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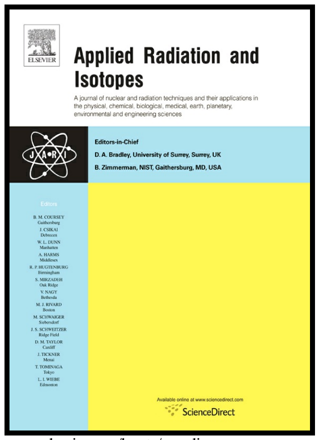

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On homogeneity approximation in calibration of gamma-spectrometry assessment of bulk samples

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ABSTRACT

The effect of the intrinsic inhomogeneity of a sample on the efficiency for the measurement of the sample by gamma-ray spectrometry is studied. The difference between the efficiency for the inhomogeneous sample and the efficiency for a sample made from the equivalent homogeneous matrix is evaluated.

Keywords: Gamma-ray spectrometry; bulk inhomogeneous samples; efficiency; uncertainty; Monte Carlo simulation.

1. Introduction

Accurate efficiency calibration of gamma-ray spectrometers for the assessment of solid samples, such as various environmental probes, is a challenging task. It can be done by using liquid or water equivalent gel calibration sources, prepared from standard solutions traceable to metrology institutes. Standards with specific matrices can also be prepared by spiking. In both cases, the effects of the differences in matrix and density between the sample of interest and the standard are subsequently taken into account by applying proper self-attenuation corrections. These procedures are perfectly adequate if the samples (and standards) are homogeneous with respect to matrix and activity distribution. However, specific bulk samples (e.g. sediment, soil) have an intrinsic inhomogeneity, comprising of several components with various matrices and specific activities. By preparing and measuring several probes using portions extracted from the sample, the inhomogeneity at scales of the order of the dimensions of the probe or bigger can be observed. However, inhomogeneity present at a scale significantly smaller than the dimensions of the probe cannot be observed in this way. And yet this inhomogeneity can change significantly the efficiency.

In a recent study (Sima, 2017) a model for the evaluation of the efficiency considering that the sample is composed from a collection of elementary building blocks (e.g. grains), each with given matrix and specific activity, was developed. It was shown that the full energy peak efficiency (denoted simply efficiency throughout the paper) depends on the characteristics of the intrinsic inhomogeneity, in particular on the dimensions of the grains; the dependence is significant in the case of low energy photons, if for example the component