AASHTO
THE VOICE OF TRANSPORTATION
SUBCOMMITTEE ON MATERIALS

SUBCOMMITTEE ON MATERIALS

2017 Annual Meeting-Phoenix, AZ
Monday, August 7, 2017
1:45 pm – 4:00 pm EST

TECHNICAL SECTION 4c
MARKINGS and COATINGS

I. Call to Order and Opening Remarks

The meeting was called to order at 1:45 PM. The chairman welcomed all members and friends.

II. Roll Call

Voting Members:

Name	State	Present
Steve Ingram(Robert)	AL	
Phil Stolarski	CA	
Bob Lauzon (Vice Chair)	CT	X
Rick Douds	GA	X
Kelly Morse	IL	X
Christopher Leibrock	KS	X
Brandi Mitchell	KY	
Jason Davis	LA	
John Grieco	MA	X
Woody Hood	MD	X
Matt Strizich	MT	X
Denis Boisvert	NH	X
Vacant	NJ	
Becca Lane	Ontario MOT	X
Dave Kuniega, Chair	PA	X
Danny Lane	TN	X
Darren Hazlett	TX	
Scott Andrus	UT	X
Bill Bailey	VA	X
	Vermont	

Non-Voting Members:

Name	Affiliation	Present
Evan Rothblatt	AASHTO	
Henry Lacinak	AASHTO	

Katheryn Malusky	AASHTO	
Jonathan Boardman	CT	
Anne Holt	Ontario MOT	
Grant Ridley	Ontario MOT	
Tim Ramirez	PA	
Maria Knake	AASHTO re:source	X
Tracy Barnhart	AASHTO re:source	
Steven Lenker	AASHTO re:source	
Bob Lutz	AASHTO re:source	
Georgine Geary	GGfGA Eng.	X
Greg Uherek	AASHTO re:source	X

Friends:

Name	Affiliation	Present
Gene Carlson	3M Company	X
Richard Baker	DBI Services	
Al Innis	Holcim Inc.	
Robert Dingess	Mercer	X
Andy Anderson	Potters	
Paul Carlson	TTI	
Greg Freeman	Kwikbond	X
David Entrekin	Future Labs	
Jason Schiro	Interplastic	
Jeff Miller	Treated Wood	

III. Approval of Technical Section Minutes

A motion was made by Montana to approve the meeting minutes. A second was made by Utah. The motion passed unopposed.

SOM TS 4c - Coatings, Paints, Preservatives, Bonding Agents, and Traffic Markings Standards

The following standards are under the jurisdiction of TS 4c. The Chairman reminded the attendees that other standards beyond coatings are part of this Tech Section.

AASHTO Designation No.	*Title*
M 133-12	Preservatives and Pressure Treatment Processes for Timber
M 143-14	Sodium Chloride
M 144-14	Calcium Chloride
M 224-91 (2014)	Use of Protective Sealers for Portland Cement Concrete
M 233-86 (2014)	Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete
M 235M/M 235-13	Epoxy Resin Adhesives
M 237-96 (2014)	Epoxy Resin Adhesives for Bonding Traffic Markers to Hardened Portland Cement and Asphalt Concrete
M 247-13	Glass Beads Used in Pavement Markings
M 248-91 (2012)	Ready-Mixed White and Yellow Traffic Paints
M 249-12	White and Yellow Reflective Thermoplastic Striping Material (Solid Form)
M 300-03 (2012)	Inorganic Zinc-Rich Primer

R 31-09 (2014)	Evaluation of Protective Coating Systems for Structural Steel
T 143-13	Sampling and Testing Calcium Chloride for Roads and Structural Applications
T 237-05 (2014)	Testing Epoxy Resin Adhesive
T 250-05 (2014)	Thermoplastic Traffic Line Material
T 333-07 (2012)	Linear Coefficient of Shrinkage on Cure of Adhesive Systems
T 337-09 (2014)	Non-Instrumental Determination of Metallic Zinc in Zinc-Rich Primers
T 338-09 (2014)	Analysis of Structural Steel Coatings for Hindered Amine Light Stabilizer (HALS)
T 339-10	Analysis of Structural Steel Coatings for Isocyanate Content
T 346-13	Glass Beads Used in Pavement Markings
MP 24-14	Waterborne White and Yellow Traffic Paints
PP 73-13	Quality Assurance, Job Site Quality Control, and Reapplication of Protective Sealers for Portland Cement Concr
PP 74-13	Determination of Size and Roundness of Glass Beads Used in Traffic Markings by Means of Computerized Optic
PP 79-14	High-Friction Surface Treatment for Asphalt and Concrete Pavements
TP 84-11 (2014)	Evaluation of Adhesive Anchors in Concrete Under Sustained Loading Conditions
TP 96-13	Protective Sealers for Portland Cement Concrete
TP 106-13	Determination of Heavy Metal Content of Glass Beads Using X-Ray Fluorescence (XRF)
TP 111-14	Measuring Retroreflectivity of Pavement Marking Materials Using a Mobile Retroreflectivity Unit

IV. Old Business

A. SOM Ballot Items - None

B. TS ballots

C. **SOM_TS 4c**

i. Full Standards Requiring Reconfirmation

1. **M 143-14** Sodium Chloride
2. **M 144-14** Calcium Chloride

These standards were revised in 2014. The standards will be sent for reconfirmation without revision.

ii. Full Standards Requiring Revision

1. **M235M/M235-13** Epoxy resin Adhesives

There is an active Task Force for this item (TF 13 A). The purpose of the task force was to consider elimination of benzene dissolution. The filler test within M235 requires the use of benzene, and an alternative technique would be required if benzene dissolution was eliminated. There is an ashing technique, but it can only currently be used for certain types of epoxy. In addition, there are other AASHTO standards for analyzing epoxy (such as R31) that use techniques where solvents are utilized. The next step will be to attempt a round robin to evaluate techniques without the use of benzene. Originally it was thought that just the ashing technique would be evaluated. Comments from Pennsylvania that were submitted to the Task Force were reviewed. Based on these comments, it was decided that methyl ethyl ketone (MEK) techniques should also be evaluated.

Since the work of this task group is still working on this issue, the standard will be sent to reconfirmation without revision for now. Once the results of the round-robin are available, a ballot with revisions will be prepared.

2. **M247-13** Glass Beads Used in Pavement Markings

The chair brought to the attention of attendees that section 3.3 is open to interpretation "The beads shall be transparent, clean, colorless glass, smooth and spherically shaped, free from milkiness, pits, or excessive bubbles and conform to the specific requirements of Section 4." A new AASHTO standard has been proposed from

an NCHRP study (Retroflectivity of Glass Beads). It is intended to predict retroflectivity of M 247, Type I glass beads in waterborne paint using laboratory simulation of a field stripping operation. It has been recommended that this new proposed standard be balloted as provisional standard, and perhaps could eventually be referred to in M247.

A motion was made by Virginia and a second by Tennessee to send to concurrent ballot a new standard based on the NCHRP research on predicting retroflectivity of Type 1 Glass Beads. The motion passed unopposed.

Since the new standard still needs to be balloted as a provisional with hopes of eventually referencing in M247, M247 will be sent to reconfirmation without revision for now.

iii. Provisional Standards Requiring 2 yr. Reconfirmation
    1. **MP 024-15** (2016) Waterborne White and Yellow Traffic paints
    2. **TP 111-14** (2016) Measuring Retroreflectivity of Pavement Markings Using a Mobile Retroreflectivity Unit

The standards will be sent for reconfirmation without revision.

iv. Provisional Standards Requiring 1 yr. Extension
    1. **PP 073-13** (2015) Quality Assurance, Job Site Quality Control and Reapplication of Protective Sealers for Portland Cement Concrete
    2. **PP 74-13** (2015) Determination of Size and Roundness of Glass Beads Used in Traffic Marking by Means of Computerized Optical Method

A motion was made by Virginia to ballot these items for 1-year reconfirmation (SOM Ballot). A second was made by Tennessee. The motion passed unopposed.

v. Provisional Standards Requiring Revision
    1. **PP079-14** (2016) High-Friction Surface Treatment for Asphalt and Concrete Pavements

Active work is being done to fully revise this provisional standard. The chair will send out a Tech Section ballot for revisions.

    2. **TP 096-13** (2015) Protective Sealers for Portland Cement Concrete

Similar to NTPEP work plan. NTPEP is interested in using the standard, but revisions are pending. It was agreed that work on this standard should be done hand-in-hand with NTPEP work. Due to the date on the standard, it will be sent for reconfirmation without revision, but work will continue to align this standard with NTPEP work.

vi. Provisional Standards - Adopt or Drop
    1. **TP 084-11** (2017) Evaluation of Adhesive Anchors in Concrete under Sustained Loading Conditions

Research experts in the field have provided the following input:

- This method includes both a short-term and a long-term test.
- There are questions about the accuracy of the long-term version of the test. The long-term test results show a great degree of variability.
- Concerns were raised about adopting the long-term test, and it is felt that extensive revisions are needed. The short-term test has been well-vetted.

It was suggested that the provisional standard be dropped. A new provisional that just includes the short-term version of the test could be developed.

- Voice vote- A motion was made to drop the standard by Virginia and a second by Massachusetts. The Motion passed unopposed. TP 084-11 will be dropped.

D. Task Force Reports

i. TF 11-C develop an unambiguous determination of transparent, clean, colorless as informed by NCHRP Report 743 (Rob Dingess, Gene Carlson, Tony Wade, Jim Swisher, Dave Kuniega PA and Jerry McMahan- VT) affecting M247 – 13 See discussion above.

ii. TR 11-D – address wet weather performance and FAA color requirements CEI table requirements affecting M249-12 (Bob Lauzon CT, Rob Dingess, Paul Carlson) - Sunset at mid-year Sunsetted, remove from future agendas.

iii. TF 13 A elimination of benzene dissolution in M235-13 See above.

iv. TF 14- 1 evaluate pavement marking friction tests and report back to TS on efficacy and recommended practice for friction measurement
TF members: Danny Lane (TN), Rob Dingess, Gene Carlson, Tony Wade, Sejal Barot (MD), Bouzid Choubane (FL))
We don't have a good way to test friction of pavement markings, especially in the field. There were indications that a new method under development (microgrip test) could be a promising technique. A number of issues have come up and still need to be resolved. The Task Force will continue to report back as the testing progresses. If you are interested in joining the Task Force, contact the Chair.

v. TF 15-A TP 106 – result of negative on P & B; Combined with TF 13E for development/use of NIST reference standards. (Andrus, CT and VT)
Danny Lane gave a brief update on the SHRP2 workplan. It is expected that within the next year there should be further updates on the on-going research. SHRP2 XRF field/handheld test effort with Alabama, Tennessee and Maine was underway and they have a work plan in place. They are planning to get samples from every project and from the suppliers.

vi. TF 15-C Standard specification on green bike lanes (friction and color box) (TN, KY, Freeman, Baker, Stenko)
A durable green bike lane draft standard was developed last year. The only component missing was friction testing.

vii. TF 16-B Proposed changes to NTPEP Structural Steel Workplan regarding color change testing for AASHTO R31 (David Kuniega(PA), Jason Davis (LA), Brandy Mitchell (KY), Derrick Castle (Sherwin Williams))
The work of this task group continues as they look at the feasibility of the proposed changes. Derrick Castle from Sherwin Williams reported regarding the NTPEP task force that comparable data between different technologies is desired. Manufacturers recommended that an RFP go out to several laboratories to solicit samples with the 5 typical chemistry makeups in 3-4 different colors to be evaluated simultaneously. Katheryn Malusky will follow up with a laboratory that was going to submit a cost estimate. Katheryn invited any members present to join the NTPEP task group if interested.

V. New Business

A. Research Proposals

How Thermal Compatibility Affects Polymer –Aggregate Systems

A research proposal on the Durability of Polymer Resin Binder Systems was presented. A brief PowerPoint presentation was given on the topic.

- M235 was primarily designed for concrete bonding agents
- Research reports indicate that multiple-layer overlays are best-suited for roads in good condition.
- Failure can be caused by thermal incompatibility with the surface treatment and the existing layer.
- TTI research did a study where coefficient of thermal expansion with different resin binders were evaluated. The High Friction Surface treatment coefficient was 5 times greater than the concrete, dense-graded HMA, or open-graded HMA.
- Surface treatments are critical to safety of our highways. We need to find more compatible materials.

At the conclusion of the presentation there was discussion about the research proposal. It was suggested that Thin-bonded polymer bridge deck overlay systems be removed from the proposal and that the focus be on High Friction Surface Treatments. There were counterpoints suggested that this is important on bridge decks as well and they should be included in the study. There was also discussion regarding the funding level proposed ($80k), which seems low. A motion was made for the TS support the research by Montana, a second by Tennessee, with the understanding that a clearer objective, in the right format, and increased funding requested. A corrected version was sent to the SOM Chair and a copy can be found attached to these minutes.

B. AASHTO Issues None
C. NCHRP Issues None
D. Correspondence, calls, meetings/ Presentation by Industry See above
E. Proposed New Standards See summary
F. Proposed New Task Forces None
G. Standards Requiring Reconfirmation (2017) See Summary
H. SOM Ballot Items (including any ASTM changes) See Summary
I. Stewards for standards None

VI. Open Discussion

NTPEP Updates- Katheryn Malusky gave some brief NTPEP Updates as follows:

TS	TC	1.) Any "out of the ordinary" items we need to bring to the attention of all the states	2.) Any action items we need to recruit interested state volunteers for	3.) Any big accomplishments that have happened since August 2016
4c	**PMM**	Nothing out of the ordinary.	None	2017 Wisconsin Test Deck has been installed successfully
4c	**SSC/CCS**	a. SSC: Looking at revisions to the work plan to better detail the testing that is being performed by KTA. Also looking at removing interim evaluations for Salt Fog & Cyclic Weathering in order to minimize the time that the test panels are out of their chambers. Would be reduced to either only 5000 hour evaluation, or they may choose to keep 4000 and 5000 hour evaluations. Finally, the TC is also discussing the adding a requirement for manufacturers to certify that the shelf life of their products will	CCS: Currently working on putting together concrete mix designs that will be used for the various test methods. May solicit for volunteers to help with the testing of these mix designs to make sure they are adequate for the different tests. KTA is putting together a	None.

		exceed the time required for testing. b. SSC/CCS: Task group is looking at adding language to the work plan to standardize the IR spectra they obtain, so that IR data is more easily comparable from one source to another.	proposal that details the areas where they need assistance.	
4c	**RPM/SRPM**	One product on the field deck is going to be removed 2 months early due to road repairs being done at the deck location (will have a 22 month evaluation instead of 24 months).	None.	None.

Machine Vision research- the chair will check with the NCHRP panel can do a webinar to give an update to the Tech Section between now and the mid-year meeting. This is a multi-disciplinary study and the results thus far have been interesting.

VII. Adjourn – A motion was made to adjourn the meeting by Connecticut. A second was made by Tennessee. The meeting adjourned at 4:02 PM.

Attachments on next page

AASHTO STANDING COMMITTEE ON RESEARCH
AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS

NCHRP Problem Statement Outline

I. PROBLEM NUMBER

To be assigned by NCHRP staff.

II. PROBLEM TITLE

How Thermal Compatibility Influences the Long-Term Durability of Polymer Resin Binder Systems for High Friction Surface Treatment (HFST) and Thin-bonded Polymer Bridge Deck Overlay Systems

III. RESEARCH PROBLEM STATEMENT

Premature failure of both high friction surface treatment (HFST) and thin-bonded polymer overlay systems can be caused by thermal incompatibility with existing concrete and asphalt surfaces. These resin-rich overlay systems have a coefficient of thermal expansion (CTE) up to five times greater than the substrates they are bonded to, resulting in large internal stresses with changing temperatures. (2016, Bryan T. Wilson and Dr. Anol Mukhopadhyay). Thermal failures are manifest as debonding and delamination when the overlay bond is insufficient, and are manifest as substrate fracture and tearing when the substrate tensile strength is too weak.

One approach to mitigating these problems is to adjust the specified material properties of the polymer resin. A more flexible and forgiving polymer resin would help reduce thermal stresses. At the same time, the strength of the resin must still be adequate to resist shearing and retain aggregate under severe traffic conditions and high ambient temperatures. Therefore, there is a need to reassess the material requirements of the polymer-resin to reduce thermal stress while maintaining performance under severe traffic and climate conditions.

Special note to AASHTO Committees and Subcommittees: Please indicate the relationship between the suggested problem and the committee's strategic plan and/or its overall research agenda.

Technical Section 4c is the owner of PP 79-14(2016) High-Friction Surface Treatments for Asphalt and Concrete Pavements which treatments are similar to Bridge Deck sealing overlays. This research will help better define the interaction between the target surface material and the treatment materials due to climatic temperature variation and potentially provide guidance for the standard and specifications to address this interaction.

Advice to State Departments of Transportation and the Federal Highway Administration: Submitters are encouraged, but not required, to vet or submit problem statements through an appropriate AASHTO committee or subcommittee.

IV. LITERATURE SEARCH SUMMARY

Three studies were found in a search that were related to HFST and Bridge Polymer overlay performance, however none addressed specifically the issue of thermal characteristics of the target surface and the treatment material though the Florida DOT/FHWA Report BDR74-977-05 did explore this issue to some degree.

The studies were:

1) Performance of Concrete Bridge Deck Surface Treatments
Prepared for Utah Department of Transportation
Authors: W. Spencer Guthrie, Ph.D., Tyler Nelsen, EIT, and Loren A. Ross of Brigham Young University
Date: May 2005
Report No.: UT-05.05

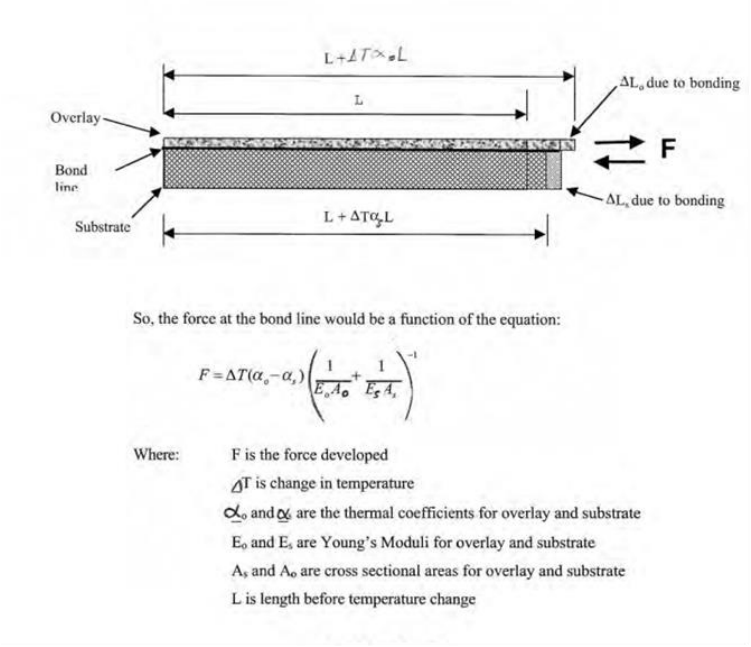
2) Alternative Aggregates and Materials for High Friction Surface Treatments
Prepared for Florida Department of Transportation and FHWA
Authors: Bryan Wilson and Anol Mukhopadhyay, Ph. D. of Texas A&M
Date: May 2016
Project No.: BDR74-977-05

3) Evaluation of Thin Polymer Overlays for Bridge Decks
Prepared for Wisconsin Department of Transportation
Authors: Habib Tabatabai, Konstantin Sobolev, Al Ghorbanpoor, Azam Nabiazdeh, Chin-Wei Lee, and Matthias Lind of University of Wisconsin-Milwaukee
Date: July 2016
Report No.: Wisconsin DOT ID 0092-12-06

V. RESEARCH OBJECTIVE

Determine material properties for the resin binder system that will mitigate issues with thermal incompatibility while maintaining a good bond, resisting shearing, and retaining aggregate under severe traffic and conditions, even at high service temperatures. These specific properties are under consideration: tensile strength, tensile elongation, compressive modulus, bond strength, and glass transition temperature. The desired outcome of this study is an eventual modification of the specified resin binder properties.

- Utilize CTE properties and calculate stresses at the bond interface. Consider the viscoelastic nature of the materials. Substrate properties for testing/modeling purposes should be representative and include worst/best scenarios based on aged asphalt pavements with low tensile properties to new, fully hydrated, high strength concrete.
- Using performance tests and/or modeling, determine the critical resin binder system requirements to remain bonded, resist shearing, and retain aggregate under severe traffic and climate conditions. The primary traffic scenario in question is turning movements around tight horizontal curves. Decelerating/accelerating intersection traffic could also be considered. For the climate condition, consider high ambient service temperatures.
- Based on findings, recommend modifications to existing ASTM test standards and/or similar. Consider the following methods as appropriate:
    - Tensile Strength and Tensile Elongation Test Method (ASTM D-638)
    - Glass Transition Temperature (Tg) Test Method (ASTM E-1640)
    - Adhesive properties Test Method (ASTM C-1583)
    - Compressive Modulus Test Method (ASTM D-695)



So, the force at the bond line would be a function of the equation:

$$F = \Delta T(\alpha_o - \alpha_s)\left(\frac{1}{E_o A_o} + \frac{1}{E_s A_s}\right)^{-1}$$

Where:
- F is the force developed
- ΔT is change in temperature
- α_o and α_s are the thermal coefficients for overlay and substrate
- E_o and E_s are Young's Moduli for overlay and substrate
- A_s and A_o are cross sectional areas for overlay and substrate
- L is length before temperature change

VI. ESTIMATE OF PROBLEM FUNDING AND RESEARCH PERIOD

Recommended Funding:

$80,000.00

(Note: The level of funded provided may be raised or lowered by the AASHTO Standing Committee on Research if and when the problem statement is selected)

Research Period:

(Note: This estimate may be changed by the Project Panel.)

VII. URGENCY AND POTENTIAL BENEFITS

The goal is to propose new resin binder property requirements that minimize tensile strains caused by thermal incompatibility by lowering tensile strength, compressive modulus, and increase tensile elongation without shearing and losing aggregate in severe service conditions. Under the current specifications, these systems are prone to premature thermal incompatibility failure because of debonding, delamination, or substrate failure. There are many studies that correlate the early age failure of thin polymer overlay and HFST systems with the relationship between substrate condition and thermal cycling (W. Spencer Guthrie, Ph.D. Tyler Nelsen, E.I.T. Loren A. Ross, 2005; Nuno Gama 1999; Sprinkel; Bryan T. Wilson and Dr. Anol Mukhopadhyay 2016; Jennifer Harper, PE 2007). It can be considered that any form of de-bonding and/or delamination of these resin based systems can be attributed at some level to thermal incompatibility. If the research is successful and implemented, the occurrence of these failures should be substantially reduced.

VIII. IMPLEMENTATION PLANNING

HFST and Polymer Overlay for Bridge Deck users and supporting industry would benefit from this research. Potential immediate specifying conditions for AASHTO standard and DOT's specifications.

IX. PERSON(S) DEVELOPING THE PROBLEM STATEMENT

Gregg Freeman
Kwik Bond Polymers
923 Teal Drive
Benicia, CA 94510
Director of Business Development
720-626-6643
gregg@kwikbonpolymers.com

X. AASHTO MONITOR

For each project selected for the NCHRP, an AASHTO Monitor will be assigned to help ensure that the research meets the needs of state DOTs and to facilitate implementation of the results. The AASHTO Monitor should be an employee of a state DOT, and typically will have been one of the authors of the problem statement. The AASHTO Monitor will be assigned by staff, but if you wish to nominate an individual for this role, please provide their specifics (name, title, affiliation, address, telephone number, e-mail address).

XI. SUBMITTED BY

Scott Andrus
UDOT State Materials Engineer/SOM TS 4c Research Liaison
scottandrus@utah.gov

Please submit completed problem statement at:

http://bit.ly/NCHRP2018Submittal

Questions on the process can be directed to chedges@nas.edu.

List of Documents:

- Meeting Minutes and attendance list
- SOM Summary TS 4C – 2017

List of Appendices

- Appendix A - Revision of MP PP079 - High Friction Surface Treatment for Asphalt and Concrete Pavements - **Tech Section Ballot**

- Appendix B - AASHTO PP xx – Provisional Practice for the Application of High friction Surface Treatment for Asphalt and Concrete Pavements - **Tech Section Ballot**

- Appendix C - AASHTO Designation T xxx - Standard Method of Test for Producing Draw Down Panels and Measuring the Coefficient of Retroreflected Luminance (RL) of Pavement Markings in a Laboratory Panel - **Concurrent Tech Section / SOM Ballot**

- Appendix D - AASHTO Designation PP XX-16 - Standard Specification for Durable Green Bike Lane Surface Treatments for Asphalt and Concrete Pavements with exposure to Vehicular Traffic – **Tech Section Ballot**