PA Turnpike E-Ticketing

Access real-time ticketing data across your entire state from any asphalt, ready-mix or aggregate producer, regardless of ticketing vendor.

FHWA E-Ticketing Directive: Task 713 HRT-22-045

United States Department of Transportation

U.S. Department of Transportation
Federal Highway Administration

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e-Ticketing Implementation Plan

Task-713_HRT-22-045_eTicketing-Implementation-Plan_HPA_508_FINAL.pdf (1.25 MB)

Historically, on highway construction projects, truck drivers collect paper tickets for every truckload they haul to a job site from a material plant. This practice of paper tickets is cumbersome and outdated. Electronic ticketing (e-Ticketing) automates the process. e-Ticketing is a market-ready digital innovation that automates the recording and transfer of information in real time for materials as they are moved from the plant to the site.

This report is the implementation plan developed to assist FHWA with the planning of e-Ticketing deployment activities under the sixth round of the Everyday Counts initiative (EDC-6).

Last updated: Wednesday, February 23, 2022

Electronic Ticketing (E-Ticketing)

Pennsylvania Becomes A Pilot State for E-Ticketing

- **2017** Penn DOT forms an E-Ticketing Steering Committee
- **2017** Penn DOT partners with Lindy Paving to demonstrate the advantages of E-Ticketing on a paving contract on SR 0030 SEC A35 in District 11, Allegheny County.
- **2021** Penn DOT rolls out an E-Ticketing App for use on pilot projects. E-Ticketing discussions with aggregate and concrete producers continues.
- **2022** Penn DOT increases the number of pilot projects using E-Ticketing.
- **2023** Penn DOT will increase E-Ticketing use via Special Provision for their contracts.
- **2024** Penn DOT will implement a E-Ticketing Specification for asphalt, concrete, and aggregate producers.

Currently the PTC is Working to Implement E-Ticketing for the 2023 Construction Season.

Producers have been invited to participate in E-Ticketing on a voluntary basis for 2023.

In 2024 E-Ticketing will be mandatory for asphalt, aggregate, and concrete delivery ticket submission.

HAULHUB TECHNOLOGIES

NAPA National Asphalt Pavement Association

NSSGA National Stone, Sand & Gravel Association

ARTBA American Road & Transportation Builders Association

NRMCA National Ready Mixed Concrete Association MEMBER

AGC The Construction Association

National e-Ticketing Task Force MEMBER

It's never been easier to get involved

E-TICKETING HAS ARRIVED IN PENNSYLVANIA

The **Pennsylvania Turnpike Commission** is moving towards digital ticketing with the goal of connecting all aggregate, asphalt and concrete producers to the PA Turnpike e-Ticketing portal by the end of 2023.

SIGN ME UP!

Whats included? | How Does It Work?

A message from the PA Turnpike

"The Pennsylvania Turnpike Commission is working in conjunction with Haul Hub to transition to Electronic Materials Delivery Ticketing. The PTC is encouraging Asphalt, Concrete, and Aggregate producers during the 2023 Construction Season to participate in the voluntary E-Ticketing initiative. The PTC intends to fully implement E-Ticketing for the 2024 construction season. The PTC thanks its producers for participating in this transition."

– Matt Burd, Assistant Chief Engineer, Construction, Pennsylvania Turnpike Commission

PA Turnpike's Invite Page for Producers

https://www.haulhub.com/pennsylvania-turnpike/

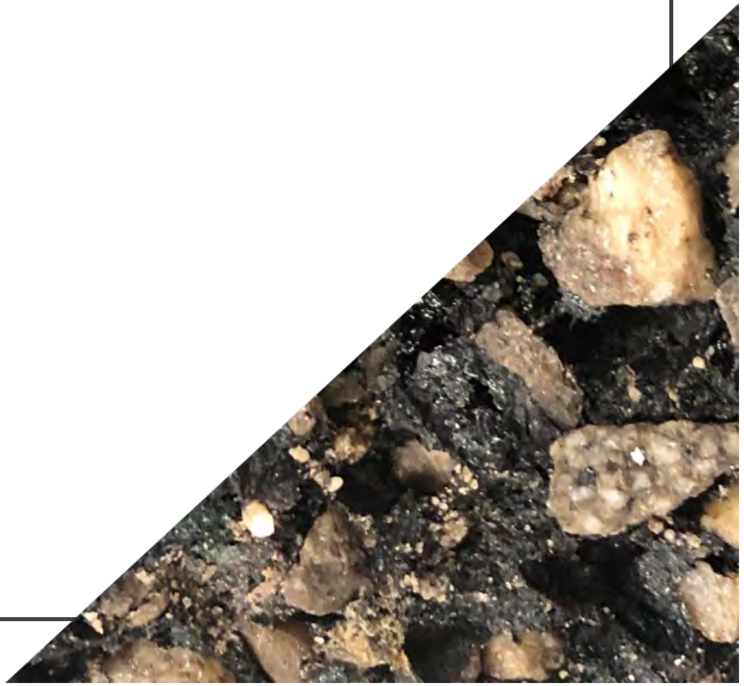
What's Next

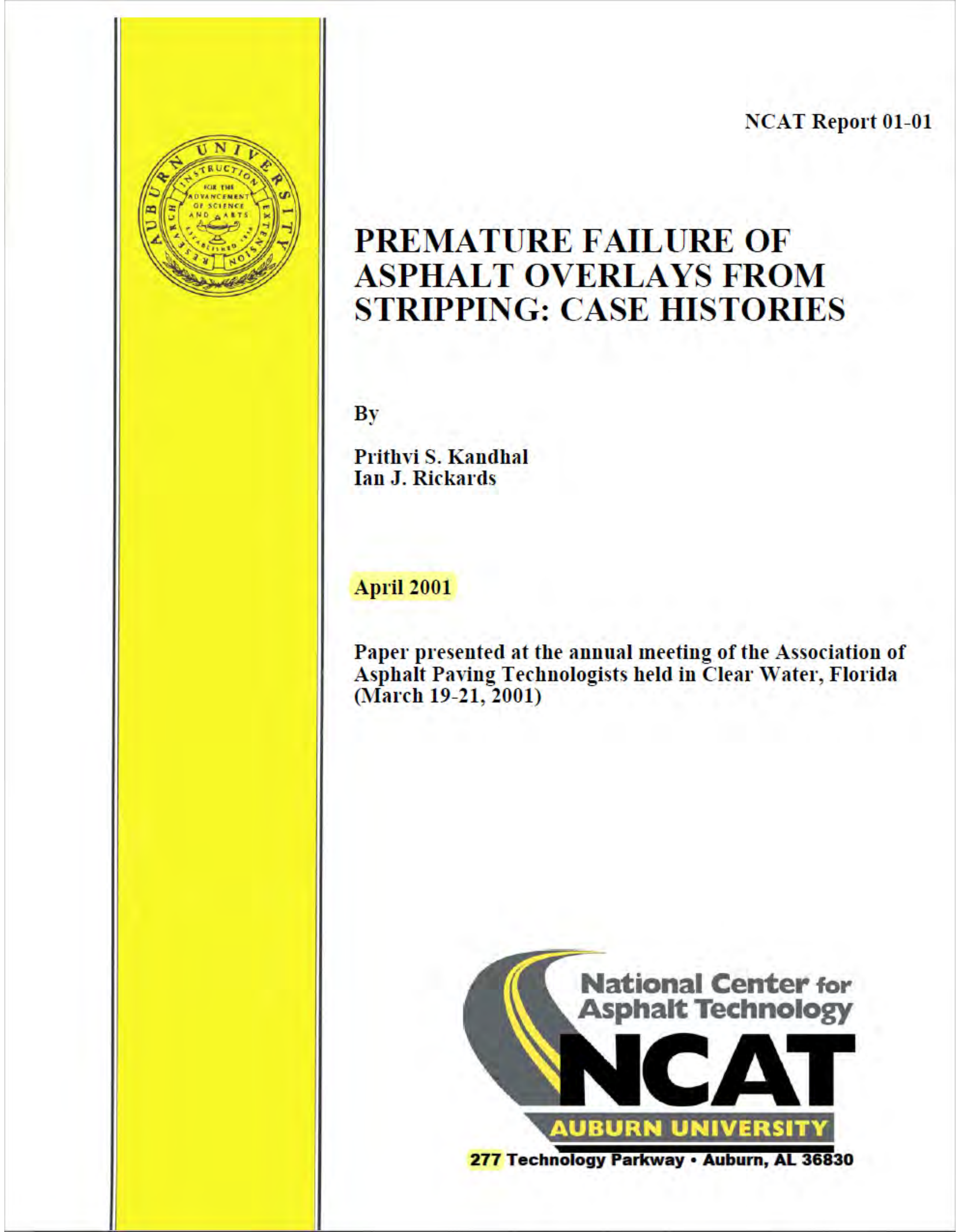
- Producer invites have been distributed to Aggregate, Asphalt and Redi Mix producers to participate in the PTC E-Ticketing initiative.

- If a producer wants to participate with the PA Turnpike in the 2023 Construction Season, the producer must submit and RFI requesting to participate in E-Ticketing and then the contract will be set up in haul hub.

- E-Ticketing discussions will be conducted at progress and pre-activity meetings.

Asphalt Stripping




NCAT Report 01-01

PREMATURE FAILURE OF ASPHALT OVERLAYS FROM STRIPPING: CASE HISTORIES

By

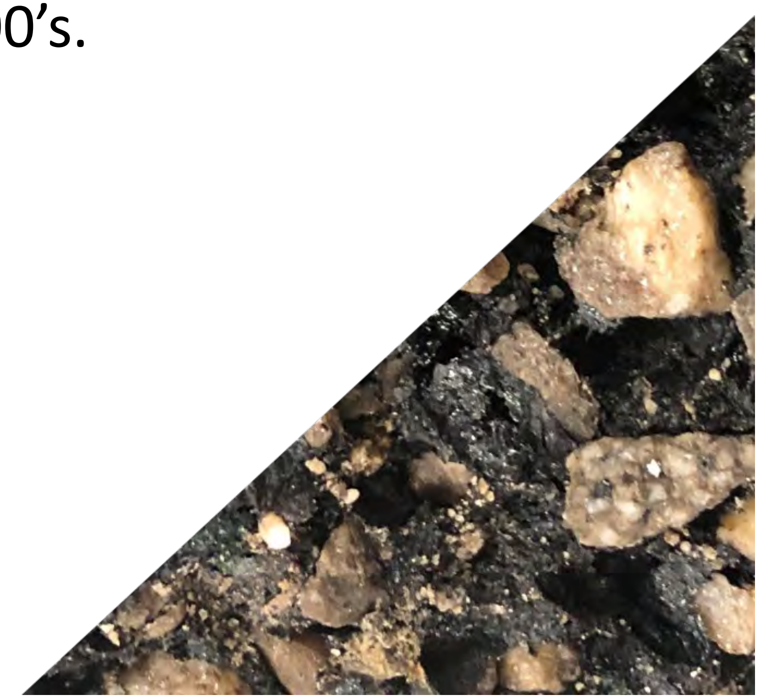
Prithvi S. Kandhal
Ian J. Rickards

April 2001

Paper presented at the annual meeting of the Association of Asphalt Paving Technologists held in Clear Water, Florida (March 19-21, 2001)

National Center for Asphalt Technology
NCAT
AUBURN UNIVERSITY
277 Technology Parkway • Auburn, AL 36830

Asphalt Stripping from aggregate due to moisture damage is not a new problem for the asphalt industry or the PA Turnpike. Asphalt stripping on in the PTC roadway was identified and studied in the early 2000’s.



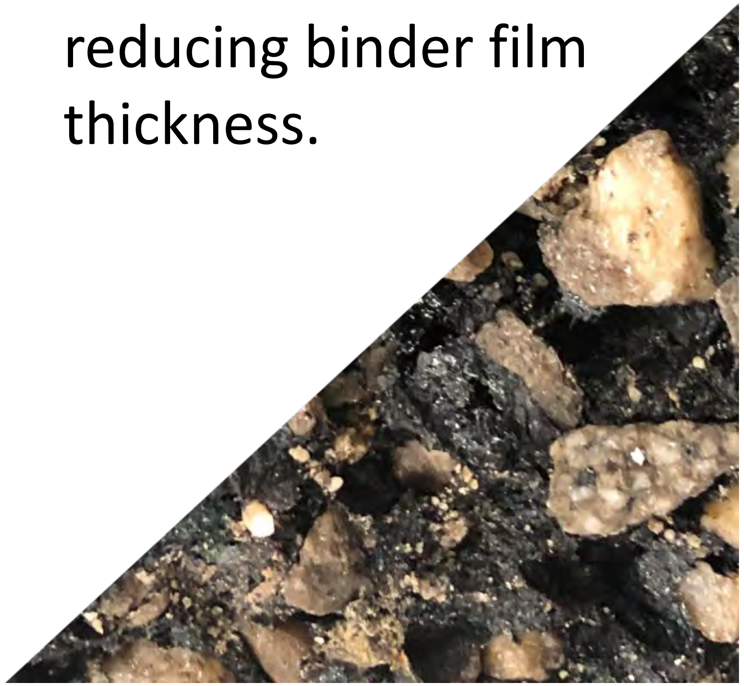
Stripping became a major problem in the United States in the late 1970s. Premature failures of asphalt overlays within two years of construction are not uncommon. This paper documents four such case histories from Pennsylvania, Oklahoma, and New South Wales in Australia.

The term "stripping" is applied to hot mix asphalt (HMA) mixtures that generally exhibit separation and removal of asphalt binder film from aggregate surfaces due primarily to the action of moisture and/or moisture vapor. Although stripping of HMA has been mentioned sporadically in the literature since early twentieth century, it became a major problem in the U.S. in the late 1970s. Several HMA related developments took place in the 1970s, which may or may not have contributed to the onset of stripping problems in the U.S. It may be interesting to list some of these developments as follows:

- The 1972 Clean Air Act required baghouses in HMA plants to collect fines which are partially or fully added back to the mix. Prior to 1972, these very fine dust particles were released into the atmosphere and were not incorporated in the mix.
- Many crude oil sources changed in 1973 due to the Arab Oil Embargo. Although not proven, some people believe that the quality of some asphalt binders changed.
- Drum mixers came into use in HMA plants, which dried the aggregate and mixed it with asphalt binder in the same drum.
- Vibratory rollers became common and the use of pneumatic tired rollers for intermediate compaction was mostly phased out. Some asphalt paving technologists believe the pneumatic tired rollers are helpful in sealing the fresh HMA mat (thus making it almost impermeable at the surface) due to kneading action.
- The use of open-graded friction course (OGFC) or plant mixed seal coats became common in some states. The Federal Highway Administration encouraged the use of OGFC to improve the skid resistance of HMA wearing courses.
- The use of siliceous aggregates which are relatively more prone to stripping, increased to obtain increased skid resistance in HMA pavements.
- PCC pavements on interstates built in the 1950s increasingly required asphalt overlays in the 1970s. The subsurface drainage of PCC pavements was generally inadequate. Overlaying the 4-lane PCC pavements along with paving the shoulders and median created a very wide asphalt surface trapping the moisture and/or moisture vapor (*1*).
- Asphalt contents in HMA mixtures generally decreased (reducing binder film thickness) to obtain increased rut resistance.
- Last but a very important factor, truck traffic (and tire pressures) had increased substantially on interstate and primary highways by 1970s and continues to increase.

Possible Causes:

- Crude Sources Changed
- Siliceous Aggregates used for skid values prone to stripping
- Asphalt contents of mixtures decreased reducing binder film thickness.



PENNSYLVANIA TURNPIKE (CUMBERLAND COUNTY)

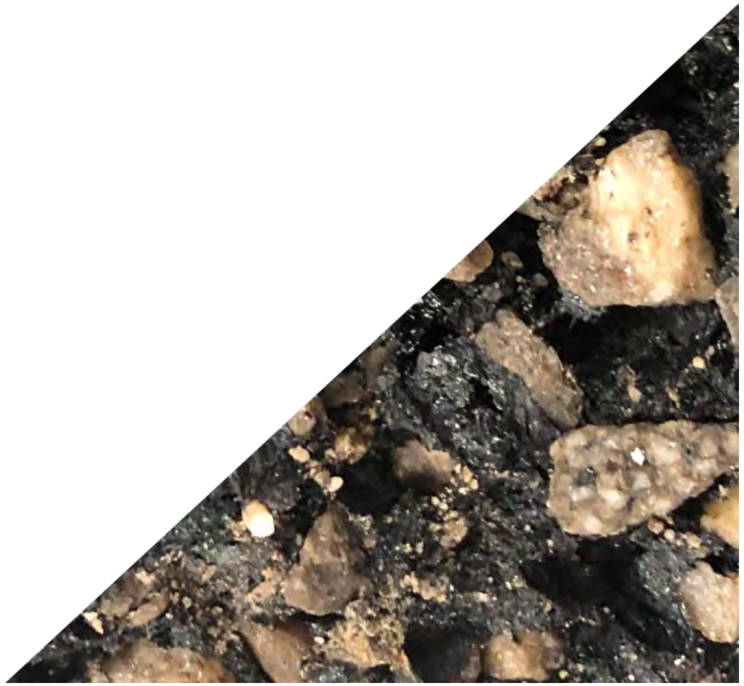
Pennsylvania Turnpike Mile Post (MP) 209.5 to 218.0 received an asphalt overlay consisting of 37 mm thick ID-2 wearing course (it is a dense-graded 9.5 mm nominal size mix) in 1994. The percentage of material passing 4.75, 2.36, and 0.075 mm was 71, 45, and 4.5 percent, respectively, with a design asphalt content of 6.3 percent. The overlay consisting of crushed gravel aggregate HMA mixture was placed during the period of April-November 1994 after milling the existing road surface to an average depth of 40 mm. This project started to exhibit premature pavement distress in 1996 primarily on the westbound (W.B.) slow lane from MP 215.5 to 218.0. The section from MP 209.5 to 215.5 did not develop any significant pavement distress. The project was inspected in July 1996 to investigate the probable cause of the distress. The following observations were recorded during the inspection.

Typical telltale signs of moisture-induced stripping: fines brought up to the surface by water (mud stains), flushing of the surface, and potholing, were clearly visible on the W.B. slow lane from MP 215.5 to 218.0 (Figure 1). Potholes had developed in both wheel tracks of the W.B. slow lane between MP 215.5 and 218.0. There were more potholes in the inside wheel track compared to the outside wheel track (Figure 2). Rutting of the pavement had also started to develop in many areas (Figure 3). A similar investigation of an adjacent section of the Pennsylvania Turnpike between MP 218 and 226 was conducted by the first author in 1978 (*1*). On that project, the potholing was primarily occurring in the inside wheel track of the slow lane and rutting associated with stripping was not a significant problem. Therefore, this project was exhibiting more severe distressed condition than the 1978 project.

MP 215.5 to MP 218.0 WB RL

Paved 1994

Stripping Noted 1996



Sampling of Pavement and Observations

It appeared prudent to sample the pavements in the distressed area (MP 215.5 to 218.0) as well as in the relatively good area (MP 215.5 to 209.5) of this project. Such investigative methodology has been recommended to establish the cause of stripping (2, 3). A jack hammer was used to cut out approximately 500 mm x 500 mm holes so that each pavement layer could be sampled for testing and visual examination in the existing condition without adding any water. One hole each was cut in the inside wheel track, between the wheel tracks, and the outside wheel track of the westbound slow lane at MP 217.65 in the distressed area (Figure 4). Each layer was observed and sampled to determine the moisture content and the maximum theoretical specific gravity of the asphalt mix.

Figure 5 shows the two top layers of the pavement: the new gravel wearing course and the old limestone binder course. The old limestone binder course was about 80% stripped with bare rock particles and hardly any cohesion. This course had a lot of cavities and free moisture (Figure 5). The new gravel wearing course had started to strip from the bottom upwards (about 50% stripping) and one could see the migrated asphalt binder at the top of this layer. It was evident that the excessive moisture or water in the old limestone binder course was causing the stripping in the new gravel wearing course because of the excessive pore pressure buildup under traffic in the slow lane.

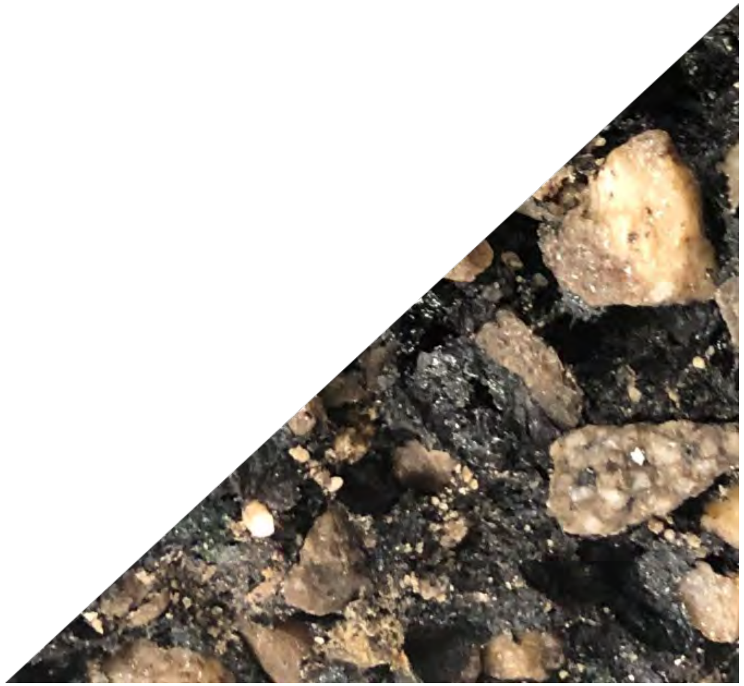
Based on the experience from the 1978 investigations it was highly likely that the old limestone binder course and the old gravel wearing course were already partially stripped when the new overlay was placed in 1994. Therefore, the water in these two stripped layers started to strip the new gravel wearing course from bottom upwards immediately after its placement. Figure 7 shows from left to right: new gravel wearing course with stripping at the bottom; old limestone binder course, wet and very badly stripped; and the old gravel wearing course, wet and very friable.

Observations: Poor condition of underlying lifts of asphalt possibly contributed to the moisture damage, as water migrated from the bottom up into the wearing surface placed in 1994.

The following recommendations based on the experience of the author were made to rectify the subsurface drainage problem and to reconstruct the asphalt overlays:

1. Mill off all asphalt overlays (about 200 mm) down to PCC pavement. Rubblize the PCC pavement. Place a 100-mm thick layer of asphalt treated permeable material (ATPM) drainage course right over the rubblized PCC pavement. The ATPM should be connected on both sides to the longitudinal edge drains. The ATPM primarily consists of AASHTO No. 57 or 67 aggregate (no fine aggregate) coated with 1-1/2 to 2-1/2 percent asphalt binder. It has been used successfully on I-90 near Erie in similar applications. The structural coefficient of ATPM is believed to be about 0.30. The ATPM should be overlaid with HMA consisting of a binder course and a wearing course of adequate thicknesses to meet the structural design requirements. (Since this investigation, the Pennsylvania Turnpike Commission has undertaken reconstruction of some segments of the Turnpike. The reconstruction involves removal of all HMA courses and the PCC pavement and providing an ATPM at the bottom of new HMA courses.)
2. Consideration should be given to the use of 1-1/2% of hydrated lime (by weight of aggregate) as an antistripping agent in all HMA mixes which are used on the Turnpike in situations similar to this project. Whereas the use of hydrated lime can not be a substitute for proper subsurface and/or surface drainage system, it can increase the resistance of the HMA mix to stripping. AASHTO T283 (modified Lottman test) with a freeze and thaw cycle should be used to determine the resistance of the HMA mixes to moisture- induced damage.

Recommendation:
1-1.5% Hydrated Lime (By weight of Aggregate) to be used as an anti-strip agent.



Pennsylvania Turnpike – Asphalt Stripping

In 2019, PTC Materials Laboratory had identified many occurrences of severe asphalt stripping while performing, non-related, research. Core specimens were obtained from various pavement locations; tested and analyzed. Stripping had been observed within core specimens obtained between milepost 54 and 282.

No Stripping

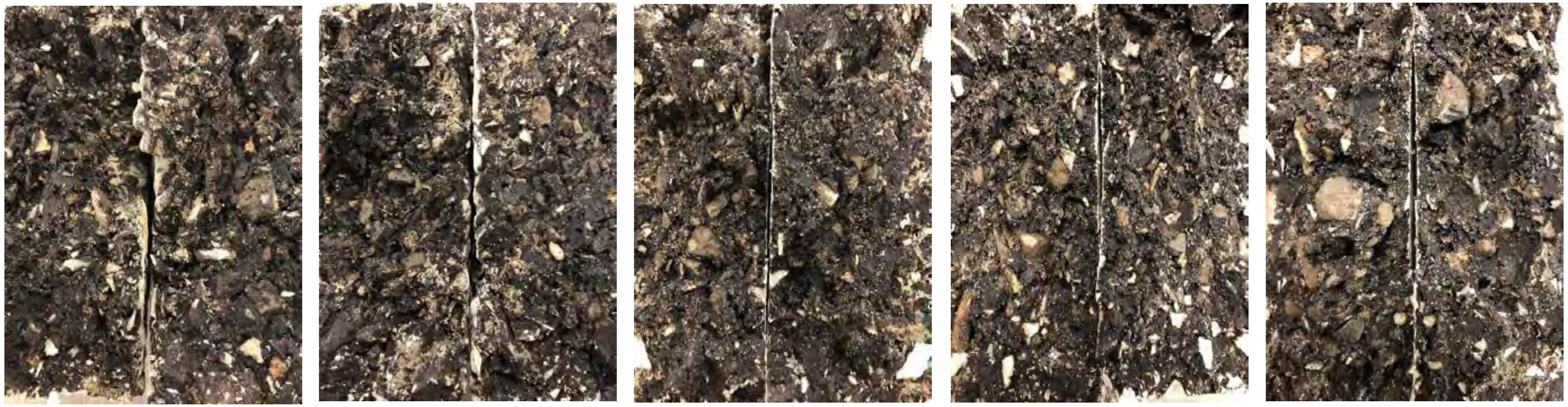
Severe Stripping


Asphalt Stripping
PA Turnpike Mainline
MP 54 to MP 282
Erie
North East
Jamestown
Salamanca
Olean
Wellsville
Alfred
Corning
Elmira
Binghamton
Vestal
Sayre
Bradford
Conneaut
Edinboro
Warren
Coudersport
Wellsboro
Mansfield
Meadville
Allegheny National Forest
Susquehannock State Forest
Sproul State Forest
St Marys
Scranton
Wilkes-Barre
Clarion
Brookville
DuBois
Grove City
Williamsport
Lock Haven
Clearfield
New Castle
Punxsutawney
Bloomsburg
Lewisburg
Hazleton
Stroudsburg
Danville
Bellefonte
Butler
Kittanning
State College
Selinsgrove
Bethlehem
Allentown
Pittsburgh
Monroeville
Greensburg
Washington
Harrisburg
Lebanon
Reading
Hershey
Mechanicsburg
Lititz
Princeton
Trenton
Hamilton Township
King of Prussia
Philadelphia
Lancaster
York
Chambersburg
Bedford
Uniontown
Gettysburg
Hanover
Cherry Hill
Wilmington
Newark
New Castle
Morgantown
Frostburg
Cumberland
Hagerstown
Bel Air

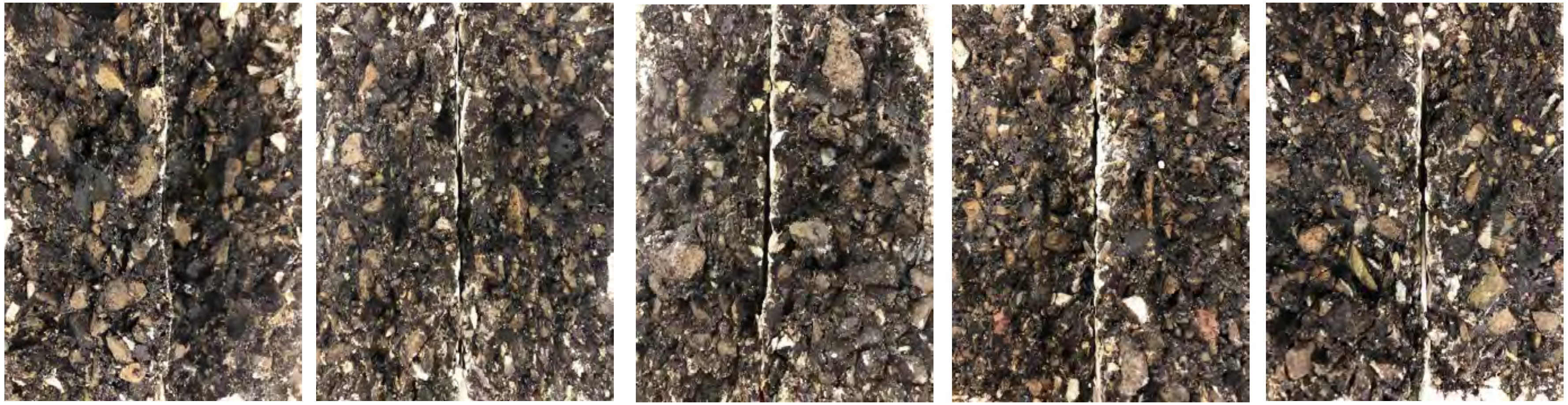
Pennsylvania Turnpike – Asphalt Stripping

MP 49 to MP 56

Beginning Milepost:	49
Ending Milepost:	56
Recently Paved:	2010
Geological Makeup:	CSS
Asphalt Supplier:	Marathon
Asphalt Grade:	76-22
Anti-Strip Supplier:	NG
Anti-Strip %:	NG
TSR Value:	95.6
Type of Distress: Raveling and Cracking	



Beginning Milepost:	94
Ending Milepost:	99
Recently Paved:	2012
Geological Makeup:	CSS
Asphalt Supplier:	Marathon
Asphalt Grade:	76-22
Anti-Strip Supplier:	ARR-MAZ
Anti-Strip %:	0.25
TSR Value:	83.2
Type of Distress: Raveling and Cracking	



MP 94 to MP 99

Pennsylvania Turnpike – Asphalt Stripping

MP 180 to MP 184

Beginning Milepost:	180
Ending Milepost:	184
Recently Paved:	2011
Geological Makeup:	CSS
Asphalt Supplier:	Nustar
Asphalt Grade:	76-22
Anti-Strip Supplier:	NG
Anti-Strip %:	NG
TSR Value:	NG
Type of Distress: Raveling and Cracking	





Beginning Milepost:	205
Ending Milepost:	206
Recently Paved:	2018
Geological Makeup:	QZ
Asphalt Supplier:	Associated
Asphalt Grade:	76-22
Anti-Strip Supplier:	AD-HERE
Anti-Strip %:	0.5
TSR Value:	98.6
Type of Distress: Rutting	



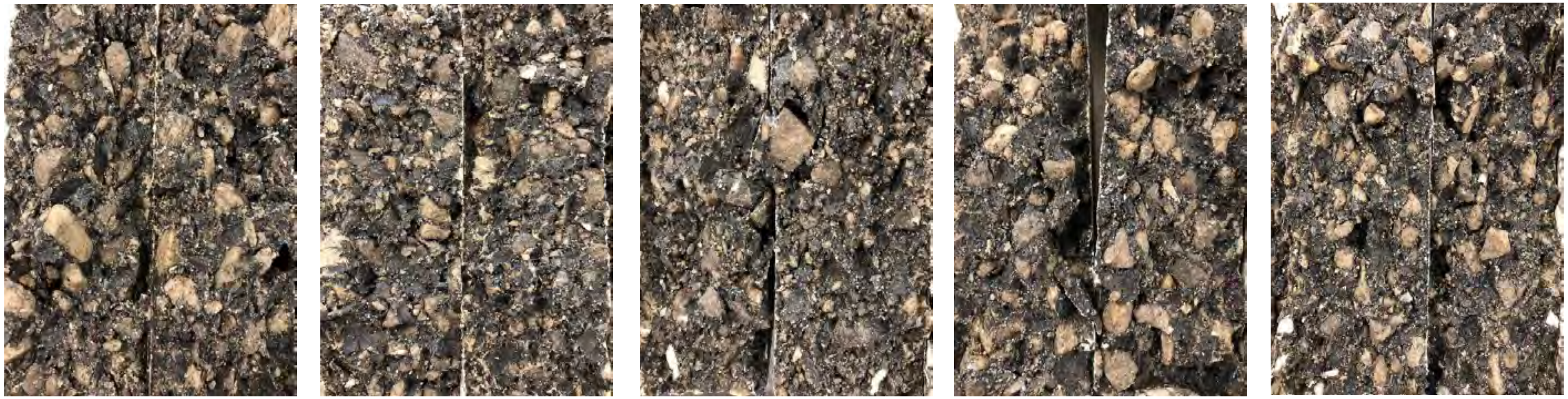


MP 205 to MP 206

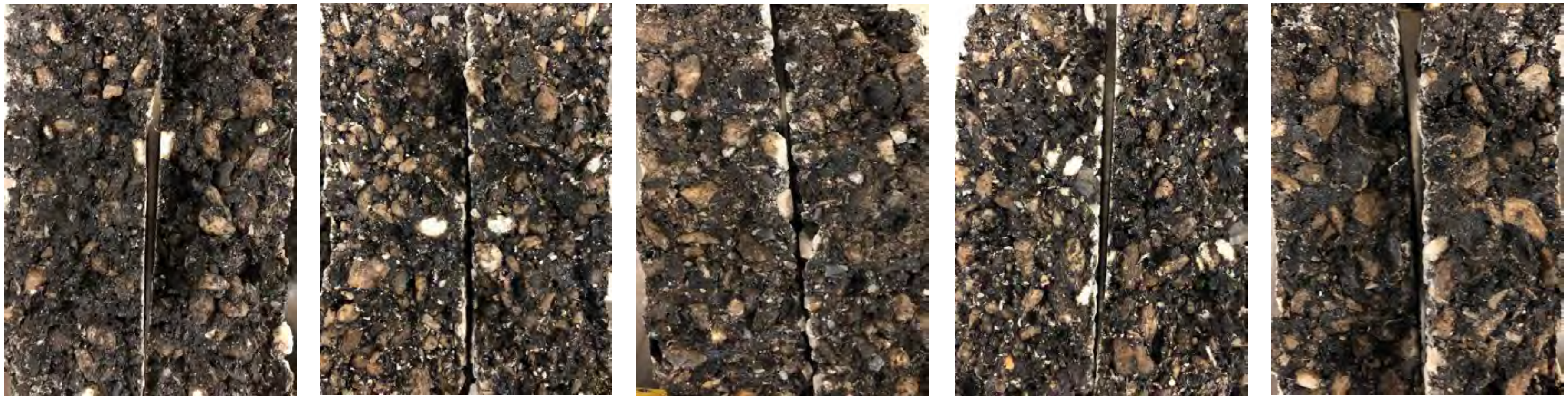
Pennsylvania Turnpike – Asphalt Stripping

MP 215 to MP 220

Beginning Milepost:	215
Ending Milepost:	220
Recently Paved:	2011
Geological Makeup:	QZ
Asphalt Supplier:	Bitnumar
Asphalt Grade:	76-22
Anti-Strip Supplier:	Pave-Grip
Anti-Strip %:	0.5
TSR Value:	99.5
Type of Distress: Rutting	



Beginning Milepost:	236
Ending Milepost:	241
Recently Paved:	2016
Geological Makeup:	QZ
Asphalt Supplier:	Axon
Asphalt Grade:	76-22
Anti-Strip Supplier:	Evotherm
Anti-Strip %:	0.25
TSR Value:	94.6
Type of Distress: Raveling and Cracking	



MP 236 to MP 241

Pennsylvania Turnpike – Asphalt Stripping

MP 247 to MP 255

Beginning Milepost:	247
Ending Milepost:	255
Recently Paved:	2011
Geological Makeup:	QZ
Asphalt Supplier:	Associated
Asphalt Grade:	76-22
Anti-Strip Supplier:	AD-HERE
Anti-Strip %:	0.25
TSR Value:	93.5
Type of Distress: Raveling and Cracking	





Summary of Concerns:

1. Sixty percent of the core specimens taken from Turnpike pavements have indicated moderate to severe stripping. However, all asphalt designs passed AASHTO T283 testing.

2. T 283 testing clearly does not identify the stripping potential of an asphalt mix. Do we have a lab test that can effectively predict asphalt stripping in the field?

3. Understanding that similar combinations of aggregates, liquid suppliers and anti-strips have been used in pavements from the Ohio line to milepost 282, 60% of the Turnpike's current mainline pavements could be severely stripped.

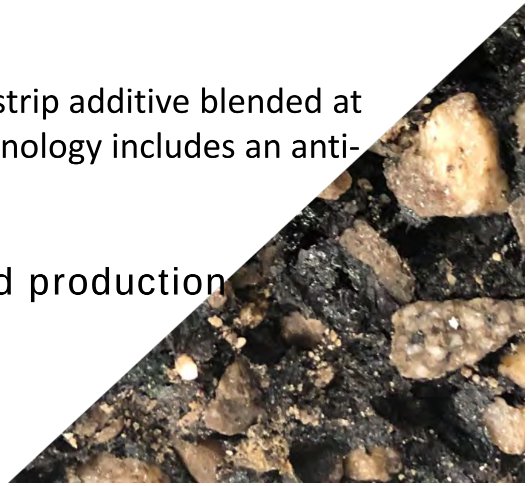
4. In the past, Lime Substrate was utilized as an anti-strip but has been replaced with chemical additives; primarily amine-based compounds.

5. Some of the mixtures analyzed in this research utilized liquid binders with added chemical anti-strip agents blended at the asphalt terminals. Are we receiving the correct percentage of anti-strip based upon total asphalt in the mix design?

PTC CS413.2(g) Revised

(g) Anti-Strip Additives. Use either a compatible, heat stable, amine-based liquid anti-strip or a compatible alternate anti-strip additive blended at the Asphalt Producer's Plant. **Asphalt terminal or refinery blending of anti-strip additive not permitted.** If the WMA Technology includes an anti-strip additive as part of its WMA Technology, perform moisture susceptibility analysis as specified in Section 413.2(e)1.

6. Can the effectiveness of amine-based anti-strips be negatively affected by elevated storage and production temperatures?



24 cores – Ingevity (Hamburg & Mist Testing)
32 cores – NECEPT (Hamburg, Ideal CT, & MIST Testing)
24 Cores – PTC Materials Lab (Hamburg & Ideal CT Testing)

PAPA Pennsylvania Asphalt Pavement Association Pennsylvania Rides on US.

EVOTHERM® ingevity

PennState College of Engineering
NORTHEAST CENTER OF EXCELLENCE FOR PAVEMENT TECHNOLOGY

Hempt Bros. / NES&L Co
JMF W125431E1
SR12.5mm WMA SRL E 3 to <30

PTC HMA DATA 2022

PENNSYLVANIA TURNPIKE

JOB MIX FORMULA REPORT

JMF NO.

2022	W125431E1
Year	Number

SUPPLIER CODE	MATERIAL CLASS
HEB21C41	WR12.5
DESIGN ESAL'S	3 to <30
AGGREGATE SRL	E
ORIGINAL APPROVAL DATE:	

DATE 04/29/22 SPEC 413 PTC CONTRACT # EN-00282-03-05

SUPPLIER NAME NESL LOCATION Locust Point

BITUMINOUS PLANT TYPE Fully automated batch mixing TONS PER HOUR 250

CONTRACTOR JD Eckman MILE POST TO MILE POST

Mix Time	
Dry	Wet
10	30

Material Supplier Code	Material Code	Material Class	% In Mix	Bulk Sp. Gr.	% Absorption
Virgin Aggregate					
HEB21C14	207	#10	30.2	2.659	1.10
HEB21B14	203	A8	18.9	2.559	1.27
HEB21B14	203	A7	31.2	2.561	1.05
Recycled Aggregate					
HEB21C14	97	TP Rap	14.2	2.640	
Virgin Asphalt					
ASSAS15	1	64E -22	4.7	1.034	
Recycled Asphalt					
HEB21C14	97	TP Rap	0.8		
Asphalt Additives					
MEAWE 15	1	Anti-Strip	0.50		
Stabilizer					

Total % Asphalt in Mix 5.5 Total % Recycled in Mix 15%

JOB MIX FORMULA AND DESIGN

	AC %	.075 mm #200	.150 mm #100	.300 mm #50	.600 mm #30	1.18 mm #16	2.36 mm #8	4.75 mm #4	9.5 mm 3/8	12.5 mm 1/2	19 mm 3/4	25 mm 1	37.5 mm 1 1/2	50 mm 2	F/A ratio	Pbe %
Design	5.5	5.2	7	9	13	19	31	46	84	96	100				1.10	4.90
% Virgin AC	4.7	% Reclaimed AC			0.8	Reclaimed Binder Ratio			0.15	Calculated Asphalt Film Thickness (microns)						10.7

MIX CHARACTERISTICS (Gyratory)

Gyrations @ Nini	Gyrations @ Ndes	Gyration @ Nmax	Design ESAL's	Combined Agg Gravity Gsb	Max Density Gmm	Ndes Density Gmb
8	100	160	3 to <30	2.603	2.439	2.342
% Voids @ Nini	% Voids @ Ndes	% Voids @ Nmax	% VMA @ Ndes	% VFA @ Ndes	Lbs / Cu. Ft.	
13.9	4.0	2.5	15.0	73	151.8	

Gyratory Compactor Data

Gyratory Manufacturer	Specimen Wt.	Height of Specimen @ Ndes
Pine	4645.2	115.8

IGNITION FURNACE DATA

Oven Make	Ignition Oven Identification	Set Temp.	Sample Size	AC Correction Factor	#200 Correction Factor
Thermolyne	Oven 1	538	1255.0	0.24	0.1
Thermolyne	Oven 2	538			

TSR DATA

AC Supplier	Dry PSI Strength	Wet PSI Strength	TSR Value	Date TSR's were done	Date of Boil Test
MEAWE 15	188.2	167.4	88.9	4/29/22	

Combined Aggregate Consensus Properties

AASHTO T176 Sand Equivalent	AASHTO T304 Uncompacted Void Content	ASTM D5821 C. Agg. Angularity 1 Face	2 Faces	ASTM D4791 Flat & Elong 5:1	3:1
96.0	46.0	100	100	0.0	0.0

GRADATION CHART IS PART OF THIS JOB MIX FORMULA

Designed by: Hunter S. Izer Date 04/29/22

Approved and Submitted by: Hunter S. Izer Date 04/29/22

Reviewed by PTC Materials Supervisor: Date

Total % Asphalt in Mix 5.5 Total % Recycled in Mix 15%

JOB MIX FORMULA AND DESIGN

	AC %	.075 mm #200	.150 mm #100	.300 mm #50	.600 mm #30	1.18 mm #16	2.36 mm #8	4.75 mm #4	9.5 mm 3/8	12.5 mm 1/2	19 mm 3/4	25 mm 1	37.5 mm 1 1/2	50 mm 2	F/A ratio	Pbe %
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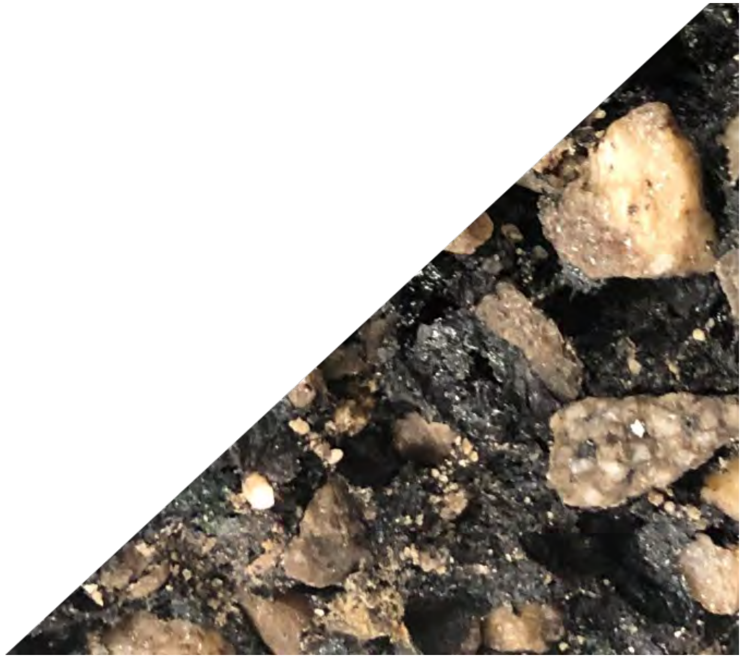
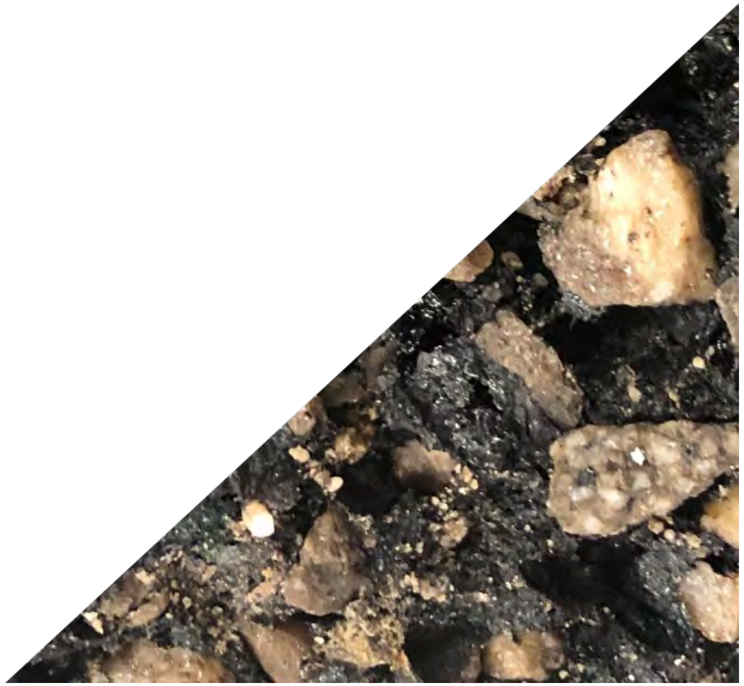
% Voids @ Nini	% Voids @ Ndes	% Voids @ Nmax	% VMA @ Ndes	% VFA @ Ndes	Lbs / Cu. Ft.	
13.9	4.0	2.5	15.0	73	151.8	



Summary of Test Data
Brian Paroda
Materials Manager, PTC Materials Lab

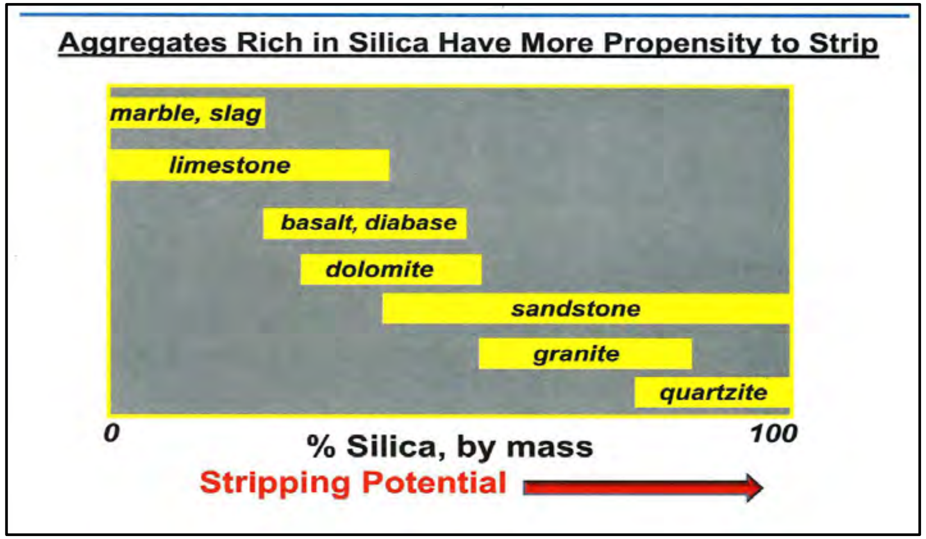


Asphalt Stripping Research Results

DWT: Hamburg Moisture Susceptibility

Stripping Research

- Selected a Quartzite Design
  - ✓ High silica content has the propensity to strip (worse case scenario)



- Obtained various liquid asphalts and chemical anti-strip additives.
- Verified the design volumetrics
- Prepared specimens with and without anti-strip for IDEAL-CT and Hamburg.
- Performed blind, collaborative testing with Penn State and Ingevity.

Hamburg: Collaborative Testing

0.5% Anti-Strip

PTC Lab Sample : Rut Depth = **3.01 mm**

Ingevity Sample : Rut Depth = **3.25 mm**

Penn State Sample : Rut Depth = **3.05 mm**

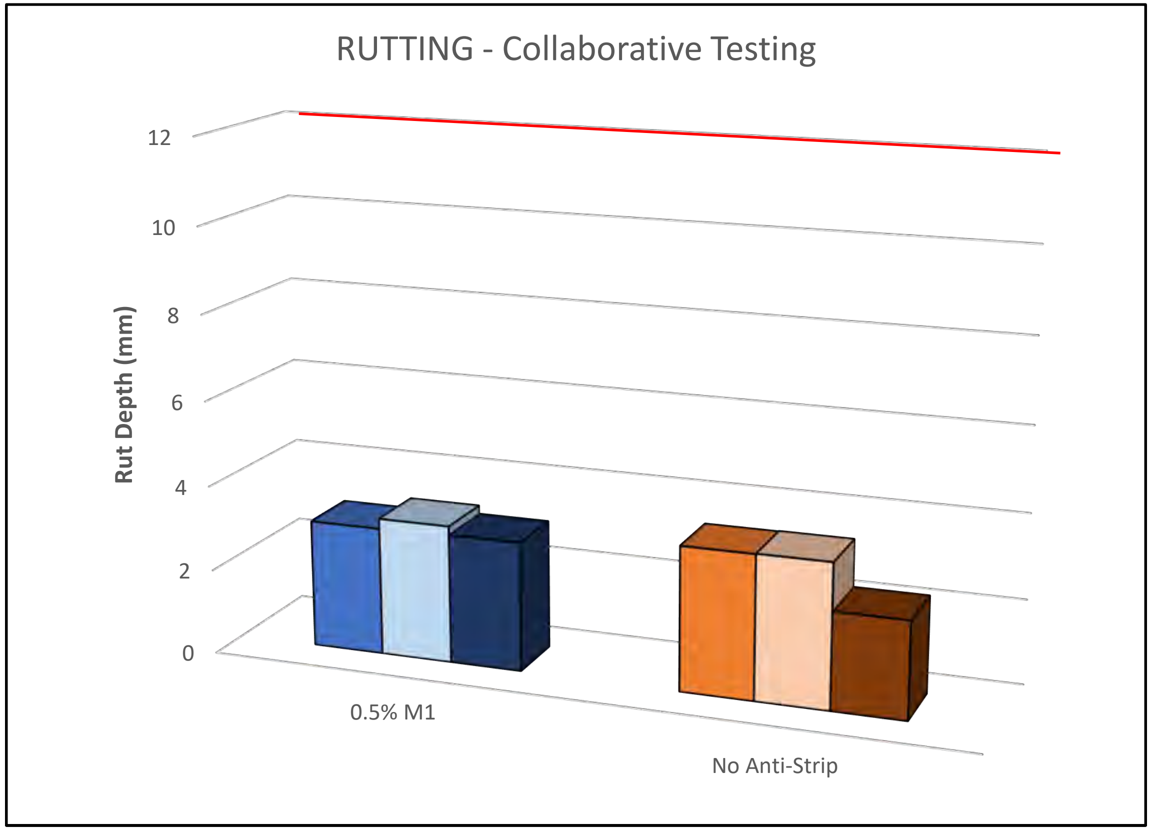
Without Anti-Strip

PTC Lab Sample : Rut Depth = **3.39 mm**

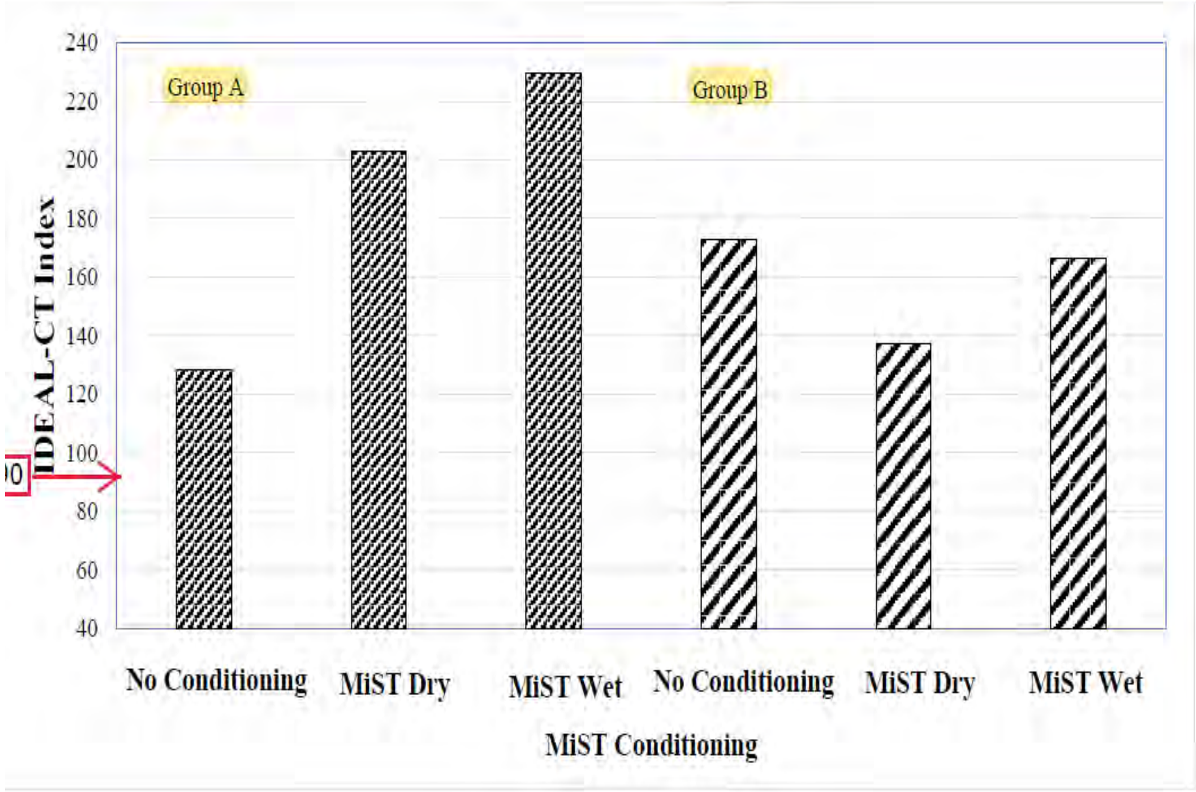
Ingevity Sample : Rut Depth = **3.25 mm**

Penn State Sample : Rut Depth = **2.29 mm**

❖ **No Stripping Inflection Point**



Penn State – M.I.S.T Results



Group A

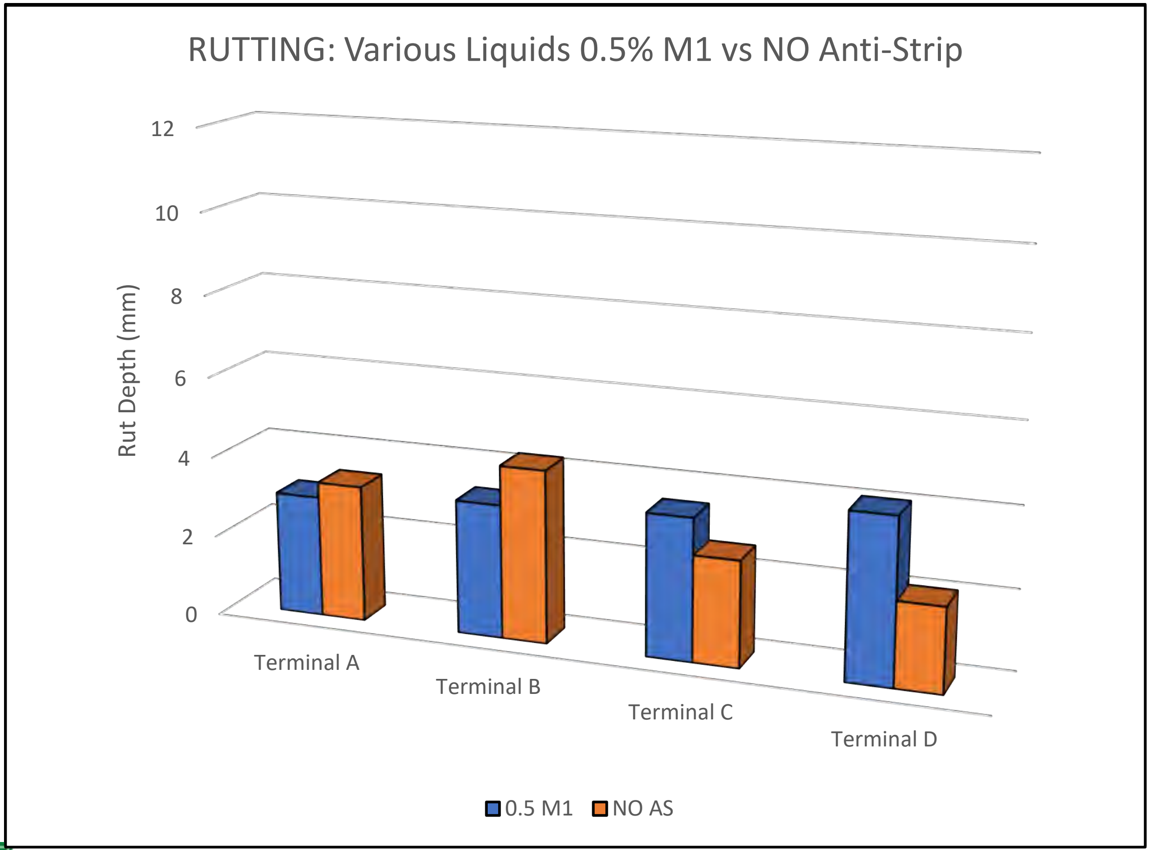
- Increased in CT-Index after being subjected to the conditioning cycle. The increase is believed to be caused by damage induced by the conditioning which weakens the mix.

Group B

- CT-Index relatively more stable.

Which group contained anti-strip?

Hamburg: PTC Lab Various 64E-22 w/wo Anti-strip

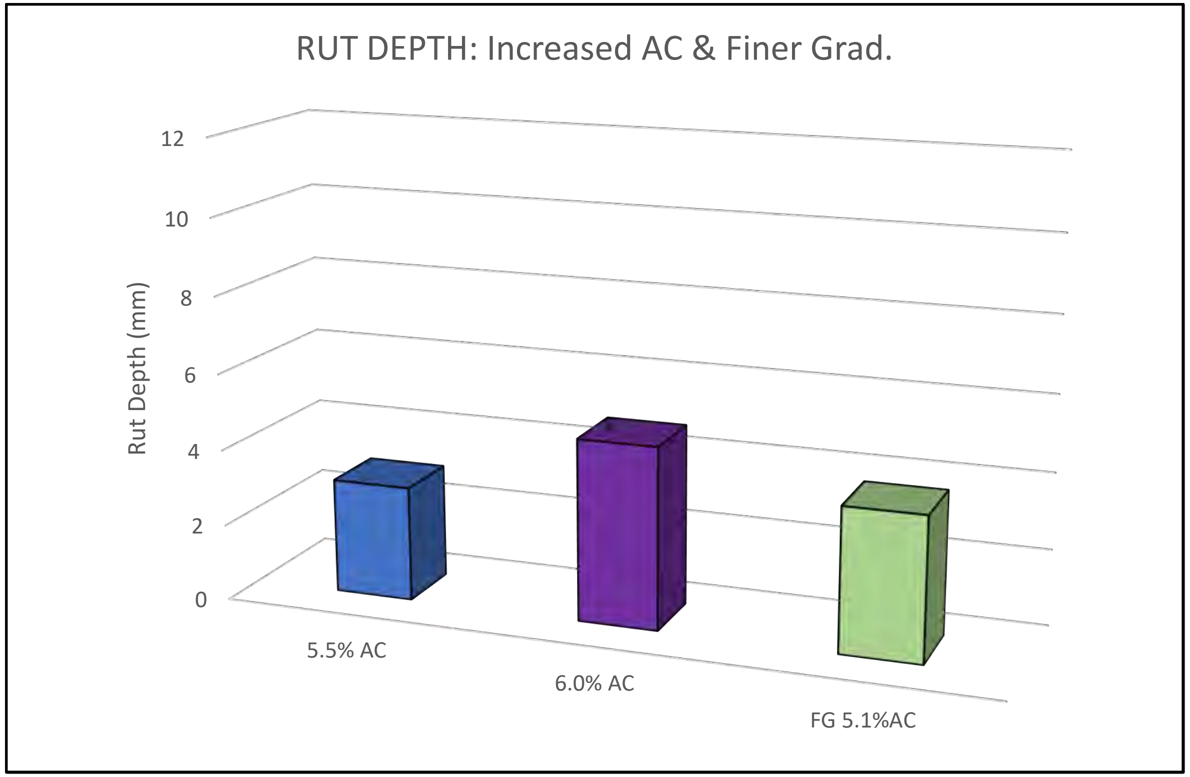


	0.5% Anti-Strip	WO Anti-Strip
Terminal "A"	3.01	3.39
Terminal "B"	3.32	4.28
Terminal "C"	3.53	2.63
Terminal "D"	4.10	2.10
Avg. Depth	3.49	3.10

- **No Stripping Inflection Point**

PENNA TURN PIKE

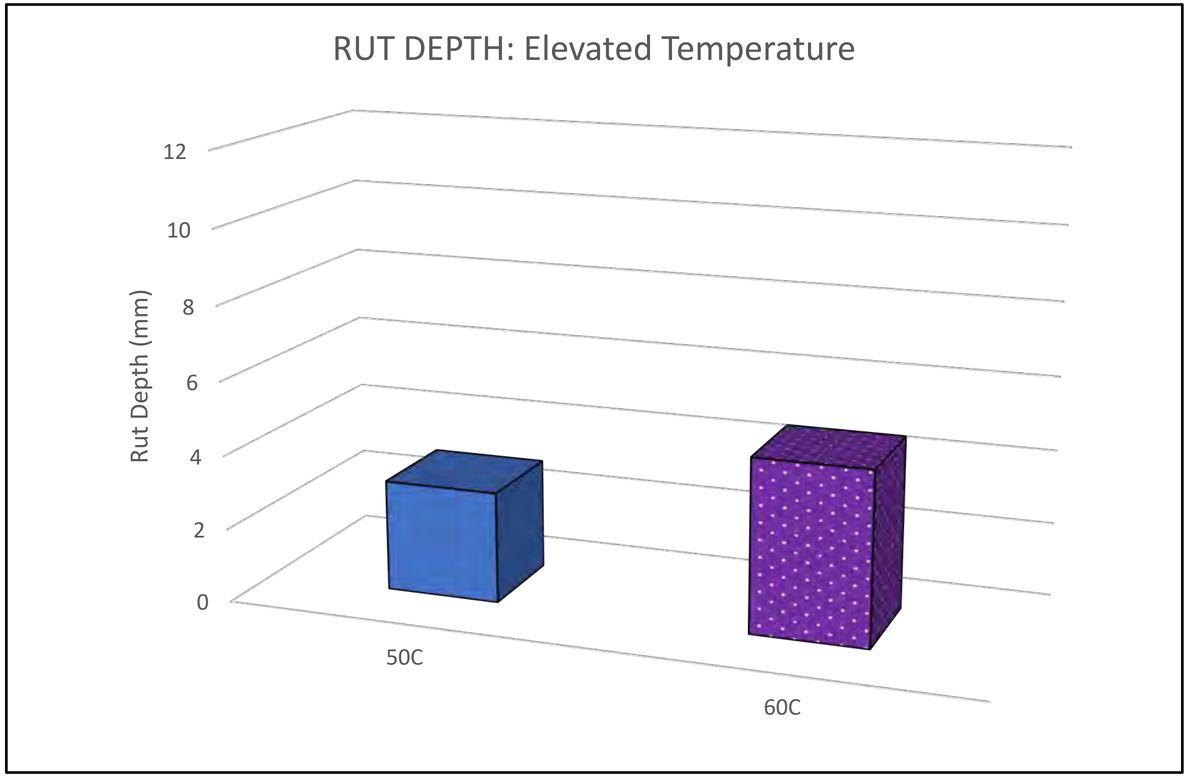
Hamburg: Design vs +0.5%AC vs Fine Grade -0.4%AC



Des. @ 5.5% AC	Des. @ 6.0% AC	Fine @ 5.1% AC
3.01	4.77	3.77

- **No Stripping Inflection Point**

Hamburg: Elevated Testing Temperature



Tested @ 50ºC	Tested @ 60ºC
3.01	4.69

- **No Stripping Inflection Point**

Fatigue Cracking

Indirect Tension Asphalt Cracking Test (IDEAL-CT)

IDEAL-CT: Collaborative Testing

<u>0.5% Anti-Strip</u>

PTC Lab Sample : CT Index = **86**

Ingevity Sample : CT Index = N/A

Penn State Sample : CT Index = **128**

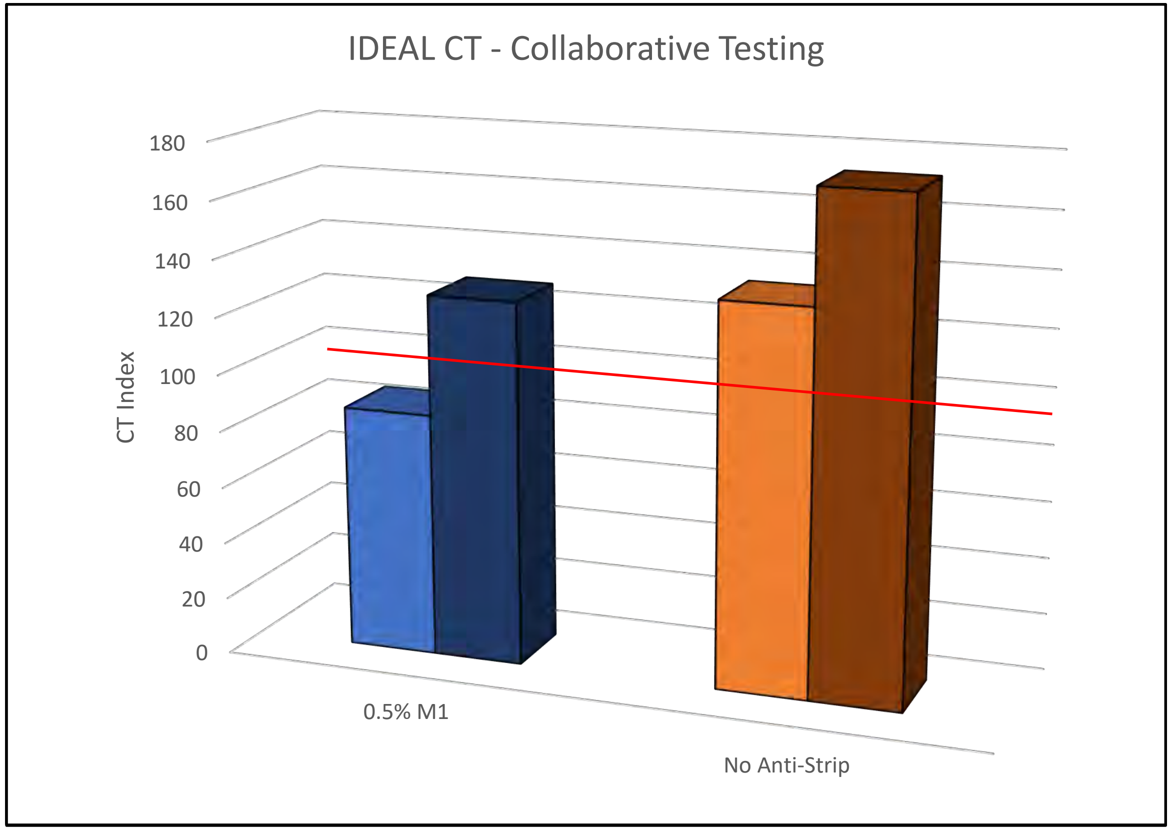
<u>Without Anti-Strip</u>

PTC Lab Sample : CT Index = **134**

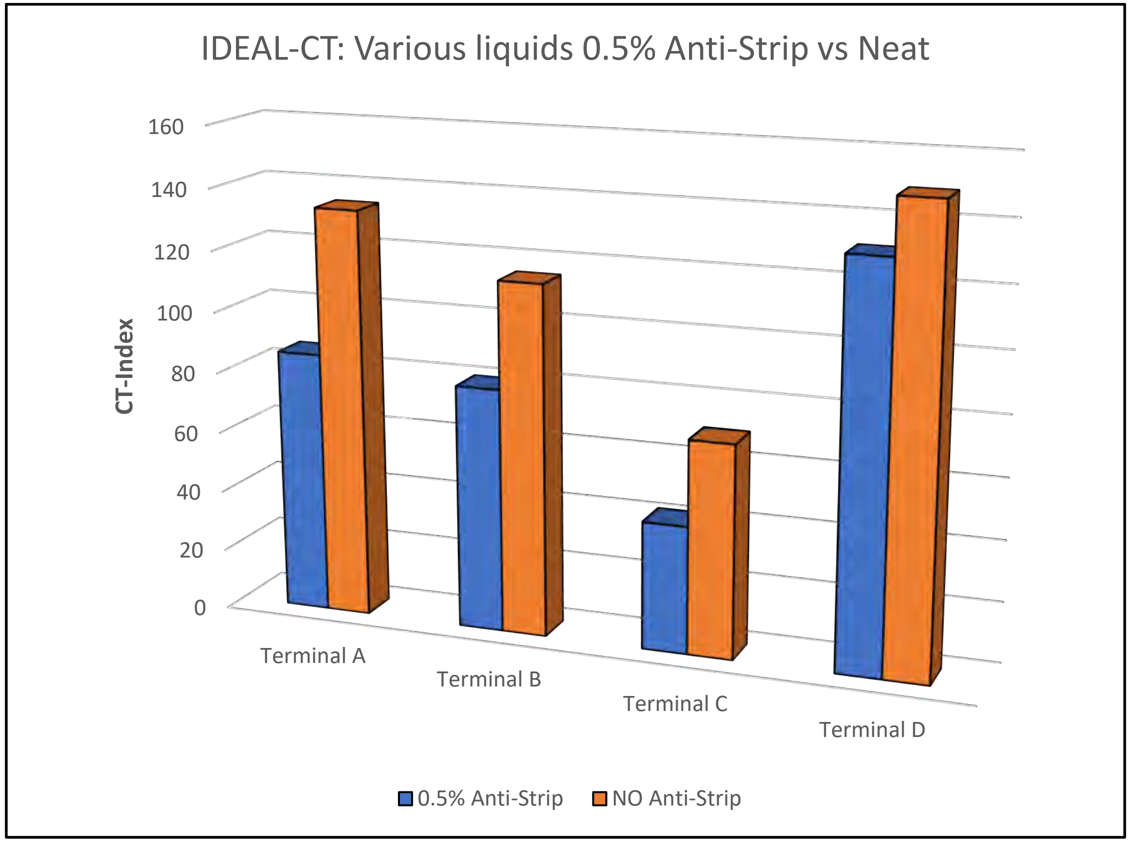
Ingevity Sample : CT Index = N/A

Penn State Sample : CT Index = **173**

❖ Better crack resistance **<u>without anti-strip</u>**



IDEAL-CT: PTC Lab Various 64E-22 w/wo Anti-strip

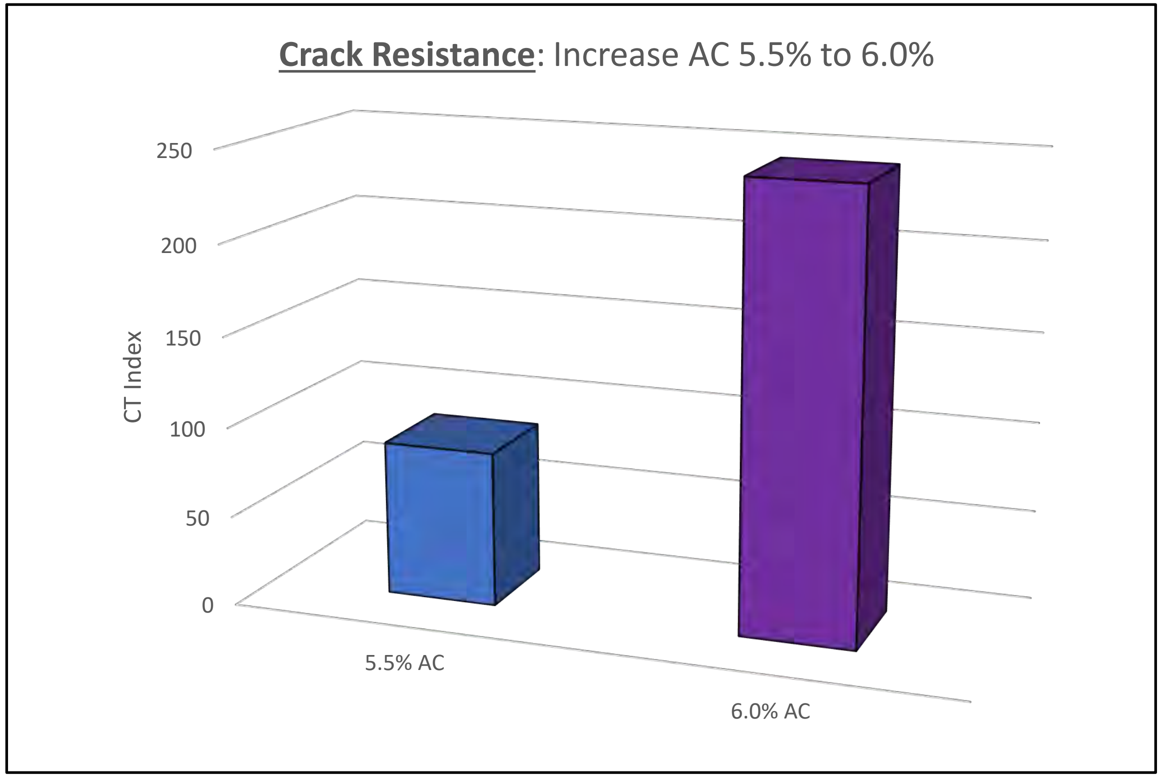


	0.5% Anti-Strip	**WO Anti-Strip**
Terminal "A"	**86**	**134**
Terminal "B"	**80**	**115**
Terminal "C"	**42**	**70**
Terminal "D"	**131**	**149**
Avg. CT Index	**85**	**117**

- ❖ Significant difference
- ❖ Better crack resistance **without anti-strip**

PENNA TURN PIKE

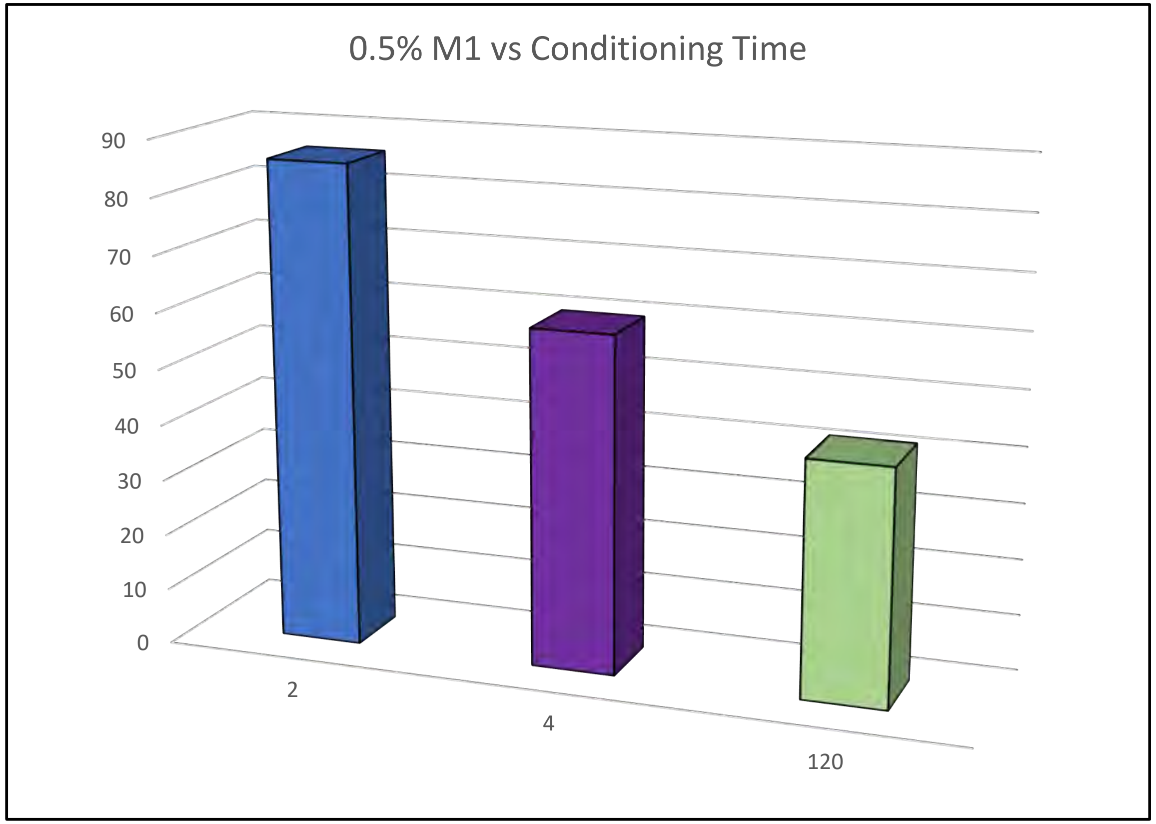
Increasing Asphalt Content: 5.5% to 6.0%



Des. @ 5.5% AC	Des. @ 6.0% AC
86	244

- ❑ Proper aggregate structure will permit additional liquid binder content without sacrificing durability.

IDEAL-CT: Conditioning Time / Temperature



CT Indices @ Various Conditioning

2 hours	4 hours	120 hours
86	60	42

- ❑ Important to properly condition specimens that will best predict field performance.

Asphalt Stripping: Summary

- Tensile Strength Ratio had not predicted stripping effectively. Good for identifying strength.
- Hamburg is beneficial in predicting rutting due to poor aggregate structure, aggregate properties and liquid binder content. Had not identified stripping.

According to our research:

- No significant differences in rutting between specimens with or without anti-strip additives.
- Rutting was minimally affected by various terminal binder liquids.
- CT Indices significantly decreased with the addition of chemical anti-strip additives. Crack resistance had greatly improved in specimens without anti-strip additives.
- CT Indices were significantly affected by source of liquid binder.

PENNA TURN PIKE

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Questions