Moisture Sensitivity Testing
PAPA Regional Technical Meetings 2016

Neal Fannin
Pavement Materials
ISSD
Stripping
Indications of a Problem

- Had severe and obvious problems with the premature deterioration of some asphalt mix designs with certain aggregates.
- Districts with moisture damage issues were forced to **require** minimum amounts of liquid anti-strip additives to mitigate moisture damage problems.
- Mix designs in border areas with other states needed anti-strip when used in other states but not in PA.
- No mix designs ever seemed to fail PA modified AASHTO T283 testing needing anti-strip.
Research Project Started

- COST BENEFIT ANALYSIS OF ANTISTRIP-ADDITIVES IN HOT MIX ASPHALT WITH VARIOUS AGGREGATES research started 2011.

- Final report May 2015.
Test result that told us we had a problem

<table>
<thead>
<tr>
<th>Test Result</th>
<th>Moisture Resistance of Aggregates in Mix</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Good</td>
</tr>
<tr>
<td>Passed</td>
<td>3</td>
</tr>
<tr>
<td>Failed</td>
<td>0</td>
</tr>
</tbody>
</table>

**Error Rates**

<table>
<thead>
<tr>
<th>Error Rates</th>
<th>Type I</th>
<th>Type II</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 %</td>
<td>100 %</td>
</tr>
</tbody>
</table>
Action Taken

- Letter to all producers of bituminous mixtures dated October 20, 2014.
  - Requires all **SRL – E and H, 9.5 mm NMAS** mixes must be reevaluated before being used in the 2015 construction season.
  - Any new mix designs submitted must also be evaluated under the new requirements.
  - Districts that currently require minimum anti-strip amounts for certain aggregate types will continue to require them.
2016 & 2017 Requirements

- **All wearing and binder mixes approved in 2016** must be reevaluated using the revised moisture susceptibility criteria in order to be approved in 2016.

- **All Base mixes approved in 2017** must be reevaluated using the revised moisture susceptibility criteria in order to be approved in 2017.
## Overall Accuracy of Modified Lottman Procedure, Level 2 Severity as Reported in Literature

<table>
<thead>
<tr>
<th>Test Result</th>
<th>Stripping Potential of Aggregates in Mix</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Low</td>
</tr>
<tr>
<td>Passed</td>
<td>18</td>
</tr>
<tr>
<td>Failed</td>
<td>1</td>
</tr>
<tr>
<td>Error Rates</td>
<td>Type I</td>
</tr>
<tr>
<td></td>
<td>5 %</td>
</tr>
</tbody>
</table>
Figure 23. B/C Ratio for Optimistic Performance, without User Delay Costs, for Different Percentages of Aggregates Susceptible to Moisture Damage, Averaged for All Traffic Levels. Legend refers to whether antistrip usage is mandatory or conditional upon test results.
### Table 32. Summary Results of LCCA Comparing High-saturation Moisture Resistance Testing to No Testing, without User Delay Costs.

<table>
<thead>
<tr>
<th>Performance of Susceptible Mixes/ Antistrip Usage</th>
<th>Cost Savings for Percentage of Susceptible Aggregates:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40</td>
</tr>
<tr>
<td>Realistic Performance/Conditional on Test Result</td>
<td>$8,003,222</td>
</tr>
<tr>
<td>Realistic Performance/Mandatory for All Mixes</td>
<td>$14,725,686</td>
</tr>
<tr>
<td><strong>Savings, Mandatory over Conditional</strong></td>
<td>$6,722,464</td>
</tr>
<tr>
<td>Savings, % of Total Cost</td>
<td>6.0</td>
</tr>
<tr>
<td>Optimistic Performance/Conditional on Test Result</td>
<td>$6,649,216</td>
</tr>
<tr>
<td>Optimistic Performance/Mandatory for All Mixes</td>
<td>$8,466,489</td>
</tr>
<tr>
<td><strong>Savings, Mandatory over Conditional</strong></td>
<td>$1,817,273</td>
</tr>
<tr>
<td>Savings, % of Total Cost</td>
<td>1.9</td>
</tr>
</tbody>
</table>
Anti-strip Research Implementation

- **Current Specials / Requirements**
  
  - Districts 1, 2, 4, & 9 Using special that requires:
    
    - 0.25% if coarse aggregate used is gravel, sandstone, siltstone, calcareous sandstone.
    - 0.25% if fine aggregate used is gravel, sandstone, siltstone, calcareous sandstone.
    - 0.5% if both fine and coarse aggregate used is gravel, sandstone, siltstone, calcareous sandstone.
  
  - Warm mix requires 0.25% anti-strip.
• Proposed change
  – Require 0.25% (or minimum required by manufacturer of anti-strip) in all asphalt mixes.
    • **Will not require additional testing of mixtures.**
  – Foamed warm mix would not require additional testing but would contain the same anti-strip as the hot mix parent.
  – Require additional AASHTO T283 testing for mixes with both coarse and fine aggregates that are gravel, sandstone, siltstone, slag, quartz, or shale with 0.5% (or dosage rate recommended by manufacturer for mixtures that fail AASTO T 283 test at lowest dosage)
Proposed change

- Require additional AASHTO T283 testing for mixes with both coarse and fine aggregates that are gravel, sandstone, siltstone, slag, quartz, or shale with 0.5% (or dosage rate recommended by manufacturer for mixtures that fail AASTO T 283 test at lowest dosage)

- Producers may add higher dosage and avoid testing.
Silicates play a large role in asphalt stripping.

Aggregates Rich in Silica Have More Propensity to Strip

- marble, slag
- limestone
- basalt, diabase
- dolomite
- sandstone
- granite
- quartzite

Stripping Potential
Anti-strip Research Implementation

• Proposed change

  - Computation of anti-strip dosage.
    • Based on *virgin* asphalt for mixes with RBR of 0.15 or less.
    • Based on *total* asphalt for mixes over 0.15 RBR.
Anti-strip Research Implementation

• Please comment on the CT 1.

• Comments due - 2/4/2016
Sources

• C, Ivan Harnish, ArrMaz Custom Chemicals, 2/3/2010 PowerPoint

• Kevin Gnegy, District 9-0, Garth Bridenbaugh, Q.A., John Swalligan, District 2-0.

• Don Christensen, Advanced Asphalt Technologies, LLC

• Dennis Morian, Quality Engineering Solutions, Inc.