

Title: A comparative analysis of radiation shielding character in engineered bricks blended with CaO, Al₂O₃, and Fe₂O₃ additives: thermal stability and Phy-X simulation insights into attenuation characteristics

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Abstract: This study employed Phy-X software to investigate the radiation protection efficacy of different bricks fabricated from a mixture of clay, CaO (calcium oxide), Al₂O₃ (aluminum oxide), and Fe₂O₃ (iron oxide). As the oxide additives substituted clay, an increased in the density of the fabricated samples was noticed, with **CL5Fe** showcasing the superior value of 2.40 g/cm³. An improved linear attenuation coefficient (LAC) was also noticed, with **CL5Fe** demonstrating the greatest LAC value of 0.154 cm⁻¹ at 0.6 MeV, which could be associated to its superior density due to presence of Fe₂O₃. The 0.6 MeV energy was chosen as a representative ¹³⁷Cs value within the Compton-dominant region. Shielding performance was further evaluated from 0.0459 to 1.46 MeV, covering photoelectric-to-Compton-dominated interactions. **CL5Fe** also outsmarted other samples in terms of thermal stability and structural integrity, making it the best choice for gamma radiation protection. Future studies should evaluate shielding performance across 1.47–15 MeV to assess material suitability for medical imaging, radiotherapy, and nuclear radiation environments.

Keywords: Radiation, Phy-X simulation insights

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