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Assessing bitumen additives for temperature reduction of asphalt mixtures

Martin Vondenhof¹, Mohammed Ammadi¹, Fabian Thumberger²

¹Shell Deutschland Oil GmbH, ²Société des Pétroles Shell

Abstract:

Hot bitumen is perfectly suited to coat mineral aggregates and the performance of asphalt is directly linked to the complete coating of the aggregate. There is, however, a push for lower bitumen temperatures – which could have a negative effect in that process - for environmental reasons. Lower temperatures during manufacturing and laying of the asphalt mixture mean less energy consumption, and less emissions. For that purpose, various bitumen additives are offered, like waxes which melt - above the melting point temperature generating a much lower viscosity of the bitumen, below the melting point leading to an additional structure and stiffness - or surface-active agents. These increase the polarity of the bitumen and thereby ease the coating process of polar aggregates. To assess the effectiveness of such agents in the laboratory, a quick and easy test method, based on a viscosity measurement was developed. The test involves a Dynamic Shear Rheometer which is equipped with a stirrer. A reference bitumen, blended with filler, is tested at different temperatures. Exchanging the bitumen with modified versions and varying the temperature results in a ranking of the effectiveness of temperature reducing additives. Lowering viscosity generally corresponds to an easier coating process and better workability of asphalt mixtures. The method should allow the further development of temperature reduction technologies.

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Laboratory Evaluation of Warm Asphalt Mixtures Containing Asphalt Shingles

Fabricio Leiva, Randy West

NCAT - Auburn University

Abstract:

Two technologies that have received substantial attention in the last few years are the use of recycled asphalt shingles (RAS) and warm mix asphalt (WMA). These new technologies address important issues that face the asphalt industry in different ways. RAS contains a high percentage of asphalt binder and WMA uses additives or other means of decreasing the viscosity of asphalt binders in order to allow lower production and compaction temperatures compared to conventional hot mix asphalt (HMA). However, some experts in the industry have questioned if the lower mix temperatures with are sufficient to soften and activate hard RAS binders. Hence, research was needed to evaluate the combined use of WMA and RAS on asphalt mixture performance. The objective of this research was to evaluate cracking potential of asphalt mixtures incorporating WMA technologies and RAS and compare them to the corresponding HMA-RAS mixture. Five field projects were selected to conduct this study. Engineering properties of plant produced WMA and HMA were used for statistical comparisons. The laboratory testing program evaluated recovered binder performance grade, and fatigue cracking laboratory and rutting performance tests including Linear Amplitude Sweep test, Multiple Stress Creep Recovery, Bending Beam Fatigue test, Energy Ratio, Overlay Tester, Semi-Circular Bend Test, Fracture Energy, and Flexibility Index, Flow Number and Hamburg Wheel Tracking Test. Based on the experimental results it was concluded that there is no detrimental effect of using WMA technologies with mixtures containing RAS. No statistical differences were evident in cracking test results for HMA and WMA mixtures and even though there were statistical differences in rutting test results, all of the mixtures passed the performance criteria.

ASSESSING WARM MIX ASPHALT CONCRETE (WMA) AS A GREEN PAVEMENTsaad sarsam¹, Zainalabiden Nihad²¹university of baghdad, ²college of engineering**Abstract:**

Warm mix asphalt concrete (WMA) is considered as one of the finest choices of green and sustainable materials in asphalt concrete paving operation. The temperatures decline in the mixing, handling, and compaction of the mix gets in saving energy, cutting emissions and significant cuts in construction costs. The fundamental concept of the WMA is to decrease the blending and compaction temperatures of the mixture and to manufacture mixture which have the same durability, performance and strength as hot mix asphalt concrete HMA. As the result of decreased temperature of WMA, it shows less aging of asphalt mixture. It is known that, asphalt oxidation lead to stiffen or harden of the binder and may result various pavement distresses. In this work, the temperature susceptibility of two types of warm mix have been compared with those of HMA. Cylindrical specimen of 63.5 mm in height and 101.6 mm in diameter have been prepared using medium curing cutback and cationic emulsion in case of warm mix and asphalt cement in case of hot mix. Specimens were tested for indirect tensile strength ITS at 5 and 20 °C. It was concluded that WMA are less susceptible to temperature than HMA. The temperature susceptibility at optimum asphalt content are (24, 17 and 19) kPa/°C for the HMA, WMA-emulsified asphalt and WMA-cutback asphalt respectively. The temperature susceptibility of WMA was lower than that of HMA by (20.8 and 29.2) % for emulsified and cutback asphalt mixes respectively. WMA exhibit higher ITS at 25 °C than HMA by 30.59% and 23.9 % when using cutback asphalt and emulsified asphalt with WMA respectively, on the other hand, WMA exhibit higher ITS at 5 °C than HMA by 11.77% and 4.14 % when using cutback asphalt and emulsified asphalt with WMA respectively.

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Experiences in Argentina with the use of warm asphalt mixtures

Mario Roberto Jair¹, Rosana Marcozzi²

¹Bitumen consultant, ²LEMIT

Abstract:

This document summarizes several results and experiences of WAM (Warm Asphalt Mixes) applications realized in Argentina. The objective of this paper is to show the important improvement obtained in terms of workability issues (main target) and sharing the laboratory results of the asphalts produced which have indicated that compaction temperature can be reduced up to 30°C keeping asphalt properties performance (WTT, ITT) at an acceptable level.

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STRIPPING POTENTIAL OF HALF-WARM MIX ASPHALT MADE WITH RECYCLED CONCRETE AGGREGATES

Ana María Rodríguez Pasandín, Ignacio Pérez Pérez, Lidia Caamaño Caamaño
Universidade da Coruña (UDC)

Abstract:

Warm-mix asphalt (WMA) and half-warm-mix asphalt (HWMA) are relatively new and sustainable techniques for the manufacture of bituminous mixtures for flexible road pavements. The use of recycled concrete aggregates (RCA) from construction and demolition waste (C&DW) as aggregate in bituminous mixtures could also contribute to the sustainable construction of such pavements. Nevertheless, the use of RCA as raw material lead to bituminous mixtures with low moisture damage resistance, particularly when used in hot-mix asphalt (HMA). In the present investigation HWMA for road binder course type AC 22 bin S has been manufactured replacing the coarse fraction of the natural aggregate by RCA. That is, 55% of RCA and 45% of hornfels have been used as aggregate. The mixture has been manufactured using low setting cationic bitumen emulsion type C60B4 as binder. The air voids, adhesion and stripping potential of the mixtures have been analyzed. The results have been compared with those obtained for a control mixture (0% RCA). As was expected, the stripping potential of the HWMA made with 55% RCA is higher than that obtained for the control mixture. Nevertheless, higher bitumen content, lead to HWMA made with RCA that comply with the Spanish Technical specifications for moisture damage resistance. A cost effective analysis has been also conducted with the aim of quantifying the economical drawbacks of using RCA in HWMA.

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The new step in the WMA production: use of green additives

Santiago Gil¹, Oscar Herrero¹, Pieter Van der Sypt²

¹Ravago Chemicals, ²Willemen Infra NV

Abstract:

Warm Mix Asphalt (WMA) concepts are perfectly implemented in Europe through the application of different available technologies. A potential complication when using these techniques, is the lower temperature range for laying and compaction. This can result in a lower density of the asphalt layers. The present study is another effective WMA demonstration by using an established green additive, vegetal-base, that facilitates the asphalt mix production (even at lower than usual WMA temperatures) and extend the compaction temperature range over 90°C. Laboratory test values and real experiences are shown by new environmental friendly additives, which provide noticeable temperature reduction while maintaining, or even increasing, the asphalt mix performances.

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Warm mix asphalt produced with liquid additive Increasing mix compactibility

Julien BUISSON¹, Nicolas PICARD²

¹Tech sales - INGEVITY, ²Lab director Europe - INGEVITY

Abstract:

Our company, leader in chemical's additive for road construction, has worked since 2006 on the development on warm mix asphalt and half warm mix. With this process of liquid additive (product based on vegetal's chemical from pine tree) for bitumen, millions of tons of warm mixes asphalt have been produced and applied with lots of different traffics, climates, roads structures and aggregates. The development of Warm Mix Asphalt (WMA) requires the control of the performances at laying temperatures to ensure those at service life. A simple lowering of mixing temperature can reduce the workability and the compactibility of asphalt mixture. So, several technics such as liquid additive and foaming are proposed to avoid or reduce this laying issue. This article presents in details the benefits of the warm mix asphalt's technic with liquid additive and specially the gain of compaction versus others technics. To study the compaction a new way to use the shear gyratory press has been applied, considering that the classic exploitation of gyrator's data (i.e. considering the void content at a given number of gyrations) is not relevant to evaluate the effect of the temperature's decrease. The idea is to use the Compaction Energy Index (CEI), area using the gyratory's curve and calculated to obtain a level of compaction, and compare it between different technics. Moreover, the lab's trials for compaction have been done at different temperatures (ie 135°C, 110°C and 90°C) to see the limit of the compactibility of the mix. As it, the use of our liquid additive is clearly the best option in terms of compactibility to balance the reduction of temperature. Thus, it gives for a warm mix asphalt compacted at 90°C results equal as a hot mix asphalt compacted at 155°C. Keywords: Compactibility, Warm Mix Asphalt (WMA), Compaction Energy, Evotherm®

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Optimizing Warm Mix concepts with combination products

Butz Thorsten¹, Oelkers Carsten¹, Johannsen Knut²

¹Sasol Performance Chemicals, Wax Division, ²EUROVIA Services GmbH

Abstract:

When producing asphalt mixes at reduced production temperatures some material aspects have to be taken into account. The reduction in temperature of the final product is achieved by a reduced power to the burner in the heating drum. This could lead to parts of the moisture staying within the natural aggregates and the recycled asphalt pavement, because they cannot be completely evaporated due to the reduced heat energy. Consequently this could lead to insufficient coating of the aggregates or to moisture being captured. Possible effects may be deficiencies due to moisture or to reduced adhesion. Additionally it has to be taken into account that due to the reduction in mix temperature the timeframe for paving and compaction also gets significantly smaller. This has to be addressed at composition or equipment level. Within this investigation a combination product consisting of a Fischer-Tropsch-wax, a petroleum-based component and an adhesion promoter was added to the bitumen to solve the mentioned problems. This solid additive may be added at asphalt production level. To prove the modified properties compaction trials on a SMA 8 S have been conducted to quantify the influence on compactibility. Fatigue tests have been conducted on standard samples and samples produced at reduced temperatures. On the one hand a reference variant without additive and without temperature reduction was evaluated and on the other hand a modified variant with additive and temperature reduction. Both variants were stored in dry conditions after preparation. To simulate a possible moisture influence, the samples of both variants were additionally stored in water. The results allowed a solution with comparable technical properties at lowered production temperatures to be found.

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BITUMINOUS TECHNIQUES ADAPTED TO THE PREMISES OF THE CIRCULAR ECONOMY

miranda lucia

repsol

Abstract:

The strategy of Circular Economy requires road construction actions, enhance those bituminous techniques that align with the premises of getting value the products so that they remain as long as possible in the economic cycle of the road and that also generates the lowest number of waste. Achieving these objectives is possible with the use of bituminous techniques in which bituminous emulsion is the element that allows on the one hand the manufacture of bituminous mixtures at lower temperatures, allowing to reduce the emission of greenhouse gases from cold and half warm mixtures and on the other hand allowing the reuse of recycled material from the road, thus achieving the closing of the economic and environmental circle. This communication describe the characteristics and contributions that the half warm mixtures as well as the cold recycled ones, that with the possibility of incorporating the RAP, contribute to the objectives of Circular Economy.

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Analysis of the long-term performance of sustainable asphalt mixtures under high-volume traffic

M. Sol-Sánchez¹, F. Moreno-Navarro¹, M. C. Rubio-Gómez¹, M. Castillo Jiménez², E. Estévez Perea², F. J. Sierra Carrillo de Albornoz³

¹Laboratory of Construction Engineering of the University of Granada, LabIC.UGR (Spain),

²Construcciones Pérez Jiménez, ³Consejería de Fomento y Vivienda de la Junta de Andalucía

Abstract:

One of the current challenges in road pavements focuses on using more durable and sustainable materials by valorising wastes and carrying out more environmentally friendly constructive techniques. Additionally, these materials must present a good long-term performance to minimize the environmental, social and economic costs associated with the interventions for pavement conservation and rehabilitation. In this context, the objective of the present paper consists of evaluating the long-term performance of sustainable asphalt mixtures used as surface layer in roads with high traffic volumes. For this purpose, a complete study from laboratory phase to road trial sections has been carried out, analysing aspects such as material workability, resistance to ageing, to plastic deformations, and to fatigue and low temperature cracking, among others. The results have demonstrated that sustainable mixtures could offer similar or even better mechanical behaviour to that measured for traditional asphalt mixtures. Based on these considerations, the use of these materials could be an interesting solution to offer more durable asphalt pavements while reducing the environmental impacts.

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Investigation of field performance of warm mix asphalt produced with foamed bitumen

Ayberk Özcan¹, Zeliha Temren², Muhammet Komut³, Seyit Ali Yıldırım⁴

¹Ösak Construction Co., ²Turkish Asphalt Contractors Association, ³General Directorate of Highways, ⁴Abt Lab.Co.

Abstract:

Warm Mix Asphalt-WMA trial sections have been constructed by using different techniques(organic and chemical agents, mineral foaming additives and foamed bitumen) since 2012 in Turkey. In consequence of gaining knowledge and experience, WMA with foamed bitumen has been preferred to be implemented in a road project. In this context, the first implementation of WMA was realized on state road located on severe climatic conditions.In this project, approximately 300.000 ton WMA has been used for base and binder courses.Surface course hasn't been completed yet, but the road has been opened to traffic in sections at the level of binder course since 2015. Additionally a trial section of WMA with foamed bitumen was constructed as a surface course on an urban road served at mild climatic condition in 2017.Around 200 ton WMA was paved and trial section has been on traffic service since 2017. To realize long- term benefit of WMA, it is required to investigate field performance. It is expected that WMA would be as good as hot mix asphalt-HMA.Therefore, the field performance of WMA pavements needs to be examined. In this study, to investigate the field performance of WMA, the data from pre-construction mix design and information for construction process and post construction will be collected. Significant material properties by laboratory tests integrated into mix design are identified by taking core samples from the road. Distress surveys such as wheel-path longitudinal cracking, rutting and moisture damage will be performed on the pavements. Additionally the other critical factors such as pavement structure, traffic and climate will be described. All of the findings will be evaluated to compare field performance of WMA with adjacent or similar HMA pavements in term of specific performance parameters. Key words: Warm mix asphalt, foamed bitumen, field performance.

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Warm mix asphalt on the Easing Sydney's Congestion Program. A success story of collaboration, sustainability and innovation

Carlos Solis Navarro

AECOM, Ground Engineering Discipline Lead for the ESC Program Office, CEng MICE

Abstract:

Australia's population reached 25 million on 8 August 2018 and Sydney's population is projected to double from the current 4 million to 8 million by 2060. This increase in population is placing additional demand on the State Governments and Roads Agencies to supply their customers with the infrastructure required to support this growth. Since its inception in 2016, the Roads and Maritime Services (RMS) Easing Sydney's Congestion (ESC) Program in New South Wales has been delivering significant improvements to increase capacity specifically at major intersections thereby reducing Sydney's congestion. The vision of the program is "making the customers' journeys better by delivering high benefit programs and projects through low impact and smart solutions". The Program is proving to be an example of the benefits of collaboration between Public and Private Sector under a consultant Partnership Agreement. Moreover, the ESC program has become a platform for innovation in achieving more sustainable pavements through the use of warm mix asphalt on each project. This paper describes the challenging conditions to deliver urban projects on the Sydney network, key issues encountered during design and specification and an initial assessment of the performance of the warm mix asphalt used on these projects.

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Characterization of Long-term Performance of Warm Mix Asphalt in the United States

Shenghua Wu¹, Shihui Shen², Weiguang Zhang³, Balasingam Muhunthan⁴

¹University of South Alabama, USA, ²Pennsylvania State University, USA, ³Southeast University, China, ⁴Washington State University, USA

Abstract:

Warm mix asphalt (WMA) has been widely adopted due to an increased awareness of sustainability in the asphalt community, nevertheless, its long-term performance is rarely investigated widely. This paper presents a comprehensive study on 28 field projects across 4 climate zones (wet freeze, wet no-freeze, dry freeze, and dry no-freeze) in the United States, characterizing the long-term performance of various WMA types including organic additive (Sasobit®), chemical package (Evotherm®, Rediset®), water-containing additive (Aspha-min®, Advera®), and water-based foaming (Astec DBG, Low Energy Asphalt, Aquablack®, Cecabase®, and Gencor®) as compared to hot mix asphalt (HMA) control. Field performance are investigated with respect to rutting, transverse cracking, and longitudinal cracking. A total of 83 field cores are characterized with respect to dynamic modulus, creep compliance, indirect tensile (IDT) test at intermediate and low temperature, and Hamburg wheel-tracking device test. In addition, asphalt binders are extracted and recovered from field cores, which are characterized with respect to performance grading (PG), multiple stress creep recovery (MSCR), monotonic fracture test, and low temperature bending beam rheometer test. This study is the first-time ever widely examining long-term performance of WMA technologies in the United States, providing an objective and in-depth understanding on engineering performance. The most significant finding from this study is that the long-term performance of WMA is comparable with that of HMA, which ensures a great confidence in the wide adoption of WMA. Material property of field cores and binders also give insightful perspectives on how to characterize WMA and HMA, which can be best indicative of long-term field pavement performance.