NATIONAL ASPHALT TECHNOLOGY RESEARCH & INITIATIVES

Kent Hansen
Kalamazoo, MI – March 29, 2016
OVERVIEW

Unified Industry & Pavement Economics Effort Explained
  ◦ Government Partnership

Pavement Economics Case Studies
  ◦ Deliverables
  ◦ Marketing and Implementation

Pavement Performance
What Does NAPA’s Pavement Economics Effort Mean?

The pavement of the future...

Smart
System - Resilient
Sustainable
THE TEAMS

- Best Quality and Competitiveness
- Environmental Sustainability
- Legislative
- Pavement Type Selection
- Pavement Design
- Pavement Preservation
Highway Funding & National Legislation

State Legislation Tracking

Market Analysis and Annual Report
Accelerated Implementation & Deployment of Pavement Technologies Program (AID-PT)

$12 million per year — $6 million for asphalt; $6 million for concrete

With most of the US highway system comprised, today’s roads are maintaining, rehabilitating, reconstructing, improving, and enhancing the capacity of existing facilities, and the public demands increased investment in all modes.

The needs of the nation’s highways are critical. More than $50 billion are spent annually on the US highway system to maintain and improve the nation’s road infrastructure. Improving the condition of the nation’s roads and highways is essential to maintain and support a viable and competitive economy.

The AID-PT program is a $12 million per year program that provides funding for research and development in the areas of asphalt and concrete pavement technologies. The program is designed to accelerate the implementation and deployment of new and improved technologies for highway construction and maintenance.

The objectives of the AID-PT program are to:

1. Provide technical assistance to pavement professionals and researchers to develop and implement new and improved technologies.
2. Accelerate the implementation and deployment of new and improved technologies for highway construction and maintenance.

The AID-PT program is a joint effort between the National Asphalt Pavement Association (NAPA) and the American Concrete Pavement Association (ACPA). The program is designed to accelerate the implementation and deployment of new and improved technologies for highway construction and maintenance.

The AID-PT program is supported by a partnership of federal, state, and local government agencies, as well as private industry. The program is funded through a combination of federal and state matching funds.

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Provided training & advice to more than 11,400 pavement professionals.

Produced & distributed more than 100 technology transfer publications and articles.

Met and advised over 25 State DOTs on specific pavement issues

Knowledge exchange tour of Japan for asphalt industry and AASHTO representatives
Partnership for Innovation in Asphalt Pavements
Where to find the latest survey report:

www.asphaltpavement.org/recycling
The Impact of Asphalt Sustainability

99%+ of the material removed from old asphalt pavements is reused in new pavements.

$2.8B+ savings from recycled materials compared to the cost of raw materials.

Warm-Mix Asphalt technologies have the benefit of reducing energy consumption which decreases the production of greenhouse gases.

32%+ Nearly a third of all asphalt pavement mixtures are produced using warm-mix technologies.

About 4.16M scrap tires were used to make quiet, rubberized asphalt pavements.

About 1.9M tons of roofing shingles were put to use in new pavement mixes and other road-building uses.

Reuse of old pavements saves 13,500 Olympic-size pools worth of landfill space.

72M tons of old pavements were put to use in new pavement mixes and other road-building activities.
WMA Usage
Percentage of Total Asphalt Production in US

<table>
<thead>
<tr>
<th>Year</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usage</td>
<td>5%</td>
<td>11%</td>
<td>19%</td>
<td>24%</td>
<td>30%</td>
<td>32%</td>
</tr>
</tbody>
</table>
Resources on Recycled Materials

store.AsphaltPavement.org
Porous Asphalt Pavements with Stone Reservoirs

This Technical Brief provides an overview of the benefits, limitations and applications of porous asphalt pavements with stone reservoirs. Considerations for design and construction, as well as maintenance, are discussed.

Introduction

Porous asphalt pavements with stone reservoirs are a multifunctional low impact development (LID) technology, which integrates ecological and environmental goals for a site with land development goals, reducing the net environmental impact for a project. Not only do they provide a strong pavement surface for parking, walkways, trails, and roads; they are designed to manage and treat stormwater runoff. With proper design and installation, porous asphalt pavements can provide a cost-effective solution for stormwater management in an environmentally friendly way. As a result, they are recognized as a best practice by the U.S. Environmental Protection Agency (EPA) and many state agencies (EPA n.d., PDEP 2006, NJDEP 2004).

Figure 1: Typical porous asphalt pavement with stone reservoir cross section
## The Risks

- Pavement Reflectivity Mandates
- The Story on Pavement and Fuel Economy
- Lack of Information on Smooth Roads and Sustainability & Performance
- Quantifying Environmental Impact

## The Strategies

- Awareness of Multiple Variables
- Further Develop Sound Data and Science
- Partnerships for Sustainability
- Lead Industry in Life Cycle Analysis
Unintended Consequences
A Research Synthesis Examining the Use of Reflective Pavements to Mitigate the Urban Heat Island Effect

by Jiachuan Yang; Zhihua Wang, Ph.D.; and Kamil E. Kaloush, Ph.D., P.E.
Arizona State University National Center of Excellence for SMART Innovations

October 2013
Fuel Economy and Pavements

- **Surface texture**: the roughness of the aggregate materials in a pavement
- **Smoothness**: surface unevenness that affects perceived ride quality
- **Pavement stiffness**: how the pavement deflects under a vehicle’s weight
Almost 75 percent of the oil consumed in the United States is used as vehicle fuel. Despite increases in vehicle fuel economy over the past few decades, fuel costs remain a significant burden for the public and businesses alike. Numerous factors influence the fuel economy of a vehicle, including aerodynamic properties, engine, pressure, and air temperature; however, just three basic forces impact fuel economy: rolling resistance, air drag, and rolling resistance. While these forces always affect fuel economy, they vary in importance based on the vehicle speed. For example, changes in fuel economy due to rolling resistance are more significant at lower speeds, while air drag becomes more significant at higher speeds.

The rolling resistance force a vehicle must overcome to maintain speed is linked to the system, bearings, transmission, tire pressure, and part of the properties of the pavement. These properties are commonly understood to influence rolling resistance.

Research has been conducted over the past 40 years to determine how each of these factors affects rolling resistance. Pavement texture influences fuel economy through the load and the contact area of the pavement. The tire deflection energy contains the rest of the tire and the atmosphere. Pavement stiffness may influence the rolling resistance, tires and pavements interact the pavement component causing the tire deflection. Rolling resistance influences the fuel consumption through energy loss due to shock absorption when the vehicle moves down the roadway and these systems work to the ride more smoothly.

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- Utilizes LTPP Data
- Free
- Web Based

- Customizable
- Life-Cycle Emission Benchmarking
Background — IRI Explorer

The IRI Explorer was created to allow users to easily interface with the LTPP data

- Easy-to-read graphs
- Statistical rigor
- Look at the effects of pavement selection on IRI and vehicle emissions
I RI Explorer — Tabs and Tools

- Sections: Search for a single section and look at its IRI performance over time

- Networks: Examine the performance of broad categories of pavement types within a regionalized network

- Pavement Comparison: Compare two pavement types. Many filters available to make specific comparisons
IRI Explorer — Tabs and Tools

• Emissions Estimator: Find the GHG emissions associated with a roadway over its entire lifetime, including use, construction, and maintenance phases.

• Overview of Trends: A discussion of trends seen in the LTPP data.

• State Data: Houses additional data gathered by certain states. Access is limited to the funding agencies.
IRI Explorer — Goals and Caveats

- Goal: To let users craft their own queries to the LTPP database; to see how different pavements perform in their region, application, road type, and so on.

- Avoid making general assumptions from specific data sets.

- All of engineering is trade-offs.
Quantifying the Asphalt Industry’s Environmental Impact

<table>
<thead>
<tr>
<th>Environmental Facts</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional Unit</td>
<td>1 metric ton of Asphalt Cement</td>
</tr>
<tr>
<td>Primary Energy Demand (MJ)</td>
<td>4.0x10^3</td>
</tr>
<tr>
<td>Non-Renewable Energy (MJ)</td>
<td>3.9x10^3</td>
</tr>
<tr>
<td>Renewable Energy (MJ)</td>
<td>5.5x10^1</td>
</tr>
<tr>
<td>Global Warming Potential (kg CO₂eq)</td>
<td>79</td>
</tr>
<tr>
<td>Acidification Potential (kg SO₂eq)</td>
<td>0.23</td>
</tr>
<tr>
<td>Eutropication Potential (kg Neq)</td>
<td>0.012</td>
</tr>
<tr>
<td>Ozone Depletion Potential (kg CFC-11eq)</td>
<td>7.3x10^-9</td>
</tr>
<tr>
<td>Smog Potential (kg O₂eq)</td>
<td>4.4</td>
</tr>
</tbody>
</table>

Boundaries: Cradle-to-Gate  
Company: XYZ Asphalt  
RAP: 10%

www.AsphaltPavement.org/EPD
# Pavement Design

## The Challenges

- Economics and Overdesign
- Mechanistic-Empirical Pavement Design
- Need for user friendly, AASHTO-based pavement design tool
- Pavement Design Guidance

## The Solutions

- State-of-the-Practice for MEPDG Implementation & Challenges
- Pavement Design & Material Improvements
- Web-based Pavement Design Software
Advancements in Flexible Pavement Design
PaveXpress
A Simplified Pavement Design Tool

www.PaveXpressDesign.com
AASHTO has been developing MEPDG for high volume roads, but a gap has developed for local roads and lower volumes.
PAVEMENT DESIGN
Simplified

Web-Based Pavement Design Tool

Designing the right pavement for the job just got easier thanks to PaveXpress, a free web-based pavement design tool for roadway and parking lot pavements.

Projects created in PaveXpress can be printed, shared, and saved, and design options can easily be evaluated in a side-by-side comparison. As a browser-based tool, PaveXpress is always up to date and can be accessed from any computer or mobile device, regardless of screen size or operating system.

PaveXpressDesign.com
Guiding Principles

• Provide accurate un-biased results...**be a trusted resource**
• Only ask the user for what is required to perform a technically sound design
• Where appropriate suggest industry accepted defaults to minimize user input
• Provide context sensitive help and guidance
• Assume users aren’t pavement design experts
Application Users

- State Transportation & Highway Agencies
- Local Government Agencies
- A/E/C Firms
- FHWA
- Engineering Students
- Foreign Companies & Governments
Approach: Web Delivery

- Browser based delivery
- Available via the web
- Supports all kinds of devices/OS
  - Desktops
  - Laptops
  - Tablets (7” – 10” - includes iPad Mini on up.
  - Handheld device capabilities
- Easily scalable and updatable
Approach: Technical

• Provide technically sound designs using:
  – Flexible: AASHTO ’93
  – Rigid: AASHTO ‘93 w/ ‘98 Supplement
  – Parking lot guidance (Flexible only)

• Use industry accepted standards and guidance
• Linkages to State and Local guidance
• Linkages to Pavement Interactive
PaveXpress Knowledge Transfer

1,650 people reached
as of July 2015

**Governmental/Academic Users**

- Governmental: 57%
- Military: 1%
- Academic: 42%

**All Registered Users**

- Governmental: 45%
- Military: 17%
- Academic: 12%
- Generic Email: 26%
- Corporate/Other: 0%
Future of **PaveXpress**

- Simplified mechanistic design for asphalt pavements
- Pavement cost estimating module
- Porous pavement design tool
- Suggestions?
# Pavement Preservation

## The Challenges

<table>
<thead>
<tr>
<th>Focus from construction to preservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>The value of the US highway and road system is estimated at $1.75 trillion</td>
</tr>
<tr>
<td>Preservation of the existing system is the challenge for pavement managers</td>
</tr>
</tbody>
</table>

## The Strategy

<table>
<thead>
<tr>
<th>Develop and place high quality Thinlay mixes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improve cost competitiveness while maintaining quality &amp; performance</td>
</tr>
<tr>
<td>Market Thinlays as an effective preservation method</td>
</tr>
</tbody>
</table>
Thinlays for Preservation: From Drawbacks to **Innovative Solutions**

- May have higher initial cost than other preservation strategies.
  - *Provide longer life*
  - *Thinner lifts*
  - *Use low-cost screenings and recycled materials (RAP, RAS, rubber)*

- Construction & application in cooler temperatures
  - *Warm Mix Asphalt*

- Durability versus permanent deformation
  - *Higher asphalt contents*
  - *Engineered binders (e.g. polymer, rubber, etc.)*
Thinlays: The Pavement Preservation Tool of Choice

NAPA Position on Thin Asphalt Overlays for Pavement Preservation

Every day in 2011, more than 48 million tons of goods, worth some $46 billion, were transported across the nation’s highways. Percent of vehicle usage fell short of the standard of “good” or “satisfactory.” Acceptable standards are those where vehicles can operate comfortably and safely.

Poor pavement can cause problems for drivers, passengers, and the environment. Given the value of the nation’s highways and the cost of maintaining them, it is critical that our nation’s highways and roads be kept in proper condition.

Many agencies apply pavement preservation techniques to cost effectively maintain our nation’s roadways and reduce maintenance costs. In fact, the Federal Highway Administration (FHWA), 49.4 percent of road miles in the United States failed to meet the length of a “... direct impact on crash rates.”

For these reasons, thin asphalt overlays are an important tool in the preservation of our nation’s highways and roads.
Thin Overlays

Thin asphalt overlays, also known as Thinlays™, are a popular approach to pavement preservation because of their ability to provide improved ride quality, reduce pavement distresses, maintain surface geometric, reduce noise levels, reduce life-cycle costs, and provide long-lasting service. Recently, NAPA helped organize a thin asphalt overlay using warm-mix asphalt and recycled materials in Nashville, Tenn.

Thin is In - in Nashville, Tenn.

Tenth Street in downtown Nashville, an urban pavement with many utility cuts, was given 10 years more of life with this green (economically and environmentally) thin asphalt overlay preservation treatment. This is a NAPA instructional demonstration for those interested in asphalt paving processes and procedures. Mike Huner, Director of Technical Services for the Tennessee Road Builders Association, is the presenter. Special thanks go to the contractor, LoJac Enterprises Inc. of Lebanon, Tenn. The Tenth Street project was completed in August 2012.

NAPA has outlined the benefits of Thinlay thin asphalt overlay mixes in a 2014 position paper. Thinlays: The Pavement Preservation Tool of Choice. When used for pavement preservation, Thinlays can help agencies better manage both pavement condition and scarce funds. Thinlays can also help increase the structural capability of a roadway when used with well-built pavements.
America depends on high-performing, safe roads.
Improved Performance with Premium Materials

- Quantify the increased improvements in service life when premium materials are utilized:
  - Polymer Modification
  - High-Polymers
  - Stone-Matrix Asphalt
  - Rubber Modification
  - Additives

Porous Pavements

- Structural Design
  - Low Volume Applications
  - Structural Value, Thickness, Material Properties

- Mix Design
  - Investigate Permeability and Scuffing Resistance
Pavement Economics Webinars have reached about 400 people in two years.

UPCOMING WEBINARS

- 2016 NAPA Legislative and Regulatory Policy Outlook
# Pavement Performance

## The Issues
- Long-term funding and lack of proper funding for preservation and maintenance
- Possible dry mixtures with low asphalt content
- Construction practices, lack of inspection, and need for training.

## The Strategy
- Pavement Performance Task Group
- Issues and Industry Strategies
- Partnerships
- Recommendations for Ensuring Durability

## The Focus
- Refocused Engineering Committee
- Focus on Durability in Partnership with FHWA & SAPAs
- Rethinking Asphalt Mixture Design & Simplifying Specifications
  - TRB Workshop
  - NAPA Workshop
  - FHWA Task Group