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Characterization of CdZnTe gamma detector for Monte Carlo based efficiency calibration of in situ gamma spectrometry of radioactive waste materials

A new gamma spectrometry method was developed for determination of isotope-selective activities of radioactive waste materials out in order to support the waste management. Investigation of radioactive materials should be often performed under in situ measuring conditions especially in nuclear energy industry. Therefore, the applied gamma spectrometer must be portable, easy to handle and good energy resolution is required for the appropriate analysis of the complex gamma spectra. In case of general in-situ measuring set-up, the empirical efficiency calibration of the detector is not obviously available. However, the Monte Carlo simulation technique offers an excellent solution for this problem of the quantitative gamma spectroscopy. Proper input model of the detector and the whole measuring set-up is crucial for the adequate approach of the activity of radioactive samples. If the simulated and measured gamma spectra fit well to each other this is the sensitive indicator for the reality of the input model. In order to construct the initial simulation model of the investigated gamma spectrometer its geometrical parameters published by the manufacturer were applied. For improvement of effectiveness of the simulation calculations it was compared to the results of empirical efficiency calibration measurements. These experiments were conducted with standard point like radioactive sources. To improve the agreement between the calculated and the measured efficiency values the sensitive volume of the detector crystal was mapped by scanning it with collimated gamma beams of ^{241}Am and ^{58}Co sources in transmission measuring set-up. The precise movement of the gamma-sources were performed by a 3D translation stage having 100 μm steps. The characterized gamma-ray spectrometer was applied to analyse different (liquid, solid) waste samples. According to the comparative analysis of the results good agreement was found between the Monte Carlo calculated specific activities and the results of gamma spectroscopy measurements carried out with a certified portable HPGe detector.

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Which "Key Question" does your Abstract address?

TEC1.4

Topics

TEC1

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