

# Hot mix vs. Warm mix (Foaming) Dickinson County Iowa Jeremy Anderson <sup>1</sup>

Global Warm Mix  
Asphalt Conference  
October 30<sup>th</sup>-31<sup>st</sup>, 2013  
Coralville, Iowa



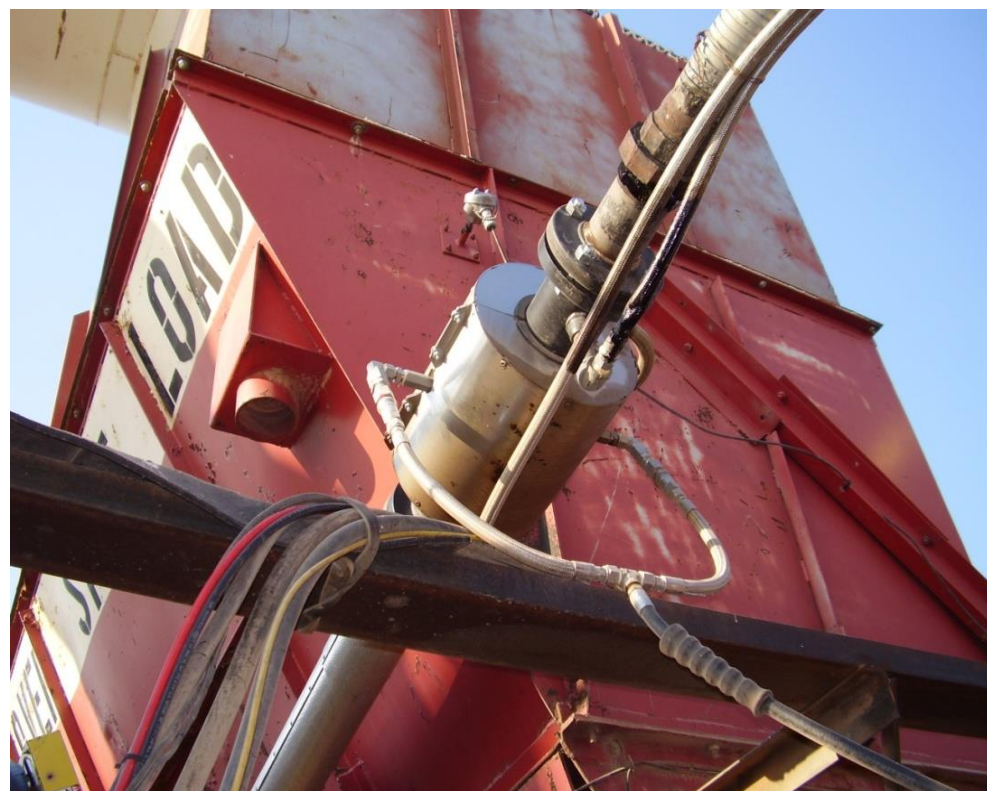
# Project Details Dickinson County

- 3 miles long
- Haul distance 16 miles
- 3.5" Total Depth:
  - 2" Int. & 1.5" Surface
- Design
  - 1/2", 1 MIL ESAL, Type B Mix
  - 5% RAP/2.5% RAS (10.3% AC)
- Fostoria Plant –
  - Parallel Flow Drum Plant
- Mixed at 240-250 F
- Lay down temps 220-230 F
  - 210-215 F were the lowest common readings



# Process

- WMA Technology Used:
- Foamed Technology, **Tarmac Tri-Mix System**



- The asphalt plant was heated up to its normal starting temperature, initially producing hot mix.
- The Tarmac foaming system began injecting water through high pressure nozzles, at the same location as the oil is injected, to begin the foaming process.
- Within two hours the mix temperature leaving the plant dropped from 310 degrees to 260 degrees.
- As we monitored densities on the road, temperatures were dropped even lower, 230 degrees to 240 degrees.
- To start nothing in the paving process was changed, with the exception of closer monitoring by our QMA personnel. Paving speed and rolling patterns stayed identical to that of hot mix.
- It was very common to see temperatures of 215 degrees to 220 degrees directly behind the paver!

# Mix Design

Form 955r ver. 7.13

## Iowa Department of Transportation

Highway Division-Office of Materials

Proportion & Production Limits For Aggregates

County : Dickinson Project No.: FM-CO30(38)--55-30 Date: 08/01/12  
 Project Location: From 310th AVE. East to Emmet Co. Line 3 Miles Mix Design No.: ADC12-3005  
 Contract Mix Tonnage: 4,825 Course: Immediate (Travel L: Mix Size (in.): 1/2  
 Contractor: TRI-STATE PAVING Mix Type: HMA (1M ESAL), INT, 1/2

Material	Ident #	% in Mix	Producer & Location	Type (A or B)	Friction Type	Beds	Gsb	%Abs	
Sand	A30508	5.0%	Fostoria/Hallett Materials Co	A	4		2.624	1.15	
Screenings	A30508	40.5%	Fostoria/Hallett Materials Co	A	4		2.600	1.85	
Manf. Sand	AMN032	12.0%	Cottonwood, Cottonwood Co/Southern M	A	2		2.636	0.21	
3/4 CA-5 3/4 Dust Free	AMN032	8.0%	Cottonwood, Cottonwood Co/Southern M	A	2		2.633	0.30	
1/2 Chips	A76004	27.0%	Moore/Martin Marietta	A			2.575	1.90	
RAP/RAS	3-0016/HV	7.5%	5% RAP/2.5% RAS (10.3% AC)	A	4	1/2	2.550	1.76	
Type and Source of Asphalt Binder:			58-28	Marathon Ashland Petroleum LLC (St P					

COMPACTED MIXTURE										
Core	Station	CL Reference	W1 Dry (g)	W2 in H2O (g)	W3 Wet (g)	Diff.	G <sub>mb</sub>	% of G <sub>mm</sub>	Pa (%)	Thickness (in.)
1	11+06	5.6 NIE Div	1,807.4	1,010.9	1,808.9	798.0	2.265	92.9	7.1	1.85
2	30+17	7.0 NIE Div	1,734.3	971.2	1,735.9	764.7	2.268	93.0	7.0	1.85
3	57+24	2.8 NIE Div	1,703.0	942.5	1,704.6	762.1	2.235	91.7	8.3	1.85
4	66+65	3.4 NIE Div	1,562.0	863.4	1,563.6	700.2	2.231	91.5	8.5	1.85
5	95+58	8.2 NIE Div	1,634.5	900.2	1,636.4	736.2	2.220	91.1	8.9	1.60
6	111+26	5.7 NIE Div	1,496.4	834.8	1,497.7	662.9	2.257	92.6	7.4	1.75
7	126+11	1.5 NIE Div	1,709.3	955.4	1,711.0	755.6	2.262	92.8	7.2	1.50
8	148+73	1.2 NIE Div	1,746.1	982.6	1,747.3	764.7	2.283	93.6	6.4	1.75
Course Placed:			Surface (Travel Lane)				Tested By: Rick Heckenlively			
Intended Lift Thickness:			1.50				Avg. Field Density: 2.253			
Date Placed:			08/02/12				Avg. % of G <sub>mm</sub> : 92.400			
Date Tested:			08/06/12				Avg. % Field Voids: 7.60			
$\text{Q.I. (lower)} = \frac{(0.965 \times 2.438) - 2.253}{0.022} = 4.53 \rightarrow \text{PWL (lower)} = 100.0$ $\text{Q.I. (upper)} = \frac{2.253 - (0.915 \times 2.438)}{0.022} = 1.01 \rightarrow \text{PWL (upper)} = 84.2$ $\text{PWL (total)} = 100.0 + 84.2 - 100.0 = 84.2$										
<b>Pay Factor = 1.000</b>										
Tons of Mix for PWL Field Voids Analysis (00.00 deducted)=				1,964.60			Field Voids Price Adjustment = \$0.00			

TEMPERATURE, °F									
Time	7:00	9:00	11:00	1:00	3:00	5:00	7:00	Spec	Comply?
Air Temp								260-330 °F	Yes
Binder Temp	302	302	302	302	302		245-330 °F		Yes
Plant Temp	305	310	308	310	290		245-330 °F		
Mat Temp									

# HMA Surface Results

# WMA Surface Results

COMPACTED MIXTURE										
Core	Station	CL Reference	W1 Dry (g)	W2 in H2O (g)	W3 Wet (g)	Diff.	G <sub>mb</sub>	% of Gmm	Pa (%)	Thickness (in.)
1	9+64	2.3 SW Dn	1,839.7	1,036.0	1,847.4	811.4	2.267	93.4	6.6	1.85
2	44+70	9.0 SW Dn	1,714.3	957.8	1,715.6	757.8	2.262	93.2	6.8	1.85
3	58+25	1.0 SW Dn	1,764.0	985.7	1,765.1	779.4	2.263	93.3	6.7	1.85
4	81+45	8.6 SW Dn	1,744.6	966.2	1,745.8	779.6	2.238	92.3	7.7	1.85
5	104+09	8.5 SW Dn	1,718.4	956.4	1,719.7	763.3	2.251	92.8	7.2	1.85
6	132+65	3.1 SW Dn	1,710.1	950.3	1,712.8	762.5	2.243	92.5	7.5	1.85
7	148+09	4.3 SW Dn	1,634.2	919.0	1,635.7	716.7	2.280	94.0	6.0	1.75
8	156+59	6.8 N/E Dn	1,747.6	969.6	1,748.8	779.2	2.243	92.5	7.5	1.85
Course Placed:			Surface (Travel Lane)				Tested By: Rick Heckenlively			
Intended Lift Thickness:			1.50				Avg. Field Density: 2.256			
Date Placed:			08/01/12				Avg. % of Gmm: 93.000			
Date Tested:			08/02/12				Avg. % Field Voids: 7.00			
$\text{Q.I. (lower)} = \frac{(0.965 \times 2.426) - 2.256}{0.014} = 6.08 \rightarrow \text{PWL (lower)} = 100.0$ $\text{Q.I. (upper)} = \frac{2.256 - (0.915 \times 2.426)}{0.014} = 2.59 \rightarrow \text{PWL (upper)} = 100.0$ $\text{PWL (total)} = 100.0 + 100.0 = 100.0$ <p style="text-align: right;"><b>Pay Factor = 1.040</b></p>										
Tons of Mix for PWL Field Voids Analysis (00.00 deducted)=				1,857.56			Field Voids Incentive = <b>\$2,191.92</b>			

TEMPERATURE, °F									
Time	7:00	9:00	11:00	1:00	3:00	5:00	7:00	Spec	Comply?
Air Temp								260-330 °F 240-280 °F 215-280 °F	Yes
Binder Temp	302	302	304	302	304		No		
Plant Temp	300	260	240	240	250				
Mat Temp									

# Benefits of WMA vs. HMA



- Able to achieve more consistent field densities
- Less roller passes
  - One less pass per roller
- Lower emissions at plant
- Higher crew moral
  - 40-50 degrees cooler in work area

# Details of the Benefits

- Percent within limits (PWL) pay factor increased .
  - .02 on intermediate and .04 on surface.
- Film thickness increased
  - .5% or greater in every instance
- 16% percent reduction in fuel costs:
  - Burner fuel usage decreased from 1.74 gal per ton (226200 BTU's) to 1.45 gal per ton (188500 BTU's)
  - Savings of roughly \$0.44 per ton
- WMA had the more effective binder and higher film thickness with a tenth less liquid asphalt. This made the WMA lighter by about 1.2 lbs per CF, about 1% of the total weight. (Determined by volumetrics from lab QC testing of Gmb and Gmm.)





## Minimal Downside

- Harder to loot and perform hand work with.
- Seems “stickier”



# WMA: The Coolest Thing In Asphalt

