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
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- 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)
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  - 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
Texas Field Project

Location: SH 31, Tyler
Construction: Completed June 2014
3 RA sections: Hydrogreen, Evoflex, ERA
One virgin section: PG 70-22
One control sect.: RAP/RAS/PG64-22
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

1. For High Temp Grade (°C):
   - Equation: $y = -2.1364x + 82.022$
   - $R^2 = 0.9762$

2. For Low Temp Grade (°C):
   - Equation: $y = -1.5714x - 18.147$
   - $R^2 = 0.9989$
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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