Fiberless SMA

Lindy Paving & Ingevity

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Agenda

SMA W/Fiber & Fiberless SMA

Mix Design overview

Production & Placement

Lindy Paving Neville Island Plant

Stone Matrix Asphalt (SMA)

- Gap graded aggregate blends with cubical shaped aggregate
- Blend of polymer-modified asphalt binder, mineral filler and fibers
- When produced and placed correctly, known for outstanding performance
- Due to high asphalt contents, a potential for “draindown” of binder exists
- Defined as liquid binder running off aggregate surface
- Results in “fat spots” and segregated areas of high and low binder content

Fiberless SMA

- To help reduce the potential of draindown, polymer - modified asphalt (PMA) and fibers are used with SMA to stabilize the asphalt binder
- In order to take out the fibers you need to lower the mixture temp to stabilize the asphalt binder
- Reduction in mixture temp will create compaction issues
- Must couple mixture temp reduction with WMA additive
- Utilize existing SMA design as your starting point (i.e. – asphalt content, aggregate blend
- Determine Draindown (AASHTO T305) vs Mixture Temperature
  - Example: 280, 285, 290, 295, 300, 305, 310F
- Visually examine mixing process to ensure coating is taking place
  - Can utilize AASHTO T195, Degree of Particle Coating as a guide

Penn. DOT PUB 408 / 419 SMA Specifications:

TABLE B
Mix Design Requirements for SMA Mixtures

AGGREGATE GRADATION REQUIREMENTS, PERCENT PASSING		
Sieve Size	**9.5-mm Mixture**	**12.5-mm Mixture**
19.0 mm (3/4 inch)	-	100
12.5 mm (1/2 inch)	100	90 – 99
9.5 mm (3/8 inch)	75 – 95	70 – 85
4.75 mm (No. 4)	30 – 50	28 – 40
2.36 mm (No. 8)	20 – 30	18 – 30
1.18 mm (No. 16)	-	-
600 µm (No. 30)	-	-
300 µm (No. 50)	-	-
150 µm (No. 100)	-	-
75 µm (No. 200)	8 – 13	8 – 11
VOLUMETRIC DESIGN REQUIREMENTS		
Design Gyrations (N_{design})	100	
Voids in Mineral Aggregate	18.0 % Minimum	
Voids in Course Aggregate (VCA)	$VCA_{mix} < VCA_{dry\ rodded}$	
Design air voids	3.5 - 4.0 %	
Minimum asphalt binder content	Table C	
Binder grade	PG 64E-22	
Stabilizer content	Cellulose: 0.2 to 0.4 % by total mix weight Mineral: 0.3 to 0.4 % by total mix weight CR: 0.3 to 1 % by total mix weight	
Draindown	0.3 % maximum	

(1) When a warm mix technology is used as the stabilizing agent the VMA may be lowered to a minimum of 17.5%.

(2) When a warm mix technology is used as the stabilizing agent, perform this test at 5 degrees above the desired high production temperature limit in the QC plan, but no higher than 305 degrees

Penn. DOT PUB 408 / 419 SMA Specifications:

TABLE C
Minimum Asphalt Binder Requirements for SMA Mixtures

Combined Aggregate Bulk Specific Gravity	Minimum Asphalt Content, % by Total Mix Weight
2.400 - 2.449	7.4
2.450 - 2.499	7.2
2.500 - 2.549	7.1
2.550 - 2.599	7.0
2.600 - 2.649	6.8
2.650 - 2.699	6.7
2.700 - 2.749	6.6
2.750 - 2.799	6.5
2.800 - 2.849	6.4
2.850 - 2.899	6.3
2.900 - 2.949	6.2
2.950 - 2.999	6.1
3.000 - 3.049	6.0

Penn. DOT PUB 408 / 419 SMA Specifications:

TABLE D
Composition Tolerance Requirements of the Completed Mix

		Single Sample (n = 1)	Multiple Samples (n ≥ 3)
Gradation			
Passing 9.5 mm (3/8 inch) and Larger Sieves		±5%	±4%
Passing 4.75 mm (No. 4) to 150 µm (No. 100) Sieves (Inclusive)		±4%	±3%
Passing 75 µm (No. 200) Sieve		±3.0%	±2.0%
Asphalt Content			
% Asphalt by Weight		±0.7%	±0.4%
Draindown			
% by Weight		0.3 % maximum	
Temperature of Mixture (F)			
Class of Material	**Type of Material**	**Minimum**	**Maximum**
PG 64E-22	Asphalt Binder	260	330

TABLE E
Volumetric Tolerance Requirements of the Laboratory Compacted Mix

	Single Specimen (n = 1)	Multiple Specimens (n ≥ 2)
Air Voids at N_{design} (V_a)	±2.0% from JMF	±1.5% from JMF
Minimum VMA	17.0	_

When a warm mix technology is used for the stabilizing agent the maximum temperature will be 300 degrees

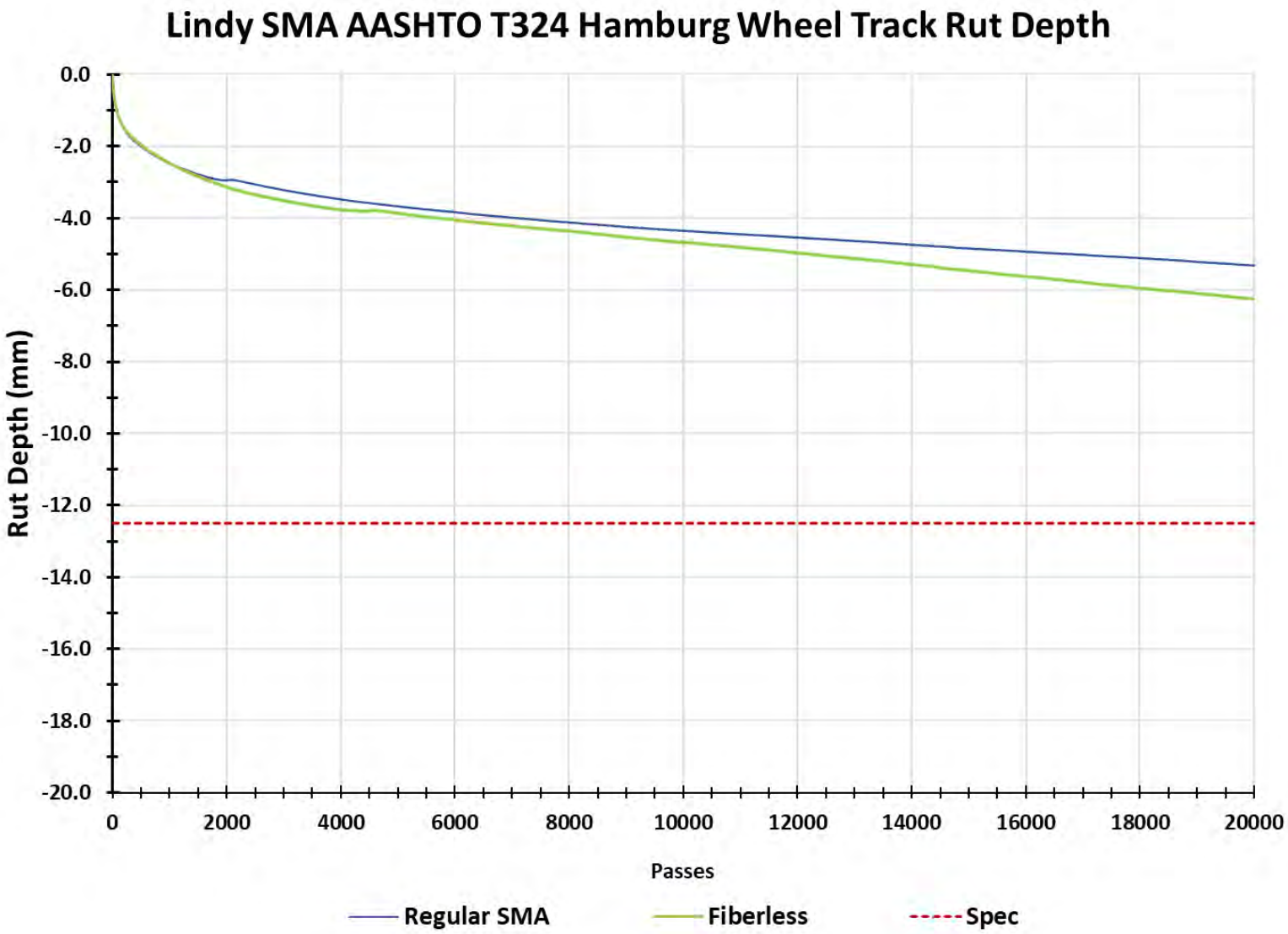
Process for making Fiberless SMA

When taking fibers out of your existing SMA mix make slight mixture adustments as necessary:

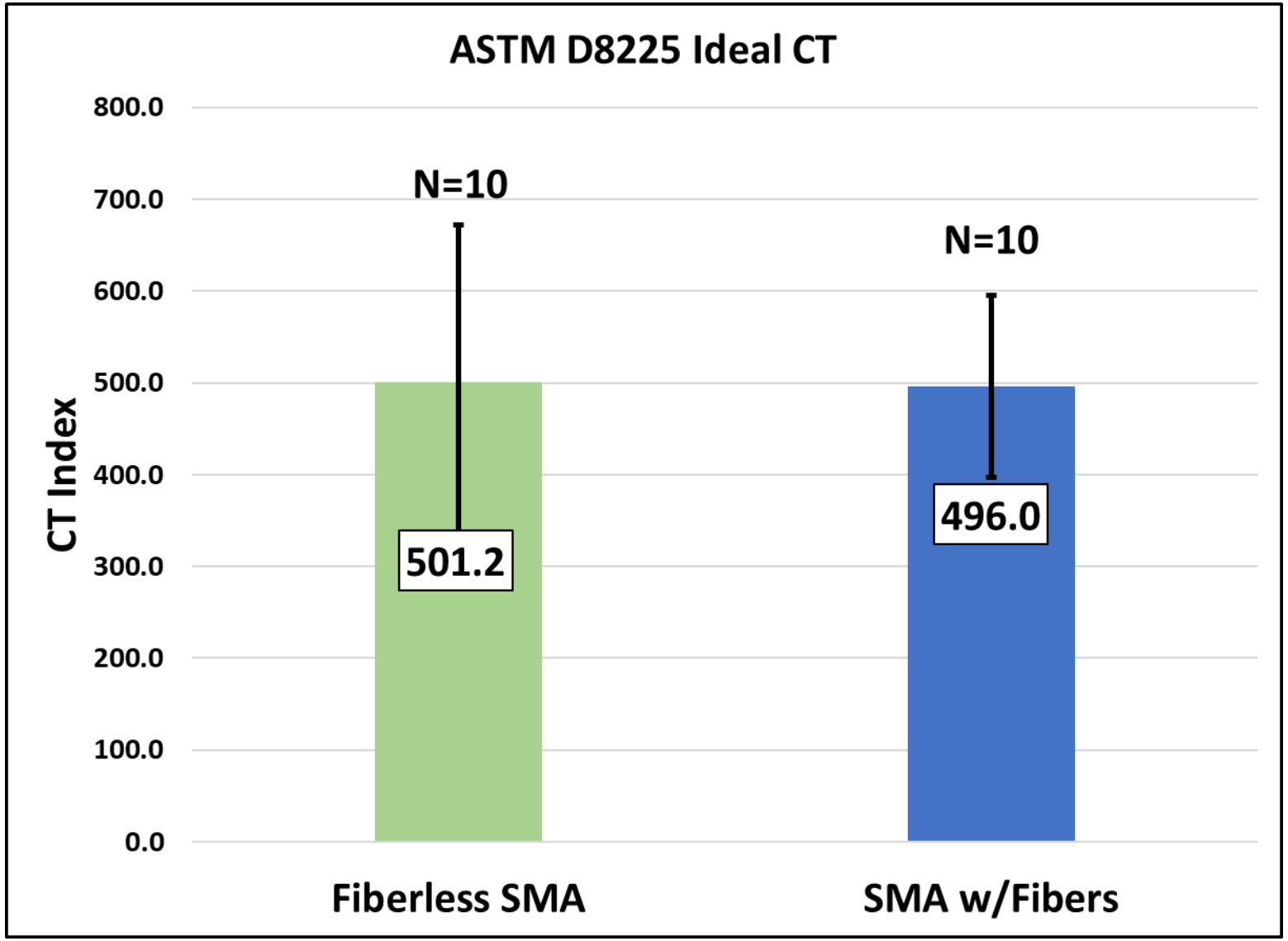
- In general, it's been found reducing fibers by 0.1% you reduce your liquid binder by 0.1%
  - I.E - 0.3% fibers lowers the liquid by 0.3% was required to maintain draindown in our situation
  - Utilize Volumetrics and Draindown testing to determine what changes are made in the design process
  - Lower the mix temperature
    - We used Evotherm J1 to produce at a lower temperature of 280 degrees
  - To meet mix design volumetrics, minor aggregate adjustments may have to be made.
- Establish drain down temperature limits
  - We used 280, 285, 290, 295, 300 and 305 as our points
  - 280 and 295 were our target production limits.

Mix Performance Tests

HWT AASTHO T 324



IDEAL CT (ASTM D8225)



Permeation: Measurement of Water Permeability of Compacted Paving Mixtures

Standard Fibers	1	2	3
Area of Tube, a (cm^2)	7.89	7.89	7.89
Thickness of Specimen, L (cm)	7.5	7.5	7.5
Area of Specimen, A (cm^2)	176.7	176.7	176.7
Flow Time, t(s)	1800	1800	
Initial Head, h1 (cm)	82.4	82.4	82.4
Terminal Timing Mark, tf (cm)	63.5	63.5	
Final Head, h2	82.4	82.4	18.9
Temp. Coeff., c	0.99	0.99	
Permeability, k (cm/s)	0.00 E+00	0.00 E+00	

Fiberless	1	2	3
Area of Tube, a (cm^2)	7.89	7.89	7.89
Thickness of Specimen, L (cm)	7.4	7.4	7.4
Area of Specimen, A (cm^2)	176.7	176.7	176.7
Flow Time, t(s)	1800	1800	
Initial Head, h1 (cm)	82.3	82.3	82.3
Terminal Timing Mark, tf (cm)	63.5	63.5	
Final Head, h2	82.3	82.3	18.8
Temp. Coeff., c	1.02	1.02	
Permeability, k (cm/s)	0.00 E+00	0.00 E+00	

Rational to try Fiberless SMA

Looking to produce SMA at any plant without the use of special equipment to provide flexibility and without sacrificing quality of the mix or laydown process

- Can take an order of SMA one day and start producing the next

Process for making Fiberless SMA

No issues with material sticking to truck bodies

PA Route 376 Fiberless SMA

- Temperature Control
  - Plant produced mix @ 270 to 280F
  - 1st Roller Pass @ 265 to 270F

- If designing and producing fiberless, must maintain fiberless temps.

PA Route 376 Fiberless SMA

We ran the same rolling train for both mixes.

Field densities of with and without fibers statistically equal

PA Route 376 Fiberless SMA

PA Route 376 Fiberless SMA

Production Summary

- Production Temp for Standard SMA = 315F to 325F
- Production Temp for Fiberless SMA 275F to 285F
- 35F to 40F production temperature drop complies with NAPA's Plan for Net-Zero Emissions
- Healthier for your employees
  - No fumes or blue smoke at the plant or paver
- Rain factor.
  - Popup shower at the plant is no longer an issue
- Eliminates fat spots in the final product
- No issue with mix buildup in truck beds
- No issue with hand work

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