A CONTRACTOR’S PERSPECTIVE ON FOAMED WMA

47th ANNUAL MEETING

Larry Shively
The Shelly Company
NOTE

It is not the intent of this presentation to recommend, promote, or endorse any particular WMA foaming system!
Why Foamed WMA?

• NO EXTRA ADDITIVES REQUIRED
• WATER-EASY TO HANDLE AND OBTAIN
• EASY CONCEPT TO UNDERSTAND
FOAMED WMA CONCEPT

- Mixes water and AC to create microscopic steam bubbles to foam the AC
- Water injection rate = less than 2% of AC flow rate (NOT 2% of mix!)
- Mix transported, placed and compacted using “normal” procedures.
Less than 2% of AC flow!
So how much water?

✓ EXAMPLE: Mix has 6.0% Binder (virgin)
✓ ODOT specification max 1.8% water injection
✓ Based on 1 ton mix
✓ 6.0% * 2000 # = 120 #
✓ 1.8% * 120 # = 2.16 # water
✓ Or approx. 0.25 gallons
✓ Or approx. 32 ounces PER TON OF MIX!!!
THE FOAMING OF THE BINDER IS THE KEY NOT THE AMOUNT OF WATER

• MORE WATER MAY NOT IMPROVE THE FOAMING

• IN SOME CASES EXCESSIVE WATER MAY CAUSE "GUMMY" MIX

• IT IS IMPORTANT TO CONTROL THE WATER DUE TO THE SMALL AMOUNT USED

• IT IS A BEST FIT PROCESS!
FOAMING OF LIQUID ASPHALT

THINK OF SHAVING CREAM
WHEN ASPHALT IS HOT IT ACTS AS A LUBRICANT & PROMOTES COATING

WHEN ASPHALT IS COLD IT ACTS AS A GLUE (CEMENT)

FOAMING ASPHALT HELPS THE LUBRICATION & COATING OF THE MIX AT A LOWER TEMPERATURE!
NORMAL ASPHALT BINDER
THIN FILM THICKNESS

9 µm
FOAMED ASPHALT BINDER THIN
FILM THICKNESS = 165 µm

APPROXIMATELY 18 TIMES VOLUME INCREASE
AFTER WATER LEAVES MIX BINDER
THIN FILM THICKNESS = 9 µm

WATER NORMALLY IS GONE BY THE TIME THE FIRST ROLLER IMPACTS THE MIX!
“MODIFYING THE BINDER SO IT TEMPORARILY LOWERS ITS OVERALL VISCOSITY AND INCREASES ITS VOLUME WITHOUT INCREASING TEMPERATURE”
Why do we heat HMA?

- To remove moisture
- To coat the aggregate
- To provide for heat transfer to RAP
- To transport the mix
- To compact the mix!

Aggregate > 212°F to remove H₂O

FOAMING ACCOMPLISHES THIS AT A LOWER TEMP!
As viscosity goes up, the more difficult it is to compact. Upper range of viscosity for compaction is approximately 64-22 SSU.
At this point the mix is basically the same as before WMA.
COMPACTION

- SINCE THE VOLUME OF THE BINDER IS INCREASED ITS LUBRICATION IS IMPROVED AND THE MIX IS EASIER TO COMPACT.
- AND ITS VISCOSITY IS REDUCED!
To date the Shelly Group has used these water injection foaming systems!

- Astec Double Barrel
- Terex
- Gencor

More foaming processes are being developed!
Astec System
Terex Foam Warm Mix Process

Expansion Chamber

Existing AC Pump

Water Pump

Water Tank

Counterflow Drum

Foam Injection pipe running along side existing AC pipe
WARM MIX ASPHALT SYSTEM

Features:
- Reduces mix temperatures by up to 9°F without costly additives
- Uses proven, patented HPR warm asphalt technology, originally patented 8/1996
- Single agitator chamber ensures consistent AC/HC ratio at any production rate
- Produces blended asphalt just outside of the drum and immediately integrates it into the drum’s mixing chamber, evenly mixing the aggregate
- No moving parts (except water pump and meter)
- Fills any unlined countercflow mixing drum
- Fast easy installation into existing drum
- Complete bituminous installation for new asphalt recycling plant to be furnished 2008
- Complete AC system is hot oil jacketed
- Instant pending

Components:
- PLC control system including customer-selectable injection valve and production
- The display shows water flow rates (in US gallons and LPM)
- Water and lock chamber, filter 3 by 2111 MI variable capacity water pumps, high production water heater and radiation plates
- Those may also be heated coil or electrical heating system
- Asphalt temperature controller to prevent material flow to AC/HC
- Reservoir from separate chamber
- Loader chute to accept material, adjustable for specification design
- Feeder AC reservoir intake for hot mix production

Applications:
- Asphalts, premixing, recirculating AC/HC transport
- 0–18 MPM or 4–45 mph
- Custom will include a 100VAC
- Input must be in the range of 1800 when the AC/HC module is hit the drum mixing chamber
- Input levels can be set per AC/HC with an “on/off” control
- Input levels are in 200B at a time is a “must have” area
- Not available mounted in the PLC, digital output can be added (devised to blend with a pump)

Digital outputs:
- Water mixing
- Water tank
- Digital output or optional lead contacts or customers can supply any other menu may move forward

Selects for further systems:
- Water mixing
- Water tank
- Digital output or optional lead contacts or customers can supply any other menu may move forward

Oldcastle

 TEREX.®

Shelly Group

Materials

Oldcastle

Materials

Oldcastle

Materials
Gencor System
Gencor Installation
REGARDLESS OF METHOD
FOAMED ASPHALT:

• ALLOWS COATING AT LOWER TEMPERATURES
• LOWERS OXIDATION OF BINDER
• CAN IMPROVE COMPACTABILITY
• REDUCES FUMES.
FOAMED ASPHALT MAY HELP REDUCE ABSORPTION
Light oils are either put in asphalt or left in asphalt during refining.

These light oils boil above 285°F.

By mixing at below 285°F, the boiling point is never reached...eliminating smoke (vapor) and corresponding smell!!
HMA
HMA - 315° F

WMA - 265° F
High Percentage Recycle Mix with Standard Grade of Asphalt

RAP AND WMA GO HAND IN HAND!

• PLANT RUNS BETTER WITH RAP
• LESS OXIDATION AT LOWER TEMPERATURES
• USE OF STANDARD BINDER
By using a standard liquid 64-22, you produce a much softer product than with virgin mix due to:

- Lower temperature results in less oxidation
- Light oil remains in liquid.
• Use less fuel due to 50°F lower temperature
• No volatiles
• Use more recycle
• Some lower emissions
GALLONS PER TON USED OIL

<table>
<thead>
<tr>
<th></th>
<th>T-1 HMA Fuel</th>
<th>T-1 WMA Fuel</th>
<th>T-2 HMA Fuel</th>
<th>T-2 WMA Fuel</th>
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</thead>
<tbody>
<tr>
<td>Gallons per Ton</td>
<td>2.08</td>
<td>1.71</td>
<td>1.77</td>
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GALLONS PER TON

0.5
1.0
1.5
2.0
2.5
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<tr>
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<tr>
<td><strong>VOC AVE LBS/HR</strong></td>
<td>8.7</td>
<td>6.39</td>
<td>6.92</td>
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<td><strong>T-1 HMA VOC</strong></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td><strong>T-1 WMA VOC</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>T-2 HMA VOC</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>T-2 WMA VOC</strong></td>
<td></td>
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</table>
AVERAGE MIX TEMPERATURE

<table>
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<tr>
<th></th>
<th>T-1 HMA Temperature</th>
<th>T-1 WMA Temperature</th>
<th>T-2 HMA Temperature</th>
<th>T-2 WMA Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>AVE MIX TEMP</td>
<td>290</td>
<td>261</td>
<td>298</td>
<td>260</td>
</tr>
</tbody>
</table>
A carbon footprint is a measure of the impact our activities have on the environment, and in particular climate change. It relates to the amount of greenhouse gases produced in our day-to-day lives through burning fossil fuels for electricity, heating and transportation etc.

The carbon footprint is a measurement of all greenhouse gases we individually produce and has units of ton (or kg) of carbon dioxide equivalent.
LEED® Credits: Green Asphalt

Sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Sustainable development, which includes green construction practices, tries to balance the needs of people, nature, and the economy.

Opportunities to recycle, manage stormwater, mitigate urban heat island (UHI) effects, and save energy provide great potential for sustainability. There are several rating programs used to evaluate a building or construction project's environmental performance. The most prevalent system is the U.S. Green Building Council's (USGBC's) Leadership in Energy and Environmental Design (LEED).

How asphalt works for green construction:

- Asphalt can help with stormwater management.
- Asphalt is America's most recycled material.
- Asphalt can help to reduce the urban heat island effect.
- Asphalt pavement is manufactured locally.
- Asphalt is the long-lasting pavement.
- Asphalt innovations reduce fuel consumption and carbon emissions.

More About LEED®

The LEED Green Building Rating System™ serves as a benchmark or scorecard for the design, construction, and operation of green buildings. It was designed to encourage the adoption of sustainable building and development practices.

High-RAP Pavements

The incorporation of high percentages of RAP (reclaimed asphalt pavement), above the 10 to 15 percent typically used, is highly beneficial for green construction. An ID point should be awarded for incorporating higher than 20 percent RAP in a pavement.

Score Card

The concepts discussed in this brochure are valid for all of the LEED rating systems which relate to pavement. The actual credits and numbers of points vary from one system to another.

The Materials and Resources (MR) credits can be strongly influenced by the selection of asphalt pavement, but are also dependent on other factors in the project. Some credits are dependent upon the existing portion of the site paved with asphalt and the portion of the pavement to be removed. The use of warm-mix asphalt offers attractive opportunities for Innovation and Design credits.

How Asphalt Earns LEED Credits

<table>
<thead>
<tr>
<th>Rating Category</th>
<th>Credit Description</th>
<th>Pavement Type</th>
<th>Credits</th>
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<tbody>
<tr>
<td>SS Credit 6.1</td>
<td>Stormwater Design: Quantity Control</td>
<td>Porous Asphalt</td>
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<tr>
<td>SS Credit 6.2</td>
<td>Stormwater Design: Quality Control</td>
<td>Porous Asphalt</td>
<td>1</td>
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<tr>
<td>SS Credit 7.X</td>
<td>Heat Island Effect: No Roof</td>
<td>Reflective surfaces</td>
<td>1 to 3</td>
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<tr>
<td>NR Credit 2.X</td>
<td>Construction Waste Management; disposal or disposal</td>
<td>RAP</td>
<td>1 to 2</td>
</tr>
<tr>
<td>ID Credit 1.X</td>
<td>Exceptional Performance</td>
<td>Warm-mix asphalt</td>
<td>1 to 4</td>
</tr>
</tbody>
</table>
INTEGRATING ENVIRONMENTAL and TRANSPORTATION INFRASTRUCTURE OBJECTIVES through PARTNERSHIPS

ANNOUNCEMENT & INVITATION

Green Highways Partnership Leadership Forum Recognition Program

TRAILBLAZERS in SUSTAINABILITY

January 13, 2009
5:00 PM until 9:00 PM

Army Navy Club
on Farragut Square
901 Seventeenth Street N.W.
Washington, D.C. 20006

COAT & TIE REQUIRED

RSVP
by JANUARY 7, 2009

2009 GHP FORUM
The 2009 GHP Leadership Forum program will focus on legislative and policy issues surrounding green transportation infrastructure and continue with the presentation of opportunities and case studies associated with the development and implementation of sustainable transportation programs and practices at the DOT and community levels. The program will conclude with keynote address on the role of innovation and technology by Dr. James Trefil of George Mason University.

PROGRAM

The Honorable David Wu
Chairman
Subcommittee on Technology and Innovation
Committee on Science & Technology
U.S. House of Representatives

“Green Transportation Infrastructure – Role of Technology, Innovation, and Collaboration”

Dr. Stephen Van Beek, PhD
President & CEO
Eno Foundation for Transportation Policy

“Climate Change, Sustainable Transportation & Economic Competitiveness”

Mr. Dan Tangherlini
City Administrator and Deputy Mayor
Office of the City Administrator, Washington, DC

“Green Transportation Infrastructure – The Key to Sustainable Communities”

Mr. David Loones
Vice President, Commercial Services
Holcim, USA Inc.

Holcim Foundation for Sustainable Construction
Awarding Innovative, Future Oriented, Sustainable Design and Construction

Mr. Granville Martin
Vice President, Environmental Affairs
JPMorgan Chase

Green Infrastructure and the Financial Markets

Dr. James Trefil, PhD
Clarence J. Robinson Professor of Physics
George Mason University

Innovation and Technology as a Framework in Ecosystem Sustainability
A CASE FOR OPTIMISM

2009 GHP RECOGNITION PROGRAM
This year’s GHP recognition program will honor individuals, agencies and organizations who have made, and continue to make, outstanding contributions to the purpose, intent and principles of the green highways partnership. The program will also recognize outstanding contributions to operational and organizational programs and practices, as well as, innovation in sustainable transportation technologies.

RSVP
Mooney.Donna@epamail.epa.gov
For Additional Information or Questions:

Wackerhoff dominium@epamail.epa.gov or rwh@tufts.edu
WILL OUR PAVEMENTS PERFORM?

- Less oxidation of mix—for every 25 degree rise in temperature oxidation doubles!

- Better coating

- More uniformity of compaction
CHALLENGES!

- Culture of paving crews
- Customer demands it—hotter is better
- Agency specifications
- Baghouse and drum flight concerns
- Low TSR results
ITEM 402  ASPHALT CONCRETE MIXING PLANTS

402.01 Description
402.02 General
402.03 Scales
402.04 Thermometers
402.05 Storage
402.06 Calibration
402.07 Computerized Plant System
402.08 Polymer Binders
402.09 Water Injection System for Warm Mix Asphalt
• **402.09 Water Injection System for Warm Mix Asphalt.**

• When allowed by specification use an approved water injection system for the purpose of foaming the asphalt binder and lowering the mixture temperature. Only use equipment that has been proven stable and effective thru project use on non-ODOT projects. Ensure the water injection never exceeds 1.8% by weight of asphalt binder.

• Ensure equipment for water injection meets the following requirements:
  • Injection equipment computer controls are in the plant control room and are tied to the plant computer metering.
  • Injection equipment has variable water injection control controlled by the plant operation rate.
  • Water injection rate cannot be manually overridden by the plant operator once in the computer.
  • Injection equipment stops water flow when a control or equipment failure in the injection system occurs.
  • The water injects into the asphalt binder flow before the asphalt binder spray hits aggregate. Do not allow water to touch aggregate before the binder spray.
  • Injection equipment includes water storage and pump control tied to the injection computer controls.
  • Water storage low water alarm in the control room.
  • Provide a PG binder sampling valve between the last piping tee on the tank side of the line and the injection equipment to sample PG binder before water is injected.
  • Provide a PG Binder sampling valve at the injection equipment to sample binder prior to spray.
SOURCES OF INFORMATION

Quality Improvement Series 125

Warm-Mix Asphalt: Best Practices

NAPA
NATIONAL ASPHALT PAVEMENT ASSOCIATION

Warm-Mix Asphalt
SUMMARY

- Simple
- Lowers mix temperature
- Increases binder volume
- Helps with coating
- Helps with compaction
- Lower emissions-plant & road
- Reduces oxidation
- **IS GREEN!!**
THANK YOU TO THE FOLLOWING COMPANIES FOR USE OF PHOTOS AND DRAWINGS:

ASTEC INDUSTRIES

TEREX GENCOR
TRANSPORTING THE MIX IS NOT A PROBLEM IF IT IS COATED AND HEATED
FOAMED ASPHALT MAY BE THE STANDARD OF THE INDUSTRY OVER TIME

- PROGRESS IN OTHER STATES SUGGESTS THE EVOLUTION OF WMA HAS OCCURRED
- BENEFITS OF ENERGY SAVINGS, BETTER COMPACTION, ABILITY TO HAUL LONGER DISTANCES, AND ABILITY TO EXTEND PAVING SEASON WILL DRIVE WMA IMPLEMENTATION
- ENVIRONMENTAL BENEFITS OF WMA SHOULD BE CONSIDERED AS EQUALLY