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Editorial: Development and Application of Bituminous Materials for Civil Infrastructures

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Editorial on the Research Topic

Development and Application of Bituminous Materials for Civil Infrastructures

Pavement maintenance has become increasingly important with recent developments in the auto industry. Pavement distress affects pavement quality and service life, which in turn affects people's daily lives. Innovative pavement materials and technologies need to be developed to enable pavement to serve its purposes, especially looking to bituminous materials. A series of engineering problems can be solved by developing advanced characterization methods and new materials through the existing and innovative test and simulation methods.

The international journal "Frontiers in Materials" is a high-visibility journal publishing rigorously peer-reviewed research across the entire breadth of materials science and engineering. This special issue "Development and Application of Bituminous Materials for Civil Infrastructures" focuses on the recent development or emerging technologies of bituminous materials. The research areas of this special issue cover three sections: advanced pavement materials, advanced test methods and simulation models.

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1) Advanced Pavement Materials: Polyether polyurethane concrete (PPC) is proposed as a new pavement material for bridge decks. Test results show that the anti-aging and overall pavement performance were improved compared to traditional and Styrene-Butadiene-Styrene (SBS) modified asphalt mixtures (Xu et al.). Direct Coal Liquefaction Residue (DCLR) was used to improve the performance of asphalt mixtures and the permanent deformation was investigated with different tire pressures and temperatures (Zhi et al.). The uniform test design method of a colored emulsified asphalt seal mixture (CEASM) was proposed and different tests were used to study the various performance indicators, including storage stability, wear resistance, anti-slide, and color durability (Sun et al.). Different types of rubbers were used in the asphalt mixtures to form different structural layers in asphalt pavement. The dynamic moduli of asphalt mixtures under different temperatures were studied (Wang et al.). An effective mixing method was proposed to improve the high-temperature performance of Terminal Blend (TB) asphalt rubber. A serial of tests was employed to evaluate and verify the performance of TB asphalt rubbers (Xie et al.). The shear fatigue life and performance of the epoxy resin waterproof adhesive layer were investigated with different temperatures, stress levels, and quantities of coating layer on bridge deck pavement. More coating on the pavement can improve the resistance to interlaminar shear fatigue failure (Xu et al.). Different modifiers were used to modify the asphalt binder, including SBS, Polyphosphoric Acids (PPA), furfural extraction oil, and dibutyl phthalate (DBP). The

adhesive properties of different asphalt binders were examined (Li et al.). Many types of granular soil materials from construction fields were mixed with different cement contents. The unconfined compressive strength was strongly related to soil properties and cement contents (Yang et al.). The effect of vibration mixing on the performance of cement-based mixtures was researched. Vibration mixing improved the dispersion uniformity of cement in aggregates and significantly enhanced the bonding strength between the cement and aggregates (Li et al.).

2) Advanced Test Methods: The aggregate skeleton of asphalt mixtures definitely affects the pavement performance, and the skeleton system can be more complex with reclaimed asphalt pavement (RAP). Three types of the contact points between aggregates were classified: new-new, new-old, and old-old. The distribution characteristics of asphalt mixtures with three contact points were analyzed through image processing (Xiao et al.). Deicing in the winter is always an issue of great interest for pavement engineers. The compression strength of ice under asphalt mixture was investigated to improve deicing equipment in the process of melting and crushing ice on pavement surfaces. Two failure modes, shear, and ductile failures can be observed from test results (Luo et al.). The compaction characteristics of cold recycle mixtures were studied, and five characteristic parameters were used to quantify the compaction of asphalt mixtures (Wang et al.). The rutting resistance of asphalt pavement in the RIOHTrack and laboratory was estimated and analyzed through different performance tests, including the dynamic modulus test, Hamburg rutting test, French rutting test, and asphalt pavement analyzer rutting test (Li et al.). The effect of the interface joint shape on the pavement life after pothole repairing was studied through the fatigue life test (Li et al.). Microwave-activated crumb rubber was used to modify asphalt binder. The properties and aging mechanism were studied through different tests, including penetration, softening point, ductility, viscosity, Dynamic Shear Rheometer (DSR), Gel Permeation Chromatography (GPC), and Fourier Transform Infrared Spectroscopy (FTIR) (Zhou et al.). The Coarse Aggregate Morphological Identification System (CAMIS) was employed and developed, allowing the shape features of aggregates above 2.36 mm to be identified based on computer images (Liu et al.). The gradation variability of the aggregates strongly relates to the volume parameters and performance of asphalt mixtures. The volume parameters include Air Voids (AV), Voids in Mineral Aggregate (VMA), Voids Filled with Asphalt (VFA), etc. The design method was analyzed and studied for the dense skeleton gradation (Liu et al.).

3) Simulation Models: The Molecular Dynamics (MD) method is a promising simulation tool to analyze materials at the nanoscale. Two carbon-based nanomaterials were used to modify asphalt binder, and the MD models were generated. The self-healing capability and properties of asphalt binders were investigated under different temperatures. The optimum contents of modifiers can be determined, and it was found that the modifier enhances the self-healing capability of asphalt binders (Gong et al.). An adaptive and piecewise model framework was proposed to analyze the deterioration process of rail track based on historical measurement data, and the progress of irregular deteriorations in the corresponding rail track sections can be monitored and displayed (Yang et al.).

Thirty manuscripts were received for possible publication in this special issue. Each manuscript was rigorously, fairly, and anonymously reviewed. Both the quality and originality of each paper were thoroughly checked. Finally, nineteen technical research articles were accepted and approved for publication.

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AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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