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Editorial: Recycled Materials in Civil Engineering

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Editorial on the Research Article

Recycled Materials in Civil Engineering

Construction and other industries around the world generate millions of tons of solid wastes every year. These wastes include but not limited to the following: concrete, bricks, clay tiles, asphalt, steel, tire, waste polyethylene terephthalate (PET), fly ash, slags, cement kiln dust, silica fume, rice husk ash, etc. A huge portion of these waste materials are landfilled or released directly to air or water. As a result, a large amount of land, which could be used for parks, schools, office buildings or other human activities, is occupied by landfills; and soil, water and air are polluted. Reusing or recycling these waste materials and therefore transforming them into construction resources in civil engineering is an economical, environmentally-friendly and sustainable way to utilize these wastes.

In order to promote research and applications of reusing/recycling of solid wastes in civil engineering, a special issue with the research topic of "Recycled Materials in Civil Engineering" has been proposed and organized by the Guest Editorial team through the platform of *Frontiers in Materials: Structural Materials*. The main objectives of this Research Topic are to collect the state-of-the-art and the state-of-the-practice of the studies and applications of recycled materials in civil engineering, and to document future research needs. Although the COVID-19 pandemic caused difficulties almost in all aspects of human life including research activities, a total of seven papers covering a wide range of solid wastes and their potential applications have been successfully collected in the Research Topic.

Among these seven papers, three are related to the applications of recycled concrete aggregate (RCA). Chen et al. performed 20 push-out tests of steel reinforced recycled aggregate concrete (SRRAC) columns subjected to a fire. It was found that the bond between I-steel and RAC decreased significantly with the increase of temperature, and the development of bond damage was related to the experienced temperature. Chen et al. also investigated the residual properties and axial bearing capacities of SRRAC columns exposed to elevated temperature by experimental testing and finite element analysis, and proposed a method to calculate the residual bearing capacity of SRRAC columns under axial compression after exposure to high temperature. Lei et al. integrated RCA into permeable asphalt mixtures (PAMs) for concrete pavement application. It was concluded that PAM incorporating RCA with modification treatments can perform satisfactorily as a pavement material in practice.

Two papers focus on the reuse of tire waste in rubberized concrete. Khern et al. investigated the effect of the surface treatment of waste tire rubber as coarse aggregates with different oxidizing solutions and different treatment durations on the mechanical, durability and thermal properties of concrete. It was concluded that a certain percentage of natural aggregates can be safely replaced with appropriately treated waste tire rubber aggregates while maintaining sufficient quality of the resulting concrete. Yang et al. studied the behaviors of recycled tire crumb rubber mortar (CRM) subjected to

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static and dynamic compression. It was found that more crumb rubber decreased the static compressive strength and modulus of elasticity, but increased its critical strain and compressive toughness. The test data also showed that adding crumb rubber to mortar could enhance CRM's dynamic compressive, deformation and energy absorption properties under dynamic impact loading.

One paper studies the reuse of coal gangue in ceramsite lightweight aggregate concrete. In a work by Wang et al., the brittleness of coal-gangue ceramsite lightweight aggregate concrete (CGCLWAC) was evaluated for different sand ratios, water-cement ratios and content of steel fibers. It was concluded that the incorporation of steel fibers can significantly change the brittleness of CGCLWAC.

The last paper authored by Zhang et al. focuses on the dynamic performance of foam concrete with recycled coir fiber (CF). It was found that an appropriate amount of CF could significantly improve the dynamic performance of foam concrete.

In summary, diverse papers are collected in this Research Topic. Four recycled materials have been studied, i.e., recycled concrete waste, recycled tire, coal gangue and recycled plant fiber (coir fiber). Both structural member (e.g., column) and nonstructural member (e.g., concrete pavement) uses are potential applications. Various behaviors of these materials (i.e., short-term mechanical behaviors subjected to static and dynamic loads, thermal behavior, and long-term durability) have been studied. Meso-scale or micro-scale measures (e.g., scanning electron microscope and X-ray diffraction) have been deployed to investigate the micro-structures of the concrete incorporating the recycled materials. The Guest Editorial team is confident that this collection of paper will be beneficial to the community of researchers, engineers, and other stakeholders who are seeking to reuse and recycle solid wastes.

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.