


Influence of Binder Modifiers Using the Poker Chip Method

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Outline

1. What prompted this study
2. What we knew / past research
3. What we developed
4. What we found

Disclaimer:
Results are from various studies and do not constitute a specification or endorsement from TxDOT.



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1. What prompted this study

1. Background
2. Same PG but different performance
3. Tests until failure


Rolling Thin-Film Oven (Tx-398-C)		1.0																
Mass change, T 240, Min, %																		
Dynamic shear, T 215																		
G*min(6), Min, 2.20 kPa, Max, 6.00 kPa		58		64		70		76		82								
Test temperature @ 10 rad/sec, °C																		
TSRCA T200, Recovery @ 1 kPa, High Temperature, % Min		-	-	20	-	20	30	-	20	30	40	20	30	40	50	30	40	50

Surrogate for...

Original Binder		230																
Flash point, T 48, Min, °C																		
Viscosity, T 135P																		
Max. 3.0 Pa.s, test temperature, °C																		
Dynamic shear, T 215P																		
G*min(6), Min, 1.00 kPa, Max, 2.00 kPa		58		64		70		76		82								
Test temperature @ 10 rad/sec, °C																		
Elastic recovery, D2004, 50°F, % Min		-	-	30	-	30	50	-	30	50	60	30	50	60	70	50	60	70


Surrogate for...
Presence of elastomeric polymer

Surrogate for...
Better cracking performance




1. What prompted this study

1. Background Better cracking performance
2. Same PG but different performance
3. Tests until failure



1. What prompted this study

1. Background Better cracking performance
2. Same PG but different performance Method + parameter that is beyond current PG framework and supplements other rheological indices
3. Tests until failure



2. What we knew / Past research

Tensile test on confined thin films:
 ✓ Failure
 ✓ Stress state

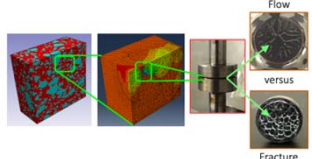


1968 Marek and Herrin	1972 Ledbetter et al.	2003 Harvey and Cebon	2011 Poulikakos and Partl	2014 Sultana et al.	2017 Haji et al.	2018 Rahim & 2022 Diak et al.
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The University of Texas at Austin

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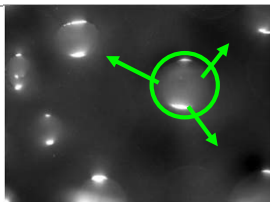


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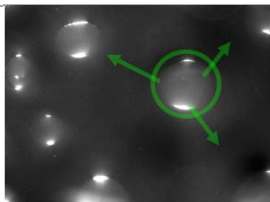


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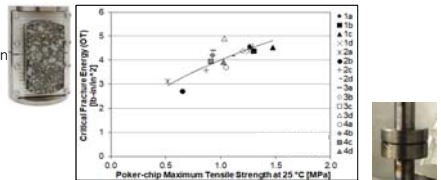


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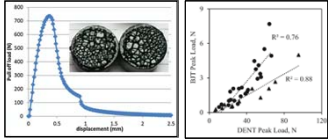


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Larger diameter simplified poker chip test →

Technical Reasons...

1. Failure test
2. Thin confined film = realistic stress state

3. What we developed

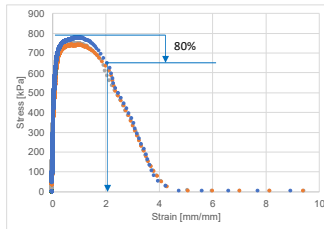
Larger diameter simplified poker chip test →

Technical Reasons...

1. Failure test
2. Thin confined film = realistic stress state

Practical reasons...

1. Direct interpretation



3. What we developed

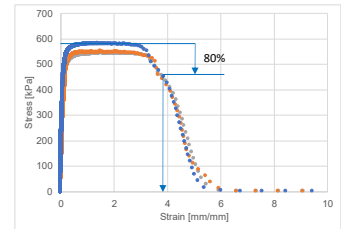
Larger diameter simplified poker chip test →

Technical Reasons...

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Practical reasons...

1. Direct interpretation



3. What we developed

Larger diameter simplified poker chip test →

Technical Reasons...

1. Failure test
2. Thin confined film = realistic stress state

Practical reasons...

1. Direct interpretation
2. Sensitive + Repeatable

3. What we developed

Larger diameter simplified poker chip test →

Technical Reasons...

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2. Thin confined film = realistic stress state

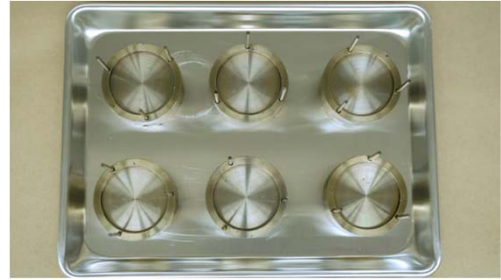
Practical reasons...

1. Direct interpretation
2. Sensitive + Repeatable
3. Can be run on typical load frame

3. What we developed



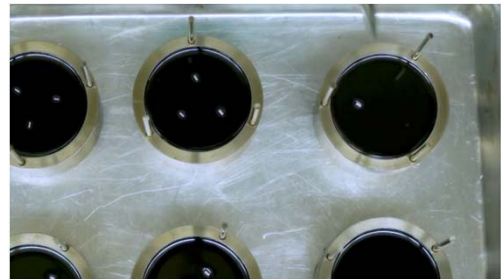
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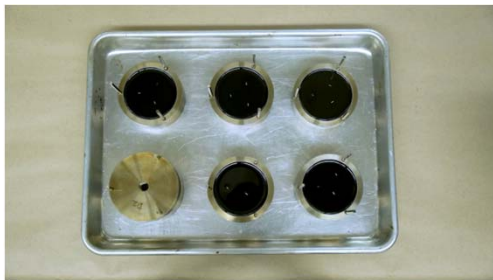
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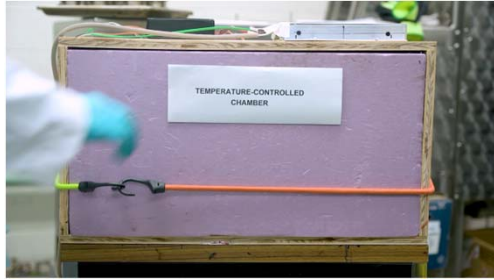
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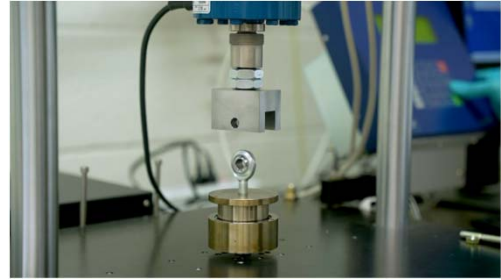
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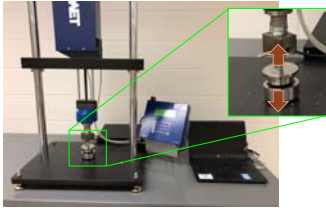
3. What we developed



3. What we developed



3. What we developed



- Equipment
 - Low capital cost
 - Small footprint
 - Plug and play
- Sample
 - Easy to prepare and run
- Results
 - Direct analysis
- Other
 - Induces failure
 - Repeatable

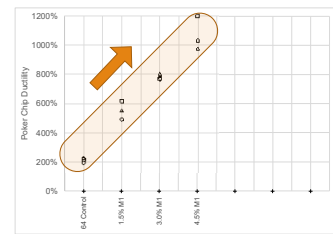
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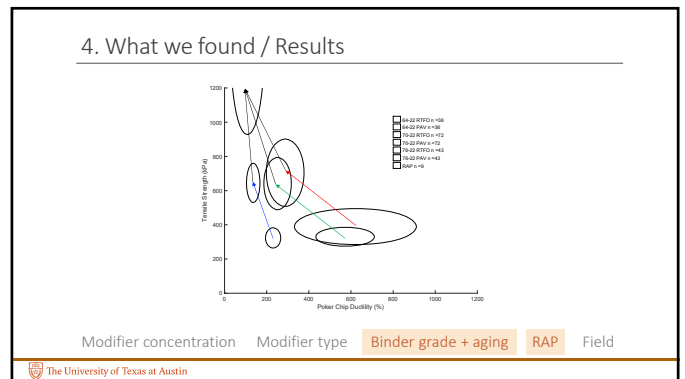
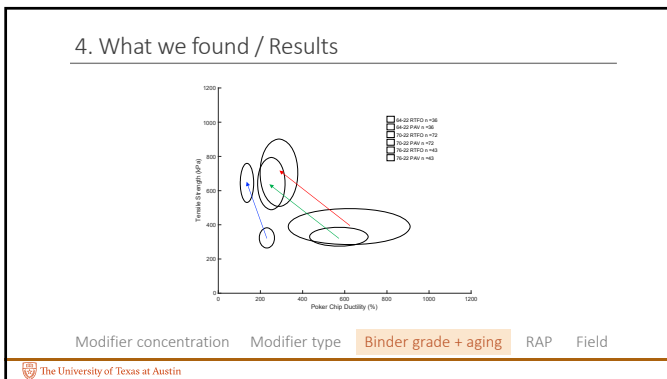
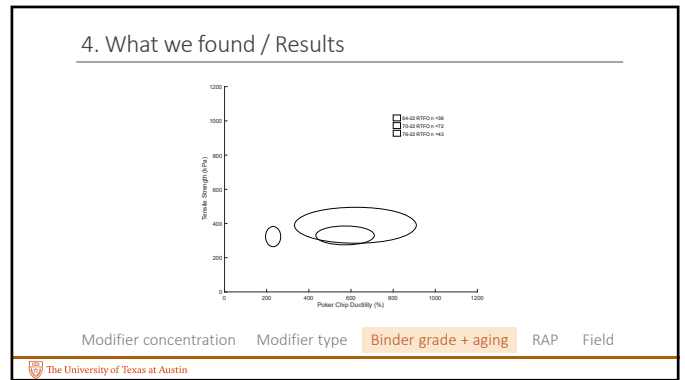
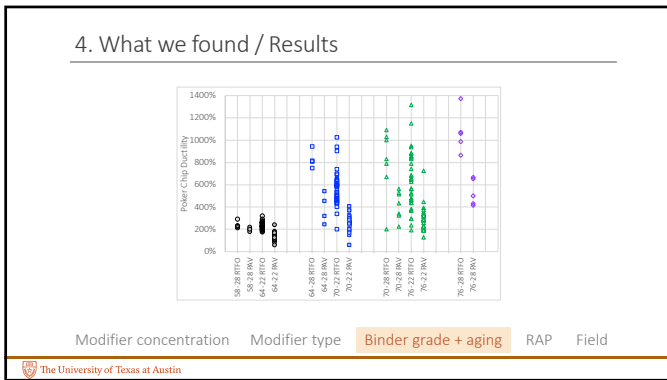
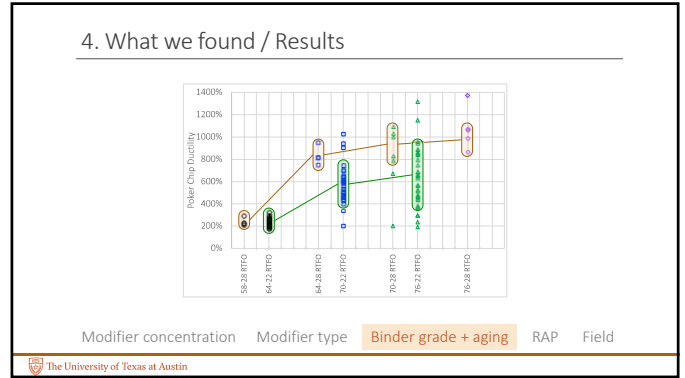
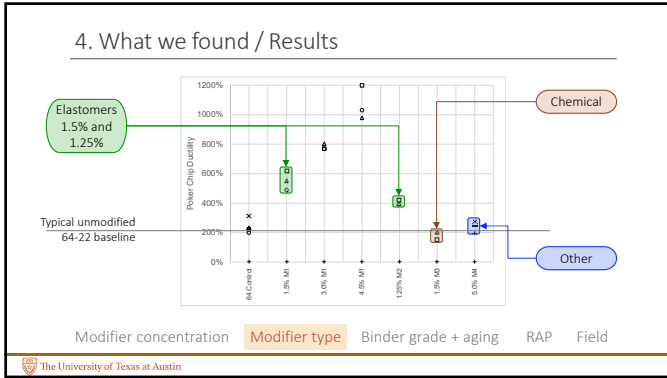
4. What we found / Results

Modifier concentration Modifier type Binder grade + aging RAP Field

4. What we found / Results

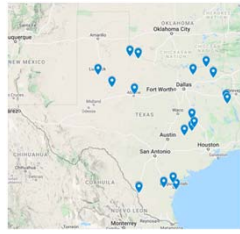


Modifier concentration Modifier type Binder grade + aging RAP Field



4. What we found / Results

- Diverse locations / weather conditions



Modifier concentration Modifier type Binder grade + aging RAP **Field**

4. What we found / Results

- Diverse locations / weather conditions

- Binder contents (%)



- Layer thickness (in)



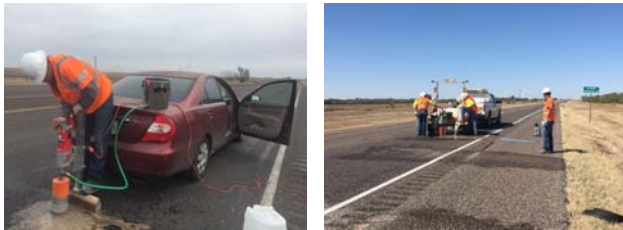
- Total HMA thickness (in)



- Truck traffic



4. What we found / Results



4. What we found / Results

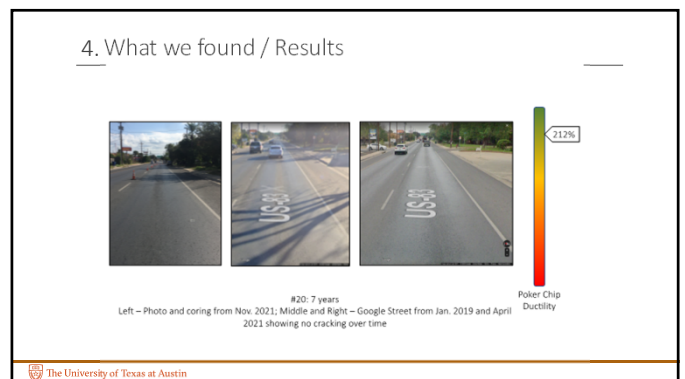
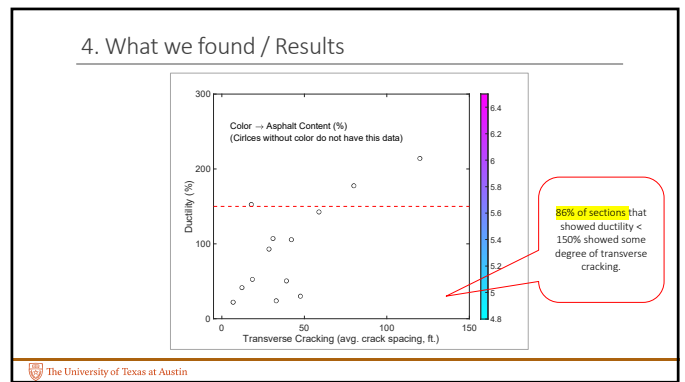
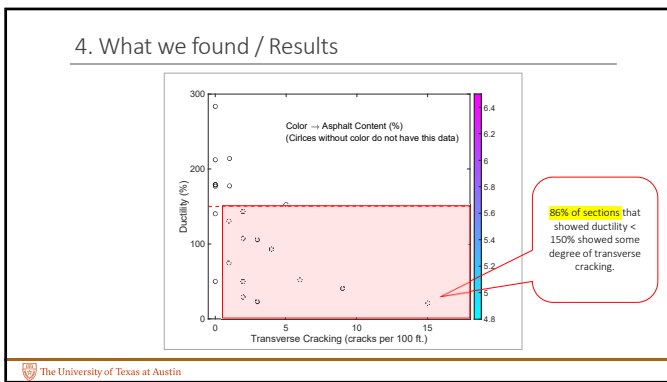
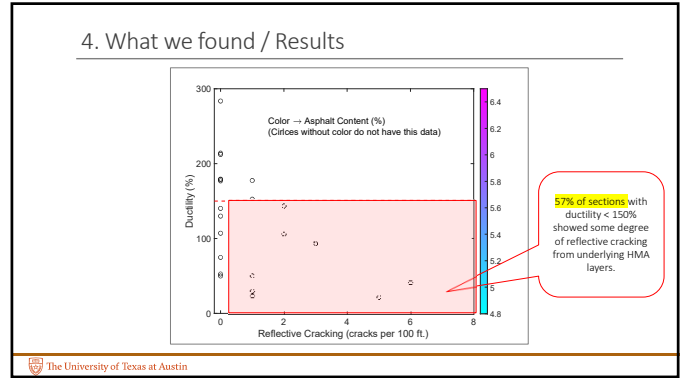
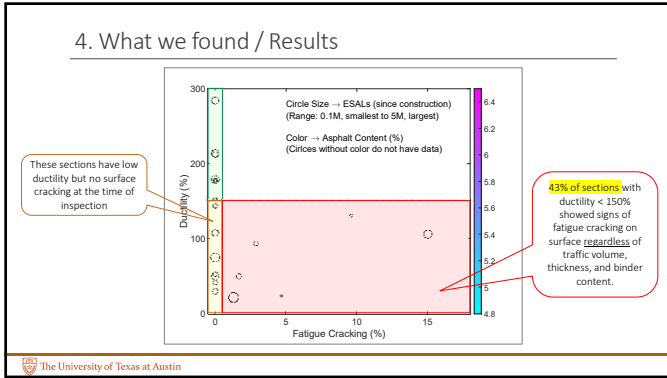


4. What we found / Results



4. What we found / Results





4. What we found / Results

#19: 7 years
Left – Photo and coring from Nov. 2021 after a recent overlay; Right – Google Street from April 2021 before the overlay showing cracking

Poker Chip Ductility 140%

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4. What we found / Results

#3: 6 years
Note: Left – Nov. 2019 during coring; Middle and Right – Google Street, Dec. 2021

Poker Chip Ductility 130%

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4. What we found / Results

#22: 9 years
Photo and coring from Nov. 2021

Poker Chip Ductility 24%

The University of Texas at Austin

4. What we found / Results

#13: 7 years
Left – Photo and coring from March 2020 after a recent seal coat showing some bleed through cracks; Right – Google Street from April 2018 before seal coat showing cracks

Poker Chip Ductility 22%

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Conclusions

- One additional piece of equipment
- + Method → Simple and repeatable
- + Equipment → Low cost, small footprint, plug and play
- + Parameter →
 - o mechanics based,
 - o induces failure and supplements rheology,
 - o measured directly,
 - o sensitive to elastomer content,
 - o sensitive to aging
- + 87% of field sections had some form of cracking when ductility < 150%

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Researchers
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