EDITORIAL ARTICLE

Advancing Sustainable Materials and Technologies

Ramadhansyah Putra Jaya[a,*], Reza Pahlevi Munirwan[b], Bunyamin Bunyamin[c]

[a]Faculty of Civil Engineering Technology, Universiti Malaysia Pahang Al-Sultan Abdullah, 26300 Kuantan, Pahang, Malaysia
[b]Department of Civil Engineering, Faculty of Engineering, Universitas Syiah Kuala, Darussalam, Banda Aceh 23111, Indonesia
[b]Department of Civil Engineering, Faculty of Engineering, Universitas Iskandarmuda, Surien, Banda Aceh 23234, Indonesia

***Corresponding Author:** Ramadhansyah Putra Jaya (ramadhansyah@umpsa.edu.my)

Articles History: **Received:** 7 July 2025; **Revised:** 15 July 2025; **Accepted:** 20 July 2025; **Published:** 25 July 2025

Keywords: Innovation, Eco-friendly, Materials, Infrastructure

SUMMARY

This second volume (2025) brings together a collection of review and research articles focused on sustainable innovations in construction materials and geotechnical engineering. The first article by Mahi et al. [1] reviews the potential of biochar as a sustainable cement replacement, highlighting its ability to improve mechanical and durability properties of concrete composites. Their research demonstrated that biochar can enhance early-age compressive strength, with the most significant improvements observed at lower replacement levels (approximately 2–5%). Moreover, flexural and tensile strengths showed moderate increases depending on the biochar dosage, feedstock origin, and pre-treatment methods. However, higher replacement levels resulted in strength reductions due to increased porosity and greater water demand.

The second article by Mahi et al. [2] examines the role of limestone powder in enhancing the mechanical performance of concrete, emphasizing its contribution to strength and sustainability. They concluded that finer limestone powder particles enhance the compressive strength of concrete by filling voids and serving as nucleation sites for hydration products. However, excessive limestone powder content may lead to a dilution effect, reducing compressive strength. Conversely, when combined with other waste materials such as marble waste aggregate, limestone powder can improve elastic modulus, as well as tensile and flexural strengths. These findings highlight limestone powder as a practical and sustainable additive for improving concrete performance.

Addressing the growing need for recycling in construction, the third study by Abhi et al. [3] investigates the compressive strength behavior of recycled concrete when fine aggregates are replaced with rubber crumb, offering insights into waste management and material reuse. They observed that conventional concrete produced the most effective results compared to mixtures containing various percentages of rubber crumb. Furthermore, the compressive strength progressively declined—by as much as 56.82%—as the proportion of rubber crumb replacement increased in the specimens.

The fourth article by Mamat et al. [4] presents a comparative analysis of fly ash-enhanced micropiles, demonstrating their effectiveness in creating more sustainable foundation systems. They concluded that micropile fly ash (MFA) offers structural advantages while promoting sustainability through the use of waste materials. The study highlights MFA's potential as a viable alternative to conventional micropile systems, providing notable environmental and performance benefits. Further research is recommended to evaluate the long-term performance and scalability of MFA systems across various geotechnical applications.

In the field of pavement engineering, the fifth contribution by Ahad Rahman Khan and Tabassum [5] explores how crumb rubber modified bitumen can significantly enhance both performance and cost-efficiency in asphalt pavement, aligning with green infrastructure goals. From their investigation, the use of crumb rubber modified bitumen proved advantageous, with binder material costs reduced by about 8% for a typical pavement section. This cost saving resulted from lower bitumen consumption and the substitution of recycled rubber, a more economical alternative.

Lastly, the sixth article by Maulida et al. [6] evaluates how flakiness and elongation index compliance affects Marshall parameters in asphalt mixtures, offering critical guidance for quality control and structural performance in road construction. Based on laboratory results indicate that mixtures containing coarse aggregates exceeding the index limit have an optimum asphalt content (OAC) of 5.85%, whereas mixtures meeting the limit achieve an OAC of 6.05%. Furthermore, asphalt mixtures with compliant aggregates exhibit higher stability and improved resistance to traffic loads, underscoring the importance of well-graded coarse aggregates in asphalt concrete mixtures.

Together, these articles reflect a strong movement toward eco-friendly practices, resource-efficient designs, and performance-optimized solutions in civil engineering.

Funding

The author(s) declare that no financial support was received for the research, authorship, and/or publication of this article.

Conflicts of Interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Author Contributions

Ramadhansyah Putra Jaya: writing, reviewing and editing. **Reza Pahlevi Munirwan:** writing, reviewing and editing. **Bunyamin Bunyamin:** writing, reviewing and editing.

References

[1] M.S.H. Mahi, M.A. Mun-Im-Dinar, and T.A. Ridoy, “Biochar as a Sustainable Cement Replacement for Enhancing Concrete Composite Properties: A Review” *Smart and Green Materials*, vol. 2, no. 1, pp.1-10, 2025, doi: http://dx.doi.org/10.70028/sgm.v2i1.24

[2] M.S.H. Mahi, T.A.. Ridoy, M.F.A. Nibir, and M.S. Sheikh, “Limestone Powder in Concrete Mixes: A Review of Mechanical Enhancements” *Smart and Green Materials*, vol. 2, no. 1, pp.11-21, 2025, doi: http://dx.doi.org/10.70028/sgm.v2i1.25

[3] A.N. Abhi, M. Nafiuzzaman, M.R. Uzzaman, A.A. Rabby, and M.M.R. Rafid, “Compressive Strength Behavior of Recycled Concrete with Fine Aggregate Replacement Using Rubber Crumb” *Smart and Green Materials*, vol. 2, no. 1, pp.22-34, 2025, doi: http://dx.doi.org/10.70028/sgm.v2i1.36

[4] R.C. Mamat, A. Ramli, A.H. Abd Aziz, M.D.H. Azhari, and A. Jackson, “A Comparative Analysis of Fly Ash Enhanced Micropiles in Sustainable Foundation Systems” *Smart and Green Materials*, vol. 2, no. 1, pp.35-46, 2025, doi: http://dx.doi.org/10.70028/sgm.v2i1.35

[5] A.F.S. Ahad Rahman Khan, and N. Tabassum, “Enhancing Pavement Performance and Economy through Crumb Rubber Modified Bitumen: A Sustainable Engineering Approach” *Smart and Green Materials*, vol. 2, no. 1, pp.47-61, 2025, doi: http://dx.doi.org/10.70028/sgm.v2i1.39

[6] S.M. Maulida, U.A. Pratama, R.M. Yusputri, A. Rahmad, A. Putri, Y. Darma, S.M. Saleh, “Influence of Flakiness and Elongation Index Compliance on Marshall Parameters in Asphalt Mixtures” *Smart and Green Materials*, vol. 2, no. 1, pp.62-70, 2025, doi: http://dx.doi.org/10.70028/sgm.v2i1.41

https://doi.org/10.70028/sgm.v1i2.49