

Flexible Pavements Annual Meeting

Warm Mix Asphalt

**2008 ODOT Field Trials and
The Future**

Ohio Department of Transportation



Warm Mix Asphalt

What is it?



2009 Flexible Pavements Annual Meeting



Warm Mix Asphalt

Why?

- Reduce production and laydown temperatures
- Reduce emissions
- Reduce energy costs
- Reduce aging of binder
- Other Possible Benefits:
 - Cool weather paving (extend season)
 - Compaction aid for stiff mixes



Warm Mix Asphalt

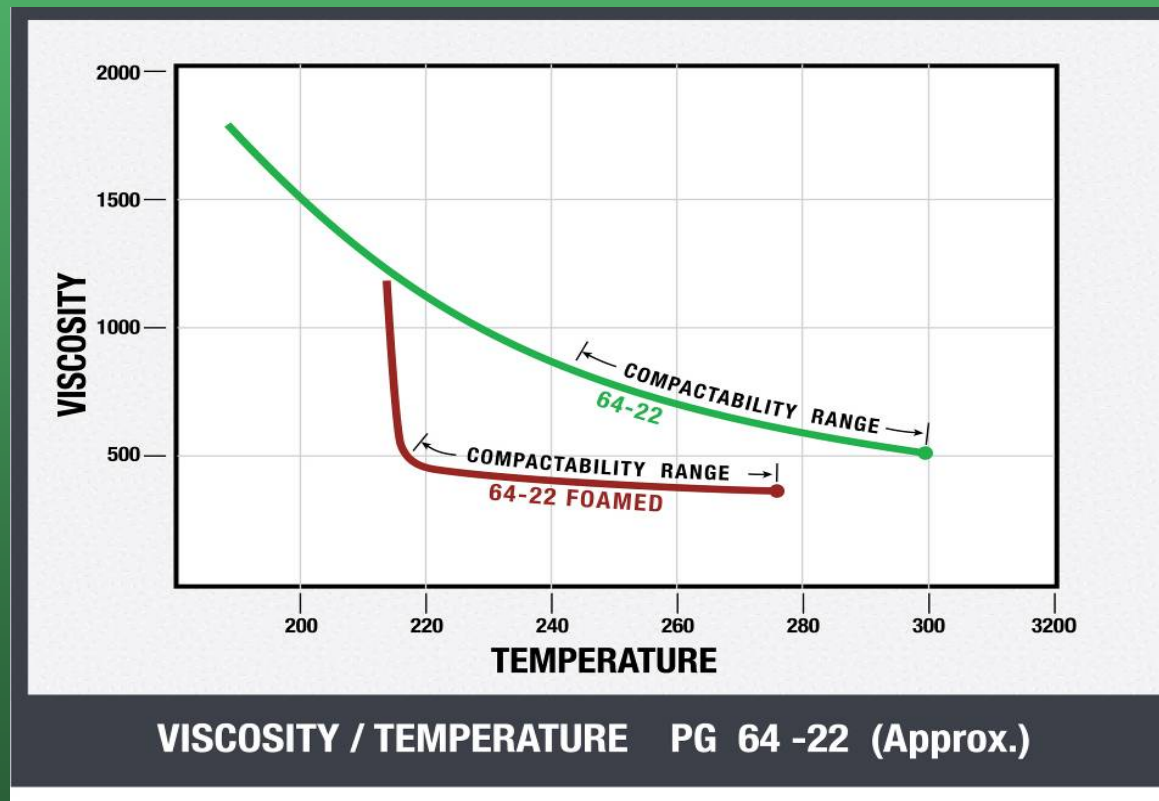
Why Foaming?

- Improved Workability / Coating
- No Smoke , Less Smell
- Longer Life Pavement
- 11% Less Plant Fuel
- 11% Higher Production
- Some Decrease in Cost



Warm Mix Asphalt

Why Foaming?



2009 Flexible Pavements Annual Meeting



Warm Mix Asphalt

How much water?

About 1% H₂O of liquid AC by weight.

1 ton mix – 2,000 lb.

5.3% AC liquid – 106 lb.

1 lb H₂O

Volume of liquid – 0.016 cu. ft.

1 lb. H₂O when converted to steam = 30 cu. ft.

Expansion = $30/0.016 = 1875$



Warm Mix Asphalt

Unknowns with Foaming

- Production limitations
- Several different foam technologies
- Emissions
- Mix life
- Cost
- Quality Control
- Placement

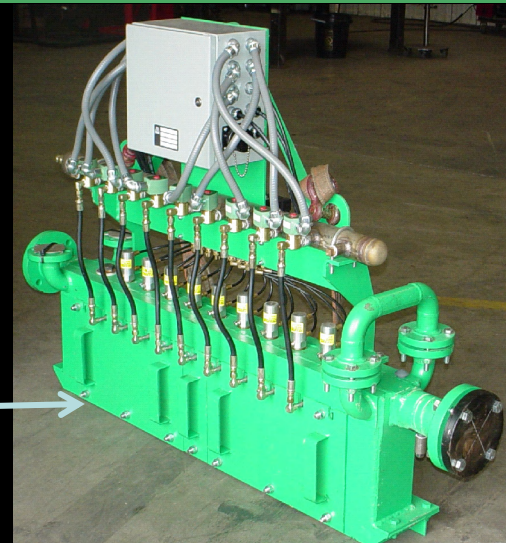
2009 Flexible Pavements Annual Meeting



Warm Mix Asphalt

Foaming Technologies

Astec



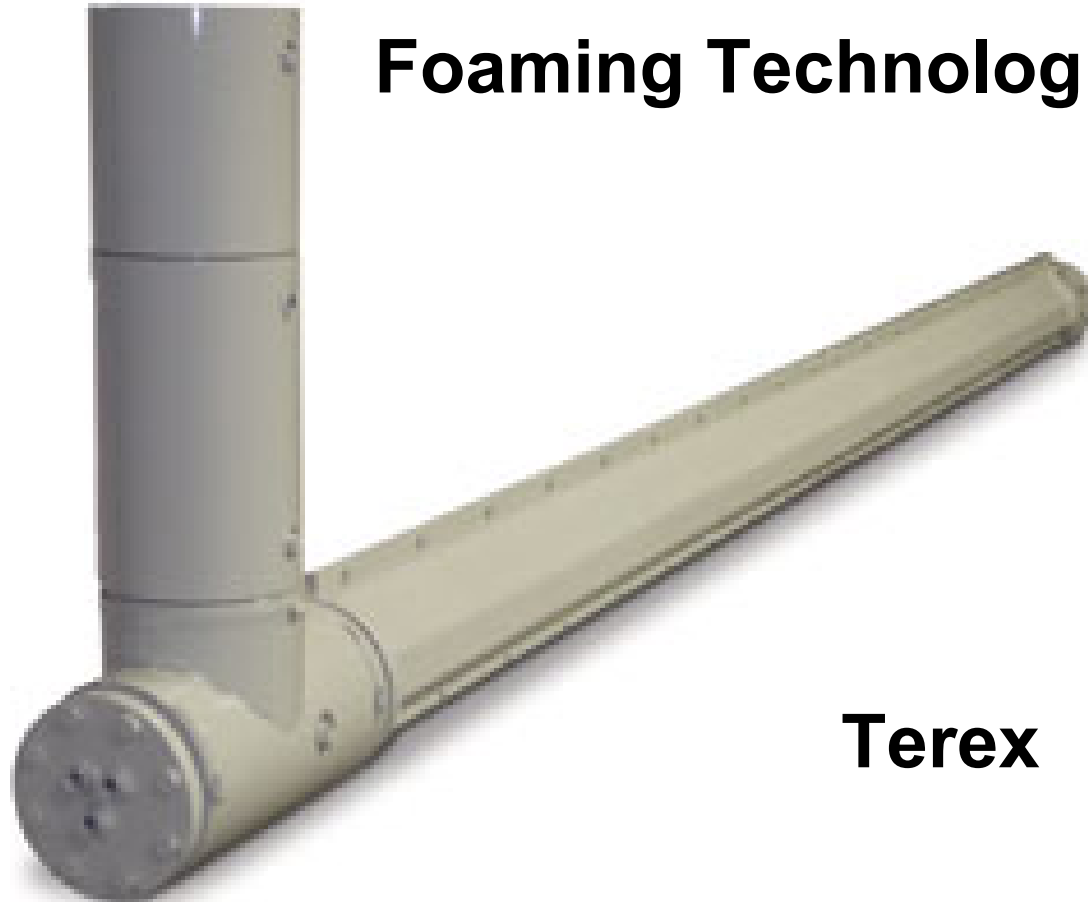
WATER IS THE ONLY ADDITIVE. WATER IS PUMPED FROM A TANK TO THE FOAM NOZZLES.

2009 Flexible Pavements Annual Meeting



Warm Mix Asphalt

Foaming Technologies



Terex

2009 Flexible Pavements Annual Meeting



Warm Mix Asphalt

Foaming Technologies

Gencor
and others



2009 Flexible Pavements Annual Meeting

Warm Mix Asphalt

2008 ODOT Field Trials

Projects with Water Injection for Foaming

In 2008 6 projects were sold to:

- 1) Determine asphalt plant emissions data
- 2) Create projects with control sections of equivalent HMA mixes to compare performance and laydown.
- 3) On some, sell as alternate to determine if realistic cost savings.

2009 Flexible Pavements Annual Meeting



Warm Mix Asphalt

2008 ODOT Field Trials

Projects with Water Injection for Foaming

One additional project was let as an alternate but was awarded as a hot mix due to the way multiple contractors bid the job for mix placement vs. mix producer.

One existing project not sold as WMA had it's 301 base mix change ordered to WMA at a savings.

Total WMA tonnage – approx. 50,000 tons in 2008



Warm Mix Asphalt

2008 ODOT Field Trials

Projects with Water Injection for Foaming

Dist	PID	Section	Length	Sale	Contractor	Stack Test
4	77838	POR-224-13.42	4.9 mi	6/4/08	Shelly	Yes
4	25554	SUM-303-8.14	2.4 mi	6/4/08	Karvo	
5	22640	LIC-40-0.58	5.7 Lmi	change order	Shelly	
6	78156	PIC-62-0.00	7.64 mi	5/21/08	Kokosing	Yes
7	77424	DAR/MIA-49-0.00	9.75 mi	5/21/08	Valley/ Walls	Yes
8	25378	CLE-132-0.00	12.43 mi	6/4/08	Barrett	Yes
8	83808	HAM-50		change order	Valley	
12	22896	CUY-176-12.76	0.59 mi	7/23/08	Karvo	

2009 Flexible Pavements Annual Meeting



Warm Mix Asphalt

Projects with Water Injection for Foaming

Dist	Contr.	Section	Project Cost	Item	Cubic Yards
4	Shelly	POR-224-13.42	1,411,473	Mill 1.5, place 1.75 446-2, 64-22	2512 WMA/ 1897 HMA
				Place 1.25 446-1, 70-22M	1539 WMA/ 1840 HMA
4	Karvo	SUM-303-8.14	962,912	Mill 1.5, place 1.5 448-1 70-22M	1835 WMA/ 937 HMA
5	Shelly	LIC-40-0.58	- 3341	301 base only for WMA	6683 WMA
6	Kokosing	PIC-62-0.00	934,073	Mill 1.5, place 1.5 446-1, 64-22	2665 HMA/ 2928 WMA
7	Valley	DAR/MIA-49-0.00	1,662,762	Place 0.5 448-1 64-22	1222 WMA
				Place 1.5 448-1H, 70-22M	3433 HMA/ 3667 WMA
8	Barrett	CLE-132-0.00	2,263,252	Mill 2.0, place 1.75 446-2	3713 total
				Place 1.5 446-1H 70-22M	3283 total
8	Valley	HAM-50		Place 1.5 448-1H 70-22M	8974 WMA
12	Karvo	CUY-176-12.76	255,843	Mill 0.5, place 1.0 424-B	1179 WMA

Warm Mix Asphalt

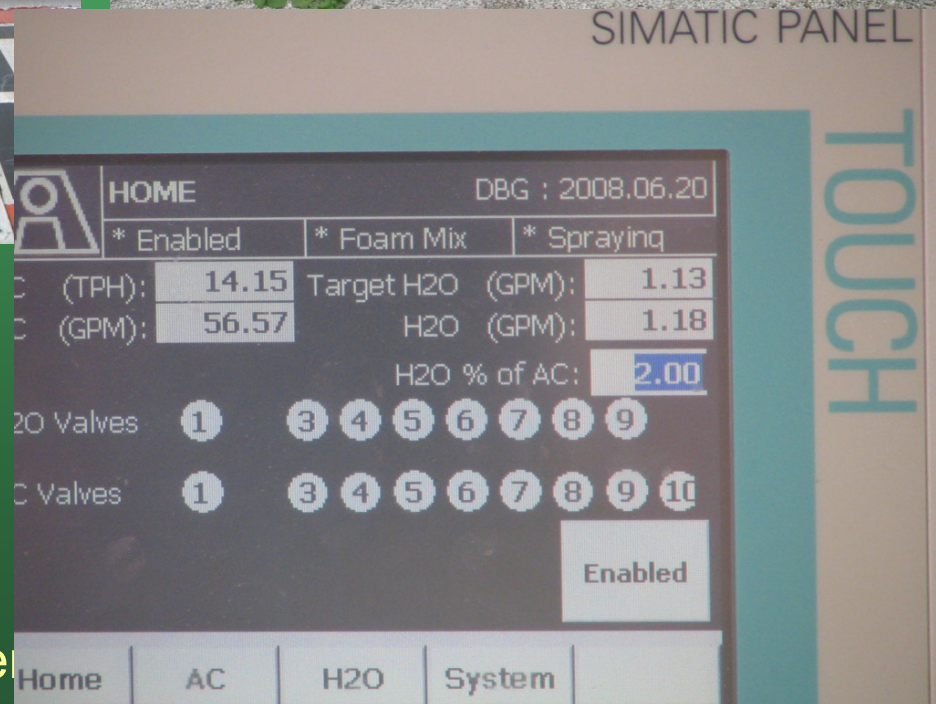
2008 ODOT Field Trials

General Project Requirements:

- Project split HMA/WMA with same JMF
- When stack test required: NO_x, CO₂ and VOC
- Use Astec multi point water injection
- Perform QC lab compaction at 25 F less than design
- Field compact as needed for density measure
- Perform T 283 moisture damage testing each day
- Collect all QC, stack and fuel data and report to ODOT



POR-224



2009 Flexible Pave

POR-224



2009 Flexible Pavement

POR-224



Annual Meeting



POR-224



al Meeting



SUM-303





SUM-303



2009 Flexible Pa

PIC-62



Annual Meeting



PIC-62



ents Annual Meeting



DAR/MIA- 49



DAR/MIA- 49



07/29/2008

DAR/MIA- 49



DAR/MIA- 49



Annual Meeting





Temp	% Density	Pay Factor
277	90.0	0.80
280	93.0	1.00
276	92.8	1.00
296	93.7	1.04

CUY- 176
424 w/ PG76-22M

2009 Flexible Pavement



2008 Warm Mix Asphalt

Fuel and Emissions

POR-224 Summary of Fuel and Emissions

	T 1 HMA	T 1 WMA	Percent Reduction	T 2 HMA	T 2 WMA	Percent Reduction
Production tons/hr	430	330		452	478	
Plant Fuel Usage gal/ton	2.08	1.71	17.8	1.77	1.57	11.3
Temp °F	290	261		298	260	
NOx lb/hr	31.97	19.10	40	30.46	27.33	10
CO ₂ lb/hr	16599	11378	31	17258	15253	12
VOC lb/hr	8.7	6.39	27	6.92	6.54	5

2009 Flexible Pavements Annual Meeting



2008 Warm Mix Asphalt

Fuel and Emissions

DAR/MIA-49 Summary of Fuel and Emissions

	Hot Mix	Warm Mix	Percent Reduction
Production tons/ hr	301.07	297.48	
Plant Fuel Usage gal/ton	1.64	1.40	14.8
Temp °F	330	295	
NOx lb/hr	21.04	17.65	16.1
CO ₂ lb/hr	14,830	12,789	13.8
VOC lb/hr	5.9	4.0	31.9

2009 Flexible Pavements Annual Meeting



Warm Mix Asphalt

2009 Specifications

<http://www.dot.state.oh.us/Divisions/ConstructionMgt/Pages/ProposalNotesSupplementalSpecificationsandSupplements.aspx>

**STATE OF OHIO
DEPARTMENT OF TRANSPORTATION
SUPPLEMENTAL SPECIFICATION 800
REVISIONS TO THE 2008 CONSTRUCTION & MATERIAL
SPECIFICATIONS**

DATED 01-16-2009

2009 Flexible Pavements Annual Meeting



Warm Mix Asphalt

2009 Specifications

401.05, Mixing Plants

On page 170.

Add as a last sentence in this section the following sentence: Asphalt mixtures may be produced using the warm mix asphalt method according to 402.09 except as restricted by specification.



Warm Mix Asphalt

2009 Specifications

402.09 Water Injection System for Warm Mix Asphalt.

When allowed by specification use a Department approved water injection system for the purpose of foaming the asphalt binder and lowering the mixture temperature. Only use equipment that has been proven stable and effective thru project use on non-ODOT projects. Ensure equipment for water injection meets the following requirements:

- Injection equipment computer controls are in the plant control room and are tied to the plant computer metering.
- Injection equipment has variable water injection control controlled by the plant operation rate and the water injection can never exceed 1.8% by weight of asphalt binder.
- Water injection rate cannot be manually overridden by the plant operator once in the computer.
- Injection equipment stops water flow when a control or equipment failure in the injection system occurs.
- The water injects into the asphalt binder flow before the asphalt binder spray hits aggregate. Do not allow water to touch aggregate before the binder spray.
- Injection equipment includes water storage and pump control tied to the injection computer controls.
- Water storage low water alarm installed in the control room.
- Provide a PG binder sampling valve between the last piping tee on the tank side of the line and the injection equipment to sample PG binder before water is injected.
- Provide a PG Binder sampling valve at the injection equipment to sample binder prior to spray.



Warm Mix Asphalt

2009 Specifications

442.01

On page 234. **Description, Add** to the end of second paragraph in 442.01 the following sentence: Do not use the warm mix asphalt method for 12.5mm mixtures.



Warm Mix Asphalt

2009 Specifications

441.09 Add: For warm mix asphalt according to 402.09 use a lab compaction temperature 30.0 °F (16.7 °C) less than the JMF lab compaction temperature for hot mix asphalt. Record on the TE-199 if the mixture produced was ran at the asphalt plant as a hot mix asphalt (HMA) or as a warm mix asphalt (WMA) produced according to 402.09 or another approved method.



Warm Mix Asphalt

2009 Specifications

Job Mix Formula for WMA

District / Project / County				
Mix type				
Submittal date	Approved date			
Job Mix Formula (JMF) numbers (HMA/WMA)		B442331	W442331	
Calibration number				



Thank You!

david.powers@dot.state.oh.us

Office of Materials Management

Ohio DOT (dot.state.oh.us)

614-275-1387

2009 Flexible Pavements Annual Meeting

