

ADOT Experience with Warm Mix Asphalt



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ADOT - Materials Group



Overview of Presentation

- History of WMA in ADOT
 - Initial WMA Projects (2009 – 2010)
 - ADOT/AGC WMA Committee (2010)
 - Trial Specifications (Early 2011)
 - Evaluation of current WMA Demonstration Projects (2011)
- Challenges / Concerns
- Benefits
- Future of WMA in ADOT



WMA First Introduced on an ADOT project in Summer 2009



State Route 85

FNF Construction

$\frac{3}{4}$ " Dense Graded - Marshall Mix

PG 76-16 Binder / 1% Lime

1100 Tons of WMA w/ Advera

1600 Tons of WMA w/ Evotherm 3G

SR 85 – Evotherm 3G WMA

- Evotherm 3G WMA
Additive – 0.65% by wt of binder
- HMA production temps
315 deg F
- WMA production temps
250 – 280 deg F
- Average Density = 91.4%
(8.6% in-place voids)



SR 85 – Advera WMA

- Advera WMA Additive – 0.25% by wt of total mix
- HMA Production Temps 315 deg F
- WMA Production Temps 250 – 275 deg F
- Average Density = 93.5% (6.5 % in-place air voids)



SR 85 – Performance Testing

Hamburg Wheel-Tracking Testing
Average Rut Depth at 20,000 passes

-Control HMA	3.86 mm
-Evotherm WMA	3.97 mm
-Advera WMA	3.62 mm

ASU performed additional E* and TSR testing – similar HMA and WMA test results

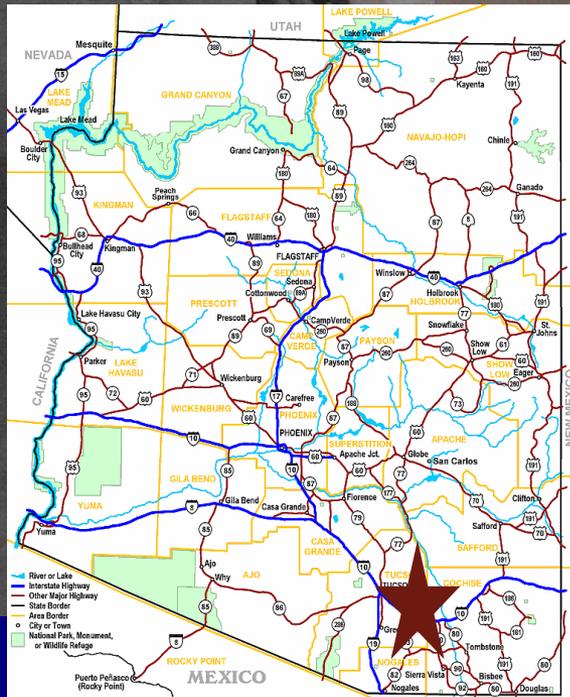
History of WMA in ADOT

- Second WMA project as a Change Order - August 2010
 - Interstate 10 south of Tucson – Granite Construction
 - 5 Lots of WMA production with a corresponding Control Lot for each WMA Lot
 - ADOT Initiated a research project to gain information – AMEC Earth & Environmental, Inc.



I-10 Tucson

- Granite Construction
- AQUA Black Water Foaming System – Maxam Equipment
- 3/4” Dense Graded – Marshall Mix with 20% RAP
- PG 70-10 Binder / 1% Cement
- 10,000 Tons of WMA placed



I-10 – Temperatures

**HMA Production Temperatures
averaged 300 degrees F**

**WMA Production Temperatures
averaged 270 degrees F**



I-10 – Summary of Test Results

Lot Numbers	Laboratory Air Voids (%)		In-Place Air Voids (%)	
	WMA	HMA	WMA	HMA
3 and 4	4.8	4.1	8.0	7.5
7 and 8	5.2	5.2	6.9	6.6
14 and 15	4.5	4.4	6.3	6.4
18 and 19	5.2	5.2	6.7	7.3
22 and 23	5.1	5.6	5.8	7.0
Average	5.0	4.9	6.7	7.0



I-10 – Performance Testing

	Lot Numbers	WMA (%)	HMA (%)
TSR on Mixtures	7 and 8	77	92
	18 and 19	62	65
	22 and 23	66	72
	Average	68	76
Immersion Compression Results on Mixtures	7 and 8	79	88
	18 and 19	87	86
	22 and 23	78	84
	Average	81	86
TSR on Cores	7 and 8	71	63
	18 and 19	59	62
	22 and 23	66	62
	Average	65	62

I-10 – Performance Testing

Hamburg Wheel Track Test Results

Lot Numbers	Average Rut Depth (mm)		Average Number of Passes to Maximum		Pass or Fail	
	WMA	HMA	WMA	HMA	WMA	HMA
3 and 4	11	20	20000	13145	Pass	Fail
7 and 8	20	18	19227	19555	Fail	Pass
14 and 15	13	13	17693	18946	Pass	Pass
18 and 19	20	20	8688	15096	Fail	Fail
22 and 23	20	16	17868	20000	Fail	Pass
Averages	17	17	16895	17348	-	

WMA Committee

- 2010 – AGC/ADOT Warm Mix Asphalt Committee
 - ADOT, Contractors, Suppliers, WMA Reps
 - Look into option for WMA in ADOT specifications
- Results of the Committee Work
 - Trial Specifications
 - Approval Process for WMA Technologies
 - 3 WMA Demonstration Projects to be Constructed on ADOT highways in 2011



WMA Specifications

- WMA defined as Production Temperatures at 215 – 275 deg F.
- WMA technology can be added to conventional HMA mix design for volumetric properties
- Moisture Susceptibility Testing requirements - need to incorporate WMA technology

WMA Specifications

- WMA must meet ADOT's PWL for the HMA standard specifications for Acceptance
 - Asphalt content
 - Mix volumetrics
 - Gradation
 - In-place voids

Requirements of WMA Technology Approval in ADOT

- Recognized WMA technology with production of at least 25,000 tons of WMA on other DOT highways
- Documentation from a minimum of 3 construction projects – mix design, test results, contact information
- Binder test results showing effect of WMA technology on the binder properties
- Partner with a Contractor and construct a test section on an ADOT project – meet all ADOT specifications during test section and show successful performance after construction



2011 Demonstration Projects

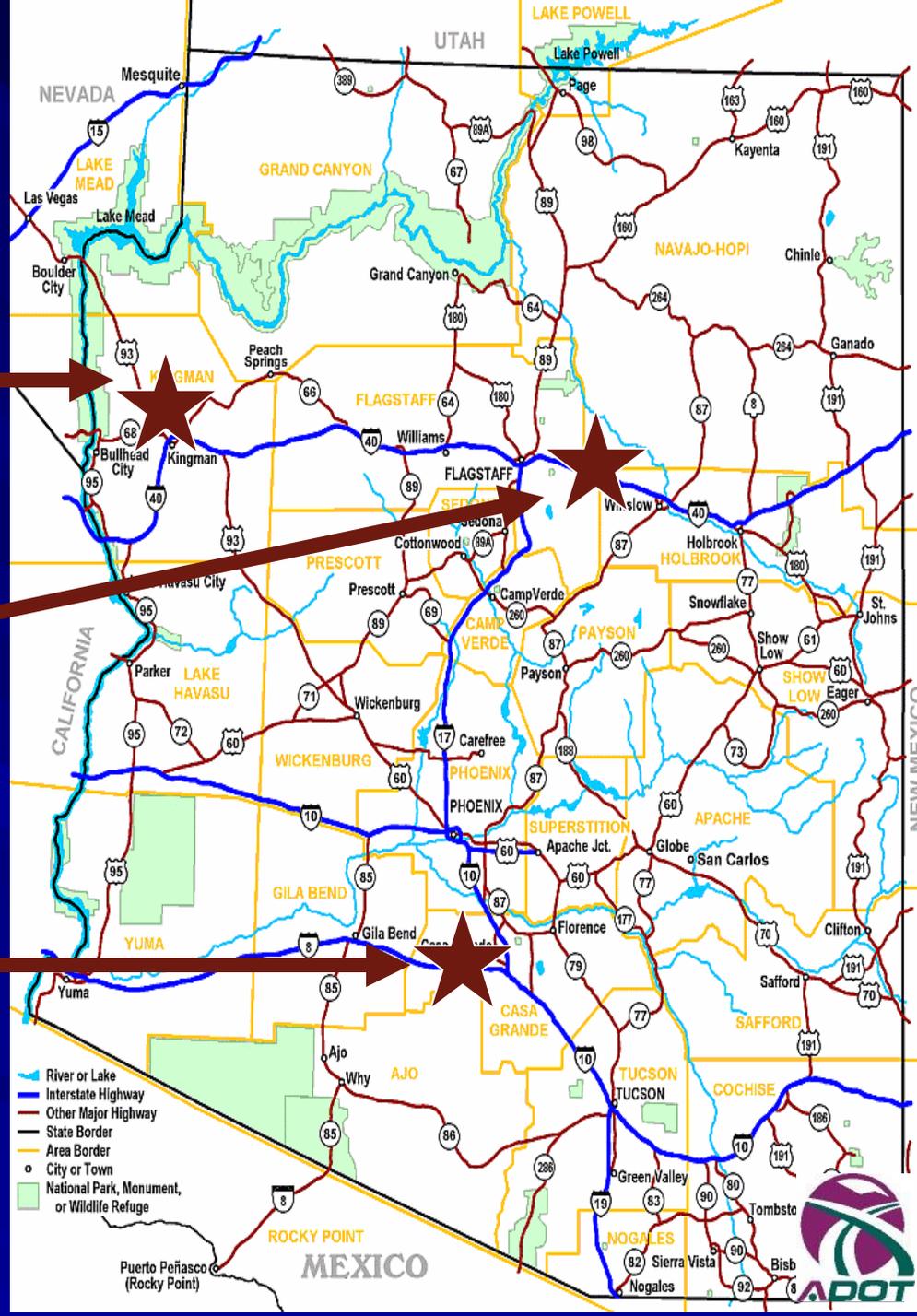
- Selected three projects to construct WMA test sections
- Get additional experience with different WMA technologies in different climatic regions, using different aggregate sources, traffic loadings, PG binders, etc.

Demonstration Projects

**US 93 -
Kingman District**

**I-40 -
Flagstaff District**

**SR 84 -
Tucson District**



2011 Demonstration Projects

- Each project will consist of 3 separate test sections with a different WMA technology in each – Contractor to select WMA technologies
- Each test section to include two Lots of paving with WMA and one Lot of paving with HMA (Control)
 - Minimum of 2000 tons of WMA
 - Laboratory testing and field monitoring plan
 - WMA Representative must be present for test sections

WMA Demonstration Projects

- US 93– McCormick Construction
- WMA Test Sections were placed in October 2011
- ¾" Marshall Mix with 15% RAP
- 1% Lime
- PG 70-10 Binder



US 93 – WMA Test Sections

HMA Production Temps 300 – 310 deg F

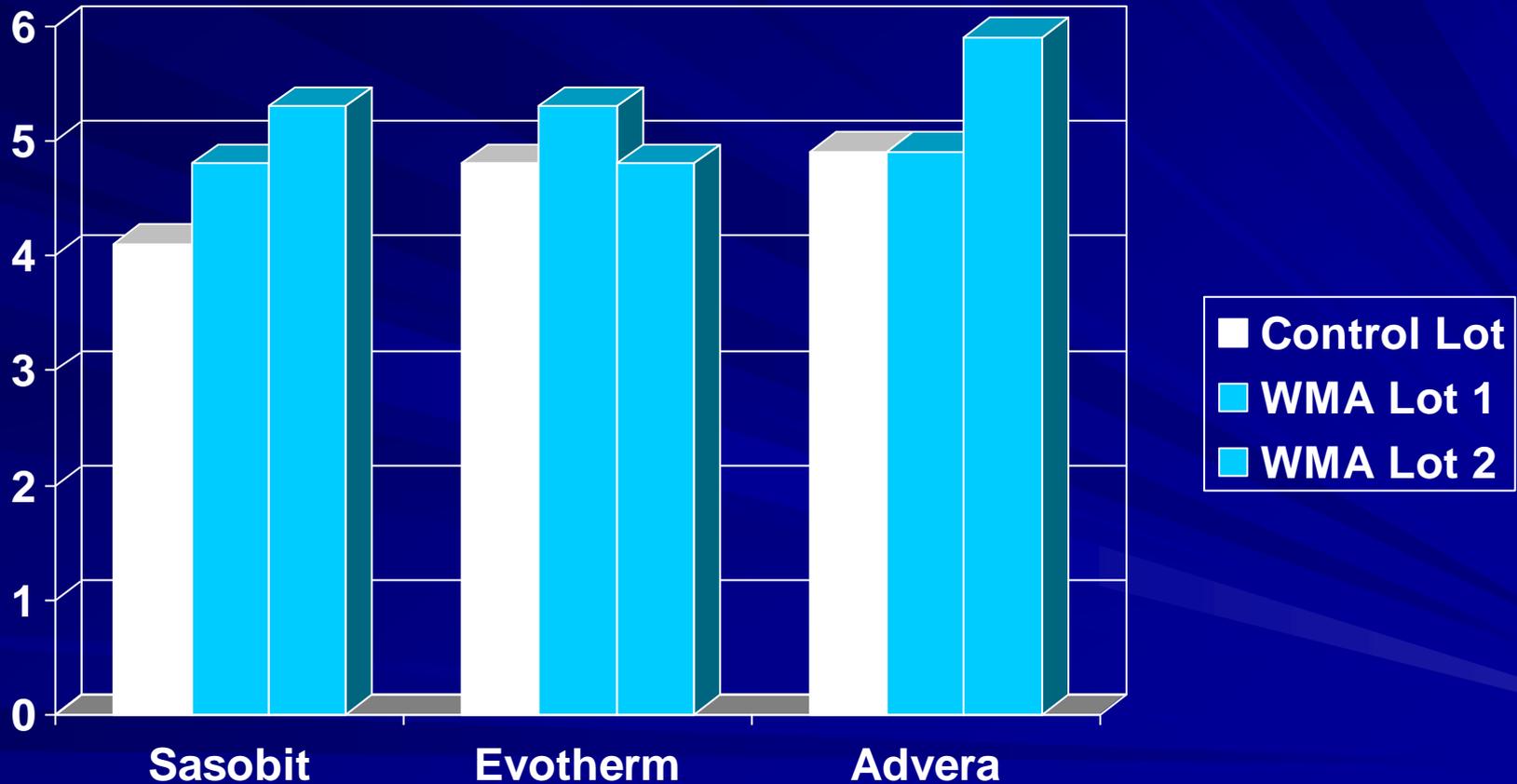
- Sasobit – 2310 tons of WMA
 - 1.5% by wt of total binder
 - Production Temps of 255 – 275 deg F

- Evotherm 3G – 2840 tons of WMA
 - 0.5% by wt of total binder
 - Production Temps of 260 – 270 deg F

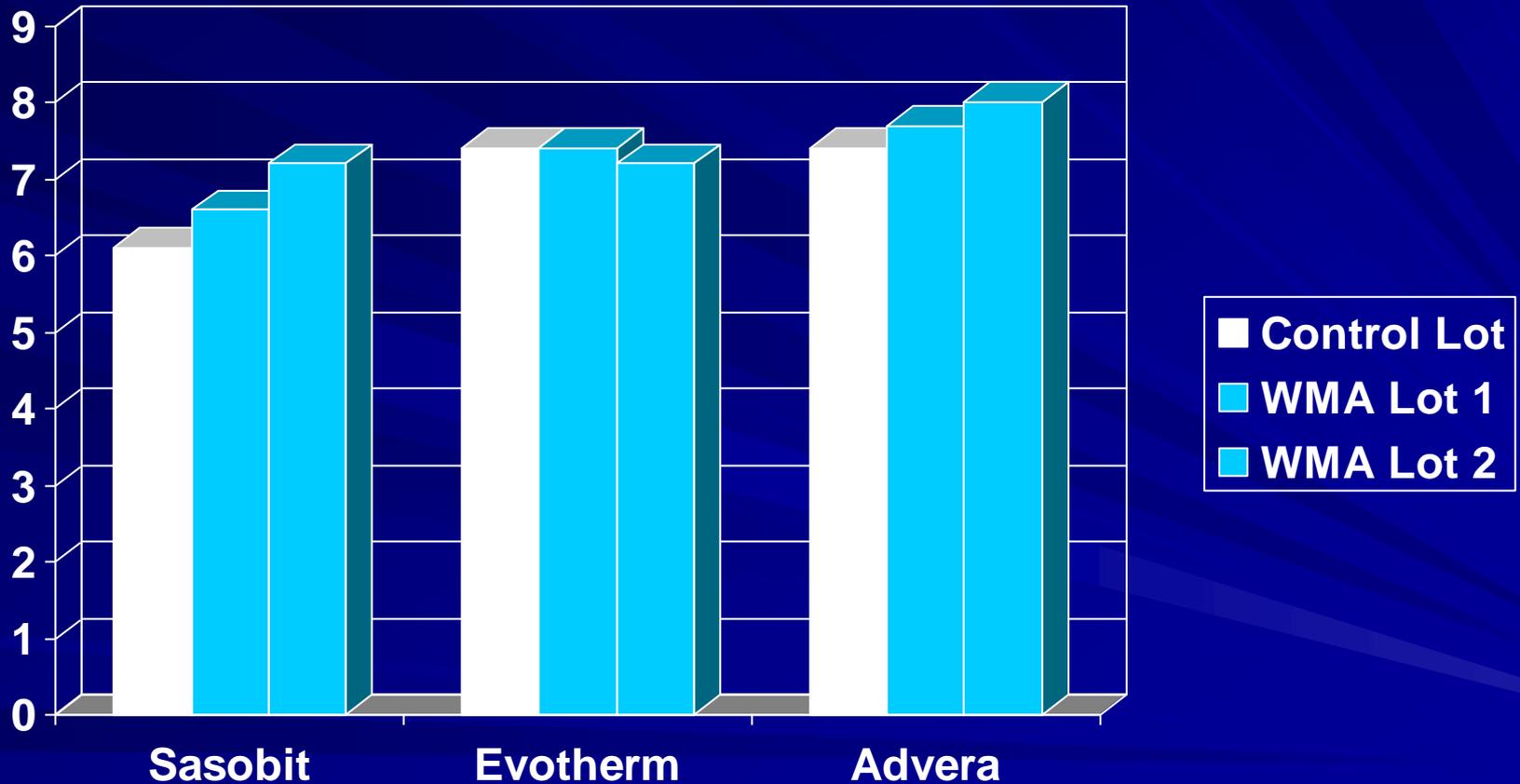
- Advera – 2400 tons of WMA
 - 0.25% by wt of asphalt mix
 - Production Temps of 250 – 265 deg F



US 93 - Laboratory Mix Voids (%)

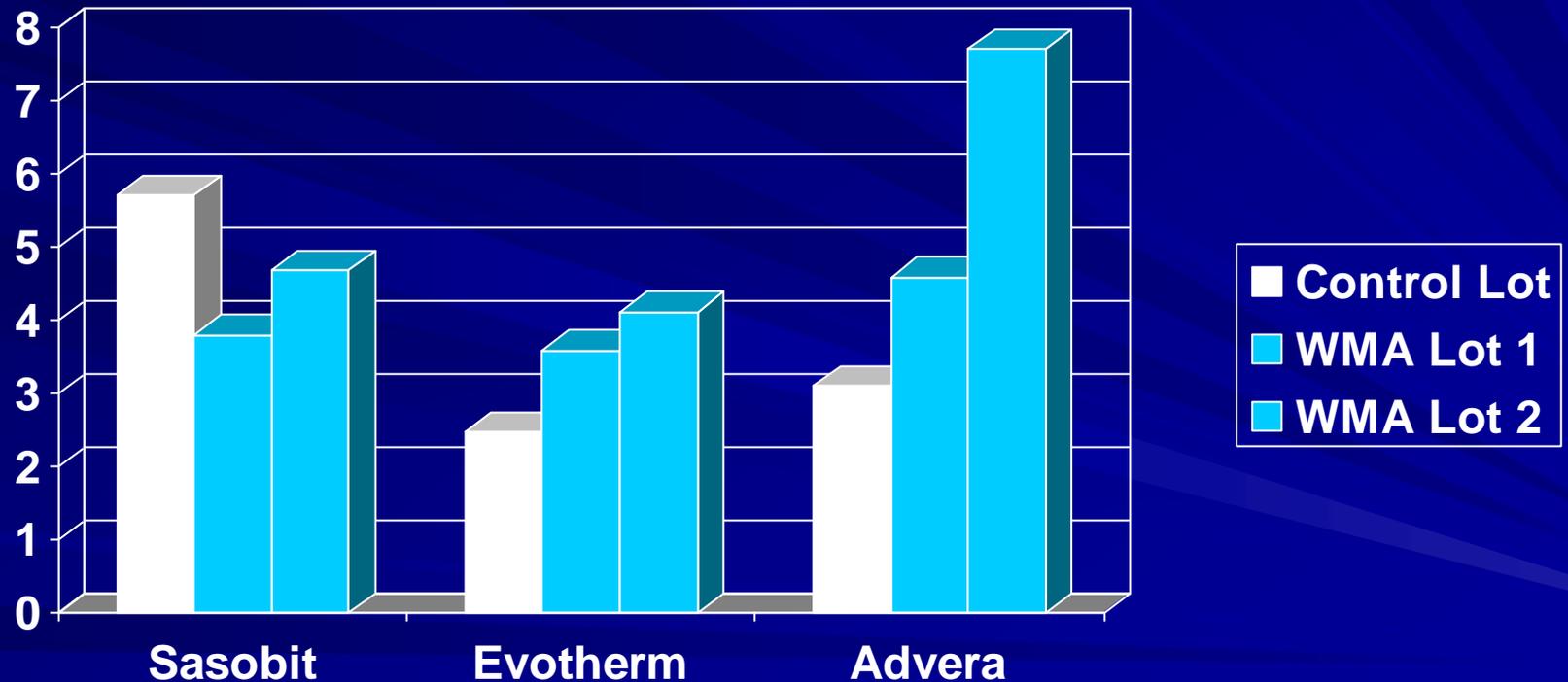


US 93 - Average In-Place Voids (%)

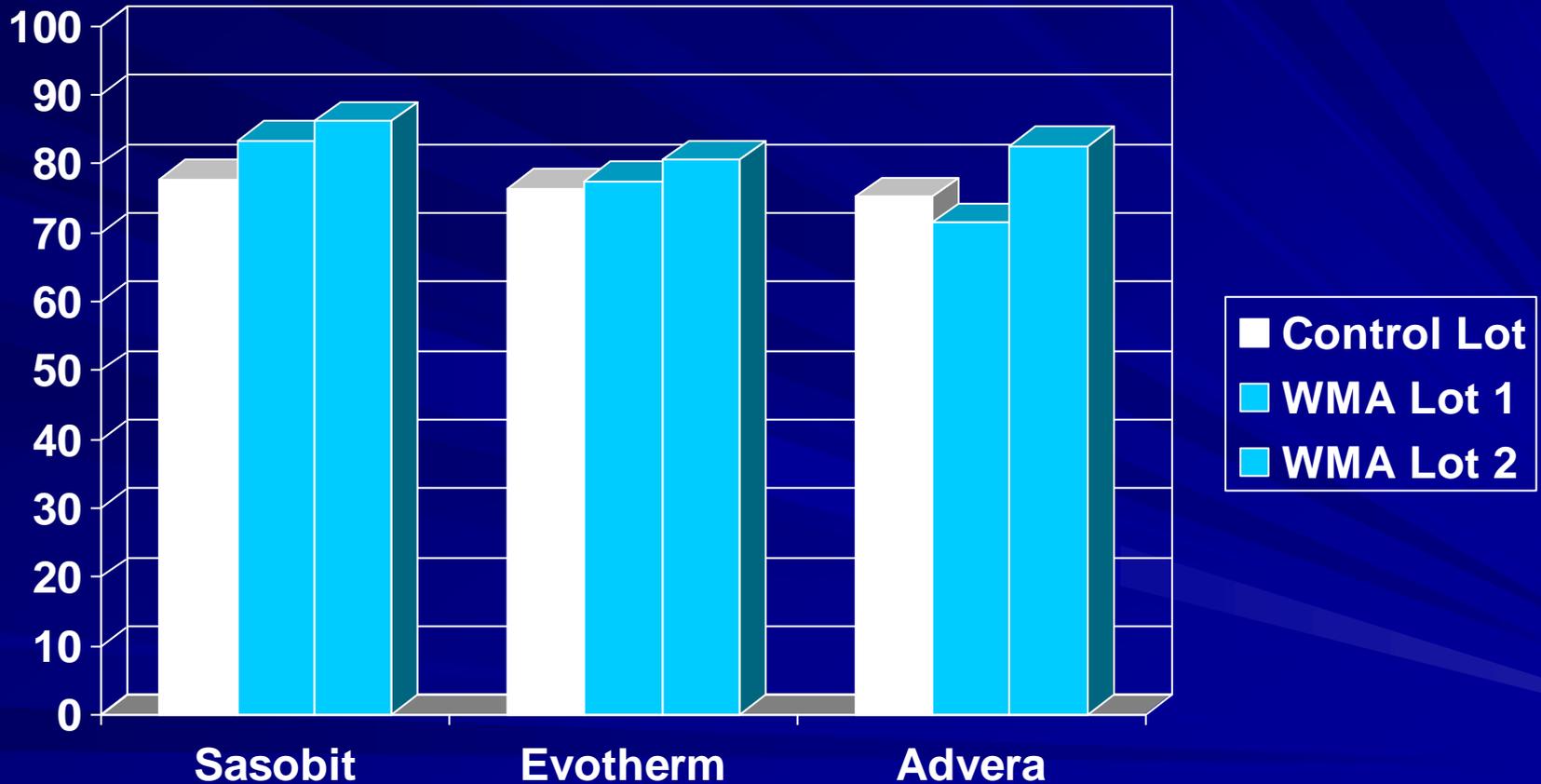


US 93 – Hamburg Wheel-Tracker

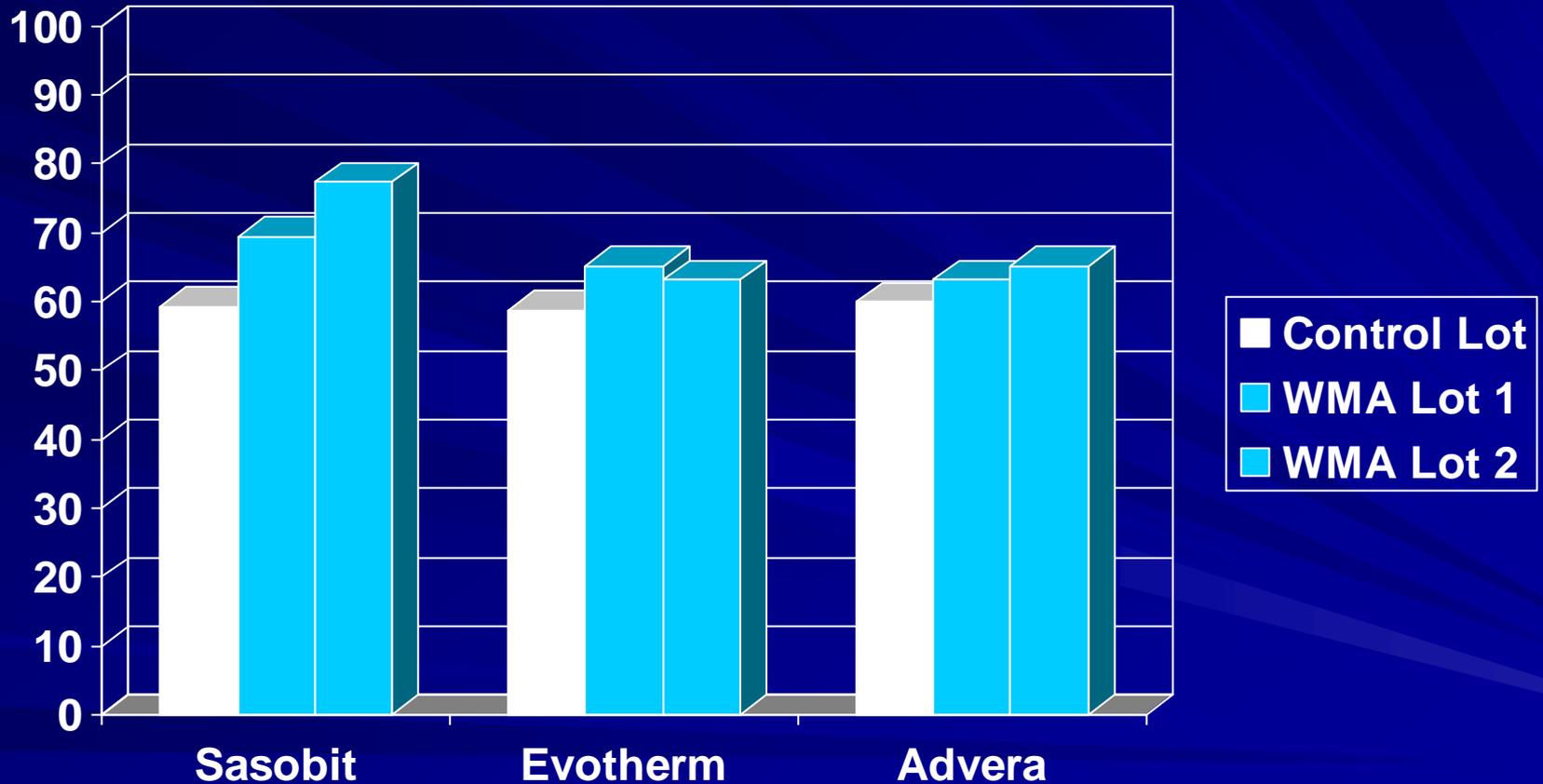
Rut Depth (mm) @ 20,000 passes



US 93 – Tensile Strength Ratio (%)



US 93 – Index of Retained Strength IMC (%)



I-40 - Flagstaff

Fann Contracting

**Placed WMA Test Sections
in November 2011**



I-40 - Flagstaff

- AQUABlack
- Advera
- Evotherm 3G



SR 84 – Casa Grande

- WMA Test Sections will be placed in early December
 - Sasobit
 - Advera
 - Evotherm 3G
- NCHRP 9 -47A to test/document the Sasobit WMA on this project

Challenges / Concerns

- Lack of Long Term Performance Data
- Specifications
- Concerns with aggregate moisture
- Concerns with rutting potential in mixes – less stiffening of the binder through the hot plant
- On-going NCHRP Research projects are looking into a lot of these issues

Benefits of WMA in ADOT

- Environmental impact
- Better Compaction
- Long hauls in rural areas
- Extend the paving season when needed in the high elevations



Next Steps for WMA in ADOT

- Complete WMA Demonstration projects
- Fully evaluate each test section – lab, field and performance
- Address concerns – make sure we are getting equal or better product with WMA
- Complete specifications to allow WMA as an option in ADOT 416 (Marshall Mix Design) and 417 (Superpave Mix Design) specifications



Thank You

Questions??

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