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Abstracts**



From Waste to Innovation: Development of Nanocomposite Materials Using Brick Powders

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Recent advances in nanotechnology have led to groundbreaking innovations in materials science and the construction industry. In particular, the growing demand for new materials with enhanced durability, lightweight properties, mechanical strength, and environmental sustainability has drawn increasing attention. In this context, the utilization of natural waste materials such as brick powders in the design of nanocomposites presents significant potential from both environmental and economic perspectives. Brick powders are cost-effective, abundant, recyclable materials that, when integrated with nanocomposites, can provide superior mechanical and functional performance. Moreover, the incorporation of different nanomaterials into clay-based composites has been shown to significantly influence their electromagnetic transmission characteristics [1] and enhance their ionizing radiation shielding capabilities, thereby expanding their applicability in advanced construction and protective material technologies [2,3].

In this study, brick powders with different nano-morphologies were combined with Ag, Co, and ZrO nanoparticles to synthesize various composites. The sonochemical method, a green synthesis approach, was employed in the fabrication process. The molecular and crystalline structures of the developed composites were characterized using Fourier Transform Infrared Spectroscopy (FTIR) and X-ray Diffraction (XRD), while their nanoscale structures and pore characteristics were investigated by Small Angle X-Ray Spectroscopy (SAXS). The radius of gyration values for nanocomposites containing 8% Ag, Co, and ZrO were calculated as 27.1 ± 0.5 nm, 26.8 ± 0.4 nm, and 23.6 ± 0.2 nm, respectively. Moreover, advanced structural analyses were performed using the SAXS analysis programs DAMMIN and DENSS to reconstruct ab initio three-dimensional (3D) electron density models. Based on these models, the nanocomposite with 8% Co-doped brick powder was predicted to exhibit the highest durability potential, owing to its most uniform pair-distance distribution function (PDDF) and compact structural configuration.

References:

1. Gouda, M.M., Abbas, M.I., Eid, M.H. et al. Impact of micro/nano cadmium oxide on shielding properties of cement–ball clay matrix. *Sci Rep* 13, 18224 (2023). <https://doi.org/10.1038/s41598-023-45516-2>
2. Vrdoljak, I., Brdarić, J., Rupčić, S., Marković, B., Miličević, I., Mandrić, V., Varevac, D., Tatar, D., Filipović, N., Szent, I., & Kukovecz, Á. The Effect of Different Nanomaterials Additions in Clay-Based Composites on Electromagnetic Transmission. *Materials*, 15(15), 5115 (2022). <https://doi.org/10.3390/ma15155115>
3. Delphine K. Nzivulu, Nadir O. Hashim, Nicholas Musila, Kapis E. Otieno, Felix O. Wanjala. Investigation of red clay and waste glass composite bricks for ionizing radiation shielding. *MethodsX*, 12, 102744 (2024). <https://doi.org/10.1016/j.mex.2024.102744>

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