Slurry Seal and Micro-Surfacing Materials

by Scott Metcalf

Ergon Asphalt & Emulsions, Inc.
Slurry Seal and Micro-Surfacing Benefits

- Preserves investment
- Cost effective
- Thin surface application for maintenance of existing road surfaces
- Fills and seals small surface cracks
- Provides a new wearing surface
- Slows the age hardening in the original road surface
Benefits of Micro-Surfacing

- Quick Return to traffic, 1 hour or less
- Minimizes traffic disruptions
- Nighttime placement
- Can be placed in multiple stone thicknesses
WHY USE? LET’S LOOK AT LAKE SHORE DR. (INCLINE VILLAGE) LAKE TAHOE AFTER 6 YEARS

Nothing Done after 7 years
Slurry Seal

Surface without Slurry or Micro-Surfacing after 7 years

Micro-Surfacing
How do you get that performance?
You get it through:

- 1. Project Selection
- 2. Materials Selection
- 3. Mix Design
- 4. Materials Inspection
- 5. Construction Inspection

*****You don’t get what you spec, you get what you inspect.*****
Design Considerations

• Slurry and Micro-Surfacing Systems are 5 component systems:
  • Aggregate
  • Emulsified Asphalt
  • Water
  • Cement or other mineral fillers (optional)
  • Chemical Additives (as required)
SLURRY SEAL AND MICRO-SURFACING COMPONENTS

- Water
- Mineral Filler
- Aggregate
- Additive
- Slurry Seal and/or Micro-Surfacing Emulsion
Materials

- Asphalt Emulsion
  - Asphalt emulsion for slurry can be neat, or polymer modified
  - Micro-Surfacing uses a polymer modified asphalt emulsion

- Purpose
  - Binder
  - Water proofing
  - Color
# Emulsion
## PMCQS and MSE

<table>
<thead>
<tr>
<th>Test</th>
<th>Specification</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity</td>
<td>15-90 SFs</td>
<td>Handling Flow</td>
</tr>
<tr>
<td>Sieve</td>
<td>0.3% maximum</td>
<td>Stability Handling</td>
</tr>
<tr>
<td>Stability (1 day)</td>
<td>1 % maximum</td>
<td>Stability</td>
</tr>
<tr>
<td>Storage Stability (5 day)</td>
<td>5% maximum</td>
<td>Shelf life</td>
</tr>
<tr>
<td>Residue</td>
<td>62% minimum</td>
<td>Asphalt content + other</td>
</tr>
<tr>
<td>Penetration</td>
<td>40 -90 dmm</td>
<td>Hardness</td>
</tr>
<tr>
<td>Softening Point</td>
<td>135 degF minimum</td>
<td>Presence of polymer</td>
</tr>
</tbody>
</table>
VTS_02_0.IFO
Slurry / Micro-Surfacing Agg
Materials

- **Aggregate**
  - There are three gradations of aggregate used for slurry and two for micro-surfacing
- **Purpose**
  - Structure
  - Wearing Surface
## Aggregate

<table>
<thead>
<tr>
<th>TEST</th>
<th>SPECIFICATION</th>
<th>MEASURES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>slurry</td>
<td>micro</td>
</tr>
<tr>
<td>Sand Equivalent</td>
<td>45 (55) minimum</td>
<td>65 minimum</td>
</tr>
<tr>
<td>Durability Index</td>
<td>55 minimum</td>
<td>55 minimum</td>
</tr>
<tr>
<td>Abrasion (LA Rattler) on Parent Rock</td>
<td>35% maximum</td>
<td>30% maximum</td>
</tr>
<tr>
<td>Crushed Particles</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Gradation</td>
<td>Type I</td>
<td>Type II</td>
</tr>
<tr>
<td></td>
<td>Type II</td>
<td>Type II</td>
</tr>
<tr>
<td></td>
<td>Type III</td>
<td>Type III</td>
</tr>
</tbody>
</table>

- **Clay content**
- **Dust/ Clay like content**
- **Resistance to abrasion to clay like particles**
- **Resistance to traffic**
- **Angularity for interlocking**

1- Fill surface voids
   - Moderate distress
   - Protection from elements
2- Fill surface voids, seal
   - Moderate distress
   - Durable wearing course
3- Max skid resistance
   - Improved wearing course
   - High traffic
   - Rut fill
Residential Streets

Parking Lots

Airports Runways

BASIC GRADATIONS OF SLURRY SEAL

TYPE I

(Fine)

8 - 12 lbs./yd²
(4.3 - 6.5 kg/m²)

AGGREGATE

1/8” Top Size
(3 - 4 mm)

10 - 16 %
Residual Asphalt
Residential Streets

County Roads

Hwy Shoulders

Basic Gradations of Slurry Seal and Microsurfacing

TYPE II
(General)

10 - 20 lbs./yd²
(5.4 - 10.8 kg/m²)

AGGREGATE

1/4” Top Size
(5 - 6 mm)

and

5.5 - 13.5 %
Residual Asphalt
4 Lane Highways

Interstates

Basic Gradations of Slurry Seal and Microsurfacing

TYPE III
(Coarse)

13 - 30 lbs./yd²
(8.1 - 16.3 kg/m²)

AGGREGATE

3/8” Top Size
(9 - 10 mm)

and

5.5 - 12 %
Residual Asphalt

2 Lane Highways
Divided Highways

Basic Gradations of Slurry Seal and Microsurfacing

TYPE III
(Coarse)
13 - 30 lbs./yd²
(8.1 - 16.3 kg/m²)

AGGREGATE
3/8” Top Size
(9 - 10 mm)

5.5 - 12 %
Residual Asphalt

Residential

Arterials
Water

Purpose

Mixing

Lubrication

Handling

Hydraulic power, or water power is power that is derived from the force or energy of moving water, which may be harnessed for useful purposes. (wikipedia)
Materials

- Mineral Filler
- Purpose
- Strength
- Durability
- Control Break, Set & Cure Process
Materials

• Chemical Additive
  • Purpose
    • Control Break by Slowing Set & Cure Process
      ▫ Adhesion (can have anti-strip properties)
Mix Design
Mix-Design Steps

• Selection and testing of component materials
• Mixture testing
• Long-term performance related testing
## Mix Design

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<tr>
<th>TEST</th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>slurry</td>
<td>micro</td>
</tr>
<tr>
<td>Mix Time</td>
<td>180 sec +</td>
<td>120 sec +</td>
</tr>
<tr>
<td></td>
<td>Compatibility</td>
<td>Proportions</td>
</tr>
<tr>
<td></td>
<td>Visual inspection</td>
<td></td>
</tr>
<tr>
<td>Cohesion</td>
<td>30 min, 12kg-cm</td>
<td>30 min, 12kg-cm</td>
</tr>
<tr>
<td></td>
<td>60 min, 20 kg-cm</td>
<td>60 min, 20 kg-cm</td>
</tr>
<tr>
<td></td>
<td>Traffic time</td>
<td>Cohesion build-up</td>
</tr>
<tr>
<td></td>
<td>Dislodged stones</td>
<td></td>
</tr>
<tr>
<td>Wet Stripping</td>
<td>90% minimum</td>
<td>90% minimum</td>
</tr>
<tr>
<td></td>
<td>Adhesion of asphalt to stone</td>
<td></td>
</tr>
</tbody>
</table>
# Mix Design

<table>
<thead>
<tr>
<th>TEST</th>
<th>SPECIFICATION</th>
<th>MEASURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet Track Abrasion Loss</td>
<td>slurry 1 hr, 75 g/ft²</td>
<td>Raveling Wearing Qualities</td>
</tr>
<tr>
<td></td>
<td>micro 1 hr, 50 g/ft² 6 day, 75 g/ft²</td>
<td></td>
</tr>
<tr>
<td>Lateral Displacement-Loaded Wheel Test</td>
<td>N/A</td>
<td>Rutting Deformation Upper Binder Limit</td>
</tr>
<tr>
<td>Excess Asphalt-Loaded Wheel Test “Max Emulsion content”</td>
<td>50 g/ft²</td>
<td>Bleeding Heavy Traffic Ability</td>
</tr>
<tr>
<td>Classification compatibility (SB&amp;R)</td>
<td>N/A</td>
<td>Abrasion Adhesion Integrity</td>
</tr>
<tr>
<td></td>
<td>11 points min, (AAA,BAA)</td>
<td></td>
</tr>
</tbody>
</table>
What the mix design boils down to:

- Compatibility of Emulsion and Rock to meet all of the previous tests.
- Quality Emulsified Asphalt.
- Good Clean Crushed Aggregate.
- Compatible Chemistry for handling, mixing and curing.
Asphalt Emulsion

Diagram showing the components of asphalt emulsion: emulsifier, water, acid, polymer, asphalt. The process involves mixing these components in a mill to create modified emulsion.
Cohesion Tester
Loaded Wheel Tester
Wet Track Abrasion Tester
Field Simulation Tests

- Wet Track Abrasion Test
- Monolayer Loaded Wheel Test
- Multilayer Loaded Wheel Test

**Schulze - Breuer - Ruck Compatibility Test**

- Micro Surfacing only - very hard to meet
- Compatibility ISSA TB 144
- Determines compatibility between:
  - Aggregate
  - Filler
  - Asphalt Residue
- Absorption
- Abrasion loss
- Adhesion
- High temperature integrity
Concluding Remarks

- Slurry and Micro-Surfacing systems are designed in the lab at 77°F and normal lab humidity.
- They are an indication that the system can work.
- They are an indication that appropriate materials are available.
- The tests are an indication of mix performance on the road.
- Good contractors can make the system work and provide superior results.
- There is a large amount of generic, non-proprietary information for these systems from around the world.
QUESTION?

SO IF MICRO-SURFACING AND SLURRY SEALS CAN WORK ON THE SAME ROADS, WHAT IS THE DIFFERENCE?
“... a mixture of an approved emulsified asphalt, mineral aggregate, water, and specified additives, proportioned, mixed and uniformly spread over a properly prepared surface...”

- ISSA Technical Bulletin A105
Micro-surfacing - definition

“… a mixture of polymer modified asphalt emulsion, mineral aggregate, mineral filler, water, and other additives, properly proportioned, mixed and spread on a paved surface… in variable thick cross-sections… which resists compaction”

- ISSA Technical Bulletin A143
The difference in definition between Micro and Slurry

“… a mixture of polymer modified asphalt emulsion, mineral aggregate, mineral filler, water, and other additives, properly proportioned, mixed and spread on a paved surface… in variable thick cross-sections… which resists compaction”

- ISSA Technical Bulletin A143
Slurry Seal is an Evaporating breaking system, which means that the water must evaporate out. This makes the system highly dependent on sunlight, humidity and ambient and surface temperatures. Should not be placed at night.

Micro- Surfacing is a chemical breaking system, which means that it is not as dependent on sunlight, humidity and ambient and surface temperatures. Micro can be placed at night, and or in cool damp coastal areas.
Slurry Application

Slurry surfacing
- Laid at one-stone thickness
- Largest stone bears traffic load
- Not designed for multiple layering in a single pass
Micro Application

Micro-surfacing
- Applied in multi-stone thickness
- Stone interlock and modified binder bears traffic load
- May be applied in multiple layers

Existing road surface
AREAS WHERE MICRO-SURFACING SHOULD BE USED INSTEAD OF SLURRY SEALS
Micro-Surfacing can be used on Rutted Pavements
Rut-filling

◆ Before and After
Re-profiling Rutted Wheel paths

For each inch of applied Micro-Surfacing mix, add 1/8” to 1/4” crown to each rut fill to compensate for return traffic compaction.

Ruts 1/2” & over must use the rut box.
Rut Filling Lay Down Box
Micro-Surfacing Machine Schematic

- Crushed aggregate
- Cement additive water
- Polymer Modified Emulsion

Direction

Mixing time 15 to 45 seconds

Mixture Brown & Homogeneous
Breaking Time 60 to 120 seconds
Traffic in Approximately One Hour

Mixture Black

Water Flows
<table>
<thead>
<tr>
<th>Difference In:</th>
<th>Slurry</th>
<th>Micro</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emulsion</td>
<td>Polymer optional</td>
<td>Always polymer modified</td>
</tr>
<tr>
<td></td>
<td>Slow set, quick set</td>
<td>Always cationic quick set</td>
</tr>
<tr>
<td></td>
<td>Anionic, cationic</td>
<td></td>
</tr>
<tr>
<td>Additives/ Break</td>
<td>More dependent on weather</td>
<td>Chemical break</td>
</tr>
<tr>
<td>Mix Stiffness/ Equipment</td>
<td>More workable mix</td>
<td>Stiffer mix</td>
</tr>
<tr>
<td></td>
<td>Drag box</td>
<td>Double auger box</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Secondary strike-off</td>
</tr>
<tr>
<td>Aggregate</td>
<td>Type I, II, III</td>
<td>Type II and III only</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Higher S.E. (cleaner)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>More durable</td>
</tr>
<tr>
<td>Application</td>
<td>Fill voids, seal ageing</td>
<td>Same plus+ high traffic, rut</td>
</tr>
<tr>
<td></td>
<td>pavement, durable wearing</td>
<td>filling, night work, correct</td>
</tr>
<tr>
<td></td>
<td>course</td>
<td>minor profile irregularities</td>
</tr>
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</table>
SOME NEW ADDITIVES THAT ARE GROWING IN USE: GROUND TIRE RUBBER, FIBER GLASS FIBERS AND THE USE OF RAP

Adding Rubber to Slurries

- Recycled tire rubber adds color
- Recycled tire rubber replaces aggregate
- Recycled tire rubber removes tires from California landfills
Tire Rubber Modified Slurry Seal

- **RPMS** Ground tire rubber added in as an additive on the truck to slurry seal as dry additive Type I, II, and III
- **TRMSS** Ground Rubber tire that is super heated into the Asphalt base stock. The rubber is added in at the refinery Type I, II and III
- **REAS** Central Plant mixed and delivered to Job site type I, II or III rubber is added in at the production plant as an additive.
Slurry Seal and Micro-Surfacing with Fiber Glass added into the Mix

- AKA Fiber Micro or Fiber Slurry; reported to help with cracking
What’s In the Future?
Hi-Mod Slurry/Micro
Type II Slurry 2.5% latex. At the end of a Cul-de-sac after one week in La Quinta CA

10.31.2014
Hi-Mod and the end of a Cul-de-sac after one week in La Quinta CA
Comparison; one is tearing the other is scuffing.

2.5% LATEX TYPE II SLURRY

HI-MOD SLURRY TYPE II
## Specifications

<table>
<thead>
<tr>
<th></th>
<th>Slurry</th>
<th>Micro surfacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISSA</td>
<td>A 105</td>
<td>A 143</td>
</tr>
<tr>
<td>Caltrans</td>
<td>Section 37</td>
<td>Section 37</td>
</tr>
<tr>
<td>Green Book</td>
<td>Section 203</td>
<td>Section 203</td>
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<tr>
<td>FAA</td>
<td>P-626</td>
<td>P-635</td>
</tr>
</tbody>
</table>
Slurry and Micro Mix Design

- International Slurry Surfacing Association (ISSA)
  - Over 60 contractor members worldwide
  - Over 150 members.
  - www.slurry.org

- Slurry Guidelines

- Micro-Surfacing
Thank you questions?

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