



## Warm Mix Asphalt SCAN

May – June 2007  
Norway-Germany-Belgium-France

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## What's a SCAN Tour?

- FHWA's Office of International Programs identifies and evaluates innovative foreign technologies and practices that could significantly benefit US transportation systems
- Main channel for accessing innovation is the *International Scanning Program*
- Program jointly undertaken with FHWA, AASHTO, and NCHRP

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## Our Visit

- Background
- Warm Mix Technologies
- European Experience
- SCAN Findings
- Implementation Direction

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## What is WMA?

- Allows reduction of temperatures at which asphalt mixes are produced and placed
  - Reduces viscosity at lower temps
  - Promotes coating of aggregate

## Issues of Interest

The purpose of the SCAN was to investigate and implement innovative technologies and policies related to WMA. Topics of interest included:

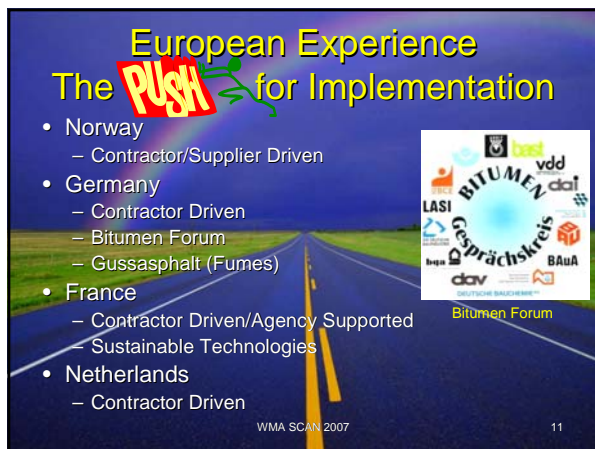
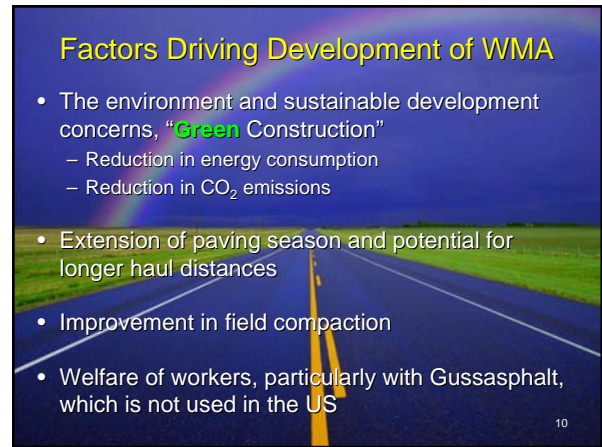
- WMA processes
- Mix design & construction practices
- WMA performance
- Limitations
- Benefits

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## Our Team

<ul style="list-style-type: none"><li>• Eric Harm, chairman</li><li>• John D'Angelo, co-chairman</li><li>• Gaylon Baumgardner</li><li>• John Bartoszek</li><li>• Matthew Corrigan</li><li>• Jack Cowser</li><li>• Tom Harman</li><li>• Mostafa (Moe) Jamshidi</li><li>• Wayne Jones</li><li>• Dave Newcomb</li><li>• Brian Prowell, reporter</li><li>• Ron Sines</li><li>• Bruce Yeaton</li></ul>	<ul style="list-style-type: none"><li>• Illinois DOT</li><li>• FHWA</li><li>• Paragon Technical Services</li><li>• Payne &amp; Dolan</li><li>• FHWA</li><li>• North Carolina DOT</li><li>• FHWA</li><li>• Nebraska DOT</li><li>• Asphalt Institute</li><li>• NAPA</li><li>• Adv. Materials Services LLC</li><li>• P.J. Keating</li><li>• Maine DOT</li></ul>
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## European Mix Design Practices

- Mix design practices varied from country to country
- Some gyratory, some Marshall
- Some empirical, some fundamental
- All used performance tests!



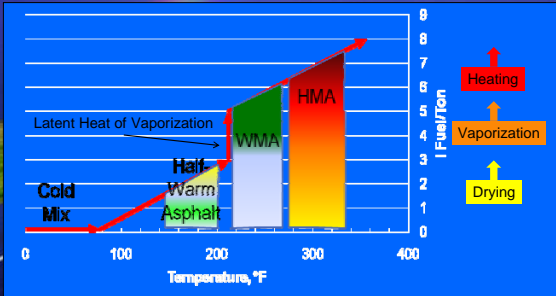
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## European Standards-CE Marking Road Materials CE TC227



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## Classification of WMA by Temperature Range



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## Warm Mix Asphalt Processes

- **Organic, Wax-like additives**
  - Sasobit® – Fisher/Tropsh Wax - Sasol
  - Asphaltan B – Montan Wax - Romolta
  - Licomont S 100 - Fatty Acid Amides - Clariant
- **Foaming Processes**
  - Aspha-min zeolite – Eurovia / MHI
  - Low Energy Asphalt – Fairco/Eiffage Travaux Publics
  - WAM Foam – Kolo Veidekke/Shell/BP
  - LEAB® – BAM
- **Emulsion Based**
  - Evotherm™ – MeadWestvaco
- **Vegetable based synthetic binders**
- **Emerging U.S. Technologies**

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## Organic/Wax Additives

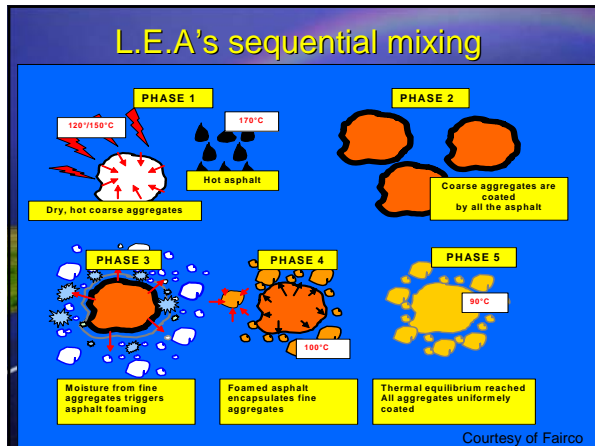
- Melting point in the 200 °F range
- Reduces mix viscosity above that temp.
  - Select wax with melting point above in-service temperature
  - Potential impact on low temperature properties
- Sasobit® – Fisher/Tropsh Wax
- Asphaltan B – Montan Wax
- Licomont S 100 - Fatty Acid Amide

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## Aspha-min

- Zeolites are crystalline hydrated aluminum silicates
- When the Zeolite is heated, it gives up its internal moisture, approximately 21% by weight, microscopically foaming the asphalt
- Aspha-min is typically added at 0.3% by TWM

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### WAM-Foam

- Two Phase addition of asphalt
  - Aggregate coated with "soft" asphalt (soft asphalt controls minimum placement temperature)
  - Hard asphalt foamed to mix with pre-coated aggregate
  - Material placed as low as 80 C (176 F), 50 to 60 C (90 to 108 F) reduction
  - Requires plant modification for foaming, estimated at \$50,000 - \$70,000. No additional costs thereafter
  - Special asphalt feeds may be required

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### LEAB®

Set of six retractable Nozzles inject foam Into BAM's pugmill

BAM Wegen bv 21

### Laboratory Foaming

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### Evotherm®

- Emulsion – approximately 70% binder residue
- Chemical package provides mixing, coating, workability, compaction and adhesion (e.g. anti-stripping agents)
- Some steam liberated upon mixing

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Water injector located on the liquid asphalt intake on drum.

FOAM NOZZLE OPEN



### Placement and Compaction

"Business as usual"

Primarily use:

- Heavy, tamping bar, vibratory screed pavers
- Steel-wheel vibratory and static rollers
- Workability generally good

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### Performance of WMA

Rv152, Hps, Km 0.046-2.339  
Aachenstr.

25  
20  
15  
10  
5  
0  
-5  
-10  
-15  
-20  
-25

01/11/06 01/12/06 01/13/06 01/14/06 01/15/06 01/16/06 01/17/06 01/18/06 01/19/06 01/20/06 01/21/06 01/22/06 01/23/06 01/24/06 01/25/06 01/26/06 01/27/06 01/28/06 01/29/06 01/30/06 01/31/06

Date

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### 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 operator, district, and city of Paris pleased with performance to date

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### BAST Official rating

Here: B 3, Schönstadt-Schwarzenborn

		Track No.	5
Field testing	Rutting <sup>1</sup>	equal	
	Postcompaction in main lane	better	
	Cracking	equal <sup>2</sup>	
Laboratory testing	Resistance to thermal distortion	equal	
	Cryogenic behaviour	equal or better	
	Aging of the binder	equal	
	Adhesion	equal or better	

Source:  
„Erfahrungssammlung über die Verwendung von Fertigprodukten und Zusätzen zur Temperaturabkühlung von Asphalt“, BAST 08/2006

aspha-min

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### 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


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### Reduced Emissions

- CO<sub>2</sub> reduced 30-40%
- SO<sub>2</sub> reduced 35%
- VOC reduced 50%
- CO reduced 10-30%
- NO<sub>x</sub> reduced 60-70%
- Dust reduced 20-25%

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### Benefits of WMA



No Fugitive Emissions

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### SCAN Challenges



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### Adapt technologies from low production European batch/drum plants to higher production plants used in the US



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### Coarse Aggregate must be DRY

- Aggregates used in Europe have relatively low water absorptions, < 2%
- Aggregates routinely used in the US 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?



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### 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

**Research at Eurovia**

- Research and Development Centre
- 100 machines in 32 zones, performing 100 different tests
- ISO2 programme:
  - Environmental protection,
  - Safety,
  - Road infrastructure management,
  - Materials and structures.
- Organization:
  - 20 engineers and technicians
  - 10 students
  - 20 partnerships with universities, research institutes and laboratories in France and abroad.

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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.

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### Implementation Goals

- WMA should be an **acceptable alternative** to HMA at the Contractor's discretion, provided the WMA meets applicable HMA specifications.

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### Implementation Goals

- An **approval system** needs to be developed for new WMA technologies. 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.
  - Realistically, such a system is needed for a broader range of modifiers/technologies used in HMA.

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### 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.

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### 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
  - Framework for Warm-Mix Asphalt Trials, developed by the WMA TWG can be found at: [http://www.hotmix.org/view\\_article.php?ID=537](http://www.hotmix.org/view_article.php?ID=537)
- The factors affecting the economic viability of WMA need to be identified and tracked.

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## Conclusions

- There is a consensus among the WMA SCAN Team that WMA is a viable technology and that US Agencies and the HMA Industry need to cooperatively pursue this path
- The US has already made great strides in evaluating WMA, thanks in part to Public-Private Partnerships like the WMA TWG and the WMA SCAN Tour

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## Questions/Discussion?

## Question:

- Which institution did the team escape from?



## Question:

- Are there any rednecks in France?



## Question:

- Did we make any lasting friendships?



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## Question:

- Did we develop any of our own ideas?



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