FAST METHODOLOGY FOR TIME COUNTING OPTIMIZATION IN GAMMA-RAY SPECTROMETRY BASED ON PRESET MINIMUM DETECTABLE AMOUNTS

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Gamma spectrometry is an analytical technique widely employed in quantitative radionuclide determination, and the use of such systems are highly demanding, requiring time counting optimization according to each particular application, especially the minimum detectable amount (MDA) desired. In this study, “a priori” counting times as a function of the preset MDA are proposed, aiming their use on a routine basis. Initially, determination of the sample time counting, which is related to sample composition kind, radionuclide being analyzed, background radiation, geometry detection flask and detection system (detector, shielding and associated electronics), was performed. Initial sample counting time was determined by using the established MDA, so that the accomplished measurement can correctly allow the detection of a given activity value. For this purpose, four HPGe detectors and four well established counting geometries were evaluated. Deionized water samples were prepared in 1 L and 3 L Marinelli flasks and in 0.1 L and 1 L polyethylene flasks. Three measurements were performed in each detection system, with seven different counting times ranging from 1000 s to 150,000 s. For each detection system, radioactive solutions with well-known activity concentrations, with their respective times and geometries, were measured. The obtained results were compared to the reference values from those samples, with their associated uncertainties. In order to validate the results, MDA values for radionuclides of interest in radioecology, namely 133Ba, 134Cs, 106Ru, 137Cs, 65Zn, and 60Co, with their respective main gamma energies, were assessed. The actual counting times obtained were in good agreement with the preset times, for all the studied detection systems and counting geometries, suggesting that the proposed methodology can be applied for a large range of counting systems. Furthermore, a counting time of 50,000 s was found to be generally sufficient to reach the agreement between the preset and actual counting times.