

Field Performance of Warm Mix Asphalt

2008 Annual Meeting
Southeastern Asphalt User/Producer Group



Brian D. Prowell, Ph. D., P.E

Acknowledgements

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- The author was employed by NCAT when much of the field work was completed. AMS is subcontractor to NCAT for the current project.
- The author thanks Andrea Kvasnak, project P.I., and the NCAT staff for their assistance.



Warm Mix Research Circa 2004 Study Objectives

- 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

Note: This slide is from a 2004 presentation on WMA



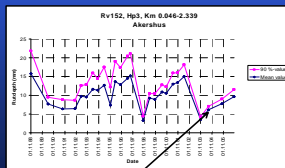
Warm Mix To Date

- More than 60 projects across the U. S.
- Well over 300,000 tons of warm mix
- Additional “commercial” utilization



FHWA Warm Mix Scan:

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.

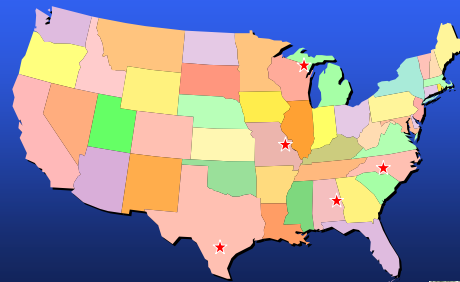


WAM-Foam

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



WMA Case Studies



Highway 115, Charlotte, NC

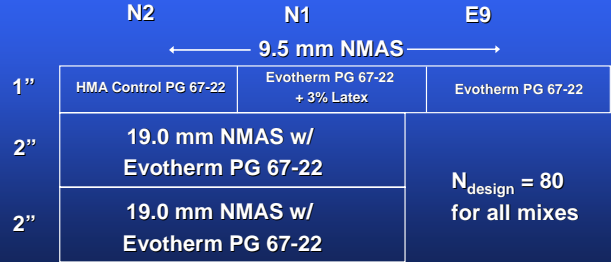
- Placed September 2004
- Aspha-min®
- PG 70-22, 9.5 mm NMAS, 10 gyration
- 10% RAP



After 26 months



Evotherm Test Sections NCAT Test Track - November 2005



Evotherm Wearing Course with Latex

Mix Produced 7:00 PM

Mix Loaded out 1:30 PM – next day

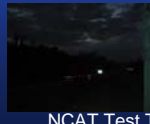


Mix held in silo at 240F overnight



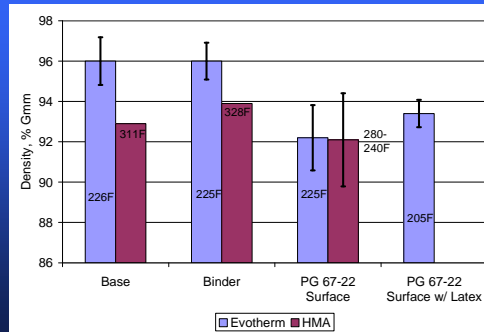
Mix Placed at 3:15 PM

Traffic Returned at 5:00 PM



NCAT Test Track

Evotherm Test Track Pavement Densities



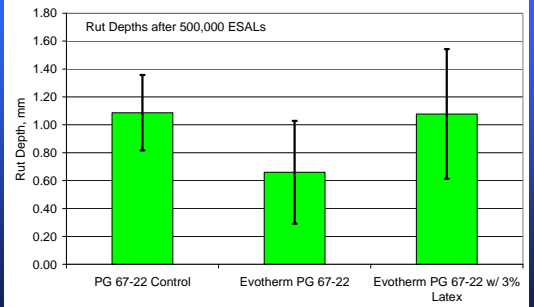
Asphalt Pavement Analyzer

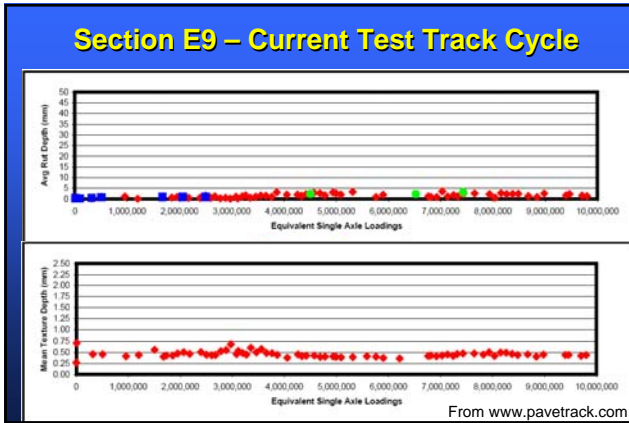
Mix Type	SGC Avg. Air Voids at N _{design} , %		Avg. APA Rut Depth, mm	
	WMA	HMA	WMA	HMA
9.5 mm Surface w/ PG 67-22	3.18	4.95	7.85	7.56
9.5 mm Surface w/ PG 67-22 +Latex	2.45	NA	5.14	NA
9.5 mm Surface w/PG 76-22 (SBS)	NA	5.2	NA	3.83
19.0 mm Binder	2.57	3.7	5.71	5.84
19.0 mm Base	2.35	3.7	7.40	5.84

Voids 40% less with Evotherm™ @ compaction temp. 100°F below HMA



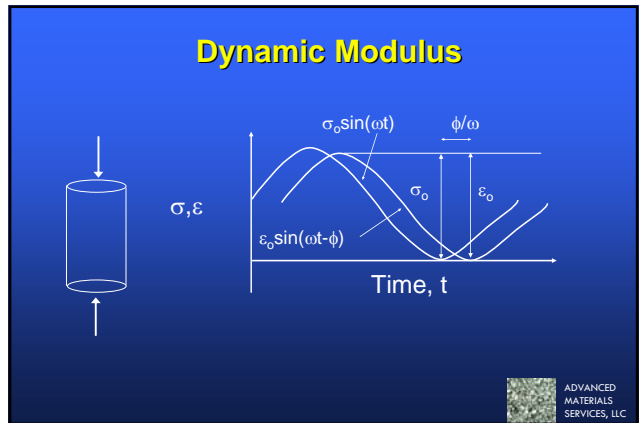
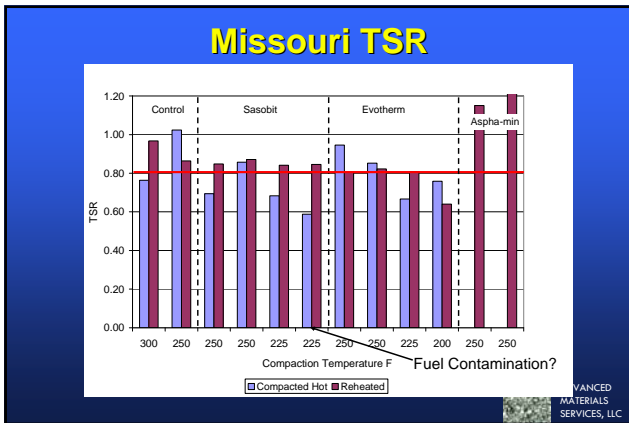
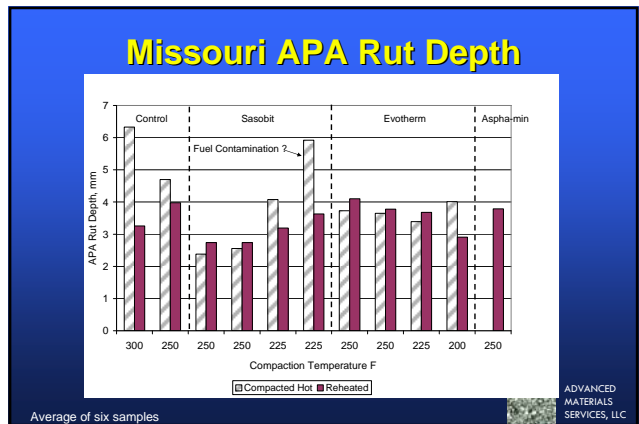
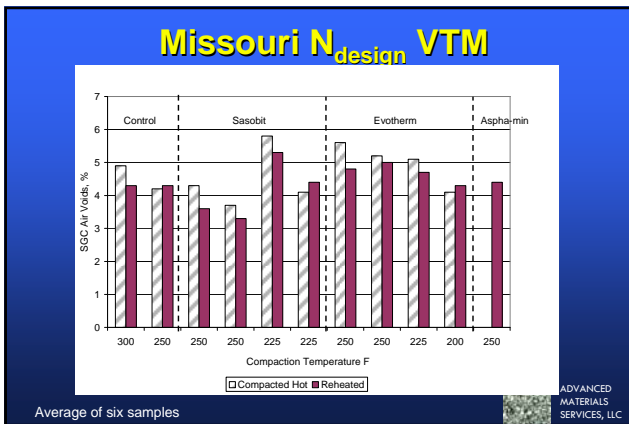
Evotherm Field Rut Depths - NCAT Test Track



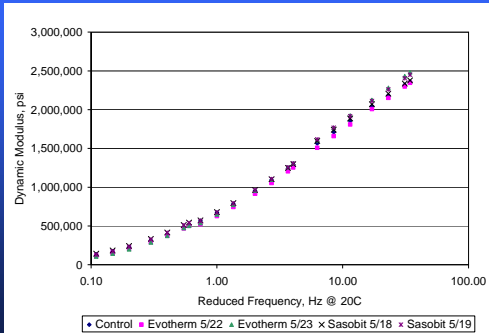


Hall Street, St. Louis, MO – May 2006

- Industrial area
- 2 lanes in each direction, plus turn lane
- WMA used to improve overlay smoothness
- Used
 - Aspha-min
 - Evotherm
 - Sasobit



Missouri E* Master Curve



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Burners at Lower Temperatures

- Low production rate for “demonstrations” may aggravate problems from reduced temperatures
- Burner problems tolerable with HMA, unacceptable with WMA
- HMA forgiving, heat will drive off volatiles before testing/placement
- Reducing fuel pressure may help – band-aid
- Good to have manufacturers representative present until we gain more experience

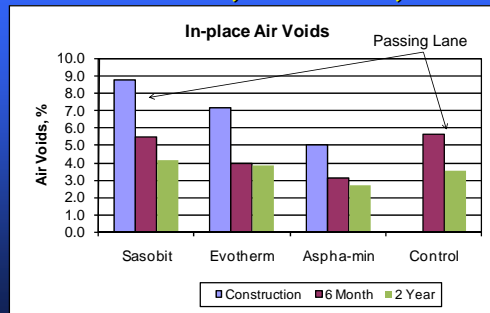
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Missouri Field Rut Depth

Mix	Lane	Avg. Rut Depth, mm	
		6 Months	2 Years
Control	NB Passing	1.1	0.5
Aspha-min	SB Travel	0.3	0.5
Evotherm	NB Travel	1.1	1.1
Sasobit	SB Passing	0.8	0.8

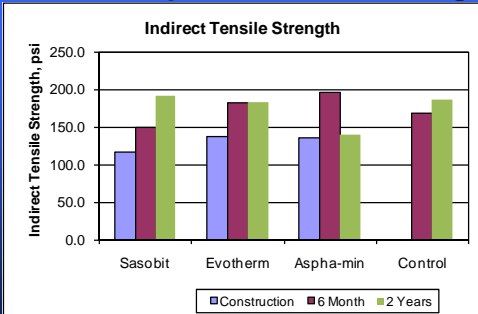
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Hall Street, St. Louis, MO



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Missouri In-place Tensile Strength



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Loop 368 - San Antonio

August 2006

- ~ 1200 tons (Evotherm)
- AC Content
 - Control - PG 76-22, 4.8%
 - Warm Mix - PG 76-22 (after mod), 4.8%
- Temperature (plant)
 - Control 320°F
 - Warm Mix 220°F
- Laydown and Compaction
 - Some roller pattern on control and warm mix.
 - No problems during laydown and compaction
 - Traffic allowed in some areas as soon as 2 hours after placement



Courtesy Dale Rand

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M95 Iron Mountain, MI – September 2006

- 9.5 mm NMAS
- $N_{design} = 86$ gyrations
- PG 58-34
- 1.5% Sasobit – can affect low temperature grade
- Carries logging trucks
- Upper peninsula – cold!

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Michigan WMA

- Mix Temperature - 260°F WMA vs 310°F HMA (50°F reduction)
- NO_x - 34% reduction from HMA
- VOC - 8% increase from HMA
- CO_2 – 18% reduction from HMA
- CO – increased compared to HMA
- Fuel Usage – 10% reduction from HMA
 - Combined VOC and CO indicate incomplete combustion

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After 2-years No Cracking

Sasobit

Control HMA

Rutting:
WMA 0-1/16"
HMA 1/16" – 2/16"

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Commercial Use of WMA

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Cold-weather Paving



- The greater the differential between the mix and ambient temperatures, the faster the mix cools
- WMA cools slower
- WMA allows compaction at lower temperatures


PG 82-22, January 12, 2008
 Avg. Density: 93.9% cores
 93.7% nuclear gauge



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Summary of Experience to Date*

- Concern: How do we design WMA?
 - NCHRP 9-43 project under way – completion 2010
- Our thoughts
 - Used to recommend dropping into existing HMA design
 - Now believe you should design with WMA process
 - Foam designs may need to be done through the plant




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*Brian's opinions

Summary of Experience to Date*

- Concern: is WMA rut resistant?
 - Less aging of binder during production – not as stiff
- WMA has been rut resistant to date
 - Quick turnover to traffic
 - Accelerated loading
 - Industrial areas




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*Brian's opinions

Summary of Experience to Date*

- Concern: Moisture damage?
 - Aggregate may not be dry
 - Binder is softer due to reduced aging (softer binders more susceptible to moisture damage)
- What we've seen
 - Lab TSR tests sometimes show lower values
 - Reheating or aging generally increases
 - No visual stripping in cores to date
 - Continue to monitor
 - Europeans use anti-stripping agents with WMA
- Addition of RAP should reduce potential for moisture damage and increase rutting resistance



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*Brian's opinions



Thanks!

Brian Prowell
 Advanced Materials Services, LLC
 1975 Mall Blvd., Suite 202
 Auburn, AL 36830
 (334) 408-4855
 Brian.AMSLLC@Charterinternet.com