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Improving the skid resistance of asphalt surfacings using lightweight aggregate

Ignacio Artamendi, Bob Allen, Phil Sabin

Aggregate Industries UK

Abstract:

In this study, friction properties of various types of commonly used mineral aggregates for road surfacings have been determined by means of the polishing stone value (PSV) and the friction after polishing (FAP) tests. A manufactured lightweight aggregate produced by the sintering process has also been evaluated in the study. Results showed that the lightweight aggregate had superior polishing and friction characteristics compared to conventional aggregates. Furthermore, friction properties of blends of conventional and lightweight aggregates were estimated theoretically based of the friction properties of the individual components and the proportions of the blends. An optimum aggregate blend was then used to design a thin asphalt surfacing material for high speed and high volume roads. Friction of the asphalt surfacing was then determined in the laboratory using the friction after polishing test. Results showed that the thin surfacing material containing a relatively small proportion of lightweight aggregate significantly improved friction and skid resistance of the asphalt surfacing. Small scale field trials were then carried out to evaluate production and installation of asphalt containing lightweight aggregate. Furthermore, in-situ friction measurements were performed on the laid materials and showed that the skid resistance of the asphalt surfacing increased with the incorporation of lightweight aggregate.

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Effect of Aggregate and Pavement Types on Skid Resistance Evolution

Emine Nazan Ünal, Muhammet Komut, Şenol Altıok

General Directorate of Highways, Research and Development Department, ANKARA, TURKEY

Abstract:

Skid resistance is an important safety factor for highway pavement that is accounted for in proper materials selection, design, and construction. In this research, Skid Resistance values are collected from different pavements with different aggregates. Skid resistance performances were measured by both Friction Tester and Laser Profilometer. Field tests are conducted several times during more than 10 years for some pavement sections. Skid resistance performance values are observed and evaluated. These assessments are used to predict friction change during the lifetime of a pavement would aid in predicting pavement performance and identifying the appropriate time for any treatment and rehabilitation. The results of this study help to choose the most suitable aggregates and pavement types allowing to reach and to maintain a relevant skid resistance level according to the demand on the roads in the Turkish Highway Network.

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Maximizing the envelope in asphalt research projects: a case study on the tendering process for test tracks using thin noise reducing asphalt layers

Vuye Cedric[1], Van den bergh Wim[1], Audenaert Amaryllis[1], Freitas Elisabete[2]

[1]University of Antwerp, [2]University of Minho

Abstract:

For the development of new asphalt mixtures or determination of “real-life” properties in many research projects, the construction of test tracks is included. As in most cases a fixed budget is available for these test tracks, it is necessary to achieve the best value for money. Ideally, this means selecting the contractor with the most (proven) experience, constructing the test tracks as needed for the project (with the best possible quality), while still respecting the available budget and obeying any restrictions imposed by existing laws on public procurement. As a case study, the tendering process for the construction of different test tracks with so-called thin noise reducing asphalt layers in the city of Antwerp is described in detail. A tendering process in two steps was developed, where only experienced contractors, based on a reference list, were allowed to submit an offer in the second step. By utilizing several selection criteria, like overall comprehensiveness of the offer (and not just the price), technical quality of the proposed asphalt mixtures, and quality of the proposed work plan, a ranking was made of the remaining contractors. Only then, decisions had to be made regarding the actual size of the different test tracks, taking into account the overall budget. In this case, the purchaser had the opportunity to wait until the very last moment with making certain decisions (number and size of test tracks, number of different mixtures …), making it possible to maximize the envelope.

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LIFE-Soundless Project: Noise Reducing Asphalt Mixes with Recycled Materials

María Elena Hidalgo Pérez[1], Miguel Angel Morcillo López[2], Maria del Carmen Pastrana Zambrana[3], Juana Torres Pérez[1], David García Ruiz[2], Begoña Arroyo Martínez[3]

[1]Eiffage Infraestructuras, [2]Fundación CIDAUT, [3]Dirección General de Infraestructuras. Junta de Andalucía

Abstract:

LIFE-Soundless is a demonstrative project (ending in August 2019), co-funded by European Union within LIFE Program and which main objective has been the noise pollution mitigation at source in urban areas through the implementation of asphalt mixes with high noise-reducing acoustic performance and durability. In this Project several asphalt mixes (SMA) with addition of recycled plastics and/or products from recycling of end-life tyres (rubber powder or nylon fibres) has been designed and tested in two noisy points on the Andalusian road network. The acoustic and surface characteristics of the new pavements have been monitored every six months during two years after the construction of the pilot section and compared with the initial situation and with a reference asphalt concrete also laid in one of the pilot sections. The paper presents and analyses the results of all monitoring campaigns developed until the end of the project and the conclusions about the effect in the noise mitigation and durability of this kind of asphalt mixtures. Furthermore, environmental and social costs considerations of these solutions are exposed

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Cool and Low Noise Asphalt Life Project in Paris

GODARD Eric[1], LEFEBVRE Jérôme[2], CHRETIEN Olivier[2], SINEAU Matthieu[3], GRIN Lionel[4], RIBEIRO Carlos[3]

[1]COLAS, [2]Ville de Paris, [3]BruitParif, [4]EUROVIA

Abstract:

The European Environment Agency indicates that 37 million of European citizens are exposed to transport-related noise at levels considered as dangerous for their health. In Paris, about 22% of the population is affected by noise pollution, mainly due to noise from road traffic. On another hand, climate change is also a major concern for European cities. Studies have shown that for 30 years, heat waves are increasingly intense and longer in Europe, the peak of heat in 2003 in Paris and its heavy health impact is a relevant example as well as the 2018 summer. The Cool & Low Noise Asphalt life project, initiated in 2017 for 5 years is managed by the city of Paris, Colas and Eurovia contractors companies and the Bruitparif association, its goal is to tackle these 2 environmental challenges, by developing innovative forms of asphalt mixes. The main goal is to devise these asphalt surfaces with both phonic and thermal properties and an acceptable durability, in order to create practical tools to directly improve city dwellers' quality of life. The project seeks to refine the properties of three widespread types of asphalt in Europe (2 compacted asphalt mixes, and 1 hot poured asphalt mix) allowing not only replicability all over Paris, but also all over Europe. This paper presents the objectives of the project and its progress to date. The mixes designs have been completed successfully, including a durability evaluation. The pilot sites have been implemented and the first results on noise measurements and thermal behaviour of the pavements are available. The monitoring of the pilot sites will be followed during 4 more years.

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The road surface label used as functional contracting to stimulate innovation – A case-study on a motorway project in the Netherlands

Frank Bijleveld[1], Arian de Bondt[1], Harco Kersten[2]

[1]Strukton Civiel, the Netherlands, [2]province of Gelderland, the Netherlands

Abstract:

Recently, the road surface label has been initiated in a working group of the United Nations. Similar to consumer goods, such as washing machines, dish washers and tyres, the road surface label provides information about the road regarding the tyre-road noise, the skid resistance, the rolling resistance and the lifespan and categorises them from A to G. The label provides transparency for society and politicians, stimulates innovation, makes the optimisation of tyre-road interaction possible, and it facilitates the interaction and communication with road users and residents. This helps to acknowledge that a road surface is a product that can industrially be developed, designed, built, maintained, removed, and reused and it facilitates the collaboration between tyre manufacturers and road contractors. A functional contracting strategy using the road surface label has been developed in combination with the Most Economically Advantageous Tender (MEAT) method. This strategy has been demonstrated on a motorway project in the Netherlands. The minimum road surface label required by the road agency was EDEE. Contractors that offered a higher label (per label indicator) could receive a fictive discount on their price (up to a maximum of 57%). A porous asphalt has been developed with a lifespan of 15-18 years, a rolling resistance of 7.5-8.0 kg/ton, a noise reduction of 7.8-8.6 dB(A), and a skid resistance of 0.64-0.67 (friction coefficient). Also, various innovative laboratory equipment and in-situ measurements were used to evaluate the asphalt quality. This paper provides a practical method for road agencies to use the road surface label for functional contracting and demonstrates how it stimulates innovation on the four label indicators. Further, the outcomes of this research contribute to a deeper understanding regarding the tyre-road noise, the skid resistance, the rolling resistance and the lifespan.

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Air particle measurements during paving of low-temperature asphalt

Anna Steneholm[1], Jenny Rissler[2], Karin Hennung[1]

[1]Nynas AB, Stockholm, Sweden, [2]RISE Research Institutes of Sweden AB, Lund, Sweden

Abstract:

Background The concentration of fumes from asphalt mixtures in air during paving are positively correlated to the paving temperatures. High concentrations of asphalt fume can cause respiratory irritation of the asphalt workers. The characteristics of the asphalt fume, like size and number distribution, is scarcely studied. Recent advances in analytical chemistry have allowed for studies on possibly hazardous ultrafine particles. In this study we aimed to increase the knowledge of asphalt fume composition during paving using low temperature asphalt (LTA). Method Paving at temperatures below 140°C was performed for two days on a rural, low trafficked road in the south of Sweden in the autumn of 2017. A trolley equipped with SMPS (Scanning Mobility Particle Sizer) and APS (Aerodynamic Particle Sizer) was rolled about 5-10 meters behind the paver, to measure particles sized 15-5000 nm. Background measurements were performed before, after and in between LTA paving activities. Results The average concentration of particles in the air during LTA paving was low; 7000 particles/cm3 and the background was approximately 1500 particles/cm3. Most of the particles were sized <500 nm and 80% of the particles were sized <100 nm. Comparing these results with previous published data the results indicate that LTA paving generate less particles but possibly somewhat smaller particles than showed in previously. Conclusion This first measuring campaign showed that LTA paving caused low concentrations of asphalt fumes in the air, comparable to common particle concentrations in ambient urban air.

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A DESIGN APPROACH FOR LAB TEST SETUP FOR MEASURING WET GRIP OF TIRE RUBBER COMPOUNDS

Muhammad Faizan Rabbani[1], Henny L. ter Huerne[1], Tanya V. Tolpekina[2], Dik J. Schipper[1]

[1]Faculty of Engineering Technology, University of Twente, P.O. Box 217, 7500 AE, Enschede, THE NETHERLANDS, [2]Apollo Tyres Global R&D B.V., P.O. Box 3795, 7500 DT | Colosseum 2, 7521 PT Enschede, The Netherlands

Abstract:

Tire-pavement friction is a very important aspect of vehicle safety, especially in wet conditions. Tire manufacturers assess the wet grip of tires by conducting “ABS braking tests”, which is a realistic assessment but are expensive and time-consuming. Tire manufacturers are keenly interested to develop an economical and reliable test on a labscale, that can be used to quickly assess the wet grip during the development of rubber compounds. In this paper, we present a design approach for a lab test method, which can be used by the tire industry to test rubber compounds with greater precision. We discuss the actual wet grip tests which are conducted on purpose-built track with an ABS (Anti-Lock Braking System) equipped car; measuring stoppage distance as a performance parameter. In light of these tests, we present the tire-pavement friction concept in terms of roles played by pavement (skid resistance) and rubber (wet grip) to produce the traction during braking in wet conditions. Then we discuss skid resistance in terms of micro and macro scale contributions, elaborating on the environment that pavement creates for rubber to generate friction. Further, we present friction generation mechanisms of rubber that are present in a typical rubber/road contact. This study aims to present a design approach of a test method in a lab-scale, that has a good prediction capability of the wet grip of tires using a friction tester called “Linear Portable Friction Tester” (LPFT) in light of the knowledge of tire-pavement friction and contact patch dynamics. We present a dedicated test scheme and its results, to perceive the viability of LPFT, to be used as an effective wet grip friction tester. The outcome of the tests reveals some instrumental design insights (choice of rubber shapes, size, etc. and counter surface), that would help in reaching a right tribo-system to have a high correlation with actual wet grip performance.

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Laboratory evaluation of emissions from Polymer modified Bitumen

Porot Laurent[1], Jellema Erica[1], Scott Donald[1], Morales Emilio[2]

[1]Kraton Polymers, [2]University of Huelva

Abstract:

In addition to technical advantages of asphalt materials, the asphalt industry is placing health and safety at the forefront, especially for workers during construction. The fumes, which are generated during the manufacture of Hot Mix Asphalt (HMA), may impact occupational exposure limits. In recent years, a spotlight has been placed on bitumen fumes, and studies have been published on this subject. Polymer modified Bitumen (PmB) is being used successfully for more than 40 years and brings a lot of advantages for the durability of the pavement and long-term maintenance plan. Due to higher viscosity, PmB may require higher mixing temperature as compared to standard paving grade bitumen. This may raise the question of impact on bitumen fumes released during, manufacturing the PmB itself, the handling of the binder and manufacturing at asphalt mix plant. This paper investigates the fume emissions of Polymer modified Bitumen based on analytical testing using headspace analysis. This specific method enables to analyse the volatile components from samples and more specifically the Polycyclic Aromatic Hydrocarbons. Two types of PmB were evaluated, a commonly used PmB with 3.5% of SBS and a highly modified binder with 7.5% of special SBS. They were compared with a conventional paving grade bitumen used as a reference. These three binders were tested at different temperatures reflecting various conditions of making hot mix asphalt. The overall results shown that the total fume emissions are very dependent to the temperature, the higher the mixing temperature, the higher the level of emission. In the case of the high modified bitumen, the specifically designed SBS polymer allows to keep the viscosity in a reasonable range, despite the higher polymer load. This leads to a direct effect on the fume emissions.