AASHTO Subcommittee on Materials
Recycled Engine Oil Task Force
Report to SCOH

Mostafa (Moe) Jamshidi, NE
Chief Engineer, Acting Director
May 12-13, 2015 Spring Meeting
“REOB or VTAE” from Used Oil

- Used Oil Delivery
- Rec’vg Screen’g
- Storage
- Water Removal/dehydration
- Fuel Extraction
- Oils
- Distillation and Processing
- Fuels
- Vacuum Tower Asphalt Extenders *
Charge - SOM REOB Task Force

- Past, current and upcoming research regarding the use of REOB in pavements including scope and timing of research
- Status of use of REOB in asphalt across State DOTs, including knowledge of presence, pertinent specifications for use, including certification or specification requirements
- Best practices for determining the presence and amounts of REOB in pavements
Charge - SOM REOB Task Force

• Recommended additional research to fully evaluate the allowance of REOB into asphalt pavements, or mitigation of its use if necessary

• Preliminary risk assessment of member State’s asphalt binder specifications and associated recommendations
Hamburg Wheel Test
courtesy MADOT
Hamburg Results: ARGG Plant Produced Mixture Delivered 10-7-14
Mixture Provided by MassDOT

MassDOT Criteria
1. A maximum rut depth of 12.5 mm at 20,000 passes for HMA and WMA.
2. No abrupt increase in the rate of deformation (Stripping Inflection Point) prior to 15,000 passes.

<table>
<thead>
<tr>
<th>Plant Mix ARGG 9-15-14</th>
<th>Plant Mix ARGG 10-6-14</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average Air Voids</strong></td>
<td><strong>Average Air Voids</strong></td>
</tr>
<tr>
<td></td>
<td>8.02%</td>
</tr>
<tr>
<td></td>
<td>8.92%</td>
</tr>
<tr>
<td><strong>Test Temperature</strong></td>
<td>50°C</td>
</tr>
<tr>
<td></td>
<td>50°C</td>
</tr>
<tr>
<td><strong>Stripping Inflection Point</strong></td>
<td>15,400</td>
</tr>
<tr>
<td></td>
<td>10,700</td>
</tr>
<tr>
<td><strong>Rut Depth at 10,000</strong></td>
<td>2.95 mm</td>
</tr>
<tr>
<td></td>
<td>10.54 mm</td>
</tr>
<tr>
<td><strong>Rut Depth at 20,000</strong></td>
<td>6.81 mm</td>
</tr>
<tr>
<td></td>
<td>20.08 mm</td>
</tr>
</tbody>
</table>
Past, Current and Upcoming Research

• REOB specific research is sparse – in the dozens of articles.
• However many relevant articles are available that address asphalt aging and hardening.
• TF examined research from a range of opinions to develop an outline of the knowledge
  – Industry sponsored research confirms that there can be a binder grading change from REOB in specific cases
  – REOB has been in use for 25 years or more, with ongoing manufacturing changes
Past, Current and Upcoming Research

• Introducing REOB introduces risk. The percent allowable is unknown and depends on the chemistry of the REOB and the Asphalt.

• Limited studies on mixture and binder indicate that low replacement levels of REOB can result in binder and mixture that pass PG Binder laboratory tests.

• Field performance issues are documented that strongly imply REOB contributed to lower life expectancy.
VT
I 89 Middlesex, VT
loss of mastic,
eroison through surface 5 yr
Status of use of REOB

• Based on survey results 20 states have received REOB of the 43 respondents*, based on FHWA test results 18 states of 37 tested had REOB present

• Nearly half the states received REOB modified PG Binders

• States were informed by:
  – Suppliers 29% **
  – FHWA test results 64%
  – I/E test results 29%
Status of use of REOB

- State specifications and expectations:
  - Specific approval  2%
  - Conditional Approval  5%
  - Prohibit  22%
  - Silent – use general PG standards  71%
- Most states consider REOB a modifier of asphalt binder.
- Industry has not uniformly reported REOB as a modifier.
Status of use of REOB

• Resellers make (further) modifications to meet State’s requirements or specifications without knowledge of prior modifications
• Modifiers can interact or confound detection requiring a suite of testing to identify materials
Available techniques for Detecting REOB

• Asphalts with REOB have higher Ash content, up to 3% in modified vs. 0.2% in neat binders - respectively.

• **X-ray Fluorescence** analysis provides semi-quantitative results based on metals content. XRF may reveal additional modifiers including Ground Tire Rubber (GTR)

• Modifiers including VTAE (a product that will include REOB) may not be quantifiable by metals content analysis in the future
Field Performance - No REOB

Highway 655, Timmins, Ontario
- Two lifts to make 90mm over granular base
- Estimate 0% REOB based on XRF and FTIR testing
- Performing well and largely free of distresses
- Centerline joint and shoulders are beginning to crack after 11 years.
Highway 655, Timmins, Ontario
- Two lifts to make 90 mm over granular base
- Estimate 9% REOB based on XRF and FTIR testing
- Severe alligator cracking since 5 years old
- Transverse cracks sprouting from wheel path and longitudinal joint
Is your state involved in REOB research?

- State Staff Led: 23.1%
- University Led: 12.8%
- No Research: 64.1%
Recommended additional research

• States are relying on national scale study to help with this issue

• Proposed NCHRP “The Impacts on Pavement Performance from Changes in Asphalt Production” will help

• Introduce REOB study into ongoing NCHRP studies with additional funding if necessary
Recommended additional research

• Compile an expanded data set for REOB test results with use of State and industry laboratories to accurately describe REOB
VT
US 2 Montpelier
Raveling through surface course, loss of mastic 5yrs
Preliminary risk assessment

– Modifiers for PG asphalt are rapidly evolving as well as changes in base asphalt qualities. These factors pose significant risk to the durability of pavements.

– Recycled materials necessitate more modifiers so increasing issues are expected

– Implement a standard practice for approval of modifiers with an updated standard
## Benefit and Value – fractional cost increases for quality

<table>
<thead>
<tr>
<th>Year</th>
<th>Project Type</th>
<th>Total Construction Costs</th>
<th>Bituminous Material Costs</th>
<th>AC Costs</th>
<th>AC Costs as Percent of Total Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>NC</td>
<td>All Projects 2014</td>
<td>$1.8 B</td>
<td>$458 M</td>
<td>$207 M</td>
<td>11.5%</td>
</tr>
<tr>
<td>VT</td>
<td>All Projects 2012</td>
<td>$163 M</td>
<td>$31.6 M</td>
<td>$10.5 M</td>
<td>6.45%</td>
</tr>
</tbody>
</table>
# SOM REOB Task Force

<table>
<thead>
<tr>
<th>Michael San Angelo AK</th>
<th>Richard Bradbury ME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matthew Mueller IL</td>
<td>Christopher Abadie LA</td>
</tr>
<tr>
<td>John Grieco MA</td>
<td>Christopher Peoples NC</td>
</tr>
<tr>
<td>Eileen Sheehy NJ</td>
<td>Becca Lane ON Province</td>
</tr>
<tr>
<td>Terry Arnold FHWA</td>
<td>Matthew Corrigan FHWA</td>
</tr>
<tr>
<td>Nelson Gibson FHWA</td>
<td>William Ahearn VT</td>
</tr>
</tbody>
</table>