

Application of the Peak-to-Valley Method for in-situ Gamma Spectroscopy Using NaI(Tl) Detector

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Abstract

The depth distribution in soil is required to quantify the radioactivity in environment using in-situ gamma spectroscopy. The conventional approach to determining depth distribution is the core sampling method, which requires samples from several depths in the soil and is a time-consuming process. In-situ gamma spectroscopy can be used as a rapid and efficient way to quantify radioactivity in large areas. The Peak-to-Valley (PTV) method which is based on the attenuation of gamma rays through matter, emerges as a novel approach, enabling the derivation of depth distribution information from in-situ gamma spectra without having core samples. The present study aimed to validate the PTV method using the NaI(Tl) detector and obtained a correlation between the PTV ratio and depth distribution. Water was used as the attenuation medium to create different depths and ¹³⁷Cs and ⁴⁰K sources were kept at different depths. The NaI(Tl) detector was used to measure spectra at each depth and calculated the PTV ratios. The results show a higher correlation of 2nd order between the PTV ratio and the depth for both ¹³⁷Cs and ⁴⁰K. It reveals that the PTV ratio of the in-situ gamma spectrum can be used to derive the depth distribution parameter. The relationship between the PTV ratio and the depth distribution parameter was obtained for several locations. This relationship is used for calibrating in-situ gamma detector which can be used in a similar environment to determine radioactivity.

Keywords: *Depth distribution, In-situ gamma spectroscopy, Peak-to-valley method*