

Warm Mix Asphalt & Beyond



Southeastern Asphalt
User/Producer
Group Annual
Meeting

Hilton Head, SC.
November 11, 2009

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Outline

- Update on Warm Mix Asphalt Usage
- Recycled Asphalt Pavement (RAP)
- Recycled Asphalt Shingles (RAS)
- Substitute Binders
- Pave-IR System



Initial Thoughts

- Before we save the planet, let's make sure it meets our specifications.
- Let's make sure it's not detrimental to our roads.
- We can try it, but what's the benefit to TxDOT?



Challenges

- Extra Cost (who is going to pay for it?)
 - Allow or Require
- Generic Specification Development
- Mix Design Impacts
- Unfamiliarity
- Hamburg Wheel Test Requirement
- Long Term Performance

Warm Mix Benefits

- More Durable Pavement
 - Less oxidized + less absorption = better fatigue life
- Better in-place densities
 - Improved fatigue life
 - better bonus for contractor
 - SMA 2.5% increase in bonus for 1% increase in density
- Wider Paving Window
 - Winter Paving
 - Night Paving
- Reduced Emissions, Smoke & Odor
- Direct Energy Savings ~ \$1/ton

Current Status

- WMA is allowed for use at Contractor's option on most HMA projects
- A few districts require WMA by plan note
 - Environmental reasons – non attainment areas
 - Overlays on pavements with rubber crack seal
- Most Contract's have or are in the process of installing a WMA additive system



Current Approved WMA Processes

- Foaming Systems
 - Astec – Double Barrel Green
 - Terex
 - Maxam - AquaBlack
 - Gencor – Ultrafoam GX
- Chemical Additives
 - Mead Westvaco – Evotherm
 - Akzo Nobel – Redi-Set WMX
- Organic (Wax)
 - Sasol Wax Americas – Sasobit
- Zeolite
 - PQ Corporation – Advera
 - Aspha-Min

Technology Providers



Where We Are Now

- TxDOT has completed 30+ WMA projects to date, 15 are being constructed, and 12 more are let but not yet constructed
- 2 Districts using WMA as maintenance mix
- Approx. 693,700 tons of WMA completed in 15 Districts
- 2009 – 563,200 tons of WMA under construction and another 173,510+ tons under contract pending construction.
- Interstate, US Highways, State Highways and FM roadways
- Numerous local government and commercial projects.

Projects Overview

District	Roadway	Lift Thickness	Mix Type	Approximate Tonnage	WMA Additive or Process
Amarillo	IH 40*	1.5 to 5 inches	Type D	30,400	
	SH 8	2 inches	Type D	5,000	Astec D.B. Green
Atlanta	FM 3129	4 inches	Type D	2,700	Astec D.B. Green
	IH 30	3 inches	Type C	15,000	Astec D.B. Green
Austin	SH 71	2 inches	Type C	7,000	Evotherm
	IH 35	2 inches	SMA C	16,500	Evotherm
Beaumont	IH 10	1 1/2 inches	SMA C	8,000	Redi-Set WMX
	US 190	2 inches	Type C	40,000	Redi-Set WMX
Bryan	SH 21	2 inches	Type C	7,700	Foaming Process
	IH 45*	2.5 inches	Type C	45,500	Foaming Process
	SH 36*	2 inches	Type C	17,200	Foaming Process
		1.5 inches	Type D	12,900	Foaming Process
	SH 6*	Type C	7,100		
	6 inches	Type B	3,600		

*construction in progress

Projects Overview

District	Roadway	Lift Thickness	Mix Type	Approximate Tonnage	WMA Additive or Process
Corpus Christi	IH 37	2 inches	Type C	46,900	Terex
	US 77	2 inches	Type C	16,800	Foaming Process
El Paso	SH 118	2 inches	CMHB-F	20,000	Terex
	FM 1110	2 inches	Type C	2,300	Evotherm
	LP 375	2 inches	Type C	10,900	Astec D.B. Green
	SPUR 601*	2 inches	Type C	1,000	Astec D.B. Green
Fort Worth	US62/180*	2 inches	Type C	26,000	Foaming Process
		3 inches	Type B	53,800	Evotherm
	2 inches	Type D			
	FM 1938	2 inches	Type D	20,000	Evotherm
		8 inches	Type B	22,000	
FM 156	2 inches	Type D	12,200	Evotherm	
	10 inches	Type B			

*construction in progress

Projects Overview

District	Roadway	Lift Thickness	Mix Type	Approximate Tonnage	WMA Additive or Process
Fort Worth	SH 183	2 inches	Type D	20,300	Foaming Process
	FM 1220	2 inches	Type D	-	Control
	IH 820*	2 inches	Type D	34,000	Evotherm
	SH 26	2 inches	Type D	3,500	Evotherm
	SH 171	1.5 inches	Type D	3,900	Evotherm
	US 180*	2 inches	Type D	38,400	Evotherm
Houston	FM 2004 / FM 2917*	1.5 inches	Type D	8,600	Evotherm
		-	-	Control	
Lufkin	FM 324	1 inch	Type D	3,800	Advera, Redi-Set, Evotherm & Sasobit
		-	-	Control	
Odessa	FM 761	2 inches	SP-C	6,000	
	SH 115*	3 inches	SP-C	32,500	

*construction in progress

Projects Overview

District	Roadway	Lift Thickness	Mix Type	Approximate Tonnage	WMA Additive or Process
Paris	SH 78		Type B & D	16,600	Astec D.B. Green
	US 82	2 inches	Type D	38,800	Astec D.B. Green
		4 & 6 inches	Type B		
	US 380*		Type B & D	83,300	Astec D.B. Green
IH 30*	2 inches	Type D	109,500	Astec D.B. Green	
	6 & 7 inches	Type B			
San Angelo	US 83	2 inches	CMHB-C	83,200	Terex
San Antonio	LP 368	2 inches	Type C	1,200	Evotherm
	IH 37*	2 inches	Type C	-	Control
				20,000	Evotherm & Sasobit
-	-	Control			
Waco	FM 2113	2 inches	Type C	5,000	Astec D.B. Green
		3 & 4 1/2 inches	Type B		
	US 190*	1 1/4 inches	SMA-F	29,600	Astec D.B. Green

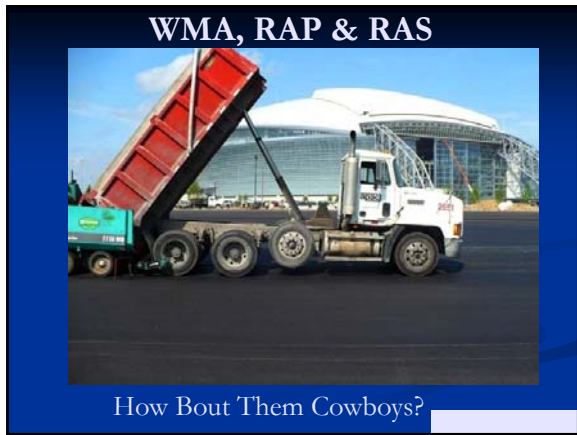
*construction in progress

Projects Overview

District	Roadway	Lift Thickness	Mix Type	Approximate Tonnage	WMA Additive or Process
Waco	SH 6*	2 inches	Type C	24,000	Astec D.B. Green
		3 inches	Type B	39,500	
Wichita Falls	US 380	2 inches	Type D	68,500	Astec D.B. Green
	US 82	1 1/2 inches	Type D	7,200	Astec D.B. Green
	US 183	2 inches	Type D	34,800	Astec D.B. Green
	US 277	4 inches	Type C	72,700	Terex

693,700 Total Tonnage of WMA Produced & Placed as of October 2009 (plus 563,200 tons under construction)

*construction in progress



Projects Planned for Construction within the Next 6 Months

District	Roadway	Lift Thickness	Mix Type	Approximate Tonnage	WMA Additive or Process
Amarillo	IH 40		Type D	30,400	
Bryan	SH 14	2 inches	Type C	3,400	
		1.5 inches	Type D	540	
Corpus Christi	US 77	2 inches	Type C	20,500	
	US 181				
	SH 141	1.5 inches	Type D	28,500	
Fort Worth	FM 1189	2 inches	Type D	320	
		2 inches	Type D	530	
		5 inches	Type B	270	
		4 inches	Type D	3,300	
	CS	1.5 inches	Type D	210	
		2 inches	Type D	1,400	
		6 & 4 inches	Type B	44,500	
SH 174	2 inches	Type C	17,000		

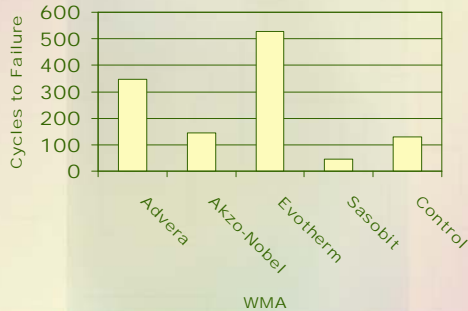
Projects Planned for Construction within the Next 6 Months

District	Roadway	Lift Thickness	Mix Type	Approximate Tonnage	WMA Additive or Process
Fort Worth	FM 1938	1 inch	Type D	830	
		2 inches	Type D	880	
		4 & 8 inches	Type B	20,570	
	FM 113	2 inches	Type D	360	

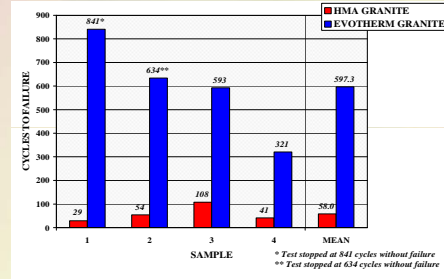
173,510 Total Tonnage of WMA Planned for Construction as of October 2009



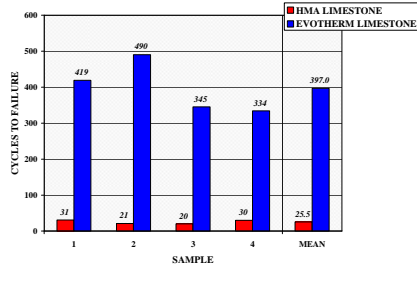
TTI Lab Study - Overlay Test Results



TTI Overlay Tester Results



TTI Overlay Tester Results



Future Plans

- Implement Special Provision allowing WMA
- Adopt AASHTO R30 curing procedure for Hamburg testing
- Develop and maintain approved list of products and processes
- Develop SP for other mix types – PFC, SMA, etc.
- Combine with increased use of RAP
 - Under oxidized + Over oxidized

Loop 368 - San Antonio

- ~ 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
 - Same 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



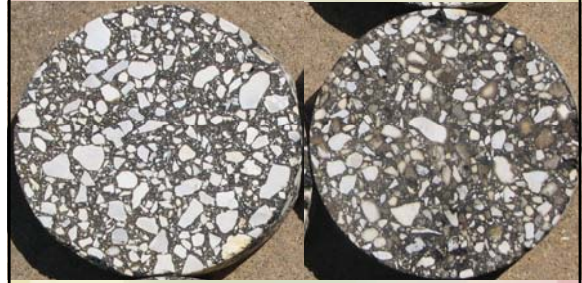
Loop 368 - San Antonio



After Two Years of Service



TxDOT Cores After 1 Year



EVO THEM
FOR THE QUALITY TECHNIQUE

Hot Mix

Hamburg-One Year Cores



US 287 - Fort Worth



US 287 - Fort Worth



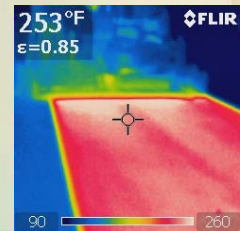
US 380 - Young Co.



US 380 - Plant Modification



US 380 - Young Co.



FM 324, Lufkin

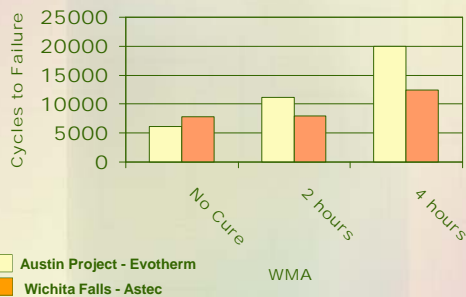
- 800 tons of Sasobit
- 800 tons of Evotherm
- 800 tons of Advera
- 800 tons of Akzo Nobel's (RediSet)
- HMA (rest of job)
- WMA produced at 260°F.



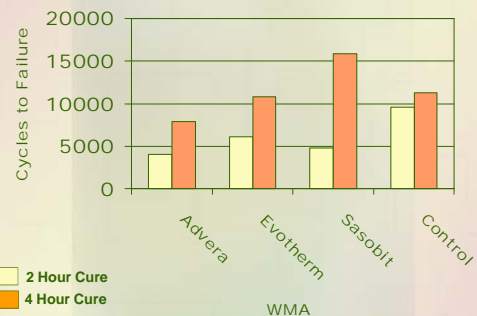
HWT Testing - Lufkin



HWT Testing - Effects of Cure Time



TTI Lab Study - HWT Cure Time



WMA Summary

- TxDOT allows WMA on all projects and requires WMA on some projects
- Overall performance has been good
- Significant increase in cracking resistance - Overlay Tester
- Less compactive effort required
- Less asphalt absorption
- More difficulty in meeting TxDOT's Hamburg requirement
- WMA is relatively insensitive to variations in compaction temperature

Pending WMA Issues/Concerns

- Long Term Performance?
- Constructability Issues - Tenderness
- Foaming Systems
 - Compaction Aid or WMA?
 - How Much Water
- Production Temperatures
- Mandated Use of WMA may be on the Horizon

Warm Mix Benefits

- More Durable Pavement
 - Less oxidized + less absorption = better fatigue life
- Better in-place densities
 - Improved fatigue life
 - better bonus for contractor
- Wider Paving Window
 - Winter Paving
 - Night Paving
- Reduced Emissions
- Reduced Smoke & Odor
- Direct Energy Savings ~ \$1/ton

New Special Provision

- SP 341-024
 - Mandatory on all projects with Item 341
 - Gives the contractor the option to use up to 5% RAS in HMA

Table 1A
Maximum Allowable Amounts of Recycled Binder, RAP & RAS

Mixture Description & Location	Maximum Ratio of Recycled Binder ¹ to Total Binder (%)	Maximum Allowable % (Percentage by Weight of Total Mixture)		
		Unfractionated RAP ²	Fractionated RAP ³	RAS ⁴
Surface Mixes ⁵	35	10	20	5
Non-Surface Mixes ⁶ < 8 in. From Final Riding Surface	40	15	30	5
Non-Surface Mixes ⁶ > 8 in. From Final Riding Surface	45	20	40	5

What's coming?

Table 3A – SP341-024
Allowable Substitute PG Binders

PG Binder Originally Specified	Allowable Substitute PG Binders
PG 76-22	PG 70-22 or PG 64-22
PG 70-22	PG 64-22 or PG 58-22
PG 64-22	PG 58-22
PG 76-28	PG 70-28 or PG 64-28
PG 70-28	PG 64-28 or PG 58-28
PG 64-28	PG 58-28

Assumptions Used for HMA Cost Estimates

Material	Cost Per Ton	Notes
Aggregate	\$22	Includes processing & freight
PG 76-22	\$538	Based on September 2009 *Index (freight not included)
PG 70-22	\$480	Based on September 2009 *Index (freight not included)
PG 64-22	\$377	Based on September 2009 *Index (freight not included)
RAP	\$15	Contains 5% AC, includes processing & freight
RAS	\$20	Contains 20% AC, includes processing & freight


* Source: Louisiana Asphalt Pavement Association

Cost of Mix (\$/Ton)					
Binder Grade	Virgin Mix	20% RAP	5% RAS	15% RAP+ 5% RAS	*One Grade Substitute
PG 76-22	47.80	41.24	42.54	37.64	35.74
PG 70-22	44.90	38.92	40.22	35.74	32.39
PG 64-22	39.75	34.80	36.10	32.39	NA

* Includes 15% RAP and 5% RAS

Conclusions

- TxDOT typically uses between 5 million and 15 million tons of HMA annually
- Substitute Binders, RAP & RAS Can Save ≈ 10% to 30% on the Cost of HMA
- Assuming HMA average cost of \$45/ton (material only) and only 10% saving, TxDOT could save \$22.5 million to \$67.5 million annually by using RAP, RAS and substitute binders
- The potential cost savings are thought to far outweigh potential risks



Incentives to Use Pave-IR System

- Currently the Minimum Surface Temperature Prior to Paving Must be 50F - 70F
- Currently Contractors are Required to Run Thermal and Density Profiles on Every Sublot and Failing Result – Waive QCQA Bonus
- Density Profiles Also Required Every Time Paver Stops and When Visual or Thermal Segregation is Identified.
- If Contractor uses Pave-IR System they can pave when Surface Temperature is 32F and Pavement is Dry and they do not have to Run Segregation or Density Profiles and are Not Subject to Waiving QCQA Bonus for Failing Thermal or Density Profile.
- Must Show Less than 25F Segregation when Pave-IR System is Used

Overall Goal of Pave-IR Implementation

- Improve Paving Quality By Having 100% Sampling for Thermal Segregation
- Passive Inspection?
- Contractors Can Fix Paving Problem if they See the Problem
- Contractors Are Allowed More Latitude if They Can Demonstrate They Have a Good Paving Practice

