WE NEED FUNDS TO PRESERVE THIS ROAD, NOW...

OTHERWISE IT WILL SOON BE A PROBLEM

LET'S WAIT TIL NEXT YEAR

NEXT YEAR IT WILL COST MORE

The Elected Official
Protecting Our Investment Cost Effectively

Pavement preservation NOW

Saves reconstruction costs LATER

www.preserveroads.org
Highway Capital Improvements

Expenditures
Needed = $186 billion annually
Current = $70.3 billion annually
Short Fall = $115.7 billion annually

Economy
Highway Pavement & Bridge Preservation

Expenditures Needed = $200 billion annually
Lack of Funding

- Last Federal Gas tax – 1993
- Of the 18.4 cents about 2.6 goes to Mass Transit
- CPI up 3.36% since 1993
- Meaning $1 today buys less than $0.30 worth of 1993 products
Driving 20,000 miles per year at 20 miles per gallon will equal 1,000 gallons of fuel per year

1,000 X $.184 / gal = $184.00 per year (50 ¢ per day)

Roads are one of the lowest cost things in our Society!!
Cost of a Gallon...

1 Gallon
$3.89*
($3.89 / gal)

6ct, 16.9oz
$3.99*
($5.04 / gal)

6ct, 16.9oz
$2.69*
($3.40 / gal)

59oz
$2.99*
($6.49 / gal)

1 Gallon
$2.98*
($2.98 / gal)

* Average Costs November 2014
## Where We Spend Our Money

<table>
<thead>
<tr>
<th>Consumer Purchase</th>
<th>Average Monthly Bill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable Television</td>
<td>$ 123</td>
</tr>
<tr>
<td>Cell Phone</td>
<td>$  71</td>
</tr>
<tr>
<td>Internet</td>
<td>$  50</td>
</tr>
<tr>
<td><strong>Road Taxes</strong></td>
<td>less than $ 35</td>
</tr>
</tbody>
</table>

Road Taxes: (Federal $15.30 + North Dakota $ 19.17)
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Treatment Life (yr.)</th>
<th>Life Extension (yr.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rejuvenator*</td>
<td>NA</td>
<td>3 - 6</td>
</tr>
<tr>
<td>Surface Sealer</td>
<td>0 - 1</td>
<td>2 - 4</td>
</tr>
<tr>
<td>Crack Sealing</td>
<td>3 - 8</td>
<td>2 - 4</td>
</tr>
<tr>
<td>Crack Filling</td>
<td>2 - 4</td>
<td>1 - 3</td>
</tr>
<tr>
<td>Slurry Seal</td>
<td>4 - 5</td>
<td>3 - 5</td>
</tr>
<tr>
<td>Micro Surfacing - Single</td>
<td>3 - 6</td>
<td>3 - 5</td>
</tr>
<tr>
<td>Micro Surfacing - Double</td>
<td>4 - 7</td>
<td>4 - 6</td>
</tr>
<tr>
<td>Chip Seal - Single</td>
<td>3 - 7</td>
<td>5 - 6</td>
</tr>
<tr>
<td>Chip Seal - Double</td>
<td>5 - 10</td>
<td>8 - 10</td>
</tr>
<tr>
<td>Ultra-thin Bonded Wearing</td>
<td>7 - 12</td>
<td>NA</td>
</tr>
<tr>
<td>Dense Graded Thin HMA</td>
<td>5 - 12</td>
<td>NA</td>
</tr>
<tr>
<td>Open Graded Thin HMA</td>
<td>6 - 12</td>
<td>NA</td>
</tr>
<tr>
<td>Hot In-place Recycling</td>
<td>6 - 10</td>
<td>NA</td>
</tr>
<tr>
<td>Cold In-place Recycling</td>
<td>6 - 10</td>
<td>NA</td>
</tr>
</tbody>
</table>

* Only certain rejuvenators were considered
<table>
<thead>
<tr>
<th>Treatment</th>
<th>Good Condition (PCI=80)</th>
<th>Fair Condition (PCI=60)</th>
<th>Poor Condition (PCI=40)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crack Fill</td>
<td>1 - 3</td>
<td>0 - 2</td>
<td>0</td>
</tr>
<tr>
<td>Crack Seal</td>
<td>2 - 4</td>
<td>1 - 3</td>
<td>0</td>
</tr>
<tr>
<td>Fog Seal</td>
<td>2 - 4</td>
<td>0 - 1</td>
<td>0</td>
</tr>
<tr>
<td>Chip Seal</td>
<td>5 - 6</td>
<td>3 - 5</td>
<td>0 - 3</td>
</tr>
<tr>
<td>Micro-Surfacing</td>
<td>4 - 6</td>
<td>3 - 5</td>
<td>1 - 4</td>
</tr>
<tr>
<td>Thin HMA</td>
<td>4 - 10</td>
<td>3 - 7</td>
<td>2 - 4</td>
</tr>
</tbody>
</table>
Life Extension of Rejuvenators & Asphalt Sealers

![Graph showing pavement condition vs age]

- **Pavement Condition**
- **Age (years)**
- **Control Section**
- **Terminal Threshold**
- **LE**
Life Extension

PMS Data Point

Very Good

Good

Fair

Poor

Very Poor

Time (Years)

Measured Life Extension

PMS Data Point
Pavement Selection
Pavement Selection
• Other potential criteria
  – Availability of qualified contractors
  – Availability of materials
  – Time (of year) of construction
  – Pavement noise
  – Facility downtime
  – Surface friction
The causes for aging and deterioration of asphalt binders

Petroleum Asphalt is comprised of two fractional components: Asphaltenes & Maltenes.
Components of asphalt.

- First acidaffins
- Second acidaffins
- Saturated hydrocarbons
- Polar compounds
- Asphaltenes
Maltene Fractions of Asphalt

Saturated hydrocarbons

First Acidifins

Second Acidifins

Polar Compounds
Aging and breakdown of asphalt binders and loss of maltenes begins at the hot-mix plant due to the extreme heating necessary to blend asphalt with aggregate and to get it to the job site in a pliable state.
Asphalt binder deterioration continues once the mixture is placed on a roadway due to:

- Constant exposure to the Sun’s UV rays
- Environmental temperatures
- Oxidation
- Stripping action of storm water and melting snow
- Traffic wear
• Ultraviolet light exposure and the sun’s heating effect cause the maltene fractions to be oxidized from the asphalt binder.
Pavement Aged 3-5 Years
Pavement Aged 13-17 Years
• Pure maltene based rejuvenators are translucent and leave pavement markings visible with no need for restriping.
The long term effectiveness of a maltene based rejuvenator.
Rejuvenator Selection

Conditions Addressed
- Oxidation
- Maltine Replenishment
- Moisture Infiltration

Limitations
- Initial Low Skid

Costs (yd²)
$0.80 – 0.95

IRI <95
• Emulsion seals the pavement from moisture, prevent oxidation and provides a temporary blackening of the pavement surface.
Cautions

- If used on tight, impermeable pavements, the oil may remain on the surface, leaving a surface with poor skid resistance. This is corrected if sand or slag is applied over the treated surface at 1 to 2 lbs/SY.

- The lower skid numbers typically return to normal or acceptable levels within 3-4 days.
Asphalt Sealer Selection

Conditions Addressed
- Oxidation
- Asphalt Film Thickness
- Initial Raveling
- Moisture Infiltration

Limitations
- Initial Low Skid

Costs (yd\(^2\))
$0.25 – 0.45

IRI <95
Crack Sealing Selection
Reservoir Types

Configuration A
Standard Reservoir-and-Flush

Configuration B
Standard Recessed Band-Aid

Configuration C
Shallow Recessed Band-Aid
Router
Cutting Drums & Cutter Bits
Carbide Cutter - 4 ¾” Wide Hub
Random Crack Saw
**Conditions Addressed**
- Water Infiltration
- Incompressibles

*Primary Working Cracks*
- Transverse cracking
- Reflective cracking

**Limitations**
- Must have Clean & Dry Reservoir

**Costs (yd²)**
$0.55 – .90

**IRI <95**

**PCR**
- 0
- 50
- 100
- 95 - 80
Melter and Applicator

- Oil-jacketed
- Thermostatic heat controls
- Continuous agitation
- Over-heating safety controls
- Heated hose and wand
- Right size tank capacity for operation
Swivel Applicator
Overband Configuration
Treating Edge Joints
Edge Drops

Water Entry
Crack Filling Selection

Conditions Addressed

• Water Infiltration
• Incompressibles

*Non-Working Cracks*

*Secondary Cracks*

• Longitudinal cracking
• Minor block cracking

Limitations

• Potential Hot Weather Tracking

Costs (yd²)

$0.55 – .90

IRI <95
Slurry Seal Selection
Low Volume Roads & Streets

Slurry Seal
Slurry Seal Selection

**Conditions Addressed**
- Moisture Infiltration
- Longitudinal cracking
- Transverse cracking
- Raveling
- Friction Loss

**Limitations**
- Opening to Traffic
  Dependent on Set-Time

**PCI**
- 100
- 85 - 70
- 50
- 0

**Costs (yd^2)**
- $1.75 – 2.50

**IRI <95**
Micro Surface Selection
Corrects Rutting, Raveling, & Friction
Company Letterhead

Date: April 1, 20XX

RE: Type III CQS-1HP Microsurfacing Mix Design

Dear ____________________,

As requested, Testing Company Name prepared a job mix formula according to ISSA accepted testing procedures using Type III aggregate from Company Name, Quarry Name, and the following emulsion CQS-1HP from Company Name, Terminal Name.

The job mix formula based on the data from the laboratory tests is reported as follows. All values are based on dry aggregate weight.

<table>
<thead>
<tr>
<th>Material</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>CQS-1HP:</td>
<td>12.0 ± 1.0%</td>
</tr>
<tr>
<td>Water:</td>
<td>5.0 - 9.0%</td>
</tr>
<tr>
<td>Cement:</td>
<td>0.5 - 1.0%</td>
</tr>
<tr>
<td>Residual Content of Emulsion:</td>
<td>62.4%</td>
</tr>
<tr>
<td>Residual AC Content:</td>
<td>7.4 ± 0.6 %</td>
</tr>
</tbody>
</table>

Test results summarized in this report represent laboratory conditions only. The laboratory tests were performed on materials submitted to this laboratory using accepted procedures. As always, laboratory and field conditions vary significantly due to fluctuations such as temperature and moisture. Care should be taken to adjust material percentages to compensate for any changes.

Sincerely,

John Smith, Chief Chemist
# Micro Surfacing Mix Design

**Date:** April 1, 20XX  
**Agg. Source:** Company Name, Quarry Site  
**Agg. Type:** Type II  
**Emulsion:** CQS-1 HP  
**Emuls. Source:** Company Name, Terminal Name

## Properties for Microsurfacing Mix Design

Tests were run with 12% emulsion by dry weight of aggregate.

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Lab Results</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISSA TB 113 Mixing Time @ 77 °F, sec</td>
<td>180+</td>
<td>120</td>
<td></td>
</tr>
<tr>
<td>ISSA TB 144 Classification Compatibility</td>
<td>12</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>ISSA TB 139 Wet Cohesion, 30 min, kg-cm</td>
<td>12</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>ISSA TB 139 Wet Cohesion, 50 min, kg-cm</td>
<td>20</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>ISSA TB 114 Wet Stripping, %</td>
<td>&gt;95</td>
<td>90</td>
<td></td>
</tr>
</tbody>
</table>

## Asphalt Content Optimization Results

ISSA TB 100 Wet Track Analysis, ISSA TB 109 Sand Adhesion

<table>
<thead>
<tr>
<th>Emulsion Content</th>
<th>1-Hour Loss, g/ft²</th>
<th>1-Hour Spec, g/ft²</th>
<th>6-Day Loss, g/ft²</th>
<th>6-Day Spec, g/ft²</th>
<th>Sand</th>
<th>Sand Spec, g/ft²</th>
</tr>
</thead>
<tbody>
<tr>
<td>9%</td>
<td>41.8</td>
<td>50.0</td>
<td>251</td>
<td>75.0</td>
<td>50.0</td>
<td></td>
</tr>
<tr>
<td>11%</td>
<td>26.9</td>
<td>50.0</td>
<td>41.3</td>
<td>75.0</td>
<td>40.0</td>
<td>50.0</td>
</tr>
<tr>
<td>13%</td>
<td>14.7</td>
<td>50.0</td>
<td>29.1</td>
<td>75.0</td>
<td>40.0</td>
<td>50.0</td>
</tr>
<tr>
<td>15%</td>
<td>8.0</td>
<td>50.0</td>
<td>20.2</td>
<td>75.0</td>
<td>46.7</td>
<td>50.0</td>
</tr>
</tbody>
</table>

**ISSA TB 147 Loaded Wheel Test Lateral Displacement and Specific Gravity**

<table>
<thead>
<tr>
<th>Emulsion Content</th>
<th>Lateral Displace, %</th>
<th>Spec</th>
<th>Specific Gravity</th>
<th>Spec</th>
</tr>
</thead>
<tbody>
<tr>
<td>11%</td>
<td>2.3</td>
<td>5.0</td>
<td>1.85</td>
<td>2.10</td>
</tr>
<tr>
<td>13%</td>
<td>2.2</td>
<td>5.0</td>
<td>1.88</td>
<td>2.10</td>
</tr>
<tr>
<td>15%</td>
<td>2.1</td>
<td>5.0</td>
<td>1.83</td>
<td>2.10</td>
</tr>
</tbody>
</table>
Micro Surfacing Mix Design

Date: April 1, 20XX
Agg. Source: Company Name, Quarry Site
Agg. Type: Type III
Emulsion: CQS-1HP
Emuls. Source: Company Name, Terminal Name

Aggregate Analysis Results

<table>
<thead>
<tr>
<th>Sieve Size % Passing</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/8&quot;</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>#4</td>
<td>85</td>
<td>70</td>
</tr>
<tr>
<td>#8</td>
<td>51</td>
<td>45</td>
</tr>
<tr>
<td>#16</td>
<td>33</td>
<td>28</td>
</tr>
<tr>
<td>#30</td>
<td>25</td>
<td>19</td>
</tr>
<tr>
<td>#50</td>
<td>18</td>
<td>12</td>
</tr>
<tr>
<td>#100</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>#200</td>
<td>8.7</td>
<td>5.0</td>
</tr>
</tbody>
</table>

Bulking Effect Loose Unit Weight, lbs/ft³

<table>
<thead>
<tr>
<th>% Water</th>
<th>Wet</th>
<th>Dry</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>103.3</td>
<td>103.3</td>
</tr>
<tr>
<td>1</td>
<td>92.4</td>
<td>91.5</td>
</tr>
<tr>
<td>2</td>
<td>86.2</td>
<td>84.5</td>
</tr>
<tr>
<td>3</td>
<td>83.5</td>
<td>81.1</td>
</tr>
<tr>
<td>4</td>
<td>83.1</td>
<td>79.9</td>
</tr>
<tr>
<td>5</td>
<td>83.5</td>
<td>79.6</td>
</tr>
<tr>
<td>6</td>
<td>86.9</td>
<td>81.2</td>
</tr>
<tr>
<td>7</td>
<td>93.9</td>
<td>88.1</td>
</tr>
</tbody>
</table>

Sand Equivalent, AASHTO T 176

<table>
<thead>
<tr>
<th>Result</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>69</td>
<td>65</td>
<td></td>
</tr>
</tbody>
</table>

Gradation

Bulking Effect

LUW, lbs/ft³

Percent Water

Gradation

Bulking Effect

National Center for Pavement Preservation
Equipment Calibration to Match Mix Design
**Conditions Addressed**
- Moisture Infiltration
- Longitudinal cracking
- Transverse cracking
- Raveling
- Friction Loss
- Bleeding
- Rutting

**Limitations**
- Mixture subject to reflective cracking

**Costs (yd²)**
- $2.00 – 5.00

**IRI <95**

**PCI**
- 100
- 85 - 70
- 50
- 0
Chip Seal Selection
Single Chip Seal

Bituminous Binder

Existing Asphalt Pavement

Uniformly Graded Aggregate
Double Chip Seal

Smaller Aggregate Application

2nd Binder Application

Uniformly Graded Aggregate

Existing Asphalt Pavement

1st Binder Application
Conditions Addressed

• Moisture Infiltration
• Longitudinal cracking
• Transverse cracking
• Block cracking
• Friction Loss
• Bleeding

Limitations

• Longer set time

Costs (yd²)
$1.50 – 2.50

IRI <95
Framework for Success

It is the:

“right” treatment on the
“right” road at the
“right” time by the
“right” people
Questions?

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(517) 432-8220 • Fax: (517) 432-8223
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www.tsp2.org

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