Warm Mix Asphalt: Leveraging the Benefits

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58th Annual Idaho Asphalt Conference
University of Idaho
October 25, 2018
NCHRP Project 20-44(01): *Increasing WMA Implementation by Leveraging the State-of-Knowledge*

**Project Approach**

- Assess published and gray literature related to WMA
- Establish and communicate WMA state-of-the-practice
- Dialogue for agencies, industry, and researchers
  - 2-Day Outcomes-based Workshop
  - Survey Agencies and Industry
  - 1 participant per DOT, asphalt contractors
  - Topics for Breakout Sessions
- Topical Bibliography
- Topical Webinars
Warm Mix Briefs

Available online at:

NCHRP Project 20-44: Increasing WMA Implementation by Leveraging the State-of-the-Knowledge

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243 Collections
1 Following
Survey of Agencies and Industry

Establish the State-of-the-Practice:

- Definitions of WMA
- Practices related to use and performance of WMA
- Identify barriers to better adoption of tools for WMA implementation
- Identify observed or perceived challenges to increased usage of WMA
- Identify best management practices (BMPs) for successful use of WMA on paving projects

Key Points:

• WMA reported to be < 10% of total asphalt proportion in 2016
• Interest in continuing education programs
• Allow contractor’s choice for WMA rather than specifying its use
• Incorporate procedures to show WMA is not that different than HMA
What really is Warm Mix Asphalt?

Agency survey revealed...

55 agencies - - 51 different definitions for WMA

- WMA Technology Use (additives, foaming, etc.)
- Temperature range requirement
- No specific definition
- Compaction aid

Better performance compared to HMA

Defined per AASHTO R35
Why Capture WMA Usage?
For Consideration...

Goals for Sustainability

Trade-offs to reduce impact require life cycle consideration

Changing standard practice (specifications and designs): protector and/or barrier?

Environmental, social, and cost implications of mix design and durability (2015)

> 92% of all U.S. paved roads are surfaced with asphalt products (2012)
Driving Factors for Warm Mix Asphalt

• Environmental & societal concerns
  – NIMBY
  – Reduce haul distances by opening WMA-only plants with reduced temperatures (encourages use of local materials)
• Sustainable development
  – Increase material performance and time between future maintenance and rehabilitation treatments
• Green construction
  – Easily combined with recycled materials
• Reduction of energy consumption
• Reduction in CO₂ emissions
• Reduced worker exposure
  – Faster compaction “get in, get out, stay out”
• Extension of construction season
  – Faster project delivery
  – Reduced user delay costs over time
Increased Use of WMA in US

Hansen and Copeland 2013
Pavement Life Cycle

Material extraction and production

- Equipment Use
  - Transport
  - Traffic delay

- Pavement vehicle interaction
- Noise
- Runoff
- Lighting
- Safety
- Lighting

Use

End-of-life

- Recycle
- Landfill

From: Kendall et al, 2010
No Temperature Drop? No Effect?

Energy Consumed in an Asphalt Pavement Life Cycle
(from FHWA 2015)

- Use: 91.5%
- Construction: 3.9%
- Maintenance: 3.2%
- End-of-Life: 1.2%
- Material Production: 0.3%

*from extra fuel due to IRI-related roughness
WMA & the Use Phase

From: FHWA, 2015
Driving Factors for Warm Mix Asphalt:

*Without Temperature Reduction*

- **Environmental & societal concerns**
  - Reduce haul distances by opening WMA-only plants with reduced temperatures (encourages use of local materials)

- **Sustainable development**
  - Increase material performance and time between future maintenance and rehabilitation treatments

- **Green construction**
  - Easily combined with recycled materials

- **Reduction of energy consumption**
  - Less compactive effort, drop one roller compactor

- **Reduction in CO₂ emissions**

- **Reduced worker exposure**
  - Faster compaction “get in, get out, stay out”

- **Extension of construction season**
  - Faster project delivery
  - Reduced user delay costs over time
IDEAS for IDAHO
The Challenges...

<table>
<thead>
<tr>
<th>Agencies</th>
<th>Contractors</th>
<th>Other</th>
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<tr>
<td>• Limitations with existing</td>
<td>• Lack of incentives within existing bid environment</td>
<td>• Lack of effective technology transfer tailored to</td>
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<tr>
<td>specifications</td>
<td>• <em>Lowest bid price wins project</em></td>
<td>the right audiences</td>
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<tr>
<td>• Temperature requirements</td>
<td>• Logistics of plant production for various customers</td>
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<td>• Prescriptive or</td>
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<td>• Long term performance and/or track record not</td>
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<td>permissive specifications</td>
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<td>available for all WMA technologies</td>
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<td>• *Neither type rewards</td>
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No cohesive leadership → no motivation!
Production & Construction Challenges

• Fear of the unknown or change to existing techniques, lack of experience with materials

• Aggregate moisture concerns & condensation in silos or baghouses

• Switching between HMA and WMA in production (different customers = different requests)
Review Bidding Environment

• Provide incentives for using WMA
  – If there is an incentive, verify use of WMA
  – Bid review includes technical points for use of WMA, which could offset the cost of additives & production changes (which results in higher bid costs)

• Create a WMA specific bid or line item

• Challenges with realizing full savings in a low-bid environment
  – Economic advantages may be understated if full production, placement, and performance aren’t considered
The Solutions...

- More effective training documents for target audiences
  
  - Short online videos, 1-pg targeted briefing documents

- Don’t use method or permissive specifications
  
  - Shift to end-result or performance-based specs

- Create case studies & a process for agencies to collaborate
  
  - Tie into or expand asset management database for WMA
  - Repository for approved product lists and technology updates
  - Clearly communicate benefits for local agencies & contractors
WMA in Idaho: Today,... in the Future?

Considerations...

• Is a guide specification enough? WMA item called out specifically?
• Loosen up the spec, incentivize the contract (LEED-type credits)?
• How do local agencies procure asphalt mix?
• What contract types are available for local agencies to use WMA?
• Is the state’s APL clearly written for local agencies to access?
• What should the performance criteria be for other spec types?
IDEAS:

- Cooperative efforts at the regional level to track impact (project lists)
- Long term impacts disseminated on fact sheets through LTAP/APA
- Communication between departments within an agency
- Environmental benefits/impacts - joint effort between agencies, contractors, academia
- Database platform and integration for effective monitoring
- Performance metrics: penalties/incentives paid, density, smoothness, public complaints
- Monitor cost savings: equipment use, work zone duration, etc.
EXAMPLE: Quantifying Traffic Delays

Energy and emissions contribution of traffic delays, due to construction activities

- *Often ignored in pavement LCAs*

Impact on environment, due to traffic delays, may be quantified using appropriate tools:

- Traffic simulator to estimate driving schedule under changing roadway capacity

- **EPA’s MOVES software** to calculate additional emissions and energy consumption with changing driving schedules

*From: FHWA, 2015*
Vehicle Emissions Simulations

**EPA’s MOVES**
- Emission modeling system for mobile sources
- Energy consumption
- Emissions to air
  - 120+ emissions

**EPA’s NONROAD**
- Emission modeling system for non-road equipment
- Energy consumption
- Emissions to air
  - HC, CO, NOx, PM, SO2, and CO2

*From: FHWA, 2015*
LCA Inventory Database

- Construction equipment
- Hauling
- Total use-phase traffic emissions
- Road related use-phase traffic emissions
- Congestion & work zone-related emission inventories
Take Idaho 53 for example...

Near Rathdrum, Idaho

Review ITD Road Data

- Heavy truck count?
- Closest asphalt plant?
- Maintenance schedule?
- Pavement condition history?

Road Data

A Brief History of Idaho Pavement Management

In 1977, the Idaho Transportation Department began a review of existing pavement management programs with the goal of adopting one to fit Idaho's needs. The ITD acquired a Pavement Performance Management Information System (PPMIS) and made it operational on ITD's mainframe computer. From 1978, the ITD steadily expanded the system and modified it to meet specific conditions in Idaho. It was tested and refined by both ITD and consultant contract. By 1986, it was able to perform simplistic economic optimization.

In 2007, ITD began running our pavement data through the HERS-ST (Highway Economic Requirements System, ST State model), at http://www.fhwa.dot.gov/infrastructure/hers/index.cfm. This online software from FHWA uses pavement deterioration curves to predict pavement behavior. However, the HERS-ST model results had to be manipulated by hand in order to meet the conditions of Idaho weather, terrain and other factors, which was a painstaking process.

The new Pavement Management System (PMS) in 2009, ITD purchased a pavement management and maintenance management software package. This new software housed a pavement management system (PMS) and a maintenance management system (MMS) to work in tandem as part of the Department's long-term vision for asset management. This software contains a robust database of several kinds of data, such as bridges, maintenance activities, pavement condition, traffic data, skid data, R-values, boring logs and several others.

The Pavement Management System (PMS) has allowed ITD to refine the way we calculate and analyze data by:
- Implementing new pavement performance curves calibrated by ITD engineers
- Implementing decision trees that mimic district engineers' choices
Idaho SR53: Case Study for WMA?
Near Rathdrum, Idaho

❖ Maintenance history & condition ratings
  • Top-down cracking in wheel paths?
✓ WMA = better compaction, less susceptible to TDC
NEXT STEPS

• Outreach ideas
  – Provide basic training materials to LTAP
  – Community of practice for WMA users (industry & public and commercial sectors)
  – Grant programs
  – Chief Engineer & District secretary presentations, IAA, other target audiences (pavement preservation & user/producer groups)
  – Contractor outreach/education to customers
  – Local agency coordinators at DOT and construction/maintenance decisionmakers

Talk with your DOT – your thoughts count!
Thank you!!

Idaho Asphalt Contractors & Suppliers
Idaho Transportation Department
University of Idaho!

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