Yellowstone & Jackson Hole 2016 ISAP Symposium

"From Molecules to Innovative Pavements"

Jointly held with concurrent sessions for the

53rd Petersen Asphalt Research Conference

July 18-21, 2016

Snow King Resort and Conference Center - Jackson, Wyoming

Gateway to Grand Teton and Yellowstone National Parks

Presented by

Western Research INSTITUTE

ISAP – International Society for Asphalt Pavements

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Welcome

Howdy, Bonjour!

As the symposium chairman and the current ISAP Vice Chair, it is my immense pleasure and privilege to welcome you to Jackson Hole, Wyoming, for the International Society for Asphalt Pavements (ISAP) 2016 Symposium and 53rd Petersen Asphalt Research Conference (PARC) combined event.

In the last couple of years, big changes have occurred in the petroleum world. Some of these changes, like huge oil price variations, have considerably impacted asphalt crude selection, production and quality. The development of knowledge, models, analytical tools and test methods for asphalt materials has never been more important. These developments are sources of progress and innovation that will allow us to continue to make cost effective and sustainable pavements.

ISAP and PARC have always been recognized forums for sharing new ideas and new knowledge. PARC, in particular, warmly welcomes presentation of ideas still "in progress".

The theme for this year's symposium is "From Molecules to Innovative Pavements". This is implicitly recognizing that chemistry matters to make durable, sustainable, cost effective and yet innovative pavements. The call for abstracts and papers was very successful and led to nearly 100 presentations in 2½ days. We will cover a lot of ground, both professionally and geographically. At least 20 nationalities will be represented, making this ISAP truly international!

I am confident this event will offer a unique opportunity to update your knowledge on both fundamental and cutting edge ideas that are implementable and applicable to solve real world problems.

As always in Wyoming, information sharing and exchange come with a friendly and open atmosphere. Do not forget that you are in one of most strikingly beautiful areas of the world, so close to the natural wonders of Grand Teton and Yellowstone National Parks.

I hope you'll have a great time and a memorable 2016 ISAP Symposium and PARC event!

Welcome to our friends from all over the world - Enjoy the West!

Jean-Pascal (JP) Planche
Vice President, Asphalt and Petroleum Technologies
Western Research Institute
Laramie, Wyoming

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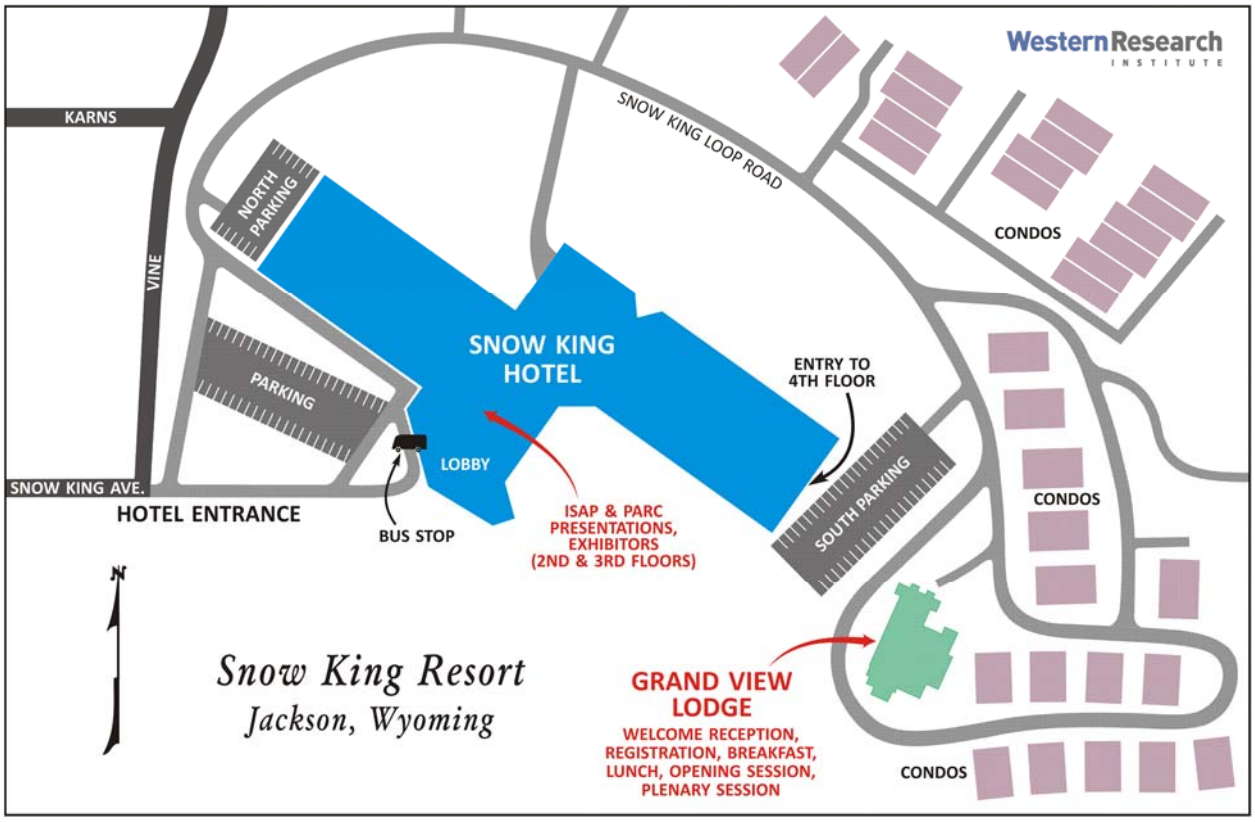
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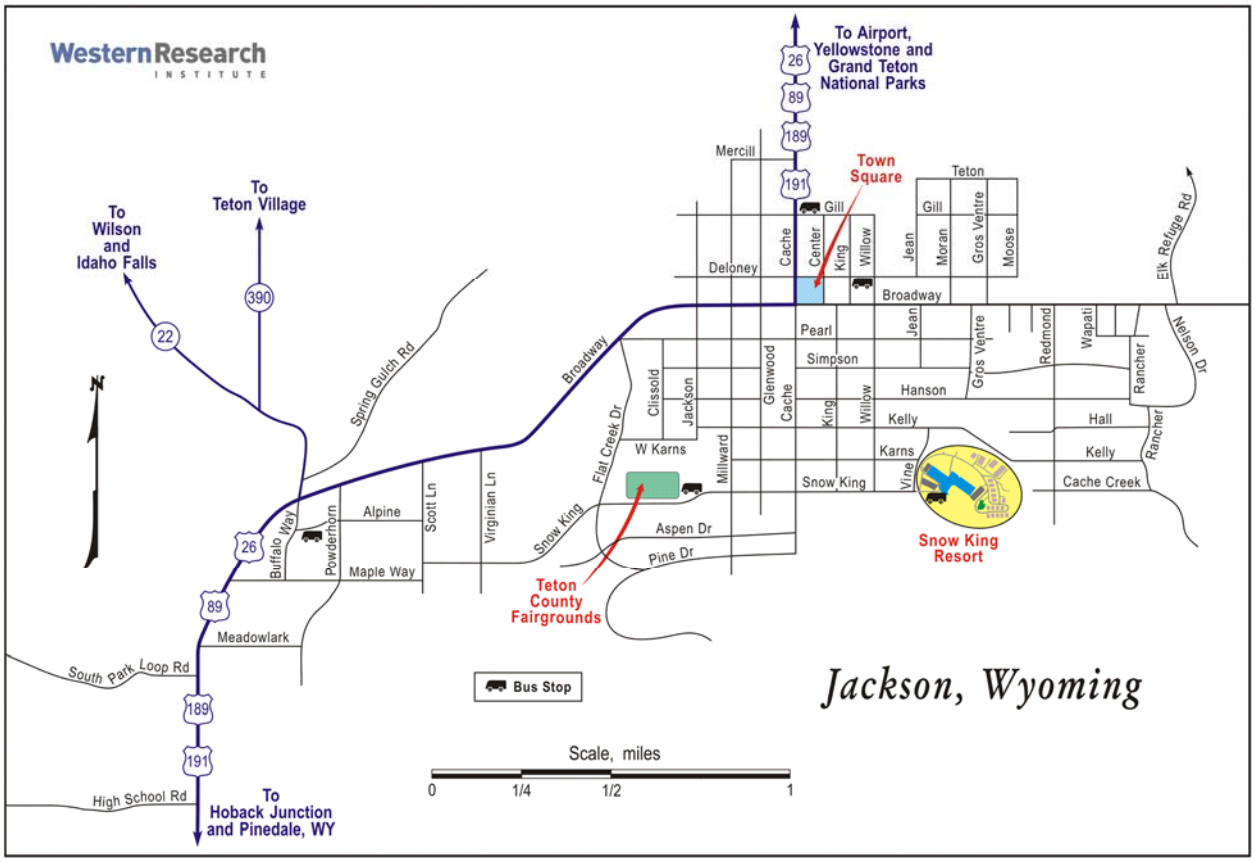
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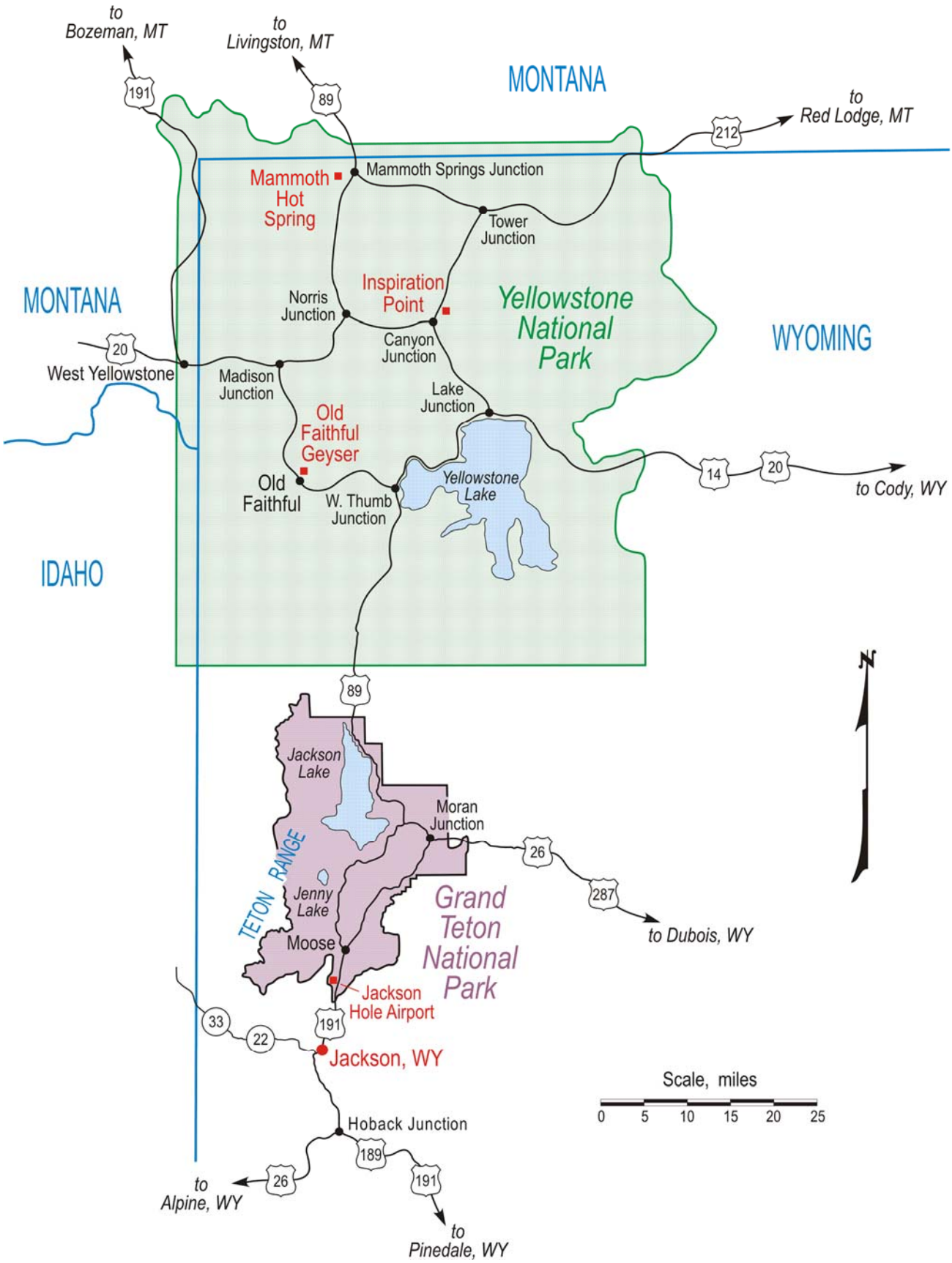
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Yellowstone & Jackson Hole 2016 ISAP Symposium
Schedule of Events and Technical Program

Snow King Resort and Conference Center • July 18-21, 2016 • Jackson, Wyoming

Monday, July 18

5:00-7:00 p.m.	Registration *(Pick up symposium materials)*	Grand View Lodge
6:30-8:30 p.m.	Welcome Reception *(hors d'oeuvres, cash bar, Birds of Prey demonstration, Park Ranger presentation)*	Grand View Lodge Ballroom

Tuesday, July 19

7:00-8:00 a.m.	Registration and Continental Breakfast	Grand View Lodge
8:00-8:45 a.m.	Opening Session *Jean-Pascal Planche, Western Research Institute* *City of Jackson Public Works Official*	Grand View Lodge Ballroom

ISAP SYMPOSIUM TECHNICAL SESSIONS - SNOW KING HOTEL

SESSION 1 Binder and Mixture Aging Performance

Grand Room Session Chair - *Gayle King, GHK, Inc.*
Teton Room Session Chair - *Dave Anderson, Penn State University & Consultant*

9:00-9:20 a.m.	Grand Room	Effect of Aging on Binder Characteristics of Virgin and Recycled Microsurfacing Materials	Garfa Arbia & Alan Carter, *École de Technologie Supérieure of Montréal ETS, Canada;* Oscar Sanou, Anne Dony & Layella Ziyani, *École Spéciale des Travaux Publics, Paris, France;* Walid Zaouali & Valérie Charton, *Probinord, France*
	Teton Room	A Study on the Properties of Asphalt Aging in Expressway Focusing on Weather Degradation for Long Period	Toshiaki Hirato & Kenji Himeno, *Chuo University, Tokyo, Japan;* Masato Murayama, *Toa Road Corp., Ibaraki, Japan;* Shigeki Takahashi, *Nippon Expressway Research Institute Company, Tokyo, Japan*

Tuesday, July 19 (continued)

SESSION I Binder and Mixture Aging Performance (continued)

9:25-9:45 a.m.	Grand Room	Addressing Asphalt Binder Aging Through the Viscous to Elastic Transition	Laurent Porot & Pieter Eduard, *Arizona Chemical BV, Almere, The Netherlands*
	Teton Room	Statistical Approach to DSR-PAV Test Improvement	Pavel Kriz, Katherine L. Soko, Stephanie R. Sta. Maria & Demetrio Meskas, *Imperial Oil Limited, Ontario, Canada*
9:50-10:10 a.m.	Grand Room	On Fundamentals-Based Modeling of Binder Oxidative Hardening in Pavements and its Effects on Mixture Durability	Charles J. Glover, Xue Luo, Avery Rose & Robert L. Lytton, *Texas A&M University, USA*
	Teton Room	Aging Evaluation of Asphalt Mixture by FTIR/ATR	Yoko Kawashima, Hiroyuki Nitta & Itaru Nishizaki, *Public Works Research Institute, Ibaraki, Japan*
10:10-10:30 a.m.		~ Break ~	
10:30-10:50 a.m.	Grand Room	The Influence of Aging on Binder Fatigue and Other Fracture Related Binders Tests	Hilde Soenen, *Nynas NV, University of Antwerp, Antwerpen, Belgium;* Xiaohu Lu, *Nynas AB, Nynashamn, Sweden;* Uwe Muehlich, *University of Antwerp, Antwerpen, Belgium;* Olli-Ville Laukkanen, *Aalto University, Aalto Finland & University of Massachusetts, USA*
	Teton Room	A New Method to Quantify and Evaluate Ageing State of Asphalt from Viscoelastic Measurement	Andrea Themeli, Paul Marsac, Miguel Perez-Martinez & Emmanuel Chailleau, *IFSTTAR, France;* Khedidja Krolkral, *LEEGO-USTHB, Alger*

Tuesday, July 19 (continued)

SESSION 2 Binder and Mixture Modeling

Grand Room Session Chair - *Chris Williams, Iowa State University*
Teton Room Session Chair - *Hinrich Grothe, Technische Universitaet Wein*

10:55-11:15 a.m.	Grand Room	Mesoscopic Numerical Analysis of Reflective Cracking in Asphalt Overlay Based on Multi-Scale Finite Element Method	Jun Zhang, Hao Chu, Yongtao Su, Zhen Gao & Bin Wang, *University of Northeast, Shenyang, China*
	Teton Room	Modification of Physical and Chemical Properties of Mastic Joint by Bentonie-impregnated in Waste Oil and Sulphur	Azade Najafghlizade & Vahid Hadadi, *Islamic Azad University, Tehran, Iran*
11:20-11:40 a.m.	Grand Room	Computational Packing of Aggregates for the Study of Virtual Asphalt Samples	Andrea Chiarelli, Andrew R. Dawson & A. Garcia, *University of Nottingham, UK*
	Teton Room	Understand Asphalt-Aggregate Interface Failure with Atomistic Modeling	Guangji Xu & Hao Wang, *Rutgers, The State University of New Jersey, USA*
11:40-1:00 p.m.		~ Lunch ~	Grand View Lodge
1:00-1:20 p.m.	Grand Room	Evaluation of Factors Affecting the Performance of Geogrid-Reinforced Flexible Pavement Using Finite Element Approach	Fan Gu, Xue Luo & Robert L. Lytton, *Texas A&M Univ.;* Yuqing Zhang, *Aston University, Birmingham, UK*
	Teton Room	Use of Particulate Composite Models and Crumb Rubber Swelling to Estimate Stiffness of Rubberized Asphalt Binders	Jose R. Medina & B. Shane Underwood, *Arizona State University, USA*
1:25-1:45 p.m.	Grand Room	Linking Mixture-Level Component Properties with Pavement Damage Performance: A Two-Way Linked Multiscale Model	Taesun You & Yong-Rak Kim, *University of Nebraska, USA*
	Teton Room	Coupled Modelling of Deformation and Cracking of Asphalt Mixtures	Yuqing Zhang & Bjorn Birgisson, *Aston University, Birmingham, UK;* Fan Gu & Robert L. Lytton, *Texas A&M University, USA*

Tuesday, July 19 (continued)

SESSION 3 Polymer, CRMA and PPA Modification

Grand Room Session Chair - *Jean-Pascal Planche, Western Research Institute*
Teton Room Session Chair - *Di Benedetto Herve, École Nationale des Travaux Publics de l'Etat*

1:50-2:10 p.m.	Grand Room	Assessing the Applicability of Rheological Parameters to Evaluate Modified Binders	David J. Mensching, *National Research Council/Federal Highway Administration, USA;* Nelson H. Gibson, *Federal Highway Administration, USA;* Adrian Andriescu, *SES Group & Associates, USA;* Geoffrey M. Rowe, *Abatech, Inc., Pennsylvania, USA;* Jo Sias Daniel, *University of New Hampshire, USA*
	Teton Room	Influence of Thermal History on Phase Separation in Polymer Modified Bitumen: A Numerical Approach	Jiqing Zhu, Romain Balieu & Niki Kringos, *KTH Royal Institute of Technology, Stockholm, Sweden;* Xiaohu Lu, *Nynas AB, Nynäshamn, Sweden*
2:15-2:35 p.m.	Grand Room	Effects of Polyphosphoric Acid (PPA) of Asphalts	Istiaque Mahmud & Dr. Zahid Hossain, *Arkansas State University, USA;* Dr. Gaylon Baumgardner, *Paragon Technical Services, Inc., Ohio, USA*
	Teton Room	Chemical and Rheological Investigation of High-Cured Crumb Rubber-Modified Asphalt	Naipeng Tang & Weidong Huang, *Tongji University, Shanghai, China*
2:40-3:00 p.m.	Grand Room	Impact of Gilsonite on the Performance of Un-Modified and Polymer-Modified Asphalt Mixtures	Peter E. Sebaaly, Elie Y. Hajj & Murugaiyah Pirateepan, *University of Nevada, Reno, USA*
	Teton Room	Weather Aging Resistance of Different Rubber Modified Asphalts	Shifeng Wang, Qiang Wang, Shuo Li & Xiaoyu Wu, *Research Institute of Polymer Material, Shanghai Jiao Tong University, Shanghai, China*
3:00-3:20 p.m.		~ Break ~	

Tuesday, July 19 (continued)

SESSION 3 Polymer, CRMA and PPA Modification (continued)

3:20-3:40 p.m.	Grand Room	Durability of Polymer Modified Asphalt Shingle	Heather E. Estes, Tanya M. Brown-Giammanco & Ian M. Giammanco, *Insurance Institute For Business & Home Safety, South Carolina, USA*
	Teton Room	Alternative Catalysts to PPA in Polymer Modified Asphalts	C.J. DuBois & George Prejean, *E. I. du Pont de Nemours & Company, Inc., Texas, USA*

SESSION 4 Novel Testing and Modification of Binders and Mixes

Grand Room Session Chair - *Hassan Tabatabaee, Cargill*
Teton Room Session Chair - *Cannone Falchetto Augusto, Technische Universität Braunschweig*

3:45-4:05 p.m.	Grand Room	Self-Healing of Asphalt Mixtures via Microwave Heating	José Norambuena-Contreras, *University of Bío-Bío, Concepción, Chile;* José L. Concha, *Edificio de Laboratorios, Concepción, Chile*
	Teton Room	Imaging and Spectroscopic Analysis of Bitumen	Ayse N. Koyun & Hinrich Grothe, *Vienna University of Technology, Vienna, Austria*
4:10-4:30 p.m.	Grand Room	Linear Viscoelastic Properties, Low Temperature and Fatigue Performances of Asphalt Mixture with Recycled Glass	Éric Lachance-Tremblay, Michel Vaillancourt & Daniel Perraton, *École de Technologie Supérieure, Montréal, Canada*
	Teton Room	Durable Fiber Reinforced Asphalt Concrete Friction Courses for Airfield Runways	Jeff Stempihar, Shane Underwood & Kamil Kaloush, *Arizona State University, USA;* Scott Nazar, *FORTA Corporation, Pennsylvania, USA*
4:35-4:55 p.m.	Grand Room	Investigation of the Adhesion and Self-healing Properties of Modified Asphalt Binder Using Pull-off Test Cancelled	Quan Lv & Weidong Huang, *Tongji University, Shanghai China*

Tuesday Evening ~ Dinner on Your Own ~

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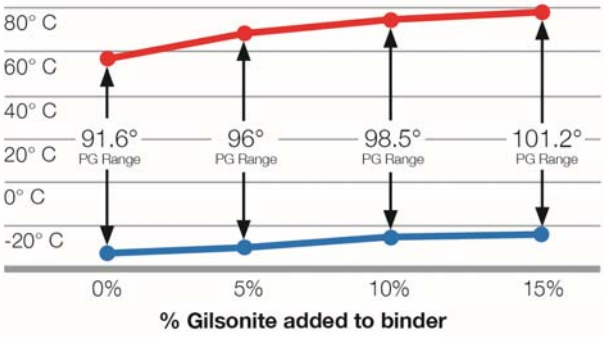

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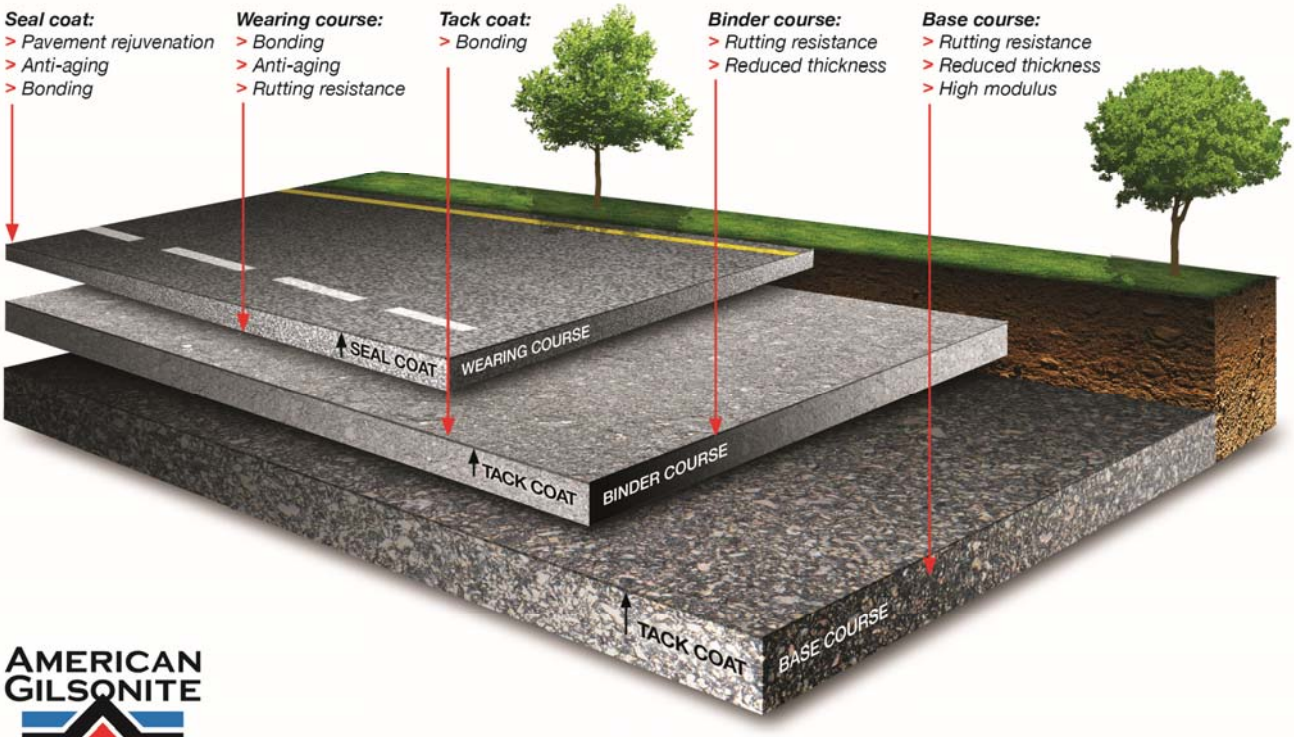

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2016 ISAP Schedule of Events and Technical Program

Wednesday, July 20

7:00-8:00 a.m.	Continental Breakfast	Grand View Lodge
8:00-8:45 a.m.	Plenary Session *Dallas Little - Keynote Speaker* *Texas A&M University*	Grand View Lodge Ballroom

ISAP SYMPOSIUM TECHNICAL SESSIONS - SNOW KING HOTEL

SESSION 5 Extender Oils, Rejuvenators and RAP

Grand Room Session Chair - *Alan Carter, École de Technologie Supérieure*
Timberline III Room Session Chair - *Todd Thomas, Colas Inc.*

9:00-9:20 a.m.	Grand Room	Rejuvenation vs. Softening: Reversal of the Impact of Aging on Asphalt Thermo-Rheological and Damage Resistance Properties	Hassan A. Tabatabaee & Todd L. Kurth, *Cargill Industrial Specialties, Minnesota, USA*
	Timber-line III Room	Performance Evaluation of HMA with High RAP Contents Using Rejuvenators	Axel Walther, *Technische Universität Braunschweig, Braunschweig, Germany*
9:25-9:45 a.m.	Grand Room	Field Performance of RAP/RAS Test Sections in Texas	Fujie Zhou, Sheng Hu & Tom Scullion, *Texas A&M Transportation Institute, USA*
	Timber-line III Room	Effect of Rejuvenator on Performance Properties of HMA Mixtures with RAP and RAS	Nam Tran, Adam Taylor, Richard Willis & Zhaoxing Xie, *National Center for Asphalt Technology, Alabama, USA*
9:50-10:10 a.m.	Grand Room	Structural Properties of Asphalt Stabilized Cold Recycled Mixtures	Charles W. Schwartz, *University of Maryland, USA;* Benjamin Bowers & Brian Diefenderfer, *Virginia Department of Transportation, USA*
	Timber-line III Room	Development of an Innovative Recycling Method for Porous Asphalt Enabling Improvement of Binder Layer's Durability	Toshihiro Tanaka, *Nippon Expressway Research Institute Co., Tokyo, Japan;* Junichi Haga, *Kajima Road Co., Tokyo, Japan*

10:10-10:30 a.m. ~ Break ~

Wednesday, July 20 (continued)

SESSION 5 Extender Oils, Rejuvenators and RAP (continued)

10:30-10:50 a.m.	Grand Room	Performance Characteristics of Vacuum Tower Asphalt Extender in Binders and RAP Mixtures	John A. D'Angelo, *D'Angelo Consulting, LLC, USA;* Ken Grzybowski, *PRI Asphalt, Florida, USA* & Al Palmer, *Kleen Performance Products, Texas, USA*
	Timber-line III Room	Digital Sieving as Tool for Designing High RAP Mixtures	Lily D. Poulikakos, Michele Griffa, Maria Chiara Cavalli & Manfred Partl, *Empa Swiss Federal Laboratories for Material Science and Technology, Dübendorf, Switzerland*
10:55-11:15 a.m.	Grand Room	Low and Intermediate Temperature Properties of Asphalt Mixtures Using Vacuum Tower Bottoms Modified with Bio-derived Rejuvenators	Joseph H. Podolsky, Ashley Buss, Nacu Hernandez, R. Christopher Williams & Eric W. Cochran, *Iowa State University, USA*
	Timber-line III Room	Effect of Capsules Containing Sunflower Oil on the Mechanical Behavior of Aged Asphalt Mixture	Rui Micaelo, *DEC, FCT, Universidade NOVA de Lisboa, Caparica, Portugal;* Tariq Al-Mansouri & Alvaro Garcia, *University of Nottingham, UK*
11:20-11:40 a.m.	Grand Room	Investigation of Effect of Bio-based and Re-refined Used Oil Modifiers on Asphalt Binder's Performance and Properties	Amir Golalipour, *Engineering & Software Consultants, Inc., Washington, DC, USA;* Hussain Bahia, *University of Wisconsin-Madison, USA*
	Timber-line III Room	Effectiveness of a Bio-based Additive to Restore Properties of Aged Asphalt Binder	Laurent Porot, *Arizona Chemical BV, Almere, The Netherlands;* William Grady, *Arizona Chemical LLC, Georgia, USA*
11:40-1:00 p.m.		~ Lunch ~	Grand View Lodge

Wednesday, July 20 (continued)

SESSION 6 Warm Mix Technologies in Asphalt Pavements

Grand Room Session Chair - *Laurent Porot, Arizona Chemical*
Timberline III Room Session Chair - *Jo Daniel, University of New Hampshire*

1:00-1:20 p.m.	Grand Room	Laboratory Evaluation of Asphalt Mixture Containing Super Absorbent Polymer (SAP) Warm Mix Additive	Chao Wang, Xiaobin Yuan, Han Zhang & Jinxi Zhang, *Beijing University of Technology, Beijing, China*
	Timber-line III Room	Warm Mix Asphalt: The Canadian Experience	Sofiane Benyoucef, Alan Carter & Daniel Perraton, *École de Technologie Supérieure de Montréal, Québec, Canada;* François Olard, *Eiffage Travaux Publics, Lyon, France*
1:25-1:45 p.m.	Grand Room	Indirect Evidences of Bitumen Chemical Modifications Introduced by Non-Foaming Warm Mix Asphalt Additives	Flavien Geisler, *Eiffage Centre d'Etudes et de Recherches, Corbas, France;* Philippe Kapsa, *École Centrale de Lyon, France;* Laurence Lapalu, *Total Marketing and Services, Solaize, France*
	Timber-line III Room	Destabilization of Cationic Bitumen Emulsions for Pavement Materials, Using Microscopical and Rheological Tools	Laure Boucard, Vincent Gaudefroy & Emmanuel Chailleux, *LUNAM Université, IFSTTAR, France;* Fabienne Farcas, *ParisTech Université, IFSTTAR, France;* Veronique Schmitt, *Bordeaux Université, Pessac, France*
1:50-2:10 p.m.	Grand Room	Modelling Coalescence Process During Breaking of Bitumen Emulsions	Abdullah Khana, Romain Balieu, Per Redelius & Niki Kringos, *KTH-Royal Institute of Technology, Stockholm, Sweden*

Wednesday, July 20 (continued)

SESSION 7 Binder/Mastic and Mixture/Pavement Performance Testing

Grand Room Session Chair - *Nader Tabatabaee, Sharif University of Technology*
Timberline III Room Session Chair - *Jo Daniel, University of New Hampshire*

1:50-2:10 p.m.	Timber-line III Room	Multiple Stress Creep and Recovery Tests of Bituminous Binders and Correlation to Asphalt Concrete Rutting Performance	Xiaohu Lu, *Nynas AB, Nynäshamn, Sweden;* Safwat Said, *VTI, Linköping, Sweden;* Hilde Soenen, *Nynas NV, Antwerp, Belgium;* Serge Heyrman, *University of Antwerp, Antwerp, Belgium*
2:15-2:35 p.m.	Grand Room	Impact of Bitumen Quality on Asphalt Mixes Performances	Frédéric Delfosse, Ivan Drouadaine, Stéphane Faucon-Dumont & Sabine Largeaud, *Eurovia Research Centre, Mérignac, France;* Bernard Eckmann, *Eurovia, Rueil Malmaison, France;* Jean-Pascal Planche & Fred Turner, *Western Research Institute, Laramie, Wyoming, USA*
	Timber-line III Room	Using Repeated Stress Sweep to Investigate Non-linearity in Asphalt Binders and Mastics by Fourier Transform Analysis	Akshay Gundla & Shane Underwood, *School of Sustainable Engineering and Built Environment, Arizona State University, USA*
2:40-3:00 p.m.	Grand Room	Using Mixture-Based Rheology to Evaluate Cracking Performance of Modified Asphalt Pavements	Jo Sias Daniel, *University of New Hampshire, USA;* David J. Mensching & Nelson H. Gibson, *Federal Highway Administration, USA;* Geoffrey Rowe, *Abatech, Inc., Pennsylvania, USA*
	Timber-line III Room	Calculation of Stiffness Change Induced by Self-heating During Cyclic Loading of Bituminous Mixtures Considered as Heterogeneous Medium	Lucas F. de A. L. Babadopulos, Cédric Sauzéat & Hervé Di Benedetto, *Université de Lyon, Cedex, France*
3:00-3:20 p.m.		~ Break ~	

Wednesday, July 20 (continued)

SESSION 7 Binder/Mastic and Mixture/Pavement Performance Testing (continued)

3:20-3:40 p.m.	Grand Room	Characterization of Asphalt Mixture Recovery Properties Based on Dissipated Energy Approach	Ivan Isailovic, Augusto Cannone Falchetto & Michael P. Wistuba, *Technische Universität Braunschweig, Braunschweig, Germany*
	Timber-line III Room	Comparison of Viscoelastic Continuum Damage and Fracture Energy Testing Approaches for Cracking Performance of Asphalt Mixtures	Jo Sias Daniel, Reyhaneh Rahbar-Rastegar, Saman Salari, Eshan V. Dave, Christopher DeCarlo & Christopher Jacques, *University of New Hampshire, USA*

SESSION 8 Binder, Mix and Pavement Moisture Sensitivity

Grand Room Session Chair - *Andrew Hanz, MTE Services*
Timberline III Room Session Chair - *Seyed Tabib, Ontario Ministry of Transportation*

3:45-4:05 p.m.	Grand Room	Experimental Investigations of Frost/Thaw Effects on Asphalt Concrete Under Several Conditions: Water, Brine, and Brine with an Additive	Sebastien Liandrat, Caroline Mauduit, Éric Crégut, Valentin Lafon & Sylvain Moreira, *Cerema Direction Territoriale Centre-Est, Clermont-Ferrand, France*
	Timber-line III Room	Laboratory and Field Investigation of Moisture Evaporation in Asphalt Pavement Cancelled	Lin Cong, Jintang Peng, Zhongyin Guo & Tiantong Zhu, *Key Laboratory of Road & Traffic Engineering of Ministry of Education, Tongji University, Shanghai, China*
4:10-4:30 p.m.	Grand Room	Extended Testing Conditions for the Evaluation of Water Sensitivity of HMA Mixes	Geoffrey M. Rowe, *Abatech Inc., Pennsylvania, USA;* Ajay Ranka, M. Ranka, Doug Zuberer & Jerry A. Thayer, *Zydex, North Carolina, USA;* Andrew LaCroix, *Instrotek, North Carolina, USA;* Chris Bacchi, *Trimat, North Carolina, USA*

Wednesday, July 20 (continued)

SESSION 9 Binder, Mix & Pavement Low Temperature Testing/Performance

Grand Room Session Chair - *Emmanuel Chailleux, IFSTTAR*
Timberline III Room Session Chair - *Pavel Kriz, Imperial Oil Ltd.*

4:10-4:30 p.m.	Timber-line III Room	Effect of Stress Singularity on Strength Size Effect of Asphalt Mixture at Low Temperature	Augusto Cannone Falchetto & Michael P. Wistuba, *Technische Universität Braunschweig, Braunschweig, Germany*
4:35-4:55 p.m.	Grand Room	Low Temperature Properties of Asphalt Mixtures Treated with Bio Sealants	Debaroti Ghosh, Jhenyffer Matias De Oliveira & Mateus Aguilar Lima, *University of Minnesota, USA;* Eddie Johnson & Allan Galistel, *Minnesota DOT Office of Materials and Road Research, USA*
	Timber-line III Room	Comparison of Analytical and Approximate Inter-conversion Methods for Thermal Stress Calculation	Augusto Cannone Falchetto, Di Wang & Michael P. Wistuba, *Technische Universität Braunschweig, Braunschweig, Germany;* Ki Hoon Moon, *Korea Expressway Corporation, Gyeonggi-do, South Korea*
5:45-8:00 p.m.		~ Social Hour & Chuckwagon Dinner ~	Teton County Fairgrounds
8:00-10:00 p.m.		~ Rodeo ~	Teton County Fairgrounds

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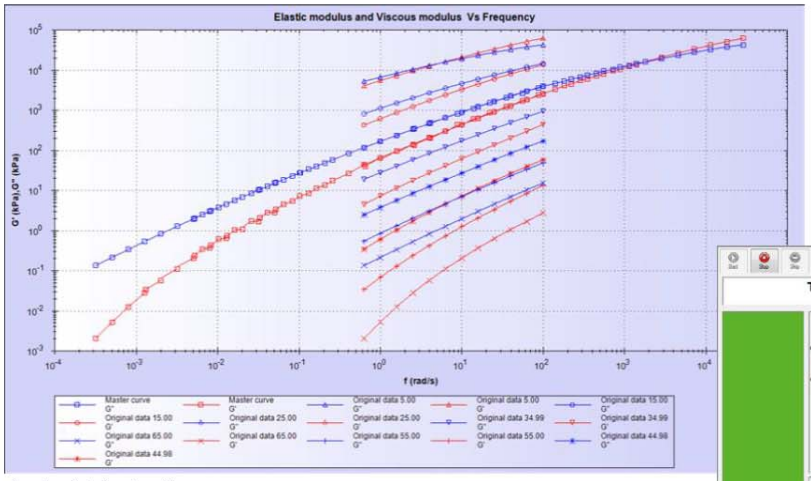

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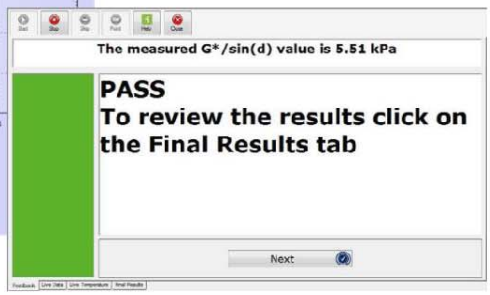

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Thursday, July 21

7:00-8:00 a.m.	Continental Breakfast	Grand View Lodge

ISAP SYMPOSIUM TECHNICAL SESSIONS - SNOW KING HOTEL

SESSION 10 Aggregates and Mixtures with Regard to Compaction and Performance

Grand Room Session Chair - *Gerald Huber, Heritage Research Group*
Teton Room Session Chair - *Mike Anderson, Asphalt Institute*

8:00-8:20 a.m.	Grand Room	Relationship Between the Aggregate Structure and Mechanical Properties of GB5® Road Base Mix	Pouget Simon & Olard François, *EIFFAGE Infrastructures, Corbas, France;* Hammoum Ferhat, *IFSTTAR Laboratoire MIT, Cedex, France*
	Teton Room	Modifying Asphalt Mixture Design to Enhance Field Compaction: A Field Study	Ali Hekmatfar & John E. Haddock, *Purdue University, USA;* Ayesha Shah & Rebecca McDaniel, *North Central Superpave Center, Purdue University, USA;* Gerald Huber, *Heritage Research Group, Indiana, USA*
8:25-8:45 a.m.	Grand Room	Measurement System for Tracking Material Flow During Simulated Asphalt Compaction	Ehsan Ghafoori Roozbahany, Manfred N. Partl & Alvaro Guarin, *KTH, Stockholm, Sweden*
	Teton Room	Effects of Rest and Load Time on Asphalt Mixture Compaction	Mohammad M. Karimi, Nader Tabatabaee, Behnam Jahangiri & Hamid Jahanbakhsh, *Sharif University of Technology, Tehran, Iran*

Thursday, July 21 (continued)

SESSION 11 Pavement Skid Resistance, Friction and Noise

Grand Room Session Chair - *Shane Underwood, Arizona State University*
Teton Room Session Chair - *Tom Scarpas, Delft University of Technology*

8:50-9:10 a.m.	Grand Room	Road Simulator Tests to Study the Effect of Asphalt Mixture Components on the Development of Surface Texture and Noise Characteristics	Doreen Siebert & Helge Mork, *NTNU, Department of Civil & Transport Engineering, Trondheim, Norway*
	Teton Room	Study on Factors Affecting Pavement Friction Durability	Hao Li & Zhiqiang Zhao, *JSTI Group, Nanjing, China;* Xingping Luo & Yushu Chen, *Guangdong Provincial Freeway Company, Guangzhou, China*
9:15-9:35 a.m.	Grand Room	Study on an Asphalt Mixture for the Surface Layer of National Highways in Snowy Cold Regions: Development of a High-performance SMA	Shunsuke Tanaka, Ryuji Abe, Kimio Maruyama & Takashi Kimira, *Civil Engineering Research Institute for Cold Region, Sapporo, Japan;* Shuichi Kameyama, *Hokkido University of Science, Sapporo, Japan*
	Teton Room	Demonstration on Fuel Consumption Reduction Performance of Low Rolling Resistance Asphalt Pavement	Atsushi Kawakami, Masaru Terada & Kazuyuki Kubo, *Public Works Research Institute, Ibaraki, Japan;* Tsutomu Ishigaki & Yuu Shirai, *Nippo Corporation, Saitama, Japan*
9:40-10:00 a.m.	Grand Room	Innovative Gap-Graded Asphalt Mixtures for Long-Lasting Low Noise Road Surfaces	Pouget Simon & Olard François, *EIFFAGE Infrastructures, Corbas, France;* Gourdon Emmanuel, *University Lyon, Vaulxen-Velin, France*
10:00-10:20 a.m.		~ Break ~	

Thursday, July 21 (continued)

SESSION 12 Pavement Performance Testing and Evaluation

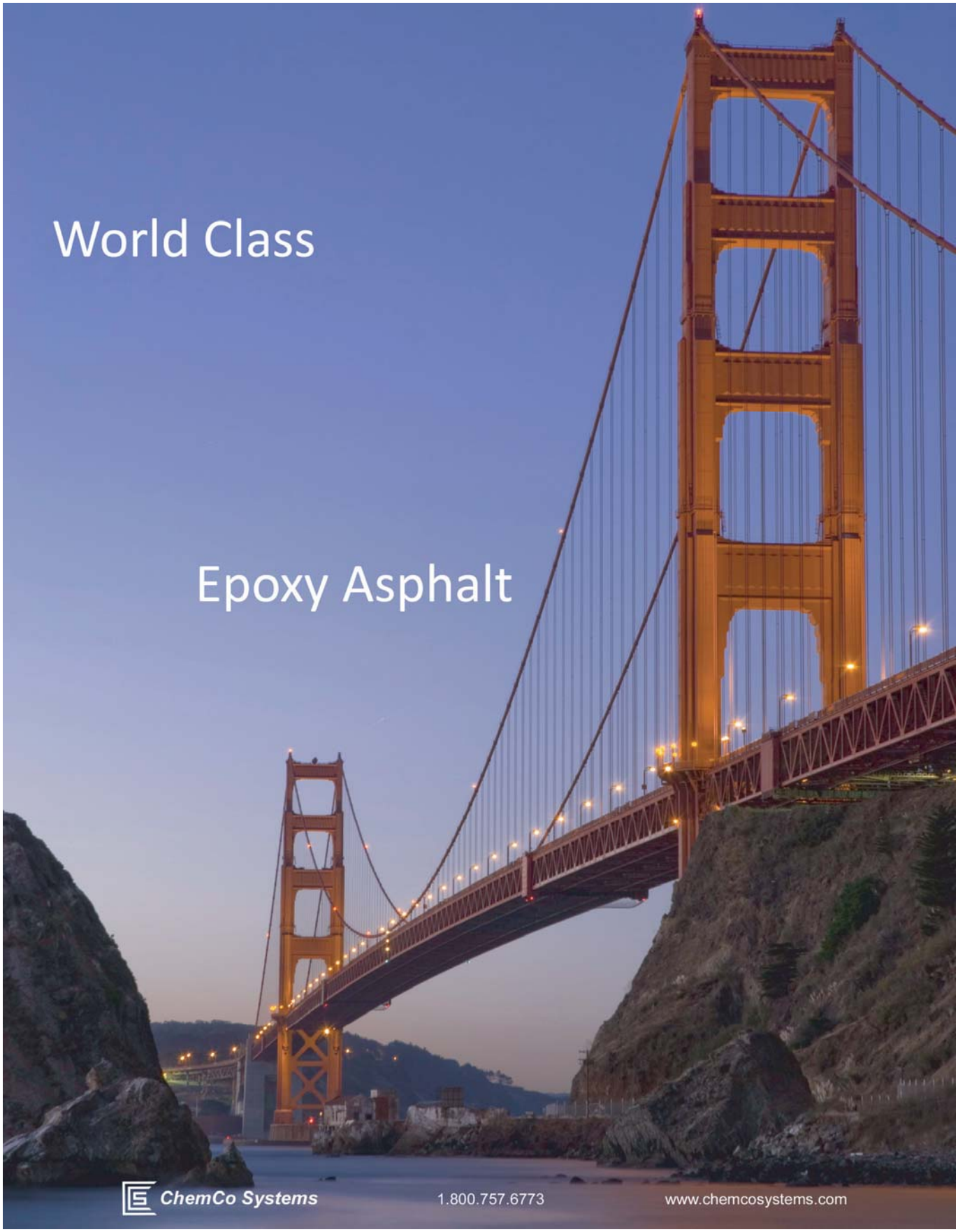
Grand Room Session Chair - *Adam Zofka, Road and Bridge Research Institute, Poland*
Teton Room Session Chair - *Gerald Reinke, MTE Services*

9:40-10:00 a.m.	Teton Room	Evaluation of Pavement Bearing Capacity at Traffic Speed	Adam Zofka, *Road and Bridge Research Institute, Warsaw, Poland*
10:00-10:20 a.m.		~ Break ~	
10:20-10:40 a.m.	Grand Room	Bayesian Performance Model for the Libyan National Road Network Without an Initial Database on Its Condition Based on Expert's Knowledge	Abdussalam Heba & Gabriel J. Assaf, *Ecole de Technologie Supérieure, Montreal, Canada*
	Teton Room	Performance and Service Life for Advanced Repair Method Utilizing Expecting Reflection Crack Delay Effect	Michito Konno, Takahiro Mizuno & Masaru Shimazaki, *Taisei Rotec Corporation, Saitama, Japan*
10:45-11:05 a.m.	Grand Room	Performance Evaluation of Open-Graded Epoxy Asphalt Concrete with Different Nominal Maximum Aggregate Sizes	Sang Luo, Zhen-dong Qian & Jing Din, *Southeast University, Nanjing, China*
	Teton Room	Impact of Hydrated Lime on Cracking Performance of Asphalt Mixtures	Jian Zou, Reynaldo Roque, Bongsuk Park & George Lopp, *University of Florida, USA*

Thursday, July 21 (continued)

SESSION 12 Pavement Performance Testing and Evaluation (continued)

11:10-11:30 a.m.	Grand Room	Performance Control of Asphalt Mixes with a High Rap Content	Frédéric Delfosse, Ivan Drouadaine, Stéphane Faucon-Dumont, Sabine Largeaud & Jacques-Antoine Decamps, *Eurovia Research Centre, Mérignac, France*
	Teton Room	Effects of Axle Load Spectra on Fatigue Cracking Performance of Flexible Pavements	Yared H. Dinegdae, *KTH Royal Institute of Technology, Stockholm, Sweden;* Björn Birgisson, *Aston University, Birmingham, UK*
11:35-11:55 a.m.	Grand Room	Pavement Performance Evaluations Using Connected Vehicles	Raj Bridgelall & Denver D. Tolliver, *Upper Great Plains Transportation Institute, North Dakota State University, USA;* Md Tahmidur Rahman & Jerome F. Daleiden, *Fugro Roadware Inc., Texas, USA*
	Teton Room	Performance Evaluation of High-Elastic Asphalt Mixture Containing Deicing Agent Mafilon	Sang Luo, *Southeast University, Nanjing, China;* Xu Yang, *Michigan Technological University, USA*
12:00-12:15 p.m.		~ Closing Remarks ~ *Jean-Pascal Planche, Western Research Institute*	Grand Room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Tuesday, July 19

PETERSEN ASPHALT RESEARCH CONFERENCE TECHNICAL SESSIONS - SNOW KING HOTEL

SESSION I **Session Chair - *Troy Pauli, Western Research Institute***

4:35-4:55 p.m.	Teton Room	Heterogeneous Simulation of Self-Heating in Asphalt Mixes	Ebrahim Riahi, Fateh Tehrani, Fatima Allou, Laurent Ulmet, Frédéric DuBois & Chrisophe Petit, *Université de Limoges, Egletons, France;* Joseph Absi, *Université de Limoges, Limoges, France;*
5:00-5:20 p.m.	Teton Room	Rheology and Proper Use of DSR Reference Fluid	David A. Anderson, John Casola & Chuck Rohn, *Consultants, USA*

Tuesday Evening ~ Dinner on Your Own ~

Wednesday, July 20

7:00-8:00 a.m.	Registration and Continental Breakfast	Grand View Lodge
8:00-8:45 a.m.	Plenary Session *Dallas Little - Keynote Speaker* *Texas A&M University*	Grand View Lodge Ballroom

PETERSEN ASPHALT RESEARCH CONFERENCE TECHNICAL SESSIONS - SNOW KING HOTEL

SESSION 2 **Session Chair - *Joe Rovani, Western Research Institute***

9:00-9:20 a.m.	Teton Room	Effect of Grind Type on RAS Binder Properties and Activation	J. Richard Willis, Paul Ideker, Kyle Watts & Kevin Hardee, *National Center for Asphalt Technology, Auburn, Alabama, USA*
9:25-9:45 a.m.	Teton Room	Influence of Oxidative Aging on Microstructural and Chemical Properties of Asphalt	Jose P. Aguiar-Moya, Alejandra Baldi-Sevilla, Jorge Salazar-Delgado, Rafael Villegas-Villegas & Luis LorÃa-Salazar, *University of Costa Rica, San Pedro, Costa Rica*
9:50-10:10 a.m.	Teton Room	Evaluation of Asphalt Mixture Strength on Small and Large Specimens at Low Temperature	Augusto Cannone Falchetto & Ki Hoon Moon, *Pavement Engineering Centre, Technische Universität Braunschweig, Braunschweig, Germany*
10:10-10:30 a.m.		~ Break ~	

Wednesday, July 20 (continued)

SESSION 3 **Session Chair - *Tom Scarpas, Delft University of Technology***

10:30-10:50 a.m.	Teton Room	Case Study: Heavier Vehicles and Modified Asphalt Evaluation in Sweden	Anders Gudmarsson, Torsten Nordgren & Mats Wendel, *Peab Asfalt AB, Swedish Transport Administration*
10:55-11:15 a.m.	Teton Room	Characterization of Aggregate-Mastic Interface Though Nanoindentation Test: A Feasible Way to Determine Blending Efficiency of RAP?	Minghui Gong, Zeheng Yao & Jun Yang, *Purdue University, West Lafayette, Indiana, USA*
11:20-11:40 a.m.	Teton Room	Effect of Aging on Embrittlement of Asphalt Binders	Raj Dongre, *Dongre Laboratory Services Inc., Fairfax, Virginia, USA*
11:40 a.m.-1:00 p.m.		~ Lunch ~	Grand View Lodge

SESSION 4 **Session Chair - *Troy Pauli, Western Research Institute***

1:00-1:20 p.m.	Teton Room	Asphalt Re-Recycling	Pavel Kriz, *Imperial Oil, Sarnia, Canada*
1:25-1:45 p.m.	Teton Room	Remote Highway Survey and Extraction of Geometrical and Physical Features	Blas Melissari, *b3consultants, Montevideo, Uruguay*
1:50-2:10 p.m.	Teton Room	Rheological Characterization of Bitumen-Filler Mastics	Denis Jelagin, Mohammed H. & Larsson P.-L., *KTH, Stockholm, Sweden;* Lu, X., *Nynas Bitumen, Sweden*
2:15-2:35 p.m.	Teton Room	Variability in J_{nr} Difference Value Obtained in the AASHTO T 332 MSCR Test - Cause and Implications	Raj Dongre, *Dongre Laboratory Services Inc., Fairfax, Virginia, USA*
2:40-3:00 p.m.	Teton Room	Examination of the Magnitude and Range of the Low Temperature Delta T_c of Paving Asphalt Binders Used in the United States	Jack Youtcheff & Raj Dongre, *Federal Highway Administration, Virginia, USA*
3:00-3:20 p.m.		~ Break ~	

Wednesday, July 20 (continued)

SESSION 5 **Session Chair - *Nam Tran, National Center for Asphalt Technology***

3:20-3:40 p.m.	Teton Room	Hot Mix Asphalt Research for Airport Pavements at Federal Aviation Administration	Navneet Garg, *Federal Aviation Administration, Atlantic City, NJ, USA*
3:45-4:05 p.m.	Teton Room	Tracking Ageing of Bitumen and its SARA Fractions Using High-Field FT-ICR Mass Spectrometry	Hinrich Grothe, Florian Handle, Mourad Harir, Josef Fuessl, Ayse N. Koyun, Daniel Grossegger, Norbert Hertkorn, Lukas Eberhardsteiner, Bernhard Hofko, Markus Hospodka, Ronald Blab & Philippe Schmitt-Kopplin, *Vienna University of Technology, Vienna, Austria*
4:10-4:30 p.m.	Teton Room	A New Preservation Technology for Porous Asphalt - An Innovative, Multi-Modal, Biopolymer Stabilized, Cationic Asphalt Emulsions	Bert Jan Lommerts, Jan Struik, Irina Cotiugă & Gerbert van Bochove, *Latexfalt, Koudekerk aan den Rijn, the Netherlands*
4:35-4:55 p.m.	Teton Room	A Quantitative Method for Determining the Adhesive versus Cohesive Failure in Asphalt Mixtures Moisture Conditioned Using the Moisture Induced Stress Tester (MIST)	Andrew LaCroix, Ali Regimand, Christopher Bacchi & Akhtarhusein Tayebali, *InstroTek, Inc., Raleigh, North Carolina, USA*
5:45-8:00 p.m.		~ Social Hour & Chuckwagon Dinner ~	Teton County Fairgrounds
8:00-10:00 p.m.		~ Rodeo ~	Teton County Fairgrounds

2016 Petersen Asphalt Research Conference
Abstracts

Tuesday, July 19

Session 1

Heterogeneous Simulation of Self-Heating in Asphalt Mixes

E. Riahi[(1)], F. Tehrani[(1)], F. Allou[(1)], L. Ulmet[(1)], J. Absi[(2)], F. Dubois[(1)], C. Petit[(1)]

[(1)]Université de Limoges, GEMH, EA 3178, F-19300 Egletons, France,
[(2)]Université de Limoges, SPCTS, F-87068 Limoges, France, ebrahim.riahi@unilim.fr

Keywords: Heterogeneous simulation, Dissipated energy, Viscoelasticity, Self-heating.

Abstract:
This paper presents a heterogeneous approach by separating viscoelastic bituminous matrix and elastic aggregates to study thermomechanical behavior of asphalt concrete. This way allows a better understanding of different processes such as the thermal dissipation due to viscoelastic properties, its thermo-sensibility and its capacity to develop a source of self-heating and the heat diffusion through aggregates.

Using a heterogeneous finite element model, this work proposes the simulation of a mechanical cyclic loading test by taking into account internal thermal evolutions, the matrix stiffness temperature dependence and the process of heat transfer. To consider the effect of temperature variation on mechanical properties of matrix a thermomechanical coupling simulation is used.

The numerical simulation results highlight that the dissipated energy field is strongly influenced by the heterogeneity of material with a high concentration in the thin matrix films. Temperature variations are calculated by considering the heterogeneous dissipated energy field as a source of heat. The result shows that the local temperature variations depend also on thermal properties of each phase and to the aggregates distribution. The effect of test temperature on self-heating and complex modulus variation is studied as well. It is observed that the share of self-heating in complex modulus diminution is influenced by the test temperature.

Rheology and Proper Use of DSR Reference Fluid

David A. Anderson[(1)], John Casola and Chuck Rohn

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DA.SC@COMCAST.NET

Keywords: DSR, Reference Fluid, Verification, Rheology

Abstract:
The AASHTO and ASTM DSR test methods recommend that Cannon Instrument Company Viscosity Standard, Number N2700000SP as a reference fluid for verifying the DSR torque transducer. The Cox-Merz rule is cited as a rationale for converting the viscosity listed on the standard to a dynamic viscosity. Other than frequency, no mention is given of the testing conditions —temperature, strain, or stress — under which the fluid shall be used. While sometimes claimed that the fluid can be used over a wide temperature range, its effective range for the manner in which it is used is between 58°C and 70°C. A detailed rheological analysis of the fluid is presented to verify this range including effects such as machine compliance, self-heating and shear rate dependency. Further, when the fluid is tested in the DSR at a given frequency only three measurements are obtained; frequency, applied torque and angular displacement. The torque and angular displacement are a reflection of the overall response of the rheometer, not just the torque transducer and therefore the reference fluid cannot be used to calibrate or verify the torque transducer. Even so, the reference fluid is a very useful tool and recommendations for its proper use are presented.

Tuesday, July 19

Session 1 (Continued)

Hot Mix Asphalt Research for Airport Pavements at Federal Aviation Administration

Navneet Garg[(1)]

[(1)] Federal Aviation Administration, William J. Hughes Technical Center, Bldg. 296, ANG-E262
Atlantic City, NJ 08405 U.S.A, Navneet.Garg@faa.gov

Keywords: asphalt, full scale APT, perpetual pavement, fatigue, rutting

Abstract:
"The Airport Technology Research and Development Branch, located at the William J. Hughes Technical Center near Atlantic City, New Jersey, support the FAA's mission by conducting the necessary research and development required to ensure the adequacy of engineering specifications and standards in the area of airport pavements and materials and, where necessary, develop data to support new standards. The FAA operates two state-of-the-art, full-scale accelerated pavement test (APT) facilities dedicated solely to airport pavement research - National Airport Pavement Test Facility (NAPTF) and National Airport Pavement & Materials Research Center (NAPMRC). The current hot mix asphalt (HMA) pavement research at NAPTF focuses on perpetual pavements, validation/refinement of asphalt fatigue model based on ratio of dissipated energy change, and overload affects. Full-scale APT at NAPMRC is performed using the Heavy Vehicle Simulator – Airfield Mark-VI (HVS-A). The current research at NAPMRC focuses on the effects of high tire pressures in the HMA surface layer, and testing the performance of greener/sustainable technologies and layer materials (like HMA, WMA, etc.). This presentation provides a brief description of the research facilities, summarizes asphalt pavement research performed to date, and discusses current and future research activities."

Wednesday, July 20

Session 2

Effect of Grind Type on RAS Binder Properties and Activation

J. Richard Willis[(1)], Paul Ideker, Kyle Watts and Kevin Hardee

[(1)]National Center for Asphalt Technology Address 1: 277 Technology Parkway, Auburn Alabama, 36849, willi59@auburn.edu

Keywords: recycled asphalt shingles; mobility; performance grade; energy

Abstract:
Recent research has suggested that two issues commonly affecting recycled asphalt shingles (RAS) mixture performance are grind size and moisture content. When the shingles are not ground fine and have moisture present, asphalt mixtures are produced with clumps of RAS and the binder from the shingle will not mobilize. Recent developments have allowed the industry to produce a finely ground shingle using a dry process. In this study, binder was extracted and recovered from the finely ground shingles and blended with a common PG 64-22 binder at 0, 10, 20, and 30 percent binder replacement. These four binder blends were then evaluated for performance grade, rutting potential using the multiple stress creep recovery test, and fatigue properties via the linear amplitude sweep test. All three tests showed that the RAS binder from the fine, dry ground RAS can perform well. Additionally, differential thermal analysis was conducted on both the fine RAS and a conventional RAS source to determine if the fine, dry RAS asphalt would mobilize more efficiently than conventional RAS. Preliminary results show the fine, dry grind on the RAS requires less energy from the binder to become liquid than required for conventional RAS binders.

Influence of Oxidative Aging on Microstructural and Chemical Properties of Asphalt

Jose P. Aguiar-Moya, Alejandra Baldi-Sevilla[(1)], Jorge Salazar-Delgado, Rafael Villegas-Villegas and Luis LorÃ-a-Salazar

[(1)]Lanamme, University of Costa Rica, San Pedro, 506, Costa Rica, alejandra.baldi@ucr.ac.cr

Keywords: oxidation, adhesion, surface energy, atomic force microscope; asphalt

Abstract:
Oxidation is an unavoidable process that occurs within the asphalt structure, causing significant changes on its chemical composition and physical behavior. To better understand this process, samples of asphalt binder were aged under field conditions for several months: air, temperature, solar radiation and rain. The chemical changes on the binder due to oxidative aging were quantified by means of surface energy measurements, allowing the quantification of changes in polarity related to oxidation. The consequences of these chemical changes on the adhesive properties of the binder were estimated by means of a physicochemical approach. Furthermore, Pulsed Force Mode measurements with an Atomic Force Microscope were performed. This technique allows imaging of elastic, electrostatic and adhesive properties of a material simultaneously with topography. The results associated to the material after field aging was also compared to those of binders aged according to Superpave specifications (RTFO+PAV). Consequently, the study looks to relate the chemical changes during oxidation to the changes in surface energy and micromechanical response of binders. The results allow for a better understanding of changes in adhesive properties of asphalt binders due to oxidative aging and its relation to the final performance of binder during its service life.

Session 2 (Continued)

Evaluation of Asphalt Mixture Strength on Small and Large Specimens at Low Temperature

Augusto Cannone Falchetto[(1)] and Ki Hoon Moon[(2)]

[(1)]Department of Civil Engineering, Pavement Engineering Centre, ISBS, Technische Universität Braunschweig, Beethovenstraße 51 b, Braunschweig, 38106, Germany, a.cannone-falchetto@tu-bs.de

[(2)]Korea Expressway Corporation, Pavement Research Division, Dongtan-myeon, Hwaseong-si Gyeonggi-do, 445-812, South Korea

Keywords: Asphalt mixture; Size effect, Bending beam rheometer, Indirect tensile test, Direct tension test.

Abstract:
Accurate assessment of fracture properties of asphalt mixture is of great importance for ensuring satisfactory performance of road infrastructures. Indirect Tensile (IDT) and Direct Tension (DT) tests are conventionally used to obtain the strength properties of asphalt mixture at low temperature; however, these tests require the use of larger servo-hydraulic machine which are not commonly available to many laboratories. In this research, a simplified approach, based on size effect theory, is used to extrapolate the strength on small asphalt mixture beams obtained with a modified bending beam rheometer (BBR). First, IDT, DT and BBR strength tests are performed on a set of mixtures and the reliability of the measurements on small beams is evaluated. The effect of temperature, conditioning time and loading rate on the measured strength is then addressed for a limited number of mixtures. Finally, IDT, DT and BBR tests are performed at three different temperatures on eight mixtures and the strength results are initially found to be statistically different. The results are then transformed to take into account specimen size and testing configuration based on the weakest link model. In this case, the statistical analysis indicates that BBR strength measurements are similar to the values obtained with IDT.

Session 3

Case Study: Heavier Vehicles and Modified Asphalt Evaluation in Sweden

Anders Gudmarsson[(1)], and Torsten Nordgren[(2)] Mats Wendel[(1)],

[(1)]Peab Asfalt AB, Box 145 Marsta, 195 23 Sweden, mats.wendel@peab.se
[(2)]Swedish Transport Administration

Keywords: PMB, design, pavement, binder, testing

Abstract:
New challenges emerge on the Swedish road network due to increasing gross weight of heavy vehicles and increased traffic volumes. At the same time there is a will to reduce pavement thickness to save materials, energy and costs. This requires use of modern materials with improved performance to meet the new challenges in pavement design.

A full scale test section of approximately 2 km, 2200 yds, was built on a Swedish highway to evaluate the potential of new designs to reduce pavement thickness. This paper presents results from the initial binder, mix and field testing of the different materials and the pavement construction. A good correlation between the mix and binder testing is seen in the comparative study between the different materials. The results indicate that field evaluation methods based on conventional designs should not be used for new materials and designs. Furthermore, complex shear modulus (G*) DSR testing and complex modulus (E*) modal testing of the highly modified binders and mixtures, respectively, shows different capabilities of constructing master curves with good accuracy.

It is anticipated that the highly modified asphalt with reduced thickness will perform as the conventional test section. This assumption is strengthened from NCAT experience of the same asphalt binder.

Session 3 (Continued)

Characterization of Aggregate-Mastic Interface Though Nanoindentation Test: A Feasible Way to Determine Blending Efficiency of RAP?

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Keywords: RAP; blending efficiency; nanoindentation test

Abstract:
The topic regarding blending efficiency of RAP (Recycled asphalt pavement) is widely discussed in various literatures. However, the issue of determining blending efficiency is not well addressed due to the small scale of blending zone and limitation of equipment which is able to conduct tests at micro scale. This study presents a methodology to measure mechanical property of aggregate-mastic interface at micro scale using nanoindentation test. Results show that obtained Young's modulus increase gradually as indentation sites move from mastic phase to interface zone, and ultimately to aggregate phase. Theoretically, blending RAP with virgin asphalt/rejuvenator would decrease modulus value of RAP's mastic phase as well as interface zone, which can be well captured by nanoindentation test. In this way, blending efficiency can be obtained without introducing any unpredictable effects from chemical solutions (e.g. extraction method).

Effect of Aging on Embrittlement of Asphalt Binders

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Keywords: embrittlement, Aging of asphalt binders, PAV aging

Abstract:
Asphalt Binders have been observed to deteriorate with time during service. This phenomenon is popularly known as aging related embrittlement. In the PG grading system the PAV is used to simulate this aging related embrittlement. The aging induced in the PAV is cited generally as simulating 5 to 8 years of in-service embrittlement. Recently the extent of embrittlement induced in the PAV has been questioned and some say that it may only correspond to 3 years of in-service aging. Also, the growing use of REOB has generated interest in changing the PAV aging time from 20 h to 40 h in hopes of doubling the amount of induced aging.

In 2010, Dongre and Marasteanu had shown data at the Peterson conference suggesting that the PAV aging (20h) may not induce the desired embrittlement at all. But rather it improves the failure properties of some asphalt binders that are being regularly used. In the current study, Dongre, is investigating the effect of 40 h aging time on embrittlement. Several commercially used unmodified and modified bitumen are included in the study. The early analysis of the available data suggests that the improvement in embrittlement continues with the additional 20 h of induced aging in the PAV (40h PAV).

One possible reason for this surprising results seen with PAV aging and embrittlement may be that the pressure and temperature used in the PAV may actually enhance the internal structure of the asphalt binder in addition to making it stiffer (increased viscosity). This has always occurred but never noticed since all efforts during SHRP and its follow up concentrated on assuming that increase in stiffness indicated brittleness. This may not be so in realty when embrittlement is studied using the failure strength and failure strain data. The DTT was used to obtain the embrittlement data.

Session 4

Asphalt Re-Recycling

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Keywords: RAP, Re-Recycling

Abstract:
Asphalt recycling received a lot of attention in a variety of studies both in the laboratory and in the field. In upcoming decades the recycling of previously recycled pavements (re-recycling) will become wide spread. There is currently little scientific knowledge on how and how many times the asphalt pavement can be recycled while sustaining its expected durability.

The current submission will present results of laboratory study. Three different asphalts were subjected to harsh aging in weather-o-meter to simulate field aging as best as possible. Subsequently these artificial RAPs were softened with 75% of virgin binder and subjected to another aging step. This was repeated four times to simulate four times recycled pavement. After the each cycle, the aged and the softened binders were subjected to detailed rheological and chemical assessment. Initial data indicate changes in molecular make-up and binder rheology, nevertheless demonstrate that multiple recycling is feasible under certain conditions and support sustainability of the current practice in upcoming decades.

Remote Highway Survey and Extraction of Geometrical and Physical Features

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Keywords: road survey; remote sensing; data analysis; automatic extraction

Abstract:
The focus of this study is to characterize the capability of existing methods for collecting highway inventory data vital to the evaluation of roads. These methods are evaluated in terms of precision, ease of implementation and cost-benefit analyses.

Furthermore, the present work presents an actual validation of the methodology, based on the data analysis of our own high resolution aerial images. The processing of the data extracted from the drone yields a 3D model of the road and its surroundings with a complete topographic information set, enabling a way of visualizing the whole road interactively from a computer terminal. This topographical data coupled with the actual RGB images are further processed by an in-house computational system in order to extract the geometrical features sought like slopes, ditches, road markings, potholes.

Image processing of aerial imagery is a cost effective and practical approach for the acquisition and analysis of road information, enabling the study of areas beyond the immediate surroundings. The acquired information is significant on many aspects such as road maintenance, reconstruction, survey, landscape design, visualized modelling and highway hazard supervision and prevention.

Session 4 (Continued)

Rheological Characterization of Bitumen-Filler Mastics

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Keywords: Instrumented indentation test; bitumen; bitumen-filler mastics; viscoelasticity

Abstract:
Rheological and adhesive properties of bitumen-filler mastics control to a great extent the performance of asphalt mixtures in the field, in particular with respect to their durability, rutting resistance and fatigue performance. Instrumented indentation allows measuring the mechanical properties of bitumen-based materials at length scales representative for the materials morphology in the asphalt mixture and provides a useful tool to monitor materials evolution due to temperature, oxidation and moisture.

In the present study, a novel indentation test suitable to measure two independent viscoelastic functions of bitumen and bitumen-filler mastics is developed. In order to examine the effects of to verify the method proposed and to evaluate the effect of testing parameters on the measurements results, indentation test on bitumen are modeled numerically. Based on the modeling outcomes, optimal testing configurations are identified.

The developed method is validated experimentally with the measurements performed on Polyoxymethylene (POM) samples. The method is then used for viscoelastic characterization of bitumen and bitumen-filler mastics samples and the obtained results are compared with the dynamic shear rheometer measurements. Furthermore, the linearity range for the instrumented indentation test is identified based on comparative indentation tests are performed at different stress levels.

Variability in J_{nr} Difference Value Obtained in the AASHTO T 332 MSCR Test – Cause and Implications

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Keywords: J_{nr} Difference, MSCR Specification, Asphalt Binder

Abstract:
The variability in J_{nr} difference value was identified as one of the impediments in implementation of the MSCR specification (AASHTO M 350) in US wide survey recently conducted by Dongre. The Jnr difference is defined as the percent difference in Jnr values at 0.1 kPa and 3.2 kPa obtained in the MSCR test. This value is limited to 75% or lower in the AASHTO M 350 specification. However, for asphalt binders with a low J_{nr} value at 3.2 kPa (0.5 and lower) with an associated high percent recovery value (60% and higher) it has been reported that typically the Jnr difference value is significantly higher than the 75% minimum required. D'Angelo has recently suggested that the possible cause of this maybe the high rebound experienced by the sample upon recovery during the test. D'Angelo has also discussed that this is possibility due to high levels of elastomers used in some PG binders formulated for the V and higher MSCR performance category.

A study was conducted to investigate and possibly add to Jnr difference observations made by D'Angelo and others. Several asphalt binders with various J_{nr} difference values were tested using the MSCR. While early data show support for D'Angleo's suggestions, it also may point to other explanations. In this presentation the concept behind J_{nr} difference and cause and implications of its variability will be discussed.

Session 4 (Continued)

Examination of the Magnitude and Range of the Low Temperature Delta T_c of Paving Asphalt Binders Used in the United States

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Keywords: S and m-value, delta T_c, low temperature performance

Abstract:
Low temperature performance of asphalt pavements has been shown to be related to critical temperature difference, delta T_c, value of the asphalt binders. Delta T_c ($T_{c,S}$ - $T_{c,m}$ = delta T_c) is defined as the difference in the calculated critical temperatures of the S(60) (Tcs at S(60) =300 MPa) and the m-value (Tcm at m-value = 0.300) parameters obtained from the BBR test used in the PG grading system. There is a lot of ongoing discussions in the asphalt binder research community about determining ways to incorporate the delta Tc in the PG binder specification. Of particular concern are asphalt binders that have a large (> 6 degree C) delta Tc value. The high delta T_c is a result of the BBR specification criterion adopted in the PG grading system. In the PG grading system the S(60) value has no lower limit (0 to 300 MPa is allowed) and the m-value has minimum limit of 0.300. What is needed is an understanding of the extent of the magnitude and range of delta T_c that is being used in the US and the associated low temperature performance where available.

In this study FHWA used the following approach to achieve that. Delta T_c data was determined using verification data obtained from a number of State Dots covering a range of paving seasons. From this data set delta T_c values are being determined. Early analysis of data available from a few State DOTs suggests that a baseline for the S(60) value may be extracted for possible future use in the PG grading improvements for better low temperature performance.

Session 5

Rutting of Asphalt Concrete Pavement by Repetitive Shear Deformations Under Heavy Vehicle Loading

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Keywords: Flexible pavement; Permanent deformation; heavy vehicle; PEDRO

Abstract:
Rutting in bituminous layers is one of a main distress that has an impact on pavement performance. Rutting gradually increases with repeated loading from heavy traffic. Rheological characteristics of asphalt concrete materials have a significant influence on rut resistance of asphalt concrete layers. A reasonable interpretation of vehicle loading and asphalt concrete properties are essential n prediction of rut formation in flexible pavement surfaces using mechanical pavement design approaches. The interpretation of traffic data regarding axle load, single or dual wheels, tire-pavement contact stresses, vehicle speed and lateral wander have a significant influence on the accuracy of rut prediction. The rheological properties of asphalt mixes are determined using a recently developed shear box for determining the dynamic shear modulus and phase angle of mixes. The objective of this study is to evaluate the resistance of asphalt mixes and the influence of traffic loading on rut estimation using a linear viscoelastic approach called PEDRO (http://www.vti.se/PEDRO) for predicting both the compressibility and shear deformation of asphalt layers under field-like conditions. The results indicate that the adopted procedure is effective for a reasonable evaluation of bituminous mixtures and rut development, as well as to quantify the influence of vehicle variables on rut formation.

Tracking Ageing of Asphalt Binder and Its SARA Fractions Using High-Field FT-ICR Mass Spectrometry

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Keywords: Asphalt binder; SARA fractions; ageing; FT-ICR-MS

Abstract:
Asphalt binder is a widely used material, but its ageing behavior is only understood at a macroscopic level as hardening and embrittlement over time. To assess asphalt binder ageing behavior on the long run, the pressure ageing vessel (PAV) testing procedure was developed. However, this procedure has not been understood on a molecular level yet. Here, a binder sample and its SARA fractions were investigated in comparison with their aged samples to study changes of their chemical compositions using high-field FT-ICR-MS. The effect of ageing was followed using aromaticity equivalent, double bond equivalent and van Krevelen plots. It was found that ageing induces reduction of condensed aromatic compounds to alicyclic and open-chain aliphatic compounds, while small aromatic compounds have been found to be relatively stable. Abundant alterations were detected in unaged binder. These changes can be assigned to resins and asphaltenes. Overall, alterations of highly condensed compounds were found to be ageing in a related way. Furthermore, CHO, CHNO and CHOS molecular compositions were more susceptible to oxygenation in aromatics, resins and asphaltenes as compared to saturates. In addition, molecular changes in asphaltenes showed significant difference from classical assessment with high content of condensed aromatic compounds.

Session 5 (Continued)

A New Preservation Technology for Porous Asphalt - An Innovative, Multi-Modal, Biopolymer Stabilized, Cationic Asphalt Emulsions

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Abstract:
A new modified biopolymer additive, designated as MAGIC Y, significantly improves the storage stability and workability of asphalt emulsions having a penetration ranging from 5 – 220 mm/10. Using this technology, storage stable and good workable emulsions can be produced having various functional properties. For the preservation of open graded asphalt roads a multi-modal emulsion has been developed, which can be sprayed onto the road surface using standard spraying equipment. The fast breaking emulsion is subsequently forced into the open graded structure by an air flow, whereby the internal surface is recoated, existing bonds between the aggregates are rejuvenated and new bonds are created. The multi-modal emulsion combines various functional properties, viz., [1] good wetting of the internal structure of the open graded asphalt, [2] rejuvenation of oxidized and aged asphalt and [3] replenishment of asphalt to create new bonds and to reinforce the pavement structure. After the application of the emulsion the road is slightly sanded in order to meet the required anti-skid performance for 120 km/hr roads, i.e.,, a minimum deceleration of 5.2 m/s2 at an initial speed of 80 km/hr. Tests conducted over the last three years at the A6, A50, A73, A30, A1 have proven that stone loss has been significantly reduced and the service life of the road is expected to increase with at least 4 years. Furthermore, damage, i.e.,, stone loss during wintertime, is almost negligibly small in comparison to untreated parts of the open graded roads. It is expected that frequent preservation, for example every 4 years, might even extend the service life of the road with a factor close to 2.

Via open innovation between various parties and stakeholders, viz., the Dutch Road Authorities [Rijkswaterstaat], universities, contractors and emulsion producers, this new technology has been evaluated in great detail. New analysis techniques like the RSAT tests [harsh wheel abrasion test], new microscopy tools and also more classical means of analyses have been performed on over 150 asphalt cores of the abovementioned highways, and the studies have corroborated that this technology will result in the predicted service life increase. The Dutch Road authorities have released the technology for application on Dutch asphalt roads and at present the impact on their current renovation plans, i.e.,, relay of top layers, are scrutinized. In view of the tangible successes and the obvious superior economics, various commercial jobs will already be issued in order to keep the momentum in the commercial implementation of this new preservation technology.

A Quantitative Method for Determining the Adhesive versus Cohesive Failure in Asphalt Mixtures Moisture Conditioned Using the Moisture Induced Stress Tester (MIST)

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Keywords: moisture damage; cohesion; adhesion; colorimetry; binder compatibility

Abstract:
Currently the sensitivity of asphalt mixture to moisture damage is evaluated using the tensile strength ratio (TSR) and the severity of stripping (loss of adhesion) using visual subjective observation. The challenge with the subjective visual stripping is that it is a qualitative operator dependent method and hard to define precisely. A recent development using a colorimetric device, the AT-I Asphalt/Aggregate Compatibility Test based on precise color measurement, can be used to objectively quantify the degree of loss of adhesion between asphalt and aggregate. This measurement methodology enables the separation of damage due to adhesion loss versus the cohesive damage caused by moisture in asphalt mixtures. In the Moisture Induced Stress Tester (MIST) conditioning process (ASTM D7870), it is now possible to study more in depth the relative contribution of the adhesion versus the cohesion failure. The objective of this presentation is to provide a conceptual methodology with test results that differentiate the contribution of adhesive versus cohesive failure in asphalt mixtures moisture conditioned using the MIST device.

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