



NCHRP 9-58

Effects of Recycling Agents on Asphalt Mixtures with High RAS and RAP Binder Ratios

Binder/Mixture ETGs

September 18, 2014




Outline

- Project Team & Panel
- Motivation & Objective
- Work Plan Overview
- Field Projects
- Draft Laboratory Experiment Design
- Preliminary Results
- Next Steps



NCHRP 9-58

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- Subcontractors
 - UNR – Elie Hajj
 - UNH – Jo Daniel
- Consultant – Gayle King
- 41 months (5/2/14 – 10/2/17)
- \$1.5 million



NCHRP 9-58 Panel

- Chair – Jim Musselman (FL DOT)
 - John Bartoszek (Payne & Dolan, Inc.)
 - John D’Angelo (D’Angelo Consulting, LLC)
 - Joe DeVol (WA DOT)
 - Tejash Gandhi (MeadWestvaco)
 - Luke Johanneck (MN DOT)
 - Edmund Naras (MA DOT)
 - Pedro Romero (Univ of UT)
- FHWA – Matt Corrigan
- TRB – Fred Hejl
- NCHRP – Ed Harrigan



Motivation

- Increased Utilization of RAP & RAS
 - Stiff recycled binders can lead to construction & cracking problems
 - Recycling agents (RA) can mitigate by rejuvenating stiff binders
- Challenges
 - Short- and long-term field performance
 - RA characterization, classification, & compatibility
 - Mix design including specimen fabrication



Objective

- Evaluate effectiveness of RAs in asphalt mixtures with high recycled binder ratios (RBRs) between 0.3 and 0.5



Work Plan – 3 Phases, 9 Tasks

Phase I – Identification of Gaps in Knowledge on Recycling Agent Use with High Recycled Binder Ratios (RBRs)

- Task 1 - Gather Information
 - Literature Search & Review
 - Survey State DOTs, Contractors, & Recycling Agent Suppliers
 - Form Internal & External Advisory Groups
- Task 2 – Design Lab Experiment
- Task 3 – Document Results and Meet with Panel



Work Plan – 3 Phases, 9 Tasks

Phase II – Investigation of Effectiveness of Recycling Agents in Restoring Binder Rheology, Development of Blending Protocol, & Associated Mixture Performance

- Task 4 – Conduct Lab Experiment
- Task 5 – Design Field Experiment, Document Results, and Meet with Panel

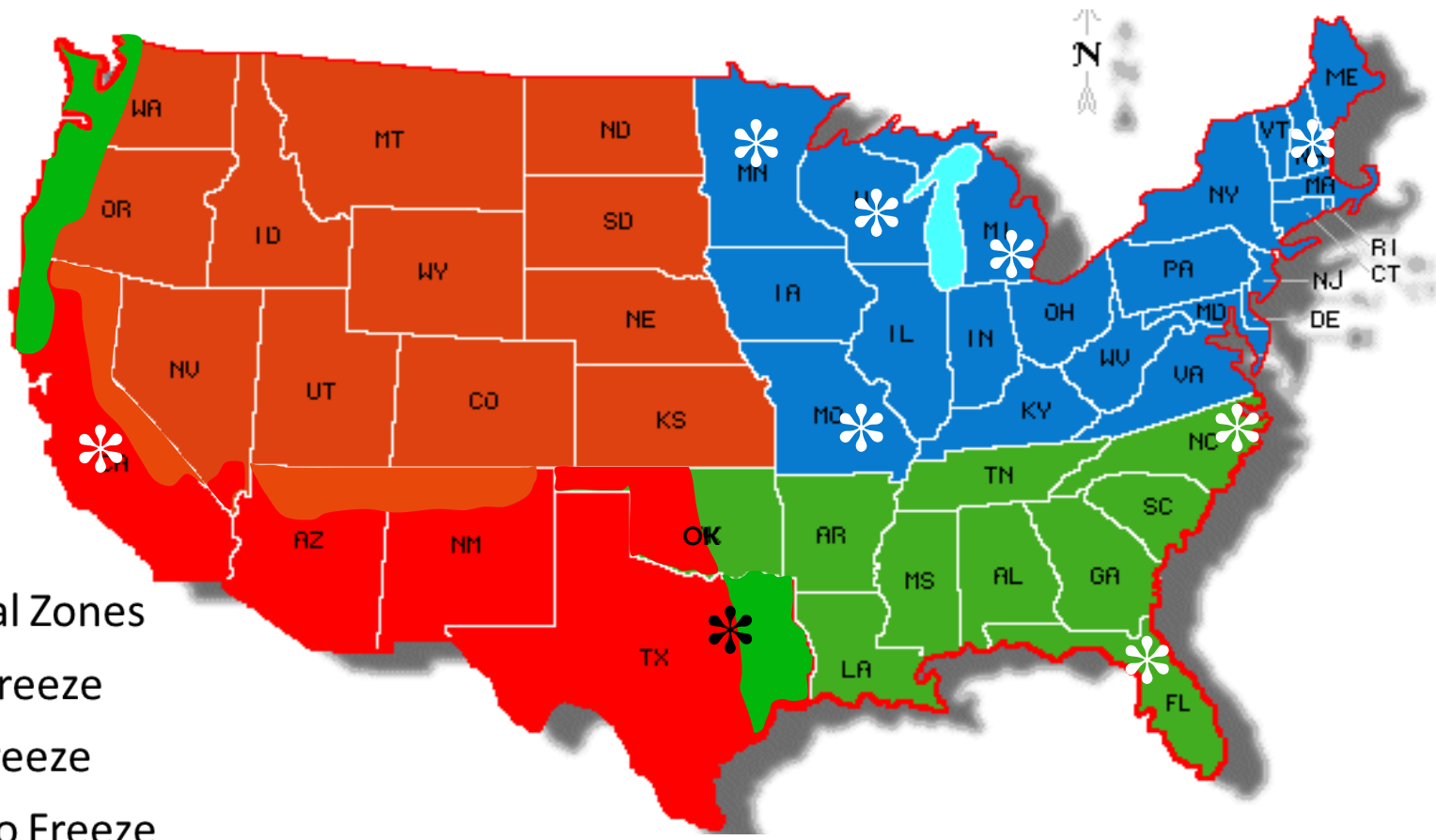


Work Plan – 3 Phases, 9 Tasks

Phase III – Validation of Recycling Agent Use in Mixtures with High Recycled Binder Ratios (RBRs)

- Task 6 – Conduct Field Experiment
- Task 7 – Propose Revisions to AASHTO Specifications & Test Methods
- Task 8 – Develop Training Materials & Best Practices and Deliver Workshop
- Task 9 – Document Results and Meet with Panel

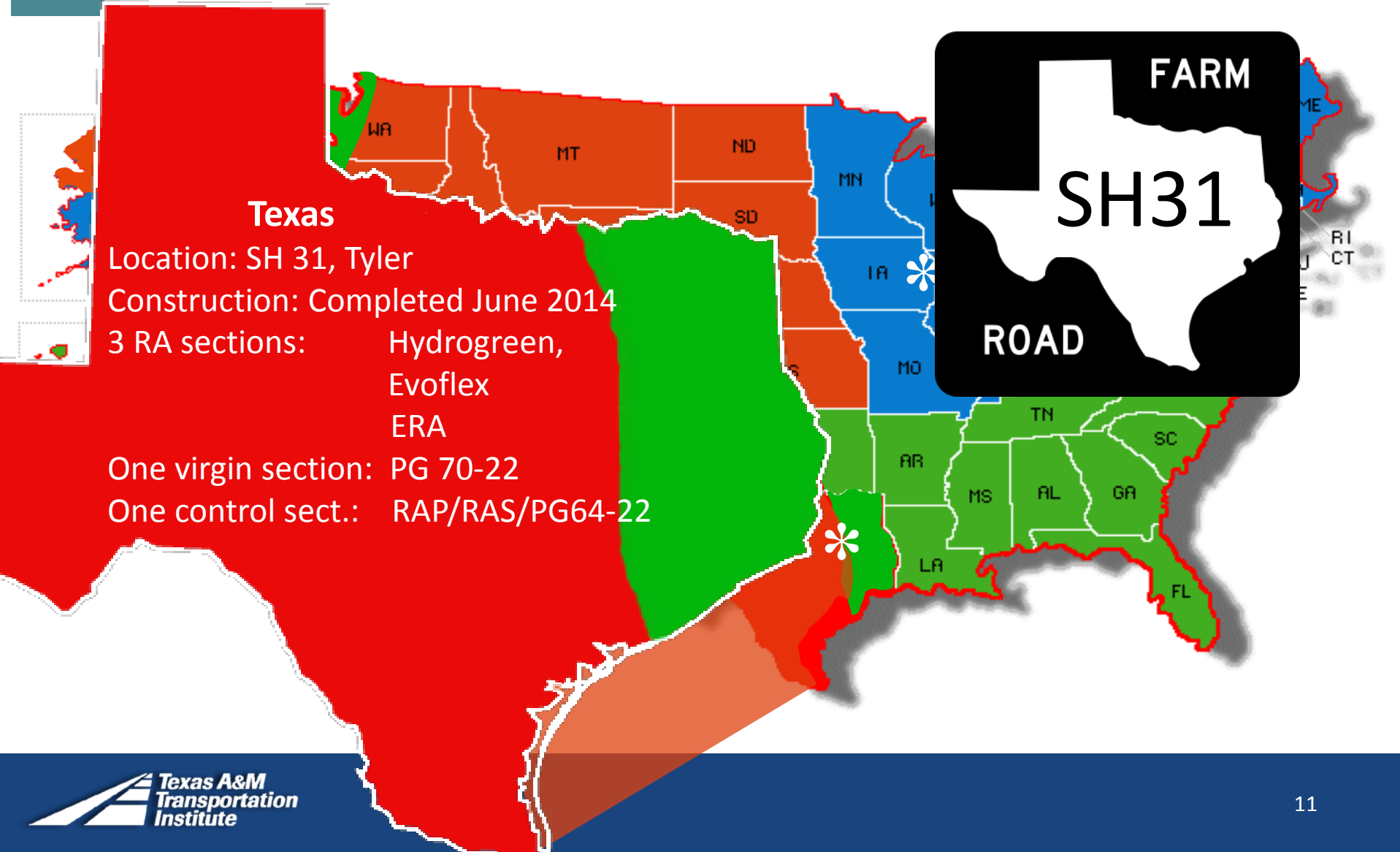
Prospective Field Projects (+TX)



Environmental Zones

- - Wet-Freeze
- - Dry-Freeze
- - Dry-No Freeze
- - Wet-No Freeze

TX Field Project





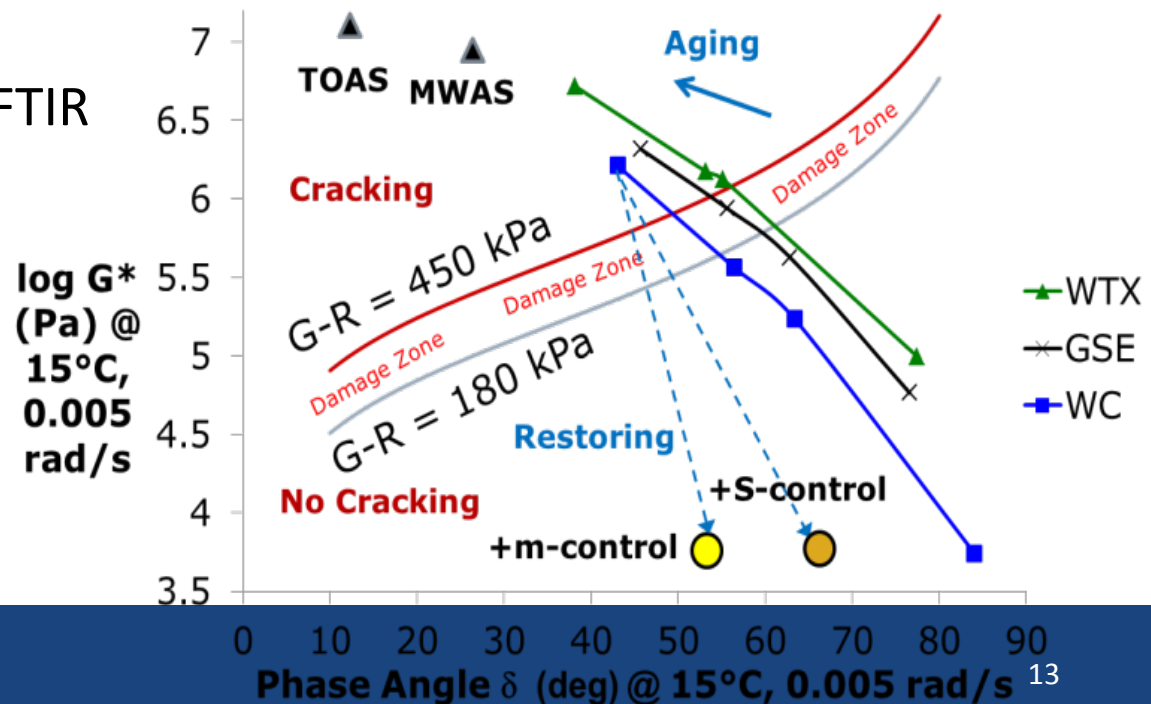
Lab Experiment Design

Materials

- Virgin Binders
 - PG 64-22 (TX w/RAP/RAS)
 - PG 64-28 (NH)
- RAP
 - TX
 - New England
- RAS
 - MWAS (TX)
 - TOAS (TX)
- Recycling Agents
 - Paraffinic Oils x 1
 - Aromatic Extracts x 1
 - Prospective Triglycerides & Fatty Acids product
 - Tall Oils x 2 (TX)
 - ERA (TX)
 - 2 soft binders (TxDOT 0-6738)

Lab Experiment Design Tests

- RA characterization by ASTM D4552
- Binder tests
 - Rheological properties: DSR/BBR
 - PG grade
 - Glover-Rowe (G-R)
 - Aging properties: DSR/FTIR
 - Aging index-FTIR
 - Glover-Rowe (G-R)



Lab Experiment Design

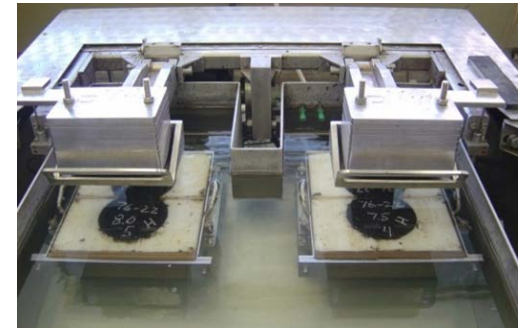
Tests

- Binder Tests for Field Oxidation Modeling
 - Aging properties: FTIR
 - POV and/or PAV aging
 - constant-rate activation energy
 - Rheological properties: DSR
 - viscosity hardening susceptibility
 - Glover-Rowe (G-R)
 - Predicted Life in specific climate to determine long-term effects (if any) of RAs



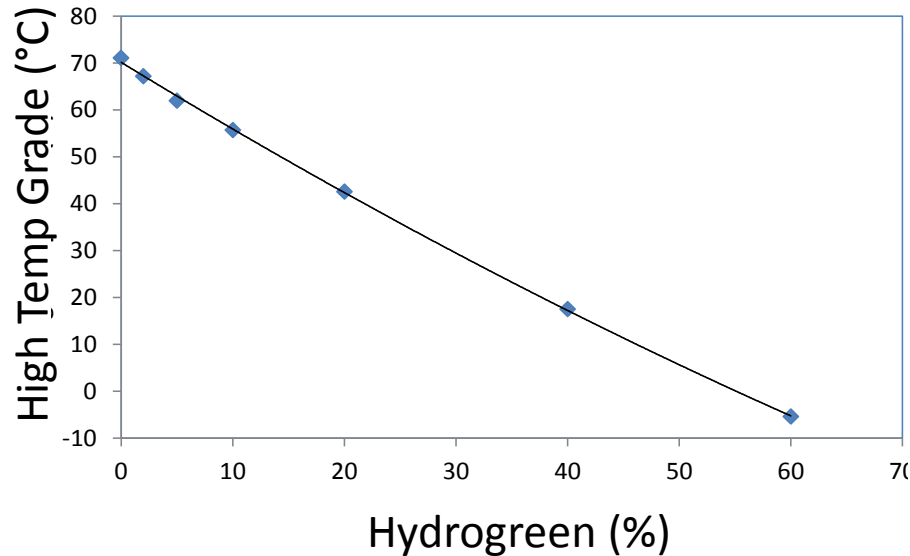
Lab Experiment Design Tests

- Mortar Tests
- Mixture Tests
 - Stiffness: Resilient Modulus (M_R)
 - Blending/short-term aging protocol
 - Long-term aging protocol
 - Cracking: S-VECD w/E*, EBM, Modified TSRST w/E*
 - Rutting/Moisture Susceptibility: HWTT

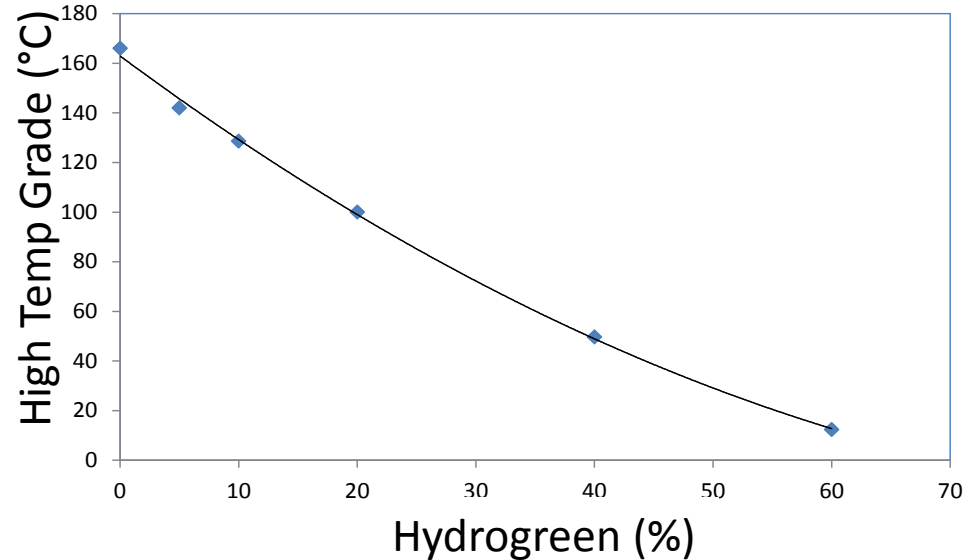



Preliminary Results from TX – Binary Blending

PG 64-22/Hydrogreen Blends

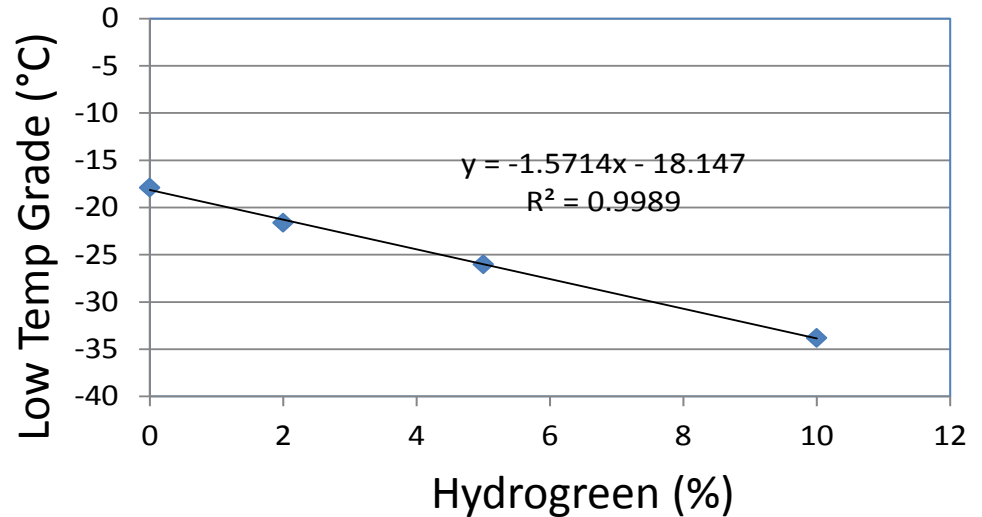
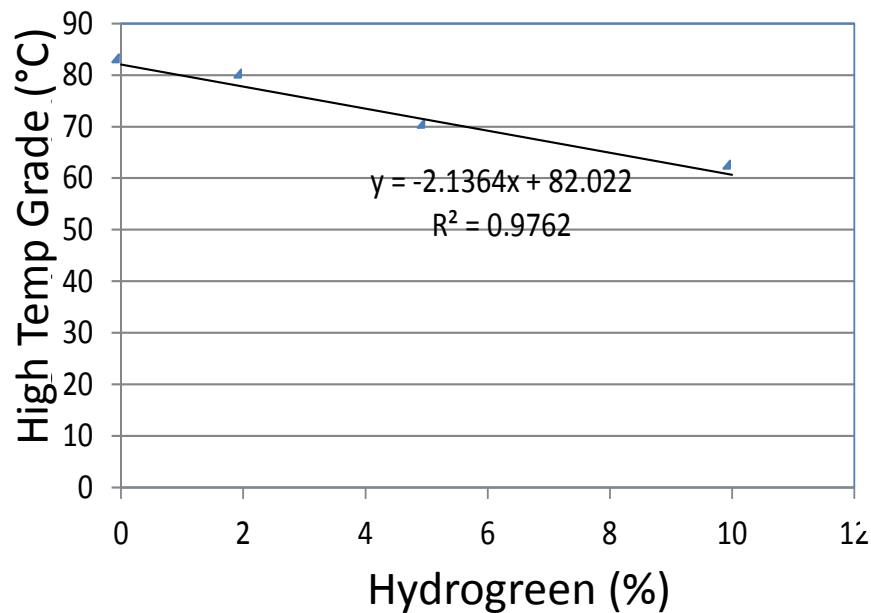


TOAS Binder/Hydrogreen Blends





Preliminary Results from TX - Multiple Blending PG 64-22+RAP+RAS+RA





Field Experiment Design

Field Project Requirements

- Virgin Mixture with NO RAP or RAS
- Control Mixture with High RBR (0.3-0.5)
- Mixture with High RBR (0.3-0.5) & Recycling Agent



Next Steps

- Form External Advisory Group
 - Field Projects – ID & Assist with Planning/Placement
 - Review Experiment Designs, Results, & Documents with NCHRP Approval
 - Meet at Binder/Mixture ETG Meetings
- Draft 1st Interim Report with Laboratory Experiment Design & Preliminary Results (TX Field Project)
 - Binder Blending
 - Mixture Blending/Short-Term Aging Protocol



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