

MEASUREMENT OF NORM SAMPLES WITH CeBr₃ DETECTORS

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Content

This paper discusses the use of CeBr₃ detector for the analysis of NORM samples. These detectors have a number of characteristics that make them suitable to field measurements: they can work at ambient temperatures, have better energy resolution than NaI(Tl) detectors for energies over 100 keV and do not present the radioactive contamination typical of the lanthanum halides detectors that contain a small fraction (0.09 %) of ¹³⁸La, a radioactive isotope of La.

To our knowledge, CeBr₃ detectors have never been used in the measurement of NORM. This paper describes its use in the frame of the European Metrology Program, MetroNORM (Metrology for processing materials with high natural radioactivity). All reported measurements have been carried out at the laboratory, as a preliminary step for later “in-situ” implementation. The experimental setup was composed by a 7.5 x 7.5 cm (3”x3”) detector together with the associated electronics and a 5 cm thick cylindrical lead shield. The sources and materials analyzed were the following:

- Ionex resin with activity concentration levels of ²³⁵/²³⁸U above the exemption limit. This material does not contain ²²⁶Ra + daughters nor ²³²Th + daughters. Sample weight was approximately 5 g in a sealed polypropylene container.
- Titanium dioxide containing ²²⁶Ra + daughters, ²¹⁰Pb, ²²⁸Ra + daughters and ²²⁸Th + daughters in activity concentration levels well above the exemption limits. It was measured using a similar container.
- Tuff containing a large mixture of isotopes (U, Ra and Pb) below the exemption limit.

Previously to these measurements, the detector was fully characterized in efficiency terms by a MonteCarlo simulation model using the code PENELOPE/PENNUC. The model was validated with a large number of reference sources (point, extended and liquid) whose activities were determined by absolute and relative methods.

Results of the measurements are compared to those made at the same laboratory using a conventional HpGe gamma-ray spectrometer system. Spectra from both measurement systems are presented and recommendations about the convenience of using these detectors instead of semiconductor models are issued for each kind of material.

About the Presenter

Dr. Virginia Peyres, physicist, responsible for γ measurements in the Radionuclide Metrology Laboratory of CIEMAT, with more than 10-year experience on measurements with semiconductor detectors and Monte Carlo modelling and 10 years of previous experience in nuclear safety.

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