Update on Using Foamed Asphalt Recycling Agent For CIR

Donald M. Matthews, PE
Technical Manager Pavement Recycling Systems, Inc.

PCCAS Recycling Meeting
University of Nevada, Reno
October 25, 2016
What is Foamed Asphalt?

Hot AC (350F +) with cold water (2-3%) in a controlled environment. Causes expansion of the asphalt and volume increase of 8 to 12x. Allows for dispersion and mixing.
Bituminous Recycling Agents

Asphalt Foam Recycling Agent
  Mastic technology
  Thought needs fines 8% to 20%
  Proven not necessary in CIR (<3% fines)

Emulsified Asphalt Recycling Agent
  Coating/Binding Technology

Concern is that with foamed asphalt, commonly too much cement is used to pass lab testing. Should maintain the 3 to 1 (2.5:1?) ratio of binder to cement. Davis is conducting research
Lab Coating

Foamed Asphalt  Emulsified Asphalt

Same aggregate; same residual asphalt content
Field Coating

Foamed Asphalt Tends to Be More Dry Looking and More “Salt and Pepper”

Emulsified Asphalt Better Coating and More Uniform Color
Relative Compaction In California

CIR TEST STRIP BREAKOVER CURVE

Breakover Unit Weight

Estimated 10 Roller Passes Required 1 Recording Pass With Steel Vibratory

Emulsified Asphalt

Foamed Asphalt
TEST FOR STRENGTH/STABILITY AND MOISTURE SENSITIVITY

Emulsified Asphalt
Marshal Stability
@ 104 Deg. F.

Foamed Asphalt
ITS @ 77 Deg. F.
Raveling Test
Emulsified Asphalt

Proper CIR

Inadequate CIR

Foamed Asphalt Will Not Pass
Equipment Misconception

Wrong! Both equipment can do either.

Wirtgen 2200 Asphalt Foam Recycling Agent

Multi Unit Trains Emulsified Asphalt Recycling Agent
Bituminous Recycling Agents

- In California
  - Since 2003 been 100% emulsified asphalt recycling agent with generally very positive results
  - CIR Subtask Group on Foam is working on an NSSP and mix design lab procedure
  - Expect to have a pilot project constructed in 2017 using a foamed asphalt recycling agent
  - Working group on mix design and quality assurance is to beginning to look for performance measures for CIR as a whole, regardless of bituminous recycling agent used
Bituminous Recycling Agents

- Other Agencies and Organizations
  - Currently across the United States emulsion is more prevalent
  - Most specifications specify the recycling agent type to be used
  - Ontario Department of Ministry allows the contractor to choose as long as “performance” measures are met
  - Virginia DOT uses primarily foamed asphalt
  - Asphalt Recycling and Reclaiming Association (ARRA) has guidelines for both and does not indicate any preference

- Pavement Recycling Systems, Inc.
  - Currently prefers emulsified asphalt for favorable weather conditions
  - Much safer (140 degs to 350 degs!)
  - Appears to behave better during the construction phase
  - Prefer foamed asphalt for night time or inclement weather conditions due to fewer curing constraints
But Conflicting Opinion From Someone Who Uses Both

“Really odd that your CIREAM (Asphalt Foam) holds up better to the rain than emulsion, and that we experience just the opposite. Perhaps gradation, type of AC & rate, ambient temperature, play a part?”

Nicholas Cifelli, BASc, MBA
Technical Services Manager
Miller Paving Limited
Long Term Performance
NCAT Test Track, 2012

10 million ESALs
Applied in 2 years
First cycle completed 2014

Used a Foamed Asphalt Recycling Agent as Per Virginia’s Preference

Has Recently Constructed More Test Sections with Both Binders

Slide Courtesy of Brian Diefenderfer, Ph.D., P.E.
Virginia Center for Transportation Innovation and Research / VDOT
NCAT Test
Track, rutting

% of 10 million ESALs

Rut depth, inches

0.5
0.4
0.3
0.2
0.1
0.0

0.17
0.20
0.15

N3
N4
S12

Slide Courtesy of
Brian Diefenderfer, Ph.D., P.E.
Virginia Center for Transportation Innovation and Research / VDOT
Tensile Strain Beneath CCPR Layer at 68F
NCAT, Lessons Learned

• Recycling can be part of a **high-volume** roadway
  • No cracking at 10 million ESALs
  • Ride quality steady
  • Rutting < 0.25 inches
  • Trends in strain data

• Perpetual section?
  • Will the presence of the FDR section make the CCPR act “perpetually”?

• Layer coefficients
  • CCPR range = 0.36-0.39 (FWD)

Slide Courtesy of
Brian Diefenderfer, Ph.D., P.E.
Virginia Center for Transportation Innovation and Research / VDOT
Structural Design Considerations

Structural Number

ARRA BARM II 0.30 – 0.35

Virginia Center for Transportation Innovation and Research/VDOT Interstate 81 Project 0.35 – 0.39

Adaption and Verification of AASHTO Pavement Design Guide - Ontario Department of Ministry 0.28 – 0.38

NCHRP 9-51 - Material Properties for CIR and FDR for Pavement Design

No Distinguishing Between Binder Types
NCHRP 9-51

- Material Properties of Cold In-Place Recycled and Full-Depth Reclamation Asphalt Concrete for Pavement Design

- Focus areas
  - Laboratory testing for structural properties of field cured materials
  - Material property inputs for MEPDG/DarWin-ME
  - Distress models for MEPDG/DarWin-ME
NCHRP 9-51
Brian Diefenderfer

- Material Properties of CIR and FDR for Pavement Design
- Partners
  - University of MD, VDOT, Colas Solutions, Wirtgen
- Project locations (22)
  - California, Colorado, Delaware, Edmonton, Georgia, Illinois, Kansas, New York, Ontario, Utah, Washington, West Virginia
Example Results

Average Dynamic Modulus at 21°C and 10Hz, psi

<table>
<thead>
<tr>
<th>Project Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCPR - Emulsion</td>
<td>1</td>
</tr>
<tr>
<td>CIR - Emulsion</td>
<td>7</td>
</tr>
<tr>
<td>CIR - Foam</td>
<td>3</td>
</tr>
<tr>
<td>FDR - Foam</td>
<td>2</td>
</tr>
<tr>
<td>I-81 CIR - Foam</td>
<td>1</td>
</tr>
<tr>
<td>I-81 CCPR - Foam</td>
<td>1</td>
</tr>
</tbody>
</table>
None Yet!

Let’s Focus on in Service Performance Measures and Not Equipment or Binder Specifications
Research ... to develop appropriate time-critical tests, generally performed during construction, that allow an agency to quickly determine the quality of the as-constructed cold recycled pavement and evaluate its readiness for traffic and surfacing.

... a guide specification for process control and product acceptance of cold recycling operations is needed to promote consistency among agencies and allow contractors to more easily operate within multiple jurisdictions.
Thank You!

Questions?
dmatthews@pavementrecycling.com
(951) 934-4753

ARRA

See you in Auburn, AL