Performance of Thin Bituminous Treatments for Low-Volume Roads

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Overview

• Introduction
• MN Historical Perspective
• Current Performance
  – Double Chip Seal
  – Otta Seal
  – Oil Gravel
• Summary
Light bituminous surface treatments … were aimed toward:

1. The reduction of maintenance costs
2. Conservation of gravel
3. Elimination of dust
4. Reduction of vehicle operating costs
5. Increased riding comfort

J. H. Swanberg
Assistant Engineer of Tests
Minnesota Department of Highways
1935
Minnesota Historical Road Oil Treatments

1925-1929

TH18 (169)
Elk River, MN

TH10 (12)
Waverly, MN

TH10 (12)
Waverly, MN

Frost Blowup
<table>
<thead>
<tr>
<th>Year</th>
<th>Type</th>
<th>Length (miles)</th>
<th>Length (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Past</strong></td>
<td>Blotter Treatment</td>
<td>784</td>
<td>1,260</td>
</tr>
<tr>
<td></td>
<td>Plant Mixed Asphalt</td>
<td>1,149</td>
<td>1,849</td>
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<tr>
<td></td>
<td>Untreated Gravel</td>
<td>4,600</td>
<td>7,401</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>6,946</td>
<td>11,176</td>
</tr>
<tr>
<td><strong>Current</strong></td>
<td>Hot Mix Asphalt</td>
<td>11,963</td>
<td>19,248</td>
</tr>
<tr>
<td></td>
<td>Portland Cement Concrete</td>
<td>2,259</td>
<td>3,683</td>
</tr>
<tr>
<td></td>
<td>Untreated Gravel</td>
<td>9</td>
<td>14</td>
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<tr>
<td></td>
<td>Total</td>
<td>14,321</td>
<td>23,042</td>
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</table>

**Gravel Surface in MN:** 69,300 miles (111,500 km)
Project Locations

- Chip Seal
- Oil Gravel
- Otta Seal
Double Chip Seal

Asphalt
Modified Asphalt – 5

1st Layer = 0.45 gal./yd² (2.0 L/m²)
2nd Layer = 0.40 gal./yd² (1.8 L/m²)

Aggregate
½ inch limestone (Single Size)

1st Layer = 45 lb/yd² (24 kg/m²)
2nd Layer = 35 lb/yd² (19 kg/m²)

Picture: 1998
Chip Seal Performance

Constructed: 1996

Maintenance Reseal 2000 & 2002

• Occasional Thermal Cracks
• No rutting

Picture: 2001

Picture: 2002
Otta Seal

Asphalt Emulsion
High Float Medium Set (HFMS-2s)

1st Layer = 0.5 gal./yd² (2.2 L/m²)
2nd Layer = 0.5 gal./yd² (2.2 L/m²)

Aggregate
MnDOT Class 5

1st Layer = 50 lb/yd² (27 kg/m²)
2nd Layer = 50 lb/yd² (27 kg/m²)
Otta Seal - St. Louis County

Applied aggregate with a paver over the emulsion

Result:
Non-uniform aggregate application led to potholes and loose aggregate on surface

Up to 2 inches (51 mm) of aggregate overspilled over emulsion

Constructed: 2000
Changes to Procedure

1. Use of a chip spreader for accurate aggregate application rate
2. No driving on the emulsion before aggregate is applied
Otta Seal - Cass County

Constructed: 2001

145 vehicles per day

• Good performance overall
• Bleeding issue in area with high agricultural traffic

• Chip seal applied in 2002
• No raveling or rutting
• 100 to 425 feet (30 to 130 m) between thermal cracks
Otta Seal
Cass County Township Road

- Sandy loose aggregate on surface
- No thermal cracks or rutting

60 vehicles per day
Constructed: 2001
No thermal cracks, dust, or loose aggregate

Constructed: 2001    Picture: Fall 2002
Cracks along shoulder

Frost Boil

\( \frac{3}{4} \text{ inch (19 mm)} \) rut in “outer wheel path”
Emulsion Oil Gravel

- Plant mixed ambient temperature mix
- Initially, cutback asphalt (MC-3000), now emulsion (HFE-300)
- Aggregate, 100% crushed, continuously graded
Oil Gravel - City of Ostego

6th International LVR conference demonstration project (1995)

Current Condition
- No rutting
- 3 major thermal cracks
- Oxidized surface

1996
- Distressed areas repaired.
- Inadequate base strength

Picture: 2003
Oil Gravel - St. Louis Co. Rd. 68

- Ruts
  - 1 to 1.5 inch (25 to 38 mm)
- Thermal cracks
  - 3 foot (0.9 m) spacing

Constructed: 1996
Pictures: Fall 2002
Oil Gravel - St. Louis Co.

Constructed: 1996

St. Louis Co. Rd. 636

- Thermal Cracks
  60 to 100 ft (18 to 30 m)
- Longitudinal cracks between wheel paths
- 1/8 in. (3 mm) rutting

Picture: 2002

St. Louis Co. Rd. 405

- Thermal cracks
  70 to 150 ft (21 to 46 m)
- No rutting

Picture: 2002
Oil Gravel - Blue Earth County

• Thermal Cracking
  70 to 200 ft
  (21 to 61 m)

• 1/8 in. (3 mm) rutting

• No performance difference between
  100% quartzite and 50/50 gravel blend

• Segregation problems at time of construction

• Seal coat applied one year later

# Surface Treatment Summary

<table>
<thead>
<tr>
<th>Surface Treatment</th>
<th>Surface Thickness Inches (mm)</th>
<th>Cost $/mile ($/km)</th>
<th>Quality of Aggregate</th>
<th>Design Complexity</th>
<th>Construction</th>
<th>Typical Traffic Volumes (ADT)</th>
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</thead>
<tbody>
<tr>
<td>Chip Seal</td>
<td>5/8 (16)</td>
<td>25,000 (15,535)</td>
<td>Medium to High</td>
<td>Moderate</td>
<td>Agency or Contractor</td>
<td>50-200</td>
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<tr>
<td>Otta Seal</td>
<td>1 3/8 (35)</td>
<td>34,000 (21,126)</td>
<td>Low to Medium</td>
<td>Low</td>
<td>Agency or Contractor</td>
<td>40-400</td>
</tr>
<tr>
<td>Oil Gravel</td>
<td>2 (50)</td>
<td>45,000 (27,961)</td>
<td>High</td>
<td>High</td>
<td>Contractor</td>
<td>150-500</td>
</tr>
</tbody>
</table>
Recommendations

- Surface treatments can be used as a surfacing technique
- Use a chip spreader for accurate application rates (Otta Seal)
- Need strong stable base!
- Project Selection is key to success
Thank You

Questions/Comments?