Micro Surfacing Innovations Improvements

Changes being driven by Northern Tier States

• Climate appropriate base asphalt

Industry driven innovation

• Evaluation and design methods for surface treatments
MICROSURFACING

Emulsion-based surface treatment for road maintenance

- Mixture of aggregate, asphalt emulsion (containing a polymer), mineral filler, chemical additives, and water

Application areas

- High-speed, high-traffic volume roads
- Airport runways
- Rut-filling operations

Applied in thin layers

- 3/8 inch to 5/8 inch for normal treatments
- 1.5 inch for rut-filling applications
In Micro Surfacing water and chemistry take the place of heat to place an asphalt mix

• Aggregate and Binder are combined on the micro surfacing paver

• All the materials are at near ambient temperature:
  – Aggregate
  – Asphalt Emulsion
  – Additives
Micro Surfacing Paver

MICRO-SURFACING MACHINE MATERIAL FLOW DIAGRAM

AGGREGATE
AGGREGATE GATE
CONVEYOR

MINERAL FILLER
WATER
ADDITIVE (IF NEEDED)
EMULSION
PADDLE MIXER

DIVERTER
MICRO-SURFACE MIX
SPREADER BOX
FRESH MICRO-SURFACE OVERLAY
Micro surfacing Components

Mix as produced

- Aggregate
- Mineral Fines
- Water
- Asphalt Emulsion
- Additive
Micro surfacing Components

Mix After Breaking & Curing *Theoretical

- Aggregate
- Mineral Fines
- Water
- Asphalt
- Voids
After Time

Equilibrium between interfacial and bulk emulsifier concentrations upset by introduction of charged aggregate.

Adhesion of emulsifier to aggregate surface causes a decrease in bulk and interfacial concentrations. Droplets begin to flocculate.
- Micro Surfacing –
  - Ruts in excess of ½” should be filled with a rut box
Rut Box

- 5 or 6 feet widths
- With augers
- V shaped screed
  - Channels larger aggregate into deeper parts of the rut
  - Feathers edges
  - Over-crowns rut to compensate for traffic compaction
Rut Filling
Rut Filled
### Slurry Seal vs. Micro

<table>
<thead>
<tr>
<th>TEST</th>
<th>SLURRY SEAL</th>
<th>MICRO-SURFACING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand Equivalent</td>
<td>45% minimum</td>
<td>65% minimum</td>
</tr>
<tr>
<td>Mix Time</td>
<td>180 seconds minimum</td>
<td>120 seconds minimum</td>
</tr>
<tr>
<td>WTAT, 1 Hour Soak</td>
<td>75 g/ft²</td>
<td>50 g/ft²</td>
</tr>
<tr>
<td>WTAT, 6 Day Soak</td>
<td>Not required</td>
<td>75 g/ft²</td>
</tr>
<tr>
<td>Lateral Displacement</td>
<td>Not required</td>
<td>5% maximum</td>
</tr>
</tbody>
</table>
Leveling (Scratch) Course

- Ruts < ½” may be filled with scratch course

The scratch coat is generally 6” less than the width of the lane.
Full Width Spreader Box

• Variable width 9 to 15 feet
• Rubber strike-off for surface
• Steel or Stiff Rubber for Level-up
Secondary strike-off

- Used to achieve desired texture
  - Burlap drag
  - Rubber strike-off
Surface Texture Adjustment with Strikeoff

Textured wearing surface
Micro Surfacing Decision-Making…Driven by Project/Agency Performance

Objectives

• Climate
• Traffic
• Time Constraints
• Existing Pavement Condition
• Base Stiffness
• Polymer & Additive Option
• Surface Texture Needs
• Design & Performance Testing
• Field Acceptance
International Slurry Seal Association (ISSA) Strategic Plan Goals and Timeline

• Slurry Seal Guideline Objectives
  Polymer-Modified Slurry Seal Guideline (Goal: June 2018)

• Inspector’s Manual (Goal: April 2018)

• ISSA TB Revisions (Goal: September 2018)

• Micro Surfacing Guideline Revisions (Goal: Q1 2019)
Micro Surfacing Future Changes / Improvements

• Base AC Grade
• Move to a climate specific Super Pave Binder
• High Performance Specification
• Design Methods
• Test equipment
• Materials
The Future of Micro Surfacing Materials

- Standard Micro Surfacing Base Asphalt
  - Normally PG 64–22 (effectively a PG 58–28) when placed under micro surfacing condition construction process.
- Additional Grades being trialed in northern states
  - PG 58–28 (PG 52–34 as placed)
  - PG XX–34 (PG XX–40 as placed)
- Note: All above are before addition of latex or polymer. Polymer raises top end 1 to 2 grades
The Future of Micro Surfacing Materials

• When you make an emulsion mix or surface treatment the binder is not subjected to the heat / oxygen in the hot mix plant.
  - CQS ~ 100 to 120 F on delivery / application
  - CRS ~ 150 to 190 F on delivery / application

• Since SHRP Superpave PG binders are tested in the lab by subjecting them to a simulated hot mix and thin film heat aging they end up “harder” than what will be on the road using an emulsion mix.
# The Future of Micro Surfacing Materials

## Performance Grades

<table>
<thead>
<tr>
<th></th>
<th>PG 46</th>
<th>PG 52</th>
<th>PG 58</th>
<th>PG 64</th>
<th>PG 70</th>
<th>PG 76</th>
<th>PG 82</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Design Temp.</td>
<td>46</td>
<td>52</td>
<td>58</td>
<td>64</td>
<td>70</td>
<td>76</td>
<td>82</td>
</tr>
<tr>
<td>Min. Design Temp.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Original

- **Flash Point**
- **Rotational Viscosity**

### (Rolling Thin Film Oven) RTFO, Mass Change ≤ 1.00%

- **DSR G*/sin δ (Dynamic Shear Rheometer)**
  - 46
  - 52
  - 58
  - 64
  - 70
  - 76
  - 82

### (Pressure Aging Vessel) PAV

<table>
<thead>
<tr>
<th></th>
<th>PG 46</th>
<th>PG 52</th>
<th>PG 58</th>
<th>PG 64</th>
<th>PG 70</th>
<th>PG 76</th>
<th>PG 82</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 hours, 2.10 MPa</td>
<td>90</td>
<td>90</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100(110)</td>
<td>100(110)</td>
</tr>
<tr>
<td>≤ 5000 kPa</td>
<td>10</td>
<td>7</td>
<td>4</td>
<td>25</td>
<td>22</td>
<td>19</td>
<td>16</td>
</tr>
<tr>
<td>S ≤ 300 MPa, m ≥ 0.300</td>
<td>BBR S (creep stiffness) &amp; m-value (Bending Beam Rheometer)</td>
<td>-24</td>
<td>-30</td>
<td>-36</td>
<td>0</td>
<td>-6</td>
<td>-12</td>
</tr>
</tbody>
</table>

If BBR m-value ≥ 0.300 and creep stiffness is between 300 and 500, the Direct Tension failure strain requirement can be used in lieu of the creep stiffness requirement.

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Future of Micro Surfacing | April 11 2018
In emulsion on the original DSR, FP & RV Values are relevant to what end up on the road
The Future of Micro Surfacing Materials & Mix Design – Softer Base

Field application ahead of fully proven mix design methodology.

• Emulsion Distillation residue yields different test values when made with PG 58-28 or softer. (Penetration & Softening Point)
  – Latex / Polymers react and differently

• Micro surfacing mix design tests produce different numbers. (Wet Track Abrasion Tests and Loaded Wheel Tests.)
The Future of Micro Surfacing Materials

- Modifiers
  - Pre-modified asphalt base
  - Latex modified emulsion
  - Fibers in mix
Polymer and Latex Modification of Micro Surfacing

Courtesy of BASF
UTILITY OF LATEX

- Improve adhesion of asphalt to aggregate

- Improve asphalt elasticity in the finished material for stability in the summer and flexibility in the winter
Types of Fiber

Glass

Polyester
Durability

Fiber Dispersion

% of Binder

Aggregate gradation

Polymer
Crack Resistance

- Fiber Dispersion
- Soft Binder
- % of Binder
- Aggregate gradation
- Polymer
Looking
Friction and Texture

Dynamic Friction Tester (DFT)  Circular Track Meter (CTM)
Micro Surfacing Mix Testing for Surface Texture and Dynamic Friction Tests

9.5 mm S4 Oklahoma DOT mix (hot plant produced)

Slab prep
Reheat mix
Compact slab

Slabs were used “as is” from the compactor
19” X 15” X 2”
Slab before treatment

- Typical slab after removal from compactor
Slurry & Micro Preparation
Texture

AMES Texture Meter was run before loading into the 3WP
Wear testing of Surface Treatments

Three Wheel Polisher in action on CRS–2LM
Note: Water spray on surface when in motion
AMES Texture

Micro surfacing texture
Before 3wp wear

Micro surfacing texture
After 8000 wear cycles
Friction

Dynamic Friction Test

Friction (mu), at 20kph

3 Wheel Polishing Cycles

Treatments:
- Chip Seal
- Fog Seal
- Latex Chip Seal
- Micro
- None
- Slurry
Texture

Circular Track Meter

Average of MPD, mm

MPD, mm

3 Wheel Polishing Cycles

3WP, Cycles

0.25
0.75
1.25
1.75
2.25
2.75
3.25

Chip Seal
Fog Seal
Latex Chip Seal
Micro
None
Slurry
Observations

Sample Preparation

• Samples did not represent aged or distressed asphalt surfaces

• Fog, Slurry & Micro samples produced reasonably close to field

• Chip (CRS–2, CRS–2LM) samples did not replicate field
  – Required additional rolling
  – Traffic effects not replicated for embedment

3 Wheel Polisher

• 3WP intended to evaluate resistance to aggregate polishing

• 3WP use on Fog, Slurry & Micro reasonably replicated field distress

• 3WP use on chip seals needs additional work to replicate field distress
  – Experienced excess chip loss
  – Chip contributed to rapid surface degradation
Flexural Tension Test

- 0.2% AR Glass Fiber
- LWT 1000 Cycles
- ½” Thick Mold
- Temp. 5c
Flexural Tension Test
Measuring Surface Texture With Ames Engineering Surface Texture Scanner

WTAT Sample

Scanned Area
Surface Texture Effect on Wet Track Abrasion Test Results
Surface Texture Appearance After WTAT Wear
Before and After Low Surface Area & WTAT Loss
Before WTAT soak low surface area & WTAT loss
After WTAT wear low surface area WTAT loss
Before and After High Surface Texture  High WTAT Loss
High Surface Texture WTAT Scan before soak and wear
High Surface Texture WTAT Scan After Soak and Wear

Aggregate Torn Out
WTAT Loss Vs EM, %

Each error bar is constructed using 1 standard deviation from the mean.
### Effect Summary (WTAT Only)

<table>
<thead>
<tr>
<th>Source</th>
<th>LogWorth</th>
<th>PValue</th>
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</thead>
<tbody>
<tr>
<td>Chem load, %*EM, %</td>
<td>10.610</td>
<td>0.00000</td>
</tr>
<tr>
<td>Gradation*H2O pre-add, %</td>
<td>7.570</td>
<td>0.00000</td>
</tr>
<tr>
<td>Chem load, %(1.2,1.8)</td>
<td>7.501</td>
<td>0.00000</td>
</tr>
<tr>
<td>Strike off S to S</td>
<td>6.998</td>
<td>0.00000</td>
</tr>
<tr>
<td>EM, %(12,14)</td>
<td>6.070</td>
<td>0.00000</td>
</tr>
<tr>
<td>Template Thicness*EM, %</td>
<td>4.562</td>
<td>0.00003</td>
</tr>
<tr>
<td>Strike off</td>
<td>2.724</td>
<td>0.00189</td>
</tr>
<tr>
<td>Strike off*Chem load, %</td>
<td>2.289</td>
<td>0.00514</td>
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<tr>
<td>Template Thicness</td>
<td>1.778</td>
<td>0.01667</td>
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<tr>
<td>Gradation</td>
<td>1.720</td>
<td>0.01904</td>
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<tr>
<td>H2O pre-add, %%(8,12)</td>
<td>1.176</td>
<td>0.06670</td>
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</tbody>
</table>
The Future of Micro Surfacing

• Challenge assumptions
• Borrow from the overall asphalt industry.
Future of Micro Surfacing –

Update Industry Source Material & Documentation

Evaluate / Revise Test Methods and Specifications