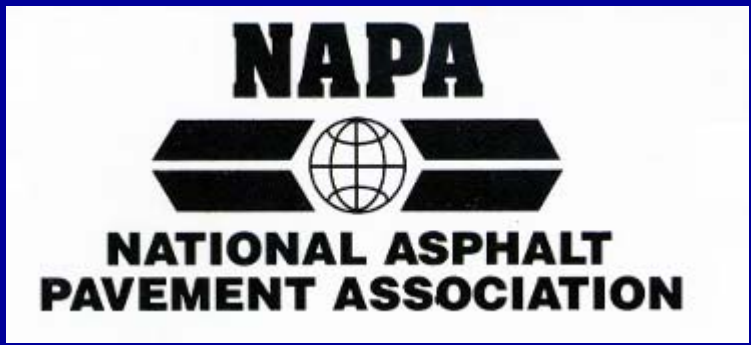
Warm Mix Asphalt



General Trends

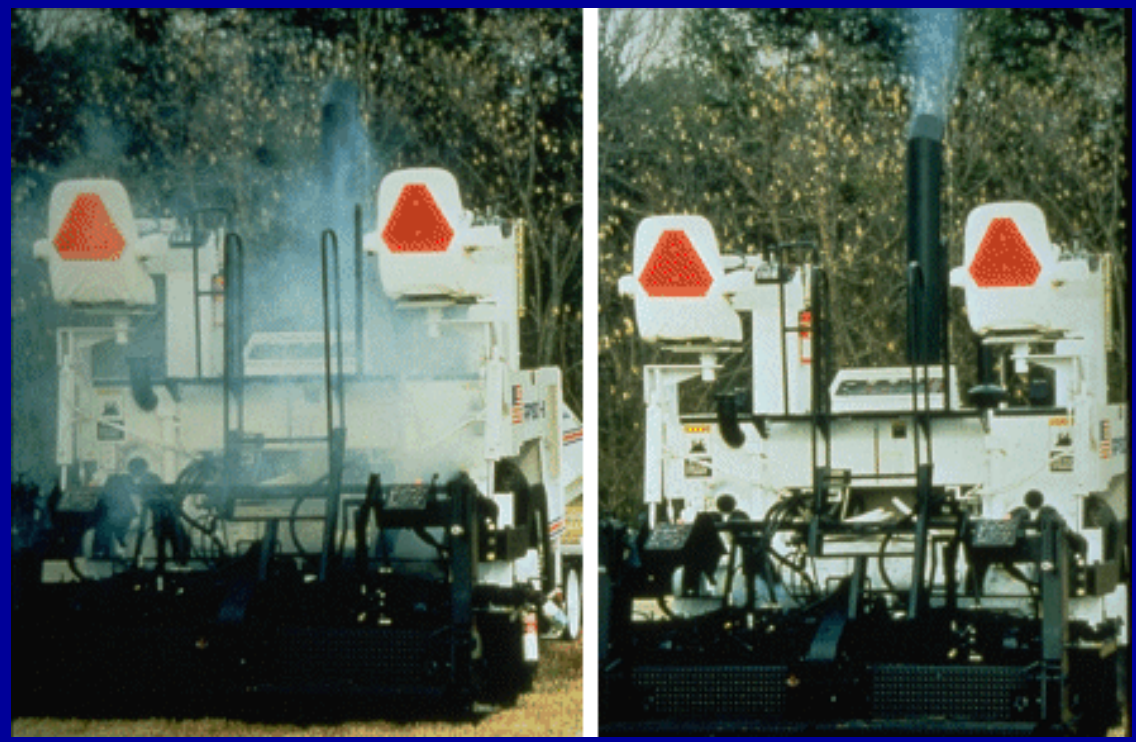
- Regulations
- Activism
- Higher Production Temperatures

NAPA Strategic Goal:

Reduce Emissions, Fumes and Odors

Strategies

- Engineering Controls
- Best Management Practices
- Low Fuming Asphalts
- Warm Mix Asphalt



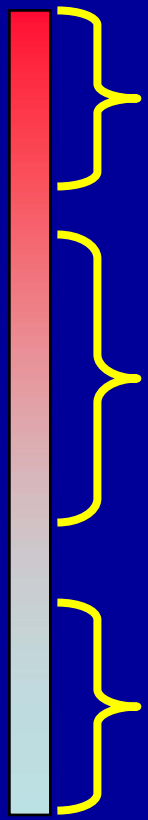
EC 101

Best Management Practices To Minimize Emissions During HMA Construction

ASPHALT PAVEMENT ENVIRONMENTAL COUNCIL

NATIONAL ASPHALT PAVEMENT ASSOCIATION
ASPHALT INSTITUTE
STATE ASPHALT PAVEMENT ASSOCIATIONS

What is Warm Mix Asphalt?



Hot Mix Asphalt 275-325°F

Warm Mix Asphalt 250-275°F

Cold Mix Asphalt 60°F

Brief History

- 1997 German Bitumen Forum
- 2000 Second Euroasphalt & Eurobitume Congress (Barcelona)
- NAPA 2002 European Scan Tour
  - Germany and Norway
- NAPA 2003 Annual Convention
  - San Diego
- World of Asphalt 2004

Why Warm Asphalt?

NAPA/State Asphalt Pavement Associations funded research by Stroup-Gardiner and Lange at AU indicates increased emissions with increased temp.

Advantages of Lower Temperatures

- Lower fumes and emissions
- Lower energy consumption
- Lower plant wear
- Decreased binder aging
- Early site opening
- Cool weather paving
- Compaction aid for stiff mixes

Goals for Warm Mix Asphalt

- Use existing Hot Mix Asphalt plants
- To meet existing standards for Hot Mix Asphalt specifications
- Focus on dense graded mixes for wearing courses
- **WMA quality = Hot Mix Asphalt quality**

Available WMA Technologies

Processes include:

- WAM Foam – Shell/Kolo Veidekke
- Zeolite – Eurovia/Hubbard Construction
- Sasobit – Sasol Int./Moore and Munger
- Evotherm - MeadWestvaco
- New processes

Warm Asphalt Mix (WAM) Foam

- Joint development between Shell and Kolo Veidekke to produce asphalt pavements at lower operating temperature

WAM-Foam

- Two Phase addition of asphalt
  - Aggregate coated with “soft” asphalt
  - Hard asphalt foamed to mix with pre-coated aggregate
  - Typical mixing temperature 250^{o}F
  - Requires plant modification for foaming, estimated at $50,000 - $70,000.

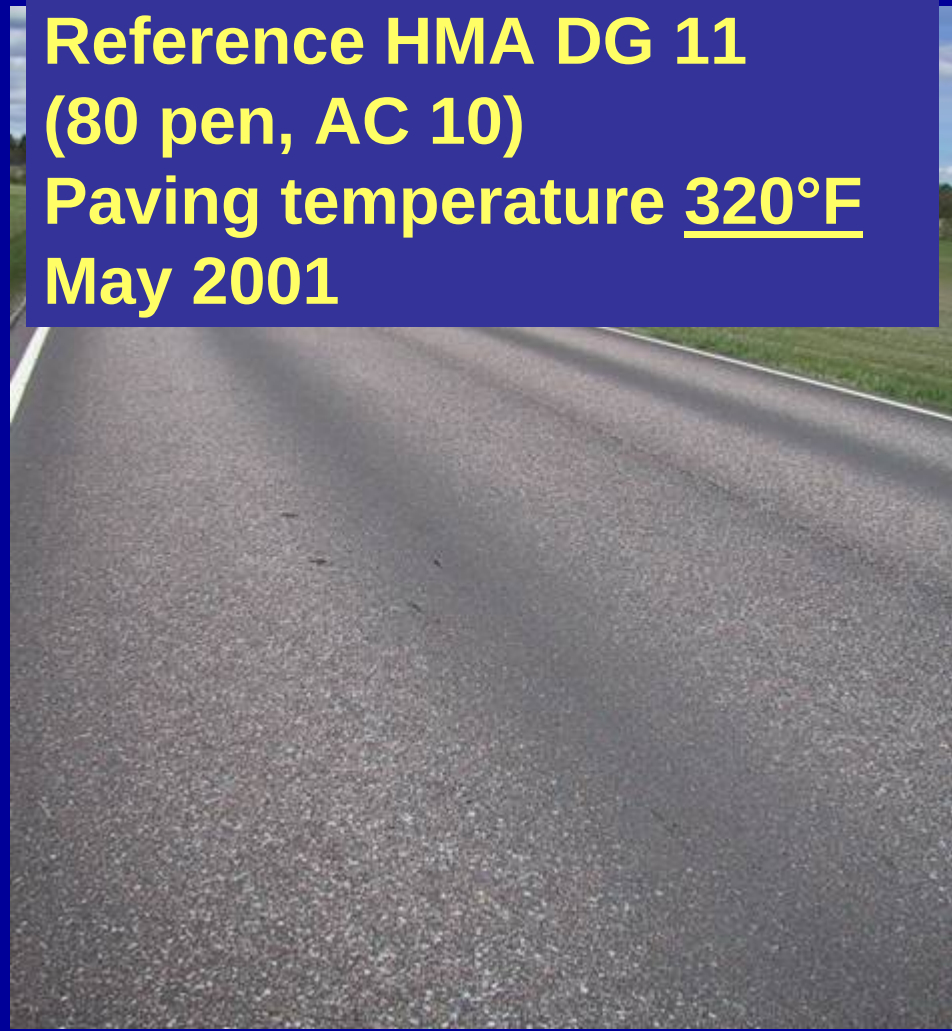

Hot Mix (155 °C)
311 °F
WAM (110 °C)
230 °F

HMA vs. WAM-Foam

Field trials RV 120 September 27, 2000.

WAM-Foam, DG 11
(80 pen, AC 10)
Paving temperature 194°F
May 2001

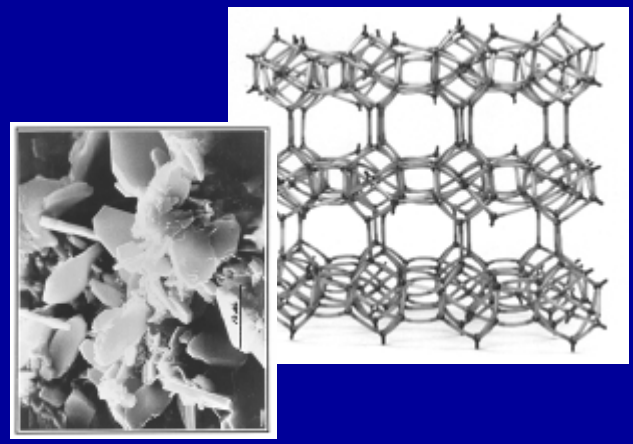
Reference HMA DG 11
(80 pen, AC 10)
Paving temperature 320°F
May 2001



EUROVIA

Warm Asphalt Mixes by adding aspha-min®, a synthetic zeolite

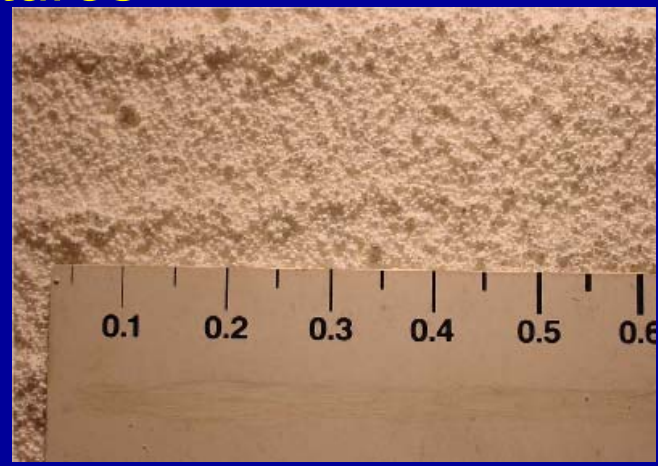
Aspha-Min®



- Zeolites
  - Framework silicates have vacant spaces in their structures that can trap water
    - Spaces interconnected forming long wide channels
  - Can lose and absorb water without damage to crystal structures
    - The trapped water is driven off by heat

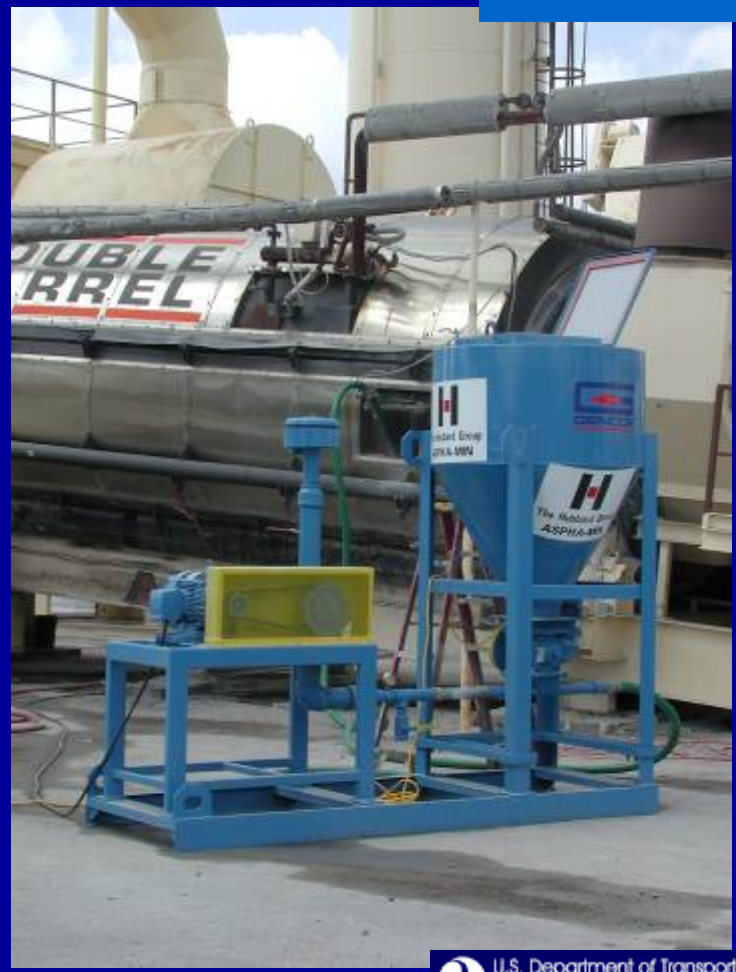
Aspha-Min®

- Zeolites
  - Framework silicates have vacant spaces in their structures that can trap water
  - Water is driven off by heat
- Add 0.3 percent by mass to mix
  - Water is released at high temperatures
    - 185 to 360º F
    - Foams the asphalt
      - Reduces viscosity
- Reported by Eurovia
  - 54º F reduction
  - Fuel savings of 30%



Aspha-Min® is a fine white powder

Aspha-Min®



EUROVIA

U.S. Department of Transportation
Federal Highway Administration

Aspha-Min®

Aspha-min Field Sections

- Paving project in Germany – Fall 2003
- Orlando Paving Company – First U.S. trial February 2004
- World of Asphalt – March 2004
- Charlotte, NC – Blythe Construction – September 2004

Polymer Modified Warm Asphalt with Zeolite at 250 F

94% Gmm
55 F Air Temp.

4 passes of Rubber Tire, followed by 4 vibratory passes, followed by static finish roller

Seeing is Believing!

Hot Mix 314 F

138.1 pcf

Warm Mix 254 F

138.5 pcf

Sasobit®

- Product of
  - Sasol Wax GmbH (Germany)
- Fischer-Tropsch parrafin wax
  - Fine crystalline long chain aliphatic hydrocarbon
  - Produced from coal gasification
- Available in
  - Flakes or powdered form
  - 2, 5, 20, and 600 kg bags

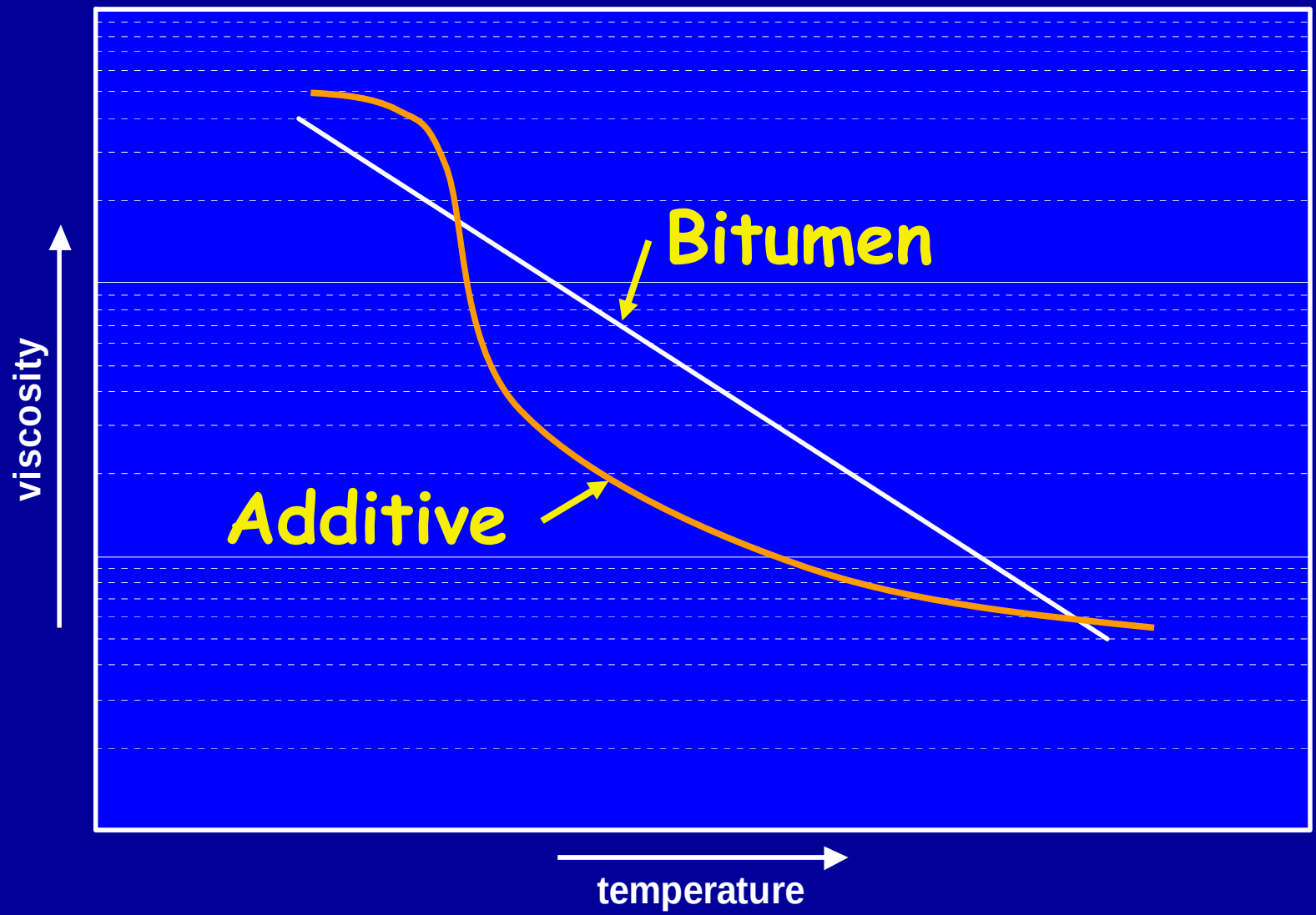
Sasobit®

- Fischer-Tropsch waxes
  - Different than naturally occurring asphalt waxes in structure and physical properties
  - Higher melting point
  - Lower penetration
  - Higher viscosity
  - Higher molecular weight

Sasobit®

- Add at 3 percent by weight
  - Caution when > 4 percent
    - May impact low temperature properties
- Recommended Application
  - Blend with hot asphalt in stirred tank
  - Feed liquid into the asphalt plant
  - Do not add solid directly to asphalt mix

How organic additives work



Organic additives

Experiences with organic additives

Frankfurt Airport

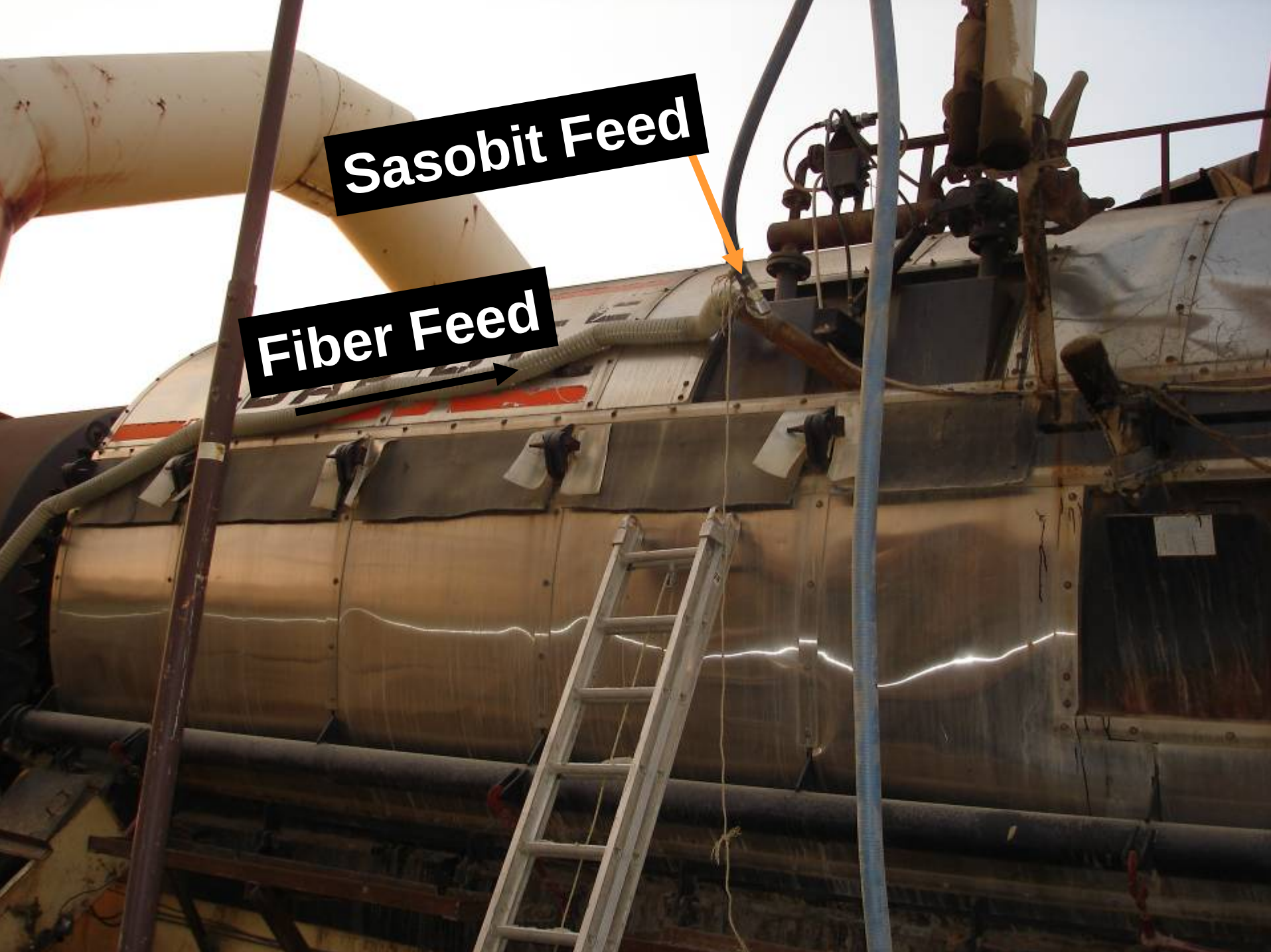
- Asphalt mixture laid at low temperature
- Better compactability
- Increased resistance to deformation at high temperatures

Frankfurt Airport

- Bear heaviest aircraft in 2-3 hours
- Reduced cooling, key to 300-step project

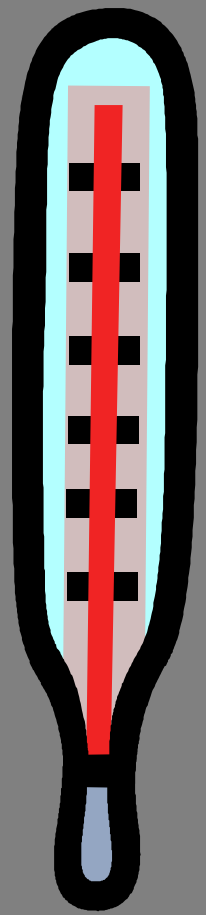
Maryland Demo

- August 2005
- Washington Beltway – Very high traffic
- SMA intermediate course
- Conventional SMA surface
- Intelligent compaction


Sasobit Feed
Fiber Feed


EVOTHERM
WARM MIX ASPHALT TECHNOLOGY
ASPHALT INNOVATIONS™
A MeadWestvaco Business

EVOTHERM
Effective Temperature Range*



Hot Mix: 150°C (302°F)

Temperature Difference:
45-90°C (81-162°F)

EVOTHERM: 60-105°C (140-221°F)

*Mixing Temperature

EVOTHERM Overview
Technology Highlights

- Innovative chemical additive technology
- Chemical structure developed & optimized for warm mix performance
- Molecular structure imparts coating, workability, strength, and adhesion
- Dispersed Asphalt Technology (D.A.T.) delivery system
- Mix & compaction temperatures as low as 60°C (140°F)
- Openly available to end users; no licensing

EVOTHERM Overview Production

- Mix & compaction temperatures as low as 60°C (140°F)
- No plant modifications required
- No unit operations problems encountered
- Reduced dust generation
- Siloable mixes

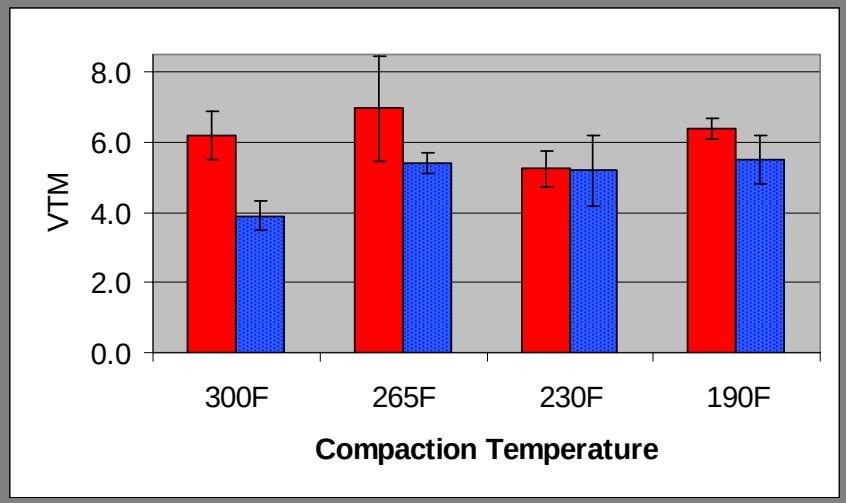
EVOTHERM Field Trials

SHRP and conventional mixes, using standard production, laydown, & compaction methods

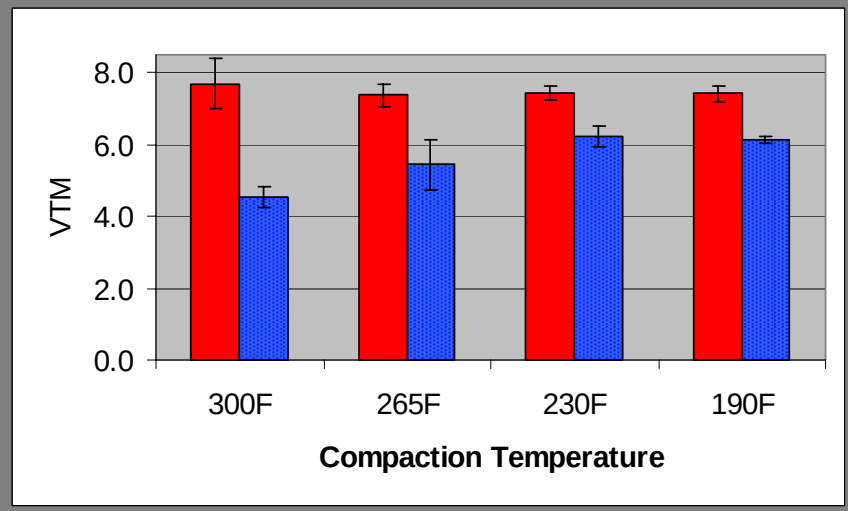
Immediate release to traffic

NCAT Study on Warm Mix Asphalt

Voids in the mix versus temperature via vibratory compactor (PG 64-22 mixes)



GRANITE

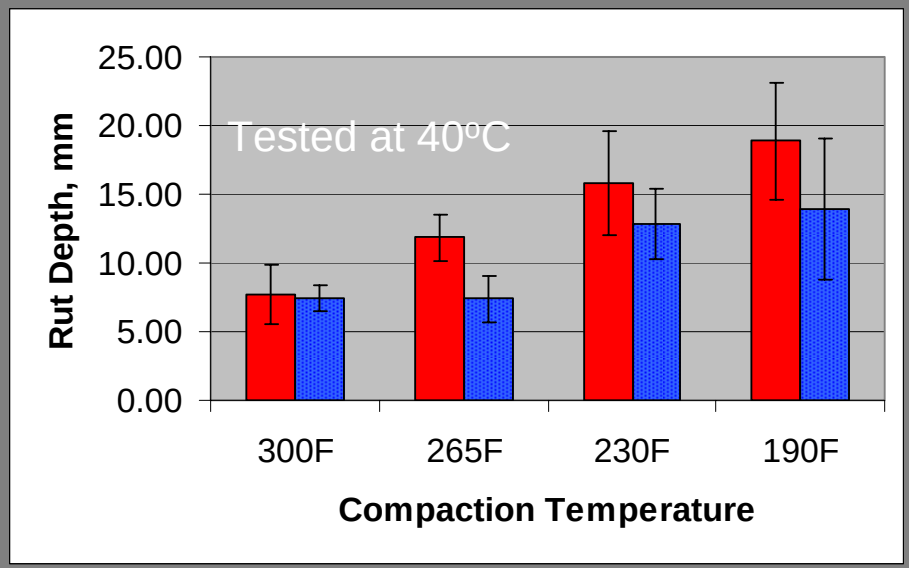


LIMESTONE

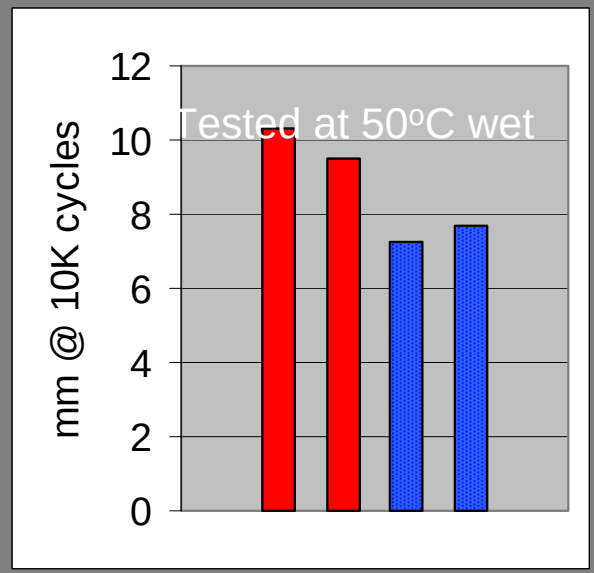
HMA EVOTHERM

NCAT Study on Warm Mix Asphalt

APA and Hamburg results were similar for HMA and EVOTHERM granite / PG 64-22 mixes



APA Rutting Depths



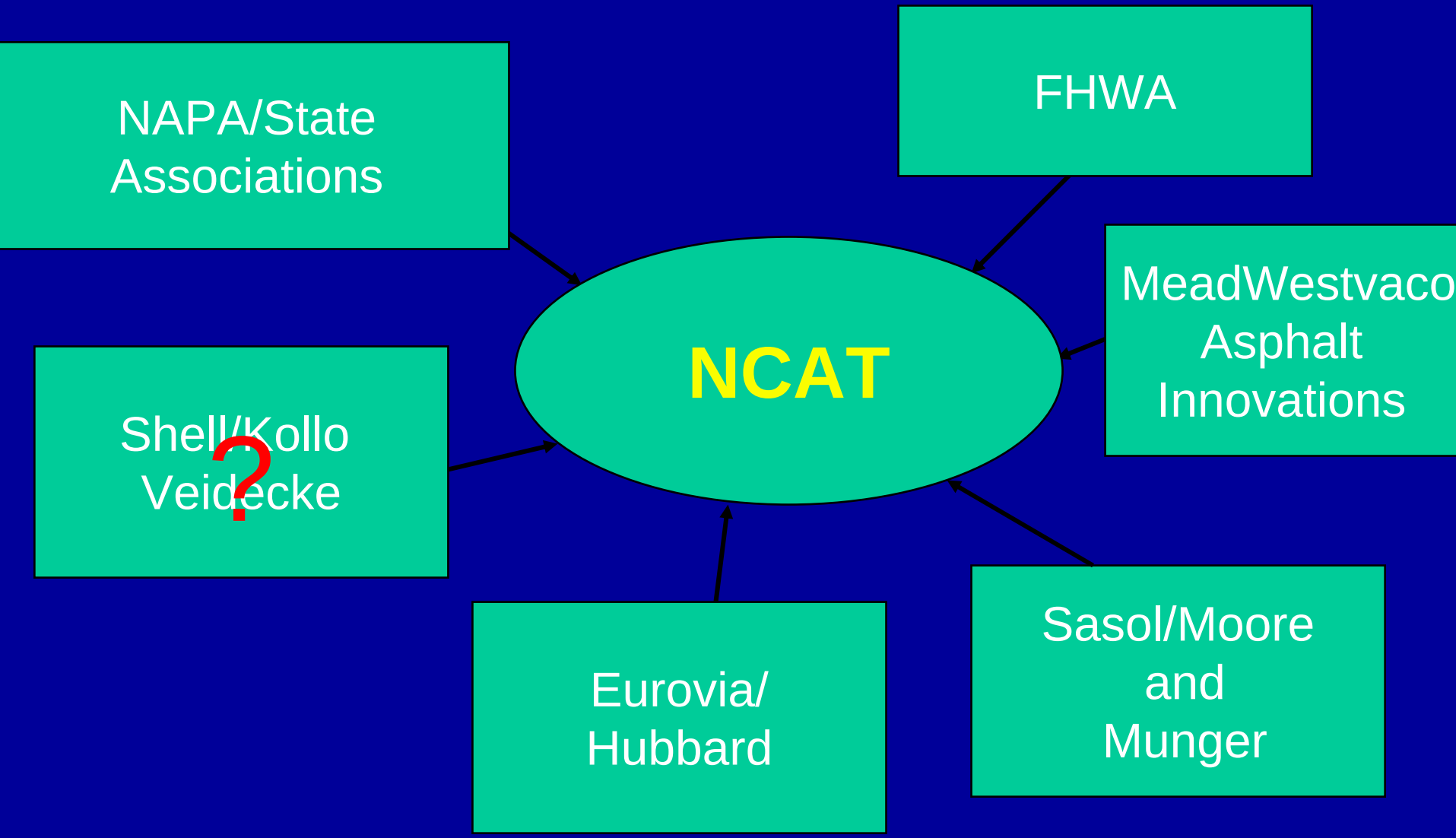
Hamburg

HMA EVOTHERM

NCAT Study

- Evaluate Warm Asphalt Technologies for U.S. Paving Practices
  - High production
  - Rapid Turn-over to traffic
- Potential Concerns
  - “Curing” Time
  - Increased Potential for Moisture Damage
  - Binder effects

Project Partners



Summary of Compaction Testing to Date

- Aspha-min and Sasobit improved laboratory compaction
- Average reduction of 0.84% air voids for Aspha-min, 0.95% for Sasobit
  - Improvement seen as low as 190 F Aspha-min, 230 F for Sasobit

Summary of Stiffness and Permanent Deformation

- Two reports available for free download from NCAT website. One more coming soon.
- No evidence of required “cure time”
- The inclusion of zeolite did not effect modulus or APA rut depth
  - Decreased temperature did decrease modulus and increase rut depth. May be due to decreased aging of the binder
  - Higher density generally resulted in higher modulus

Concerns?

- Rutting potential increases at lower temperatures due to reduced short-term aging of binder
  - How soon does in-place aging “catch up”
  - May need binder bump or other additive (lime) below 250 °F
- Moisture in mix/Moisture susceptibility
  - Lab tests at low temperature starting with damp aggregates indicate increased moisture susceptibility in some cases
  - Can be mitigated with appropriate additives

Simulating a Drum Plant

Recommendations

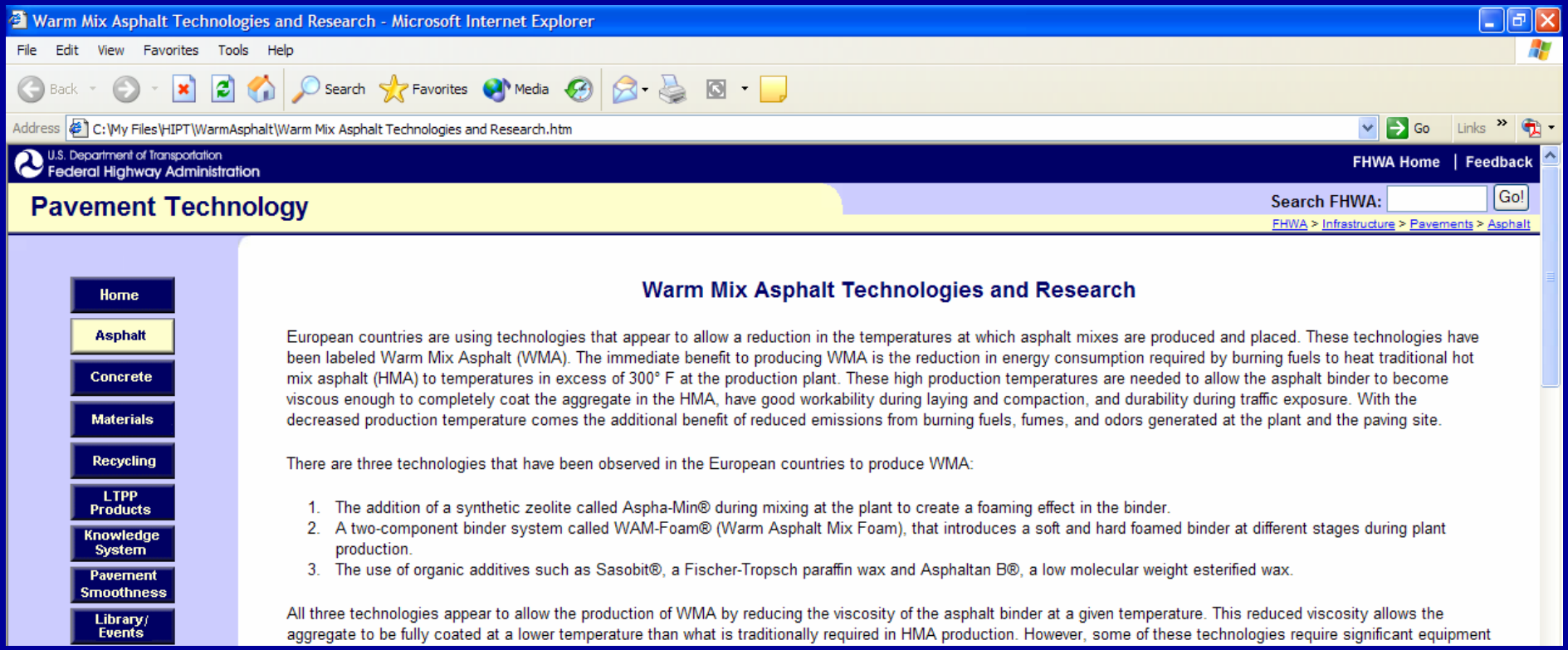
- At this time, determine optimum asphalt content without warm asphalt additive
- If mixing temperature is below 275 °F, consider using stiffer binder grade
- Conduct Tensile Strength Ratio Tests at anticipated production temperatures
- Consider use of Hamburg wheel tracking test in lieu of TSR

What Next?

- Field Trials! - There are many more questions that need to be answered about:
  - compaction
  - moisture in the mixes
  - strength gain/aging in-place
  - environmental impacts
- More laboratory work to back up field work and develop future framework for use
  - Evaluation protocol for new products

Written Summary of WMA @

www.fhwa.dot.gov/pavement/wma.htm




Questions?