



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?

- 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

What is WMA?

- Allows reduction of temperatures at which asphalt mixes are produced and placed
 - Reduces viscosity at lower temps
 - Allows the complete 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

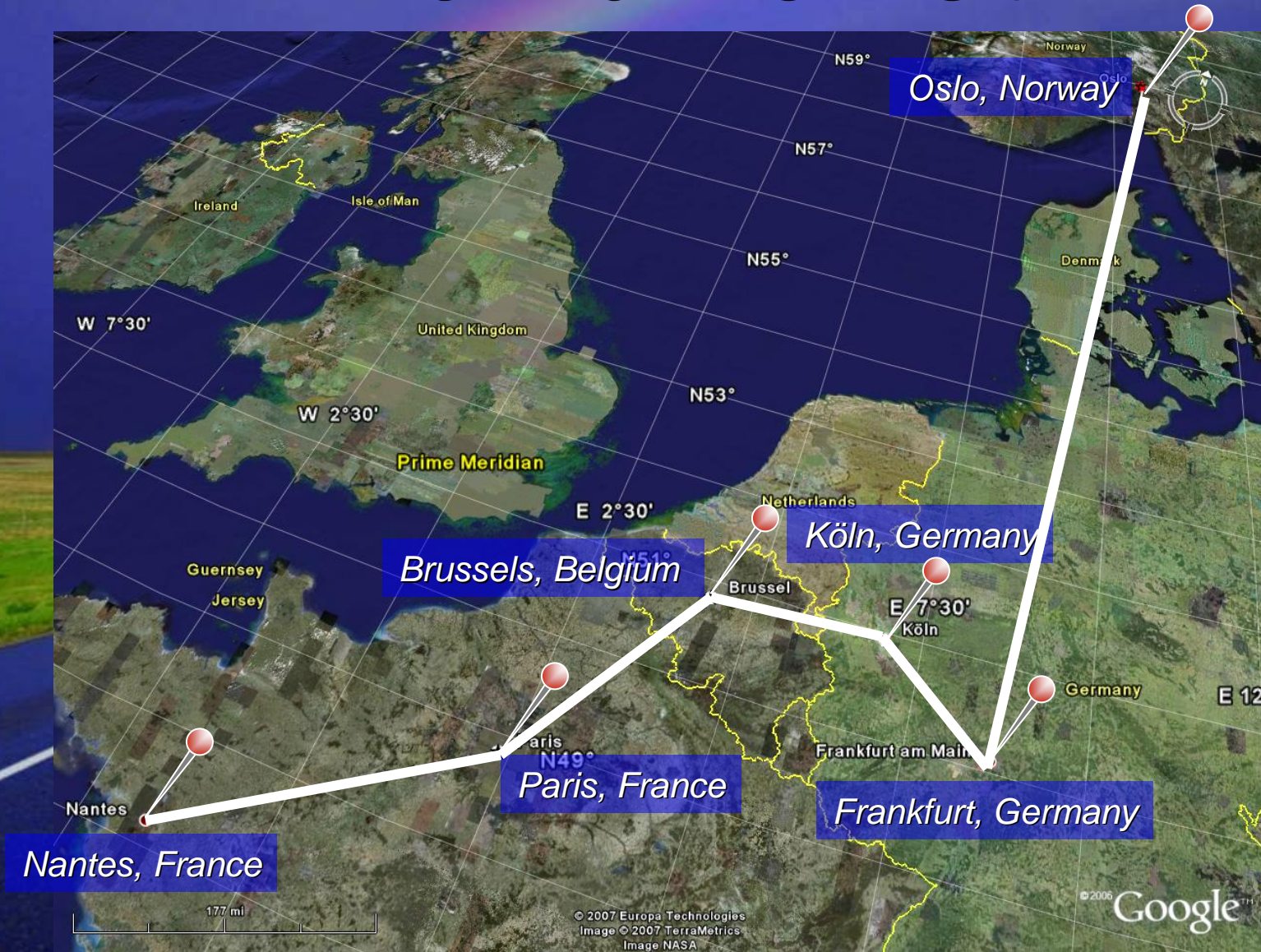
Our Team

- Eric Harm, 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

2007 WMA Scan Team



Who Did We Visit?



What Did the Scan Team Do?



Factors Driving Development of WMA

- The environment and sustainable development concerns, “**Green** Construction”
 - Reduction in energy consumption
 - Reduction in CO₂ 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 US

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



Bitumen Forum

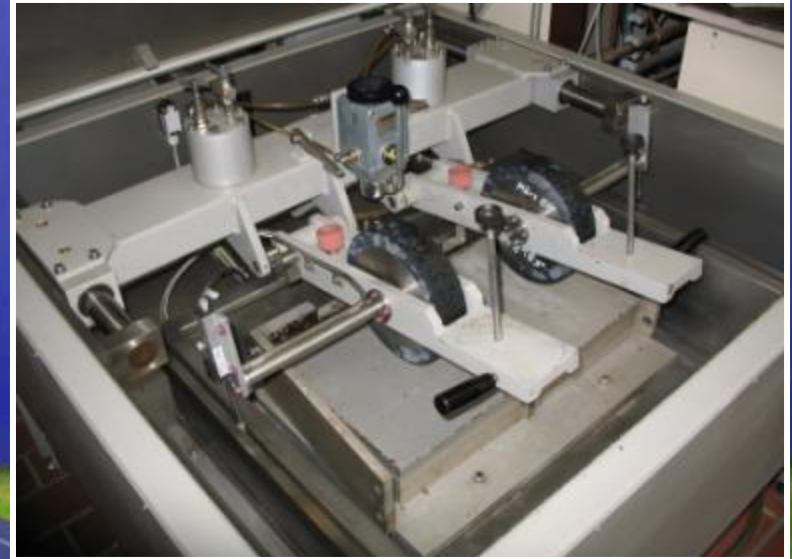
What is Gussasphalt?

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

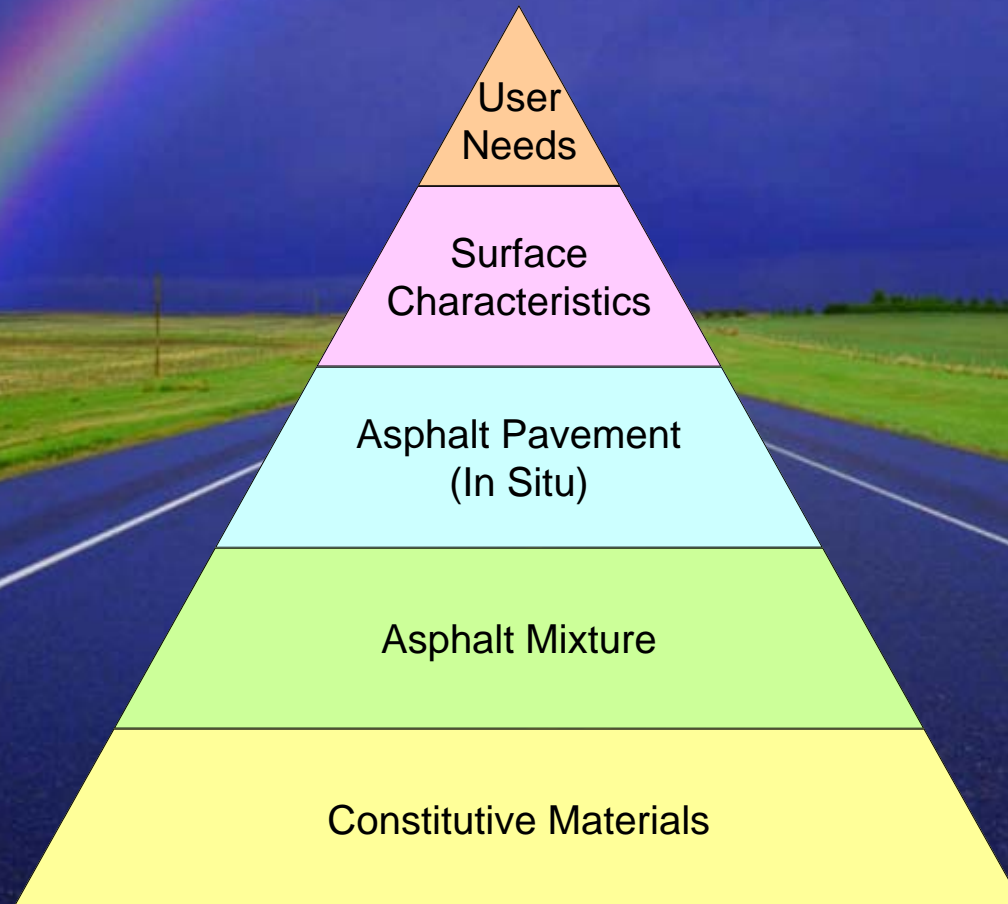


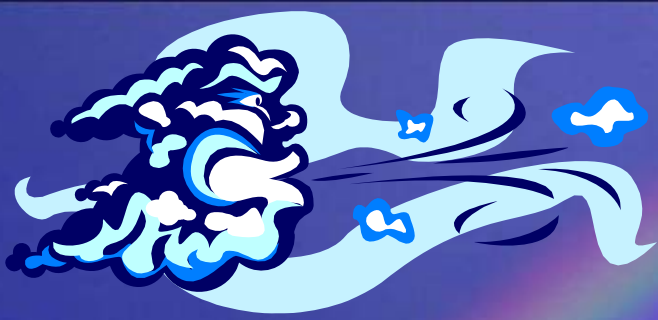
European Mix Design Practices

- 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





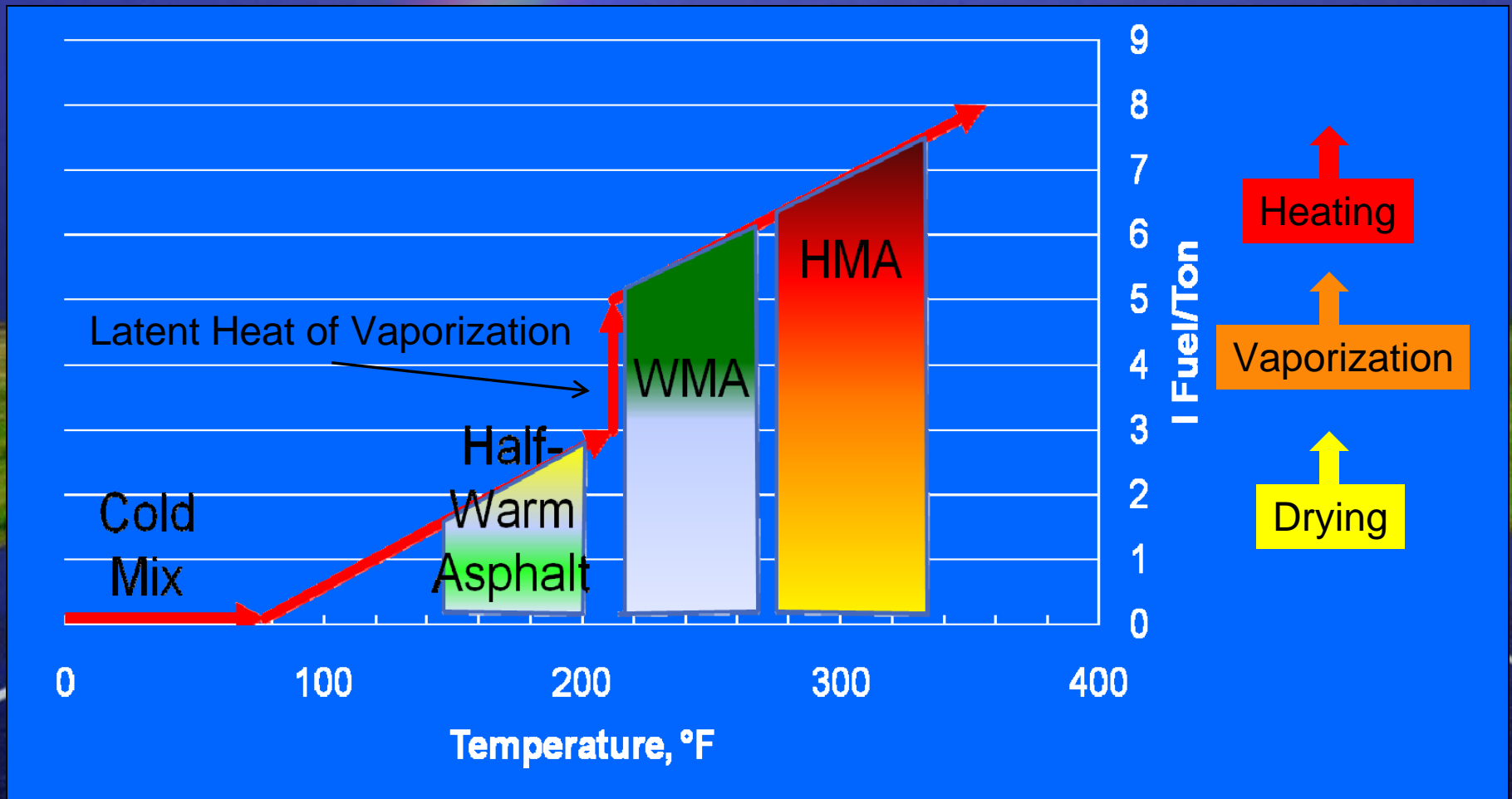
WMA Technologies

- Organic Additives
- Foaming Systems w/ Stabilizers
- Emulsion Systems
- Others...

Warm Mix Asphalt Technologies

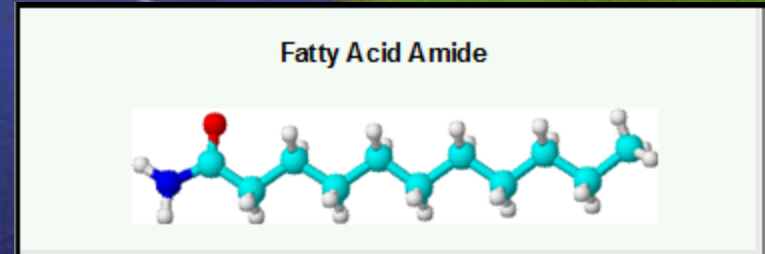
- **Organic, Wax-like additives**
 - Sasobit® – Sasol International
 - Asphaltan B – Romanta
 - Fatty Acid Amides – Licomont S 100
- **Foaming Processes**
 - Aspha-min zeolite – MHI/Eurovia
 - Low Energy Asphalt – Fairco/Eiffage Travaux Publics
 - WAM Foam –Kolo Veidekke/Shell/BP
 - LEAB® – BAM
- **Emulsion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

Classification of WMA by Temperature Range

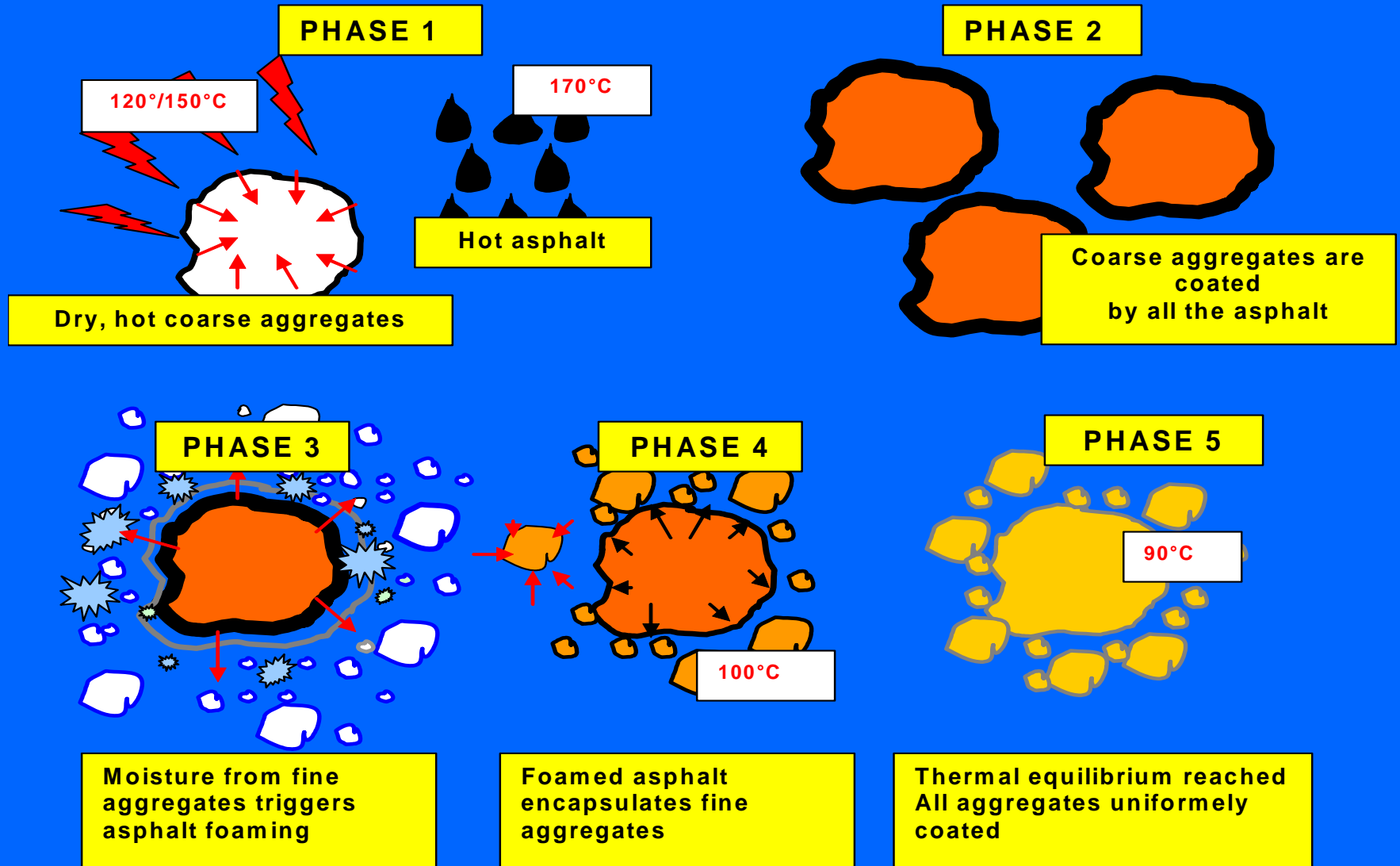


Licomont® BS 100

- Mixture of fatty acid amides
- Softening point ~ 286°F
- Available as powder or granules
- Sübit – modified binder used in Germany
- Similar products used in roofing industry



L.E.A's sequential mixing



LEAB®



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

Laboratory Foaming



Placement and Compaction

“Business as usual”

Primarily use:

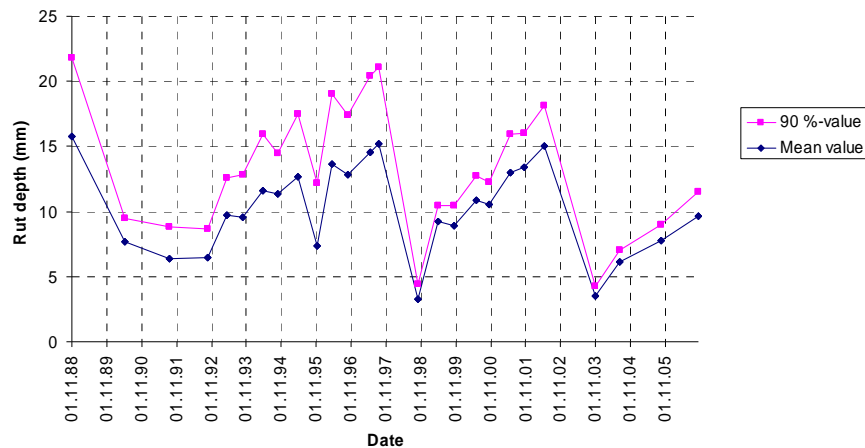
- Heavy, tamping bar, vibratory screed pavers
- Steel-wheel vibratory and static rollers
- Workability generally good



Performance of WMA



Rv152, Hp3, Km 0.046-2.339
Akershus



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

BASt Official rating

Here: B 3, Schönstadt-Schwarzenborn

Tabelle 2: Qualitative Bewertung der Erprobungsfelder im Vergleich zum Referenzfeld

Streckennummer	1	2	3	4	5	6
Feldmessungen						
Spurrinnenbildung ¹	gleich	gleich	gleich	gleich	gleich	gleich
Nachverdichtung in der Rollspur	gleich	günstiger	gleich	günstiger	günstiger	gleich
Rissbildung	gleich ²	gleich ²	gleich ²	gleich ²	gleich ²	gleich ²
Laboruntersuchungen						
Wärmestandfestigkeit	günstiger	günstiger	gleich	günstiger	gleich	günstiger
Tieftemperaturverhalten	gleich	gleich oder günstiger	gleich	gleich	gleich oder günstiger	gleich oder günstiger
Alterung des Bindemittels	gleich oder günstiger	gleich oder günstiger	gleich oder günstiger	gleich oder günstiger	gleich	gleich
Haftung	gleich oder günstiger	gleich oder günstiger	günstiger	gleich	gleich oder günstiger	gleich oder günstiger

¹ auf niedrigem Niveau = 10 mm; ² gleich = keine; * es liegt kein Referenzfeld vor, siehe [2]

Track No.	5	
Field testing	Rutting ¹	equal
	Postcompaction in main lane	better
	Cracking	equal ²
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 Temperaturabsenkung von Asphalt“; bast 08/2006

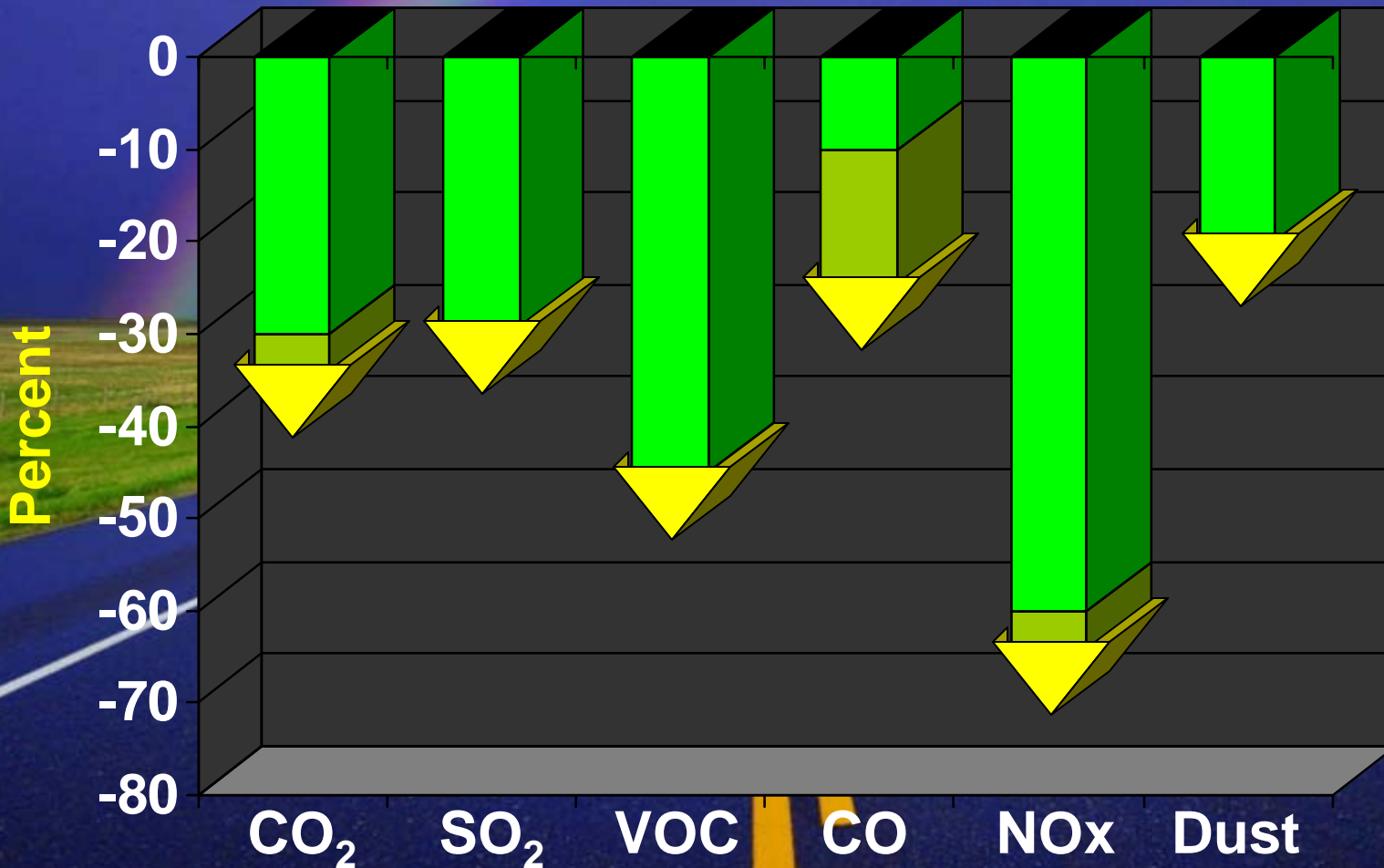
Benefits of WMA

- 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

- CO₂ reduced 30-40%
- SO₂ reduced 35%
- VOC reduced 50%
- CO reduced 10-30%
- NO_x reduced 60-70%
- Dust reduced 20-25%

Reduced Emissions



Benefits of WMA



No Fugitive Emissions



SCAN Challenges

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



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?



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

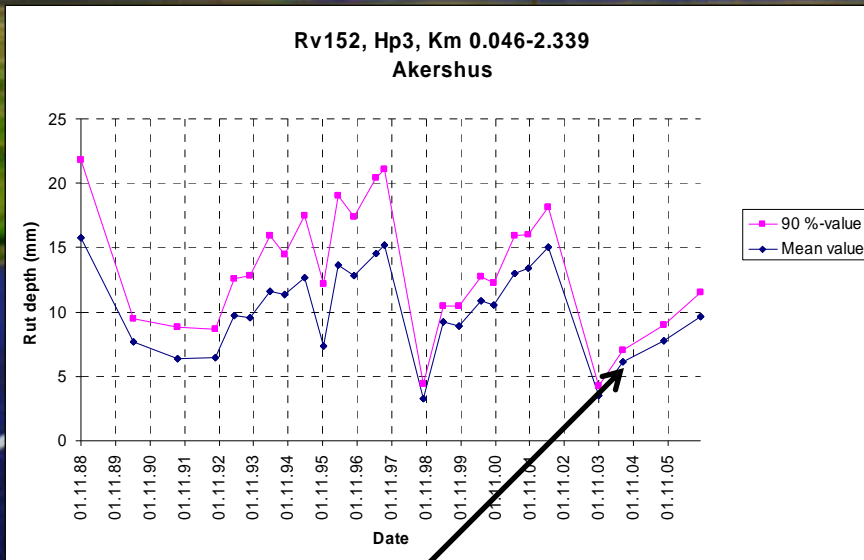


The slide features a blue header with a logo of four white dots and the text "Research at Eurovia". The main content is a white box with a blue border containing a bulleted list. To the right of the text are three images: a hand holding a glowing blue cube, a person working at a computer with a microscope, and a modern white building with a pond in front.

Research at Eurovia

- Research and Development Centre
- 100 machines in 37 rooms, performing 160 different tests
- R&D programme:
 - Environmental protection,
 - Safety,
 - Road infrastructure management,
 - Materials and structures.
- Organisation:
 - 30 engineers and technicians
 - 10 students
 - 20 partnerships with universities, research institutes and laboratories in France and abroad.

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.



WAM-Foam

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

Implementation Goals

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

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.

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:
http://www.hotmix.org/view_article.php?ID=537
- The factors affecting the economic viability of WMA need to be identified and tracked.

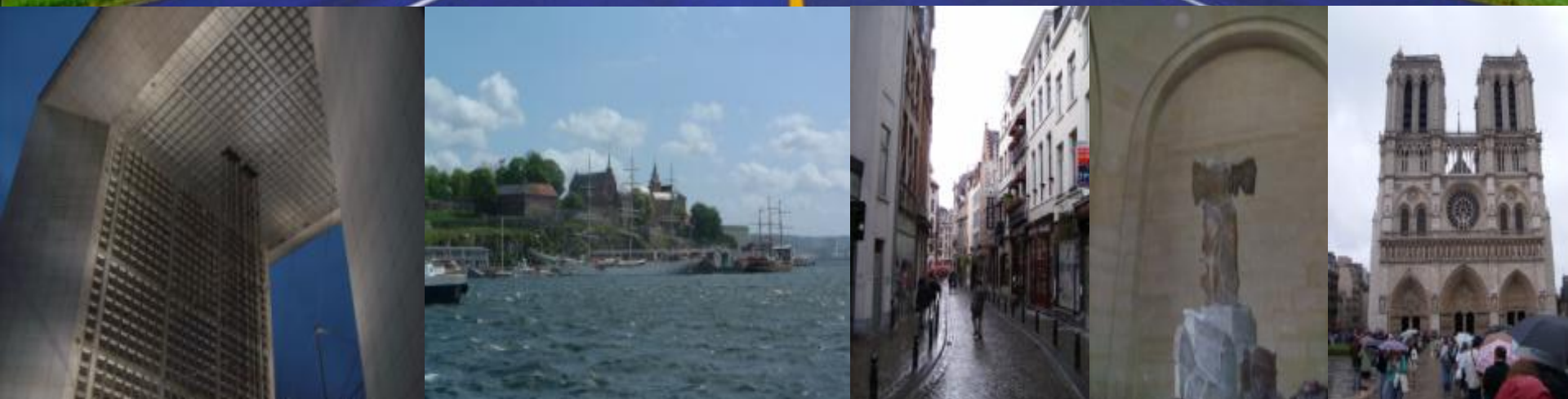
Conclusions

- 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



Thank You!

Questions/Discussion?



WAM-Foam

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

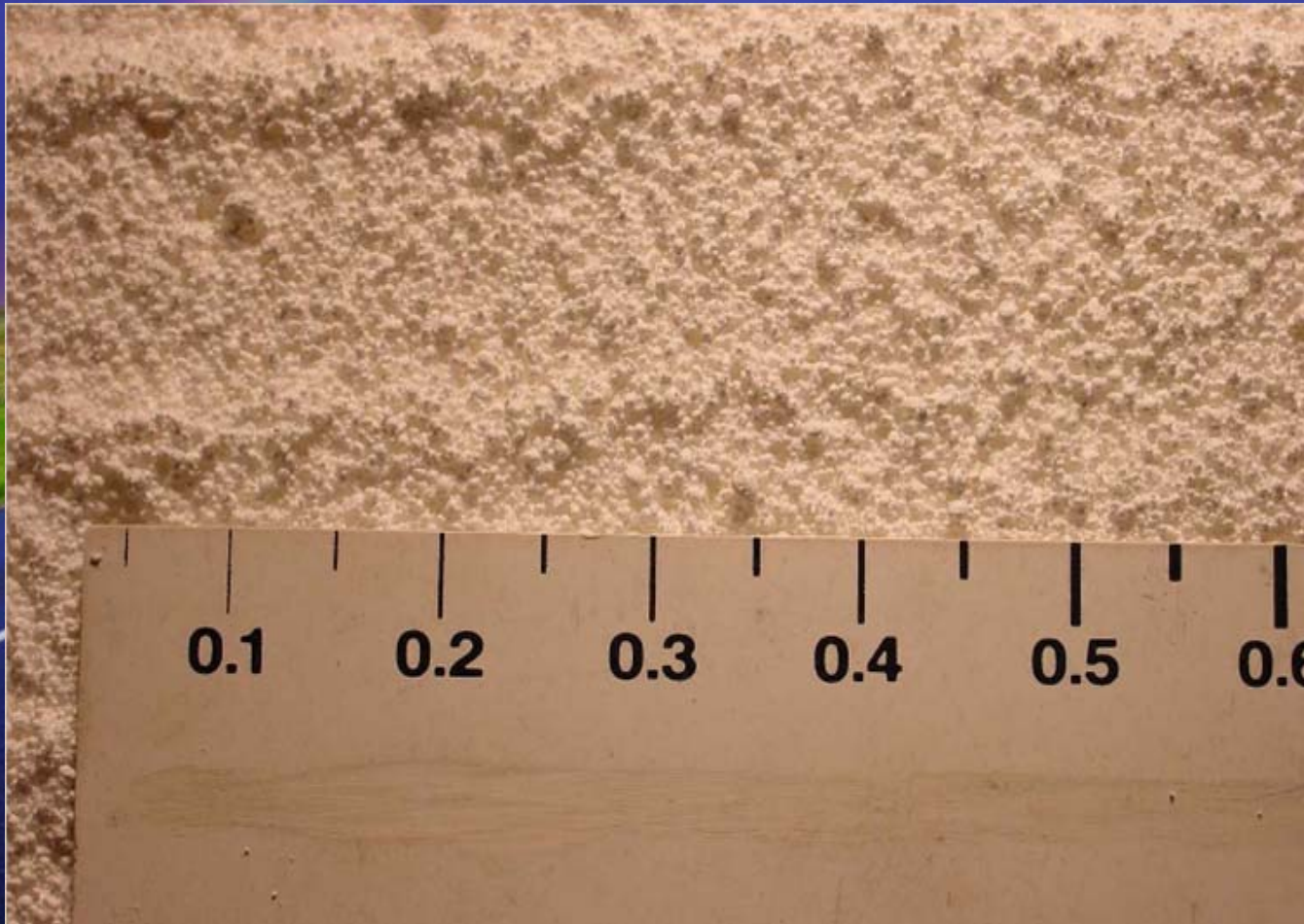
WAM Foam Installation in Hot Mix Asphalt Plant



Zeolite

- 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

Granulated aspha-min[®]



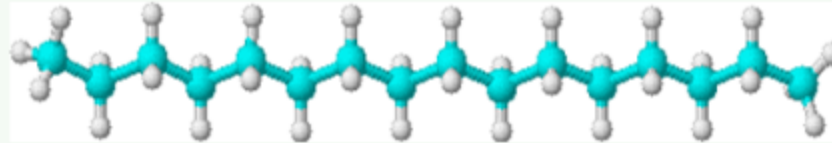
Sasobit®

- Fischer-Tropsch synthetic waxes – Sasobit
 - Produced by treating hot coal or natural gas feed stocks with steam in the presence of a catalyst
 - They are long-chain aliphatic hydrocarbon waxes with a melting point of more than 208°F
 - Added to binder or directly into mix
 - May negatively impact low temperature properties

Chemical Structures of Modifiers 1-3

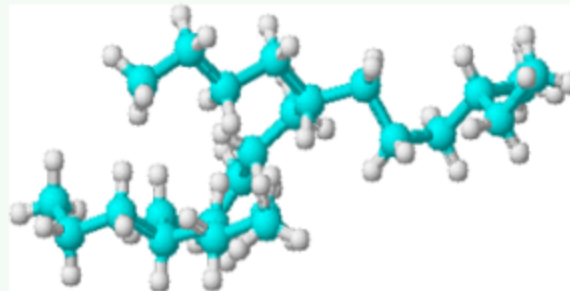
Sasobit

Hydrocarbons (linear)

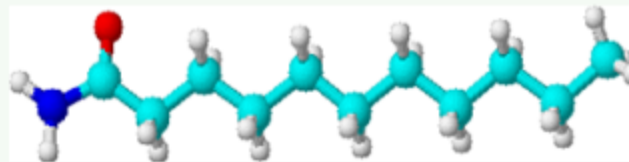


Montan Wax

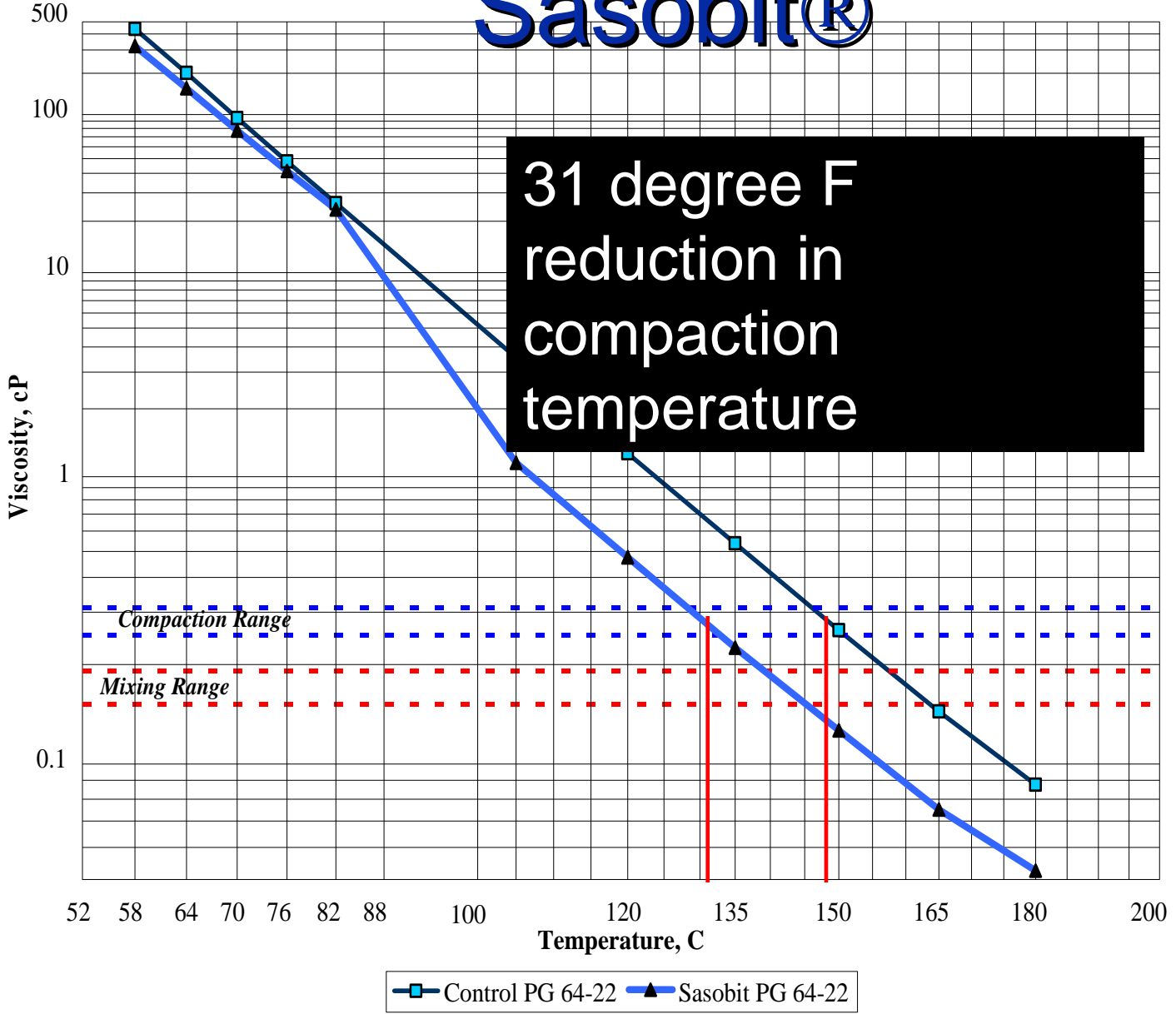
Hydrocarbons (branched)



Fatty Acid Amide



Sasobit®



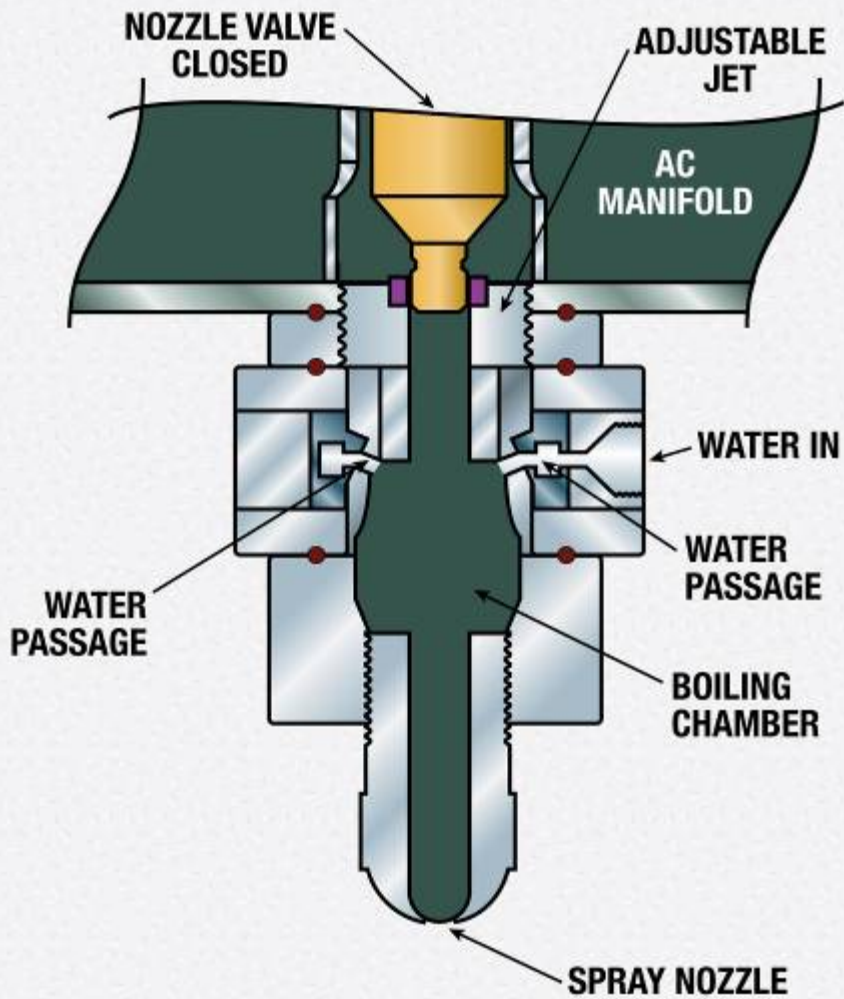


Sasobit®

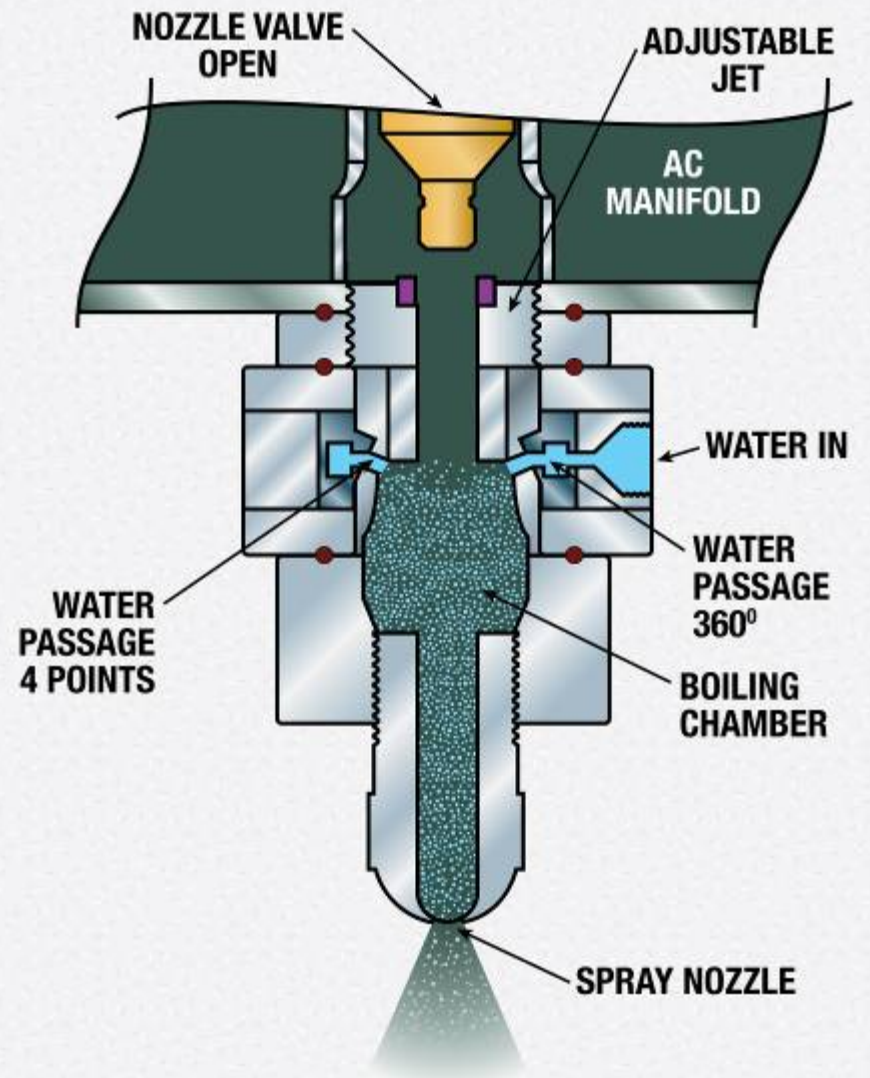


Evotherm®

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



FOAM NOZZLE CLOSED



FOAM NOZZLE OPEN

FOAM NOZZLE

Water injector located on the liquid asphalt intake on drum.





Tamping bars on heavy, tamping bar, vibratory screed paver