

# Surface Treatments Tennessee (S4) & Mississippi (S3) Sections

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**MnROAD/NCAT Partnership  
2018 Fall Sponsor Meeting**

# Objective of the Study

To screen among eight different surface rejuvenators that could, potentially, be selected as the surface treatment for sections S3 and S4.



# Materials



# Materials

Base asphalt layer was a mix with gravel aggregate constructed for the 2012 Test Track.

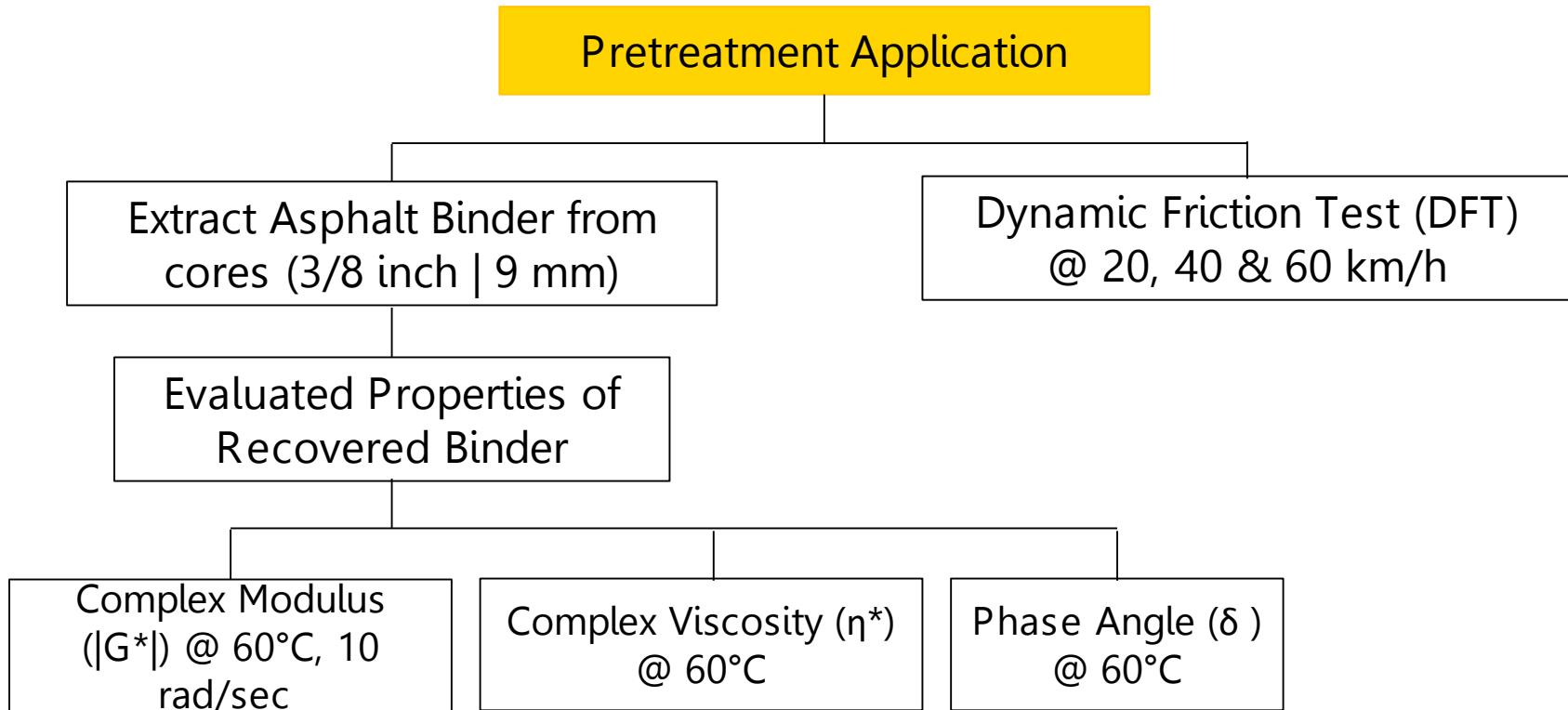
<i>Surface Treatment</i>	<i>Application Rate</i>
Product #1	0.08 gal/yd <sup>2</sup>
Product #2	0.08 gal/yd <sup>2</sup>
Product #3	0.07 gal/yd <sup>2</sup>
Product #4	0.06 gal/yd <sup>2</sup>
Product #5	0.10 gal/yd <sup>2</sup>
Product #6	0.03 gal/yd <sup>2</sup>
Product #7	0.015 gal/yd <sup>2</sup>
Product #8	0.08 gal/yd <sup>2</sup>



# Methods



# Testing Matrix



## Federal Aviation Administration (FAA) Procedure *P-632 (Bituminous Pavement Rejuvenation)*

The purpose of the selected product is rejuvenation of the upper 3/8 inch (9 mm) of oxidized/aged asphalt binder without causing an unacceptable reduction in the friction characteristics of the pavement section.

# After Surface Treatment Application

Dynamic Friction Test (DFT)  
@ 20, 40 & 60 km/h  
After 3, 24 and 96 hrs of curing

Dynamic Friction Test (DFT)  
@ 20, 40 & 60 km/h  
after conditioning surface with  
Three Wheel Polishing Device  
(TWPD) 1 h of curing, 500 cycles  
3 hrs of curing, +2000 cycles  
4 hrs of curing, +2500 cycles

Extract Asphalt Binder from cores  
(3/8 inch | 9 mm) after 2 and 4 weeks

Evaluated Properties of  
Recovered Binder

$|G^*|$  @ 60°C,  
10 rad/sec

$\eta^*$  @  
60°C

$\delta$  @  
60°C



TWPD operated  
at 60 rpm, 50 psi  
tire pressure, and  
91 lbs. gross  
carriage weight



# Results







Control



Product #1



Product #2



Product #3



Product #4



Product #5



Product #6



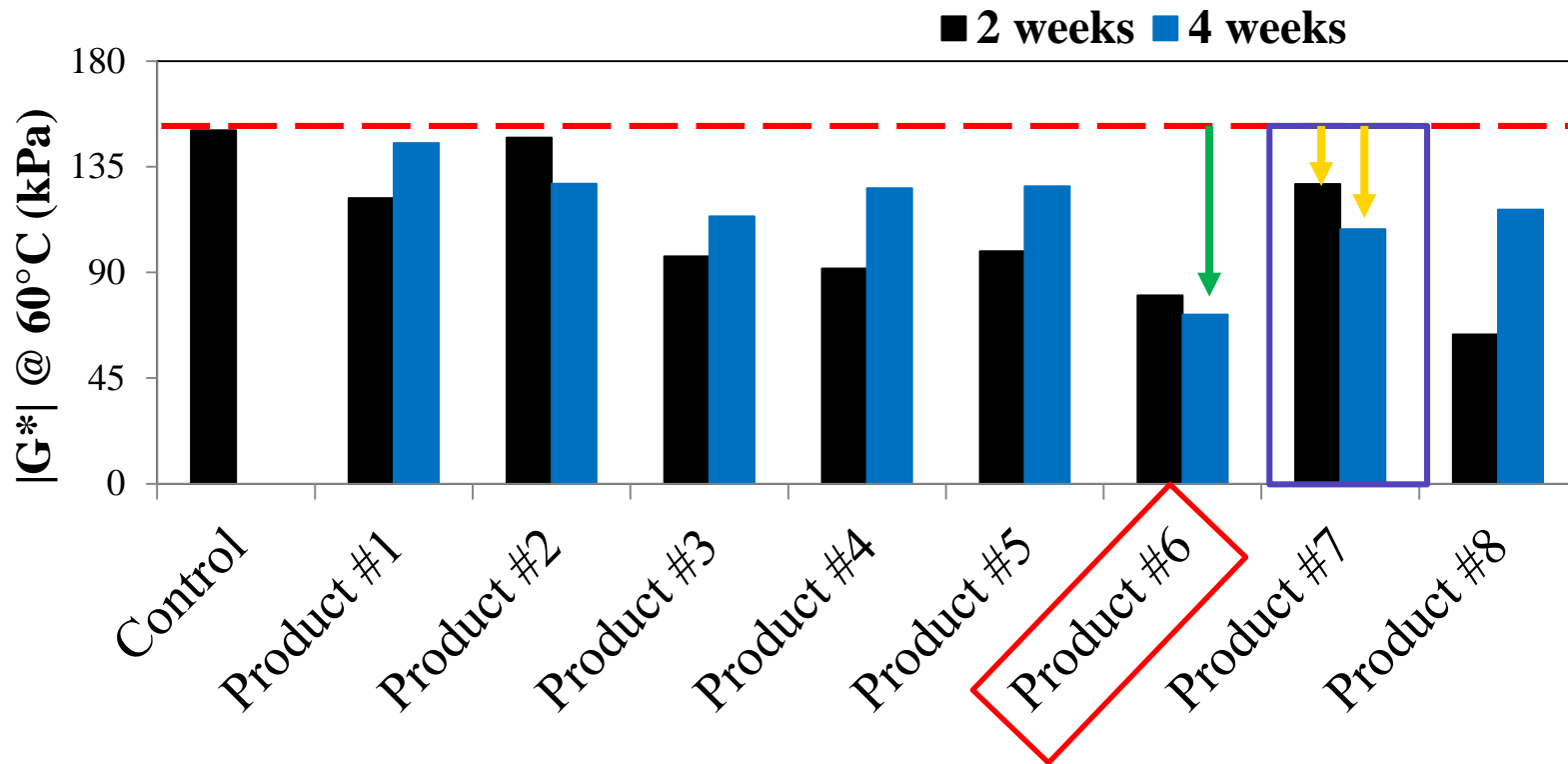
Product #7



Product #8

**4 weeks  
cores  
(after surface  
treatment  
application)**

# Complex Modulus ( $|G^*|$ ) @ 60°C, 10 rad/sec (kPa)



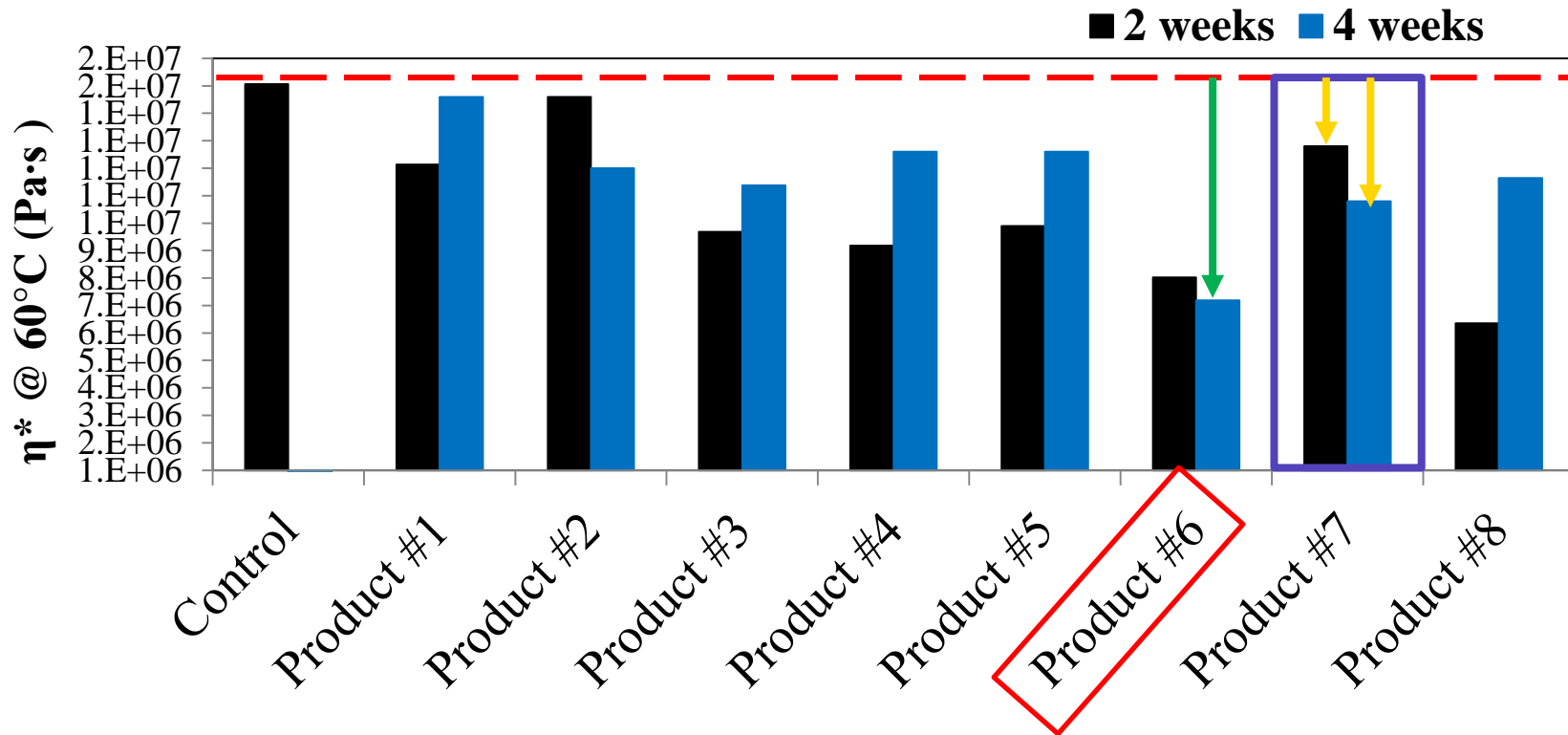
**$|G^*|$  difference = 52.15%**

## FAA P-632 (Bituminous Pavement Rejuvenation) Procedure

For pavement more than 3 years in age, 30-45 days after application of rejuvenation product →  $|G^*|$  @ 60°C must have % decrease  $\geq 40\%$

Restore the binder rheological properties

# Complex Viscosity @ 60°C (Pa.s) $\eta^* = |G^*|/\dot{\omega}$



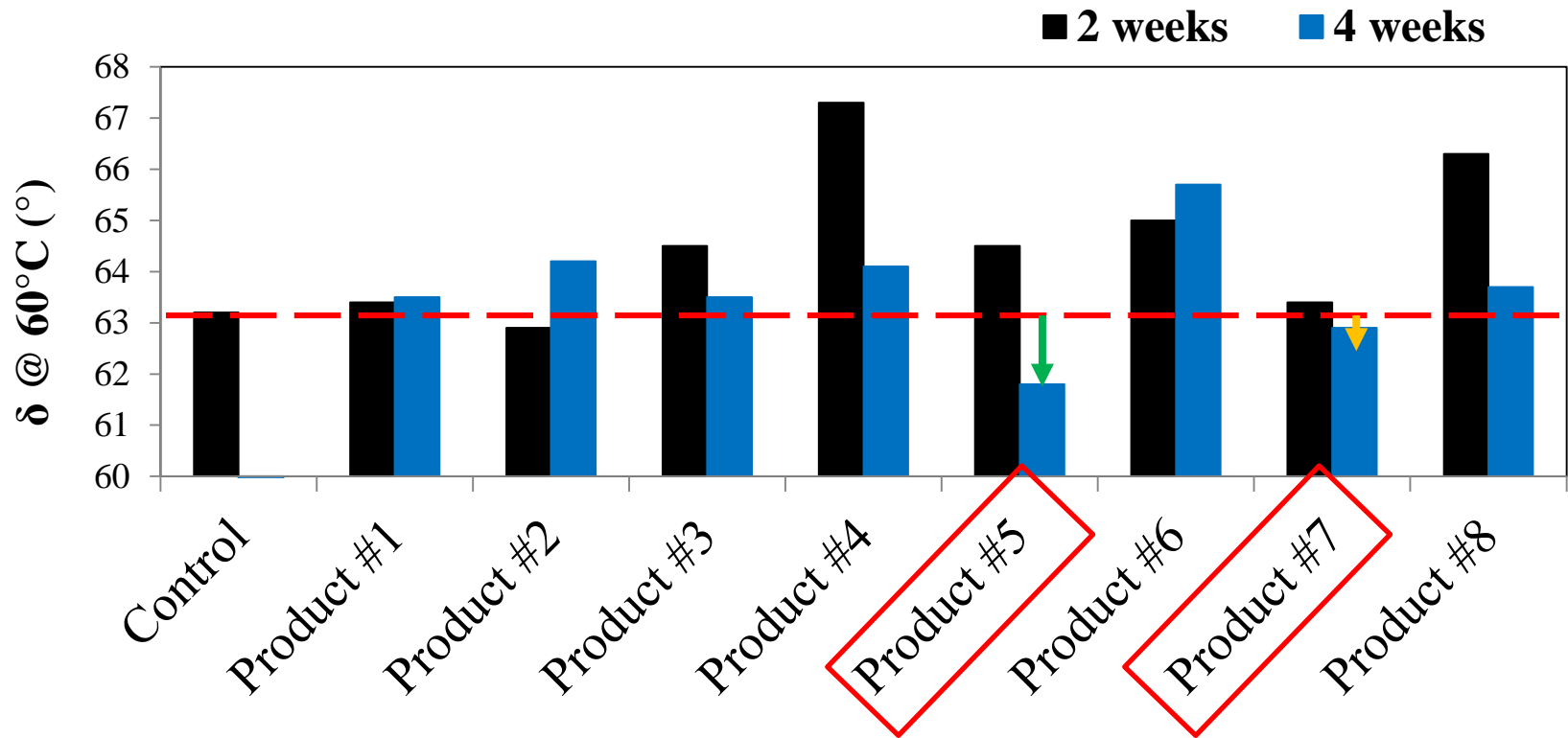
$\eta^*$  difference = 52.26%

## FAA P-632 (Bituminous Pavement Rejuvenation) Procedure

For pavement more than 3 years in age, 30-45 days after application of rejuvenation product  $\rightarrow \eta^* @ 60^\circ\text{C}$  must have % decrease  $\geq 40\%$



# Phase Angle @ 60°C (°)

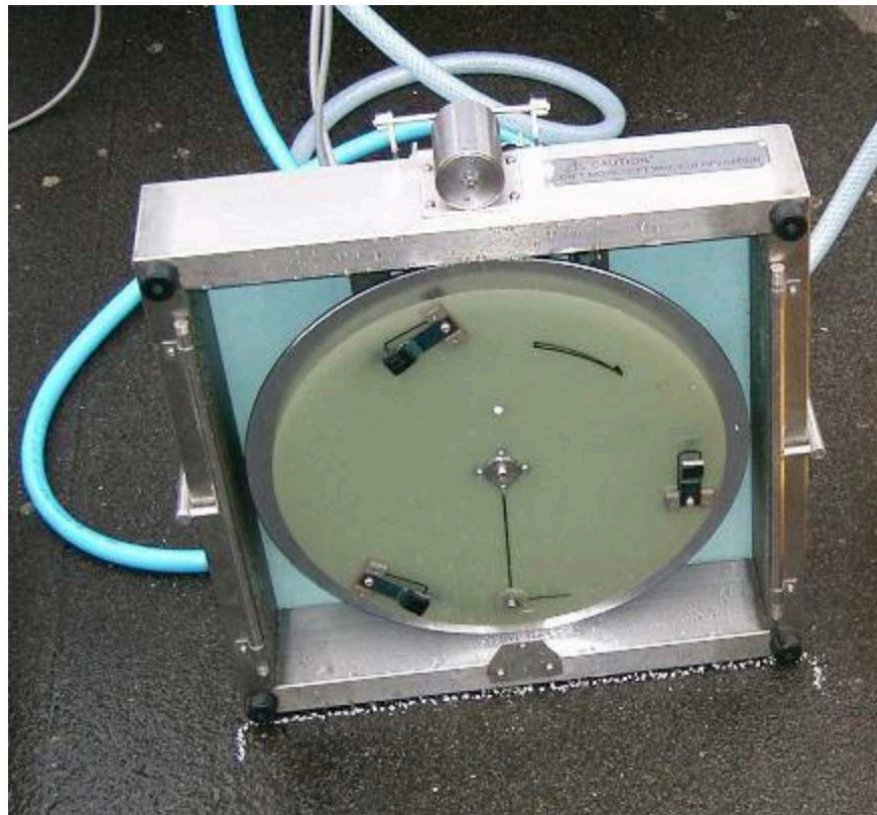


## FAA P-632 (Bituminous Pavement Rejuvenation) Procedure

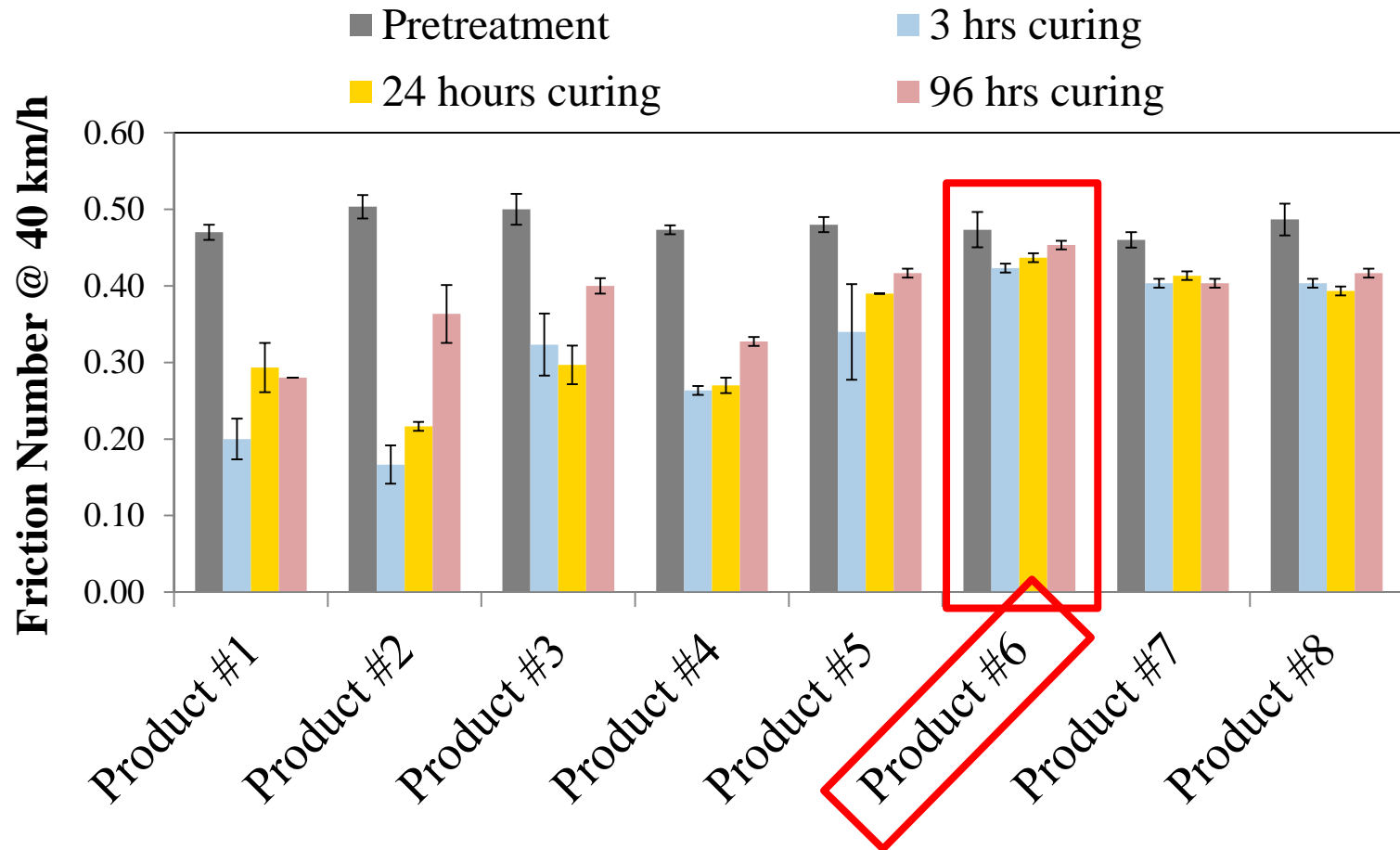
No limit required.

# Dynamic Friction (DF) Tester

Horizontal spinning disk fitted with 3 spring loaded rubber sliders which contact the paved surface as the disk rotational speed decreases due to the friction generated between the sliders and the paved surface. A water supply unit delivers water to the paved surface being tested. The torque generated by the slider forces measured during the spin down is then used to calculate the friction as a function of speed.



# Friction Values with Curing Time

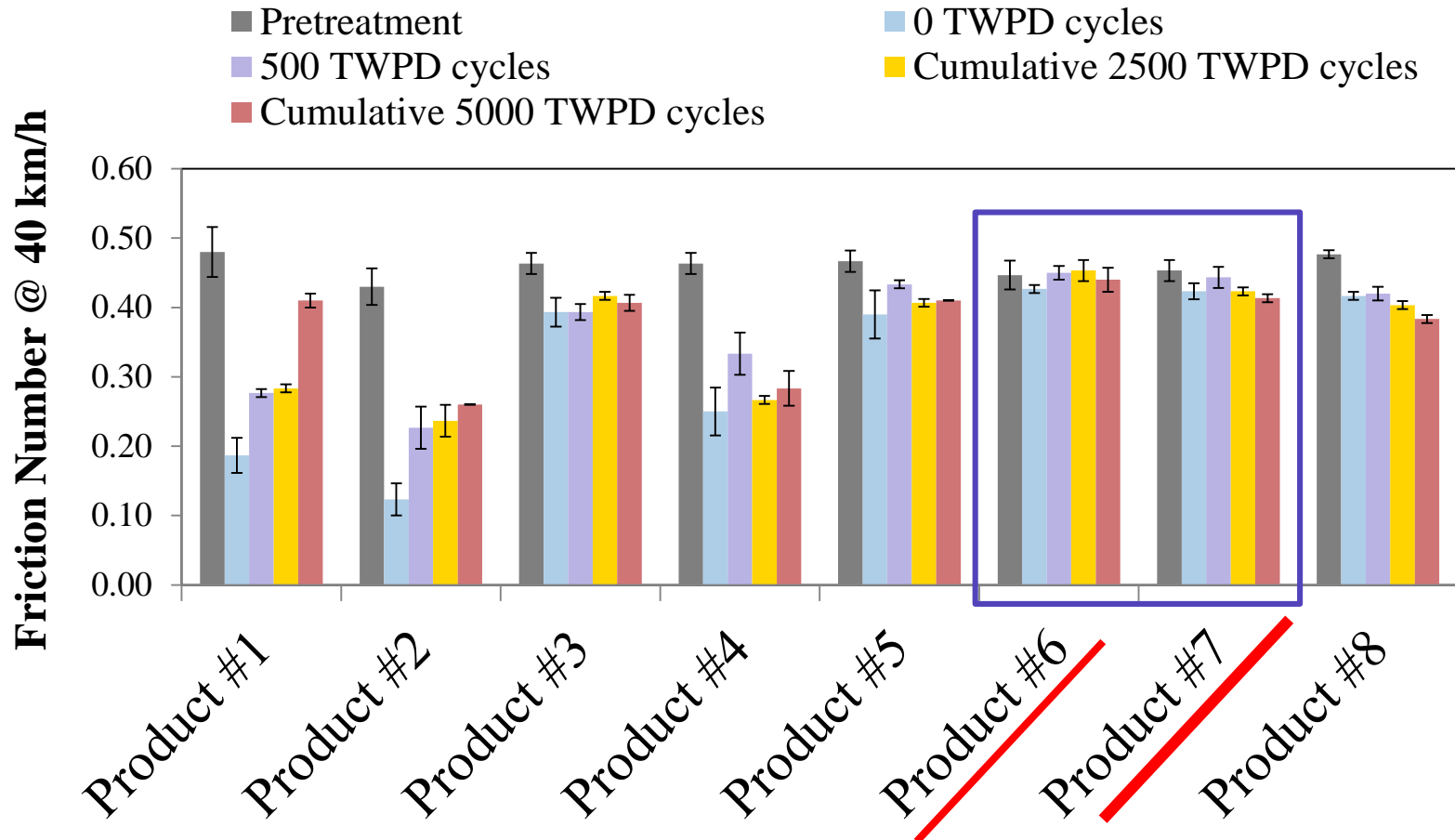


## FAA P-632 (Bituminous Pavement Rejuvenation) Procedure

Results between 24 and 96 hours indicate friction is increasing at a rate to obtain similar friction value of the pavement surface prior to application.



# Friction Values with Traffic



No apparent adverse effect with increased traffic relative to friction values and existing pavement surface.

# Performance Grade Evaluation

	After 2 weeks		After 4 weeks	
	HT PG	LT PG	HT PG	LT PG
Control	94	-4		
Product #1	94	-4	94	-4
Product #2	94	-4	100	-4
Product #3	94	-10	94	-4
Product #4	94	2	94	2
Product #5	88	-4	94	-4
Product #6	94	-4	100	-10
Product #7	94	-4	94	-4
Product #8	88	-10	88	-10

# Product Evaluation

Product no.	Application rate [gal/yd <sup>2</sup> ]	HTTG_Original 4 weeks	HTTG_RTFO 4 weeks	Look - darkness (1 indicates the darkest look)	Cumulative 5000 TWPD cycles Friction value ranking (1 indicates highest friction number)	96hrs curing friction number ranking (1 indicates highest friction number)	Passing on G* at 60C reduction criterion	Passing on complex viscosity at 60C reduction criterion	UTI
1	0.08	101.7	98.5	1	4	8			98
2	0.08	100.6	101.4	7	8	6			104
3	0.07	99.4	97.9	8	5	5			98
4	0.06	97.9	100.1	2	7	7			92
5	0.1	100.2	99	3	3	2			98
6	0.03	102.6	100.8	6	1	1	Yes	Yes	110
7	0.015	99.6	99.5	4	2	4			98
8	0.08	95.1	92.8	5	6	3			98



Feel free to use this closing slide or create your own.

# THANKS!

Any questions?  
Reach me at  
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**2018 NCAT Test Track Conference**