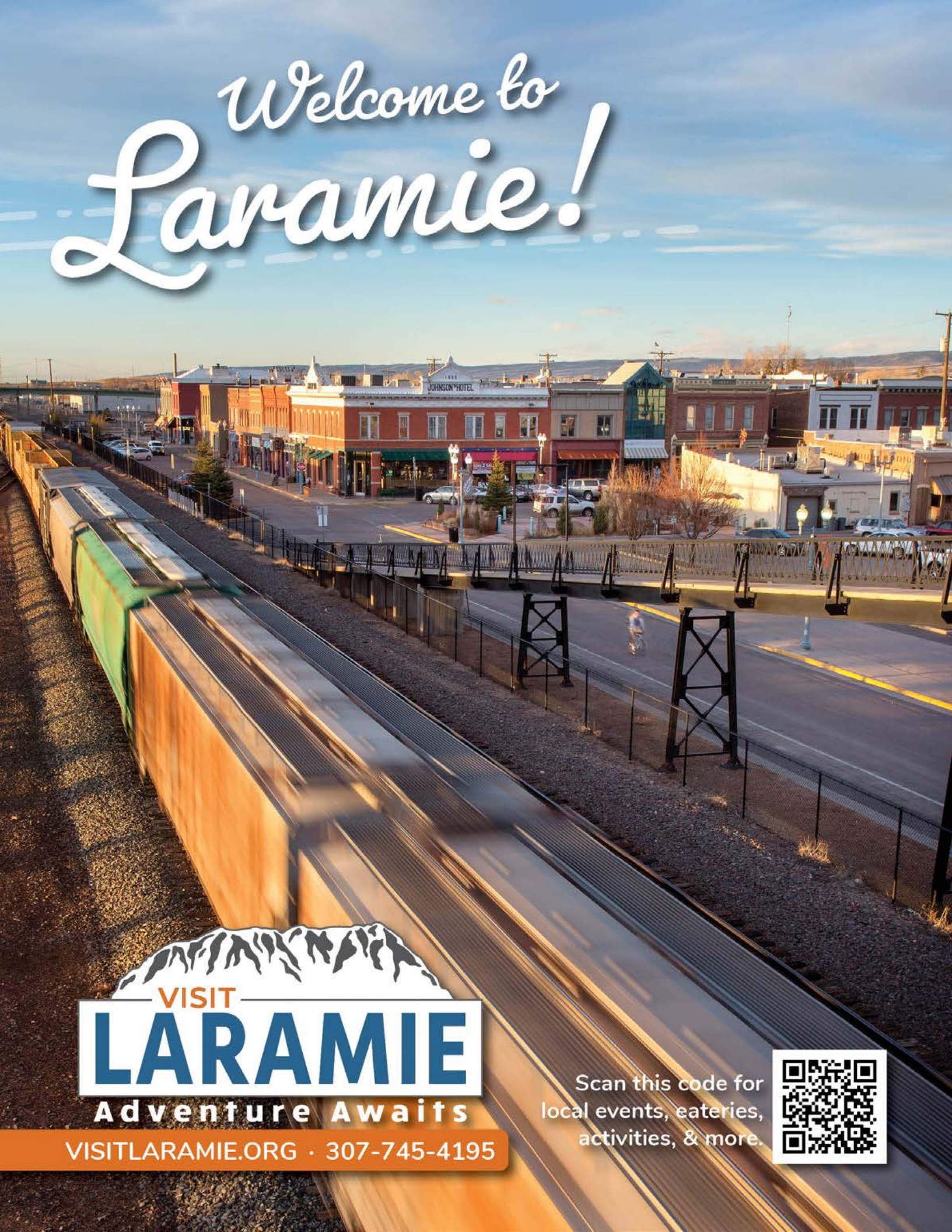
60TH PETERSEN ASPHALT RESEARCH CONFERENCE

MONDAY, JULY 17 - THURSDAY, JULY 20, 2023

Western Research INSTITUTE

PETERSENASPHALTCONFERENCE.ORG

TABLE OF CONTENTS


Welcome to
Laramie!
JOHNSON HOTEL
VISIT
LARAMIE
Adventure Awaits
VISITLARAMIE.ORG · 307-745-4195
Scan this code for
local events, eateries,
activities, & more.

WELCOME

Welcome and *Bienvenue* to the Petersen Asphalt Research Conference 2023 (PARC 2023) onsite and online! Can you believe it is the 60th!

Once again, we are very pleased to welcome you in person to the "gem city" of Laramie for this unique event, while still providing this conference remotely online for those who cannot make the trip to Wyoming. From the wealth of abstracts submitted, the number and quality of participants, sponsors, and exhibitors who registered, we are confident this 60th will be THE "grand cru" to remember. Get ready to explore cutting edge ideas and discover new approaches in our field of asphalt materials, as well as to network and reconnect or make new friends.

PARC 60th presenters from across the continent and around the globe will share recent findings. A cross section of students, scientists, engineers, manufacturers, suppliers, and users are exploring new ways to bring research from the lab into production and construction to improve the performance of infrastructure, public, commercial, and residential engineered products for pavements and roofing. We have 38 selected abstracts for oral or poster presentation, in addition to 10 invited presentations spanning across a 2 ½ day format.

For this special 60th event, PARC will set the stage by offering a dedicated session on "Alternative asphalt materials for a net zero future". Invited experts representing most industry stakeholders will share their view on what needs to be done, obstacles and current solutions for developing materials, particularly binders on the route to net zero. This is also the opportunity to look back and into the future through another very special session with invited guests that will give us their perspectives on the legacy and impact of PARC on the asphalt research and the industry.

Naturally, PARC 2023 edition will continue to offer presentations on the session tracks/topics including Asphalt Chemistry; Recycling, Sustainability and Alternative Materials; Rheological and Physical Characterization of Asphalt; Asphalt Aging; and Asphalt Mixtures: Characterization and Evaluation. Home to the University of Wyoming, Laramie enjoys an atmosphere of "thinking out of the box" as the university motto says "The World Needs More Cowboys." This year's conference will further explore fresh ideas and solutions to brace for and embrace new materials, upcycling, circular economy, and environmental impacts.

No matter what, never forget that "Chemistry Matters" as Dr. Claine Petersen, the estimated conference founder, used to say.

Before you leave Laramie make sure to take a moment and experience the beautiful western outdoors. The last afternoon will be partly dedicated to outdoor outings to some nearby mountains – weather dependent. Please register for it (free).

We cannot leave before thanking all sponsors and exhibitors who are helping to make the 60th anniversary of this hybrid conference possible! Your thoughts matter: please be sure to answer the brief survey that you will receive after the conference so that PARC 2024, the 61st will reach another height.

We look forward to interacting with you during PARC 60th ! Thank you for attending!

Jean-Pascal (JP) Planche
Chief Executive Officer
Western Research Institute
Laramie, Wyoming

Thank you
TO OUR PLATINUM SPONSORS

ExxonMobil

Imperial

VISIT LARAMIE

cenovus ENERGY

ExxonMobil

Imperial

Still your **A-team** Now by another name

Husky Asphalt is now Cenovus Asphalt

In 2021, Husky and Cenovus Energy combined to create a stronger, more resilient Canadian energy company. As a result, our Asphalt "A-team" is better than ever. Whether you're working with our dedicated researchers, quality control specialists or responsive sales team, we are committed to building better roads and strengthening relationships.

cenovus ENERGY | Asphalt

Visit: **CenovusAsphalt.com**

Request more information: **asphalt.inquiries@cenovus.com**

Husky is now part of the Cenovus group of companies.

Thank you

TO OUR GOLD SPONSORS

GAF

EIFFAGE

ERGON
Asphalt & Emulsions

paragon
technical services, inc.

Offer infinite wind speed coverage

GAF WINDPROVEN™ INFINITE WIND SPEED PROTECTION ROOFING SYSTEM LIMITED WARRANTY

For more homeowner confidence

Only one roofing system qualifies for WindProven™ — the wind warranty with no maximum wind speed limitation.[1] Just install GAF Shingles with LayerLock™ Technology, plus four required GAF accessory products. Your customer gets outstanding wind coverage, and you get rave reviews. Find out more at **gaf.com/windproven**

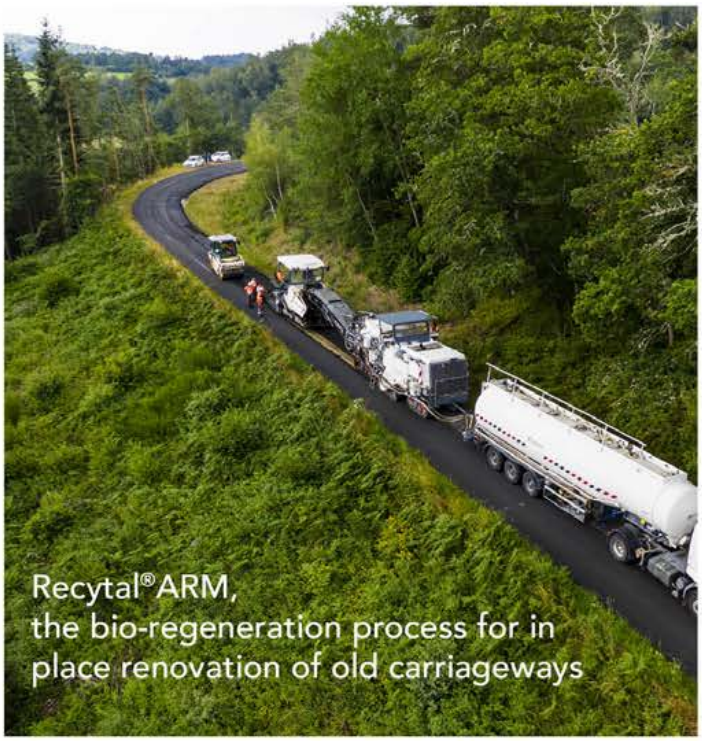
A standard INDUSTRIES COMPANY

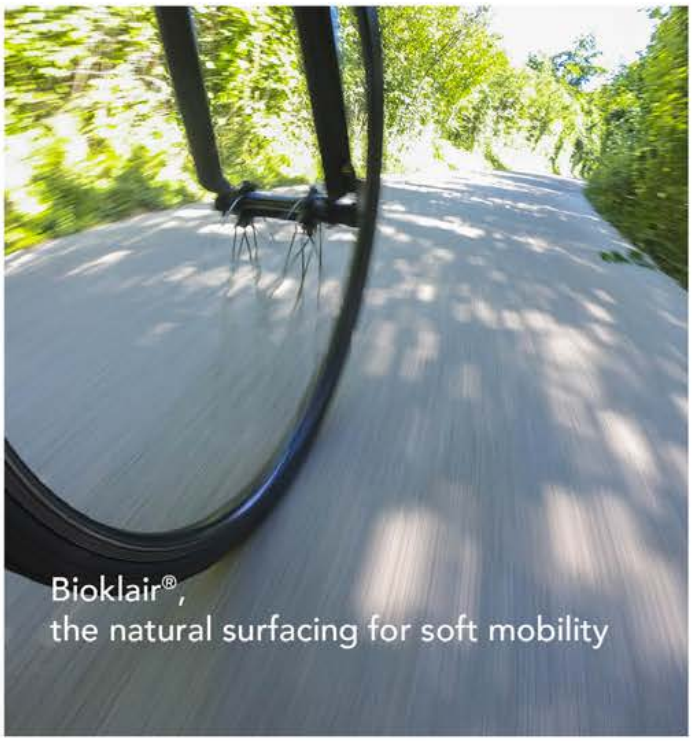
GAF

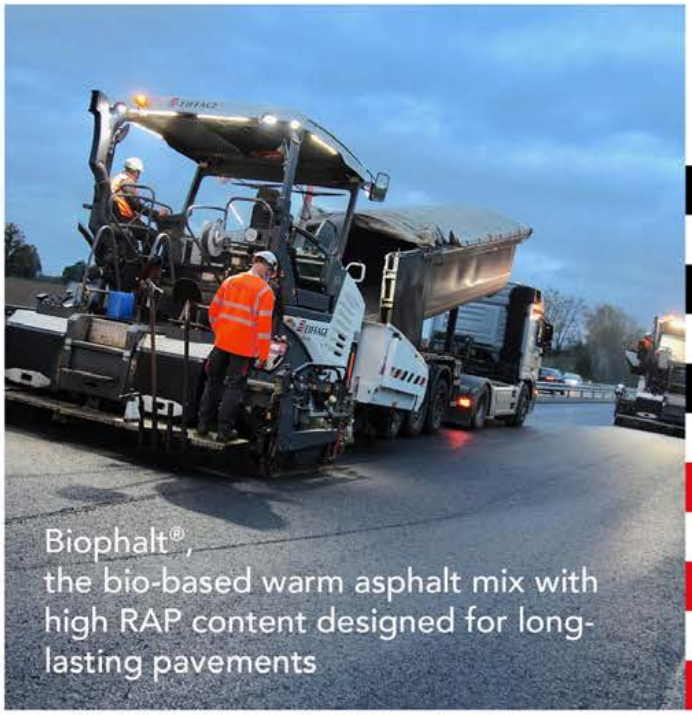
We protect what matters most™

[1] 15-year WindProven™ limited wind warranty on GAF Shingles with LayerLock™ Technology requires the use of GAF Starter Strips, Roof Deck Protection, Ridge Cap Shingles, and Leak Barrier or Attic Ventilation. See *GAF Roofing System Limited Warranty* for complete coverage and restrictions. Visit gaf.com/LRS for qualifying GAF products. For installations not eligible for the GAF Roofing System Limited Warranty, see the *GAF Shingle & Accessory Limited Warranty*.

Developing innovative and responsible solutions for the benefit of all gives meaning to our daily lives.





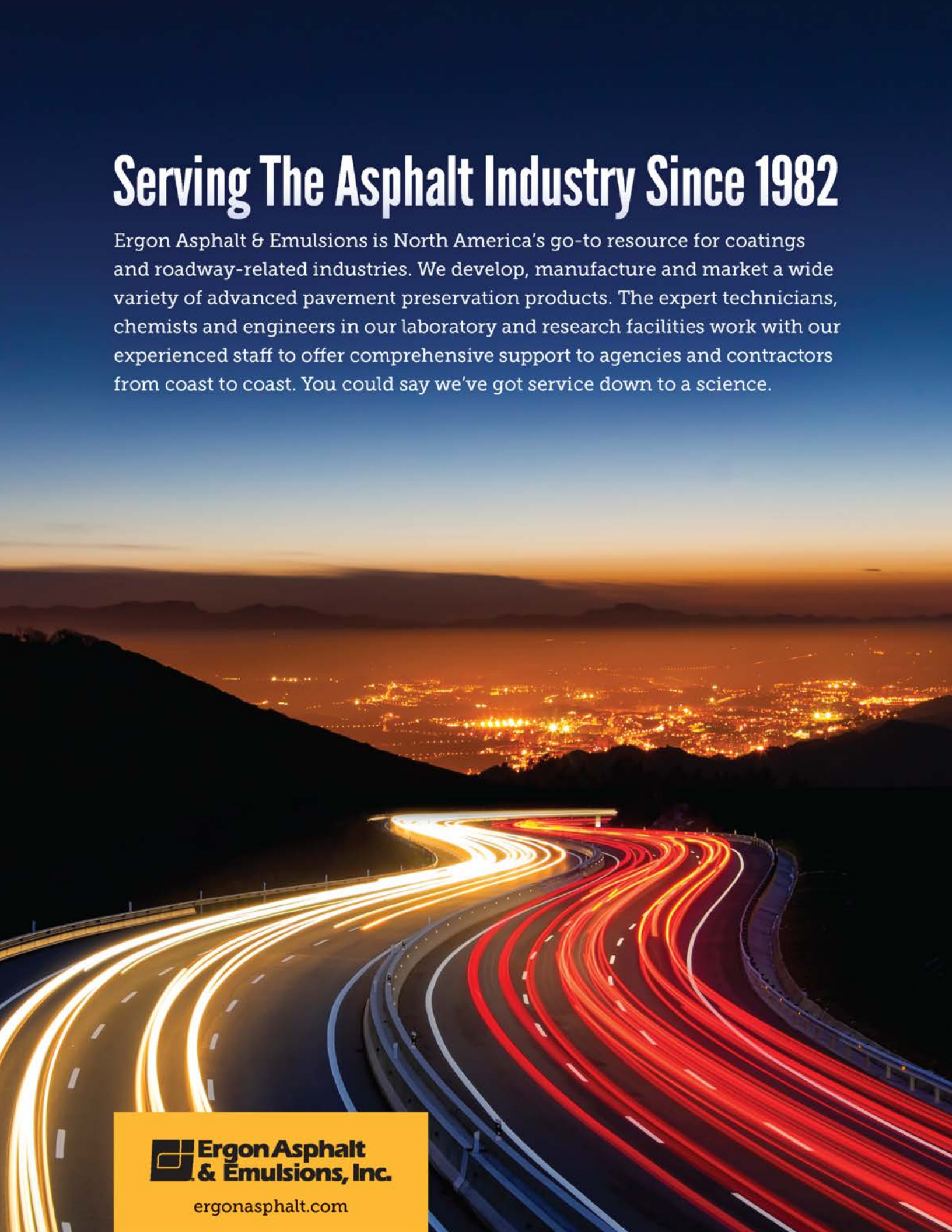


EIFFAGE
ROUTE

www.eiffageroute.com

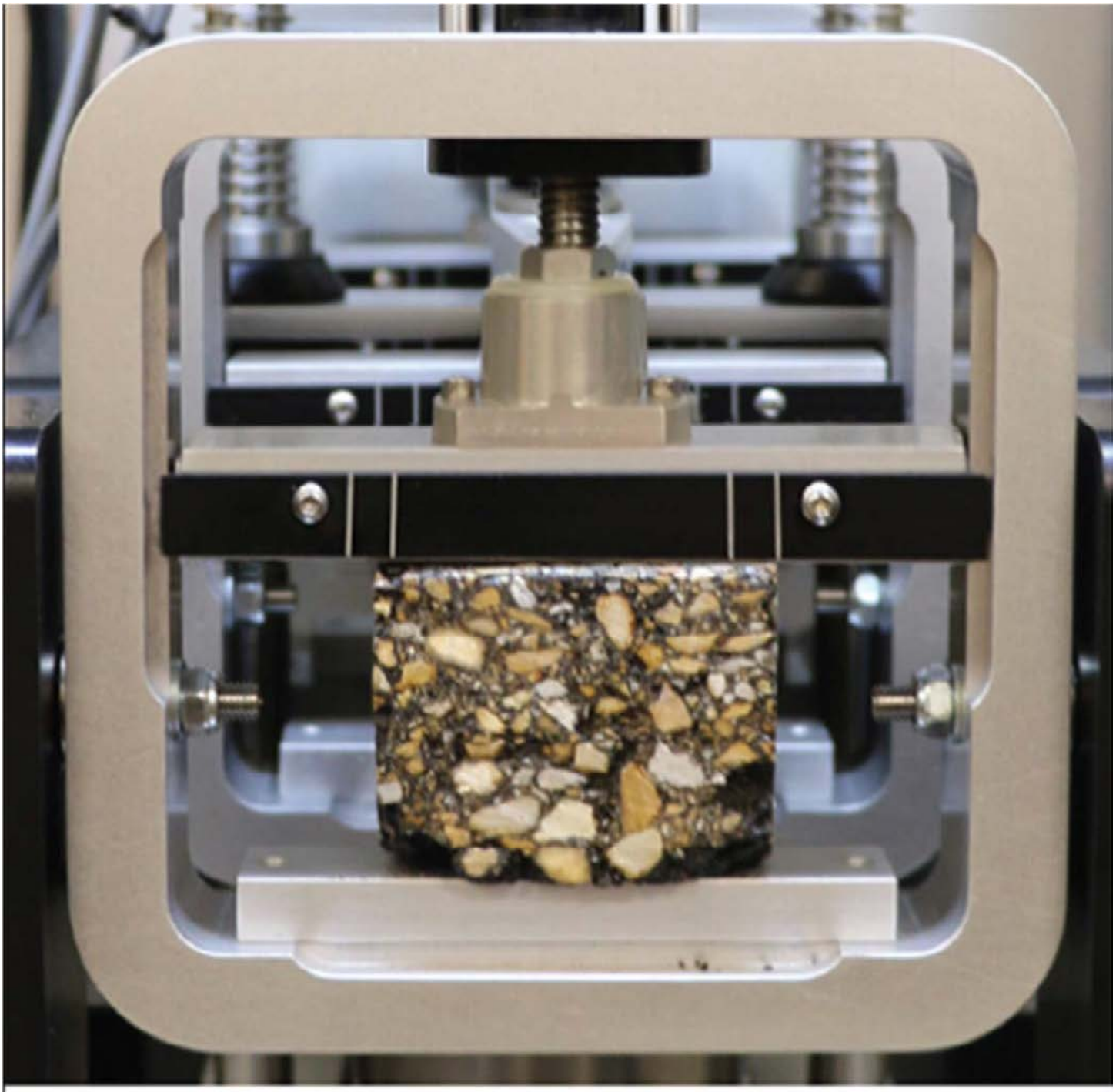
Serving The Asphalt Industry Since 1982

Ergon Asphalt & Emulsions is North America's go-to resource for coatings and roadway-related industries. We develop, manufacture and market a wide variety of advanced pavement preservation products. The expert technicians, chemists and engineers in our laboratory and research facilities work with our experienced staff to offer comprehensive support to agencies and contractors from coast to coast. You could say we've got service down to a science.



Ergon Asphalt & Emulsions, Inc.

ergonasphalt.com



WE DO OUR BEST WORK UNDER PRESSURE.

Whether it's a deadline or PSI, compromising accuracy and consistency is never an option.

paragon
technical services, inc.

ptsilab.com

Thank you

TO OUR SILVER SPONSORS

Innophos

DOW

PRI ASPHALT TECHNOLOGIES

AND BRONZE SPONSORS

OWENS CORNING

Nouryon

HF Sinclair

MC McASPHALT

certainteed SAINT-GOBAIN

SURFACE TECH

ingevity

Thank you

TO OUR LANYARD SPONSOR

Thank you
TO OUR EXHIBITORS

Anton Paar

UW School of Energy Resources

BAKELITE SYNTHETICS

AmSpec

BRUKER

BASF We create chemistry

NETZSCH

infraTest USA

VISIT LARAMIE

Western Research INSTITUTE

Thanks!

FOR SPONSORING OUR WELCOME RECEPTION

NAPA
NATIONAL ASPHALT PAVEMENT ASSOCIATION

BASF
We create chemistry

Thanks!

FOR SPONSORING OUR POSTER RECEPTION

BASF
We create chemistry

Hunt
REFINING COMPANY

CONFERENCE AGENDA

MONDAY, JULY 17

6:00PM	**Welcome Reception:** *University of Wyoming Gateway Center* **Early Registration/Check-in**	

TUESDAY, JULY 18

7:30AM	Registration/Check-in	
8:30AM	Opening Remarks	
8:50AM	**SESSION 1: Decarbonization, Circular Economy, Performance, and Evaluation for a Net Zero Asphalt Future**	Moderator: **Jeramie Adams** *Western Research Institute*
8:50AM	An Overview of Life Cycle Analysis in the Asphalt Industry	**Chait Bhat** *Asphalt Institute*
9:10AM	The DOD's Approach to Mitigating GHG Emissions for Construction Materials and Infrastructure	**Sadie Casillas** *US Army Engineer Research and Development Center*
9:30AM	An Asphalt Producer / Contractor View on a Net Zero Asphalt Future	**Ron Sines** *CRH Americas Materials, Inc.*
9:50AM	Industry Perspective and Expectations for a Net Zero Asphalt Future	**Richard Taylor** *Shell*
10:10AM	Break	
10:40AM	Exploring the Applicability of Conventional Asphalt Tests for Predicting Durability and Recyclability of Alternative Materials: A Step towards Achieving a Net Zero Asphalt Future	**Frédéric Delfosse** *Vinci Construction*

11:00AM	Asphalt Shingles – The Next Several Decades	**Laurand Lewandowski** *Owens Corning Science and Technology*
11:20AM	Net Zero Panel Discussion	
11:45AM	Lunch	
1:00PM	SESSION 2: Case Studies/ Field Performance	Moderator: **Yogesh Kumbargeri** *Western Research Institute*
1:00PM	Design Pavement Structures with Aramid Fiber: Man O War Blvd Case Study *Authors: Phillip Blankenship and Zack McKay*	**Phillip Blankenship** *Blankenship Asphalt Tech and Training, PLLC*
1:30PM	Qualitative Spectral Analysis of New Hampshire Department of Transportation Asphalt Binders - A Case Study *Authors: Satish Belagutti, Asphalt Materials Engineer (FHWA/SES Group & Assoc. LLC); Michael Elwardany, Assistant Professor (Florida State University); and David J. Mensching, Asphalt Materials Research Program Manager (Federal Highway Administration)*	**Satish Belagutti** *FHWA/SES Group & Associates, LLC*
2:00PM	Accelerated Field Performance of a Hybrid B2Last®+SBS Modified Asphalt Pavement *Authors: Nam Tran (NCAT); David Timm (Auburn University); Brian Orr (BASF); and Bernie Malonson (BASF)*	**Nam Tran** *NCAT*
2:30PM	Digitalization and Sensor Technology: Wireless Vertical Temperature Monitoring *Author: Ersun Görener, CEO (InfraTest)*	**Matthias Martus** *InfraTest*
3:00PM	Break	
3:30PM	SESSION 3: Asphalt Additives	Moderator: **Flavian Geisler** *Eiffage Infrastructures*
3:30PM	Development of a New Reactive Isocyanate-Based Modified Asphalt for the Roofing Industry *Authors: Joe Rovani; Yogesh Kumbargeri; Brian Orr (BASF); Patrick Hamilton (BASF); and Bernie Malonson (BASF)*	**Joe Rovani and Yogesh Kumbargeri** *Western Research Institute*
4:00PM	EXPERIMENTAL AND SIMULATION-BASED DESIGN OF SELF-HEALING ASPHALT CAPSULES *Authors: Yujia Lu (UIUC) and Ramez Hajj (UIUC)*	**Yujia Lu** *University of Illinois at Urbana-Champaign*
4:30PM	Poster Session with cocktail	
6:30PM	Dinner on your own	

WEDNESDAY, JULY 19

8:20AM	**SESSION 4: The Legacy and Impact of PARC on Asphalt Research and Industry**	Moderator: **Jack Youtcheff** *Federal Highway Administration*
8:20AM	WRI-PARC: Inspiring Asphalt Chemists for Decades	**Gayle King** *GHK, Inc.*
8:40AM	Legacy and Impact of PARC: A Researcher's Perspective	**David Anderson** *Penn State University, retired*
9:00AM	Soup to Nuts and Quality Asphalt Binder - the PARC Factor	**Gaylon Baumgardner** *Ergon*
9:20AM	From Yesterday to Tomorrow: Forever PARC	**Jean-Pascal Planche** *Western Research Institute*
9:40AM	Open Mic	
10:00AM	Break	
10:00AM	**SESSION 5: Asphalt Chemistry**	Moderator: **Joe Rovani** *Western Research Institute*
10:30AM	Characterization of the Asphaltene Architecture in Asphalt Binders by X-ray Scattering and Assessment of the Colloidal Structure *Authors: Fayçal Lahjiri (Vinci Construction SP); Frédéric Delfosse (Vinci Construction SP); Anne Dony (ESTP Paris); Virginie Mouillet (Cerema Méditerranée); Layella Ziyani (ESTP Paris); Sabine Gazeau (Vinci Construction SP); Philippe Dieudonne-George (Université de Montpellier); and François Henn (Université de Montpellier)*	**Fayçal Lahjiri** *Vinci Construction SP*
11:00AM	Characterization of Long-Term Aged Bitumen with FTIR Spectroscopy and Multivariate Analysis Methods *Authors: Kristina Hofer; Johannes Mirwald; Johann Lohninger; and Bernhard Hofko*	**Kristina Hofer** *CD laboratory for bitumen analysis, Institute of Transportation, TU Wien, Vienna*
11:30AM	Low Temperature Exudation of Oils from Asphalt *Authors: Jerron Zhang; Chandra Mohanta; Chanaka Nawarathna; Jianmin Ma; and Simon Hesp (Department of Chemistry, Queen's University, Kingston, Ontario, Canada)*	**Jerron Zhang** *Queen's University*

Noon	Lunch	
1:00PM	SESSION 6: Recycling, Sustainability and Alternative Materials	Moderator: Richard Taylor, *Shell*
1:00PM	**Coal-Based Asphalt and Limitations in Petroleum Asphalt for New Alternative Materials for Paving Applications** *Authors: Jeramie J. Adams; Louis C. Muller (University of Wyoming); Jean-Pascal Planche; Yogesh Kumbargeri; Jenny Loveridge; Chris Seago; Trina Pfeiffer (University of Wyoming); Paul Behrens (University of Wyoming); LeAnne Hazard; Justin Flock; and Justin Martin*	**Jeramie Adams** *Western Research Institute*
1:30PM	**Evaluating the Performance of High-RAP Mixtures with Crude Vegetable Oils and Antioxidant: Mechanical and Environmental Perspectives** *Authors: Nitish R. Bastola (University of Nebraska-Lincoln); Hamzeh F. Haghshenas (University of Nebraska-Lincoln); Mahdieh Khedmati (University of Nebraska-Lincoln); and David Mensching (Federal Highway Administration)*	**Nitish Bastola** *University of Nebraska-Lincoln*
2:00PM	**Effect of Bio- and Petroleum-Based Recycling Agents on Rheological and Mechanical Performance of Bituminous Materials** *Authors: Hamzeh F. Haghshenas (SES group & Associates LLC); Adrian Andriescu (SES group & Associates LLC); Varun Veginati (SES group & Associates LLC); David Mensching (FHWA); and Jack Youtcheff (FHWA)*	**Hamzeh Haghshenas** *SES Group & Associates LLC*
2:30PM	**Impact of Variability in the Source of Waste Polyethylene in Asphalt Mixture Design** *Authors: Venkatsushanth Revelli (Rowan University); Ayman Ali (Rowan University); Yusuf Mehta (Rowan University); and Ben C. Cox (US Army ERDC)*	**Venkatsushanth Revelli** *PhD student, Rowan University*
3:00PM	Break	
3:30PM	**Assessing the Environmental Impact of Pavement Construction through Life-Cycle Assessment and Balanced Mix Design: A Case Study** *Authors: Ram Kumar Veeraragavan (Highway Technology Partners LLC); Derek Nener-Plante (Federal Highway Administration); and Leslie Myers (Federal Highway Administration)*	**Ram Kumar Veeraragavan** *Highway Technology Partners, LLC*
4:00PM	SESSION 7: Rheological and Physical Characterization of Asphalt	Moderator: Lorena Garcia Cucalon, *Kraton Polymers LLC*

4:00PM	**Asphalt Tribology: Influence of Laboratory Ageing, Substrate Nature and Warm Mix Additives on Frictional Coefficient** *Authors: Corentin VERILHAC (LCPO/VCSP); Jean-François LE-MEINS (LCPO); Stéphane CARLOTTI (LCPO); Thomas LEBARBE (VCSP); Frédéric DELFOSSE (VCSP); Lise DEVES (ARKEMA); and Gilles BARRETO (ARKEMA)*	**Corentin Verilhac** *LCPO UMR5629 / Vinci Construction Service Partagé*
4:30PM	**Prediction of Fatigue Tolerance of Softener-Polymer Modified Asphalt** *Authors: Abdulgafar Sulaiman (Illinois Center for Transportation, University of Illinois at Urbana-Champaign); Javier J. Garcia Mainieri (Illinois Center for Transportation, University of Illinois at Urbana-Champaign); and Imad L. Al-Qadi (Illinois Center for Transportation, University of Illinois at Urbana-Champaign)*	**Abdulgafar Sulaiman** *University of Illinois at Urbana-Champaign*
5:00PM	**Rheological Parameters to Define the Shape of the Master Curve** *Authors: GM Rowe and SF Raposo*	**Geoffrey Michael Rowe** *Abatech*
5:30PM	**Dismiss and Drive to Banquet Venue:** *Black Fox on Welsh* *See program for map and directions to Black Fox on Welsh* *Note: Attendees are encouraged to carpool to the banquet venue due to limited parking availability*	
6:00PM	**Cocktail and Banquet**	

THURSDAY, JULY 20

8:30AM	**SESSION 8: Asphalt Aging**	Moderator: **Robert O'Leary** *Owens Corning Science and Technology*
8:30AM	**Global Consortium for Antioxidants Research: Results from Phase 1A** *Authors: Dheeraj Adwani (University of Texas at Austin); Anand Sreeram (University of Cambridge); Georgios Pipintakos (University of Antwerp); Johannes Mirwald (TU Wien); Yudi Wang (University of Illinois at Urbana Champaign); Ramez Hajj (University of Illinois at Urbana Champaign); Ruxin Jing (Delft University of Technology); and Amit Bhasin (University of Texas at Austin)*	**Anand Sreeram/ Johannes Mirwald** *University of Cambridge/ TU Wien*
9:00AM	**Feasibility of Pressure Aging Vessel (PAV) Application to Simulate the Aging of Roofing and Waterproofing Asphalts** *Authors: Amir Bahadori and Nicholas Fales*	**Amir Bahadori** *Certainteed/Saint-Gobain*
9:30AM	**Evaluating the Combined Effect of Photooxidation and Thermal Ageing on Asphalt Binders** *Authors: Johannes Mirwald; Bernard Maric; Kristina Hofer; and Bernhard Hofko*	**Johannes Mirwald** *TU Wien*
10:00AM	**Break**	
10:30AM	**SESSION 9: Asphalt Mixtures: Characterization and Evaluation**	Moderator: **Jean-Pascal Planche** *Western Research Institute*
10:30AM	**Fatigue Cracking Performance Evaluation of Statewide Performance Engineered Mixtures (PEM)** *Authors: Ali Raza Khan; Ayman Ali; and Yusuf Mehta, Center for Research and Education in Advanced Transportation Engineering Systems (CREATES)*	**Ali Raza Khan** *PhD Student, Rowan University*
11:00AM	**Streamlining Conditioning Guidance for Asphalt Mixtures** *Authors: Varun Veginati; Michael Elwardany; David Mensching; and Hamzeh F. Haghshenas*	**Varun Veginati** *SES Group of Companies*
11:30AM	**Closing Remarks and Dismiss**	
Noon	**Lunch on your own**	
1:00PM	**Activity start:** *Hiking in the Snowy Range Mountains, or Tour of Wyoming Territorial Prison State Historic Site* *See program for map and directions to Snowy Range Mountains and Wyoming Territorial Prison*	

POSTER PRESENTATIONS

Author & Affiliation	Title of Poster Presentation
Natalie Pramounmat *Owens Corning Science & Technology Center*	**Tying Morphological Features of Polymer Modified Asphalt to Rheological Behavior** *Co-author: Robert O'Leary*
Keara Saud *BASF*	**Onset of Nonlinear Rheological Behavior of Asphalt with Reactive-Isocyanate-Based Asphalt Modifiers** *Co-authors: Brian Orr and Bernie Malonson*
Geoffrey Michael Rowe *Abatech*	**Asphalt Binder Specifications for Intermediate Temperatures and Climatic Considerations** *Co-author: SF Raposo*
Richard Blackwell *Kraton Corporation*	**Influence of Polymer Modification on DTc** *Co-authors: Bob Kluttz; Marsha Thompson; and Renee Linscombe*
Vahid Hadadi and Azade Najafgholizade *Islamic Azad University*	**Modification of Rheology and Mechanical Properties of Bitumen with Cellulosic Fiber Composite**
Anik Roy *University of Arkansas*	**Thermal and Chemical Characterization of Asphalt Emulsion through Thermogravimetric Analysis (TGA) and Fourier Transform Infrared (FTIR) Techniques** *Co-authors: Andrew Braham and Jingyi Chen*
Stefan Werkovits *TU Wien*	**The Surface Chemistry of Light-Aged Bitumen** *Co-authors: Markus Bacher; Thomas Rosenau; Bernhard Hofko; and Hinrich Grothe*
Juan Lopez *Innophos, Inc.*	**Elimination of Hydrogen Sulfide via Scavengers** *Co-author: Kevin Kempton*
Carlos Manuel Hermoza Atausinchi *University of Utah*	**Determination of Aged Asphalt Binder Blending Potential by Dissolution in Heptane/Toluene Solutions** *Co-author: Pedro Romero Zambrana*
Jerron Zhang *Queen's University*	**Effects of Thermo-Reversible Aging of Asphalt Binder on Stress Relaxation** *Co-authors: Chandra Mohanta; Hanwalle M.C. Nawarathna; and Simon A.M. Hesp*
Tanner Turben *University of Arkansas*	**Impact of Equipment Type on Particle Size Measurement of Civil Engineering Materials** *Co-authors: Tasnimul Ferdous; Andrew Braham; and Wen Zhang*

Phillip Blankenship *Blankenship Aspahalt Tech and Training, PLLC*	**Reactive Isocyanate-Based Asphalt Binder Modification: Lab and Field Trials** *Co-authors: Zack McKay and Jean-Pascal Planche (Western Research Institute)*
Jeramie Adams *Western Research Institute*	**Sustainable Alternative for Recycling of Asphalt Pavements Using End-of-Life Wind Turbine Blades** *Co-authors: Jeramie J. Adams; Yogesh Kumbargeri; Jean-Pascal Planche; Seth Bassham; and Alex Literati*
Kushal Modi *Bruker Scientific USA*	**Detection of Vanadyl Porphyrins and Sulfur-Containing Vanadyl Porphyrins in Asphaltenes** *Co-authors: Matthias Witt and Estrella Rogel*
Steph Bredenhann *NAIDU Consulting*	**Rheological Fingerprinting of Bitumen-Rubber Modified Binders in South Africa for PG Specification and Quality Control Purposes**

Banquet

WEDNESDAY, JULY 19 | 6-9:00PM

BLACK FOX
on Welsh

Join us at Black Fox and enjoy one of the best Laramie locations

100 WELSH LANE | LARAMIE, WY | 82070

Catered By:

BOND'S BREWING COMPANY

UW CATERING

Note: Attendees are encouraged to carpool to the banquet venue due to limited parking availability

BAKELITE
SYNTHETICS

TUFFTREK

PRODUCTS FOR ROADS AND ROOFING

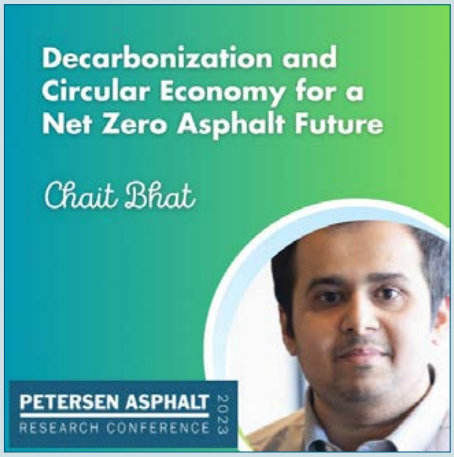
Scan this code to get more information now

Please Visit us at our booth here at Petersen Asphalt Research Conference

bakelite.com

SPECIAL SPEAKER SERIES

NET ZERO INVITED SPEAKERS:



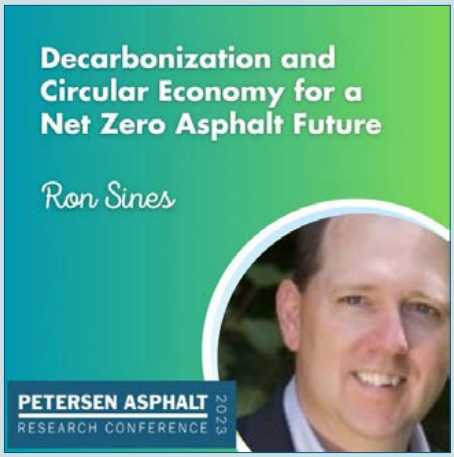
Chait Bhat

Chait Bhat is currently working as a Sustainability Engineer at the Asphalt Institute (AI). Chait graduated with a Ph.D. in Civil and Environmental engineering from Michigan Technological University in Fall 2020 with a focus on developing life cycle information models that would facilitate the development of consistent Environmental Product Declarations (EPDs) during public procurement decision-making. Chait is also a certified Life Cycle Assessment Practitioner by the American Center for Life Cycle Assessment. Chait was involved in the compilation of background data for the FHWA's LCAPave tool and played a key role in developing 2022 American Center for Life Cycle Assessment (ACLCA)'s Product Category Rule (PCR) guidance toolkit that was majorly funded by the Federal Highway Administration (FHWA). Chait is an active member of the FHWA's Sustainable Pavements Technical Working Group and is providing technical support in exploring and developing public background database required for EPDs and LCAs.

Sadie Casillas

Dr. Sadie Casillas joined the U.S. Army Engineer Research and Development Center as a Research Civil Engineer in 2020. She received a BS from the University of Arkansas in May 2013 followed by an MS in May 2015. For the next year, she worked at HBK Engineering in Chicago, Illinois as a civil design engineer for the telecommunications sector. In June of 2016, she returned to the University of Arkansas to pursue a PhD, which she completed in June 2020. Dr. Casillas's graduate research focused on asphalt pavement recycling and rehabilitation, sustainability of asphalt pavements, and asphalt emulsions.

Since joining ERDC, Dr. Casillas has managed the asphalt materials lab and worked on various projects related to improving design, construction, and maintenance of military airfield asphalt pavements. With the goal of extending pavement life through higher quality materials, better construction practices, and reduced major maintenance activities in mind, Dr. Casillas's work at ERDC has sought to enhance the sustainability of military airfield asphalt pavements. Her work to date has been sponsored by a diverse range of customers from multiple branches of military, including the Air Force, Army, and Navy. She has also had the opportunity to partner with private industry, academia, other ERDC labs, and the USACE Transportations Systems Center (TSC) through her research.

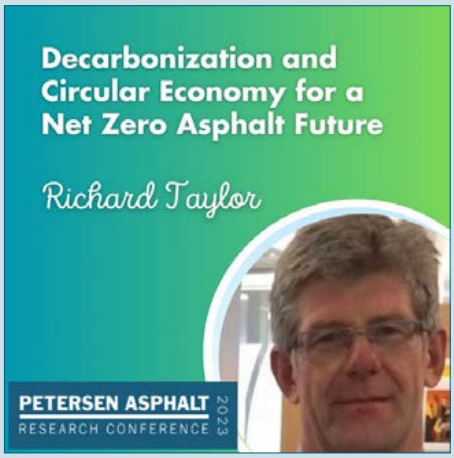


Ron Sines

Mr. Sines has been employed by CRH Americas Materials for the past twenty-three years, and is currently the Vice President – Sustainability and Decarbonization where he is responsible for developing the strategy for CRH's multi-year sustainability and decarbonization program. He leads AMAT's continuous improvement in these areas targeting a 42% reduction in CO emissions by 2030. Prior to taking on this role Mr. Sines was the Vice President – Asphalt Performance where he was responsible for asphalt initiatives ongoing across all CRH Americas Materials 400+ asphalt plants. CRH Americas Materials is a vertically integrated company producing 216 million tons of aggregate, 53 million tons asphalt, 16 million cubic yards of ready-mix concrete, and provides construction services for these products.

Mr. Sines is a member of the National Asphalt Pavement Association and the National Center for Asphalt Technology Boards of Directors. Ron previously worked for the New York State Department of Transportation's Materials Bureau for 15 years where he managed all aspects of the State's asphalt materials program.

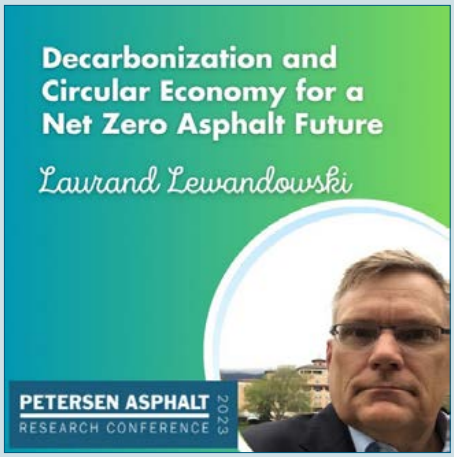
Ron received a Bachelor of Engineering degree in Civil Engineering from Youngstown State University and is a registered Professional Engineer in New York.



Richard Taylor

Dr. Taylor has more than 35 years of construction materials experience, having worked as a Materials Engineer on many major civil engineering projects (motorways, tunnels, airfields, ports) and later specializing in research and technical development of construction materials. He obtained a Bachelor of Science degree (First Class with Honours) and later graduated with a Ph.D from the School of Civil Engineering at the University of Nottingham. He currently holds the role of Global Technology Development Manager for Shell Construction & Road.

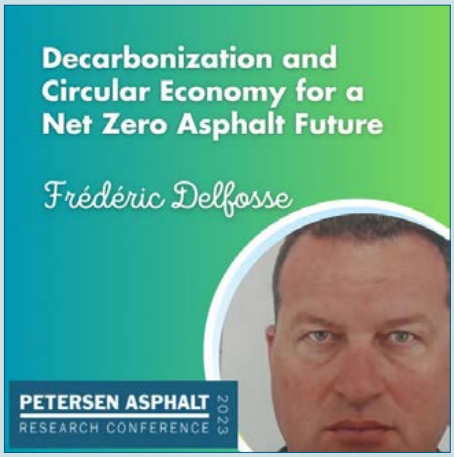
Richard is an Honorary Professor at the University of Nottingham, a Fellow of The Institute of Asphalt Technology, a Member of the Institute Environmental Management and Assessment and the Chair of Eurobitume's Bitumen Sustainability Steering Group. He was honoured to receive the Howard Medal from the Institution of Civil Engineers as part of a project team focused on increasing recycling and sustainability in surface course materials and co-author or Road Note 43



Laurand Lewandowski

Laurand Lewandowski is the Director of Asphalt Innovation for Owens Corning. Previously he was VP of Business Development for PRI, Inc in Tampa, Florida. Laurand has also held roles in numerous other companies; Director of Asphalt Technology (GAF), Asphalt Modification Manager (Goodyear), Global SBR Latex Manager (Goodyear), Industry Consultant. Laurand has over 30 years of experience in Asphalt Technology in both Roofing and Paving. He currently co-chairs ARMA Asphalt Roofing Recycling Committee and the Roofing Technical Advisory Committee of the Asphalt Institute. He is a Board Member of the Asphalt Institute Foundation (AIF) and previously lead the their Research Committee. Laurand has 17 patents covering both paving and roofing related areas.

Laurand resides in Newark, Ohio and has three children and loves playing golf when he is not doing asphalt things.



Frédéric Delfosse

Frédéric Delfosse joined Vinci Construction in 1998, he is Director of the research centre based in France, close to Bordeaux. He is a physico-chemical engineer. He started his career as research engineer on asphalt emulsion and cold mixes during 5 years before becoming project manager on different research programs on asphalt.

Since 2016, he is in charge of the research centre. 36 people are working on numerous international research projects on asphalt, asphalt mixes, cold products, innovative additives for road industry, development of new mechanical tests, road marking, aggregate, low carbon cement concrete, railway, innovative asset management systems and new artificial intelligence projects.

University of Wyoming

School of Energy Resources
Center for Carbon Capture and Conversion

RenuMAT
Western Research Institute

COphalt

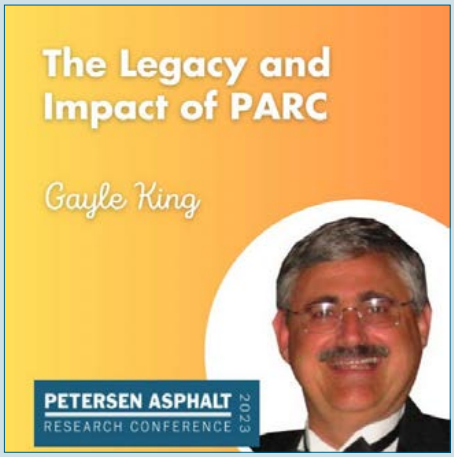
Carbon Ore, Coal-derived Asphalt

A green alternative to petroleum-based asphalt.

Cradle-to-gate, COphalt from Powder River Basin coal emits less than 1/3 the amount of CO_2 emitted from asphalt produced from conventional crude oil.

Any CO_2 emitted can be capture for storage or usage making COphalt carbon negative.

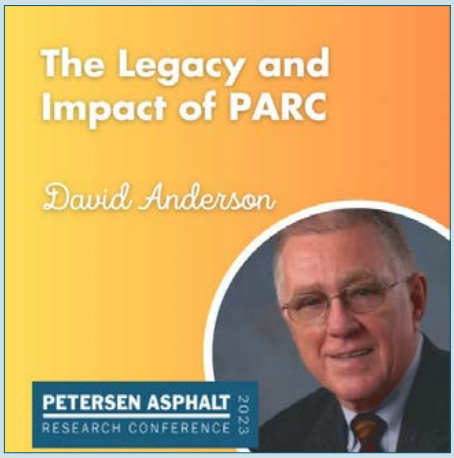
LEGACY AND IMPACT OF PARC INVITED SPEAKERS:



Gayle King

Dr. King was a statistics instructor in the US Air Force, and taught physical chemistry for four years at Rose-Hulman Institute of Technology before the lure of an industrial career pulled him away to become asphalt research manager for Bituminous Materials, Elf Asphalt, Elf Aquitaine (France), Koch Materials, and Koch Pavement Solutions. His twenty-five years of R&D responsibilities centered on asphalt chemistry, polymer modified asphalt and emulsified paving products. Gayle and his family also spent two years in Lyon, France, where he had the opportunity to study European paving technology while directing Elf France's long term asphalt research program. He has co-authored over 80 technical papers on asphalt characterization, and has been a frequent speaker at paving conferences, technical symposia and trade association meetings on five continents.

Dr. King and his wife Helen retired from Koch Materials in 2005 to form GHK, Inc, a consulting business offering services related to asphalt binder research and technology. Recent accomplishments include efforts to upgrade asphalt emulsion specifications by incorporating Superpave Binder Tools, specifications for low temperature relaxation properties of asphalt binders, hypotheses for cooling damage mechanisms leading to surface block cracking and raveling, and efforts to improve the performance of rejuvenator seals and recycled asphalt pavements, particularly when using bio-based rejuvenators.



David Anderson

Dr. Anderson has been active as a researcher and teacher in the area of paving materials and pavement performance for 60 years. He received his BSCE and MSCE degrees from the University of Connecticut in 1962 and 1964, and Ph.D. degree from Purdue University in 1971. Dr. Anderson worked in industry and taught at West Virginia University before spending 28 years on the faculty at Penn State University, retiring as Professor Emeritus in 2003. Dr. Anderson has been an active researcher in a number of pavement-related areas including skid resistance and surface characteristics, recycling, pavement maintenance, aggregate properties, field instrumentation studies and has published more than 250 refereed papers and technical reports. He is recognized nationally and internationally for his work on the rheological properties of asphalt binders used in highway paving applications and for playing a lead role during the Strategic Highway Research Program (SHRP) in the development of the asphalt binder test methods and specification. After his official retirement from Penn State in 2003, Dr. Anderson continued to work in the area of asphalt binders as a researcher, lecturer, consultant, and as a contributor to the FHWA asphalt binder Expert Task Group on asphalt binders, ASTM and other professional organizations.

Gaylon Baumgardner

Dr. Baumgardner has more than forty (40) years of experience in the petroleum and petroleum related products industries with strong ties to asphalt and asphalt related products and systems. He has worked and continues to work closely with agencies, academia, and industry researchers to address industry issues.

Prior to employment by Ergon, Inc. in 1988, Dr. Baumgardner served as Manager of Technical Development for Siplast, Inc., a producer of commercial modified bitumen roofing systems, directing development of conventional and modified bitumen roofing products for use in commercial roofing applications. From 1988 to now, Paragon Technical Services, Inc., (PTSi), formerly Ergon Technical Development, has operated under direction of Dr. Baumgardner. At PTSi, he is responsible for research and development services for Ergon Asphalt and Emulsions, Inc. and Ergon Armor, Inc. with primary focus in paving and related products, which include asphalt, polymer modified asphalt, asphalt emulsions, and polymer modified asphalt emulsions as well as specialty coatings. He also oversees full-service third-party testing and development capabilities offered by PTSi to the petroleum refining, roofing, waterproofing, protective coatings, specialty asphalt and asphalt paving industries.

Jean-Pascal Planche

Dr. Jean-Pascal Planche (JP) has been with the Western Research Institute in Laramie, Wyoming, USA, since 2010 where he became CEO in 2020 after acting as Senior VP of Asphalt and Petroleum Technologies.

Prior to WRI, JP worked for Elf and TOTAL, French oil majors, as research engineer, project leader, and research coordinator for TOTAL Bitumen worldwide. JP has worked in this asphalt field for 37 years. With his WRI team, he has been involved in developing innovative solutions for characterizing and improving hydrocarbon products, particularly asphalts for paving and roofing applications, and more recently in upcycling hydrocarbon waste and coal into asphalt materials using green chemistry as part of a circular economy approach. Current PI for the NCHRP 9-60 project on developing new specifications addressing binder damage resistance, JP also consults for the WRI-Asphalt Industry Research Consortium to help partners cope with asphalt binder variability, aged asphalts recycling and developing alternative binders.

He got inducted in 2011 into the Association of Modified Asphalt Producers Hall of Fame for lifetime achievement in the field of the development of PMA's.

Active with the TRB/AKM10 committee, AAPT (BOD vice-president), AMAP, ISAP (BOD past-chair), and the former FHWA Binder ETG. He was earlier on the European standardization committee of bitumen.

Join us!

THURSDAY, JULY 20 AT 1:00PM

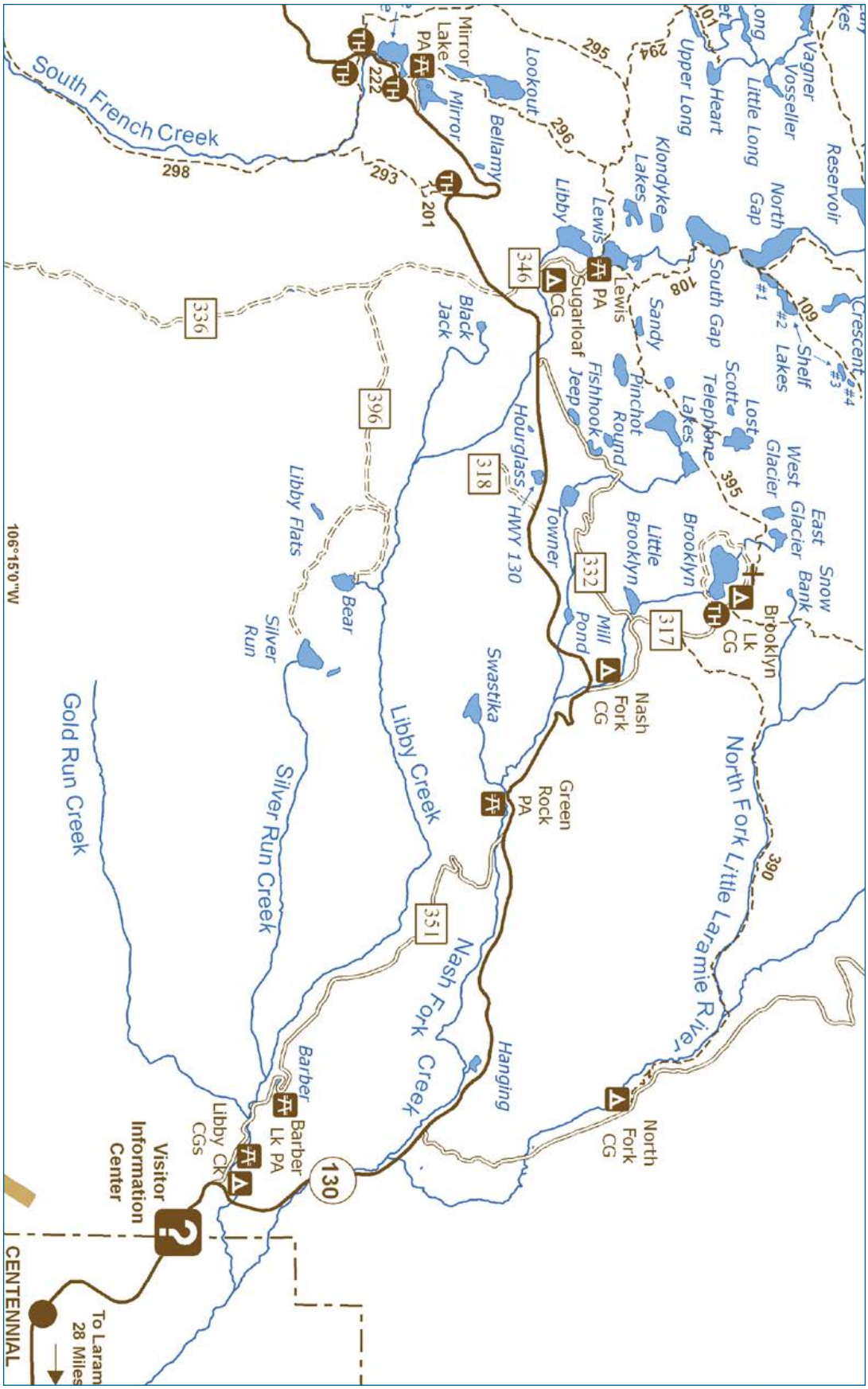
JOIN THE PARC COMMITTEE FOR HIKING OR TOURING THE TERRITORIAL PRISON.
SEE THE MAP ON PAGE XX FOR LOCATION DETAILS. HOPE TO SEE YOU THERE!

1. HIKING IN THE BEAUTIFUL SNOWY RANGE MOUNTAINS

OR

2. EXPLORING THE TERRITORIAL PRISON

Map for Snowy Range including trails



AmSpec® ASPHALT

AMSPEC LABORATORIES INSPECTION, TESTING AND CERTIFICATION SERVICES

AT AMSPEC GROUP, WE ARE DEDICATED TO EXCEEDING OUR CLIENT'S EXPECTATIONS AND STRIVING FOR THE HIGHEST PERFORMANCE.

We do this with well-documented systems, training, experienced employees, and continuous improvements of overall operations. Our employees are empowered to provide unparalleled levels of service.

We offer a wide range of Asphalt testing methods to comply with **AASHTO, ASTM, EN** standards, as well as blending services to comply with your Performance grade, Viscosity grade, and Penetration grade criteria.

Our accreditation scope includes **AASHTO Quality System Management** (**R18** Establishing and Implementing a Quality System for Construction Materials Testing Laboratories) and **ISO 17025** (International Organization for Standardization).

FOR MORE INFORMATION, PLEASE CONTACT:

AmSpec Cincinnati: Asphaltcincinnati@amspecgroup.com
AmSpec New Orleans: AsphaltNola@amspecgroup.com
AmSpec Philadelphia Harbor: Philadelphia@amspecgroup.com
AmSpec St Louis: Stlouisasphalt@amspecgroup.com

EMPOWERING A SAFER, MORE SUSTAINABLE WORLD

ABSTRACTS

Session 1: Decarbonization, Circular Economy, Performance, and Evaluation for a Net Zero Asphalt Future

Note: It is a special invited session. No abstracts available but speaker bios (including photos) provided in the program.

Session 2: Case Studies/ Field Performance

Design Pavement Structures with Aramid Fiber: Man O War Blvd Case Study

Speaker: Phillip Blankenship

Authors: Phillip Blankenship and Zack McKay

Abstract: New innovations are needed to produce resilient and sustainable pavements that are needed to meet the world's ever changing transportation and climatic needs. Producers and contractors are interested in ways they can become more efficient and sustainable while making profit. The use of aramid fiber to reinforce asphalt concrete pavements has been shown to exhibit rut resistance and crack resistant properties. However, little information in the literature exists on how to design asphalt mixtures with aramid fiber and more importantly, how critical the dispersion of the aramid fiber is in the mixture. This paper will discuss a case study on a project that utilized aramid fiber in various pavement layers and the resulting field data (i.e., falling weight deflectometer) and the need for using a different structural coefficient when designing pavements (in this case when using AASHTO '93). Using aramid fiber in the full pavement structure improves the modulus at least 58% and the structural number by at least 20% which ultimately will improve the capacity of the pavement. Using aramid fiber in every pavement layer results in substantial structural capacity which would allow for a more sustainable, long last pavement or the ability to reduce layer thickness where site limitations exist.

Qualitative Spectral Analysis of New Hampshire Department of Transportation Asphalt Binders – A Case Study

Speaker: Satish Belagutti

Authors: Satish Belagutti, Michael Elwardany, and David J. Mensching

Abstract: Asphalt binders are in a state of change due to varying crude sources, refining techniques, and the use of modifiers. These changes pose concerns about the consistency of the asphalt binders supplied to the end user, especially as the current Superpave asphalt binder rheology-based specification is inadequate for capturing the presence of certain additives. FTIR-ATR is one simple technique that has been successfully used to study binder chemistry. The FHWA Asphalt Binder and Mixture Laboratory – Implementation and Delivery (ABML-ID) resource evaluated rheological properties, as well as FTIR spectra of various neat and modified binders' data collected by the New Hampshire Department of Transportation over a period of two years from various plant locations and suppliers. FHWA conducted a preliminary data analysis to demonstrate the opportunities and challenges associated with implementing this approach at the DOT level. The primary objective of this study is to provide a qualitative analysis to determine consistency in binder supply; assess aging potential based on spectral changes with conditioning; and identify the modification types. Asphalt binder analysis of functional groups and rheological aging indices were used to separate oxidative aging effects from other factors that may impact binder rheology, such as volatilization and polymer phase separation.

Accelerated Field Performance of a Hybrid B2Last®+SBS Modified Asphalt Pavement

Speaker: Nam Tran

Authors: Nam Tran, David Timm, Brian Orr, and Bernie Malonson

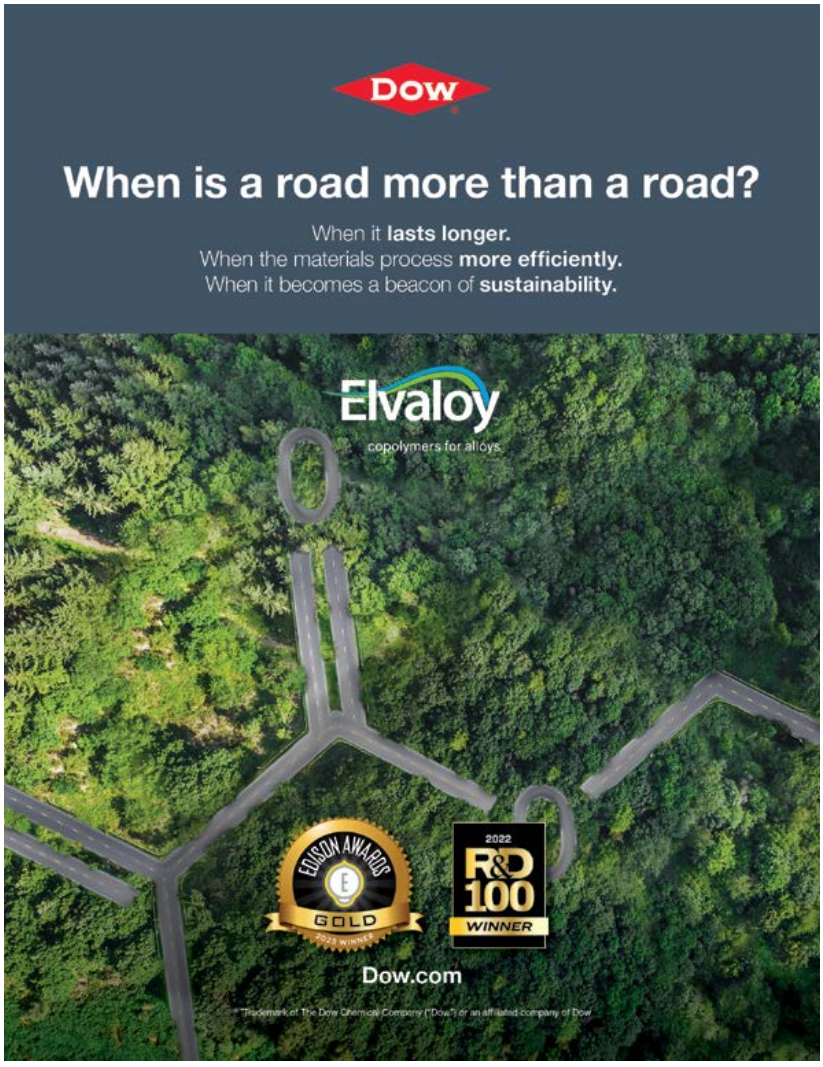
Abstract: The reactive isocyanate monomer, B2Last, can be used alone or with other modifiers to enhance asphalt binders, enabling them to meet the stringent requirements set by state agencies. In this study, a PG 88-22 binder was formulated by modifying a PG 64-22 binder using SBS and B2Last. This hybrid binder was then utilized to produce an asphalt mixture for evaluation on the NCAT Pavement Test Track. The test section constructed with the hybrid binder was compared with a control test section that employed a PG 76-22 SBS-modified binder. Both test sections were built in 2021 and have endured over five million ESALs of traffic. Samples of asphalt binders and plant mixtures were also collected during construction for a laboratory evaluation to assess the mixture performance characteristics and conduct structural pavement simulations. While both test sections show good performance, characterized by minimal rutting and no cracking, the hybrid binder test section displayed significantly higher strain levels due to variations in the subgrade and base moduli, suggesting the hybrid binder has the potential to withstand higher strain levels without experiencing fatigue. The field performance of the test sections will continue to be monitored for another year, subject to an additional five million ESALs.

Digitalization and Sensor Technology: Wireless Vertical Temperature Monitoring

Speaker: Matthias Martus

Authors: Ersun Görener and Matthias Martus

Abstract: Knowing how the ambient temperature affects the temperature in the asphalt layers is very important. The entire layer thickness dimensioning of the road structure, especially the performance-based dimensioning, is based on this knowledge. Time-unlimited recording of the vertical temperature distribution in the asphalt is meanwhile state of the art. Using this technology it is possible to see the layer temperature in different depths, measured and monitored 24/7 online in real time. The monitoring of values in the asphalt pavement AFTER the paving is essential. Actually, we do not know what is happening in the pavement after the paving. We put a lot of effort in mix design where we use empiric temperature distributions. Mostly based on air temperature and using models for the vertical effect of it. This results in theoretical assumption on the vertical temperature distribution. Working this way doesn't take into account the regional and local peculiarities. Shadows on the road surface, different aggregate colors on the surface have or may have impacts on the vertical temperature distribution. Using new sensors and transmission technologies it is possible to measure these types of values and transmit them wirelessly. This gives a completely new outlook for the design of roads and help to understand what is happening inside.



Session 3: Asphalt Additives

Development of a New Reactive Isocyanate-Based Modified Asphalt for the Roofing Industry

Speaker: Joe Rovani and Yogesh Kumbargeri

Authors: Joe Rovani, Yogesh Kumbargeri, Brian Orr, Patrick Hamilton, and Bernie Malonson

Abstract: Roofing asphalt is conventionally produced by air blowing soft grade fluxes to produce binders with low thermal susceptibility behavior and sufficient stiffness for proper shingle performance. Roofing binder modification using elastic polymers such as SBS is increasingly being used for better weathering and impact resistance characteristics. Levels of six to twelve percent SBS are typically employed. An alternative modification, reactive isocyanate at a level of eight percent, was examined in the present study to determine its potential for roofing applications. Blending was performed in the laboratory and reaction progression was monitored. The modified product was compared to its lab-prepared air blown counterpart from the same flux. Spectroscopic, chromatographic (SAR-AD, SEC), and rheological comparisons were obtained for both products in their unaged states, as well as a progression of PAV-aged extents. With respect to the chemical results, better colloidal index values (i.e., indicating stable and favorable chemical composition) were observed. Furthermore, better age-resistant physical and rheological behavior was observed (as compared to the air blown counterpart) based on softening point, performance grading, and temperature and frequency sweep data. The rheological results strongly point towards the retaining of superior viscoelastic properties through the aging cycles. This can be attributed to the presence of the cross-linked reaction product or apparent polymer formed after reaction as shown by SEC. The findings are promising and suggest additional work avenues. An effort to study the synergistic effects of reactive isocyanate modification with SBS is also planned.

Experimental and Simulation-based Design of Self-healing Asphalt Capsules

Speaker: Yujia Lu

Authors: Yujia Lu and Ramej Hazz

Abstract: An emerging technology to mitigate the cracking of asphalt pavements is the use of self-healing capsules embedded in asphalt mixtures. In this study, self-healing aggregate capsules are fabricated by covering rejuvenators with calcium-alginate shells. However, there is a critical need for a capsule design protocol through careful consideration of chemical compositions, thermodynamics, and mechanics by experiments and molecular dynamics (MD) simulation. To explore the thermodynamic process, interdiffusion coefficient, and blending degree between rejuvenators and shell molecules are evaluated through molecular scale studies. At mesoscale, the stiffness, compressive and tensile strength of capsules are tested by experiments and compared with MD simulation to determine the design by which capsules survive compacting and initiate its fracture to release rejuvenators. Macroscale fine aggregate matrix (FAM) is employed to study the capsules' effect on healing. The research reveals that the interaction between asphalt binder, rejuvenator, and capsules highly depend on their chemical compositions and that the thickness of capsule shells does not influence interdiffusion rate but does influence penetration degree, and structural failure process. The derived healing index based on viscoelastic continuum damage (VECD) facilitates a better selection of capsule designs. A recommended calcium-alginate capsule design is presented.

Session 4: The Legacy and Impact of PARC on Asphalt Research and Industry

Note: It is a special invited session. No abstracts available but speaker bios (including photos) provided in the program.

Session 5: Asphalt Chemistry

Characterization of the Asphaltene Architecture in Asphalt Binders by X-ray Scattering and Assessment of the Colloidal Structure

Speaker: Fayçal Lahjiri

Authors: Fayçal Lahjiri, Frédéric Delfosse, Anne Dony, Virginie Mouillet, Layella Ziyani, Sabine Gazeau, Philippe Dieudonne-George, and François Henn

Abstract: Asphalt is a material that undergoes changes in its composition and properties due to oxidative ageing and environmental factors. The rheological behavior of asphalt is influenced by its colloidal structure, and therefore, it is crucial to accurately assess and comprehend this structure. In this study, the focus is on characterizing the colloidal structure, with a specific emphasis on the aggregation state of the asphaltene phase. Various analytical techniques, including Fourier-transform infrared spectroscopy (FTIR), saturates, aromatics, and resins-asphaltene determinator (SAR-AD™), and temperature modulated differential scanning calorimetry (TMDSC), were utilized to investigate two types of binders (before and after PAV ageing) in order to understand the impact of composition and polarity changes in different asphalt subfamilies. Additionally, X-ray scattering techniques such as wide, small, and ultra-small X-ray scattering (WAXS, SAXS, and USAXS) were employed to evaluate the aggregation state of the asphaltenes, ranging from nanoaggregates (~1-5 nm) to secondary-tertiary asphaltene clusters (>500 nm). The architecture of the asphaltene structure was observed to evolve when varying solvent nature (e.g., without separation of asphaltenes-directly within the asphalt, or asphaltene dilution in toluene), temperature, or ageing state.

Characterization of Long-Term Aged Bitumen with FTIR Spectroscopy and Multivariate Analysis Methods

Speaker: Kristina Hofer

Authors: Kristina Hofer, Johannes Mirwald, Johann Lohninger, and Bernhard Hofko

Abstract: Since asphalt binder aging impacts both mechanical and chemical properties a variety of applicable analysis methods have been developed. One of the most common techniques used to investigate this from the chemical perspective is Fourier-Transformation Infrared (FTIR) spectroscopy. A possibility for post-processing of FTIR data is to apply multivariate analysis (MVA) methods, which allow e.g., for exploratory data analysis and reduction of data dimensionality. In the past, MVA methods have already been used for classifying differently aged asphalt binders. However, the deployed aging methods only included standard laboratory methods and

failed to consider factors like reactive oxygen species or light. The purpose of this study was the investigation of aged asphalt binders with FTIR spectroscopy and subsequent data processing with MVA. Therefore, nine asphalt binders were subjected to aging with the PAV, Viennese Binder Aging (VBA) and light and characterized with FTIR spectroscopy and various MVA methods. It was possible to differentiate between the aging methods solely based on FTIR data. Furthermore, important wavenumbers for the classification were identified. This study shows the potential of MVA methods to maximize the information content gained by experimental analysis methods and for the development of fast and easy characterization methods.

Low Temperature Exudation of Oils from Asphalt

Speaker: Jerron Zhang

Authors: Jerron Zhang, Chandra Mohanta, Chanaka Nawarathna, Jianmin Ma, and Simon Hesp

Abstract: Exudation of oils from an asphalt binder can be an important mechanism responsible for age hardening. This is especially true for poor-quality aggregates and/or unstable binders. It can lead to pavement distresses, like premature raveling, cracking, and moisture damage, ultimately reducing the life cycle performance of a pavement. Historical research has shown that incompatible paraffin-type oils tend to phase separate and then exude from the bulk material. This study investigated 60 asphalt binders from commercial contracts around North America in addition to a set of SHRP Materials Reference Library binders for comparison. The extended bending beam rheometer (EBBR, AASHTO TP 122) protocol, combined with a dynamic shear rheometer (DSR) temperature sweep test before and after EBBR conditioning, were used to quantify the effect of cold conditioning on exudative hardening. The results show that for many commercial binders the effect of exudation can be of similar magnitude to that of thermo-reversible aging. Straight Alberta, Canada (AAA, AAL, AAN) and Laguna, Venezuela (ABG) binders with compatible phase structures show superior performance as reflected by their insignificant change upon cold storage in the EBBR.

UNDERSTANDING ASPHALT

An Analysis of Vanadyl Porphyrins and Sulfur

Thursday, August 3 • 10:00-11:00 EST

Metallo-porphyrins are present in crude oil and enriched in asphaltenes. The most common forms are vanadyl porphyrins which are used as biomarkers for the oil. The different forms of these petro-porphyrins are of high interest and can be purified via chromatographic methods. However, due to the high abundance of these petro-porphyrins in the asphaltene, these compounds can be directly detected in the asphaltene fractions using ultra-high resolution mass spectrometry. Both vanadyl porphyrins and sulfur containing vanadyl porphyrins were directly detected from the asphaltene without chromatography.

Session 6: Recycling, Sustainability and Alternative Materials

Coal-Based Asphalt and Limitations in Petroleum Asphalt for New Alternative Materials for Paving Applications

Speaker: Jeramie Adams

Authors: Jeramie J. Adams, Louis C. Muller, Jean-Pascal Planche, Yogesh Kumbargeri, Jenny Loveridge, Chris Seago, Trina Pfeiffer, Paul Behrens, LeAnne Hazard, Justin Flock, and Justin Martin

Abstract: Coal-based asphalt, derived from Wyoming Powder River Basin (PRB) subbituminous coal—and renewable vegetable oil-based solvents—produces novel paving materials that have the potential for a low, or possibly negative, carbon footprint. Using vegetable-based renewable solvents, as a co-reactant to break down the coal macromolecular structure while modifying the molecules, allows for products to be produced which can store large amounts of CO_2, thus advancing carbon capture utilization and storage (CCUS) practices. Current formulations of the coal-based asphalt have a similar chemical composition to a petroleum asphalt according to the Saturates, Aromatics, Resins-Asphaltene Determinator (SAR-AD) and by size exclusion chromatography. However, it has different physical characteristics. When using Superpave criteria, coal-based asphalt blended with petroleum asphalt behave similarly to petroleum asphalt, and mixture prepared from the material also compacts similar to petroleum asphalt. However, applying common DSR testing criteria to the coal-based asphalt alone gives erroneous conclusions about the material. Black space plots using 4 mm DSR shows a significantly different response to the viscous and elastic components than petroleum asphalt, and MSCR shows some differences from petroleum asphalt. Normal methods to obtain the upper and lower PG information by DSR will be shown compared to petroleum asphalt. Shear thickening was also explored and ruled out as a potential reason for the discrepancy. Polymer modification of the coal-based asphalt shows significant promise in improving the properties of the material according to MSCR testing.

Evaluating the Performance of High-RAP Mixtures with Crude Vegetable Oils and Antioxidant: Mechanical and Environmental Perspectives

Speaker: Nitish Bastola

Authors: Nitish R. Bastola, Hamzeh F. Haghshenas, Mahdieh Khedmati, and David Mensching

Abstract: Petroleum- and bio-based Recycling Agents (RAs) have been a common solution to mitigate the adversity of Reclaimed Asphalt Pavement (RAP) materials. However, the current need is to use sustainable sources of RAs such as vegetable-based oils. Therefore, this study investigated the effect of crude soybean and corn oils as RAs on performance of asphalt mixtures containing 65% RAP. In addition, simultaneous utilization of zinc diethyldithiocarbamate (ZnDEC) as an antioxidant (AO) was considered in order to improve the aging resistance of vegetable-based oils. The mechanical performance of the high-RAP mixture was assessed in terms of cracking, rutting, and moisture resistance. Finally, environmental testing was conducted using leaching procedures. Life Cycle Impact Analysis (LCIA) was also performed to understand the overall life cycle impact during the mixture production. The results showed that vegetable-based oils enhanced the cracking performance of the RAP mixtures, however, the rutting and moisture susceptibility of these mixtures increased. The ZnDEC had a beneficial effect on age retarding of mixtures without significantly affecting the rutting and moisture susceptibility. Furthermore, the environmental analysis demonstrated that RAs and AO have no detrimental impact on the environment, and the use of the RAP mixture resulted in a lower overall life cycle impact.

Effect of Bio- and Petroleum-Based Recycling Agents on Rheological and Mechanical Performance of Bituminous Materials

Speaker: Hamzeh Haghshenas

Authors: Hamzeh F. Haghshenas, Adrian Andriescu, Varun Veginati, David Mensching, and Jack Youtcheff

Abstract: This study examined the effect of four different recycling agents (RAs), including two bio- and two petroleum-based RAs, on the performance of bituminous materials containing 40% Recycled Asphalt Pavement (RAP). To determine proper dosages targeting desired bituminous grade, continuous performance grading (PG), relaxation constant (m-value), stiffness (S-value), and Delta Tc at low temperatures, as well as Glover-Rowe (G-R) parameters and Critical Tip Opening Displacement (CTOD) at mid temperatures, were considered. The results indicated that optimization based on PG could not result in meeting all the rheological and failure parameters of the target bitumen. The selected dosage of each RA, determined based on high-end PG, was then applied to control bituminous mixtures with 40% RAP and the mechanical performance of these mixtures were evaluated using Hamburg Wheel Tracking Test (HWTT) for rutting and moisture damage characterization and Indirect Tensile Asphalt Cracking Test (IDEAL-CT) for cracking characterization. The results showed that the addition of RAs improved the cracking resistance of the control mixtures without significantly affecting their rutting resistance. Also, the RAs used in this study did not negatively affect the moisture damage resistance of the mixtures. Overall, the results revealed that bio-based RAs have comparable performance with petroleum-based ones.

Impact of Variability in the Source of Waste Polyethylene in Asphalt Mixture Design

Speaker: Venkatsushanth Revelli

Authors: Venkatsushanth Revelli, Ayman Ali, Yusuf Mehta, and Ben C. Cox

Abstract: The usage of waste plastics in asphalt industry suffers from a serious problem of infinite variability in sources, preventing proper guidelines for field applications. The aim of the study is to address the variability in source of waste plastic and identify their role in asphalt mixture design. Polyethylene(PE) from five different sources was used in this study as a replacement for asphalt binder at dosage levels of 3%, 6%, and 9% by weight. The changes in asphalt mixture volumetrics were correlated to plastic characterization such as density(ρ), viscosity (ρ), melting point (Tm), and Degree of Crystallinity (Xc). Although four plastics irrespective of sources could be categorized as PE, the Xc value of plastic along with ρ had a prominent role in governing the volumetric properties of asphalt mixtures. Polyethylenes with a low Xc value (<60%), were found to be a suitable replacement to asphalt binder as a binding agent irrespective of source of plastic. Increase in Xc value (> 60%) of PE consequently reduced the workability of a PE-modified asphalt mixture. It is recommended to address PE in terms of core properties (Xc and ρ) rather than source or supplier to better understand its behavior in an asphalt mixture.

Assessing the Environmental Impact of Pavement Construction through Life-Cycle Assessment and Balanced Mix Design: A Case Study

Speaker: Ram Kumar Veeraragavan

Authors: Ram Kumar Veeraragavan, Derek Nener-Plante, and Leslie Myers

Abstract: One of the key areas of concern in pavement sustainability is the environmental impact of infrastructure and construction materials, especially now with the environmental stewardship to incorporate waste materials in pavement construction. To address this, life-cycle assessment (LCA) has been developed as a comprehensive approach to estimating the environmental impact of a product or process, from raw material production to end of life. The Federal Highway Administration (FHWA) has developed the LCA Pave tool in collaboration with stakeholders to provide a transparent LCA tool for pavements that can accept data from industries' Environmental Product Declarations (EPDs). This study conducted a cradle-to-gate analysis on two MATC site projects using the LCA Pave tool to assess the environmental impacts of different mix designs using materials from different sources. The study also tested and compared rutting and cracking performance of Stone Matrix Asphalt (SMA) mixtures and dense graded surface mixture (Superpave Type IVS) for potential Balanced Mix Design (BMD) implementation. The study found that the use of LCA and BMD could benefit Departments of Transportation in terms of cost-economics, societal, and environmental benefits. Sensitivity analysis could be useful to quantify the benefits of addition of different percentages of RAP in the dense mixes. Lessons learned about the process of conducting LCA will be shared from the perspective of pavement engineers.

BASF
We create chemistry

21st Century Asphalt Binders Require A 21st Century Asphalt Solution

Introducing B2Last

A Revolutionary New Liquid Asphalt Modifier from BASF

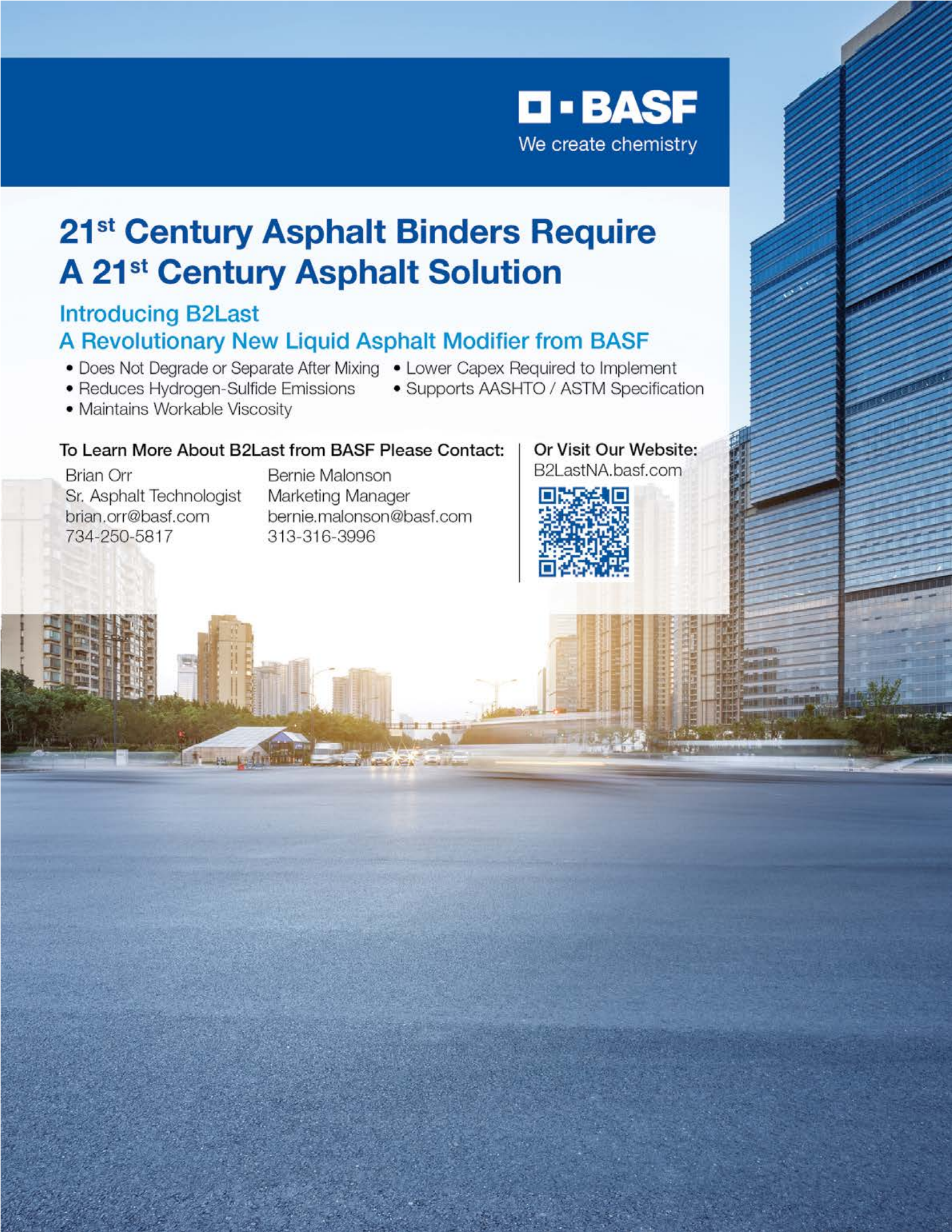
- Does Not Degrade or Separate After Mixing
- Reduces Hydrogen-Sulfide Emissions
- Maintains Workable Viscosity
- Lower Capex Required to Implement
- Supports AASHTO / ASTM Specification

To Learn More About B2Last from BASF Please Contact:

Brian Orr
Sr. Asphalt Technologist
brian.orr@basf.com
734-250-5817

Bernie Malonson
Marketing Manager
bernie.malonson@basf.com
313-316-3996

Or Visit Our Website:
B2LastNA.basf.com



Session 7: Rheological and Physical Characterization of Asphalt

Asphalt Tribology: Influence of Laboratory Ageing, Substrate Nature and Warm Mix Additives on Frictional Coefficient

Speaker: Corentin Verilhac

Authors: Corentin Verilhac, Jean-François Le-meins, Stéphane Carlotti, Thomas Lebarbe, Frédéric Delfosse, Lise Deves, and Gilles Barreto

Abstract: The workability of asphalt aggregates mixtures poses challenges in its study and linking it with the behavior of bitumen blends is difficult. Traditional methods, such as examining the impact of additives on viscosity, are commonly used to analyze asphalt mixtures workability, but these methods are limited to organic additives like waxes and cannot explain the influence of chemical additives. Recent studies have explored tribological experiments as a new analytical approach to better understand the behavior of bitumen in asphalt mixtures, by incorporating frictional coefficient parameters to improve comprehension. In this tribological study, a comprehensive approach was undertaken using a ball-on-three-plates system in a dynamic shear rheometer (DSR) to investigate the influence of various parameters on the frictional behavior of two bitumen samples. These parameters included asphaltene and maltene content, short- and long-term ageing, substrate nature of tribological plates (Inox, PTFE, limestone, and quartzite), and the impact of warm mix additives (waxes and interface chemical). Furthermore, attempts were made to establish correlations between asphalt tribology and hot/warm mix asphalt behavior as determined by Freundl, Nynas, and gyratory compaction experiments. The frictional coefficient is considered a useful approach, in addition to viscosity, for evaluating the effectiveness of additives in modifying asphalt pavements workability.

Prediction of Fatigue Tolerance of Softener-Polymer Modified Asphalt

Speaker: Abdulgafar Sulaiman

Authors: Abdulgafar Sulaiman, Javier J. Garcia Mainieri, and Imad L. Al-Qadi

Abstract: Several tests have been implemented to characterize asphalt concrete (AC) fatigue behavior. However, most of these tests have limitations. On the other hand, asphalt binder fatigue tolerance could help in controlling load-related asphalt concrete pavement cracking. Fatigue tolerance could be related to asphalt binder's capacity calculated from complex shear modulus using the Linear Amplitude Sweep (LAS) test. The LAS parameter Δ|G*|peakT quantifies the reduction of complex shear modulus before the sample's stress response decreases when another cycle of increasing strain is applied. This parameter could successfully capture the effect of aging and softening modifiers. The Δ|G*|peakT was used to discriminate styrene-butadiene-styrene (SBS) modified asphalt binders. The effect of SBS on Δ|G*|peakT was studied on modified binders by (a) softeners (b) SBS and (c) softeners and SBS. Dg is capable of distinguishing binders modified with polymers. According to this parameter polymer modified binders have a higher fatigue tolerance.

Rheological Parameters to Define the Shape of the Master Curve

Speaker: Geoffrey Michael Rowe

Authors: Geoffrey Michael Rowe and Sergio Raposo

Abstract: In empirical asphalt binder specifications defined by penetration and softening point the temperature susceptibility is controlled by upper and lower limits on softening point and penetration. This temperature susceptibility is related to rheological type, in an approximate manner. The introduction of the SHRP/Superpave specifications in the mod-1990s did not control rheological type in a well-defined manner despite have defined rheological measurements. This, combined with the realization that the standard PAV 20-hour aging does not capture long term performance to an adequate extent, has permitted the use of binders which tend to be more oxidized. Various workers have more recently explored the use of rheological limits such as delta Tc, rheological index, phase angle at a pre-defined stiffness and/or cross-over modulus to define the rheological type. In several cases, workers have suggested that an upper and

lower limit should be applied to the binder rheology with respect to one or more of these measures. Each of these four parameters control the shape of the master curve. Which is the better measure and do we need all four or just one? This paper explores, that if this approach is adopted, what are the better measures to define the rheological type.

Session 8: Asphalt Aging

Global Consortium for Antioxidants Research: Results from Phase 1A

Speaker: Anand Sreeram/ Johannes Mirwald

Authors: Dheeraj Adwani, Anand Sreeram, Georgios Pipintakos, Johannes Mirwald, Yudi Wang, Ramez Hajj, Ruxin Jing, and Amit Bhasin

Abstract: The effective design and use of antioxidant additives to reduce or slow down the aging of asphalt binders can bring about tremendous benefits to the asphalt industry. However, in spite of several hundred peer-reviewed research papers on this topic over the past decades, very little is known about its effectiveness and widespread applicability when considering geographically (and chemically) different binders. In view of this, a global consortium consisting of 17 research laboratories was initiated in late 2021 to improve the understanding of the science; and to ultimately employ this understanding to validate the possibility for practice level applications. This work presents the results Phase 1A which tested the effectiveness of promising antioxidants using chemically diverse binders from various parts of the world. Specifically, seven different binders from various geographical regions in the world i.e., Texas (USA), Vienna (Austria), Illinois (USA), Antwerp (Belgium), and Delft (Netherlands) were blended with the four promising antioxidants at different proportions. The chemical and rheological properties of the blends were then evaluated using advanced analysis methods. The results indicated that although some antioxidants may reduce oxidation based chemical indices, their effect on rheology is more complicated and likely related to unique physicochemical interactions in each binder.

Feasibility of Pressure Aging Vessel (PAV) Application to Simulate the Aging of Roofing and Waterproofing Asphalts

Speaker: Amir Bahadori

Authors: Amir Bahadori and Nicholas Fales

Abstract: Weathering performance, including indoor Weather-O-Meter (WOM) conditioning or outdoor weathering exposure deck conditioning, is a key metric for evaluating asphalt shingle durability. The roofing industry applies ASTM D4798, "Standard Practice for Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Xenon-Arc Method)," and ASTM D1669, "Standard Practice for Preparation of Test Panels for Accelerated and Outdoor Weathering of Bituminous Coatings" to evaluate the aging behavior of asphalt. Although this method is a conventional aging method for the roofing/waterproofing asphalts, the whole procedure can take up to 60 days to qualify an asphalt blend for roofing application. This study evaluates the applicability of a Pressure Aging Vessel (PAV) to simulate the aging of roofing asphalt. For this purpose, samples were aged in both PAV and WOM, and the progress of oxidation was evaluated through chemical and rheological analyses. The comparison between samples aged with WOM and PAV showed that the PAV method could be used as a durability test in the roofing industry to expedite the quality control process for asphalt.

Evaluating the Combined Effect of Photooxidation and Thermal Ageing on Asphalt Binders

Speaker: Johannes Mirwald

Authors: Johannes Mirwald, Bernard Maric, Kristina Hofer, and Bernhard Hofko

Abstract: With a continuous decline in the global asphalt binder production a rising need for a complete understanding of the material and its changes during its service life become a prerequisite. Thus, when addressing binder ageing, a combination of environmental ageing factors such as temperature, moisture, reactive gases, or sun light need to be considered. Since all of these factors can potentially induce different oxidation mechanisms on the material, a

considerate approach is sought after. This suggests that photooxidation needs to be understood on a fundamental level, before combining it with other factors such as temperature. This study shows the impact of individual light domains, mimicking merely parts of the sun light spectrum and eventually combines it with thermal ageing. Fourier-Transform-Infrared (FTIR) spectroscopy, polarity-based SARA fractionation and Dynamic Shear Rheometer (DSR) were deployed to analyze the ageing effects. The results revealed that by combining light and temperature, a significant ageing acceleration can be achieved, compared to pure thermal ageing. Furthermore, different wavelength domains induced a varying amount of oxidation products and stiffness levels, indicating alterations in the oxidation reactions taking place in dependence of the photoenergy participating. These results provide an additional piece in the overall binder ageing puzzle.

Session 9: Asphalt Mixtures: Characterization and Evaluation

Fatigue Cracking Performance Evaluation of Statewide Performance Engineered Mixtures (PEM)

Speaker: Ali Raza Khan

Authors: Ali Raza Khan, Ayman Ali, and Yusuf Mehta

Abstract: This study aims to evaluate the different agency approved Performance Engineered Mixtures (PEM) having polymers and aramid fibers. Eight (08) different New York State Department of Transportation (NYSDOT) approved plant mixes from different regions (typically from regions 2, 7, 8, and 9) of the state were collected to evaluate the cracking and fatigue performance against agency recommended threshold value. Out of eight mixtures, four mixtures were fiber reinforced asphalt mixtures (FRAM), three were polymer modified asphalt (PMA) mixtures and one mix was prepared using polymer fibers. The three FRAM mixtures were prepared using the polyolefin/ aramid fibers (PFA) and one was prepared with Sasobit coated aramid (SCA) fibers at the recommended dosages of the manufacturer. Cracking performance was evaluated by performing Indirect Tensile Asphalt Cracking Test (IDEAL-CT), Semi-circular Bend (SCB) test, additionally, fatigue performance was evaluated using four-point bending beam (4PB), and Texas Overlay test (OT) test. Performance interaction charts were also developed for IDEAL-CT test to identify the impact on mix behavior. The test results showed that PMA outperformed the FRAM in terms of cracking and fatigue performance and passed the agency recommended threshold values. Performance interaction chart identified higher elasticity for PMA and higher toughness for FRAM mixtures.

Streamlining Conditioning Guidance for Asphalt Mixtures

Speaker: Varun Veginati

Authors: Varun Veginati, Michael Elwardany, David Mensching, and Hamzeh F. Haghshenas

Abstract: This research aims to streamline conditioning time for intermediate test temperatures in order to enhance the efficiency of obtaining index properties for balanced mixture design implementation. The study adopts the Scrum methodology, commonly used in software development, to manage complex applied research projects. The research focuses on reducing conditioning time for AMPT cyclic fatigue tested at Target, Target + 3 °C, Target – 3 °C, Indirect Tensile Asphalt Cracking Test (IDEAL-CT) tested at 20 °C, 25 °C, 28 °C, and Illinois Flexibility Index Test (I-FIT) tested at 20 °C, 25 °C, 28 °C. The study suggests that conditioning time for cyclic fatigue and IDEAL-CT tests could potentially be reduced to 60 and 90 minutes for I-FIT. The researchers provide a streamlined testing version based on a predefined evaluation approach to ensure critical parameters' adequate equivalency from the full testing suite. Overall, this study demonstrates the usefulness of the Scrum methodology in applied research and its potential for enhancing the efficiency of obtaining index properties for balanced mixture design implementation.

The Leader in Advanced Asphalt Analysis

NETZSCH
Thermal Analysis Instruments
Software and Services.

Can we do it? **YES!**

Fully automated analysis for PG Grade Determination

Accurate determination of Mixing and Compaction Temperatures and Softening Point

Blend testing of Polymers, Warm Mix, Crumb Rubber, PPA, and other additives

Benchmarking and comparisons of competitive products

Evaluation of viscosity, tack, mix, friction, and penetration

Molecular weight and weight distribution

Emulsion testing for viscosity and stability

The Kinexus DSR

Used by more accredited labs worldwide

Simple testing to AASHTO, ASTM and EN specifications

Backed by the best service and support in the industry

Scan the Code to Learn More!
netzsch-thermal-analysis.com/us/products-solutions/rheology/kinexus-dsr-plus/

NETZSCH Instruments North America, LLC
netzsch-thermal-analysis.com/us/

NETZSCH
Proven Excellence.

Poster presentations

Tying Morphological Features of Polymer Modified Asphalt to Rheological Behavior

Speaker: Natalie Pramounmat

Authors: Natalie Pramounmat and Robert O'Leary

Abstract: Compatibility of the asphalt and polymer additives is vital in designing formulation. A micro-scale behavior of a multi-phase material can affect overall performance of the polymer modified aspahlt.1 Here in, we are looking at the influence of molecular weight and crystallinity of polyolefins on rheological performance of asphalt formulations developed for a variety of applications. The microstructure of the polymer modified asphalt shows how the network of polyolefins form in the maltene phase of the asphalt. The crystallinity we observed in microstructure and differential scanning calorimetry measurement support our theory on how crystallinity in the blends affect rheological performance. The crystallinity can be further explained with molecular weight distribution of the polymers. Moreover, we studied morphology evolution of polyolefin-modified asphalts with increasing and decreasing in temperature to observe swelling of polymers and how asphalt fractions interact with the morphological change of the polymer. This study provides an insight on interfacial interaction between asphalt and polyolefins at the micro-level, which is helpful for optimizing storage stability and rheological properties of the polyolefin-modified asphalts.

Onset of Nonlinear Rheological Behavior of Asphalt with Reactive-Isocyanate-Based Asphalt Modifiers

Speaker: Keara Saud

Authors: Keara Saud, Brian Orr, and Bernie Malonson

Abstract: Asphalt binder modification is employed to improve the performance of asphalt binders and mixtures. Common modifiers include polyphosphoric acid, elastic polymers like styrene-butadiene-styrene (SBS), and, more recently, reactive isocyanate-based modifiers. To predict performance of these modified binders and quantify differences between modifiers and the unmodified formulation, dynamic shear rheology (DSR) is a particularly powerful tool that requires minimal sample size and relatively shorter test times. In industry, asphalt binder failure is often described in terms of DSR parameters such as the rutting index, fatigue index, Glover-Rowe parameter, etc. These parameters are typically taken from the linear viscoelastic (LVE) regime of the binder which historically have correlated well with its nonlinear viscoelastic (NLVE) behavior. However, with increasingly complex asphalt formulation these correlations don't necessarily hold. Therefore, a better understanding on the NLVE behavior of asphalt binders is needed. Here, we compare and contrast the onset of nonlinearity of asphalt binders with different modifiers: SBS, a reactive isocyanate-based modifier, and a combination of SBS and the reactive isocyanate-based modifier. Prior work has found that the onset of nonlinearity does not vary significantly between neat and modified binders. We investigate if this holds true for the new category of reactive isocyanate-based modifiers and will discuss implications of the onset of nonlinearity for binder performance.

Asphalt Binder Specifications for Intermediate Temperatures and Climatic Considerations

Speaker: Geoffrey Michael Rowe

Authors: Geoffrey Michael Rowe and Sergio Raposo

Abstract: Asphalt binder specifications in the intermediate temperature range can be susceptible to fatigue and/or durability cracking. Recently, NCHRP has developed procedures based on a modified Glover-Rowe parameter to assess cracking. This parameter is examined for traditional non-modified asphalt and highly modified materials. In addition, we have accessed the NOAA climatic database for climate and analyzed the entire USA for the average annual pavement temperature to assess the ranges proposed by the NCHRP 9-59 workers. Analysis has considered the use of the loss modulus in the current specifications and the Glover-Rowe parameter in the traditional manner and that proposed by

9-59 workers. We comment on the ranges proposed and the ranges observed in the analysis. The adoption of the correct temperature for intermediate specifications is critical to ensure that durable pavements are built that will perform.

Influence of Polymer Modification on ΔTc

Speaker: Richard Blackwell

Authors: Richard Blackwell, Bob Kluttz, Marsha Thompson, and Renee Linscombe

Abstract: Delta Tc has gained increasing traction as a parameter that can be used to distinguish between unmodified base asphalts with respect to potential for age-related cracking, either as a forensic measure for in-service pavements or as a predictive indicator with lab aged samples. However, prior evidence has suggested that DeltaTc does not adequately indicate propensity for cracking in SBS polymer modified asphalts. In this study, we evaluated the Delta Tc of polymer modified asphalts with a wide range of SBS polymer structures. Three base asphalts were selected for modification based on a range of Delta Tc after 40hrs of PAV aging. Results indicate that SBS polymer modification, in general, leads to neutral or lower Delta Tc results after PAV aging compared to the unmodified asphalt, with no indication of a consistent influence of any single polymer design variable. This result is in conflict with the widely accepted benefit of SBS polymer modification with respect to crack resistance observed in field studies. However, a closer inspection of the two parameters that define Delta Tc indicate that SBS polymer modification almost always has a positive impact on Tc,S and many times will positively affect Tc,m, particularly in bases with higher Delta Tc values.

Modification of Rheology and Mechanical Properties of Bitumen with Cellulosic Fiber Composite

Speaker/Authors: Vahid Hadadi and Azade Najafgholizade

Abstract: Disposed newspapers and other printed papers are bulky wastes that easily fill the landfill capacity. There are different suggestions for pyrolyzing and recycling papers. However, these methods consume lots of energy and release chemical agents that are hazardous to the environment. The fiber of waste paper with long chain molecules and low cost is an alternative material for bitumen modification. In this study shredded newspaper and polyethylene grafted maleic (as compatibilizer) directly were added to bitumen and the mechanical and thermal behaviors of blends were investigated. Modification of bitumen was based on two methods: the addition of polymer and 5% newspaper fiber to bitumen: at separate times and in composite form. Experimental data showed that waste of newspaper in presence of polymer improved bitumen specifications. However, results were exceptional when the composite form of newspaper fiber and grafted polymer were added to bitumen. Achieved data from this study indicated that the waste papers not only were recycled without introducing toxic substances into the environment, but they also improve the rheological properties of bitumen.

Thermal and Chemical Characterization of Asphalt Emulsion through Thermogravimetric Analysis (TGA) and Fourier Transform Infrared (FTIR) Techniques

Speaker: Anik Roy

Authors: Anik Roy, Andrew Braham, and Jingyi Chen

Abstract: The chemical and thermal characterization of asphaltic materials, specifically asphalt emulsion, is crucial for understanding their composition and behavior under different conditions. Limited work has been done on asphalt emulsion in analyzing chemical and thermal characterization. This work aims to characterize asphalt emulsion materials both chemically and thermally to understand the behavior of asphalt emulsion. Five materials were explored in this study: asphalt binder, soap solution (emulsifier, HCl, and water), asphalt emulsion, soap solution residue, and asphalt emulsion residue. Thermogravimetric Analysis (TGA) and Fourier Transform Infrared (FTIR) were used to characterize these five materials. The TGA study found that the thermal stability of asphalt emulsion residue is lower than asphalt binder. Five newly established regions for asphalt emulsion of the TGA distinguished the polar and non-polar regions of asphalt binder, including the water and emulsifier regions. FTIR analysis found carbonyl (C=O) and sulfoxide (S=O) indices higher

in asphalt binder than asphalt emulsion residue and asphalt emulsion. Moreover, the amine group was found on the four materials that contained emulsifier. The results concluded that thermal and chemical characterization of asphalt emulsion based on other asphaltic materials through TGA and FTIR analysis can provide insight to the composition of these materials.

The Surface Chemistry of Light-Aged Bitumen

Speaker: Stefan Werkovits

Authors: Stefan Werkovits, Markus Bacher, Thomas Rosenau, Bernhard Hofko, and Hinrich Grothe

Abstract: Asphalt roads and sealing layers of rooftops are permanently exposed to sunlight. Solar radiation induces molecular reactions resulting in irreversible changes in the material. These processes appear on the surface but impact the bulk chemistry and mechanical properties of the construction materials as time progresses. Bitumen, a mixture of organic molecules is particularly susceptible to such influences. However, the unique reaction mechanisms of light-induced ageing are still poorly explored. Here we show the impact of light on the formation of oxidation products, the restructuring of aromatic systems, and how both processes depend on ageing atmosphere, bitumen source, and time. The applied analytical techniques were infrared, fluorescence, and nuclear magnetic resonance spectroscopy. The presence of oxygen was essential for molecular changes. We found evidence for the formation of sulfoxides, multiple carbonyl species and aliphatic alcohols. The number of fluorescent aromatic molecules and the average size of aromatic systems changed due to processes such as photo-induced degradation, dehydrogenative polymerization and aromatization reactions. Ageing rates were dependent on the origin of the binder and the light source, showing an asymptotic profile with time. By understanding the molecular processes in more detail, efficient ways to prevent solar influences might be reachable in the future.

Elimination of Hydrogen Sulfide via Scavengers

Speaker: Juan Lopez

Authors: Juan Lopez and Kevin Kempton

Abstract: Hydrogen Sulfide (H_2S) abatement is needed to improve the safety of personnel in the asphalt industry and to increase the longevity of critical equipment. H_2S gas forms when sulfur, an inherent component of asphalt, undergoes a chemical conversion promoted by high temperature and/or modification. H_2S presents its biggest hazards at points in which the asphalt binder is held at high temperatures, particularly at the loading rack within the asphalt terminal. H_2S scavengers have been adopted by the asphalt industry to treat crude rundown at the refinery. Metal scavengers are the most prevalent chemistry utilized in asphalt binder due to their resistance to high temperatures and their binding capacity to sulfide species to prevent H_2S from evolving. However, H_2S reversion can occur during asphalt modification, and special care should be taken to select the correct H_2S scavenger for the binder formulation being produced. The goal of the presentation is to promote a better understanding of how to leverage available scavenging technologies at the liquid terminal to reduce the risk of H_2S exposure. A key focus of the presentation will be a comparison of scavenger efficiency amongst different binder formulations as they pertain to H_2S abatement.

Determination of Aged Asphalt Binder Blending Potential by Dissolution in Heptane/Toluene Solutions

Speaker: Carlos Manuel Hermoza Atausinchi

Authors: Carlos Manuel Hermoza Atausinchi and Pedro Romero Zambrana

Abstract: This research aims to develop a practical approach for evaluating the solubility of aged binders and estimating their blending potential in recycled asphalt pavement (RAP) mixtures. The study investigates the use of the gray-level analysis of Heptane/Toluene solutions to assess solubility of aged asphalt binders and predict the blending potential of RAP binders. The methodology involves analyzing the color variation of solutions of n-heptane and toluene containing unaged, 20-hour PAV, and 40-hour PAV asphalt binders from different sources using settled and agitated approaches.

The research finds that the gray-level analysis of heptane-toluene solutions is a cost-effective and straightforward method for transportation agencies to estimate the general blending potential of RAP binders. The results demonstrate that the agitated approach provides more accurate and consistent results than the settled approach and yields a reliable parameter for assessing blending potential. The findings of this study provide valuable insights into the mechanisms of asphalt binder aging and can inform the development of effective rejuvenation techniques. The insights gained from this research can contribute to the development of more sustainable and cost-effective practices in the asphalt industry, ultimately leading to improved pavement performance and longevity.

Effects of Thermo-Reversible Aging of Asphalt Binder on Stress Relaxation

Speaker: Jerron Zhang

Authors: Jerron Zhang, Chandra Mohanta, Hanwalle M.C. Nawarathna, and Simon A.M. Hesp

Abstract: It is important to account for the effects of thermo-reversible aging for the accurate grading of asphalt binder, especially when used in cold climate regions. The main barriers to the wide acceptance of the extended bending beam rheometer (EBBR, AASHTO TP 122) test are the fact that it is time-consuming and labor-intensive. This study aimed to develop a more practical method to quantify thermo-reversible aging by using the stress relaxation spectrum obtained using a dynamic shear rheometer (DSR). Twenty asphalt binders were obtained from contracts around North America. Pressure aging vessel (PAV) residue was used to perform stress relaxation in the DSR at 0°C after rapid and slow cooling. The effects of cooling rate on the stress relaxation spectra were assessed and correlated with the low temperature grade losses in the EBBR protocol. The changes in the stress relaxation spectra of the asphalt binders after slow cooling can be used to obtain a thermo-reversible aging degree. This study provides a simple and precise method for the evaluation of thermo-reversible aging of asphalt binder as an alternative to the EBBR test. Straight Alberta, Canada binder with a compatible phase structure shows superior performance as it is not affected by cooling rate.

Impact of Equipment Type on Particle Size Measurement of Civil Engineering Materials

Speaker: Tanner Turben

Authors: Tanner Turben, Tasnimul Ferdous, Andrew Braham, and Wen Zhang

Abstract: The particle size of fine materials (passing #200 sieve) used in civil engineering applications affects important material characteristics. While the effect of particle size is well documented, there is little consensus on the methods used in particle size analysis (PSA). The objective of this study is to compare two PSA technologies and provide recommendations for development of PSA standards, potentially including percent of particles smaller than 10%, 50%, and 90% of the sample and span. This research focused on laser diffraction and Coulter counter technologies, two popular methods for performing PSA. Both technologies report particle diameter: laser diffraction through optical scattering and Coulter counter by electrical impedance. Samples of sands, clays, asphalt emulsions, and cements were compared using both technologies to assess differences of each method. Additionally, a scanning electron microscope (SEM) was used to quantify the particle shape and determine any effects between shape and PSA results. It was found that PSA of dry and wet sieved sands are different; wet sieved exhibited lower standard deviation. SEM revealed the cements were all different shapes. The results could be used to recommend preferable methods for measuring each type of material, comparing results obtained between technologies, and recommending future PSA standards.

Our Services

Renewable Upcycling

Materials

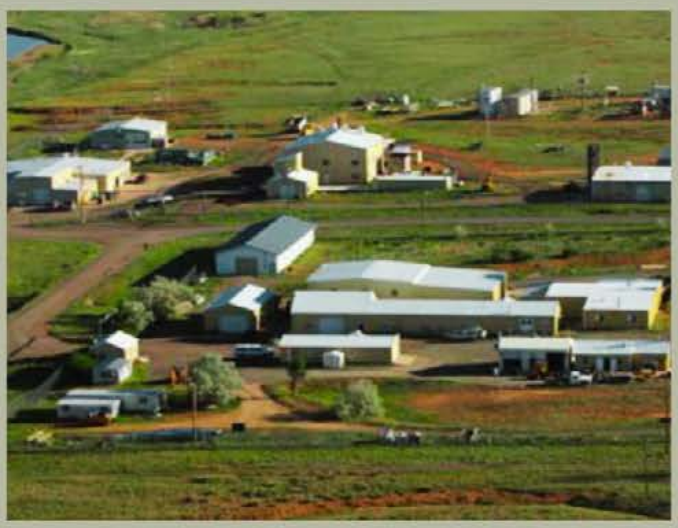
Asphalt Technologies

Engineering

WesternResearch INSTITUTE

celebrating 40 years as WRI

Reimagining tomorrow's energy and materials for a lower carbon intensity and sustainable future



To learn more, scan this code!

www.westernresearch.org

custom solutions for every client!

Reactive Isocyanate-Based Asphalt Binder Modification: Lab and Field Trials

Speaker: Phillip Blankenship

Authors: Phillip Blankenship, Zack McKay, and Jean-Pascal Planche

Abstract: Asphalt binder modification using elastic polymers, reactive terpolymers, and ground tire rubber are used to improve the performance of asphalt mixtures. Modified asphalts are increasingly used to improve cracking resistance, durability, and improve resistance permanent deformation. However, changing climatic conditions and increased traffic volume and load, demand the need for newer additives to improve pavement performance even more. While adding polymers to the asphalt binder improve the quality, additional processing is usually needed at a terminal or asphalt mix plant. Reactive-isocyanate-based asphalt modification was introduced most recently in the US beginning in 2015. Reactive-isocyanate based modifiers are low viscosity, liquid-based, reactive modifiers that are typically added at the liquid asphalt terminal with agitation and can be used with or without other polymers. The product crosslinks bitumen components and asphaltenes to molecularly integrate and functionally improve the binder. Reactive isocyanate-based modified binders show strong elastic properties and excellent durability across a wide range of temperatures. Substantial research has been performed by several institutions including Asphalt Institute, Texas A&M, UNH, NCAT and WRI. Research included detailed evaluations of the binder and mixture properties. This paper will provide an overview of the research performed and multiple project field trials with performance to-date.

Sustainable Alternative for Recycling of Asphalt Pavements Using End-of-Life Wind Turbine Blades

Speaker: Jeramie Adams

Authors: Jeramie J. Adams, Yogesh Kumbargeri, Jean-Pascal Planche, Seth Bassham, and Alex Literati

Abstract: Renewable energy from wind is rapidly growing in the United States with more than 71 thousand wind turbines installed since July 2022, and many more wind farms (on-shore and off-shore) are scheduled to be built in the next 5 years. Each wind turbine consists of three wind turbine blades (WTB). WTB are massive (up to 115 ft long, and up to 30,000 lbs long) composite structures mainly consisting of thermoset resin (often epoxy) and glass fibers (some are made with carbon fiber) that are typically replaced every 20 years. At the end of their life, these highly engineered composites end up in landfills, as they are difficult to recycle. It is estimated that by 2030, there could be as many as 100,000 tons of WTB produced each year. Under the WRI's Waste Re-engineering Initiative, a thermochemical method was developed to use renewable bio-based carbon reactive solvents to breakdown the thermoset resins and produce an oxidatively stable oil that works well as a recycling agent (RA) for oxidized asphalt. An in-depth chemical and rheological investigation was conducted to gauge the performance of this WTB based RA. The oxidative stability of this product was demonstrated by comparing it to a commercial bio-based recycling agent. Specific asphalt bases where chosen that are oxidation sensitive with a very high rate of deterioration with respect to fatigue and low temperature cracking properties. The WTB based RA was very effective in rejuvenating these "difficult asphalts". This strategy provides blueprint for an effective solution to sustainably recycle asphalt pavements using end-of-life wastes from other industries struggling to become more circular by using the benefits of renewable green chemistry.

Detection of Vanadyl Porphyrins and Sulfur-Containing Vanadyl Porphyrins in Asphaltenes

Speaker: Kushal Modi

Authors: Kushal Modi, Matthias Witt, and Estrella Rogel

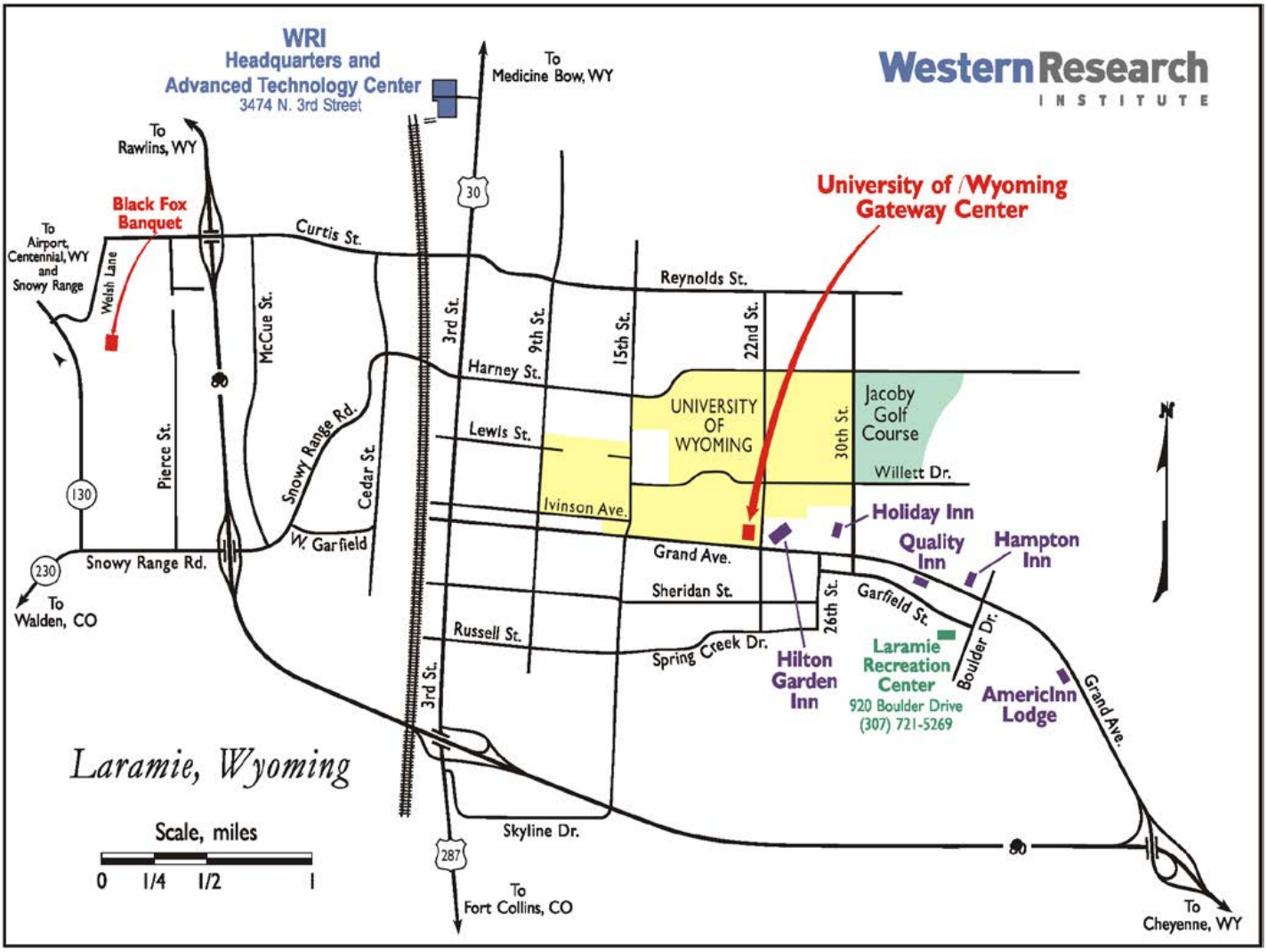
Abstract: Metallo-porphyrins are present in crude oil and enriched in asphaltenes. The most common forms are vanadyl porphyrins which are used as biomarkers for the oil. The different forms of these petro-porphyrins are of high interest and can be purified via chromatographic methods. However, due to the high abundance of these petro-porphyrins in the asphaltene, these compounds can be directly detected in the asphaltene fractions using ultra-high resolution mass spectrometry. Both vanadyl porphyrins and sulfur containing vanadyl porphyrins were directly detected from the asphaltene without chromatography.

Rheological Fingerprinting of Bitumen-Rubber Modified Binders in South Africa for PG Specification and Quality Control Purposes

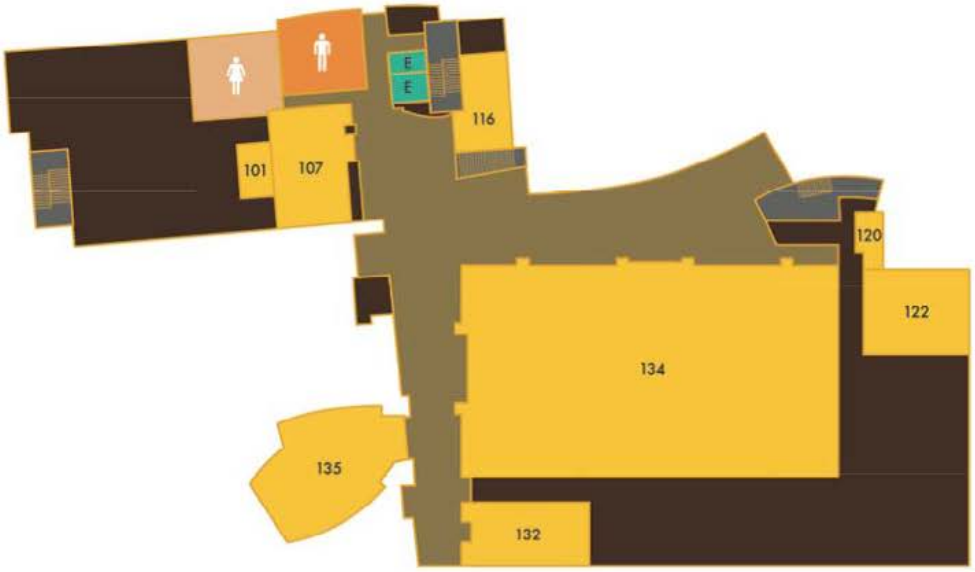
Speaker Author: Steph Bredenhann

Authors: Steph Bredenhann, S Naidoo, B. Nzuza

Abstract: The South African National Roads Agency (SANRAL), as part of their national route, N3, upgrade project in Kwazulu-Natal, decided to investigate and test the available bitumen-rubber products in South Africa. The aim with the study is two-fold, viz. firstly, identify the products and develop a fingerprint of each product for quality control purposes and secondly, provide adequate background information to develop a reliable project specification, especially with the implementation of the South African Performance Grade Specification (SATS 3208). Binder by two secondary suppliers were tested, each using two bitumen sources and two manufacturing technologies, viz. traditional wet-method and modified with Fisher-Tropsch technology, thus eight binders in total were tested. The bitumen-rubber binder will be used open-graded mixes as a wearing course on the N3 upgrade projects for its ability to optimise the safety and comfort characteristics - safety in terms of superior skid resistance and drainage capacity and comfort in terms of reduced noise generation. Open-graded wearing courses are considered for very high traffic loading that warrants the higher quality binder.


WRI
Headquarters and
Advanced Technology Center
3474 N. 3rd Street
Western Research
INSTITUTE
To
Medicine Bow, WY
To
Rawlins, WY
Black Fox
Banquet
University of Wyoming
Gateway Center
To
Airport,
Cencennial, WY
and
Snowy Range
Welsh Lane
Curtis St.
McCue St.
3rd St.
9th St.
15th St.
22nd St.
Reynolds St.
Harney St.
UNIVERSITY
OF
WYOMING
30th St.
Jacoby
Golf
Course
Willett Dr.
Lewis St.
Ivinson Ave.
Pierce St.
Snowy Range Rd.
Cedar St.
W. Garfield
Holiday Inn
Quality
Inn
Hampton
Inn
Grand Ave.
Sheridan St.
Garfield St.
26th St.
Boulder Dr.
Russell St.
Spring Creek Dr.
Hilton
Garden
Inn
Laramie
Recreation
Center
920 Boulder Drive
(307) 721-5269
AmericInn
Lodge
Grand Ave.
Snowy Range Rd.
To
Walden, CO
Laramie, Wyoming
Scale, miles
0 1/4 1/2 1
Skyline Dr.
To
Fort Collins, CO
To
Cheyenne, WY

MARIAN H. ROCHELLE
GATEWAY CENTER

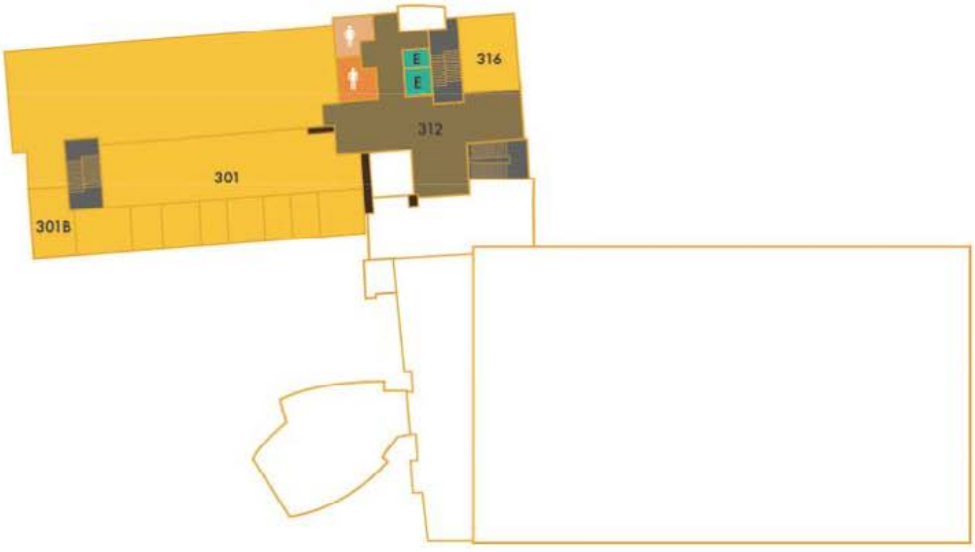


1ST FLOOR

101 - Alumni Offices
107 - Blalock Family Room
116 - Tomé Student Admissions Center
120 - Facility Manager
122 - Cowboy Call Center
132 - Cline President's Room
134 - Event Center
135 - McMurry Foundation UW Legacy Hall

2ND FLOOR

203 - Boyd Conference Room
212 - Hartman Reception Area
216 - Rile Training Center
217 - Walters Corporate Reception Area
219 - Dyekman Conference Room
222-231 - Career Recruiting Rooms
232 - First Interstate Bank Conference Room



3RD FLOOR

301 - UW Foundation Offices
301B - Clay Conference Room
312 - Mendicino Reception Area
316 - Guthrie Conference Room

- Stairs
- Elevators