Second Strategic Highway Research Program (SHRP2)
Round 7 Implementation Assistance Program Webinar

Pavement Solutions

Techniques to Fingerprint Construction Materials (R06B)
Advanced Methods to Identify Pavement Delamination (R06D)
Guidelines for the Preservation of High-Traffic-Volume Roadways (R26)

March 22, 2016
• SHRP2 update
• Implementation Assistance Program opportunities
• Product description & assistance opportunities:
  ▪ *Techniques to Fingerprint Construction Materials* (R06B)
  ▪ *Advanced Methods to Identify Pavement Delamination* (R06D)
  ▪ *Guidelines for the Preservation of High-Traffic-Volume Roadways* (R26)
• Round 7 Schedule
• Questions
SHRP2 at a Glance

- **SHRP2 Solutions** – 63 products
- **Solution Development** – processes, software, testing procedures, and specifications
- **Field Testing** – refined in the field
- **Implementation** – 350 transportation projects; adopt as standard practice
- **SHRP2 Education Connection** – connecting next-generation professionals with next-generation innovations

350 SHRP2 projects nationwide
Focus Areas

**Safety**: fostering safer driving through analysis of driver, roadway, and vehicle factors in crashes, near crashes, and ordinary driving

**Reliability**: reducing congestion and creating more predictable travel times through better operations

**Capacity**: planning and designing a highway system that offers minimum disruption and meets the environmental and economic needs of the community

**Renewal**: rapid maintenance and repair of the deteriorating infrastructure using already-available resources, innovations, and technologies
SHRP2 Implementation: Moving Us Forward

- **$122 million** in FUNDING ASSISTANCE
- **63** SHRP2 SOLUTIONS
- **350** PROJECTS IMPLEMENTED

- **52** Recipients in DOT
- **29** Recipients in MPO/LOCAL
- **10** Recipients in UNIVERSITY
- **7** Recipients in FEDERAL/TRIBAL

- **179** RENEWAL
- **95** CAPACITY
- **65** RELIABILITY
- **11** SAFETY
SHRP2 Implementation: Moving Us Forward

- **Participants Engaged**: 145,831
- **Outreach Activities**: 5,713
- **Hours of Technical Assistance**: 6,155

<table>
<thead>
<tr>
<th>Activity</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training</td>
<td>5,474</td>
</tr>
<tr>
<td>Workshops</td>
<td>152</td>
</tr>
<tr>
<td>Peer Exchanges</td>
<td>40</td>
</tr>
<tr>
<td>Demos</td>
<td>29</td>
</tr>
<tr>
<td>Showcases</td>
<td>18</td>
</tr>
</tbody>
</table>
Designed to help State DOTs, MPOs, local agencies, and other interested organizations deploy SHRP2 Solutions.

<table>
<thead>
<tr>
<th>Proof of Concept Pilot</th>
<th>Lead Adopter Incentive</th>
<th>User Incentive</th>
</tr>
</thead>
<tbody>
<tr>
<td>To evaluate product readiness.</td>
<td>To help offset costs associated with product implementation and risk mitigation.</td>
<td>To support implementation activities, such as conducting internal assessments, changing processes, and organizing peer exchanges.</td>
</tr>
</tbody>
</table>
Techniques to Fingerprint Construction Materials (R06B)

Maria Chrysochoou
School of Engineering, University of Connecticut
Techniques to Identifying Construction Materials (R06B)

Challenge

• Verification that construction materials meet project specifications can be challenging.
• More field methods to quickly analyze construction materials are beneficial to enhancing quality assurance.

Research Goal

Explore expanded use of portable spectroscopy technologies in their ability for in situ analysis of commonly used construction materials in the field to aid in quality assurance.
Techniques to Identifying Construction Materials (R06B)

Solution

- **X-Ray Florescence Analyzer (XRF)**
  - Suited for identifying the metal content of any material.
  - Specific application developed in R06B - testing traffic paints using their Ti content as QA/QC criterion.

- **Fourier Transform Infrared Spectroscopy (FTIR)**
  - Suited for fingerprinting pure chemical compounds; additives or contaminants in complex mixtures; and quantifying polymer additives.
  - Generic Guidance - For evaluating oxidation degree in RAP and admixtures in fresh PCC (accelerators, retarders, curing compounds).
## XRF and FTIR – Success Stories

<table>
<thead>
<tr>
<th>XRF</th>
<th>FTIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pb paint forensics</td>
<td>Identification of hazardous substances in plastics, food and pharmaceutical industries</td>
</tr>
<tr>
<td>Main QA/QC tool in cement industry</td>
<td>QA/QC of polymers</td>
</tr>
<tr>
<td>Analysis of additives and impurities in oil and lubricants, no matter if oils, greases or waxes need to be qualified (ASTM D6443, DIN 51361) and to detect engine debris in the form of wear metals (DIN 51399).</td>
<td>Numerous components on automobiles are ideal for FTIR analysis: epoxies, oil coatings on parts, fuel, rubber seals and o-rings, tires, paints, fabrics (flame retardants) and exhaust emissions</td>
</tr>
<tr>
<td></td>
<td>Analysis of Oxygenated Extenders in Gasoline</td>
</tr>
</tbody>
</table>
## Visual Output

### Exported Results in Excel format (Concentration mg/Kg)

<table>
<thead>
<tr>
<th>Sample</th>
<th>Ni</th>
<th>Ni +/-</th>
<th>Ni Pass</th>
<th>Ti</th>
<th>Ti +/-</th>
<th>Ti Pass</th>
<th>Cr</th>
<th>Cr +/-</th>
<th>Cr Pass</th>
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</thead>
<tbody>
<tr>
<td>XYZ -1</td>
<td>189</td>
<td>27</td>
<td>Pass</td>
<td>4784</td>
<td>248</td>
<td>Pass</td>
<td>18098</td>
<td>299</td>
<td>Pass</td>
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<tr>
<td>XYZ -2</td>
<td>&lt;LOD</td>
<td>70</td>
<td></td>
<td>6863</td>
<td>215</td>
<td>Pass</td>
<td>346</td>
<td>18</td>
<td>Pass</td>
</tr>
<tr>
<td>XYZ -3</td>
<td>&lt;LOD</td>
<td>56</td>
<td></td>
<td>5396</td>
<td>197</td>
<td>Pass</td>
<td>203</td>
<td>15</td>
<td>Pass</td>
</tr>
<tr>
<td>XYZ -4</td>
<td>85</td>
<td>19</td>
<td>Pass</td>
<td>4553</td>
<td>178</td>
<td>Pass</td>
<td>3730</td>
<td>65</td>
<td>Pass</td>
</tr>
<tr>
<td>XYZ -5</td>
<td>72</td>
<td>19</td>
<td>Pass</td>
<td>9538</td>
<td>231</td>
<td>Pass</td>
<td>225</td>
<td>14</td>
<td>Pass</td>
</tr>
<tr>
<td>XYZ -6</td>
<td>52</td>
<td>17</td>
<td>Pass</td>
<td>4697</td>
<td>146</td>
<td>Pass</td>
<td>271</td>
<td>13</td>
<td>Pass</td>
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<tr>
<td>XYZ -7</td>
<td>60</td>
<td>14</td>
<td>Pass</td>
<td>7792</td>
<td>170</td>
<td>Pass</td>
<td>164</td>
<td>10</td>
<td>Pass</td>
</tr>
<tr>
<td>XYZ -8</td>
<td>&lt;LOD</td>
<td>43</td>
<td></td>
<td>9122</td>
<td>199</td>
<td>Pass</td>
<td>280</td>
<td>13</td>
<td>Pass</td>
</tr>
<tr>
<td>XYZ -9</td>
<td>78</td>
<td>18</td>
<td>Pass</td>
<td>10195</td>
<td>225</td>
<td>Pass</td>
<td>204</td>
<td>12</td>
<td>Pass</td>
</tr>
<tr>
<td>XYZ -10</td>
<td>74</td>
<td>20</td>
<td>Pass</td>
<td>5689</td>
<td>180</td>
<td>Pass</td>
<td>156</td>
<td>13</td>
<td>Pass</td>
</tr>
</tbody>
</table>
Detection of Pb and As in glass beads (NJ developed draft AASHTO standard)

Detection of Pb and other contaminants in bridge paints, soils, aggregates or any other materials

Detection of lime in asphalt

Steel grade QA/QC

QC for epoxies and traffic paints (draft AASHTO developed by R06B, ASTM standard recently published D5381-93(2014))
XRF Advantages and Limitations

**Advantages**

- Pre-calibrated for a wide range of elements
- Automatic reading – no analysis experience required
- 1-3 min testing time
- Little or no sample preparation required
- No maintenance required – costs only associated with equipment acquisition ($35-40K)
- Several applications possible in addition to the paint testing -> more bang for your $

**Limitations**

- Can only be used by certified personnel
- Upper and lower limits -> different calibrations needed for trace metals vs. ores (only a cost consideration)
FTIR – How it Works
(more complicated than XRF)

1. Obtain a reference spectrum of a pure compound (identify characteristic peaks)
2. Compare material mixture with reference and determine whether the characteristic peaks of the compound show up (DETECTION)
3. Use height of observed peaks to infer concentration (QUANTIFICATION)

ATR spectrometer $25-35K
FTIR Applications for Construction Materials

- Identification of curing compounds and other admixtures in Portland cement concrete (draft AASHTO developed by R06B)
- Evaluation of oxidation in recycled asphalt pavement (draft AASHTO developed by R06B)
- Identification of recycled engine oil bottoms in asphalt
- Identification of crumb rubber
- Identification and quantification of polymers in asphalt
- Identification of diesel, oils, tar in soils and other media
FTIR Advantages and Limitations

Advantages

• Only available method for the particular applications proposed
• Little to no sample preparation
• Actual testing time is 3-5 min
• No maintenance costs
• Widely applicable for a wide range of organic materials (e.g. solvents)

Limitations

• Detection limits fairly high for admixtures
• Training and experience required to interpret spectra, especially for the RAP application
• Wide variability in RAP composition and behavior renders standard development time-consuming and labor-intensive
Benefits

• Promising field technologies for aiding in forensics the quality assurance of some materials.
• Rapid in-situ testing
• Minimizes the risk for noncompliance
• Only available method for RAP testing
R06B Implementation Assistance Opportunities

<table>
<thead>
<tr>
<th>Type of assistance</th>
<th>Number available</th>
<th>Amount of assistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proof of Concept</td>
<td>Up to 3*</td>
<td>Up to $250K**</td>
</tr>
</tbody>
</table>

* Up to 3 agencies participating, with 2 advancing XRF, 1 advancing FTIR, on materials advanced as part of the research or other material(s).

** Plus equipment

Who can apply: State DOTs
Proof of Concept

- Participate in a technology showcase/demo.
- Prepare a detailed work plan, in cooperation with FHWA, AASHTO and our SME.
- Complete all work plan activities within 2.5 years.
- Provide periodic updates on work plan execution.
- Document and sharing of findings.
- Willingness to provide input to the generic testing procedures and draft specs contained in R06B Solution.
- Participate in periodic coordination calls, as well as regional and national knowledge sharing events, webinars, and peer exchange.
Advanced Methods to Identify Asphalt Pavement Delamination (R06D)

Michael Heitzman
National Center for Asphalt Technology
Challenge

• Several pavement distresses can be attributed to delamination.
• Primarily caused by debonding and stripping.
• Identifying the extent and severity of delamination is difficult.
• Coring is a destructive method providing limited value as part of a pavement evaluation.
• Non-destructive testing (NDT) methods are needed for comprehensive, rapid evaluation and detection.

Research Goal

• Identify and develop NDT technology that can:
  • Detect & quantify delamination in Hot Mix Asphalt (HMA)
  • Operate at reasonable traveling speed
  • Cover full-lane width
<table>
<thead>
<tr>
<th>Top 2-inch lift</th>
<th>Full bond</th>
<th>Full bond</th>
<th>Full bond</th>
<th>Partial No bond</th>
<th>No bond</th>
<th>partial stripping</th>
<th>Full bond</th>
<th>Full bond</th>
<th>Full bond</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bottom 3-inch lift</td>
<td>no bond</td>
<td>Full bond</td>
<td>Full bond</td>
<td>Full bond</td>
<td>Full bond</td>
<td>Full bond</td>
<td>partial Stripping</td>
<td>partial No bond</td>
<td>No bond</td>
</tr>
<tr>
<td>Existing surface</td>
<td>PCC</td>
<td>PCC</td>
<td>HMA</td>
<td>HMA</td>
<td>HMA</td>
<td>HMA</td>
<td>HMA</td>
<td>HMA</td>
<td>HMA</td>
</tr>
</tbody>
</table>

R06D Test Sections at NCAT Test Track
Solutions

• Ground-penetrating radar (GPR) antenna array with frequency sweep

• Manufactured by 3D-Radar

• Impact echo (IE) and seismic analysis of surface waves (SASW) rolling wheel scanning system

• Built by Olson Engineering
GPR - Ground Penetrating Radar
GPR at NCAT Test Track
GPR Depth Slice

Water infiltration

Stripped areas
Project Length Analysis – Single Pass

Introsuction
R06B Product Overview
R06D Product Overview
R26 Product Overview
Closing/Q&A
IE/SASW –
Mechanical Surface Waves
IE/SASW at NCAT Test Track

IE report

SASW report
Real-Time IE Output During Test

- Delamination at 5 inches
- Sound 12-inch pavement
<table>
<thead>
<tr>
<th>LANE SECTION</th>
<th>DEPTH = &lt; 0.25 ft</th>
<th>DEPTH = 0.25 to 0.50 ft</th>
<th>DEPTH = 0.50 to 0.75 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>(MP) (direction)</td>
<td>VELOCITY &gt;4500 fps</td>
<td>VELOCITY &gt;4500 fps</td>
<td>VELOCITY &gt;4500 fps</td>
</tr>
<tr>
<td>35.1 EB</td>
<td>90</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>35.2 EB</td>
<td>92</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>35.3 EB</td>
<td>90</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>35.4 EB</td>
<td>92</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>35.5 EB</td>
<td>91</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>35.6 EB</td>
<td>90</td>
<td>7</td>
<td>3</td>
</tr>
</tbody>
</table>

VELOCITY 4000 to 4500 | VELOCITY < 4000 |
---|---|
4000 to 4500 | < 4000 |
---|---|
75 | 20 |
77 | 18 |
40 | 40 |
10 | 30 |
76 | 20 |
75 | 19 |
Benefits

• GPR with frequency sweep antenna array
  – Can identify variations in the pavement, isolate the depth of discontinuity, and provide a relative degree of severity.
  – Operates at reasonable speed and full-lane width in a single pass.
  – Multi-functional NDT (pavement, bridge decks, embankment, etc.).

• IE/SASW scanner
  – Can identify variations in the pavement; width depends on system configuration and the depth of discontinuity.
  – Multi-functional NDT tool (pavement and bridge deck delamination).
  – Excellent forensic tool for project level analysis.
The Future

Product demand will drive software development to make data analysis more efficient and effective.

- Real-time display detail
- Automated signal identification in distressed areas
R06D Implementation Assistance Opportunities

<table>
<thead>
<tr>
<th>Type of assistance</th>
<th>Number available</th>
<th>Amount of assistance</th>
</tr>
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<tr>
<td>Proof of Concept</td>
<td>Up to 4*</td>
<td>Up to $250,000 per opportunity</td>
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</table>

* Up to 4 agencies participating with 2 advancing GPR, 2 advancing IE/SASW, or combination of both for project level analysis of pavement delamination.

Who can apply: State DOTs
Proof of Concept

- Participate in a technology showcase/demo.

- Prepare detailed work plan in cooperation with FHWA, AASHTO, and SME.

- Availability of equipment (either on-hand or lease, procure in support of work plan activities).

- Complete all work plan activities within 2.5 years.

- Provide periodic updates on work plan execution.

- Document & sharing of findings.

- Willingness to participate in regional and national knowledge sharing events, webinars, and peer exchange.
Preservation of High-Traffic-Volume Highways (R26)

Thomas Van
Project Lead
Federal Highway Administration

David Peshkin
Subject Matter Expert
Applied Pavement Technology, Inc.
Challenge

• *Preserving Pavements on High-Traffic-Volume Roadways* can yield significant benefits but carries a high level of risk,

• Many effective pavement preservation techniques exist, but until now they have been used, especially in urban settings, primarily for low-volume roads.

Research Goal

• Identify and develop pavement preservation technologies that can be used to extend the life of high-traffic-volume roads and avoid disruptive and costly major rehabilitation and reconstruction projects.
R26 Project Implementation Goals

1. Assist states in understanding processes for preserving high-volume roadway pavements.

2. Develop and demonstrate tools to assist in selection, design and construction of preservation activities on high-volume roadway pavements.

3. Assist states in implementing technologies that use the *Guidelines for the Preservation of High-Traffic-Volume Roadways*.

4. Document the processes, identify issues, and evaluate the economic benefits of preserving high-volume roadways.
R26 Project Strategies

1. Build Capacity
   - Technical Assistance

2. Technology Sharing
   - Peer Exchanges
   - User Groups
   - Case Studies

3. Education and Outreach
   - Workshops
   - Training Course
   - Publications
Round 1 Activities

1. Demonstration Projects
   • 13 Construction projects
   • 1 Technology sharing event

2. Education and Outreach
   • Workshops
   • Training course
   • Publications
   • Peer exchanges
   • User groups
   • Case studies

Wisconsin DOT applies a pavement preservation treatment using the Guidelines for the Preservation of High-Traffic-Volume Roadways (R26). | Photo courtesy WisDOT
Who can apply: State DOTs, State Tollway and Thruway authorities, local agencies, tribal agencies.

Local agencies must work with their State DOTs to submit the application.
Sample Assistance Programs

• Selection of Projects
  – Workshops
  – Risk analysis
  – Demonstration and use of selection tools

• Project Development
  – Specifications assistance
  – Design considerations

• Construction
  – Specialized Training for Inspectors
  – Materials Testing

• Project Evaluation
  – Guide for tracking performance
  – Analysis of benefits
User Incentive Expectations

• Evaluate agency gaps/needs for preservation program
• Schedule R26 workshops, training, etc. working with FHWA and SME.
• Identify demonstration project where R26 technology will be used
• Participate in product evaluation activities, assessments, etc. of the R26D product conducted by our contracting support staff.
• Willingness to participate in regional and national knowledge sharing events, webinars, and peer exchange.
• Product-specific webinars
  – March 8 – March 22, 2016

• Round 7 application period
  – April 1– April 29, 2016

• Round 7 recipients announced
  – June 2016
For More Information

Product Leads:
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Jameelah Hayes
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Additional Resources:
GoSHRP2 Website: fhwa.dot.gov/GoSHRP2
AASHTO SHRP2 Website: http://shrp2.transportation.org
GoSHRP2 Alert Sign Up: fhwa.dot.gov/goshrp2/contact
Email: GoSHRP2@dot.gov

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• Round 7 assistance opportunities
• SHRP2 Milestones