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Editorial

Construction Materials

Editorial

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Watching my little son taking his first step, hanging on to me to seek support, and feeling secure are amazing moments with many responsibilities and obligations that will extend to upcoming generations. These can be articulated in the term 'sustainability', which ensures opportunities for future generations to enjoy lives that are at least at the same level as our own. Several countries have committed to the United Nations' 2030 Agenda for Sustainable Development and prioritised actions towards sustainability, targeting net-zero carbon dioxide and climate-resilient operations by 2030 (Lin and Agyeman, 2020). Among several sectors, more attention has been directed to construction and building materials as one of the main contributors to greenhouse gas (GHG) emissions and high energy consumption (Li and Chen, 2016; Reddy and Jagadish, 2003).

Generally, the total life cycle energy of a building includes both operating and embodied energies (Thormark, 2002). Operating energy is the energy required to operate the building in processes, such as cooling and heating to provide comfortable thermal conditions for occupants, whereas embodied energy is the total amount of energy consumed throughout the building materials' life, including production, recurring (renovation and replacement) and demolition phases. In order to optimise energy efficiency and promote low carbon dioxide emission buildings, both types of energy must be minimised. The four papers presented in this issue highlight a number of direct and indirect strategies to achieve the aforementioned goal.

The first paper, by Sharook *et al*. (2023), addresses the importance of minimising the used material's thermal conductivity and its role in enhancing the building's thermal insulation. Considering its low density, expanded perlite aggregate was incorporated into foamed concrete wall panels as a replacement for up to 30% of the fine aggregate. The higher the perlite aggregate content, the lower the thermal conductivity achieved. This result confirms the efficiency of expanded perlite as a thermal insulation material. In order to overcome the anticipated reduction in the strength due to perlite aggregate addition, the feasibility of replacing cement with 60% by weight of fly ash was examined. Results reveal that such a combination forms an eco-friendly mix with adequate thermal insulation properties and sufficient strength.

Another direct strategy to increase construction materials' sustainability is presented by Sosa *et al*. (2023) in the second paper, in particular the use of fine recycled concrete aggregate (FRCA) as a replacement for fine natural aggregate in concrete. While many ecological and environmental benefits are associated with such action, the authors highlight the lack of technical data needed to support the acceptance of FRCA. The authors provide a comprehensive analysis of the linkage between the properties of concrete incorporating FRCA and the features of FRCA parent concrete. They conclude that the total water-to-cement ratio in recycled aggregate concrete is a dominant factor influencing concrete performance compared with the quality and composition of FRCA.

Improving construction materials' performance and extending the service life is another strategy contributing to sustainability in the construction sector. Lopes *et al*. (2023) highlight in the third paper the benefits of incorporating short fibres to overcome the low tensile behaviour of concrete and directly improve its crack resistance. The authors are more ambitious in understanding the role of restraining the cracks at the nanoscale by providing nano-reinforcements with the aid of carbon nanotubes (CNTs). Adding only 0.05% CNTs increased the maximum flexural strength by 9% for steel fibre-reinforced concrete and by more than 48% when compared with concrete without fibres, leading to greater rigidity, toughness and load-bearing capacity.

In the fourth paper in this issue, Bhaskar *et al*. (2023) also focus on concrete cracks and reducing their negative impact on concrete durability to extend its service life. The authors rely on pre-incorporating healing agents that enhance the self-healing ability of the material to repair its internal damage without any external intervention. Two different bacterial strains, with zeolite as a protective carrier, are used to boost autonomous self-healing. The produced bacteria-based self-healing engineered cementitious composites (ECCs) exhibit a high healing crack threshold (total healing of 80 μm wide cracks) and recovery of flexural strength and stiffness. There is also a higher percentage of calcium carbonate precipitation in specimens with bacteria than those without bacteria. This observation confirms that bacteria-based self-healing is a powerful method that can yield excellent efficiency for healing cracks.

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