frontiers | Frontiers in Built Environment

TYPE Editorial
PUBLISHED 20 February 2023
DOI 10.3389/fbuil.2023.1160556

OPEN ACCESS

EDITED AND REVIEWED BY
Paul Awoyera,
Covenant University, Nigeria

*CORRESPONDENCE
Hosam M. Saleh,
hosam.saleh@eaea.org.eg
hosamsaleh70@yahoo.com

SPECIALTY SECTION
This article was submitted to Construction Materials, a section of the journal Frontiers in Built Environment

RECEIVED 07 February 2023
ACCEPTED 13 February 2023
PUBLISHED 20 February 2023

CITATION
Saleh HM, Dawoud MM and Hassan AI (2023), Editorial: Sustainable and eco-friendly building materials.
Front. Built Environ. 9:1160556.
doi: 10.3389/fbuil.2023.1160556

Editorial: Sustainable and eco-friendly building materials

Hosam M. Saleh*, Mohamed M. Dawoud and Amal I. Hassan

Radioisotope Department, Nuclear Research Center, Egyptian Atomic Energy Authority, Cairo, Egypt

KEYWORDS

sustainability, building materials, eco-materials, cementitious materials, cement composites

Editorial on the Research Topic
Sustainable and eco-friendly building materials

The environmental studies demonstrate that global warming is worsening and hurting an increasing number of people, combating climate change has clearly become a top concern. Worldwide, the acceleration of climate change due to carbon dioxide emissions is beginning to have a direct impact on people's lives, and buildings generate nearly 40% of annual global carbon dioxide emissions (Sovacool et al., 2021). As a result, one of the most significant worldwide challenges to lowering carbon dioxide emissions is to reform the building sector. There are numerous significant trends in sustainable architecture that will assist lower the building industry's carbon impact (Ali et al., 2020).

Nowadays, concrete is utilized in almost every structure, including buildings, bridges, residences, and infrastructure. With a growing emphasis on sustainability in recent years, structural engineers are being pushed to achieve both traditional design criteria and the developing norms that promote sustainable building (Miller et al., 2021).

Green composites are a type of biocomposites in which a bio-based polymer lattice is reinforced by common strands, and they represent a growing field in polymer research. Concrete is a composite material composed of coarse granular material (the filler aggregate) encased in a hard matrix of material (the cement or binder) that fills the space between the aggregate particles and bonds them together (Mindess et al., 1981).

A biocomposite is a cement or polymer matrix combined with organic fibers derived from agricultural and forest resources, either as a fiber crop or as waste (Saleh et al., 2020a) (Saleh et al., 2020b). A new/added topic is the use of vegetable fibers as reinforcement in cement-based materials. Several researches have also reported on the incorporation of plant-based natural fibers into cement concrete. Various plant fibers, such as cellulose fiber, lignocellulose waste, sugar can bagasse, wheat and eucalyptus, coconut fiber or shell, waste tea leaves, or processed waste tea, are utilized in the making of cement and bio-composites (Mindess et al., 1981) (Parameswaran et al., 1989).

In our laboratory, new trends in waste stabilization have been implemented, including cement with difficult waste items such as cement kiln dust, in order to limit the consumption of cement (Saleh et al., 2019a, Saleh et al., 2020d; Saleh et al., 2021), nanomaterials (Saleh et al., 2019c, Saleh et al., 2019b), natural clays (Saleh, 2014) or polymers (Eskander et al., 2021) (Saleh et al., 2020c) to make lightweight bricks with the right characteristics for use in construction applications or as a stabilizing substance for hazardous wastes.

Green construction refers to a structure constructed in an ecologically friendly manner that is efficient in the use of energy and resources. The environment is the primary focus of green buildings; the economic benefits of a long-term green transition weigh significantly.

When compared to conventional buildings, green buildings frequently result in lower operational expenditures, increasing profitability for developers and proprietors (Sun et al., 2022).

Furthermore, the efficacy of renewable thermal insulation materials is determined by their ability to reduce heat transfer *via* solid and gaseous conduction, thermal radiation, and, in certain situations, convection (Dreißigacker, 2021). The heat transmission mechanism for thermal insulation materials is mostly determined by the material's structure and density (Le et al., 2021). With the growing requirement for sustainability, the material used for thermal insulation has grown increasingly significant in the modern construction (Füchsl et al., 2022). Today, multi-purpose solutions, such as thermal and acoustic insulation, are now widely used in building construction. So, natural fibers are mostly used in the building sector for their hygrothermal qualities would considerably improve their market attractiveness (Santoni et al., 2019).

Therefore, this Research Topic entitled" Sustainable and Eco-friendly Building Materials" has been proposed to know modern applications of sustainable building materials that represent effective external shielding and achieve those standard values for the stabilization of hazardous waste, including radioactive waste. Onyelowe et al. have stated that the global warming potential based on the dose of cement Portland cement contributes about 90% of the total result. In addition, the result of the ground acidification potential of concrete mixtures in this study showed that the inferior cement mixture "C340-FAg658-FA0-SF15" has human toxicity, carcinogenic and non-carcinogenic showed additive effects. Finally, the addition of Fly ash (FA) and silica fume (SF) in concrete was found to have a low effect on the environmental impact indices due to the lower dose of cement. FA and SF are used in concrete production by relative replacement of cement, which indicates a lower proportion of cement. The model predictions also showed that an artificial nerve network with a performance index of 0.986 (4.8%) showed a critical superiority in predicting compressive strength for FA-SF concrete over evolutionary polynomial regression, 0.951 (8.7%), genetic programming, 0.94 (9.5%) and gene expression programming, 0.93 (10%). Green roofs have gained popularity as new roofing surfaces due to their ability to provide several environmental and social advantages. So, the study of Kader et al. demonstrated critical data about green roofs and growth mediums to aid in the positive selection of substrates for green roof technology. They also referred to the characteristics of selecting a sustainable substrate for green roofs while preserving the climatic conditions of a particular area. Furthermore, the research suggested that future studies be climatically specific and conform to acknowledged norms and recommendations, as well as define rules for dry climatic zones, which are heavily influenced by evaporation owing to temperature variations. Ahmad et al.'s study aimed to experimentally measure the internal and external temperatures of a building in Peshawar for validation using CFD modeling. As well as simulating the building by adding locally available, natural, and recycled insulation materials to the roof to keep the interior environment within a comfortable temperature range, especially in winter and summer. The study concluded that the use of waste with low thermal conductivity improves positively and significantly, the temperatures in winter and summer, and at the same time solves the energy crisis and overcomes the adverse climate effects.

The main objective of Al-Khateeb et al.'s study was to find out the effect of cement/asphalt percentage (C/A), temperature, and loading frequency on the fragmentation resistance of asphalt binders using statistical analysis, using uncured condition and short-term aging condition in a rolling thin film oven (RTFO). The one-way ANOVA test used in this study's analysis revealed that there is a significant difference in the C/A proportion between the tested unaged and RTFO-aged cement-modified asphalt by the dynamic shear rheometer test. The correlation test revealed that changing the loading frequency has a substantial effect on the rutting parameter at different temperatures and C/A percentages.

We hope that readers will find these papers interesting and beneficial in their innovative research in this field. The Editors of this Research Topic are like to express their appreciation to all of the authors for their significant contributions, as well as to the professional reviewers for their time, devotion, and valuable comments.

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.

Publisher's note

References

Ali, K. A., Ahmad, M. I., and Yusup, Y. (2020). Issues, impacts, and mitigations of carbon dioxide emissions in the building sector. *Sustain* 12, 7427. doi:10.3390/SU12187427

Dreißigacker, V. (2021). Thermal battery for electric vehicles: High-temperature heating system for solid media based thermal energy storages. *Appl. Sci.* 11, 10500. doi:10.3390/app112110500

Eskander, S. B., Saleh, H. M., Tawfik, M. E., and Bayoumi, T. A. (2021). Towards potential applications of cement-polymer composites based on recycled polystyrene foam wastes on construction fields: Impact of exposure to water ecologies. *Case Stud. Constr. Mater.* 15, e00664. doi:10.1016/j.cscm.2021.e00664

Füchsl, S., Rheude, F., and Röder, H. (2022). Life cycle assessment (lca) of thermal insulation materials: A critical review. *Clean. Mater.* 5, 100119. doi:10.1016/j.clema.2022.100119

Le, V. T., San Ha, N., and Goo, N. S. (2021). Advanced sandwich structures for thermal protection systems in hypersonic vehicles: A review. *Compos. Part B Eng.* 226, 109301. doi:10.1016/j.compositesb.2021.109301

Miller, S. A., Habert, G., Myers, R. J., and Harvey, J. T. (2021). Achieving net zero greenhouse gas emissions in the cement industry via value chain mitigation strategies. *One Earth* 4, 1398–1411. doi:10.1016/j.oneear.2021.09.011

Mindess, S., Young, J. F., and Darwin, D. (1981). *Concrete prentice-Hall*. New Jersey: Scientific Research Publishing.

Parameswaran, V. S., Krishnamoorthy, T. S., and Balasubramanian, K. (1989). Current research and applications of fiber reinforced concrete composites in India. *Transp. Res. Rec.*, 1226.

Saleh, H. M., Aglan, R. F., and Mahmoud, H. H. (2020a). Qualification of corroborated real phytoremediated radioactive wastes under leaching and other weathering parameters. *Prog. Nucl. Energy* 119, 103178. doi:10.1016/j.pnucene.2019.103178

Saleh, H. M., El-Saied, F. A., Salaheldin, T. A., and Hezo, A. A. (2019a). Influence of severe climatic variability on the structural, mechanical and chemical stability of cement kiln dust-slag-nanosilica composite used for radwaste solidification. *Constr. Build. Mater.* 218, 556–567. doi:10.1016/j.conbuildmat.2019.05.145

Saleh, H. M., El-sheikh, S. M., Elshereafy, E. E., and Essa, A. K. (2019b). Mechanical and physical characterization of cement reinforced by iron slag and titanate nanofibers to produce advanced containment for radioactive waste. *Constr. Build. Mater.* 200, 135–145. doi:10.1016/j.conbuildmat.2018.12.100

Saleh, H. M., El-Sheikh, S. M., Elshereafy, E. E., and Essa, A. K. (2019c). Performance of cement-slag-titanate nanofibers composite immobilized radioactive waste solution through frost and flooding events. *Constr. Build. Mater.* 223, 221–232. doi:10.1016/j.conbuildmat.2019.06.219

Saleh, H. M., Moussa, H. R., El-Saied, F. A., Dawoud, M., Bayoumi, T. A., and Abdel Wahed, R. S. (2020b). Mechanical and physicochemical evaluation of solidified dried submerged plants subjected to extreme climatic conditions to achieve an optimum waste containment. *Prog. Nucl. Energy* 122, 103285. doi:10.1016/j.pnucene.2020.103285

Saleh, H. M., Salman, A. A., Faheim, A. A., and El-Sayed, A. M. (2021). Influence of aggressive environmental impacts on clean, lightweight bricks made from cement kiln dust and grated polystyrene. *Case Stud. Constr. Mater.* 15, e00759. doi:10.1016/j.cscm.2021.e00759

Saleh, H. M., Salman, A. A., Faheim, A. A., and El-Sayed, A. M. (2020c). Polymer and polymer waste composites in nuclear and industrial applications. *J. Nucl. Energy Sci. Power Gener. Technol.* 9.

Saleh, H. M., Salman, A. A., Faheim, A. A., and El-Sayed, A. M. (2020d). Sustainable composite of improved lightweight concrete from cement kiln dust with grated poly(styrene). *J. Clean. Prod.* 277, 123491. doi:10.1016/j.jclepro.2020.123491

Saleh, H. M. (2014). Some applications of clays in radioactive waste management," in *Clays and Clay Minerals: Geological Origin, Mechanical Properties and Industrial Applications*. Editors L. R. Wesley (Nova Science Pub. Inc.), 403–415.

Santoni, A., Bonfiglio, P., Fausti, P., Marescotti, C., Mazzanti, V., Mollica, F., et al. (2019). Improving the sound absorption performance of sustainable thermal insulation materials: Natural hemp fibres. *Appl. Acoust.* 150, 279–289. doi:10.1016/j.apacoust.2019.02.022

Sovacool, B. K., Griffiths, S., Kim, J., and Bazilian, M. (2021). Climate change and industrial F-gases: A critical and systematic review of developments, sociotechnical systems and policy options for reducing synthetic greenhouse gas emissions. *Renew. Sustain. Energy Rev.* 141, 110759. doi:10.1016/j.rser.2021.110759

Sun, H., Mao, W., Dang, Y., and Xu, Y. (2022). Optimum path for overcoming barriers of green construction supply chain management: A grey possibility DEMATEL-NK approach. *Comput. Ind. Eng.* 164, 107833. doi:10.1016/j.cie.2021.107833