Synthesis and monte carlo simulation of improved concrete composites for enhanced x-ray/gamma ray radiation shielding

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Abstrak

Synthesis and Monte Carlo simulation of improved concrete composites as x-ray/gamma ray shielding materials were performed. Samples of shieldings were synthesized using the base materials of Portland-type cement concrete with fillers of alloy steel, Co, Mn, and Cr, mixed separately as additives. The samples were characterized using Scanning Electron Microscopy-Energy Dispersive X-ray Spectrometry (SEM-EDS) to determine the constituent elements quantitatively. Linear attenuation coefficients of the samples were measured in the experiments and also simulated using Monte Carlo transport code MCNP5 in order to evaluate their shielding performance. The results of the experimentation and computer simulation reveal concrete with alloy steel added as having the best shielding properties, although concrete with other fillers added also exhibited enhanced shielding performance. It was demonstrated that 6.06 w% of fillers enhanced the x-ray/gamma ray shielding capability of ordinary concrete composites by improving their attenuation coefficient values by 40–60%.