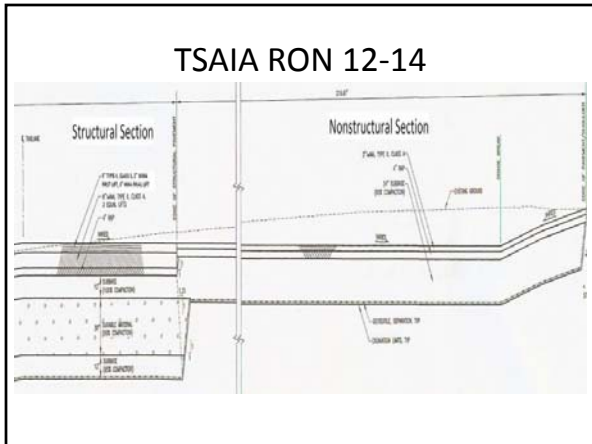




Project Info

- Provide remote overnight parking area for very heavy aircraft on three PCC hard stands.
- Granite Construction began construction on July 9, 2009. Must complete in 2009
- The project required demolishing the previous hardstands and apron, excavating peat from the sub base, building a new sub base, and constructing new hardstands and paving in September with PMA.
- On July 17, 2009 Granite requested to use Warm mix asphalt using the Evotherm additive on the project.

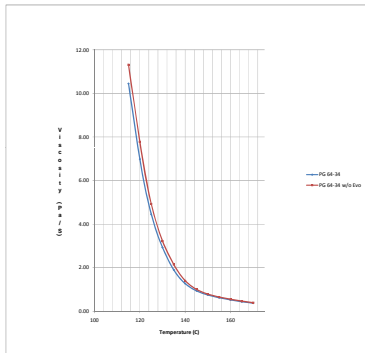
TSAIA RON 12-14



DOT Approval Criteria

- Historical performance
 - NCAT test track performance – no failures
 - HVS testing – Cal Trans: good performance
- Job Mix design (Marshall & Superpave)
 - No change in PG 64-34 properties
 - Pass APA with not more than 1mm difference from mix without Evotherm. Spec ≤ 3mm
- Field produced mix must meet:
 - APA design specifications
 - All acceptance tests must meet specifications

Viscosity Comparison, 0.5% Type M1



Temperature ranges from 286 to 41 degrees Fahrenheit. From the thermal imaging it is apparent that the heat is distributed very evenly through the pavement as it exits the screed. This well distributed heat pattern also corresponds to achieving even compaction throughout the entire mat because it has been shown that compaction is proportionately related to temperature.



HWD Testing – Good Results



Granite Paving Video

- Paving with 0.5 % Evotherm, Type M1
- Metered into the asphalt cement storage tank at the asphalt plant
- Mixing was accomplished by circulating pumps
- Plant operation was not modified
- Started as hot mix then lowered temperature

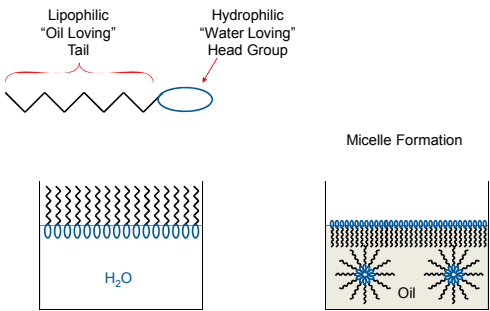
EVO THERM
WARM MIX ASPHALT TECHNOLOGY



Evotherm What is it?

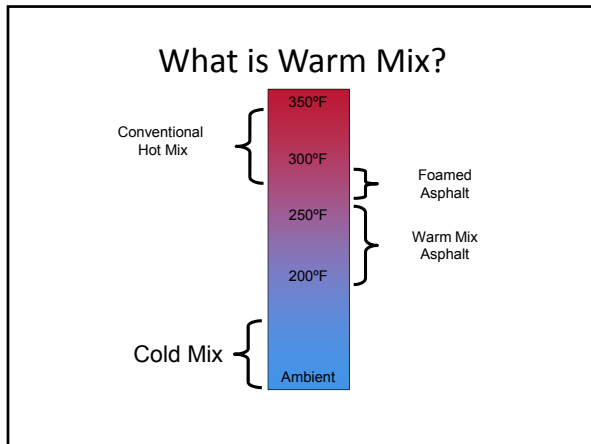
- Comprehensive chemical package
- Optimized to deliver
 - Mixing
 - Coating
 - Workability
 - Compaction
 - Adhesion

Surfactant Chemistry



Evotherm Delivery Systems

- Evotherm DAT
 - Chemical concentrate solution directly injected into asphalt line at plant
 - 85 - 100°F cooler than HMA
- Evotherm 3G
 - Water-free version, suitable for both terminal-add and plant-add
 - 65 - 85°F cooler than HMA



Evotherm

How does it work?

- Delivered at 0.3-0.7% by asphalt weight (5-11 oz by mix weight)
- Effective temperature range
 - Mix temperature
 - 250-170°F
 - Compaction temperature
 - 235-160°F

Evotherm Advantages

- Easy to Use
- Proven Performance
- Lowest Temperatures

Evotherm 3G - Minnesota



Advantages of Evotherm

- Easy to use
 - Can be produced in any mix plant
 - Same production & lay down equipment as conventional mix
 - Easy mix design evaluations
 - No plant modifications
 - Zero capital investment – lab or plant

Evotherm Pump



Evothem Plant Injection

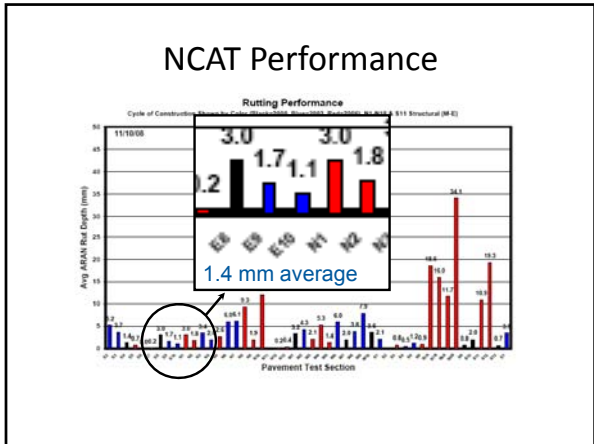


Evothem Terminal Addition

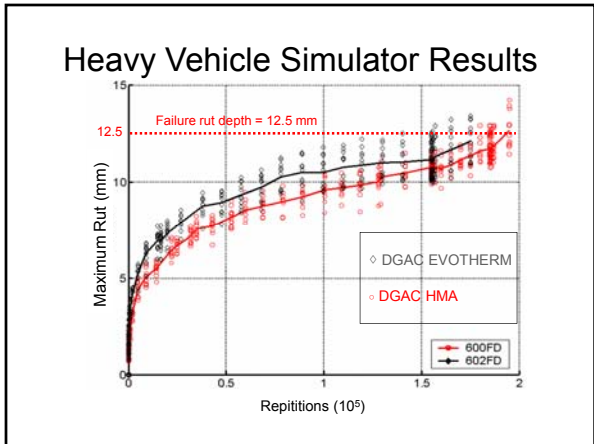


Advantages of Evothem

- Proven track record of performance
 - Hundreds of projects
 - 9 independent studies
 - 15+ DOT Evaluations
 - 10+ million ESAL on NCAT Test Track
 - < 2 mm of rutting



- ### Advantages of Evotherm
- Proven track record of performance
 - More than 400 projects
 - 9 independent studies
 - 15+ DOT Evaluations
 - 10+ million ESAL on NCAT Test Track
 - < 2 mm of rutting
 - Caltrans HVS Evaluation
 - Same performance as HMA



Advantages of Evotherm

- Lowest Temperatures
 - 70 - 100°F cooler than HMA
 - Large compaction window
 - Reduced thermal segregation
 - Extended hauls & paving season
 - Longer service life
 - Major reductions in fuel & emissions
 - Increased usage of RAP

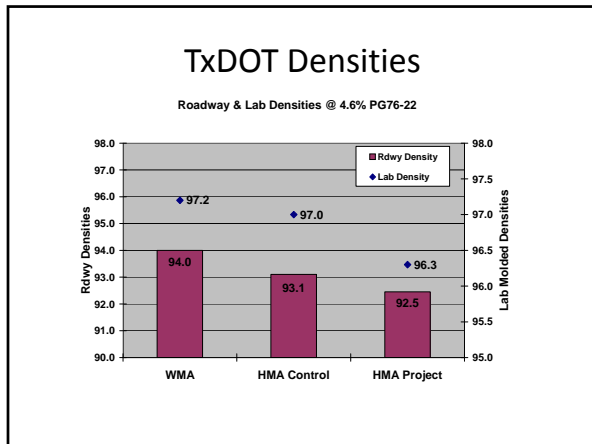
Advantages of Warm Mix

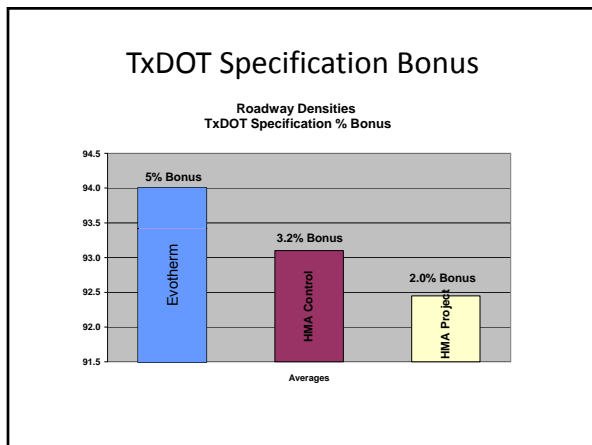
- Larger compaction window

Texas DOT - San Antonio

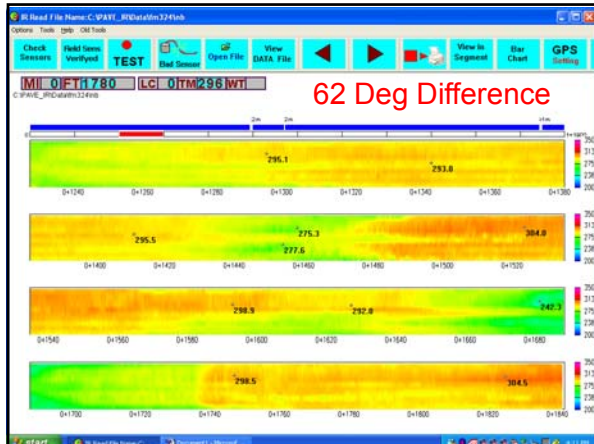


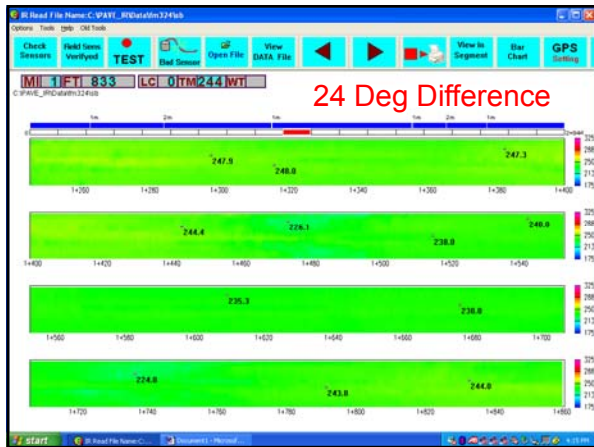
Limestone
PG76-22
3000 Tons,
T mix: 240°F
ΔT: 95°F





- ### Advantages of Warm Mix
- Larger compaction window
 - Reduced thermal segregation

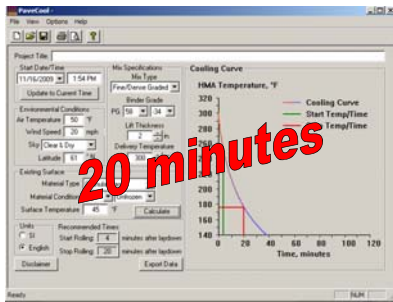




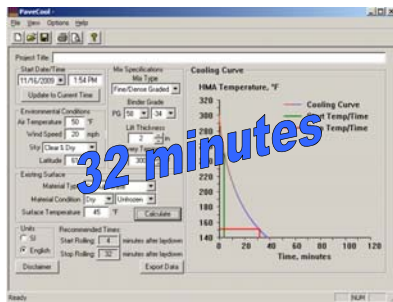
Advantages of Warm Mix

- Larger compaction window
- Reduced thermal segregation
- Extended hauls & paving season

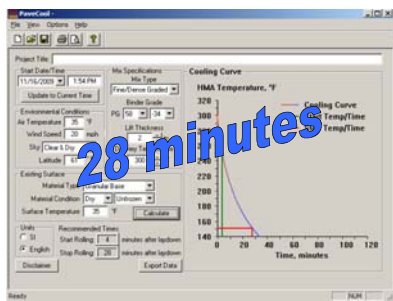
Anchorage—HMA at 50°F



Anchorage—Evotherm at 50°F



Anchorage—Evotherm at 35°F



Extended Season Paving

New York City, 8 Dec. 08, 40% RAP PG 64-22



Ground temperature at 7 a.m. was < 15°F

Evothem mix temperature behind the screed

Extended Season Paving

New York City, 8 Dec. 08, 40% RAP PG 64-22

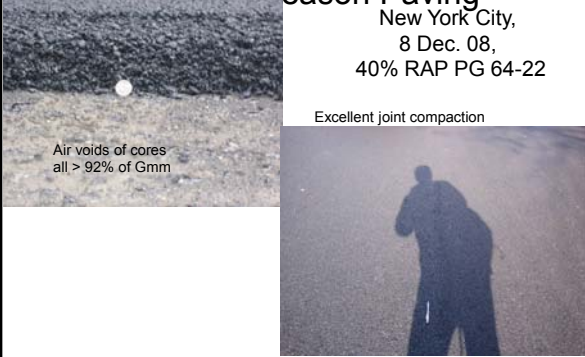


Paving

Compaction

Interest in EVOTHERM: Extended Season Paving

New York City, 8 Dec. 08, 40% RAP PG 64-22



Air voids of cores all > 92% of Gmm

Excellent joint compaction

Cold Weather Paving



280 mile, 8 hour haul
10°F air temperature
Bridge resurfacing

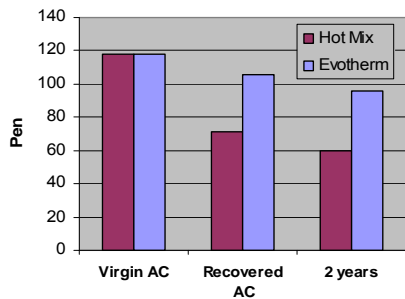
350°F production
240°F delivery

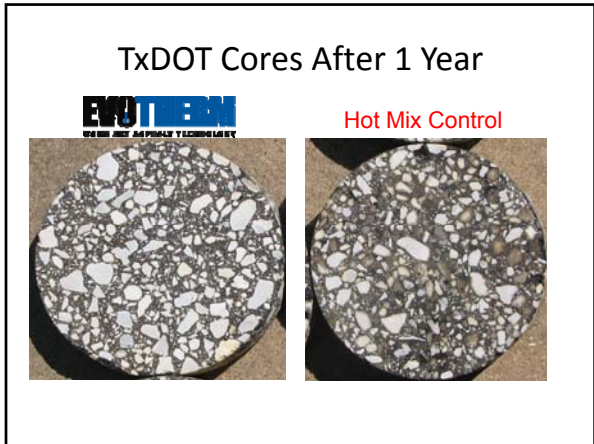


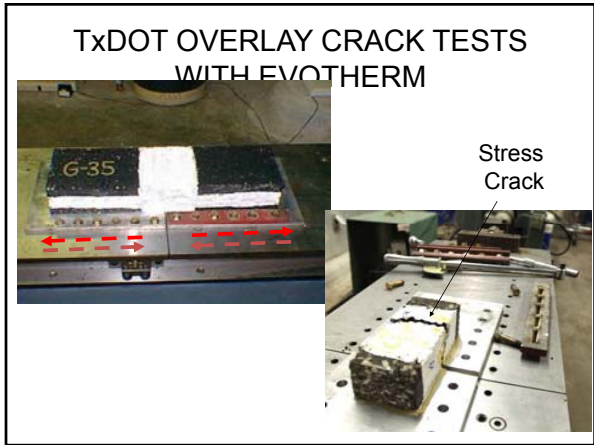
Advantages of Warm Mix

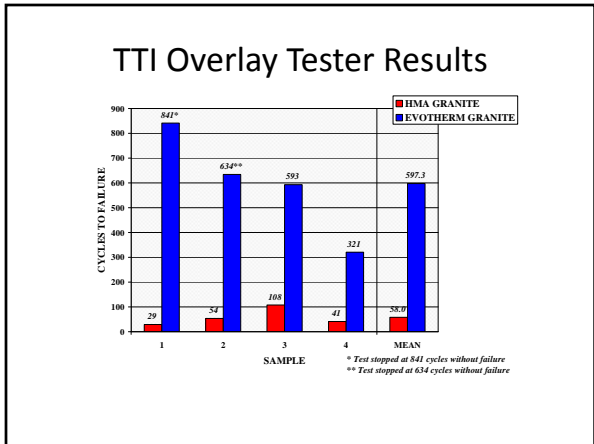
- Larger compaction window
- Reduced thermal segregation
- Extended hauls & paving season
- Longer service life

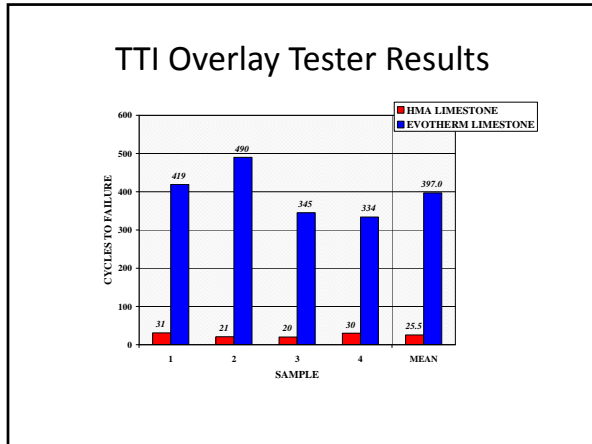
Reduced Binder Aging



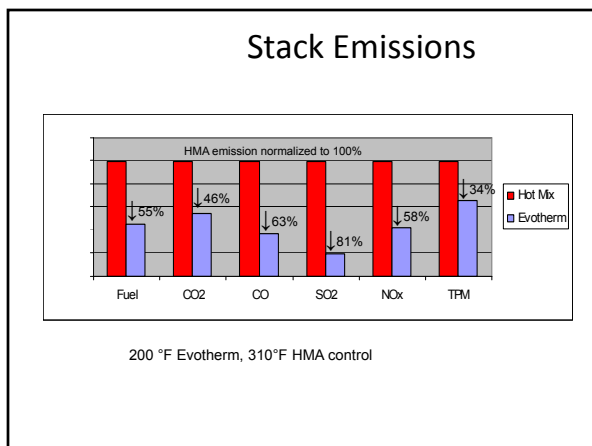








- ### Advantages of Warm Mix
- Larger compaction window
 - Reduced thermal segregation
 - Extended hauls & paving season
 - Longer service life
 - Major reductions in fuel consumption and emissions



Reduced Emissions



Hot Mix



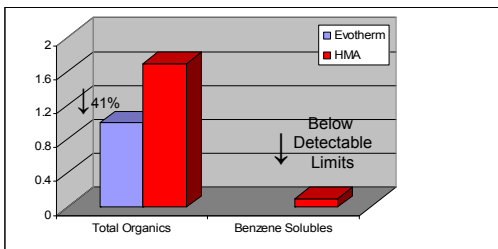
EVOTHERM

Reduced Emissions




Hot Mix

Jobsite Emissions vs. HMA




**Jobsite Emissions:
Interstate-78 NEW JERSEY**



HMA Control

Lower Production
Temperatures Mean
Significantly Lower
Fumes & Odors



Evotherm

Advantages of Warm Mix

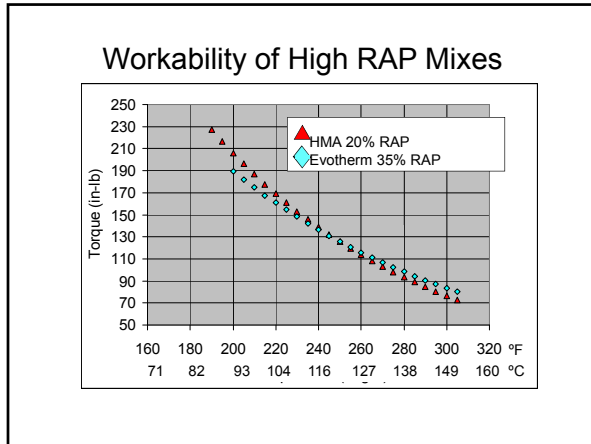
- Larger compaction window
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- Increased usage of RAP

Increased RAP

High RAP Warm Mix Asphalt

	Control	20% RAP	28% RAP	35% RAP
Pen	29	39	32	28
Viscosity	25,920	16,087	16,738	23,470
Ductility	38	79	54	42
DSR 64	7.35	4.39	5.74	7.56
MSCR	26	42	37	32
DSR 70	3.48	2.11	2.91	3.59
BBR -12	0.394	0.437	0.406	0.393

Source: D. Williams - MoDOT



High RAP Binder Properties

Property	40% RAP HMA Control	40% RAP Evotherm WMA	Superpave Specification
Mix Production Temperature, °F	330	248	not applicable
Viscosity (Pa-s)	1.357	1.017	3 Pa-s max.
G*/sinδ at 64°C, kPa	9.60	5.31	not applicable to field binder samples
G*/sinδ at 70°C, kPa	4.54	2.59	
G*/sinδ at 76°C, kPa	2.18	1.27	
G*/sinδ at 82°C, kPa	1.08	0.642	
G*/sinδ at 88°C, kPa	0.56	-	
Penetration (dmm)	15	23	not applicable
BBR Stiffness (MPa)	222	158	300 MPa max
m-value	0.296	0.328	0.300 min
Pressure Aging Vessel G* x sinδ, kPa	5663	3218	5000 kPa max

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EVOTHERM HIGH-RAP MIXTURE MEETS PG 76-22 BINDER GRADE

HMA FAILS

Evotherm at Anchorage Intl.



EVO THERM
WARM MIX ASPHALT TECHNOLOGY



www.evothem.com
