



ASPHALT INSTITUTE

Effect of Long-Term Aging on Binder and Mix Performance Test Results

PRESENTED BY

Gregory A. Harder, P.E.

Senior Regional Engineer

Tully, NY

January 21, 2026

PA ASPHALT PAVEMENT ASSOCIATION

PAPA

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CONFERENCE**



- Purpose of this study was to look at changes in CT Index after LTOA
- 5 different long term aging methods – R121
- Two 9.5mm mixes (plant produced)
- Nomenclature used: x-y
 - X – is the mix
 - P or H
 - Y – is the aging method
 - N- no LTOA
 - A,B,C,D,E
- Acknowledgements Tom Abbey (Hawbaker) & John Friedline and Gary Foux (Suit-Kote)

Standard Practice for

**Long-Term Laboratory Conditioning
of Asphalt Mixtures**

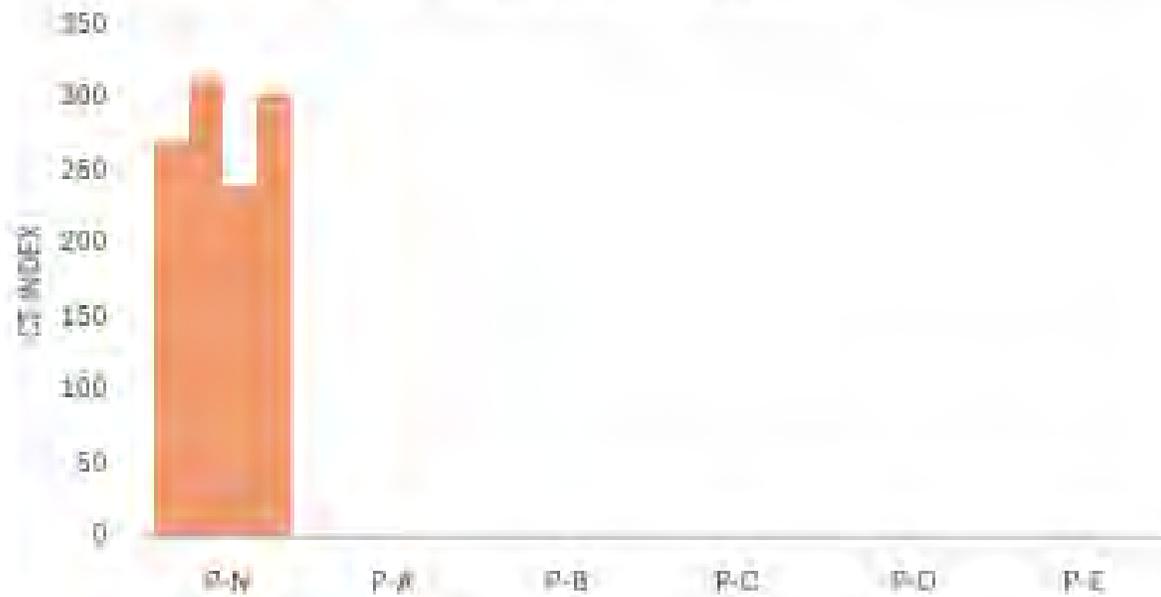
AASHTO Designation: R 121-24¹

First Published: 2024

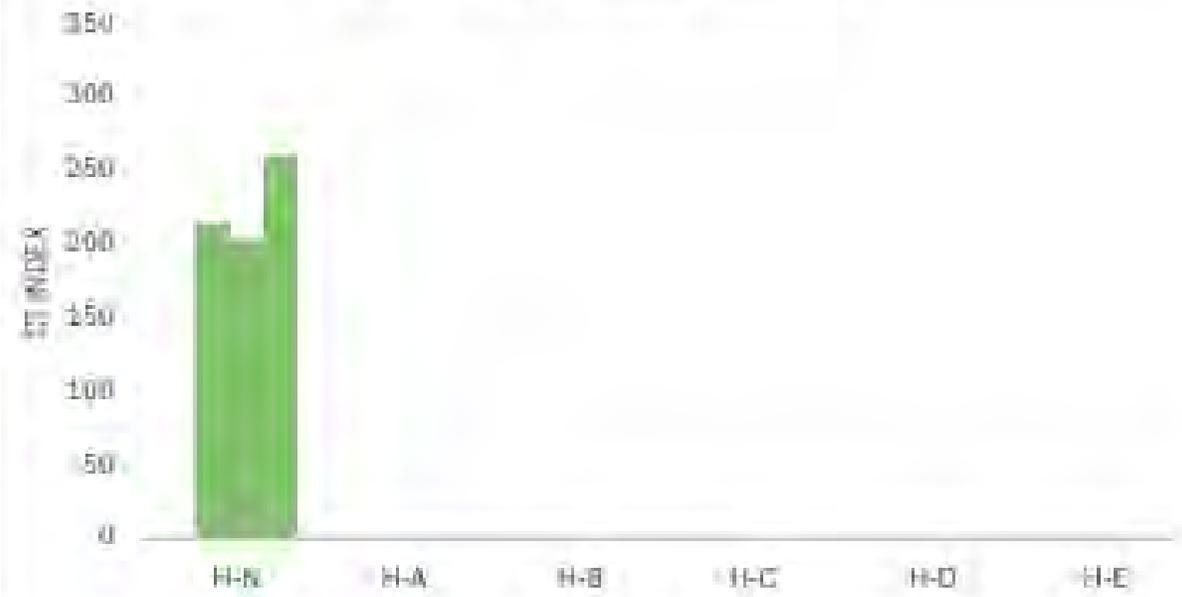
Technical Subcommittee: 2c, Asphalt–Aggregate Mixtures

Reheat – 4 hrs @ 135C

Mix P - CT Index Values

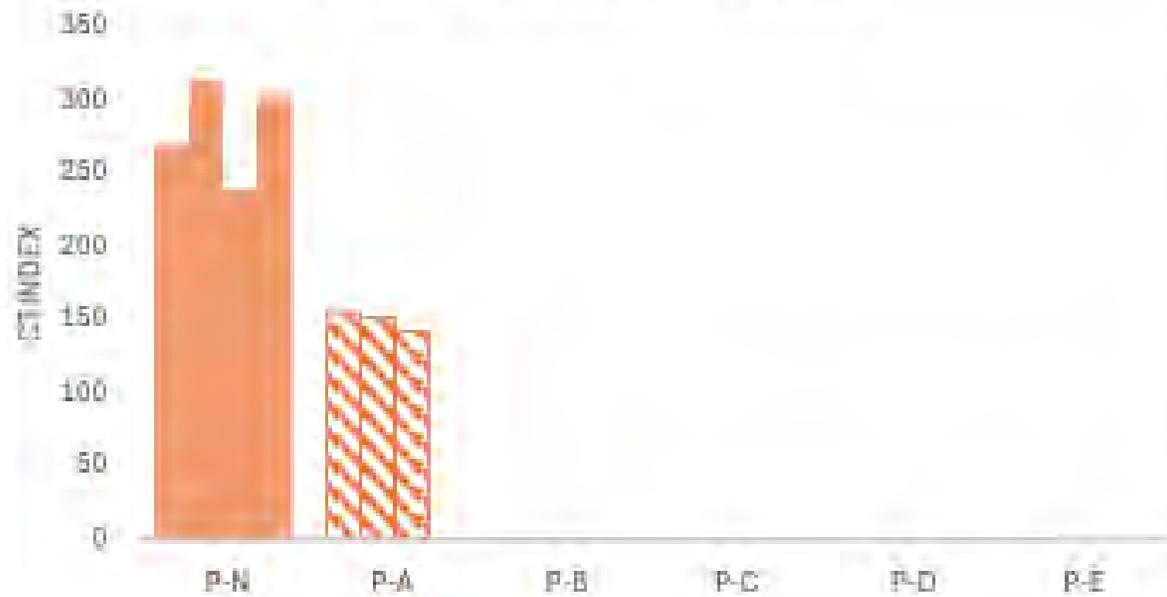


Mix H - CT Index Values

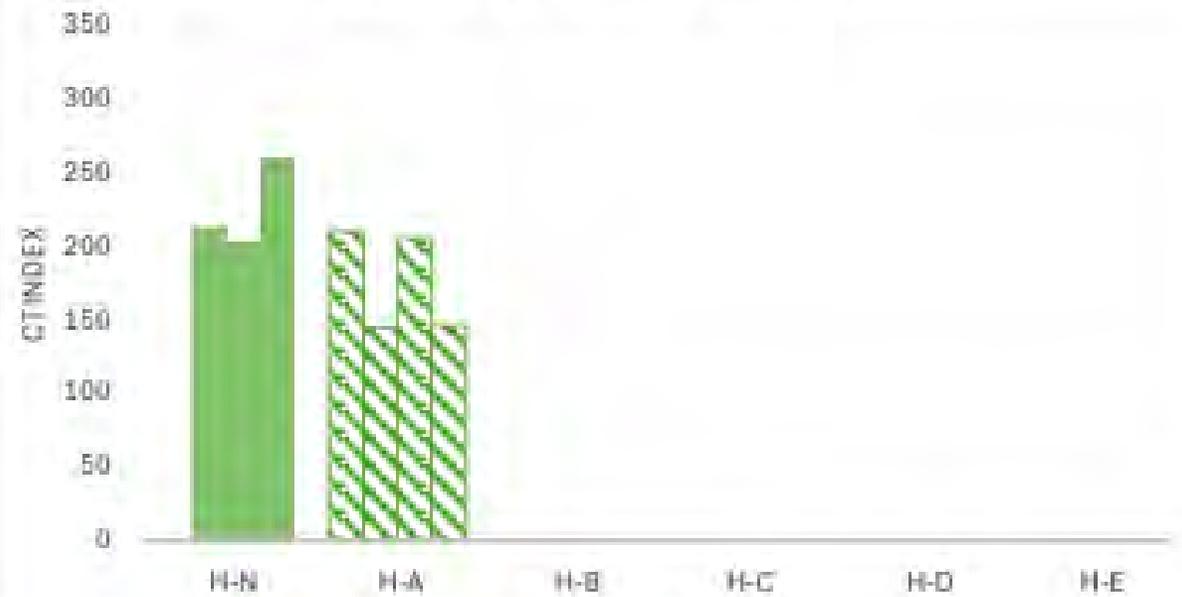


- Applies to laboratory prepared mixtures subjected R 30 and plant mixes and field cores
- Simulates 23,000 CDD – 1 to 2 yrs (warm) – 2 to 3 yrs (cold)
- Compacted specimen
- 120 hrs +/-0.5
- 85C +/- 3C
- Remove from oven after 120 hrs +/-0.5 – allow to cool to room temperature for minimum of 16 hours

Mix P - CT Index Values

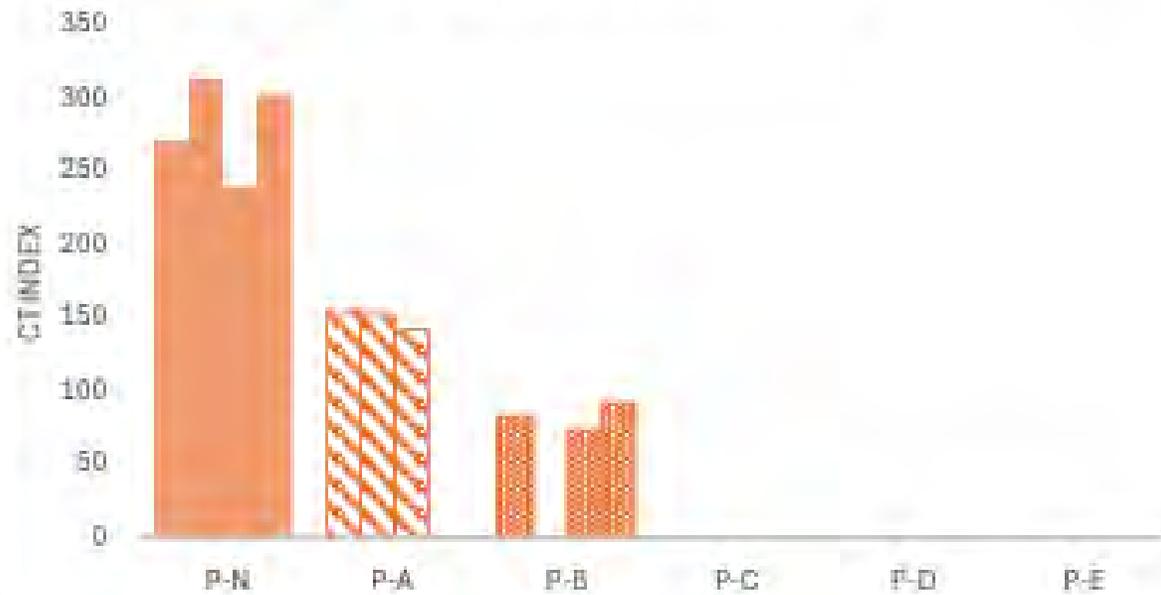


Mix H - CT Index Values

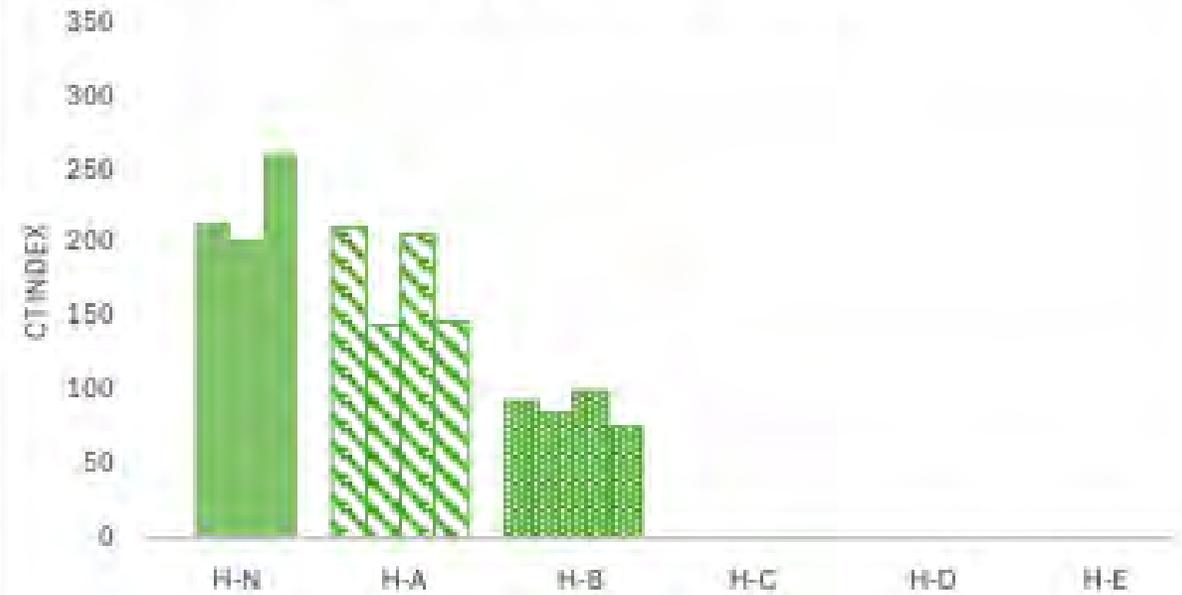


- Applies to laboratory prepared mixtures subjected R 30 and plant mixes
- Simulates 134,000 CDD – 7 to 10 yrs (warm) – 12 to 14 yrs (cold)
- Loose mix spread evenly 25 to 50mm – stir every 24 hours
- 120 hrs +/-0.5
- 85C +/- 3C
- Remove from oven after 120 hrs +/-0.5 – allow to cool to room temperature

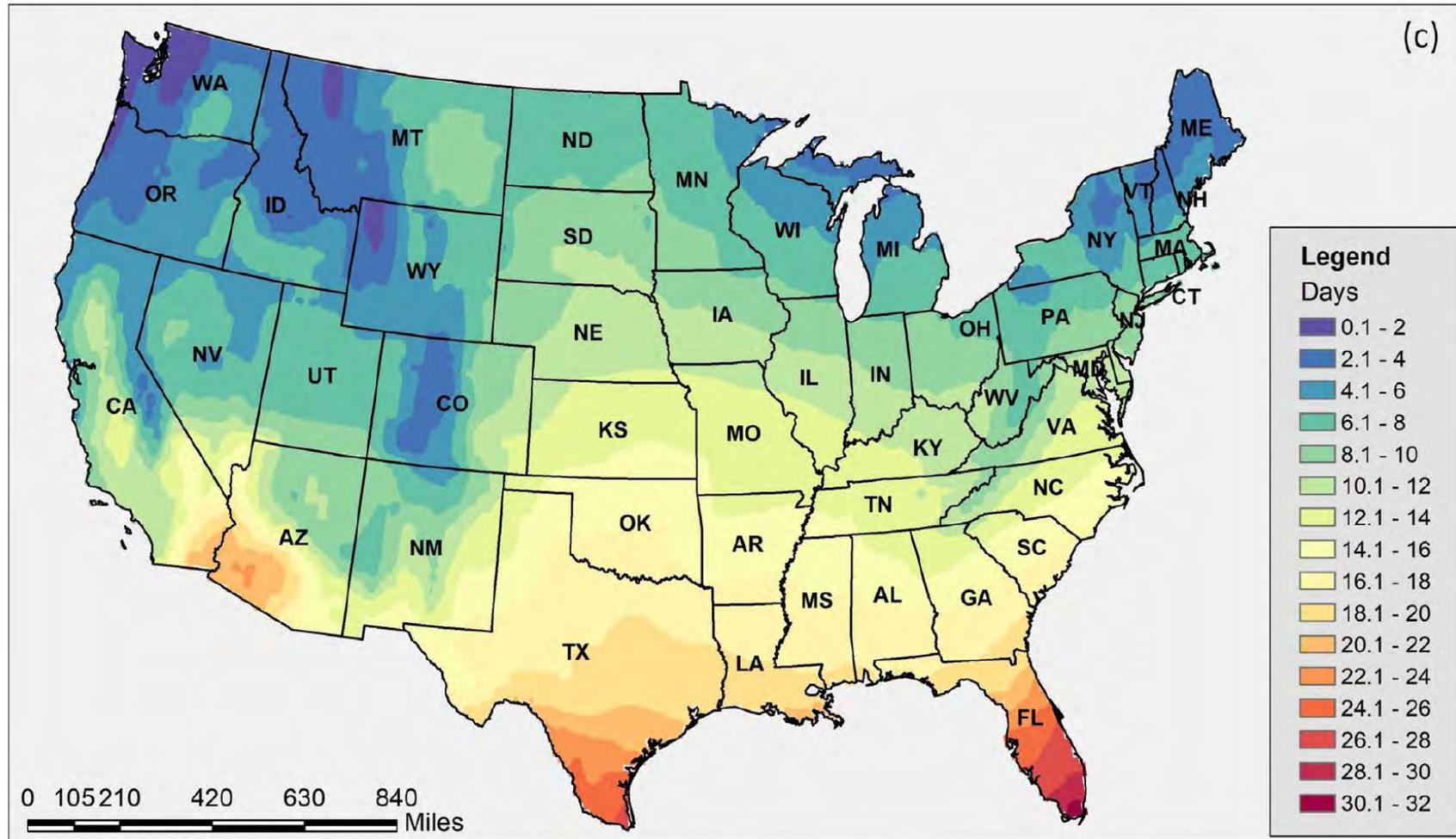
Mix P - CT Index Values



Mix H - CT Index Values



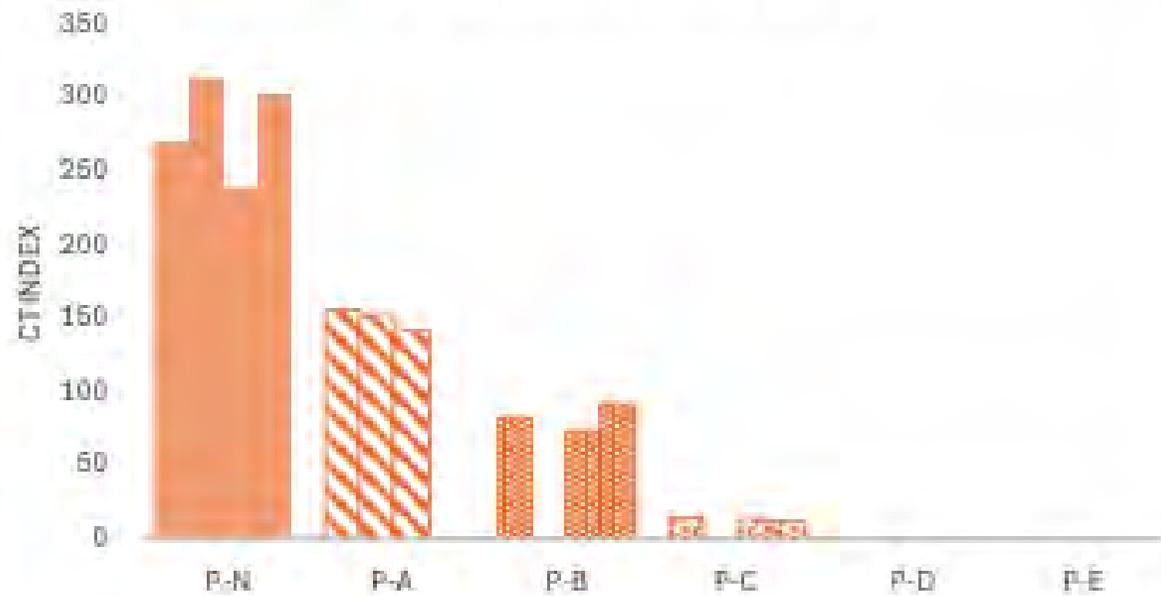
- Applies to laboratory prepared mixtures subjected R 30 and plant mixes
- Rotate the pans to different shelves at four evenly spaced time intervals
- Loose mix spread evenly NMAS +/- 2mm thick
- Number of hours depends on desired level of aging and location
- 95C +/- 3C
- Remove from oven after aging and combine all pans– allow to cool to room temperature



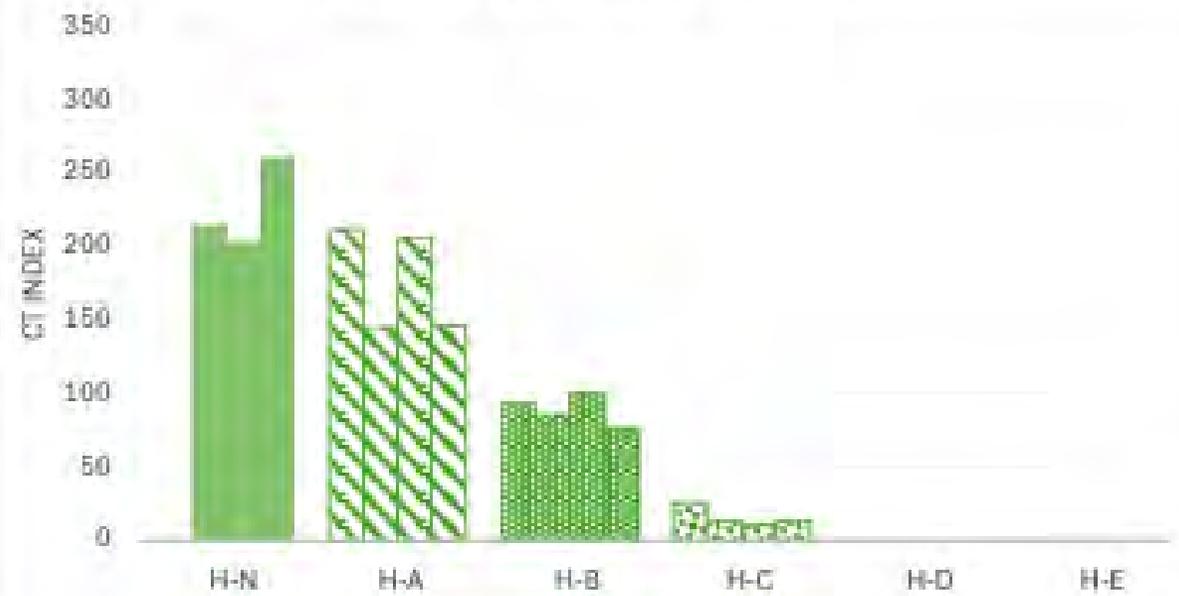
c. Sixteen Years of Field Aging

Figure 1 (Continued)—U.S. Map of Loose Mixture Conditioning Duration at 95°C to Match Level of Field Aging 6 mm below Pavement Surface for (a) 4, 8, and 16 Years of Field Aging for Method C (Kim et al., 2021)

Mix P - CT Index Values



Mix H - CT Index Values



- Applies to laboratory prepared mixtures subjected R 30 and plant mixes
- It is expected to yield approximately 8 years of field aging of the top 25 mm (or 1 in.) asphalt layer or 12 years of field aging of asphalt layer(s) at 50 mm (or 2 in.) below pavement surface.
- Loose mix spread evenly 25-50mm thick
- 20 hrs +/-0.5
- 100 to 125C +/- 3C (depends upon desired level of aging)
- Remove from oven after 20 hrs +/-0.5 – allow to cool to room temperature

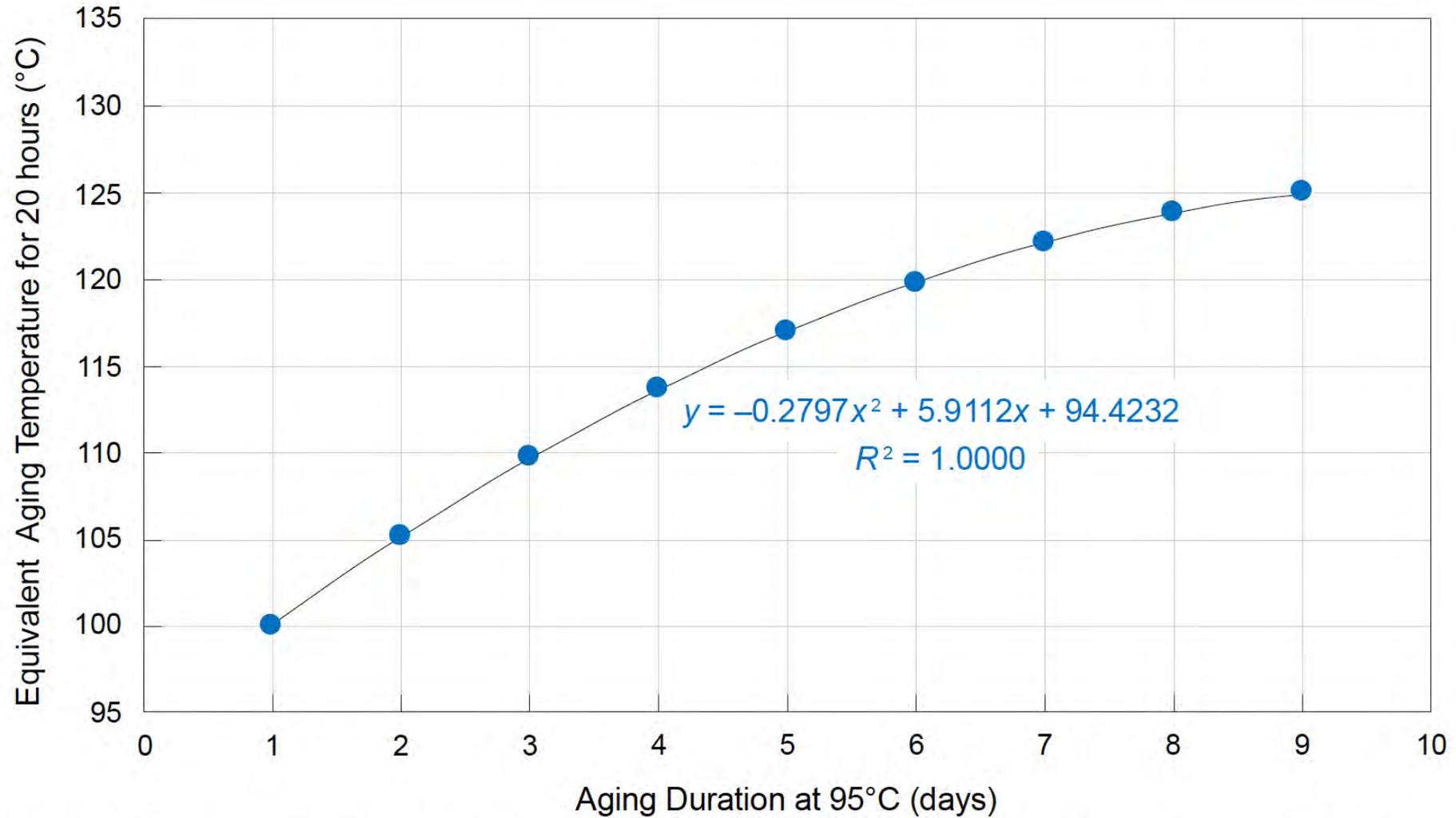
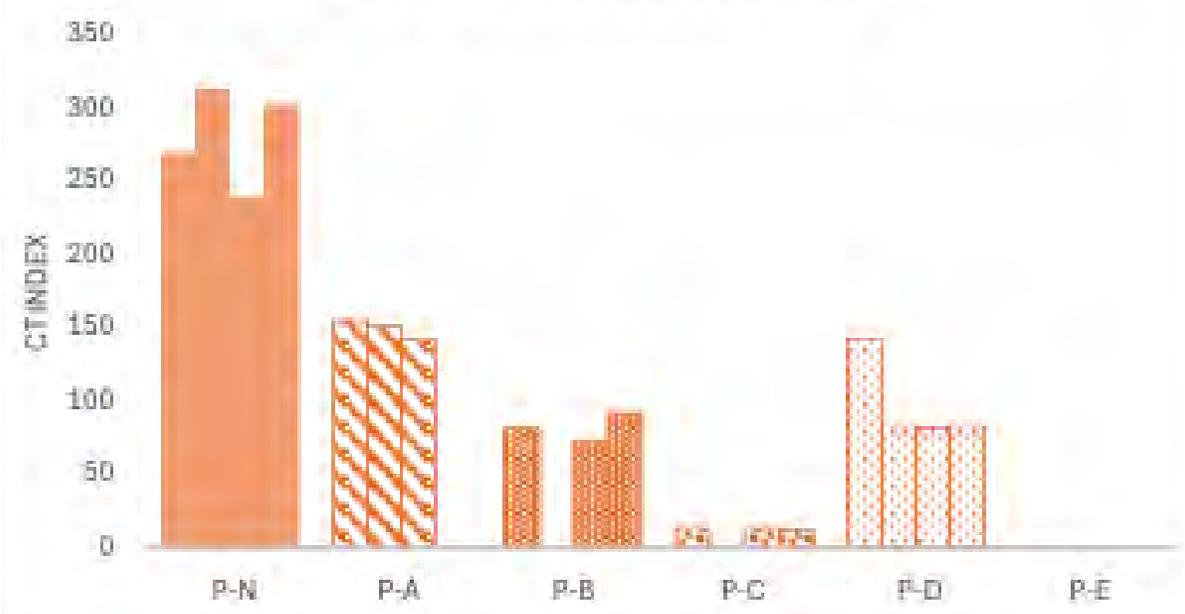
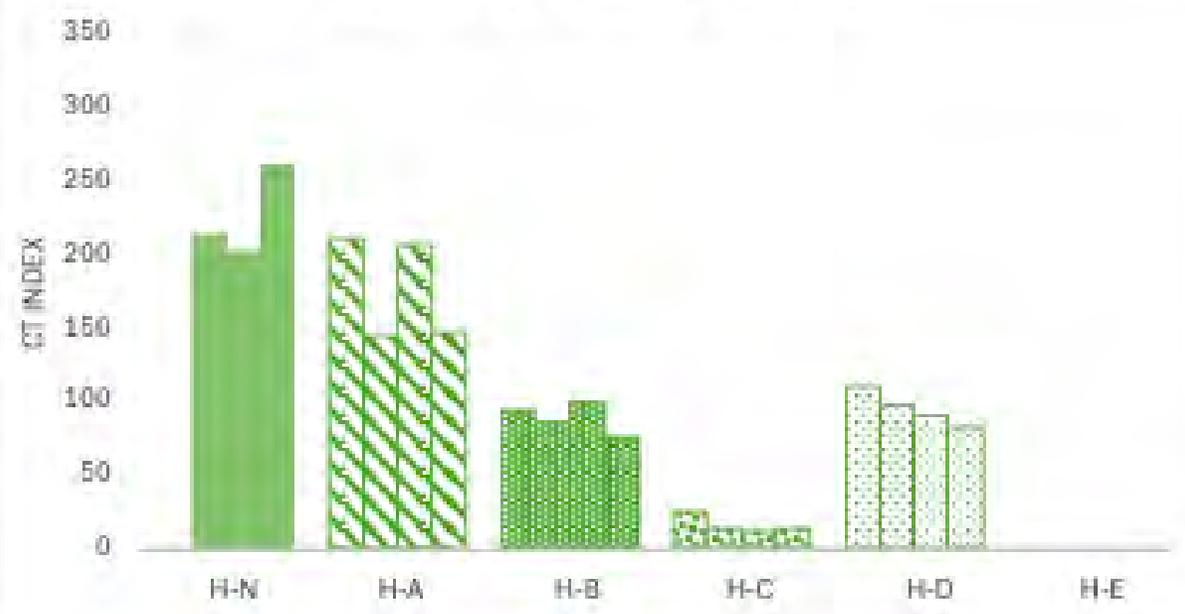


Figure 4—Mixture Cracking Property-Based Equivalent Aging Temperature Curve (Zhou et al., 2022)

Mix P - CT Index Values

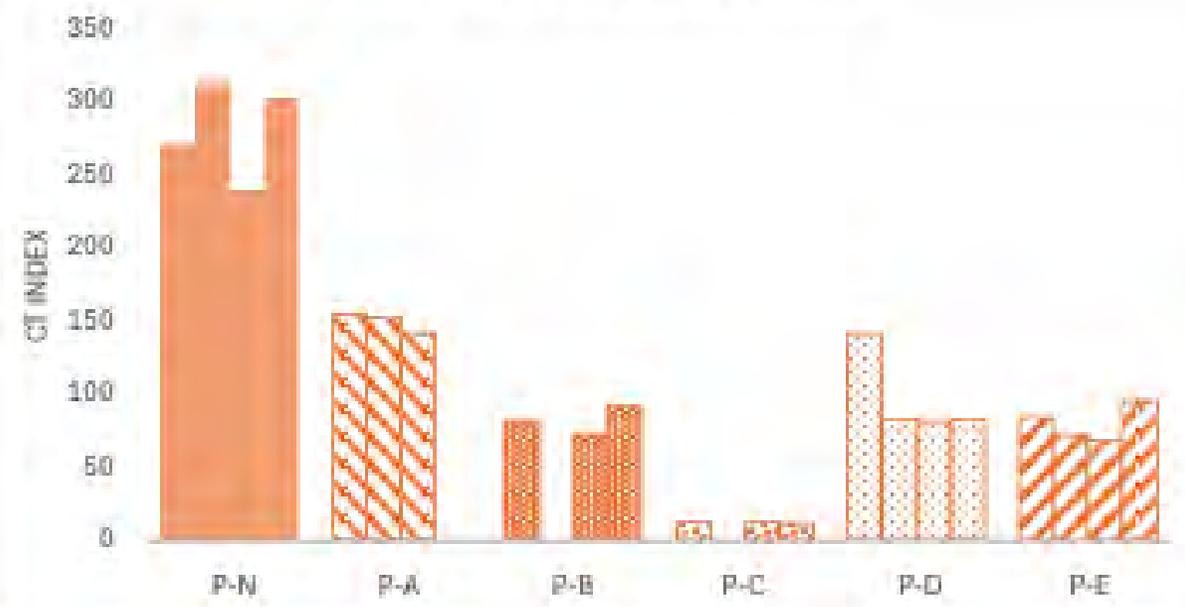


Mix H - CT Index Values

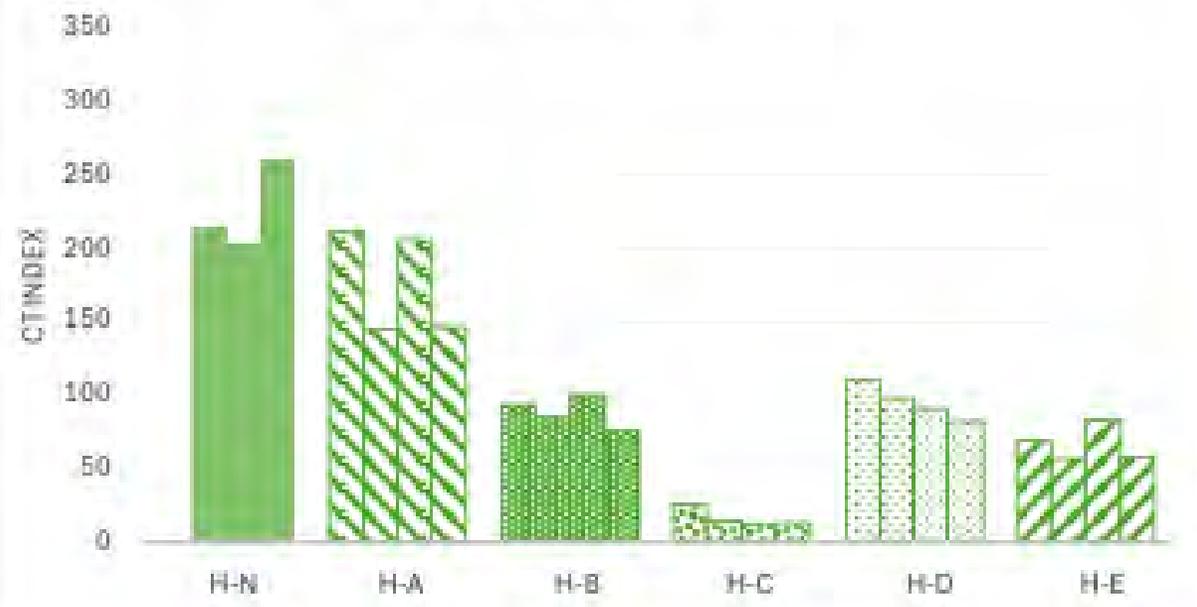


- Applies to laboratory prepared mixtures subjected R 30 and plant mixes
- Simulates 85,000 CDD – 5 to 7 yrs (warm) – 8 to 10 yrs (cold)
- Loose mix spread evenly at NMAS
- 8 hrs +/-0.5
- 135C +/- 3C
- Remove from oven after 8 hrs +/-0.5 – allow to cool to room temperature

Mix P - CT Index Values



Mix H - CT Index Values



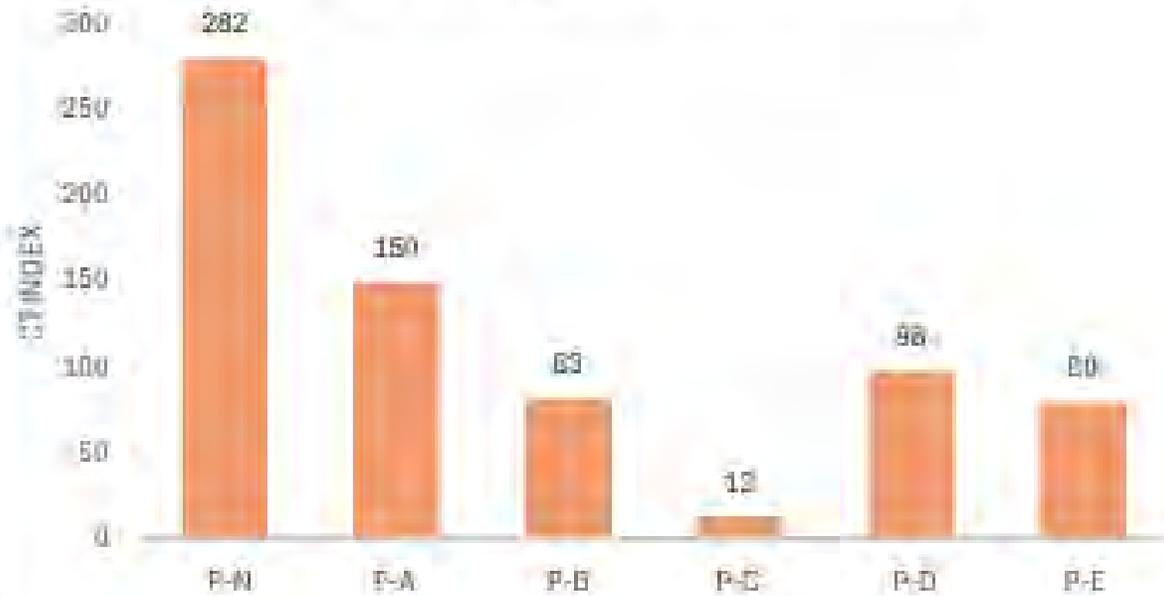
Summary Of The Aging Conditions Used

	Type	Depth	Time	Temperature
Method A	Compacted Sample	n/a	5 days	85C
Method B	Loose mix	25-50 mm	5 days	85C
Method C	Loose mix	NMAS +/- 2mm	7 days	95C
Method D	Loose mix	25-50 mm	20 hours	110C
Method E	Loose mix	NMAS	8 hours	135C

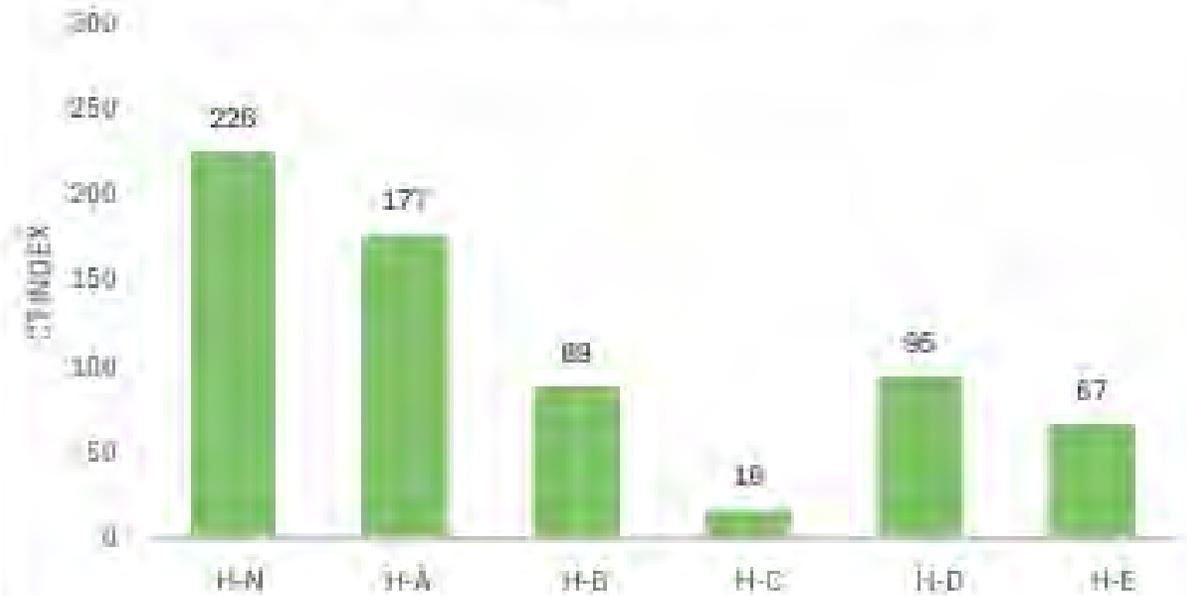


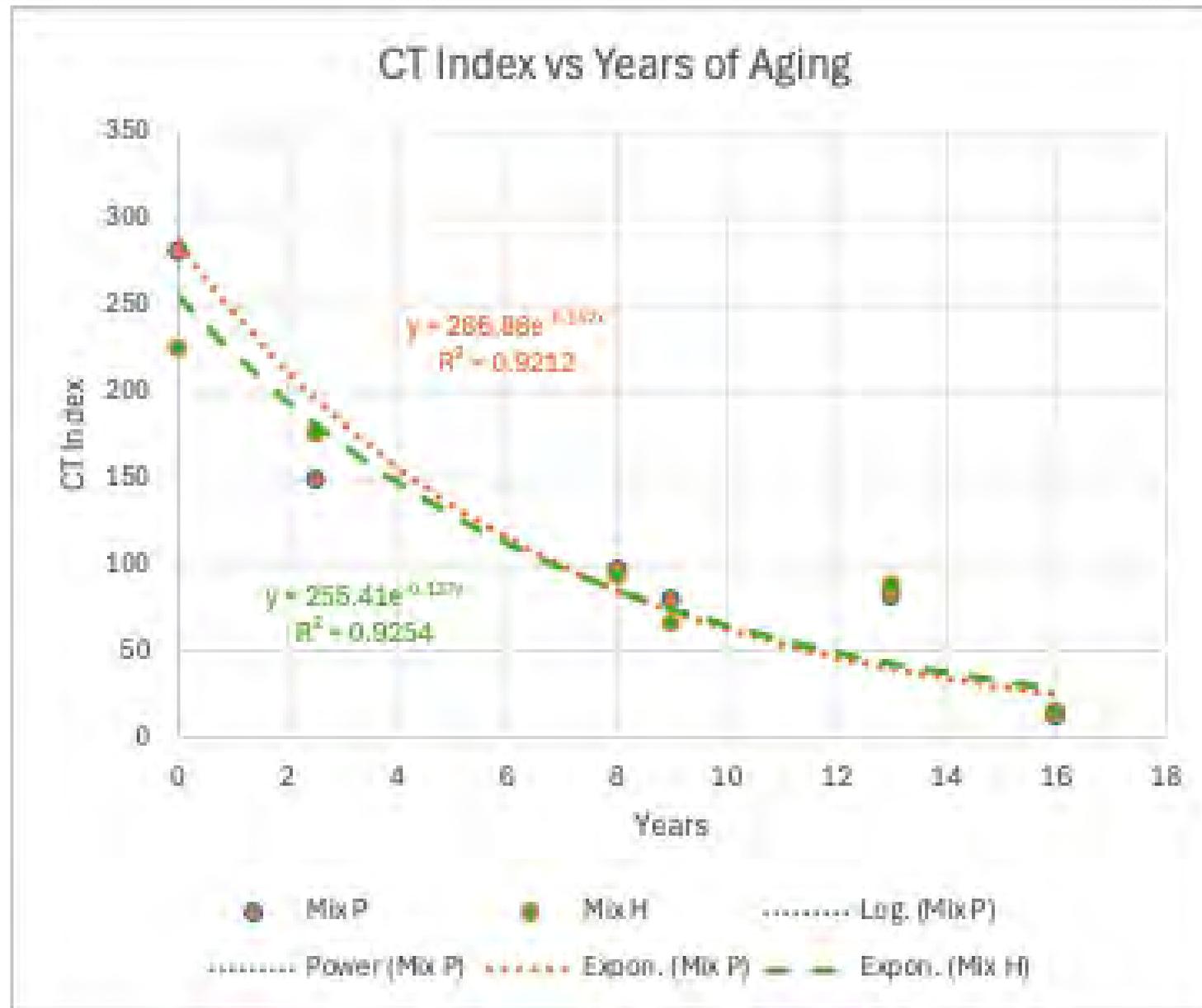
Averages

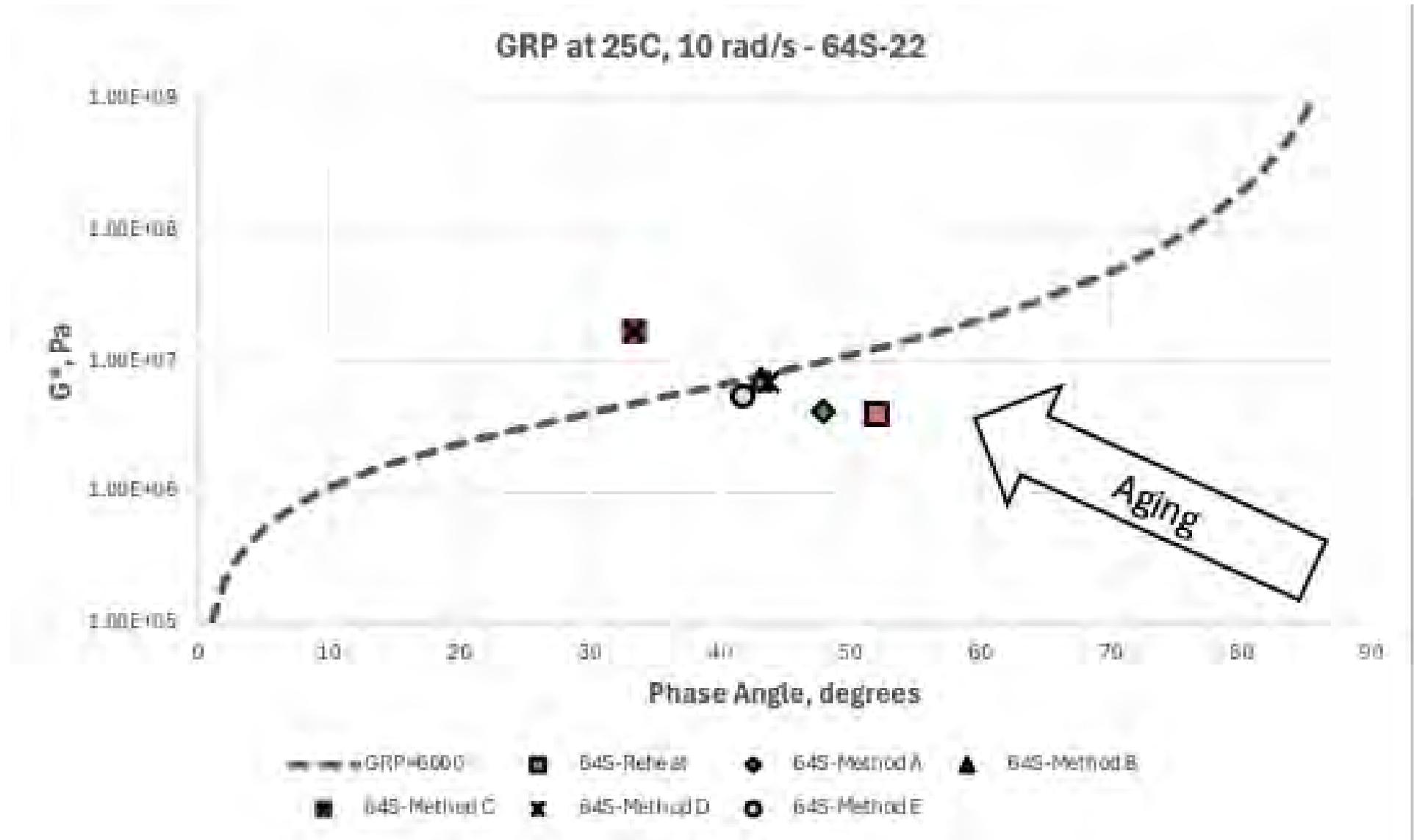
Mix P - Average CT Index Values

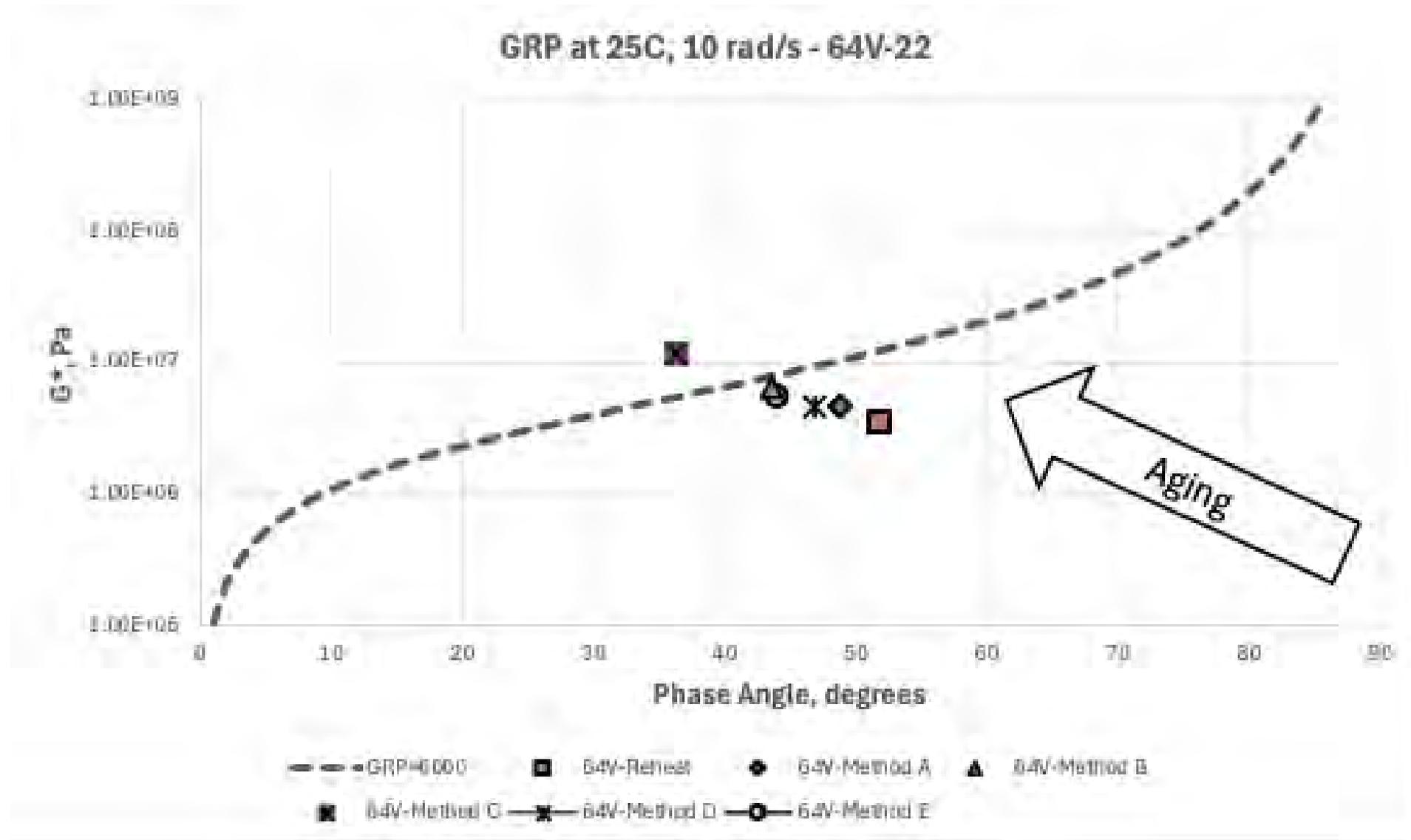


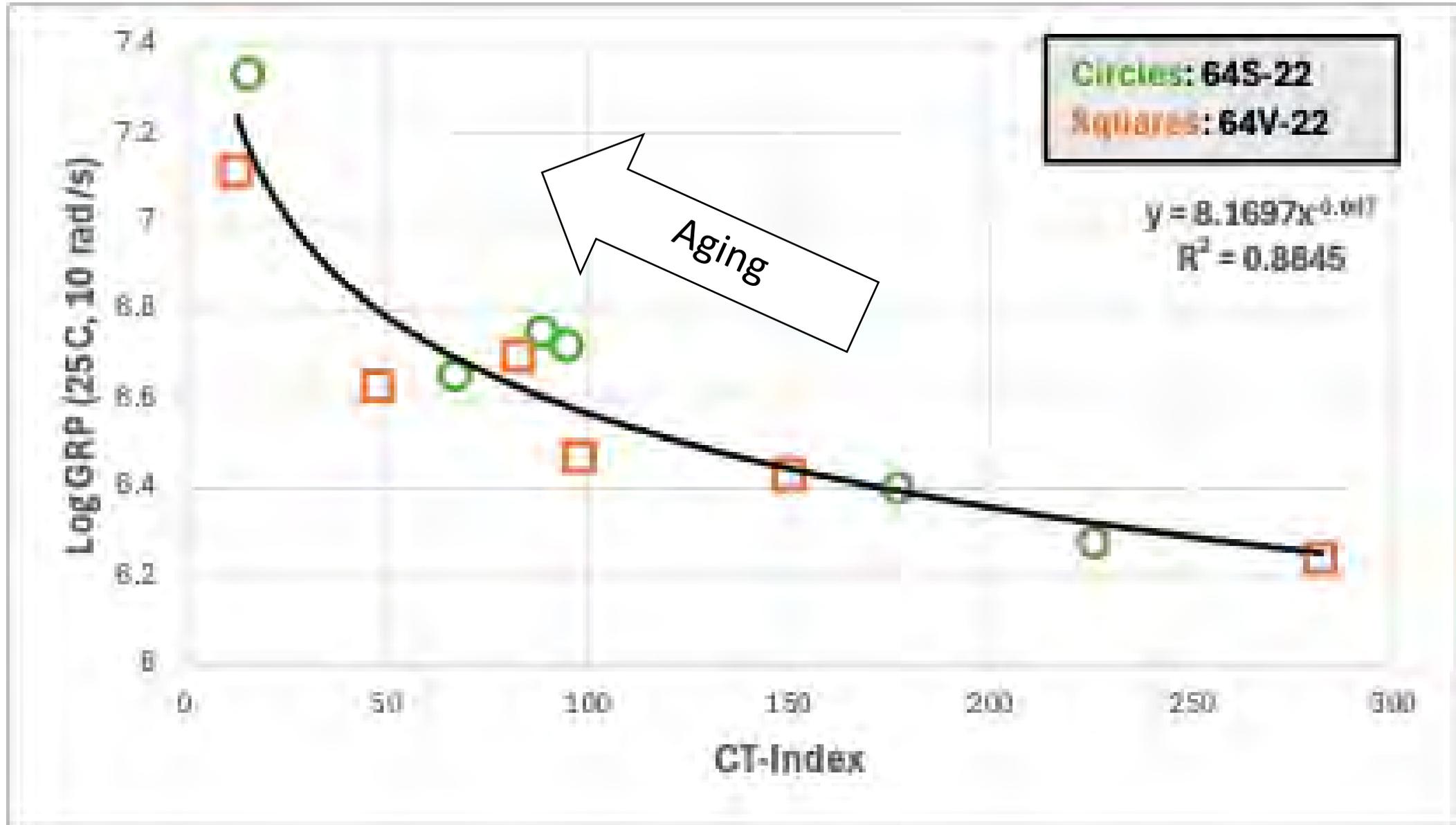
Mix H - Average CT Index Values

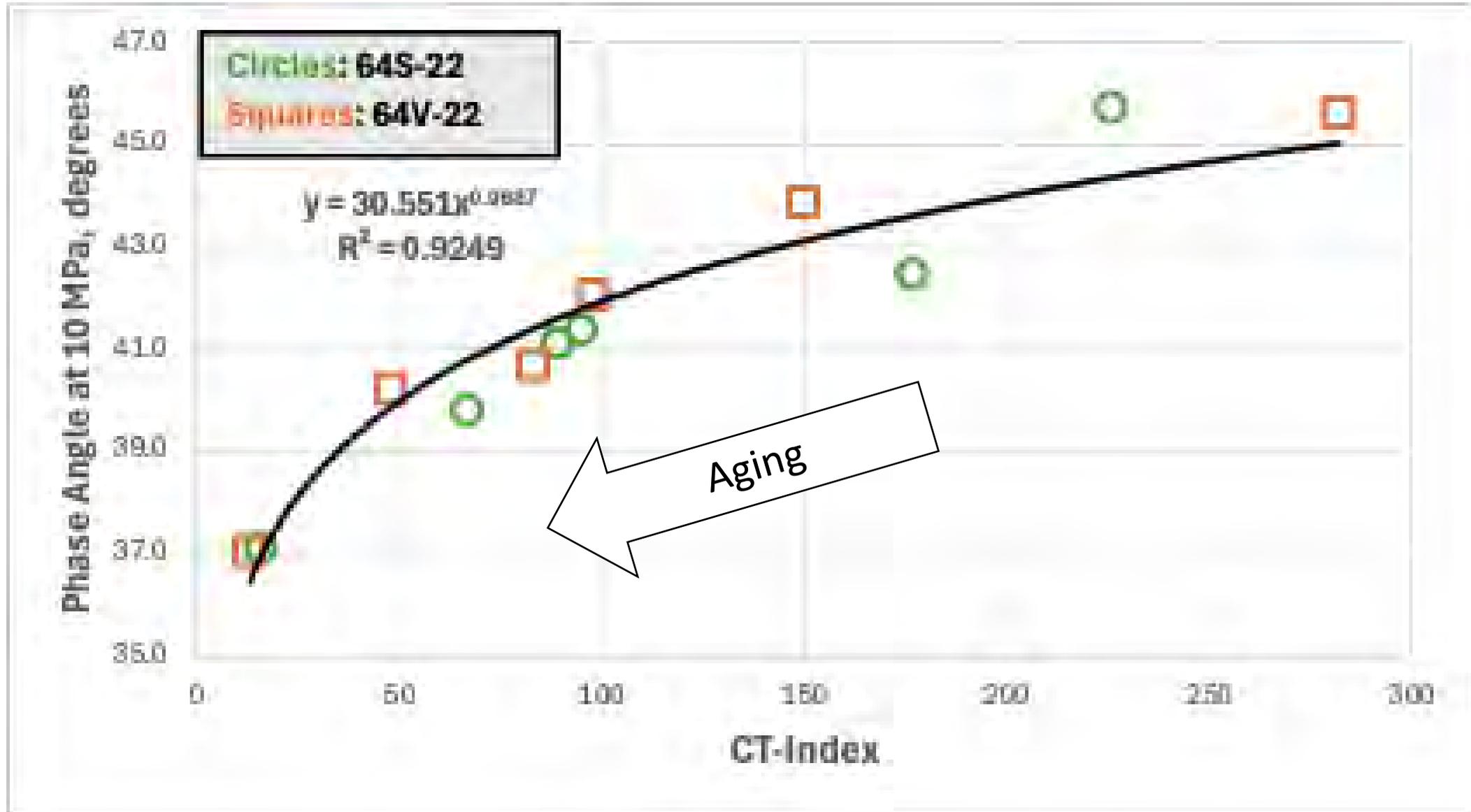










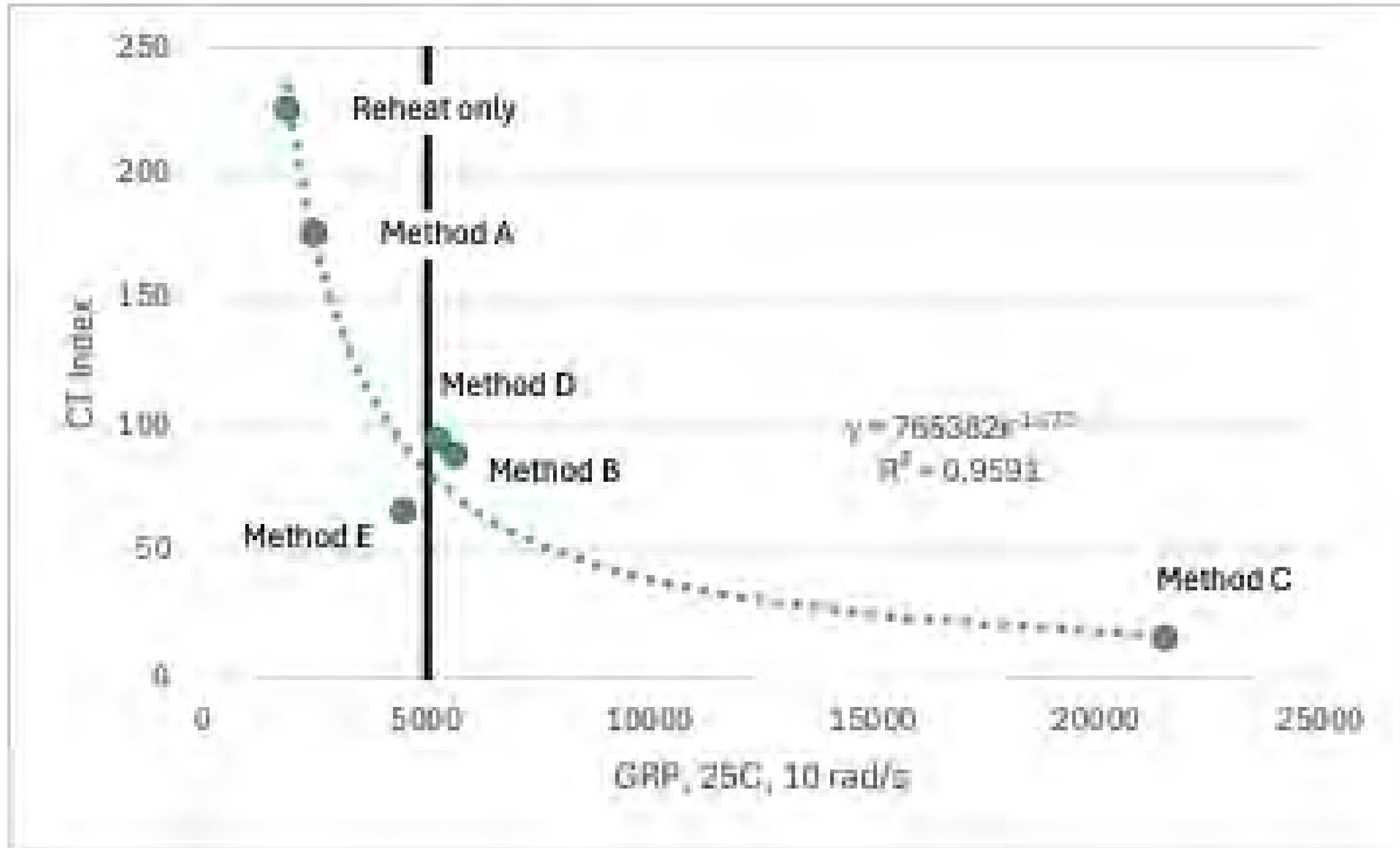


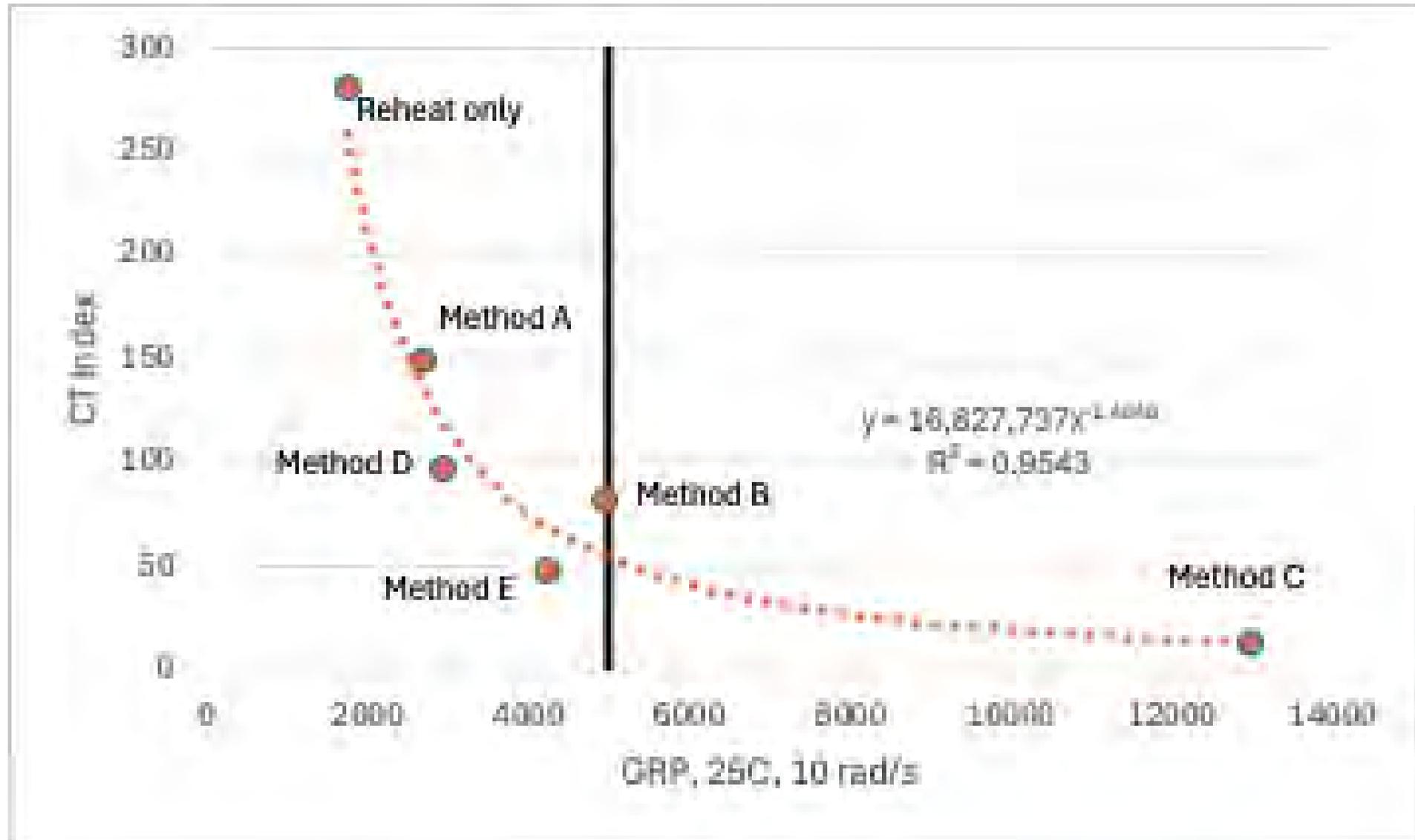
- Long term aging should be considered
- Well defined reheat method is needed
- Method A is relatively easy – however 5 days of aging is problematic – begin aging Wed. – Fri. – also provides the least amount of aging of the methods
- Method B has larger issue with 5 days as stirring required every 24 hours
- Methods C and E require many pans as the mix depth is thin
- Method C may also pose problems as the pans must be rotated at 4 evenly spaced time intervals during the aging process

- Methods B, D, and E provide similar amounts of aging
- Method C offers the biggest range of aging based the numbers of simulated years and depth from surface selected
- Method D will likely be the preferred method – fewer pans, no rotating or stirring, Mon. – Thurs.

Takeaways

- Recovered binder testing captures aging effect
- Recovered binder testing correlates well with CT index results
- RAP quantity and quality affects results





CT Index Adjustment Factors (CAPRI)



- Reheat adjustment fact RAF
 - Reheated sample CT Index/hot compacted sample CT Index
- Aging adjustment factor AAF
 - Long term aged sample CT Index/reheated sample CT Index

Aging Adjustment Factor (AAF)

Method A Method B Method C Method D Method E

Mix P	0.52	0.32	0.05	0.35	0.29
Mix H	0.78	0.39	0.07	0.42	0.30

Thank you



Questions or Comments?



Gregory A. Harder, P.E.

Asphalt Institute Senior Regional Engineer

397 State Route 281 – Suite A

Tully NY 13159

Mobile: 315-807-7306

Email: ggharder@asphaltinstitute.org

