

Measurement Laboratories

Mário João Capucho dos Reis

The Measurement Laboratories (LM) provides analytical services in the area of radioactive analysis of low and medium activity samples and in measurement of ions in liquid samples.

Together with the Environmental Radioactivity Group (GRA), which is responsible for collection, chemical preparation of the samples and data organization, the LM carries out Portugal's obligations under Article 35 of the EURATOM Treaty which requires member states to conduct national environmental radiological survey annually.

The LM is also involved in research work and provides analytical services to external clients in order to support industrial and commercial activities.

The techniques used are high resolution gamma-ray spectrometry; gross alpha/beta counting and beta counting of specific radionuclides using gas flow proportional counters; liquid scintillation and alpha spectrometry. Ion chromatography is also used to assist in the evaluation of the residual beta activity and in characterization of liquid samples.

The range of radioactivity measurements includes: analysis of radioisotopes in water to assist in the surveillance of ITN's research reactor, control of foodstuffs, export or import products and building materials, analysis of gross alpha/beta and tritium in drinking water (in collaboration with the GRA) and measurement of ^3H in biological samples for cancer research purposes (by request of Radiopharmaceutical Sciences Group of UCQR).

Regarding the external quality control of the measurements, during 2010 the LM group has participated, together with the GRA, in several international intercomparison exercises organized by the International Atomic Energy Agency (IAEA), the European Commission (EC) and the Consejo de Seguridad Nuclear (CSN), including samples of different matrices (water, soils and foodstuff ashes) with natural and artificial radionuclides. Furthermore, the gamma spectrometry Laboratory has also participated in a gamma spectrometry proficiency test

organized by the National Physical Laboratory (NPL), in the *Menu2010* interlaboratory emergency response comparison exercise sponsored by the Food Emergency Response Network of the USA, and in ICRM Part II exercise on intercomparison of the methods used for computing the coincidence summing corrections.

The group remains involved in the ongoing *KADRWaste* project, mainly through the radiological characterization of soil and rock samples using high resolution gamma-ray spectrometry.

Collaborative activities with the Dosimetry and Radiobiology Group (GDR) were maintained, regarding the application of Monte Carlo simulation techniques to computational efficiency calibration of HPGe detectors, computation of self-attenuation and coincidence summing correction factors.

Giving continuity to the accreditation process, during this year internal quality audits were carried out by the Instituto de Soldadura e Qualidade (ISQ) to the following techniques: gross alpha/beta in waters using GPC and LSC, tritium in waters using LSC and gamma spectrometry using HPGe detectors.

During 2010, the Measurement Laboratories also received a great number of study visits, mainly from groups of students of secondary schools and universities.

Regarding the education and training, during 2010:

- Two group members received technical training (IAEA financed fellowships) under the framework of the IAEA Project RER/0/031;
- Two group members concluded the post-graduation studies (DFA) on Radiological Protection and Safety, at the Technical University of Lisbon.

Research Team

Researcher

M. REIS (75%), Aux., Group Leader

Fellow

G. CARVALHAL, FCT grant

Technical Personnel

L. SILVA

J. ABRANTES

L. TORRES

J.M. OLIVEIRA (30%)

G. SILVA

Comparison of Methods Used for Computing the Coincidence Summing Corrections

G. Carvalhal, L. Silva, M. Reis

Objectives

Coincidence summing effects occurs when two or more gamma-rays (or annihilation photons or X-rays) are emitted in cascade following the decay of the same nucleus, and are recorded simultaneously within the resolving time of the detector, leading to a loss of counts in the individual photo-peaks while incrementing the counts in the sum peak. Due to the common use of high volume detectors, together with short distance measurements, this phenomenon should be carefully addressed. Different methods could be used to compute coincidence summing correction factors, namely empirical methods, numerical computation or Monte Carlo simulation techniques. Nowadays, the attention is mainly focused on the use of Monte Carlo based codes. Keeping that in mind, the Gamma Spectrometry Working Group of the International Committee for Radionuclide Metrology (ICRM) organized an international exercise on the intercomparison of the methods used for computing the coincidence summing correction. The Gamma Spectrometry Laboratory of the Measurements Laboratories has participated on the Part II of that exercise, focused on volume sources.

Results

The intercomparison was focused on the calculation of corrective factors for ^{152}Eu and ^{134}Cs , considering several energies and three types of volume samples, using three different screens between sample and detector (Plexiglas, copper and Mylar). The participant laboratories received the experimental spectra corresponding to the different acquisition conditions

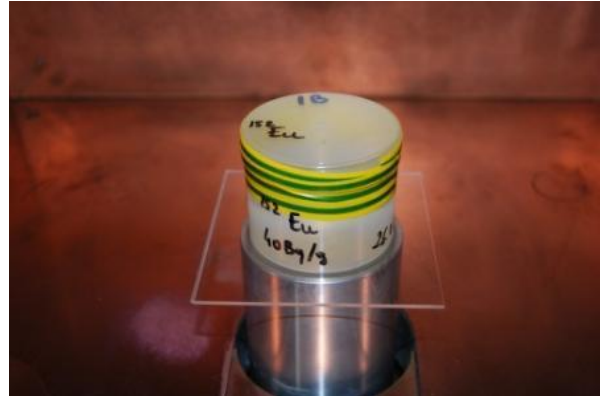


Fig 1 Acquisition set-up with ^{152}Eu volume sample on top of the detector and the Plexiglas screen.

and were asked to compute the coincidence summing corrective factors for both radionuclides and for all acquisition combinations.

Different codes were used for the participant laboratories: GESPECOR, TrueCoinc, CSCOR, LABSOCS, ETNA+MCNP, CCCC and ETNA+PENELOPE.

As example of the preliminary results, the Figure presented below shows the mean value of the coincidence summing corrective factor for the main energies of ^{152}Eu , computed by the participants for one of the volume samples at contact with the detector and using the Plexiglas screen.

Published Work

G. Carvalhal, Exercise ICRM 2009-2010: Intercomparison of the methods used for computing the coincidence summing corrections – Part II, *ICRM GS Workshop*, Italy, Rome, 18-19 October 2010.

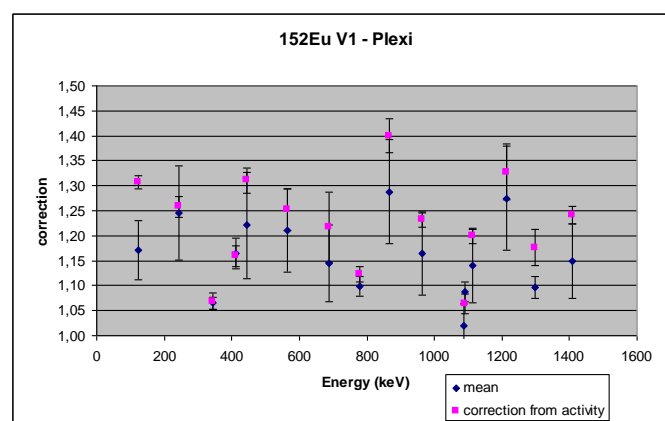


Fig 2 Mean correction factor for ^{152}Eu according to the acquisition set-up showed above

Application of Monte Carlo Techniques to Gamma Spectrometry

G. Carvalhal, L. Silva, R. Luis, J. Bento, P. Nogueira, P. Teles, P. Vaz

During 2010 was given continuity to the collaborative activities between the Measurement Laboratories (LM) and the Dosimetry and Radiobiology Groups (GDR), regarding the application of Monte Carlo simulation techniques to computational efficiency calibration of HPGe detectors, computation of self-attenuation and coincidence summing correction factors by using different Monte Carlo codes. As a result of those activities two papers were published in international journals and one communication was presented in an international Conference.

Accreditation of Radioanalytical Techniques

J. Abrantes, G. Carvalhal, M. Reis, L. Silva, G. Silva

During 2010 the LM group remains involved in the preparation of the accreditation process according to ISO/IEC 17025 standard. Internal quality audits were carried out by the Instituto de Soldadura e Qualidade (ISQ) to the following techniques: determination of gross alpha/beta activity in waters by Gas Proportional Counting (GPC) and Liquid Scintillation Counting (LSC), determination of tritium in waters by LSC and determination of gamma emitters in solid and liquid matrices using high resolution gamma-ray spectrometry.

Under the framework of the IAEA Project RER/0/031 (Strengthening Sustainability of Nuclear Research and Development Institutes in the Modern Science and Technology Environment), two group members have participated in technical training programmes (IAEA financed fellowships, two weeks duration) related to the establishment of QA/QC practices: one in gamma spectrometry with HPGe detectors and the other regarding the measurement of alpha and beta emitters by Gas Proportional Counters and Liquid Scintillation Counters. The training took place at the Physics, Chemistry and Instrumentation Laboratory of the IAEA (Seibersdorf), in the first case and at the Department of Analytical Chemistry of Barcelona University and at the Institute of Energy Technology of the Technical University of Catalunya, in the second case.

SERVICES

Analytical Services on Radioactivity Measurement and Liquid Ion Chromatography

J. Abrantes, G. Carvalhal, J. M. Oliveira, M. Reis, L. Silva, G. Silva, L. Torres

In 2010, around 2000 analysis have been performed (excluding analysis for calibration, quality control and intercomparison exercises). The above mentioned analysis were carried out in the framework of the national environmental radiological survey, as services for external entities and for research projects, either of UPSR or other ITN sectors. The services provided to external entities represent a net income for ITN of about 19 kEuros.