Warm Mix Asphalt
SCAN
May – June 2007
Norway-Germany-Belgium-France
Our Visit

• Background
• Warm Mix Technologies
• European Experience
• SCAN Findings
• Implementation Direction
What’s the Purpose of a SCAN Tour?

- Provide the opportunity to access innovation
- Joint Program… FHWA, AASHTO, NCHRP, and Industry
Issues of Interest

The purpose of the SCAN was to investigate innovative technologies and policies related to WMA.

- WMA processes
- Mix design & construction practices
- WMA performance
- Limitations
- Benefits
2007 WMA Scan Team

Plus Two German Colleagues
Our Team

- Eric Harm, co-chairman
- John D’Angelo, co-chairman
- Gaylon Baumgardner
- John Bartoszek
- Matthew Corrigan
- Jack Cowsert
- Tom Harman
- Mostafa (Moe) Jamshidi
- Wayne Jones
- Dave Newcomb
- Brian Prowell, reporter
- Ron Sines
- Bruce Yeaton

- Illinois DOT
- FHWA
- Paragon Technical Services
- Payne & Dolan
- FHWA
- North Carolina DOT
- FHWA
- Nebraska DOT
- Asphalt Institute
- NAPA
- Adv. Materials Services LLC
- P.J. Keating
- Maine DOT
Who Did We Visit?

- Oslo, Norway
- Köln, Germany
- Brussels, Belgium
- Paris, France
- Frankfurt, Germany
- Nantes, France
What Did the Scan Team Do?
Factors Driving European Development of WMA

- The environment and sustainable development concerns, “Green Construction”
  - Reduction in energy consumption
  - Reduction in CO\textsubscript{2} emissions
- Extension of paving season and potential for longer haul distances
- Improvement in field compaction
- Welfare of workers, particularly with Gussasphalt, which is not used in the U.S.
What is Gussasphalt?

Also called mastic asphalt, Gussasphalt is not SMA. It is a binder rich mixture placed at 0% voids with coarse aggregate rolled into the surface. Typically placed at ± 450°F.
European Experience
The
PUSH
for Implementation

• Norway
  – Contractor/Supplier Driven
• Germany
  – Contractor Driven
  – Bitumen Forum
  – Gussasphalt (Fumes)
• France
  – Contractor Driven/Agency Supported
  – Sustainable Technologies
• Netherlands
  – Contractor Driven
European Mix Design Practices

- Mix design practices varied from country to country
- Some gyratory, some Marshall
- Some empirical, some fundamental
- All used performance tests!
European Standards - Marking
Road Materials CE TC227

User Needs
Surface Characteristics
Asphalt Pavement (In Situ)
Asphalt Mixture
Constitutive Materials

WMA SCAN 2007
Classification of WMA by Temperature Range

- Latent Heat of Vaporization
- Cold Mix
- Warm Asphalt
- Half-Warm Asphalt
- WMA
- HMA

Temperature, °F

Fuel/Ton

Heating
Vaporization
Drying
WMA Technologies

• Organic, Wax-like additives
  – Sasobit® – Sasol International
  – Asphaltan B – Romanta
  – Fatty Acid Amides – Licomont S 100

• Foaming Processes
  – Aspha-min zeolite – MHI/Eurovia
  – Low Energy Asphalt – Fairco/Eiffage Travaux Publics
  – WAM Foam – Kolo Veidekke/Shell/BP
  – LEAB® – BAM

• Emulsion Based
  – Evotherm™ – MeadWestvaco

• Vegetable based synthetic binders

• Other … Emerging US Technologies
Placement and Compaction

“Business as usual”
Primarily use:
• Heavy, tamping bar, vibratory screed pavers
• Steel-wheel vibratory and static rollers
• Workability generally good
Performance of WMA

Rv152, Hp3, Km 0.046-2.339
Akershus

- Mean value
- 90% value
Performance of WMA

• Consensus of European Countries that WMA should provide equal or better performance than HMA
  – Norway – performance mixed, problems not attributed to WMA
  – Germany – performance same or better, developed guidelines to allow use of waxes and zeolite
  – France – toll road, district, and city of Paris pleased with performance to date
Benefits of WMA

- Reduced Emissions
- Reduced Fuel Usage
- Paving Benefits
  - Pave in cool weather and still obtain density
  - Haul mix longer distances and still have workability
  - Improved compaction
  - Facilitate deep patches
  - Ability to use more RAP
- Reduced Worker Exposure
Reduced Emissions

- CO$_2$ reduced 30-40%
- SO$_2$ reduced 35%
- VOC reduced 50%
- CO reduced 10-30%
- NO$_x$ reduced 60-70%
- Dust reduced 20-25%
SCAN Challenges to Implementation
Adapt technologies from low production European batch/drum plants to higher production plants used in the U.S.
Coarse Aggregate must be DRY

- Aggregates used in Europe have relatively low water absorptions, < 2%
- Aggregates routinely used in the U.S. have higher water absorptions
- Best Practices should be used to minimize the moisture content in aggregate
Initial product approval; how do we sort out the good products from the bad?
Products should be approved on a national or at least a regional basis

- German agencies, industry, and academia have jointly developed a “Merkblatt” or guidelines for the use of WMA.
- In France, SETRA performs certifications of new products. Cooperatively supported between agency and industry.

Aspha-min Certificate
Individual Contractors are going to have to determine which WMA process will work over the widest range of applications.

In the past changes have been mandated by agencies. In Europe, contractors have staffs who routinely do research to develop new products.
The overall performance of WMA must be as good as HMA. On a life-cycle basis, if WMA does not perform as well, there will not be energy savings or reduced emissions in the long run.

- Build sections with HMA controls
- Data collection guidelines
- Monitor for 3 to 5 years

WAM-Foam
Implementation Goals

WMA should be an **acceptable alternative** to HMA, used at the Contractor’s discretion, provided the WMA meets applicable HMA specifications.
Implementation Goals

• Development of an approval system for new WMA technologies is needed.
• The approval system should be based on performance testing and supplemented by field trials.
  – WMA TWG should lead the development of a performance based evaluation plan for new WMA products.
  – Ideally, such a system is needed for a broad range of modifiers/technologies used in HMA.
Implementation Goals

• The WMA SCAN Team will provide technology transfer of the information gained through presentations, articles, and reports.

• Best practices need to be implemented for handling and storing aggregates to minimize moisture content, burner adjustment, and WMA in general or specific technologies.
Implementation Goals

• Encourage more field trials with:
  – Higher traffic
  – Larger size with representative production of WMA
  – Built in conjunction with a control section
  – Monitored for a minimum of three years by the agency
  – Data collection guidelines, developed by the WMA TWG can be found at: warmmixasphalt.com

• The factors affecting the economic viability of WMA need to be identified and tracked.
WMA Technologies

Test Frameworks
The Warm-Mix Asphalt Technical Working Group has devised test frameworks to help researchers obtain data in a uniform format so that analysis can be done by using data from a multitude of projects. There is one framework for material properties and another for emissions and energy reductions.

Products and Processes
These products and processes are listed for information only. The WMA Technical Working Group does not endorse any particular proprietary product or technology. These applications should be considered as experimental.

Advanced Concepts Engineering Co.: LFA CO
Arkema Group: CECABASE RT
Aspha-min: Aspha-min Online
Aste Industries: Double Barrel Green System
MeadWestvaco Asphalt Innovations: Evotherm
PQ Corporation: Advera WMA
Sasol Wax Americas, Inc.: Sasobit
WMA Technical Working Group (WMA TWG)

- FHWA / NAPA sponsored
- Co-Chairs
  - Matthew Corrigan, FHWA
  - Tim Doctor, Industry
- Represented
  - State DOT
  - State APA
  - NCAT
  - Hot Mix Asphalt Industry
  - AASHTO
  - Labor
  - NIOSH

WMA SCAN 2007
WMA Technical Working Group
(WMA TWG)

• Formed in 2005
• Purpose:
  – Promote Technology Transfer
  – Facilitate Product Approval Methods
  – Encourage Research
  – Develop Quality and Environmental Testing Protocols
  – Provide Guidelines for Mix Design and Construction
  – Identify Other Benefits of WMA
WMA TWG Accomplishments

- www.warmmixasphalt.com
- Material Testing Framework
- Emission Testing Framework
- WMA Best Practices Document
- Research Needs Identified
  - Developed three (3) research statements
  - Submitted through AASHTO to NCHRP
    - All projects highly ranked by SCOR
    - Total $1.4 million
NCHRP Research Projects

- NCHRP Project 09-43
  - “Mix Design Practices for Warm Mix Asphalt”
  - $500,000.00
  - Principal Investigator:
    Dr. Ramon Bonaquist,
    Advanced Asphalt Technologies, LLC
  - Completion Date:
    March 2010
NCHRP Research Projects

• NCHRP Project 09-47
  – “Engineering Properties, Emissions, and Field Performance”
  – $900,000.00
  – Principal Investigator: TBD
  – Completion Date: not to exceed 42 months
  – [Link](http://www.trb.org/TRBNet/ProjectDisplay.asp?ProjectID=1625)
Binder ETG Research Projects

• Laboratory Evaluation: Wax Additives in Warm-Mix Asphalt Binder

• Evaluate the effect of wax additives on physical properties and characteristics of asphalt binders and their subsequent performance in mixtures.
Binder ETG Research Projects

- Asphalt – One (1)
  - Lion Oil PG64-22 Eldorado, AR Refinery
- Wax Additives – Nine (9)
  - Non-Paraffin Wax Additives
- Aggregates
  - Vulcan Barin Quarry Granite, Columbus, GA
- Mix Design
  - 12.5mm Dense Graded SuperPave Gyratory
    - ~5.5% Binder
    - ~7.0% Air Voids
Binder ETG Research Projects

- Fourier Transform Infra-Red Spectroscopy
- Gel Permeation Chromatography
- Glass Transition (Tg)
- Branching
- Physical Hardening (32 days saturation at -12°C) Bending Beam Rheometry
  - Testing at 1, 2, 4, 8, 16 and 32 Days
- Multi-Step Creep Recovery (MSCR)
- Binder Stress Sweep Fatigue
- Additional testing … etc.
International WMA Conference

• NAPA, FHWA & AASHTO sponsored
• November 11-13, 2008 in Nashville, TN
• Features:
  – Processes
  – Mix Production & Placement
  – Energy consumption
  – Mix Design
  – Material Properties
  – Environmental Performance

warmmixasphalt.com

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Warm Mix Asphalt: Best Practices

- Quality Improvement Series (QIP) 125
  - Stockpile Moisture Management
  - Burner Adjustments and Efficiency
  - Aggregate Drying and Baghouse Temperatures
  - Drum Slope and Flighting
  - Combustion Air
  - RAP usage
  - Placement Changes
There is a consensus among the WMA SCAN Team that WMA is a viable technology. U.S. Agencies and the HMA Industry need to cooperatively pursue this path.

The U.S. has already made great strides in evaluating WMA, thanks in part to Public-Private Partnerships like the WMA TWG and the WMA SCAN Tour.
WMA Investigation and Implementation

- FHWA working in partnership with AASHTO and Industry to establish clear targets for implementation
- WMA Technical Working Group (TWG)
- FHWA Expert Task Groups
  - Binder, Mixture, and Models
- Regional User-Producer Groups
  - Share data and information
- More pavement test sections
- Training and Education
WMA European Scan Tour

• Scan Final Report Status
  – Currently in review by Office of Public Affairs
  – Upon approval will have .pdf available
  – Hard copies available shortly afterward
Thank You!

Matthew Corrigan, P.E.
Mobile Asphalt Laboratory Program Manager
Warm Mix Asphalt Program Manager

Office of Pavement Technology
HIPT-10, Room E73-465
1200 New Jersey Ave. S.E.
Washington, DC 20590

matthew.corrigan@fhwa.dot.gov
www.fhwa.dot.gov/pavement