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Title: Self-attenuation in the low-energy range: an experimental study on ^{210}Pb

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Text:

Quantitative analysis of environmental samples generally involves volume source with low radioactivity and an unknown composition of the sample matrix. Unless an efficiency calibration with the same geometry and matrix is available, it is necessary to correct the raw counting rates for self-attenuation effects in order to obtain the correct sample activity. This can be achieved either experimentally or by means of calculation based on mass attenuation coefficients that can be directly measured or taken from tabulated absorption data. The self-attenuation effect is more pronounced when the energy of the emitted photons is low. This is the case with ^{210}Pb , which is a low-energy gamma emitting radionuclide (46.54 keV) suffering strong absorption in the sample matrix and whose concentration in the environment must be regularly monitored according to public health regulations.

Within the framework of the GSWG, twelve laboratories agreed to carry out measurements with matrices containing ^{210}Pb and to compare their approaches to the determination of self-attenuation correction factors in order to draft practical recommendations for users.

With this aim, the Laboratoire National Henri Becquerel (LNHB) prepared two different sets of three samples, each packed in cylindrical containers with known activities of ^{210}Pb and ^{137}Cs , according to the preparation procedure using standard solutions. The sample filled with resin was meant to be considered as a standard source by the participants and could be used for the efficiency calibration of the detectors. The goal of the exercise was to determine the activity of the two radionuclides included in the other two samples, with unknown matrices. This required the participants to establish the self-attenuation correction factors between the calibration and the measurement matrices. Inactive matrices can be used to experimentally determine the attenuation coefficients for calculating self-absorption.

The different approaches and results obtained by the participants are presented and general recommendations are proposed.

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