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# Editorial: “Functional pavement and advanced material testing technology”

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## Editorial on the Research Topic

### “Functional pavement and advanced material testing technology”

Pavement quality and its maintenance technologies have been intensively researched recently, as road condition significantly affects daily traveling. However, how to build high-quality pavement or/and when to maintain the pavement is needed remain concerns. Innovative pavement materials and technologies are therefore essential to address the existing engineering challenges.

“Frontiers in Materials” is a high-visibility and well-known international journal, that mainly publishes rigorously peer-reviewed research articles in the field of materials science and engineering. This Research Topic “Functional Pavement and Advanced Material Testing Technology” summarizes the recent or emerging technologies of pavement engineering. The Research Topic covers three sections: “Advanced Materials, Advanced Compaction and Sensing Methods, and Simulation Models”.

- (1) Advanced Materials: The carbon black with different contents was used and added to the rapid-hardening cement grouting paste. Different properties were examined with different tests, including fluidity, color difference, spectrum reflectance, thermal conductivity, and flexural and compressive strength. The results show that the fluidity remained high while the conductivity, flexural strength, and compressive strength exhibited reduction compared to the control (Haibin et al.). Recently, a new “gussasphalt” modified binder was developed using styrene-butadiene-styrene, terpene resin, furfural extraction oil, and other related materials with Qingchuan Rock Asphalt (QRA). The key properties of the modified asphalt, such as the rheological properties, microstructure, and thermal stability were studied. The optimum ratio of different components in the modified asphalt was also determined Li et al. The use of Reclaimed Asphalt Pavement (RAP) for pavement maintenance is also fully discussed. The different tests of asphalt mixtures with different proportions of RAP were employed for the performance evaluation, including the dynamic modulus, rutting resistance, dynamic creep, semicircular bending, and freeze-thaw splitting tests. The rejuvenator was identified as effectively enhancing the low-temperature performance and moisture susceptibility of modified asphalt mixtures with RAP. The research results show that the maximum content of RAP can be used up to 50% (Ma et al.). The crumb rubber was added to the asphalt to improve the compatibility between the rubber and asphalt through the dry process with various treatments. Three kinds of treatments (i.e., high-temperature, pre-swelling, and microwave treatments) were adopted

and evaluated with different measurements for the modified asphalt, including the viscosity, rutting resistance, and microstructures. The results show that these treatments all work effectively for the improvement of performance in rubber-modified asphalt (Liang et al.).

- (2) **Advanced Compaction and Sensing Methods:** The dynamic response of asphalt pavement was investigated under the vibration rolling compaction. The Dynamic Stiffness Method (DSM) with the multidimensional Fourier transform was proposed and used to solve 3D pavement response under compaction. The stiffness matrix and 3D solution were derived and validated. The field test was also conducted and verified through sensors and tests, including the SmartRock sensor, acceleration sensor, temperature sensors, and non-nuclear density meter. The research results show that the thickness and acceleration keep a linear trend during the compaction. The compaction mechanism relates to the modulus and vibration acceleration (Shan et al.). Recently, the graphene platelets and carbon nanotubes (CNTs) with different surface areas were added to the epoxy composites for the investigation of the morphological, electrical, and mechanical properties, and the strain-electrical resistance. From the test results, it is possible that the modified epoxy composite can be treated as a strain sensor for pavement monitoring (Xin et al.). Besides, the toll station and video surveillance data can be integrated together to help with pavement maintenance and management. The traffic or toll station information includes vehicle type, axle load, lane, speed, and temporal information. The Bayesian method was used to train the traffic data and recover data. The research results provide a reference for preventive pavement maintenance (Dan et al.).
- (3) **Simulation Models:** The Discrete Element Method (DME) is a promising simulation method to analyze materials at the microscale. A comprehensive literature review on the application of DEM in asphalt mixtures was elucidated. The development history of DEM was mentioned and the test results were also used to verify the models. Different modeling methods were developed to construct digital samples, such as the methods of user-defined, image-based, and random modeling. The loading model and modeling procedure were discussed and some thoughts and discussions on the development of DEM were also elaborated. The review paper will advance the simulation of pavement materials (Yao et al.). In addition, a workflow with the photogrammetry and Fourier transform method was proposed to accurately express the natural pore morphology of porous rocks,

such as acquiring, characterizing, and regenerating pores. The uniaxial compression simulations were carried out to study the influences of porosity and pore morphology on the strength and stiffness of rocks. The simulation results indicate that the porosity shows a first-order control on the mechanical properties of rocks and pore orientation affects the Fourier descriptors D2. The pore morphology influences the rock failure and mechanical properties like the rock strength and Young's modulus (Zhao et al.).

Nine manuscripts were received and considered for possible publication in the Research Topic. All manuscripts were rigorously, fairly, and anonymously reviewed. Both the quality and originality of these papers were thoroughly examined and checked. Finally, nine research articles were accepted and approved for publication.

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## Author contributions

HY and H-CD drafted the editorial, and KL and WM helped revise the draft.

## 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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