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## **ASPHALT CONCRETE TEST SECTIONS CONTAINING BITUMEN OF DIFFERENT ORIGINS**

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### **Abstract:**

2010 Sweden adapted the new harmonized European bitumen specification (EN-12591:2009). The Swedish so-called A-deviation concerning higher requirements for dynamic viscosity at 60 °C disappeared, and this change led to a wider range of bitumen of various crude oil origins. For investigating the impact of the change, the former Swedish Road Administration initiated this project in 2008 by inviting different bitumen suppliers to participate in a large scale project where bitumen 70/100 was purchased according to the new European specification for penetration grade bitumen. For each bitumen type, 500 tonnes of asphalt mixture (wearing course, SMA16) were produced and placed on a road. Bitumen and asphalt mixture samples were taken out during production for comparative testing in the laboratory. In addition, core samples were taken from the road and analyzed. Today the different sections have served for 10 years out on the road and this case study tells us how the seven different 70/100-bitumen have changed during the years and how the different sections have performed.

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**Experiences in building a new container terminal**

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**Abstract:**

The container terminal in Wilhelmshaven “Jade Weser Port” was built in the period from August 2011 to August 2013 as an asphalt construction on a cement stabilized dredged sandlayer. Approximately 950,000 m<sup>2</sup> pavement surface was produced for use with straddle carriers and reach stackers, as well as storage space for container handling. The analytical design of the surface attachment was based on the German regulations for this topic (RDO) and resulted in a 17 to 19 cm thick asphalt structure, consisting of 2 layers for the container shelves or 3 layers in the straddle carrier routes, using a 25/55-55 A resp 10/40-65 A bitumen. The sub-base layer consists mainly of a solidification of the hydraulic filled sand, in some areas the base course was alternatively built with crushed mineral aggregate. After 7 (the first part of the terminal) resp 6 years (the whole area) of operation, the asphalt surfaces are basically in good condition and operation with straddle carriers works well. There are varying levels of cracking in various areas, but these are not cause for concern at present. Sporadic and slight grain losses can be seen occasionally. Due to the continuous tracking of the straddle carriers, the first slight ruts in the container storage areas have occurred, but this does not represent any major impairment of the operation and was also expected.

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### **Implementation of Low Rolling Resistance Pavements in Denmark**

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#### **Abstract:**

Low rolling resistance pavements have been investigated and optimized during the last six years in Denmark. A durability study was completed by verifying wearing, rutting and cracking resistance. Laboratory investigations were done looking into the asphalt mixtures used for the low rolling resistance pavement. The results have shown that they, if correctly designed and paved, should guarantee a long-lasting lifespan and stable texture, comparable to the conventional mixtures already used on the Danish motorways. The social economic benefit, introduced by the application of this pavement type, relies on the fact that these new pavements should last at least 15 years. In the light of this scenario, the Ministry of Environment has financed a demonstration project focused on paving 50 km on the state road network with the Low rolling resistance asphalt mixture in 2018. Contractors involved in the construction of these pavements were defined by public tendering process. All the paved sections were sampled and controlled following a specific laboratory investigation and paving operations were monitored to assess and verify the quality in the field. Functional characteristics of the finished climate friendly layers were measured and controlled afterwards to verify and validate prediction models. All the different demonstration sections and relative data will be described focusing on the challenges faced by the different contractors; challenges from the optimization of the asphalt mixture at the laboratory to the practical implementation at the asphalt plants and the paving operations themselves.

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**Reduction of the production- and fabrication temperature of asphalt using viscosity reducing additives - Results of a 12 years observation**

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**Abstract:**

This paper describes the results of the investigations and long-term observation within the research and development project "Reduction of the production- and fabrication temperature of asphalt using viscosity reducing additives". The materials investigated were two Stone Mastic Asphalts, SMA 8 S and SMA 11 S and also one binder course asphalt AC 16 B S. To reduce the viscosity of the material, both viscosity reduced binders and viscosity reducing additives were applied. As reference material, a polymer-modified bitumen 25/55-55 A was applied. The viscosity / temperature reduction was achieved via the application of products such as FT-wax, amide-wax or aliphatic hydrocarbon. During the conception phase, 9 variants of SMA and asphalt binder mixes were optimised using the temperature-reduction potential and by considering the target value "void content" for the following: Workability Low temperature cracking Resistance to permanent deformation The different bitumen were tested both in its original state and laboratory-aged state with the conventional test methods (e. g. softening point ring and ball, needle penetration) and also with the performance-related test methods (e. g. DSR, BBR). Further tests were carried out on the extracted bitumen directly after finishing the construction of the asphalt layers within two trial sections. The trial sections were subjected to a systematic observation program (beginning 2004). Further observation was then conducted after 2, 4 and 8 years whilst working under traffic and weather conditions. At these specific points samples were taken from the trial sections to carry out laboratory tests. Visual checks concerning surface conditions (e. g. cracks, patches) and measurements concerning grip resistance or evenness were conducted. The comparison of the result between the reference material and the temperature-reduced asphalt mixtures showed no significant disadvantages. In addition to these investigations results of an observation after 4 more years showed the beginning of specific changes.

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**Renewal of the pavement of a very heavily trafficked German highway on the basis of an availability model**

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**Abstract:**

The public-private partnership project “BAB6 AS Wiesloch/Rauenberg - AK Weinsberg” comprises a 48km section of the German highway BAB 6 in Baden-Württemberg, which ranks among the most heavily stressed highways nationwide, counting about 273 million equivalent 10t-axle passages over 30 years. This project was placed as an availability model and contains the partial six-laning and the operation for 30 years. In 2017, the contract has been awarded to the project company “ViA6 West”, who will operate and maintain the entire section. However, “Via6 West” subcontracted the execution planning and constructional implementation of the required construction activities to the consortium “A6 West”. To ensure high quality and performance, “ViA6 West” supervises “A6 West” and the execution planning occurred in close coordination. The pavement is optimized by computational dimensioning, the selection and enhancement of the material, and appropriate construction methods to assure bearing capacity and performance of the pavement over and also beyond the operation period. Because of topographical reasons, the section contains only 5 overpasses, but 31 bridges, including the 1.35km long crossing of the Neckar Valley. The highway is extended from 4 to 6 lanes on 25km length in total by basically renewing the pavement, thereof 16km with porous asphalt surface course for noise protection. The remaining renewed parts get a stone mastic asphalt surface course. The asphalt mixtures contain the reclaimed asphalt of the previous pavement, so that 100% of the reclaimed asphalt will be recycled. As an innovation, the sealing below the porous asphalt surface course consists of very dense asphalt concrete, paved as upper layer with the compact asphalt method. The sections with stone mastic asphalt surface course are paved hot on hot with compact asphalt method as well. The renewal of the pavement started in 2018 and is planned to be completed in mid-2020.

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**Practical experience in the viscosity modification of asphalt for performance or workability purposes in Germany**

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**Abstract:**

The application of viscosity modifying additives or viscosity modified bitumen in Germany traces back primarily to the reduction of the asphalt-temperature in order to fulfil health and safety requirements for the paving of mastic asphalt and to cost-savings at the asphalt production. The temperature reduction of asphalt is mandatory as well as implemented in the German technical specification in case of mastic asphalt since 2007. In addition, roller-compacted asphalt shall be laid temperature reduced since 2014 also, if placed in tunnels. But beyond working temperature reduction, the viscosity modification of roller-compacted asphalt offers also further potential ranging from better workability and compactability to an earlier road opening to traffic and to enhanced asphalt performance in practice. The application by reason of performance was shown for example on heavy trafficked motorways, logistics as well as port areas, and roundabouts. The advantage of better workability and compactability requires that the working temperature is kept, but allows laying or better results in special conditions such as unfavourable weather conditions, placing by hand, or geometry of the area. Because of the increasing application of viscosity modification, an advice on the classification of viscosity modified bitumen was published in Germany in 2016. Indeed, this allows an easier comparison of the different existing viscosity modified bitumen; but for viscosity modification of asphalt in general as well as in case of adding viscosity modifying additives at the mixing plant, suitable information concerning the application as well as formal guidelines still lack or notes are manufacturer- or product-specific. Therefore, some engineers or contracting authorities avoid viscosity modification, even if the performance or durability of the pavement could be improved by the application. The paper describes the successful experience with viscosity modification of asphalt in Germany on the basis of different applications and gives suitable information.

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**Design and development of new bituminous mixtures, based on waste recovery, to be used as the main component of slab tracks in urban tram lines.**

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**Abstract:**

This article aims to show the work carried out to develop a new slab tracks in urban tram lines that, thanks to the intrinsic viscoelastic behavior of the bituminous mixtures, which allows to mitigate the transmission of vibrations from its origin (the wheel-rail contact) to the ground, thus attenuating the condition to the environment and the arrival of these to the foundations of the adjoining structures. To achieve this objective, bituminous mixtures have been designed and studied, including the addition of plastics from recycled materials, thus seeking an improvement in their global properties, while achieving a revaluation of waste, with the economic and environmental advantages that this implies. This article presents the results obtained in laboratory tests carried out to evaluate the behavior of the material, the numerical modeling developed for design (Structural checks and vibratory considerations) and the execution and evaluation of a bituminous mixtures slab track pilot section. To evaluate the behavior of different bituminous mixtures to mitigate the transmission of vibrations, resistance to fatigue and stiffness tests were carried out according to current European standards. The numerical modeling developed was calibrated and validated for concrete slab tracks in tram projects previously to this study and it was adapted and used to design and optimize the structural section which was executed as pilot section. A bituminous mixtures slab track pilot section located in El Campello, Spain (Owner: TRAM Metropolitana D`Alacant. Generalitat Valenciana) was built, checked and monitored along the time. After more than five years, this pilot section continues to function properly and keeps its properties intact, thereby it can be considered that the success of the project has been achieved.

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**Influence of bituminous sublayer on high speed line structure behaviour: Case study Brittany-Loire HSL**

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**Abstract:**

Feedback on the use of a bituminous sublayer in the trackbed of the Brittany-Loire (BPL) high-speed line (HSL) is presented in this paper. This ballasted HSL has 105km of innovative trackbed with bituminous sublayer (GB), and 77km of conventional unbound granular material (UGM) trackbed. In order to monitor the behaviour of the innovative track, three sections of the GB zone were instrumented with multiple sensors such as accelerometers, extensometers, anchored displacement sensors and temperature and humidity probes. A section of the UGM zone was also instrumented to serve as reference. The sensors were placed during the track construction at different positions and depths in order to monitor the behaviour of each component of the track, from the sleepers to the soil. This paper presents the acceleration (on sleepers and sublayer) and strain (in GB layer) measurements for train circulations at speeds ranging from 160 to 352 km/h. The comparison with the measurements from the reference section shows a clear reduction of the vertical accelerations of the track components with the use of a bituminous sublayer. This would lead to lower ballast deterioration induced by dynamic loads. Additionally, the magnitude of the strain measurements at the bottom of the bituminous layer was found to be compatible with the track structure dimensioning hypothesis, which validates the design. Moreover, the strain levels were observed to be very low, compared to typical values observed in conventional highway structures, which might lead to slow fatigue damage of the bituminous mixture. These observations suggest that the trackbed design and the used materials are compatible with the 100 years lifetime required for the HSL structure.

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**Synthetic waste material as competitive stabilizing additive**

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**Abstract:**

The paper presents results of SMA mix containing stabilizing additive made of synthetic material – HDPE originated from recycling processes. The paper contains both report on in field trial section made in August 2013 and laboratory tests. Laboratory tests enabled to make comparison between SMA containing commonly used cellulose fibers and HDPE additive without cellulose fibers. Analysis shows that HDPE additive has both stabilizing possibilities positive side effects concerning i.e. rutting resistance. After 5 years of traffic laboratory tests were repeated and trial section was analyzed in terms of its condition and certain parameters.

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**From 9 field demonstrators to many lab studies: Sustainability of the Multirecycling process through the PN MURE Project**

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**Abstract:**

A collaborative national research project, known as MURE (which stands for the multirecycling of asphalt) got under way in France in 2014. Its aim is to demonstrate know-how in the area of high recycling rates coupled with techniques that lower temperatures, and to forecast the consequences of recycling asphalt that already contain high proportions of RA, reclaimed asphalt, i.e. multirecycling. Nine field demonstration sites were created between 2015 and 2018 with either 40 or 70% RAP content, wearing courses. Both hot and warm mixes were manufactured.. Three of these sites (an additive warm asphalt with 40% RA rate, a foam warm asphalt with 70%RAP, an additive warm asphalt with 40% RA including PMB ) were constructed in four stages in order to simulate the construction of a new wearing course followed by three recycling operations, i.e. approximately 40 years of service. This paper will set out the aims of the field demonstration sites. The industrial accelerated ageing method used to simulate 10 or so years of service will be described. Results that demonstrate the ability to forecast the thermoviscoelastic properties of the asphalt using the 2S2P1D model will be presented. The rate of mixing between the binder in the RA and the added bitumen will be addressed. To date the main conclusions of the project are: up to 40% RAP, no issue. Tests methods, scientific concepts are pertinent to characterize and modelize the asphalt properties. Whatever the way of manufacturing the asphalt, a quasi perfect blending between the new and the old bitumen can be achieved and this fact can be tested. For the 70% RA asphalt studies are still under way. The nine demonstrators will be followed up until 2025 to secure these conclusions.

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**Development of high performance asphalt mixtures for port pavements**

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**Abstract:**

Due to the advances produced in modified asphalt binders, bituminous mixtures are being used in infrastructures where cement concrete has been traditionally conceived as a more competitive solution. In this respect, the use of bituminous mixtures is becoming more popular in the construction and maintenance of port pavements. However, in spite of these advances, the design of bituminous mixture is carried out under similar criteria to those used for road pavements, and their mechanical performance do not offer the expected durability. Because of this fact, during the research study, a new design procedure has been developed in order to define more durable asphalt materials to be used in port pavements. For this purpose, the mechanical response of high-performance bituminous mixtures is evaluated under similar load and environmental conditions to those occurred during their service life (static and dynamic punching, the effect of heavy vehicles at low speed and the presence of fuel). Results demonstrate that using the procedure presented it is possible to optimize the design of bituminous mixtures in order to improve their resistance, especially under adverse service conditions.

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**Bituminous materials for railway engineering**

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**Abstract:**

Railway is considered to be a fundamental transportation system by providing diverse environmental and economic advantages, particularly after the development of high speed railway. However, during the design of modern railway, it should be also considered that the continuous rise in train speed leads to important increases in the dynamic loads transmitted to the track, while these infrastructure requiring higher resistant and quality indexes. In this context, the application of bituminous mixtures at the top of the substructure could allow for improving the mechanical performance and durability of the global track section while reducing maintenance costs. However, to obtain such benefits, it is required a proper design and analysis of the bituminous materials to guarantee its long-term performance. Thus, the present paper focuses on developing high-performance asphalt materials designed according to their application in railway tracks. For this purpose, diverse studies were carried out for the design of resistant asphalt mixtures for railways through laboratory tests specifically developed to simulate real traffic and climate conditions expected during this application. Similarly, a laboratory test was designed to analyse the effect of the bituminous mixtures on the global railway section under different track states and conditions. Results showed that the application of the asphalt materials designed in this paper allows for improving the mechanical behaviour and durability of the railway track in reference to the conventional bituminous materials used in this field.

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**Experiences from cold recycled materials used in asphalt bases: a comparison between five European countries**

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**Abstract:**

The application of reclaimed asphalt is becoming increasingly important in the European Road Network. The demand for more environmentally friendly methods to construct pavements is growing constantly. Most developed countries are seeking new ways to consume less energy and virgin materials and produce less CO<sub>2</sub>-emissions and less waste. Beside the conventional recycling options (i.e. hot asphalt mixtures), cold recycling is becoming more popular and have been successfully applied in numerous road structures. However, the guidelines on when and how cold recycling can and should be applied differ from country to country. Structural design and mix design are also different in the European countries. A comparison of the use of cold recycling in road construction indicates that some countries are ahead of others and that comparing methods and approaches could be beneficial for all. In this paper, experiences and results are compared from five European countries. Each country presents 2-4 road sections where cold recycled materials are included in the asphalt base layer and where test results are available. Structural design, mix design, traffic loads and test results are compared to assess the success each road and study what could be learned for future constructions.

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**Re-evaluation of tracks built with a system of combined polymer and Gilsonite modification**

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**Abstract:**

Natural asphalt additives are used for a variety of purposes like enhancing bitumen properties or giving additional rutting resistance to asphalt pavements. High quality products consist mainly of asphaltenes and no significant filler amounts, which makes them usable as a bitumen additive. It is also used in pulverized form as an asphalt additive by dosing it directly to the hot mix at production stage. In Germany, some sections with extreme traffic amounts in terms of weight (like bus stops) have been built in different layouts and with different pavement types. The oldest section dates from 2009. The scope of the paper is presenting the results of a visual inspection of these areas after a service life of five to nine years.