Workshop-4 Program

Changes in the binder properties and the role of additives

Join hands together in sharing ideas to develop “Circular, Sustainable and Smart Pavements for Tomorrow…”

July 15, 2021
### Changes in the binder properties and the role of additives

<table>
<thead>
<tr>
<th>Time</th>
<th>Session 1: Changes in the bitumen market and methods to manage the current challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:30-12:35 (GMT)</td>
<td>Welcome</td>
</tr>
<tr>
<td>14:30-14:35 (CEST)</td>
<td>Moderators: Dr. Sayeda Nahar, TNO, The Netherlands</td>
</tr>
<tr>
<td></td>
<td>Dr. Xueyan Liu, Delft University of Technology</td>
</tr>
<tr>
<td>12:35-13:50 (GMT)</td>
<td>Session 1: Changes in the bitumen market and methods to manage the current challenges</td>
</tr>
<tr>
<td>13:50-14:00 (GMT)</td>
<td>Dutch challenges due to the changes in the bitumen market: the research project ‘Grip on bitumen’</td>
</tr>
<tr>
<td></td>
<td><em>Inge van Vilsteren, RWS</em></td>
</tr>
<tr>
<td>14:35-15:50 (CEST)</td>
<td>Bitumen quality variability and impacts on pavement materials, what is missing in current specifications</td>
</tr>
<tr>
<td></td>
<td><em>Frédéric Delfosse, Eurovia</em></td>
</tr>
<tr>
<td>14:35-15:50 (CEST)</td>
<td>A Tale of Two Deltas: Analysis approach, proposed limits, and validation work to address binder quality-related thermally induced surface damage.</td>
</tr>
<tr>
<td></td>
<td><em>Michael Elwardany, Dave Mensching, FHWA</em></td>
</tr>
<tr>
<td>13:50-14:00 (GMT)</td>
<td>Session 2: Binder additives and trends in the asphalt recycling practices</td>
</tr>
<tr>
<td>14:00-15:15 (GMT)</td>
<td>Recycling practices and additives in asphalt: Current practices and the future trends</td>
</tr>
<tr>
<td></td>
<td><em>Lily Poulakakos, EMPA</em></td>
</tr>
<tr>
<td>16:00-17:15 (CEST)</td>
<td>Routes to durability and sustainability: Recycling of PmB containing RAP</td>
</tr>
<tr>
<td></td>
<td><em>Dr. Xueyan Liu, TU Delft</em></td>
</tr>
<tr>
<td>15:15-15:30 (GMT)</td>
<td>Designing a toolbox for bitumen to answer the need for tomorrow's pavement</td>
</tr>
<tr>
<td>17:15-17:30 (CEST)</td>
<td><em>Laurent Porot, Kraton Polymer B.V.</em></td>
</tr>
<tr>
<td></td>
<td><strong>Expert discussion</strong></td>
</tr>
</tbody>
</table>
**Session-1: Changes in the bitumen market and methods to manage the current challenges**

**Dutch challenges due to the changes in the bitumen market: the research project ’Grip on bitumen’**

*Inge van Vilsteren, specialist construction materials*

*Rijkswaterstaat: Ministry of Infrastructure and the Environment, The Netherlands*

**Abstract:**
More than 90% of the wearing course on the Dutch motorway consists of porous asphalt. Stone Mastic Asphalt and Noise reduction thin layers are the most common wearing course of the national roads, which are mostly expressways. At the regional access roads and ringways, dense asphalt concrete and Stone Mastic Asphalt are used.

The asphalt pavement on the Dutch roads are mainly constructed using penetration grade bitumen. Polymer modified bitumen is used in specific application of wearing courses, but this is not widely used.

Nowadays, the Netherlands do not have a bitumen refinery within their borders. Knowing that the refineries changes there processes over the last couple of years, the perception was that the quality of bitumen was not that constant anymore. At the same time asphalt mixtures become increasingly complex and specialized and the roads economic life cycle are becoming increasingly important.

With this growing realization a new research project started; “Grip on Bitumen” (GoB). Within a working group consisting of 20 members from engineering companies, laboratory-facilities, road-constructors, asphalt-producers, bitumen suppliers, branch originsations and normative institute, all knowledge was combined.

This project team started in 2018 and the last deliverables are due is summer. At the iFRAE one member of Grip on Bitumen will take you through the current challenges in complying with the binder properties in the Dutch context. She will take you through the current findings, the knowledge provided out of parallel projects and the follow up after this.
About the speaker

Inge van Vilsteren is a specialist construction materials within the section of Roads and Geo-engineering at Rijkswaterstaat, the Dutch highway authority. Within a team of 35 specialists the section Roads and Geo-engineering is the dedicated advisory-group for around 8000 colleagues.

Inge is the specialist on construction materials in general and in asphalt concrete in particular. With around 90% Porous asphalt as the top-layer paving material on highways, this is a specific knowledge area.

Within the research program of the Section Roads and Geo-engineering, her research topics mostly relate to the development and implementation of innovative asphalt-mixes, with the focus on durability and sustainability. Within Rijkswaterstaat, Inge is one of the knowledge-group members of the internal Program for the Transition towards sustainable roads.

She is a member of the National Working Group Asphalt (CROW) for the Dutch implementation of technical requirements for pavement materials. This is a fine combination with the membership of CEN/TC227 working groups and technical committees on the international level involved in developing EN-norms e.g. technical requirements for pavement materials.

Inge is a member of the Dutch mirror-group for CEN/TC336 Bitumen and bituminous binders. Her knowledge of bituminous binders is well used in the binder-project “Grip on bitumen” within a Dutch branch-wide project “Asphalt-Impulse”.

Bitumen quality variability and impacts on pavement materials, what is missing in current specifications

Frédéric DELFOSSE, Eurovia Research Centre, Mérignac, France

Abstract

The current situation of revamping and rationalization from refiners creates concerns about the quality and consistency of the delivered bitumen, especially as the current specifications appear insufficient to ensure satisfactory performance of the finished products. In this context, the search for relationships and correlations between bitumen properties and performance of the asphalt mixtures and the pavement has become very relevant. Moreover, with the constant increasing of RAP content in new asphalt mixes coupled with the usage “rejuvenators”, some limits of conventional tests methods can be pointed out.

This presentation will highlight some new innovative bitumen and HMA indicators, allowing one to guarantee the durability of the road for the future. A study based
from a standard mix design with one type of aggregate (similar volumetric properties) and 16 bitumens from various origins is presented. The characterization of asphalt mixes covered various mechanical tests such as modulus, rutting, fatigue, water sensitivity and thermal cracking.

Also, this study spotlights how crucial it is to consider long-term ageing on the low-temperature end, since their behaviour can highly be impacted for both bitumen and asphalt mixes.

About the speaker

Frédéric Delfosse is a physico-chemical engineer who joined Eurovia in 1998. He is currently the Director of Eurovia’s Research Centre near Bordeaux, France. He started his career as research engineer on emulsions and cold mixes for 5 years before becoming a project manager working on different research programs concerning asphalt. Since 2016, he oversees 33 people working at the Research Centre on various international research projects related to asphalt, such as cold products, innovative additives for the road industry, the development of new mechanical tests for HMA, road marking, aggregates, railway, new innovative sensors to measure road properties in place or even artificial intelligence for autonomous vehicles for instance.

A Tale of Two Deltas: Analysis approach, proposed limits, and validation work to address binder quality-related thermally induced surface damage.

Michael Elwardany, Dave Mensching, Jean-Pascal Planche, and Gayle King

Federal Highway Administration, and Western Research Institute, USA

Abstract:

Superpave specifications address binder properties that may lead to rutting, transverse cracking, and fatigue damage with varying degrees of success. However, asphalt binder production and formulation has significantly changed and introduced much more variability in terms of quality since the development of Superpave Performance-Grade system because of economic, technical, and environmental reasons. Consequently, aged-induced surface distresses under combined thermal and traffic loading have become the main challenge for highway agencies. Thermally induced surface deterioration appears in the form of traditional transverse cracking, block cracking, and raveling, or accelerating
damage at construction joints. This study evaluated the limitations of the proposed linear viscoelastic (LVE) rheological cracking surrogates, such as $\Delta T_c$, R-value, and G-R parameters, and the ability of the Asphalt Binder Cracking Device (ABCD) failure test to overcome these limitations. ABCD is particularly appropriate to rank binder performance because the measured cracking temperature ($T_{cr}$) encompasses binder LVE properties, failure strength, coefficient of thermal contraction, and cooling rate. The proposed parameter ($\Delta T_f = T_c (S=300 \text{ MPa})$ from BBR - $T_{cr}$ from ABCD) relates the failure temperature to the equi-stiffness temperature and gives credit to well-formulated and compatible polymer-modified binders expected to increase binder strength and strain tolerance. This paper proposes a specification framework based on both $\Delta T_c$ and $\Delta T_f$ universally applicable, regardless of binder composition. Additionally, preliminary specification limits are proposed based on the analysis of 44 binders, 15 with corresponding field performance data. Obviously as confirmed by a recent stakeholder workshop and industry feedbacks, these preliminary specification limits need further validation and possible adjustments to account for regional experience and local challenges. Current efforts at FHWA TFHRC, in collaboration with various State Highway Agencies (SHA’s), are focused to further validate the framework and specification limits.

About the speakers

**Dr. Michael Elwardany** is the manager of the Asphalt Binder and Mixture Laboratories (ABML) at the Federal Highway Administration (FHWA) Turner Fairbank Highway Research Center. He was the program manager for paving asphalts at the Western Research Institute (WRI) for three years. Dr. Elwardany served as project lead to the National Cooperative Highway Research Program (NCHRP) 09-60 Project and the project manager for the Asphalt Industry Research Consortium (AIRC). He is an active member of several Transportation Research Board’s Standing Committees, Association of Asphalt Paving Technologists (AAPT), RILEM, and ASCE-Airfield Pavement Committee. Dr. Elwardany holds Master’s degrees from University of New Hampshire and a Ph.D. from North Carolina State University. He is a licensed professional engineer in the State of Wyoming, USA.
Dr. David Mensching is the Asphalt Materials Research Program Manager for the Federal Highway Administration (FHWA). He is the director of Turner-Fairbank Highway Research Center’s Asphalt Binder and Mixture Laboratory and has research interests in automation and data science, connected pavements, resilience, and performance specifications. He is the chair of the Transportation Research Board's Standing Committee on Binders for Flexible Pavement and an active member of the Association of Asphalt Paving Technologists. Dr. Mensching holds Bachelors and Masters degrees from Villanova University and a Ph.D. from the University of New Hampshire. He is a licensed professional engineer in the Commonwealth of Virginia.

Session-2: Binder additives and trends in the asphalt recycling practices

Recycling practices and additives in asphalt: Current practices and the future trends

Lily Poulikakos, Ph.D
Senior Scientist, Empa - Swiss Federal Laboratories for Materials, Switzerland

About the speaker

Dr. Lily Poulikakos received her B.S in architectural engineering from the university of Colorado, Boulder USA, M.S. in civil engineering from university of Illinois USA and Ph.D in civil engineering from ETH Zurich, Switzerland. She is currently a senior scientist at Empa, the Swiss federal laboratories for materials science and technology. Her research focus is on using multi scale characterization methods to study innovative bituminous materials chemically and mechanically. She is a leading member of Rilem as former deputy chair of the technical committee TC-231 NBM on nano bituminous materials and TC-252 CMB chemo mechanical characterization of bituminous materials and currently chair of TC-279 WMR on waste and marginal materials for roads. Dr. Poulikakos is the author of over 100
publications in peer reviewed journals and editor of Elsevier journal Construction and Building Materials CBM.

Routes to durability and sustainability: Recycling of PmB containing RAP

Dr. Xueyan Liu, Associate professor
Delft University of Technology, The Netherlands

Abstract

Recycling of base asphalt pavement with rejuvenators or soft binders has been applied for many decades and a lot of experience has been gained. However, the high-quality recycling technique of polymer modified asphalt (PMA) has still not been sufficiently studied. The aging mechanism of PMA is complex, including the combined effects of the oxidation of bitumen and the degradation of the polymer. The current commercially available rejuvenators are designed mostly for base bitumen and not suitable for the recycling of PMA. For this reason, this research aims at designing an innovative rejuvenator specifically for the recycling of PMA. Firstly, a series of performance-based test methods, including viscoelastic properties, rutting resistance, fatigue resistance, cracking resistance, relaxation ability and aging ability, has been performed to select the appropriate source materials and to determine the optimum ratio between different components. After that, a specific SBS-based rejuvenator was found to be most effective in PMA rejuvenation. To reveal the rejuvenation mechanism, an environment scanning electron microscope (E-SEM) was utilized in investigating the microstructure of the rejuvenated binder. The results illustrated that E-SEM method can distinguish the influence of rejuvenator dosage, rejuvenator types, and addition of fresh bitumen on the morphology of aged PMB, which can help us to have a better understanding of the rejuvenation mechanism.

About the speaker

Dr. Liu is currently an associate Professor in the Section of Pavement Engineering of the Faculty of Civil Engineering & Geosciences of TU Delft. He works in the areas of constitutive modelling, numerical modelling and material experimental characterization. Within the research program of the Section Pavement Engineering, his research topics mostly relate to the development and implementation of constitutive models for the simulation of the static and dynamic response of various pavement engineering materials like soils, asphalt concrete, liner and reinforcing systems etc. and sustainable development technologies, i.e., multiscale
Designing a toolbox for bitumen to answer the need for tomorrow's pavement

Laurent Porot, Kraton Polymer B.V., Amsterdam, the Netherlands

Abstract

The asphalt industry is facing some key challenges. There is a need to move towards more sustainable and environmental friendly solutions to construct the pavements for tomorrow. This has to answer the market needs for greater performance with improved warranties, increased safety and less impact on environment, all in required budget constraints. At the same time, there is an even greater diversity in binders, petroleum based binders from different sources or processes for which bitumen quality may be affected. Up to now, specifications and characterisation for asphalt binders have been designed for known petroleum-based bitumen. With complex binders, more fundamental understanding and properties have to be considered to really capture the long-term benefits in road and airport engineering. And finally, beyond the technical requirements, sustainable aspects need to be part of the design including circularity, environmental impacts, health and safety amongst others. This is an important paradigm where new technologies are needed and adjustment of designing materials.

Thus, the need for new solutions are becoming increasingly common practice. Designing the exact solution may depend on various parameters such as the nature of the modifier, the dosage level, or the expected effects on the binder, on the
asphalt mix and finally on the pavement. It can be viewed as a toolbox where different options can be selected and combined together to adjust the properties of the binders that fits the need for pavement applications.

Through some examples with the specific use of polymers and bio-based additives, an example of general framework will be discussed to be served as a toolbox to design materials to bring the frontiers of road and airport engineering a step further to the future.

**About the speaker**

Laurent is Market Development Manager at Kraton, based in the Netherlands, in charge of technical development for polymer and pine chemical additives in paving and roofing application. He has a master degree of civil engineering from Ecole Nationale des Ponts et Chaussees, France. With 30 years of experience, he has capitalised a worldwide expertise on pavement engineering with pavement design, materials, job works and research & development.

He is member of numerous international scientific committees and representative in industry association. He has been working with key research institutes in the field of asphalt and pavement materials within projects and inter-laboratory experiment. With a robust technical background he extended his learning on environmental impacts and Life Cycle Assessment. He is passionate about interacting with people to design more sustainable solutions.