New Jersey Micro-Surface Pavement Noise Evaluation

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Outline

• Impetus for Research
• Background of Pavement Selection
• Introduction to Micro-Surface
• Flexible Micro-Surface Project Description
• Micro-Surface OBSI Noise Results
• Conclusions
IMPETUS FOR RESEARCH
Distressed Roads in New Jersey

Multi-Year Status of State Highway System

8410 System Lane Miles

Source: NJDOT Pavement Management System
Predicted IRI vs Funding Levels

% Above Trigger

(Millions)

- $225
- $275
- $290
- $300
- $375
- $600

Years

Source: NJDOT Pavement Management System
BACKGROUND OF PAVEMENT SELECTION
Pavement Prediction Model

- Prediction Model
  - Current Time
  - Default Distress Index Model
  - Trigger

- Distress Index Model
  - Measured
  - Site Specific Distress Model
  - Predicted

- Years
  - 2000
  - 2005
  - 2010
  - 2015
  - 2020
Deduct Value Curves

[Graphs showing various distress value curves for different pavement conditions and asset types.]
Where Does Noise Fit?

- State Pavement Management System (PMS) Evaluates
  - PCI
  - IRI (Ride Quality)
  - Texture
  - Skid (Friction)
  - Noise

{[Overall Condition Index (OCI)]}
Performance Prediction Model

- Performance Prediction Model
- Benefit or Effectiveness (Area under the curve)
- Predicted Performance
- Trigger Limit
- Margin Cost Effectiveness
  Incremental Benefit/Cost Ratio
- Age or Traffic Loads
  - Life
  - Extension
  - Increase
Selecting a Treatment Strategy (Prevention or Maintenance)

Graph showing the relationship between Pavement Condition Index and Time or Traffic Loads, with trigger limits indicating when different strategies (Strategy 1 and Strategy 2) should be applied.
Asphalt Pavement Design Uses

**Structural Overlay**
- HMA Asphalt Pavement
- Rutting Resistance
- Fatigue Resistance
- Crack Resistance
- Load-Associated Structural Design

**Functional Overlay**
- Preventive Maintenance
- Noise Reduction
- Splash and Spray Reduction
- Increased Skid Resistance
- No Present Guidelines
Pavement Selection Process

- Structural
- Functional

ILLISLAB

BISAR
Abbreviated List - Pavement Preservation Surfaces

- Micro-Surface
- Novachip
- Cape Seal
- AROGFC
- Sandwich Seal

- Chip Seal
- High Performance Thin Overlay (HPTO)
- Sand Seal
- Fog Seal
- Crack Seal
Pavement Preservation Use in NJ

NJ PREVENTIVE MAINTENANCE

NJ State Highway System
Lane Miles of Preventive Maintenance Pavement Work
(Total system mainline lane miles = 8410)

Lane Miles

<table>
<thead>
<tr>
<th>Fiscal Year</th>
<th>HPTO</th>
<th>SMA TH OV</th>
<th>UTFC</th>
<th>MICRO</th>
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<tbody>
<tr>
<td>2008</td>
<td>27</td>
<td></td>
<td></td>
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<td>2011</td>
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<td>19</td>
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<td>2013</td>
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Summary of Benefits of Pavement Preservation

- **Financial Incentive**
  - Less time for construction
  - Less manpower for construction
  - Less engineering/design costs and testing*
  - Less materials

- **Elevated Public Acceptance**
  - Less time lanes are closed to paving operations
  - More “new and improved” surfaces to drive on
  - Sense of entitlement for having freshly paved roads
  - Less complaints about potholes/roughness
INTRODUCTION TO MICRO-SURFACE
Micro-Surface

Components/Design:
- Polymer modified asphalt emulsion, mineral aggregate, mineral filler, water, properly proportioned mixed and spread on a pavement.
Micro-Surface Paving Process

Source: http://www.asphaltpavingsystems.com/
Micro-Surface Gradation

Nominal Sieve Size

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<th>Percent Passing</th>
<th>Sieve Size (mm)</th>
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<td>12.50</td>
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<tr>
<td>0.5</td>
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Micro-Surface

9.5mm DGA

Chip Seal

OGFC
FLEXIBLE MICRO-SURFACE PROJECT DESCRIPTION
Project Opportunity for Noise Testing in PA

Project Location
Original Road Surface- Good Candidate for PA Trial Project
Project Characteristics

• History
  - 1934 – Original (type unknown) wearing course
  - 1975 – New base course
  - 1978 – 2” (50.8mm) wearing course
  - 1999 – 4’ (1.2m) widening each side 1 inch (25mm) depth
  - 2000 – ¾” (19mm) leveling and 1” (25mm) asphalt overlay
  - 2013 – Micro-surface project

• 2013 Micro-surface project
  - 45 MPH (72.4 km/h) minor arterial
  - Design Speed – 50 mph (80.5 km/h)
  - ADT – 1347 (2013) AND 1660 (2033 projected)
  - Truck Traffic – 9% throughout
4 Test Sections Selected and Paved in 2013
Micro-surface Types Utilized

• PA Conventional
  ▪ Standard Type II Micro-surface

• Kraton® HiMA
  ▪ Type II with a polymer modified binder

• Road Science
  ▪ Type II with rubber modified binder

• MWV Fiberglass
  ▪ Type II with fiberglass strands
Close-Ups

Conventional

Road Science

MWV Fiberglass

Kraton® HiMa
OBSI Testing
MICRO-SURFACE OBSI NOISE RESULTS
## Results

<table>
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<tr>
<th>Material</th>
<th>dBA</th>
<th>St Dev</th>
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<tr>
<td>Kraton HiMa</td>
<td>100.89</td>
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<tr>
<td>MWV Fiberglass</td>
<td>100.03</td>
<td>0.14</td>
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<tr>
<td>Road Science</td>
<td>100.77</td>
<td>0.18</td>
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<tr>
<td>PA Conventional</td>
<td>99.95</td>
<td>0.21</td>
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<tr>
<td>NJ Rt. 206</td>
<td>101.52</td>
<td>1.10</td>
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<td>NJ Rt. 23</td>
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Conventional Type II Mixes NJ and PA

Frequency, Hz

OBSI Level, dBA

PA Conventional
NJ Rt. 133
NJ Rt. 206
NJ Rt. 23
Kraton®HiMA vs. PA Conventional

OBSI Level, dBA vs. Frequency, Hz

- Kraton HiMA
- Conventional
MWV Fiberglass vs. PA
Conventional

OBSI Level, dBA vs. Frequency, Hz

MWV Fiberglass
Conventional

Frequency, Hz
400 Hz 500 Hz 630 Hz 800 Hz 1000 Hz 1250 Hz 1600 Hz 2000 Hz 2500 Hz 3150 Hz 4000 Hz 5000 Hz

OBSI Level, dBA
60 70 80 90 100 110
Road Science vs. PA Conventional

![Graph showing the comparison between Road Science and Conventional in terms of OBSI Level (dBA) across different frequencies (Hz). The graph indicates a higher OBSI Level for Conventional at certain frequencies compared to Road Science.](image-url)
Summary

• Financial benefits to utilizing functional overlays are significant.

• Every micro-surface mix tested so far has been fairly similar.

• Each of the micro-surface mixes tested so far (both NJ and PA) have been loud compared to other conventional NJ functional pavements.

• The NJDOT is increasing the amount of Pavement Preservation Surfaces but the current standard mix is a loud alternative to some of the other functional overlays or even conventional mixes.
Conclusions

• The PA conventional Type II mix was quieter than the NJ mix from 400 Hz to 1250 Hz but louder in the high frequencies, which could be related to different construction techniques or different aggregate source properties.

• MWV Fiberglass and Road Science were louder in the low frequencies which is likely due to positive macro-texture created from the additives used in the mix which slightly changed the surface during construction.

• Kraton® HiMA was louder than the Conventional micro-surface, notably from 800-5000 Hz, which indicates that it was a smoother pavement surface.

• Not enough of a notable benefit noticed from the initial noise quality of the flexible micro-surfaces to suggest utilizing them in NJ. Longevity of the mixes has not been tested yet to determine if there were either noise or pavement quality benefits over the lifespan compared to standard NJ mixes.
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