

# Innovative Warm Mix Asphalt Projects: The Contractor's Perspective

NESMEA 2009

Portland, ME

October 7<sup>th</sup> 2009

ROD BIRDSALL, PE

# What is Warm-Mix Asphalt (WMA)?

- Asphalt Mix produced at 40-100°F less than conventional HMA
- Typically 212-280°F vs. 320°F
- Produced and placed with conventional HMA equipment

# Why Use WMA?

- Environmentally Sound
- Reduces green house gas emissions
- Reduces energy use
- Improves workability
- Reduces binder aging
- Reduces paving temperatures
- Offers the potential to increase the % of RAP used in mix
- Offer the potential to extend the paving season

## Warner Bros.,LLC. Design of Bituminous Concrete Mixtures

**PROJECT:** Tri State Materials  
**MIX:** MHD Binder Course

**PAVEMENT TYPE:** 40% Rap Binder  
**PLANT LOCATION:** Trew stone LLC., East Deerfield, MA  
**DATE:** 5/10/2009

### STOCKPILE GRADATIONS - % PASSING

MATERIAL	BLEND	1-1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200
SCREENINGS	0	100	100	100	100	100	99	74	45	29	19.5	12.7	7.5
NATURAL SAND	10	100	100	100	100	100	93	80	58	27	11	3.5	2.5
3/8" CRUSHED STONE	15	100	100	100	100	96	22	2	1	1	0.5	0.5	0.5
1/2" CRUSHED STONE	0	100	100	100	96	28	3	1	1	1	1	0.5	0.5
3/4" CRUSHED STONE	35	100	100	96	15	2	1	1	1	1	1	1	1
RAP 9/16-	40	100	100	100	95	91	68	54	40	34	24	11.5	7
RESULTANT	100	100	100	99	68	62	40	30	22	17	11	5	4.0

		1-1/2"	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200
JOB MIX FORMULA		100	100	99	68	62	40	30	22	17	11	5	4.0
ACTION LIMIT	UAL				72	66	44	33	25	20	13	7	5.0
	LAL			95	64	58	36	27	19	14	9	3	3.0
SUSPENSION LIMITS	USL				75	69	47	34	26	21	15	9	6.0
	LSL			92	61	55	33	26	18	13	7	1	2.0
DESIGN GRADATION BAND			100	80-100	55-75		28-50	20-38		8-22	5-15		0-5

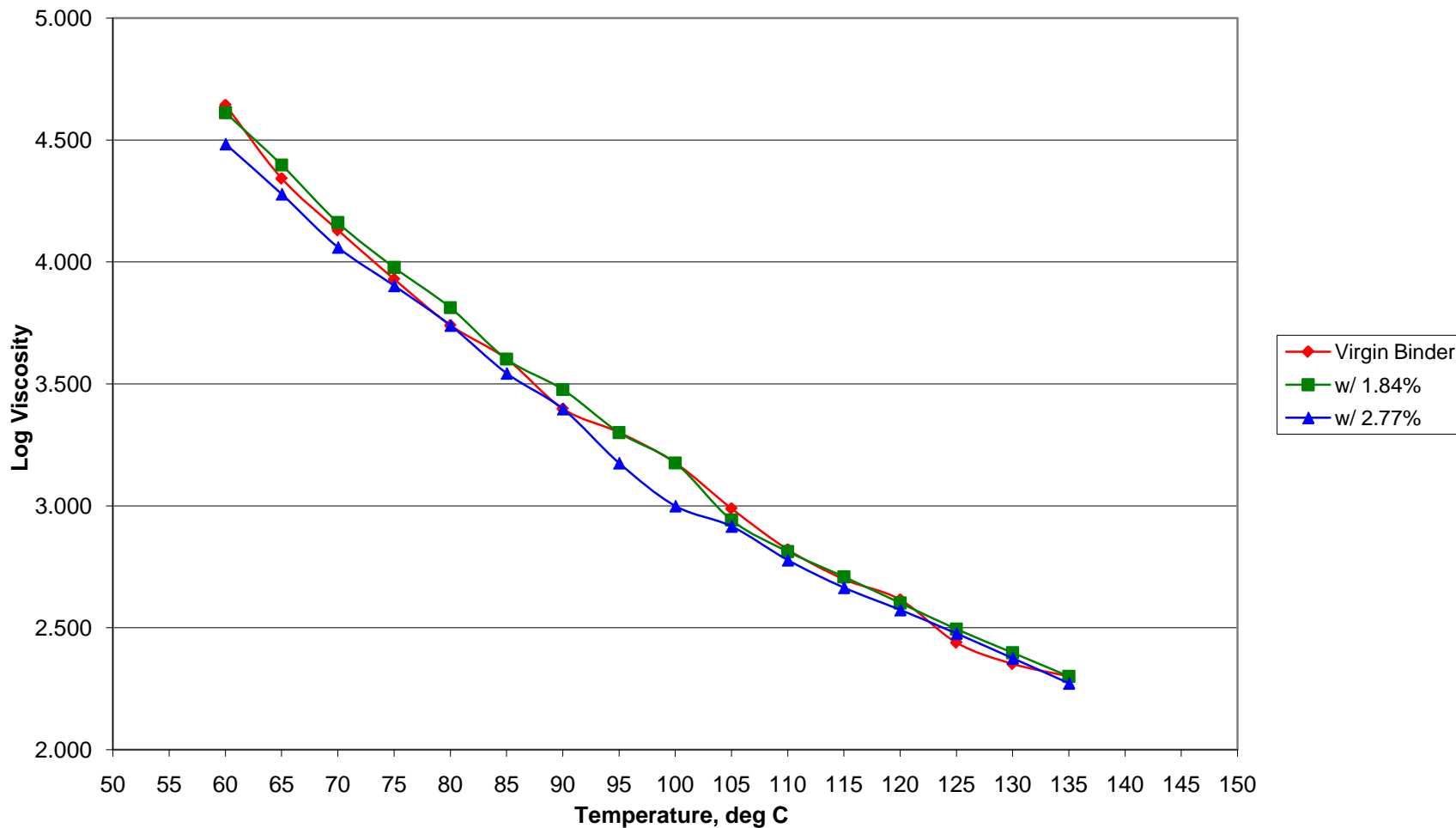
### AGGREGATE:

### ASPHALT:

COARSE:	Trew Stone LLC. East Deerfield, MA	SOURCE(S):	Tri State Materials
FINE:	Natural Sand: Delta Sand and Gravel Inc., Sunderland, MA Screenings: Trew stone LLC., Deerfield, MA	GRADE:	PG 52-34
		OTHER:	

**TEMPERATURE:** Mixing: 265 f  
Final Compaction: 225 f

## Log Viscosity vs. Temperature





# Deerfield, MA Terminal - ECOBIT™









# Deerfield, MA Terminal - ECOBIT™





# Saratoga Springs, NY (Palette Stone) - **ECOBIT**<sup>TM</sup>

BR 328 (1/02)

NEW YORK STATE DEPARTMENT OF TRANSPORTATION  
MATERIALS BUREAU

Plant Palette Stone Corp.  
Location Saratoga Springs  
Facility No. 10280

## COMPUTATION OF VOLUMETRIC MIX PROPERTIES

Formula No. H023007001  
Mix Description 19.0<30  
Lot No. \_\_\_\_\_ Sublot \_\_\_\_\_

Info  
Warm  
Mix

Sample ID	Compaction Temperature °C	Weight - grams			Volume	Maximum Sp Gr $G_{mm}$	@N <sub>Design</sub> = <u>75</u> gyrations				@N <sub>Actual</sub> = <u>8</u> gyrations				VMA	VFB	
		In air	In water	SSD			Sample Height mm	Bulk Sp Gr $G_{mb}$	% $G_{mm}$	% Air Voids	Sample Height mm	Bulk Sp Gr $G_{mb}$	% $G_{mm}$				
		a	b	c			d	e	f	g	h	i	j	k			l
A1		4908.0	2963.7	4907.7	1944.3		112.5	2.522				123.1	2.305	89.45			
A2		4899.2	2962.2	4905.0	1942.8		112.4	2.522				123.0	2.305	89.45			
A3		4896.5	2958.8	4900.1	1941.3		112.7	2.522				123.3	2.305	89.45			
QC avg						2.577		2.522	97.87	2.13			2.305	89.45	1186	82.04	
QA avg																	

	QC Sample		QA Sample		Combined Bulk SG ( $G_{sb}$ )			Consensus Properties			
	7A	8B	1A	1B	Aggregate	Bulk SG $G_s$	% Agg. $P_s$	CA Ang	FA Ang	Flat & Elong	Sand Equiv
A	2444.6	2411.6			No.3 Stone						
D	7495.5	7464.1			No.2 Stone						
E	8991.6	8939.7			No.1 Stone						
$G_{mm}$	2.577	2.577			No.1 Stone Non-Carb						
Avg $G_{mm}$	2.577				No.1A Stone						
					No.1A Stone Non-Carb						
QCT: <u>[Signature]</u>	Date: <u>9-1-2009</u>				Manuf. Sand						
QAT:	Date:				Natural Sand						
					Min. Filler						

### Volumetric Property Descriptions

$G_{mm}$  = Maximum Sp Gr of HMA mixture  
 A = Weight of dry sample in air (g)  
 D = Weight of flask filled with airless water at 25°C (g)  
 E = Weight of flask filled with water & sample at 25°C (g)  
 $G_{mm} = A + [A + D - E]$   
 $VMA = 100 - [(G_{mb} \times P_s) + G_{ab}]$   
 $VFB = 100 [(VMA - P_s) + VMA]$   
 $G_{mb}$  = Bulk Sp Gr for the total HMA mixture  $G_{mb} = 2.522$   
 $G_{ab}$  = Bulk Sp Gr for the total aggregate,  $G_{ab} = 2.727$   
 $[P_s] + [P_1/G_1 + P_2/G_2 + \dots + P_n/G_n]$   
 $P_s$  = Aggregate, percent by total weight of HMA mixture  $P_s = 95.3$   
 $P_a$  = Percent voids in total HMA mixture  $P_a = 2.13$

Binder: PG 64-22 with **ECOBIT**<sup>TM</sup>

# Saratoga Springs, NY (Palette Stone) - **ECOBIT**<sup>™</sup>



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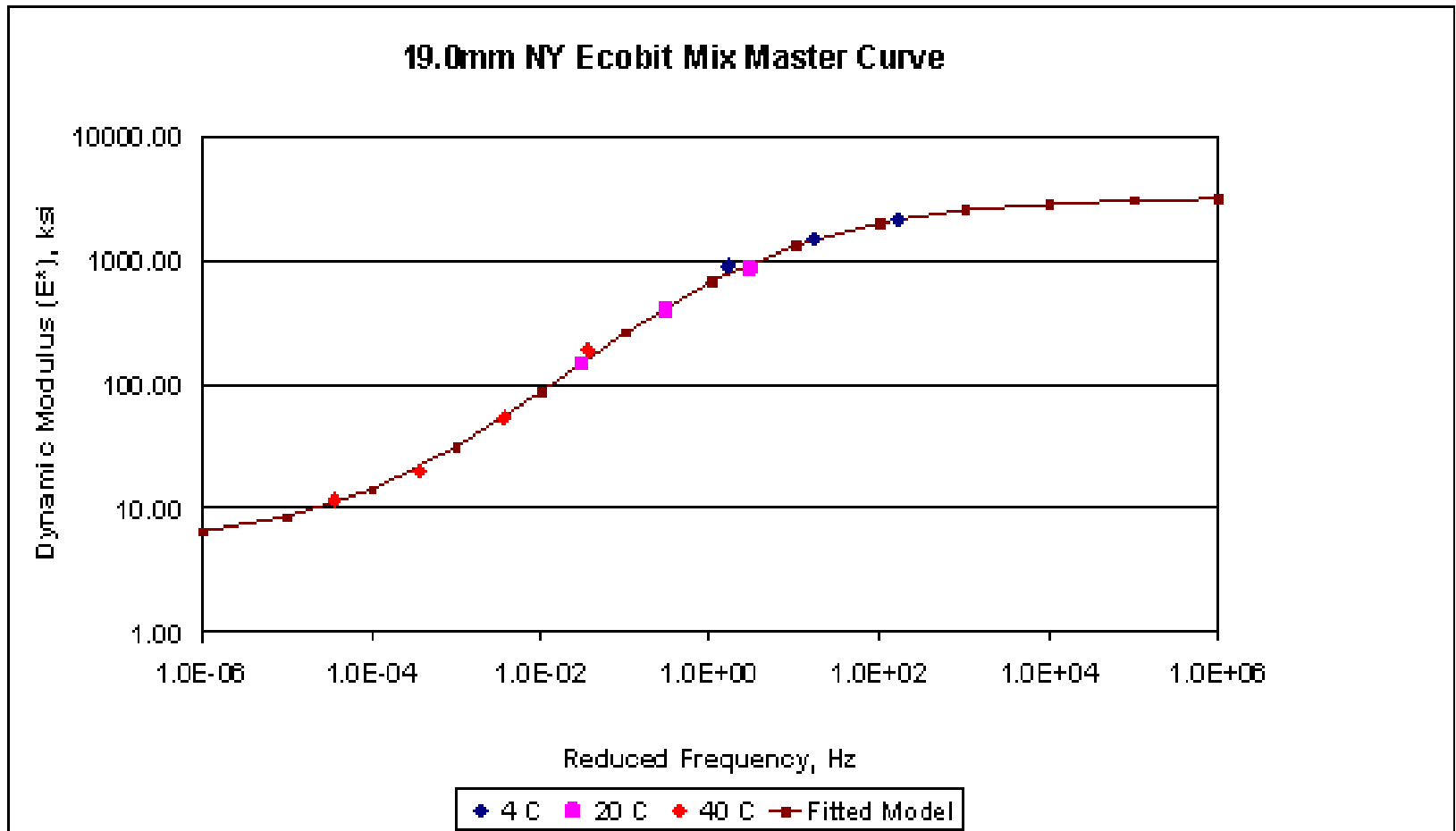


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# I-78 Somerset County, NJ – AR OGFC

- I-78 mile marker 29 to 42
- 77,270 AADT with 30% trucks
- 9.5mm AR OGFC, placed 1 inch compacted
- 8.5% Design Binder content using ASTM D-6114 AR
- Average IRI after paving 35 inches per mile (previously 70)

# I-78 Somerset County, NJ – AR OGFC



# I-78 Somerset County, NJ – AR OGFC





# I-78 Somerset County, NJ – AR OGFC with NuStar EVOTHERM

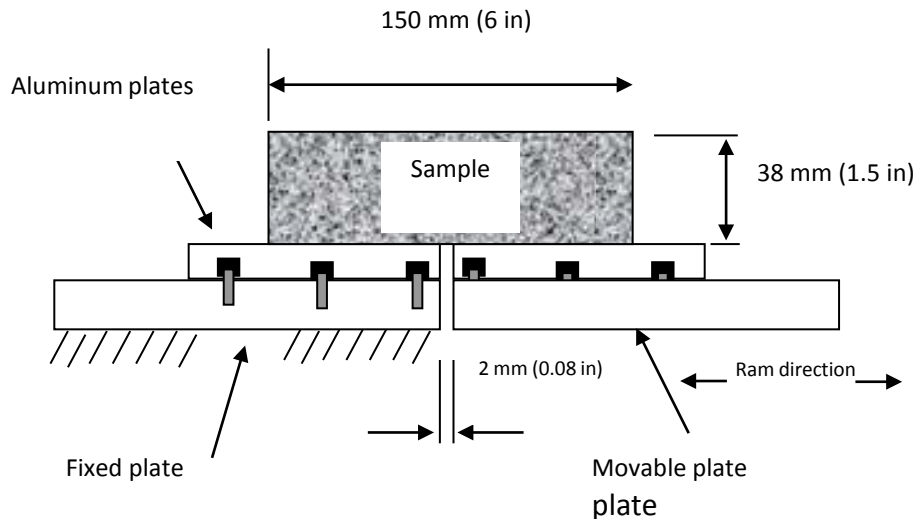


# I-78 Somerset County, NJ – AR OGFC

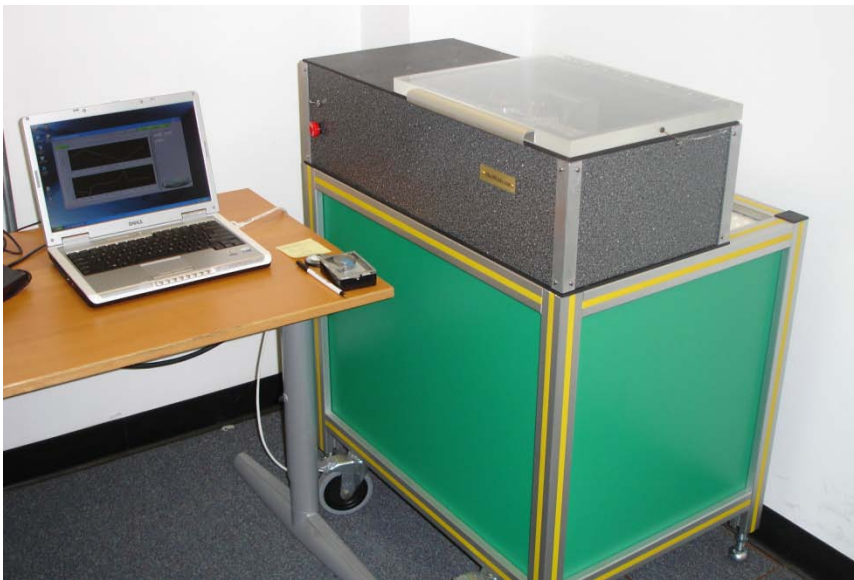




# Overlay Tester



- Sample size: 6'' long by 3'' wide by 1.5'' high
- Loading: Continuously triangular displacement 5 sec loading and 5 sec unloading
- Definition of failure
  - Discontinuity in Load vs Displacement curve



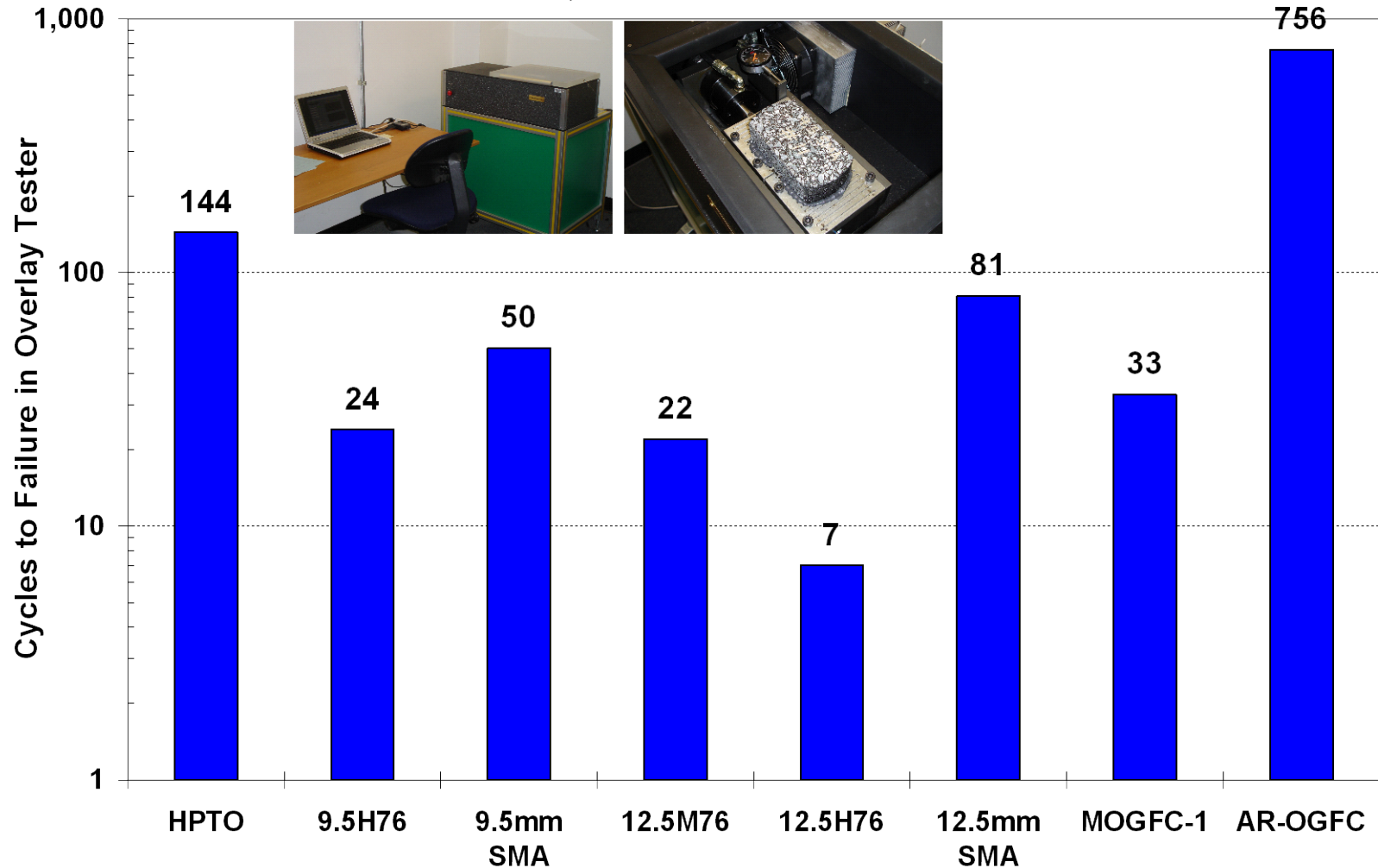


# Typical NJDOT (Surface Course) Overlay Mixes



NJ 195 (2007)

59°F, 0.025" Horizontal Deflection



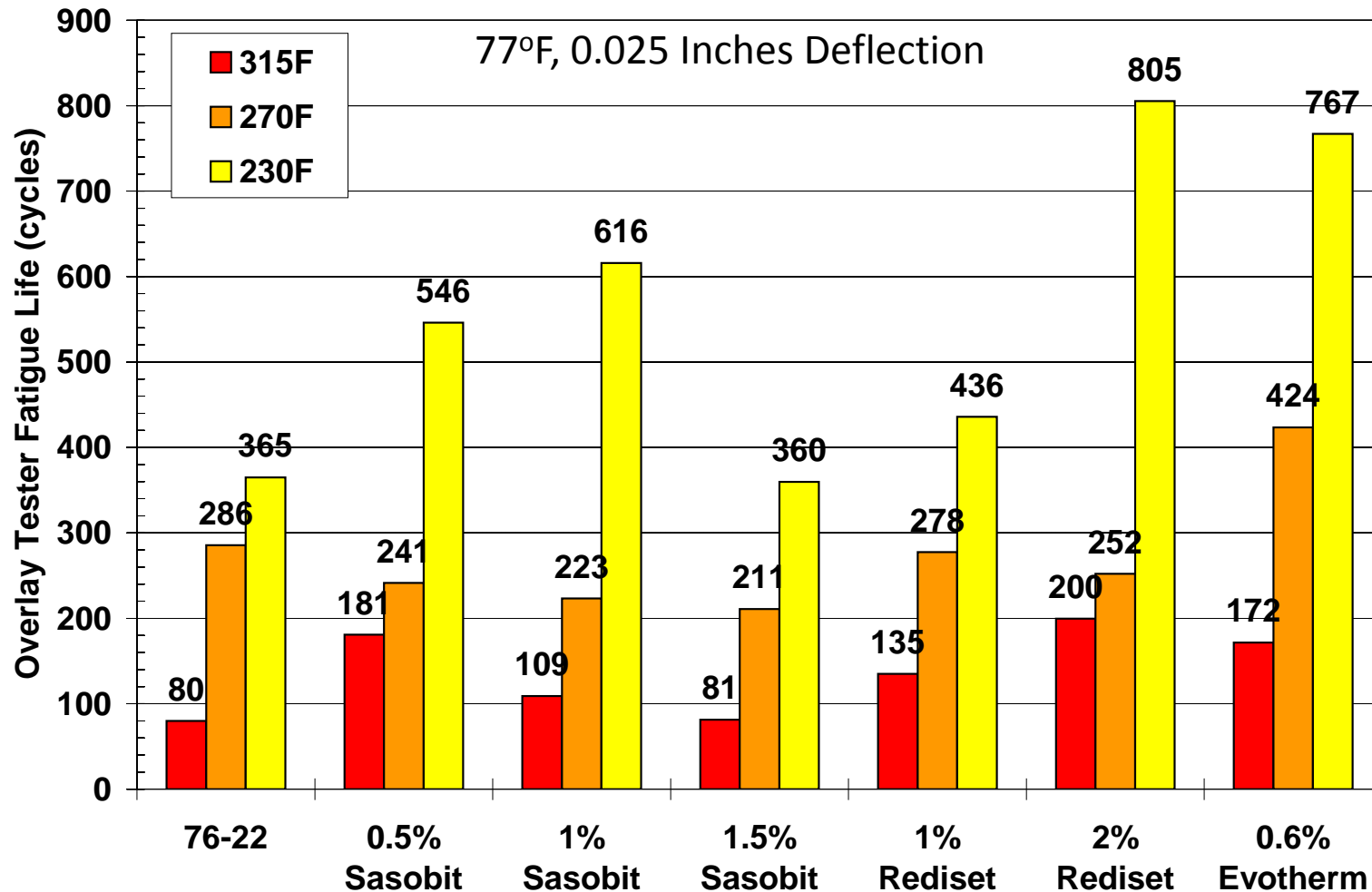


- The use of warm mix asphalt may help in reducing cracking potential of asphalt mixtures
  - Reduces oxidation aging of base asphalt binder at higher temperatures
  - Reduces polymer degradation at higher temperatures
  - May reduce asphalt binder absorption when produced at lower temperature (results in higher effective asphalt contents)

# Overlay Results at Different Mixing Temperatures



## Lab Produced 12.5mm Superpave Mixture with PG76-22



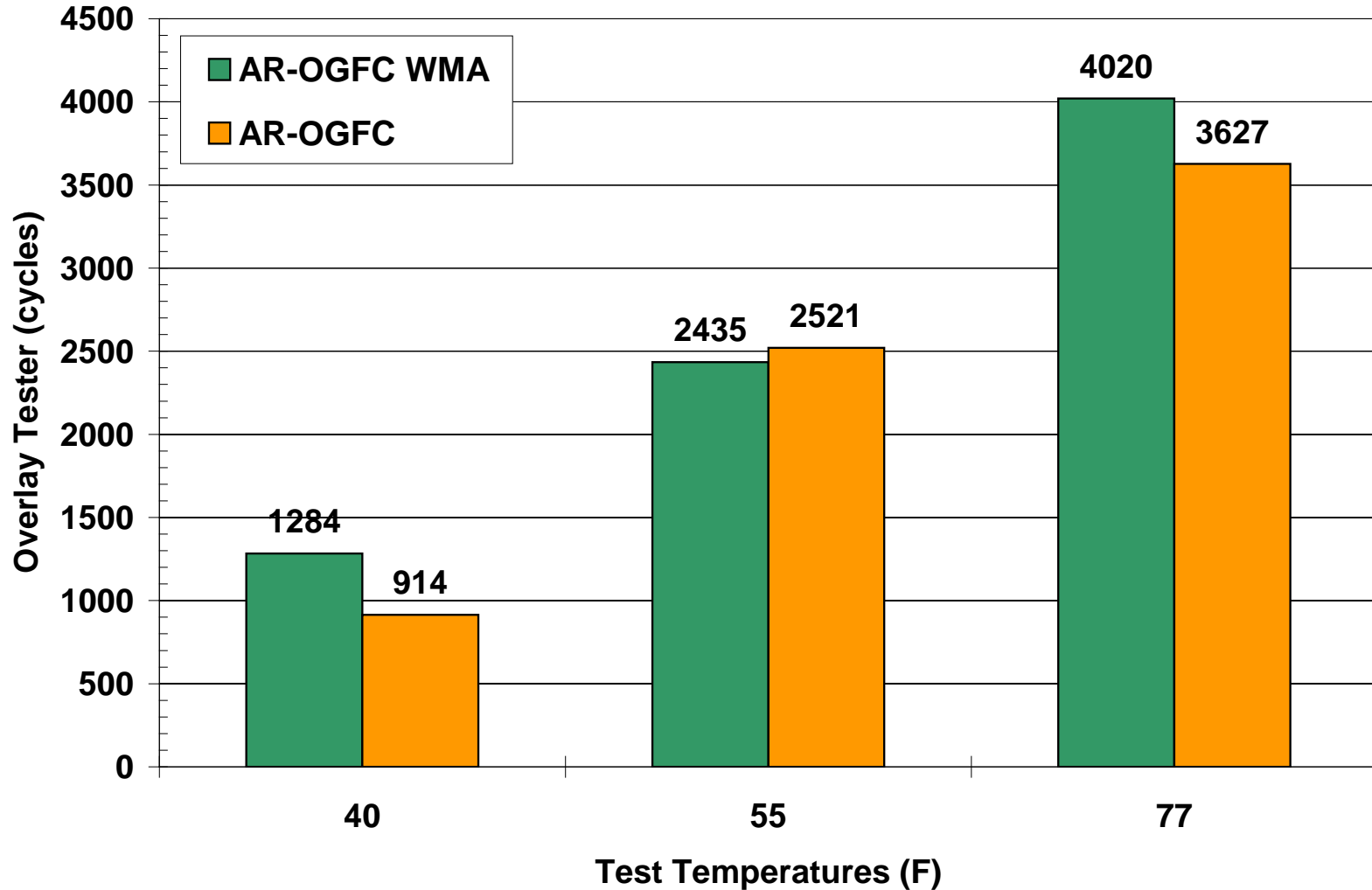


# Overlay Tester Cracking Results



NJ I78, 2009

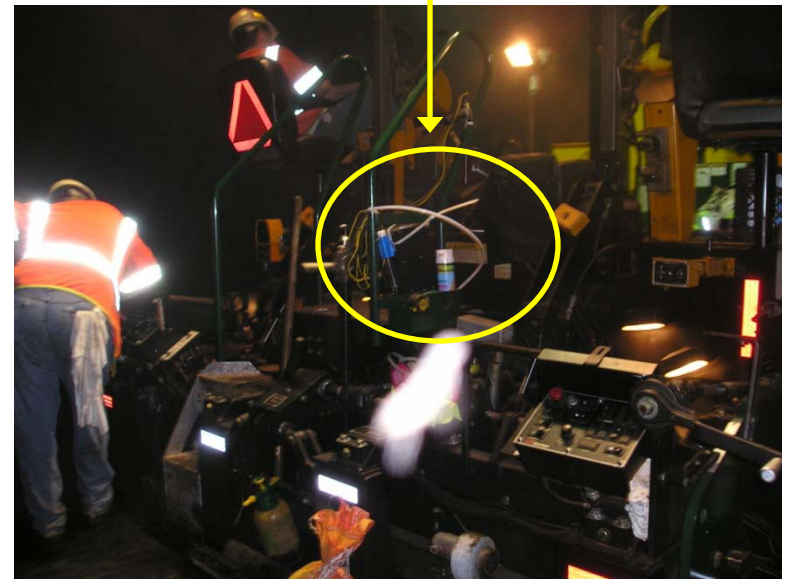
Horizontal Deflection = 0.025 Inches



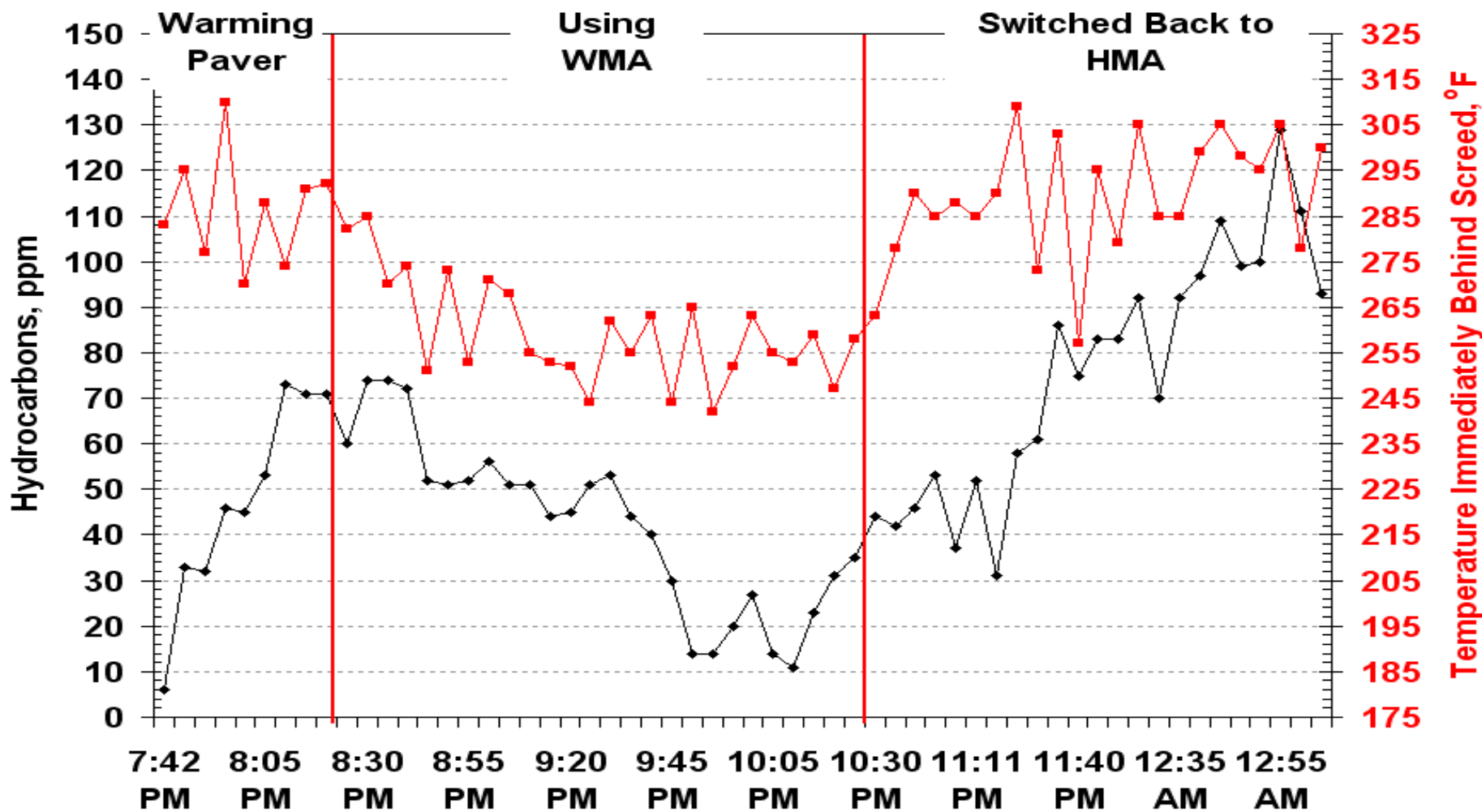
# Emissions Testing



- Looked at quantifying emission reduction at paver with and without WMA
- Used portable emissions tester mounted to railing on back of paver (where workers would stand)



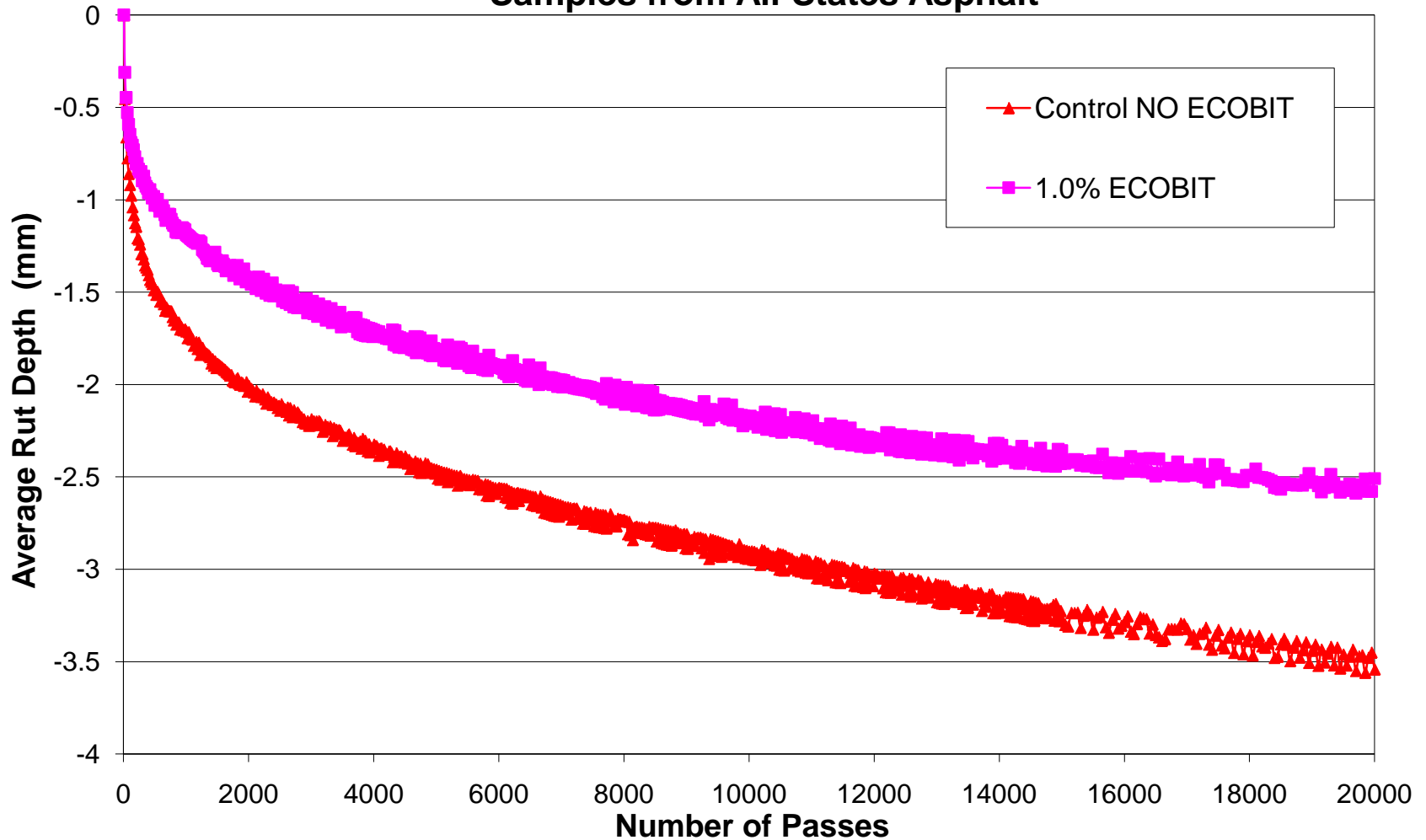
# Example of Typical Emissions at Paver



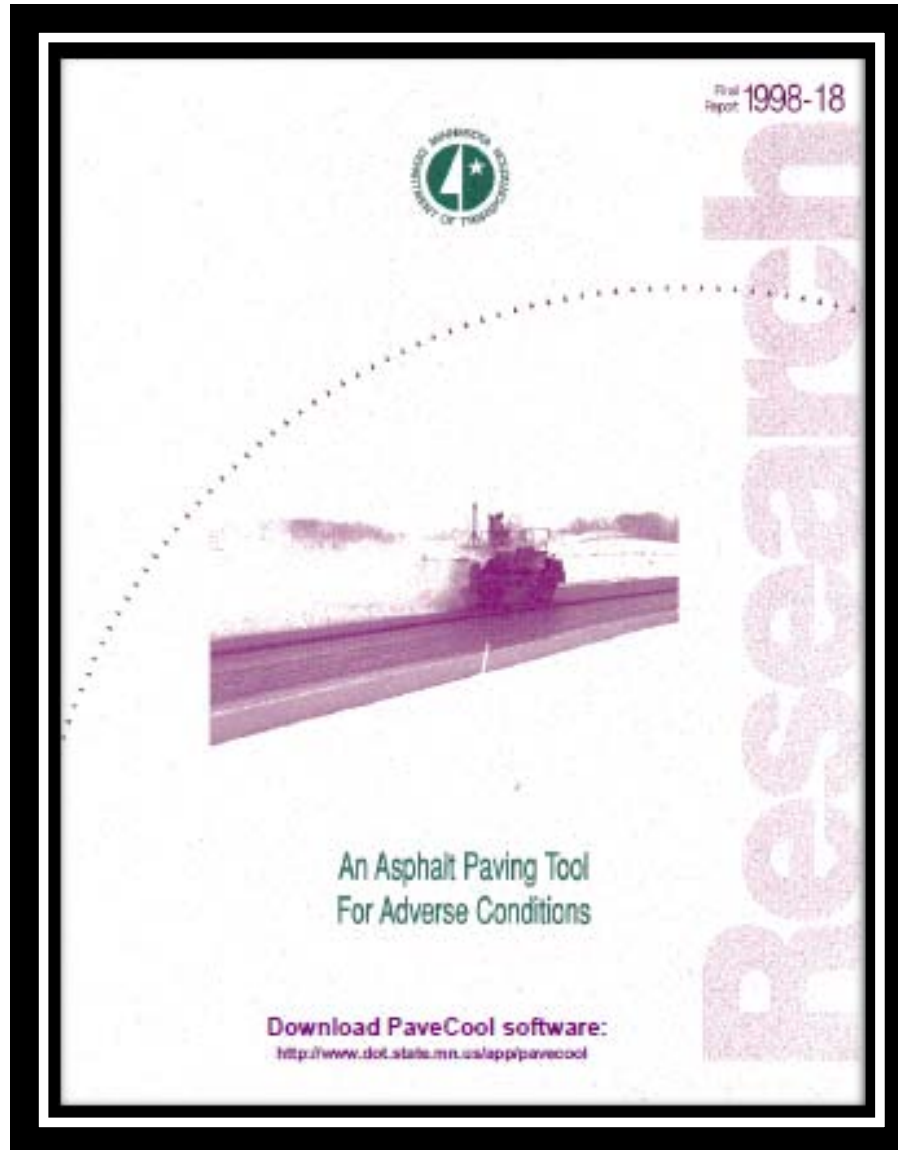


- AR GG mix – 1/2 '' nominal maximum size
- 7.5% ASTM D-6114 AR Binder
- 1 ¼'' compacted over micro-milled surface
- 20,000 ton night paving project
- Current spec requires 55F pavement temperature
- With **ECOBIT**<sup>™</sup>, Mass Highway will reduce pavement temperature to 45F for last 5,000 tons

## Hamburg Test Results - PA Landers Lab Produced ARGG Mix (Rt.3) Samples from All States Asphalt



# PaveCool (Minnesota DOT program)





## PaveCool 2.4 - Simulation Results

**Input File:** PaveCool

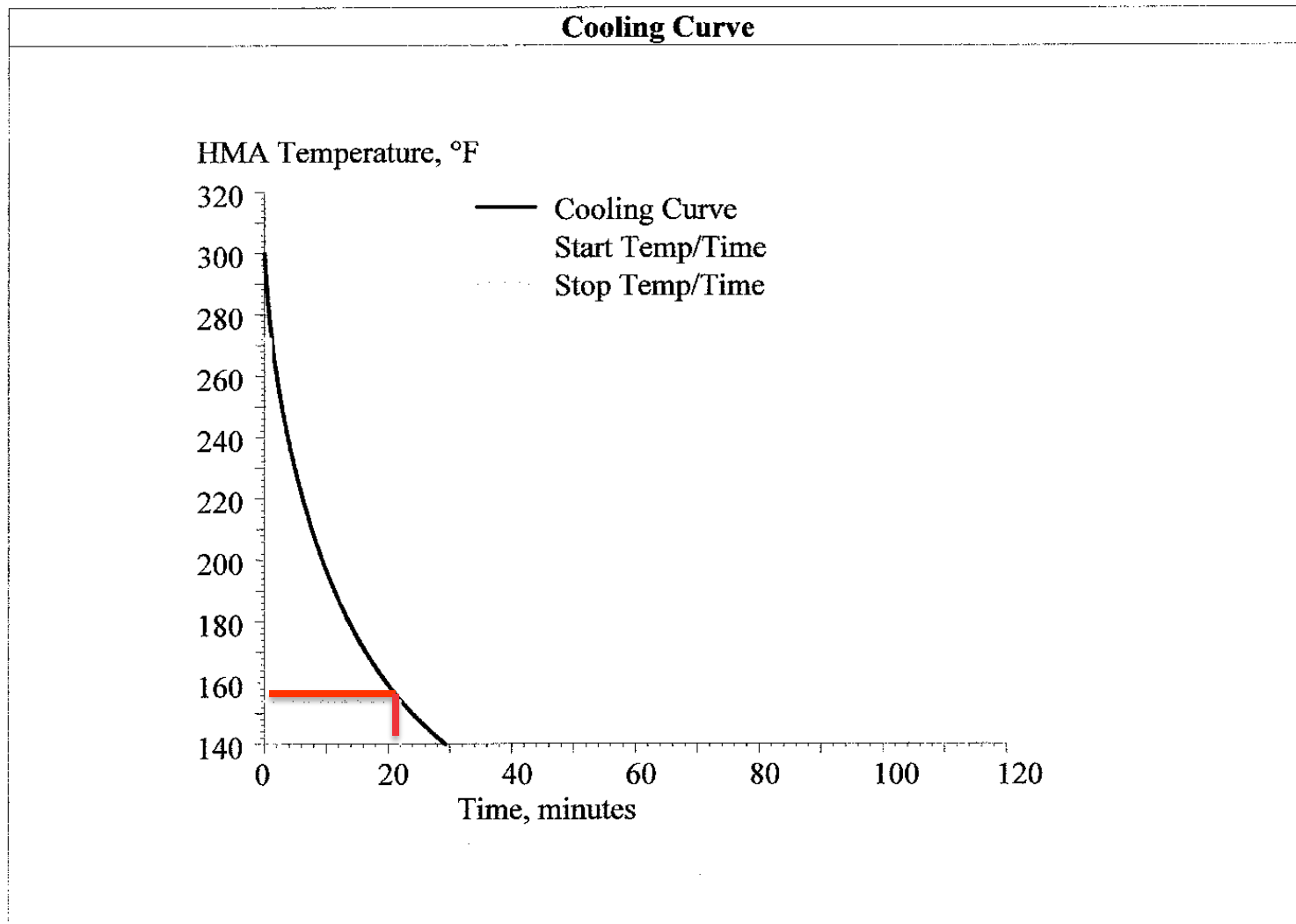
**Project:** PA Landers Asphalt Rubber Gap Graded + 1% ECOBIT

Project Date & Time	Start Rolling*	Stop Rolling*
09/02/09 12:10 PM	1 min. (272 °F)	22 min. (154 °F)

<b>HMA Mix Type</b>	<b>Binder Grade</b>	<b>Thickness</b>	<b>Delivery Temp.</b>
Coarse/SMA	PG 82-28	1.50 in.	300 °F
<b>Air Temp.</b>	<b>Wind Speed</b>	<b>Sky</b>	<b>Latitude</b>
35.0 °F	10 mph	Clear & Dry	42.0 ° North
<b>Existing Surface</b>	<b>Moisture</b>	<b>State</b>	<b>Surface Temp.</b>
AC	N/A	MA	35.0 °F

\* Some asphalt mixtures will require compaction start and stop times different from those recommended by this program. As always, good judgement must be exercised in order to ensure a properly compacted surface. Special considerations should be made for polymer modified asphalt binders. In this case, manufacturer guidelines should supersede recommendations made by this program. Consult the Help file for further details. In no event will the Minnesota Department of Transportation, the University of Minnesota or their suppliers be liable for damages or expenses arising out of the use of this program.

Simulation Time: 09/02/09 2:51 PM



# Summary

## WMA is:

- Environmentally sound
- Greatly reduces emissions
- Reduces Binder aging
- Has been used successfully in many applications
- Offers the potential to increase the % of RAP in mix
- Offers the potential to extend the paving season
- Very user Friendly



# THANK YOU



## Products & Services

- **ECOBIT™** WMA Binder
- Asphalt Rubber SAM & SAMI
- FiberMat® SAM & SAMI
- NovaChip®
- Chip Seals
- Liquid Calcium/Magnesium Chloride
- Full Depth Reclamation
- Hot & Cold Mix Asphalt
- CRMB for HMA

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