Use Of Local Aggregates In SMA

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About The Illinois Tollway

Dynamic 294-mile transportation network
1.6 million vehicles per day
88 percent pay electronically
User-fee system
No state or federal taxes for maintenance and operations
Stone-matrix asphalt (SMA) used for all mainline overlays
2008 to 2009 – Full-depth asphalt on the Jane Addams Memorial Tollway (I-90) in Rockford area
2015 – Reagan Memorial Tollway (I-88) rehabilitation
2018 – Veterans Memorial Tollway (I-355) overlay
2018 – I-88 rehabilitation

327,000 tons of SMA, six producers
Coarse Aggregates For Tollway SMA

Friction Surface SMA
• High traffic pavements and curves
• Coarse aggregate: quartzite, granite, diabase/trap rock, crushed steel slag

Binder SMA and Surface SMA
• Coarse aggregate: typically crushed gravel (also surface aggregates)
• 2008 friction evaluation – acceptable for tangents
Friction aggregates – Non-Illinois sources

Crushed gravel – Southern Wisconsin

2015 – Evaluated local crushed gravel and dolomite sources

2018 – Implemented aggregate testing, including coarse FRAP
Local Aggregates For Tollway SMA

2015 evaluation approach

– Identify potential sources
– Aggregate breakdown
  • Micro-Deval testing
  • Gyratory compaction to $N_{\text{max}}$
Aggregate Sources – 2015

Control
- Rock Road Companies Inc., Janesville, Wis.: Lathers crushed gravel (1/2” and 3/8”)
- Michels Corp., Brownsville, Wis.: quartzite (1/2”)

Crushed Gravel
- Beverly Materials LLC, Elgin, Ill. (1/2” and 3/8”)
- Lafarge Aggregates, Elburn, Ill. (1/2” and 3/8”)
- Meyer Material Co., Algonquin, Ill. (3/8” and 3/4”- scalped)
- Thelen Materials LLC, Antioch, Ill. (3/8” and 3/4”- scalped)
Aggregate Sources – 2015

Dolomite

– Vulcan Materials Co., Sycamore, Ill. (3/8” and 3/4”- scalped)
– Lafarge Aggregates Fox River Quarry, South Elgin, Ill. (3/8” and 3/4”- scalped)
– RiverStone Group Inc., Osborn, Ill. (3/4”-scalped)
– RiverStone Group Inc., Milan, Ill. (3/8”)
– Macklin Inc., Rochelle, Ill. (3/8” and 3/4”- scalped)
– Hanson Aggregates, Thornton, Ill. (3/8” and 3/4”- scalped)
Micro-Deval Of Coarse Aggregates

AASHTO T327

- Aggregate breakdown (percent loss) in presence of water
- Good identifier of pavement performance
- “Mini” L.A. Abrasion
- Repeatable test
- Some agencies use in lieu of soundness
Micro-Deval Loss – Dolomite

Presented by Ross Bentsen on November 6, 2018
Degradation Evaluation

- Aggregate substituted into an existing mix design at optimum asphalt content
- Samples gyrated to $N_{\text{max}} = 225$ gyrations
- Voids analysis
- Extraction gradation
- Hamburg of $N_{225}$ samples - 20,000 cycles
## Degradation Evaluation

### Control Aggregates

<table>
<thead>
<tr>
<th></th>
<th>Michels Quartzite</th>
<th>Lathers Crushed Gravel</th>
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</thead>
<tbody>
<tr>
<td>$N_{80}$ Voids (Design)</td>
<td>3.5</td>
<td>3.8</td>
</tr>
<tr>
<td>$N_{225}$ Voids (Max)</td>
<td>2.2</td>
<td>2.0</td>
</tr>
<tr>
<td>% Passing 200, Loose</td>
<td>8.1</td>
<td>7.7</td>
</tr>
<tr>
<td>% Passing 200 @ $N_{80}$</td>
<td>9.3</td>
<td>9.2</td>
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<td>% Passing 200 @ $N_{225}$</td>
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## Degradation Evaluation

### Crushed Gravel

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<thead>
<tr>
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<tr>
<td>$N_{225}$ Voids (Max)</td>
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<td>1.6</td>
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</tr>
<tr>
<td>% Passing 200 @ $N_{80}$</td>
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<td>8.9</td>
<td>8.7</td>
</tr>
<tr>
<td>% Passing 200 @ $N_{225}$</td>
<td>9.4</td>
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# Degradation Evaluation

## Dolomite

<table>
<thead>
<tr>
<th></th>
<th>Riverstone</th>
<th>Macklin Rochelle</th>
<th>Vulcan Sycamore</th>
<th>Hanson Thornton</th>
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Degradation Evaluation

• Samples gyrated to $N_{\text{max}} = 225$ gyrations
• Hamburg of $N_{225}$ samples – 20,000 cycles
• Inconclusive results – all mixes (quartzite, crushed gravel, dolomite) had rut depths between 2.5 and 3.2 mm (6 mm max)
Specification – Coarse Aggregate For SMA

L.A. Abrasion – Less than 28 percent loss

Micro-Deval loss

– Single source: less than 12.0 percent
– Coarse aggregates: design weighted average < 9.5 percent
  (includes coarse FRAP) – A-OK, proceed with mix design
– If design weighted average is 9.5 to 12.0 percent
  • Conduct mix design – optimum AC at 3.5 percent Air Voids
  • Air voids at optimum AC and $N_{225} \geq 2.0$ percent
How Does This Compare?

**NCHRP 557 (aggregate tests for HMA)**
- Micro-Deval: Max loss of 15 recommended

**AASHTO T327 (Micro-Deval for coarse aggregate)**
- 17-18 for HMA surface course (Max 21 for lower courses)

**AASHTO M325 (standard for SMA)**
- Max L.A. Abrasion = 30
- Higher values have been successful
2018 SMA Mix Designs

4 contracts, 6 producers, 327,000 tons of SMA
5 “local” sources used: MicroDeval = 7.7 to 11.6
17 of 18 SMA designs used coarse FRAP
  – MicroDeval = 6.8 to 9.0
Additional Performance Testing

2018

– 18 SMA mix designs (all types)
– Hamburg wheel testing @ 20,000 passes
  • 1.8 to 5.9 mm (less than 6 mm required)
– DC(T) – Fracture energy
  • 642 to 1217 J/m² (minimum 600-650 required)
Why SMA?
THANK YOU