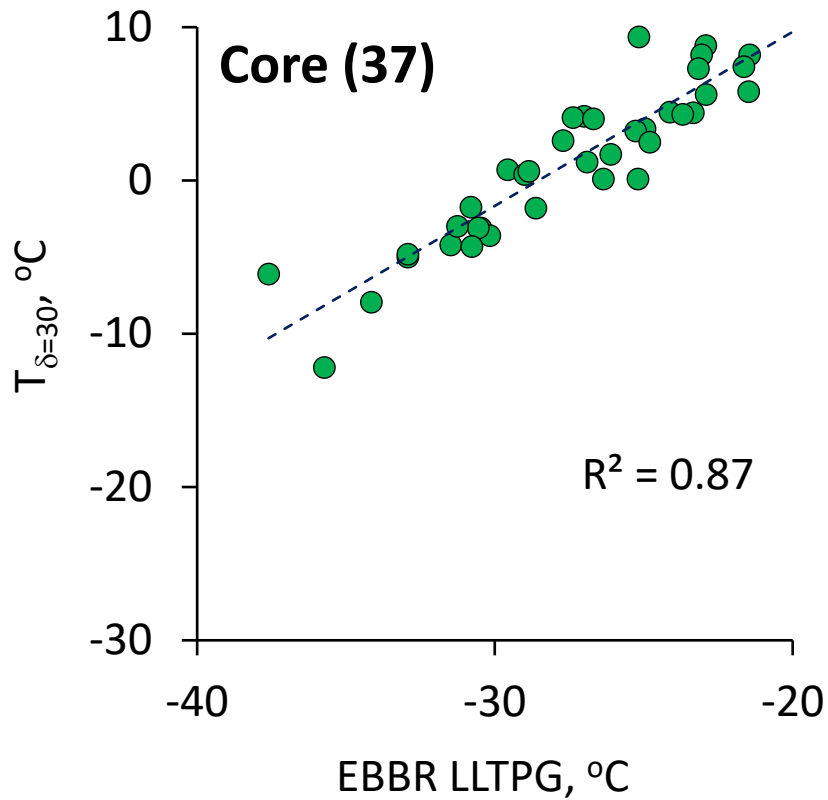
AASHTO T 406-23 EBBR Grade Margins (EBBR LLTPG - Design LTPG)

257 Samples/17 Agencies

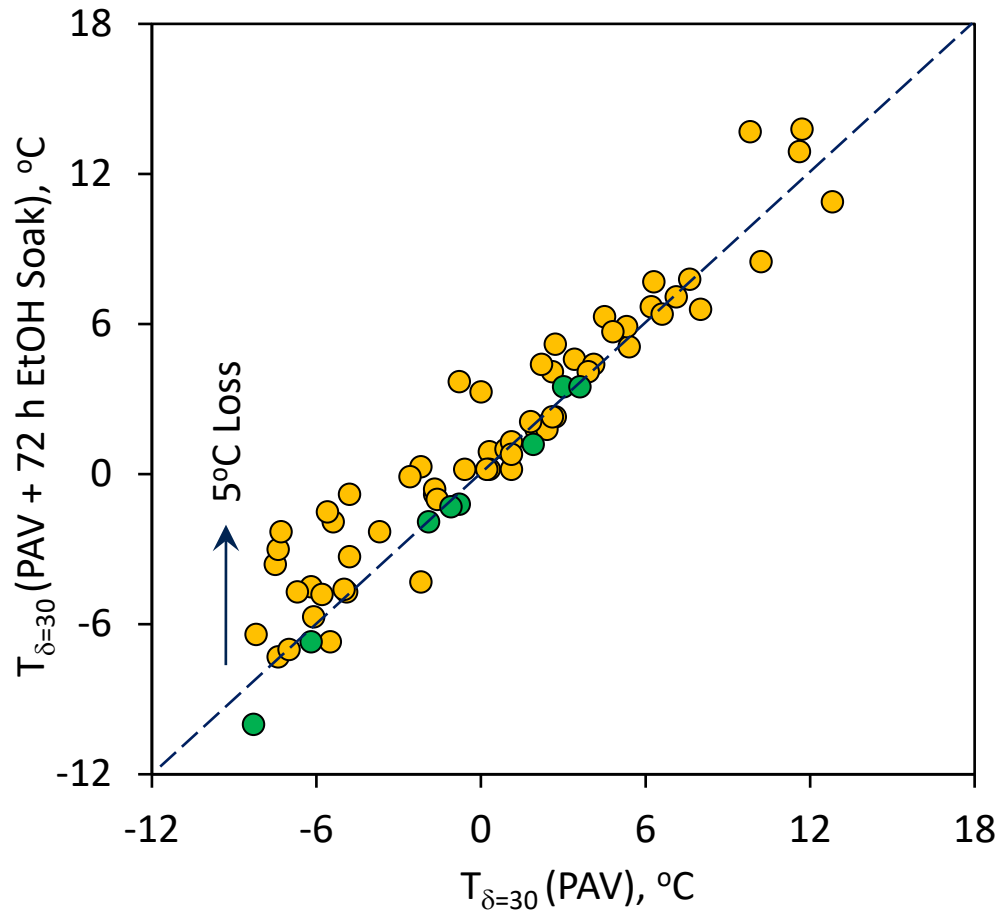
[6 = average \pm SD for 12 US agencies (n = 95)]



DSR $T_{\delta=30}$ vs EBBR LLTPG (277)



DSR $T_{\delta=30}$ before vs after EBBR LLTPG (8 + 60)



Binders

Straight Alberta (8)

Commercial (60)

Grade Loss, °C

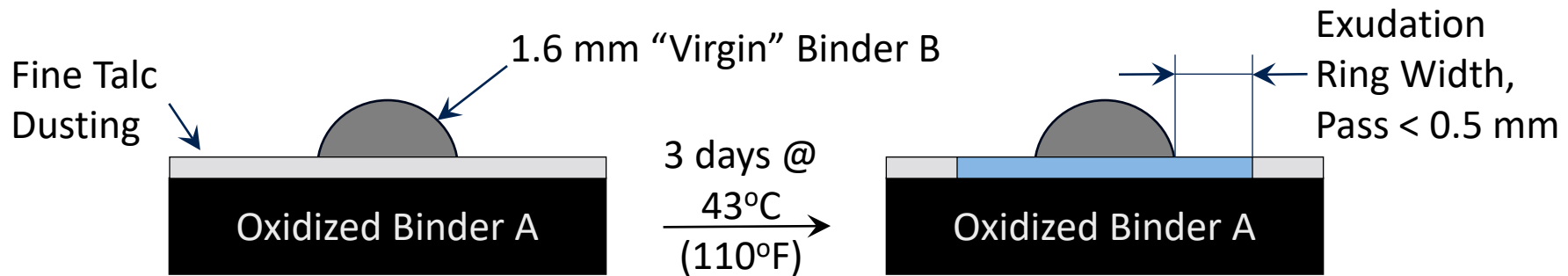
-0.4 ± 0.64

1.0 ± 1.66



- Straight Alberta binders show superior stability.
- Soft commercial binders can lose as much as 5°C through low temperature exudative hardening.

Oliensis Exudation Test (1930s)



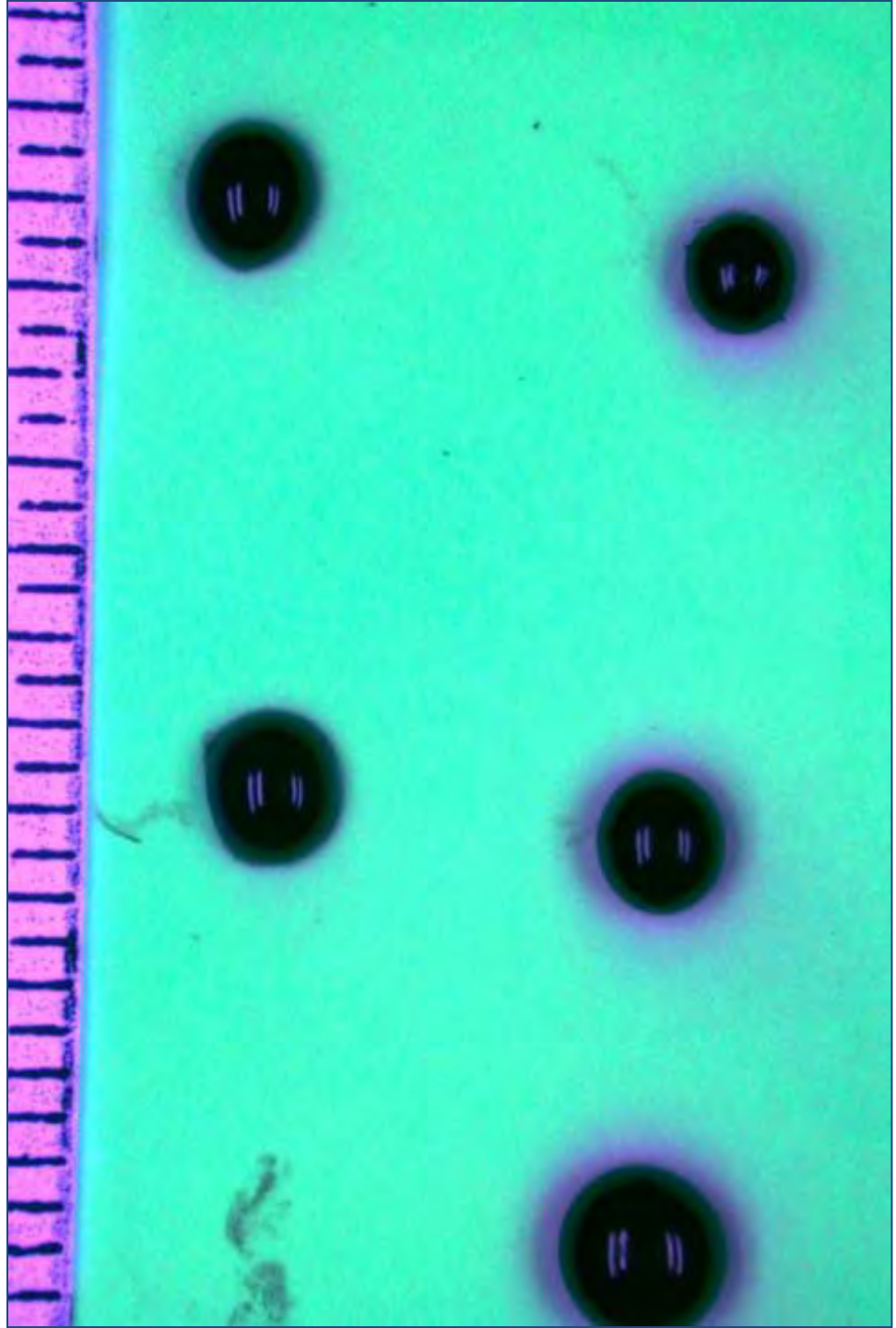
| Width of Ring, mm | | | |
|-------------------|-----------------|-------|--------|
| | Virgin Binder B | 1 day | 3 days |
| Hard | H1 | 0.0 | 0.0 |
| | H2 | 0.0 | 0.0 |
| | H3 | 0.15 | 0.25 |
| Soft | S1 | 0.0 | 0.0 |
| | S2 | 0.25 | 0.7 |
| | S3 | 0.9 | 1.5 |

Australian Exudation Test

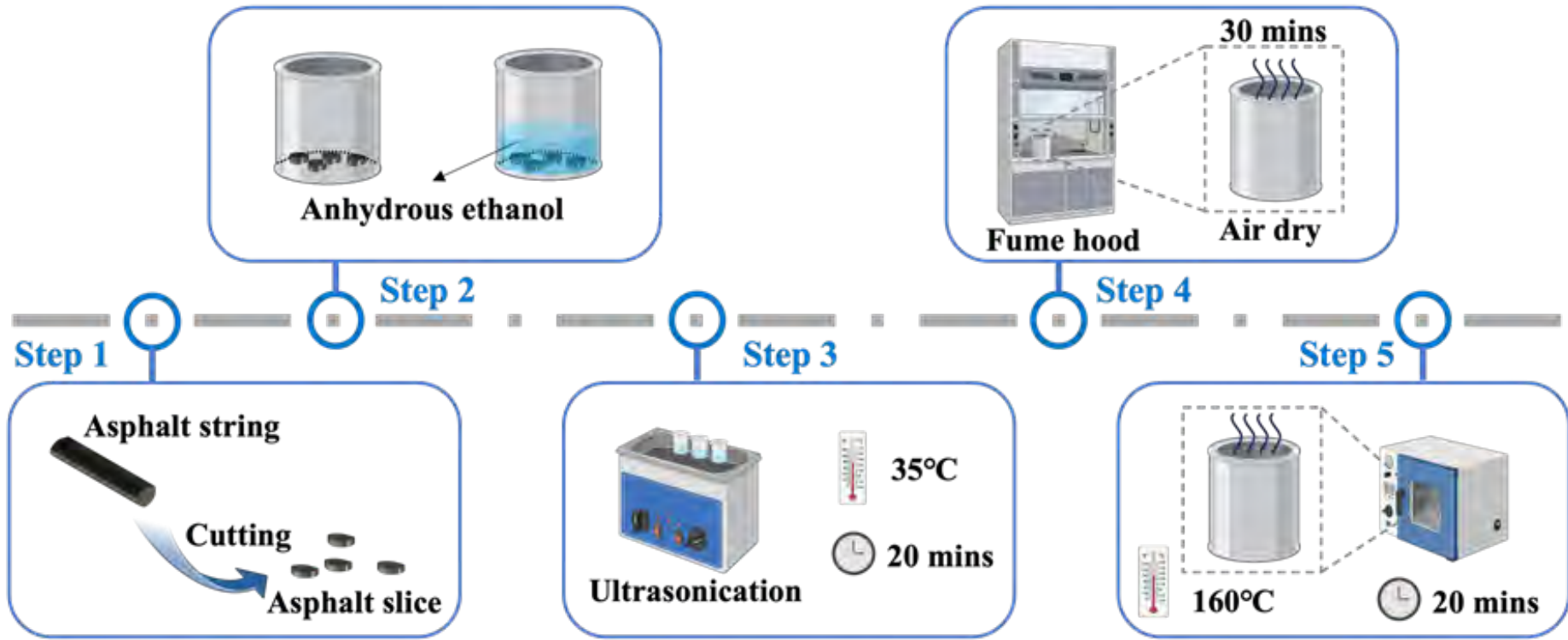
Fluorescence
Microscopy

Merck:
Silica Gel 60 F254

65°C, 2.5 days



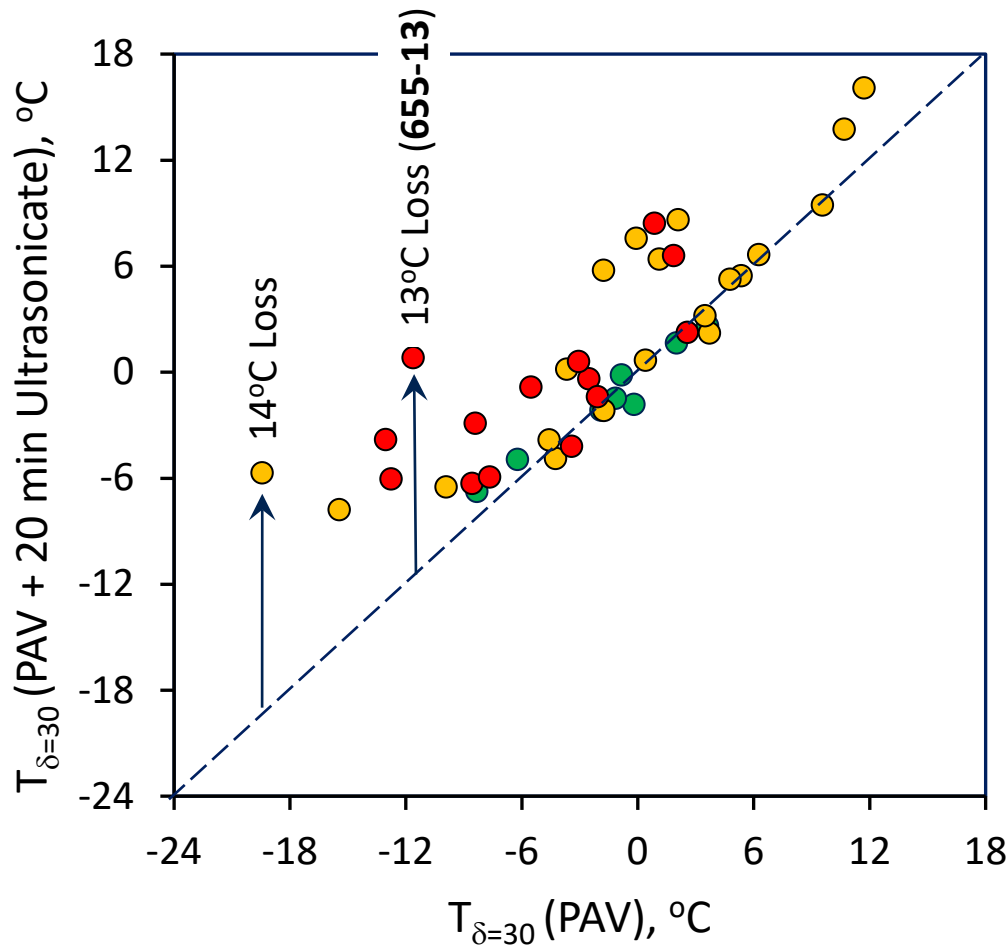
Simplified Exudation Test



DSR before and after exudation to determine $T_{\delta=30^\circ}$, $T_{\delta=45^\circ}$ and $\Delta T_{c\delta}$



DSR $T_{\delta=30}$ before vs after 20 min Ultrasonication in Ethanol at 35°C (8 + 20 + 14)

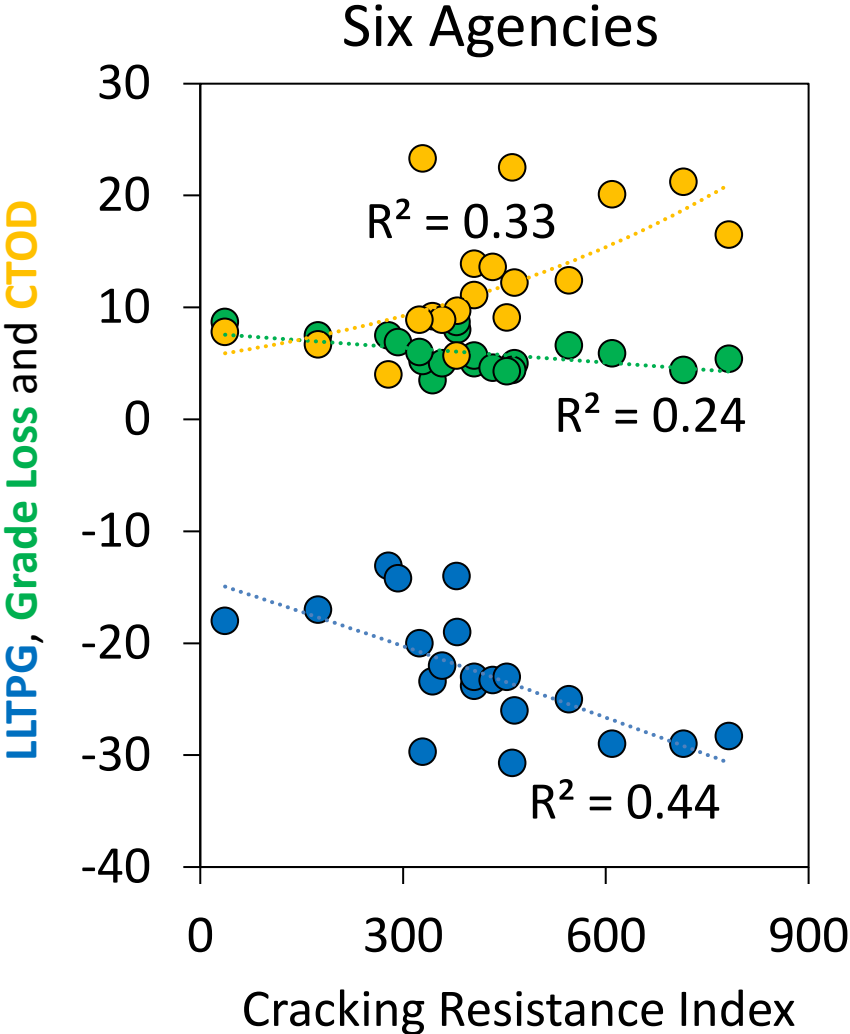
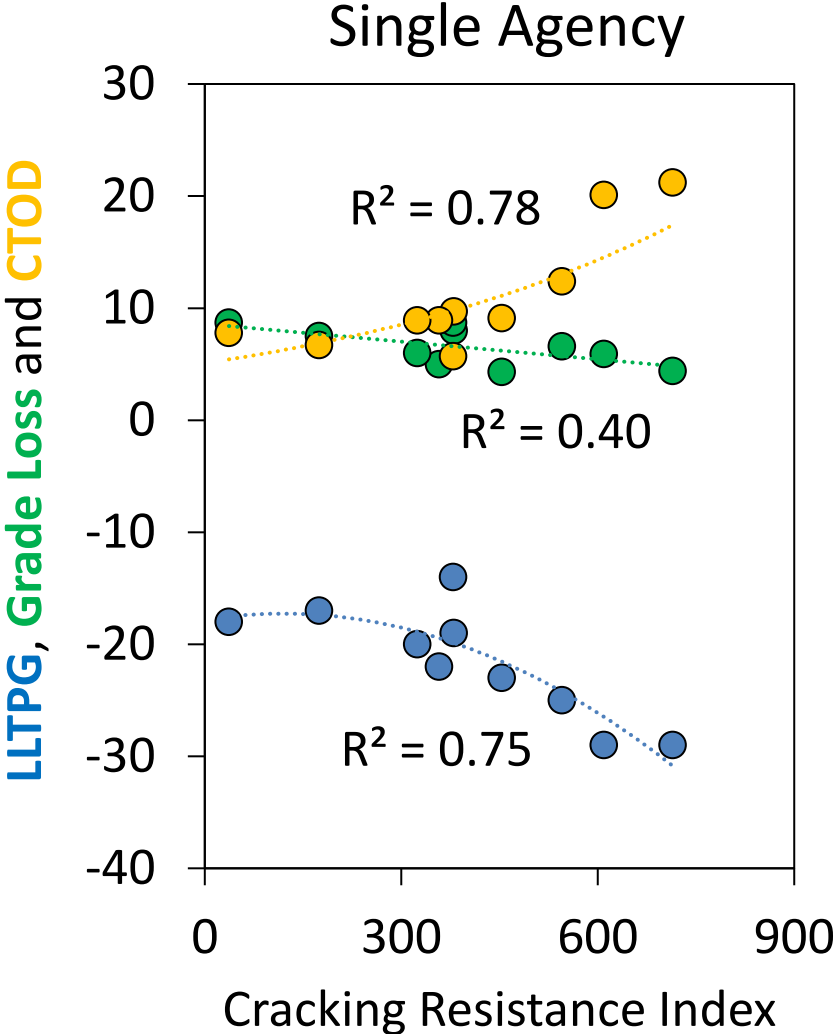


| Binders | Grade Loss, °C |
|----------------------|------------------|
| Straight Alberta (8) | 0.0 ± 1.1 |
| Commercial (20) | 3.2 ± 4.0 |
| Trial Sections (14) | 4.4 ± 3.8 |



- Straight Alberta binders once more show superior stability.
- One soft commercial binder lost nearly 14°C through exudative hardening while several others tainted with REOB lost 8°C!

Semi-Circular Bend Mixture Testing



Pearson's Correlation Analysis

Mixture (23 x 2 x 6) versus Binder Results (23)

| Indicators | Conditioning time, hours | BBR LTPG, °C | EBBR LLTPG, °C | EBBR Grade Loss, °C | CTOD, mm |
|------------|--------------------------|--------------|----------------|---------------------|----------|
| FI | 2 | 0.53 | 0.49 | 0.02 | 0.44 |
| FI | 72 | 0.59 | 0.54 | 0.02 | 0.48 |
| CRI | 2 | 0.70 | 0.65 | 0.03 | 0.53 |
| CRI | 72 | 0.70 | 0.65 | 0.04 | 0.50 |
| CII | 2 | 0.62 | 0.56 | 0.01 | 0.52 |
| CII | 72 | 0.65 | 0.58 | 0.05 | 0.43 |

Getting it Right on Princess Street, Kingston, ON (2010 vs 2011/12)

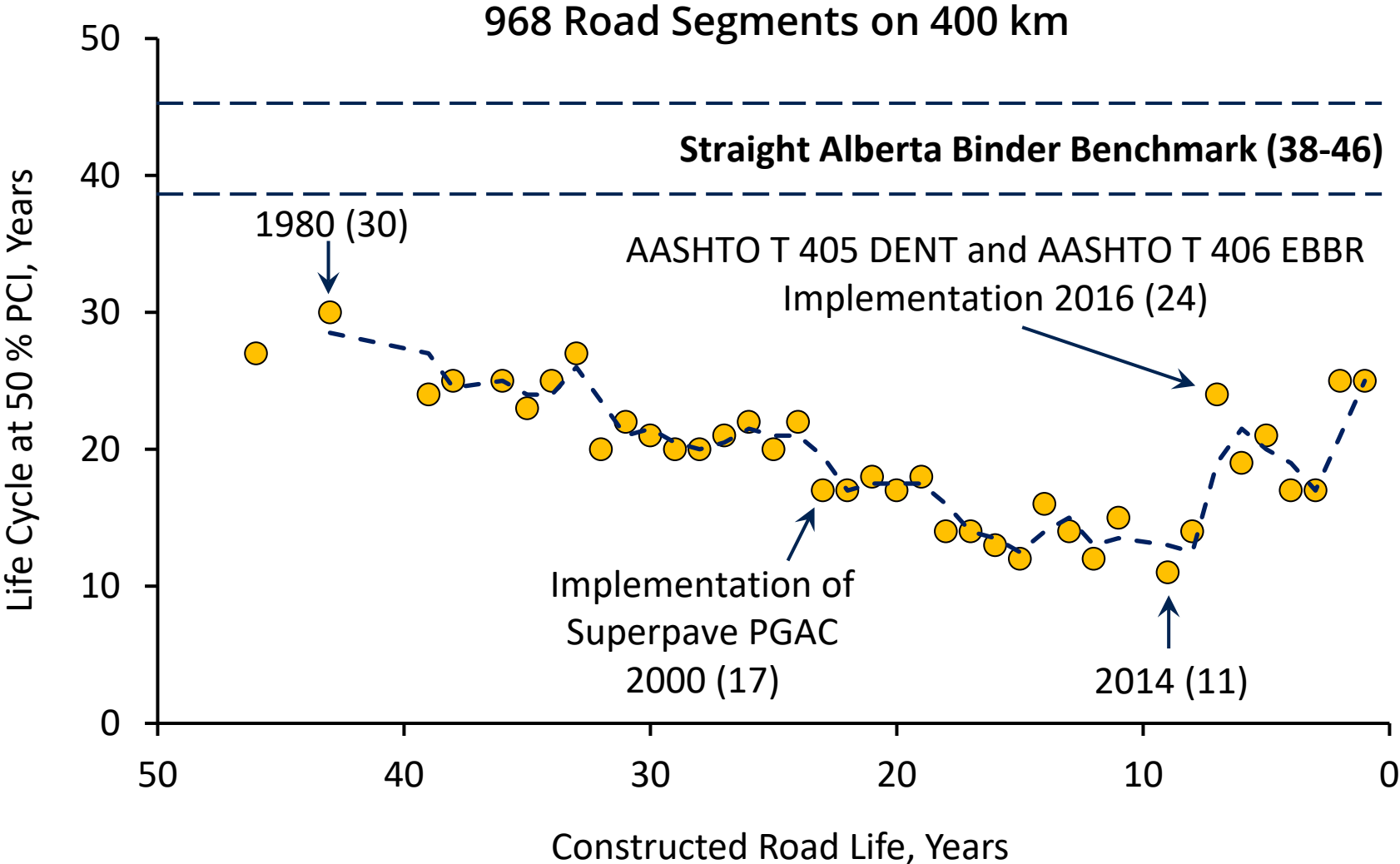
40 cracks/100 m (2010)



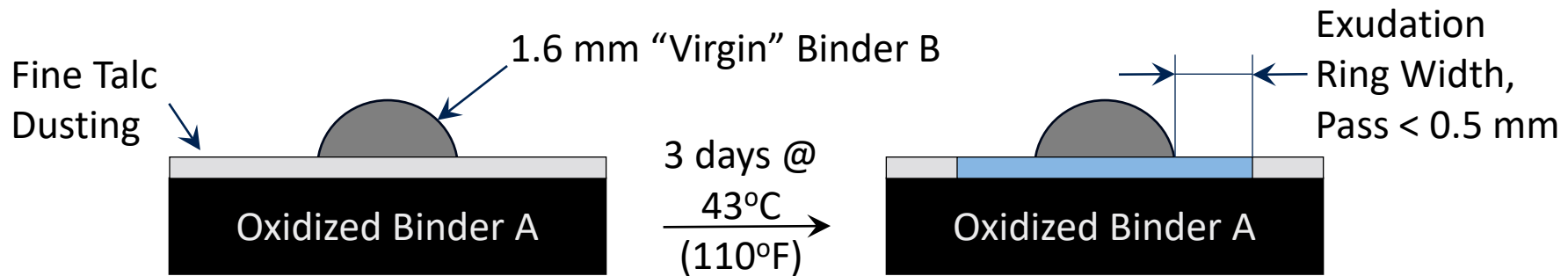
0 cracks/1,000 m (2011/12)



Getting it Right for a Smart Ontario Municipality



Oliensis Exudation Test (1930s)



| Width of Ring, mm | | | |
|-------------------|-----------------|-------|--------|
| | Virgin Binder B | 1 day | 3 days |
| Hard | H1 | 0.0 | 0.0 |
| | H2 | 0.0 | 0.0 |
| | H3 | 0.15 | 0.25 |
| Soft | S1 | 0.0 | 0.0 |
| | S2 | 0.25 | 0.7 |
| | S3 | 0.9 | 1.5 |

Sustainable Recycling



- Replace less virgin binder by using only the coarse fraction of screened reclaimed asphalt (RAP).
- Use batch mix plant instead of drum for better mixing.
- Use 100% Hot In-place Recycling (HIR).
- Use rejuvenators that actually rejuvenate rather than just soften and exude.
- Avoid bad RAP and recycled asphalt shingles (RAS).
- Test extracted and recovered binders for appropriate performance-based properties!

Conclusions

- DSR $T_{\delta=30}$ correlates with EBBR for field-aged binders.
- Tank and loose mix samples produce outliers due to oil exudation with losses of $\sim 6-12^{\circ}\text{C}$ and higher!
- Straight Alberta binders show no oil exudation.
- Mix tests correlate poorly with EBBR and DENT results.
- Alberta binder can pave all roads on earth for 100-200 years, generating $\sim \$12$ trillion in revenue and cutting Scope 3 GHG emissions by $\sim 50\%$.
- AASHTO T 405 and T 406 can double pavement lifecycles and tighter criteria can restore these to ~ 40 years.
- Budget, user delay costs and environmental savings will be substantial.

Questions?

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Disclosure

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