ABSTRACT

This study aimed to synthesize PVC–PEG composites with $BaSO_4$–Fe_2O_3 filler variations and analyze their physical characteristics, chemical structure, and gamma radiation attenuation performance. The composites were fabricated using the solvent casting method with filler compositions expressed in weight percent (% w/w), with a total filler content of 30%. Characterization included density and thickness measurements, Fourier Transform Infrared (FTIR) analysis, and gamma attenuation testing using a NaI(Tl) scintillation detector with Am-241 and Cs-137 sources. The results showed that the addition of $BaSO_4$ and Fe_2O_3 fillers increased the composite density up to 1.608 g/cm³. FTIR analysis indicated that no new functional groups were formed; however, slight changes in peak intensity and minor shifts suggested physical interactions between the fillers and the PVC–PEG matrix. Gamma attenuation testing revealed that the Linear Attenuation Coefficient (LAC) and Mass Attenuation Coefficient (MAC) increased, while the Half Value Layer (HVL), Tenth Value Layer (TVL), and Mean Free Path (MFP) decreased under all testing conditions. The composite containing 30% $BaSO_4$ exhibited the best attenuation performance with a maximum LAC of 2.048 cm^{-1} at 59.5 keV, along with the lowest HVL and MFP values. Overall, the attenuation performance of the composites is comparable to or better than several polymer-based composites reported in the literature containing $BaSO_4$, Fe_2O_3, and other polymer systems. These findings indicate that PVC–PEG/$BaSO_4$–Fe_2O_3 composites have potential as lightweight, flexible, and environmentally friendly lead-free gamma radiation shielding materials.

Keywords: *PVC–PEG composite, $BaSO_4$, Fe_2O_3, FTIR, gamma radiation attenuation, lead-free radiation shielding*