

Background

Gamma-ray spectrometry is a fast and widespread method used to identify radio nuclides and to determine their radioactivity. Compared to the other methods used to determine radioactivity, sample preparation is relatively easy and the method can even be used in a non-destructive way.

The gamma-ray spectrometry laboratory at SCK•CEN was established in 1969 and at that time only NaI(Tl) scintillator detectors are available allowing low-resolution spectroscopy. Later on, these detectors were gradually upgraded by Ge(Li) semiconductor detectors and in the eighties by High Purity Germanium detectors (HPGe) offering the possibility of high-resolution gamma-ray spectroscopy.

Currently, measurements of the radioactivity of gamma- or X- rays emitting radio nuclei in the energy region 5 - 2500 keV are carried out. The High-Resolution Gamma-ray Spectrometry Laboratory is engaged with measurements of amounts of gamma or X-ray emitting substances intermixed with non-radioactive material in solid and liquid samples. Calibrated High Purity Germanium detectors are used for all the measurements. The detectors are calibrated for measuring sample volumes ranging from 1mL up to 2.5L (Marinelli beaker) in a close-to-detector measurement configuration. For the very low energy gamma-rays, the radioactivity is deposited on a planchet and measured with a Low Energy Germanium Detector (LEGe). The experimental calibrations can be complemented with numerical calibrations. Numerical calibrations are based on simulation software that is developed in the laboratory. With the aid of numerical calibrations it is possible to easily account for all possible deviations from a reference calibration geometry and hence to account for e.g. differences in apparent density, material composition, filling height, wall thickness etc. In order to setup numerical calibrations, all dimensional parameters and material specifications describing the sample and detector need to be known (see figure below).

Objectives

The objectives of the laboratory are:

- To make high-quality gamma-ray spectrometry analysis at a high throughput for an economic price for internal and external clients;
- To advice and help customers in the field of nuclear measurements;
- To develop new methods for new needs.

Principal results

ACCREDITATION

The laboratory implemented a quality system based on the EN 45001 standard and got accredited already in 1995 by the Belgian accreditation body BELTEST. In 2000 we upgraded the quality system conform to the ISO/IEC 17025 standard (General Requirements for the Competence of Testing and Calibration Laboratories). Currently we are accredited by BELAC with a scope of accreditation covering measurements of every liquid or solid sample that can be homogenized. The accreditation according to the ISO/IEC 17025 standard

confirms the high quality of measurements carried out by the laboratory and allows our customers to have full confidence in the work carried out for them. Measurements are performed according to the quality assurance program:

- Following written instructions;
- Quality Control (QC) with reference sources for each spectrometer on a weekly basis;
- Regular participation in national and international proficiency tests;



Collecting data (e.g. wall thickness) of the different vials for use in the simulation of the detector response.

MEASUREMENTS OF THE RADIOACTIVITY OF GAMMA AND X-RAY EMITTERS

Measurements of activities of gamma- and X-ray emitters in samples:

- Collected in the frame of the Radiological Surveillance of the Belgian Territory coordinated by the Federal Agency for Nuclear Control (FANC);
- Collected in the frame of the radiological surveillance of the food chain coordinated by the Belgian Federal Agency for the Safety of the Food Chain;
- Inspection of food- and feed stuffs for import or export of goods (these are samples from external parties, mainly export offices and inspection bodies);
- Collected in the frame of the characterisations in the different phases of the decommissioning of nuclear facilities;
- Effluents of the BR2 reactor, for the secure exploitation of the reactor;
- Filters, swipes, liquids and solids for general radiation protection purposes;
- Measurements of specific radio nuclides used in research.



A Marinelli beaker is inserted in the lead shield containing the HPGe detector.

We perform about 1600 measurements per year (identification and activity determination of about 12000 radio nuclides). The laboratory foresees in a 24h, 7/7 days stand-by function which allows us to respond fast to possible urgent needs and to emergency situations.

RESEARCH

Research in support of typical measurement problems is done as these problems arise. Research is further generally devoted to the improvement of the measurement accuracy and sensitivity.

Future work

We currently foresee in the design and development of a dedicated and custom-made (Laboratory Information and Management System) LIMS for the laboratory. The LIMS will optimise data transfer between the laboratory and the client. In the future, analysis results will be transferred between LIMS (e.g. the laboratory LIMS and the LIMS of certain governmental organisations).

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