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Measurement of Exposure Buildup Factors: The Influence of Scattered Photons on Gamma-Ray Attenuation Coefficients

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Abstract

Scattered photon's influence on measured values of attenuation coefficients (μ_m , cm^2g^{-1}) for six low-Z (effective atomic number) building materials, at three photon energies has been estimated. Narrow-beam transmission geometry has been used for the measurements. Samples of commonly used engineering materials (Cements, Clay, Lime-Stone, Plaster of Paris) have been selected for the present study. Standard radioactive sources Cs^{137} and Co^{60} have been used for obtaining γ -ray energies 661.66, 1173.24 and 1332.50 keV. The optical thickness (OT) of 0.5 mfp (mean free path) has been found the optimum optical thickness (OOT) for μ_m -measurement in the selected energy range (661.66-1332.50 keV). The aim of this investigation is to provide neglected information regarding subsistence of scattered photons in narrow beam geometry measurements for low-Z materials. The measurements have been performed for a wide range of sample-thickness (2-26 cm) such that their OT varies between 0.2-3.5 mfp in selected energy range. A computer program (GRIC2-toolkit) has been used for various theoretical computations required in this investigation. It has been concluded that in selected energy-range, good accuracy in μ_m -measurement of low-Z materials can be achieved by keeping their sample's OT below 0.5 mfp. The exposure buildup factors have been measured with the help of mathematical-model developed in this investigation.

Keywords: Exposure buildup factor; Gamma-ray measurement; Optimum optical thickness.

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